

TECHNICAL MANUAL

**OPERATOR'S, ORGANIZATIONAL, DIRECT
SUPPORT, AND GENERAL SUPPORT
MAINTENANCE MANUAL**

**TOPOGRAPHIC SUPPORT SYSTEM
DIRECT SUPPORT SECTION
MODEL ADC-TSS-17
(6675-01-105-5764)**

This manual supersedes TM 5-6675-326-14, 15 June 1983

HEADQUARTERS, DEPARTMENT OF THE ARMY

27 JULY 1984

CHANGE

NO. 3

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Operator's, Organizational, Direct Support
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TOPOGRAPHIC SUPPORT SYSTEM
DIRECT SUPPORT SECTION
MODEL ADC-TSS-17
(6675-01-105-5764)

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1-9 and 1-10
1-17 and 1-18
1-23 through 1-26
1-51 and 1-52
1-55 and 1-56
1-61 through 1-64
1-71 and 1-72
1-77 and 1-78
2-37/2-38

2-51 through 2-54
2-65 and 2-66
2-69 and 2-70
4-27 and 4-28
4-31 and 4-32
5-15 and 5-16
6-5 and 6-6
6-61 and 6-62
6-139 and 6-140
6-141 and 6-142
6-145 and 6-146

6-149 through 6-154
11-5 through 11-8
11-11 through 11-14
B-5 through B-14
C-3 through C-10
C-15 through C-34
C-35 through C-37/C-38
E-1 through E-3/E-4

Insert pages

1-9 and 1-10
1-17 and 1-18
1-23 through 1-26
1-51 and 1-52
1-55 and 1-56
1-61 through 1-64
1-71 and 1-72
1-77 and 1-78
2-37 and 2-38
2-38.1/2-38.2
2-51 through 2-54
2-65 and 2-66
2-69 and 2-70
4-27 and 4-28
4-31 and 4-32
5-15 and 5-16
6-5 and 6-6
6-61 and 6-62
6-139/6-140
6-141/6-142
6-145 and 6-146
6-146.1/6-146.2
6-149 through 6-154
11-5 through 11-8
11-11 through 11-14
B-5 through B-14
C-3 through C-10
C-15 through C-33/C-34

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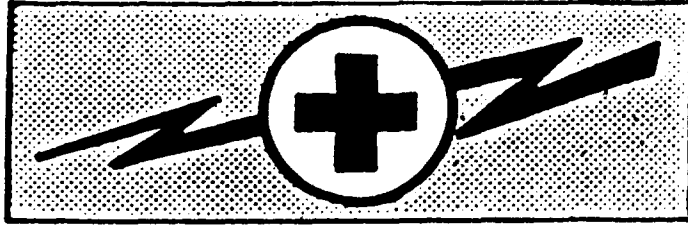
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WARNING**WARNING**

HIGH VOLTAGE

Use extreme caution when performing checks, services, or maintenance at or near power entry panel and power panel. Failure to do so may result in death or serious injury.

WARNING

ELECTRICAL SHOCK

Turn off individual circuit breaker. Turn off electrical switch and unplug equipment before service or maintenance. Failure to do so may result in death or serious injury.

WARNING

CHEMICAL HAZARD

Avoid prolonged contact with solvent PD-680. Failure to do so may result in serious injury to skin. Fumes can cause irritation and damage to lungs.

WARNING

HEAVY EQUIPMENT

Use proper lifting equipment to remove or install heavy equipment. Failure to do so may result in death or serious injury.

TECHNICAL MANUAL

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WASHINGTON, D.C., 27 July 1984

NO. 5-6675-326-14

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TOPOGRAPHIC SUPPORT SYSTEM
DIRECT SUPPORT SECTION
MODEL ADC-TSS-17
(6675-01-105-5764)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of away to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, U.S. Army Troop Support Command, ATTN: AMSTR-MCTS, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. A reply w-ill be furnished directly to you.

		Page
CHAPTER 1	DIRECT SUPPORT SECTION	1-1
Section I	Introduction	1-1
Section II	Operating Instructions	1-12
Section III	Operator Maintenance	1-28
Section IV	Organizational Maintenance	1-34
Section V	Direct/General Support Maintenance	1-62
CHAPTER 2	SPLIT-STAGE LIGHT TABLE	2-1
Section I	Introduction	2-1
Section II	Operating Instructions	2-8
Section III	Operator Maintenance	2-33
Section IV	Organizational Maintenance	2-39
Section V	Direct/General Support Maintenance	2-50
CHAPTER 3	ZOOM STEREOSCOPE 95R	3-1
Section I	Introduction	3-1
Section II	Operating Instructions	3-2
Section III	Operator Maintenance	3-14
Section IV	Organizational Maintenance	3-14
Section V	Direct/General Support Maintenance	3-14
CHAPTER 4	ZOOM TRANSFER SCOPE (ZT4-H)	4-1
Section I	Introduction	4-1
Section II	Operating Instructions	4-5
Section III	Operator Maintenance	4-26
Section IV	Organizational Maintenance	4-31
Section V	Direct/General Support Maintenance	4-31

	Page
CHAPTER 5	PORTABLE TRACING/SCRIBING BOARD 5-1
Section I	Introduction 5-1
Section II	Operating Instructions 5-2
Section III	Operator Maintenance 5-7
Section IV	Organizational Maintenance 5-16
Section V	Direct/General Support Maintenance 5-22
CHAPTER 6	QUANTITY PROCESSING SYSTEM (QPS) 6-1
Section I	Introduction 6-1
Section II	Operating Instructions 6-11
Section III	Operator Maintenance 6-132
Section IV	Organizational Maintenance 6-146
Section V	Direct/General Support Maintenance 6-146
CHAPTER 7	ULTRASONIC CLEANER 7-1
Section I	Introduction 7-1
Section II	Operating Instructions 7-3
Section III	Operator Maintenance 7-8
Section IV	Organizational Maintenance 7-8
Section V	Direct/General Support Maintenance 7-16
CHAPTER 8	POCKET CALCULATOR 8-1
Section I	Introduction 8-1
Section II	Operating Instructions 8-4
Section III	Operator Maintenance 8-26
Section IV	Organizational Maintenance 8-28
Section V	Direct/General Support Maintenance 8-28
CHAPTER 9	FACSIMILE TRANSMISSION AND RECEIVING DEVICE 9-1
CHAPTER 10	DIAZO REPRODUCTION SET 10-1
CHAPTER 11	FURNITURE AND CABINETS 11-1
Section I	Introduction 11-1
Section II	Operating Instructions 11-4
Section III	Operator Maintenance 11-4
Section IV	Organizational Maintenance 11-4
Section V	Direct/General Support Maintenance 11-17
CHAPTER 12	SUPPORT ITEMS 12-1
Section I	Introduction 12-1
Section II	Operating Instructions 12-3
Section III	Operator Maintenance 12-24
Section IV	Organizational Maintenance 12-30
Section V	Direct/General Support Maintenance 12-30

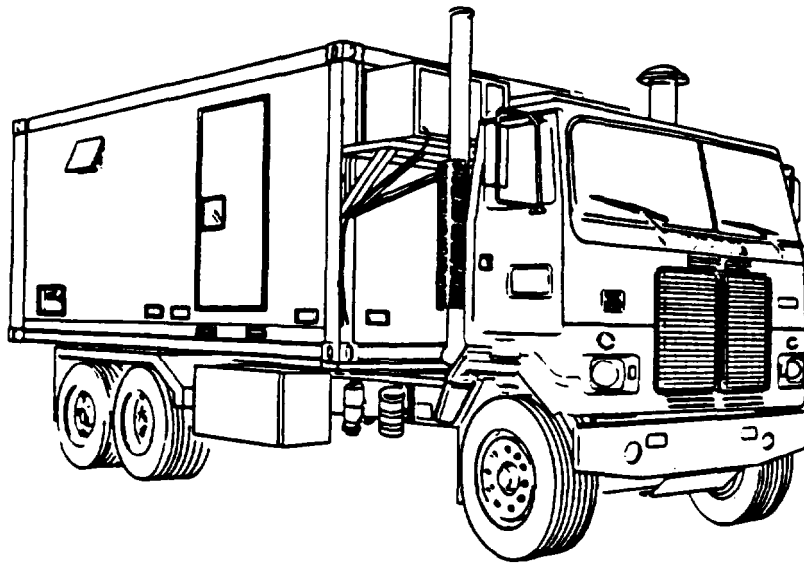
	Page
APPENDIX A	REFERENCES A-1
APPENDIX B	MAINTENANCE ALLOCATION CHART B-1
Section I	Introduction B-1
Section II	Maintenance Allocation Chart for Direct Support Section B-5
Section III	Tool and Test Equipment Requirements for Direct Support Section B-13
Section IV	Remarks B-14
APPENDIX C	COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS C-1
Section I	Introduction C-1
Section II	Components of End Item C-2
Section III	Basic Issue Items C-10
APPENDIX D	ADDITIONAL AUTHORIZATION LIST D-1
Section I	Introduction D-1
Section II	Additional Authorization List D-1
APPENDIX E	EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST E-1
Section I	Introduction E-1
Section II	Expendable/Durable Supplies and Materials List E-2
INDEX	INDEX 1

CHAPTER 1

DIRECT SUPPORT SECTION

Section I. INTRODUCTION

1-1 GENERAL INFORMATION.



1-1.1 Scope. This manual contains operating and maintenance instructions for the ADC-TSS-17, Direct Support Section, Truck-Mounted, Topographic Support System (TSS). The purpose of the Direct Support Section is to provide military geographic information to the organization to which it is assigned. Chapters in this manual provide detailed descriptions and instructions. The truck chassis is covered in TM9-2320-281-10, Operator's Manual, Truck Chassis: For Direct Support Section, Topographic Support System (TSS); TM9-2320-281-20, Organizational Maintenance Manual, Truck Chassis: For Direct Support Section, Topographic Support System (TSS); TM9-2320-281-34, Direct Support and General Support Maintenance Manual, Truck Chassis: For Direct Support Section, Topographic Support System (TSS). Repair parts and special tools are listed in TM5-6675-326-24P, Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List, Direct Support Section, Truck-Mounted, Topographic Support System (TSS). Lubrication instructions are contained in LO5-6675-326-12, Lubrication Order, Direct Support Section, Truck-Mounted, Topographic Support System (TSS). All authorized equipment, supplies, and their locations for transport are shown in Location and Description of Major Components.

1-1.2 Maintenance 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 (TAMMS).

1-1.3 Destruction of Army Materiel to Prevent Enemy Use. For information on destruction of materiel to prevent enemy use, refer to TM 750-244-3, Procedures for Destruction of Equipment to Prevent Enemy Use.

1-1.4 Preparation for Storage or Shipment. Perform Preparation for Movement procedures (para 1-6.2). In the event individual items of equipment must be removed from section for repair or replacement, refer to TM 740-90-1 for storage instructions.

1-1.5 Hand Receipt (-HR) Manuals. This manual has a companion document with a TM number followed by "-HR" (which stands for Hand Receipt). The TM5-6675-326-14-HR consists of preprinted hand receipts (DA Form 2062) that list end item related equipment (i.e., COEI, BII, and AAL) you must account for. As an aid to property accountability, additional HR manuals may be requisitioned from the following source in accordance with procedures in chapter 3, AR 310-2:

The US Army Adjutant General Publications Center
2800 Eastern Blvd
Baltimore, MD 21220

1-1.6 Reporting Equipment Improvement Recommendations (EIRs). If the Direct Support Section needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell US what you do not like about your equipment. Let us know why you do not like the design or performance. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at: US Army Troop Support Command, ATTN: AMSTR-QX, 4300 Goodfellow Blvd, St. Louis, MO 63120-1798. We will send you-a-reply.

1-2 EQUIPMENT DESCRIPTION AND DATA.

1-2.1 Equipment Characteristics, Capabilities, and Features. Provides a mobile facility for collection, analysis, cataloging, and retrieval of topographic information. Provides required military geographic support to command to which it is assigned. The Direct Support Section has the following capabilities and features:

Mobile when mounted on truck chassis.

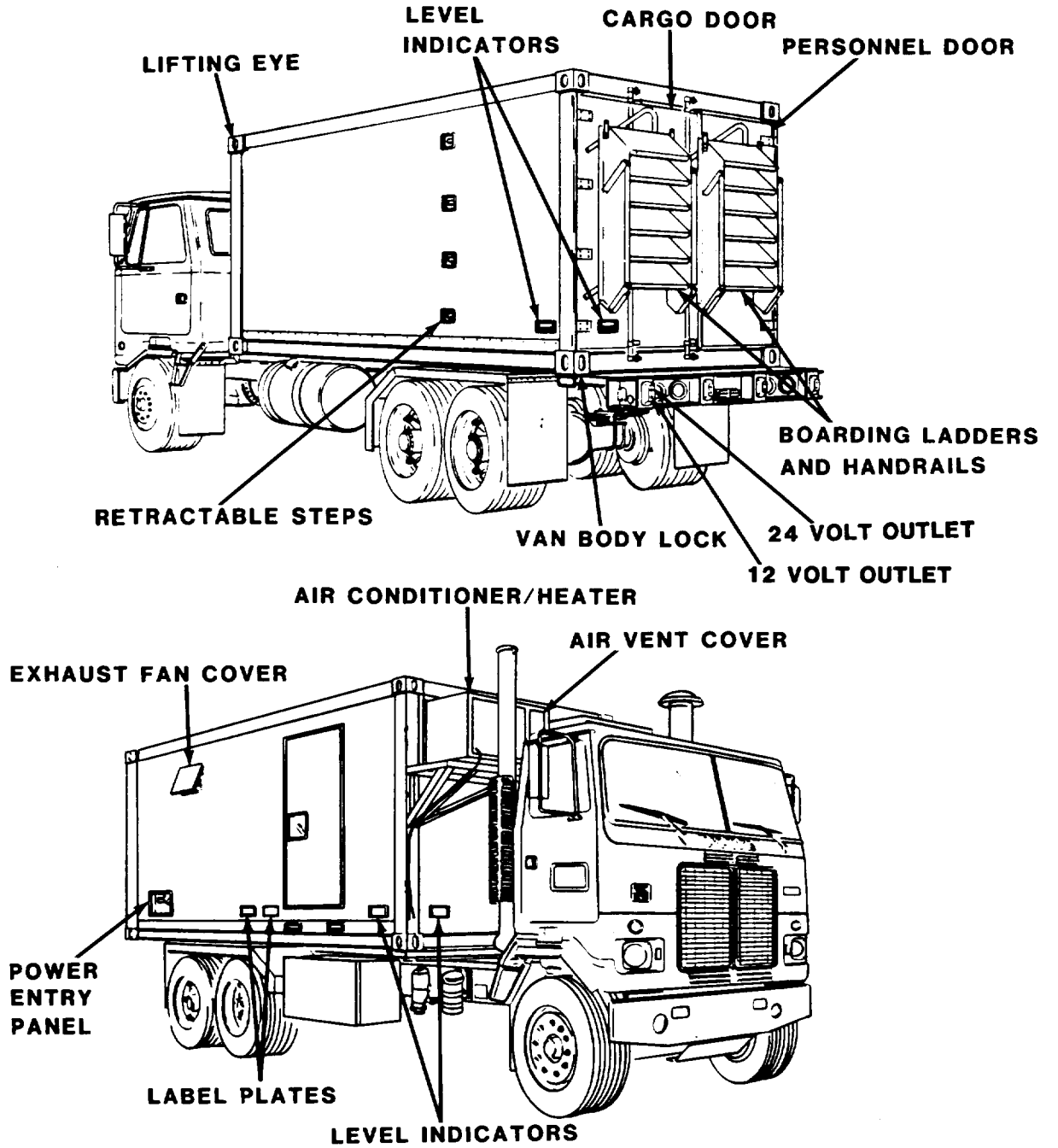
Air and sea transportable.

Limited cross-country capability.

Controlled internal environment.

1-2.2 Location and Description of Major Components

Exterior



1-2.2 Location and Description of Major Components - Continued

BOARDING LADDERS AND HANDRAILS. Provide access to section.

LIFTING EYES. Attachment points for lifting van from truck chassis.

RETRACTABLE STEPS. Provide access to roof.

CARGO DOOR. Access to remove or install equipment. Door, 60-1/4 in. (153.04 cm) wide by 85-1/2 in. (217.17 cm) long.

PERSONNEL DOOR. Access for personnel entry and exit. Door, 35-1/2 in. (90.17 cm) wide by 85-1/2 in. (217.17 cm) long.

VAN BODY LOCKS. Secure section to truck chassis.

LEVEL INDICATORS. Indicate inclination of section in front-rear, right-left directions.

EXHAUST FAN COVER. Weatherproof cover for exhaust fan.

AIR CONDITIONER/HEATER. Internal environmental control.

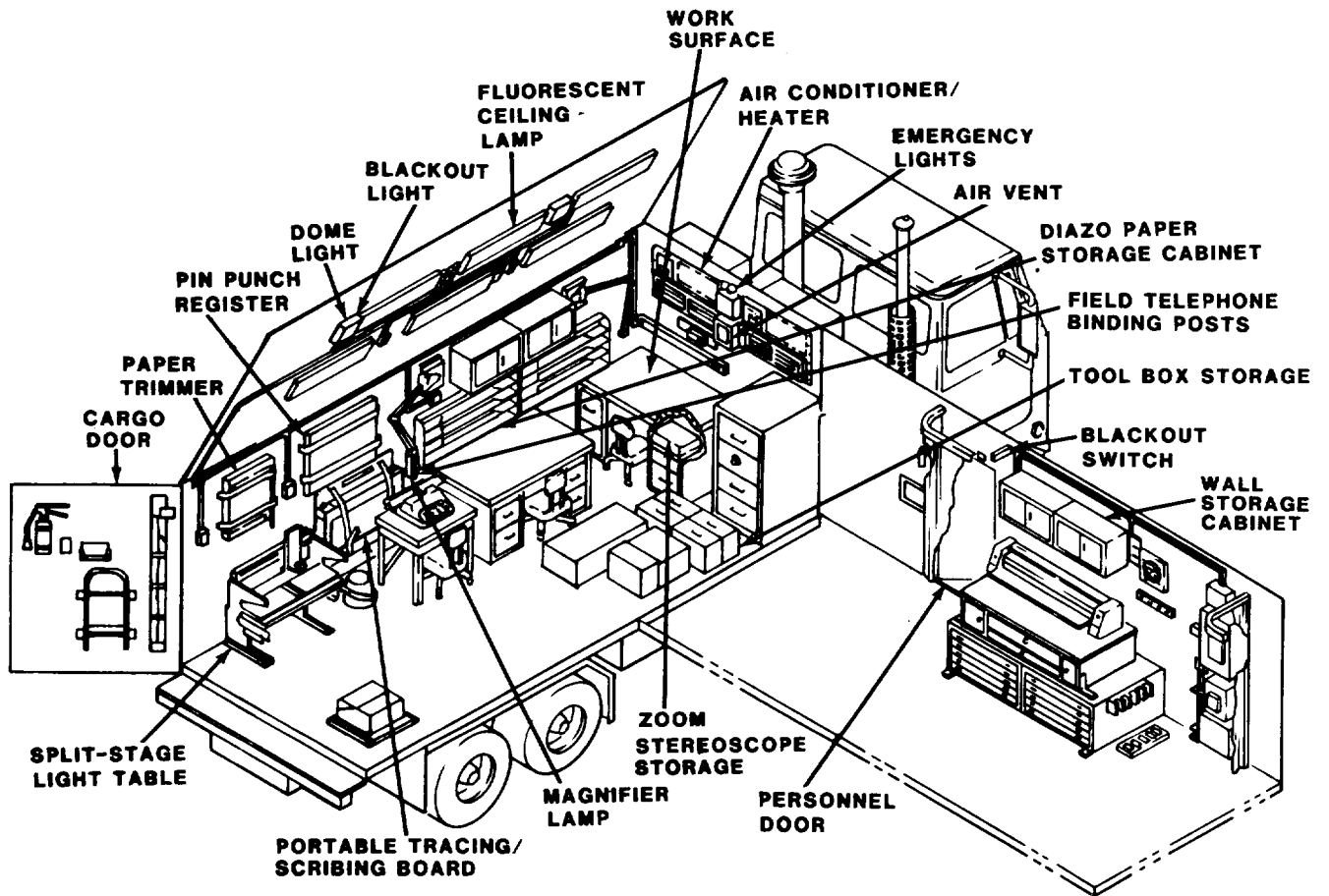
AIR VENT COVER. Weatherproof cover for air vent.

LABEL PLATES. Identification and shipping data plates.

POWER ENTRY PANEL. Contains terminals for grounding cable, power cables, and telephone lines.

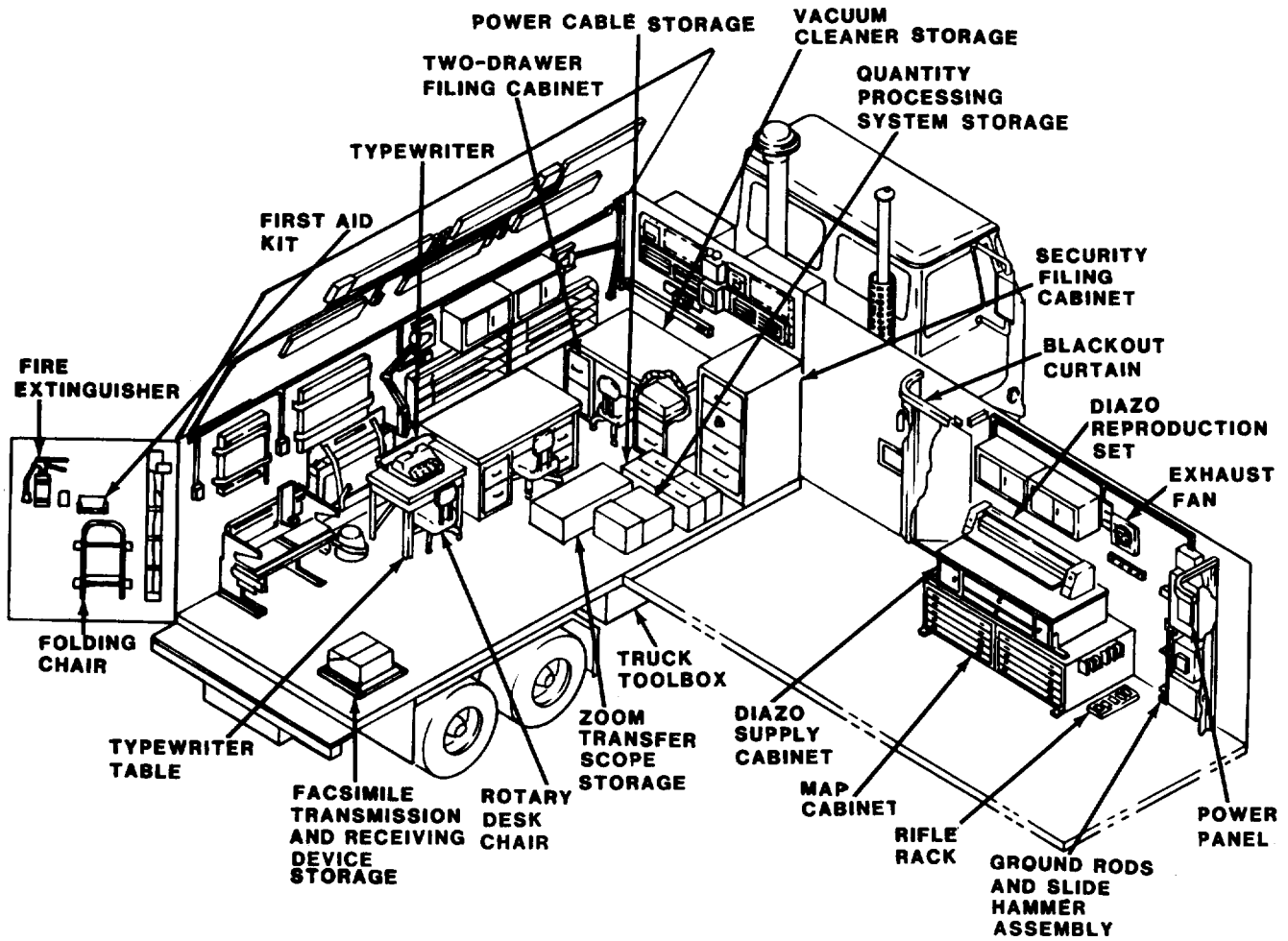
1-2.2 Location and Description of Major Components - Continued

Interior



1-2.2 Location and Description of Major Components - Continued

Interior



1-2.2 Location and Description of Major Components - Continued

PERSONNEL DOOR. Weatherproof door fitted with blackout switch.

BLACKOUT SWITCH. Turns white lights off when activated.

CARGO DOOR. Access for equipment installation/removal.

SPLIT-STAGE LIGHT TABLE. Used to view aerial roll film.

PAPER TRIMMER. Trims paper sheets.

PORTABLE TRACING/SCRIBING BOARD. Provides illuminated work surface for tracing and scribing.

FLUORESCENT CEILING LAMP. White overhead light.

PIN PUNCH REGISTER. Provides hole punch capabilities.

FIELD TELEPHONE BINDING POSTS. Connection for field telephones.

MAGNIFIER LAMP. Illuminated magnifier lamp.

BLACKOUY LIGHT. Red-lens 12 vac light activated when blackout switch is on.

DOME LIGHT. White lens, 12 vdc light.

DIAZO PAPER STORAGE CABINET. Storage for bulk diazo paper.

WALL STORAGE CABINET. Storage.

WORK SURFACE. Provides table top surface for working.

ROTARY DRAFTING CHAIR. Adjustable-height chair.

AIR CONDITIONER/HEATER. Internal environmental control unit.

ZOOM STEREOSCOPE. Provides stereoscopic (three-dimensional) view of photographs.

EMERGENCY LIGHTS. Battery-powered lighting activated by power failure.

AIR VENT. Permits air to enter section.

TOOLBOX STORAGE. Transport storage for toolboxes.

SECURITY FILING CABINET. Storage for classified materials.

BLACKOUT CURTAIN. Light trap for personnel door.

1-2.2 Location and Description of Major Components - Continued

DIAZO REPRODUCTION SET. Ammonia process copier.

EXHAUST FAN. Vents section of fumes. Fitted with lightproof louvers.

FIRE EXTINGUISHER. Used to extinguish fires.

POWER PANEL. Power entry connections, circuit breakers, and fuse.

GROUND RODS AND SLIDE HAMMER ASSEMBLY. Used to ground section prior to operation of internal equipment.

RIFLE RACK. Weapon storage.

MAP CABINET. Storage for maps and flat paper.

DIAZO SUPPLY CABINET. Storage for diazo bulk supplies and developer.

QUANTITY PROCESSING SYSTEM. Provides electronic estimation of area, distance, perimeter, and volume of geographic shapes found on maps, drawings, aerial photographs, etc.

TRUCK TOOLBOX. Storage for power cable and tools.

ZOOM TRANSFER SCOPE. Used to optically superimpose photographic image on map or chart.

TYPEWRITER. Wide carriage, manual typewriter.

ROTARY DESK CHAIR. Adjustable-height chair.

TYPEWRITER TABLE. Provides mounting surface for typewriter.

FACSIMILE TRANSMISSION AND RECEIVING DEVICE. Provides transmission of graphic material from one point to another by electrical means.

FOLDING CHAIR. Additional seating for work in van.

FIRST AID KIT. Limited first aid supplies.

POWER CABLE. Connects electrical system of section to power source.

VACUUM CLEANER. Provides for cleaning of van interior.

TWO-DRAWER FILING CABINETS. Storage for nonclassified documents.

1-2.3 Equipment Data

Weight

Gross (section and truck chassis)	32,390 lbs (14,668.74 kg)
Tare (section only)	11,730 lbs (5325.42 kg)

Dimensions

Length	353 in. (896.37 cm)
Width	96 in. (243.84 cm)
Height	96 in. (243.84 cm)

Center of Gravity	50.0 in. (126.96 cm) from roadside (Driver's side), 43 in. (109.22 cm) from bottom
-------------------	--

Connections

Telephones	Two telephone (three- post) connections
------------	--

Power	One 120/208 v, 3-phase, four-wire connection and one 12 vdc connection
-------	--

Ground	Ground cable
--------	--------------

Air conditioner/heater (two units)

Cooling	18,000 Btu/hr each
Heating	14,300 Btu/hr (max) each

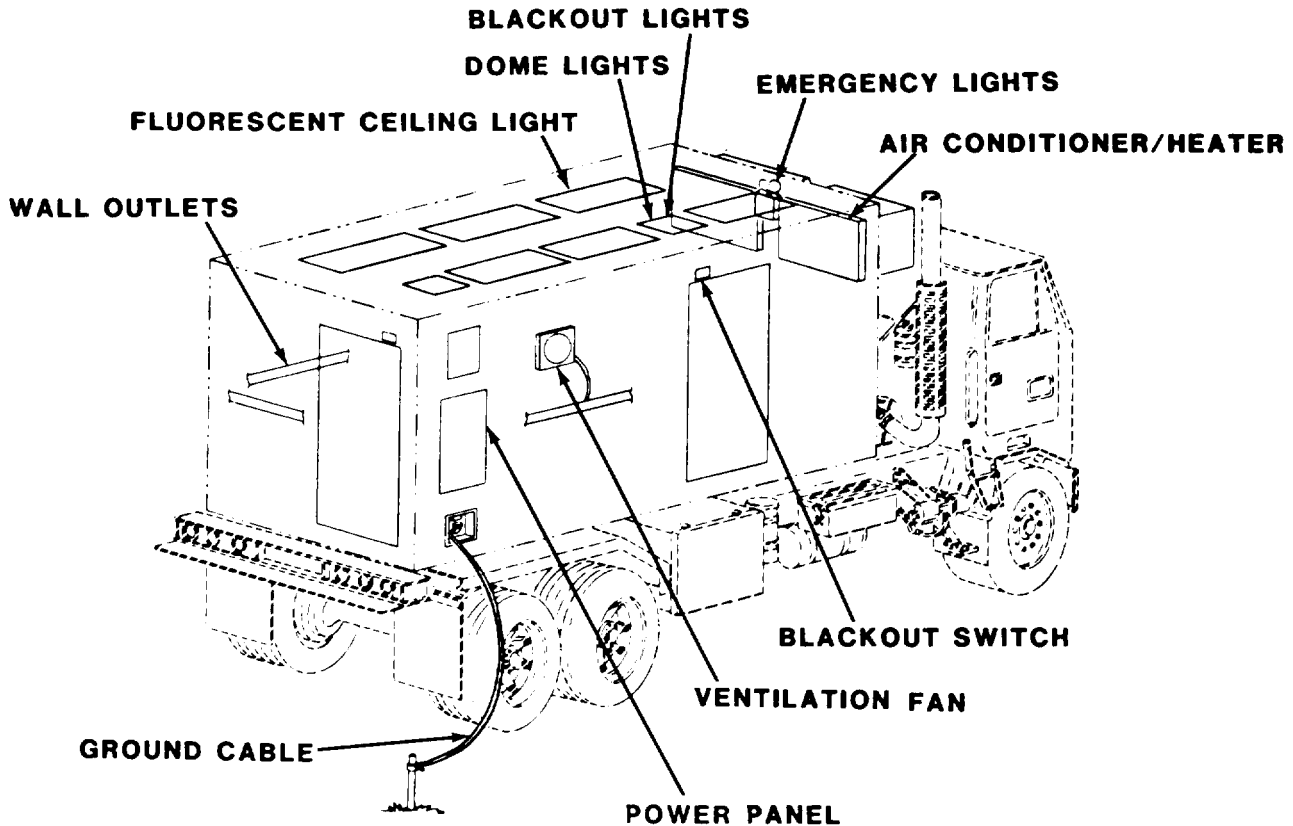
Ventilation Fan	289 cfm
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Air Vent	289 cfm (open)
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1-3 TECHNICAL PRINCIPLES OF OPERATION.

1-3.1 General. The operation of individual components is explained in each corresponding chapter.

1-3.2 Electrical System



GROUND ROD. Used to ground van body.

GROUND CABLE. Used with ground rod.

POWER PANEL. Contains voltage indicator, phase monitor, main disconnect, and fifteen 50-amp circuit breakers.

WALL OUTLETS. Provide grounded outlets for plug-in equipment.

DOMES LIGHTS. White-lens, 12 vdc lights powered from external source. Separately switched and fused.

BLACKOUT LIGHTS. 12 vdc lights actuated when blackout bypass is activated.

1-3.2 Electrical System - Continued

VENTILATION FAN. Plug-in. Separately fused.

FLUORESCENT CEILING LIGHTS. Two-level (high/low) overhead lights with blackout bypass switches.

EMERGENCY LIGHTS. Battery-powered. Activated by external power loss.

AIR CONDITIONER/HEATER. Air conditioner and electrical heater powered by 3-phase, 208 v, 30 amp current.

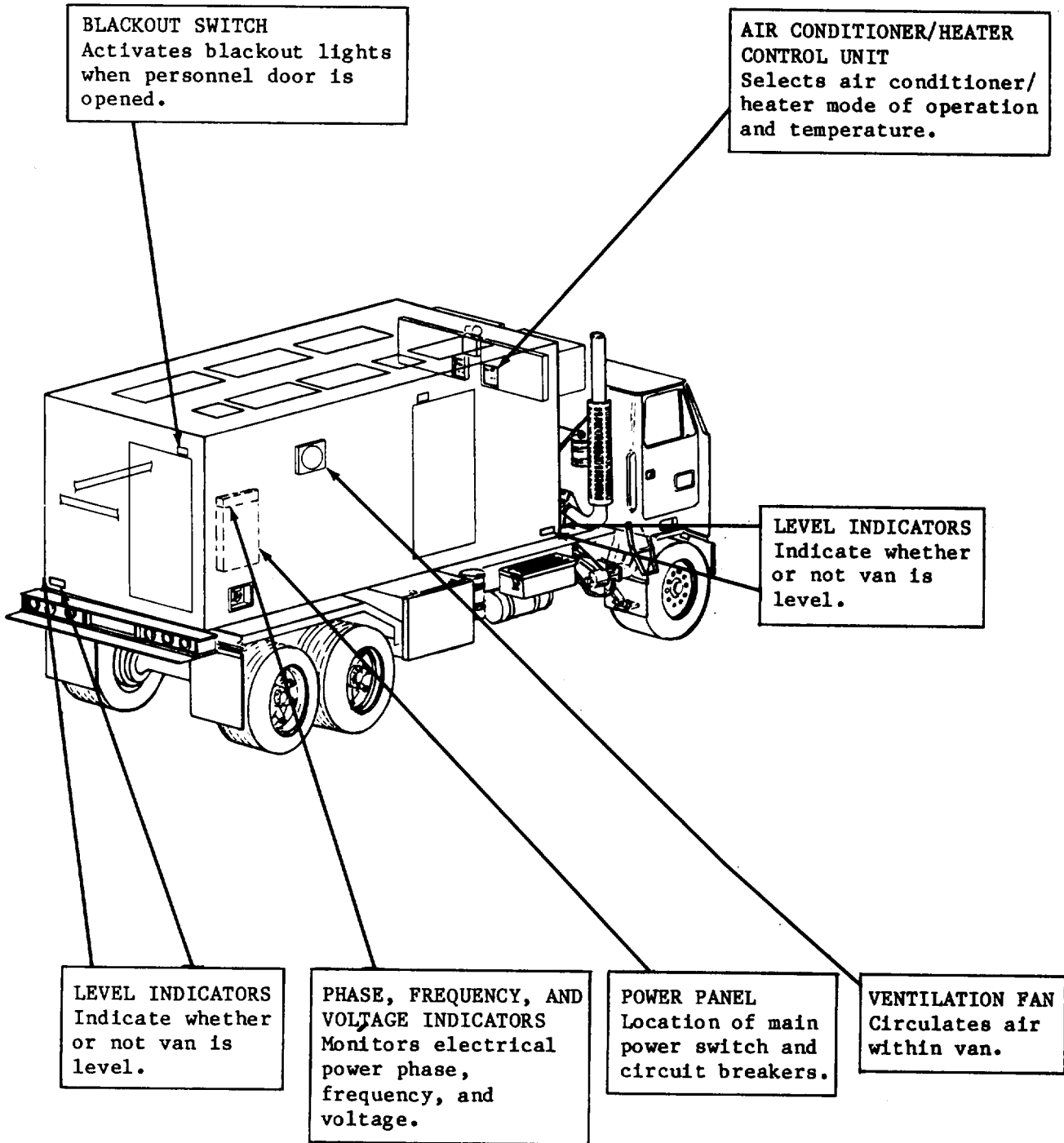
BLACKOUT SWITCHES. Disconnect power to overhead lights when personnel doors open.

1-3.3 Ventilation System. Air from air conditioners/heaters is directed through ceiling vents into section. Return air is filtered before entry into air conditioner/heater. In vent mode, outside air is drawn into section for distribution.

Detailed description of air conditioner/heater operation is contained in Operator's, Organizational, Direct Support, and General Support Maintenance Manual, Air Conditioner, Horizontals, Compact, 18,000 BTU/hr Cooling, TM5-4120-367-14, and Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List for Air Conditioner, Horizontal, Compact, 18,000 BTU/hr Cooling, TM5-4120-367-24P.

Section II. OPERATING INSTRUCTIONS

1-4. DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS.



1-5 OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

1-5.1 General. The direct support section (van) must be regularly inspected to find and correct defects.

1-5.1.1 Before You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your BEFORE (B) PMCS.

1-5.1.2 While You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your DURING (D) PMCS.

1-5.1.3 After You Operate. Be sure to perform your AFTER (A) PMCS.

1-5.1.4 If Your Equipment Fails To Operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

1-5.2 PMCS Procedures

1-5.2.1 PMCS are designed to keep the equipment in good working condition by performing periodic service tasks.

1-5.2.2 Service intervals provide you, the operator, with time schedules that determine when to perform specified service tasks.

1-5.2.3 The "Equipment is Not Ready/Available If" Column is used for identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.

1-5.2.4 If your equipment fails to operate after PMCS is performed, immediately report this condition to your supervisor.

1-5.3 PMCS Columnar Entries

1-5.3.1 Item Number Column. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for your "TM number" Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.

1-5.3.2 Interval Column. This column determines the time period designated to perform your PMCS.

1-5.3.3 Item To Be Inspected and Procedures Column. This column lists functional groups and their respective assemblies and subassemblies as shown in the Maintenance Allocation Chart (Appendix B). The appropriate check or service procedure follows the specific item to be inspected.

1-5.3.4 Equipment Is Not Ready/Available If: Column. This column indicates the reason or cause why your equipment is not ready/available to perform its primary mission.

Table 1-1. Operator Preventive Maintenance Checks and Services

B - Before Operation
W - Weekly

D - During Operation
Q - Quarterly

A - After Operation

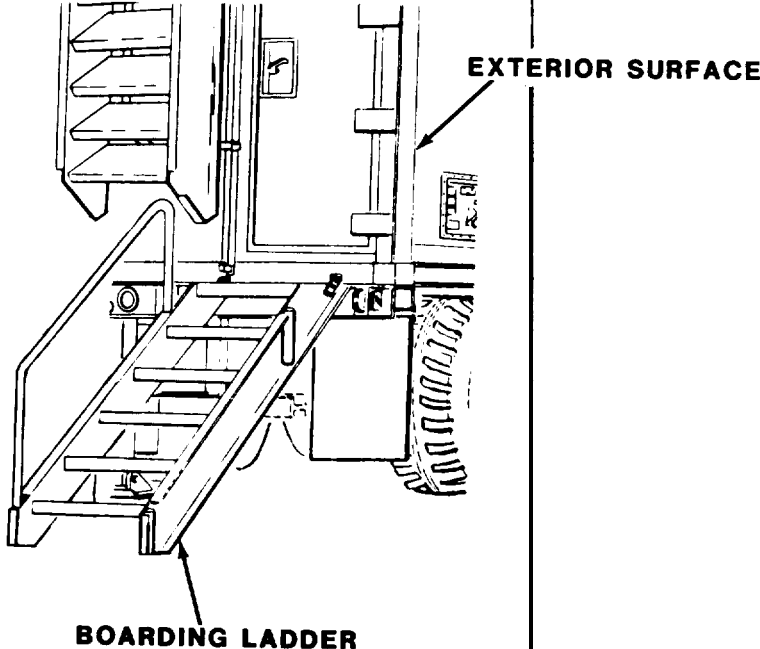
Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	D	A	W	Q		
1	•					 <p>EXTERIOR SURFACE. Check surface for punctures, cracks, or open seams that could permit moisture to enter wall.</p>	Punctures, cracks, or open seams are present.
2	•					<p>BOARDING LADDERS. Check for secure attachment of handrails. Check to see if locking pins are in place and steps are not broken.</p>	Steps are broken or will not lock in place.

Table 1-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation
W - Weekly

D - During Operation
Q - Quarterly

A - After Operation

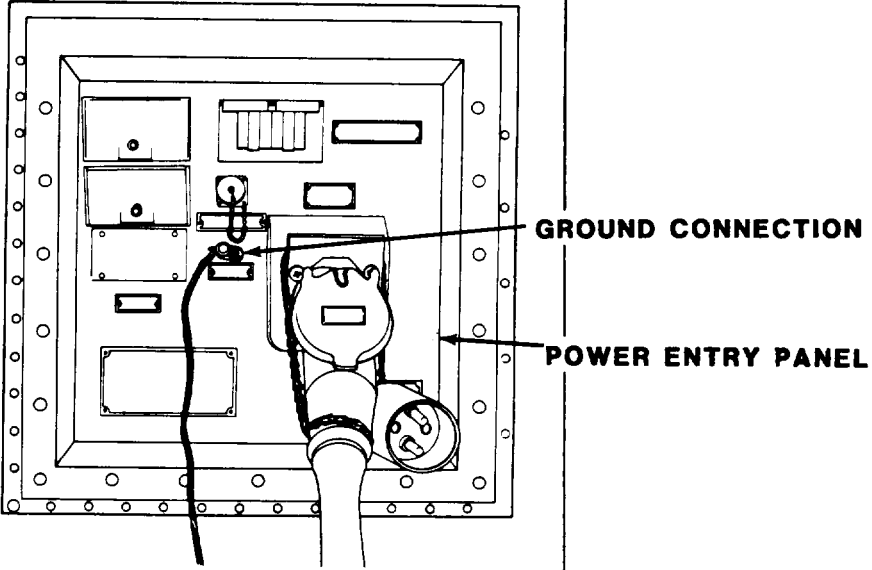
Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	D	A	W	Q		
3	•					 <p>GROUND CONNECTIONS. Check to see if ground cable is connected to terminal lug in power entry panel and to ground rod.</p> <p>WARNING</p> <p>ELECTRICAL SHOCK Power cable must be disconnected before servicing power entry panel connections. Failure to do so may result in death or serious injury.</p> <p>Check ground connections for dirt or foreign matter. Clean connections by removing ground cable and brushing cable wires and ground lug on power entry panel with wire brush.</p>	Ground connections are broken or missing.
	•						

Table 1-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation
W - Weekly

D - During Operation
Q - Quarterly

A - After Operation

Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	D	A	W	Q		
4	•				•	POWER ENTRY PANEL. Check to see that unused receptacles are covered. Inspect power entry panel for accumulated dirt, water, or corrosion. Clean with wire brush.	Covers are missing.
5	•					LEVEL INDICATORS. Check to see if level indicators are damaged.	Indicators are damaged.
6	•					AIR CONDITIONER/HEATER DRAIN TUBE. Check to see if tube is not loose or missing.	Drain tube is missing.
7	•					VENTILATION FAN COVER AND AIR VENT COVRES. Check to see if ventilation fan cover and air vent covers are blocked or clogged.	Covers are blocked or clogged.
8					•	WALLS, CEILING, AND FLOOR. Check for holes, open seams, or signs of seepage or leaks.	Leaks are present.
9		•				STORAGE CABINETS. Check for broken hinges, latches, and locks.	Hinges, latches, and locks are broken.

Table 1-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation
W - Weekly

D - During Operation
Q - Quarterly

A - After Operation

Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	D	A	W	Q		
10	•					FIRE EXTINGUISHER. Check to see if security seals are broken. Check to see if fire extinguisher is missing.	Fire extinguisher is missing or seals are broken.
11	•					FIRST AID KIT. Check container and contents for damage. Use checklist to inventory contents. Replace damaged or missing contents.	Contents are damaged or missing.
12	•					BLACKOUT CURTAINS. Check curtains and valances for tears, missing hooks, or broken eyelets. Check to see if nylon hook tape on curtain and wall are secure.	Curtains are damaged.
13	•					POWER CORDS, CABLES, AND PLUG CONNECTORS. Check to see if wires are kinked, cut, or cracked. Check to see if plug connectors are tight.	Wires or cables are cracked or cut.

Table 1-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation
W - Weekly

D - During Operation
Q - Quarterly

A - After Operation

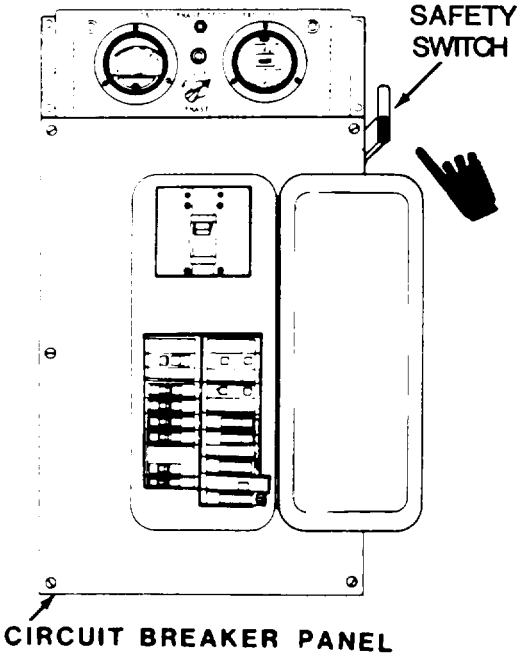
Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	D	A	W	Q		
						 <p style="text-align: center;">CIRCUIT BREAKER PANEL</p>	
14					•	<p>CIRCUIT BREAKER PANEL. Test Phase and Voltage (reference para 1-6.1h), then set safety switch to ON. Set main circuit breaker to ON. Set each circuit breaker to OFF, then ON.</p>	Circuit breaker is defective.
15				•		<p>FLUORESCENT LIGHTS AND LAMPS. Check for proper operation and broken lamps.</p>	Fluorescent light is not operating. Lamp is broken.
16				•		<p>BLACKOUT LIGHTS. Set light switches to ON and blackout switches to OFF. Open door and check to see if internal lights turn off.</p>	Blackout system is inoperable.

Table 1-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation
W - Weekly

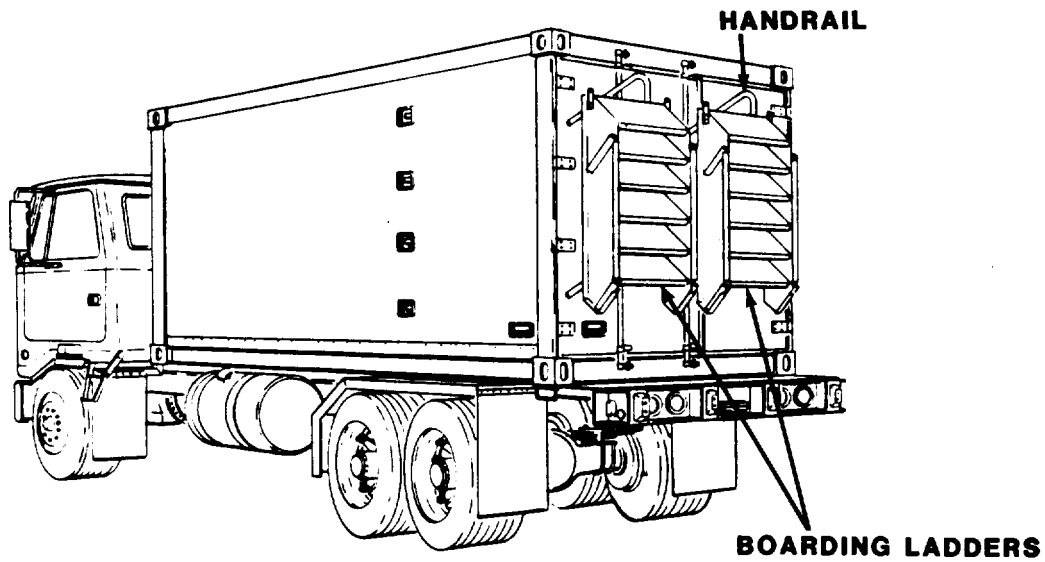
D - During Operation
Q - Quarterly

A - After Operation

Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	D	A	W	Q		
17	•		•			<p>EMERGENCY LIGHTS. Test by pressing test button.</p> <p>AIR CONDITIONER/HEATER. Refer to TM5-4120-367-14 for preventive maintenance checks and services that pertain to air conditioners/heaters.</p> <p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">ELECTRICAL SHOCK</p> <p>Do not use wet or damp cloth to clean equipment, power cords, or power cables that are plugged in. Death or serious injury may result.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Do not sweep interior. Dislodged dirt or dust will damage optical, electronic, and photographic equipment and supplies.</p> <p>VAN INTERIOR. Wipe wall surfaces with cloth (item 16, appendix E) moistened with solution of general purpose detergent (item 19, appendix E) and fresh water. Dry wall surfaces with clean cloth. Vacuum interior of section to remove dirt and waste.</p>	Emergency lights do not light.
18	•						
19	•						

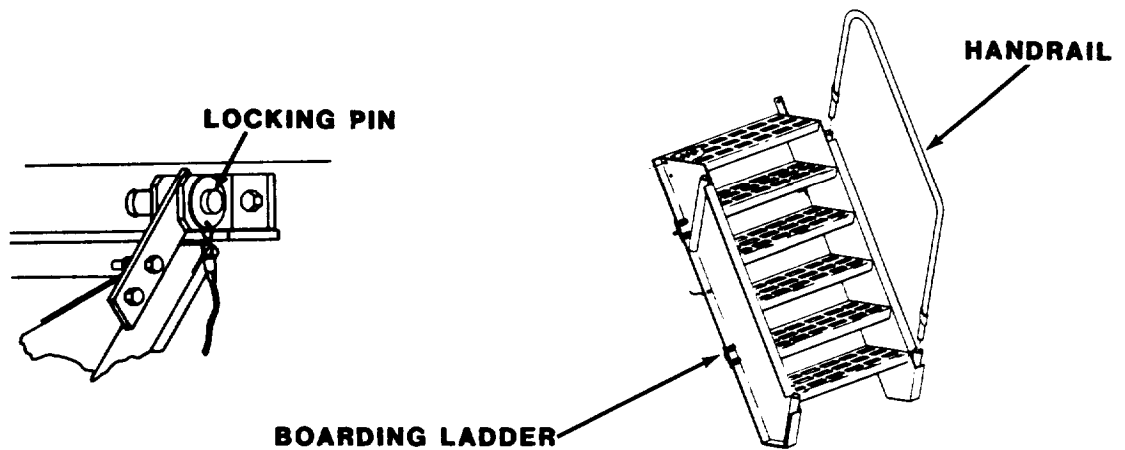
1-6 OPERATION UNDER USUAL CONDITIONS.

1-6.1 Assembly and Preparation for Use



- a. Remove boarding ladders and handrails from back of truck.
- b. Remove handrails from boarding ladders.

1-6.1 Assembly and Preparation for Use - Continued



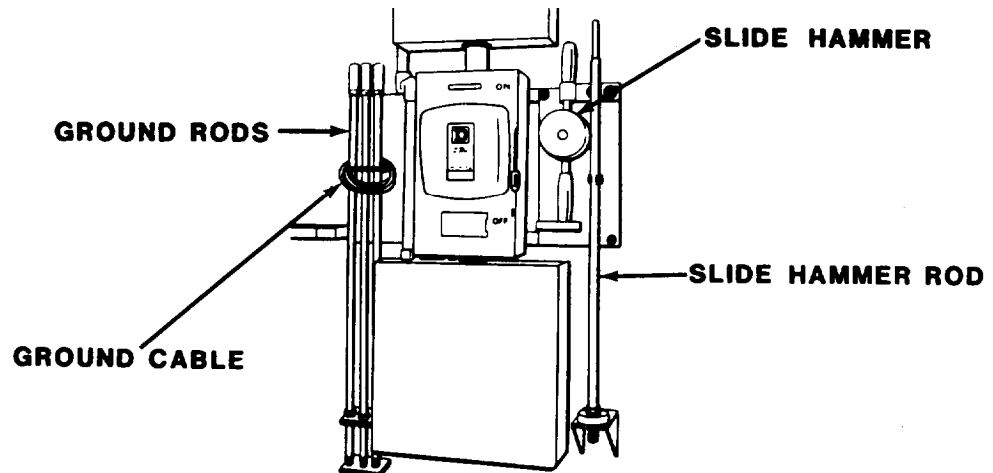
- c. Mount boarding ladders at personnel doors, and secure with locking pins.
- d. Mount one handrail on each boarding ladder.
- e. Enter truck. Make sure all power switches are off.

WARNING

HIGH VOLTAGE

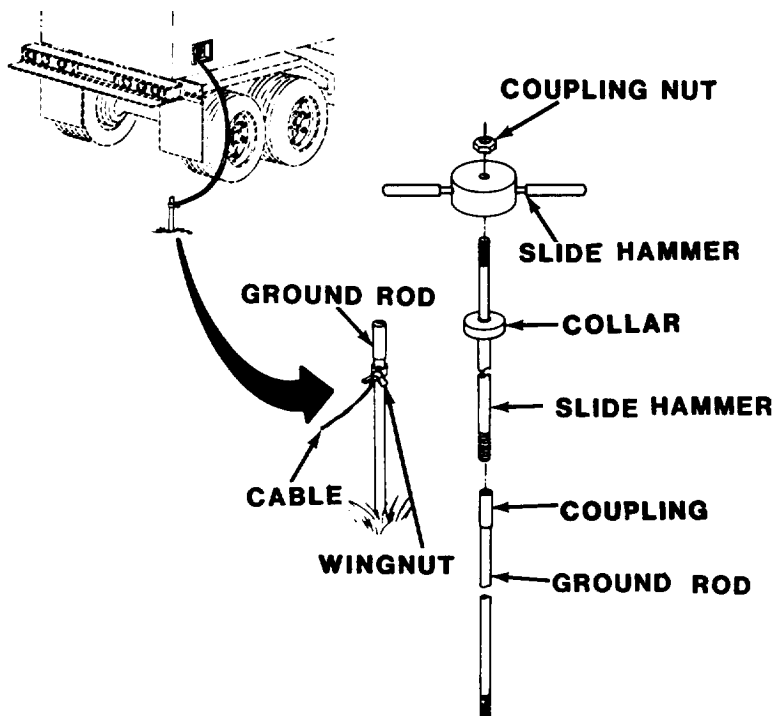
Do not connect power cables until truck is grounded.
Failure to do so may result in death or serious injury.

- f. Ground the truck.



- (1) Remove ground rods, slide hammer, slide hammer rod, and ground cable from van.

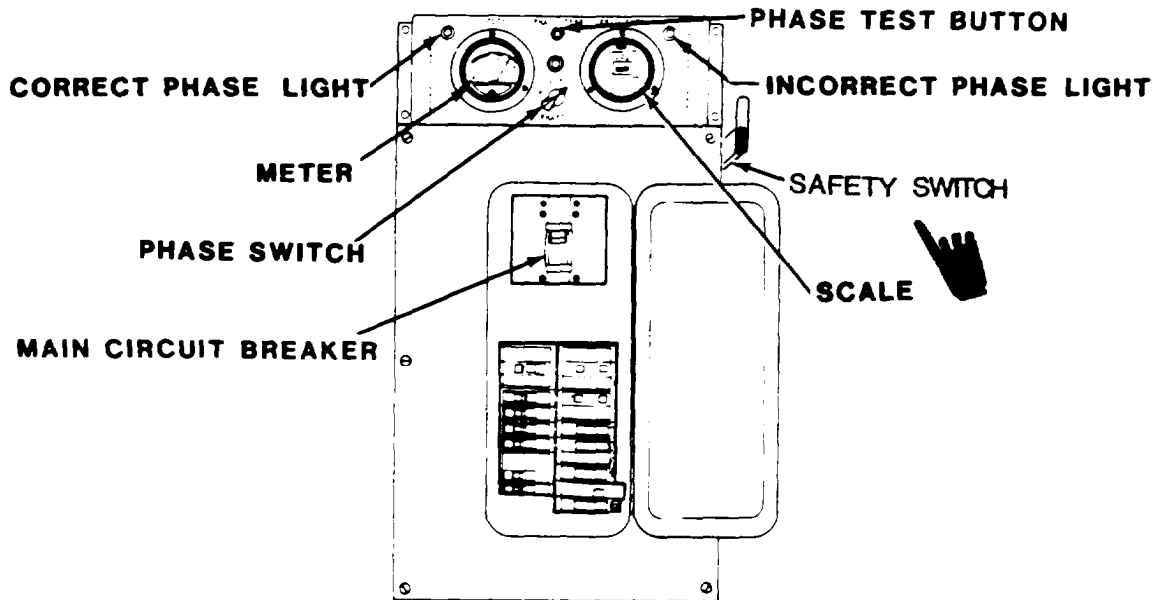
1-6.1 Assembly and Preparation for Use - Continued



- (2) Assemble slide hammer assembly.
 - (a) Slide collar onto slide hammer rod.
 - (b) Screw slide hammer rod into coupling until it is secure in ground rod. Adjust collar until it rests against coupling.
 - (c) Put slide hammer on slide hammer rod.
 - (d) Screw coupling nut on top of slide hammer rod.
- (3) Drive ground rod into ground by slamming hammer down on collar. Drive ground rod into-ground until 6 in. (15 cm) are left above the ground.
- (4) Unscrew slide hammer rod from coupling on ground rod. Screw next section of ground rod into coupling. Screw slide hammer rod into coupling.
- (5) Drive rod into ground until 6 in. (15 cm) above ground.
- (6) Repeat steps (4) and (5) for third section of ground rod.
- (7) Remove coupling nut, slide hammer, and collar from slide hammer rod. Remove slide hammer rod. Store in van.
- (8) Mount ground cable to ground rod. Secure with wingnut.

1-6.1 Assembly and Preparation for Use - Continued

- (9) Connect other end of ground cable to ground lug in power entry panel.
- g. Connect power cable to power cable jack in power entry panel.

**CAUTION**

Be sure safety switch is ON before setting main circuit breaker ON. Do not turn power on in van if incorrect phase lamp comes on. Damage to equipment may result.

- h. Check voltage and frequency.
- (1) Push down PHASE TEST button.
 - (2) Observe CORRECT PHASE or INCORRECT PHASE lights.
 - (3) Turn PHASE switch to A.
 - (4) Read voltage on meter.

NOTE

Voltage must be between 110 and 125 vac.

- (5) Read frequency on scale.

NOTE

Frequency must be 60 ± 1 Hz.

1-6.1 Assembly and Preparation for Use - Continued

- (6) Repeat for positions B and C on PHASE switch.

NOTE

If INCORRECT PHASE light comes on, voltage is not within 110 and 125 vac, or frequency is not 60 ± 1 Hz. There is an electrical problem at the power source. Contact supervisor for correction.

- (7) Turn ON safety switch.
- i. Turn ON main circuit breaker.
- j. Turn ON circuits in the following order: individual light switches, curbside and roadside air conditioners/heaters (TM5-4120-367-14), and individual equipment switches.
- k. Connect telephone lines to corresponding telephone binding posts.
- l. Test blackout switches.

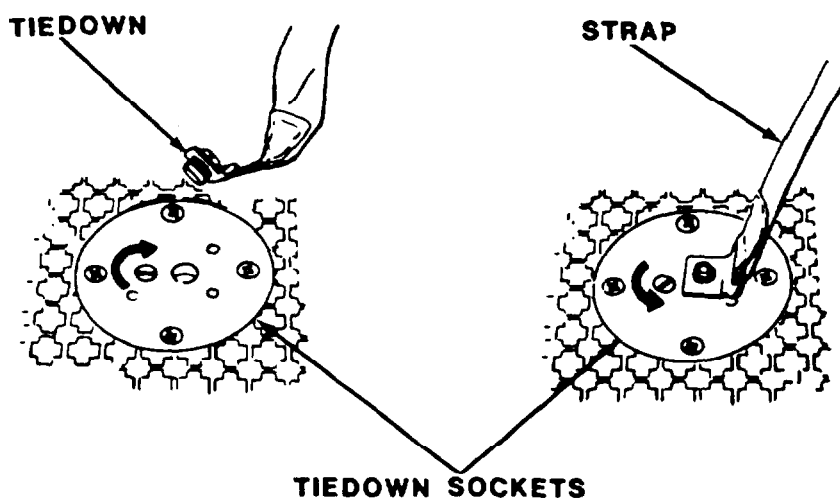
NOTE

Under blackout conditions, be sure equipment that must continue operation is plugged into receptacles not marked BLACKOUT.

- m. Plug in emergency lights, and turn switch to READY.
- n. Deactivate air suspension with caution. (Refer to TM 9-2320-281-10, para 2-16h(4)(6).)

1-6.2 Preparation for Movement

- a. Secure equipment in proper containers as specified in appropriate chapters.



1-6.2 Preparation for Movement - Continued

- b. Install tiedowns in tiedown sockets.
- c. Secure straps and remove slack from straps.

WARNING

HIGH VOLTAGE

Turn power off before disconnecting power cable. Death or serious injury may result.

- d. Turn OFF equipment switches.
- e. Set circuit breakers to OFF.
- f. Turn OFF main circuit breaker.
- g. Turn OFF safety switch.
- h. Disconnect main power cable from power source. Disconnect power cable from power entry panel.
- i. Disconnect telephone lines from telephone binding posts.
- j. Remove ground cable from power entry panel.
- k. Remove ground cable from ground rod by loosening wing nut on rod.
- l. Remove ground rod from ground,
 - (1) Remove slide hammer assembly from van body.
 - (2) Screw slide hammer rod into coupling of ground rod. Put slide hammer on slide hammer rod and slide collar onto slide hammer rod. Screw coupling nut onto top of slide hammer rod.
 - (3) Pull ground rod out of ground by thrusting the slide hammer upward against the collar.
 - (4) When first section is completely out of ground, unscrew slide hammer rod, and screw into next section of ground rod.
 - (5) Remove remaining two sections of ground rod following steps (1) thru (4).
 - (6) Wipe dirt from ground rods. Reinstall ground rods and slide hammer assembly into van.

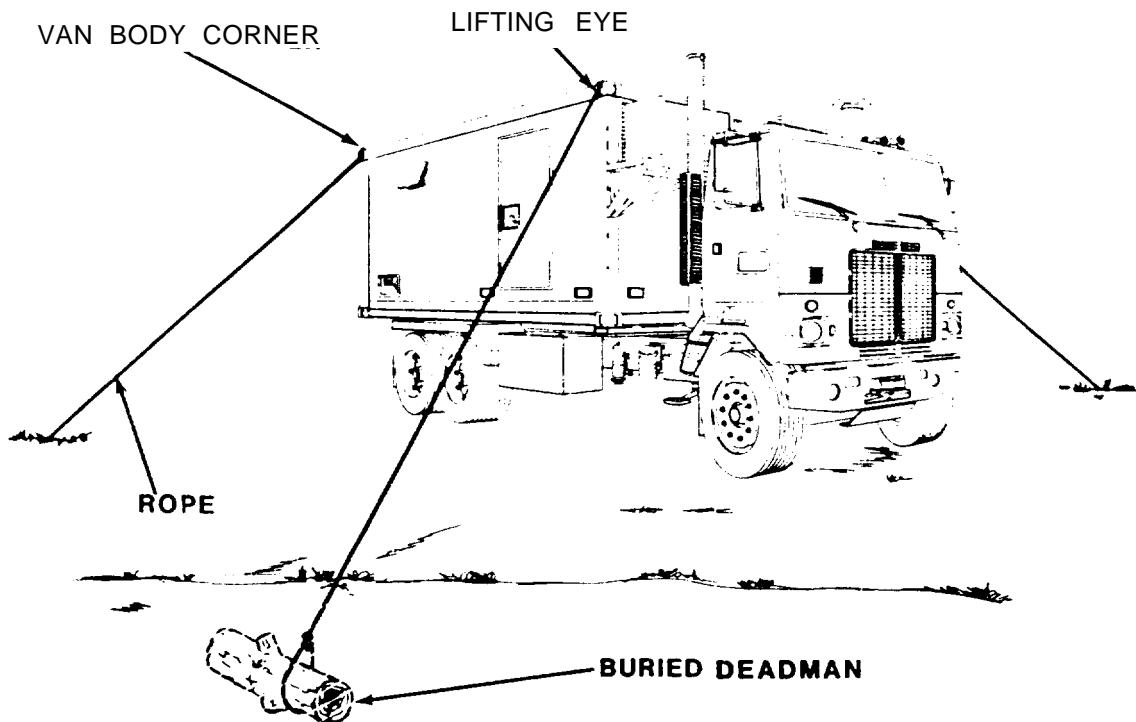
1-6.2 Preparation for Movement - Continued

- m. Close all vents.
- n. Reinstall covers on interior vents,
- o. Close van doors. Secure and lock doors.
- p. Remove handrails from ladders.
- q. , Remove ladders from van, and mount handrails on back of ladders. Secure ladders to back of van body.

1-7 OPERATION UNDER UNUSUAL CONDITIONS.

1-7.1 Operation in High Wind or Storm Conditions

- a. Relocate truck if trees present hazard.



- b. Secure van body corners with rope at lifting eyes to buried deadmen
- c. Move any loose objects out of area.

1-7 OPERATION UNDER UNUSUAL CONDITIONS - Continued**CAUTION**

During transportation, when van heaters are not operating, liquid supplies may freeze and break containers. Damage to equipment can result.

1-7.2 Operation in Cold Weather. During operation the van interior is an environmentally controlled atmosphere, and internal equipment is not affected by outside temperatures.

CAUTION

Extreme cold can cause external power cable and ground cable to become hard and brittle. Avoid kinks or loops in cables. Permanent damage to cables may result.

Position cables to avoid kinks or loops.

CAUTION

During transportation, when van air conditioners are not operating, consumable supplies will suffer reduced shelf life, and internal seals and gaskets will deteriorate rapidly.

1-7.3 Operation in Extreme Heat. During operation the van interior is an environmentally controlled atmosphere, and internal equipment is not affected by outside temperatures.

CAUTION

During transportation, when van air conditioners are not operating or when van is not being used, mold or mildew will form on equipment, supplies, and documents. Damage to equipment, supplies, and documents will result.

1-7.4 Operation in Tropical Conditions. During operation the van interior is an environmentally controlled atmosphere, and internal equipment is not affected by outside temperatures.

CAUTION

During transportation or when van is not operating and air conditioners are not operating, dust and sand may enter van and damage equipment and supplies.

1-7.5 Operation in Desert Conditions. During operation the van interior is an environmentally controlled atmosphere, and internal equipment is not affected by outside temperatures.

- a. Change air filters frequently.
- b. Clean van interior frequently.

1-7.6 Emergency Procedures. During emergency situations, operation of the van and its equipment will continue. The blackout lights will be used during emergency situations and are activated automatically when the personnel door is open and the emergency switch is turned to READY.

Section III. OPERATOR MAINTENANCE

1-8 LUBRICATION INSTRUCTIONS.

Lubrication instructions for the Direct Support Section are contained in LO5-6675-326-12, Lubrication Order, Direct Support Section, Topographic Support System.

1-9 OPERATOR TROUBLESHOOTING PROCEDURES.

1-9.1 General

1-9.1.1 The table lists the common malfunctions which you may find during the operation and maintenance of the direct support section (van). You should perform the tests/inspections and corrective actions in the order listed.

1-9.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 1-2. Operator Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

1. NO ELECTRICAL POWER TO SECTION.

WARNING

HIGH VOLTAGE

Use extreme caution when performing checks or maintenance at or near main power panel. Death or serious injury can result.

Step 1. Observe voltage meter, frequency scale, and phase lights.

CAUTION

Do not energize van if voltage and frequency are incorrect or INCORRECT PHASE is Indicated. Damage to equipment may result. Notify your supervisor for service at power source.

Step 2. Check position of safety switch.

Turn on safety switch.

Step 3. Check position of main circuit breaker.

Reset main circuit breaker to ON.

2. NO ELECTRICAL POWER TO EQUIPMENT.

Step 1. Check equipment power switch.

Turn on power switch.

Step 2. Check power cord connection.

Plug in power cord.

Step 3. Check circuit breaker panel for position of circuit breaker.

Reset circuit breaker to ON.

Table 1-2. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
3. BLACKOUT SWITCH DOES NOT OPERATE.	<p>Step 1. Check position of blackout switch.</p> <p style="padding-left: 40px;">Reset switch to ON.</p> <p>Step 2. Check to see if striker plate touches roller on microswitch activating blackout light.</p> <p style="padding-left: 40px;">Reposition plate up or down until microswitch operates. Loosen screw to reposition plate. Secure in position.</p>	

1-10 OPERATOR MAINTENANCE PROCEDURES.

This section contains step-by-step instructions covering operator performed maintenance instructions.

1-10.1 Replace Fluorescent Ceiling Lamp

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

MATERIALS/PARTS: Fluorescent lamp

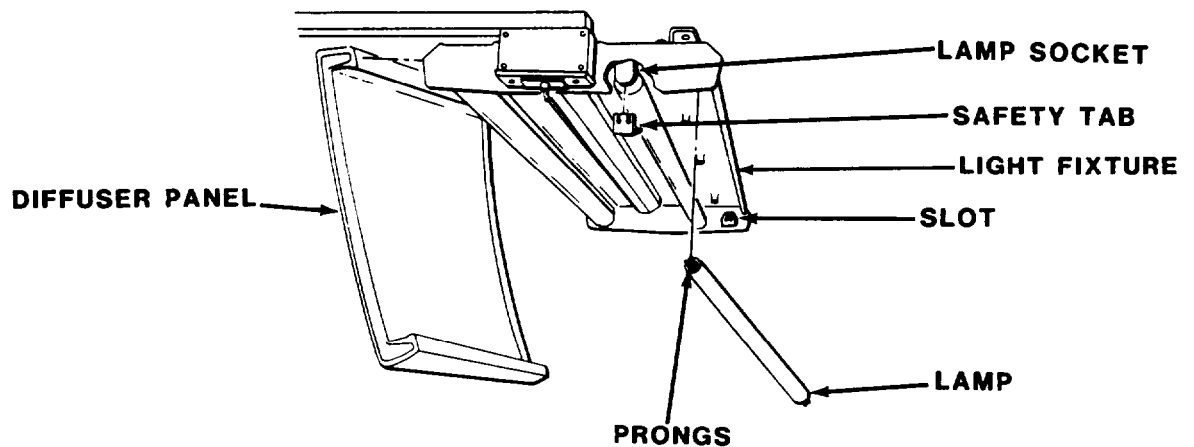
REMOVAL:

WARNING

ELECTRICAL SHOCK

Set ceiling light switch and ceiling light circuit breaker to OFF.
Failure to do so may result in death or serious injury.

- a. Turn ceiling light switch OFF. Turn ceiling light circuit breaker OFF.

1-10.1 Replace Fluorescent Ceiling Lamp - Continued

- b. Pull diffuser panel from light fixture, and place it out of way of working area.
- c. Remove safety tab from lamp socket.
- d. Turn defective lamp until lamp prongs are free from slot. Remove defective lamp.

INSTALLATION:

- a. Install new lamp into socket. Turn until prongs fit snugly into slot.
- b. Reinstall safety tab on lamp socket.
- c. Reinstall diffuser panel on light fixture.
- d. Turn ceiling light circuit breaker ON. Turn ceiling light switch ON.

1-10.2 Service Ventilation Ducts

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

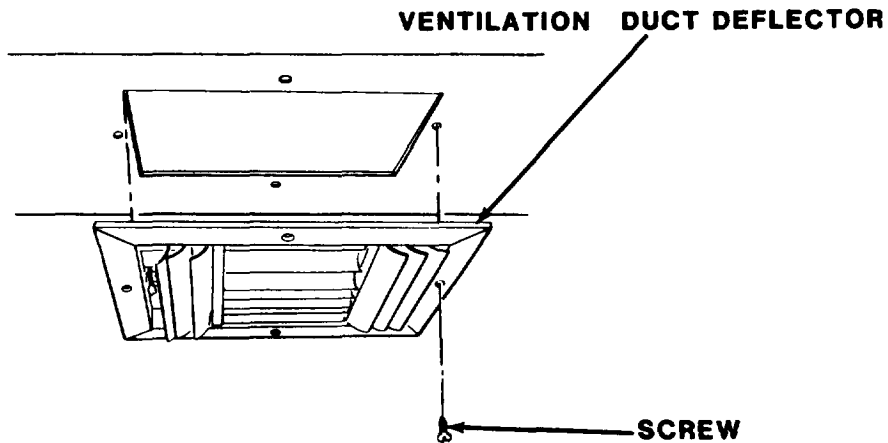
TOOLS: Vacuum cleaner
No. 1 cross-tip screwdriver

1-10.2 service Ventilation Ducts - Continued

CAUTION

Dust and dirt can damage equipment, documents, and supplies. Cover or put away all equipment. Close drawers and cabinets. Put away documents, paperwork, and supplies.

- a. Turn OFF air conditioners/heaters.



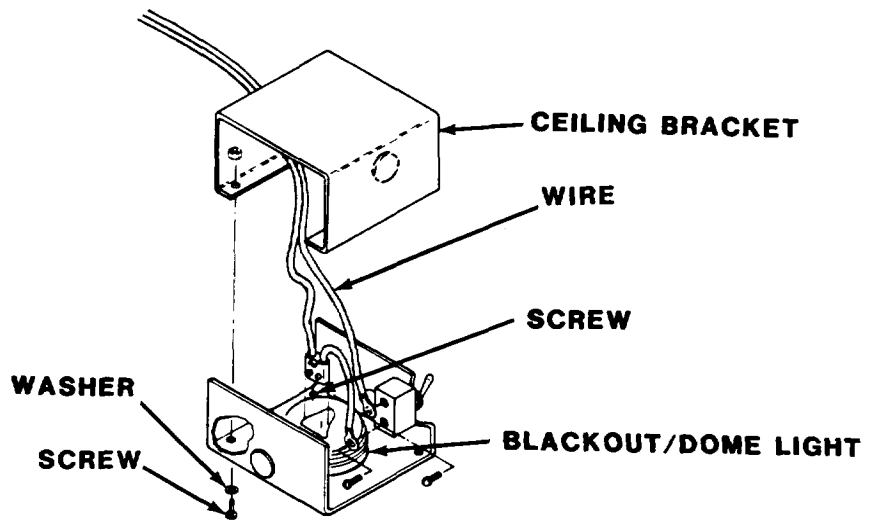
- b. Remove four screws from each ventilation duct deflector.
- c. Remove ventilation duct deflectors.
- d. Vacuum dust from ventilation deflectors.
- e. Insert vacuum cleaner hose into each ventilation duct, and vacuum as far as hose will reach.
- f. Reinstall each ventilation duct deflector. Secure with four screws.
- g. Vacuum any dirt and dust from interior of van.
- h. Turn ON air conditioners/heaters.

1-10.3 Replace Blackout/Dome Light

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: No. 2 cross-tip screwdriver
1/4-in. Flat-tip screwdriver

MATERIALS/PARTS: Blackout/dome light

1-10.3 Replace Blackout/Dome Light - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Turn OFF blackout/dome switch before replacing blackout/dome light. Failure to do so may result in death or serious injury.

- a. Remove four screws and washers holding blackout/dome light to ceiling bracket.
- b. Remove two screws connecting wires from blackout/dome light to ON/OFF switch.
- c. Unplug wire connector connecting blackout/dome light to van electrical system.
- d. Remove defective blackout/dome light.

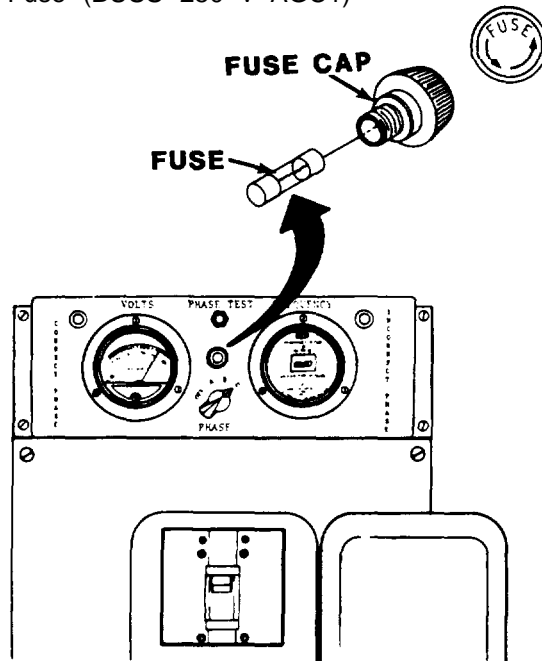
INSTALLATION:

- a. Install new blackout/dome light.
- b. Plug wire connector into new blackout/dome light.
- c. Reinstall two screws connecting wires to blackout/dome light.
- d. Reinstall blackout/dome light to ceiling bracket. Secure with four screws and washers.

1-10.4 Replace Main Power Fuse

PERSONNEL REQUIRED: 1 Terrain analyst M3S 81Q

MATERIALS/PARTS: Fuse (BUSS 250 v AGC1)



REMOVAL:

WARNING

ELECTRICAL SHOCK

Turn off main circuit breaker before replacing fuse. Failure to do so may result in death or serious injury.

- a. Push in on fuse cap. Turn fuse cap to left and remove.
- b. Remove defective fuse from fuse cap.

INSTALLATION:

- a. Install new fuse into fuse cap.
- b. Reinstall fuse cap. Turn to right to lock in place.

Section IV. ORGANIZATIONAL MAINTENANCE

1-11 REPAIR PARTS; SPECIAL TEST; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT.

1-11.1 For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

1-11.2 For special tools, TMDE, and support equipment refer to TM5-6675-326-24P, Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools), and the Maintenance Allocation Chart (MAC) in appendix B of this manual.

1-11.3 Repair parts are listed and illustrated in repair parts and special tools list (TM5-6675-326-24P) covering organizational maintenance for this equipment.

1-12 SERVICE UPON RECEIPT.

The van may be received mounted on a truck chassis, as a van body to be mounted on an available truck chassis or on site. Inspection of the truck chassis is covered in TM 9-2330-281-20.

- a. Check van body exterior for tears, breaks, corrosion, or other damage.
- b. Enter van. Check for unsecured chairs, equipment, or toolboxes. Check unsecured items for damage.
- c. Check interior of van for water damage, mold, or corrosion.
- d. Inventory van contents using Component of End Item and Basic Issue Items Lists (appendix C).
- e. Inventory consumable supplies using Expendable/Durable Supplies List (appendix E).
- f. Perform operational checks on individual equipment in accordance with corresponding chapters.

1-13 ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

1-13.1 General. The direct support section (van) must be regularly inspected to find and correct defects.

1-13.1.1 Monthly. Always keep in mind the WARNINGS and CAUTIONS. Perform your MONTHLY (M) PMCS.

1-13.1.2 Semiannually. Always keep in mind the WARNINGS and CAUTIONS. Perform your SEMIANNUAL (S) PMCS.

1-13.1.3 If Your Equipment Fails To Operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

**1-13 ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) -
Continued**

1-13.2 PMCS Procedures

1-13.2.1 PMCS are designed to keep the equipment in good working condition by performing periodic service tasks.

1-13.2.2 Service intervals provide you with time schedules that determine when to perform specified service tasks.

1-13.2.3 If your equipment fails to operate after PMCS is performed, immediately report this condition to your supervisor.

1-13.3 PMCS Columnar Entries

1-13.3.1 Item Number Column. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for "TM number" Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.

1-13.3.2 Interval Column. This column determines the time period designated to perform your PMCS.

1-13.3.3 Item to be Inspected Column. This column lists functional groups and their respective assemblies and subassemblies as shown in the Maintenance Allocation Chart (appendix B).

1-13.3.4 Procedures Column. The column describes the procedures necessary to perform the check.

Table 1-3. Organizational Preventive Maintenance Checks and Services

M - Monthly

S - Semiannually

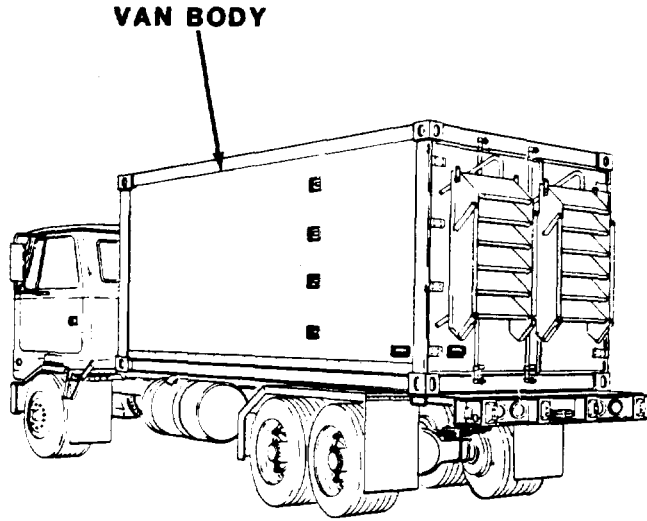
Item No.	Interval		ITEM TO BE INSPECTED	PROCEDURE
	M	S		
1	●		VAN BODY	 <p>Check exterior for blistered or flaking paint, bare metal spots, or dents. Repair or repaint in accordance with TM43-0139.</p>

Table 1-3. Organizational Preventive Maintenance Checks and Services - Continued

M - Monthly

S - Semiannually

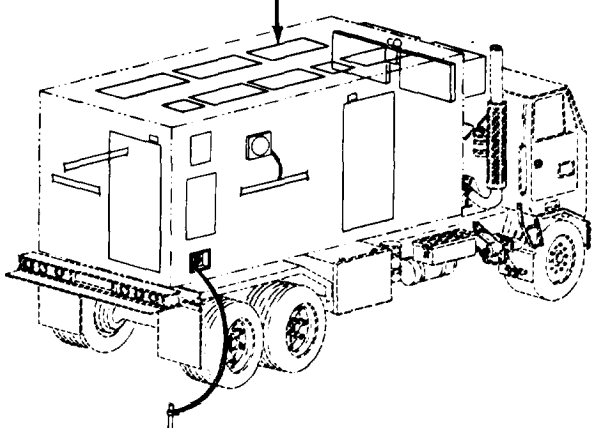
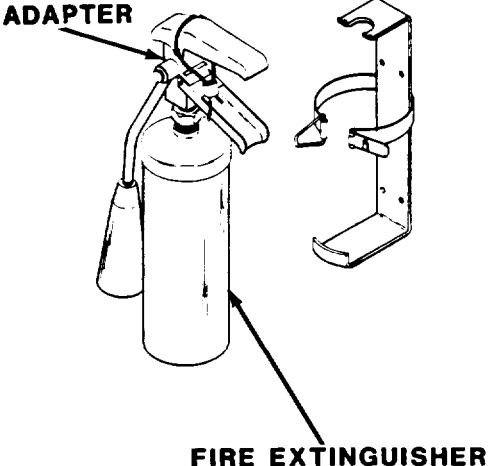
Item No.	Interval		ITEM TO BE INSPECTED	PROCEDURE
	M	S		
2	●		POWER CABLE	<p><u>WARNING</u></p> <p>ELECTRICAL SHOCK Do not service power cable if it is connected to power source or to van. Failure to do so may result in death or serious injury.</p> <p>Check power cable for kinks, abrasions, frays, or cuts. Replace as needed.</p>
3	●		LIGHTING SYSTEM	<p>LIGHTING SYSTEM</p>  <p><u>WARNING</u></p> <p>ELECTRICAL SHOCK Do not service electrical connections, switches, or circuit breakers when main circuit breaker is on. Failure to do so may result in death or serious injury.</p> <p>Check power panel for loose screws, bolts, or clamps. Tighten as needed. Check for loose screws and nuts on ceiling, conduits, electrical outlets, and light switches. Tighten as needed. Check for cracked or broken outlets or switches.</p>

Table 1-3. Organizational Preventive Maintenance Checks and Services - Continued

Item No.	Interval		ITEM TO BE INSPECTED	PROCEDURE
	M	S		
4	•		AIR VENT	<p>Check air vent for dust and dirt. Vacuum air vent to clean.</p> 
5		•	FIRE EXTINGUISHER	<p>Check nozzle and adapter for damage. Check to see if seal is broken. Replace fire extinguisher as needed.</p>

1-14 ORGANIZATIONAL TROUBLESHOOTING.

1-14.1 General

1-14.1.1 The table lists the common malfunctions which you may find during the maintenance of the direct support section (van) or its components. You should perform the tests/inspections and corrective actions in the order listed.

1-14.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 1-4. Organizational Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. FLUORESCENT CEILING LIGHT IS INOPERATIVE.	<p>Step 1. Verify that fluorescent ceiling light is inoperative.</p> <p>Step 2. Check to see if light is operating.</p> <p>Step 3. Check to see if light is operating.</p>	<p>Replace lamp ballast (para 1-15.2).</p> <p>Replace light switch (para 1-15.4).</p> <p>Replace radio frequency (RF) filter (para 1-15.3).</p>
2. VENTILATION FAN IS INOPERATIVE.	<p>Step 1. Check to see if ventilation fan is plugged into wall outlet.</p> <p>Step 2. Check operation of ventilation fan OFF/ON switch.</p>	<p>Plug ventilation fan into wall outlet.</p> <p>Replace ventilation fan (para 1-15.9).</p>
3. EMERGENCY LIGHTS ARE INOPERATIVE.	<p>Move OFF/READY switch to READY and push test indicator button to see if light fails.</p>	<p>Replace emergency light assembly (para 1-15.11).</p>
4. AIR CONDITIONERS/HEATERS ARE INOPERATIVE.		<p>Refer to direct support and general support maintenance for replacement.</p>

1-15 ORGANIZATION MAINTENANCE PROCEDURES.

This section contains step-by-step instructions covering organizational maintenance procedures.

1-15.1 Index of Organizational Maintenance Procedures

<u>Procedure</u>	<u>Paragraph</u>	Page
Repair Conduit Base and Cover	1-15.7	1-49
Repair Personnel Ladder	1-15.17	1-61
Repair Van Body Skin (Temporary)	1-15.13	1-56
Replace Air Vent Door	1-15.16	1-60
Replace Blackout Curtain	1-15.12	1-56
Replace Electrical Receptacles	1-15.6	1-48
Replace Emergency Light Assembly	1-15.11	1-54
Replace Fluorescent Lamp Ballast	1-15.2	1-41
Replace Fluorescent Light Switch	1-15.4	1-45
Replace Level Indicator	1-15.15	1-58
Replace ON/OFF Switch	1-15.5	1-46
Replace Radio Frequency (RF) Filter	1-15.3	1-43
Replace Telephone Binding Post Assembly	1-15.8	1-51
Replace Tiedown Socket	1-15.14	1-58
Replace Ventilation Fan	1-15.9	1-52
Replace Ventilation Fan Cover	1-15.10	1-53

1-15.2 Replace Fluorescent Lamp Ballast

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 1/4-in. spanner wrench
 11/32-in. spanner wrench

MATERIALS/PARTS: Lamp ballast
 Wire ties

1-15.2 Replace Fluorescent Lamp Ballast - Continued

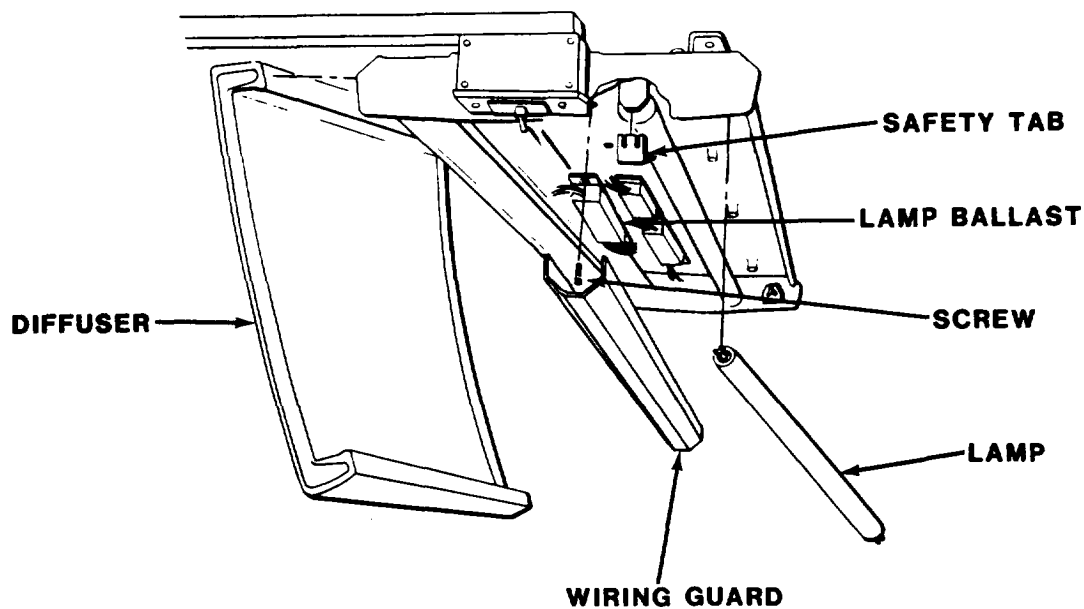
REMOVAL:

WARNING

ELECTRICAL SHOCK

Turn ceiling light switch and ceiling light circuit breaker OFF. Failure to do so may result in death or serious injury.

- a. Turn ceiling light switch OFF. Turn off ceiling light circuit breaker OFF.



- b. Tilt diffuser away from light fixture and remove.
- c. Remove safety tabs and lamps. Set aside.
- d. Remove wiring guard.
- e. Remove wire ties as required.
- f. Label and cut wires as close as possible to lamp ballast.
- g. Remove two screws. Remove defective lamp ballast.

1-15.2 Replace Fluorescent Lamp Ballast - Continued

INSTALLATION:

- a. Install new lamp ballast. Secure with two screws.
- b. Install wires as marked to new lamp ballast.
- c. Reinstall wire ties as needed.
- d. Reinstall wiring guard.
- e. Reinstall lamps and safety tabs.
- f. Reinstall diffuser panel.
- g. Turn ceiling light circuit breaker and ceiling light switch ON.

1-15.3 Replace Radio Frequency (RF) Filter

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 1/4-in. spanner wrench
11/32-in. spanner wrenchMATERIALS/PARTS: RF filter
Wire ties
Wire nuts

REMOVAL:

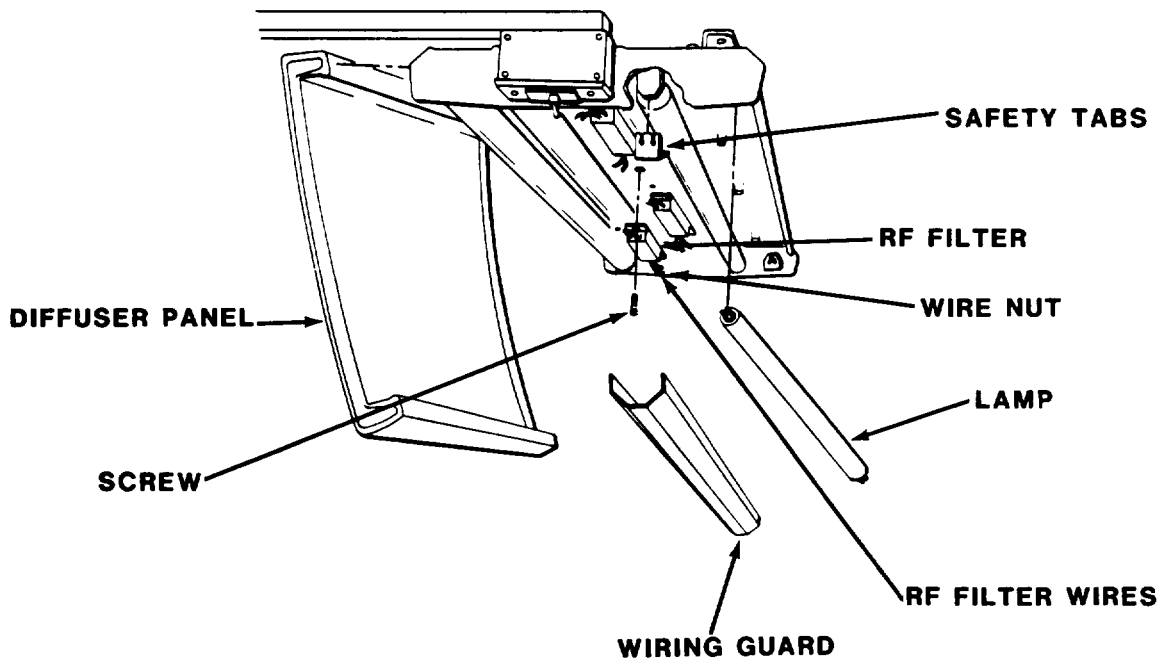
WARNING

ELECTRICAL SHOCK

Turn ceiling light switch and ceiling light circuit breaker OFF. Failure to do so may result in death or serious injury.

- a. Turn ceiling light switch OFF. Turn ceiling light circuit breaker OFF.

1-15.3 Replace Radio Frequency (RF) Filter - Continued



- b. Tilt diffuser panel away from light fixture and remove.
- c. Remove safety tabs and lamps. Set aside.
- d. Remove wiring guard.
- e. Remove wire ties as needed.
- f. Label wires to RF filter.
- g. Remove wire nuts and disconnect RF filter wires.
- h. Remove two screws and defective RF filter.

1-15.3 Replace Radio Frequency (RF) Filter - Continued

INSTALLATION:

- a. Install new RF filter. Secure with two screws.
- b. Reconnect wires and remove labels. Install wire nuts.
- c. Reinstall wire ties as needed.
- d. Reinstall wiring guard.
- e. Reinstall lamps and safety tabs.
- f. Reinstall diffuser panel on light fixture.
- g. Turn ceiling light switch and ceiling light circuit breaker ON.

1-15.4 Replace Fluorescent Light Switch

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 1/4-in. flat-tip screwdriver
 Needle-nose pliers
 9/16-in. combination box and open end wrench

MATERIALS/PARTS: Fluorescent light switch assembly

REMOVAL:

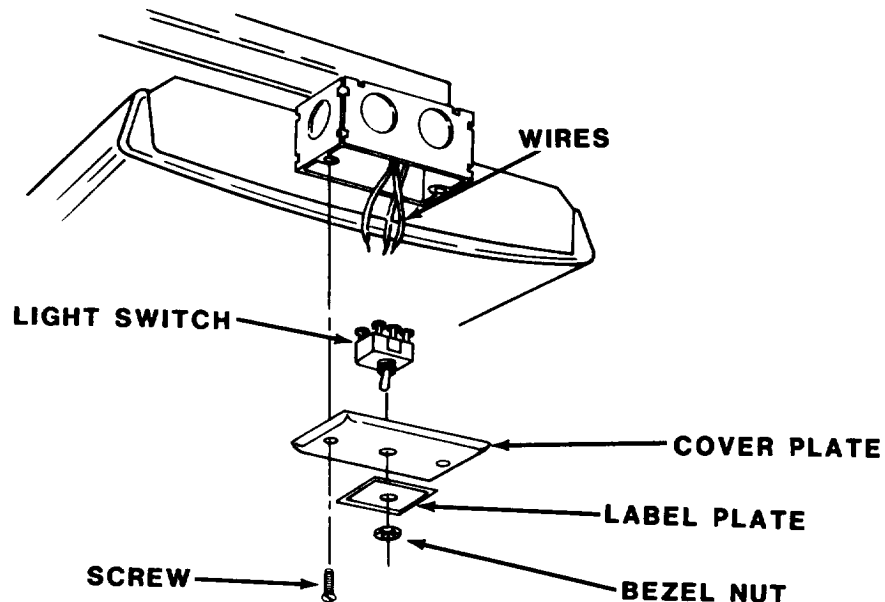
WARNING

ELECTRICAL SHOCK

Turn ceiling light switch and ceiling light circuit breaker to OFF. Failure to do so may result in death or serious injury.

- a. Turn ceiling light circuit breaker, main circuit breaker, and ceiling light switch OFF.

1-15.4 Replace Fluorescent Light Switch - Continued



- b. Remove bezel nut. Mark position of label plate on cover plate and remove.
- c. Remove two screws. Remove cover plate.
- d. Label and disconnect wires from light switch. Remove defective light switch.

INSTALLATION:

- a. Install new switch. Remove labels and reconnect wires.
- b. Reinstall cover plate. Secure with two screws.
- c. Reinstall label plate over switch. Make sure label plate is aligned with mark on cover plate. Secure with bezel nut.
- d. Turn ceiling light circuit breaker, main circuit breaker, and ceiling light switch ON.

1-15.5 Replace ON/OFF Switch

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 1/4-in. flat-tip screwdriver

MATERIALS/PARTS: ON/OFF switch

1-15.5 Replace ON/OFF Switch - Continued

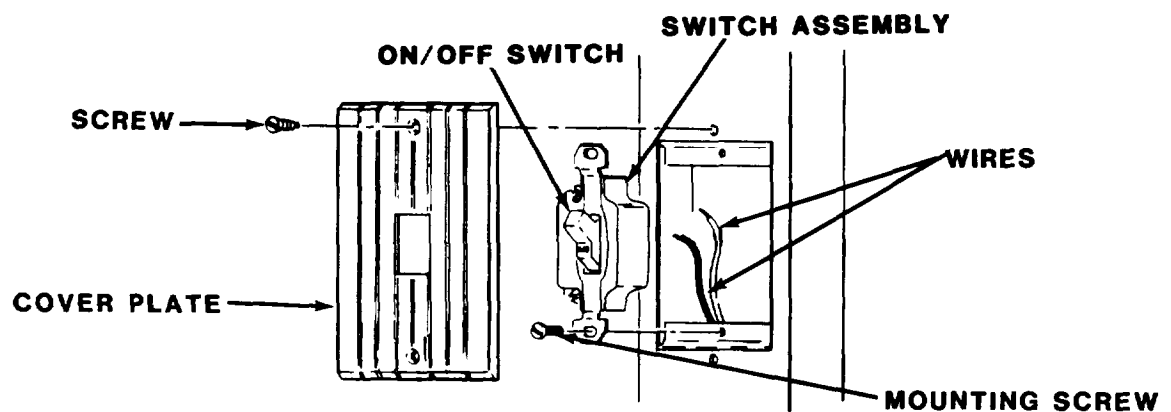
REMOVAL:

WARNING

ELECTRICAL SHOCK

Turn switch, circuit breaker, and main circuit breaker OFF. Failure to do so may result in death or serious injury.

- a. Turn switch, circuit breaker, and main circuit breaker OFF.



- b. Remove two screws. Remove cover plate.
- c. Remove mounting screws. Remove switch assembly to access wires .
- d. Loosen terminal screws. Disconnect wires. Remove defective ON/OFF switch from switch assembly.

INSTALLATION:

- a. Install new switch in switch assembly. Reconnect wires. Secure with terminal screws.
- b. Reinstall switch assembly. Secure with mounting screws.
- c. Reinstall cover plate. Secure with two screws.
- d. Turn main circuit breaker, circuit breaker, and switch ON.

1-15.6 Replace Electrical Receptacles

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 1/4-in. flat-tip screwdriver

MATERIALS/PARTS: Electrical receptacle

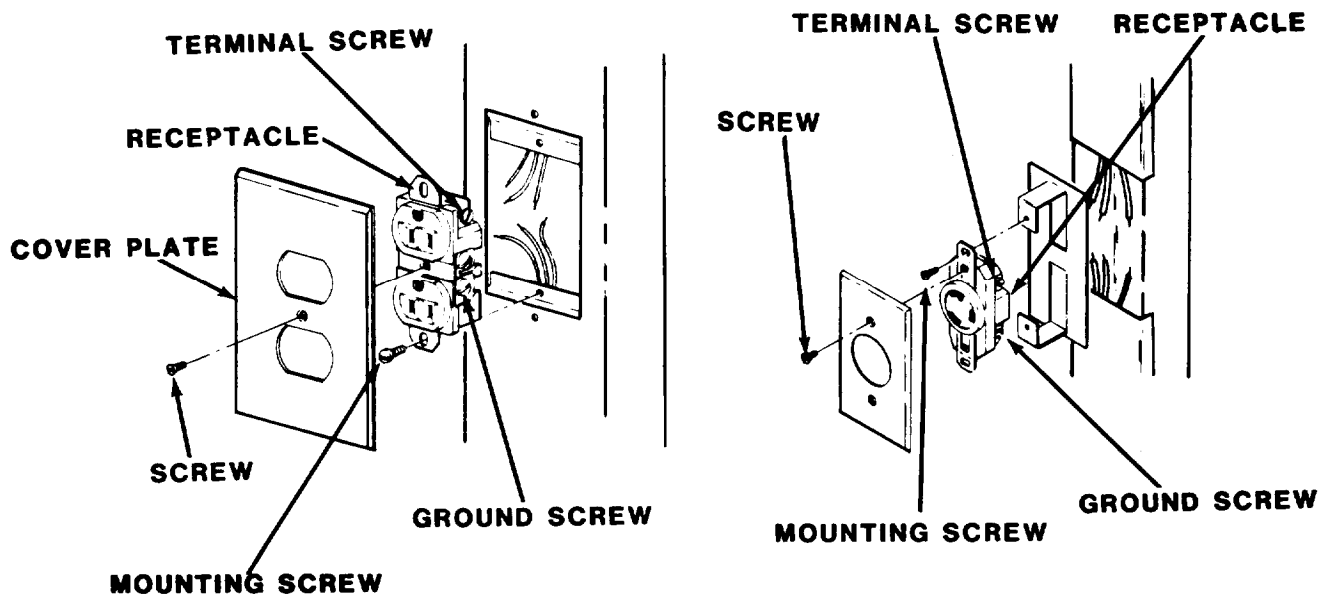
REMOVAL:

WARNING

ELECTRICAL SHOCK

Turn all receptacle circuit breakers and main circuit breaker OFF. Failure to do so may result in death or serious injury.

- a. Turn all receptacle circuit breakers and main circuit breaker OFF.



- b. Remove screws from cover plates. Remove cover plates.
- c. Remove mounting screws.
- d. Loosen terminal screws and ground screw. Label and disconnect wires. Remove defective receptacle.

1-15.6 Replace Electrical Receptacles - Continued

INSTALLATION:

- a. Install new electrical receptacle. Remove labels and reconnect wires. Connect ground screw and then terminal screws.
- b. Reinstall mounting screws.
- c. Reinstall cover plate. Secure with screws.
- d. Turn main circuit breaker and all receptacle circuit breakers ON.

1-15.7 Repair Conduit Base and Cover

PERSONNEL REQUIRED: 1 Utilities equipment repairer MOS 52C

TOOLS: No. 2 cross-tip screwdriver
Hacksaw
Electric drill and bits
File

MATERIALS/PARTS: Salvage conduit
Paint brush
Paint
Cloth

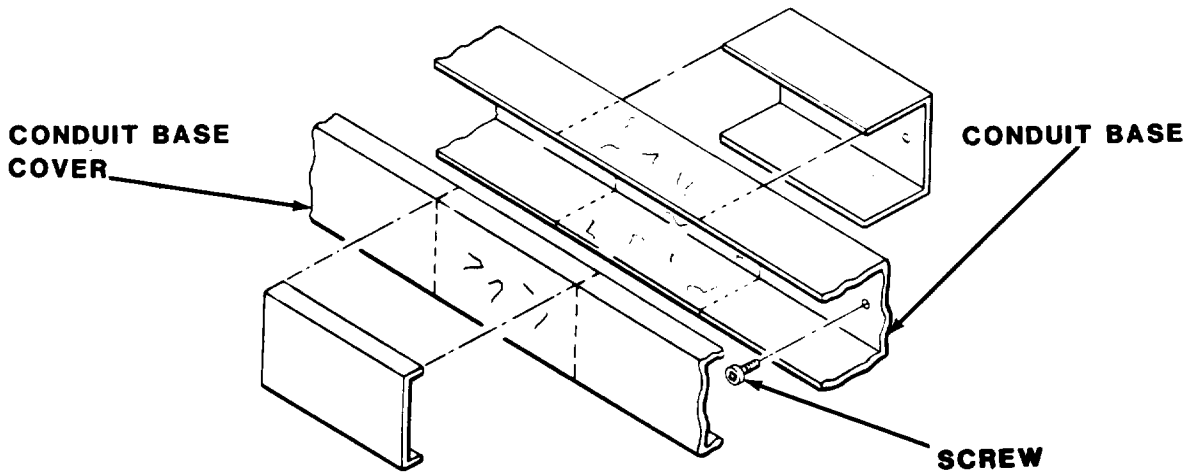
WARNING

ELECTRICAL SHOCK

Turn main circuit breaker and all circuit breakers to receptacles and equipment OFF. Failure to do so may result in death or serious injury.

- a. Turn main circuit breaker and all circuit breakers to receptacles and equipment OFF.
- b. Remove conduit base cover.

1-15.7 Repair Conduit Base and Cover Continued



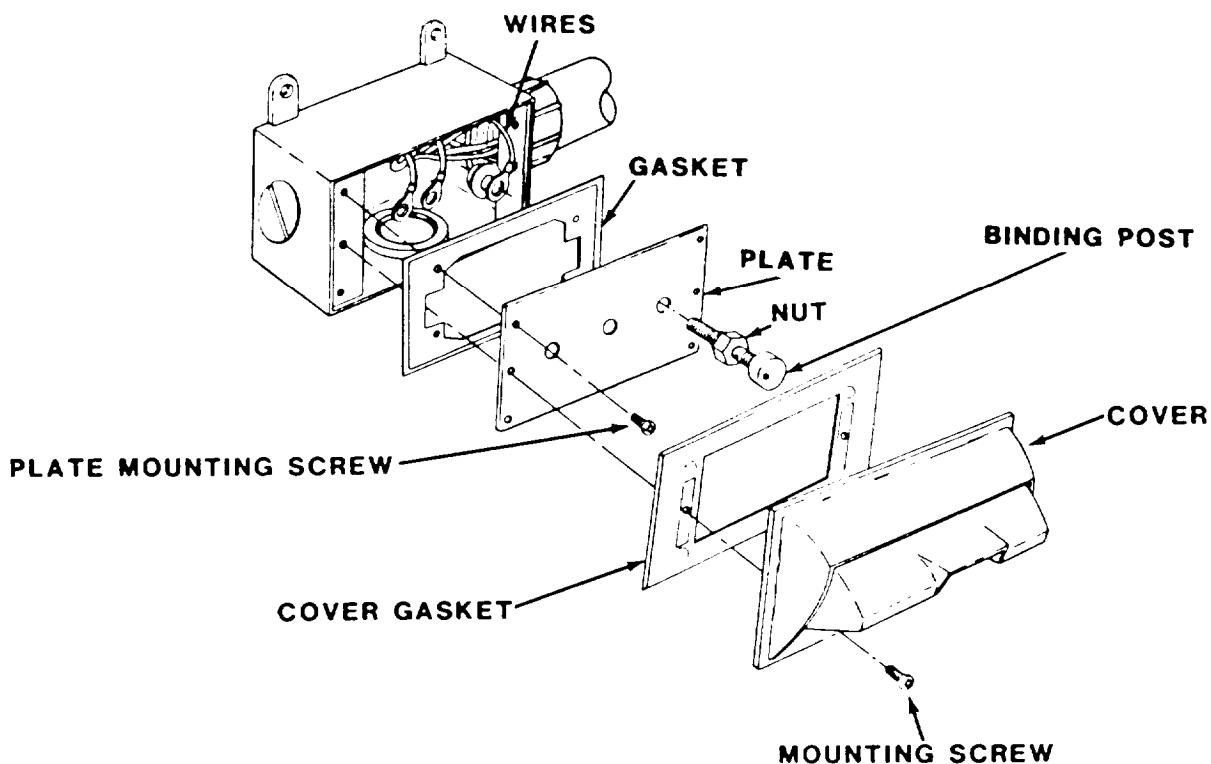
- c. Loosen wire and pull it from conduit base and if damage refer to DS for repair.
- d. Remove screws and damaged conduit base from wall.
- e. Mark damaged area on conduit base. Measure length, and record measurement.
- f. Cut damaged area from conduit base.
- g. Cut new conduit base from salvaged conduit base to measured length.
- h. Mark mounting holes on new conduit base.
- i. Drill mounting holes in places marked.
- j. File rough edges.
- k. Paint new conduit base.
- l. Reinstall conduit base on wall. Secure with screws.
- m. Reinstall wire in conduit base.
- n. Repair conduit base cover by using above procedures except to cut cover from salvaged conduit cover.

1-15.8 Replace Telephone Binding Post

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: No. 2 cross-tip screwdriver
 1/4-in. flat-tip screwdriver
 1/2-in. combination box and open end wrench

MATERIALS/PARTS: Telephone binding post assembly



REMOVAL:

- a. Remove four mounting screws. Remove cover and cover gasket.
- b. Remove four plate mounting screws, Remove plate and gasket.
- c. Label wires. Remove nuts and wires from binding posts.
- d. Remove defective binding posts.

INSTALLATION:

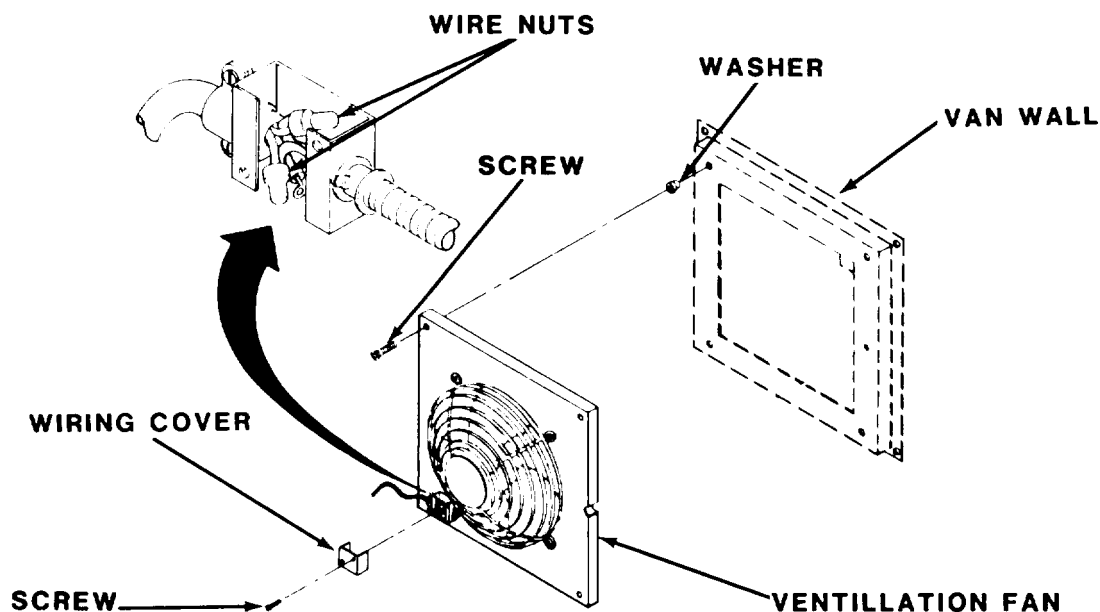
- a. Install new binding posts.
- b. Reconnect wires, and secure with nuts. Remove labels.
- c. Reinstall gasket and plate. Secure with four mounting screws.
- d. Reinstall cover gasket and cover. Secure with four mounting screws.

1-15.9 Replace Ventilation Fan

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 3/8-in. flat-tip screwdriver
No. 2 cross-tip screwdriver
No. 3 cross-tip screwdriver

MATERTALS/PARTS: Ventilation fan assembly
Wire nuts



REMOVAL:

WARNING

ELECTRICAL SHOCK

Turn ventilation fan switch OFF and unplug power cord before servicing. Failure to do so may result in death or serious injury.

- a. Turn fan switch OFF. Unplug power cord.
- b. Remove four screws and washers securing ventilation fan to van wall. Loosen cable clamp screw and place fan on work surface.
- c. Remove two screws and wiring cover.
- d. Label wires, and remove wire nuts to disconnect wires.
- e. Remove defective ventilation fan.

1-15.9 Replace Ventilation Fan - Continued

INSTALLATION:

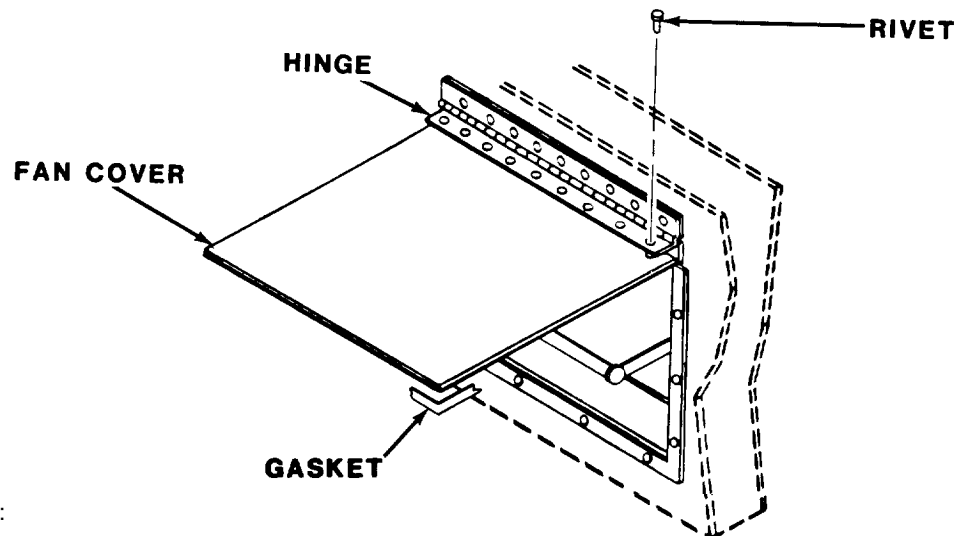
- a. Install new fan assembly.
- b. Reconnect wires with wire nuts. Remove labels.
- c. Reinstall wiring cover. Secure with two screws.
- d. Reinstall fan assembly on van wall. Secure with four washers and screws.
- e. Plug in power cord. Turn switch ON.

1-15.10 Replace Ventilation Fan Cover

PERSONNEL REQUIRED: 1 Utilities equipment repairer MOS 52C

TOOLS: Electric drill and bits
Riveter

MATERIALS/PARTS: Rivets
Ventilation fan cover
Gasket
Adhesive



REMOVAL:

Drill rivets out of hinged fan cover. Remove defective fan cover from hinge.

INSTALLATION:

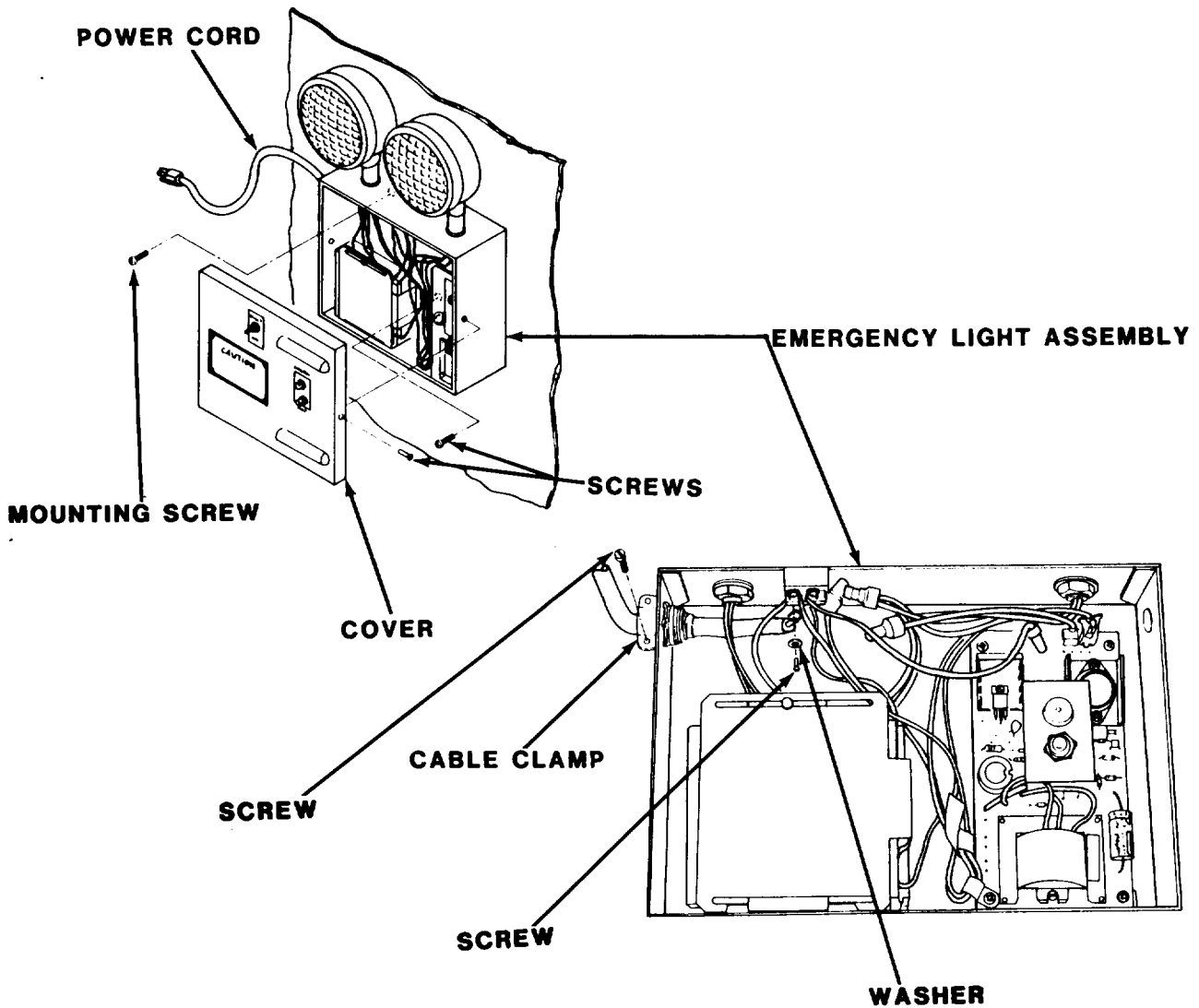
- a. Install gasket on new fan cover with adhesive.
- b. Align ventilation fan cover with hinge. Rivet to hinge.

1-15.11 Replace Emergency Light Assembly

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: No. 3 cross-tip screwdriver
No. 2 cross-tip screwdriver
No. 1 offset cross-tip screwdriver

MATERIALS/PARTS: Emergency light assembly



1-15.11 Replace Emergency Light Assembly - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug emergency light power cord before replacing. Failure to do so may result in death or serious injury.

- a. Unplug power cord.
- b. Remove screws. Remove cable clamp.
- c. Remove two screws from cover. Remove cover.
- d. Remove screw and washer securing power cord to emergency light assembly.
- e. Remove power cord.
- f. Remove two mounting screws.
- g. Remove defective emergency light assembly.

INSTALLATION:

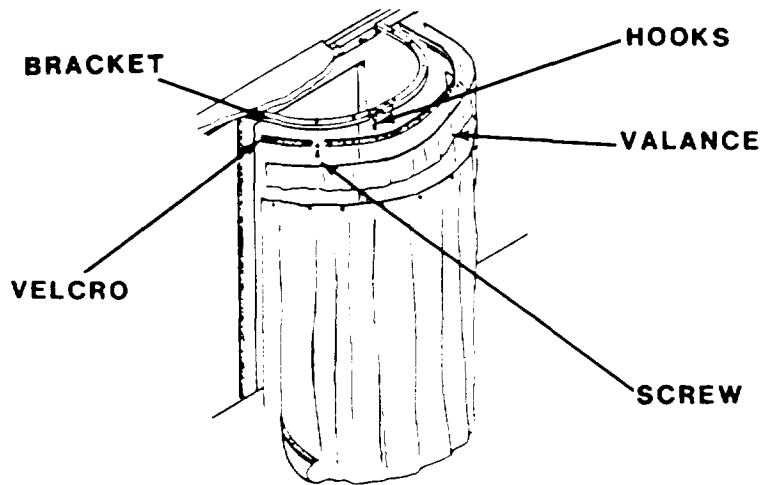
- a. Install new emergency light assembly. Secure with two mounting screws.
- b. Reinstall power cord. Secure with washer and screw to emergency light assembly.
- c. Reinstall cover. Secure with two screws.
- d. Reinstall cable clamp. Secure with screws.
- e. Plug in power cord.

1-15.12 Replace Blackout Curtain

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: No. 1 cross-tip screwdriver

MATERIALS/PARTS: Hooks
Valance
Blackout curtain



- a. Remove defective blackout curtain from hooks.
- b. Remove valance from velcro.
- c. Remove eight screws holding bracket to ceiling.
- d. Remove defective hooks.

INSTALLATION:

- a. Install new hooks.
- b. Reinstall bracket on ceiling with eight screws.
- c. Reinstall valance on velcro.
- d. Install new blackout curtain on hooks.

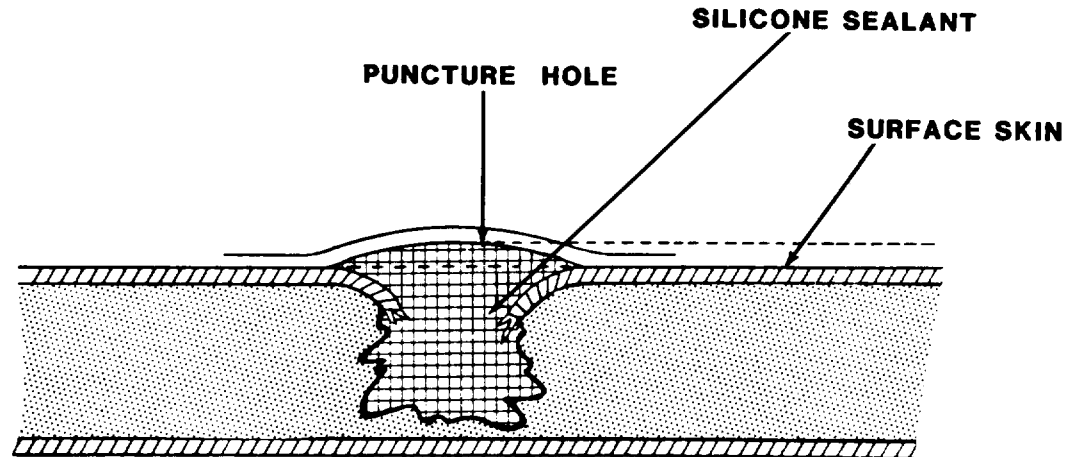
1-15.13 Repair Van Body Skin (Temporary)

PERSONNEL REQUIRED: 1 Utilities equipment repairer MOS 52C

TOOLS: Needle nose pliers
Ball-peen hammer
Shears

1-15.13 Repair Van Body Skin (Temporary) - Continued

MATERIALS/PARTS: Cloth duct sealing tape (item 89, appendix E)
Silicone sealant (item 84, appendix E)



- a. Bend broken edges of skin inward into puncture hole. Do not attempt to remove fragments of skin by bending or pulling outward.
- b. Remove any loose fragments of foam.
- c. Use cloth (item 16, appendix E) dampened with water to clean area around puncture. Wipe dry.
- d. Inject silicone sealant (item 84, appendix E) into puncture. Fill to 1/8 in. (3.2 mm) above surface of unbroken skin. Apply sealant to cracks leading to puncture.

NOTE

Length and width of sealing tape, number of tape strips, and amount of overlapping will affect sealing capability of repair. Each piece of tape should extend 1-1/2 in. (38.1 mm) beyond sealant it will cover.

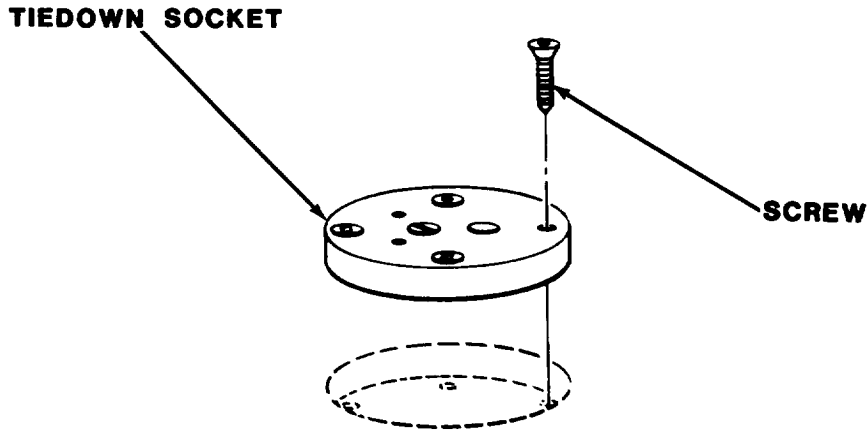
- e. Hold sealing tape (item 89, appendix E) taut and apply. Apply sealing tape lightly. Rub into place.
- f. Van should be referred to direct support and general support maintenance as soon as possible for permanent van body skin repair.

1-15.14 Replace Tiedown Socket

PERSONNEL REQUIRED: 1 Utilities equipment repairer MOS 52C

TOOLS: No. 3 cross-tip screwdriver
3/8-in. flat-tip screwdriver

MATERIALS/PARTS: Tiedown socket



REMOVAL :

- a. Remove four screws from tiedown socket.
- b. Pry tiedown socket from floor. Remove defective tiedown socket.

INSTALLATION:

Install new tiedown socket. Rotate and secure with four screws.

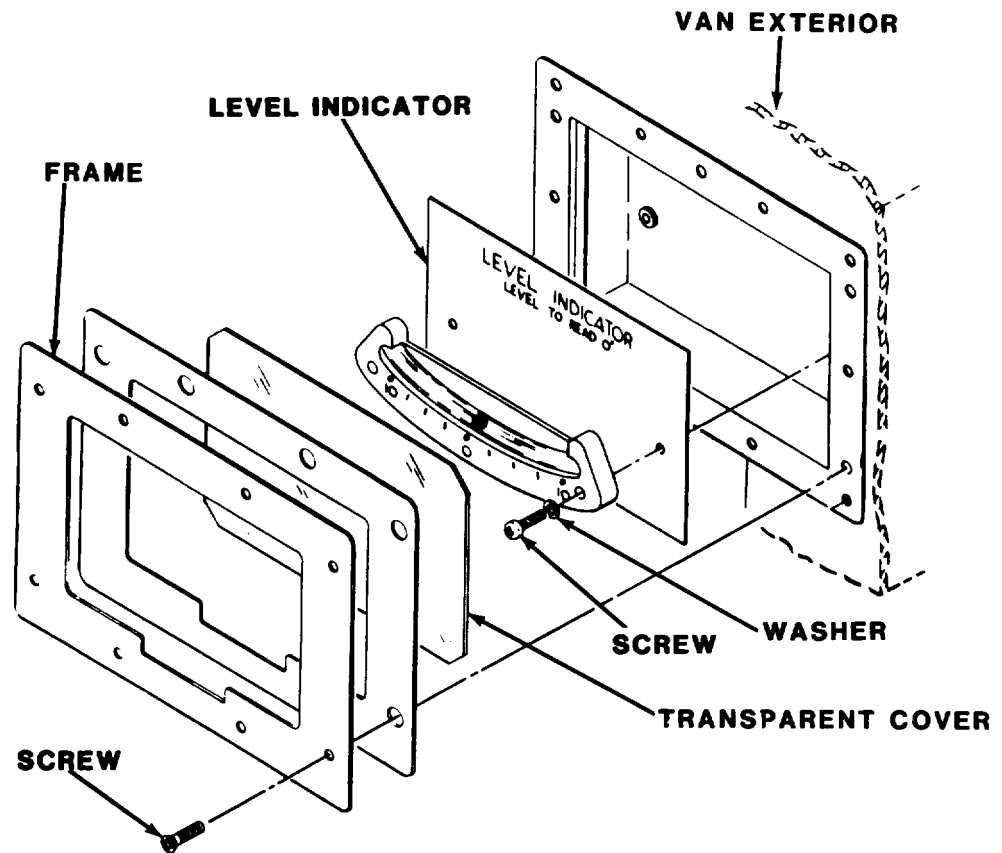
1-15.15 Replace Level Indicator

PERSONNEL REQUIRED: 1 Utilities equipment repairer MOS 52C

TOOLS: No. 1 cross-tip screwdriver
3/16-in. flat-tip screwdriver
Carpenter's level

MATERIALS/PARTS: Level indicator

1-15.15 Replace Level Indicator - Continued



REMOVAL :

NOTE

Van must be level before new level indicator is installed. If van is not level, misalignment of level indicator may result.

- a. Use carpenter's level on floor of van to check if van is level.
- b. Remove eight screws securing frame and gasket to van exterior.
- c. Remove transparent cover.
- d. Remove two screws and washers securing level indicator to van exterior.
- e. Remove defective level indicator.

1-15.15 Replace Level Indicator - Continued

INSTALLATION:

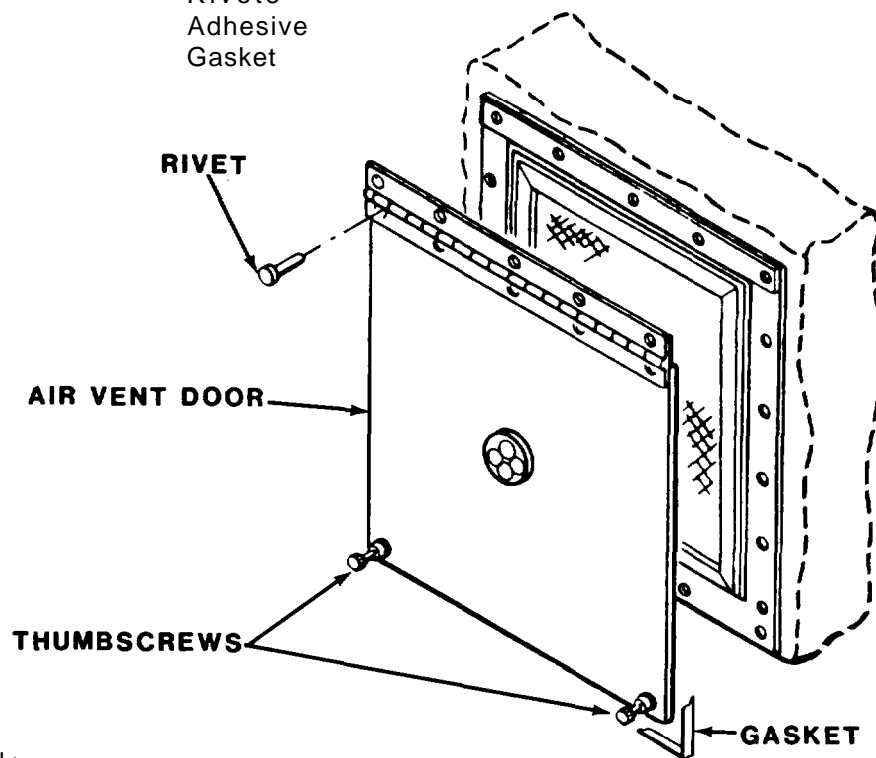
- a. Install new level indicator. Secure to van exterior with two washers and screws.
- b. Reinstall transparent cover.
- c. Reinstall gasket and frame. Secure to van exterior with eight screws.
- d. Make sure level indicator shows correct alignment. Loosen or tighten screws to adjust level indicator for correct alignment.

1-15.16 Replace Air Vent Door

PERSONNEL REQUIRED: 1 Utilities equipment repairer MOS 52C

TOOLS: Electric drill and bits
Riveter

MATERIALS/PARTS: Air vent door
Rivets
Adhesive
Gasket



REMOVAL:

- a. Loosen thumbscrews.
- b. Drill rivets from hinge. Remove defective air vent door.

1-15.16 Replace Air Vent Door - Continued

INSTALLATION :

- a. Install gasket on new vent door with adhesive.
- b. Aline new vent door with hinge. Rivet to hinge.
- c. Tighten thumbscrews to secure.

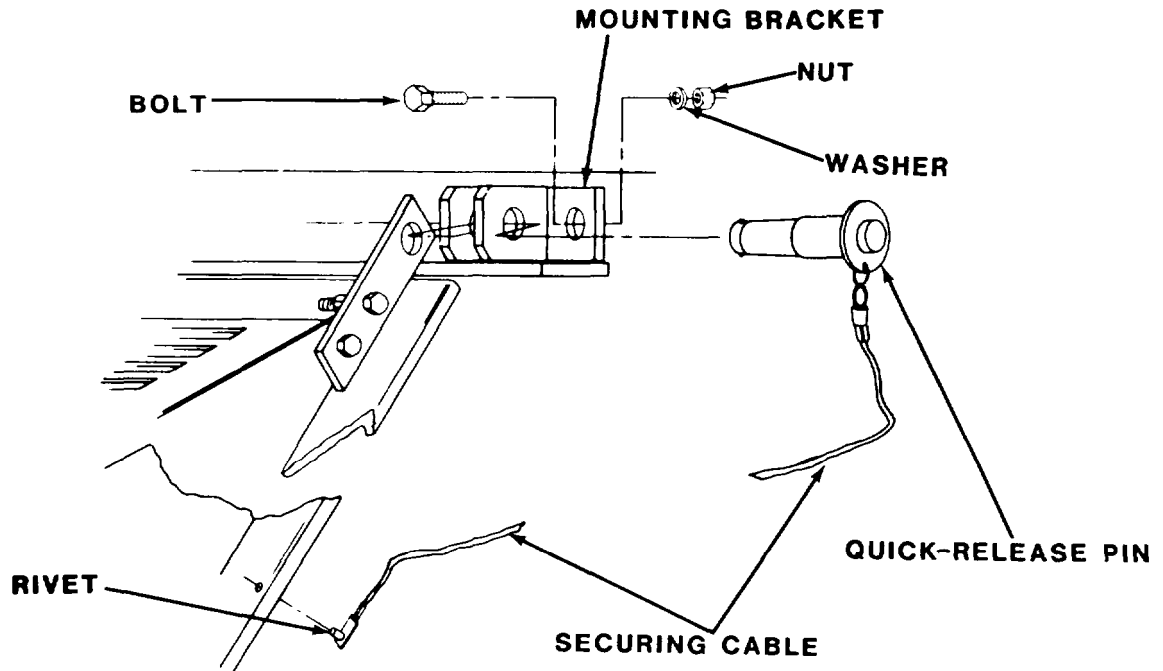
1-15.17 Repair Personnel Ladder

PERSONNEL REQUIRED: 1 Utilities equipment repairer MOS 52C

TOOLS: Riveter

9/16-in. combination box and open end wrench

MATERIALS/PARTS: Quick-release pin
Cable
Rivets
Mounting bracket



- a. Remove personnel ladder from mounting bracket on van body.
- b. Remove nut, washer, and bolt securing mounting bracket to van body. Remove defective mounting bracket.
- c. Install new mounting bracket. Secure with bolt, washer, and nut.
- d. Remove damaged quick-release pin from mounting bracket.

1-15.17 Repair Personnel Ladder - Continued

- e. Remove securing cable by punching out rivet on ladder.
- f . Install new quick-release pin by mounting securing cable to ladder with rivet. Reinstall quick-release pin in mounting bracket.

Section V. DIRECT/GENERAL SUPPORT MAINTENANCE

1-16 SPECIAL TOOLS: TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT.

1-16.1 For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

1-16.2 For special tools, TM DE, and support equipment, refer to TM5-6675-326-24P, Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) and the Maintenance Allocation Chart (MAC) in appendix B of this manual.

1-16.3 Repair parts are listed and illustrated in the Repair Parts and Special Tools List (TM5-6675-326-24P) covering direct support and general support maintenance for this equipment.

1-17 DIRECT/GENERAL SUPPORT PREVENTIVE MAINTENANCE CHECKS AN SERVICES (PMCS).

There are no PMCS at the direct/general support levels for the direct support section (van).

1-18 DIRECT/GENERAL SUPPORT TROUBLESHOOTING.

1-18.1 General

1-18.1.1 The table lists the common malfunctions which you may find during the maintenance of the direct support section (van) or its components. You should perform the test/inspections and corrective actions in the order listed. Troubleshooting procedures for AC/Heating unit are listed in TM 5-4120-367-14 and for the chassis, truck in TM 9-2320-281-34.

1-18.1.2 This manual cannot list all the malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 1-5. Direct/General Support Troubleshooting

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

-
1. PERSONNEL/CARGO DOORS DO NOT CLOSE COMPLETELY.
 - Step 1. Check to see if latch rollers rotate freely.

Replace latches (para 1-19.2).
 - Step 2. Check to see if latch rods are bent.

Replace latch rods (para 1-19.2).
 - Step 3. Check to see if door gasket is torn or broken.

Replace door gasket (para 1-19.3).
 2. PERSONNEL/CARGO DOORS DO NOT LATCH PROPERLY.

Check door latch for missing or damaged components.

Replace door latch (para 1-19.2).
 3. AIR OR WATER ENTERS VAN AROUND PERSONNEL/CARGO DOOR.

Check to see if door gasket is torn or broken.

Replace door gasket (para 1-19.3).
 4. RECEPTACLES DO NOT OPERATE BUT CIRCUIT BREAKERS ARE ON.

WARNING

ELECTRICAL SHOCK

Turn OFF main circuit breaker before inspecting or servicing circuit breakers or receptacles. Failure to do so may result in death or serious injury.

- Step 1. Check to see if power cable is firmly connected to power entry panel.

Connect power cable.

Table 1-5. Direct/General Support Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. RECEPTACLES DO NOT OPERATE BUT CIRCUIT BREAKERS ARE ON - Continued

Step 2. Check to see if voltage meter, frequency scale, and CORRECT PHASE lamp indicate correct power.

Notify your supervisor for service of power supply at source.

5. CIRCUIT BREAKERS TRIP CONTINUALLY.

WARNING

ELECTRICAL SHOCK

Turn OFF main circuit breaker before inspecting or servicing circuit breakers or receptacles. Failure to do so may result in death or serious injury.

Step 1. Check to see if receptacles are overloaded.

Reconnect equipment to different receptacles.

Step 2. Check to see if receptacles are damaged.

Replace receptacles (para 1-15.6).

1-19 DIRECT/GENERAL SUPPORT MAINTENANCE PROCEDURES.

This section contains step-by-step instructions covering direct/general support maintenance procedures.

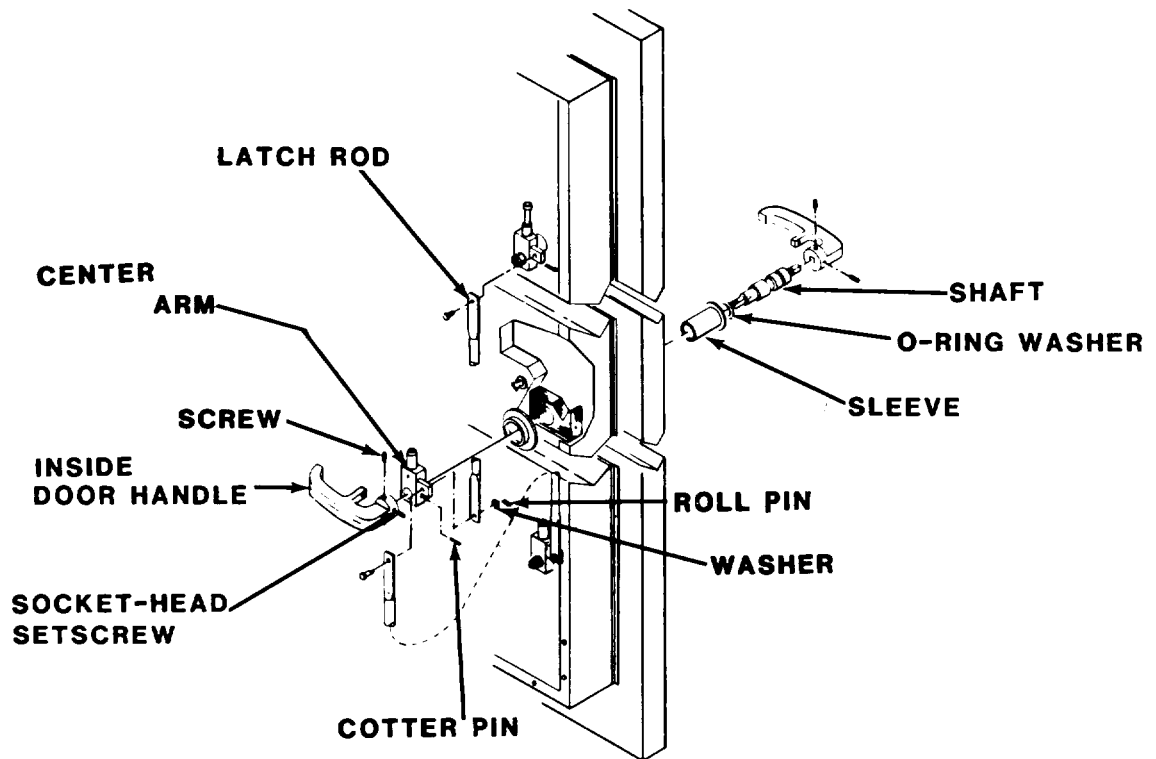
1-19.1 Repair Personnel/Cargo Door Handle

PERSONNEL REQUIRED: 1 Wheel vehicle repairer MOS 63W

TOOLS: No. 3 cross-tip screwdriver
No. 4 cross-tip screwdriver
Needle-nose pliers
15/16-in. combination box and open end wrench
Ball-peen hammer
Center punch

1-19.1 Repair Personnel/Cargo Door Handle - Continued

MATERIALS/PARTS: Personnel/cargo door handle assembly
 Motor oil (30 wt)
 O-ring washer
 Sleeve
 Roll pin
 Cotter pin
 Cloth
 Oiler



- a. Loosen screw and two socket-head setscrews. Remove defective inside door handle.
- b. Remove cotter pin and pins from center latch arm.

1-19.1 Repair Personnel/Cargo Door Handle - Continued

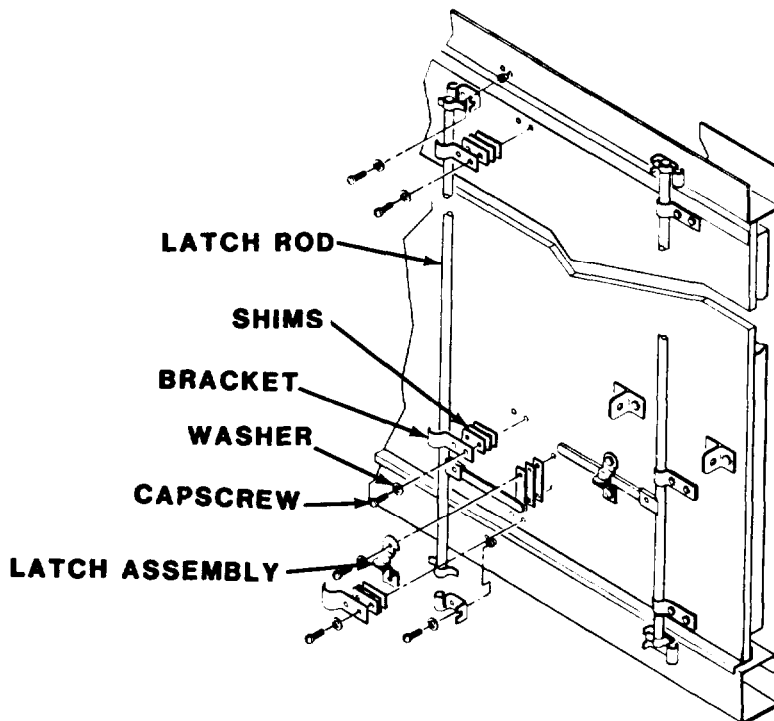
- c. Move latch rods out of way.
- d. Punch roll pin from center latch arm, and pull latch arm from shaft.
- e. Withdraw latch and defective handle from outside.
- f. Inspect components for wear.
- g. Replace worn O-ring washer and sleeve.
- h. Replace other worn components as needed.
- i. Reinstall shaft and new handle from outside.
- j. Aline center latch arm on shaft. Secure with new roll pin.
- k. Aline latch rods. Attach to latch arm with pins, washers, and new cotter pin.
- l. Reinstall new handle from inside.
- m. Lightly oil all moving parts. Wipe off excess oil.

1-19.2 Replace Personnel/Cargo Door Latch Assembly

PERSONNEL REQUIRED: 1 Wheel vehicle repairer MOS 63w

TOOLS: 9/16-in. combination box and open end wrench

MATERIALS/PARTS : Personnel/cargo door latch assembly



1-19.2 Replace Personnel/Cargo Door Latch Assembly - Continued

REMOVAL:

- a. Unlock latch.
- b. Remove two capscrews and washers from brackets. Remove brackets and shims.
- c. Remove defective latch assembly and latch rod.

INSTALLATION:

- a. Install new latch assembly and latch rod.
- h. Reinstall shims, brackets, washers, and capscrews.
- c. Check movement of latch rod and latch assembly. Lock latch.

1-19.3 Replace Personnel/Cargo Door Gasket

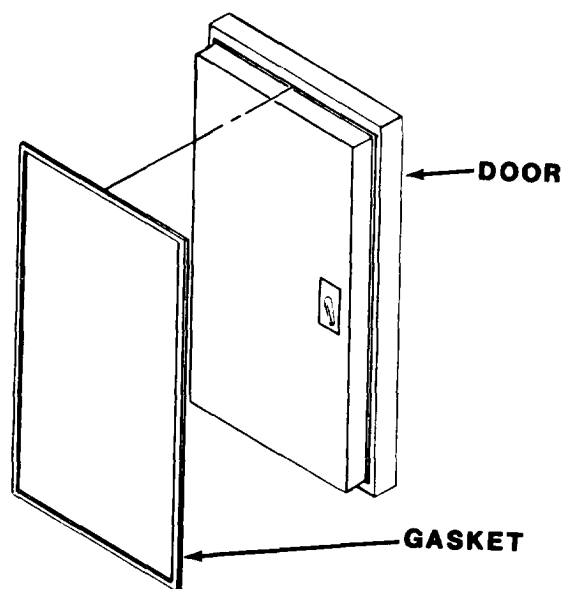
PERSONNEL REQUIRED: 1 Wheel vehicle repairer MOS 63W

TOOLS: Knife

MATERIALS/PARTS: Vinyl gasket
Adhesive
Solvent PD-680

REMOVAL:

- a. Open door completely and secure in open position.



1-19.3 Replace Personnel/Cargo Door Gasket - Continued

WARNING

CHEMICAL HAZARD

Avoid prolonged contact with solvent PD-680. Failure to do so may result in serious injury to eyes and skin. Fumes can cause irritation and damage to lungs.

- b. Remove defective gasket by prying gasket from door. Scrape traces of gasket and adhesive from door. Wash with solvent PD-680 (item 87, appendix E). Wipe dry.

INSTALLATION:

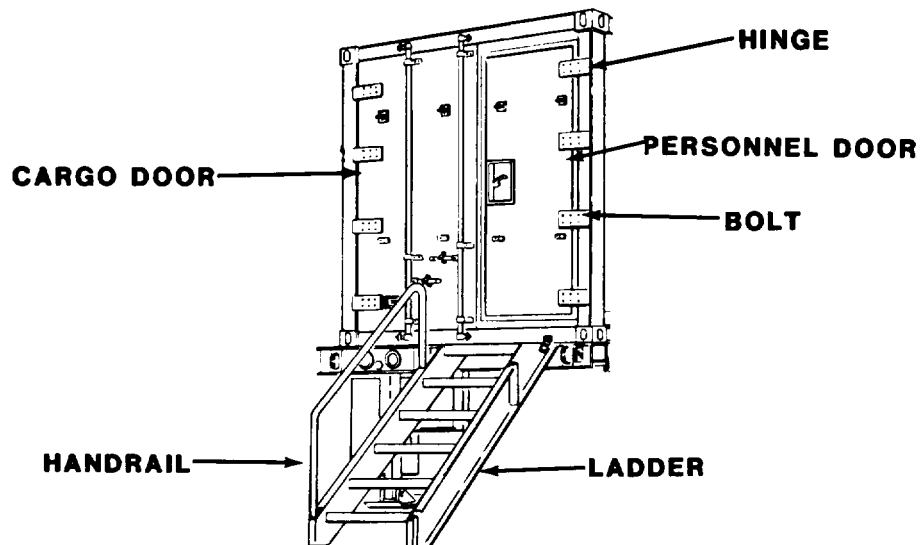
- a. Coat gasket area on door with adhesive.
- b. Firmly press new gasket onto door.
- c* Wipe excess adhesive from gasket.
- d. Close door and wipe excess adhesive from door and frame.
- e. Allow adhesive to dry before using door.

1-19.4 Replace Personnel/Cargo Door

PERSONNEL REQUIRED: 2 Wheel vehicle repairers MOS 63W

TOOLS: Riveter
Electric drill and bits
Hoist
3/4-in. combination box and open end wrench

MATERIALS/PARTS: Personnel/cargo door
Rivets
Vinyl gasket
Adhesive
Paint
Paint brush
Cloth

1-19.4 Replace Personnel/Cargo Door - Continued

REMOVAL :

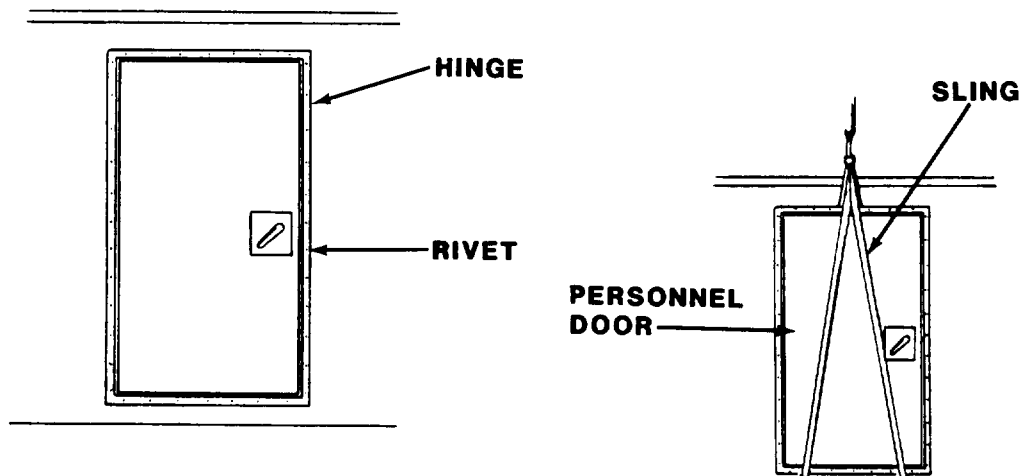
WARNING

HEAVY EQUIPMENT

Use proper lifting equipment or hoist to remove doors. Failure to do so may result in death or serious injury.

- a. Remove handrails and ladders if cargo door is to be replaced.
- b. Unlock and open door to be replaced.

1-19.4 Replace Personnel/Cargo Door - Continued



- c. Place sling around door and put slight strain on hoist to remove weight from hinges.
- d. Remove bolts from hinges on rear personnel door. On side personnel door drill out rivets from hinges. Remove hinges from doors.
- e. Remove bolts from hinges on cargo door. Remove hinges from doors.
- f. Remove damaged door using hoist.

INSTALLATION:

- a. Install new door using hoist.
- b. Reinstall hinges on rear personnel door. Reinstall hinges on cargo door. Secure with bolts. Reinstall hinges on side personnel door. Secure with rivets.
- c* Remove sling from door.
- d. Install new gasket on door after it is mounted (para 1-19.3).
- e. Repaint door as needed.
- f. Close and lock door.

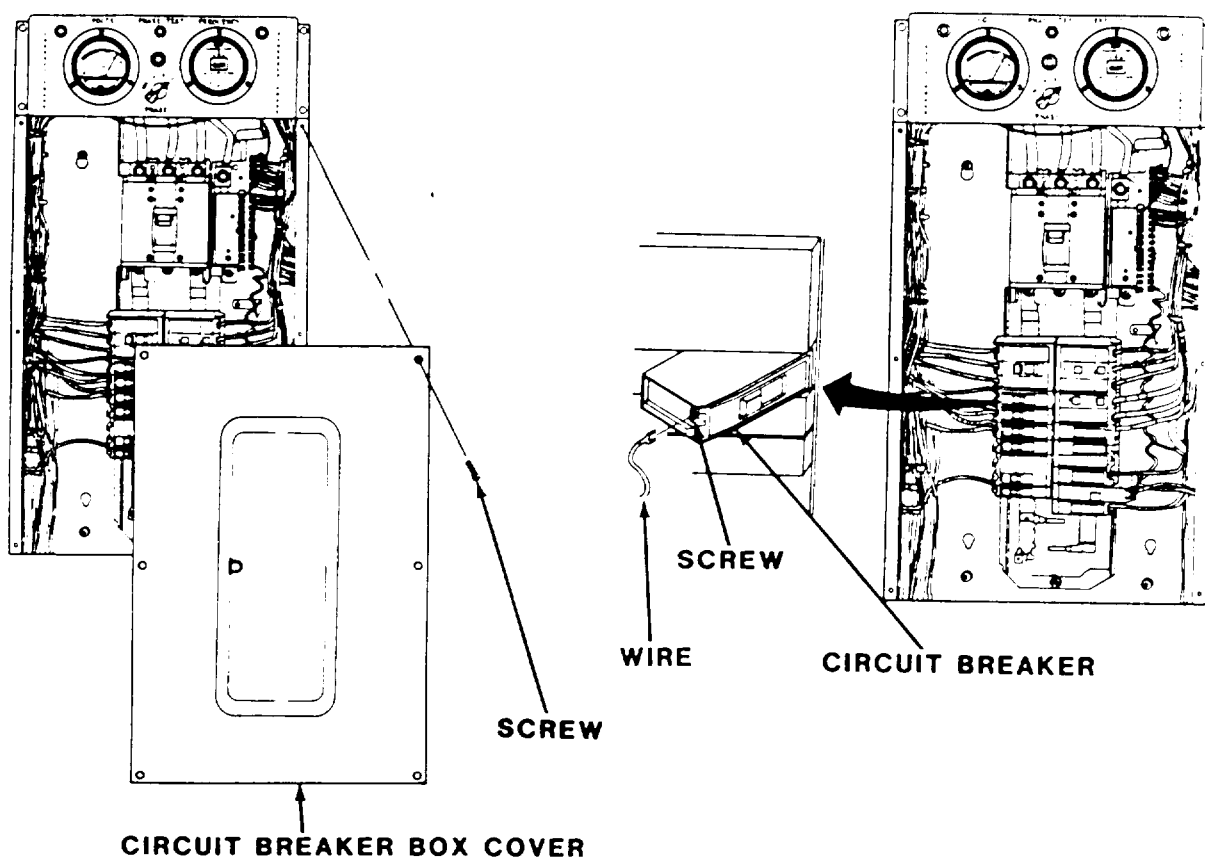
1-19.5 Replace Circuit Breaker

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 1/4-in, flat-tip screwdriver

TEST EQUIPMENT: Multimeter

MATERIALS/PARTS: Circuit breaker



REMOVAL:

WARNING

ELECTRICAL SHOCK

Turn OFF main circuit breaker and all individual circuit breakers before inspecting or servicing circuit breakers. Failure to do so may result in death or serious injury.

- a. Turn OFF main circuit breaker, individual circuit breakers and safety switch.
- b. Remove six screws from circuit breaker box cover, Remove cover.

1-19.5 Replace Circuit Breaker - Continued

- c. Use multimeter to make sure voltage and frequency are completely off.
- d. Remove defective circuit breaker by pushing and snapping out of place.
- e. Tag wires. Loosen screw and remove wire from defective circuit breaker.

INSTALLATION:

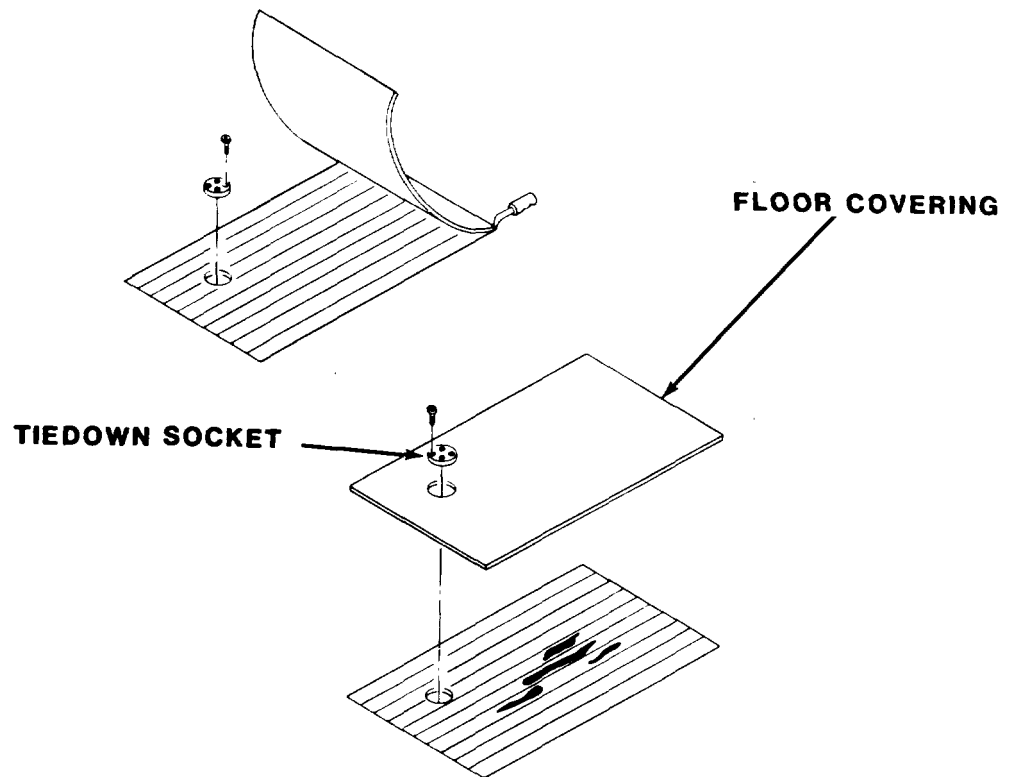
- a. Connect wires to new circuit breaker. Secure wires with screw.
- b. Install new circuit breaker by pushing and snapping into place.
- c. Reinstall circuit breaker box cover. Secure with six screws.
- d. Turn ON main circuit breaker and individual circuit breakers.

1-19.6 Repair Floor Covering

PERSONNEL REQUIRED: 1 Utilities equipment repairer MOS 52C

TOOLS: Utility knife
No. 4 cross-tip screwdriver
Scraper
Straightedge

MATERIALS/PARTS: Vinyl floor covering
Epoxy resin
Floor covering patch
Cloth

1-19.6 Repair Floor Covering - Continued

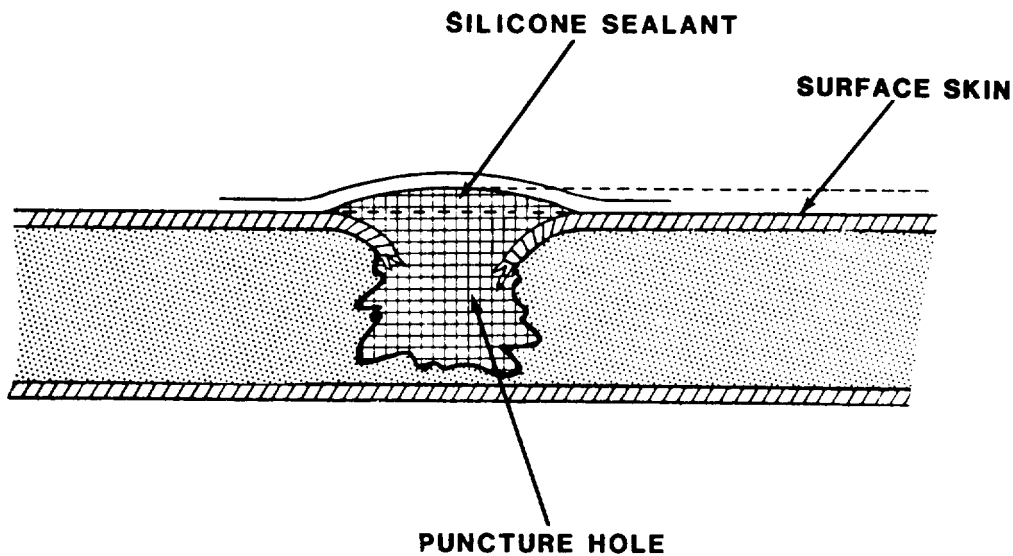
- a. Cut rectangular area from damaged floor covering.
- b. Remove four screws securing tiedown socket. Remove damaged floor covering.
- c. Cut new floor covering to fit. Apply adhesive to floor. Press down new floor covering.
- d. Reinstall tiedown socket. Secure with four screws.

1-19.7 Repair Van Body Skin (Permanent)

PERSONNEL REQUIRED: 1 Wheel vehicle repairer MOS 63W

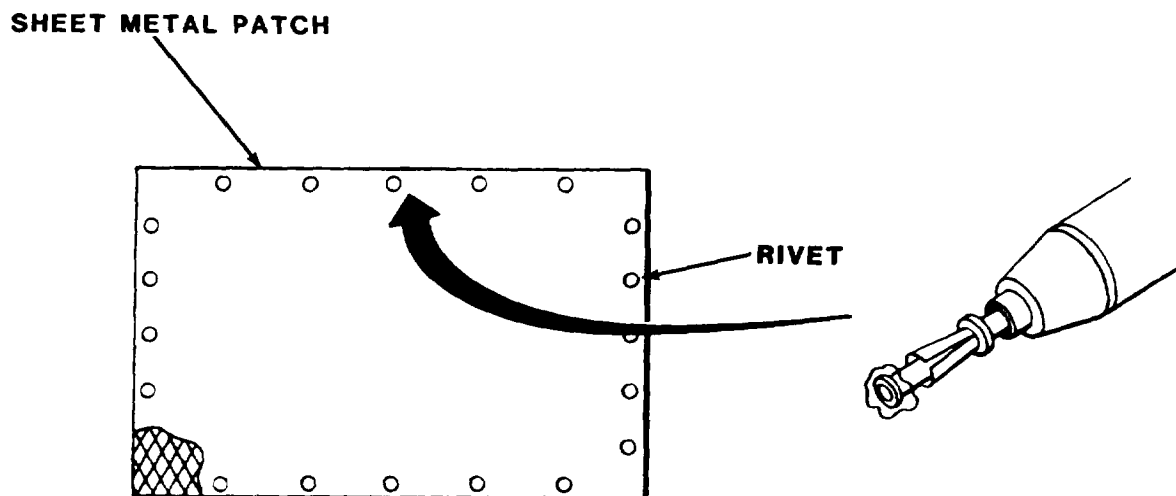
TOOLS: Riveter
Electric drill and bits

MATERIALS/PARTS: Rivets
Silicone sealant
Sheet metal
Paint
paint brush



- a. Bend broken edges of skin inward into puncture hole. Do not attempt to remove fragments of skin by bending or pulling outward.
- b. Remove any loose fragments of foam.
- c. Use cloth (item 16, appendix E) dampened with water to clean area around puncture. Wipe dry.
- d. Inject silicone sealant into puncture. Fill to 1/8 in. (3.2 mm) above surface of unbroken skin. Apply sealant to cracks leading to puncture.

1-19.7 Repair Van Body Skin (Permanent) - Continued



- e. Prepare sheet metal patch large enough to cover damaged area with overlap.
- f. Place patch over damaged area and mark around edges of patch.
- g. Drill holes 1 in. (2.54 cm) apart.
- h. Apply silicone sealant to edges of patch.
- i. Apply patch to van body.
- j. Install rivets, beginning at center of each side. Rivets should be placed 1 in. (2.54 mm) apart.
- k. Paint as needed.

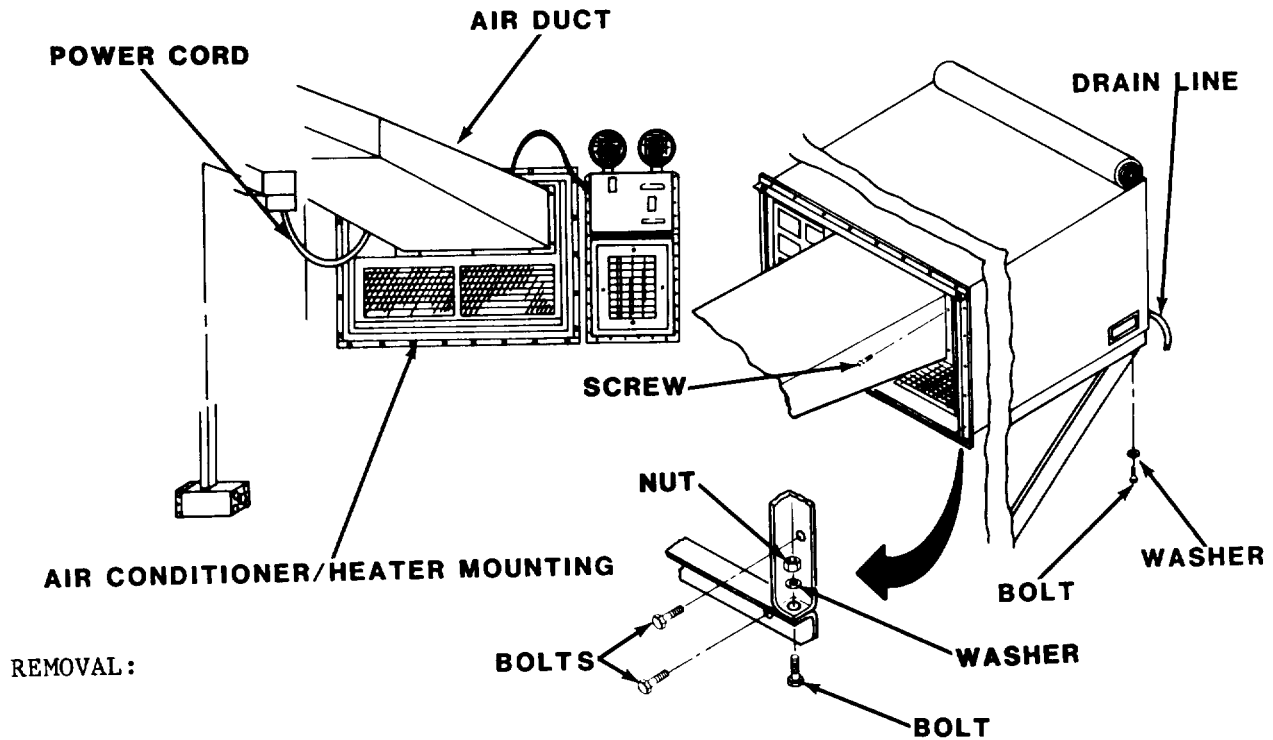
1-19.8 Replace Air Conditioner/Heater

PERSONNEL REQUIRED: 2 Wheel vehicle repairers MOS 63W

TOOLS: No. 2 cross-tip screwdriver
 7/16-in. combination box and open end wrench
 10-in. adjustable wrench
 Lifting equipment

1-19.8 Replace Air Conditioner/Heater - Continued

MATERIALS/PARTS: Air conditioner/heater
Solvent
Gasket
Sealant
Adhesive



REMOVAL:

WARNING

HEAVY EQUIPMENT

- Use hoist or proper lifting equipment to replace air conditioner/heater. Failure to do so can result in death or serious injury.

ELECTRICAL SHOCK

- Turn off air conditioner/heater circuit breaker and unplug power cord. Failure to do so may result in death or serious injury.
- a. Turn OFF air conditioner/heater circuit breaker. Unplug power cord.

1-19.8 Replace Air Conditioner/Heater - Continued

- b. Remove eight screws holding air duct to air conditioner/heater.
- c. Remove nut, washer, and screw from each corner of air conditioner/heater mounting. Remove thirteen screws securing mounting to van wall.
- d. Disconnect drain lines from air conditioner/heater.
- e. Attach sling to lifting handles. Raise hoist enough to remove slack from sling.
- f. Remove six mounting bolts and washers.
- g. Slide out air conditioner/heater until other lifting handles are free. Attach sling to handles.
- h. Raise defective air conditioner/heater with hoist until unit is free from brackets and van body.
- i. Place air conditioner/heater on flat-bed truck or pallet.

INSTALLATION:

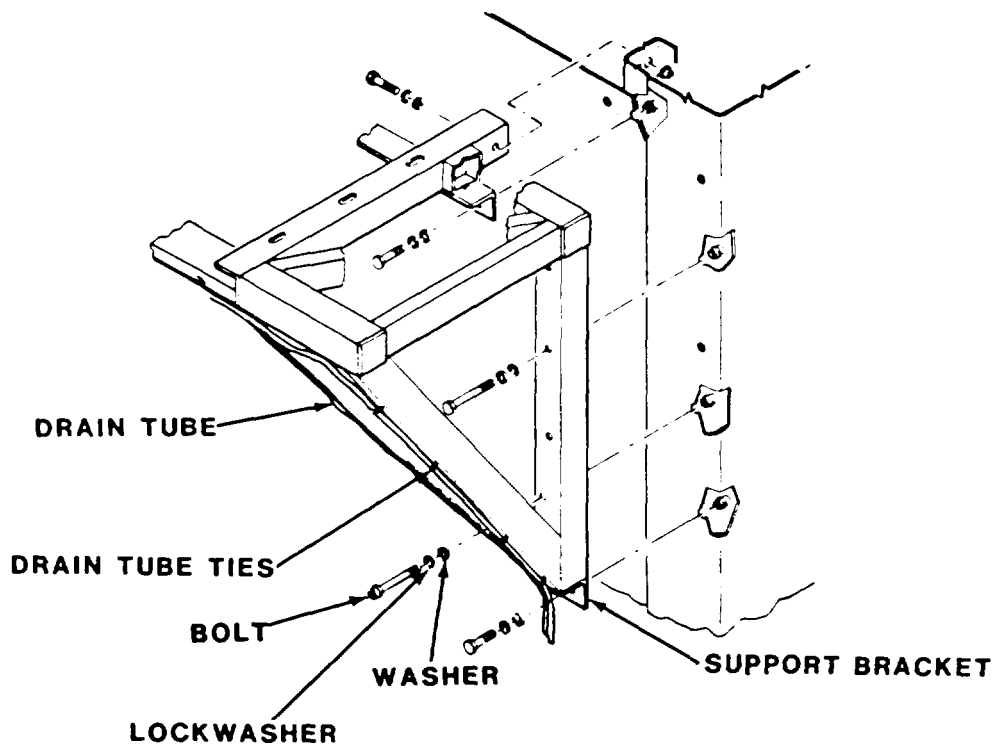
- a. Wipe off sealant, and remove any damaged gasket.
- b. Raise new air conditioner/heater until it rests on air conditioner/heater brackets.
- c. Remove two sling hooks as unit is eased into hole until grille touches duct.
- d. Remove remaining sling.
- e. Reinstall six washers and mounting bolts.
- f. Reconnect drain lines.
- g. Reinstall thirteen screws securing air conditioner/heater mounting to van wall. Reinstall screw, washer, and nut to each corner of mounting.
- h. Reinstall eight screws securing air duct to air conditioner/heater.
- i. Plug in power cord. Turn ON air conditioner/heater circuit breaker.

1-19.9 Replace Air Conditioner/Heater Support Bracket

PERSONNEL REQUIRED: 2 Wheel vehicle repairers MOS 63W

TOOLS: 9/16-in. combination box and open end wrench
Lifting equipment
Shears

MATERIALS/PARTS: Air conditioner/heater support bracket
Drain tube ties



REMOVAL:

WARNING

HEAVY EQUIPMENT

Use hoist and proper lifting equipment to remove air conditioner/heater. Failure to do so may result in death or serious injury.

- a. Remove air conditioner/heater (para 1-19.8).
- b. Cut drain tube ties, and remove drain tube from support bracket.
- c. Remove bolts, lockwashers, and washers securing support bracket to van body.
- d. Remove defective support bracket.

1-19.9 Replace Air Conditioner/Heater Support Bracket - Continued

INSTALLATION:

- a. Install new support bracket. Secure to van body with washers, lockwashers, and bolts.
- b. Reinstall drain tube on support bracket, and secure with new ties.
- c. Reinstall air conditioner/heater (para 1-19.8).

1-19.10 Replace Ventilation Duct

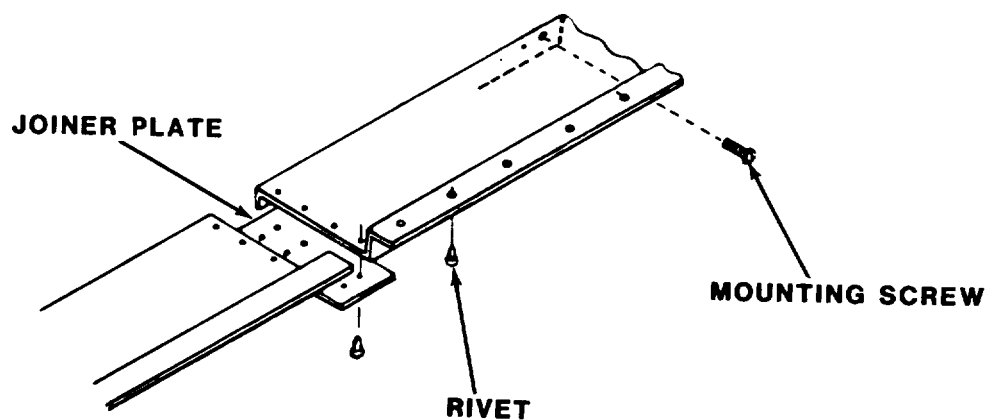
PERSONNEL REQUIRED: 1 Utilities equipment repairer MOS 52C

TOOLS: Hacksaw
 Electric drill and bits
 Ball-peen hammer
 Riveter
 No. 1 cross-tip screwdriver

MATERIALS/PARTS: Sealant
 Wood block
 Rivets
 Cloth
 Salvage ventilation duct
 Paint
 Paint brush

REMOVAL:

- a. Turn OFF air conditioner/heater so air will not blow through duct.



1-19.10 Replace Ventilation Duct - Continued

- b. Drill rivets from damaged section of duct. Remove joiner plates.
- c. Remove mounting screws to remove damaged sections of duct.
- d. Straighten remaining sections of duct at edges using hammer and wood block.

INSTALLATION:

- a. Place sealant on mounting edges.
- b. Install new duct section cut from salvaged duct. Secure to van body with mounting screws.
- c. Reinstall joiner plates. Install rivets to secure.
- d. Turn ON air conditioner/heater.

1-20 PREPARATION FOR STORAGE OR SHIPMENT.

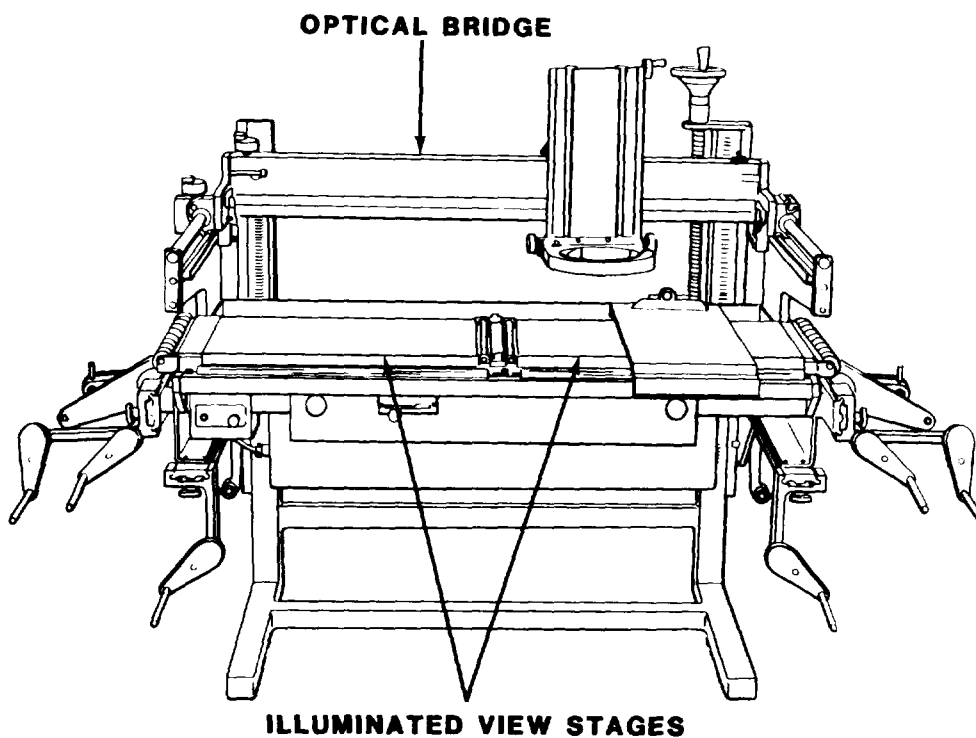
In the event that the van (section) must be stored or shipped, refer to TM 740-90-1 for storage instructions.

CHAPTER 2

SPLIT-STAGE LIGHT TABLE

Section I. INTRODUCTION

2-1 GENERAL INFORMATION.



2-1.1 Scope

Model Number and Equipment Name:

Model MIM3-35100 Split-Stage Light Table

Purpose of Equipment: To view aerial roll film for analysis and interpretation.

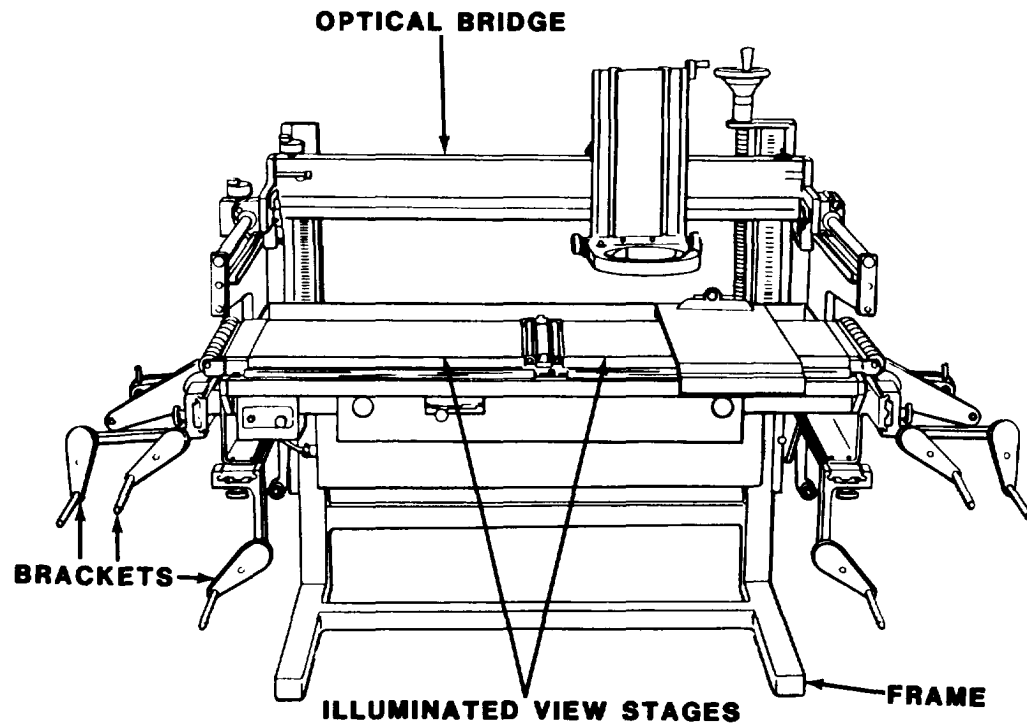
2-1.2 Glossary

Collimation	To make light rays parallel by adjustment of optical/mechanical system.
Stereo-pair photographs	Photographs taken of same object or area from two different positions.
Stereoscope	Optical device to apparently superimpose two separate photographs.
Stereoscopic	An apparent three-dimensional image obtained when two two-dimensional photographs are viewed through stereoscope.
X-axis	Horizontal or left-right direction.
Y-axis	90° from X-axis, in same plane. Front-back direction.
Z-axis	Vertical or up-down direction.

2-2 EQUIPMENT DESCRIPTION AND DATA.

2-2.1 Equipment Characteristics, Capabilities, and Features. Provides three-axis mount for optical viewing equipment. Reel configurations allow for conventional, split-vertical, and short- or long-loop film threading, Accepts up to 1000 ft (304.8 m) of dual strand film (up to 5-1/2 in. or 13.97 cm wide) or single strand film (up to 9-1/2 in. or 24.13 cm wide). Has variable intensity light grids. Has electrically coupled clutches for movement of optical mounting in horizontal plane. Safety clutch on optical mount prevents rapid movement of optical system toward view stages. Has variable stage height. Optical bridge assembly is removable. Has masking assemblies contained in view stages.

2-2.2 Location and Description of Major Components



OPTICAL BRIDGE. Mounts stereoscope.

ILLUMINATED VIEW STAGES. Controlled intensity light grids shine light through aerial roll film.

REEL BRACKETS. Transport aerial roll of film across view stages.

FRAME. Maintains alinement of components.

2-2.3 Equipment Data

Dimensions

Length

Reel brackets removed 45.50 in. (115.57 cm)

Reel brackets attached 56.75 in. (144.15 cm)

Width 26.75 in. (67.95 cm)

Height 63.63 in. (161.62 cm)

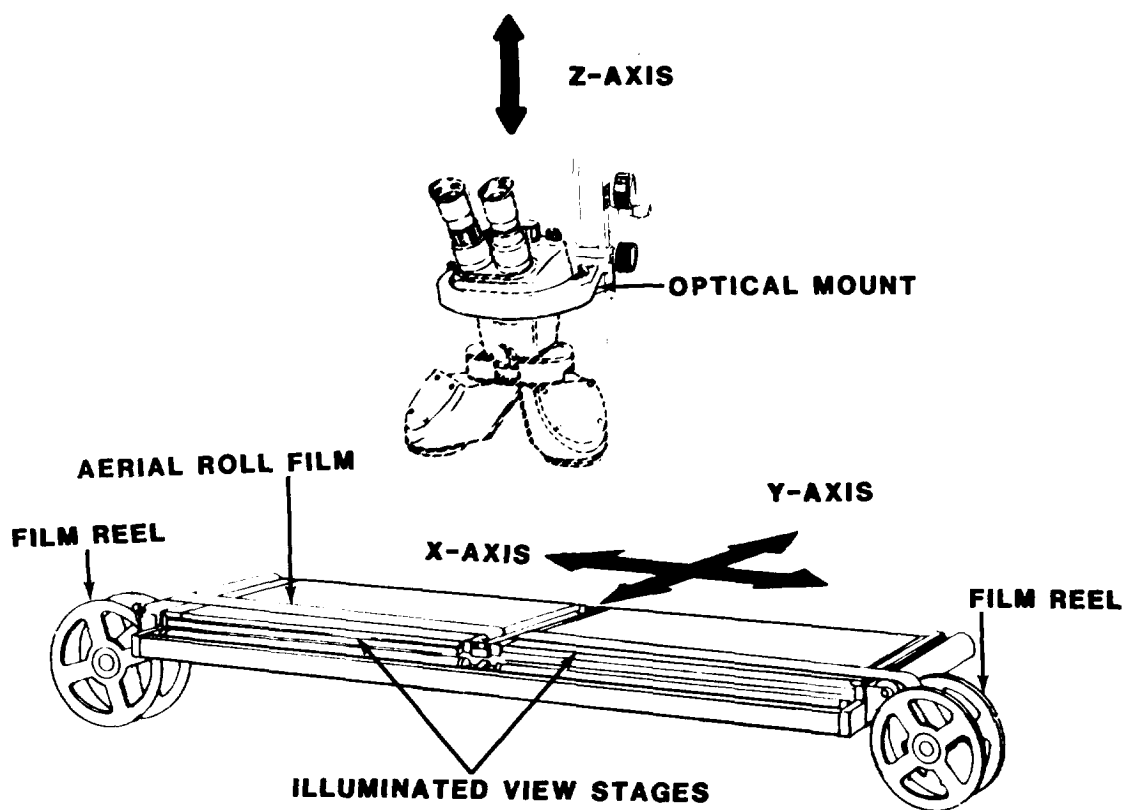
Weight 360 lbs (163.4 kg)

2-2.3 Equipment Data - Continued

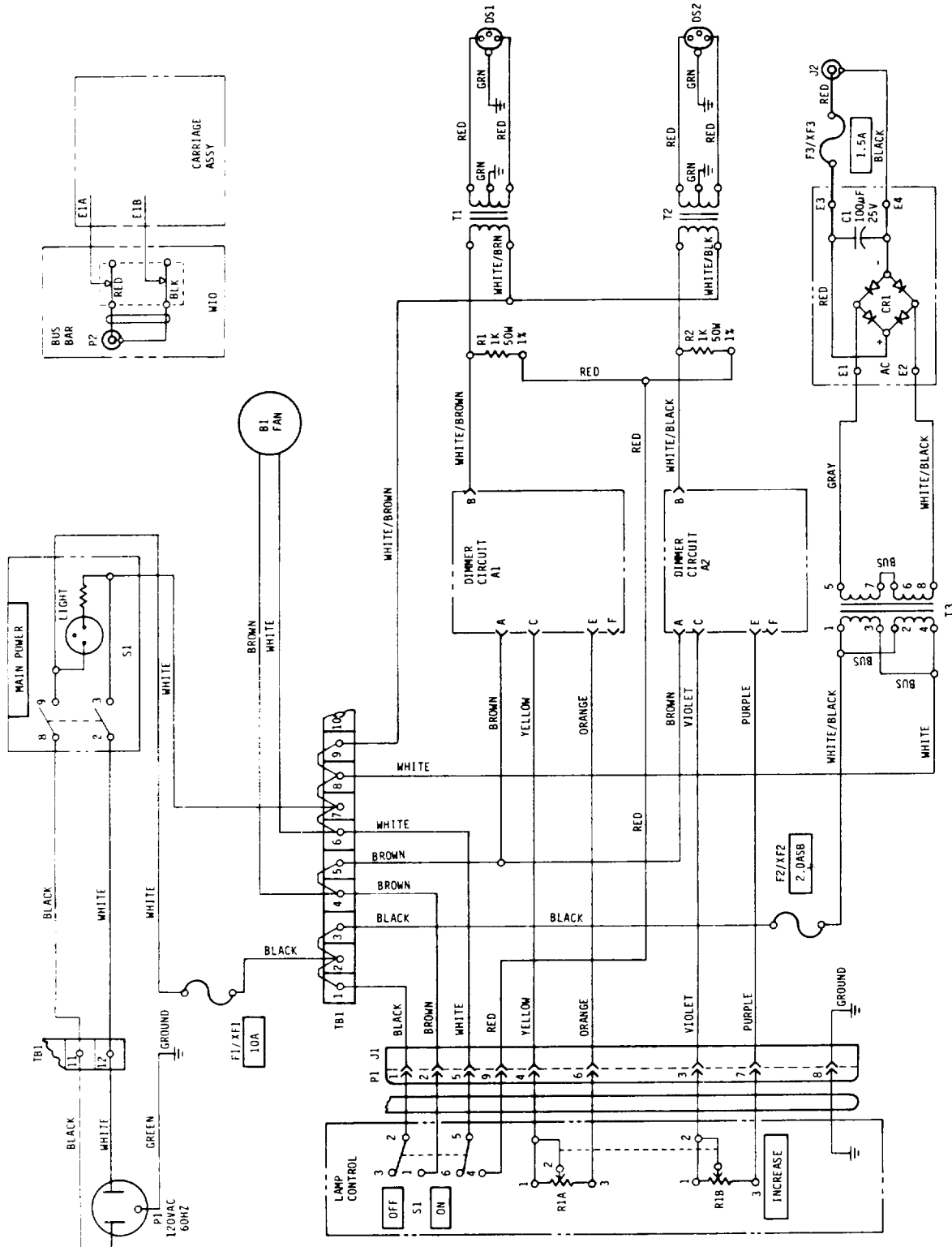
Illumination

Two stages (each stage)	11 in. X 18 in. (27.94 cm X 45.72 cm)
Maximum light intensity	2500 footlamberts
Dimming control	Variable intensity to 20% of maximum illumination
Power requirements	120 vac, 50/60 Hz, 8 amps

2-3 TECHNICAL PRINCIPLES OF OPERATION



2-3.1 General. Aerial roll film is manually moved between film reels, over rollers, across illuminated view stages. Optical mount moves stereoscope right-left (X-axis), front-back (Y-axis), or up-down (Z-axis) for analysis and interpretation of stereo-pair images on aerial roll film. Stereoscope movement is accurately controlled to maintain collimation over entire viewing area.

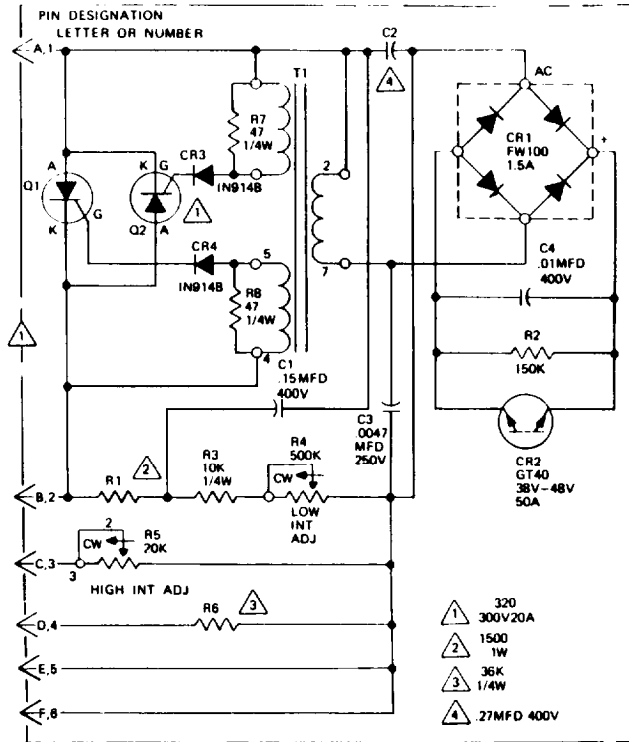


SPLIT-STAGE LIGHT TABLE
WIRING DIAGRAM

2-3.2 Detailed Theory of Operation

2-3.2.1 Illumination. Two encapsulated, cold-cathode, argon mercury light grids each provide a maximum of 2500 footlamberts of brightness through viewing surfaces. Intensity of light is controlled by a dimming circuit. Light can be reduced to 20 percent of maximum value.

Current (120 v, 50/60 Hz) is passed through the main power switch. The illumination control panel on the switch operates the fan and light grids. The increase potentiometer controls voltage to the dimmer boards.



Alternate current enters the dimmer circuit boards through pin A and is transferred to pin B through silicon-controlled rectifier (SCR) Q1 or Q2, which determines the amount of the ac sine wave voltage that is applied to the external high-voltage transformer to light the grid lamp. The SCRs prevent all of each ac half-wave from being transferred, but when triggered, allow current to flow during the remaining portion of each half sine wave until the zero crossing point is reached, whereupon the SCR is turned off and the ac waveform is again blocked.

When the ac voltage enters the control board, it is applied to C1 and R1 which provide a slight delay in the input voltage, which is applied to the timing circuit composed of capacitor C2 and resistors R4, R3, R5, and external potentiometer 1R1. (Note that resistor R6 is not used in this application.)

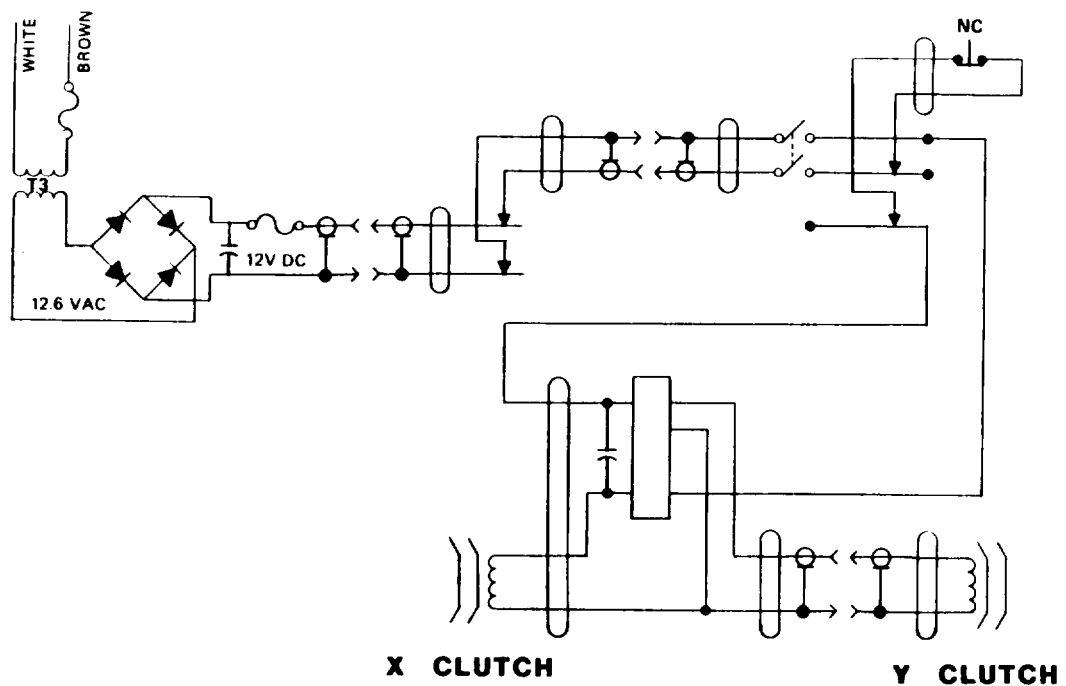
As the delayed ac voltage is applied across capacitor C2, the capacitor begins to charge at a rate depending upon the setting of potentiometer 1R1. The voltage across C2 also appears across rectifier CR1 and trigger diode CR2.

2-3.2.1 Illumination – Continued

When the trigger diode reaches the breakover voltage of 43 ± 5 v, it conducts to complete the path across rectifier bridge CR1. This forms a closed loop circuit through capacitor C2, the primary of pulse transformer T1, and rectifier CR1, and current flows until capacitor C2 is discharged. The discharge time is very fast and a short duration pulse is generated, shaped by capacitor C3.

The pulse current flowing through the primary of pulse transformer T1 induces a voltage across the appropriate secondary, which is applied through diode CR3 or CR4 to the gates of SCR Q2 or Q1, respectively. When either SCR is triggered, it allows the rest of the ac half-wave to pass to the external grid lamp transformer 1T1 through pin B. The SCR will continue to conduct until the ac half-wave reaches the zero crossing point, at which time it turns off.

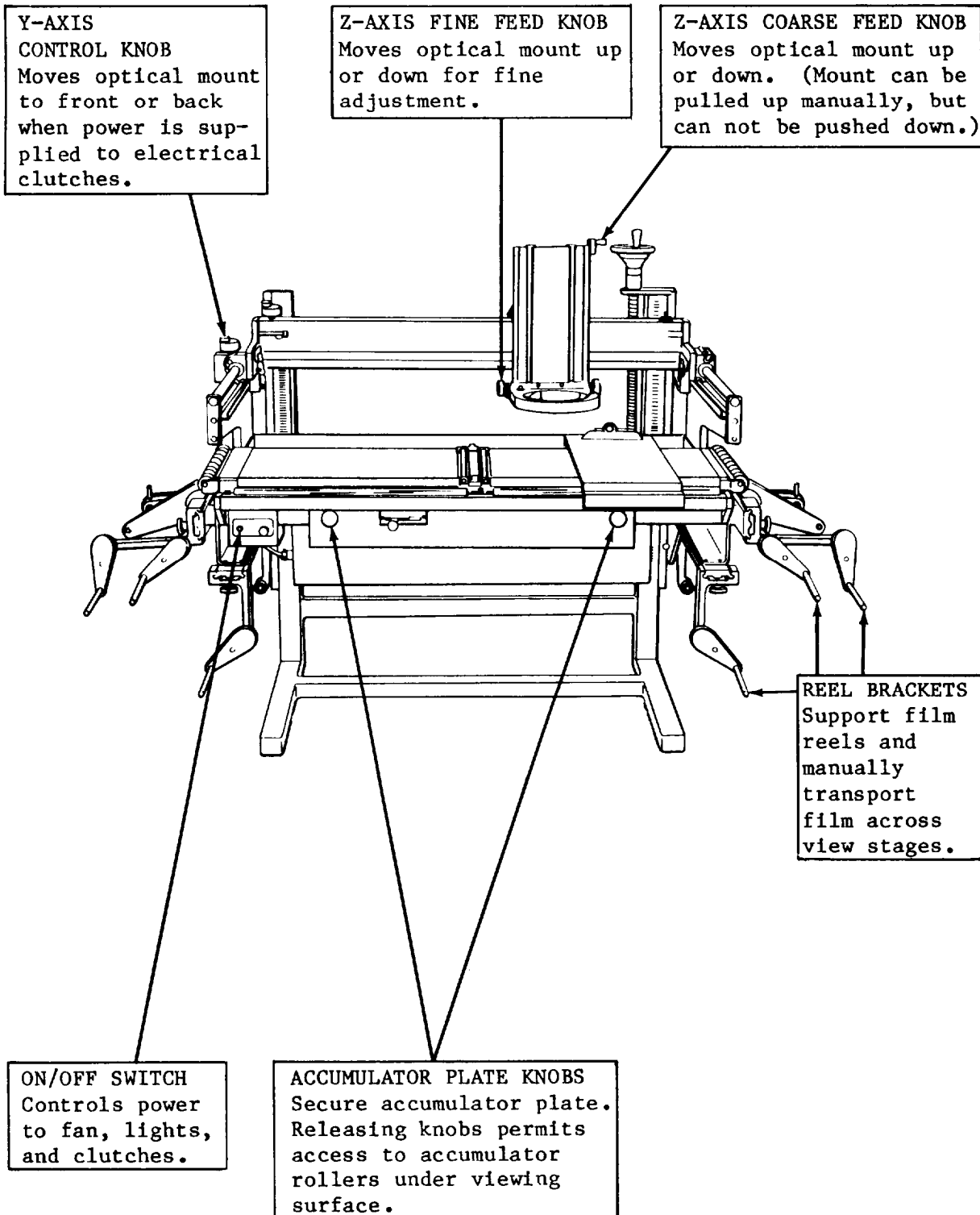
2-3.2.2 Clutch Control. X- and Y-axes manual motion controls are connected through electrically operated clutches to chain drives. Power to the clutches may be interrupted to decouple chain drives and permit rapid movement of the optical mount in the X- and Y-axes.



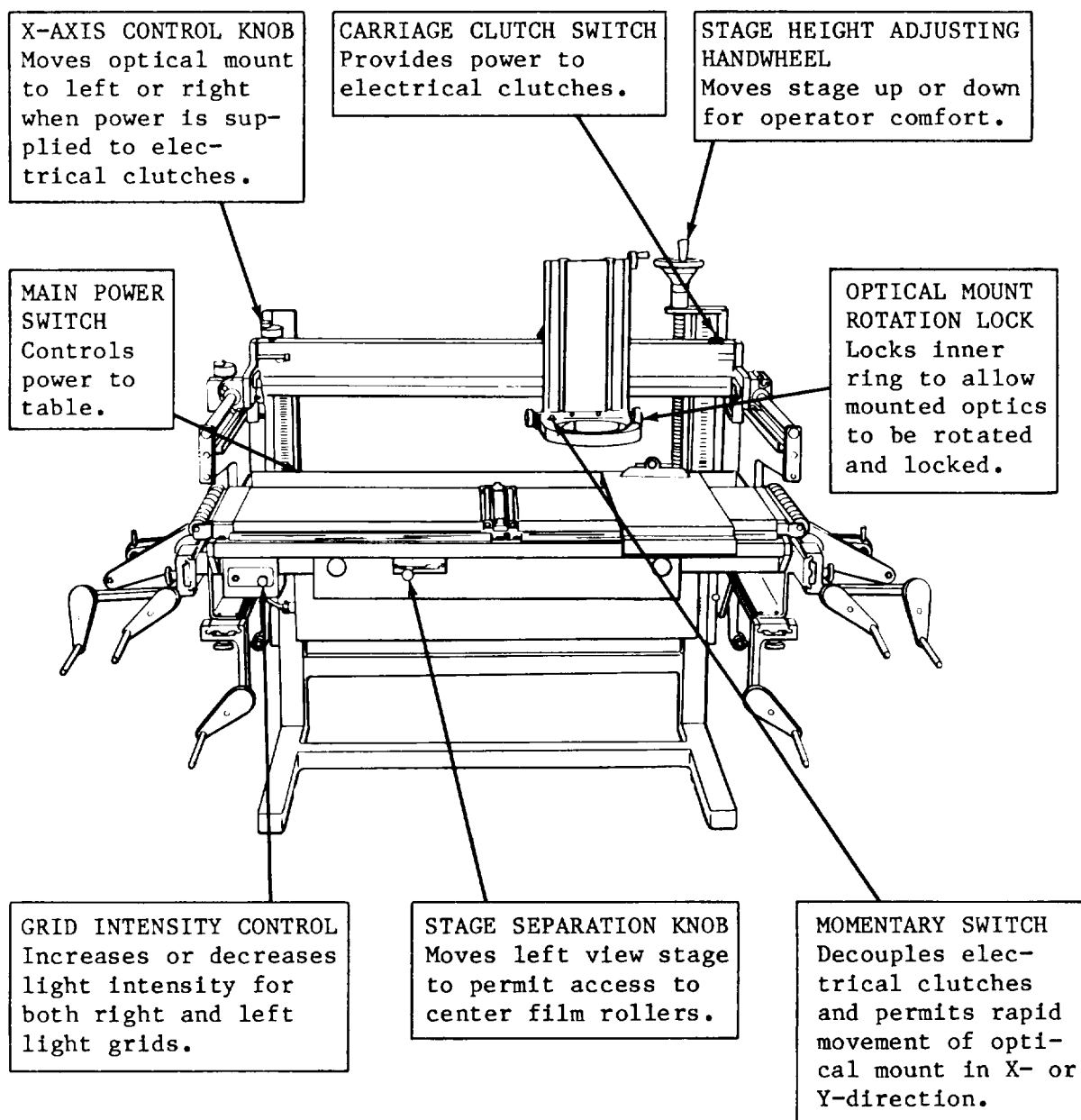
Current (120 v, 50/60 Hz) is stepped down to 12.6 vac in the transformer, rectified in printed circuit assembly (PCA) A4 to 12 vdc. Current passes through the quick-disconnect and brushes to the quick-disconnect and clutch power switch. The momentary switch on the optical carriage is normally on, except when pressed by the operator. Twelve vdc passes through the brushes to the series-connected clutches. Note that the quick-disconnect separates the Y-axis clutch from the circuit.

Section II. OPERATING INSTRUCTIONS

2-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS.



2-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued



2-5 OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

2-5.1 General. The split-stage light table must be regularly inspected to find and correct defects.

2-5.1.1 Before You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your BEFORE (B) PMCS.

2-5.1.2 While You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your DURING (D) PMCS.

2-5.1.3 After You Operate. Be sure to perform your AFTER (A) PMCS.

2-5.1.4 If Your Equipment Fails To Operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

2-5.2 PMCS Procedures

2-5.2.1 PMCS are designed to keep the equipment in good working condition by performing periodic service tasks.

2-5.2.2 Service intervals provide you, the operator, with time schedules that determine when to perform specified service tasks.

2-5.2.3 The "Equipment Is Not Ready/Available If" Column is used for identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.

2-5.2.4 If your equipment fails to operate after PMCS is performed, immediately report this condition to your supervisor.

2-5.3 PMCS Columnar Entries

2-5.3.1 Item Number Column. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for your "TM number" Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.

2-5.3.2 Interval Column. This column determines the time period designated to perform your PMCS.

2-5.3.3 Item To Be Inspected and Procedures Column. This column lists functional groups and their respective assemblies and subassemblies as shown in the Maintenance Allocation Chart (Appendix B). The appropriate check or service procedure follows the specific item to be inspected.

2-5.3.4 Equipment Is Not Ready/Available If: Column. This column indicates the reason or cause why your equipment is not ready/available to perform its primary mission.

Table 2-1. Operator Preventive Maintenance Checks and Services

B - Before Operation

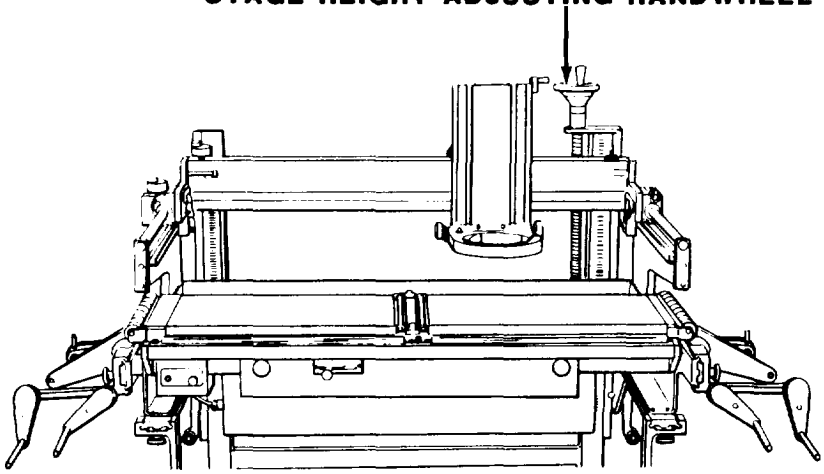
Item No.	Interval	ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
1	B	<p style="text-align: center;">STAGE HEIGHT ADJUSTING HANDWHEEL</p>  <p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">ELECTRICAL SHOCK</p> <p>Unplug power cord before servicing split-stage light table. Failure to do so may result in death or serious injury.</p> <p style="text-align: center;"><u>NOTE</u></p> <p>The side braces should be removed before performing PMCS on split-stage light table.</p> <p>STAGE HEIGHT MUSTING HANDWHEEL. Rotate left and right. Check for free movement of gear mechanism. Check that view stage height changes.</p>	View stage binds.

Table 2-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation

Item No.	Interval	ITEM TO BE INSPECTED	Equipment Is Not Ready/Available If:
	B	PROCEDURE	
2	●	<p>MASKING ASSEMBLIES. Retract four masking assemblies into wells by rotating knurled knobs. Check that knobs move freely and that assemblies are not torn.</p>	
3	●	<p>VIEW STAGE SURFACES. Check view stage surfaces for dust or dirt. Clean with moistened cotton cloth (item 16, appendix E). Dry surfaces with chamois (item 10, appendix E).</p> <p>Check view stage surfaces for cracks or scratches.</p>	View stage is damaged.

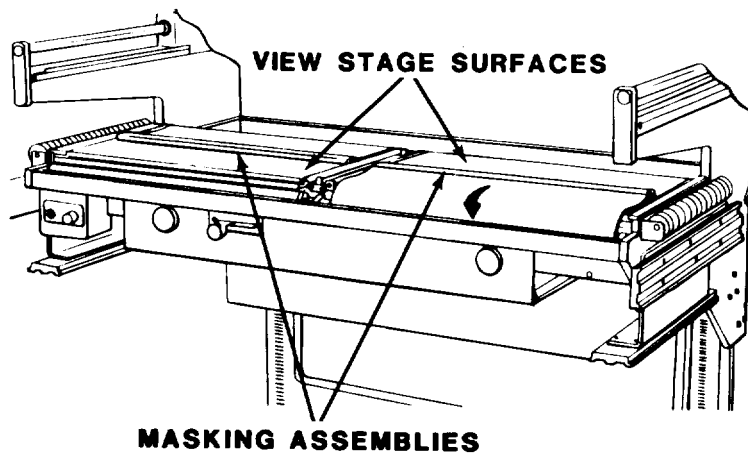


Table 2-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation

Item No.	Interval	ITEM TO BE INSPECTED	Equipment Is Not Ready/Available If:
	B	PROCEDURE	If:
4	●	STAGE SEPARATION KNOB. Move knob to right (notched position) and then to left. Check for freedom of movement.	Stages are frozen in place.
5	●	FILM ROLLERS. Inspect rollers for scratches and abrasions.	
6	●	REEL BRACKETS. Check for security of mounting, free movement of spindles, and slight end-play of reels.	Reel brackets are broken, missing, or binding.

Table 2-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation

Item No.	Interval	ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	<div> <p>The diagram shows a mechanical assembly with two eyepieces. A label 'OPTICAL MOUNT' points to the central body. To the right, there are two knobs: the upper one is labeled 'Z-AXIS COARSE FEED KNOB' and the lower one is labeled 'Z-AXIS FINE FEED KNOB'. Lines indicate the movement axes of the optical mount.</p> </div> <div> <p>NOTE</p> </div> <div> <p>Make sure that spring clips securing optical mount are disengaged.</p> </div>	
7	●	<p>OPTICAL MOUNT. Check that optical mount can be manually moved left-right (X-axis), front-back (Y-axis), and up, but cannot be pushed down.</p>	Optical mount binds or slips.
8	●	<p>Z-AXIS COARSE FEED KNOB AND Z-AXIS FINE FEED KNOB. Rotate both controls and check that optical mount moves up and down freely.</p>	Z-axis binds.

Table 2-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation

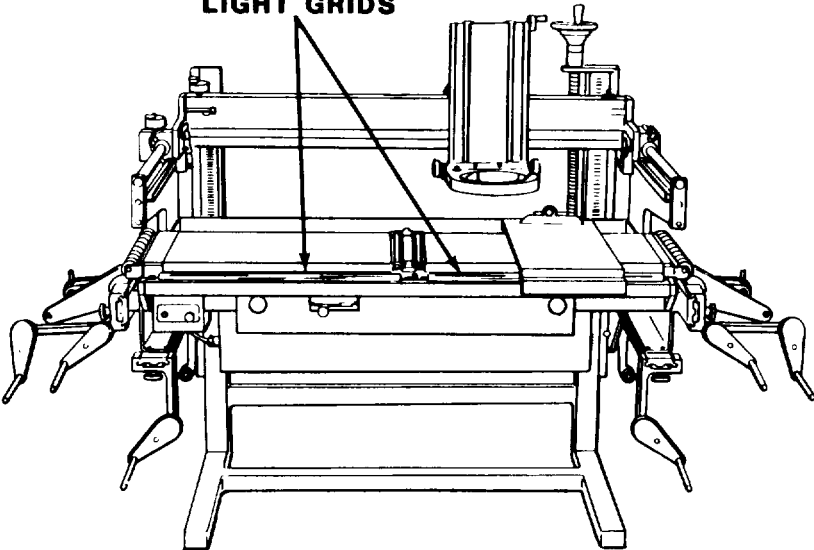
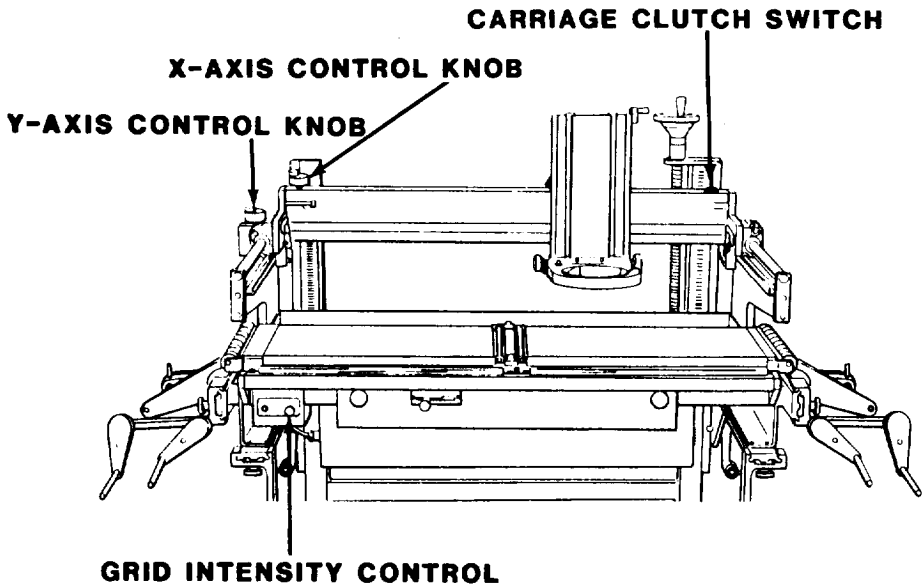
Item No.	Interval	ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	<p style="text-align: center;">LIGHT GRIDS</p> 	
9	●	<p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">ELECTRICAL SHOCK</p> <p>Do not use equipment with defective or worn wiring. Death or serious injury may result.</p> <p>POWER CORD AND WIRING. Inspect for breaks, tears, fraying, or broken connectors.</p>	<p>Wiring is defective or worn.</p>
10	●	<p style="text-align: center;"><u>CAUTION</u></p> <p>Do not operate light grids if cooling fan is not operating. (Listen for sound of fan.) Operation of light table without cooling fan will cause equipment failure.</p> <p>LIGHT GRIDS. Plug in power cord. Turn power ON. Set ON/OFF switch to ON. Check that both light grids light.</p>	<p>One or both light grids do not light.</p>

Table 2-1. Operator Preventive Maintenance Checks and Services - Continued

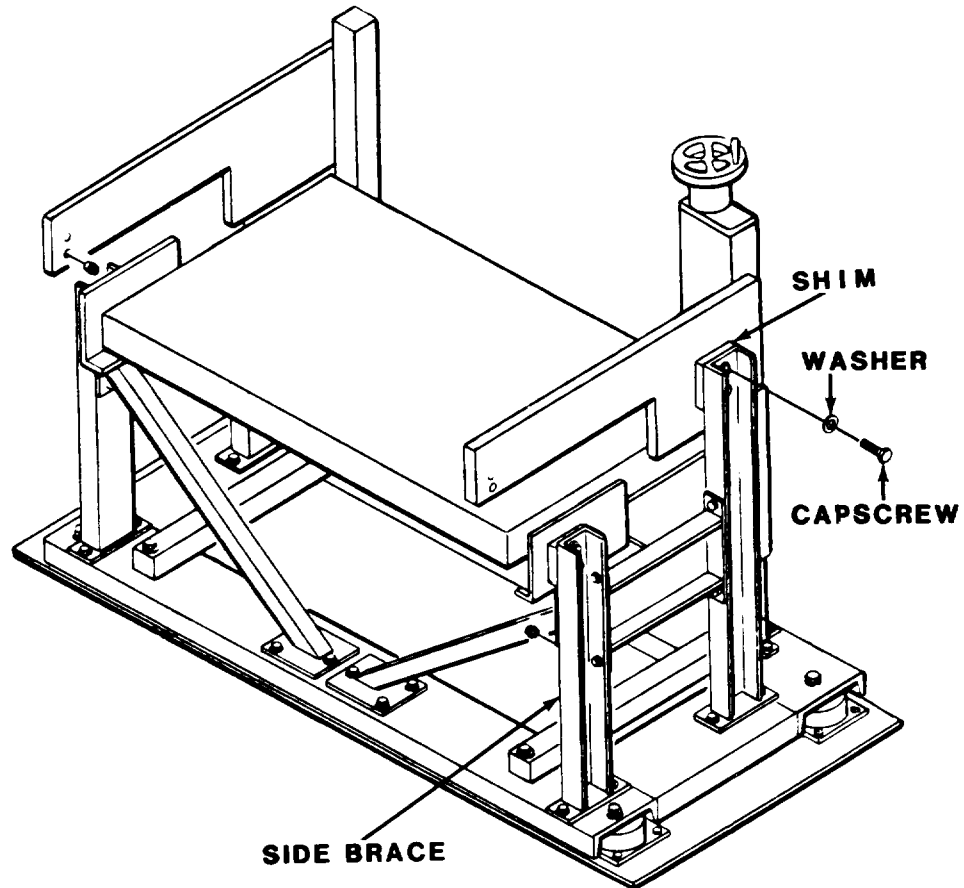
B - Before Operation

Item No.	Interval	ITEM TO BE INSPECTED	Equipment Is Not Ready/Available If:
	B	PROCEDURE	If:
			
11	●	<p>GRID INTENSITY CONTROL. Turn control fully right. Check that light intensity of both grids increases and continues to increase until grids are warmed up. Turn control gradually left. Check for even decrease in intensity.</p>	
12	●	<p>CARRIAGE CLUTCH SWITCH, X-AXIS AND Y-AXIS CONTROL KNOBS. Check for tight connections at clutch switch connectors. Turn power ON. Set carriage clutch switch to ON. Rotate X-axis and Y-axis control knobs. Check that optical mount moves left-right and front-back.</p>	<p>Clutch is inoperative. X- and Y-axis controls are inoperative.</p>

2-6 OPERATION UNDER USUAL CONDITIONS.

2-6.1 Assembly and Preparation for Use

- a. Remove side braces.

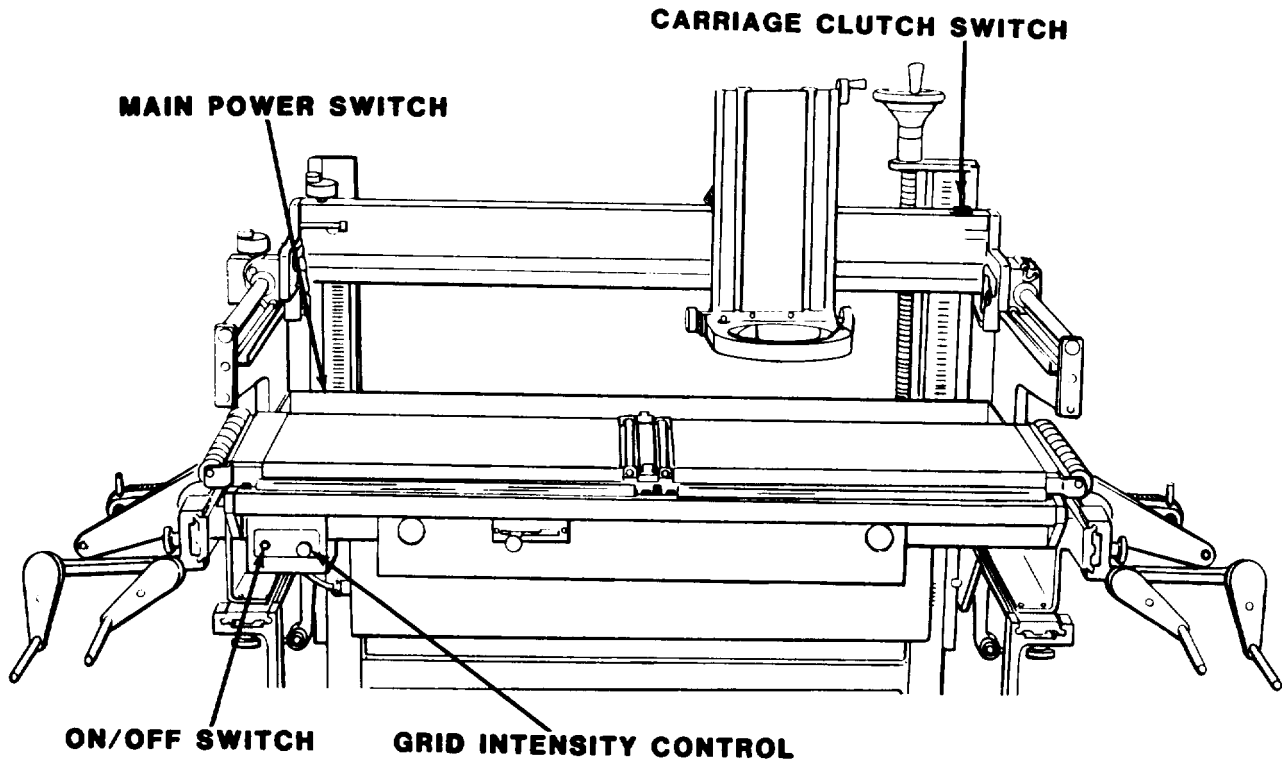


NOTE

Do not remove side braces until there is a mission that requires use of the lower reel brackets.

- (1) Remove 22 capscrews and washers from sides and base of table.
 - (2) Remove shims.
 - (3) Save screws, washers, and shims for reuse.
 - (4) Slide braces out from underneath table.
- b. Release air from air shocks.

2-6.1 Assembly and Preparation for Use - Continued



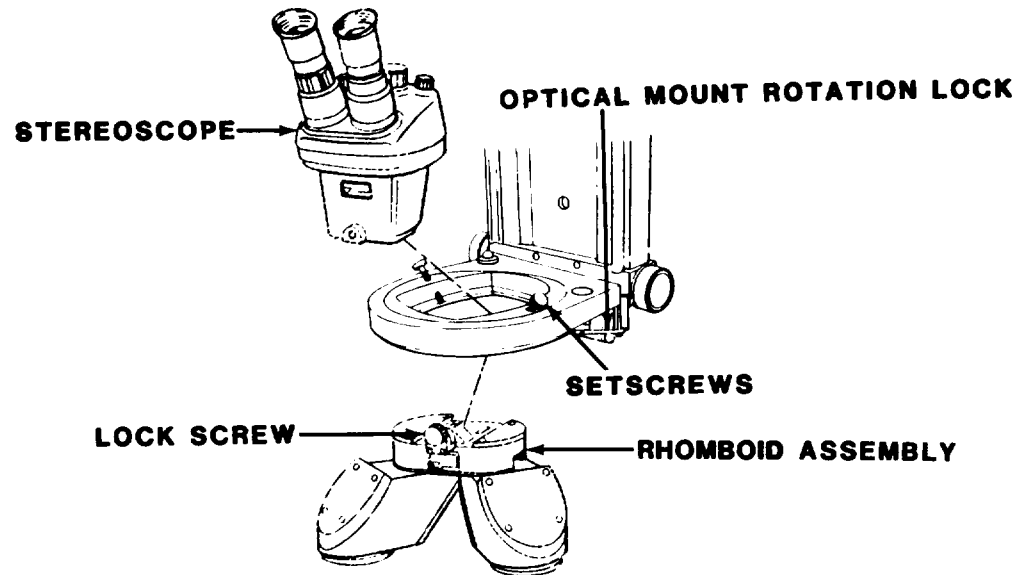
- c. Plug in power cord, and turn main power switch ON.
- d. Set ON/OFF switch to ON and turn grid intensity control fully right.
- e. Set carriage clutch switch to ON.

NOTE

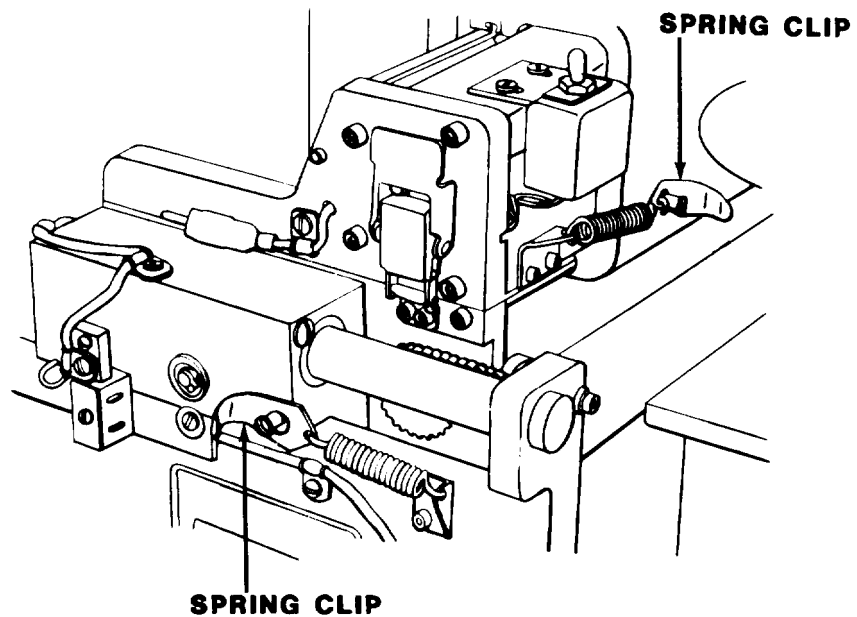
Light grids require at least 15 minutes to warm up.

- f. Place stereoscope in optical mount.
 - (1) Remove shipping bracket.
 - (2) Lift optical mount to at least midpoint of travel.
 - (3) Loosen two setscrews.
 - (4) Insert stereoscope and tighten two setscrews.
 - (5) Connect rhomboid assembly and tighten locking screw.
 - (6) Lock stereoscope into place with optical mount rotation lock.

2-6.1 Assembly and Preparation for Use - Continued



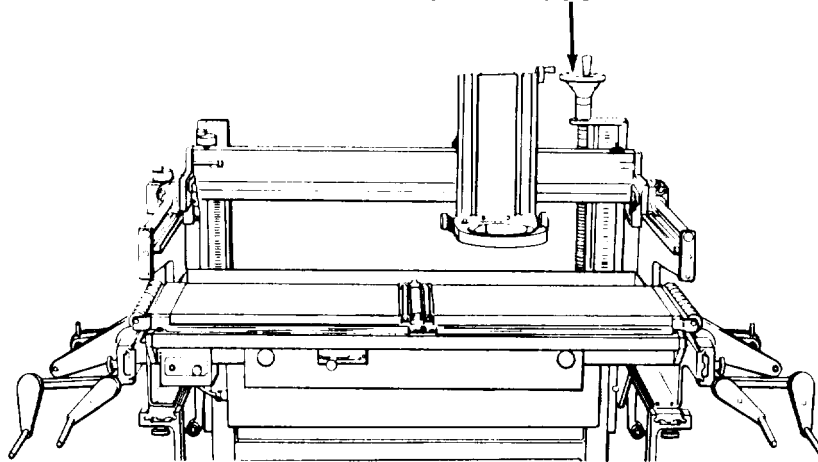
- (7) Remove plastic dust protectors.
- (8) Install eyepieces.
- (9) Install eyeguards, if desired.



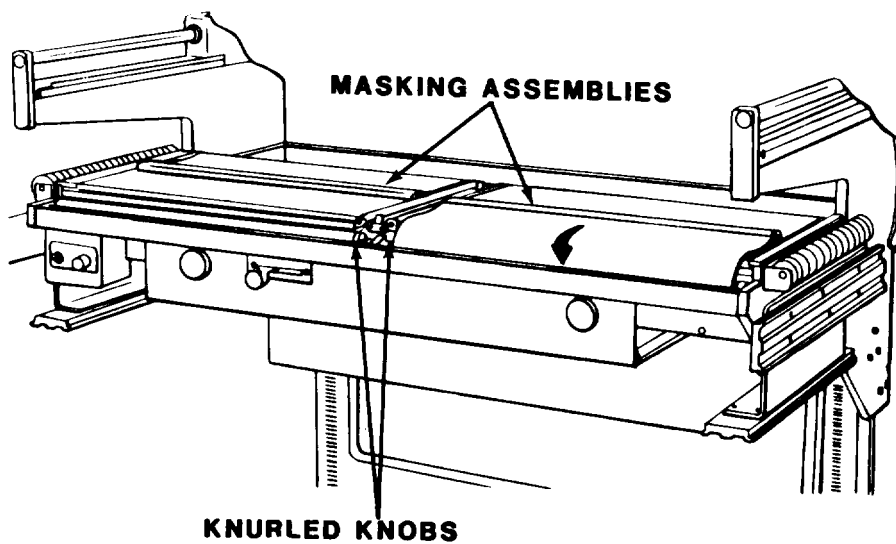
- g. Free optical mount by releasing spring clips.

2-6.1 Assembly and Preparation for Use - Continued

STAGE HEIGHT ADJUSTING HANDWHEEL



- h. Rotate stage height adjusting handwheel left or right to raise or lower view stage to comfortable height.



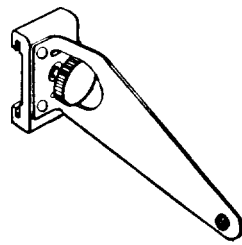
- i. Rotate knurled knobs until masking assemblies are retracted into their wells.

2-6.1 Assembly and Preparation for Use - Continued

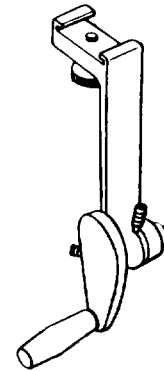
NOTE

This step is required if reel brackets have been removed for preventive maintenance, storage, or shipment.

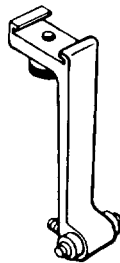
- j. Mount reel brackets.



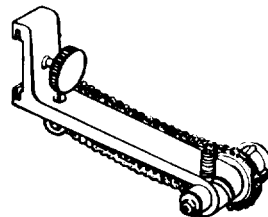
CENTER IDLER BRACKET



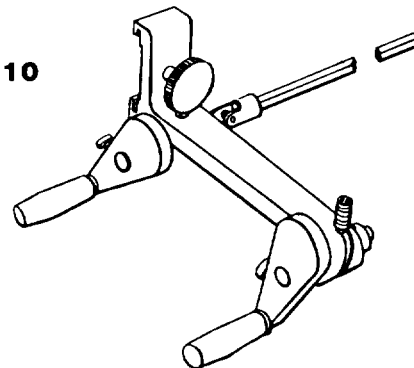
DRIVER BRACKET T-1-10



IDLER REEL BRACKET T-1-10



REAR BRACKET T-2-10-DC



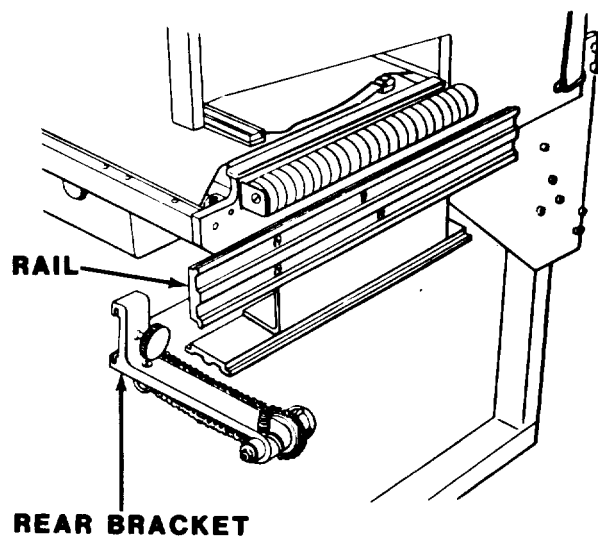
FRONT BRACKET T-2-10-DC

NOTE

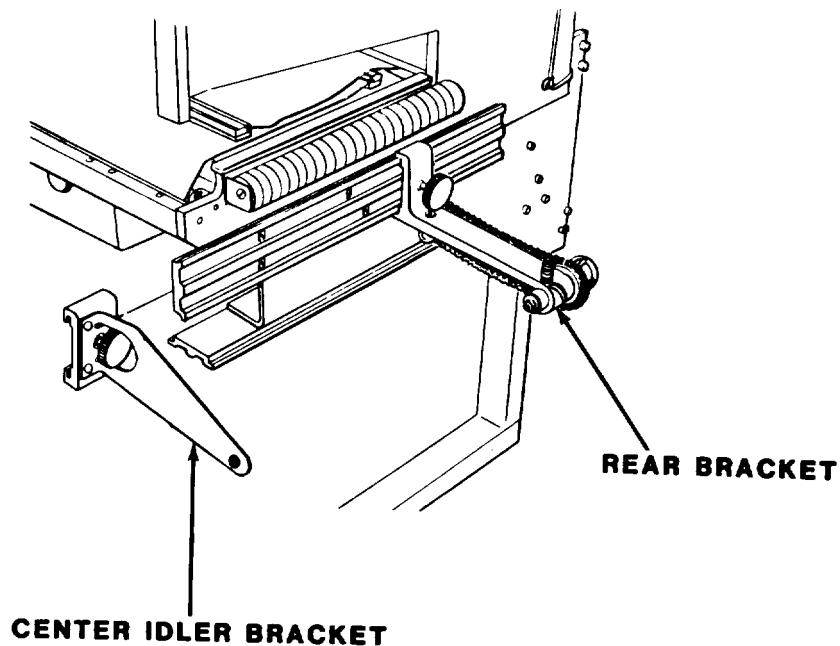
T-2-10-DC brackets are used to transport dual film strands. T-1-10 brackets are used to transport single film strands and as take-up brackets for split vertical film.

2-6.1 Assembly and Preparation for Use - Continued

- (1) Install T-2-10-DC brackets.

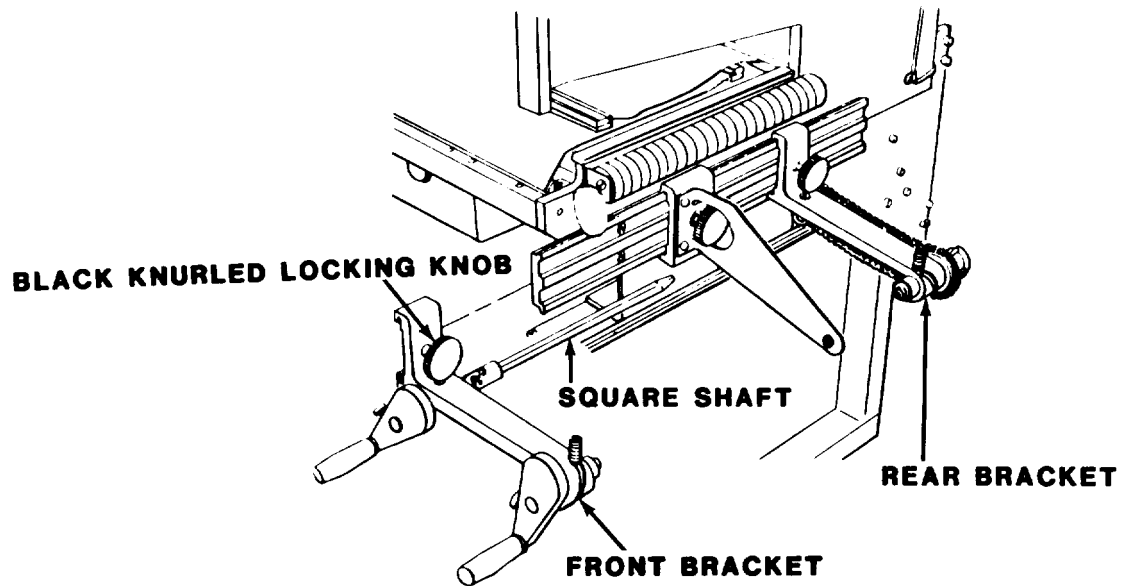


- (a) Slide each rear reel bracket to rear of rail.



- (b) Slide each center idler bracket into position on rail near center of rail. Align bearings with spindle tip of each rear bracket.

2-6.1 Assembly and Preparation for Use - Continued

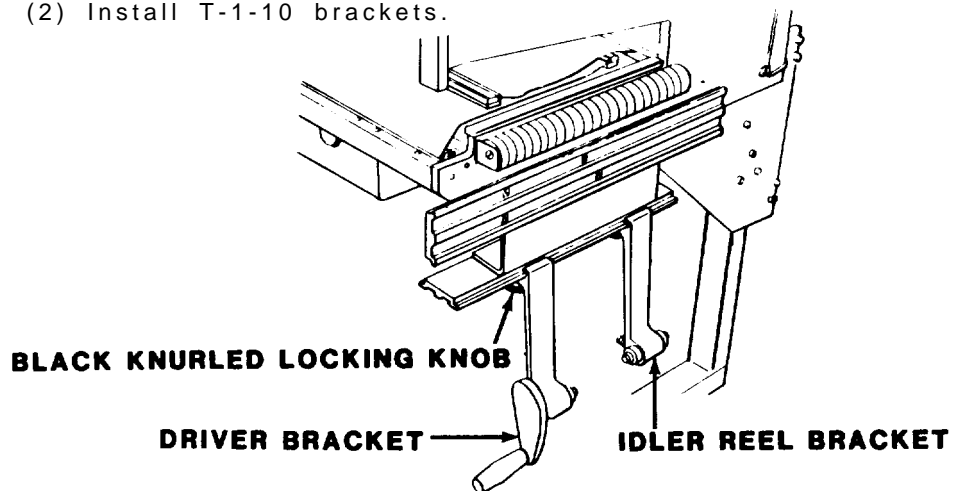


(c) Slide each front bracket on rail. Guide square shaft of bracket into hole in center sprocket of rear bracket.

(d) Aline front bracket base with front edge of tail.

(e) Turn black knurled locking knobs.

(2) Install T-1-10 brackets.



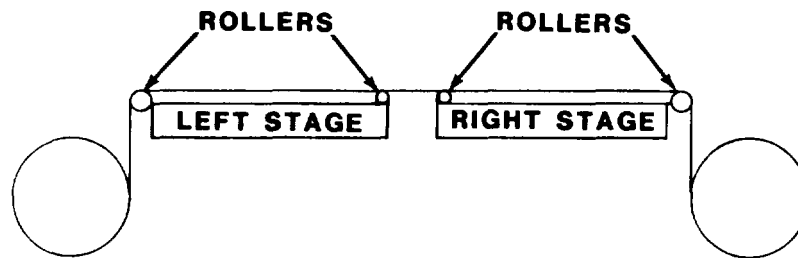
(a) Slide idler reel bracket to rear of lower rail. Spindle tip faces front.

(b) Slide driver bracket on lower rail, crank facing front. Aline front of bracket with front of rail.

(c) Tighten black knurled locking knobs.

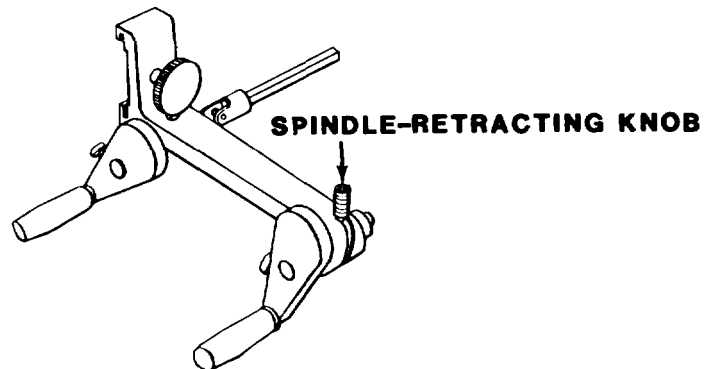
2-6.1 Assembly and Preparation for Use - Continued

k. Thread film.

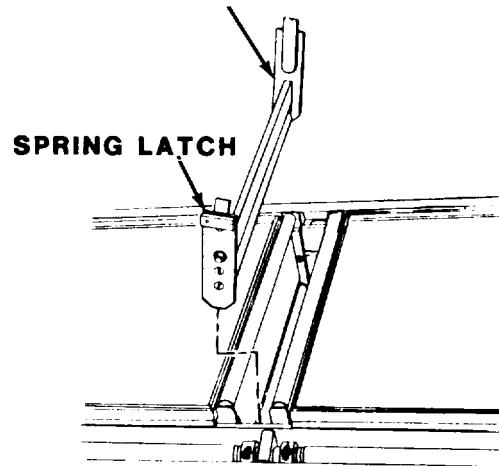


CONVENTIONAL

(1) Conventional threading.



- (a) Extend drive spindles on all drive reel brackets by turning grooved spindle-retracting knob to upper locked position.
- (b) Insert film supply reel between front bracket and center idler bracket. Front bracket drive spindle engages key slot on reel.
- (c) Loosen black knurled locking knob on center idler bracket. Move bracket toward film reel, and engage bearing on bracket with center hole in reel. Adjust position so that film reel is securely held and has very slight end-play.
- (d) Tighten black knurled locking knob on center idler bracket.
- (e) Install take-up reel at opposite end of table using same procedure.

2-6.1 Assembly and Preparation for Use - Continued**CENTER ACCUMULATOR ROLLER**

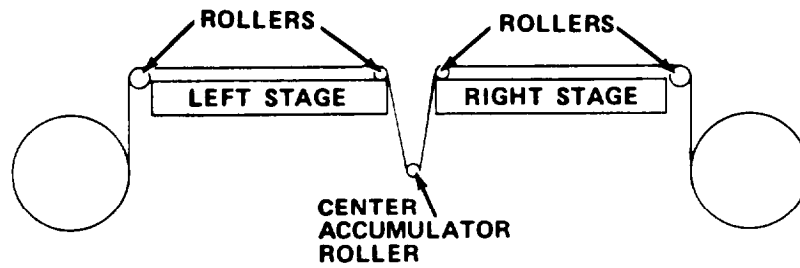
- (f) Remove center accumulator roller by pinching spring-loaded latches and lifting from between view stages.
- (g) Move stage separation knob to right. Make sure that view stages close and knob locks into slot.
- (h) Thread film leader over rollers across view stage to take-up reel.
- (i) Adjust drag brake knobs on crank handles until film tension is suitable for operator's use.

NOTE

Perform steps (j) through (n) to view dual film strips.

- (j) Mount rear film supply reel on idler bracket. Reel key slot engages bearing on idler bracket.
- (k) Slide rear driver bracket to front until drive spindle engages reel key slot.
- (l) Tighten black knurled locking knob on driving bracket.
- (m) Install take-up bracket at opposite end of split-stage light table.
- (n) Thread rear film strand.

2-6.1 Assembly and Preparation for Use - Continued



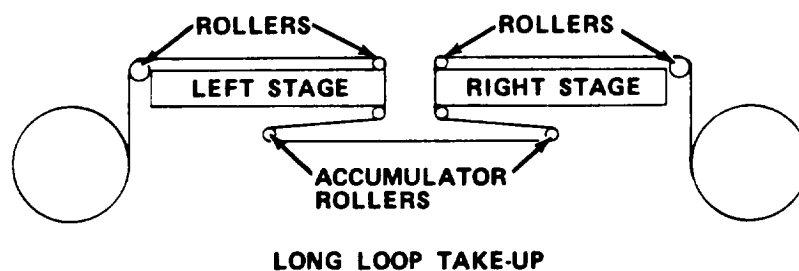
SHORT LOOP TAKE-UP

(2) Short loop take-up threading.

NOTE

After film is threaded conventionally, the following steps will provide a short loop take-up.

- (a) Push stage separation knob down and to the left. Make sure that view stages separate.
- (b) Loosen drag brake knobs on reel brackets.
- (c) Start short film loop.
- (d) Insert center accumulator roller over film between view stages. Pinch spring-loaded latches and latch into position.
- (e) Adjust drag brake tension on reel brackets until film tension is suitable for operator's use.

2-6.1 Assembly and Preparation for Use - Continued

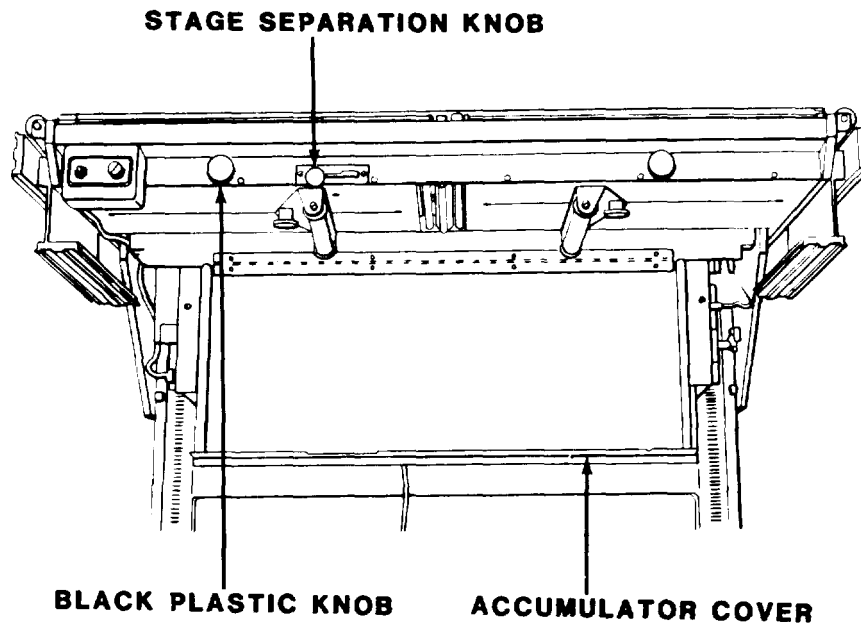
(3) Long loop take-up threading.

CAUTION

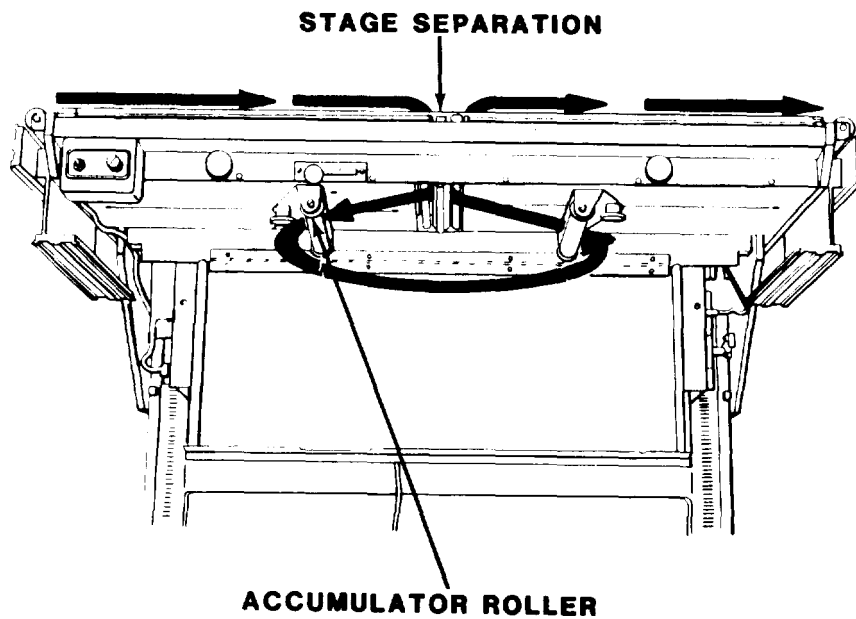
Do not close view stages when film is threaded in long loop position. Damage to film may result.

- (a) Push stage separator knob down and to the left. Make sure that view stages separate.
- (b) Remove center accumulator roller by pinching spring-loaded latches and lifting from between view stages.
- (c) Insert film supply reel between front bracket and center idler bracket. Front bracket drive spindle engages key slot on reel.
- (d) Loosen black knurled locking knob on center idler bracket. Move bracket toward film reel, and engage bearing on bracket with center hole in reel. Adjust position so that film reel is securely held and has very slight end-play.
- (e) Tighten black knurled locking knob on center idler bracket.
- (f) Install take-up reel at opposite end of table using same procedure.

2-6.1 Assembly and Preparation for Use - Continued



(g) Loosen black plastic knobs on film accumulator cover, and let cover drop down.

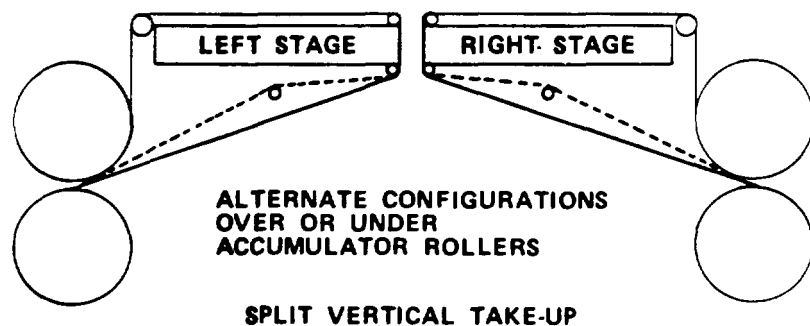


(h) Thread film across view stage, down through stage separator, and over accumulator roller.

2-6.1 Assembly and Preparation for Use - Continued**CAUTION**

Do not catch film on any hardware while threading. Damage to film may result.

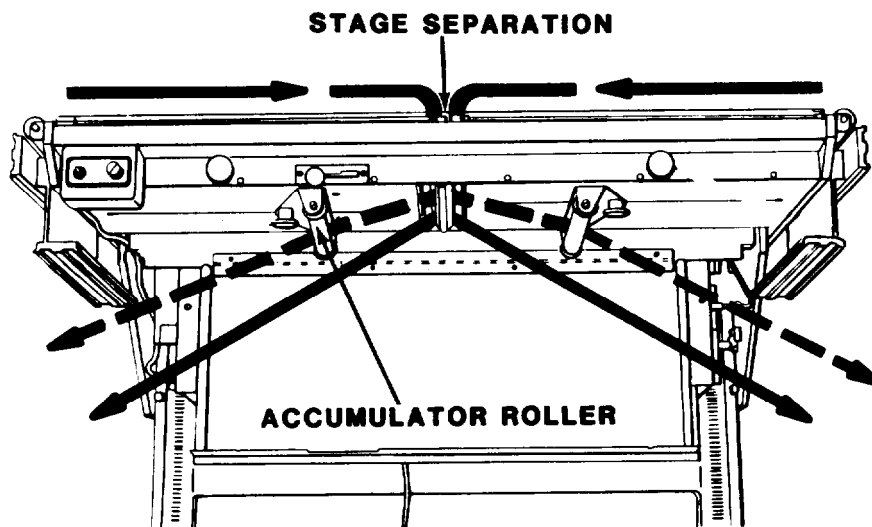
- (i) Continue threading the film across to second accumulator roller. Thread film over roller, up through stage separation, and across second view stage to take-up reel.
- (j) Loosen locking knobs, and adjust accumulator rollers for desired length of take-up loop. Tighten locking knobs.
- (k) Adjust drag brake knobs on reel brackets until film tension is suitable for operator's use.
- (l) Close film accumulator cover, and secure by tightening knobs.



- (4) Split vertical take-up threading.
 - (a) Remove center idler brackets.
 - (b) Mount supply reels on top rails.
 - (c) Mount take-up reels on bottom rails.
 - (d) Push stage separation knob down and to the left. Make sure that view stages separate.
 - (e) Remove center accumulator roller by pinching spring-loaded latches and lifting from between view stages.

2-6.1 Assembly and Preparation for Use - Continued

- (f) Loosen black plastic knobs on film accumulator cover. Let cover drop down.



- (g) Thread film leader from supply reel across view stage, down through stage separation, over accumulator roller, and directly to take-up reel.
- (h) Adjust drag brake knobs on reel brackets until film tension is suitable for operator's use.
- (i) Move rollers to far left and right travel positions, and tighten locking knobs.

CAUTION

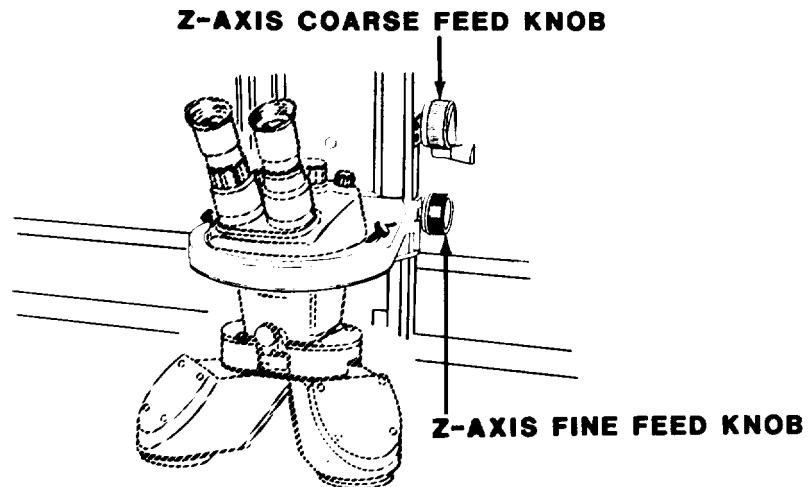
Do not close stage separation. Damage to film may result.

- (j) Close film accumulator cover, and secure by tightening black plastic knobs.

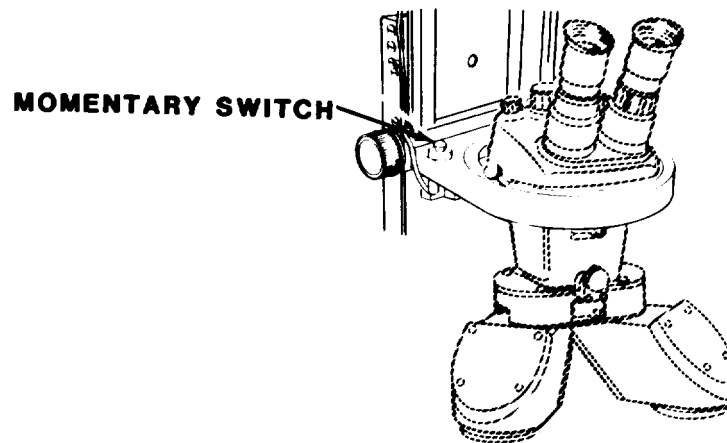
1. Install clipboard over viewing surfaces, if desired.

2-6.2 Operating Procedures

- a. Adjust light grid intensity to comfortable illumination level.



- b. Position optics at approximate viewing level.
- (1) Rotate Z-axis coarse feed knob to right or left.
 - (2) Rotate Z-axis fine feed knob to obtain operating position.



- c. Position optics to approximate horizontal position.
- (1) Press momentary switch and hold.
 - (2) Move mount left, right, forward, or back while switch is pressed, then release switch.
 - (3) Use X-axis control knob for fine positioning in left-right direction.
 - (4) Use Y-axis control knob for fine positioning in front-back direction.

2-6.2 Operating Procedures - Continued

d. Shut down light table.

- (1) Rewind film on reel.
- (2) Remove film reels. Hold film reel with one hand. Use other hand to pull grooved spindle-retracting knob from locked position and move to retract position.
- (3) Set ON/OFF switch to OFF.
- (4) Set carriage clutch switch to OFF.
- (5) Set main power switch to OFF.
- (6) Cover view stages with masking assemblies.
- (7) Unplug power cord.

CAUTION

Do not touch optical surfaces with bare fingers. Fingerprints will hinder equipment performance.

- (8) Move optical mount to far right rear position.
- (9) Secure optical mount with spring clips.
- (10) Remove and store optics.
- (11) Remove and store reel brackets.
- (12) Remove and store clipboard.
- (13) Lower optical mount. Install shipping bracket.
- (14) Cover with dust cover.

2-6.3 Preparation for Movement

- a. Perform all shut down light table (para 2-6.2d) steps except covering with dust cover.
- b. Reinstall all mounting brackets, and tighten bolts.
- c. Cover light table with dust cover.

2-7 OPERATION UNDER UNUSUAL CONDITIONS.

Operation of the split-stage light table is limited to conditions that will not damage aerial roll film or stereoscope.

Section III. OPERATOR MAINTENANCE

2-8 LUBRICATION INSTRUCTIONS.

CAUTION

Unnecessary or improper attempts to lubricate the split-stage light table will damage film, bearings, or internal components.

No lubrication is authorized at the operator's level. Maintenance procedures at organizational and direct support levels require limited lubrication of chains and precision bearings when there is a reason to perform corrective action requiring the removal of components.

2-9 OPERATOR TROUBLESHOOTING PROCEDURES.

2-9.1 General

2-9.1.1 The table lists the common malfunctions which you may find during the operation or maintenance of the split-stage light table or its components. You should perform the tests/inspections and corrective actions in the order listed.

2-9.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 2-2. Operator Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. FAN DOES NOT RUN. LIGHT GRIDS DO NOT WORK. CARRIAGE CLUTCHES DO NOT WORK.		<p>Step 1. Check if power cord is unplugged.</p> <p style="padding-left: 40px;">Plug in power cord.</p> <p style="padding-left: 40px;">Reset circuit breakers.</p> <p>Step 2. Check if fuses are damaged or blown.</p> <p style="padding-left: 40px;">Replace defective fuses (para 2-10.1).</p>

Table 2-2. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. CLUTCHES DO NOT OPERATE. LIGHT GRIDS OPERATE.	Step 1. Check if carriage clutch switch is OFF.	Set switch to ON.
	Step 2. Check if fuses are damaged or blown.	Replace defective fuse (para 2-10.1).
3. OPTICAL RESOLVING POWER IS LIMITED. FILM IMAGE IS DISTORTED WHEN CARRIAGE POSITION IS MOVED.	Replace stereoscope.	If distortion is eliminated, evacuate defective stereoscope through normal maintenance channels,
		Collimate light table (para 2-10.3).

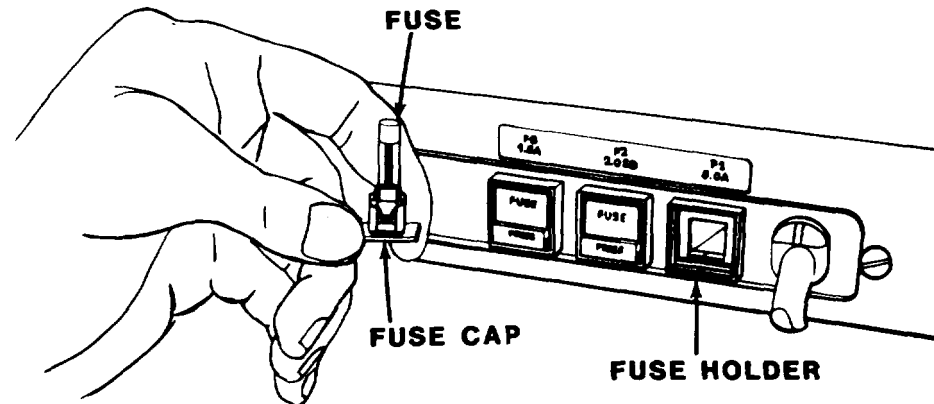
2-10 OPERATOR MAINTENANCE PROCEDURES.

This section contains step-by-step instructions covering operator performed maintenance functions.

2-10.1 Replace Fuse

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

SUPPLIES: Fuse (8 amp)
 Fuse (1.5 amp)
 Fuse, Slo-Blo (2 amp)



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Press on fuse holder bottom to release fuse cap.
- c. Inspect fuse for broken/burned element.
- d. Discard defective fuse.

2-10.1 Replace Fuse - Continued

INSTALLATION:

CAUTION

- New fuse must be of equal value to fuse removed.
 - If new fuse burns out immediately, do not operate equipment until electrical fault is isolated and repaired. Serious equipment damage may occur.
- a. Install new fuse of equal value and configuration.
 - b. Push fuse holder with new fuse into receptacle until fuse holder latches.
 - c. Plug in power cord, and turn power ON.

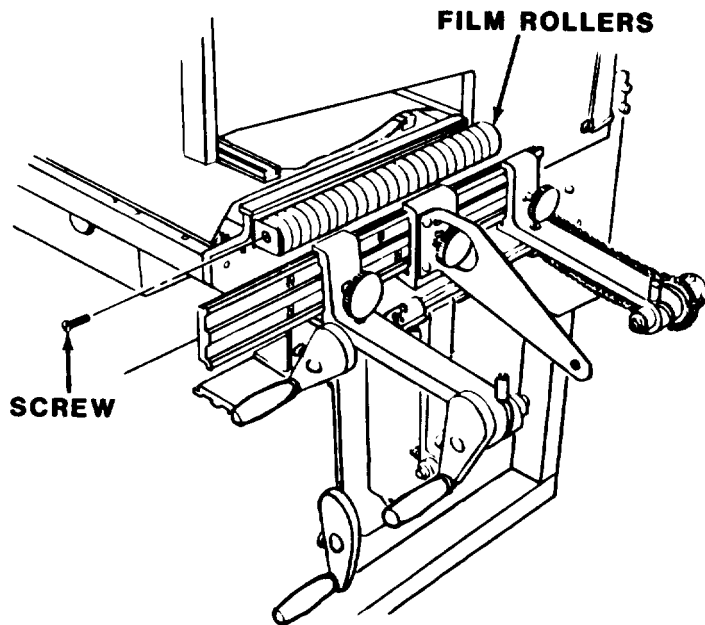
2-10.2 Replace Film Rollers

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: 9/64-in. flat-tip screwdriver

MATERIAL/PARTS: Film rollers

REMOVAL:



- a. Remove screw from end of film roller assembly.
- b. Slide defective film rollers off assembly.

2-10.2 Replace Film Rollers - Continued

INSTALLATION:

- a. Install new film rollers on assembly.
- b. Reinstall assembly and secure with screw.

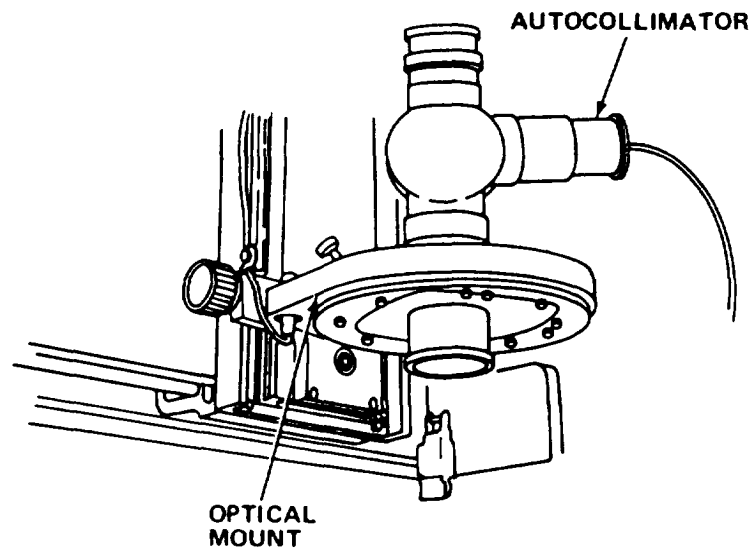
2-10.3 Collimation.

MOS: 41 B, Topographic Instrument Repair Specialist

TOOLS: Autocollimator
Adjustable Wrench
9/64 in. Flat Tip Screwdriver

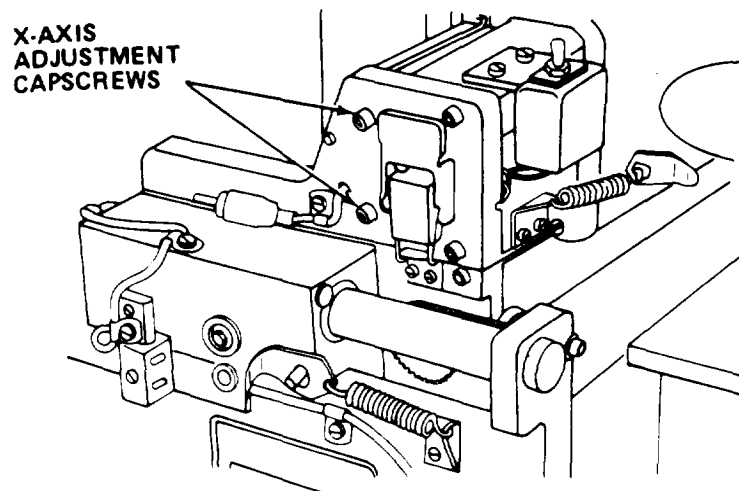
NOTE

- Make sure that all attaching hardware is tight before attempting to collimate split-stage light table.
- Collimation should be performed after movement to new site or when tests indicate collimation is-required.



- a. Collimation equipment will not fit optical mount properly, unless setscrews are removed from the optical mount first.
- b. Mount autocollimator in optical mount.

2-10.3 Collimation Continued



- c. Loosen four (4) capscrews securing X-rail to end support plates. Tighten lower, rear screws at each end. Three (3) other screws on each end should be snug.
- d. Fold piece of thick paper over right-hand, rear, upper edge of X-rail to protect surface. Fit wrench over protected section of X-rail.
- e. Move optical mount to right-hand stop. Move carriage between front and rear stops. Check collimation.
- f. If collimation is outside ± 5 minutes of arc, use wrench to turn X-rail to bring collimation within limits. Tighten upper front attaching screw on X-rail support plate on right-hand end securely.
- g. Move optical mount to left-hand stop, and repeat procedures for left-hand end of carriage assembly.
- h. Check Y-axis collimation at point near center of table. Readjust X-rail, if necessary.
- i. Tighten all four (4) attaching screws on both X-rail support plates, and recheck collimation in Y-axis.
- j. Move carriage assembly so that autocollimator mirror is near rear end of stage glass. Move optical mount between left-hand and right-hand limits while checking collimation.
- k. Move carriage assembly so that autocollimator mirror is near front end of stage glass. Move optical mount between left-hand and right-hand limits while checking collimation.
- l. If X-axis collimation is outside of ± 3 minutes of arc, move optical mount to point just below uppermost limit of travel,
- m. Loosen four (4) capscrews attaching vertical carriage to X-bearing housing assembly.
- n. Tip vertical carriage assembly slightly to left or right, by adjusting five (5) socket head adjusting screws as required, to bring collimation along X-axis within limits.
- o. Tighten four (4) capscrews and recheck collimation.

Section IV. ORGANIZATIONAL MAINTENANCE

2-11 REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT.

2-11.1 For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

2-11.2 Special tools, TMDE, and support equipment required at the organizational level are indicated in Appendix B, Section III of this manual.

2-11.3 Repair parts are listed and illustrated in the Repair Parts and Special Tools List (TM5-6675-326-24P) covering organizational maintenance for this equipment,

2-12 ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

There are no PMCS at the organizational level for the split-stage light table.

2-13 ORGANIZATIONAL TROUBLESHOOTING.

2-13.1 General

2-13.1.1 The table lists the common malfunctions which you may find during the operation or maintenance of the split-stage light table or its components. You should perform the tests/inspections and corrective actions in the order listed.

2-13.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 2-3. Organizational Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. LIGHT GRID, FAN MOTOR, AND CARRIAGE CLUTCH SWITCHES ARE INOPERATIVE.		<p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">ELECTRICAL SHOCK</p> <p style="text-align: center;">Unplug the power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.</p> <p>Step 1. Remove two quick-disconnect screws and remove cover from power panel.</p> <p>Step 2. Perform continuity check for ON/OFF switch at terminal board.</p> <p style="padding-left: 40px;">If no continuity is present, replace ON/OFF switch (para 2-14.1).</p>
2. LIGHT GRID INTENSITY WILL NOT CHANGE.		<p>Perform continuity check for potentiometer.</p> <p style="padding-left: 40px;">If no continuity is present, replace potentiometer (para 2-14.2).</p> <p style="padding-left: 40px;">Notify direct support maintenance for reversal of dimmer card connector or replacement of dimmer circuit card.</p>
3. ONLY ONE LIGHT GRID LIGHTS.		<p>Inspect connections to light grid.</p> <p style="padding-left: 40px;">Tighten loose connections.</p> <p style="padding-left: 40px;">Notify direct support maintenance for replacement of dimmer circuit card.</p>
4. FAN MOTOR WILL NOT RUN. LIGHT GRIDS AND CLUTCHES WORK.		<p style="padding-left: 40px;">Notify direct support maintenance for replacement of fan.</p>

Table 2-3. Organizational Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
5. FAN OPERATES. CLUTCHES DO NOT OPERATE.		<p>Perform continuity check for carriage clutch switch.</p> <p>If no continuity is present, notify direct support maintenance for replacement of carriage clutch switch.</p>
6. CLUTCHES DO NOT OPERATE. LIGHT GRIDS OPERATE.		<p>Step 1. Set carriage clutch switch to OFF.</p> <p>Step 2. Perform continuity check for carriage assembly.</p> <p>If no continuity is present, notify direct support maintenance for replacement of carriage clutch switch.</p> <p>Step 3. Perform continuity check for X-axis brushes.</p> <p>If no continuity is present, replace brushes (para 2-14.4).</p>
7. X-, Y-, OR Z-AXIS CHAINS JUMP SPROCKETS.		<p>Inspect for slack in chain.</p> <p>Notify direct support maintenance for tightening of chain.</p>
8. X-, Y-, OR Z-AXIS CONTROLS ARE SLUGGISH.		<p>Step 1. Inspect chain for too much tension.</p> <p>Notify direct support maintenance for loosening of chain.</p> <p>Step 2. Inspect chain for dirt.</p> <p>Notify direct support maintenance for servicing of chain.</p> <p>Step 3. Inspect worm gears and bearings.</p> <p>Notify direct support maintenance for servicing of worm gears and bearings.</p>

2-14 ORGANIZATIONAL MAINTENANCE PROCEDURES.

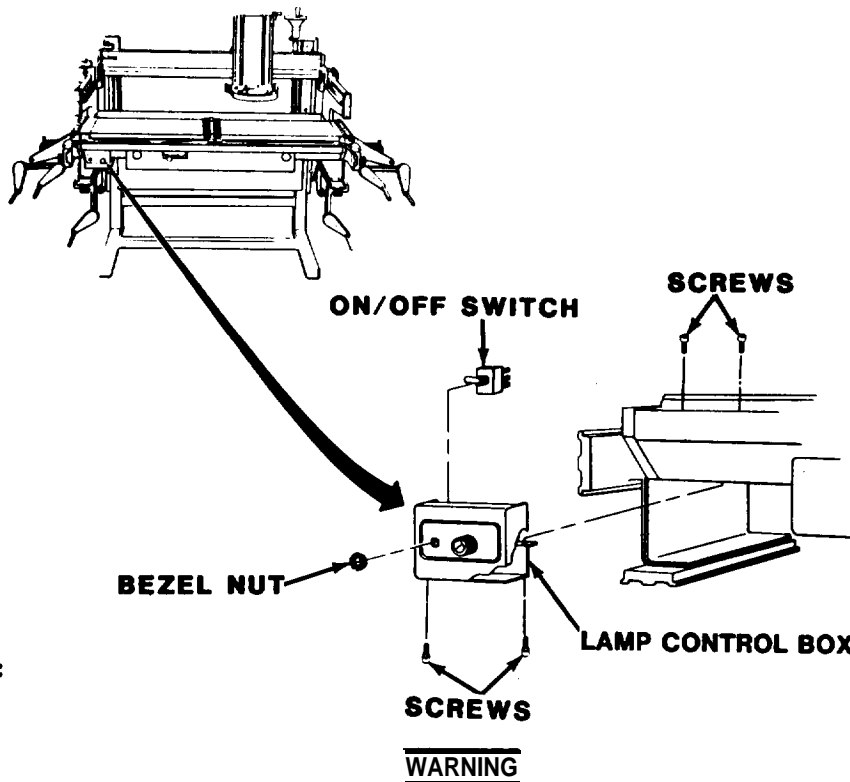
This section contains step-by-step instructions covering organizational maintenance procedures.

2-14.1 Replace ON/OFF Switch

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 7/64-in. socket-head screw key
7/16-in. combination box and open end wrench
Soldering gun

MATERIALS/PARTS: Toggle switch
Solder, item 87, appendix E



REMOVAL:

- a. Turn power OFF, and unplug power cord.
- b. Remove four socket-head screws, and move cover to expose rear of lamp control box.
- c. Remove bezel nut. Withdraw ON/OFF switch from back.

2-14.1 Replace ON/OFF Switch - Continued**NOTE**

Wiring is connected to cover and switches.

- d. Tag wires and desolder from ON/OFF switch.

INSTALLATION:

- a. Solder wires to new ON/OFF switch. Remove tags.
- b. Install new ON/OFF switch and secure with bezel nut.

NOTE

Make sure that wires are not loose, crossed, or disconnected before securing cover. Green (ground) wire is connected to cover screw.

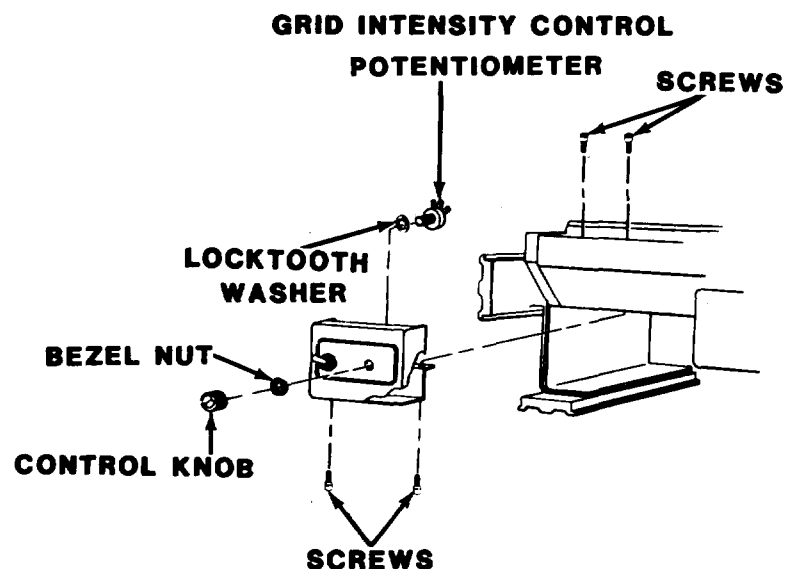
- c. Reinstall cover and secure with four socket-head screws.
- d. Plug in power cord, and turn power ON.

2-14.2 Replace Grid Intensity Control Potentiometer

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 7/64-in. socket-head screw key
 1/2-in. socket-head screw key
 1/2-in. combination box and open end wrench
 Soldering gun

MATERIALS/PARTS: Potentiometer
 Solder, item 87, appendix E



2-14.2 Replace Grid Intensity Control Potentiometer - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Remove four socket-head screws, and move cover to expose rear of lamp control box.
- c. Loosen two socket-head screws, and remove control knob.

NOTE

Wiring is connected to cover and switches.

- d. Remove bezel nut.
- e. Tag wires and desolder from potentiometer.
- f. Withdraw grid intensity control potentiometer and lock-tooth washer from rear of control box.

INSTALLATION:

- a. Solder wires to new grid intensity control potentiometer. Remove tags.
- b. Install potentiometer and lock-tooth washer and secure with bezel nut.
- c. Reinstall control knob and tighten two socket-head screws.

NOTE

Make sure that wires are not loose, crossed, or disconnected before securing cover. Green (ground) wire is connected to cover screws.

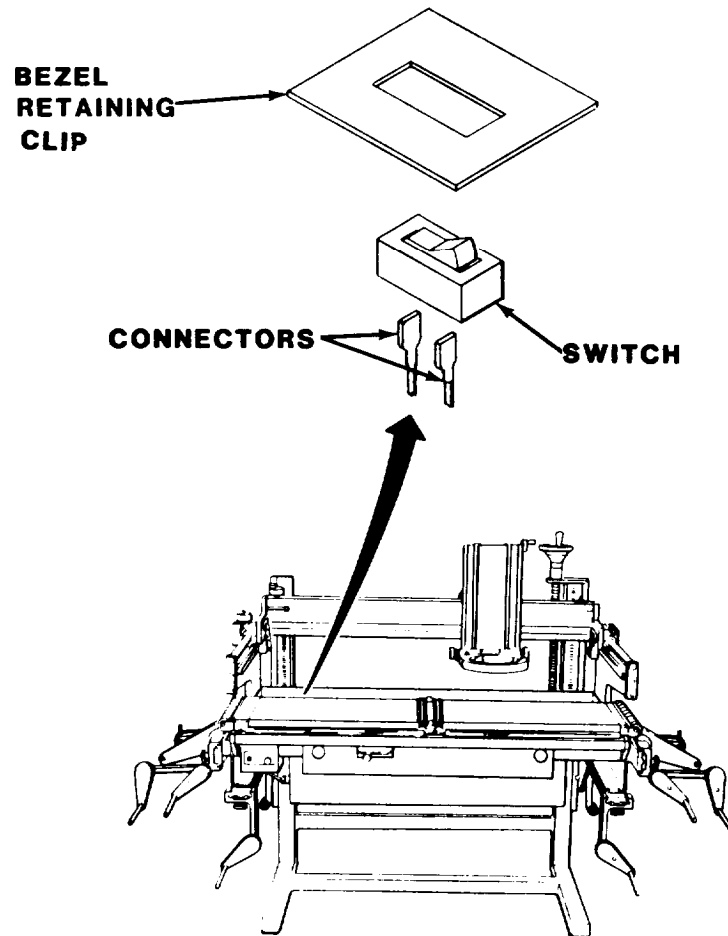
- d. Reinstall cover on lamp control box, and secure with four socket-head screws.
- e. Plug in power cord, and turn power ON.

2-14.3 Replace Main Power Switch

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-in. flat-tip screwdriver

MATERIALS/PARTS: Power switch



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Loosen two quick-disconnect screws, and remove front cover.
- c. Release switch from bezel retaining clip.
- d. Tag wires and disconnect from switch.

2-14.3 Replace Main Power Switch - Continued

INSTALLATION:

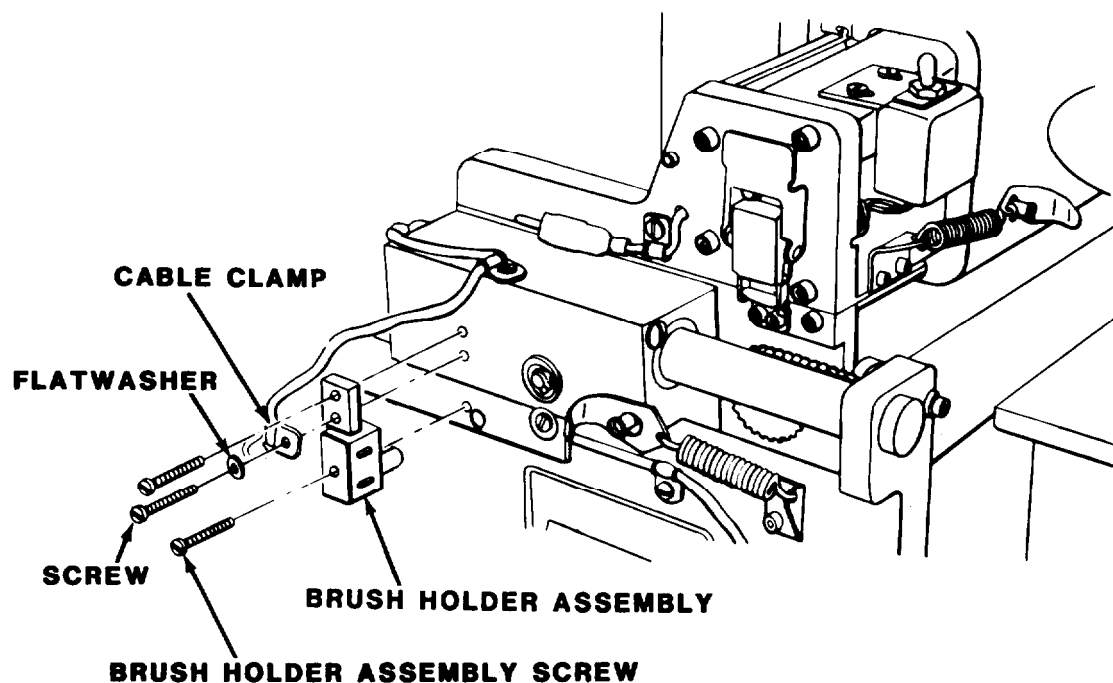
- a. Connect wires to new power switch. Remove tags.
- b. Install switch into bezel.
- c. Reinstall front cover, and secure with two quick-disconnect screws.
- d. Plug in power cord, and turn power ON.

2-14.4 Replace Brush

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 0.070 jeweler's screwdriver
9/64-in. flat-tip screwdriver
5/16-in. combination box and open end wrench
Soldering gun

MATERIALS/PARTS: Brush
Solder, item 87, appendix E



2-14.4 Replace Brush - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

NOTE

Two brush holder assemblies are used (X- and Y-axes). Procedure for replacement of either X- or Y-axis brushes is same.

- a. Turn power OFF, and unplug power cord.
- b. Remove screw, and flat washer from cable clamp adjacent to brush. Remove cable clamp.
- c. Remove screw, and lift brush holder assembly from contact strips.
- d. Carefully note parts relationship, and disassemble brush holder assembly.
- e. Desolder electrical connections to brush.

INSTALLATION:

- a. Solder electrical connections to new brush.
- b. Reassemble brush holder assembly.
- c. Aline brush holder assembly with mounting hole, and secure with screw.
- d. Reinstall cable clamp and flat washer and secure with screw.
- e. Plug in power cord, and turn power ON.

2-14.5 Replace Split-Stage Light Table

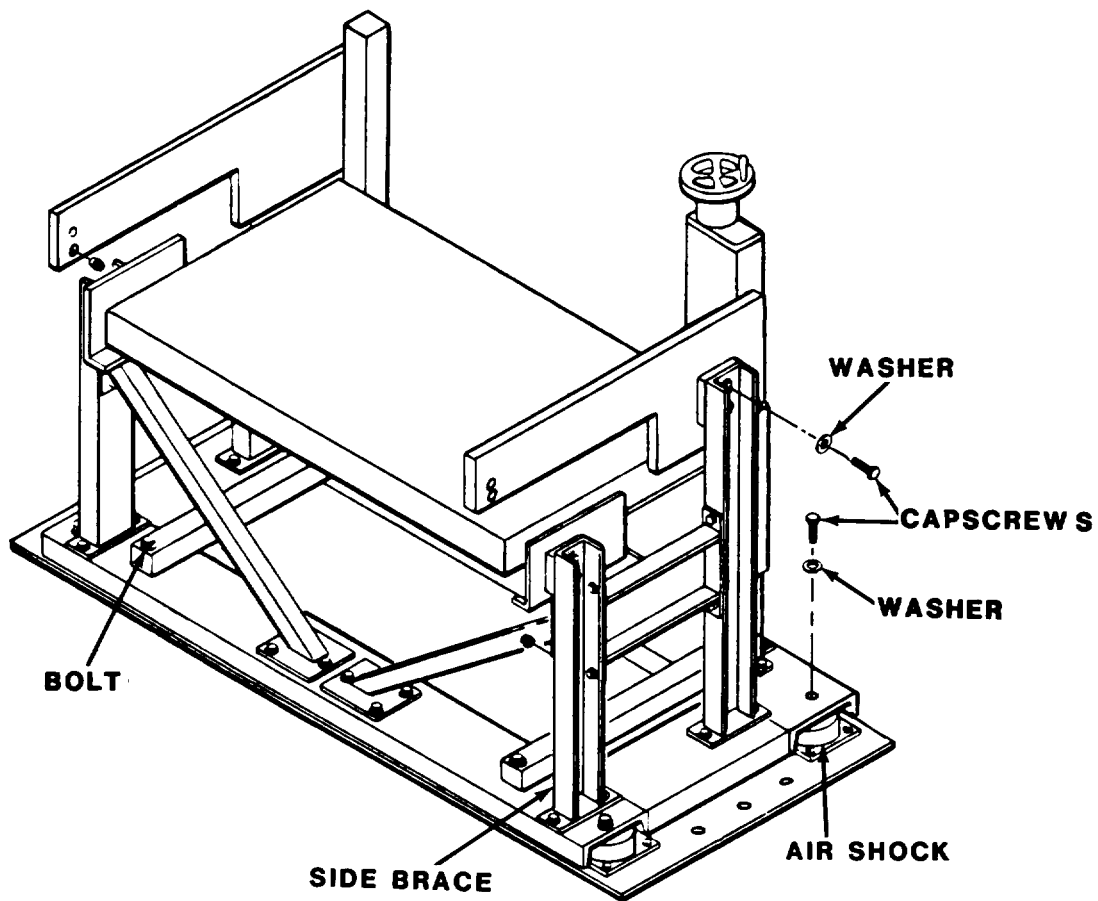
PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: Socket wrench set (1/2 in. drive)

MATERIALS/PARTS: Split-stage light table

REMOVAL:

- a. Turn power OFF, and unplug power cord.
- b. Coil and tape power cord.



2-14.5 Replace Split-Stage Light Table - Continued

- c. Deflate air shocks to allow access to capscrew. Remove four capscrews and washers from air shocks.
- d. Block table frame.
- e. Remove side braces.
 - (1) Remove 22 capscrews and washers from sides and base of table.
 - (2) Remove shims.
 - (3) Slide braces out from underneath table.
- f. Remove two bolts securing rear legs of table.
- g. Remove two bolts securing front legs of table.
- h. Slide defective table to center aisle and remove from van.

INSTALLATION:

- a. Install new table, and secure front legs with two bolts.
- b. Secure rear legs of table with two bolts.
- c. Reinstall shims and side braces, and secure with 22 capscrews and washers.
- d. Reinstall four washers and capscrews in air shocks. Inflate air shocks.
- e. Remove tape, and uncoil power cord.
- f. Plug in power cord, and turn power ON.

2-15 PREPARATION FOR STORAGE OR SHIPMENT.

In the event that the split-stage light table must be removed from the section for repair or replacement, refer to TM 740-90-1 for storage instructions.

Section V. DIRECT/GENERAL SUPPORT MAINTENANCE

2-16 REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT.

2-16.1 For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

2-16.2 Special tools, TMDE, and support equipment used in direct/general support maintenance of the split-stage light table are listed in the Repair Parts and Special Tools List (TM5-6675-326-24P) and in the Maintenance Allocation Chart (Appendix B of this manual).

2-16.3 Repair parts are listed and illustrated in the Repair Parts and Special Tools List (TM5-6675-326-24P) covering direct/general support maintenance for this equipment.

2-17 DIRECT/GENERAL SUPPORT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

There are no PMCS at the direct/general support level for the split-stage light table.

2-18 DIRECT/GENERAL SUPPORT TROUBLESHOOTING.

2-18.1 General

2-18.1.1 The table lists the common malfunctions which you may find during the operation or maintenance of the split-stage light table or its components. You should perform the tests/inspections and corrective actions in the order listed.

2-18.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 2-4. Direct/General Support Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. LIGHT GRIDS ARE TOO DIM OR TOO BRIGHT.	Measure light intensity to determine if high and low level potentiometers on card A1 or A2 are out of adjustment.	Adjust light grid intensity to 2500 footlamberts and 500 footlamberts (para 2-19.1)
2. Z-AXIS MOVEMENT IS SLUGGISH OR HARD TO MOVE	Test for free movement without binding	If movement binds or lugs, adjust and lubricate Z-axis as required (para 2-19.7).
3. LIGHT GRIDS LIGHT BUT INTENSITY WILL NOT CHANGE	Reverse connector to dimmer card.	
NOTE		
Dimmer card connector is not keyed and maybe reversed. If card is reversed, grid lamp will operate at maximum intensity, and lamp intensity will not change.		
Mark card and connector to indicate proper connection,		
Replace dimmer circuit card (para 2-19.8).		

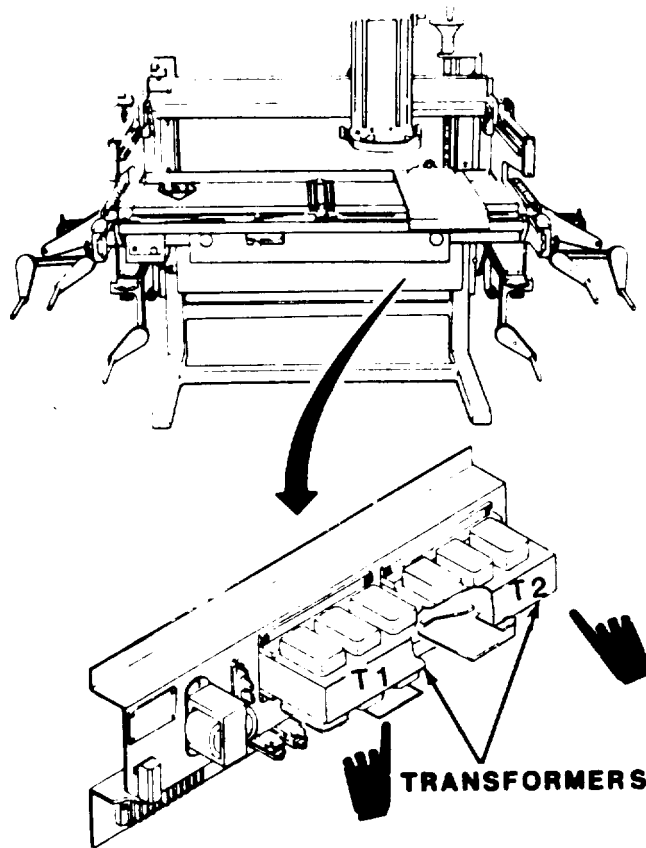
2-19 DIRECT/GENERAL SUPPORT MAINTENANCE PROCEDURES.

This section contains step-by-step instructions covering direct/general support maintenance procedures.

2-19.1 Adjust Light Grids

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41 B

TOOLS: Photometer (LM150A or equivalent)
9/64-in. flat-tip screwdriver



WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Loosen two quick-disconnect screws, and remove cover
- c. Check that wiring is tight and transformers are properly connected.

2-19.1 Adjust Light Grids - Continued**WARNING**

ELECTRICAL SHOCK

When voltage is applied to split-stage light table, 9000 v are present inside power box. This voltage is lethal.

- Use extreme caution when working inside power box while equipment is on. Touch only those components that you are specifically directed to touch. Failure to do so may result in death or serious injury.
 - Do not leave equipment unattended when power is on.
- d. Plug in power cord, and turn main power switch ON.
 - e. Set ON/OFF switch to ON.
 - f. Turn grid intensity control fully right (maximum intensity).
 - g. Allow 15 minutes for equipment to warm up. Do not leave equipment during warm-up period.
 - h. Set photometer at center of one view stage surface.

CAUTION

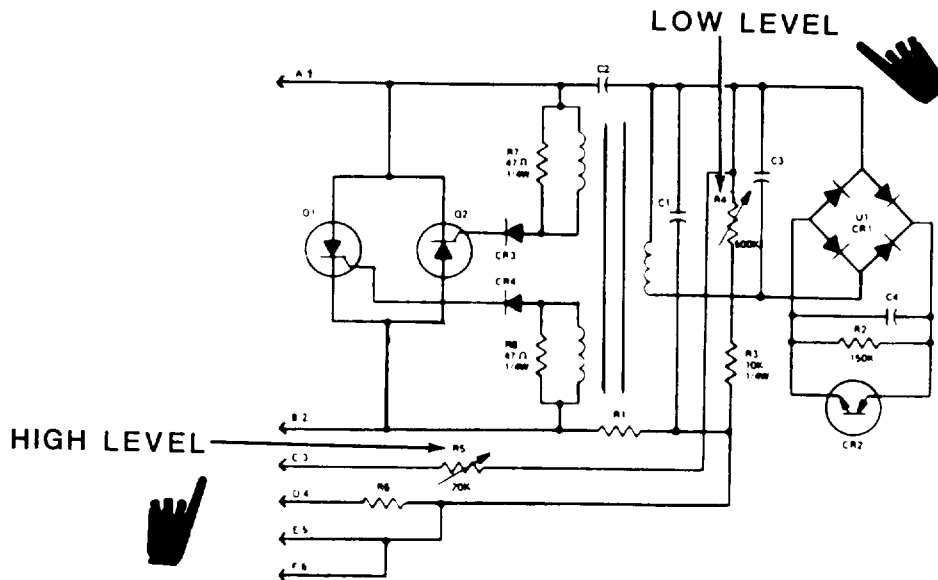
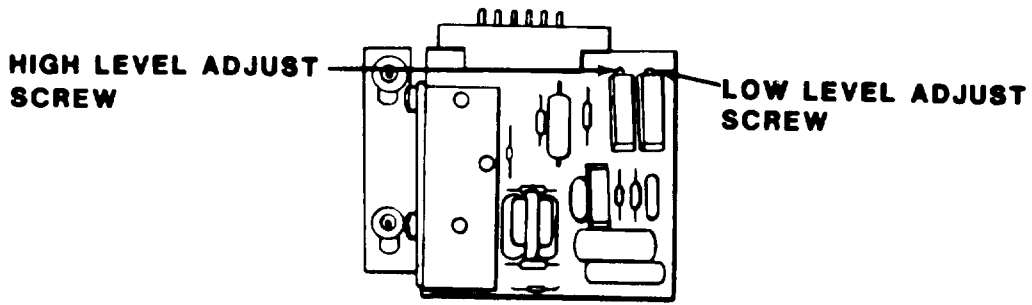
Do not leave light grid intensity set over 2500 fl. Intensity over 2500 fl will shorten grid lamp life.

NOTE

Poorly adjusted resistor may require many complete turns to adjust.

- i. Carefully turn screw in high level adjustment resistor to adjust light intensity to 2500 fl.

2-19.1 Adjust Light Grids - Continued

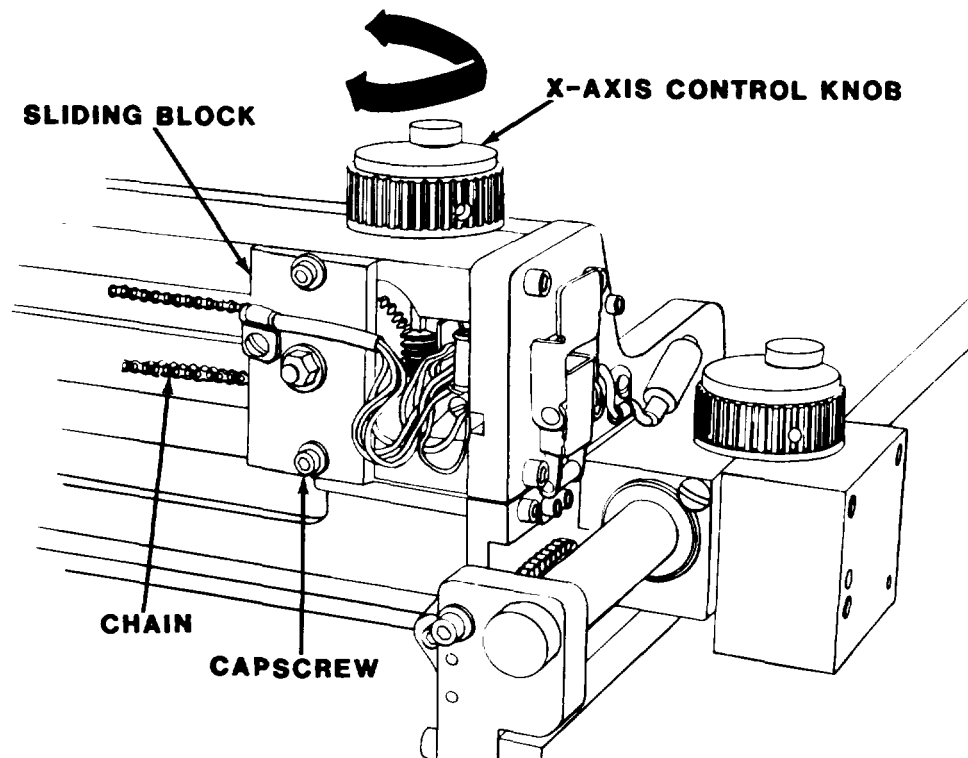


- j. Turn grid intensity control fully left.
- k. Carefully turn screw in low level adjustment resistor until light output is 500 fl.
- l. Recheck high intensity by turning grid intensity control fully right and readjust as required.
- m. Repeat procedure for other light grid. Adjust so that light grids are as equal as possible.
- n. Turn main power switch OFF and set ON/OFF switch to OFF.
- o. Reinstall cover, and tighten screws.

2-19.2 Adjust X-Axis Chain

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-in. socket-head screw key

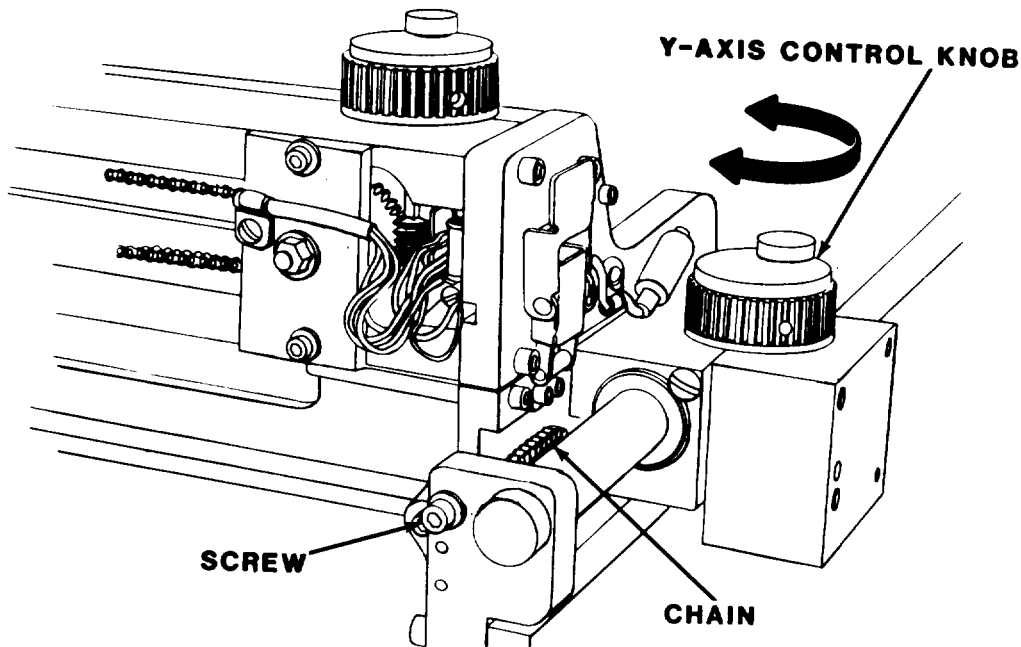


- a. Turn power OFF.
- b. Set carriage clutch switch to OFF.
- c. Loosen socket-head capscrews on sliding block until block can be moved.
- d. Move block with fingers toward end of carriage until chain is tight.
- e. Hold block with one hand and tighten socket-head capscrews.
- f. Turn power ON. Set carriage clutch switch to ON.
- g. Move optical mount to left and right with X-axis control knob. If motion is jerky, chain is too tight. If sprockets jump links, chain is too loose.
- h. Readjust as required until optical mount moves smoothly to left and right.

2-19.3 Adjust Y-Axis Chain

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-in. socket-head screw key



- a. Turn power OFF.
- b. Set carriage clutch switch to OFF.
- c. Turn screws on left and right side equal amounts. Turning to right tightens chain. Turning to left loosens chain.

NOTE

Seven spring washers are under each bolt. Amount of adjustment is limited.

- d. Turn power ON, and set carriage clutch switch to ON.
- e. Rotate Y-axis control knob to bring optical mount forward and back. Chain jumps sprockets if too loose. Carriage jerks if too tight.
- f. Readjust, if necessary.

2-19.4 Service Z-Axis

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

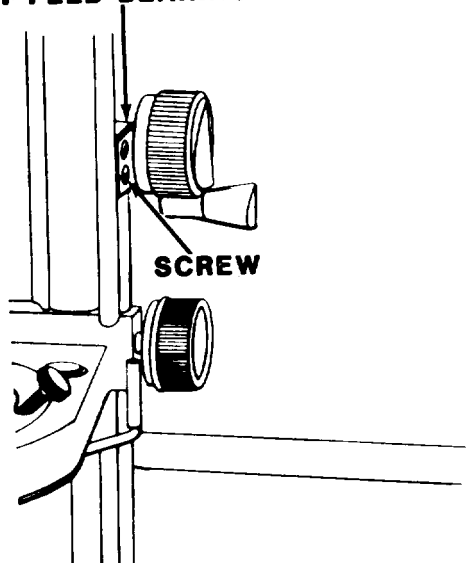
TOOLS: 9/64-in. flat-tip screwdriver

MATERIALS/PARTS: Bearing cleaner, item 11, appendix E
Cotton cloth, item 16, appendix E
General purpose lubricating oil, item 54, appendix E**WARNING**

ELECTRICAL SHOCK

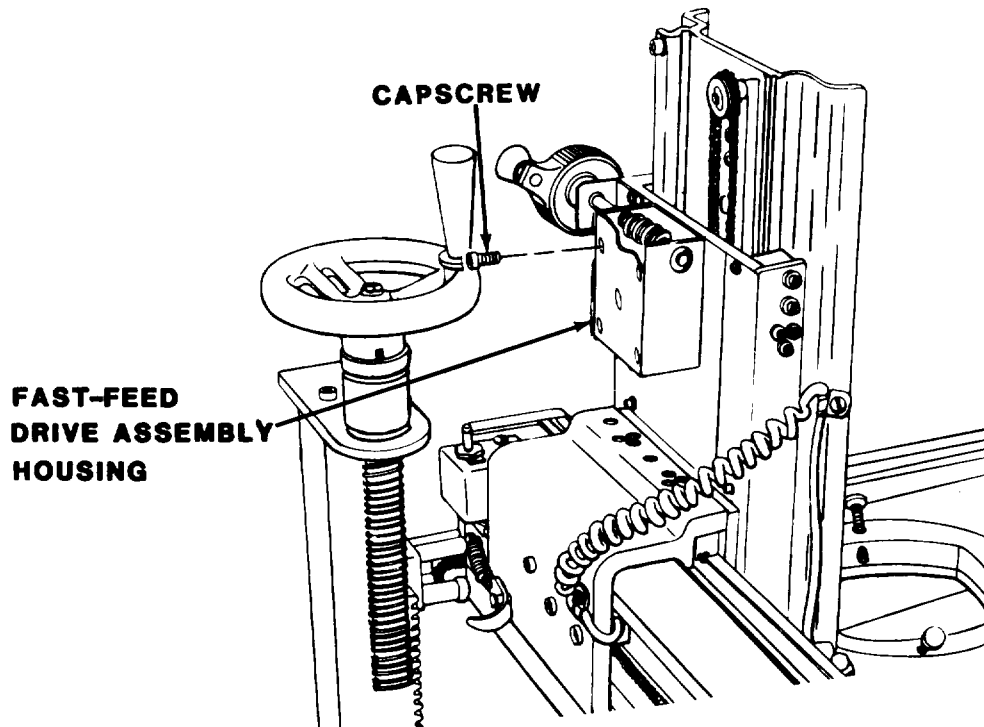
Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Lift optical mount to upper limit of travel.

FAST-FEED BEARING BRACKET

- c. Remove two screws to release fast-feed bearing bracket.

2-19.4 Service Z-Axis - Continued



- d. Remove four capscrews, and lift off fast-feed drive assembly housing.

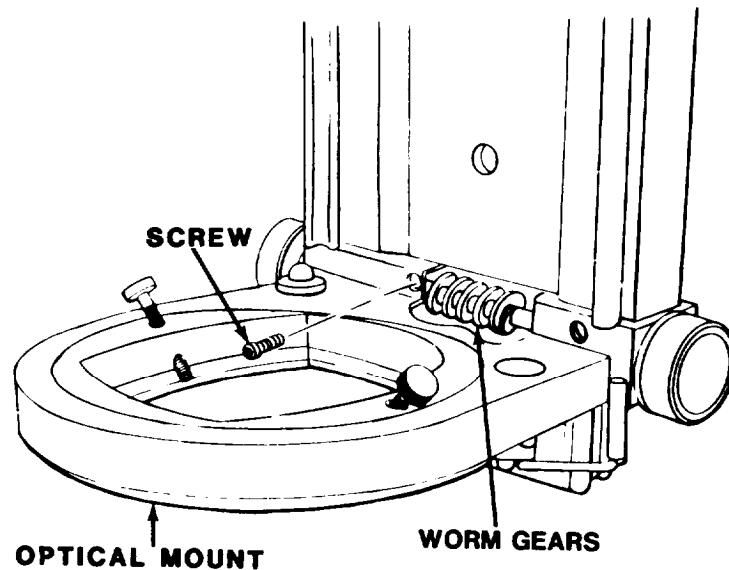
CAUTION

To prevent damage to film, do not allow lubricant or solvent to contact any surface other than that being serviced.

- e. Clean exposed worm gear and worm with bearing cleaner.
- f. Dry exposed worm gear and worm.
- g. Lubricate worm and worm gear. Wipe off excess.
- h. Reinstall fast-feed drive assembly. Secure with two screws. capscrews.
- i. Reinstall fast-feed bearing bracket. Secure with two screws.
- j. Remove optics and move optical mount to lowest limit of travel.

NOTE

Do not proceed unless collimation equipment is available.

2-19.4 Service Z-Axis - Continued

- k. Support optical mount while removing four screws.

CAUTION

Be careful not to drop bearings when lifting gear housing assembly.

- l. Lift optical mount and gear housing clear. Set on work surfaces.
- m. Disengage chain from sprocket.

NOTE

Do not lose any shims from sprocket shaft.

- n. Lift worm gear and attaching parts from split-stage light table, and set on work surface.
- o. Remove bearing caps, and lift worm free.
- p. Spray worm gears with bearing cleaner. Wipe up excess cleaner.
- q. Reinstall worm on worm gear, and reinstall bearing cap.

2-19.4 Service Z-Axis - Continued

- r. Reinstall worm gear assembly. Make sure that all shims are on sprocket shaft.
- s. Reengage chain and sprocket.
- t. Reinstall optical mount gear housing. Secure with four screws.
- u. Test motion by moving Z-axis coarse feed knob.
- v. Collimate optical mount (para 2-10.3).
- w. plug in power cord.

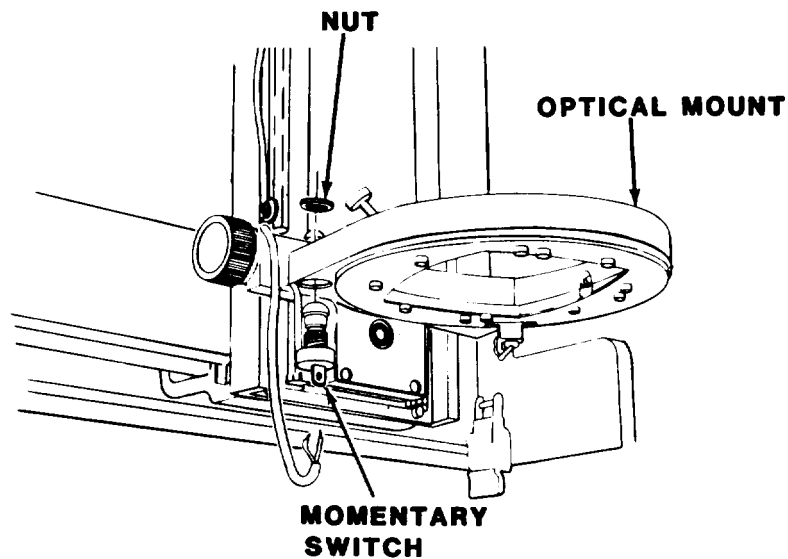
2-19.5 Replace Momentary Switch

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-in. flat-tip screwdriver
5/8-in. combination box and open end wrench
Soldering gun

MATERIALS/PARTS: Solder, item 87, appendix E
Momentary Switch

TEST EQUIPMENT: Multimeter



2-19.5 Replace Momentary Switch - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Raise optical mount to maximum height.
- c. Remove two cable clamps.
- d. Remove nut.
- e. Remove momentary switch and wires by withdrawing through bottom of optical mount.
- f. Tag wires and desolder from switch.

INSTALLATION:

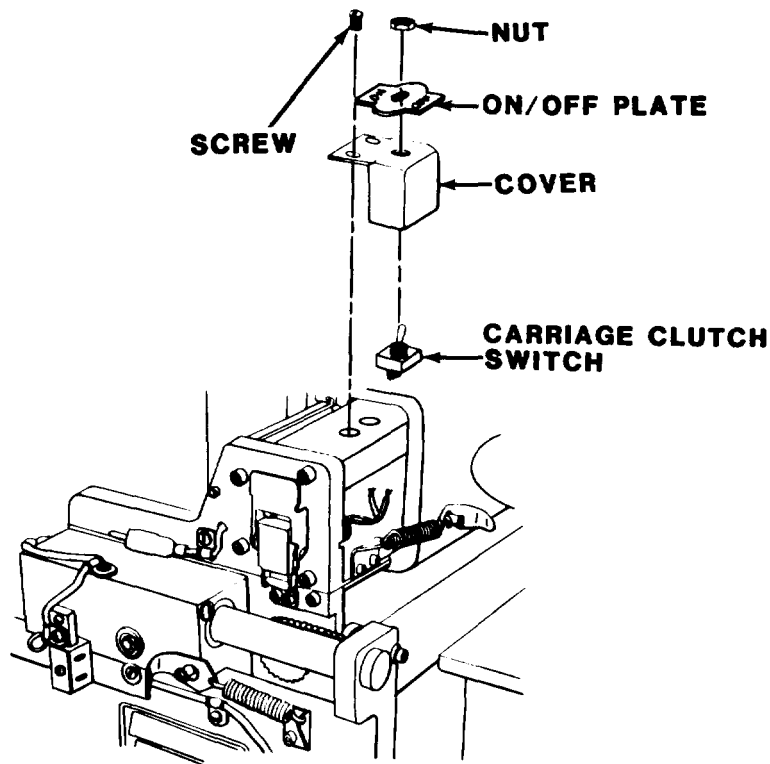
- a. Solder wires to new switch, and remove tags. Connect wires so that operation of switch interrupts continuity in line. Use multimeter to test continuity.
- b. Install momentary switch, and secure with nut. Avoid twisting body as nut is tightened.
- c. Reinstall two cable clamps.
- d. Plug in power cord, and turn power ON.

2-19.6 Replace Carriage Clutch Switch

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: Soldering gun
9/16-in. combination box and open end wrench
9/64-in. flat-tip screwdriver

MATERIALS/PARTS: Solder, item 87, appendix E
Carriage clutch switch



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Remove two screws.
- c. Lift cover and carriage clutch switch free.
- d. Remove securing nut, and withdraw carriage clutch switch from cover.
- e. Tag wires and desolder from switch.

2-19.6 Replace Carriage Clutch Switch - Continued

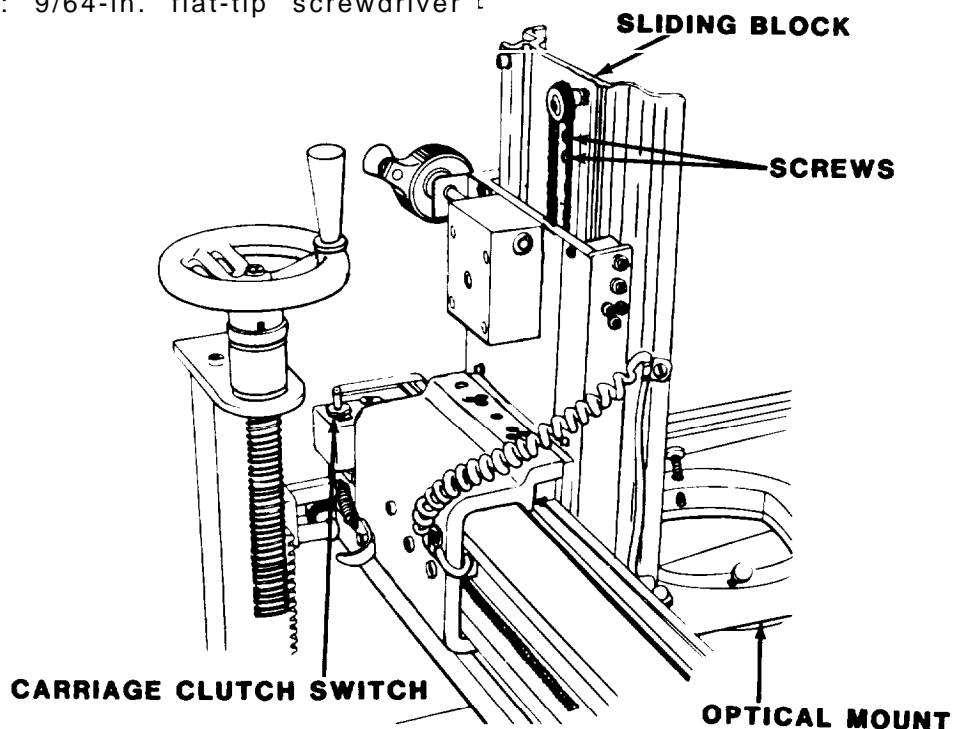
INSTALLATION:

- a. Solder wires to new carriage clutch switch, and remove tags.
- b. Install carriage clutch switch through hole in cover, and secure with nut.
- c. Reinstall cover, and secure with two screws.
- d. Plug in power cord, and turn power ON.

2-19.7 Adjust Z-Axis Chain

PERSONNE LREQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-in. flat-tip screwdriver □



- a. Turn power OFF, and set carriage clutch switch to OFF.
- b. Lift optical mount to point at least 2-1/2 in. (6.35 cm) above lower limit.
- c. Loosen two screws.
- d. Pull sliding block upward to tighten chain.
- e. Tighten screws to hold adjustment.

2-19.7 Adjust Z-Axis Chain - Continued

- f. Move optical mount from upper limits to lower limits and observe chain movement. If chain jumps sprockets, it is too loose. If optical mount does not move smoothly, chain is too tight.
- g. Readjust, if necessary.
- h. Mount stereoscope.
- i. Use Z-axis coarse feed knob to move optical mount up and down. Observe movement.

CAUTION

Remove stereoscope before readjusting chain. Weight of stereoscope may cause mount to drop and damage viewing stages.

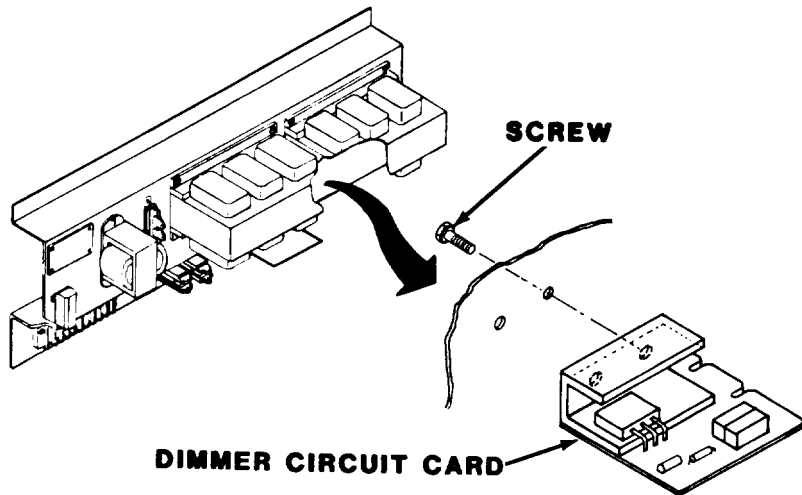
- j. Remove stereoscope.
- k. Readjust chain, if necessary.
- l. Turn power ON.

2-19.8 Replace Dimmer Circuit Card

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 5/32-in. offset flat-tip screwdriver
9/64-in. flat-tip screwdriver.

MATERIALS/PARTS: Heat sink compound, item 18, appendix E
Dimmer circuit card



2-19.8 Replace Dimmer Circuit Assembly - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Loosen two quick-disconnect screws, and remove front cover.
- c. Loosen two screws, and remove rear cover.
- d. Remove two screws, and remove defective dimmer circuit card.

INSTALLATION:

- a. Apply heat sink compound to dimmer circuit card mounting bracket.
- b. Install new dimmer circuit card by alining pins carefully and pressing into position. Secure with two screws.
- c. Reinstall rear cover, and tighten two screws.
- d. Reinstall front cover, and tighten two quick-disconnect screws.
- e. Plug in power cord.
- f. Turn power ON, and allow light grids to warm up.
- g. Adjust light grids (para 2-19.1).

2-19.9 Replace Transformers T1 and T2

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B
1 Terrain analyst MOS 81Q

TOOLS: 9/64-in. flat-tip screwdriver
Soldering gun

MATERIALS/PARTS: Solder, item 19, appendix E
Transformers T1 and T2.

REMOVAL:

WARNING

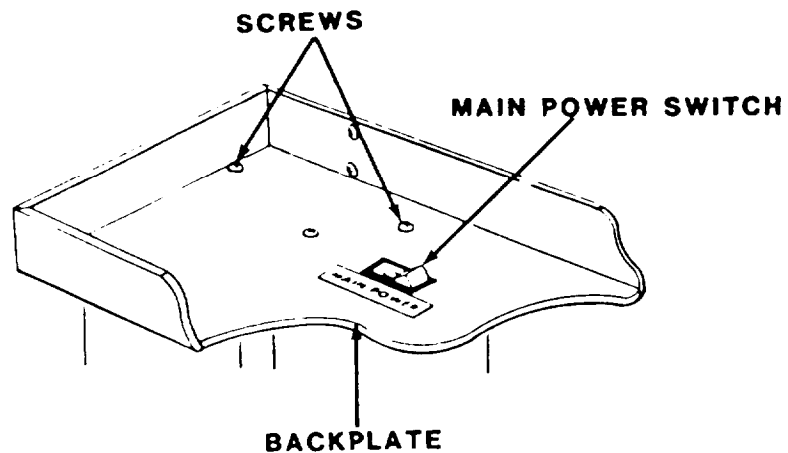
ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

NOTE

The same procedure is used to replace transformers T1 and T2.

- a. Turn power OFF, and unplug power cord.
- b. Loosen two screws, and remove front cover.



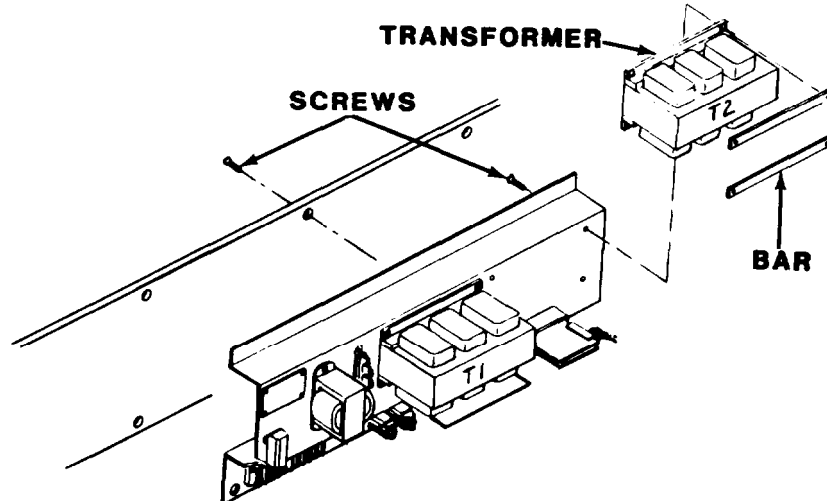
2-19.9 Replace Transformer - Continued

- c. Remove quick-disconnect from power panel.
- d. Remove main power switch from backplate by releasing switch from bezel retaining clip.

CAUTION

Power panel must be supported when screws are removed from backplate. Damage to equipment will result if power panel falls freely.

- e. Remove seven screws from main power switch backplate.
- f. Lower power panel.
- g. Remove two screws securing back cover.



- h. Tag wires and desolder from transformer.
- i. Remove four screws securing bars and transformer.

INSTALLATION:

- a. Reinstall bars on new transformer.
- b. Install new transformer and secure with screws.
- c. Solder wires, and remove tags. Check that all connections are tight.
- d. Raise power panel, and secure to main power switch backplate with seven screws.

2-19.9 Replace Transformer - Continued

- e. Reinstall main power switch and secure with bezel retaining clip.
- f. Reinstall quick-disconnect to power panel.
- g. Reinstall front and back covers, and secure with screws.
- h. Plug in power cord, and turn power ON.

2-19.10 Replace Fan

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B
1 Terrain analyst MOS 81Q

TOOLS: 9/64-in. flat-tip screwdriver
5/16-in. combination box and open end wrench
Wire cutters

MATERIALS/PARTS: Tie wrap, item 96, appendix E
Fan

REMOVAL:

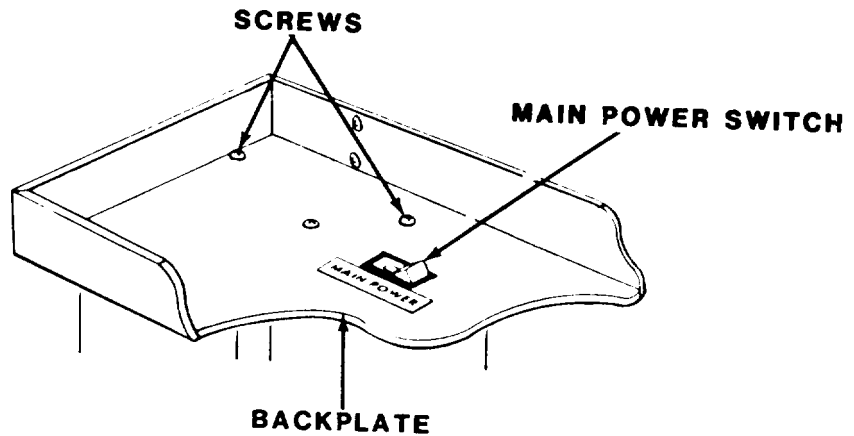
WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Loosen two screws, and remove connector from below fan.
- c. Remove quick-disconnect from power panel.

2-19.10 Replace Fan - Continued

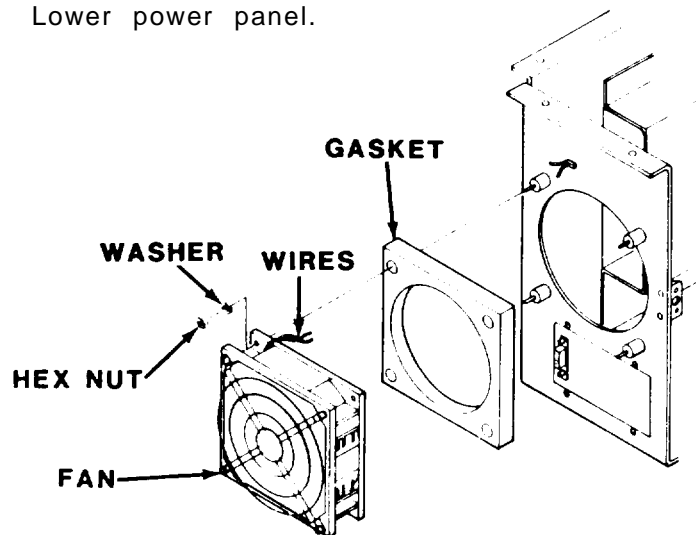


- d. Remove main power switch from backplate by releasing switch from bezel retaining clip.

CAUTION

Power panel must be supported when screws are removed from backplate. Damage to equipment will result if power panel falls freely.

- e. Remove seven screws from main power switch backplate.
- f. Lower power panel.



- g. Disconnect wires from bottom of terminals 4 and 6.
- h. Cut wire ties on terminal assembly.
- i. Cut wires at fan assembly as close as possible to fan. Discard old wiring.

2-19.10 Replace Fan - Continued

- j. Remove four hex nuts and washer securing fan.
- k. Remove defective fan. Retain sponge gasket.

INSTALLATION:

- a. Thread wires for new fan through housing. Attach terminal lug of white wire to terminal 6 and brown wire to terminal 4.
- b. Install new fan with old gasket in place. Secure with four hex nuts and washers.
- c. Raise power panel, and secure to main power switch backplate with seven screws.
- d. Reinstall main power switch, and secure with bezel retaining clip.
- e. Reinstall quick-disconnect to power panel.
- f. Reinstall connector below fan, and secure with two screws.
- g. Plug in power cord, and turn power ON.

2-19.11 Redate Light Grid Assembly

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

■ TOOLS: No. 6 socket-head screw key
3/16-in. flat-tip screwdriver
9/64-in. flat-tip screwdriver
Diagonal cutting pliers
Soldering gun

MATERIALS/PARTS: Light grid assembly
Filament tape, item 93, appendix E
■ Solder, item 19, appendix E

REMOVAL:

WARNING

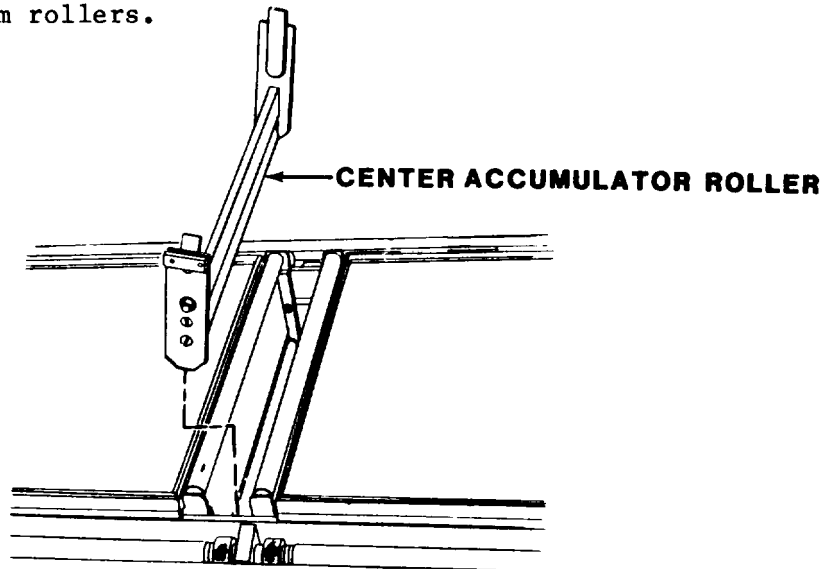
ELECTRICAL SHOCK

Unplug power cord before servicing the split-stage light table. Failure to do so may result in death or serious injury.

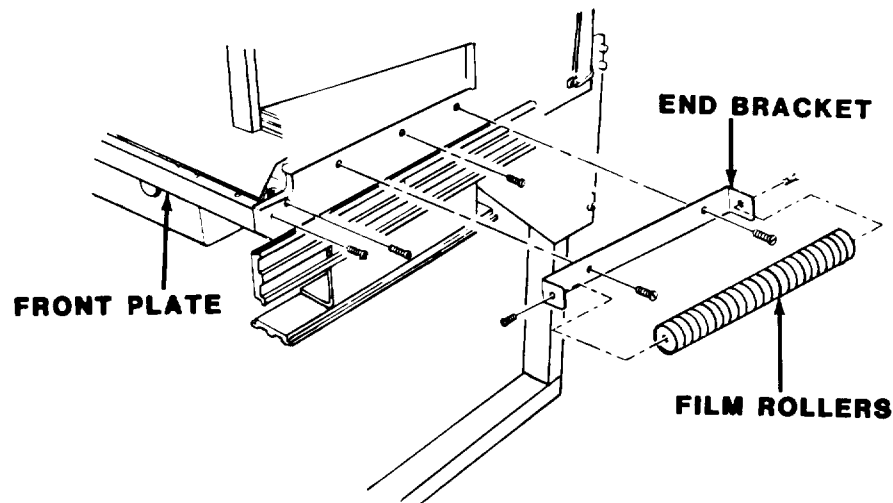
- a. Turn power OFF, and unplug power cord.

2-19.11 Replace Light Grid Assembly - Continued

- b. Loosen two screws, and remove front cover from power panel.
- c. Retract masking assemblies into their wells by rotating knurled knobs.
- d. Remove screw from end of each film roller assembly. Remove **film rollers**.

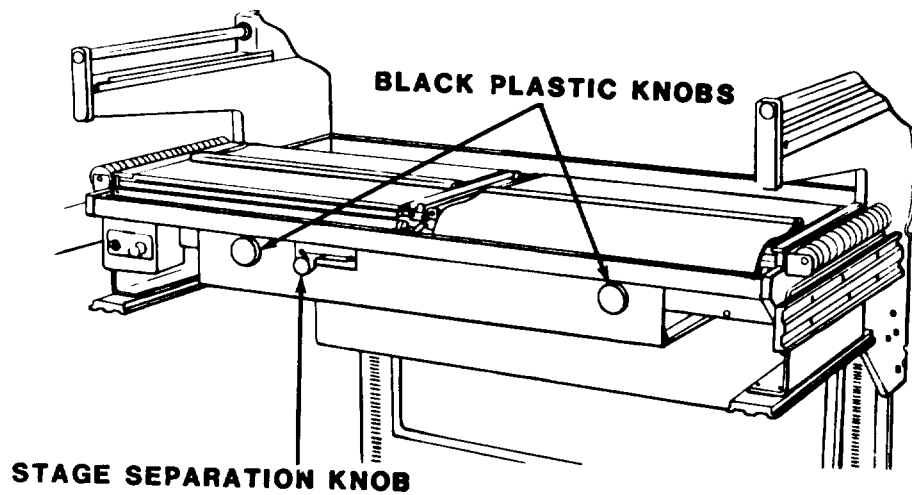


- e. Remove center accumulator roller from between view stages by pinching tabs and lifting free.

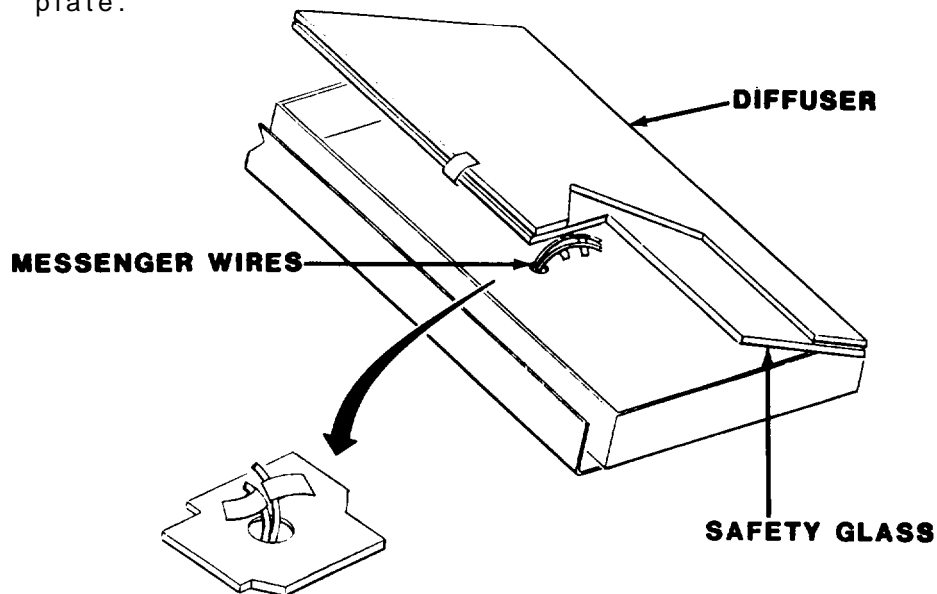


- f. Remove screws securing end brackets and plates. Note two screws are on left view stage and three screws are on right view stage.

2-19.11 Replace Light Grid Assembly - Continued



- g. Loosen two knobs to allow bottom plate to fall free.
- h. Remove two screws and stage separation plate to locate access hole. Remove screw and stage separation knob.
- i. Remove four socket-head screws securing ON/OFF switch assembly.
- j. Remove two socket-head capscrews to release front plate from end plates.
- k. Remove six socket-head screws and washers securing front plate.



- 1. Move defective grid until wires are accessible inside light box. Tag and cut red wires. Disconnect green wire.

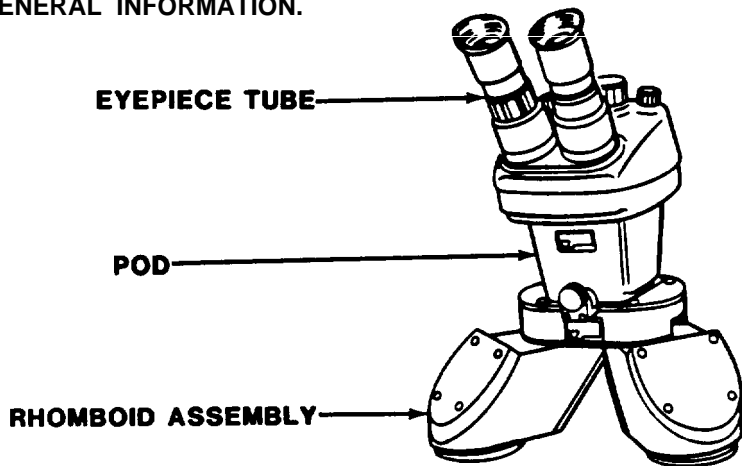
2-19.11 Replace Light Grid Assembly - Continued

INSTALLATION:

- a. Loosen two socket-head capscrews and washers and remove middle roller as an assembly from view stage. Attach to new grid assembly.
- b. Splice red wires from new grid assembly to exposed red wires from defective assembly. Thread new wires to transformer terminal.
- c. Desolder old wires from terminal and remove from splice. Solder new wires to transfer terminal and remove tags. Attach green wire to ground.
- d. Ground ON/OFF switch to table chassis. Plug in power cord. Turn main power switch ON.
- e. Turn ON/OFF switch to ON. Check that grid assembly lights. Turn main power switch to OFF. Unplug power cord.
- f. Reinstall front plate and secure with six socket-head screws and washers.
- g. Reinstall ON/OFF switch assembly. Secure with four socket-head screws.
- h. Aline stage separation knob and view stage. Secure with screw.
- i. Reinstall stage separation plate, and secure with two screws.
- j. Reinstall end plates and brackets. Secure to left view stage with two screws. Secure to right view stage with three screws.
- k. Reinstall center accumulator roller.
- l. Raise bottom plate, and secure with two knobs.
- m. Reinstall film rollers. Secure with screw on end of each film roller.
- n. Plug in power cord, and turn power ON.
- o. Adjust light grid intensity (para 2-19.1).
- p. Reinstall front cover on power panel and tighten two screws.
- q. Collimate split-stage light table (para 2-10.3).

CHAPTER 3
ZOOM STEREOSCOPE 95R
Section I. INSTRODUCTION

3-1 GENERAL INFORMATION.



3-1.1 Scope

Model Number and Equipment Name:

Model 95R Zoom Stereoscope

Purpose of Equipment: Component of photointerpretation system. Provides stereoscopic (three-dimensional) view of photographs.

3-2 EQUIPMENT DESCRIPTION AND DATA.

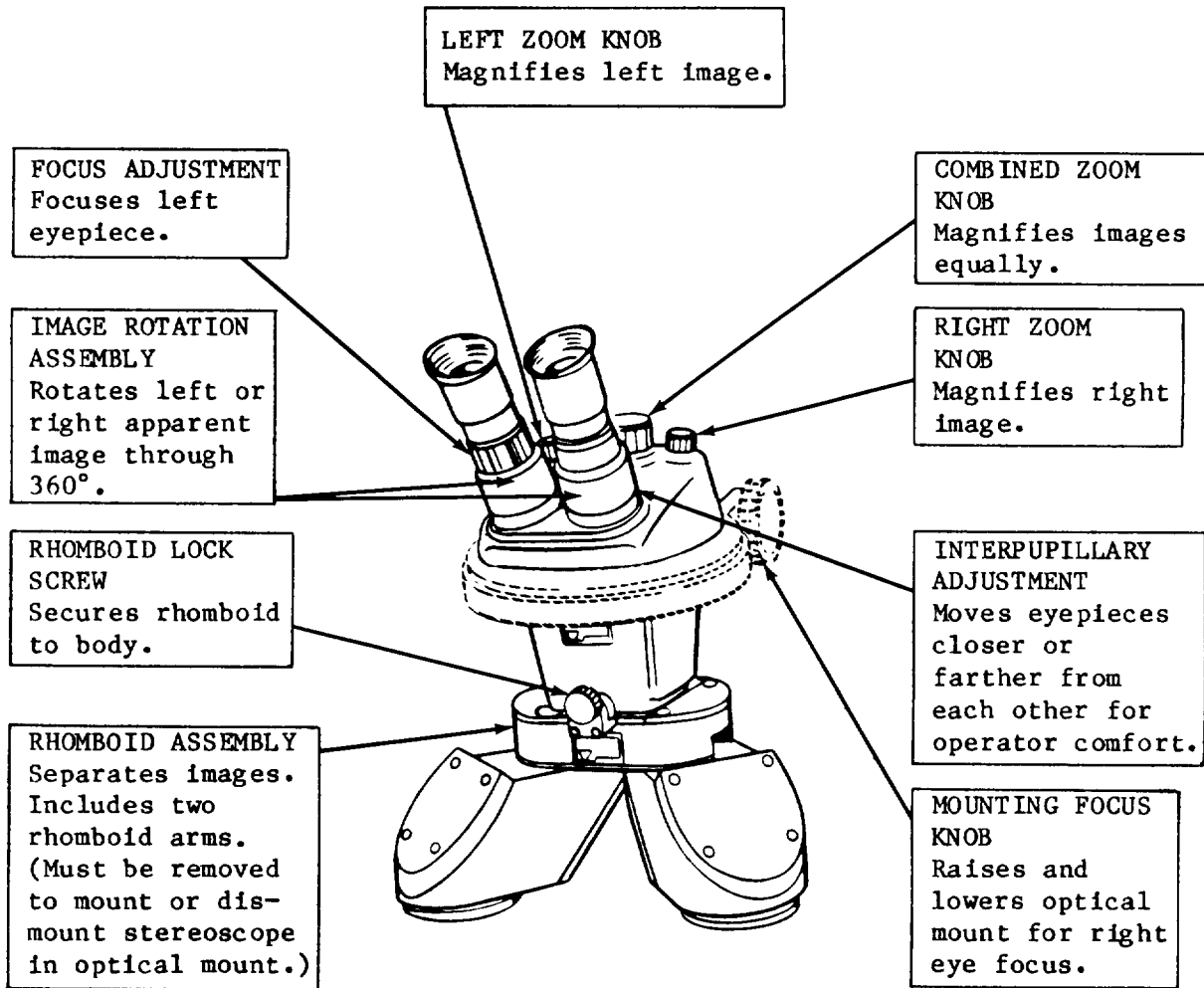
3-2.1 Equipment Characteristics, Capabilities, and Features. Magnifies strip, film clip, or stereo-pair photographs. Creates an apparent three-dimensional model of the photographs for interpretation by operator. Optically rotates randomly oriented, uncut film for optimum stereo images.

3-2.2 Equipment Data

Width	11 in. (27.94 cm)
Depth	9 in. (22.86 cm)
Height	12 in. (30.48 cm)
Weight	5.5 lbs (2.5 kg)
Magnification	2.5X to 10.6X
Field of View	3.08 in. (7.82 cm) to 0.37 in. (0.94 cm)

Section II. OPERATING INSTRUCTIONS

3-3 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS.



3-4 OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

3-4.1 General. The zoom stereoscope must be regularly inspected to find and correct defects.

3-4.1.1 Before You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your BEFORE (B) PMCS.

3-4.1.2 While You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your DURING (D) PMCS.

3-4.1.3 After You Operate. Be sure to perform your AFTER (A) PMCS.

3-4.1.4 If Your Equipment Fails To Operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

3-4.2 PMCS Procedures

3-4.2.1 PMCS are designed to keep the equipment in good working condition by performing periodic service tasks.

3-4.2.2 Service intervals provide you, the operator, with time schedules that determine when to perform specified service tasks.

3-4.2.3 The "Equipment Is Not Ready/Available If" Column is used for identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.

3-4.2.4 If your equipment fails to operate after PMCS is performed, immediately report this condition to your supervisor.

3-4.3 PMCS Columnar Entries

3-4.3.1 Item Number Column. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for "TM number" Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.

3-4.3.2 Interval Column. This column determines the time period designated to perform your PMCS.

3-4.3.3 Item To Be Inspected and Procedures Column. This column lists functional groups and their respective assemblies and subassemblies as shown in the Maintenance Allocation Chart (Appendix B). The appropriate check or service procedure follows the specific item to be inspected.

3-4.3.4 Equipment Is Not Ready/Available If: Column. This column indicates the reason or cause why your equipment is not ready/available to perform its primary mission.

Table 3-1. Operator Preventive Maintenance Checks and Services

B – Before Operation

Item No.	Interval	ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	<div> </div> <ul style="list-style-type: none"> <li>● RHOMBOID ARMS. Check for freedom of movement. <li>● EYEPIECE TUBES. Check for freedom of movement. 	<p>Rhomboid arms are jammed or broken.</p>

Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

B – Before Operation

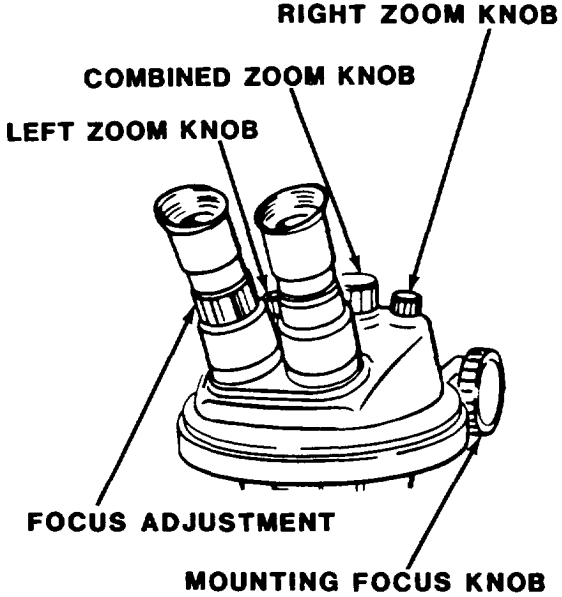
Item No.	Interval	ITEM TO BE INSPECTED	Equipment Is Not Ready/Available If:
	B	PROCEDURE	
3	●	 <p>EIGHT, LEFT, AND COMBINED ZOOM KNOBS. Turn knobs fully to right. Pull combined zoom knob up. Rotate left and right zoom knobs. Observe left and right images change size. Turn knobs fully to right. Adjust knobs until images are equal in size.</p>	Images do not change size or cannot be matched in size.
4	●	<p>MOUNTING FOCUS KNOB AND FOCUS ADJUSTMENT. Move mounting focus knob on optical mount until right eye image is clearly focused. Move focus adjustment on left eyepiece to focus left eye image.</p>	Unable to focus right image.

Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

B- Before Operation

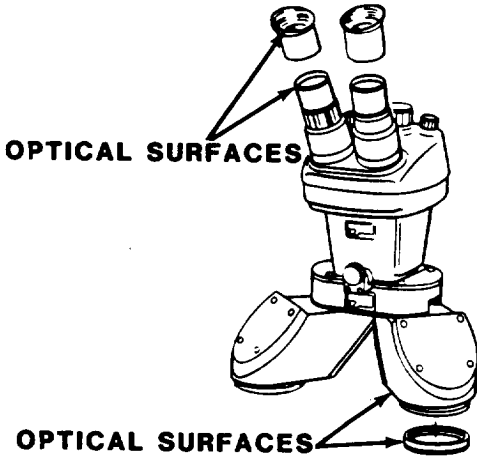
Item No.	Interval	ITEM TO BE INSPECTED	Equipment Is Not Ready/Available If:
	B	PROCEDURE	
5	●	 <p style="text-align: center;">CAUTION</p> <p>Dirt and dust on optical surfaces will hinder equipment's performance.</p> <ul style="list-style-type: none"> ● Do not wipe optical surfaces until dust and foreign matter have been removed. ● Do not touch optical surfaces with bare fingers. ● Do not use lens tissue containing silicone to clean optical surfaces. <p>OPTICAL SURFACES. Use watchmaker's blower to remove all dust, dirt, and foreign matter from exposed optical surfaces. Slightly dampen lens tissue with lens cleaner.</p>	

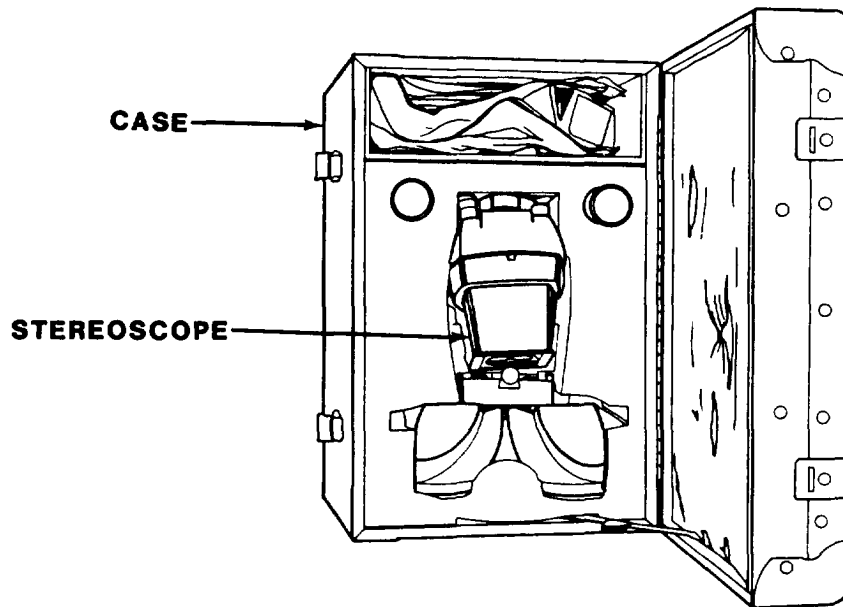
Table 3-1. Operator Preventive Maintenance Checks and Services - Continued

B – Before Operation

Item No.	Interval	ITEM TO BE INSPECTED	Equipment Is Not Ready/Available If:
	B	PROCEDURE	
5 (cont)		Gently wipe exposed optical surfaces. Use circular motion starting from center of glass and working to edge. Use new tissue for each surface. Dry cleaned optical surface with fresh lens tissue, using circular motion starting at center and working to edge. Clean internal mirror surfaces of rhomboid assembly with cotton swabs. Do not attempt to clean remaining internal mirror surfaces.	

3-5 OPERATION UNDER USUAL CONDITIONS

3-5.1 Assembly and Preparation for Use



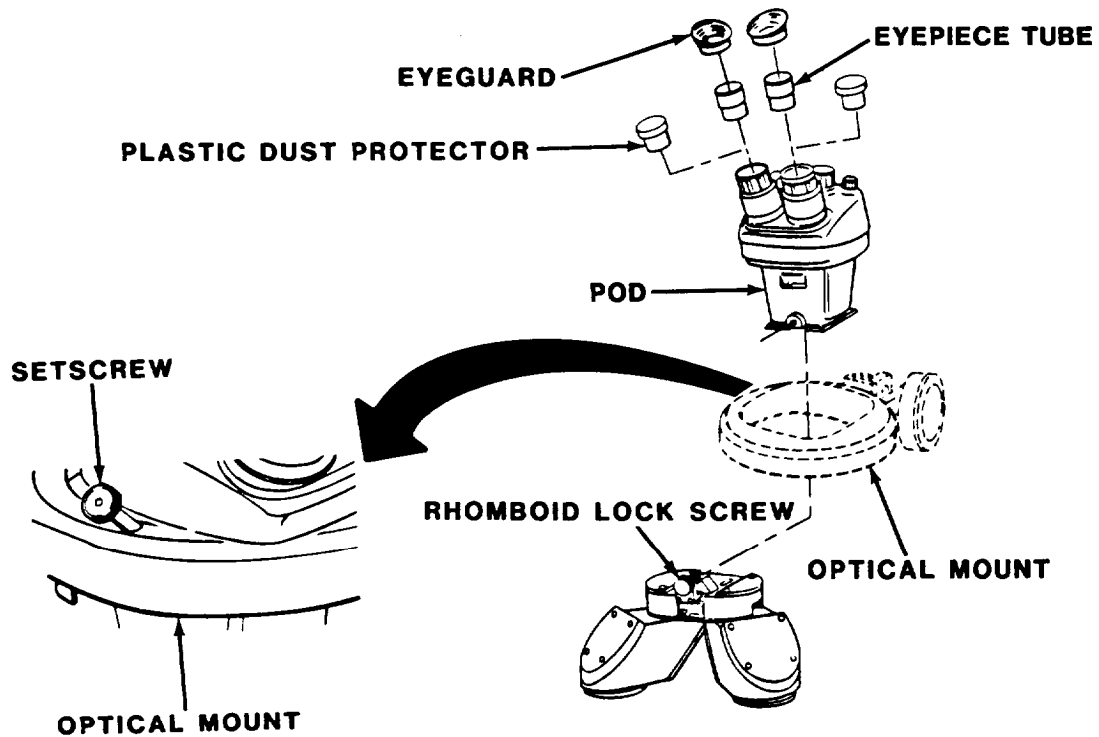
- a. Remove stereoscope case from storage and place on hard surface.

CAUTION

Dirt and dust on optical surfaces will hinder equipment's performance.

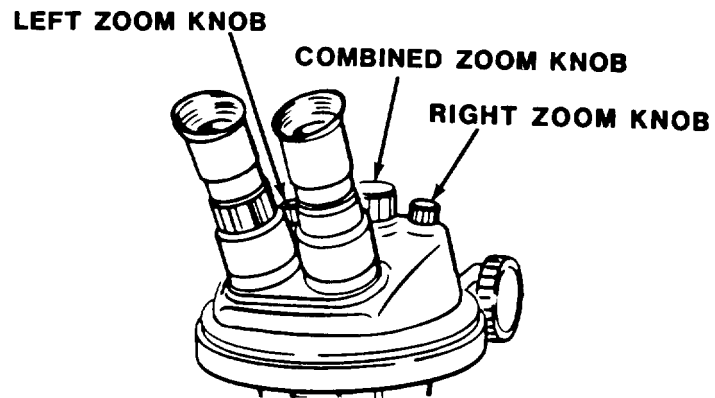
- Do not touch optical surfaces with bare fingers.
- Do not wipe optical surfaces until dust and foreign matter have been removed.

- b. Remove stereoscope from case.

3-5.1 Assembly and Preparation for Use - Continued

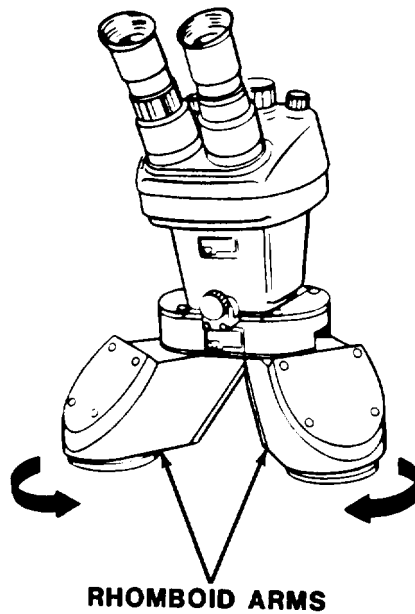
- c. Place pod into optical mount with eyepiece holes toward operator.
- d. Lock pod into optical mount by tightening setscrews.
- e. Aline rhomboid dovetail on pod. Slide rhomboid on to pod until rhomboid lock screw contacts hole.
- f. Secure rhomboid to pod by turning rhomboid lock screw to right until finger tight.
- g. Select either 10X (short) or 20X (long) eyepiece tubes from case and place on work surface.
- h. Remove two plastic dust protectors from eyepiece holes in pod. (Store dust protectors for reuse.) Insert eyepieces into eyepiece holes.
- i. Install eyeguards, if desired.

3-5.2 Operating Procedures

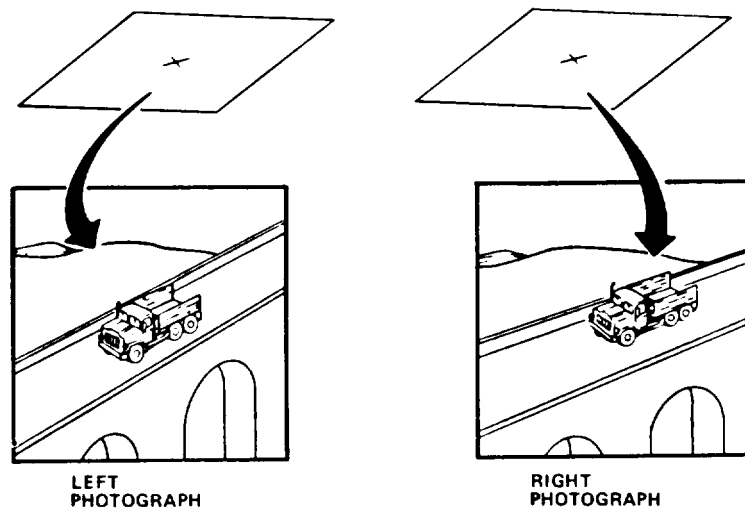


3-5.2.1 Focus

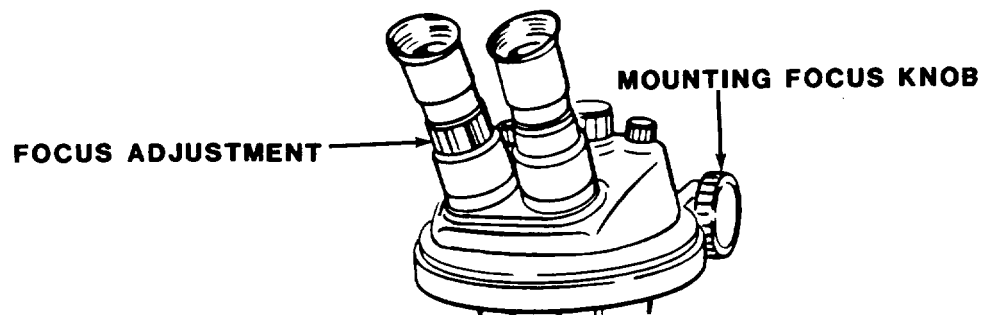
- a. Set right and left individual zoom knobs and combined zoom knob to their midpoint positions.



- b. Swing rhomboid arms together to minimum separation. Place a stereo pair of photographs under rhomboid arms on work surface.

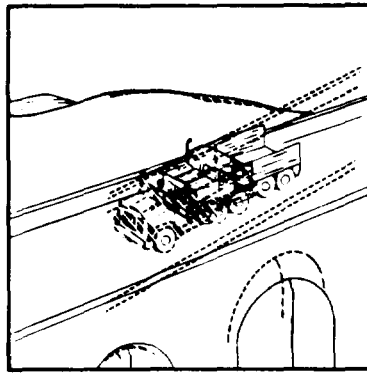
3-5.2.1 Focus - Continued

- c. Adjust rhomboid arms so that object in left photograph is seen by left eye and identical object in right photograph is seen by right eye.

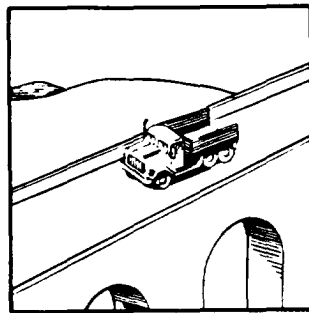


- d. Turn mounting focus knob to obtain clear vision in right eye. Adjust focus adjustment to obtain clear vision in left eye.
- e. Move eyepiece tubes toward or away from each other until two fields of view merge. (Check by closing right, then left eye; field should be completely visible without head movement.)

3-5.2.2 Change Magnification



- a. Set all zoom knobs to same setting. (Photographs are same scale.)
 - (1) Rotate zoom knobs fully to right. Pull up combined zoom knob.
 - (2) Set combined zoom knob to full right and push down.
 - (3) Rotate combined zoom knob to change magnification.
- b. Change image size. (Right and left photographic scales are different.)
 - (1) Lift combined zoom to uppermost limit.
 - (2) Adjust left and right zoom knobs until photographic images are same size.

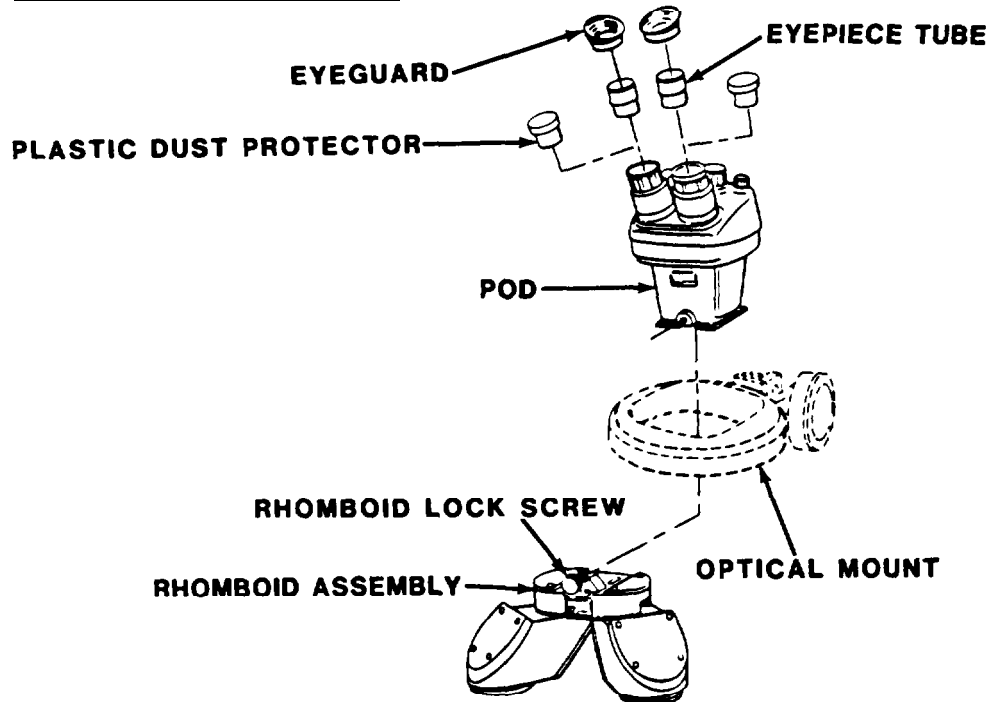


- (3) Adjust each image using pod controls, and rotate each image with image rotation assembly. When images are equal in size and rotation, the images merge together in an apparent three-dimensional object. Push combined zoom control knob down.

3-5.2.2 Change Magnification - Continued

- c. Install attachment lenses (if required). The 2X attachment lenses double the magnification and halve the field of view.

3-5.3 Preparation for Movement



CAUTION

- Internal components of zoom stereoscope are precisely aligned. Instrument must be protected from shock, jolts, and sudden or extreme temperature changes. Damage to equipment or misalignment may occur. When not in use, zoom stereoscope should be stored in transport case.
 - Do not touch optical glass surfaces with bare fingers. Fingerprints will cause images to blur.
- a. Place transport case on work surface.
 - b. Remove eyeguards (if installed) and store in case.
 - c. Remove eyepiece tubes, and inspect lenses for dirt, dust, or smudges. Clean, if dirty. Store in transport case.

3-5.3 Preparation for Movement - Continued

CAUTION

Failure to use dust protectors may result in loss of optical properties or mechanical problems.

- d. Place plastic dust protectors in eyepiece tube holes.
- e. Loosen rhomboid lock screw by turning to left until screw threads are clear of pod.
- f. Slide rhomboid free of pod and place rhomboid in transport case.
- g. Unlock pod from optical mount by loosening setscrews and lift free.
- h. Place stereoscope in case. Be sure all components are in case. Secure case and store in designated space.

Section III. OPERATOR MAINTENANCE

3-6 LUBRICATION INSTRUCTIONS.

This equipment does not require periodic lubrication.

3-7 OPERATOR TROUBLESHOOTING PROCEDURES.

Troubleshooting procedures at the operator level are limited to cleaning of optical glass surfaces to obtain clear vision or improve optical performance. Failure of optical system requires the zoom stereoscope 95R to be exchanged for an instrument in proper working order.

Section IV. ORGANIZATIONAL MAINTENANCE

3-8 There are no assigned organizational maintenance tasks for this equipment.

3-9 PREPARATION FOR STORAGE OR SHIPMENT.

In the event that the zoom stereoscope must be removed from the section for repair or replacement, refer to TM 740-90-1 for storage instructions.

Section V. DIRECT/GENERAL SUPPORT MAINTENANCE

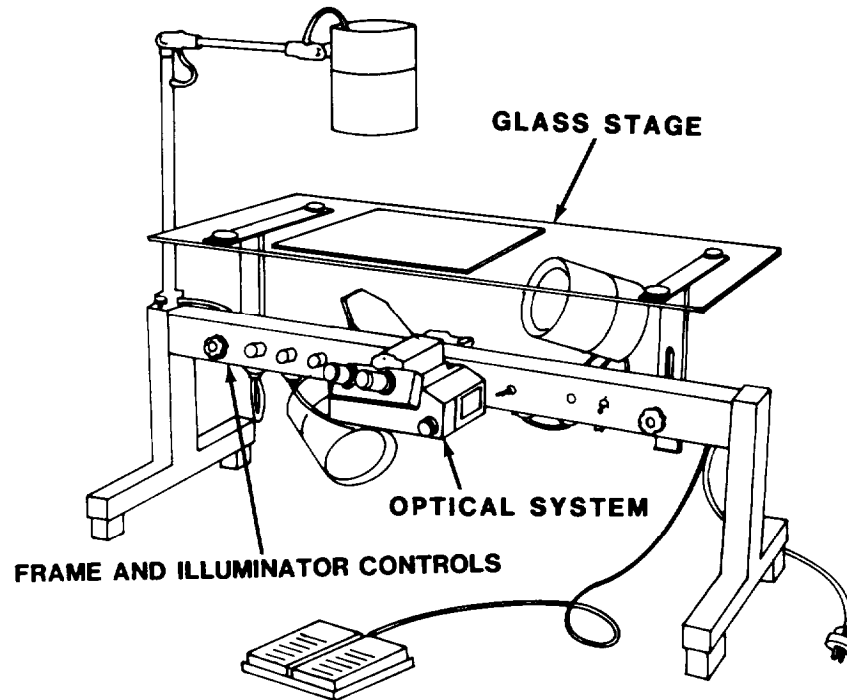
3-10 There are no assigned direct/general support maintenance tasks for this equipment.

CHAPTER 4

ZOOM TRANSFER SCOPE (ZT4-H)

Section I. INTRODUCTION

4-1 GENERAL INFORMATION.

4-1.1 Scope

Model Number and Equipment Name:

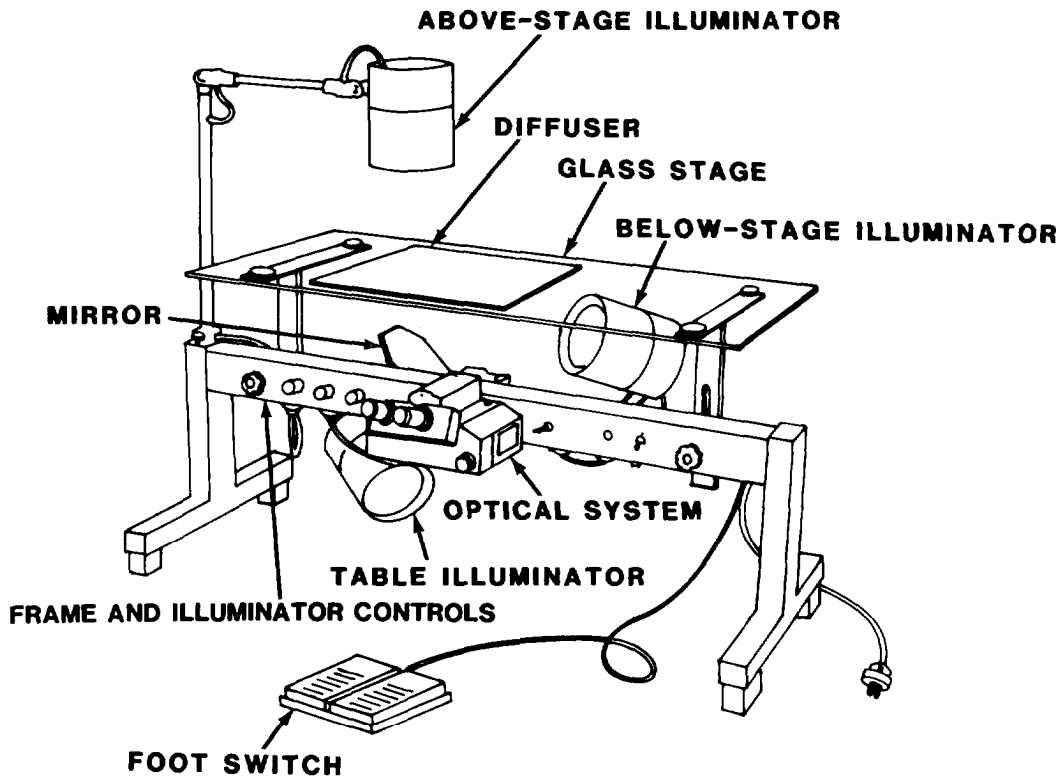
Model ZT4-H Zoom Transfer Scope

Purpose of Equipment: To optically superimpose photographic image on map or chart.

4-2 EQUIPMENT DESCRIPTION AND DATA.

4-2.1 Equipment Characteristics, Capabilities, and Features” Optically matches map and photographic scale. Optically rotates or stretches image. Uses photographs, transparencies, or other material to form image. Has zoom control magnification. Has foot on/off control of illuminators.

4-2.2 Location and Description of Major Components



ABOVE-STAGE ILLUMINATOR. Illuminates top of glass stage.

GLASS STAGE. Supports item from which image is to be formed. Transparent to permit light to shine through it.

BELOW-STAGE ILLUMINATOR. Illuminates bottom of glass stage.

FRAME AND ILLUMINATION CONTROLS. Supports other equipment and contains electrical controls.

OPTICAL SYSTEM. Contains magnification, focusing, rotation, and stretch controls, and prisms and lenses.

TABLE ILLUMINATOR. Illuminates work surface and map.

MIRROR. Directs light from glass stage to optical system.

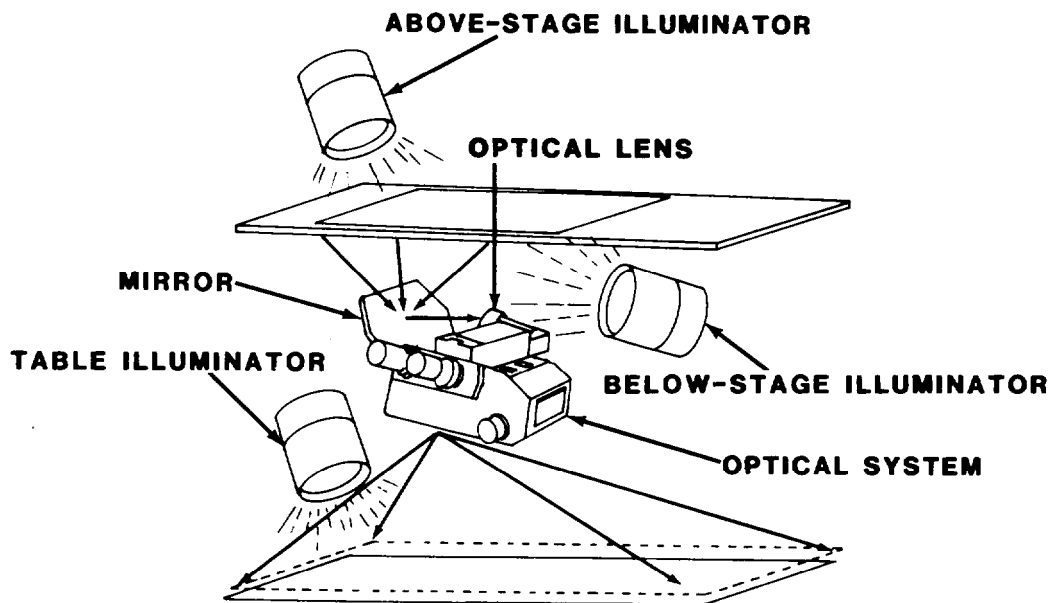
DIFFUSER. Flattens object on glass stage and provides even light on top of stage.

FOOT SWITCH. Turns off stage or table illumination when pedal is pressed.

4-2.3 Equipment Data

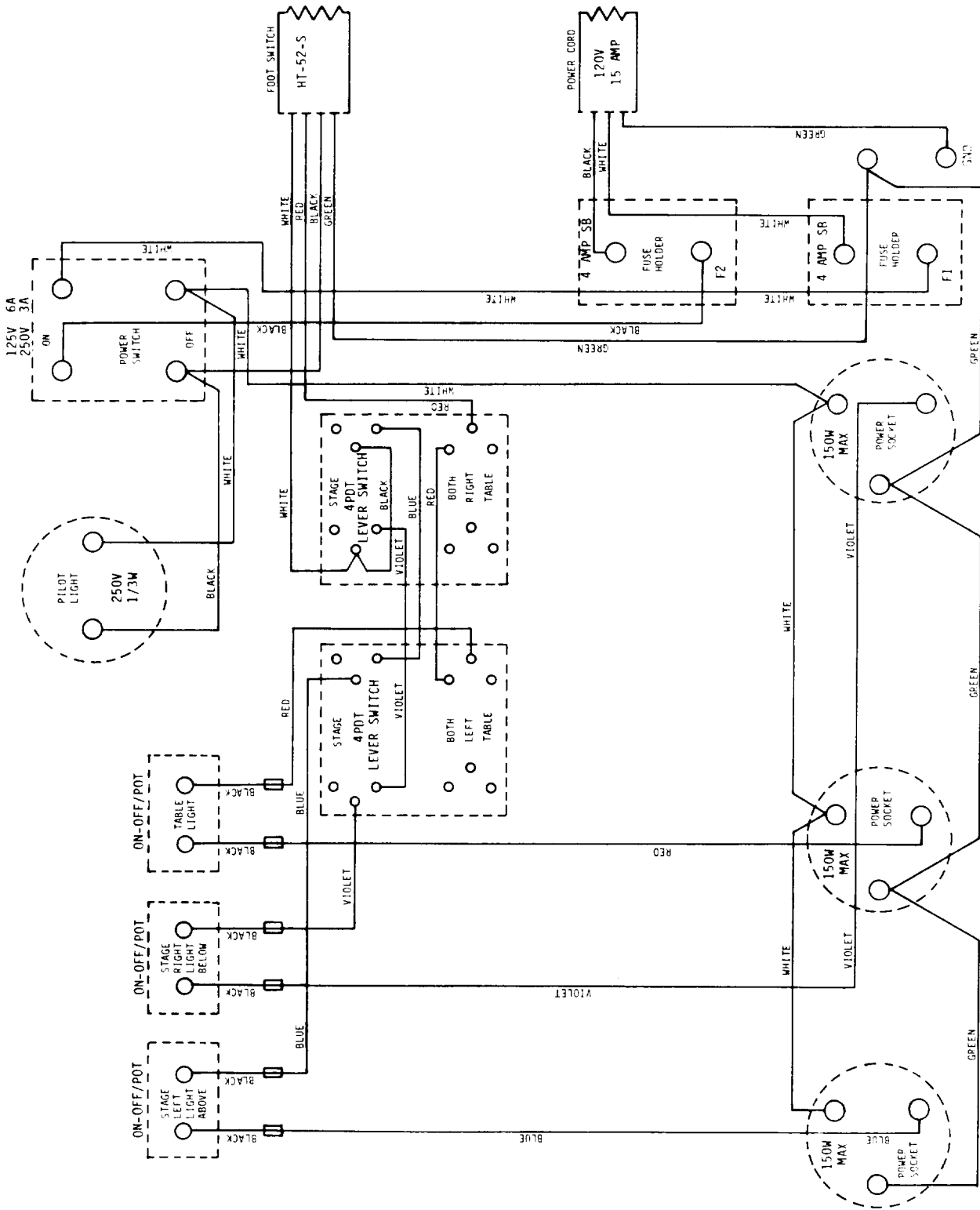
Zoom Range	1X to 7X
Optical Rotation	360°
Optical Stretch Correction	1:1 to 2:1
Power Requirements	110 vat, 60 Hz
Illumination	Three 150 w flood lamps
Map Field of View	19.0 cm (7.49 in.)

4-3 TECHNICAL PRINCIPLES OF OPERATION.



4-3.1 General. The above-stage illuminator or below-stage illuminator shines light on the transparency or photograph mounted on the glass stage. The image of the transparency or photograph is reflected from the mirror onto the optical lens. The optical system magnifies, rotates, or distorts the reflected image to match the map. The operator illuminates the map with the table illuminator and views the image through the optical system. The operator's view of the map has an apparent image of the photograph superimposed on it. The wiring diagram of the zoom transfer scope is shown in paragraph 4-3.2.

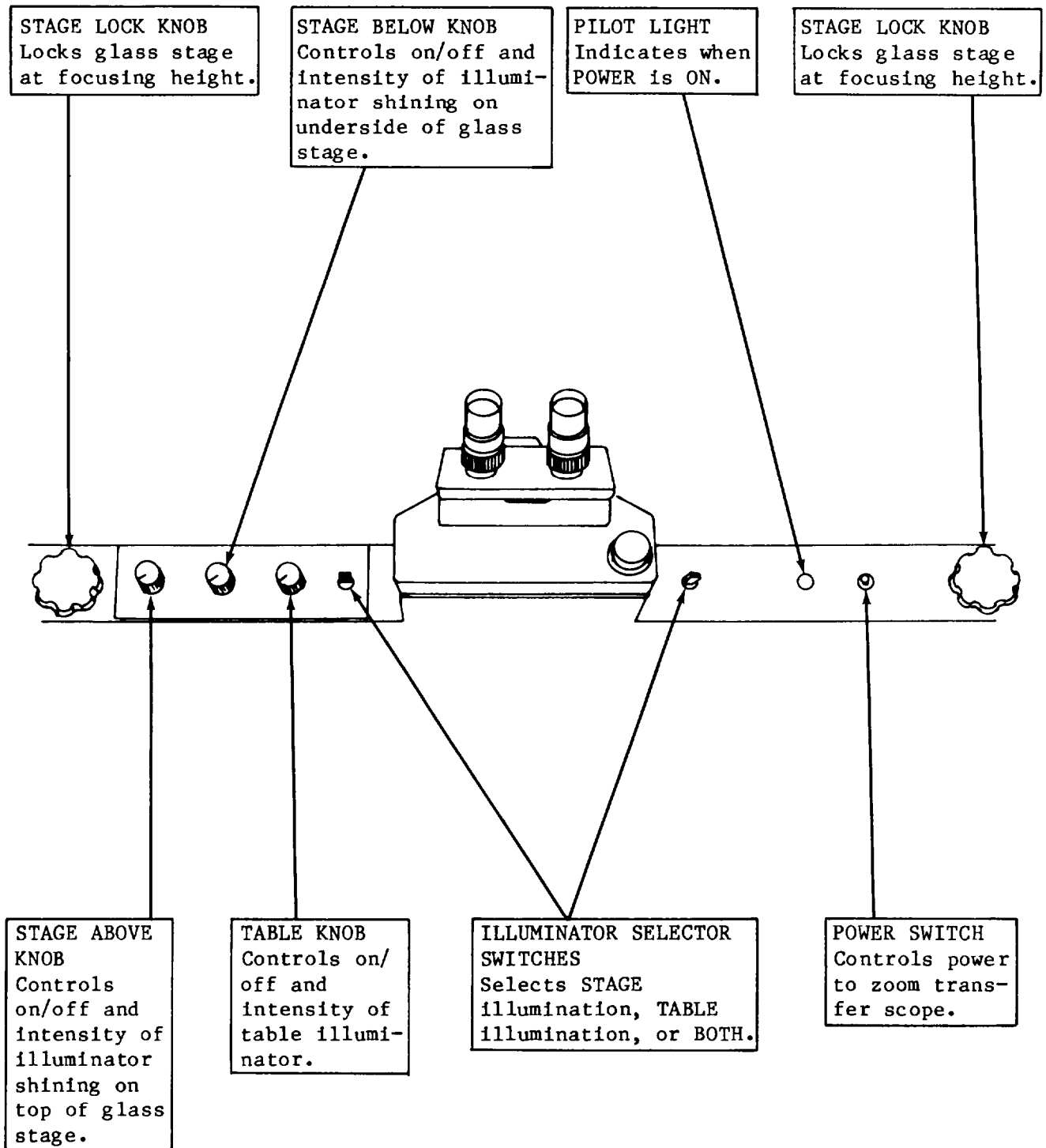
4-3.2 Wiring Diagram



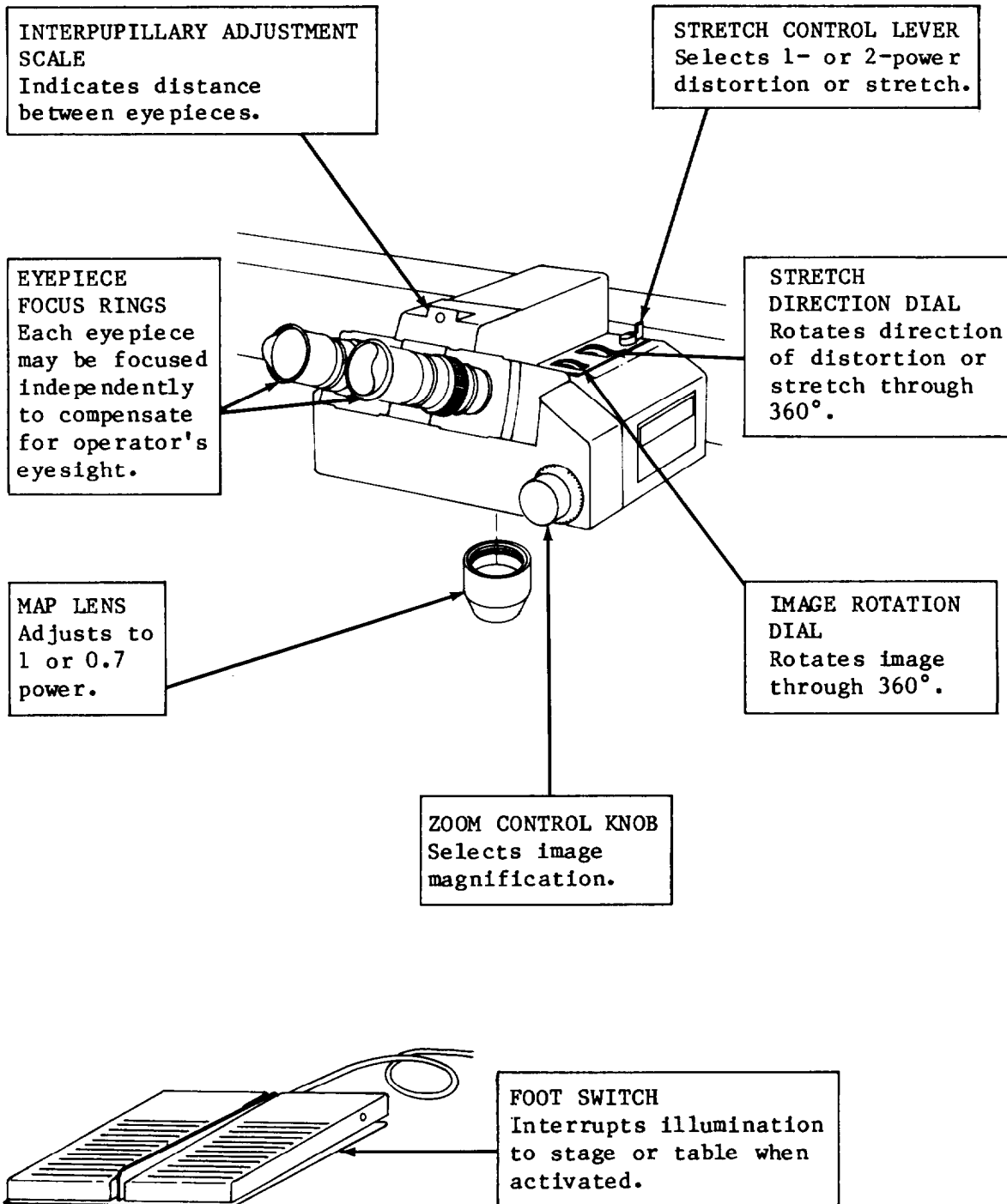
ZOOM TRANSFER SCOPE ZT4H
WIRING DIAGRAM

Section II. OPERATING INSTRUCTIONS

4-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS.



4-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued



4-5 OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

4-5.1 General. The zoom transfer scope must be regularly inspected to find and correct defects.

4-5.1.1 Before You Operate. Always keep In mind the WARNINGS and CAUTIONS. Perform your BEFORE (B) PMCS.

4-5.1.2 While You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your DURING (D) PMCS.

4-5.1.3 After You Operate. Be sure to perform your AFTER (A) PMCS.

4-5.1.4 If Your Equipment Fails To Operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

4-5.2 PMCS Procedures

4-5.2.1 PMCS are designed to keep the equipment in good working condition by performing periodic service tasks.

4-5.2.2 Service intervals provide you, the operator, with time schedules that determine when to perform specified service tasks.

4-5.2.3 The "Equipment is Not Ready/Available If" Column is used for identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.

4-5.2.4 If your equipment fails to operate after PMCS is performed, immediately report this condition to your supervisor.

4-5.3 PMCS Columnar Entries

4-5.3.1 Item Number Column. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for your "TM number" Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.

4-5.3.2 Interval Column. This column determines the time period designated to perform your PMCS.

4-5.3.3 Item To Be Inspected and Procedures Column. This column lists functional groups and their respective assemblies and subassemblies as shown in the Maintenance Allocation Chart (Appendix B). The appropriate check or service procedure follows the specific item to be inspected.

4-5.3.4 Equipment Is Not Ready/Available If: Column. This column indicates the reason or cause why your equipment is not ready/available to perform its primary mission.

Table 4-1. Operator Preventive Maintenance Checks and Services

B – Before Operation

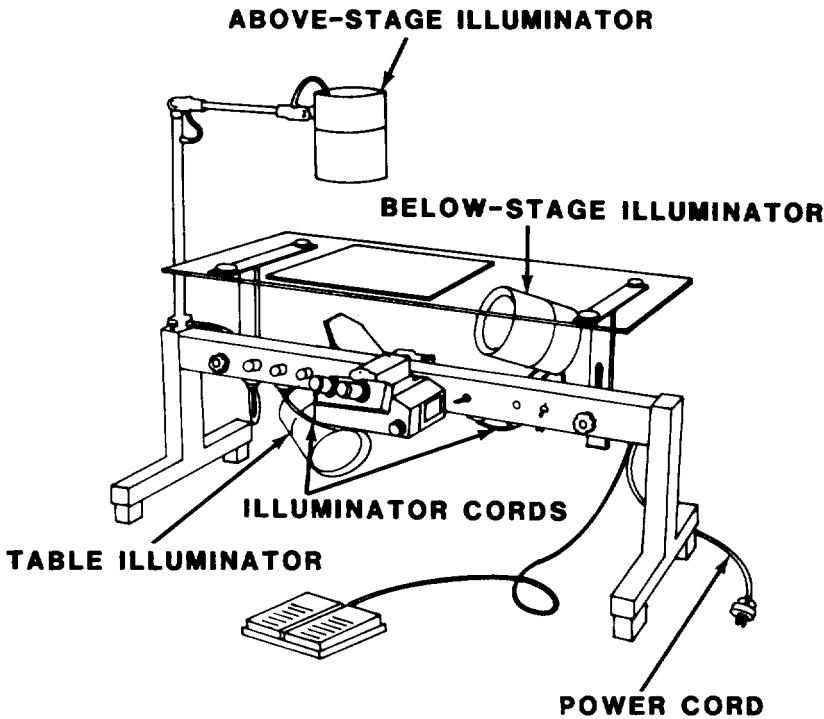
Item No.	Interval	ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	 <p style="text-align: center;">WARNING</p> <p style="text-align: center;">ELECTRICAL SHOCK</p> <p>Do not use equipment with defective wiring or cords. Defective wiring or cords connected to power source can cause death or serious injury.</p>	
1	●	<p>ILLUMINATOR CORDS, POWER CORD, AND WIRING. Check for defects, kinks, burns, and broken plugs.</p>	<p>Wiring is defective.</p>
2	●	<p>ABOVE-STAGE, BELOW-STAGE, AND TABLE ILLUMINATORS. Check for working lights.</p>	<p>Illuminators are inoperative.</p>

Table 4-1. Operator Preventive Maintenance Checks and Services - Continued

B – Before Operation

Item No.	Interval	ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B		
3	●	<p>ILLUMINATOR SELECTOR SWITCHES. Check for illumination. Set illuminator selector switches to STAGE, BOTH, and TABLE positions. In TABLE position, only the table is illuminated; in STAGE position, only the stage is illuminated; and in BOTH position, table and stage are illuminated. Para 4-4</p>	
4	●	<p>EYEPIECES, ATTACHMENT LENS, MIRROR, MAP LENS. Check for chips, cracks, dirt, dust, and fingerprints. Clean by carefully wiping with lens paper.</p>	<p>Optics are missing or broken.</p>

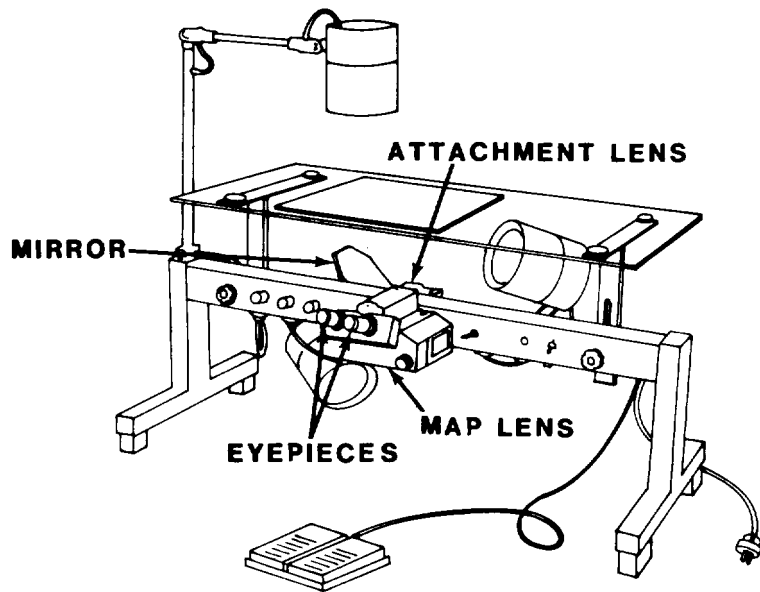


Table 4-1. Operator Preventive Maintenance Checks and Services - Continued

B – Before Operation

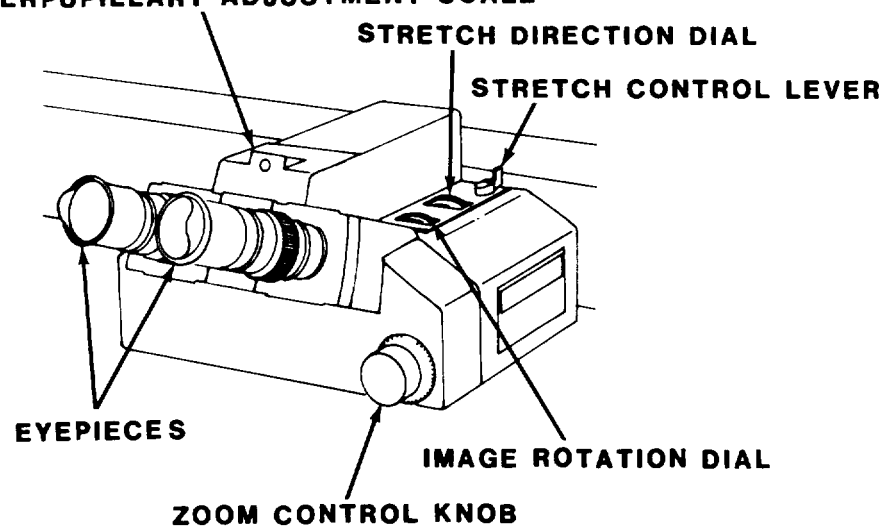
Item No.	Interval	ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	<p>INTERPUPILLARY ADJUSTMENT SCALE</p> <p>STRETCH DIRECTION DIAL</p> <p>STRETCH CONTROL LEVER</p>  <p>EYEPIECES</p> <p>IMAGE ROTATION DIAL</p> <p>ZOOM CONTROL KNOB</p>	
5	●	<p>STRETCH CONTROL LEVER, STRETCH DIRECTION DIAL, IMAGE ROTATION DIAL, ZOOM CONTROL KNOB. Check rotation and freedom of movement for each control.</p> <p>NOTE</p> <p>Do not remove eyepieces.</p>	<p>Controls are jammed or broken.</p>
6	●	<p>EYEPIECES. Check that each eyepiece moves freely in and out of its eyepiece tube.</p>	
7	●	<p>INTERPUPILLARY ADJUSTMENT SCALE. Check that eyepieces move toward or away from each other.</p>	

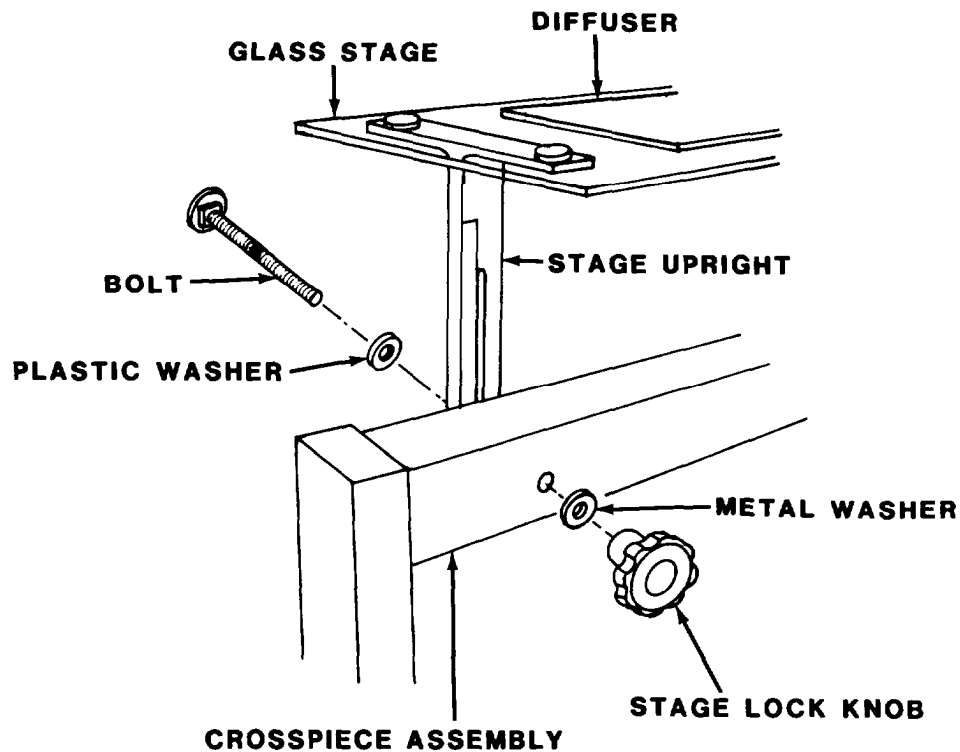
Table 4-1. Operator Preventive Maintenance Checks and Services - Continued

B – Before Operation

Item No.	Interval	ITEM TO BE INSPECTED	Equipment Is Not Ready/Available If:
	B	PROCEDURE	
8		<p style="text-align: center;"><u>WARNING</u></p> <p style="text-align: center;">ELECTRICAL SHOCK</p> <p>Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Dirt and dust on optical surfaces will hinder equipment's performance.</p> <ul style="list-style-type: none"> ● Do not wipe optical surfaces until dust and foreign matter have been removed. ● Do not touch optical surfaces with bare fingers. <p>GLASS STAGE AND OPTICAL SURFACES. Check top and bottom of glass stage and optical surfaces for dirt, dust, and fingerprints. Use watchmaker's blower to remove dust and dirt from exposed surfaces. Clean with cotton cloth moistened with mild liquid dishwashing detergent (item 19, appendix E), solution diluted at least 10:1. Use distilled water for dilution, if possible. Wipe surface dry with cotton (item 17, appendix E). Wipe with chamois (item 10, appendix E) to remove water spots.</p>	

4-6 OPERATION UNDER USUAL CONDITIONS.

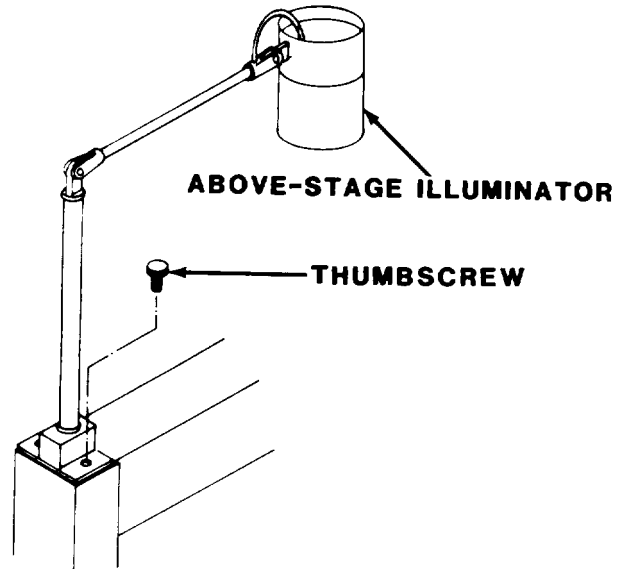
4-6.1 Assembly and Preparation for Use



- a. Remove zoom transfer scope from transport case.
- b. Set zoom transfer scope on flat work surface.
- c. Attach glass stage.
 - (1) Remove stage lock knobs, bolts, and washers from crosspiece assembly.
 - (2) Position stage upright with arms facing toward rear.
 - (3) Thread bolts with plastic washers through stage arms and crosspiece assembly.
 - (4) Place metal washer and knob on threaded end of bolt. Tighten knob.
 - (5) Observe index (focusing) scale on front of upright, and align prefocused mark or common mark on each upright with top of crosspiece.
 - (6) Place diffuser on glass stage.

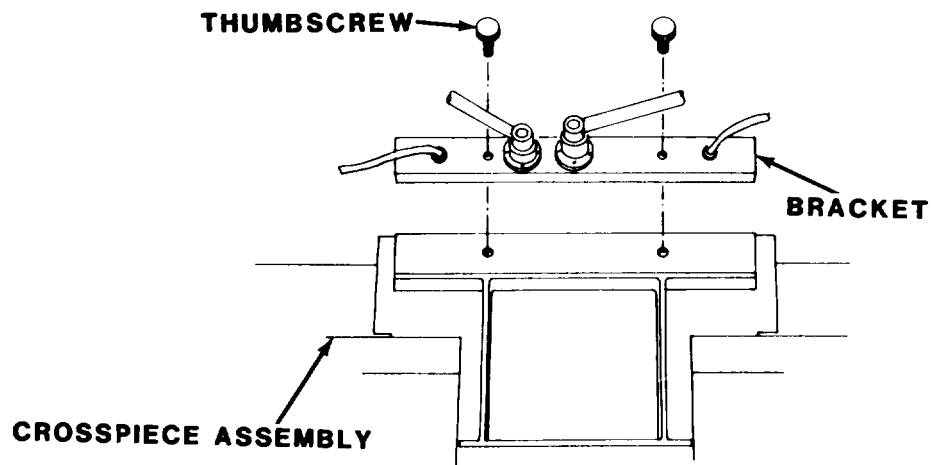
4-6.1 Assembly and Preparation for Use - Continued

d. Attach above-stage illuminator.



- (1) Mount above-stage illuminator onto left side of zoom transfer scope.
- (2) Secure with thumbscrews.
- (3) Plug illuminator cord into receptacle.

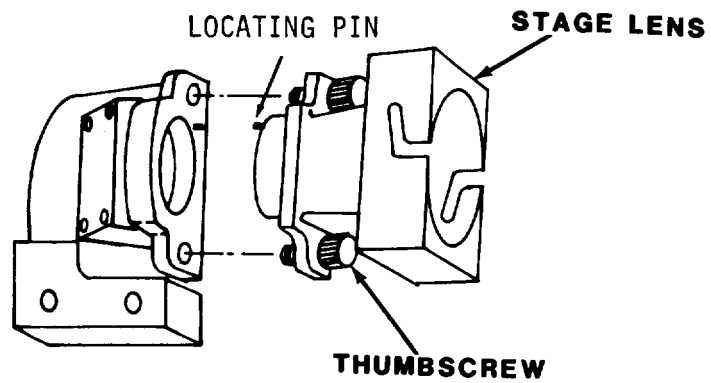
e. Attach table and stage illuminators.



- (1) Attach bracket to underside of crosspiece assembly with thumbscrews.
- (2) Plug illuminator cords into receptacles.

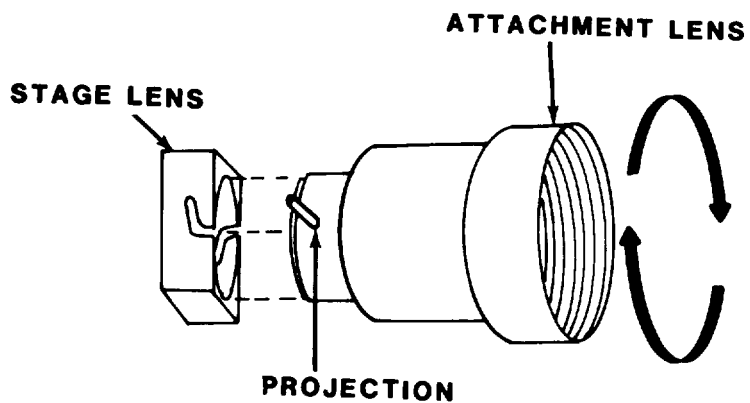
4-6.1 Assembly and Preparation for Use - Continued

f. Attach stage lens to back of crosspiece assembly.

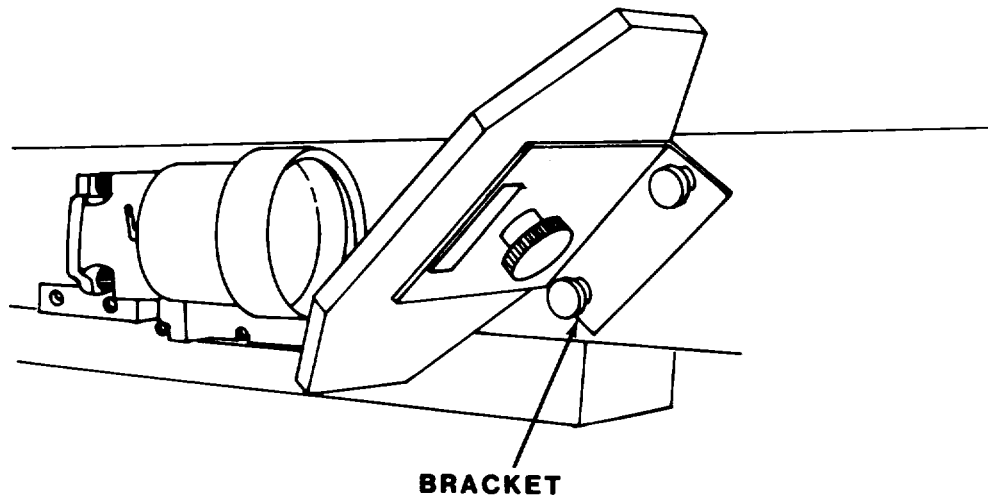


- (1) Aline stage lens locating pin with hole in mount.
- (2) Seat stage lens fully in mount.
- (3) Tighten two thumbscrews.

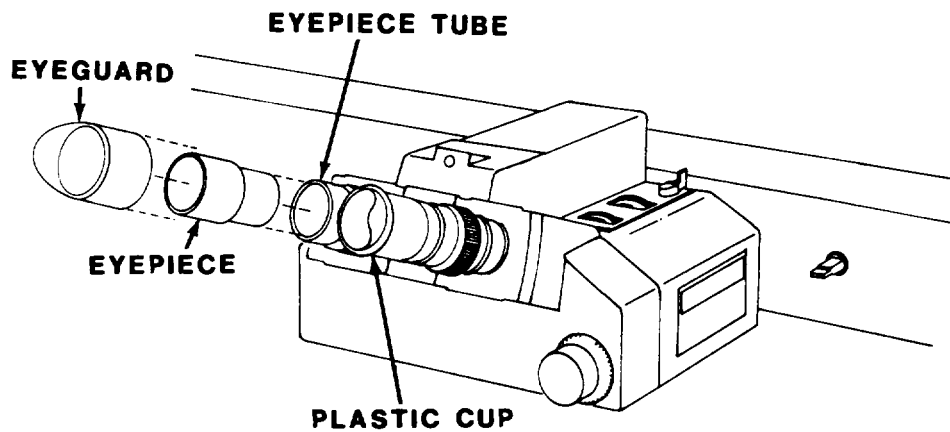
g. Insert attachment lens into stage lens.



- (1) Aline projections with slots in stage lens.
- (2) Insert attachment lens.
- (3) Twist to right to lock.

4-6.1 Assembly and Preparation for Use - Continued

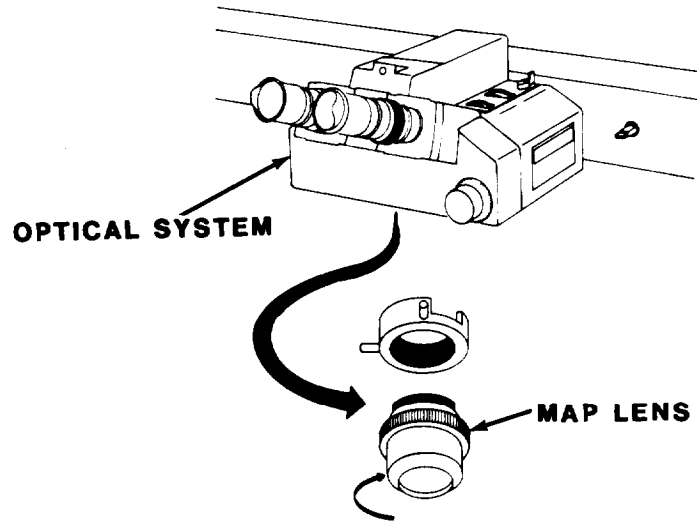
- h. Attach mirror bracket to outer holes on back of cross piece assembly.



- i. Insert eyepieces.
- (1) Remove plastic cups.
 - (2) Insert eyepieces into eyepiece tubes, pushing in until fully seated.
 - (3) Place eyeguards on eyepieces, if desired.

4-6.1 Assembly and Preparation for Use Continued

j. Attach map lens.



- (1) Place threaded end of lens into hole located on underside of optical system.
- (2) Turn to right until lens is fully screwed into fixture.

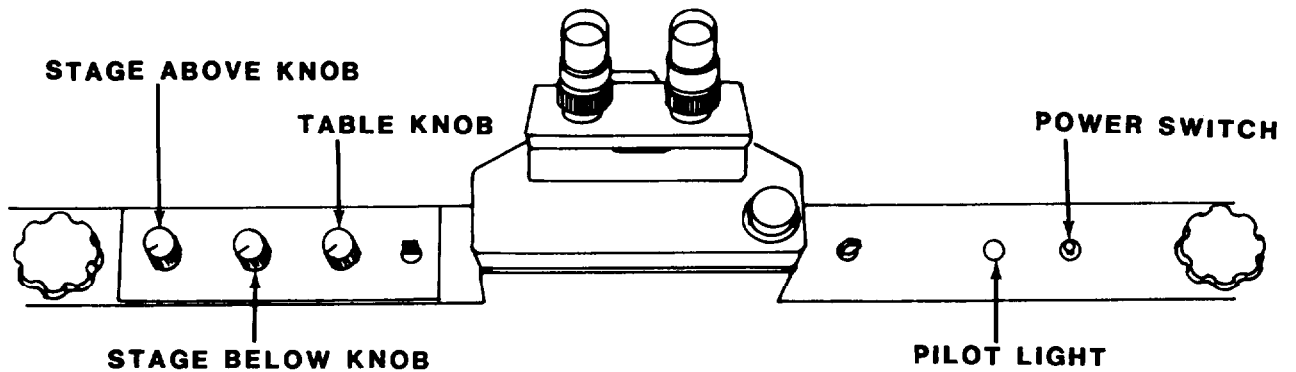
NOTE

The legs on the ends of the zoom transfer scope should be left folded up when the 1X or accessory 2X or 4X map lenses are used. The legs should be extended only if the accessory 0.75X map lens is used.

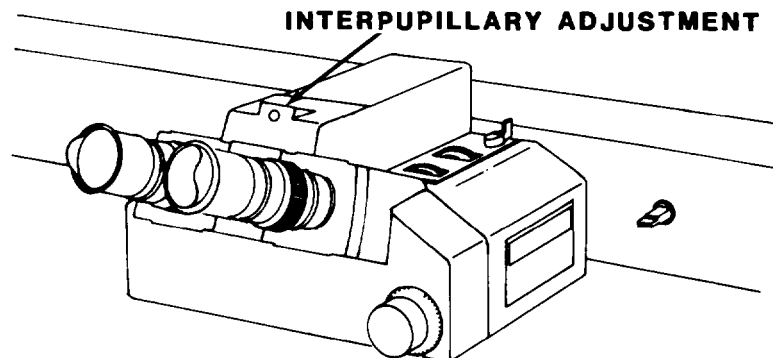
4-6.2 Operating Procedure

4-6.2.1 Preliminary Procedure

- a. Plug in power cord to grounded 110 v, 60 Hz power outlet.
- b. Turn POWER switch ON.

4-6.2.1 Preliminary Procedure - Continued

- c. Check that pilot light is on.
- d. Turn STAGE ABOVE knob to right and check that top illuminator is on. Turn knob left to OFF.
- e. Turn STAGE BELOW knob to right and check that middle illuminator is on. Turn knob left to OFF.
- f. Turn TABLE knob to right and check that bottom illuminator is on. Leave illuminator on.
- g. Place suitable map or material on work surface under map lens.
- h. Set interpupillary distance and focus.



- (1) Move interpupillary adjustment scale to left or right until operator has full field of view with both eyes. Note indexing on interpupillary adjustment scale for future use.

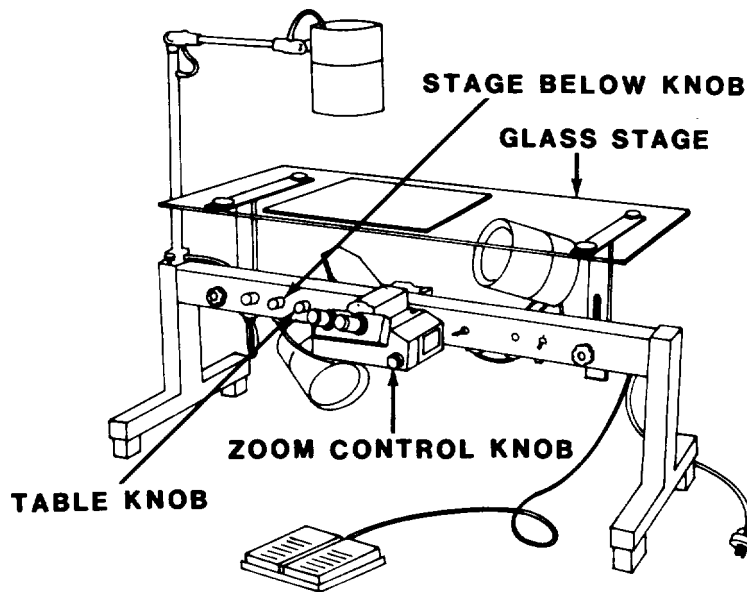
4-6.2.1 Preliminary Procedure - Continued

NOTE

If operator wears eyeglasses and correction is spherical, operator may take off glasses and focus eyepieces to compensate.

- (2) Focus each eyepiece by turning eyepiece focus ring until sharpest image is seen in each eye. Verify focus by closing each eye in turn.

i. Focus stage.



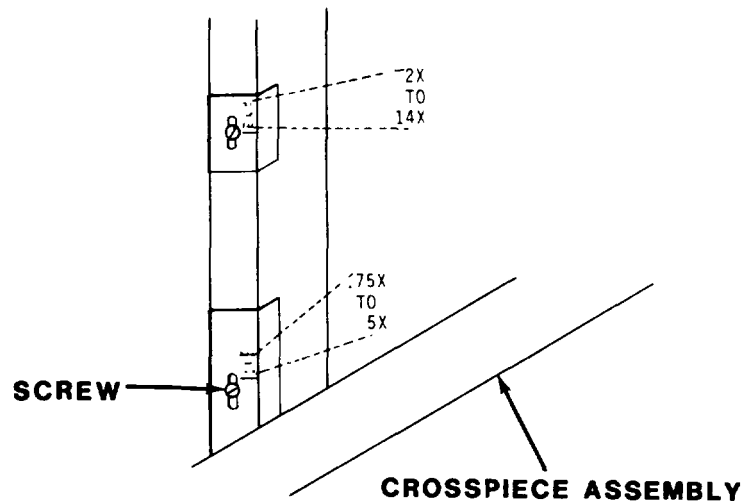
NOTE

This step is not required if stage uprights are marked to indicate best focus for attachment lens in use. Refocus stage when attachment lenses are changed.

- (1) Place object with fine detail or resolution target facing downward on glass stage.
- (2) Turn TABLE knob left to OFF.
- (3) Turn STAGE BELOW knob to right to illuminate object or target from below.
- (4) Set zoom control knob to highest reading.

4-6.2.1 Preliminary Procedure - Continued

- (5) Alternately loosen stage lock knobs and move stage up or down keeping readings on each scale equal.
 - (6) Record high and low readings where image of stage target just starts to go out of focus.
 - (7) Set stage height halfway between high and low reading.
- j. Adjust index mark.



- (1) Loosen screw.
- (2) Move mark up or down until index line is level with crosspiece.
- (3) Tighten screw.

4-6.2.2 Operation

- a. Select and position material to be used.
 - (1) For photographic revision of map, place photograph on glass stage, and place map on table.
 - (2) For map generalization, place large-scale map on glass stage, and place small-scale map on table.

4-6.2.2 Operation - Continued

- b. Determine map lens power. Lowest power provides greatest field of view; highest power provides greatest detail.

NOTE

Photograph and map must be at same relative scale in order to make accurate cartographic corrections.

- (1) Determine map scale and photographic scale.

Example: 200 scale: 1 in. on map equals 200 ft of terrain.
 1 in. = 1 mi: 1 in. on map equals 1 mi of terrain.
 RF 1:24,000: Reduction factor of map. 1 in. of map equals 24,000 in. of terrain.

- (2) Determine reduction factor (RF) of both photograph and map.

Example: 200 scale = RF 1/2400: 1 in. on map equals 2400 in. on terrain (200 ft = 2400 in.).
 1 in. = 1 mi = RF 1/63,360: 1 in. on map equals 63,360 in. on terrain. (1 mi = 5280 ft = 63,360 in.)

- (3) Determine matching scale S. Use RF of photograph as I/P and RF of map as I/M. Then the scale S can be expressed as photograph reduction factor (P) over the map reduction factor (M). $S = I/M$ divided by I/P or $S = P/M$

Example: Photograph RF = 1:80,000; Map RF = 1:24,000.
 Thus, $P = 80,000$; $M = 24,000$; and
 $s = 80,000/24,000 = 3.3$.

- (4) Use the value of S to determine map lens and photograph magnification:

<u>S Value</u>	<u>Map Lens</u>	<u>Photograph Magnification</u>
1-7	1X	1X-7X
2-14	1X	2X-14X

Example: If 3.3 is the value of S, then map lens of 1X and either 1X-7X attachment lens or 2X-14X (without attachment lens) may be used.

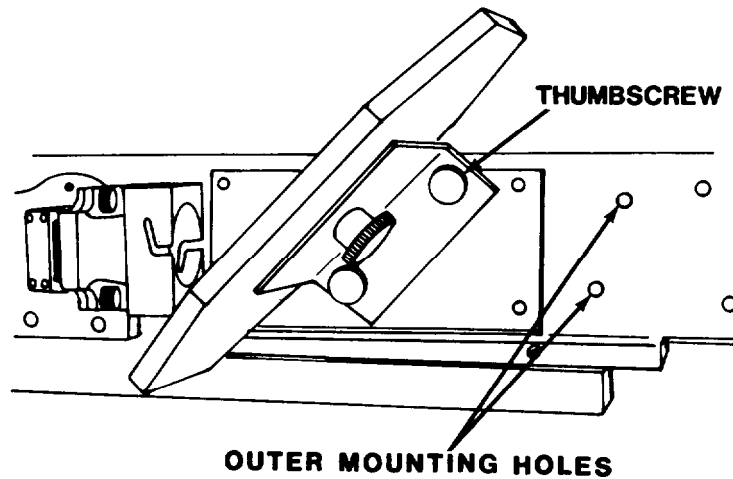
4-6.2.2 Operation - Continued

- c. Set magnification.

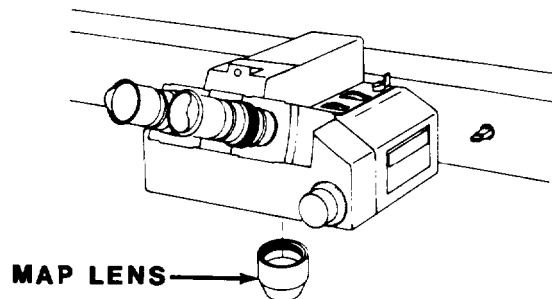
NOTE

The following steps should be taken if it is necessary to convert the zoom transfer scope to the 2X-14X range of magnification.

- (1) Remove attachment lens.

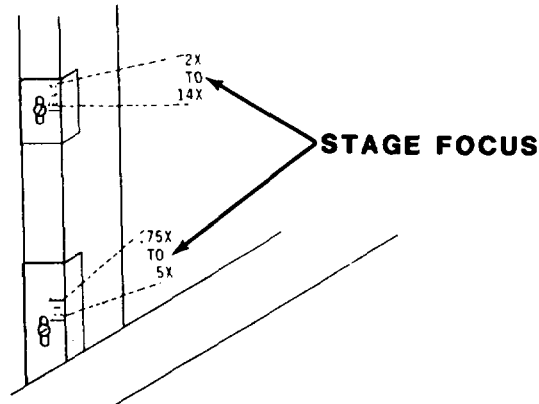


- (2) Move mirror from outer mounting holes to inner mounting holes.
- (3) Tighten thumbscrews.
- (4) Lower glass stage to 2X to 14X Index and refocus glass stage.
- (5) Set 2X to 14X index plate.

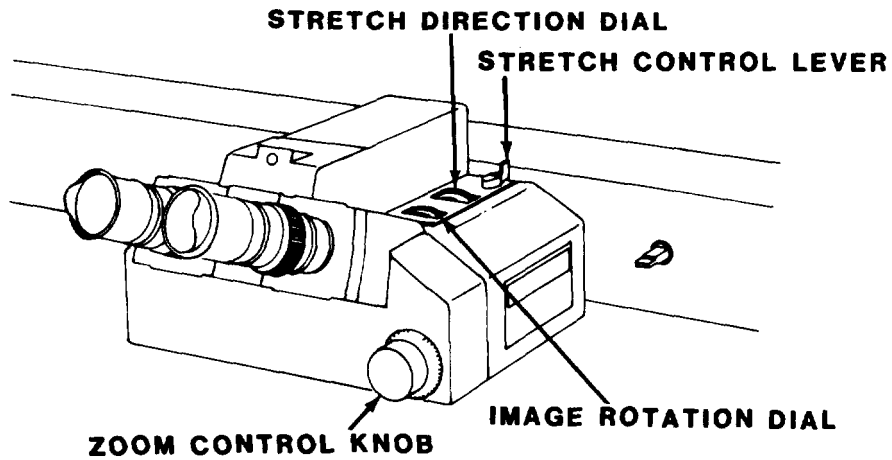


- (6) Adjust map lens. Turn lower knurled ring fully left for 1x. Turn lower knurled ring fully right for 0.7x.

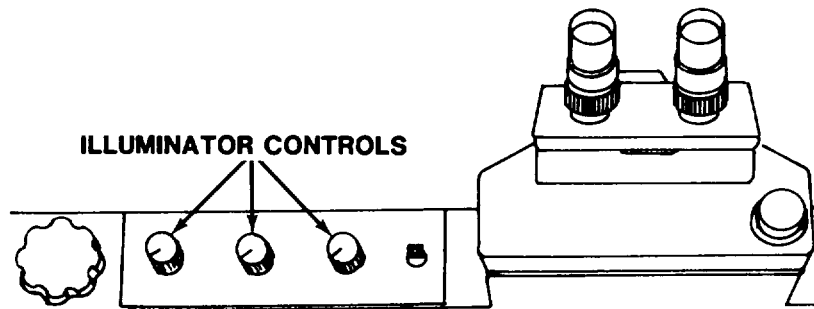
4-6.2.2 Operation - Continued



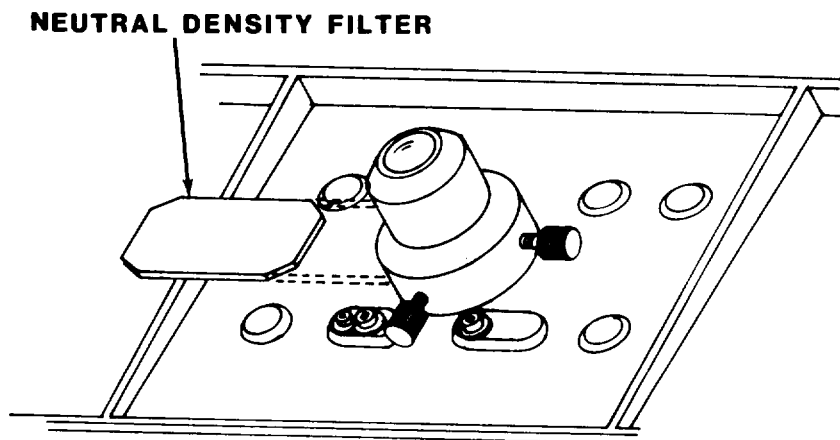
- d. Check that stage focus is at proper magnification setting.
- e. Set optical controls.



- (1) Set IMAGE ROTATION dial to 0 and move object on glass stage to left or right. If image movement is reverse of object's movement, turn IMAGE ROTATION dial until 0 appears again.
 - (2) Set zoom control knob to 1X.
 - (3) Set STRETCH control lever to 1X.
 - (4) Set STRETCH DIRECTION dial to 0.
- f. Move lamp positions so lamps shine on field of view.
 - g. Focus eyepieces, if required.

4-6.2.2 Operation - Continued

- h. Adjust intensity. Turn illuminator controls until both glass stage and table can be comfortably viewed.



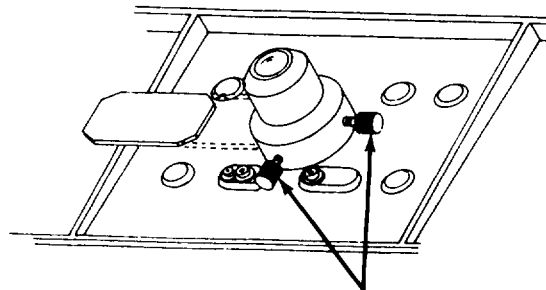
- i. In brightly lit room, neutral density filter may be inserted in slot above map lens to improve map image.
- j. Match images.

NOTE

Flicking either illuminator selector switch up or down will illuminate glass stage or table. Images not in register will jump. Foot switch will also turn off either stage or map illuminator when pedal is pressed.

4-6.2.2 Operation - Continued

- (1) Pick common feature on both maps and place feature in center of field of view of each viewing system (stage and table).
- (2) Rotate IMAGE ROTATION dial to move images so lines, such as streets, rivers, etc are parallel. Check that adjacent objects are also parallel.



X- AND Y-ADJUSTMENT SCREWS

CAUTION

Do not overtighten adjustment screws. Do not remove adjustment screws from hole. Damage to map lens may result.

- (3) Move map on table to left, right, forward, or backward to roughly aline image in X-Y direction. Turn X- and Y-adjustment screws for precise alinement.
- k. Match scale of stage image and map.
- (1) Pick feature near edge of field of view, and change zoom magnification until both features are alined.
 - (2) When point near edge is chosen, pick second point near opposite edge, and change zoom magnification until one-half the coincident distance is covered to second point.
- l. Repeat match. Continue to match images. Match scales until best fit between map and image is obtained.
- m. Use STRETCH control lever. Set STRETCH control lever to 1X or 2X, and rotate STRETCH DIRECTION dial to improve fit between map and image.

4-6.2.2 Operation - Continued

- n. Repeat match using the following summary.

NOTE

Each adjustment will change previous adjustments slightly, so matching steps must be repeated until best compromise fit is obtained.

- (1) Image Rotation - Approximate orientation.
- (2) Zoom - Approximate scale.
- (3) Stretch/Stretch Direction - Match shapes.
- (4) Image Rotation - Aline lines.
- (5) Stretch Direction - Aline lines perpendicular to those in previous step.
- (6) Stretch - Match shapes.
- (7) Zoom- Match scale.
- (8) Repeat as required.

CAUTION

Dust, dirt, and fingerprints will hinder equipment's performance. Use dust cover when zoom transfer scope is not in operation.

- o. Cover optical system with dust cover.

4-6.3 Preparation for Movement

- a. Remove dust cover and place in transport case.
- b. Remove map lens.
- c. Remove eyeguards and eyepieces.
- d. Place plastic cups in eyepiece tubes.

4-6.3 Preparation for Movement - Continued

- e. Remove mirror.
- f. Remove attachment lens.
- g. Remove stage lens.
- h. Detach table and below-stage illuminators.
- i. Remove above-stage illuminator.
- j. Remove diffuser.
- k. Remove glass stage.
- l. Place zoom transfer scope and equipment in transport case, and secure case.

Section III. OPERATOR MAINTENANCE

4-7 LUBRICATION INSTRUCTIONS.

This equipment does not require lubrication.

4-8 OPERATOR TROUBLESHOOTING PROCEDURES.

4-8.1 General

4-8.1.1 The table lists the common malfunctions that you may find during the operation or maintenance of the zoom transfer scope or its components. You should perform the tests/inspections and corrective actions in the order listed.

4-8.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 4-2. Operator Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. IMAGES BLURRED, POOR CONTRAST OR RESOLUTION.		<p>Inspect optical system and glass stage for fingerprints and dirt.</p> <p>Clean optical surfaces and glass stage.</p> <p>If problem remains, notify direct support maintenance for replacement of optical system.</p>
2. ILLUMINATORS DO NOT WORK. PILOT LIGHT IS OFF.		<p>Step 1. Check if power cord is not plugged in and POWER switch is OFF.</p> <p>Plug in power cord and turn POWER switch ON.</p> <p>Reset circuit breakers.</p> <p>Step 2. Check if fuses are blown or damaged.</p> <p>Replace defective fuses (para 4-9.3).</p> <p>If problem remains, notify direct support maintenance for replacement of power switch, power cord, or fuse holders.</p>
3. ONE ILLUMINATOR DOES NOT WORK.		<p>Check if illuminator connector is not properly seated in receptacle.</p> <p>Seat connector properly.</p> <p>Replace bulb (para 4-9.2).</p> <p>If problem remains, notify direct support maintenance for replacement of illuminator control potentiometer or illuminator plug receptacle.</p>
4. ILLUMINATORS REMAIN ON OR OFF. PILOT LIGHT IS ON.		<p>Notify direct support maintenance for replacement of foot switch or illuminator selector switches.</p>
5. ILLUMINATORS WORK. PILOT LIGHT IS OFF.		<p>Notify direct support maintenance for replacement of pilot light.</p>

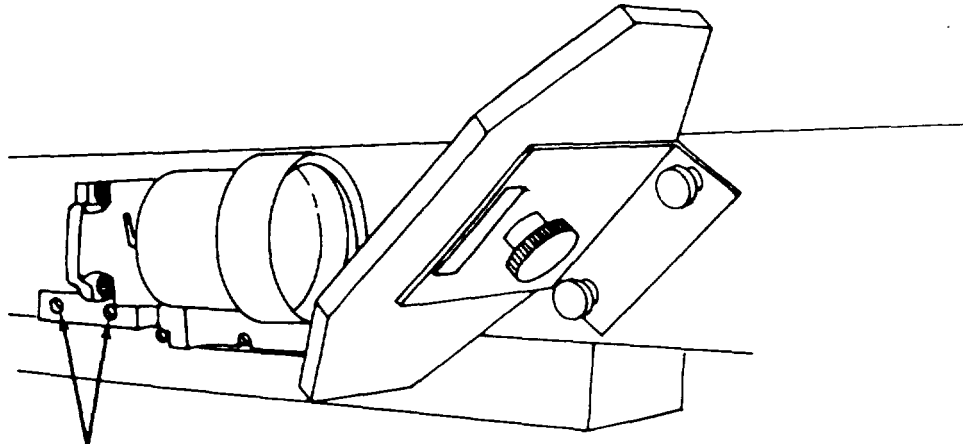
4-9 OPERATING PROCEDURES.

This section contains step-by-step instructions covering operator performed maintenance functions.

4-9.1 Adjust Drag

PERSONNEL REQUIRED: I Terrain analyst MOS 81Q

TOOLS: 1/8-in. socket-head screw key



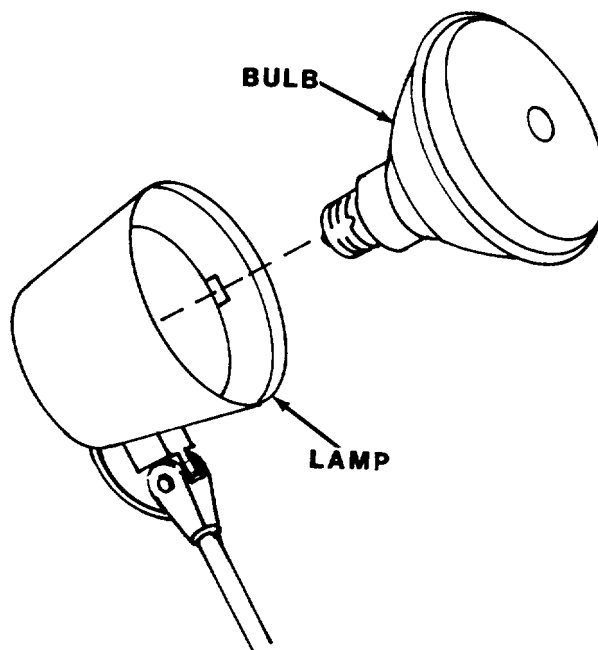
ADJUSTMENT SCREWS

- a. Rotate attachment lens and stage lens to vertical and horizontal positions. Observe if gravity pulls lenses down or if tension is too great to easily move lenses.
- b. Use socket-head screw key on adjustment screws. Turning key to right tightens adjustment screw, increasing drag. Turning to left loosens adjustment screw, decreasing drag.
- c. Test adjustment by positioning lenses. Observe that lenses retain position. Movement must be firm but not too tight.

4-9.2 Replace Bulb

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

MATERIALS/PARTS: Bulb



REMOVAL :

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Unscrew and dispose of defective bulb.

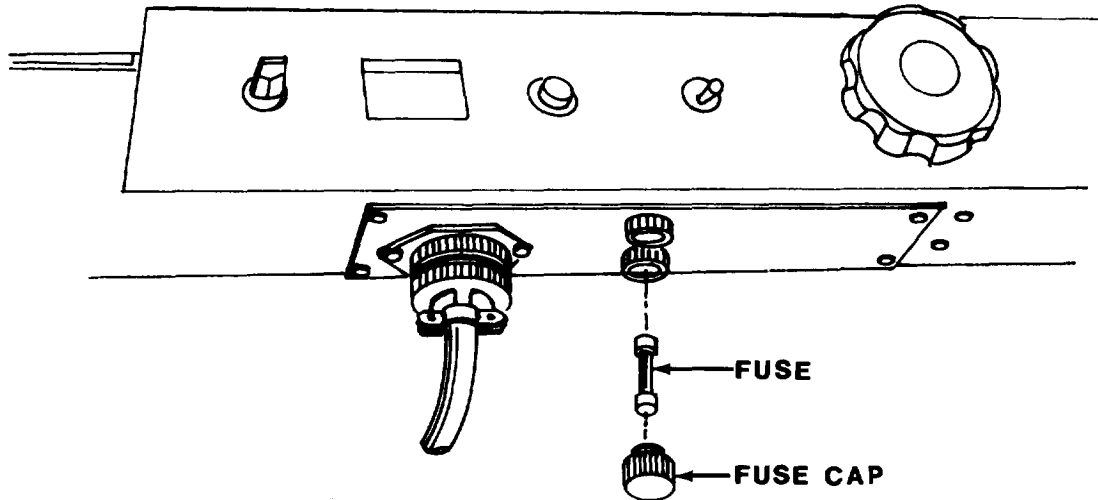
INSTALLATION:

- a. Install new bulb.
- b. Plug in power cord, and turn power ON.

4-9.3 Replace Fuse

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

MATERIALS/PARTS: Fuse



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Turn fuse cap to left and remove.
- c. Remove defective fuse.

INSTALLATION:

- a. Install new fuse into fuse cap.
- b. Reinstall fuse cap. Turn to right to lock.
- c. Plug in power cord, and turn power ON.

Section IV. ORGANIZATIONAL MAINTENANCE

4-10 There are no assigned organizational maintenance tasks for this equipment.

Section V. DIRECT/GENERAL SUPPORT MAINTENANCE

4-11 REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT.

4-11.1 For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

4-11.2 Special tools, TMDE, and support equipment are not required for this equipment.

4-11.3 Repair parts are listed and illustrated in the Repair Parts and Special Tools List (TM5-6675-326-24P) covering direct/general support maintenance for this equipment.

4-12 DIRECT/GENERAL SUPPORT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

There are no PMCS at the direct/general support level for the zoom transfer scope.

4-13 DIRECT/GENERAL SUPPORT TROUBLESHOOTING.

Troubleshooting at the direct/general support level is shown in Table 4-3.

Table 4-3. Direct/General Support Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

MOS: 41B
 TOOLS: Multimeter

Supplies: Fuse

1. PILOT LIGHT IS OFF.

- Step 1. Check fuse with multimeter for continuity.
 - (a) Replace fuse if defective.
 - (b) If fuse is good, proceed to next step.

Step 2. Check for power at plug-in receptacle.

Read voltage meter, frequency scale, incorrect phase or correct phase lamps or correct power input. If incoming power is correct, proceed to next step. If incorrect, notify appropriate power supply supervisor.

Step 3. Check for 120 V ac output with circuit breaker on

If 120 V ac is present, proceed to next step. If not correct, replace circuit breaker.

Step 4. Remove receptacle and check for 120 V ac into receptacle.

(a) If 120 V ac is present, proceed to next step. If not present, identify defective wire and repair or replace.

(b) Replace receptacle.

2. ONE ILLUMINATOR DOES NOT WORK.

Step 1. Check for correct voltage range at the potentiometer output terminals

With multimeter leads in place, slowly rotate illuminator knob fully right and fully left. Observe for 0-120 V ac between fully left position and fully right position. If correct, voltage range is present, repair or replace wiring between potentiometer and receptacle. If correct voltage range is not present, proceed to next step.

Step 2. Check for 120 V ac input at potentiometer.

If correct voltage is not present, proceed to next step. If correct voltage is present, replace potentiometer.

Step 3. Check for continuity at wiring between switch and probable defective potentiometer.

(a) If continuity is not present, repair or replace wiring.

(b) If problem continues to exist, use accompanying wiring diagram and continue to troubleshoot wiring until defective wiring is located. Then repair or replace defective wire.

3. ILLUMINATORS WORK BUT PILOT LIGHT IS OFF.

Check for correct voltage at pilot light leads. If correct voltage is present, troubleshoot wiring. If voltage is not present, replace pilot light.

4-14 DIRECT/GENERAL SUPPORT MAINTENANCE PROCEDURES.

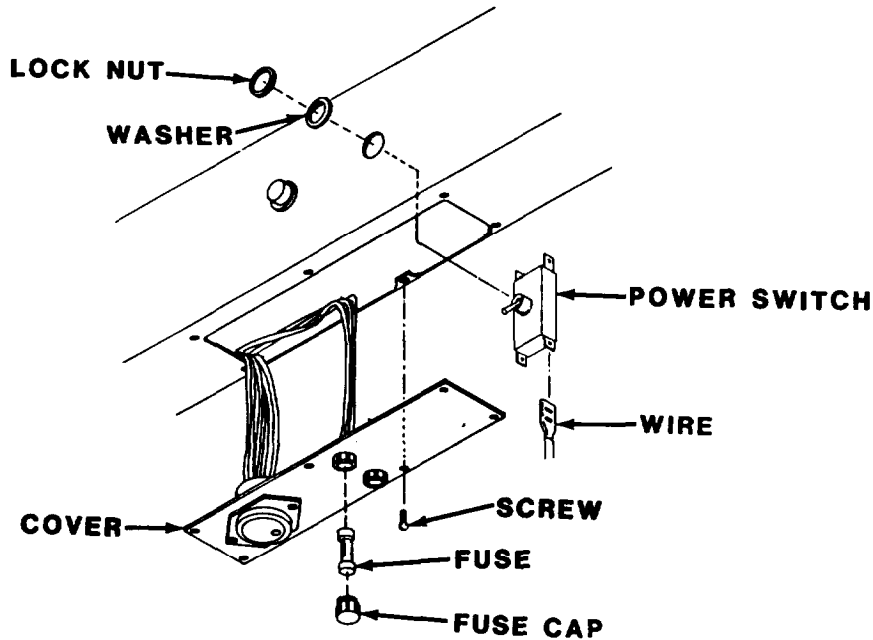
This section contains step-by-step instructions covering direct/general support maintenance functions.

4-14.1 Replace Power Switch

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-inch flat-tip screwdriver
Straight-nose pliers

MATERIALS/PARTS: Power switch



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Unplug below-stage illuminator cord.
- c. Remove fuse caps and fuses.
- d. Remove six screws from cover on underside of crosspiece assembly. Move cover to allow access to power switch.

4-14.1 Replace Power Switch - Continued

- e. Remove lock nut and washer securing power switch to control panel.
- f. Remove power switch through underside of crosspiece assembly.
- g. Tag and remove wires from power switch.

INSTALLATION:

- a. Connect wires to new power switch and remove tags.
- b. Position power switch in crosspiece assembly.
- c. Reinstall washer and lock nut securing power switch to control panel.
- d. Reinstall cover on underside of crosspiece assembly, and secure with six screws.
- e. Reinstall fuses and fuse caps.
- f. Plug in below-stage illuminator cord.
- g. Plug in power cord, and turn power ON.

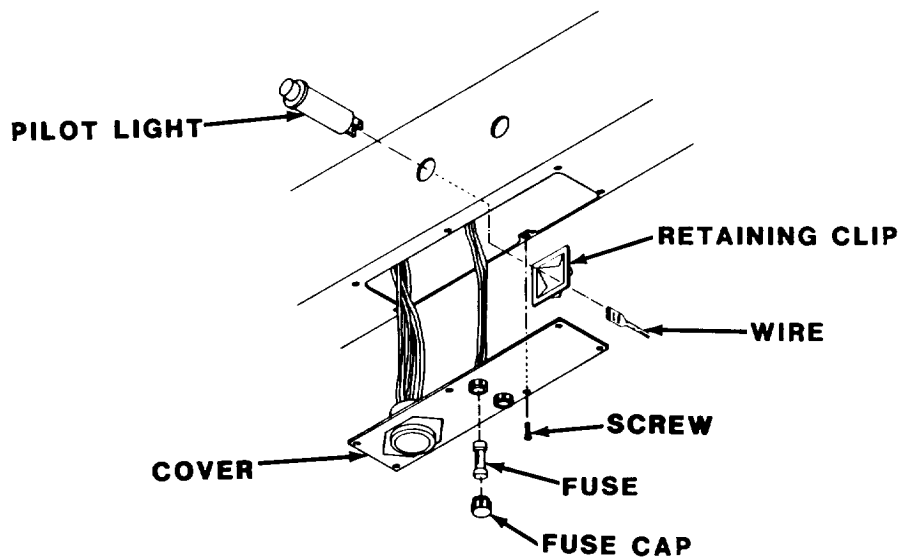
4-14.2 Replace Pilot Light

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-inch flat-tip screwdriver
Needle-nose pliers

MATERIALS/PARTS: Pilot light

4-14.2 Replace Pilot Light - Continued



REMOVAL :

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF , and unplug power cord.
- b. Unplug below-stage illuminator cord.
- c. Remove fuse caps and fuses.
- d. Remove six screws from cover on underside of crosspiece assembly. Move cover to allow access to pilot light.
- e. Tag and remove wires from pilot light.
- f. Remove retaining clip. Remove pilot light.

4-14.2 Replace Pilot Light - Continued

INSTALLATION:

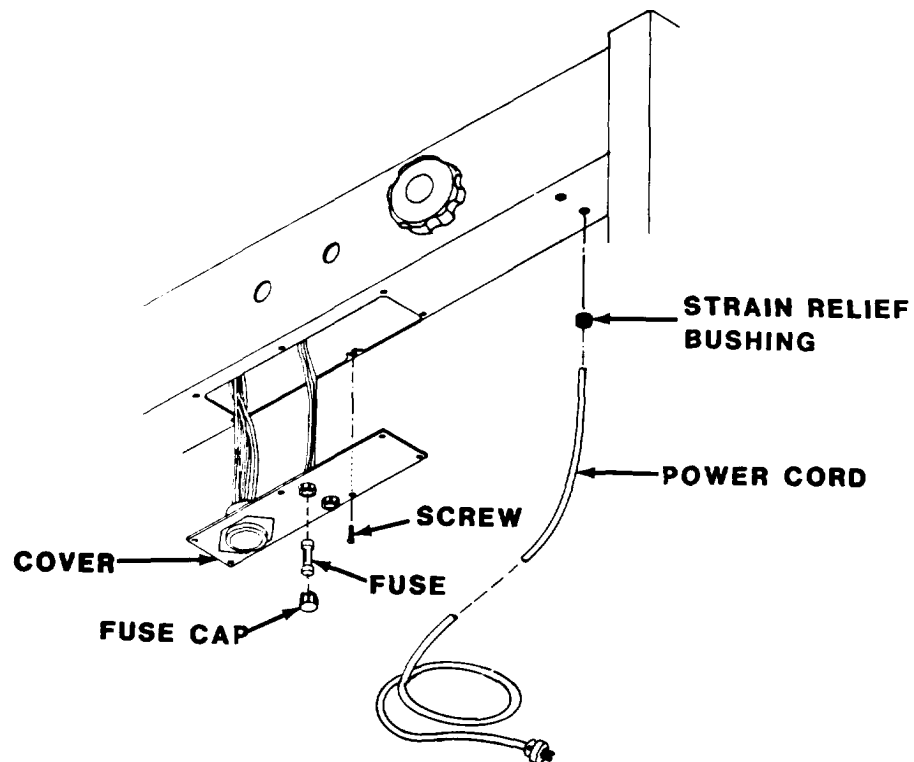
- a. Position new pilot light through hole on crosspiece assembly.
- b. Reinstall retaining clip.
- c. Connect wires to pilot light and remove tags.
- d. Reinstall cover on underside of crosspiece assembly, and secure with six screws.
- e. Reinstall fuses and fuse caps.
- f. Plug in below-stage illuminator cord.
- g. Plug in power cord, and turn power ON.

4-14.3 Replace Power Cord

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-inch flat-tip screwdriver
Straight-nose pliers

MATERIALS/PARTS: Power cord



4-14.3 Replace Power Cord - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Unplug below-stage illuminator cord.
- c. Remove fuse caps and fuses.
- d. Remove six screws from cover on underside of crosspiece assembly.
- e. Release strain relief bushing from power cord.
- f. Push power cord into crosspiece assembly to allow for give.
- g. Note color of wires connected to fuse holders and to ground. Disconnect wires from fuse holders and ground.
- h. Remove power cord through hole in crosspiece assembly.

INSTALLATION:

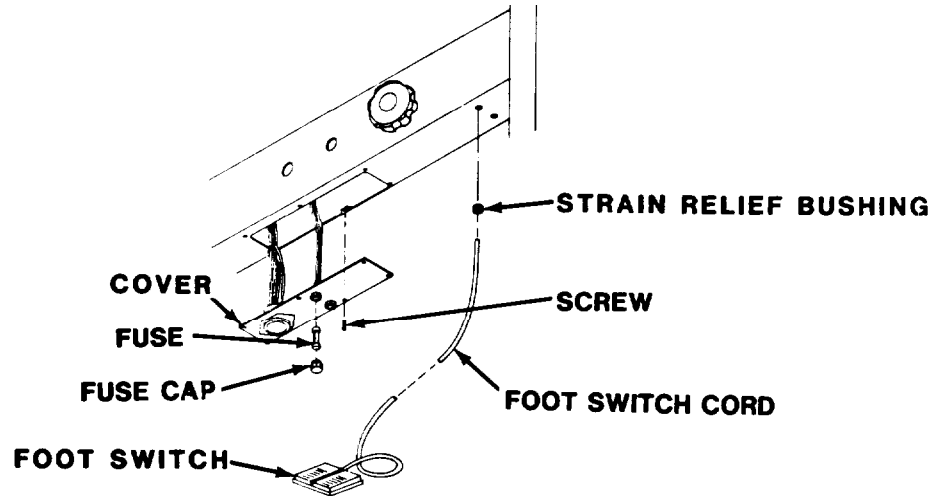
- a. Install new power cord through hole in crosspiece assembly.
- b. Connect wires to ground and fuse holders.
- c. Reinstall strain relief bushing on power cord.
- d. Reinstall cover on underside of crosspiece assembly, and secure with six screws.
- e. Reinstall fuses and fuse caps.
- f. Plug in below-stage illuminator cord.
- g. Plug in power cord, and turn power ON.

4-14.4 Replace Foot Switch

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-inch flat-tip screwdriver
Straight-nose pliers

MATERIALS/PARTS: Foot switch



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Unplug below-stage illuminator cord.
- c. Remove fuse caps and fuses.
- d. Remove six screws from cover on underside of crosspiece assembly.
- e. Release strain relief bushing on foot switch cord.
- f. Push foot switch cord into crosspiece assembly to allow for give.
- g. Tag and remove wires from foot switch cord.
- h. Remove foot switch cord through hole in crosspiece assembly.

4-14.4 Replace Foot Switch - Continued

INSTALLATION:

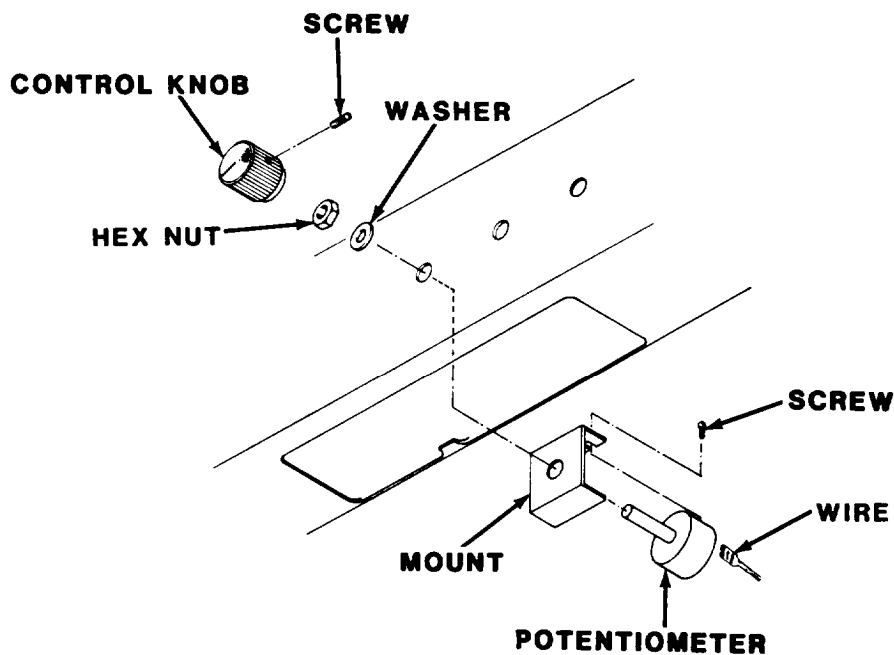
- a. Install cord for new foot switch through hole in crosspiece assembly.
- b. Connect wires to cord and remove tags.
- c. Reinstall strain relief bushing on foot switch cord.
- d. Reinstall cover on underside of crosspiece assembly, and secure with six screws.
- e. Reinstall fuses and fuse caps.
- f. Plug in below-stage illuminator cord.
- g. Plug in power cord, and turn power ON.

4-14.5 Replace Illuminator Control Potentiometer

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-inch flat-tip screwdriver
Socket head screw key set
9/16-inch combination box and open end wrench
Solder gun

MATERIALS/PARTS: Illuminator control potentiometer
Solder, item 87, appendix E



4-14.5 Replace Illuminator Control Potentiometer - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Unplug above-stage and table illuminator cords.
- c* Remove six screws from cover on underside of crosspiece assembly. Move cover to allow access to potentiometer.
- d. Loosen two socket-head screws on illuminator control knob. Remove hex nut and washer. Remove knob.
- e. Remove potentiometer through underside of crosspiece assembly.
- f. Loosen screw on potentiometer and remove mount.
- g. Tag and desolder wires.

INSTALLATION:

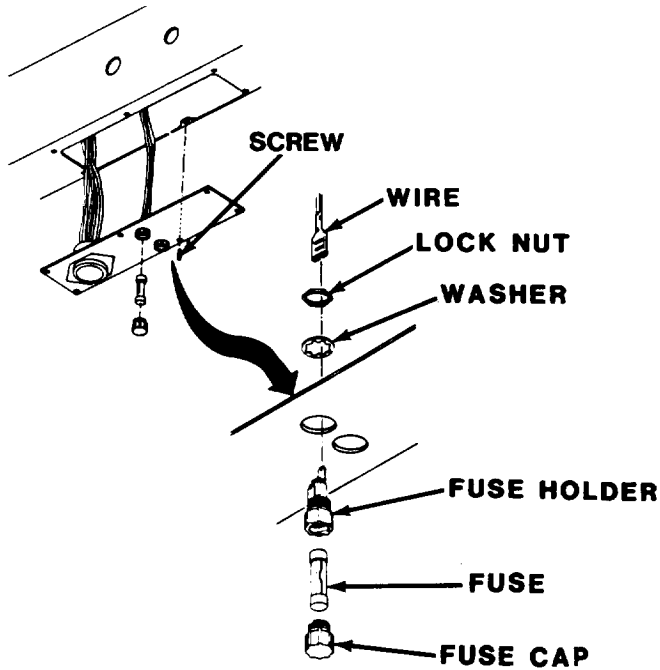
- a. Solder wires to new potentiometer and remove tags.
- b. Reinstall mount and tighten screw.
- c. Position potentiometer in crosspiece assembly.
- d. Reinstall washer and hex nut. Reinstall knob and tighten socket-head screws.
- e. Reinstall cover on underside of crosspiece assembly, and secure with six screws.
- f. Plug in above-stage and table illuminator cords.
- g. Plug in power cord, and turn power ON.

4-14.6 Replace Fuse Holder

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-inch flat-tip screwdriver
9/16-inch combination box and open end wrench

MATERIALS/PARTS: Fuse holder



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Unplug below-stage illuminator cord.
- c. Remove fuse caps and fuses.
- d. Remove six screws from cover on underside of crosspiece assembly. Move cover to allow access to fuse holder.
- e. Tag and remove wires from fuse holder.
- f. Remove lock nut and washer securing fuse holder to crosspiece assembly. Remove fuse holder.

4-14.6 Replace Fuse Holder - Continued

INSTALLATION:

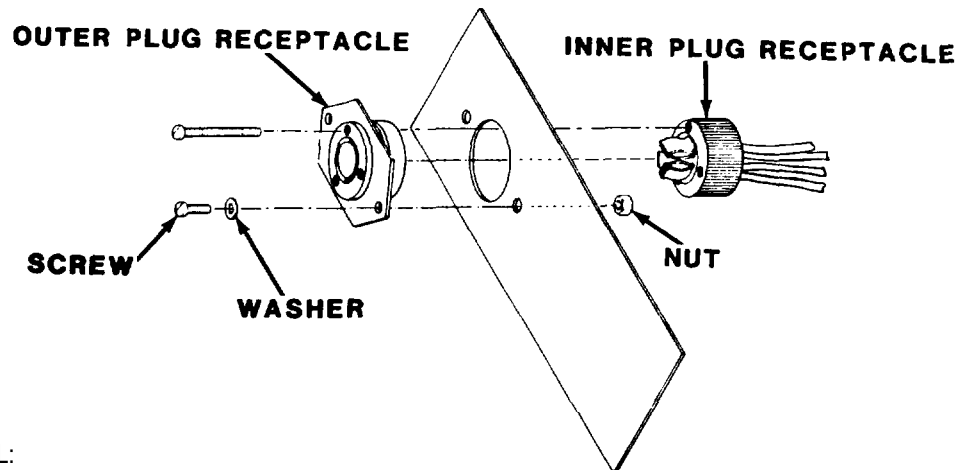
- a. Install new fuse holder and secure with washer and lock nut.
- b. Connect wires to fuse holder and remove tags.
- c. Reinstall cover on underside of crosspiece assembly, and secure with six screws.
- d. Reinstall fuses and fuse caps.
- e. Plug in below-stage illuminator cord.
- f. Plug in power cord, and turn power ON.

4-14.7 Replace Illuminator Plug Receptacle

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64-inch flat-tip screwdriver

MATERIALS/PARTS: Illuminator plug receptacle



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.

4-14.7 Replace Illuminator Plug Receptacle - Continued

- b. Unplug illuminator cord(s).
- c. Remove fuse caps and fuses, if necessary.
- d. Remove six screws from cover on underside of crosspiece assembly.
- e. Remove three screws, securing outer plug receptacle to inner plug receptacle.
- f. Remove two screws, washers, and nuts securing outer plug receptacle to cover.
- g. Tag wires and remove from inner plug receptacle, by loosening three screws.

INSTALLATION:

- a. Remove three screws securing new outer plug receptacle to new inner plug receptacle.
- b. Connect wires to new inner plug receptacle and tighten three screws. Remove tags.
- c. Install new outer plug receptacle on cover, and secure with two screws, washers, and nuts.
- d. Connect inner and outer plug receptacles and secure with three screws.
- e. Reinstall cover on underside of crosspiece assembly, and secure with six screws.
- f. Reinstall fuses and fuse caps, if removed.
- g. Plug in illuminator cord(s).
- h. Plug in power cord, and turn power ON.

4-14.8 Replace Illuminator Selector Switch

PERSONNEL REQUIRED: 1 Topographic repair specialist MOS 41B

TOOLS: Socket head screw key set
Solder gunMATERIALS/PARTS: Illuminator selector switch
Solder, item 87, appendix E

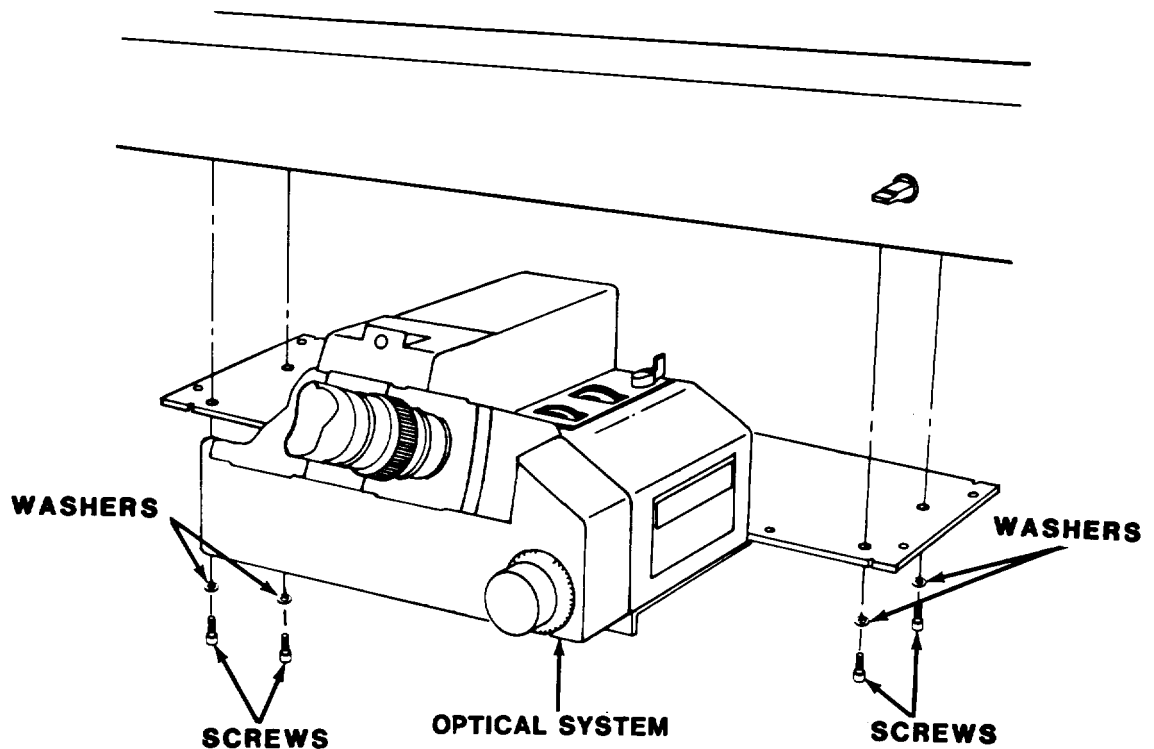
REMOVAL:

WARNING

ELECTRICAL SHOCK

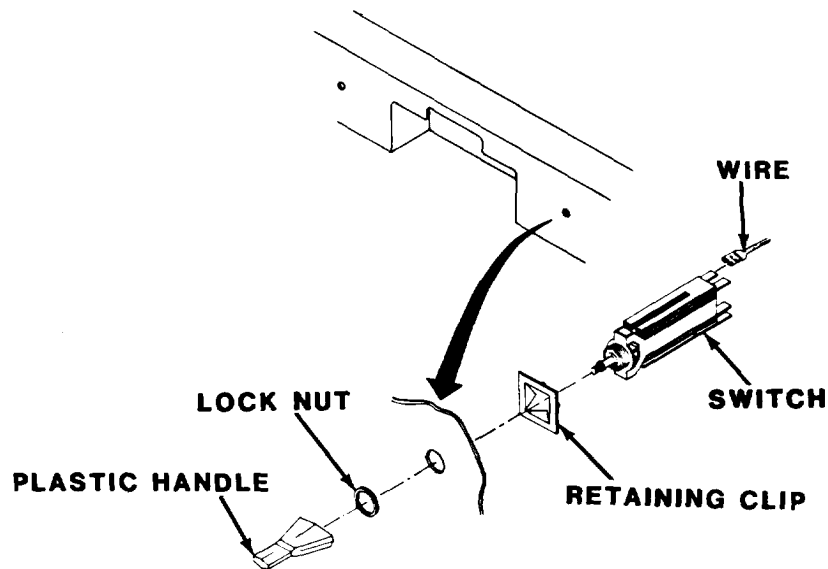
Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.



- b. Remove four socket-head screws and washers, securing optical system to underside of crosspiece assembly.

4-14.8 Replace Illuminator Selector Switch - Continued



- c. Unscrew plastic handle from switch.
- d. Remove lock nut and retaining clip.
- e. Remove switch through underside of crosspiece assembly.
- f. Tag and desolder wires from switch.

INSTALLATION:

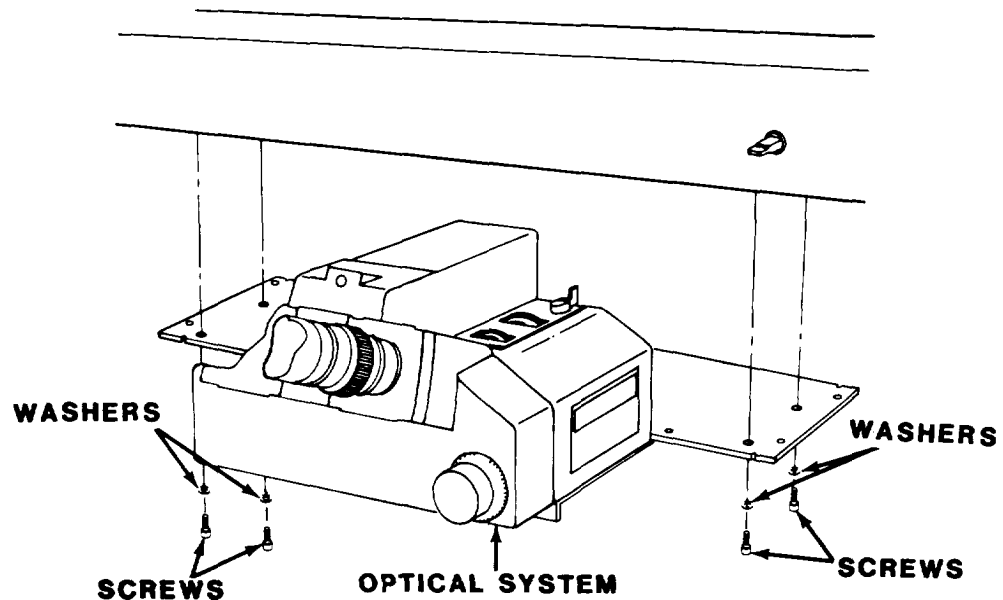
- a. Solder wires to new switch and remove tags.
- b. Position switch in crosspiece assembly.
- c. Reinstall retaining clip and lock nut.
- d. Reinstall plastic handle on switch.
- e. Reinstall optical system, and secure with four washers and socket-head screws.
- f. Plug in power cord, and turn power ON.

4-14.9 Replace Optical System

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: Socket head screw key set

MATERIALS/PARTS: Optical system



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the zoom transfer scope. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Remove four socket-head screws and washers, securing optical system to bottom of crosspiece assembly.

INSTALLATION:

- a. Install new optical system and secure with four washers and socket-head screws.
- b. Plug in power cord, and turn power ON.

4-15 PREPARATION FOR STORAGE OR SHIPMENT.

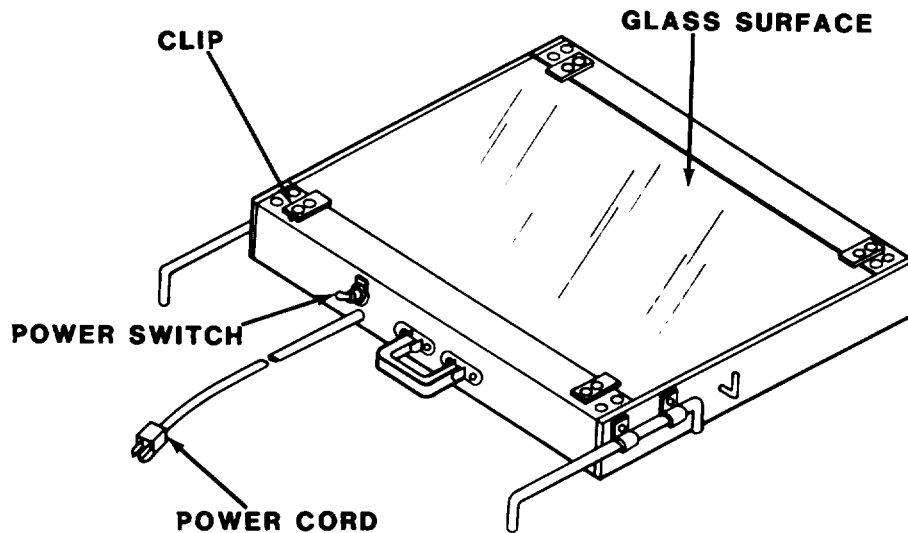
In the event that the zoom transfer scope must be removed from the section for repair or replacement, refer to TM 740-90-1 for storage instructions.

CHAPTER 5

PORTABLE TRACING/SCRIBING BOARD

Section I. INTRODUCTION

5-1 GENERAL INFORMATION.



5-1.1 Scope

Model Number and Equipment Name:

Model 51J3 Portable Tracing/Scribing Board

Purpose of Equipment: To provide illuminated work surface for tracing or scribing.

5-2 DESCRIPTION AND DATA.

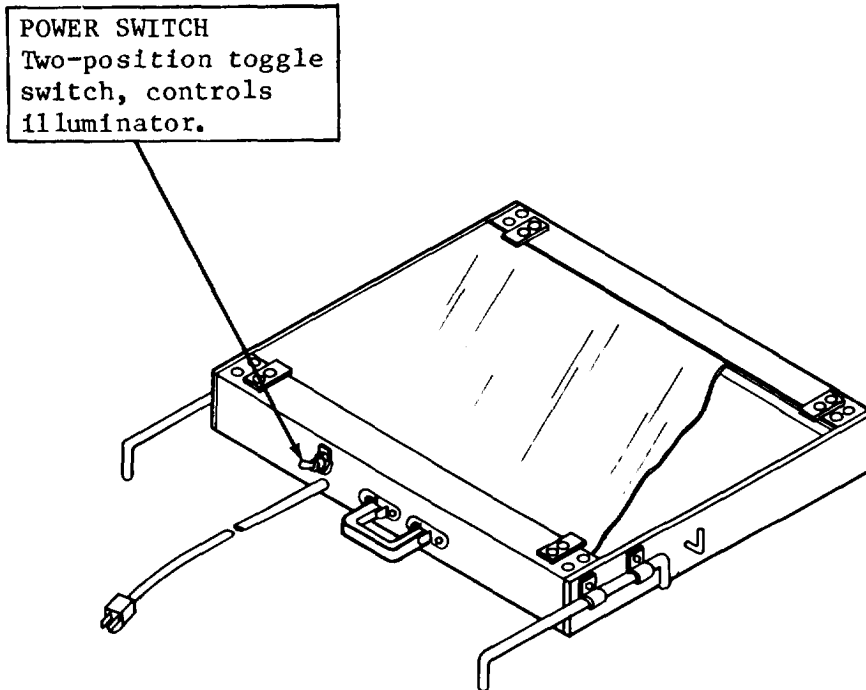
5-2.1 Equipment Characteristics, Capabilities, and Features. Provides lightweight, portable, and diffused light source. Used as work surface for tracing or scribing.

5-2.2 Equipment Data

Power requirements	110 vat, 60 Hz
Illumination	Two 30 w fluorescent lamps
Work surface	36 in. x 23.5 in. (91.44 cm x 59.69 cm)

Section II. OPERATING INSTRUCTIONS

5-3 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS.



5-4 OPERATOR PREVENTIVE MAINTENANCE AND SERVICE (PMCS).

5-4.1 General. The portable tracing/scribing board must be regularly inspected to find and correct defects.

5-4.1.1 Before You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your BEFORE (B) PMCS.

5-4.1.2 While You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your DURING (D) PMCS.

5-4.1.3 After You Operate. Be sure to perform your AFTER(A) PMCS.

5-4.1.4 If Your Equipment Fails To Operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

5-4.2 PMCS Procedures

5-4.2.1 PMCS are designed to keep the equipment in good working condition by performing periodic service tasks.

5-4.2.2 Service intervals provide you, the operator, with time schedules that determine when to perform specified service tasks.

5-4.2.3 The "Equipment Is Not Ready/Available If" Column is used for identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.

5-4.2.4 If your equipment fails to operate after PMCS is performed, immediately report this condition to your supervisor.

5-4.3 PMCS Columnar Entries

5-4.3.1 Item Number Column. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for your "TM number" Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.

5-4.3.2 Interval Column. This column determines the time period designated to perform your PMCS.

5-4.3.3 Item To Be Inspected and Procedures Column. This column lists functional groups and their respective assemblies and subassemblies as shown in the Maintenance Allocation Chart (Appendix B). The appropriate check or service procedure follows the specific item to be inspected.

5-4.3.4 Equipment Is Not Ready/Available If: Column. This column indicates the reason or cause why your equipment is not ready/available to perform its primary mission.

Table 5-1. Operator Preventive Maintenance Checks and Services

B - Before Operation

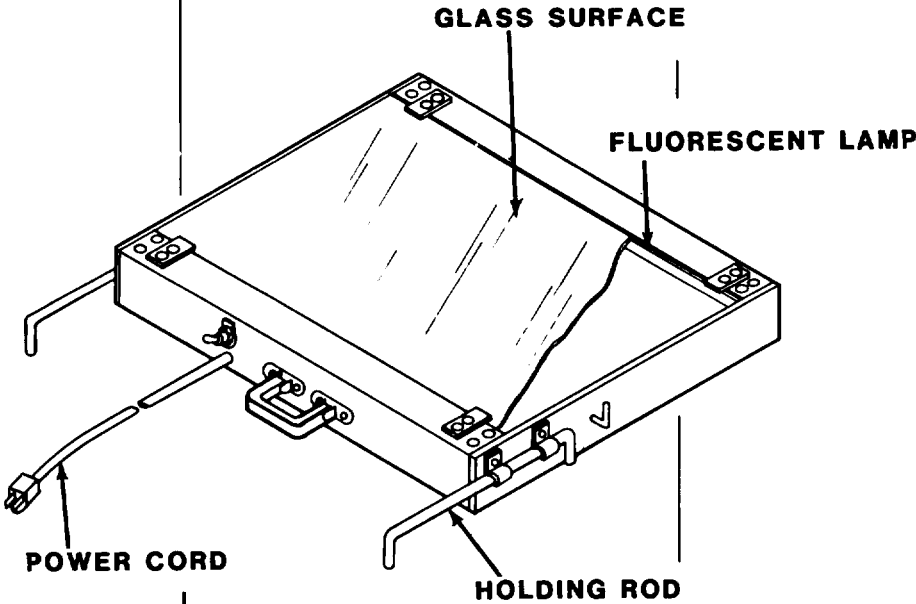
Item No.	Interval <u>B</u>	ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
1		 <p style="text-align: center;"><u>WARNING</u> ELECTRICAL SHOCK</p> <p>Unplug power cord before servicing portable tracing/scribing board. Failure to do so may result in death or serious injury.</p> <ul style="list-style-type: none"> ● HOLDING ROD. Rotate each holding rod to check for freedom of movement. 	

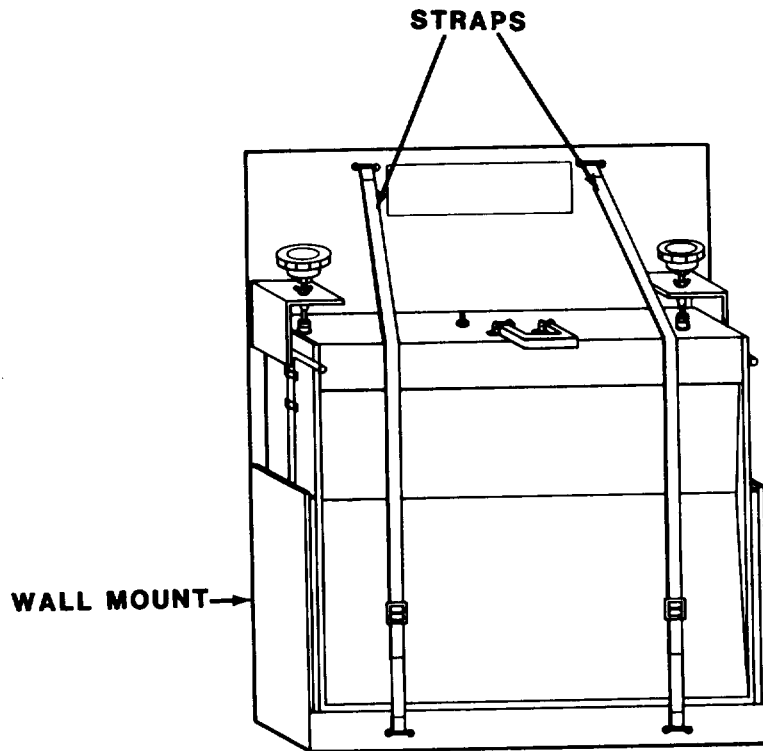
Table 5-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation

Item No.	Interval	ITEM TO BE INSPECTED	Equipment Is Not Ready/Available If:
	B	PROCEDURE	
2	●	POWER CORD. Check power cord for kinks, frays, or burns. If power cord is defective, notify organizational maintenance.	Power cord is damaged.
3	●	FLUORESCENT LAMPS. Check lamps for partial lighting. Replace as needed (para 5-8.2).	Fluorescent lamp is damaged.
4	●	GLASS SURFACE. Check glass surface for dust and dirt. Wipe glass surface with moistened cotton cloth (item 16, appendix). Wipe surface with clean dry cotton cloth (item 16, appendix E) to remove smears or streaks. Check glass surface for cracks or breaks. Replace as needed (para 5-8.4).	Glass surface is broken.

5-5 OPERATION UNDER USUAL CONDITIONS.

5-5.1 Assembly and Preparation for Use



- a. Remove portable tracing/scribing board from wall mount by loosening straps. Place board on work surface.
- b. Plug in power cord, and turn power ON.

5-5.2 Preparation for Movement

- a. Turn power OFF, and unplug power cord.
- b. Place board in wall mount with glass surface facing padded mount.
- c. Secure board in wall mount with straps.

Section III. OPERATOR MAINTENANCE**5-6 LUBRICATION INSTRUCTIONS.**

This equipment does not require lubrication.

5-7 OPERATOR TROUBLESHOOTING PROCEDURES.**5-7.1 General**

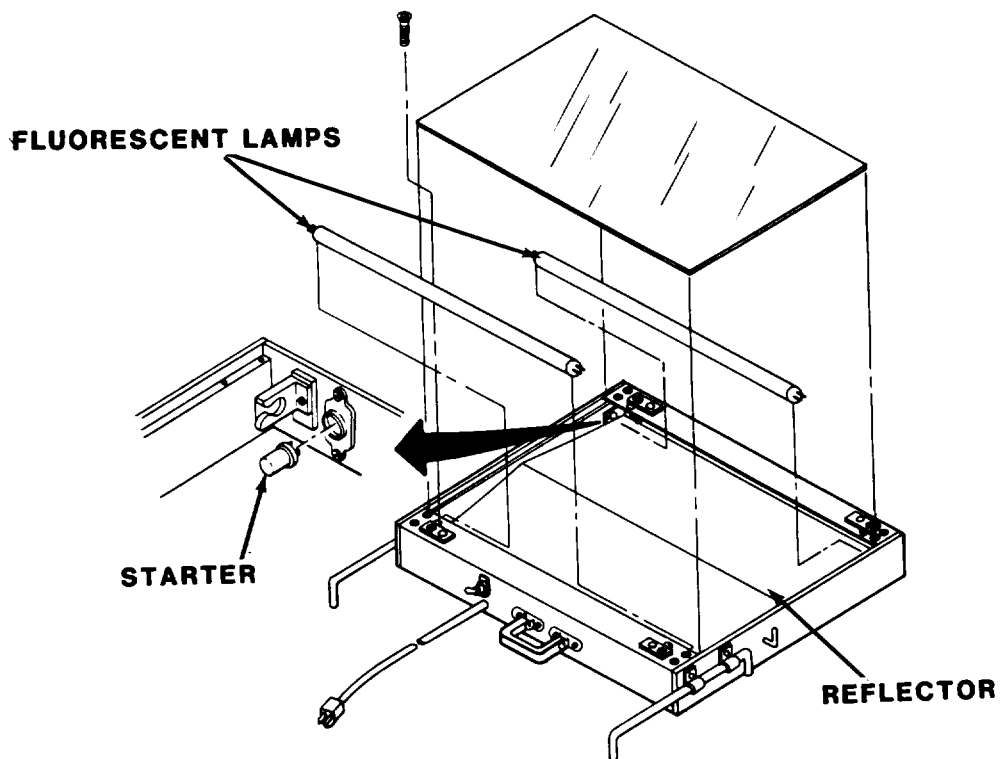
5-7.1.1 The table lists the common malfunctions which you may find during the operation or maintenance of the portable tracing/scribing board or its components. You should perform the tests/inspections and corrective actions in the order listed.

5-7.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 5-2. Operator Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

ILLUMINATION UNEVEN.



WARNING

ELECTRICAL SHOCK

Use care when power is connected during inspections or corrective actions. Death or serious injury may result.

Step 1. Check to see if reflector behind fluorescent lamps is dirty.

Clean reflector (para 5-8.1).

Table 5-2. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

ILLUMINATION UNEVEN - Continued

Step 2. Check to see if one fluorescent lamp is partially lighted or is dark.

Replace lamp (para 5-8.2).

Step 3. Check to see if either fluorescent lamp is partially lighted.

Replace defective starter (para 5-8.3).

5-8 OPERATOR MAINTENANCE PROCEDURES.

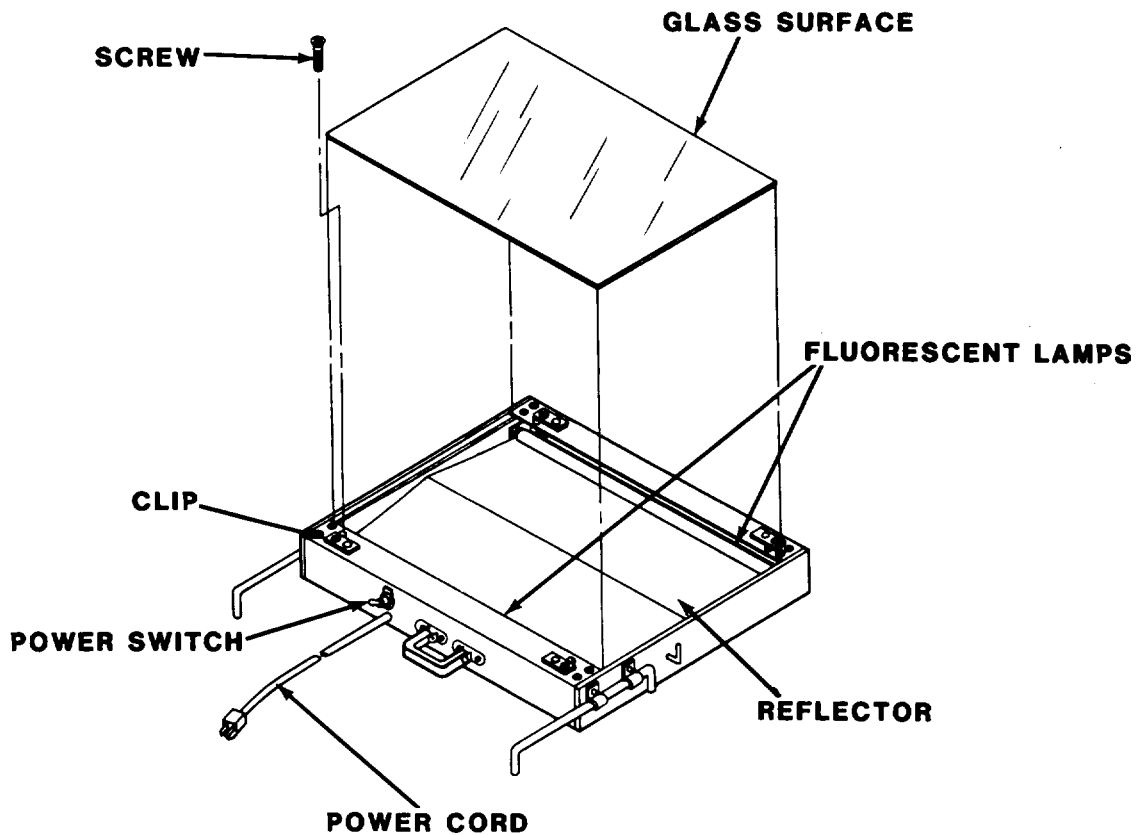
This section contains step-by-step instructions covering operator performed maintenance functions.

5-8.1 Clean Reflector

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: No. 2 cross-tip screwdriver
Vacuum cleaner

MATERIALS/PARTS: Cotton cloth, item 16, appendix E



5-8.1 Clean Reflector - Continued**WARNING**

ELECTRICAL SHOCK

Unplug power cord before servicing the portable tracing/scribing board. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Remove one screw from each of four clips. Loosen other screws.
- c. Turn clips 90° to right or left.
- d. Remove glass surface.
- e. Vacuum reflector surface and fluorescent lamps with brush attachment on vacuum cleaner.

NOTE

Be sure lamps are secure in their sockets.

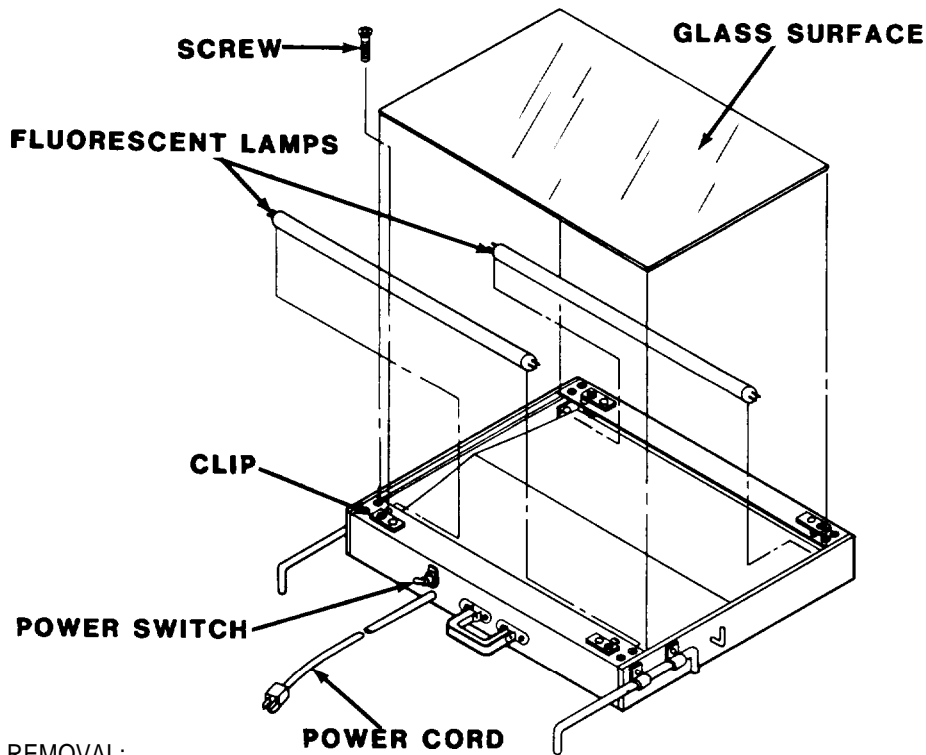
- f. Wipe reflector and lamps with moistened cotton cloth (item 16, appendix E).
- g. Wipe or vacuum both sides of glass surface.
- h. Reinstall glass surface.
- i. Turn clips to secure glass surface. Aline holes, and reinstall screws. Tighten all screws.
- j. Plug in power cord, and turn power ON.

5-8.2 Replace Fluorescent Lamp

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: No. 2 cross-tip screwdriver

MATERIALS/PARTS: Fluorescent lamp (30 w)



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the portable tracing/scribing board. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Remove one screw from each of four clips. Loosen other screws.
- c. Turn clips 90° to right or left.
- d. Remove glass surface.
- e. Remove defective fluorescent lamp.

5-8.2 Replace Fluorescent Lamp - Continued

INSTALLATION:

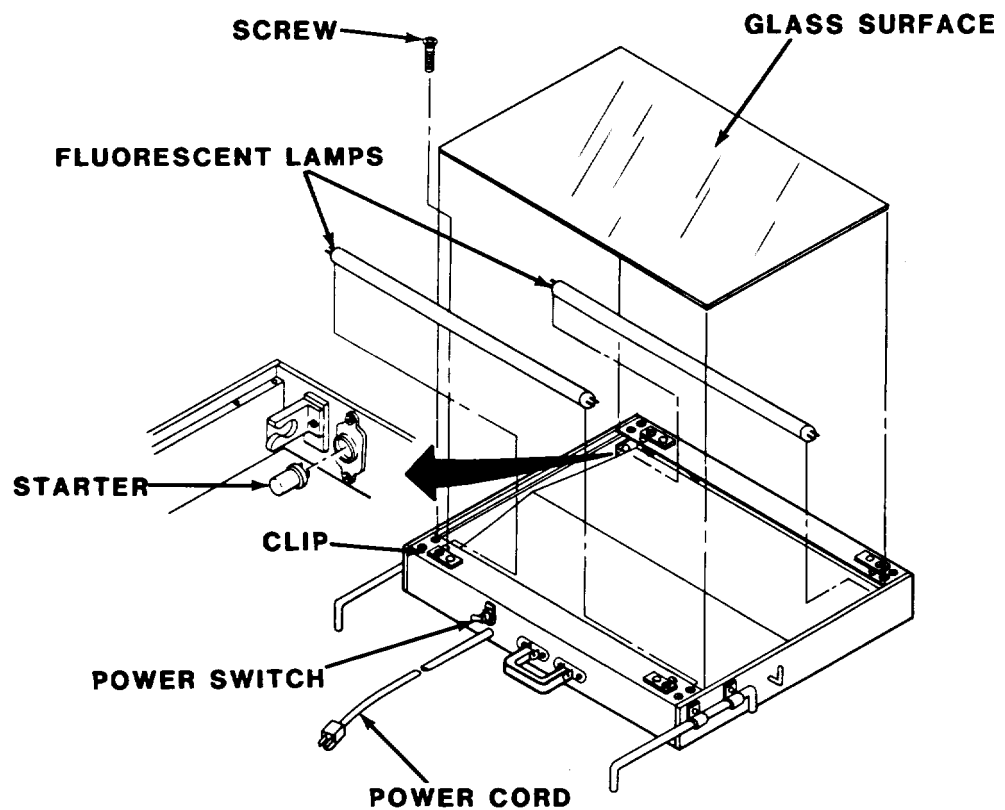
- a. Install new fluorescent lamp.
- b. Reinstall glass surface.
- c. Turn clips to secure glass surface. Aline holes, and reinstall screws. Tighten all screws.
- d. Plug in power cord, and turn power ON.

5-8.3 Replace Starter

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: No. 2 cross-tip screwdriver

MATERIALS/PARTS: Starter



5-8.3 Replace Starter - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the portable tracing/scribing board. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Remove one screw from each of four clips. Loosen other screws.
- c. Turn clips 90° to right or left.
- d. Remove glass surface.
- e. Remove fluorescent lamp in front of starter.
- f. Remove starter by pushing in and turning left until free.

INSTALLATION:

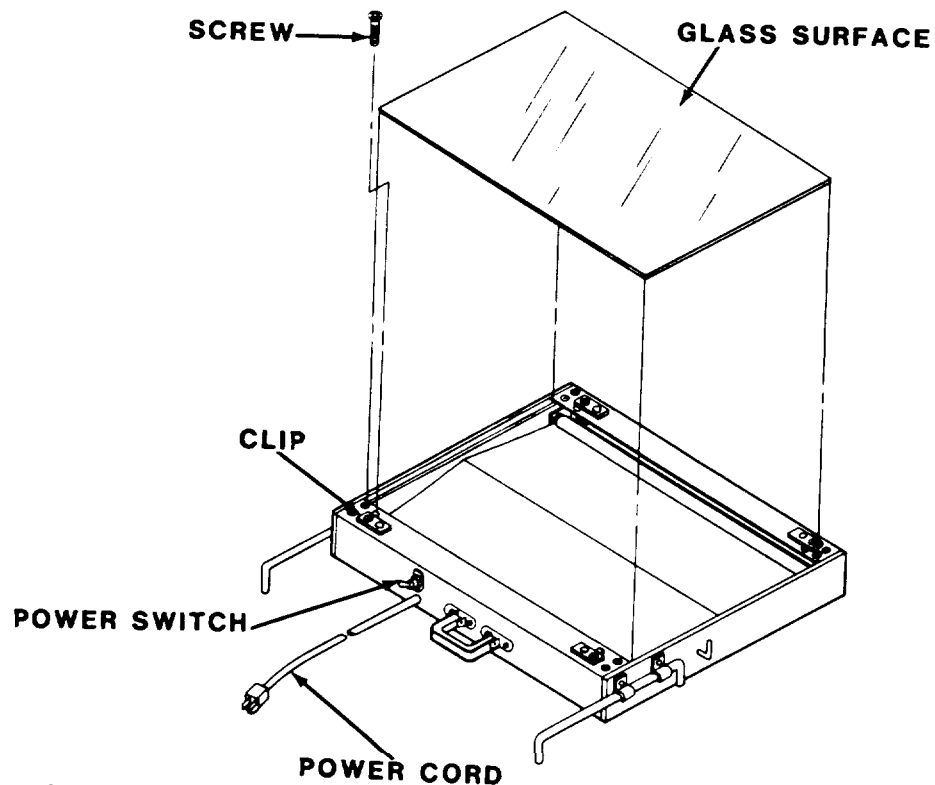
- a. Install new starter in socket by pushing in and turning right until locked.
- b. Reinstall fluorescent lamp.
- c. Reinstall glass surface.
- d. Turn clips to secure glass surface. Aline holes, and reinstall screws. Tighten all screws.
- e. Plug in power cord, and turn power ON.

5-8.4 Replace Glass Surface

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: No. 2 cross-tip screwdriver

MATERIALS/PARTS: Glass surface



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the portable tracing/scribing board. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Remove one screw from each of four clips. Loosen other screws.
- c. Turn clips 90° to left or right.

5-8.4 Replace Glass Surface - Continued

WARNING

Use care when handling damaged glass. Failure to do so may result in serious cuts.

- d. Remove damaged glass surface.

INSTALLATION:

- a. Install new glass surface.
- b. Turn clips to secure glass surface. Aline holes, and reinstall screws. Tighten all screws.
- c. Plug in power cord, and turn power ON.

Section IV. ORGANIZATIONAL MAINTENANCE

5-9 REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT.

5-9.1 For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

5-9.2 Special tools, TMDE, and support equipment required at the organizational level are indicated in Appendix B, Section III of this manual.

5-9.3 Repair parts are listed and illustrated in the Repair Parts and Special Tools List (TM5-6675-326-24P) covering organizational maintenance for this equipment.

5-10 ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

There are no PMCS at the organizational level for the portable tracing/scribing board.

5-11 ORGANIZATIONAL TROUBLESHOOTING.

There is no troubleshooting at the organizational level for the portable tracing/scribing board.

5-12 ORGANIZATIONAL MAINTENANCE PROCEDURES.

This section contains step-by-step instructions covering organizational maintenance procedures.

NOTE

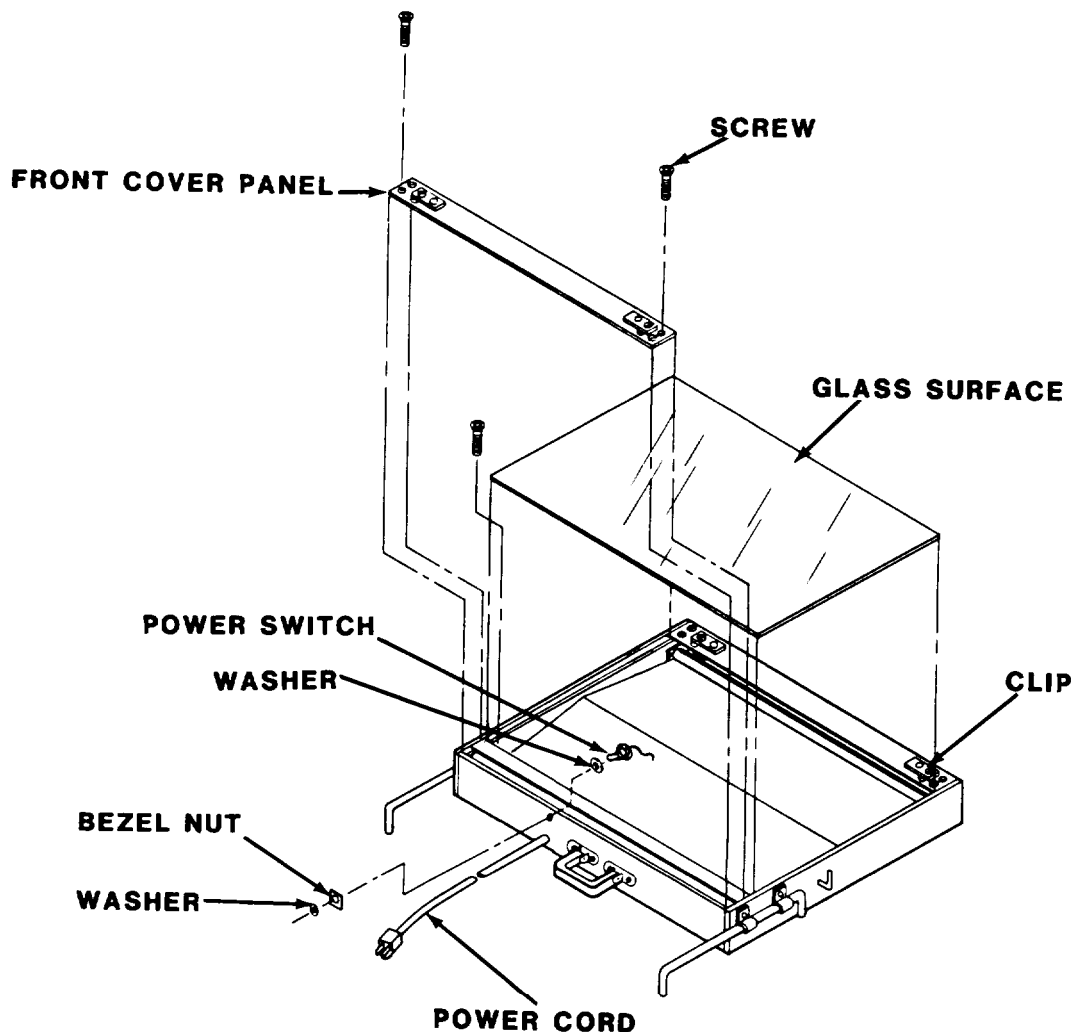
The maintenance procedures for the portable tracing/scribing board consist of replacing three different electrical components. A multimeter is needed to determine which component is defective and needs replacement.

5-12.1 Replace Power Switch

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: No. 2 cross-tip screwdriver

MATERIALS/PARTS: Power switch
Ballpoint pen



5-12.1 Replace Power Switch - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the portable tracing/scribing board. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Remove one screw from each of four clips. Loosen other screws.
- c. Turn clips 90° to left or right.
- d. Remove glass surface and set aside.
- e. Remove screws and front cover panel.
- f. Remove washers and bezel nut from power switch.

NOTE

Ground wire is not connected to switch.
Mark position for reinstallation.

- g. To remove defective power switch, pull to inside of board. Tag and disconnect wires.
- h. Remove defective switch.

INSTALLATION:

- a. Connect wiring, and remove tags on new power switch to install.
- b. Reinstall washers and bezel nut. Adjust for proper positioning of power switch.
- c. Reinstall front cover panel and secure with screws.
- d. Reinstall glass surface.
- e. Turn clips 90° to secure glass surface.

5-12.1 Replace Power Switch - Continued

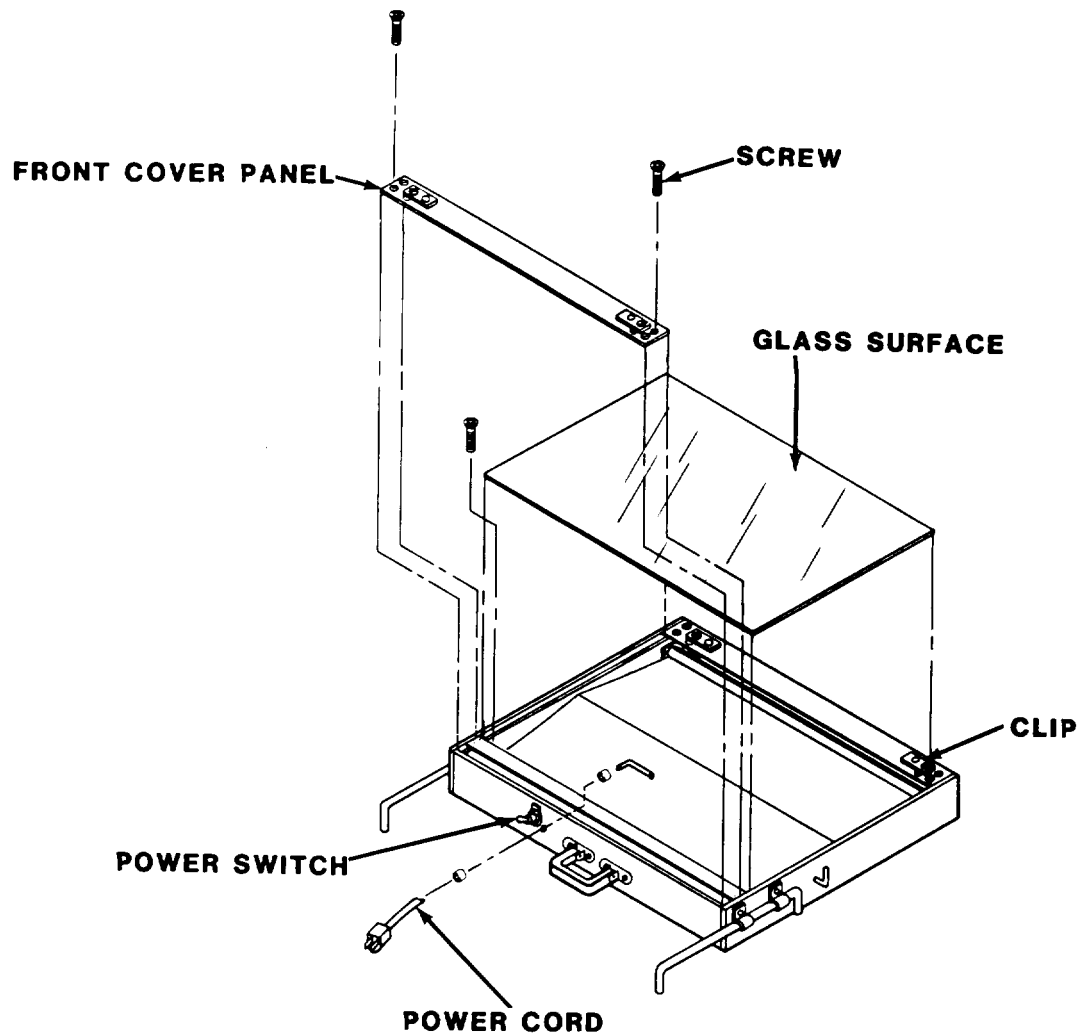
- f. Reinstall screws on clips. Tighten all screws.
- g. Plug in power cord, and turn power ON.

5-12.2 Replace Power Cord

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: No. 2 cross-tip screwdriver
Needle-nose pliers

MATERIALS/PARTS: Power cord



5-12.2 Replace Power Cord - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the portable tracing/scribing board. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Remove one screw from each of four clips. Loosen other screws.
- c. Turn clips 90° to left or right.
- d. Remove glass surface and set aside.
- e. Remove screws and front cover panel.
- f. Tag and disconnect wires to remove defective power cord.
- g. Remove inner and outer strain relief bushings.

INSTALLATION:

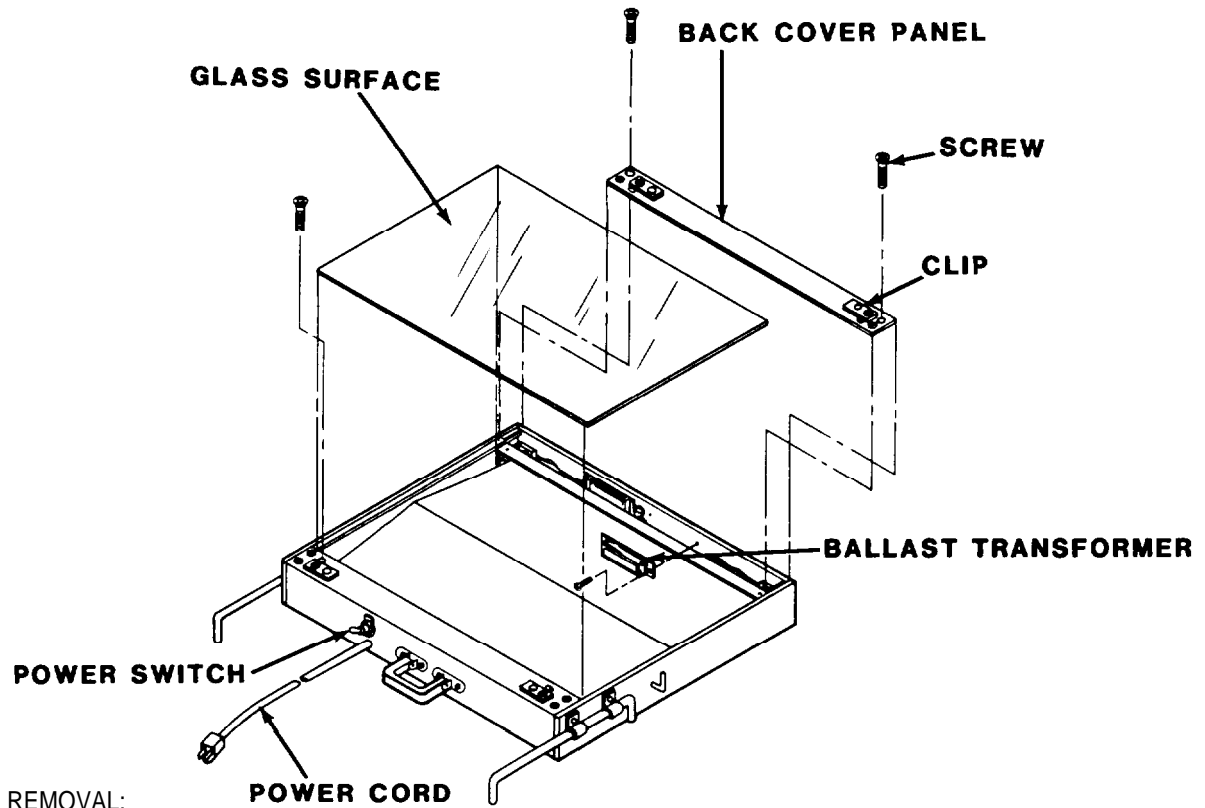
- a. Reinstall inner and outer strain relief bushings on new power cord.
- b. To install, connect wires to power cord, and remove tags.
- c. Reinstall front cover panel, and secure with screws.
- d. Reinstall glass surface.
- e. Turn clips 90° to secure glass surface.
- f. Reinstall screws on clips. Tighten all screws.
- g. Plug in power cord, and turn power ON.

5-12.3 Replace Ballast Transformer

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: No. 2 cross-tip screwdriver

MATERIALS/PARTS: Ballast transformer



REMOVAL:

WARNING**ELECTRICAL SHOCK**

Unplug power cord before servicing the portable tracing/scribing board. Failure to do so may result in death or serious injury.

- a. Turn power OFF, and unplug power cord.
- b. Remove one screw from each of four clips. Loosen other screws.
- c. Turn clips 90° to left or right.

5-12.3 Replace Ballast Transformer - Continued

- d. Remove glass surface and set aside.
- e. Remove screws and back cover panel.
- f. Remove screws and defective ballast transformer.
- g. Disconnect and tag wires from ballast transformer.

INSTALLATION:

- a. Connect wiring on new ballast transformer, and remove tags.
- b. Install new ballast transformer, and secure with screws.
- c. Reinstall back cover panel, and secure with screws.
- d. Reinstall glass surface.
- e. Turn clips 90° to secure glass surface.
- f. Reinstall screws on clips. Tighten all screws.
- g. Plug in power cord, and turn power ON.

5-13 PREPARATION FOR STORAGE OR SHIPMENT.

In the event that the portable tracing/scribing board must be removed from the section for repair or replacement, refer to TM 740-90-1 for storage instructions.

Section V. DIRECT/GENERAL SUPPORT MAINTENANCE

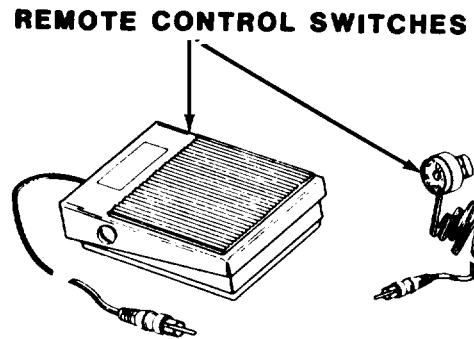
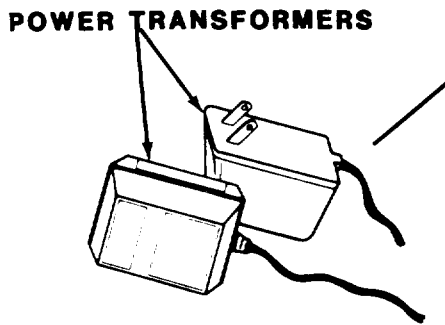
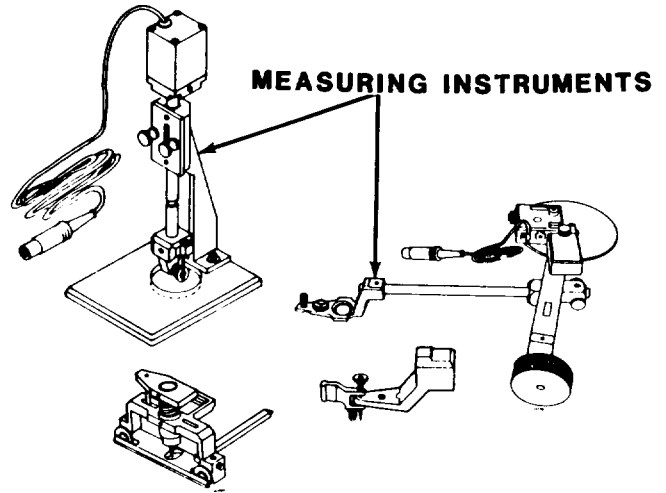
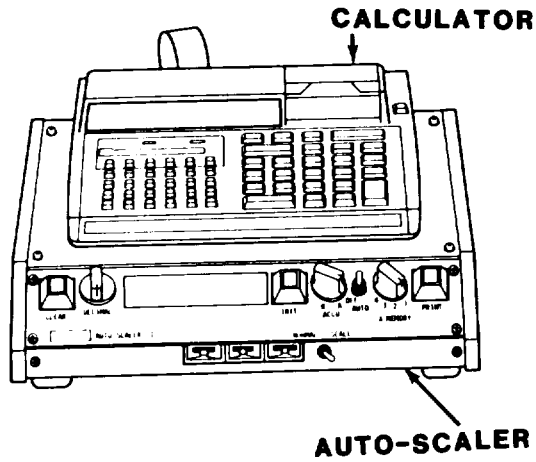
5-14 There are no assigned direct/general support maintenance tasks for this equipment.

CHAPTER 6

QUANTITY PROCESSING SYSTEM (QPS)

Section I. INTRODUCTION

6-1 GENERAL INFORMATION.



6-1.1 Scope

Model Number and Equipment Name:

Model L2501 Quantity Processing System (QPS)

Purpose of Equipment: To provide electronic estimation, in proper units and scale, of area, perimeter, distance, and volume of geographic shapes found on maps, drawings, aerial photographs, etc.

6-1.2 Reference Information

Numerical values shown on the Calibration Records Sheet, which is provided with your QPS, must be used to successfully operate the equipment.

6-1.3 Glossary

Constant	Factor used to convert electronic measurement counts of the planimeter or linear measuring probe, to needed unit of measurement.
Contour	Closed loop on contour map. Indicates height by interval.
Contour interval	Difference in elevation of two consecutive contour lines.
Contour method	Estimates volume of fill or cut from its contours.
Cut	Excavation or depression-like formation.
Daylighted contour	Point or edge where cut becomes fill or fill becomes cut.
Fill	Embankment or hilly formation.
Planimeter	Instrument that provides data used to estimate area of geographic shape by tracing its boundary line.
QPS	Quantity Processing System.
R_L or R_2	Alinement reading of linear measuring probe representing total number of pulse counts emitted by probe, per unit of length.
R_T or R_1	Alinement reading of planimeter representing total number of pulse counts derived by measuring area described by test rule.
Scale ratio	Ratio between given distance on map or drawing to corresponding distance on ground.

6-1.3 Glossary - Continued

Slope	Natural or artificial incline or slant of ground.
Subroutine	Distinct routine or program. Part of larger routine or program that will perform its own distinct functions when used.
Test rule	Device used to aline planimeter and obtain a constant factor.
	Resolution factor for linear measuring probe or planimeter at specified tracer are length. Represents smallest length or area, measuring instrument can measure. Measuring instrument emits single pulse count for each μ unit.

6-2 EQUIPMENT DESCRIPTION AND DATA.

6-2.1 Equipment Characteristics, Capabilities, and Features. Provides electronic estimation, in scale, of area, perimeter, distance, and volume of geographic shapes on maps, drawings, aerial photographs, etc. The equipment has the following capabilities and features:

Calculator provides for data storage and manipulation.

Automatically estimates distance, area, or volume as measuring instrument is moved.

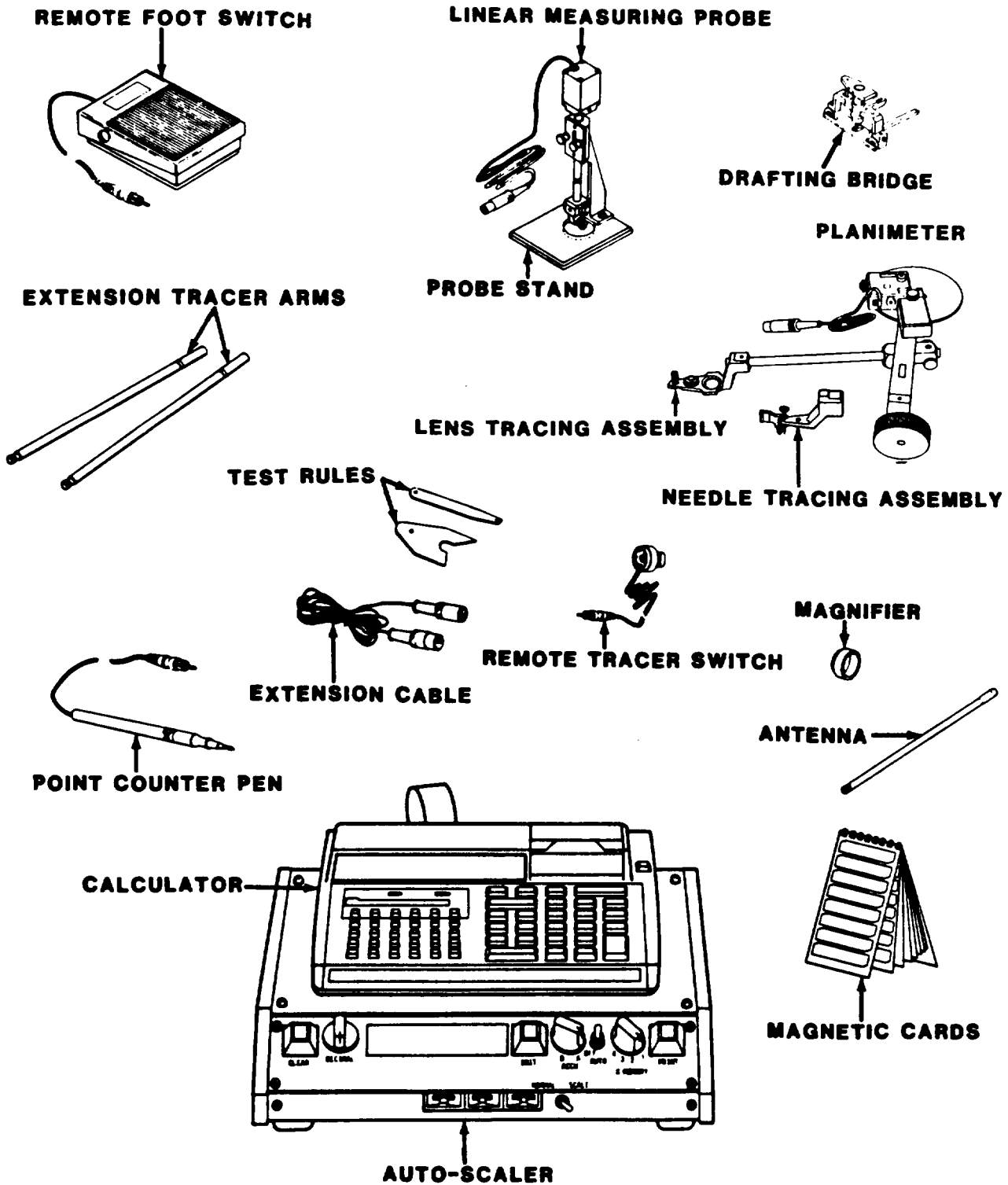
Displays results of measurements in proper scale and units.

Calculator prints measurement automatically or on command. █

Planimeter provides for measurement of surface areas and volume.

Linear measuring probe provides for measurement of distances.

6-2.2 Location and Description of Major Components



6-2.2 Location and Description of Major Components - Continued

AUTO-SCALER. Counts pulses from measuring instruments. Displays count. Interfaces with calculator.

CALCULATOR. Calculates measurements according to program data. Displays results of measurements. Prints measurement results.

PLANIMETER. Wheel mounted measuring instrument. Measures surface area and volume.

LINEAR MEASURING PROBE. Hand held or stand held measuring instrument. Measures distance.

PROBE STAND. Metal stand that holds linear measuring probe to secure its fixed position during measurements.

DRAFTING BRIDGE. Provides mount for planimeter encoder for use during measurements or detailed layout work.

POINT COUNTER PEN. Pen that contains transducer. Pen emits one pulse for each stroke (count) made during count measurement.

REMOTE FOOT SWITCH. Enables operator to remotely control four auto-scaler functions: Print, Clear, Actuate, or Initialize.

EXTENSION CABLE. Used with planimeter to extend its reach.

TEST RULES. Metal plates of specific lengths. Used for alinement and testing of planimeter.

PREPROGRAMMED CARDS. Magnetic cards containing instructions to calculate, store, print, and display measurement input.

MAGNETIC CARDS. Blank cards used for recording original programs.

REMOTE TRACER SWITCH. Mounted on planimeter or drafting bridge. Enables operator to remotely control four auto-scaler functions: Print, Clear, Actuate, or Initialize. Provides remote operation of auto-scaler command switches.

ANTENNA. Holds signal cables out of way of plantimeter.

MAGNIFIER. Placed over lens of lens tracing assembly to improve visibility of fine lines.

NEEDLE TRACING ASSEMBLY. Assembly mounted on end of planimeter tracer arm. Used to provide polar compensation in tracing measurements.

LENS TRACING ASSEMBLY. Assembly mounted on end of planimeter tracer arm. Traces lines by centering with a small dot printed on center of lens.

EXTENSION TRACER ARMS. Extend reach of planimeter tracing assembly.

6-2.2 Location and Description of Major Components - Continued

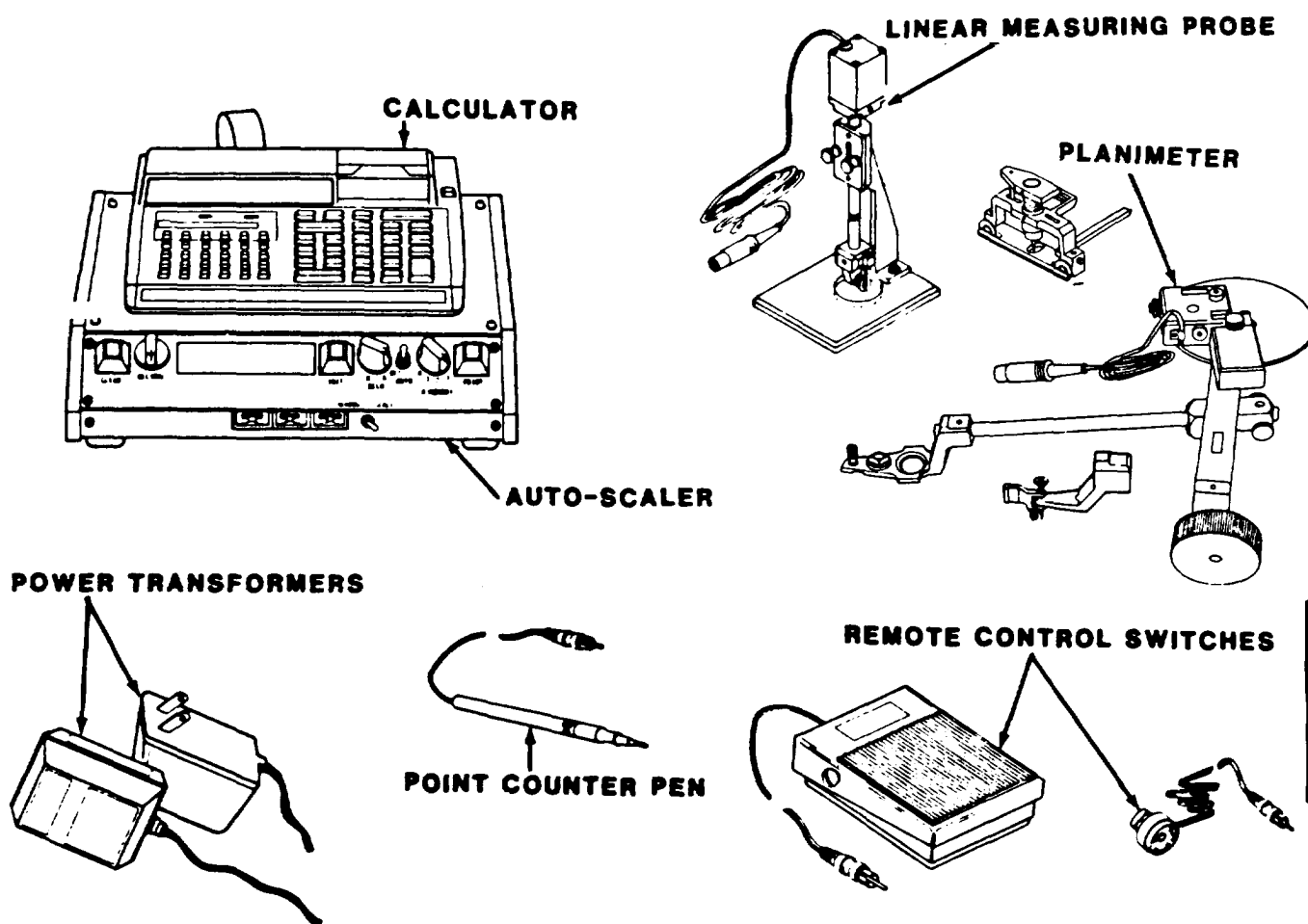
6-2.3 Equipment Data

Quantity Processing System total weight	25 lbs (11.4 kg)
Power requirements	
Calculator	110 vac, 60 Hz
Auto-scaler	110 vac, 60 Hz
Linear measuring probe	
Weight	0.25 lb (0.11 kg)
Smallest measurable length	0.0014 in. (.0036 cm)
Planimeter	
Weight	12 lbs (5.4 kg)
Maximum reach of tracer arm	45 in. (114.3 mm)
Smallest measurable length	0.002 in. 0.0051 cm)
Smallest measurable area	0.0017 in. ² (0.011 cm ²)
Calculator	
Weight	2.5 lbs (1.14 kg)
Number of memory registers	26
Program length	224 steps max
Operating time with battery	3 to 6 hours max
Battery charge time	6 hours (calculator OFF) 17 hours (calculator ON)

6-3 TECHNICAL PRINCIPLES OF OPERATION.

The QPS consists of five major components which interface with each other. The calculator can be used independently from the system. When used as a total system the QPS can provide advanced measurement capabilities. The five major components of the QPS are the auto-scaler, calculator, linear measuring probe, planimeter, and a point counter pen.

6-3 TECHNICAL PRINCIPLES OF OPERATION - Continued



6-3.1 Measuring Instruments. Provide an approximate measurement of a line or area by translating the movement of measuring instruments during tracing into electronic pulses. Measurement pulses (counts) are emitted as long as the measuring instrument is moving. The pulses (counts) are sent to the auto-scaler. There are four measuring instruments: planimeter, linear measuring probe, point counter pen, and drafting bridge.

6-3.1.1 Planimeter. Used to trace the perimeter or boundary line of a plane figure. Pulses emitted during tracing are sent to the auto-scaler and counted. The count is then used in calculating the estimated area or volume measurement of the figure.

6-3.1.2 Linear Measuring Probe. Used to measure the length (distance) of curved or straight lines. The linear measuring probe emits pulses per unit of length measured. The pulses are sent to the auto-scaler and counted. The count is then used in calculating the estimated length or distance of line measured.

6-3.1.3 Point Counter Pen. Used to count items of a similar type found on a map, blueprint, plan, etc. Each time the point counter pen is stroked in counting, the transducer in the pen emits a signal pulse which is sent to the auto-scaler for totaling.

6-3.1.4 Drafting Bridge. A layout instrument and mount for the encoder of the planimeter. When the encoder is moved from the planimeter and mounted on the drafting bridge, it can be used for linear measurement and detailed layout work.

6-3.2 Auto-Scaler. Processes pulses emitted by measuring instruments. The pulses are input into the rear of the auto-scaler through the applicable input jack (E₁, E₂, or POINT COUNT). There are two modes of entry to the auto-scaler, NORMAL and SCALE. This is determined by the NORMAL/SCALE switch. When switch is on NORMAL, pulses bypass the scaler circuit and are applied to the decade up/down counter. When the switch is on SCALE, pulses are first input into the scaler circuit before counting. The auto-scaler has five functional components: scaler, decade up/down counter, LED display, calculator interface circuit, and command switches.

6-3.2.1 Scaler. Enables operator to perform a scale reduction of the pulse count. When activated by NORMAL/SCALE switch, the scaler uses a correction constant to divide input pulses. The correction constant is input by setting dials. Pulses are then sent to the decade up/down counter.

6-3.2.2 Decade Up/Down Counter. Counts pulses received from the measuring instruments or scaler circuit. It counts up or down depending on the direction that the measuring instrument is moved. The pulse count is continuously output to the calculator interface circuit and scaler LED display.

6-3.2.3 LED Display. Displays current total of the decade up/down counter. The decimal place for the display is controlled by the DECIMAL switch.

6-3.2.4 Calculator Interface Circuit. Converts pulse count into data compatible with the calculator and transmits it through a ribbon cable to the calculator. Converts and transmits signals from the command switches. When switch is on AUTO, data is automatically and continuously transmitted to the calculator. When switch is on MAN, data is transmitted only when the Print command is received from the PRINT X command switch on the calculator.

6-3.2.5 Command Switches. Control the operating modes of the auto-scaler, data transmission, and remote operation of the calculator. There are six command switches: CLEAR, PRINT, INIT, X MEMORY, MAN/AUTO, and ACCU.

6-3.2.5.1 CLEAR. Command sent to clear LED display on calculator and LED display and decade up/down counter on auto-scaler.

6-3.2.5.2 PRINT. Command sent to signal calculator to implement instructions of subroutine E, stored in memory, which prints the pulse count data. PRINT also initiates transmission of that data for printing when auto-scaler is in MAN.

6-3.2.5.3 INIT. Command sent to signal calculator to implement subroutine D, which resets memory data registers for the next set of data.

6-3.2.5.4 X MEMORY. Has four settings: 1, 2, 3, and 4. Tells the calculator which primary register memory location (1, 2, 3, or 4), and its contents, is to be used in calculations.

6-3.2.5.5 MAN/AUTO. Determines the mode of data transmission for the auto-scaler.

6-3.2.5.6 B/ACCU/A/OFF. Controls the operating status of the decade up/down counter. There are four possible settings: OFF, A, ACCU, and B. OFF turns the auto-scaler OFF. A enables the decade up/down counter to increment the count, B enables it to decrement the count, and ACCU freezes the decade up/down counter at its current total.

6-3.3 Calculator. Performs manipulations and calculations on pulse count data, prints results and intermediate steps in the proper units on command, and stores data and programs. There are six functional parts: memory, logic circuitry, keyboard, LED display, magnetic card reader, and printer.

6-3.3.1 Memory. Stores pulse count data, constants, results of calculations, and subroutines containing programmed instructions (for using pulse count data and constants). In order to use the QPS, the programs with instructions for performing calculations are entered into the calculator memory. The memory is divided into three parts: automatic memory stack, storage registers, and program memory.

6-3.3.1.1 Automatic Memory Stack. Has four available locations (X, Y, Z, and T) which are used by the operator and the calculator in performing calculations. The logic circuitry uses the automatic memory stack in performance of its instructions and to store intermediate results of calculations.

6-3.3.1.2 Storage Registers. Used to store special numbers such as pulse counts and constants. Each register can hold one constant number or command. Primary register R₁ is directly connected to the calculator interface circuitry in the auto-scaler. Contents of storage registers are affected only by the keyboard or program command. The INIT signal begins a program which commands the calculator to clear the storage registers. The storage registers are divided into two parts: 16 primary registers

6-3.3.1.2 Storage Registers - Continued

and 9 secondary registers. The primary registers contain data and constants that need to be readily available and accessible for use. The MEMORY 1, 2, 3, or 4 signal is a release command for the contents of the corresponding primary register, R₁, R₂, R₃, or R₄. The remaining 12 primary registers are only used when operating programs. The secondary registers contain data that is not immediately needed. They are only accessible through the use of the special command key **P** \approx **S**.

6-3.3.1.3 Program Memory. Stores the instructions of a complete program or subroutine. Programs and subroutines are entered into the memory either manually, keyed in from the keyboard, or from a preprogrammed magnetic card. The programs are recalled by command each time new information must be processed. A subroutine automatically processes data and implements recorded instructions.

6-3.3.2 Logic Circuitry. Performs all calculations, commands, and data and signal transfers. The logic circuitry is the interface for all external inputs, including auto-scaler signals, and directs all operations of the calculator.

6-3.3.3 Keyboard. Gives operator direct access and control of the calculator operation. Pressing a key results in the corresponding command or signal being sent to the logic circuitry and memory. The keyboard has two modes: **PRGM** (program) and **RUN**. In **PRGM**, all keystroke signals are entered into the memory and sent to the logic circuitry which identifies the location on the keyboard of the function, letter, or number the keystroke signal represents. In **RUN**, all keyboard signals are sent to the logic circuitry for implementation or transfer.

6-3.3.4 LED Display. Displays last entry mode into calculator or contents of any memory register when commanded. Also provides all the visual indications of error conditions that may exist and the key code of each step of a program when being entered or run.

6-3.3.5 Magnetic Card Reader. Used to store programs and subroutines on magnetic cards. Reads and loads contents of preprogrammed cards into calculator memory.

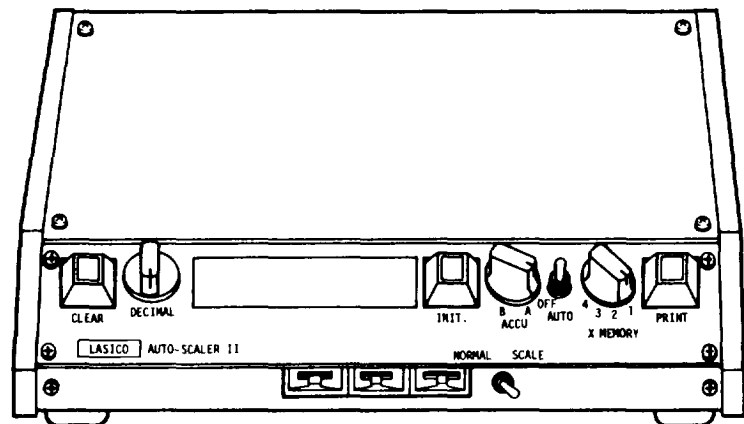
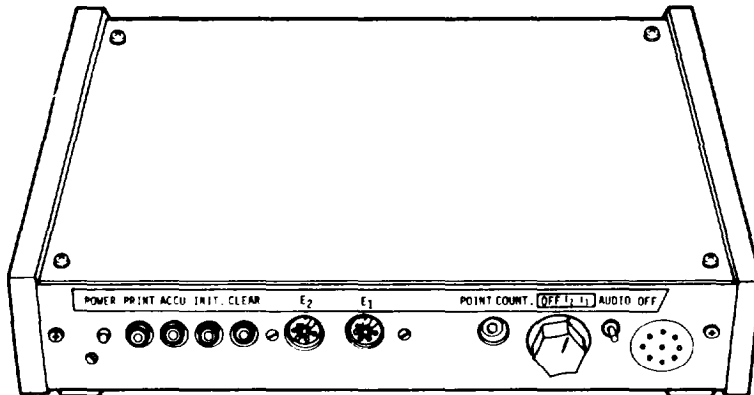
6-3.3.6 Printer. Provides hard copy of any data, calculation results, or program steps.

6-3.4 Remote Control Switches. The planimeter pushbutton remote tracer switch and foot switch enable the operator to remotely activate two of four possible signals: CLEAR, PRINT, INIT, or ACCU. The signals that the switches control depend on which input jacks the switches are plugged into.

6-3.5 Power Transformers. Converts ac power to dc power on the auto-scaler. The calculator uses ac power.

Section II. OPERATING INSTRUCTIONS

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS.



AUTO-SCALER

Control or Indicator	Function
CLEAR button	Clears all displays and memories.
DECIMAL switch	Selects position of decimal point in auto-scaler display.
LED indicator light	Indicates when pulse count is positive.
LED display	Displays current pulse count total.
SCALE dials	Inputs three most significant figures of constant into scaler.
NORMAL/SCALE	In NORMAL, pulse count is not scaled. In SCALE, activates internal scaling circuit.

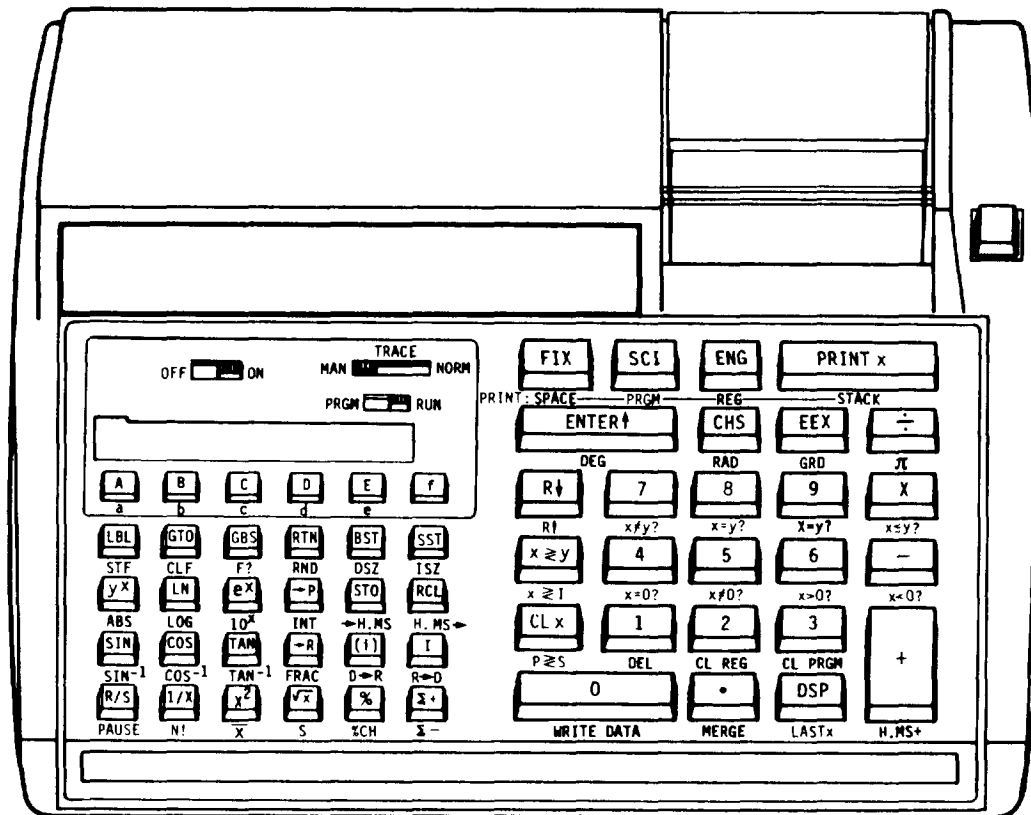
6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Control or Indicator	Function
INIT. button	Sends initialize command signal to calculator.
B/ACCU/A/OFF	Controls pulse counter: A: Counts up B: Counts down ACCU: Freezes count OFF: Turns auto-scaler off
MAN/AUTO switch	Controls pulse count sent to calculator. Man count is sent when Print is activated. Auto count is sent automatically.
X MEMORY switch	Selects memory register 1, 2, 3, or 4 to be used in calculator.
PRINT switch	Sends Print command to calculator and auto-scaler.
POWER supply jack	Input for power transformer plug.
PRINT input jack	Input for remote tracer switch or foot switch plug, used to activate Print command.
ACCU input jack	Input for foot switch or remote tracer switch plug, used to activate Actuate command.
INIT. input jack	Input for foot switch plug, used to activate Initialize command.
CLEAR input jack	Input for foot switch plug, used to activate Clear command.
E2 encoder socket	Input for planimeter.
E1 encoder socket	Input for linear measuring probe.
POINT COUNT. input jack	Input for point counter pen.
OFF/E2/E1 switch	Selects input from linear measuring probe, planimeter, or turns on input.

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Control or Indicator	Function
AUDIO/OFF switch	Used to turn audio alarm on or off.
Audio alarm	Emits audible tone each time pulse (stroke count) is received from point counter pen.




6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued



CALCULATOR

NOTE

Numbers, letters, symbols, and words that are on top of the calculator keys will be boxed throughout the text.

Key	Control or Indicator	Function
	LED display	Displays numbers or message.
	Paper advance button	Advances printer paper.
OFF  ON	Off/on switch	Turns calculator on or off.

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
MAN TRACE NORM	Manual/trace/normal switch	Selects operating mode for printer. MAN: Prints only when commanded. TRACE: Prints intermediate and final calculations as they are performed. NORM: Prints entry-by-entry records of entries and commands.
PRGM RUN	Program/run switch	Selects operating mode of calculator. RUN: Operates normally. PRGM: Used to manually enter program.
f	Function prefix key	Shifts next keystroke to activate function written beneath key.
ENTER DEG	Enter/degrees key	ENTER : Value in X-register is stored in Y-register. DEG: Instructs calculator that units for all angles and trig calculations will be in degrees.
PRINT X PRINT : STACK	Print X/print stack key	PRINT X Value of display is printed. PRINT:STACK: Used to print contents of entire automatic memory stack.
FIX PRINT:SPACE	Fix/print space key	FIX : Fixes decimal point of LED display to one position. PRINT:SPACE: Instructs printer to advance paper one line.

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
ENG PRINT:REG	Engineering notation/ print register key	ENG I : Instructs LED display to display all numbers in engineering notation. PRINT: REG : Instructs printer to print contents of all primary storage registers.
CHS RAD	Change sign/radians key	CHS : Change sign of number or exponent in X-register (LED display). RAD : Instructs calculator that units for all angles and trig calculations will be in radians.
EEEX GRD	Exponents/grads key	EEEX : Numbers keyed in after pressing EEEX are to be displayed as exponents of 10. GRD : Instructs calculator that units for all angles and trig calculations will be in grads.
\div π	Divide arithmetic/ π key	\div : Divides number in Y-register by number in X-register. π : Enters value of pi into X-register.
X X ≤ Y?	Multiply arithmetic/ X Y? key	X I : Multiplies number in Y-register by number in X-register. x Y?: Used in program. Compares numbers in X- and Y-memories. If X is less than or equal to Y, next step in program is performed. If X is not less than or equal to Y, test is negative and calculator skips next step in program.

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
<div style="border: 1px solid black; display: inline-block; padding: 2px;">-</div> X < 0?	Subtract arithmetic/ X < 0? key	<div style="border: 1px solid black; display: inline-block; padding: 2px;">-</div> : Subtracts number in X-memory from number in Y-memory. X < 0? : Used in programs to compare number in X-register to 0. If x is less than 0, calculator performs next program step. If X is not less than 0, calculator skips next program step.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">+</div> H.MS+	Add arithmetic/hours, minutes, seconds key	+I : Adds number in X-register to number in Y-register. H.MS+ : Adds hours, minutes, and seconds, or degrees, minutes, and seconds in the Y-register to those displayed in the X-register.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">R ↓</div> R ↓	R ↓ roll stack key	<div style="border: 1px solid black; display: inline-block; padding: 2px;">R ↓</div> : Instructs calculator to roll down contents of automatic memory stack (X, Y, Z, and T) into X-register. Each time new number is displayed, old one moves to top of stack. First value moved is in Y-register. R ↓ : Instructs calculator to roll up contents of automatic memory stack (X, Y, Z, and T) into X-register, starting with number in T-register.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">X ↔ Y</div> X ↔ I	X ↔ Y/X ↔ I manipulation key	<div style="border: 1px solid black; display: inline-block; padding: 2px;">X ↔ Y</div> : Interchanges numbers in X- and Y-memory registers. X ↔ I : Interchanges numbers in X- and I-memory registers.

6-4 DESCRIPTION AND USE OF OPERATOR' S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
<div style="border: 1px solid black; display: inline-block; padding: 2px;">CLx</div> P \rightleftharpoons S	Clear X/P \rightleftharpoons S key	CLx : Clears contents of X-memory register (LED display) to zero. P \rightleftharpoons S : Interchanges contents of primary memory registers with contents of secondary memory registers.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">0</div> WRITE DATA	0/write data key	<div style="border: 1px solid black; display: inline-block; padding: 2px;">0</div> : Enters number 0 into X-register (LED display). WRITE DATA : If a magnetic card is passed through the card reader immediately after this operation, the contents of the storage registers are recorded on the card.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">.</div> MERGE	Decimal point/merge key	<div style="border: 1px solid black; display: inline-block; padding: 2px;">.</div> Enters decimal point in desired position in X-register (LED display). MERGE : Merges, rather than overwrites, data or program from magnetic card with data or program in calculator.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">1</div> DEL	1/delete key	1|: Enters number 1 into desired position in X-register (LED display). DEL : Deletes current instruction from program memory. All subsequent instructions moved up one step.
<div style="border: 1px solid black; display: inline-block; padding: 2px;">2</div> CL REG	2/clear register key	<div style="border: 1px solid black; display: inline-block; padding: 2px;">2</div> : enters number 2 into desired position in X-register (LED display). CL REG : Clears contents of all primary memory registers.

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
<p>3</p> <p>CL PRGM</p>	<p>3/clear program key</p>	<p>3: Enters number 3 into desired position in X-register (LED display). CL PRGM: Clears calculator's program memory down to all R/S (run/stop) instructions, and clears all flags. Sends calculator to step 000 and instructs it to operate in fix decimal point and degrees modes.</p>
<p>6</p> <p>X≠0?</p>	<p>6 / X ≠ 0? key</p>	<p>6: Enters number 6 into desired position in X-register (LED display). X≠0?: Used in program. Compares number in X-register to 0. If X is greater than 0, calculator executes next program step. If X is 0 or less than 0, calculator skips next program step and executes the following step.</p>
<p>7</p> <p>X≠Y?</p>	<p>7 / X ≠ Y? key</p>	<p>7: Enters number 7 into desired position in X-register (LED display). X≠Y?: If X is not equal to Y, calculator skips one step before continuing program.</p>
<p>8</p> <p>X=Y?</p>	<p>8 / X = Y? key</p>	<p>8: Enters number 8 into desired position in X-register (LED display). X=Y?: If X equals Y, calculator will execute next instruction in program.</p>

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
4 X=0?	4/ X = 0 key	4 : Enters number 4 into desired position in X-register (LED display). X=0: Compares number in X-register to 0. If X equals 0, calculator executes next program step. If X is not 0, calculator skips next step and executes the following step.
5 X≠0?	5/X ≠ 0? key	5 : Enters number 5 into desired position in X-register (LED display). X≠0?: Compares number in X-register to 0. If x is not 0, calculator executes next program step. If x is 0, calculator skips next step and executes the following step.
9 X=Y?	9/X=Y? key	9 Enters number 9 into desired position in X-register (LED display). X=Y?: Compares number in X-register to Y-register. If X is equal to Y, calculator executes next program step. If not, it skips the next step and executes the following step.

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS Continued

Key	Control or Indicator	Function
A		
a		
B	A through E/e	<p>Used to assign user-defined labels. With calculator in PRGM, pressing LBL and label key or LBL, f, and label key assigns that label to "routine or subroutine within a program.</p> <p>In RUN, calculator searches program memory for that label. Calculator begins execution of program memory at that point. GTO or GBS followed by label key or f, label key: calculator stops execution, searches memory for designated label, and begins execution there.</p>
b	NOTE	
C	Small letter labels a through e are called with f prefix key.	
c		
D		
d		
E		
e		
LBL	Label/set flag key	<p>LBL In PRGM, enters label designation A/a through E/e or 0 through 9 into program step. In RUN, calculator searches program memory for designated label, and begins execution there.</p>
STF		<p>STF: Followed by flag designation 0, 1, 2, or 3, sets designated flag.</p>

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
GTO CLF	Go to/clear flag key	<p>GTO: When calculator is in PRGM, GTO followed by . and three-digit step number sets calculator to three-digit step number of program memory. No instructions are executed. When calculator is in RUN, GTO followed by . and three-digit step number sets calculator to three-digit step number of program memory. No instructions are executed. In RUN, followed by label designator A/a through E/e or 0 through 9, sends calculator to first designated label in memory.</p> <p>CLF: Followed by flag designation 0, 1, 2, or 3, clears designated flag.</p>
RCL H.MS →	Recall/hours, minutes, seconds key	<p>RCL Followed by address of memory register, places value of that register into X-register (LED display).</p> <p>H.MS→ Converts hours, minutes, seconds, or degrees, minutes, seconds displayed in X-register to decimal hours or degrees.</p>
SIN SIN ⁻¹	Sine/arc sine ⁻¹ trig key	<p>SIN: Computes sine of number in X-register.</p> <p>SIN⁻¹: Computes arc sine of number in X-register.</p>
COS COS ⁻¹	Cosine/arc cosine trig key	<p>COS: Computes cosine of number in X-register.</p> <p>COS⁻¹: Computes arc cosine of number in X-register.</p>

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS `Continued

Key	Control or Indicator	Function
(1) D → R	Register/degrees, radians key	(1) : Subtracts 1 from contents of storage register specified by value in 1. Skips one step if value is then 0. D → R : Converts degrees displayed in X-register to radians.
RTN RND	Return/round key	RTN : Followed by 000, returns calculator to step 000 of program memory. When encountered as step in program or subroutine, returns calculator to first step of that program or subroutine. RND : Rounds mantissa of 10-digit number in X-register to that of actual value seen in display.
BST DSZ	Back step/decrement and skip if 0 key	BST : In PRGM , moves calculator back one step in program memory to previous input. In RUN , stops program and moves calculator back one program step in memory. Original X-register contents return when key is released. DSZ : Followed by I , subtracts 1 from contents of 1.

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS MD INDICATORS - Continued

Key	Control or Indicator	Function
STO → H.MS	Store/hours, minutes, seconds key	STO : Followed by address key(0 through 9 or A through E), stores displayed number in corresponding primary memory register: R₀ through R₉ , RA through RE , or I . → H.MS : Converts decimal hours or degrees in X-register to hours, minutes, seconds or degrees, minutes, and seconds.
I R→D	I-register/radians, degrees key	I : Recalls number in I-register into X-register. R→D : Converts radians in X-register to degrees.
R/S PAUSE	Run/stop/pause key	R/S : In RUN , begins program execution. If program is already running, pressing R/S stops program. If encountered in program as program step, program stops at that point. PAUSE : Momentarily stops running program and transfers control to keyboard for 1 second.
SCI PRINT:PRGM	Scientific notation/print program key	SCI : Selects scientific notation display. PRINT:PRGM : Prints program.
GBS F?	Go to subroutine/flag true? key	GBS : Causes calculator to begin executing instructions. F? : Is flag true? When followed by designator, it tests flag. Clears flags after testing.

6-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
SST ISZ	Single step/increment	SST : Moves calculator forward one step in program memory. ISZ : Increments value in I register.
→R FRAC	Polar magnitude/fraction	→R : Converts polar magnitude X and angle Y in X- and Y-registers to rectangular X and Y coordinates. FRAC : Leaves only fractional portion of number in X-register.
Y^X ABS	Exponent/absolute value	Y^X : Raises number in Y-register to power of number in X-register. ABS : Gives absolute power of number in X-register.
LN LOG	Natural logarithm/ logarithm	LN : Computes natural logarithm of number in X-register. LOG : Computes common logarithm of number in X-register.
e^X 10^X	Antilogarithm/common antilogarithm	e^X : Natural antilogarithm. Raises e to power of number in X-register. 10^X : Common antilogarithm. Raises 10 to power of number in X-register.
P INT	Polar, rectangular conversion/integer	→P : Converts X and Y rectangular coordinates placed in X- and Y-registers to polar magnitude and angle 0. INT : Leaves only integer part of number in X-register.

6-4 DESCRIPTION AND USE OF OPERATOR' S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
TAN TAN⁻¹	Tangent/arc tangent	TAN : Computes tangent of value in X-register. TAN⁻¹ : Computes arc tangent of number in X-register.
1/X N!	Reciprocal/factorial	1/X : Computes reciprocal of number in X-register. N! : Computes factorial of number in X-register.
X² X̄	Square/average	X² : Computes square of number in X-register. X̄ : Computes mean (average) of X and Y values.
√X S	Square root/standard deviation	√X : Computes square root of number in X-register. S : Computes sample standard deviations of X and Y values.
Σ+ Σ-	Accumulate/subtract	Σ+ : Accumulates numbers from X- and Y-registers into secondary storage registers. Σ- : Subtracts X and Y values from storage registers.
DSP LAST X	Display/recall	DSP : Followed by number key, selects number of displayed digits. LAST X : Recalls number displayed before previous operation back into X-register.
Z Z CH	Percent/change	Z : Computes X% of Y. % CH : Computes percent of change from number in Y-register to number in X-register.

6-5 OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS) .

6-5.1 General. The QPS must be regularly inspected to find and correct defects.

6-5.1.1 Before You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your before (B) PMCS.

6-5.1.2 While You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your during (D) PMCS.

6-5.1.3 After You Operate. Be sure to perform your after (A) PMCS.

6-5.1.4 If Your Equipment Fails To Operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

6-5.2 PMCS Procedures

6-5.2.1 PMCS are designed to keep the equipment in good working condition by performing periodic service tasks.

6-5.2.2 Service intervals provide you, the operator, with time schedules that determine when to perform specified service tasks.

6-5.2.3 The "Equipment Is Not Ready/Available If" Column is used for identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.

6-5.2.4 If your equipment fails to operate after PMCS is performed, immediately report this condition to your supervisor.

6-5.3 PMCS Columnar Entries

6-5.3.1 Item Number Column. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for "TM number" Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.

6-5.3.2 Interval Column. This column determines the time period designated to perform your PMCS.

6-5.3.3 Item To Be Inspected and Procedures Column. This column lists functional groups and their respective assemblies and subassemblies as shown in the Maintenance Allocation Chart (Appendix B). The appropriate check or service procedure follows the specific item to be inspected.

6-5.3.4 Equipment Is Not Ready/Available If: Column. This column indicates the reason or cause why your equipment is not ready/available to perform its primary mission.

Table 6-1. Operator Preventive Maintenance Checks and Services

B - Before Operation M - Monthly Q - Quarterly

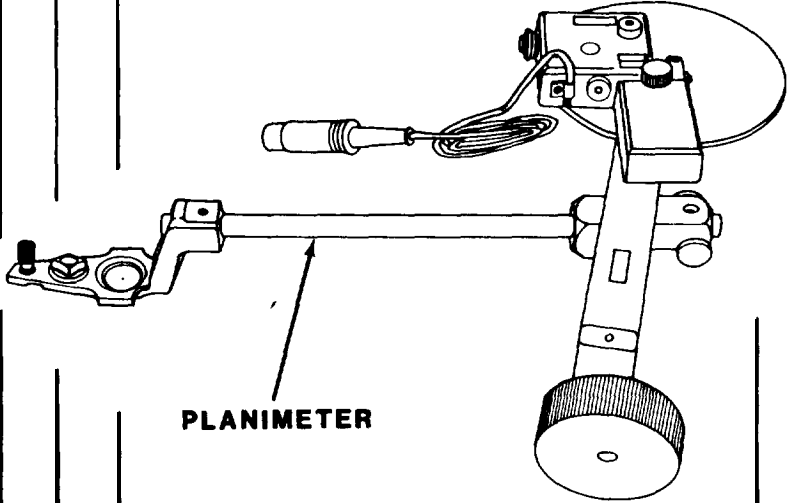
Item No.	Interval			ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	M	Q		
				 <p>PLANIMETER. Check wheels, lens tracing assembly, axle, and paper disk for dirt, cracks, and breaks. Clean with soft brush. Replace paper disk as needed (para 6-9.4).</p> <p>Check planimeter drive gears for dirt or breaks. Check for jammed or loose drive gears.</p> <p>Check Teflon guide washer underneath tracing lens for cracks, dirt, or looseness. Clean with soft brush as needed. Replace Teflon guide washer as needed (para 6-9.2).</p>	<p>Components are dirty or broken.</p> <p>Drive gears are damaged.</p> <p>Teflon guide washer is dirty or cracked.</p>

Table 6-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation M - Monthly Q - Quarterly

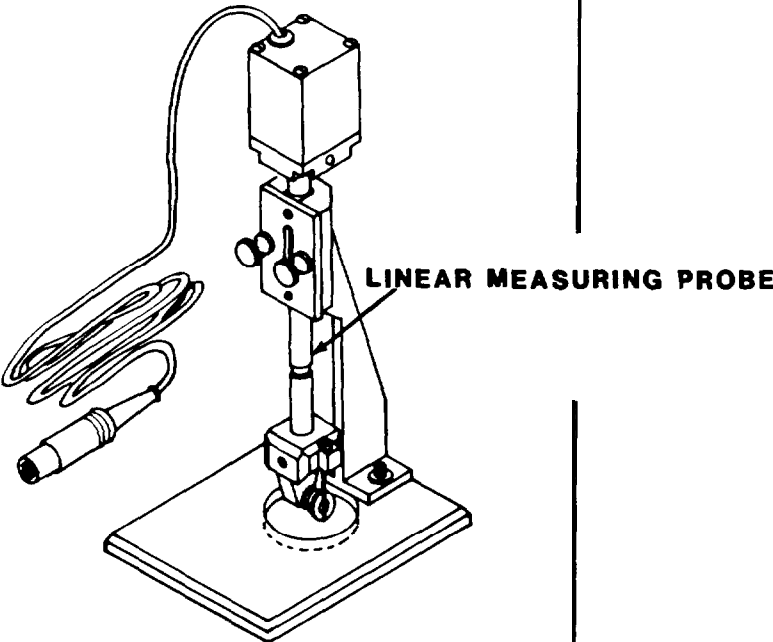
Item No.	Interval			ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:				
	B	M	Q						
2	•								
								<p>LINEAR MEASURING PROBE. Check case, stand, guiding wheel, and gears for cracks, breaks, or dirt. Clean with soft brush as needed.</p>	Linear measuring probe is damaged.
								<p>Clean base of linear measuring probe with soft brush.</p>	
		•		<p>Remove dirt from linear measuring probe gears with soft brush. Apply one drop of oil (item 54, appendix E) to drive gears.</p>	Linear measuring probe is dirty.				

Table 6-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation M - Monthly Q - Quarterly

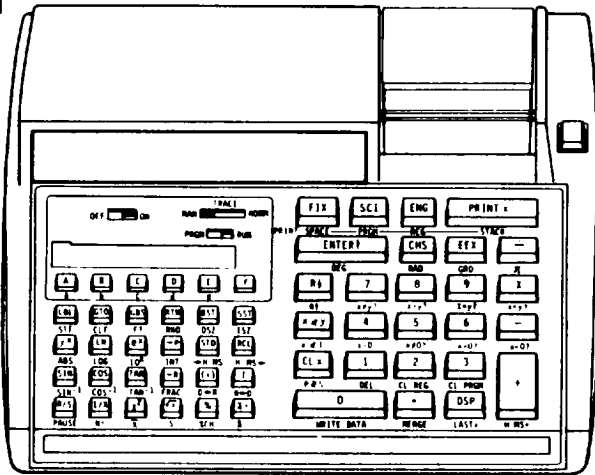
Item No.	Interval			ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	M	Q		
2 (cont)				 <p style="text-align: center;">CALCULATOR</p>	
3	•			<p>CALCULATOR. Inspect keyboard, battery pack, display, and casing for cracks or breaks. Replace calculator as needed.</p> <p style="text-align: center;">CAUTION</p> <p>Do not allow alcohol to touch any part of the calculator. Damage to calculator could result.</p> <ul style="list-style-type: none"> • Inspect calculator battery pack contacts. Clean with cotton swabs (item 17, appendix E) moistened with alcohol. • Inspect ribbon cable and power jacks for cracks or breaks. • Wipe dirt and dust from calculator with soft cloth (item 16, appendix E). 	<p>Calculator is damaged.</p> <p>Battery pack contacts are dirty.</p> <p>Ribbon cable or power jacks are damaged.</p>

Table 6-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation M - Monthly Q - Quarterly

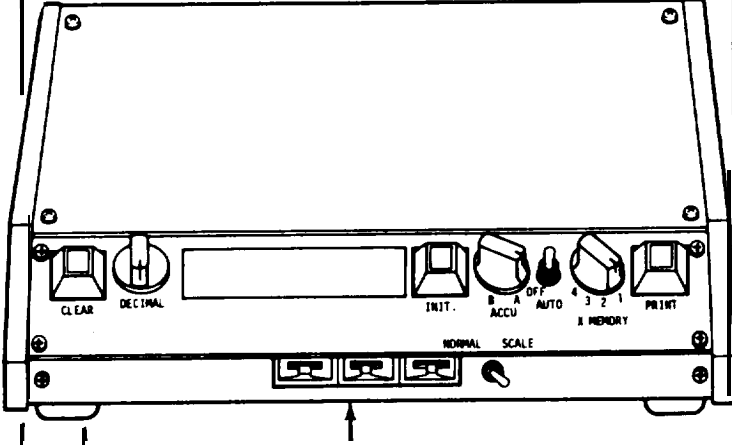
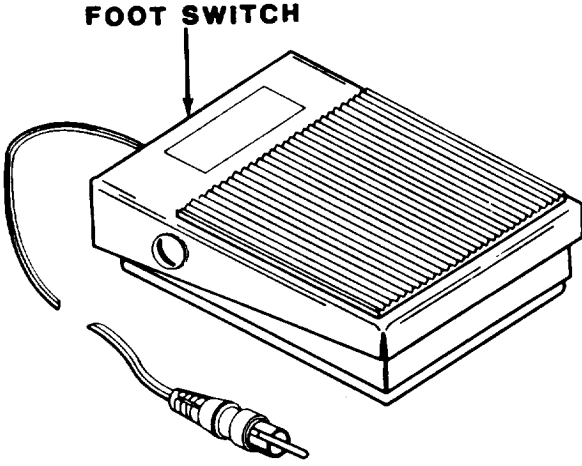
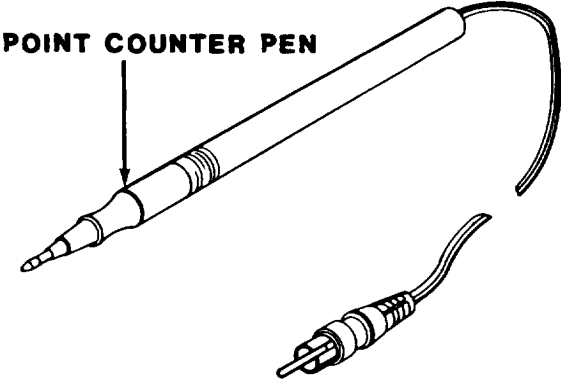
Item No.	Interval			ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	M	Q		
3 (Cont)				<p style="text-align: center;"><u>CAUTION</u></p> <p>Use head cleaning card only as a result of continued use of preprogrammed cards. Head cleaning card is abrasive. Damage to calculator reader could result.</p> <ul style="list-style-type: none"> • Clean magnetic card reader heads with head cleaning card. • Wipe magnetic cards with soft cloth (item 16, appendix E) moistened with alcohol. 	
4				<p>AUTO-SCALER: Inspect front panel, back panel, and casing for dirt, cracks, or breaks. Clean with soft brush as needed.</p> <p>Inspect power jacks on back panel of auto-scaler for breaks or loose fittings.</p>	<p>Auto-scaler is damaged.</p> <p>Power jacks are broken or loose.</p>

Table 6-1. Operator Preventive Maintenance Checks and Services - Continued

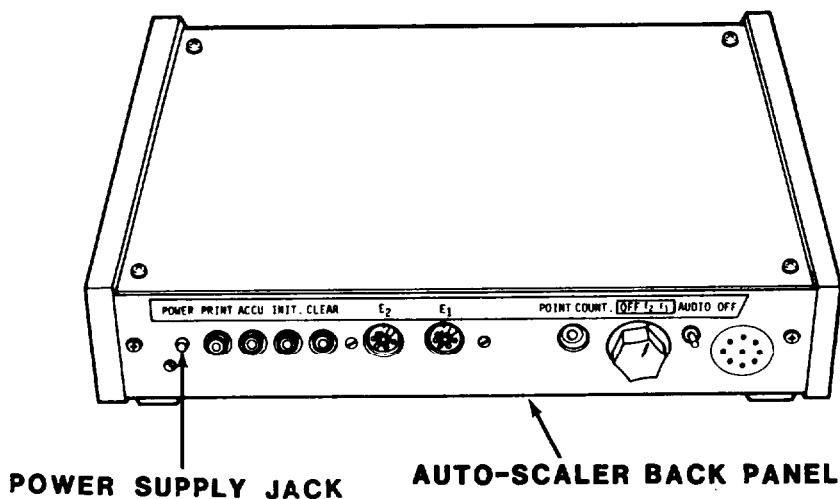
B - Before Operation M - Monthly Q - Quarterly

Item No.	Interval			ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available. If:
	B	M	Q		
4 (cont)				 <p>FOOT SWITCH</p>	
5	•			<p>FOOT SWITCH. Inspect for cracks or breaks. Inspect foot switch cord for frays or breaks.</p>  <p>POINT COUNTER PEN</p>	<p>Foot switch is damaged. Foot switch cord is damaged.</p>
6	•			<p>POINT COUNTER PEN. Inspect for cracks or breaks. Inspect point counter pen cord for breaks or frays.</p>	<p>Point counter pen is damaged. Point counter pen cord is damaged.</p>

6-6 OPERATION UNDER USUAL CONDITIONS

6-6.1 Assembly and Preparation for Use

- a. Remove auto-scaler from case. Set on table near drawing, map, or photograph to be measured.
- b. Remove calculator from case. Place on top of auto-scaler with keyboard facing front of auto-scaler.

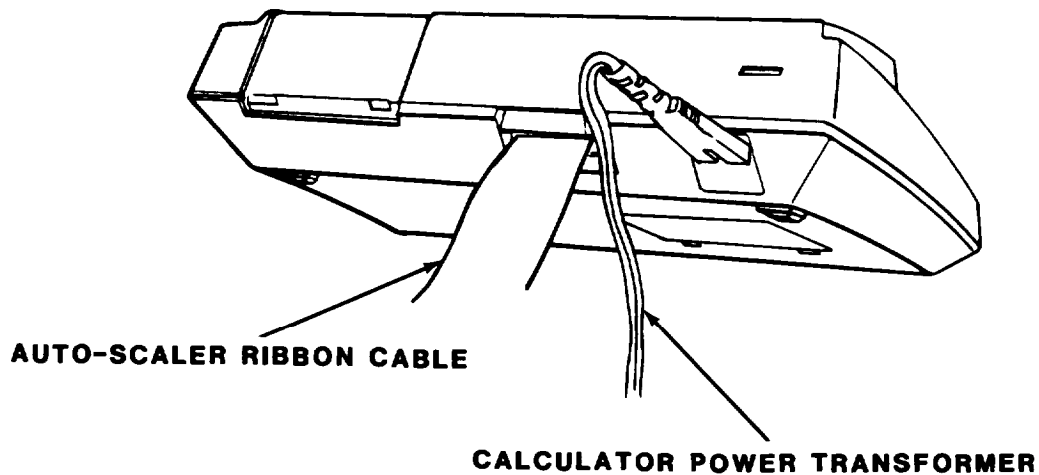


CAUTION

Do not plug power transformer into power supply rated over 125 vac. Permanent damage to auto-scaler can result.

- c. Plug auto-scaler power transformer plug into POWER supply jack on auto-scaler back panel.

6-6.1 Assembly and Preparation for Use - Continued



CAUTION

Arrows on ribbon cable and calculator must align. Damage to calculator can result if cable is plugged in backwards.

- d. Plug auto-scaler ribbon cable into cable jack in back of calculator.

CAUTION

Do not plug power transformer into power supply rated over 125 vac. Permanent damage to calculator can result.

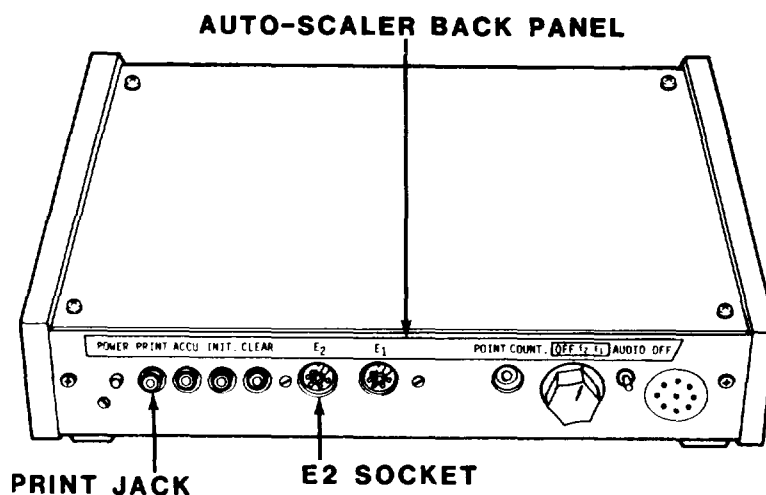
- e. Plug calculator power transformer into power jack on calculator back panel.

6-6.1 Assembly and Preparation for Use - Continued

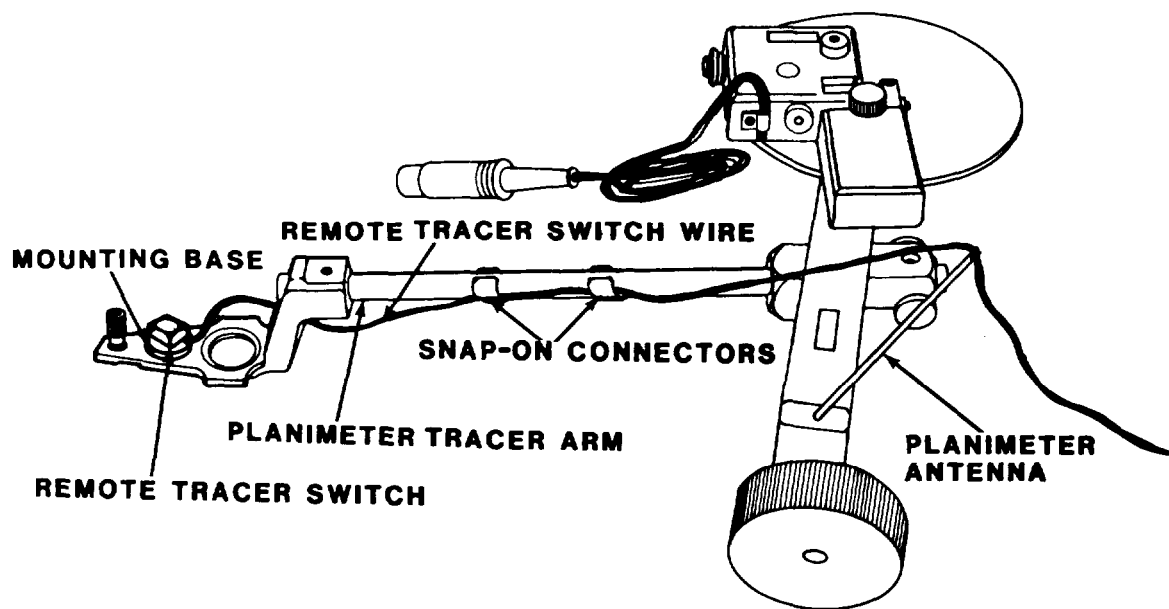
CAUTION

Do not carry planimeter by top. Damage to planimeter or misalignment can result.

- f. Carefully remove planimeter from case. Place on table near auto-scaler.

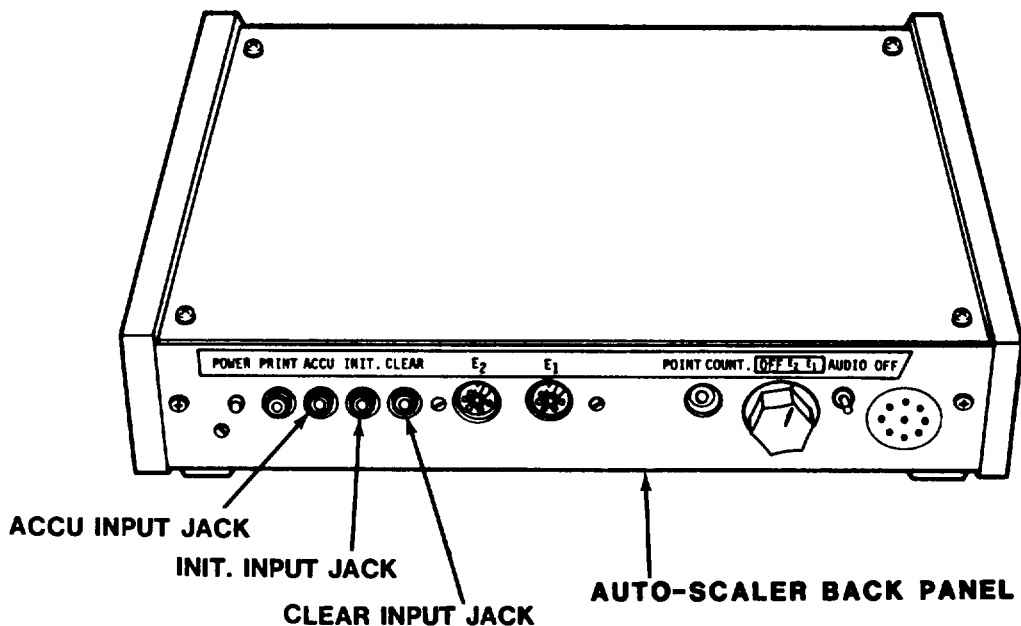


- g. Plug planimeter into E2 encoder socket on auto-scaler back panel.
- h. Remove remote tracer switch from case. Plug into PRINT input jack on auto-scaler back panel.



6-6.1 Assembly and Preparation for Use - Continued

- i. Mount remote tracer switch on mounting base at end of planimeter tracer arm by pressing against mounting base.
- j. Remove planimeter antenna from case. Screw into hole on top of planimeter body.
- k. Attach remote tracer switch wires to tracer arm with snap-on connectors.
- l. Remove cap from antenna and guide remote tracer switch wire through slotted end of antenna. Replace cap.



- m. Remove foot switch from carrying case. Plug into CLEAR, INIT., or ACCU input jack on auto-scaler back panel.

6-6.1 Assembly and Preparation for Use - Continued

- n. If using point counter pen, remove from case. Plug into POINT COUNT. input jack on auto-scaler back panel.
- o. If using linear measuring probe, remove from case. Plug into E1 encoder socket on auto-scaler back panel.
- p. Plug both power transformers into 110 vac outlets.

6-6.2 **OPERATING PROCEDURES.**

6-6.2.1 General. The QPS provides for estimation of distance, area, perimeter, and volume of geographic shapes found on maps, drawings, and aerial photographs. It is precisely set and alined at the factory. Factory determined values, necessary for accurate calculations and estimations, are different for each QPS. The formulas and values on the Calibration Records Sheet, provided with the equipment, must be used in order to obtain correct results from measurements.

6-6.2.2 Index of Operating Procedures

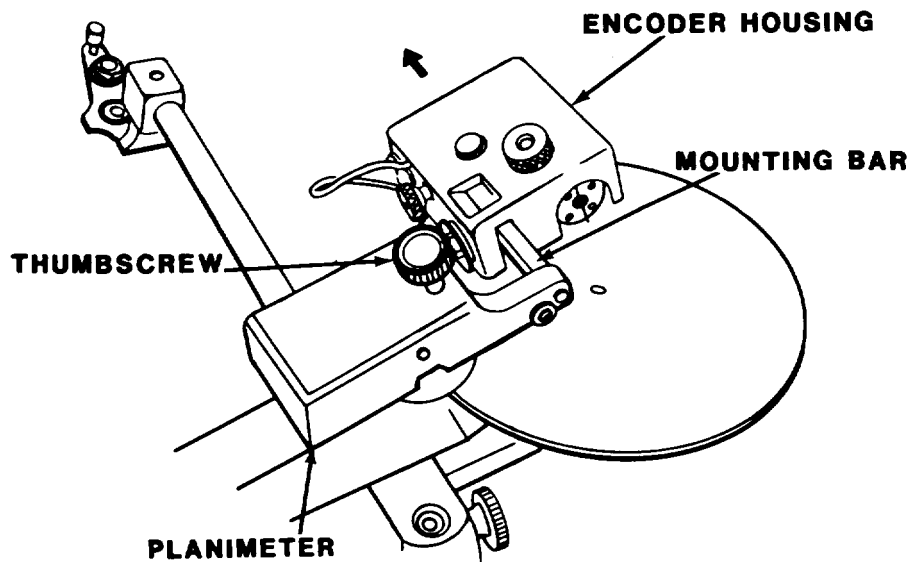
<u>Procedure</u>	<u>Paragraph</u>	<u>Page</u>
Alinement of Linear Measuring Probe	6-6.2.16	6-52
Alinement of Planimeter With Lens Tracing Assembly	6-6.2.14	6-50
Alinement of Planimeter With Needle Tracing Assembly	6-6.2.15	6-52
Area Measurements on Aerial Photographs of Unknown Scale or Magnification	6-6.2.33	6-88
Diverging Volume Runs	6-6.2.28	6-80
Installing Blank Cartridge in Point Counter Pen	6-6.2.9	6-45
Installing Paper in Calculator	6-6.2.8	6-44
Layout Work With Linear Measuring Probe	6-6.2.23	6-67
Linear Measurements on Aerial Photographs of Unknown Scale or Magnification	6-6.2.32	6-86
Linear Measuring Probe Measurements Without the Calculator	6-6.2.24	6-69
Loading Magnetic Cards	6-6.2.10	6-46

6-6.2.2 Index of Operating Procedures - Continued

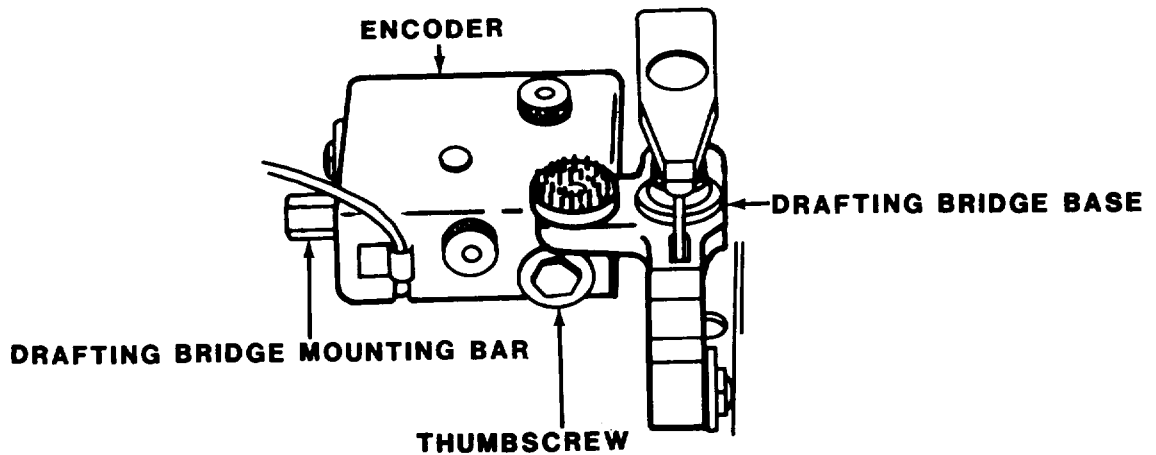
<u>Procedure</u>	<u>Paragraph</u>	<u>Page</u>
Manual Program Loading	6-6.2.11	6-47
Measuring Areas To Be Added and/or Subtracted	6-6.2.18	6-58
Measuring Areas With Planimeter	6-6.2.17	6-55
Measuring Areas Without the Calculator	6-6.2.21	6-62
Measuring Lengths With Linear Measuring Probe To Be Added and/or Subtracted	6-6.2.22	6-65
Measuring Surface Area of Slope	6-6.2.19	6-59
Measuring Slopes To Be Added and/or Subtracted	6-6.2.20	6-61
Merging Volume Runs	6-6.2.27	6-76
Mounting Drafting Bridge Assembly	6-6.2.3	6-39
Mounting Linear Measuring Probe in Stand	6-6.2.7	6-43
Mounting Magnifier in Lens Tracing Assembly	6-6.2.6	6-42
Mounting Needle Tracing Assembly	6-6.2.5	6-41
Mounting Tracer Arm Extension Assembly	6-6.2.4	6-40
Point Counts With Point Counter Pen and Constants	6-6.2.25	6-71
Printing Out Programs	6-6.2.12	6-48
Out-of-Phase Adjustment	6-6.2.31	6-85
Recording Program on Magnetic Card	6-6.2.13	6-48
Standard Volume Run Using Contour Method	6-6.2.26	6-73
Vertical Cross Sections	6-6.2.29	6-82
Volume Erase Procedure	6-6.2.30	6-84

Tables

- Table 6-2. Preprogrammed Subroutines
(Programs I, II, III, and IV)
- Table 6-3. Preprogrammed Keystroke Entries
(Programs I, II, 111, and IV)
- Table 6-4. Preprogrammed Diagnostic Entries

6-6.2.3 Mounting Drafting Bridge Assembly

- a. Loosen thumbscrew holding encoder housing on planimeter.
- b. Grasp encoder housing and slide off mounting bar.



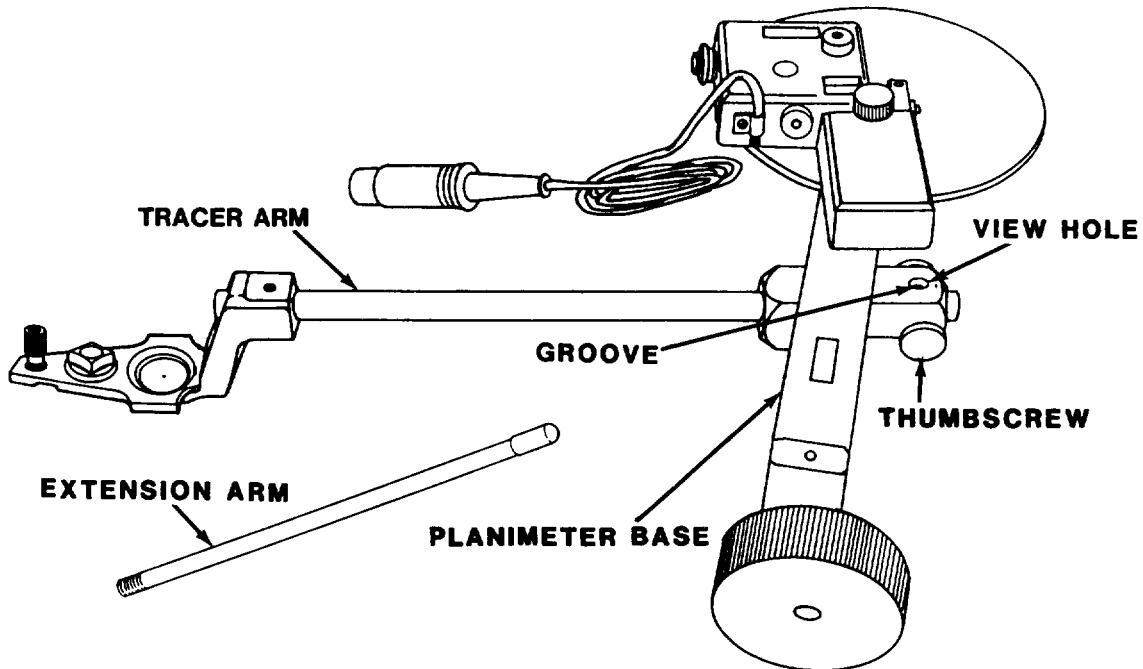
- c. Slide encoder onto drafting bridge mounting bar until it fits snugly against drafting bridge base. Tighten thumbscrew to secure.

6-6.2.3 Mounting Drafting Bridge Assembly - Continued

- d. Remove remote tracer switch from end of planimeter.
- e. Mount remote tracer switch on mounting base of drafting bridge.

6-6.2.4 Mounting Tracer Arm Extension Assembly

- a. Remove desired lengths of tracer arm extension from case.



CAUTION

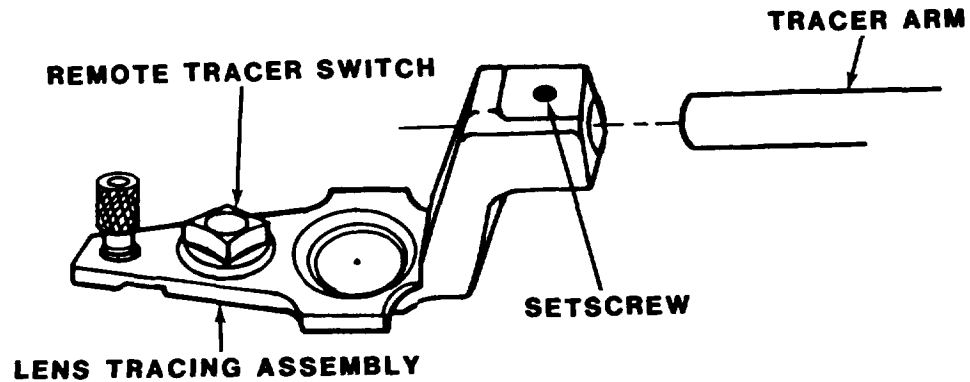
Do not release hold on planimeter when tracer arm is removed. Planimeter will turn on its side. Damage to planimeter disk can result.

- b. Loosen two thumbscrews at back of tracer arm.
- c. Hold tracer arm with one hand. With other hand, slide tracer arm out of planimeter base.
- d. While still holding planimeter, slide one end of extension arm into tracer arm slot on planimeter base. Move extension arm until groove in end lines up with view hole in tracer arm slot.

6-6.2.4 Mounting Tracer Arm Extension Assembly - Continued**NOTE**

Different tracer arm lengths with same tracer arm can be obtained by loosening two thumbscrews and sliding tracer arm in and out of its slot. Tracer arm lengths should be premarked short, medium, and long. If any other tracer arm length is desired, planimeter must be realigned.

- e. Tighten two thumbscrews to secure tracer arm extension. Be sure lens tracing assembly is flat on table surface.
- f. Readjust encoder and remote tracer switch wires through antenna.

6-6.2.5 Mounting Needle Tracing Assembly

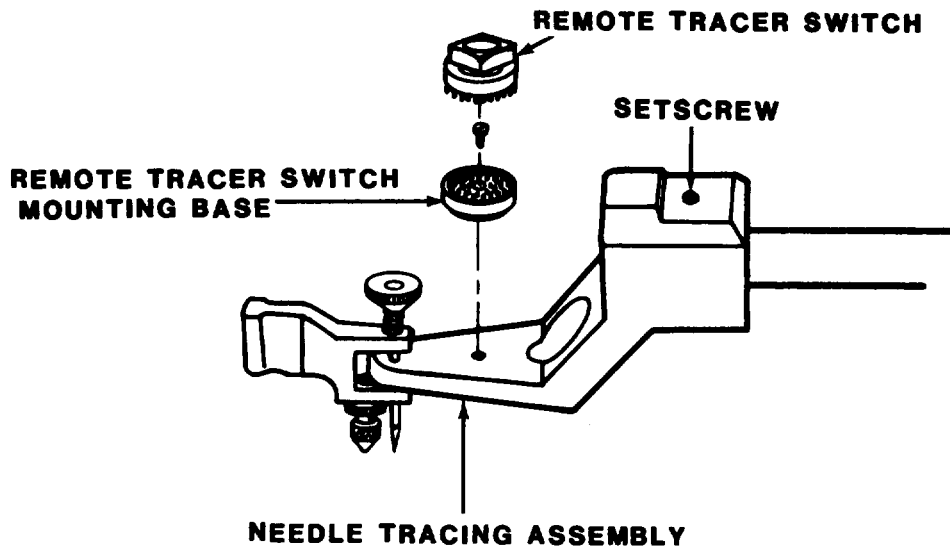
- a. Remove remote tracer switch from lens tracing assembly.

CAUTION

Hold tracer arm while removing lens tracing assembly. Planimeter will turn on its side. Damage to planimeter disk can result.

- b. Loosen setscrew. Sliding lens tracing assembly from tracer arm, remove.

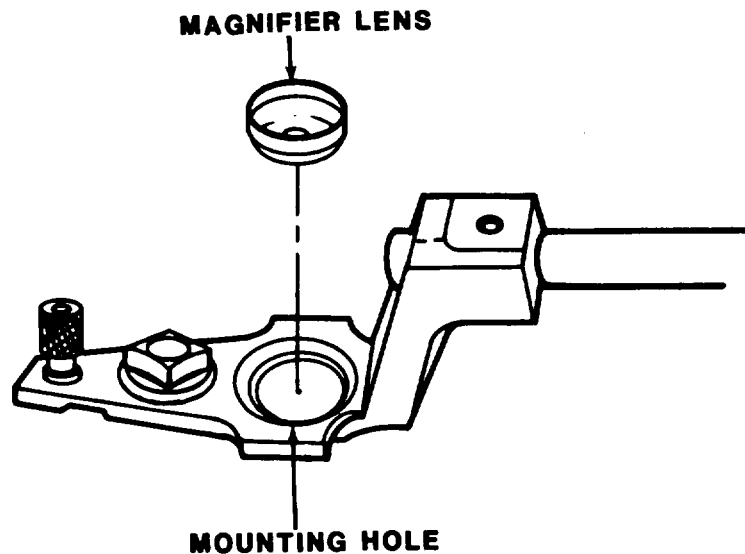
6-6.2.5 Mounting Needle Tracing Assembly - Continued



- c* Slide needle tracing assembly onto tracer arm. Tighten setscrew to secure.
- d. Secure remote tracer switch mounting base to needle tracing assembly with screw. Snap remote tracer switch into needle tracing assembly.

6-6.2.6 Mounting Magnifier in Lens Tracing Assembly

- a. Remove magnifier lens from carrying case.



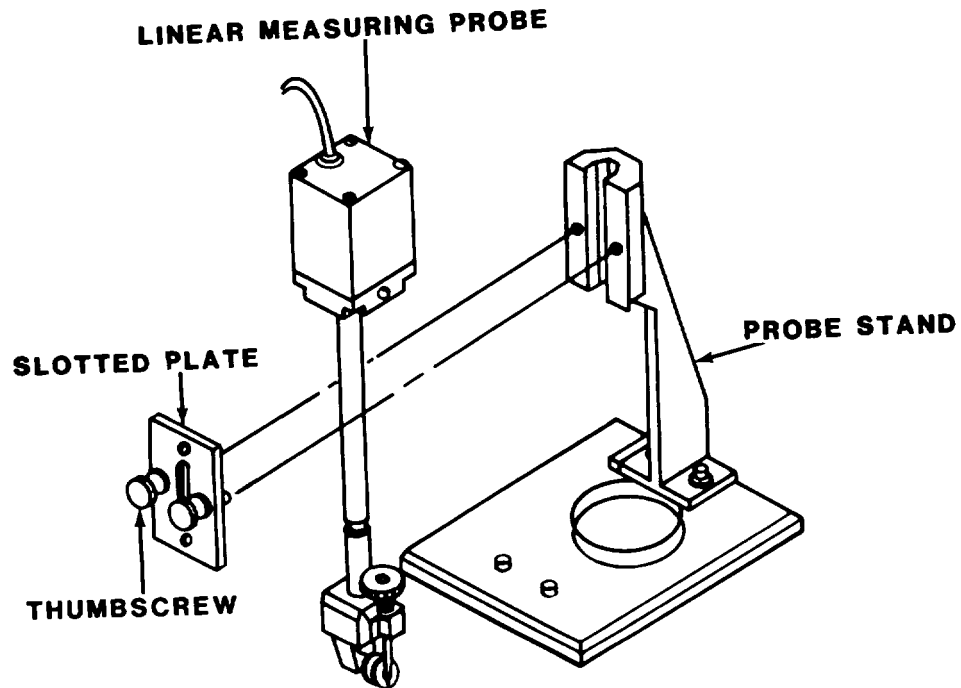
6-6.2.6 Mounting Magnifier in Lens Tracing Assembly - Continued**CAUTION**

Do not touch optical surface with bare fingers.
Viewing will be impaired.

- b. Holding lens by edges, drop into mounting hole. Press lens into place with finger wrapped in tissue.

6-6.2.7 Mounting Linear Measuring Probe in Stand

- a. Remove linear measuring probe and probe stand from case.

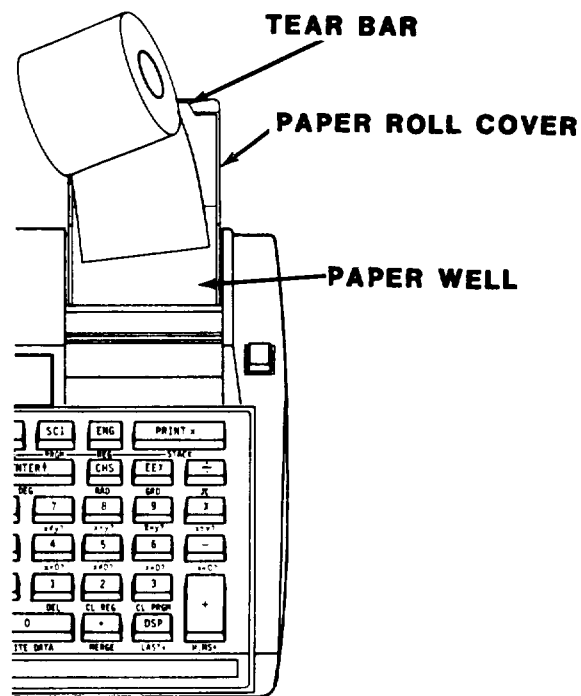


- b. Remove two thumbscrews on front of probe stand that hold slotted plate. Remove slotted plate.
- c. Place linear measuring probe into recess under slotted plate.

6-6.2.7 Mounting Linear Measuring Probe in Stand - Continued

- d. Set linear measuring probe so that alignment stud is in center of recess and facing front.
- e. Reinstall slotted plate. Secure with two thumbscrews.

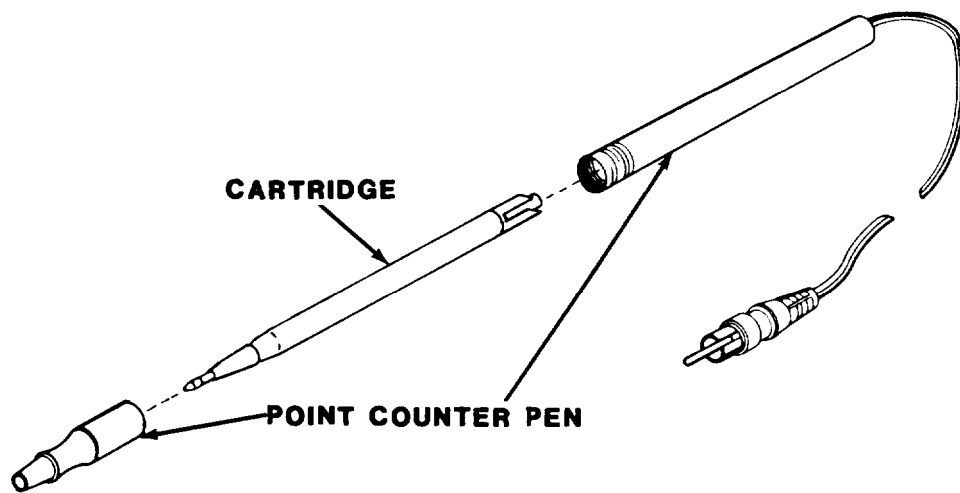
6-6.2.8 Installing Paper in Calculator



- a. Open paper roll cover. Remove empty core from paper well.
- b. Remove first two inches of paper from new roll before installing.

6-6.2.8 Installing Paper in Calculator - Continued

- c. Fold and crease leading edge of paper.
- d. Insert leading edge of paper into slot at bottom of paper well.
- e. Turn calculator OFF/ON switch to ON. Press paper advance button until leading edge of paper becomes visible beneath tear bar.
- f. Place roll of paper in paper well. Close paper roll cover.

6-6.2.9 Installing Blank Cartridge in Point Counter Pen**CAUTION**

Cartridge is spring-loaded. Do not let spring fall out. Pen will not work without spring.

- a. Grasp point counter pen at both ends. Unscrew two halves of pen.

6-6.2.9 Installing Blank Cartridge in Point Counter Pen - Continued

- b. Remove ink cartridge.
- c. Insert blank cartridge.
- d. Screw two halves of pen back together.

6-6.2.10 Loading Magnetic Cards

- a. Turn calculator OFF/ON switch to ON. Turn MAN/TRACE/NORM switch to MAN. Turn PRGM/RUN switch to RUN.

CAUTION

- Hold magnetic cards by the edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.
 - Do not continue to hold card after it is grasped by feed mechanism. Damage to magnetic card or calculator can result.
- b. Insert magnetic card into reader. If calculator displays ERROR, press any key to clear. Pass side one of magnetic card through reader again. If calculator displays Crd, reverse card, and load side two.
 - c. Print out program to obtain record of program from magnetic card.
 - (1) Press **RTN** and **f** keys.
 - (2) Press **PRINT:PRGM** key.

NOTE

- Printout should have three columns. The first column is program step number, the second column is keystrokes entered, and the third column shows key codes for the keystroke entries.
- To stop printout at any point, press **R/S** key.
- To start over at beginning of program, press **RTN** key.

6-6.2.11 Manual Program Loading. Programs are entered as a series of keystrokes. The calculator will display two groups of numbers during the course of programming. The three-digit display to the left is the program step number. The digits to the right are key code numbers identifying keys pressed by row and column. Keystrokes that make up the program are stored in the program memory of the calculator. The program memory has a storage capacity of 224 steps.

- a. Turn calculator OFF/ON switch to ON. Turn MAN/TRACE/NORM switch to MAN and PRGM/RUN switch to PRGM.
- b. Press **f** and **CL PRGM** keys.

NOTE

Pressing **f** and **CL PRGM** keys clears calculator memory of any previous programs.

- c. Determine and write down natural sequence of keystrokes that are required to perform functions in program.
- d. Assign program an identifying label by pressing **LBL** key, followed by one of the following keys: A through D, a through e, or 0 through 9.

NOTE

Two different programs cannot be given same label on same magnetic card at same time in calculator memory.

- e. Key in keystrokes of program determined in step c.

NOTE

Except for the following seven functions, all functions can be recorded. **f** **CL PRGM**, **BST**, **SST**, **f** **DEL**, **GTO**, **.**, and **f** **PRINT:PRGM** are used to load, edit, and modify programs.

- f. Print out program to verify.
 - (1) Press **RTN**.
 - (2) Press **f** and **PRINT:PRGM** keys.

6-6.2.12 Printing Out Programs. All programs should be printed out. The printout can verify the program, and provide a copy of the program should the magnetic card get damaged or lost. The printout can be used to record a verified program onto a magnetic card.

a. Load contents of magnetic card into calculator memory.

- (1) Turn calculator OFF/ON switch to ON. Turn MAN/TRACE/NORM switch to MAN. Turn PRGM/RUN switch to RUN.

CAUTION

- Hold magnetic card by the edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic card.
- Do not continue to hold card after it is grasped by feed mechanism. Damage to magnetic card or calculator can result.

- (2) Insert magnetic card into reader. If calculator displays ERROR, press any key to clear. If calculator displays CRD, reverse card and load side two.

b. To obtain printout of program now loaded into calculator memory, press: **RTN**, **f**, and **PRINT:PRGM** keys. To stop printout at any time, press **R/S** key. To return to beginning of program, press **RTN** key.

c. To obtain printout of manually loaded program, follow above steps after keying last keystroke. Use printout to verify program, and load magnetic card.

6-6.2.13 Recording Program on Magnetic Card

a. Manually enter desired program into calculator memory (para 6-6.2.11).

b. Obtain printout to verify program.

(1) Press **RTN**.

(2) Press **f** and **PRINT:PRGM** keys.

NOTE

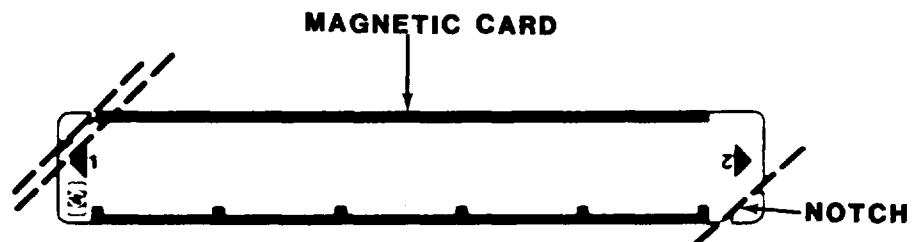
If printout does not verify program, repeat steps a and b.

6-6.2.13 Recording Program on Magnetic Card - Continued

- c. Set PRGM/RUN switch to PRGM. If display does not show 000 or 001, press **BST** key.
- d. Select unclipped and unmarked magnetic card from packet of cards.

CAUTION

- Hold magnetic card by the edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic card.
 - Do not continue to hold card after it is grasped by feed mechanism. Damage to magnetic card can result.
- e. Load side one of magnetic card through reader. If calculator displays ERROR, press any key to clear. Pass side one through magnetic card again. If calculator displays Crd, reverse card and load side two.
 - f. Print out program to verify.



- g. Mark magnetic card to identify program.
- h. To protect contents of magnetic card from being erased, cut corners of card along notches.

6-6.2.14 Alinement of Planimeter With Lens Tracing Assembly. Alinement of the planimeter provides information needed to make area and volume measurements. Using the testing procedure provides values needed to check alinement with factory determined values and provides a constant in determining additional measurements and calculations. Test measurement is made with the test rule. Measurement with test rule traces a circle with a two-inch radius. The area of that circle has a factory determined area, AT, found on the Calibration Records Sheet provided with the equipment.

- a. Assemble QPS using the planimeter with lens tracing assembly.
- b. Activate QPS:
 - (1) Plug foot switch into CLEAR input jack on back panel of auto-scaler.
 - (2) Plug remote tracer switch into ACCU input jack on back panel of auto-scaler.
 - (3) Plug planimeter into E₁ encoder socket on back panel of auto-scaler.
 - (4) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (5) Plug power transformer cable into wall outlet.
 - (6) Plug power cord into back of calculator.
 - (7) Plug power cord into wall outlet.
 - (8) Set encoder OFF/E₂/E₁ switch on back panel of auto-scaler to E₁.
 - (9) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO .
 - (10) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (11) Set auto-scaler MAN/AUTO switch to AUTO.
 - (12) Set auto-scaler X MEMORY switch to 1.
 - (13) Set calculator OFF/ON switch to ON.
 - (14) Set calculator MAN/TRACE/NORM switch to NORM.
 - (15) Set calculator PRGM/RUN switch to RUN.
 - (16) Press following keys: **1** , **STO** , **1** , and **ENTER ↓** .

6-6.2.14 Alinement of Planimeter With Lens Tracing Assembly - Continued

- c. Remove Y-shaped test rule from carrying case.
- d. Tape piece of paper to table. Draw a horizontal line 12 inches long.
- e. place planimeter on paper so it straddles line drawn.
- f. Hold tracer arm in place and turn wheels on planimeter so that wheel axle forms 90° angle with tracer arm.
- g. Press point of Y-shaped test rule into paper on horizontal line.
- h. Place lens tracing assembly so that recessed end of Y-shaped test rule rests against edge of lens. Press edge of lens so that it rides against inside edges of test rule recess.
- i. Clear auto-scaler by pressing and releasing foot switch.

NOTE

If planimeter is allowed to slip, area measured will not be actual area of test rule, and results will be inaccurate.

- j. Keep lens pressed firmly against test rule. Slowly trace 360° circle by moving lens in a clockwise direction around center of test rule. Stop when you return to starting point. Record pulse count value. Clear auto-scaler by pressing and releasing foot switch.
- k. Repeat steps h through j, four times. Reposition test rule at different point on line after three measurements. Average the pulse counts shown on LED display after each test measurement to obtain R_T value.

NOTE

- o If average R_T value is not within $\pm 0.2\%$ of factory determined R_T value, the planimeter may be defective. Repeat alinement procedure. Notify direct support and general support maintenance for service or replacement.
- o If using preprogrammed cards, manual calculation of C_A (calibration constant) is not necessary.

6-6.2.14 Alinement of Planimeter With Lens Tracing Assembly - Continued

NOTE

Press **SCI** key to perform following equation.

$$C_A = \frac{(S_{HOR} \times S_{VERT}) \times A_T}{R_T}$$

S_{HOR} = Horizontal scale of shape to be measured

S_{VERT} = Vertical scale of shape to be measured

A_T = Area of test rule

R_T = Average of pulse count readings

S_{HOR} and S_{VERT} are usually provided with map.

A_T is premarked value on top of test rule.

R_T can be found on Calibration Records Sheet or from average of measurements made with test rule.

- l. If QPS is being initially alined with premarked tracer arm lengths, compare average R_T value to R_T value found on Calibration Records Sheet provided with equipment.
- m. Note value of actual area measured by test rule, which is premarked on top of test rule. Use test rule area and the scale ratio of shape to be measured to determine C_A (calibration constant). C_A is needed to perform various measurements.

6-6.2.15 Alinement of Planimeter With Needle Tracing Assembly. Alinement of the planimeter with the needle tracing assembly follows the same procedure as alinement of the planimeter with the lens tracing assembly (para 6-6.2.14). The test measurement checks the alinement of the planimeter with the initial use of the needle tracing assembly. The needle on the needle tracing assembly fits into the hole on the long test rule to make test measurements. The average R_T reading obtained by following the steps for the lens tracing assembly should be within $\pm 0.2\%$ of R_T value given on Calibration Records Sheet provided with equipment. The same formula is used to determine the calibration constant, C_A .

6-6.2.16 Alinement of Linear Measuring Probe. Alinement of the linear measuring probe provides information needed to make linear measurements. Using the testing procedure provides values needed to check alinement with factory determined values and provides a constant to use in determining additional measurements and calculations.

6-6.2.16 Alinement of Linear Measuring Probe - Continued

- a. Assemble QPS with the linear measuring probe.
- b. Activate QPS:
 - (1) Plug foot switch into CLEAR input jack on back panel of auto-scaler.
 - (2) Plug linear measuring probe into E₁ encoder socket on back panel of auto-scaler.
 - (3) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (4) Plug power transformer cable into wall outlet.
 - (5) Plug power cord into back of calculator.
 - (6) Plug power cord into wall outlet.
 - (7) Set encoder OFF/E₂/E₁ switch on back panel of auto-scaler to E₁.
 - (8) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
 - (9) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (10) Set auto-scaler MAN/AUTO switch to AUTO.
 - (11) Set auto-scaler X MEMORY switch to 1.
 - (12) Set calculator OFF/ON switch to ON.
 - (13) Set calculator MAN/TRACE/NORM switch to NORM.
 - (14) Set calculator PRGM/RUN switch to RUN.
 - (15) Press following keys: **1**, **STO**, **1**, and **ENTER ↓**.
- c. Tape piece of paper to table. Draw line exactly 10 inches long. Label ends of line A and B.

6-6.2.16 Alinement of Linear Measuring Probe - Continued

NOTE

Foot switch must remain depressed until ready to begin measurement, so that movement and handling of linear measuring probe will not increment counter.

- d. Press CLEAR button on auto-scaler. Depress foot switch to initiate ACCU and freeze count at 0.
- e. Place linear measuring probe and stand so that pricking pin is at beginning mark of line.
- f. Release foot switch.
- g. Grasp probe body and roll linear measuring probe along length of line. Stop when needle is precisely at end of line.
- h. Press foot switch.
- i. Divide digital readout on LED display by 10 to determine alined pulse count reading, R_L . Record this number.
- j. Repeat steps d through i four times. Average the five pulse count results obtained from the LED display after each test measurement to obtain R_L value.

NOTE

If average R_L value is not within $\pm 0.2\%$ of factory determined R_L value, the linear measuring probe may be defective. Repeat alinement procedure. Notify direct support and general support maintenance for service or replacement.

- k. Compare average R_L value to R_L value found on Calibration Records Sheet provided with equipment.

NOTE

If using preprogrammed cards, Program III, manual calculation of C_L is not necessary.

6-6.2.16 Alinement of Linear Measuring Probe - Continued

1. Use scale of map, plan, or blueprint being measured to determine C_L (calibration constant). C_L is needed to perform various measurements.
- m. Use the following equation to determine C_L .

$$C_L = \frac{S}{R_L}$$

S = Scale, in desired units for measurements
 R_L can be found on Calibration Records Sheet
 or from average of test measurements.

6-6.2.17 Measuring Areas With Planimeter

- a. Assemble QPS with planimeter.
- b. Activate QPS:
 - (1) Plug foot switch into PRINT input jack on back panel of auto-scaler.
 - (2) Plug remote tracer switch into ACCU input jack on back panel of auto-scaler.
 - (3) Plug planimeter into E2 encoder socket on back panel of auto-scaler.
 - (4) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (5) Plug power transformer cable into wall outlet.
 - (6) Plug power cord into back of calculator.
 - (7) Plug power cord into wall outlet.
 - (8) Set encoder OFF/E2/E1 switch on back panel of auto-scaler to E2.
 - (9) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
 - (10) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (11) Set auto-scaler MAN/AUTO switch to MAN.
 - (12) Set auto-scaler X MEMORY switch to 1.

6-6.2.17 Measuring Areas With Planimeter - Continued

- (13) Set calculator OFF/ON switch to ON.
- (14) Set calculator MAN/TRACE/NORM switch to NORM.
- (15) Set calculator PRGM/RUN switch to RUN.
- (16) Press following keys: **1**, **STO**, **1**, and **ENTER ↑**.

CAUTION

Hold magnetic cards by edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.

- c. Load preprogrammed magnetic card (para 6-6.2.10), Program I, into calculator.
- d. Tape map or drawing to be measured to table.
- e. Select correct tracer arm length.

NOTE

Tracer arm should be shortest one possible that will allow entire shape to be measured without moving planimeter.

- f. Aline planimeter with tracer arm length selected (para 6-6.2.14). Record R_T value.

NOTE

Factory determined R_T value is provided on Calibration Records Sheet provided with equipment. Alinement is performed as a check.

- g. Place planimeter near shape to be measured so that length of tracer arm lies along imaginary line through center of shape. Set wheels so that their axles form 90° angle with tracer arm.
- h. Make practice trace to be sure tracer arm will cover area in one operation.
- i. Select starting point for measurement on shape where Imaginary line crosses boundary of shape. Mark point.

6-6.2.17 Measuring Areas With Planimeter - Continued

- j. Set dot in lens tracing assembly over starting point.
- k. Enter into calculator horizontal and vertical scales of shape and R_T value.
- (1) Key in horizontal scale; press **ENTER ↓**.
 - (2) Key in vertical scale; press **ENTER ↓**.
 - (3) Key in R_T value; press **B**.
 - (4) For results in square feet or square feet and acres, press **f** and **d**.

NOTE

- If R_T value is not entered, all results from calculator will be zero.
 - When results are printed, the first area given will be in square feet, the second in acres.
- l. Clear auto-scaler by pressing CLEAR button.
- m. Trace in clockwise direction boundary line of shape using dot in lens tracing assembly. Stop when you reach starting point.
- n. Press remote tracer switch to activate Actuate function and freeze count.
- o. Press foot switch to activate Print command. Calculator will print area of shape in square feet or square feet and acres.
- p. To measure several shapes, keep foot switch and remote tracer switch depressed. Reposition planimeter to next shape and repeat steps i, and 1 through o.
- q. To change functions or change scale of next shape to be measured: Press **D** and repeat steps k through o.

6-6.2.18 Measuring Areas To Be Added and/or Subtracted

- a. Assemble QPS with planimeter.
- b. Activate QPS:
 - (1) Plug foot switch into PRINT input jack on back panel of auto-scaler.
 - (2) Plug remote tracer switch into ACCU input jack on back panel of auto-scaler.
 - (3) Plug planimeter into E2 encoder socket on back panel of auto-scaler.
 - (4) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (5) Plug power transformer cable into wall outlet.
 - (6) Plug power cord into back of calculator.
 - (7) Plug power cord into wall outlet.
 - (8) Set encoder OFF/E2/E1 switch on back panel of auto-scaler to E2.
 - (9) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO .
 - (10) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (11) Set auto-scaler MAN/AUTO switch to MAN.
 - (12) Set auto-scaler X MEMORY switch to 1.
 - (13) Set calculator OFF/ON switch to ON.
 - (14) Set calculator MAN/TRACE/NORM switch to NORM.
 - (15) Set calculator PRGM/RUN switch to RUN.
 - (16) Press following keys: **1** , **STO** , **1** , and **ENTER ↓** .
- c. Set up planimeter for area measurement (pars 6-6.2.17).
- d. To add areas being measured, in square feet or square feet and acres, press **C**
- e. Reposition planimeter near next shape to be measured. Keep remote tracer switch pressed.
- f. Clear auto-scaler by pressing CLEAR button.

6-6.2.18 Measuring Areas To Be Added and/or Subtracted - Continued

- g. Trace boundary line of shape using dot on lens tracing assembly. Stop when you reach starting point.
- h. Press foot switch to activate Print command.

NOTE

Calculator will print data on area just measured. It prints area of single shape in square feet first followed by area in square feet and acres. Current total areas are printed in same order.

- i. If area is to be subtracted instead of added, press **f** and c for Actuate routine. Repeat measurement procedure.

6-6.2.19 Measuring Surface Area of Slope

- a. Assemble QPS with planimeter.
- b. Activate QPS:
 - (1) Plug foot switch into PRINT input jack on back panel of auto-scaler.
 - (2) Plug remote tracer switch into ACCU input jack on back panel of auto-scaler.
 - (3) Plug planimeter into E2 encoder socket on back panel of auto-scaler.
 - (4) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (5) Plug power transformer cable into wall outlet.
 - (6) Plug power cord into back of calculator.
 - (7) Plug power cord into wall outlet.
 - (8) Set encoder OFF/E2/E1 switch on back panel of auto-scaler to E2.
 - (9) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
 - (10) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (11) Set auto-scaler MAN/AUTO switch to MAN.

6-6.2.19 Measuring Surface Area of Slope Continued

- (12) Set auto-scaler X MEMORY switch to 1.
- (13) Set calculator OFF/ON switch to ON.
- (14) Set calculator MAN/TRACE/NORM switch to NORM.
- (15) Set calculator PRGM/RUN switch to RUN.
- (16) Press following keys: **1** , **STO** , **1** , and **ENTER ↑** .

c. Set up planimeter for area measurement (para 6-6.2.17).

CAUTION

Hold magnetic cards by edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.

- d. Load preprogrammed card (para 6-6.2.10), Program 1, into calculator.
- e. Tape map or drawing to be measured to table.
- f. If needed, align planimeter with tracer arm length selected (para 6-6.2.14). Record R_T value.

NOTE

Factory determined R_T value is given on Calibration Records Sheet provided with equipment. Alinement is performed as a check.

- g. Position planimeter near shape to be measured so that tracer arm lies along imaginary line through center of shape. Set wheels so that their axles form 90° angle with tracer arm.
- h. Enter into calculator horizontal and vertical scales of shape and R_T value.
 - (1) Key in horizontal scale; press **ENTER ↑** .
 - (2) Key in vertical scale; press **ENTER ↑** .
 - (3) Key in R_T value; press **B**

6-6.2.19 Measuring Surface Area of Slope - Continued**NOTE**

Slope ratio should be given. Slope ratio can be determined by using the reciprocal of given horizontal scale and vertical scale.

$$\frac{\text{horizontal scale}}{\text{vertical scale}} \text{ invert to } \frac{\text{vertical scale}}{\text{horizontal scale}} = \text{slope ratio}$$

Example: $\frac{\text{horizontal scale}}{\text{vertical scale}} = \frac{10}{50} = \frac{1}{5}$ invert to $\frac{5}{1}$ or

5:1 = slope ratio

- (4) Key in slope ratio (Enter 5); press \boxed{f} and b.
- i. Press CLEAR button to clear auto-scaler.
 - j. Trace boundary of shape using dot in lens tracing assembly. Stop when you reach starting point.
 - k. Press foot switch to activate Print command and freeze count.

NOTE

Calculator will print area of shape. Horizontal area in square feet will be printed first followed by true surface area in square feet.

1. Keeping foot switch depressed, reposition planimeter near next shape to be measured. Repeat steps i through k.

6-6.2.20 Measuring Slopes To Be Added and/or Subtracted. This procedure follows Measuring Surface Area of Slope (para 6-6.2.19), steps a through i. After completing steps a through i, follow the steps provided below to add or subtract from slope measurement obtained.

- a. If slope to be measured will be added, press \boxed{C} .
- b. If slope to be measured will be subtracted, press \boxed{f} and c.
- c. Press CLEAR button to clear auto-scaler.
- d. Trace boundary of shape using dot in lens tracing assembly. Stop when you reach starting point.

6-6.2.20 Measuring Slopes To Be Added and/or Subtracted - Continued

- e. Press foot switch to activate PRINT command and freeze count.

NOTE

Calculator will print horizontal and true slope surface area of shape last measured, followed by totals (added or subtracted) of horizontal and true slope surface areas.

- f. Keeping foot switch depressed, reposition planimeter near slope to be measured. Make next measurement.
- g. If change is made in planimeter function or if new scales or slope ratios are used, press **D** to initiate measurement. Begin measurement procedures.

6-6.2.21 Measuring Areas Without the Calculator

- a. Assemble QPS with the planimeter.
- b. Activate QPS:
 - (1) Plug foot switch into ACCU input jack on back panel of auto-scaler.
 - (2) Plug planimeter into E2 encoder socket on back panel of auto-scaler.
 - (3) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (4) Plug power transformer cable into wall outlet.
 - (5) Plug power cord into back of calculator.
 - (6) Plug power cord into wall outlet.
 - (7) Set encoder OFF/E2/E1 switch on back panel of auto-scaler to E2.
 - (8) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
 - (9) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (10) Set auto-scaler MAN/AUTO switch to MAN.

6-6.2.21 Measuring Areas Without the Calculator - Continued

- (11) Set auto-scaler X MEMORY switch to 1.
- (12) Set calculator OFF/ON switch to OFF.
- c. Tape map or drawing to be measured to table.
- d. Select correct tracer arm length.
- e. If needed, align planimeter for tracer arm length selected (para 6-6.2.14). Record R_T value.

NOTE

Factory determined R_T value is given on Calibration Records Sheet provided with equipment. Alinement is performed as a check.

- f. Manually calculate alinement constant, C_A , using the following equation:

$$C_A = S^2 \times u$$

C_A = Alinement constant

S^2 = Scale ratio squared (given on map being measured or determined by equation in para 6-6.2.19)

u = Value of one planimeter unit (factory determined value provided on Calibration Records Sheet provided with equipment)

- g. Enter three most significant digits of alinement constant, C_A , into auto-scaler using scaler dials.
 - (1) Set first most significant digit on left-hand dial.
 - (2) Set second most significant digit on middle dial.
 - (3) Set third most significant digit on right-hand dial.
 - (4) Example: If C_A is 10.571, left-hand dial should read 1, middle dial should read 0, and right-hand dial should read 5.
- h. Set decimal selector according to value of first significant digit of alinement constant.

6-6.2.21 Measuring Areas Without the Calculator - Continued

NOTE

- Decimal selector sets decimal place for auto-scaler LED display.
 - If constant is one or greater, set decimal selector to 0.
 - If constant is less than one, set decimal selector according to place value of first significant digit.
- i. Place planimeter near shape to be measured so that length of tracer arm lies along imaginary line through center of shape. Set wheels so that their axles form 90° angle with tracer arm.
 - j. Make practice trace to be sure tracer arm will cover area.
 - k. Select starting point for measurement, and mark.
 1. Set dot of lens tracing assembly over starting point.
 - m. Press CLEAR button to clear auto-scaler.
 - n. Trace boundary line of shape using dot in lens tracing assembly. Stop when you return to starting point.
 - o. Press foot switch to activate ACCU and freeze count.
 - p. Multiply numbers shown in the auto-scaler LED display to obtain area of shape in square feet.

NOTE

- If first significant digit of CA is in ones column (one place to left of decimal point), multiply auto-scaler LED display by 10.
- If first significant digit is in tens column, multiply auto-scaler LED display by 100.
- If first significant digit is three or more places to left of decimal point, increase multiplication factor by 10 for each position it lies further to left.

6-6.2.22 Measuring Lengths With Linear Measuring Probe To Be Added and/or Subtracted

- a. Assemble QPS with linear measuring probe.
- b. Activate QPS:
 - (1) Plug foot switch into PRINT input jack on back panel of auto-scaler.
 - (2) Plug linear measuring probe into E1 encoder socket on back panel of auto-scaler.
 - (3) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (4) Plug power transformer cable into wall outlet.
 - (5) Plug power cord into back of calculator.
 - (6) Plug power cord into wall outlet.
 - (7) Set encoder OFF/E2/E1 switch on back panel of auto-scaler to E1.
 - (8) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
 - (9) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (10) Set auto-scaler MAN/AUTO switch to MAN.
 - (11) Set auto-scaler X MEMORY switch to 1.
 - (12) Set calculator OFF/ON switch to ON.
 - (13) Set calculator MAN/TRACE/NORM switch to NORM.
 - (14) Set calculator PRGM/RUN switch to RUN.
 - (15) Press following keys: **1** , **STO** , **1** , and **ENTER ↓** .

CAUTION

Hold magnetic cards by edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.

- c. Load preprogrammed magnetic card (para 6-6.2.10), Program I, into calculator.

6-6.2.22 Measuring Lengths With Linear Measuring Probe To Be Added and/or Subtracted - Continued

- d. Tape drawing or map to be measured to table.
- e. If needed, align linear measuring probe (para 6-6.2.16). Record RL value.

NOTE

Factory determined RL value is given on Calibration Record Sheet provided with equipment. Alinement is performed as a check.

- f. Key in scale of map or drawing to be measured.
- g. Press **f** and **a** to call up (from memory) lengths routine for feet. press **f** and **d** if printout in feet and inches is desired.

NOTE

Linear measuring probe stand is used to facilitate measurement using a straightedge.

- h. If needed, mount linear measuring probe in stand.
- i. Press CLEAR button to clear auto-scaler.
- j. Press foot switch. Do not release until ready to begin measurement.
- k. Position linear measuring probe so that the pricking pin is at beginning of length to be measured. Release foot switch.
- l. Make measurement by tracing length of line with linear measuring probe.
- m. Press foot switch to Initiate Print command and freeze count.
- n. To make another measurement, repeat steps j through m.
- o. If additional lengths are to be added, press **f** and **c** to initiate ACCU and addition subroutine.

6-6.2.22 Measuring Lengths With Linear Measuring Probe To Be Added and/or Subtracted - Continued

- p. If additional lengths are to be subtracted, press **f** and **e** for ACCU and subtraction subroutine.
- q. To change scale or function with new measurement, press **D** to initiate calculator memory.

6-6.2.23 Layout Work With Linear Measuring Probe

- a. Assemble QPS with linear measuring probe.
- b. Activate QPS:
 - (1) Plug foot switch into PRINT input jack on back panel of auto-scaler.
 - (2) Plug remote tracer switch into ACCU input jack on back panel of auto-scaler.
 - (3) Plug linear measuring probe into E₁ encoder socket on back panel of auto-scaler.
 - (4) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (5) Plug power transformer cable into wall outlet.
 - (6) Plug power cord into back of calculator.
 - (7) Plug power cord into wall outlet.
 - (8) Set encoder OFF/E₂/E₁ switch on back panel of auto-scaler to E₁.
 - (9) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
 - (10) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (11) set auto-scaler MAN/AUTO switch to MAN.
 - (12) Set auto-scaler X MEMORY switch to 1.
 - (13) set calculator OFF/ON switch to ON.
 - (14) Set calculator MAN/TRACE/NORM switch to NORM.

6-6.2.23 Layout Work With Linear Measuring Probe - Continued

(15) Set calculator PRGM/RUN switch to RUN.

(16) Press following keys: **1** , **STO** , **1** , and **ENTER** .

CAUTION

Hold magnetic cards by edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.

- c. Load preprogrammed magnetic card (para 6-6.2.10), Program I, into calculator.
- d. Tape drawing or map to be measured and paper for layout to table.
- e. If needed, align linear measuring probe (para 6-6.2.16). Record R_L value.

NOTE

Factory determined R_L value is given on Calibration Record Sheets provided with equipment. Alinement is performed as a check.

- f. Key in scale of map or drawing on which measurements will be made.

NOTE

If layout is to be drawn to a different scale than original map or drawing, key in scale for layout.

- g. Press **f** and **a**.
- h. Press **f** and **d** for printout in feet and inches.
- i. Press CLEAR button to clear auto-scaler.
- j. Press foot switch. Do not release until ready to begin measurement.
- k. Position linear measuring probe so that the pricking pin is at beginning of length to be measured. Release foot switch.
- l. Make measurement by tracing length of line with linear measuring probe.

6-6.2.23 Layout Work With Linear Measuring Probe - Continued

- m. Press, then release foot switch to initiate Print command.
- n. Position linear measuring probe on layout sheet at beginning of line just measured. Press pricking pin.
- o. Press CLEAR button to clear auto-scaler.
- p. Using a straightedge as a guide, move linear measuring probe until auto-scaler LED display shows count total identical to previously measured line.
- q. When LED display shows the same count, stop linear measuring probe. Press pricking pin.

NOTE

Pricking pin marks identify beginning and end of lines being laid out.

- r. For each new line, repeat steps g through q.
- s. To change scale or function, press **[D]** to initiate calculator memory.

6-6.2.24 Linear Measuring Probe Measurements Without the Calculator

- a. Assemble the QPS with the linear measuring probe.
- b. Activate QPS:
 - (1) Plug foot switch into ACCU input jack on back panel of auto-scaler.
 - (2) Plug linear measuring probe into E₁ encoder socket on back panel of auto-scaler.
 - (3) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (4) Plug power transformer cable into wall outlet.
 - (5) Plug power cord into back of calculator.
 - (6) Plug power cord into wall outlet.
 - (7) Set encoder OFF/E₂/E₁ switch on back panel of auto-scaler to E₁.

6-6.2.24 Linear Measuring Probe Measurements Without the Calculator -
Continued

- (8) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO .
 - (9) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (10) Set auto-scaler MAN/AUTO switch to MAN.
 - (11) Set auto-scaler X MEMORY switch to 1.
 - (12) Set calculator OFF/ON switch to OFF.
 - (13) Set auto-scaler NORMAL/SCALE switch to SCALE.
- c. Tape map or drawing to be measured to table.
- d. Calculate linear scale constant, C_L , using the following equation:
- $$C_L = \frac{S_c}{R_L}$$
- C_L = Linear scale constant
 S_c = Scale ratio of drawing or map
 R_L = Alinement constant (found on Calibration Records Sheet provided with equipment)
- e. Enter three most significant digits of linear scale constant, C_L , into auto-scaler using scaler dials.
- (1) Set first most significant digit on left-hand dial.
 - (2) Set second most significant digit on middle dial.
 - (3) Set third most significant digit on right-hand dial.
 - (4) Example: If C_L is 10.571, left-hand dial should read 1, middle dial should read 0, and right-hand dial should read 5.
- f. Set decimal selector according to value of first significant digit of linear scale constant, C_L .

NOTE

Decimal selector switch sets decimal place for auto-scaler LED display.

6-6.2.24 Linear Measuring Probe Measurements Without the Calculator -
Continued

NOTE

- If constant is one or greater, set decimal selector to 0.
 - If constant is less than one, set decimal selector according to place of first significant digit.
- g. Place linear measuring probe on line to be measured so that pricking pin is at starting point.
 - h. Press CLEAR button to clear auto-scaler.
 - i. Make measurement by tracing length of line with linear measuring probe.
 - j. Press foot switch to activate ACCU and freeze count.
 - k. Multiply number shown in auto-scaler LED display to obtain length of line in feet.

NOTE

- If first significant digit of CL is in ones column (one place to left of decimal point), multiply auto-scaler LED display by 10.
- If first significant digit is in tens column, multiply auto-scaler LED display by 100.
- If first significant digit is three or more places to left of decimal point, increase multiplication factor by 10 for each position it lies further to the left.

6-6.2.25 Point Counts With Point Counter Pen and Constants

- a. Assemble QPS with point counter pen.
- b. Activate QPS:
 - (1) Plug point counter pen into POINT COUNT. input jack on back panel of auto-scaler.
 - (2) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.

6-6.2.25 Point Counts With Point Counter Pen and Constants - Continued

- (3) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
- (4) Plug power transformer cable into wall outlet.
- (5) Plug power cord into back of calculator.
- (6) Plug power cord into wall outlet.
- (7) Set encoder OFF/E₂/E₁ switch on back panel of auto-scaler to OFF.
- (8) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
- (9) Set auto-scaler B/ACCU/A/OFF switch to A.
- (10) Set auto-scaler MAN/AUTO switch to MAN.
- (11) Set auto-scaler X MEMORY switch to 1.
- (12) Set calculator OFF/ON switch to ON.
- (13) Set calculator MAN/TRACE/NORM switch to NORM.
- (14) Set calculator PRGM/RUN switch to RUN.

CAUTION

Hold magnetic cards by edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.

- c. Load preprogrammed magnetic card (para 6-6.2.10), Program I, into calculator.
- d. Tape drawing or map to be measured to table.
- e. When multiplying counts by one constant, key in constant, press **ENTER** and **A**.
- f. Press CLEAR button to clear auto-scaler.
- g. Using point counter pen, make point count.
- h. Press PRINT to obtain results of count.
- i. To make point count with two to four constants, follow steps a through d.

6-6.2.25 Point Counts With Point Counter Pen and Constants - Continued

- j. When multiplying counts by two to four constants, key in each constant followed by **ENTER ↵**.
- k. After last constant has been keyed in, press **ENTER ↵**, **f**, and **e**.
- l. Press CLEAR button to clear auto-scaler.
- m. Using point counter pen, make point count.
- n. Press PRINT to obtain results of count.
- o. Change X MEMORY switch to 2. Press CLEAR button to clear auto-scaler.
- p. Using point counter pen, make point count.
- q. Press PRINT to obtain results of count.
- r. Repeat steps m through q if there is another constant being used.

6-6.2.26 Standard Volume Run Using Contour Method

- a. Assemble QPS with planimeter.
- b. Activate QPS:
 - (1) Plug foot switch into ACCU input jack on back panel of auto-scaler.
 - (2) Plug remote tracer switch into PRINT input jack on back panel of auto-scaler.
 - (3) Plug planimeter into E2 encoder socket on back panel of auto-scaler.
 - (4) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (5) Plug power transformer cable into wall outlet.
 - (6) Plug power cord into back of calculator.
 - (7) Plug power cord into wall outlet.
 - (8) Set encoder OFF/E2/E1 switch on back panel of auto-scaler to E2.

6-6.2.26 Standard Volume Run Using Contour Method - Continued

- (9) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
- (10) Set auto-scaler B/ACCU/A/OFF switch to A.
- (11) Set auto-scaler MAN/AUTO switch to MAN.
- (12) Set auto-scaler X MEMORY switch to 1.
- (13) Set calculator OFF/ON switch to ON.
- (14) Set calculator MAN/TRACE/NORM switch to NORM.
- (15) Set calculator PRGM/RUN switch to RUN.
- (16) Press following keys: **1** , **STO** , **1** , and **ENTER ↓** .

CAUTION

Hold magnetic cards by edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.

- c. Load preprogrammed magnetic card (para 6-6.2.10). Program II, into calculator.
- d. Tape map or drawing to be measured to table.
- e. Select correct tracer arm length.

NOTE

The tracer arm length should be shortest one possible that will allow entire shape to be measured without moving the planimeter.

- f. If needed, align planimeter with tracer arm length selected (para 6-6.2.14). Record R_T value.

NOTE

Factory determined R_T value is given on Calibration Record Sheet provided with equipment. Alinement is performed as a check.

- g. Key in horizontal and vertical scales of contour map or photo and R_T value.

- (1) Key in horizontal scale, press **ENTER ↓** .

6-6.2.26 Standard Volume Run Using Contour Method - Continued

- (2) Key in vertical scale, press **ENTER ↓** .
- (3) Key in R_T value, press **ENTER ↓** .
- h. Key in section interval of contours to be measured, and press **ENTER ↓** .
- i. Press **A** to call up subroutine A.
- j. Determine if object of contour is cut (excavation) or fill (embankment).
- (1) If contour is fill, press **B** .
- (2) If contour is cut, press **f** and **b**.
- k. Press **INIT** button to clear calculator.
- l. Key in value for elevation of first contour to be measured.
- m. Press **c**.
- n. Place planimeter at starting point of boundary line for measuring contour loop.
- o. Make practice trace to make sure tracer arm will cover area in one operation.
- p. Press **CLEAR** button to clear auto-scaler.
- q. Trace boundary line of contour loop with dot in lens tracing assembly. Stop when you reach starting point.
- r. Press and hold down remote tracer switch to activate **PRINT** command.

NOTE

- Calculator will print the following information after the first measurement.
 - ***Elevation
 - ***Section of contour loop
- Additional measurements will provide values for intermediate volume and total volume.
 - 0.00 Intermediate volume in cubic yards
 - 0.00 Total volume in cubic yards

6-6.2.26 Standard Volume Run Using Contour Method - Continued

- s. Move to next contour loop. Release remote tracer switch. Repeat steps q through r until desired volume is determined.
- to To change contour interval when next loop to be measured is at a different interval, key in new interval. Press **f** and **a**.
- u. If last elevation is not even contour interval, key in value for last elevation. Press **f** and **c**. Repeat steps q through t.
- v. To start new run, press **B** or **f** and **b** to initiate memory. Repeat steps k through q.

6-6.2.27 Merging Volume Runs

- a. Assemble QPS with planimeter.
- b. Activate QPS:
 - (1) Plug foot switch into ACCU input jack on back panel of auto-scaler.
 - (2) Plug remote tracer switch into PRINT input jack on back panel of auto-scaler.
 - (3) Plug planimeter into E₁ encoder socket on back panel of auto-scaler.
 - (4) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (5) Plug power transformer cable into wall outlet.
 - (6) Plug power cord into back of calculator.
 - (7) Plug power cord into wall outlet.
 - (8) Set encoder OFF/E₂/E₁ switch on back panel of auto-scaler to E₁.
 - (9) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
 - (10) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (11) Set auto-scaler MAN/AUTO switch to AUTO.

6-6.2.27 Merging Volume Runs - Continued

- (12) Set auto-scaler X MEMORY switch to 1.
- (13) Set calculator OFF/ON switch to ON.
- (14) Set calculator MAN/TRACE/NORM switch to NORM.
- (15) Set calculator PRGM/RUN switch to RUN.
- (16) Press following keys: **1** , **STO** , **1** , and **ENTER ↑** .

CAUTION

Hold magnetic cards by edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.

- c. Load preprogrammed magnetic card (para 6-6.2.10), Program II, into calculator.
- d. Tape map or drawing to be measured to table.
- e. Select correct tracer arm length.

NOTE

The tracer arm length should be shortest one possible that will allow entire shape to be measured without moving the planimeter.

- f. If needed, aline planimeter with tracer arm selected (para 6-6.2.14). Record R_T value.

NOTE

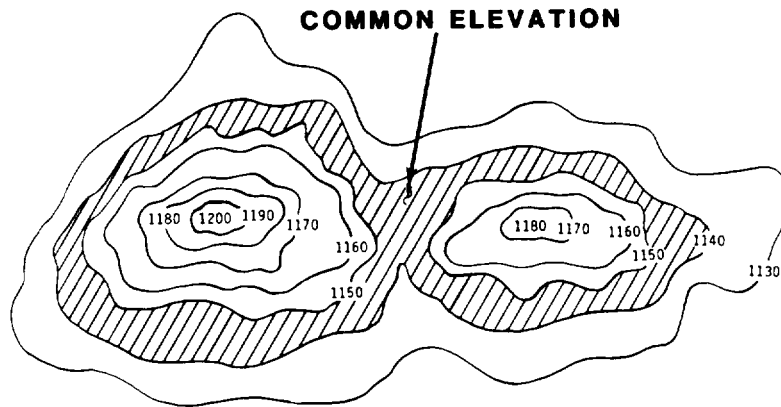
Factory determined R_T value is given on Calibration Record Sheet provided with equipment. Alinement is performed as a check.

- g. Key in horizontal and vertical scales of contour map or photo and R_T value.
 - (1) Key in horizontal scale, press **ENTER ↑** .
 - (2) Key in vertical scale, press **ENTER ↑** .
 - (3) Key in R_T value, press **ENTER ↑** .

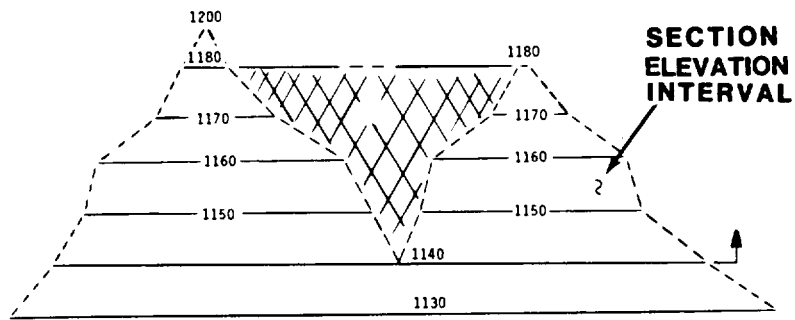
6-6.2.27 Merging Volume Runs - Continued

NOTE

In contour map example of twin peak mountain, area is elevation where volumes merge into common base. Volume of left peak above merge point will be measured first.



NORMAL VIEW



SIDE VIEW

- h. Key in section elevation interval of contours to be measured. Press **A**.
- i. If contour is a fill, press **B**.
If contour is a cut, press **f** and **b**.
- j. Place planimeter at starting point of boundary line for measuring first contour.

6-6.2.27 Merging Volume Runs - Continued

- k. Press INIT. button to clear calculator.
- l. Make practice trace to make sure tracer arm will cover area in one operation.
- m. Press CLEAR button to clear auto-scaler.
- n. Key in starting elevation and press **C**.
- o. Trace boundary line of contour loop with dot in lens tracing assembly. Stop when you reach starting point.
- p. Press and hold down remote tracer switch to activate PRINT command.

NOTE

- Calculator will print the following information after the first measurement.

***Elevation

- Additional measurements will provide values for intermediate volume and total volume.

0.00 Area of contour loop
 0.00 Intermediate volume in cubic yards
 0.00 Total volume in cubic yards

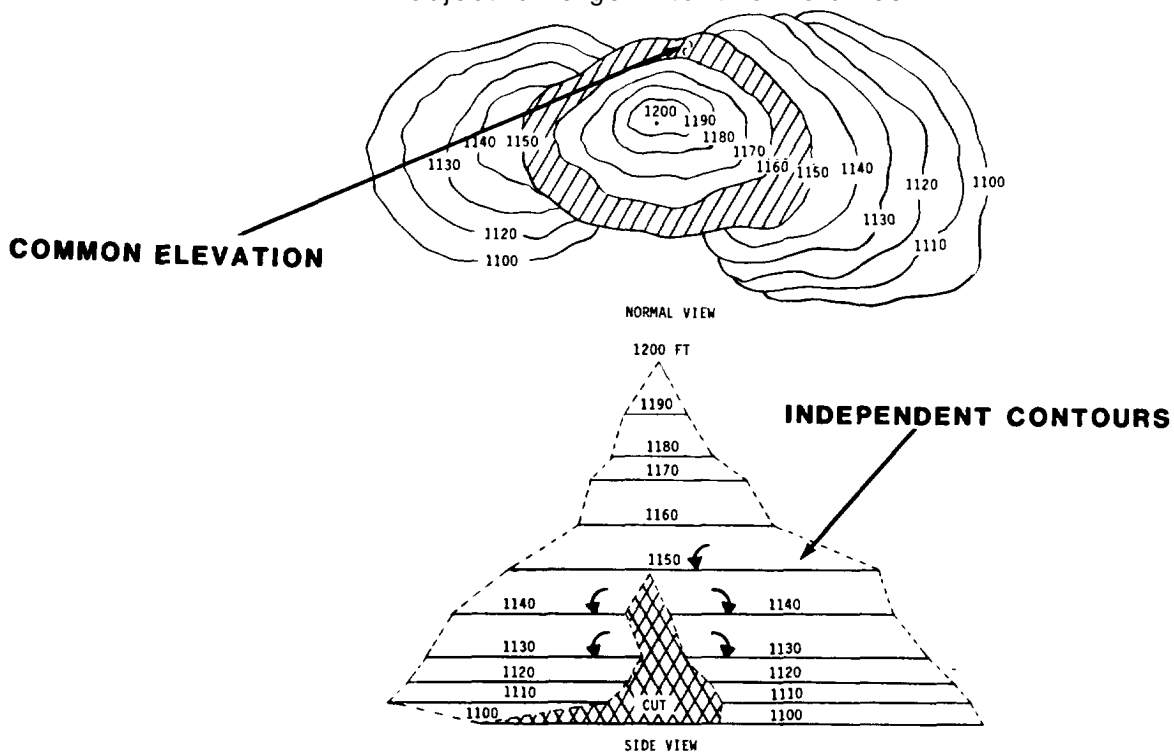
- q. Press and hold down foot switch. Reposition planimeter to make measurement of next contour loop. Release foot switch.
- r. Repeat steps o through q for each consecutive loop measured before merge.
- s. To change contour Interval when next loop to be measured is at a different interval, key In new interval, press **f**, and **a**.
- t. Repeat steps o through s for each of the independent volumes, until all independent volumes have been measured.
- u. Reposition planimeter for measuring merge volume, and repeat steps o through s.
- v. To measure next object, press **D**, and repeat steps g through s.

6-6.2.28 Diverging Volume Runs

- a. Use Merging Volume Runs (para 6-6.2.27) to begin procedure for Diverging Volume Runs. Follow steps a through n.
- b. Trace boundary line of contour. Stop when you reach starting point.
- c. Move up or down contours until you reach last contour before split (diverging volume).
- d. Position planimeter to measure first contour adjacent to diverging cut.
- e. Trace boundary of first contour. Press and hold down foot switch to reposition planimeter over adjacent contour area.

NOTE

- In contour map, example of diverging-cut ridge, area is elevation where features of object diverge into two volumes.



- Contours adjacent to diverging cut represent independent portions of total volume of object. Each contour must be measured at each elevation interval. Total counts must be entered before PRINT command to prevent negative volume of cut being added to total.

6-6.2.28 Diverging Volume Runs - Continued

- f. Release foot switch. Press remote tracer switch to activate Print command.
- g. Key in elevation of first adjacent contour. Press **f** and **c**.
- h. Retract first loop of short (smaller) side.
- i. Repeat steps d through f until last contour of short (smaller) side has been traced and printed.
- j. Reposition tracer arm to first adjacent contour on larger (higher) side.
- k. Press **f** and **c**. Enter **0**, **STO**, and **0**.
- l. Trace contour. Press remote tracer switch to activate PRINT command.
- m. Repeat steps d through f until last contour of larger (higher) side has been traced and printed.

NOTE

- Calculator will print the following information after the first measurement.

***Elevation

- Additional measurements will provide values for area of contour, intermediate volume, and total volume.

0.00 Area of contour
 0.00 Intermediate volume
 0.00 Total volume so far

- n. To measure new object, press **D** to initiate memory. Repeat steps a through e.

6-6.2.29 Vertical Cross Sections

- a. Assemble QPS with planimeter.
- b. Activate QPS:
 - (1) Plug foot switch into ACCU input jack on back panel of auto-scaler.
 - (2) Plug remote tracer switch into PRINT input jack on back panel of auto-scaler.
 - (3) Plug planimeter into E2 encoder socket on back panel of auto-scaler.
 - (4) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (5) Plug power transformer cable into wall outlet.
 - (6) Plug power cord into back of calculator.
 - (7) Plug power cord into wall outlet.
 - (8) Set encoder OFF/E2/E1 switch on back panel of auto-scaler to E2.
 - (9) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO .
 - (10) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (11) Set auto-scaler MAN/AUTO switch to MAN.
 - (12) Set auto-scaler X MEMORY switch to 1.
 - (13) Set calculator OFF/ON switch to ON.
 - (14) Set calculator MAN/TRACE/NORM switch to NORM.
 - (15) Set calculator PRGM/RUN switch to RUN.
 - (16) Press following keys: 1 , STO , 1 , and ENTER ↓ .

CAUTION

Hold magnetic cards by edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.

6-6.2.29 Vertical Cross Sections - Continued

- c. Load preprogrammed magnetic card (para 6-6.2.10), Program II, into calculator.
- d. Tape map or drawing to be measured to table.
- e. Select correct tracer arm length.

NOTE

Tracer arm length should be shortest one possible that will allow entire shape to be measured without moving the planimeter.

- f. If needed, align planimeter with tracer arm length selected (para 6-6.2.14).

NOTE

Factory determined R_T value is given on Calibration Records Sheet provided with equipment. Alinement is performed as a check.

- g. Key in horizontal scale and vertical scale of contour map or photo and R_T value.
 - (1) Key in horizontal scale; press **ENTER ↑** .
 - (2) Key in vertical scale; press **ENTER ↑** .
 - (3) Key in R_T value; press **ENTER ↑** .
- h. Key in section interval of contours to be measured; press **Δ I** .
- i. Determine if object contour described is cut (excavation) or fill (embankment). If object is fill, press **B** . If object is cut, press **f** and **b** .
- j. Press INIT button to clear calculator.
- k. Key in value for elevation of first station point to be measured.

NOTE

If contour is cut, first station point elevation should be largest. If contour is fill, first station point elevation should be smallest.

6-6.2.29 Vertical Cross Sections - Continued

- l. P r e s s **C**
- m. Place planimeter at starting point on boundary line of contour loop.
- n. Press CLEAR button to clear auto-scaler.
- o. Trace boundary line of contour loop with dot in lens tracing assembly. Stop when you reach starting point.

NOTE

When running vertical sections, odd stations (elevations) may occur. Odd stations may be keyed in by the following steps:

- Key in next station (elevation).
 - Press **f** and **c**.
 - Trace section.
- p. Press and hold down remote tracer switch to activate Print command.
 - q. Move to next contour loop. Release remote tracer switch. Repeat steps n through p for each consecutive loop until desired volume is determined.

NOTE

- Calculator will print the following information after the first measurement.

***First station
***Section area

- l Additional measurements will provide values for intermediate volume and total volume.

0.00 Intermediate volume in cubic yards
0.00 Total volume in cubic yards

- r. To start new run, press **D** , and repeat steps g through q.

6-6.2.30 Volume Erase Procedure

- a. If error in tracing was made and caught before initiating Print command, reposition planimeter at starting point. Press **CLEAR** button to clear auto-scaler. Retrace boundary of contour.

6-6.2.30 Volume Erase Procedure - Continued

- b. If error is caught after initiating PRINT command, reposition planimeter at starting point. Press **CLEAR**, **f** , and **e**. Retrace boundary of contour.
- c. If volume run is completed before error is caught, repeat entire volume run up to error. Elevation after incorrect section does not have to be rerun.
 - (1) Rerun volume starting from elevation section immediately above incorrect section down to error. Press **f** and d to initiate reload of volume run.
 - (2) Key in area of each section, read from previous printout that follows incorrect section. Press **ENTER** ↑ and **E** .

6-6.2.31 Out-of-Phase Adjustment

NOTE

Out-of-phase adjustment is used when there is constant section interval, but sections are not even elevations.

- a. Determine phase differential:

NOTE

Program II automatically locates next even elevation from first section entered. Determine what this number is, and subtract it from desired second elevation. Result is phase differential.

Example: Running vertical sections at 100-ft intervals

$$\begin{array}{r}
 525 = \text{Desired second elevation} \\
 - \underline{600} = \text{Next even 100-ft elevation} \\
 -75 = \text{Phase differential}
 \end{array}$$

Example: Running contours at 10-ft intervals

$$\begin{array}{r}
 1215 = \text{Desired second elevation} \\
 - \underline{1210} = \text{Next even 10-ft elevation} \\
 +5 = \text{Phase differential}
 \end{array}$$

6-6.2.31 Out-of-Phase Adjustment - Continued

- b. Key in phase differential.
- c. Press **f** and **P \approx S**.
- d. Press **STO** and **0**.
- e. Press **f** and **P**.

6-6.2.32 Linear Measurements on Aerial Photographs of Unknown Scale or Magnification. To make linear measurements of aerial photographs, there must be a known length of an object. This known factor is used to compute constants needed for measurements.

- a. Assemble QPS with measuring probe.
- b. Activate QPS:
 - (1) Plug foot switch into ACCU input jack on back panel of auto-scaler.
 - (2) Plug linear measuring probe into E₁ encoder socket on back panel of auto-scaler.
 - (3) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (4) Plug power transformer cable into wall outlet.
 - (5) Plug power cord into back of calculator.
 - (6) Plug power cord into wall outlet.
 - (7) Set encoder OFF/E₂/E₁ switch on back panel of auto-scaler to E₁.
 - (8) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
 - (9) Set auto-scaler B/ACCU/A/OFF switch to A.
 - (10) Set auto-scaler MAN/AUTO switch to AUTO.
 - (11) Set auto-scaler X MEMORY switch to 1.
 - (12) Set calculator OFF/ON switch to ON.
 - (13) Set calculator MAN/TRACE/NORM switch to MAN.

6-6.2.32 Linear Measurements on Aerial Photographs of Unknown Scale or Magnification - Continued

(14) Set calculator PRGM/RUN switch to RUN.

(15) Press following keys: **1** , **STO** , **1** a n d **ENTER** .

CAUTION

Hold magnetic cards by edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.

- c. Load preprogrammed magnetic card (para 6-6.2.10), Program IV, into calculator.
- d. Tape photograph to be measured to table.
- e. If needed, align linear measuring probe (para 6-6.2.16). Record R_L value.

NOTE

Factory determined R_L value is given on Calibration Records Sheet provided with equipment. Alignment is performed as a check.

- f. Press CLEAR button to clear auto-scaler.
- g. Determine length constant, C_L (multiplier), using the following formula:

$$C_L = \frac{D}{R}$$

C_L = Length of constant
 D = Length of known object
 R = Counts generated by measuring length of known object

Example: On aerial photograph of unknown scale or magnification where a telephone line is visible, use the known distance between two-telephone poles, 105 feet, for D in formula.

- (1) With linear measuring probe, measure the known distance (between two telephone poles) to obtain R .
- (2) The value shown on the auto-scaler LED display (5692) can be used for R in the formula.
- (3) Compute $C_L = \frac{D}{R}$ or $C_L = \frac{105}{5692}$

6-6.2.32 Linear Measurements on Aerial Photographs of Unknown Scale or Magnification - Continued

- (4) Result is 0.02. press **DSP** and **6** to display six decimal places,' 0.018447 = CL.
- (5) Press **PRINT X** to activate Print command.
- h. Key in CL value (computed with known length of object in photograph being measured). Press **STO** , **1** , and **ENTER** ↓ , .
- i. Press foot switch. Do not release until ready to begin measurement.
- j. Position linear measuring probe so that pricking pin is at beginning of length to be measured. Release foot switch.
- k. Make measurement by tracing length of line with linear measuring probe.
- l. Press **PRINT** to activate PRINT command and freeze count.

6-6.2.33 Area Measurements on Aerial Photographs of Unknown Scale or Magnification. To make area measurements of aerial photographs, there must be a known length of an object. This known factor must be used to compute constants needed for measurements.

- a. Assemble QPS with planimeter.
- b. Activate QPS:
 - (1) Plug foot switch into ACCU input jack on back panel of auto-scaler.
 - (2) Plug planimeter into E2 encoder socket on back panel of auto-scaler.
 - (3) Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
 - (4) Plug power transformer cable into wall outlet.
 - (5) Plug power cord into back of calculator.
 - (6) Plug power cord into wall outlet.
 - (7) Set encoder OFF/E2/E1 switch on back panel of auto-scaler to E2.

6-6.2.33 Area Measurements on Aerial Photographs of Unknown Scale or Magnification - Continued

- (8) Set AUDIO/OFF switch on back panel of auto-scaler to AUDIO.
- (9) Set auto-scaler B/ACCU/A/OFF switch to A.
- (10) Set auto-scaler MAN/AUTO switch to AUTO.
- (11) Set auto-scaler X MEMORY switch to 1.
- (12) Set calculator OFF/ON switch to ON.
- (13) Set calculator MAN/TRACE/NORM switch to MAN.
- (14) Set calculator PRGM/RUN switch to RUN.
- (15) Press following keys: **1** , **STO** , **1** , and **ENTER ↑** .

CAUTION

Hold magnetic cards by edge. Be sure hands are clean. Grease, oil, or other materials can damage magnetic cards.

- c. Load preprogrammed magnetic card (para 6-6.2.10), Program IV, into calculator.
- d. Tape photograph to be measured to table.
- e. Select correct tracer arm length.

NOTE

Tracer arm length should be shortest one possible that will allow entire shape to be measured without moving the planimeter.

- f. Align planimeter with tracer arm length selected (para 6-6.2.13). Record R_T value.

NOTE

Factory determined R_T value is given on Calibration Records Sheet provided with equipment. Alinement is performed as a check.

6-6.2.33 Area Measurements on Aerial Photographs of Unknown Scale or Magnification - Continued

- g. Place planimeter near shape to be measured so that length of tracer arm lies along imaginary line through center of shape. Set wheels so that axles form 90° angle with tracer arm.
- h. Make practice trace to be sure tracer arm will cover area in one operation.
- i. Determine area constant, C (multiplier), using the following formula:

$$C = \frac{S_c^2 \times A_T}{R_T}$$

- C = Area of constant
- A_T = Area of test rule (given on Calibration Records Sheet provided with equipment)
- R_T = Encoder count for each revolution (given on Calibration Records Sheet provided with equipment)
- S_c = Scale ratio

- (1) Determine S_c by using the following formula:

$$S_c = C_L \times R_L$$

- S_c = Scale ratio
- C_L = Length constant (para 6-6.2.32)
- R_L = Counts per inch (given on Calibration Records Sheet provided with equipment)

- (2) Example: Use given R_L value (724) on Calibration Records Sheet and C_L value (0.018447) obtained from linear measurements on aerial photographs (para 6-6.2.32).

$$S_c = 0.018447 \times 724 = 13.355628$$

$$S_c^2 = 178.372799$$

6-6.2.33 Area Measurements on Aerial Photographs of Unknown Scale or Magnification - Continued

- (3) Use values provided on Calibration Records Sheet for A_r and R_r .

For this example, the value for R_r is 2157 and A_r is 12.54.

The formula can now be computed on the calculator.

$$C = \frac{178.372799 \times 12.54}{2157} - \frac{2236.794903}{2157} = 1.036993$$

- (4) Press **PRINT X** to activate Print command.
- j. Key in C value (computed with known length of object in photograph being measured). Press **STO** , **2** , and **ENTER ↑**.
- k. Set auto-scaler X MEMORY switch to 2.
- l. Trace boundary line of shape using lens tracing assembly. stop when you reach starting point.
- m. Press **PRINT X** to activate Print command and freeze count.

NOTE

Following are tables providing information found on preprogrammed magnetic cards. The tables can be used to verify programs or to program the calculator if preprogrammed cards are damaged or lost.

Table 6-2. Preprogrammed Subroutines (Programs I, II, III, and IV)

Label Key	Routine	Function and Usage Notes
<u>Program I</u>		
A	Point Counts	Used to total point counts and multiply total by constant. Must be reinitiated if different count is to be used.
a	Lengths	Used to measure lengths with linear measuring probe or planimeter. Must be reinitiated if scales are changed.
B	Areas	Computes area of measurement. Prints area in square feet. Must be reinitiated if tracer arm length is changed.
b	Slope Area	Computes area of slope. Must be reinitiated if new slope ratios or scales are to be used.
C	ACCU +	Addition routine for adding slopes or areas.
c	ACUU -	Subtraction routine for subtracting slopes or areas.
D	Initiate	Places zero in memory registers so they can be used for new input.
d	Inches/Acres	Converts computed area measurement into units of acres.
E	Print	Master print routine. Contains subroutines for printing results and data of other label routines in inches, square feet, or acres.
e	Memory Load	Loads constants 4, 3, 2, and 1 into memory stack.

Table 6-2. Preprogrammed Subroutines (Programs I, II, III, and IV) - Continued

Label Key	Routine	Function and Usage Notes
<u>Program II</u>		
A	Load Data	Used to enter horizontal and vertical scales of item to be measured and alinement data.
a	New Interval	Used to change or enter contour interval. Next even contour interval elevation for new interval is automatically determined.
B	Fill Routine	Sets system for measurement and calculation of fill.
b	Cut Routine	Sets system for measurement and calculation of cut.
C	First Section	Automatically determines next even-valued section elevation from one being measured.
c	Next Section	Used anytime manual loading of next elevation is required. Used to run sections not on even elevation intervals.
D	Initiate	Stores zeros in memory registers so they can be used for new input.
d	Reload Stack	Used to rerun volume run where an incorrect section was entered. Resets memory stack for input of areas of sections that follow erroneous section on tape.
E	Print	Master print routine contains subroutines for printing results and data of other label routines.

Table 6-2. Preprogrammed Subroutines (Programs I, II, III, and IV) - Continued

Label Key	Routine	Function and Usage Notes
e	Erase	Erases results and data for last (volume) contour trace made so incorrect intervals can be eliminated before volume run is completed. Calculator will reprint all data groups for previous section and ready itself for next measurement. Can only be used to erase one step at time.

Program III

E	Print	Prints new value of X.
A B C D	Load Register	Loads multiple constants or factors stored in registers 2-9 into register 1. Pressing corresponding label key loads new constant or factor into that register.
a, b, c, d		

Program IV

A	Enter 1	Loads number 1 into memory.
B	Constant/Ratio	Computes constants CL and Sc for aerial photographs.
C	CL	Loads value of CL into memory.
E	Print	Prints results of calculations.

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV)

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program I - Points, Areas, and Lengths			
001	LBL A	001 21 11	Point Counts Routine
002	STO A	002 35 11	Storage for Constant
003	f SPACE	003 16-11	Space Printer
004	1	004 01	
005	STO 1	005 35 01	Constant
006	CL X	006 -51	
007	STO I	007 35 46	Print Indicator, I
008	RTN	008 24	Return to 001
009	LBL f a	009 21 16 11	Lengths Routine
010	STO A	010 35 11	Scale (of map)
011	7	011 07	
012	2	012 02	Register
013	4	013 04	
014	f SPACE	014 16-11	Space Printer
015	÷	015 -24	Register
016	STO 1	016 35 01	Constant
017	1	017 01	Input
018	STO I	018 35 46	Print Indicator, I
019	RCL A	019 36 11	
020	f SPACE	020 16-11	Space Printer
021	RTN	021 24	Return to 000

**Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV)
Continued**

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program I - Continued			
022	LBL B	022 21 12	Areas Routine
023	1	023 01	
024	2	024 02	
025	.	025 -62	AT, Area of Test Rule
026	5	026 05	
027	5	027 05	
028	X ≥ Y	028 -41	
029	R ↓	029 -31	Roll Down Stack 1
030	X	030 -35	Multiply S ₂ X AT
031	X	031 -35	
032	X Y	032 -41	
033	÷	033 -24	Divide by RT
034	STO 1	034 35 01	Store Constant
035	1	035 01	Input
036	CHS	036 -22	Change Sign
037	STO 1	037 35 46	Printer Indicator, 1
038	CL X	038 -51	Clear X
039	f SPACE	039 16-11	Space Printer
040	RTN	040 24	Return to 000
041	LBL f b	041 21 16 12	Slope Area Routine
042	STO 8	042 35 08	Slope Factor

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program I - Continued			
043	RCL I	043 36 46	
044	f X ≠ 0?	044 16-45	Conditional Area Test
045	GTO 7	045 22 07	Go to Slope Calculation
046	RTN	046 24	Return to 000 (Test Failed)
047	LBL 7	047 21 07	Slope Area Calculation
048	R ↓	048 -31	Adjust Memory Stack
049	1	049 01	Input
050	PRINT X	050 -14	Print Display
051	f SPACE	051 16 11	Space Printer
052	X ≥ Y	052 -41	
053	÷	053 -24	
054	f TAN⁻¹	054 16 43	Arc Tangent
055	COS	055 42	Slope Cosine (Run)
056	STO 7	056 35 07	Slope Storage
057	RTN	057 24	Return to 000
058	LBL C	058 21 13	Actuate + Routine
059	1	059 01	Input
060	STO 6	060 35 06	Storage Indicator
061	f SPACE	061 16-11	Space Printer
062	RTN	062 24	Return to 000
063	LBL f c	063 21 16 13	Actuate - Routine

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code	Display	Meaning or Purpose
Program I - Continued				
064	1	064	01	Input
065	CHS	065	-22	Change Sign
066	STO 6	066	35 06	Store Indicator
067	f SPACE	067	16-11	Space Printer
068	RTN	068	24	Return to 000
069	LBL D	069	21 14	Initiate Routine
070	0	070	00	Input 0
071	STO 0	071	35 00	Zero Register 0
072	STO 2	072	35 02	Zero Register 2
073	STO 3	073	35 03	Zero Register 3
074	STO 4	074	35 04	Zero Register 4
075	STO 5	075	35 05	Zero Register 5
076	STO 6	076	35 06	Zero Register 6
077	STO 7	077	35 07	Zero Register 7
078	STO 8	078	35 08	Zero Register 8
079	STO 9	079	35 09	Zero Register 9
080	f SPACE	080	16-11	Space Printer
081	RTN	081	24	Return to 000
082	LBL f d	082	21 16 14	Inches/Acres Routine
083	1	083	01	Input
084	STO 9	084	35 09	Zero Register 9

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code	Display	Meaning or Purpose
Program I - Continued				
085	RCL I	085	36 46	
086	f X > 0?	086	16-44	Test for Length or Area
087	GTO 5	087	22 05	To Calculate Inches
088	RCL 1	088	36 01	
089	4	089	04	
090	3	090	03	
091	5	091	05	Constant
092	6	092	06	
093	0	093	00	
094	.	094	-24	Divide
095	f SPACE	095	16-11	Space Printer
096	STO 2	096	35 02	
097	RTN	097	24	Return to 000
098	LBL E	098	21 15	Print Routine
099	STO 0	099	35 00	
100	RCL I	100	36 46	
101	f X=0?	101	16-43	Test for Points
102	GTO 0	102	22 00	If Yes
103	RCL 8	103	36 08	If No
104	f X≠0?	104	16-42	Test for Slope
105	GTO 4	105	22 04	If Yes, Routine 4

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code	Display	Meaning or Purpose
Program I - Continued				
106	RCL 9	106	36 09	If No
107	f X > 0?	107	16-44	Test for Inches/Acres
108	GTO 2	108	22 02	If Yes, Routine 2
109	GTO 1	109	22 01	If No, Routine 1
110	RTN	110	24	Return to 000
111	LBL 1	111	21 01	Print Areas or Length Routine
112	RCL 0	112	36 00	
113	PRINT X	113	-14	Print Display
114	RCL 6	114	36 06	
115	f X ≠ 0?	115	16-42	Test for Actuate
116	GTO 8	116	22 08	If Yes, Routine 8
117	f SPACE	117	16-11	If No
118	R ↓	118	-31	Adjust Memory Stack
119	RTN	119	24	Return to 000
120	LBL 8	120	21 08	Print Actuate Routine
121	X	121	-35	Input X
122	RCL 3	122	36 03	
123	+	123	-55	Add
124	STO 3	124	35 03	
125	PRINT X	125	-14	Print Total
126	f SPACE	126	16-11	Space Printer

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code	Display	Meaning or Purpose
Program I - Continued				
127	RTN	127	24	Return to 000
128	LBL 2	128	21 02	Print Inches/Acres Routine
129	RCL 0	129	36 00	
130	PRINT X	130	-14	Print Display
131	RCL 1	131	36 01	
132	÷	132	-24	
133	RCL 2	133	36 02	
134	X	134	-35	
135	PRINT X	135	-14	Print Inches/Acres
136	STO 5	136	35 05	
137	RCL 6	137	36 06	
138	f X≠0?	138	16-42	Test for Actuate
139	GTO 9	139	22 09	If Yes, Routine 9
140	f SPACE	140	16-11	If No
141	R ↓	141	-31	Adjust Memory to X
142	RTN	142	24	Return to 000
143	LBL 9	143	21 09	Print Inches/Acres Actuate Routine
144	RCL 0	144	36 00	
145	RCL 6	145	36 06	
146	X	146	-35	

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program I - Continued			
147	RCL 3	147 36 03	
148	+	148 -55	Add
149	STO 3	149 35 03	
150	PRINT X	150 -14	Print Display
151	RCL 5	151 36 05	
152	RCL 6	152 36 06	
153	X	153 -35	Input
154	RCL 4	154 36 04	
155	+	155 -55	Add
156	STO 4	156 35 04	
157	PRINT X	157 -14	Print
158	f SPACE	158 16-11	Space Printer
159	f SPACE	159 16-11	Space Printer
160	RTN	160 24	Return to 000
161	LBL 0	161 21 00	Print Points Routine
162	RCL 0	162 36 00	
163	RCL A	163 36 11	
164	PRINT X	164 -14	
165	X	165 -35	Input
166	PRINT X	166 -14	
167	f SPACE	167 16-11	

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code	Display	Meaning or Purpose
Program I - Continued				
168	RTN	168	24	Return to 000
169	LBL 4	169	21 04	Print Slope Routine
170	RCL 0	170	36 00	
171	PRINT X	171	-14	Print
172	RCL 7	172	36 07	
173	÷	173	-24	Divide
174	PRINT X	174	-14	Print
175	STO 5	175	35 05	
176	f SPACE	176	16-11	Space Printer
177	RCL 6	177	36 06	
178	X≠0?	178	16-42	Test for ACCU
179	GTO 9	179	22 09	If Yes, Routine 9
180	R↓	180	-31	If No, Move Stack
181	RTN	181	24	Return to 000
182	LBL 5	182	21 05	Inches Routine
183	RCL 1	183	36 01	
184	RCL A	184	36 11	
185	÷	185	-24	Divide
186	STO 2	186	35 02	

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program I - Continued			
187	f SPACE	187 16-11	Space Printer
188	RTN	188 24	Return to 000
189	LBL f e	189 21 16 15	Memory Load Routine
190	STO 4	190 35 04	
191	R ↓	191 -31	Move Memory Stack
192	STO 3	192 35 03	
193	R ↓	193 -31	Move Memory Stack
194	STO 2	194 35 02	
195	R ↓	195 -31	Advance Memory Stack
196	STO 1	196 35 01	
197	1	197 01	
198	STO I	198 35 46	
199	f SPACE	199 16-11	Space Printer
200	R/S	200 51	Run/Stop, End of Program

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program II - Volumes by Contour			
001	LBL A	001 21 11	Load Data Routine
002	STO E	002 35 15	
003	f R↑	003 16-31	Roll Up Stack
004	STO A	004 35-11	Horizontal Scale Entry
005	f R↑	005 16-31	Roll Up Stack
006	STO B	006 35 12	Vertical Scale Entry
007	R↓	007 -31	Roll Down Stack
008	1	008 01	
009	2	009 02	
010	.	010 -62	Actual Area of Test Rule
011	5	011 05	
012	5	012 05	
013	STO C	013 35 13	Test Area
014	f R↑	014 16-31	Roll Up Stack
015	STO D	015 35 14	
016	f R↑	016 16-31	Roll Up Stack
017	CL X	017 -51	Clear Display
018	f SPACE	018 16-11	
019	RTN	019 24	Return to 000
020	LBL B	020 21 12	Fill Routine
021	1	021 01	

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program II- Continued			
022	LBL 4	022 21 04	Cut/Fill Indication
023	STO I	023 35 46	Entry
024	f SPACE	024 16-11	
025	RTN	025 24	Return to 000
026	LBL C	026 21 13	First Section Routine
027	STO 9	027 35 09	
028	f SPACE	028 16-11	
029	RCL 5	029 36 05	
030	RCL 6	030 36 06	
031	f P ≥ S	031 16-51	
032	STO 6	032 35 06	
033	R ↓	033 -31	Roll Down Stack
034	STO 5	034 35 05	
035	f P ≥ S	035 16-51	
036	0	036 00	
037	STO 0	037 35 00	
038	RTN	038 24	Return to 000
039	LBL D	039 21 14	Initiate Routine
040	RCL A	040 36 11	Indicator
041	RCL B	041 36 12	
042	X	042 -35	Multiply

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program II- Continued			
043	RCL C	043 36 13	
044	X	044 -35	Multiply
045	RCL D	045 36 14	
046	÷	046 -24	Divide
047	STO 1	047 35 01	0 Stored
048	0	048 00	
049	STO 5	049 35 05	Store O's
050	STO 6	050 35 06	Store O's
051	STO 7	051 35 07	Store O's
052	STO 8	052 35 08	Store O's
053	STO 9	053 35 09	Store O's
054	f P \geq S	054 16-51	
055	STO 0	055 35 00	Store O's
056	STO 1	056 35 01	Store O's
057	STO 2	057 35 02	
058	STO 3	058 35 03	
059	STO 4	059 35 04	
060	STO 5	060 35 05	
061	STO 6	061 35 06	
062	f P \geq S	062 16-51	
063	f SPACE	063 16-11	

Table 6-3. Preprogrammed Keystroke Entries (Program I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program II- Continued			
064	f CLF 0	064 16 22 00	Clear Flag 0
065	RTN	065 24	Return to 000
066	LBL E	066 21 15	Print Routine
067	RCL 6	067 36 06	
068	f P \geq S	068 16-51	Current Area next to Last Area
069	STO 2	069 35 02	
070	f P \geq S	070 16-51	
071	X \geq Y	071 -41	
072	STO 6	072 35 06	Store New Area in Current Area
073	RCL 7	073 36 07	
074	f P \geq S	074 16-51	
075	STO 3	075 35 03	Store Current Intermediate Volume in Last Intermediate Volume
076	f P \geq S	076 16-51	
077	RCL 9	077 36 09	
078	PRINT X	078 -14	Print Next Elevation
079	RCL 6	079 36 06	
080	PRINT X	080 -14	Print New Area
081	f P \geq S	081 16-51	
082	RCL 2	082 36 02	

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program II- Continued			
083	+	083 -55	Add
084	f P ≥ S	084 16-51	
085	RCL 0	085 36 00	Section/Volume Calculation
086	X	086 -35	Multiply
087	5	087 05	
088	4	088 04	Constant
089	÷	089 -24	Divide
090	RCL 9	090 36 09	
091	RCL 5	091 36 05	
092	-	092 -45	Subtract
093	X	093 -35	Multiply
094	STO 7	094 35 07	
095	PRINT X	095 -14	Print Intermediate Volume
096	RCL 8	096 36 08	
097	f P ≥ S	097 16-51	
098	STO 4	098 35 04	
099	f P ≥ S	099 16-51	
100	+	100 -55	Add
101	STO 8	101 35 08	Store Total Volume
102	PRINT X	102 -14	Print Total Volume
103	RCL 9	103 36 09	

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code	Display	Meaning or Purpose
Program II- Continued				
104	f P ≥ S	104	16-51	
105	RCL 5	105	36 05	
106	f P ≥ S	106	16-51	
107	-	107	-45	Subtract
108	f X=0?	108	16-42	Twin Peak Test
109	GTO 0	109	22 00	If Yes
110	RCL 6	110	36 06	If No
111	f P ≥ S	111	16-51	
112	RCL 6	112	36 06	
113	f P ≥ S	113	16-51	
114	+	114	-55	Add
115	STO 6	115	35-06	
116	LBL 0	116	21 00	Twin Peak Routine
117	RCL 9	117	36 09	
118	f F? 0	118	16 23 00	Test Flag 0
119	GTO 2	119	22 02	If Yes
120	RCL E	120	36 15	If No
121	÷	121	-24	Divide
122	f FRAC	122	16 44	
123	f X=0?	123	16-43	Test for 000
124	GTO 1	124	22 01	If Yes

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program II- Continued			
125	RCL I	125 36 46	If Odd Elevations
126	1	126 01	
127	-	127 -45	Subtract
128	2	128 02	
129	÷	129 -24	Divide
130	CHS	130 -22	Change Sign
131	RCL 9	131 36 09	
132	RCL E	132 36 15	
133	÷	133 -24	Divide
134	+	134 -55	Add
135	f INT	135 16 34	Truncate to Integer
136	RCL E	136 36 15	
137	X	137 -35	
138	GTO 2	138 22 02	To Twin Peak Routine
139	LBL 1	139 21 01	Even Elevation Routine
140	RCL 9	140 36 09	
141	LBL 2	141 21 02	Twin Peak Routine
142	RCL 1	142 36 46	
143	RCL E	143 36 15	
144	X	144 -35	Multiply
145	+	145 -55	Add

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, 111, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program II- Continued			
146	f F? 0	146 16 23 00	Test Flag 0
147	GTO 8	147 22 08	If Yes
148	f P ≥ S	148 16-51	If No
149	RCL 0	149 36 00	
150	f P ≥ S	150 16-51	
151	+	151 -55	Add
152	LBL 8	152 21 08	In Twin Peak Routine
153	RCL 9	153 36 09	
154	RCL 5	154 36 05	
155	f P ≥ S	155 16-51	
156	STO 1	156 35 01	
157	f P ≥ S	157 16-51	
158	R ↓	158 -31	Roll Down Stack
159	STO 5	159 35 05	
160	R ↓	160 -31	
161	STO 9	161 35 09	
162	1	162 01	
163	STO 0	163 35 00	
164	RCL 8	164 36 08	
165	f P ≥ S	165 16-51	
166	RCL 0	166 36-00	

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code	Display	Meaning or Purpose
Program II- Continued				
167	f XY0?	167	16-42	Test for Twin Peak
168	f STF 0	168	16 21 00	Set Flag to 0
169	f P ≥ S	169	16-51	
170	RCL 8	170	36 08	
171	f SPACE	171	16-11	Space Printer
172	RTN	172	24	Return to 000
173	LBL f a	173	21 16 11	New Interval Routine
174	STO E	174	35 15	
175	f SPACE	175	16-11	Space Printer
176	RCL 5	176	36 05	
177	STO 9	177	35 09	Store Last Elevation
178	f P ≥ S	178	16-51	In Current Elevation
179	RCL 1	179	36 01	
180	f P ≥ S	180	16-51	
181	STO 5	181	35 05	
182	GTO 0	182	22 00	To First Section Routine
183	LBL f b	183	21 16 12	Cut Routine
184	1	184	01	
185	CHS	185	-22	Change Sign
186	GTO 4	186	22 04	
187	LBL f c	187	21 16 13	Next Section Routine

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code	Display	Meaning or Purpose
Program II- Continued				
188	STO 9	188	35 09	
189	f SPACE	189	16-11	Space Printer
190	RTN	190	24	Return to 000
191	LBL f d	191	21 16 14	Reload Stack Routine
192	GBS 5	192	23 05	To Subroutine 5, Data Load
193	f R ↑	193	16-31	
194	RCL E	194	36 15	
195	RCL I	195	36 46	Set Up for Next Elevation
196	X	196	-35	Multiply
197	+	197	-55	Add
198	STO 9	198	35 09	
199	RCL 8	199	36 08	
200	f SPACE	200	16-11	
201	RTN	201	24	Return to 000
202	LBL f e	202	21 16 15	Erase Routine
203	RCL 5	203	36 05	
204	STO 9	204	35 09	
205	f P ≧S	205	16-51	Backs Up Data
206	RCL 1	206	36 01	Group 1 Section
207	RCL 2	207	36 02	
208	RCL 3	208	36 03	

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program II- Continued			
209	RCL 4	209 36 04	
210	f P ≥ S	210 16-51	
211	f STACK	211 16-14	Print Stack
212	LBL 5	212 21 05	Loader Routine
213	STO 8	213 35 08	
214	R ↓	214 -31	Roll Down Stack
215	STO 7	215 35 07	Loads Stack into Memory
216	R ↓	216 -31	Roll Down Stack
217	STO 6	217 35 06	
218	R ↓	218 -31	Roll Down Stack
219	STO 5	219 35 05	
220	R ↓	220 -31	Roll Down Stack
221	RTN	221 24	Return to 000
222	R/S	222 51	Run/Stop, End of Program

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program III - Multiple Scale or Alinement Factors			
001	LBL E	001 21 15	Print X Routine
002	PRINT X	002 -14	
003	RTN	003 24	Return to 000
004	LBL A	004 21 11	Loads Register 2
005	RCL 2	005 36 02	
006	STO 1	006 35 01	Loads Register 2 into 1
007	RTN	007 24	Return to 000
008	LBL B	008 21 12	Loads Register 3
009	RCL 3	009 36 03	
010	STO 1	010 35 01	Loads Register 3 into 1
011	RTN	011 24	Return to 000
012	LBL C	012 21 13	Loads Register 4
013	RCL 4	013 36 04	
014	STO 1	014 35 01	Loads Register 4 into 1
015	RTN	015 24	Return to 000
016	LBL D	016 21 14	Loads Register 5
017	RCL 5	017 36 05	
018	STO 1	018 35 01	Loads Register 5 into 1
019	RTN	019 24	Return to 000
020	LBL f a	020 21 16 11	Loads Register 6
021	RCL 6	021 36 06	

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code Display	Meaning or Purpose
Program III - Continued			
022	STO 1	022 35 01	Loads Register 6 into 1
023	RTN	023 24	Return to 000
024	LBL f b	024 21 16 12	Loads Register 7
025	RCL 7	025 36 07	
026	STO 1	026 35 01	Loads Register 7 into 1
027	RTN	027 24	Return to 000
028	LBL f c	028 21 16 13	Loads Register 8
029	RCL 8	029 36 08	
030	STO 1	030 35 01	Loads Register 8 into 1
031	RTN	031 24	Return to 000
032	LBL f d	032 21 16 14	Loads Register 9
033	RCL 9	033 36 09	
034	STO 1	034 35 01	Loads Register 9 into 1
035	RTN	035 24	Return to 000
036	R/S	036 51	Run/Stop, End of Program

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code	Display	Meaning or Purpose
Program IV - Linear Measuring Probe Program for Aerial Photos				
001	LBL A	001	21 11	Enter 1 Routine
002	1	002	01	
003	STO 1	003	35 01	Enter 1 into Memory
004	RTN	004	24	Return to 000
005	LBL B	005	21 12	Constant/Ratio Routine
006	ENTER ↓	006	-21	
007	RCL I	007	36 01	
008	X	008	-35	Multiply
009	1/X	009	52	Reciprocal of X
010	RCL 8	010	36 08	
011	X	011	-35	Multiply
012	PRINT X	012	-14	Print X
013	STO 3	013	35 03	
014	7	014	07	
015	2	015	02	Constant
016	4	016	04	
017	X	017	-35	
018	PRINT X	018	-14	
019	f SPACE	019	16-11	Space Printer
020	RTN	020	24	Return to 000
021	LBL C	021	21 13	CL Routine

Table 6-3. Preprogrammed Keystroke Entries (Programs I, II, III, and IV) - Continued

Step	Keystroke Entry	Key Code	Display	Meaning or Purpose
Program IV - Continued				
022	RCL 3	022	36 03	
023	STO 1	023	35 01	Enter CL in Memory
024	RTN	024	24	Return to 000
025	LBL E	025	21 15	Print Routine
026	PRINT X	026	-14	
027	RTN	027	24	Return to 000
028	R/S	028	51	Run/Stop, End of Program

Table 6-4. Preprogrammed Diagnostic Entries

Step	Keyboard Entry	Purpose
001	*LBLO	Clear registers subroutine
002	CLRG	
003	P ≥ S	
004	CL REG	
005	RTN	
006	*LBLa	Function test subroutine
007	RND	
008	RCLi	
009	X_oY?	
010	R/S	
011	*LBL2	
012	DSZI	DSZI and RCLi subroutine
013	*LBL5	
014	RCLi	
015	RTN	RCLi and STOP if called
016	*LBLc	
017	RCLi	
018	RCLi	Verifies registers and sum in
019	X_oY?	R _o subroutine
020	R/S	
021	STO 0	

Table 6-4. Preprogrammed Diagnostic Entries - Continued

Step	Keyboard Entry	Purpose
022	DSZI	
023	GTOC	
024	3	
025	EEEX	
026	2	
027	RCL0	
028	X/Y?	Test R0
029	R/S	
030	RTN	
031	*LBL_e	Decrement x subroutine
032	1	
033	-	
034	RTN	
NOTE		
These first 34 instruction steps are standard for any program run. They are used to set registers and flags for the following program.		
035	*LBLA	Start and pause after first subroutine execution.
036	5	
037	7	
038	GBSO	

Table 6-4. Preprogrammed Diagnostic Entries - Continued

Step	Keyboard Entry	Purpose
039	→ P	
040	GBSe	Decrement x
041	ENT ↑	
042	R ↑	Stack (X, Y, Z, T) test
043	X=Y	
044	R ↓	
045	R ↓	
046	X > Y	
047	R ↓	
048	X≠0?	
049	X≠Y?	
050	RTN	
051	GBSe	Decrement x
052	X > Y?	
053	RTN	
054	GBSe	X-to-Y comparisons
055	X=Y?	
056	RTN	
057	GBSe	
058	X ≤ Y?	
059	GT01	

Table 6-4. Preprogrammed Diagnostic Entries - Continued

Step	Keyboard Entry	Purpose
060	RTN	
061	*LBL1	Decrement x
062	GBSe	
063	STOI	I-register test
064	RCLI	
065	X ≥ Y	
066	X ≠ Y?	X-to-O comparisons
067	RTN	
068	GBS2	
069	X = 0?	
070	GT03	
071	RTN	
072	*LBL3	
073	GBS2	
074	X = 0?	
075	RTN	
076	GBS2	
077	X < 0?	
078	RTN	
079	GBS2	

Table 6-4. Preprogrammed Diagnostic Entries - Continued

Step	Keyboard Entry	Purpose
080	X > 0?	
081	GT04	
082	RTN	
083	*LBL4	Check set status on flags
084	DSZI	
085	F12	
086	GT05	
087	DSZI	
088	F11	
089	GT05	
090	DSZI	
091	F13	
092	GT06	
093	GT05	
094	*LBL6	
095	DSZI	
096	F10	
097	GT07	
098	GT05	
099	*LBL7	Check complement of set status on flags

Table 6-4. Preprogrammed Diagnostic Entries - Continued

Step	Keyboard Entry	Purpose
100	STF2	
101	STF1	
102	CF?0	
103	DSZI	
104	F?3	
105	GT05	
106	DSZI	
107	F?0	
108	GT05	
109	DSZI	
110	F?2	
111	GT08	
112	GT05	
113	*LBL8	
114	DSZI	
115	F?1	
116	GT09	
117	GT05	
118	*LBL9	Check F2 for test clearing
119	DSZI	
120	F?2	

Table 6-4. Preprogrammed Diagnostic Entries - Continued

Step	Keyboard Entry	Purpose
121	GT05	
122	GBS2	Test DEG, SIN, SIN ⁻¹
123	DSP7	
124	DEG	
125	SIN	
126	SIN⁻¹	
127	GBSa	
128	COS	Test COS, COS ⁻¹
129	COS⁻¹	
130	GBSa	
131	TAN	Test TAN, TAN-I
132	TAN⁻¹	
133	GBSa	
134	→P	Test→P,→R
135	→R	
136	GBSa	
137	SIN	Test →H.MS, H.MS→
138	→H.MS	
139	H.MS→	
140	SIN⁻¹	
141	GBSa	

Table 6-4. Preprogrammed Diagnostic Entries - Continued

Step	Keyboard Entry	Purpose
142	LOG	Test LOG , 10^x
143	10^x	
144	GBSa	
145	LN	Test, LN , e^x
146	e^x	
147	GBSa	
148	\sqrt{x}	Test x , X^2
149	x^2	
150	GBSa	
151	ENT ↑	Test y^x , LAST X , $1/x$
152	y^x	
153	LAST X	
154	$1/X$	
155	y^x	
156	GSBa	
157	ENT ↑	Test + , -
158	+	
159	LAST X	
160	-	
161	GBSa	
162	ENT ↑	Test x , \div

Table 6-4. Preprogrammed Diagnostic Entries - Continued

Step	Keyboard Entry	Purpose
163	X	
164	LAST X	
165	\div	
166	GBSa	
167	\sqrt{X}	Test FRAC, INT
168	FRAC	
169	LAST X	
170	INT	
171	+	
172	X²	
173	GBSa	Test D→R, R→D
174	D→R	
175	R→D	
176	GBSa	
177	EEX	Test EEX, %
178	2	
179	X ≥ Y	
180	Z	
181	GBSa	
182	DSP1	Test registers 24 and 0
183	*LBLb	

Table 6-4. Preprogrammed Diagnostic Entries - Continued

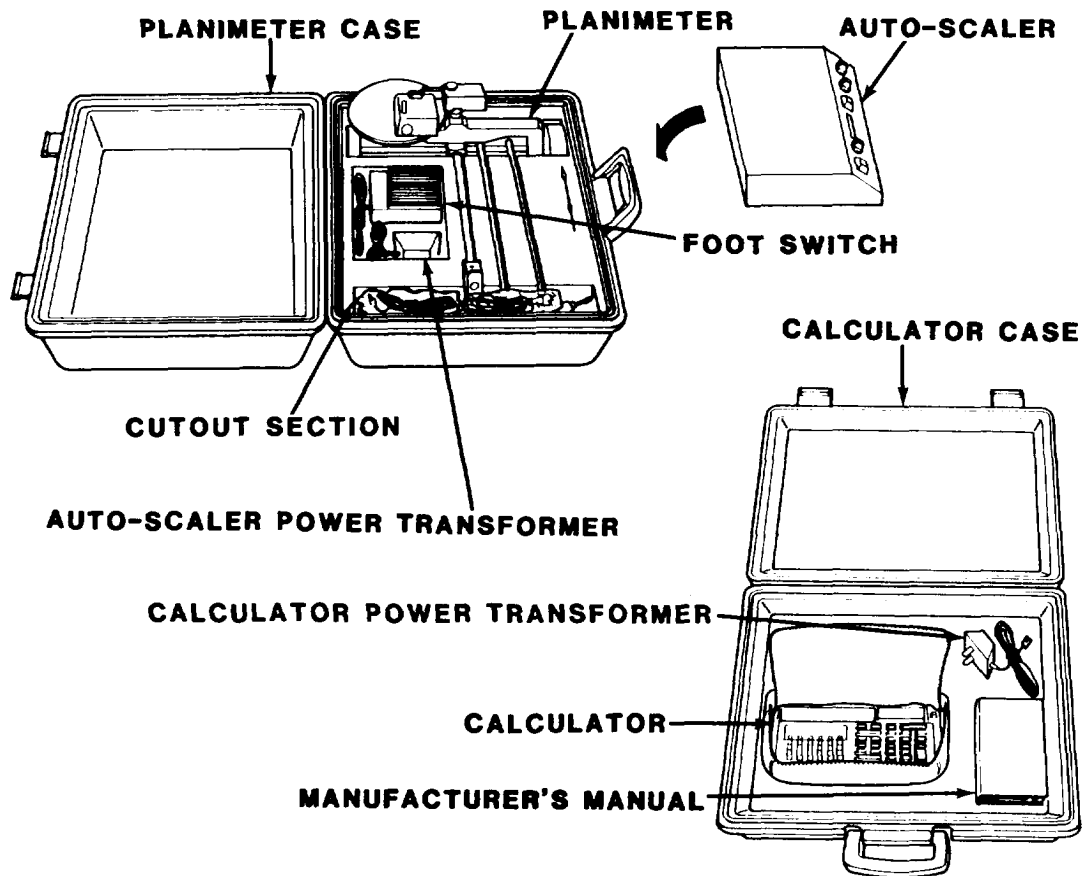
Step	Keyboard Entry	Purpose
184	RCLI	
185	STO1	(Sensitivity of lower-order register to higher-order register changes.)
186	DSZI	
187	GTOb	
188	2	
189	4	
190	X \geq I	
191	GBSc	
192	GBSO	
193	*LBLd	
194	DSZI	
195	RCLI	
196	ABS	
197	STO1	
198	2	
199	4	
200	X/Y?	
201	GTOd	
202	STOI	
203	GBSc	
204	9	Generate *PASS* display

Table 6-4. Preprogrammed Diagnostic Entries - Continued

Step	Keyboard Entry	Purpose
205	EEEX	
206	8	-8-888888888-88
207	7	
208	1/X	
209	8	
210	CHS	
211	X	
212	STF0	
213	CLF1	Reset status for possible second pass
214	STF3	
215	RAD	
216	DSP3	Test display formatting and printing
217	ENG	
218	PRINT X	
219	SCI	
220	PRINT X	
221	DSPI	
222	FIX	
223	PRINT X	
224	R/S	End of test

6-6.3 Preparation for Movement

- a. Disconnect all cables and switches from equipment.
- b. Cover components with their respective plastic covers.



- c. Place foot switch and auto-scaler power transformer into planimeter case.
- d. Place planimeter tracer arm extensions into cutout section of planimeter case.
- e. Place planimeter with lens tracing assembly sideways into case.
- f. Place remote tracer switch, point counter pen, linear measuring probe, needle tracing assembly, and drafting bridge into cutout section of planimeter case.
- g. Place auto-scaler in planimeter case.

6-6.3 Preparation for Movement - Continued

- h. Place calculator in small case.
- i. Place calculator in case, calculator power transformer, magnetic card pack, and manufacturer's manual in large calculator case.
- j. Close and secure both cases.

Section III. OPERATOR MAINTENANCE

6-7 LUBRICATION INSTRUCTIONS.

This equipment does not require lubrication.

6-8 OPERATOR TROUBLESHOOTING PROCEDURES.

6-8.1 General

6-8.1.1 The table lists the common malfunctions which you may find during the operation and maintenance of the QPS. You should perform the tests/inspections and corrective actions in the order listed.

6-8.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 6-5. Operator Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

1. AUTO-SCALER DOES NOT OPERATE.

Step 1. Check to see if power transformer is plugged into wall outlet and auto-scaler back panel.

Plug power transformer into wall outlet and auto-scaler back panel.

Step 2. Check to see if electrical wall outlet is active.

Plug power transformer into different wall outlet.

Set circuit breaker.

Replace auto-scaler.

Table 6-5. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. CALCULATOR DOES NOT OPERATE.	Step 1. Check to see if power transformer is plugged into wall outlet and back of calculator.	Plug power transformer into wall outlet and back of calculator.
	Step 2. Check to see if electrical wall outlet is active.	Plug power transformer into different wall outlet. Set circuit breaker.
	Step 3. Check to see if calculator will energize with good battery pack.	If calculator energizes, replace power transformer.
	Step 4. Check to see if calculator will energize with new power transformer.	Replace calculator.
3. AUTO-SCALER AND CALCULATOR DISPLAY ALL ZEROS.	Step 1. Check to see if NORMAL/SCALE switch is set on SCALE, with scale dials set to 000.	Set NORMAL/SCALE switch to NORMAL.
	Step 2. Check to see if switches on auto-scaler front panel are set correctly for specific measuring procedure.	Set switches correctly.
	Step 3. Check to see if remote tracer switch is stuck.	Free remote tracer switch.
	Step 4. Check to see if auto-scaler OFF/E ₂ /E ₁ switch is set correctly for specific measuring procedure.	Set switch correctly.

Table 6-5. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
	Step 5. Perform alinement procedure using linear measuring probe (para 6-6.2.16).	
4. AUTO-SCALER DISPLAYS ALL ZEROS. CALCULATOR DISPLAYS CORRECT COUNT.	Check to see if auto-scaler switches are set correctly for specific measuring procedures.	Set switches correctly.
5. AUTO-SCALER DISPLAYS CORRECT COUNT. CALCULATOR DISPLAYS ALL ZEROS.	Step 1. Check to see if ribbon cable in back of calculator is correctly connected.	Insert ribbon cables correctly.
	Step 2. Check to see if 1 , STO , 1 , and ENTER have been keyed into calculator memory.	Key into calculator 1 , STO , 1 , and ENTER .
	Step 3. Check to see if auto-scaler MAN/AUTO switch, X MEMORY switch, and INIT button are set correctly for specific measuring procedure.	Set switches correctly.
	Step 4. Run calculator Diagnostic Program on preprogrammed magnetic card.	Replace calculator.
6. AUTO-SCALER DISPLAY IS ERRATIC. CALCULATOR DISPLAYS CORRECT COUNT.	Perform checks in malfunction 5.	
7. CALCULATOR DISPLAYS CORRECT COUNT BUT DOES NOT RESPOND TO AUTO-SCALER SWITCHES.	Step 1. Check to see if ribbon cable in back of calculator is correctly connected.	Insert ribbon cable correctly.

Table 6-5. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
	Step 2. Run calculator Diagnostic Program on preprogrammed magnetic card.	Replace calculator.
8. CALCULATOR AND AUTO-SCALER DISPLAYS ARE ERRATIC.	Step 1. Check to see if encoder cable is correctly inserted into auto-scaler back panel.	Insert encoder cable correctly.
	Step 2. Check to see if encoder mounting screws are loose or missing*	Notify direct support maintenance for tightening or replacing of screws.
	Step 3. Check to see if planimeter drive gears are slipping or jamming.	Tighten or loosen setscrew on wheel axle to adjust drive gears.
	Step 4. Check to see if compression spring is operating.	Replace compression spring (para 6-9.3).
	Step 5. Check to see if encoder measuring wheel is in contact with planimeter disk.	Proceed to step 6.
	Step 6. Check for any obstruction under the planimeter disk.	Remove obstruction. Press encoder housing in place.
	Step 7. Check to see if there are enough paper disks in planimeter.	Add another disk to planimeter.

Table 6-5. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
9. AUTO-SCALER DISPLAYS CORRECT COUNT.	CALCULATOR DISPLAY IS ERRATIC.	Perform checks in malfunction 8.
10. POINT COUNTER PEN DOES NOT INCREMENT COUNT CORRECTLY.		
	Step 1. Check to see if point counter pen cable is correctly connected to auto-scaler back panel.	Insert point counter pen cable correctly.
	Step 2. Check to see if point of point counter pen is jammed.	Free point.
		Replace cartridge (para 6-6.2.9).
		Replace point counter pen.
	Step 3. Check to see if point counter pen will operate with new cartridge.	Replace cartridge (para 6-6.2.9).
		Replace point counter pen.
	Step 4. Check to see if auto-scaler LED display shows erratic counting while moving point counter pen.	Replace point counter pen.
11. BOTH DISPLAYS APPEAR NOW. ALINEMENT RESULTS ARE INCORRECT OR INCONSISTENT.		
	Step 1. Check to see if planimeter tracer arm has slipped or moved.	Set tracer arm to proper length.
	Step 2. Check to see if planimeter wheels are clean.	Clean wheels using soft brush.

Table 6-5. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
	Step 3.	Check to see if Teflon guide washer beneath the lens tracing assembly is clean and in contact with surface. Clean Teflon guide washer with soft clean cloth. Replace Teflon guide washer (para 6-9.2).
	Step 4.	Check to see if paper disk on planimeter is clean. Replace paper disk (para 6-9.4).
	Step 5.	Check to see if auto-scaler NORMAL/SCALE switch is set to NORMAL. Set NORMAL/SCALE switch to NORMAL.
	Step 6.	With 90° triangle, check to see if axis of tracing assembly is at 90° angle to surface being measured. Adjust axis of tracing assembly until it is at 90° angle with surface being measured.
	Step 7.	With 90° triangle, check to see if axis of tracer arm and axis of wheel axle are at 90° angle. Adjust tracer arm assembly until it is at 90° angle with axis of wheel axle.
	Step 8.	Check to see if encoder measuring wheel is clean. Clean encoder measuring wheel with soft brush.
	Step 9.	Check to see if encoder is alined. Notify direct support maintenance for encoder alinement and replacement.
12. AUTO-SCALER AND CALCULATOR DISPLAYS DO NOT AGREE BY TWO OR MORE COUNTS.		Check to see if ribbon cable in back of calculator is correctly connected. Insert ribbon cable correctly.

Table 6-5. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
13. CALCULATOR WILL NOT ACCEPT MAGNETIC CARD.	Step 1. Check to see if magnetic card is being fed into reader backwards or upside down.	Feed magnetic card correctly.
	Step 2. Check to make sure calculator is correctly keyed to accept card.	Set keys correctly (para 6-6.2.10).
	Step 3. Check to see if head-cleaning card will be accepted into magnetic card reader.	Proceed to step 4. Run head-cleaning card through magnetic card reader.
	Step 4. Check to see if magnetic card is dirty.	Clean magnetic card with cloth moistened with alcohol.
	Step 5. Check to see if battery pack contacts are clean and straight.	Clean battery pack contacts with cotton swab moistened with alcohol. Straighten battery pack contacts by pressing down with finger. Replace battery pack (para 6-9.1).
	Step 6. Run calculator Diagnostic Program on preprogrammed magnetic card.	Replace calculator.

Table 6-5. Operator Troubleshooting — Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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14. CALCULATOR PRINTER WILL NOT ADVANCE.

- Step 1. Check to see if paper roll is jammed.
Free paper roll.
- Step 2. Check to see if battery pack is defective.
Replace battery pack (para 6-9.1).
- Step 3. Check to see if calculator display is active.
Replace calculator.
- Step 4. Check to see if calculator PRGM/RUN switch is set to PRGM.
Set switch to RUN.
- Step 5. Run calculator Diagnostic Program on preprogrammed magnetic card.
Replace calculator.

15. CALCULATOR PRINTER ADVANCES, BUT NOTHING PRINTS WHEN PRINT X IS ACTIVATED.

- Step 1. Check to see if paper roll is jammed.
Free paper roll.
- Step 2. Perform checks in malfunction 14.

16. AUTO-SCALER LED DISPLAY DOES NOT OPERATE OR SHOWS INCORRECT COUNT.

(deleted).

Pages 6-140 and 6-141 are deleted.

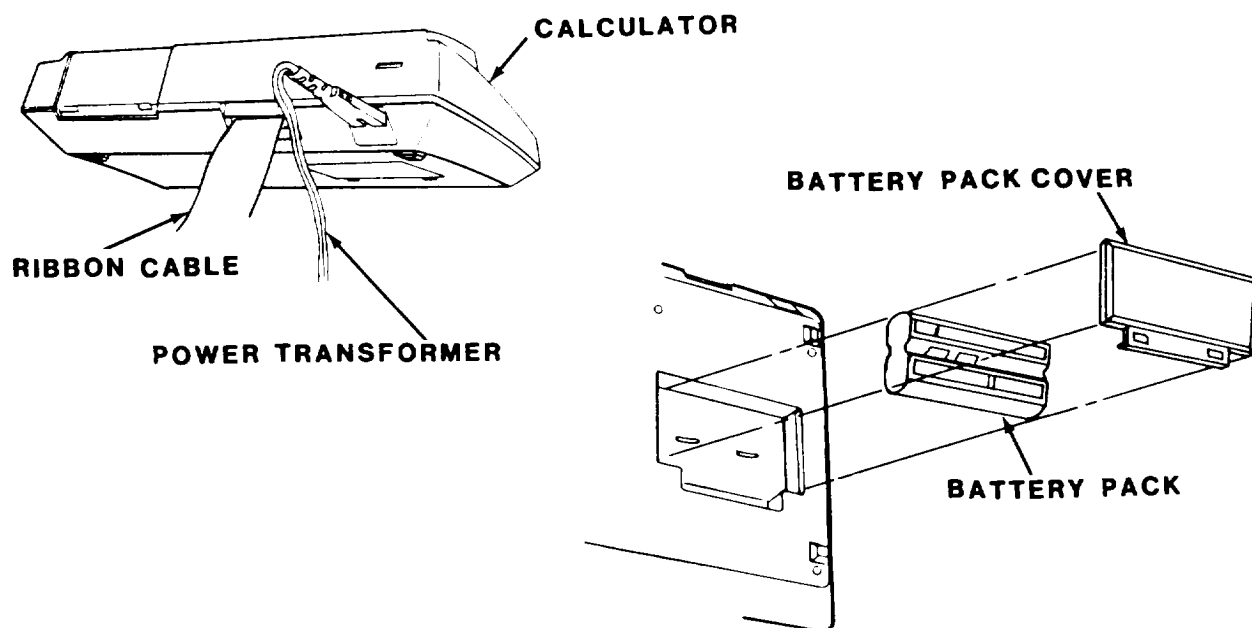
6-9 OPERATOR MAINTENANCE PROCEDURES.

This section contains step-by-step instructions covering operator performed maintenance functions.

6-9.1 Replace Battery Pack

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

MATERIALS/PARTS: Battery pack



REMOVAL:

- a. Turn calculator OFF/ON switch to OFF. Disconnect power transformer from wall outlet.
- b. Remove ribbon cable.
- c. Turn calculator over. Slide battery cover latches open. Remove cover.
- d. Remove defective battery pack.

INSTALLATION:

- a. Install new battery pack so contacts face calculator and line up with connectors.
- b. Replace cover. Slide cover latches over to secure.

6-9.1 Replace Battery Pack - Continued**CAUTION**

Arrows on ribbon cable and calculator must align. Damage to calculator can result if cable is plugged in backwards.

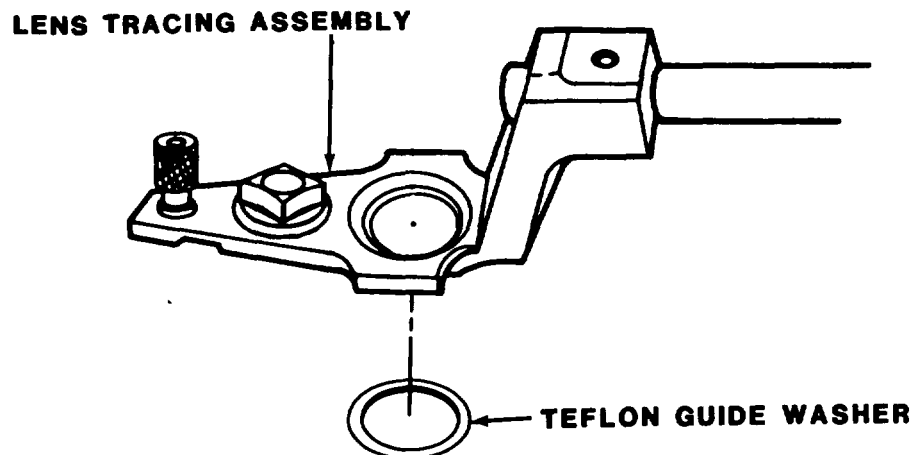
- c. Turn calculator over. Replace ribbon cable.
- d. Reconnect power transformer to wall outlet. Turn calculator ON.

6-9.2 Replace Teflon Guide Washer

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: 3/16-in. flat-tip screwdriver
Steel knife
3/32-in. socket-head screw key

MATERIALS/PARTS: Teflon guide washer
General purpose glue (item , appendix E)
Technical acetone (item , appendix E)



REMOVAL:

CAUTION

Hold tracer arm with one hand before removing lens tracing assembly. Tracer arm will fall and damage planimeter.

- a. Remove lens tracing assembly from planimeter tracer arm by loosening setscrew on top. Slide lens tracing assembly off tracer arm.

6-9.2 Replace Teflon Guide Washer - Continued

- b. Turn over lens tracing assembly. Pry up Teflon guide washer.
- c. Scrape off glue and pieces of washer from base of lens tracing assembly.

INSTALLATION:

- a. Apply small amount of general purpose glue to bottom of new Teflon guide washer.
- b. Press new Teflon guide washer into place. Remove excess glue with technical acetone and soft cloth.
- c. Check to be sure Teflon washer guide is level and is flat on surface.
- d. Slide lens tracing assembly on tracer arm. Secure by tightening setscrew on top.

6-9.3 Replace Compression Spring

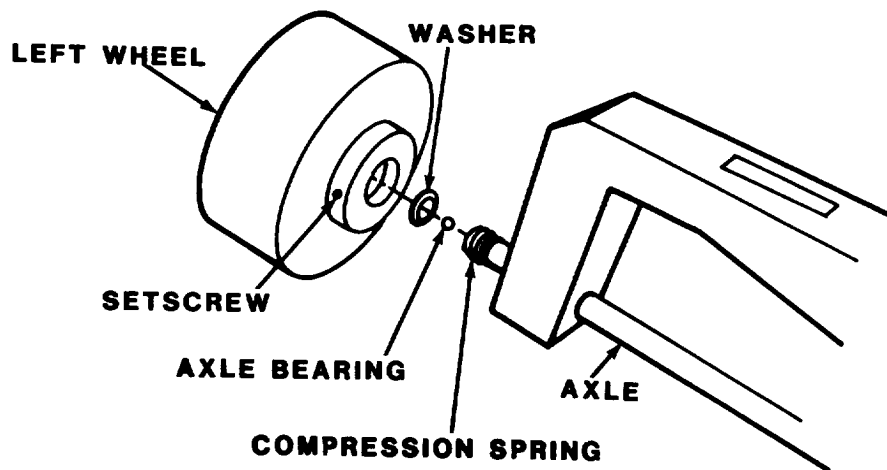
PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: 5/64-in. socket-head screw key

MATERIALS/SUPPLIES: Compression spring

REMOVAL:

- a. Remove wires from antenna and tracer arm assembly.



6-9.3 Replace Compression Spring - Continued

- b. Facing the back of the planimeter, loosen the setscrews holding left wheel on axle.
- c. Slide left wheel and washer from end of axle.
- d. Slide axle bearing off.
- e. Pull defective compression spring from end of axle.

INSTALLATION:

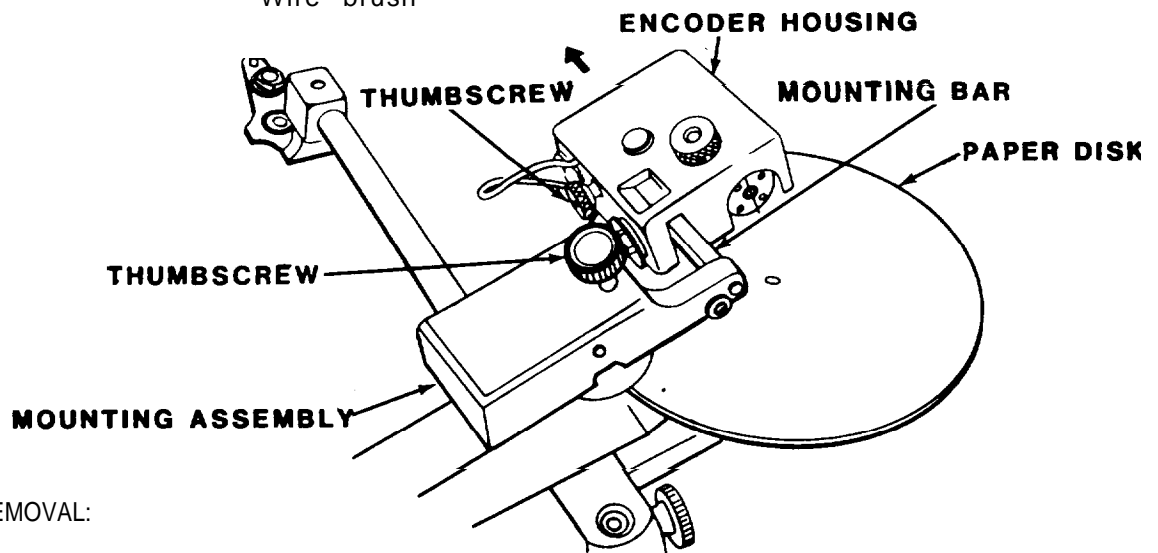
- a. Install new compression spring on end of axle.
- b. Reinstall axle bearing.
- c. Reinstall washer and left wheel on end of axle.
- d. Evenly tighten setscrews.
- e. Reinstall wires on tracer arm assembly and antenna.

6-9.4 Replace Paper Disk

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: Knife

MATERIALS/PARTS: Paper disk
 Adhesive glue (item 2, appendix E)
 Alcohol (item 3, appendix E)
 Wire brush



REMOVAL:

- a. Loosen thumbscrew on side of encoder housing. Slide encoder housing off mounting bar.

6-9.4 Replace Paper Disk - Continued

- b. Turn thumbscrew to move mounting assembly away from paper disk.
- c. Pry up old paper disks with knife and remove.
- d. Remove any remaining glue with alcohol and a brush.

INSTALLATION:

- a. Spread three or four drops of general purpose glue along edge of paper disk.
- b. Reinstall new disk on planimeter surface. Press down firmly.
- c. Trim excess paper from edges with knife. Remove any excess glue from edges
- d. Slide encoder housing onto mounting bar. Tighten thumbscrew.

Section IV. ORGANIZATIONAL MAINTENANCE

6-10 There are no assigned organizational maintenance tasks for this equipment.

Section V. DIRECT/GENERAL SUPPORT MAINTENANCE

6-11 REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT.

6-11.1 For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

6-11.2 Special tools, TMDE, and support equipment are not required for this equipment.

6-11.3 Repair parts are listed and illustrated in the Repair Parts and Special Tools List (TM5-6675-326-24P) covering direct/general support maintenance for this equipment.

6-12 DIRECT/GENERAL SUPPORT PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

There are no PMCS at the direct/general support level for the QPS.

6-13 DIRECT/GENERAL SUPPORT TROUBLESHOOTING.

6-13.1 General.

6-13.1.1 Direct/general troubleshooting procedures cover the most common malfunctions that may be repaired at the direct/general level. Repair or adjustment requiring specialized equipment is not authorized unless such equipment is available. Troubleshooting procedures used at lower levels should be conducted in addition to the direct/general support troubleshooting procedures.

6-13.1.2 This manual cannot list all the possible malfunctions or every possible test/inspection and corrective action. If a malfunction is not listed or corrected by a listed corrective action, notify your supervisor.

Table 6-6. Direct/General Support Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
AUTO-SCALER LED DISPLAY DOES NOT OPERATE OR SHOW INCORRECT COUNT.		
Step 1.	Check to see if power source has 10 vdc to 15 vdc output.	Change power source.
Step 2.	Check to see if voltage on regulator on main logic PC board is 8 vdc.	Replace main logic PC board.
Step 3.	Check to see if there is power at power source but not on main logic PC board.	Replace main logic PC board and front display PC board.
Step 4.	Check to see if auto-scaler LED display shows numbers but does not count.	Replace main logic PC board and front display PC board.
Step 5.	Check to see if auto-scaler LED display shows count only increasing or only decreasing.	Replace main logic PC board and front display PC board.
Step 6.	Check to see if auto-scaler LED display shows erratic counts or skips counts.	Replace main logic PC board and front display PC board.
Step 7.	Check to see if auto-scaler LED display does not show even or odd digits.	Replace main logic PC board.
Step 8.	Check to see if auto-scaler LED display shows inaccurate counts.	Replace main logic PC board.
Step 9.	Check to see if calculator LED shows incorrect readings.	Replace main logic PC board.
Step 10.	Check to see if calculator LED display will clear.	Replace main logic PC board.
Step 11.	Check to see if auto-scaler NORMAL/SCALE switch and scale dials are operating correctly.	Replace scaler PC board. Replace auto-scaler.

6-14 DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE PROCEDURES.

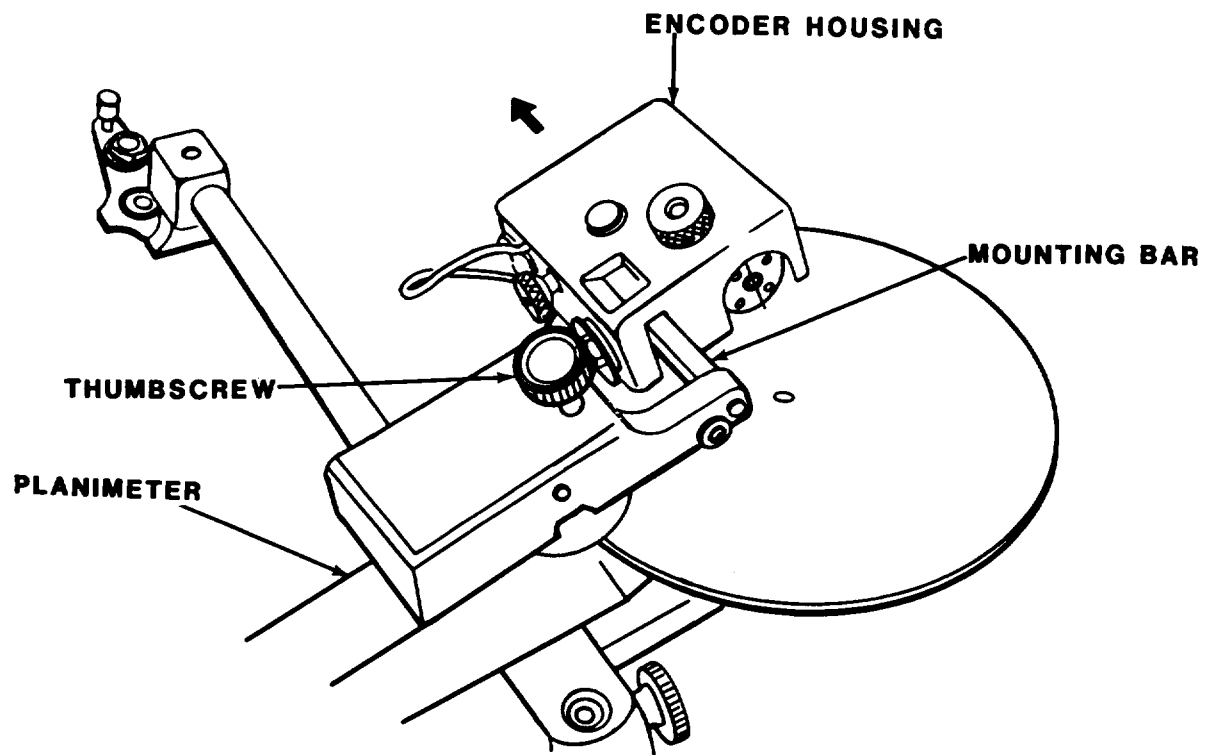
This section contains step-by-step instructions covering direct support and general support maintenance procedures.

6-14.1 Replace Planimeter Encoder

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

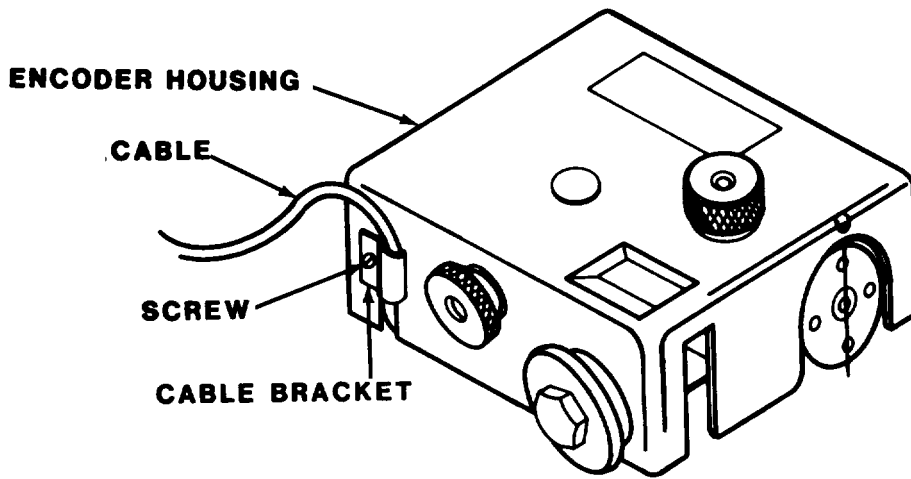
TOOLS: 5/64-in. socket-head screw key
No. 2 jeweler's screwdriver
3/16-in. flat-tip screwdriver
No. 2 cross-tip screwdriver
Scribe

MATERIALS/PARTS: Encoder

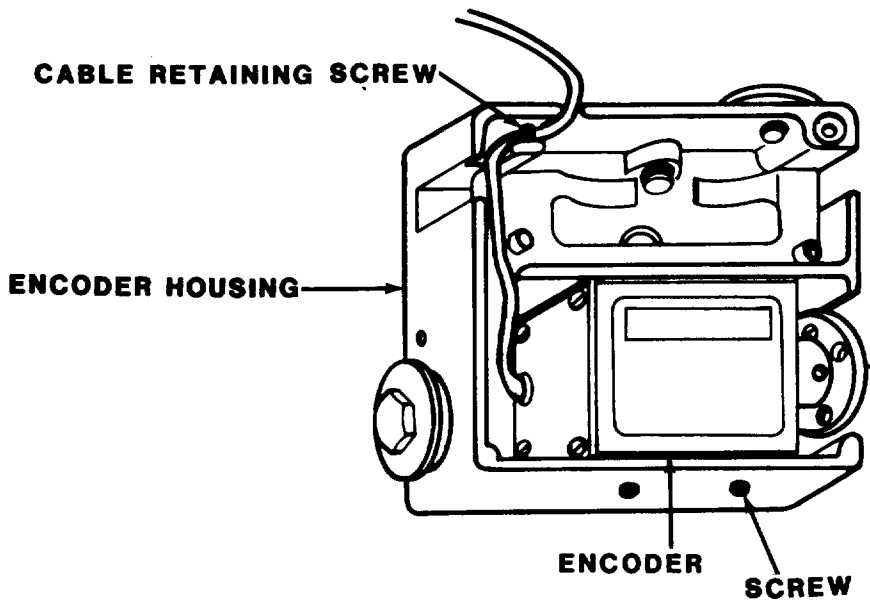
**REMOVAL:**

- a. Loosen thumbscrew holding encoder housing on planimeter.
- b. Grasp encoder housing and slide off mounting bar.

6-14.1 Replace Planimeter Encoder - Continued



- c. Remove screw holding cable bracket to encoder housing. Remove cable bracket and cable.



- d. Remove cable retaining screw.
- e. Mark exact position of encoder on inside walls of encoder housing with scribe.
- f. Remove two hex head screws on side of housing.
- g. Remove defective encoder from housing.

6-14.1 Replace Planimeter Encoder - Continued

INSTALLATION:

- a. Reinstall new encoder in housing.
- b. Make sure the new encoder is parallel with the bottom of the housing and placed exactly between the marks made on the housing.
- c. Reinstall two hex head screws on side of encoder housing.
- d. Insert cable in housing. Reinstall cable retaining screw.
- e. Reinstall cable bracket. Secure with screw.
- f. Slide encoder housing onto mounting bar of planimeter.
- g. Tighten thumbscrew holding encoder housing on planimeter.

6-14.2 Aline Planimeter Encoder

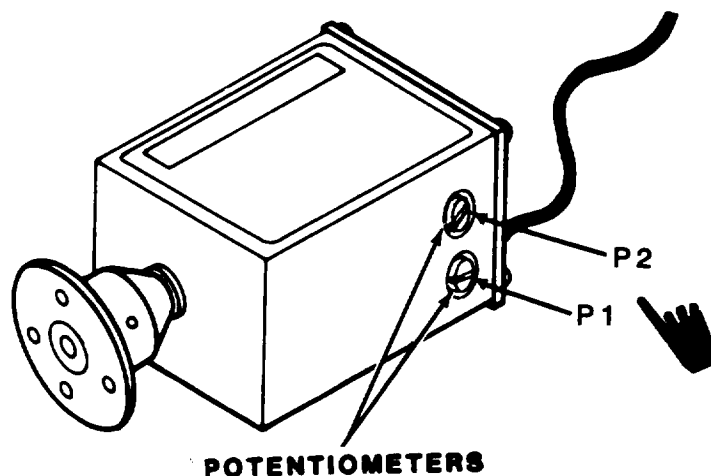
PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 3/16-in. flat-tip screwdriver
 1/8-in. flat-tip screwdriver
 No. 2 cross-tip screwdriver
 No. 2 jeweler's screwdriver
 5/64-in. socket-head screw key
 Dip-clip (14 pin)

TEST EQUIPMENT: Multimeter

MATERIALS/PARTS: Acrylic orange resin
 Technical acetone

- a. Remove planimeter encoder from housing (para 6-14.1).



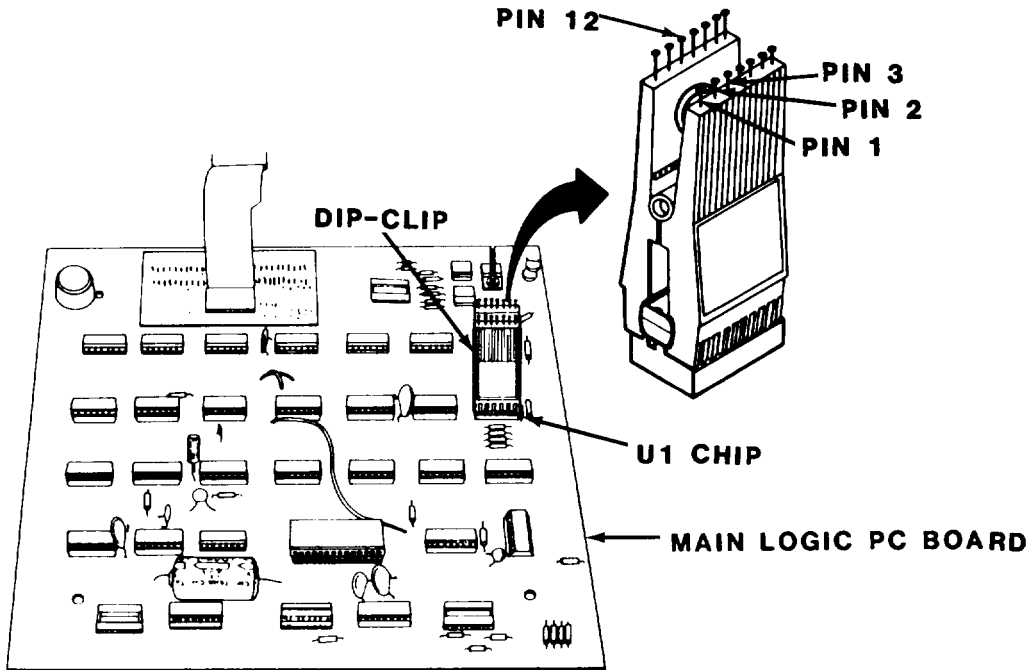
6-14.2 Aline Planimeter Encoder - Continued

- b. With technical acetone, remove resin covering from adjustment potentiometers, P1 and P2.
- c. Remove four screws and washers from top of auto-scaler. Lift off top.
- d. Plug encoder into E1 encoder socket on back of auto-scaler.
- e. Set encoder switch to E1.

CAUTION

Plug transformer power cable into auto-scaler before connecting it to wall outlet. Failure to do so could result in damage to auto-scaler.

- f. Plug power transformer cable into POWER supply jack on back panel of auto-scaler.
- g. Plug power transformer cable into wall outlet.



CAUTION

Make sure power is OFF before attaching dip-clip to U1 chip. Failure to do so could result in damage to auto-scaler.

- h. Attach dip-clip to U1 chip on main logic PC board.

6-14.2 Aline Planimeter Encoder - Continued

- i. Attach positive lead from meter to pin 3 on U1 chip. Attach negative lead to pin 12.
- j. Turn B/ACCU/A/OFF switch to A.
- k. Take voltage reading on encoder calibrator. Divide voltage reading by two to obtain encoder alinement voltage.

NOTE

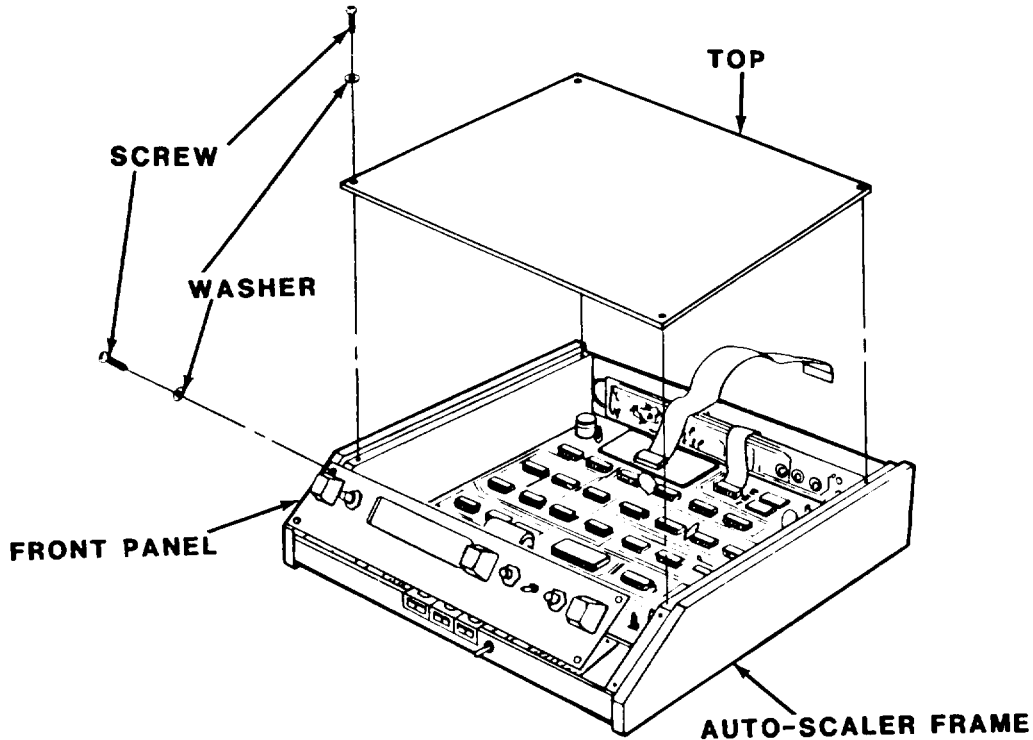
- o **At pin 3 and pin 12, voltage should be 12 vdc.**
 - o **The encoder wheel must be turning to aline.**
- l. Turn B/ACCU/A/OFF switch to OFF.
 - m. Disconnect positive lead from pin 3 and attach to pin 1, Leave negative lead on pin 12.
 - n. Turn B/ACCU/A/OFF switch to A.
 - o. While encoder wheel is turning, adjust P1 by turning screw slowly to obtain encoder alinement voltage (6 ± 0.3 vdc).
 - p. Turn B/ACCU/A/OFF switch to OFF.
 - q. Disconnect positive lead from pin 1 and attach to pin 2. Leave negative lead on pin 12.
 - r. Turn B/ACCU/A/OFF switch to A.
 - s. While encoder wheel is turning, adjust P2 by turning screw slowly to obtain encoder alinement voltage (6 ± 0.3 vdc).
 - t. Turn B/ACCU/A/OFF switch to OFF.
 - u. After encoder alinement is obtained, coat adjustment potentiometers, P1 and P2 with acrylic orange resin.
 - v. Disconnect and remove probes from dip-clip.
 - w. Reinstall encoder in housing (para 6-14.1).
 - x. Reinstall top on auto-scaler. Secure with four washers and screws.

6-14.3 Replace Main Logic PC Board

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 3/16-in. flat-tip screwdriver
No. 2 cross-tip screwdriver
Needle-nose pliers

MATERIALS/PARTS: Main logic PC board



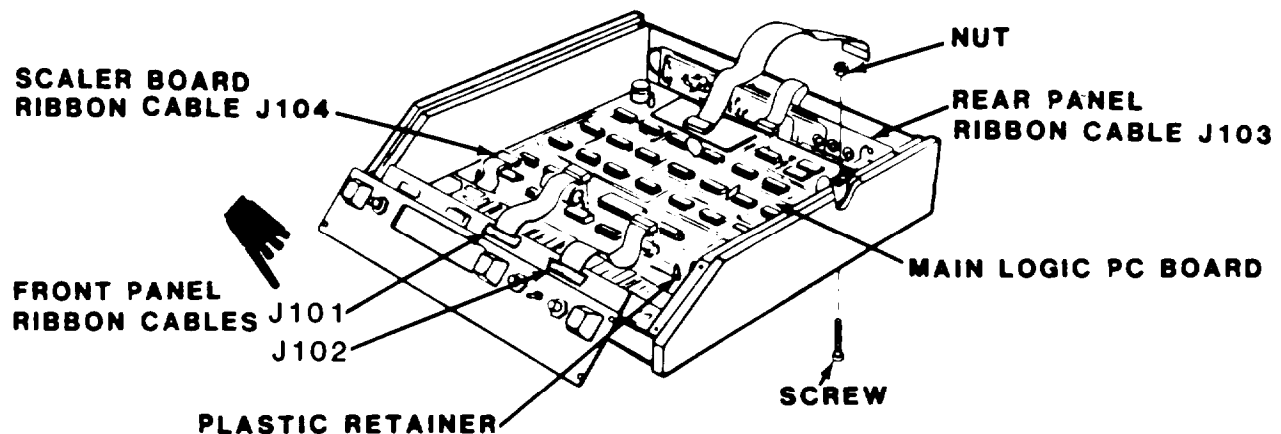
REMOVAL :

- a. Remove four screws and washers from top of auto-scaler. Lift off top.

CAUTION

Front panel is connected to frame of auto-scaler by two ribbon cables. Do not pull front panel more than a few inches from frame. Damage to circuit boards can result.

- b. Remove four screws on front panel of auto-scaler. Pull front panel free from auto-scaler frame.

6-14.3 Replace Main Logic PC Board - Continued

- c. Disconnect front panel ribbon cables J101 and J102 from main logic PC board.
- d. Disconnect scaler board ribbon cable J104 and rear panel ribbon cable J103 from main logic PC board.
- e. Remove screw and nut from upper right corner of main logic PC board.
- f. Pinch plastic retainers to free main logic PC board from auto-scaler base.
- g. Remove defective main logic PC board. Remove plastic retainers from board.

INSTALLATION:

- a. Install plastic retainers in auto-scaler base.
- b. Press new main logic PC board onto plastic retainers in auto-scaler base.
- c. Reinstall screw and nut on upper right corner of main logic PC board.
- d. Reconnect rear panel ribbon cable J103 and scaler board ribbon cable J104 to main logic PC board.
- e. Reconnect front panel ribbon cables J101 and J102 to main logic PC board.
- f. Reinstall front panel on auto-scaler frame. Secure with four screws.
- g. Reinstall top on auto-scaler. Secure with four washers and screws.

6-14.4 Replace Front Display PC Board

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 3/16-in. flat-tip screwdriver
1/2-in. box-end wrench
No. 2 cross-tip screwdriver

MATERIALS/PARTS: Front display PC board

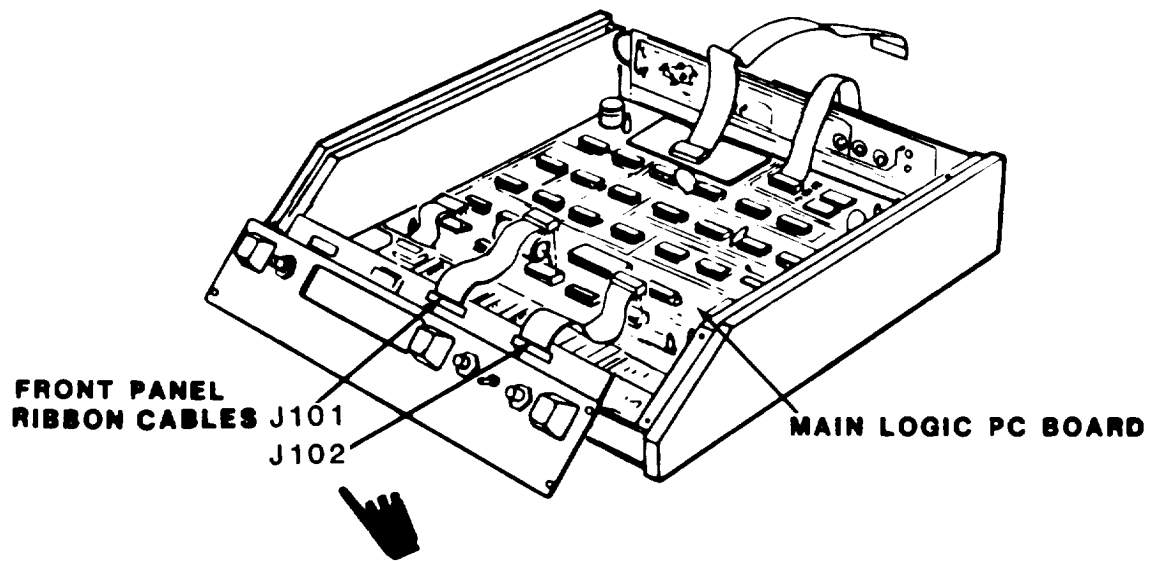
REMOVAL:

- a. Remove four screws and washers from top of auto-scaler. Lift off top.

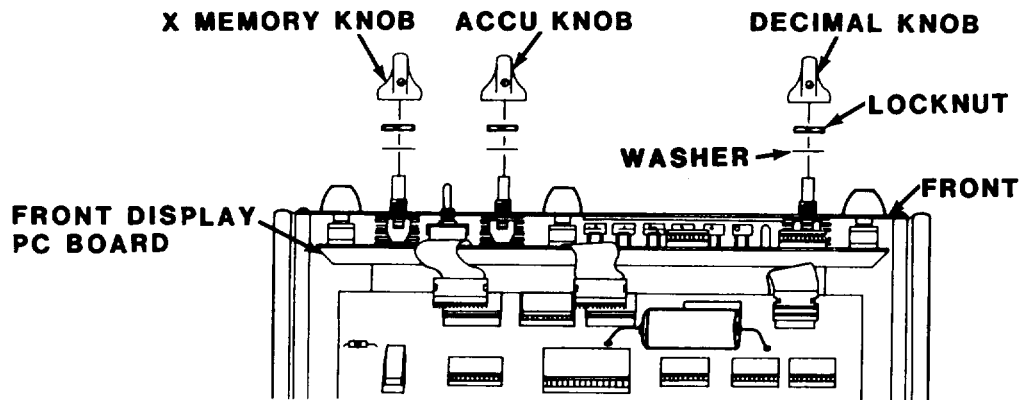
CAUTION

Front panel is connected to frame of autoscaler by two ribbon cables. Do not pull front panel more than a few inches from frame. Damage to circuit boards can result.

- b. Remove four screws on front panel of auto-scaler. Pull front panel free from auto-scaler frame.



- c. Disconnect front panel ribbon cables J101 and J102 from main logic PC board.

6-14.4 Replace Front Display PC Board - Continued

- d. Loosen setscrews holding DECIMAL, ACCU, and X MEMORY switch knobs to front panel. Remove knobs.
- e. Remove three locknuts and washers from front panel. Lift off front panel. Remove defective front display PC board.

INSTALLATION:

- a. Place front panel on new front display PC board. Reinstall three washers and locknuts to front panel.
- b. Reinstall DECIMAL, ACCU, and X MEMORY knobs on front panel. Tighten setscrews to secure.
- c. Reconnect front panel ribbon cables J101 and J102 to main logic PC board.
- d. Reinstall front panel on auto-scaler frame. Secure with four screws.
- e. Reinstall top on auto-scaler. Secure with four washers and screws.

6-14.5 Replace Rear Input PC Board

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

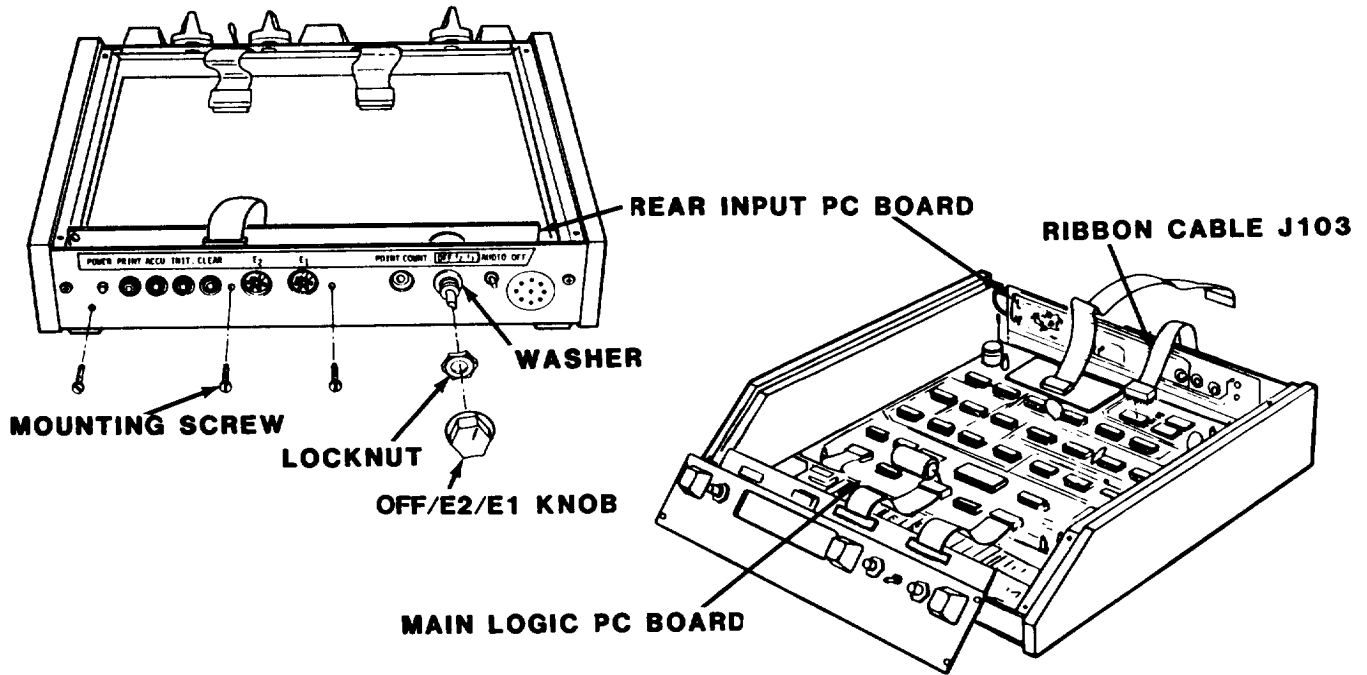
TOOLS: 3/16-in. flat-tip screwdriver
No. 2 cross-tip screwdriver

MATERIALS/PARTS: Rear input PC board

6-14.5 Replace Rear Input PC Board - Continued

REMOVAL:

- a. Remove four screws and washers from top of auto-scaler. Lift off top.



- b. Disconnect rear panel ribbon cable J103 from main logic PC board.
- c. Loosen OFF/E2/E1 knob locknut. Remove OFF/E2/E1 knob, locknut, and washer from back panel.
- d. Remove three rear input PC board mounting screws and nuts from back panel. Remove defective rear input PC board.

INSTALLATION:

- a. Secure new rear input PC board on back panel with three nuts and screws.
- b. Reinstall OFF/E2/E1 washer, locknut, and knob on back panel. Tighten locknut.
- c. Reconnect rear panel ribbon cable J103 to main logic PC board.
- d. Reinstall top on auto-scaler. Secure with four washers and screws.

6-14.6 Replace Scaler PC Board

PERSONNEL REQUIRED: 1 Special electronic devices repairer MOS 35E

TOOLS: 3/16-in. flat-tip screwdriver
No. 2 cross-tip screwdriver
Needle-nose pliers

MATERIALS/PARTS: Scaler PC board

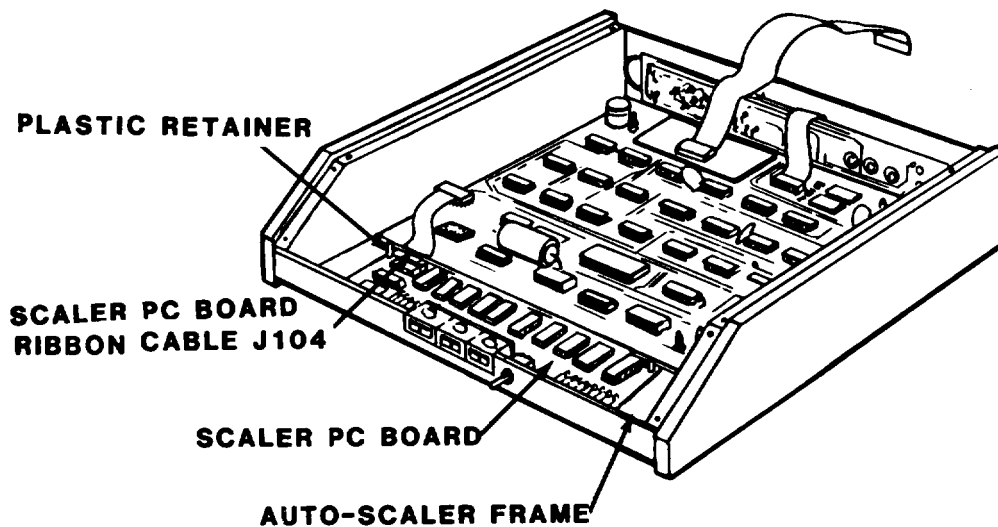
REMOVAL:

- a. Remove four screws and washers from top of auto-scaler. Lift off top.

CAUTION

Front panel is connected to frame of auto-scaler by two ribbon cables. Do not pull front panel more than a few inches from frame. Damage to circuit boards can result.

- b. Remove four screws on front panel of auto-scaler. Pull front panel free from auto-scaler frame.
- c. Disconnect front panel ribbon cables J101 and J102 from main logic PC board. Set front panel to one side.



6-14.6 Replace Scaler PC Board - Continued

- d. Disconnect scaler board ribbon cable J104 from scaler PC board.
- e. Pinch plastic retainers, and gently pry scaler PC board free from auto-scaler frame. Lift out scaler PC board.

INSTALLATION:

- a. Install new scaler PC board by snapping onto plastic retainers.
- b. Reconnect scaler board ribbon cable J104 to scaler PC board.
- c. Place front panel on auto-scaler frame.
- d. Reconnect front panel ribbon cables J101 and J102 to main logic PC board.
- e. Secure front panel to auto-scaler frame with four screws.
- f. Reinstall top on auto-scaler. Secure with four washers and screws.

6-15 PREPARATION FOR STORAGE OR SHIPMENT.

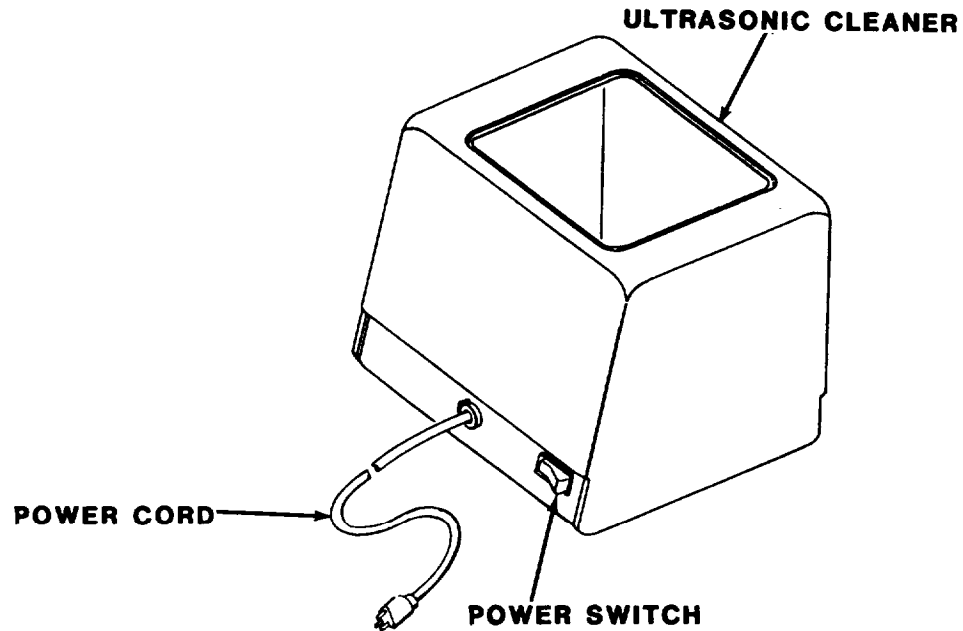
In the event that the QPS must be removed from the section for repair or replacement, refer to TM 740-90-1 for storage instructions.

CHAPTER 7

ULTRASONIC CLEANER

Section I. INTRODUCTION

7-1 GENERAL INFORMATION.



7-1.1 Scope

Model Number and Equipment Name:

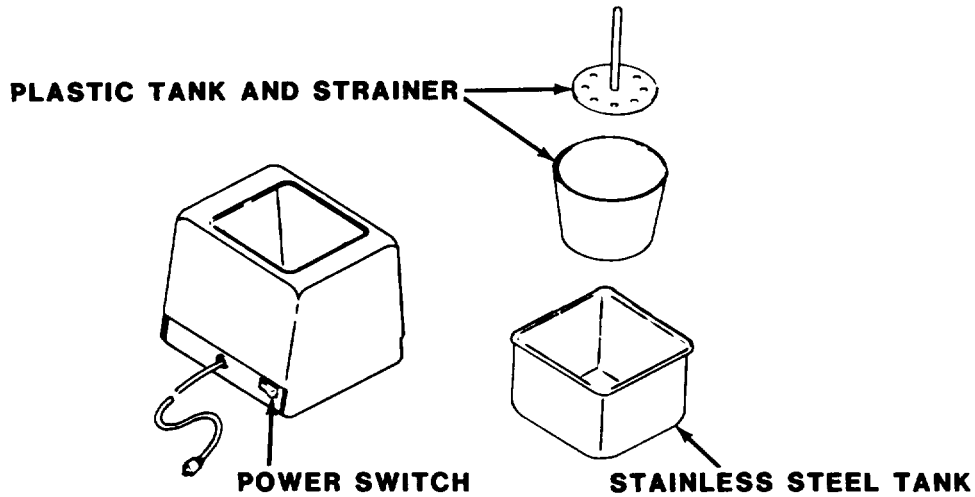
Model 3069USC3 Ultrasonic Cleaner

Purpose of Equipment: To clean drafting/drawing pens.

7-2 EQUIPMENT DESCRIPTION AND DATA.

7-2.1 Equipment Characteristics, Capabilities, and Features. Rapidly cleans drafting/drawing pens that are either assembled or disassembled. Equipment can remove dried ink and is portable.

7-2.2 Location and Description of Major Components



STAINLESS STEEL TANK. Holds cleaning solution.

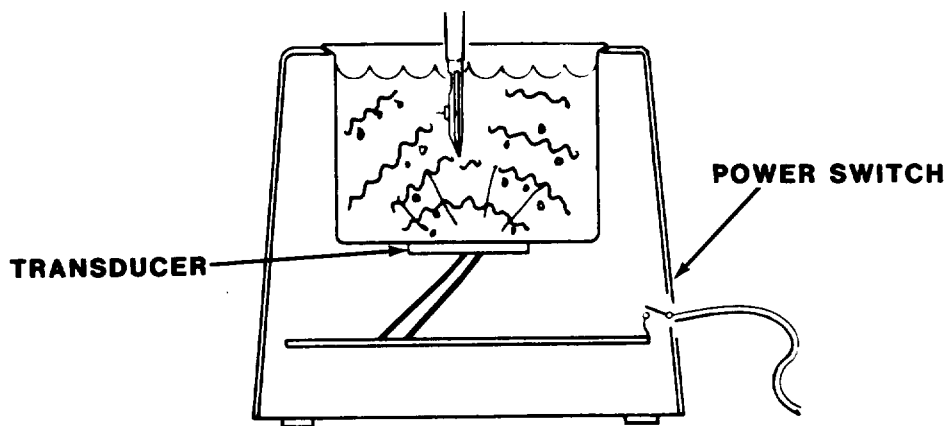
PLASTIC TANK AND STRAINER. Holds small parts of pen in solution for cleaning.

POWER SWITCH. Turns machine ON and OFF.

7-2.3 Equipment Data

Weight	5.51 lbs (2.5 kg)
Power Requirements	115 vat, 60 Hz, 60 w

7-3 **TECHNICAL PRINCIPLES OF OPERATION.**

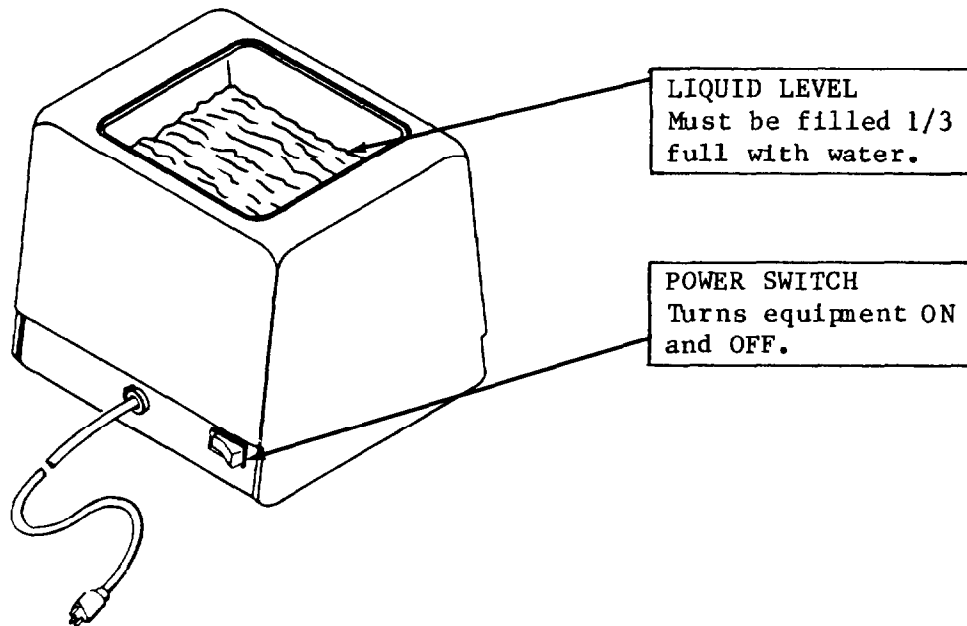


POWER SWITCH. When turned on, provides power to the transducer.

TRANSducer. Generates ultrahigh-frequency sound waves in liquid cleaning solution.

Section II. OPERATING INSTRUCTIONS

7-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS.



7-5 OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

7-5.1 General. The ultrasonic cleaner must be regularly inspected to find and correct defects.

7-5.1.1 Before You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your BEFORE (B) PMCS.

7-5.1.2 While You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your DURING (D) PMCS.

7-5.1.3 After You Operate. Be sure to perform your AFTER (A) PMCS.

7-5.1.4 If Your Equipment Falls to Operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

7-5.2 PMCS Procedures

7-5.2.1 PMCS are designed to keep the equipment in good working condition by performing periodic service tasks.

7-5.2.2 Service internals provide you, the operator, with time schedules that determine when to perform specified service tasks.

7-5.2.3 The "Equipment is not Ready/Available If" column is used for Identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.

7-5.2.4 If your equipment fails to operate after PMCS is performed, immediately report this condition to your supervisor.

7-5.3 PMCS Columnar Entries

7-5.3.1 Item Number Column. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for "TM number" Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.

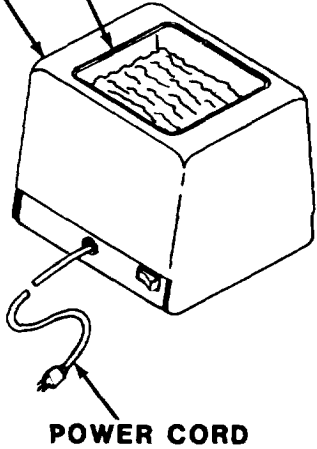
7-5.3.2 Interval Column. This column determines the time period designated to perform your PMCS.

7-5.3.3 Item To Be Inspected and Procedures Column. This column lists functional groups and their respective assemblies and subassemblies as shown in the Maintenance Allocation Chart (Appendix B). The appropriate check or service procedure follows the specific item to be inspected.

7-5.3.4 Equipment Is Not Ready/Available If: Column. This column indicates the reason or cause why your equipment is not ready/available to perform its primary mission.

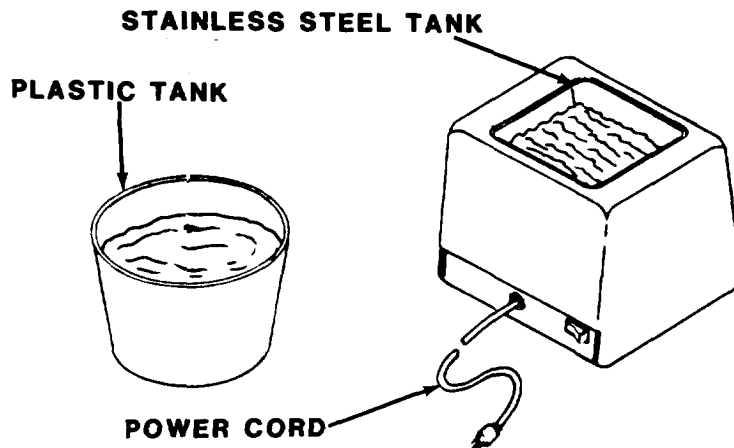
Table 7-1. Operator Preventive Maintenance Checks and Services

B - Before Operation

Item No.	Interval	ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	<p>ULTRASONIC CLEANER</p>  <p>STAINLESS STEEL TANK</p> <p>POWER CORD</p> <p><u>WARNING</u></p> <p>ELECTRICAL SHOCK</p> <p>Unplug power cord before servicing the ultrasonic cleaner. Failure to do so may result in death or serious injury.</p>	
1	●	<p>POWER CORD. Check power cord for kinks, frays, or burns. If power cord is defective notify organizational maintenance.</p>	Power cord is damaged.
2	●	<p>STAINLESS STEEL TANK. Check tank for dirt or chemical residue. Clean tank by wiping with cotton cloth (item 16, appendix E) moistened with water.</p>	
3	●	<p>ULTRASONIC CLEANER. Check for agitation of water surface.</p>	Water surface is not agitating.

7-6 OPERATION UNDER USUAL CONDITIONS.

7-6.1 Operating Procedure



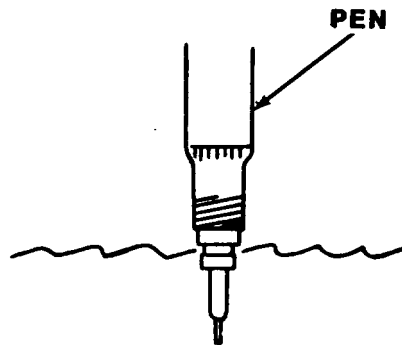
- a. Fill stainless steel tank 1/3 full with fresh, clean water. Fill plastic tank with water, to within 1/2 inch (1.27 cm) of top.
- b. Add 4 ml (0.135 oz) of cleaning concentrate (item 12, appendix E) to stainless steel tank.
- c. Plug in power cord to 110-115 vat, 60 Hz grounded outlet.

WARNING

BODY TISSUE DAMAGE

Do not put fingers in stainless steel tank when ultrasonic cleaner is operating. Cleaning solution may be driven through skin or ultrasonic waves may cause damage to body tissue.

- d. Turn power ON. Make sure water surface in stainless steel tank is agitating.
- e. Prepare cleaning solution by operating the ultrasonic cleaner for one minute before cleaning pen tips.

7-6.1 Operating Procedure - Continued**CAUTION**

Do not immerse pen beyond cap threads. Damage to pen will result.

- f. Dip pen 3/4 inch (1.9 cm) into cleaning solution.
- g. Lift pen from cleaning solution. Keeping point downward, shake solution from pen onto cotton cloth (item 16, appendix E).
- h. Wipe pen.
- i. Draw pen over scrap paper until ink flows freely and shows uniform color.
- j. Turn power OFF. Unplug power cord.
- k. Dispose of cleaning solution when dirty.

CAUTION

Avoid getting water into body of ultrasonic cleaner. Damage to circuit board can result.

- 1. Carefully rinse stainless steel tank.
- m. Wipe tank dry with clean cotton cloth (item 16, appendix E).

Section III. OPERATOR MAINTENANCE

7-7 LUBRICATION INSTRUCTIONS.

This equipment does not need lubrication.

7-8 OPERATOR TROUBLESHOOTING PROCEDURES.

There are no operator troubleshooting procedures for the ultrasonic cleaner.

7-9 OPERATOR MAINTENANCE PROCEDURES.

Operator maintenance is limited to regular preventive maintenance checks and services and changing of cleaning solution.

Section IV. ORGANIZATIONAL MAINTENANCE

7-10 REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT.

7-10.1 For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

7-10.2 Special tools, TMDE, and support equipment are not required for this equipment.

7-10.3 Repair parts are listed and illustrated in the Repair Parts and Special Tools List (TM 5-6675-326-24P) covering organizational maintenance for this equipment.

7-11 ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

There are no PMCS at the organizational level for the ultrasonic cleaner.

7-12 ORGANIZATIONAL TROUBLESHOOTING.

7-12.1 General.

7-12.1.1 The table lists the common malfunctions which may be repaired at the organizational level. You should perform the tests/inspections and corrective actions in the order listed.

7-12.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 7-2. Organizational Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. NO CLEANING ACTION, WATER AGITATES.	<p>Step 1. Check cleaning action using fresh cleaning solution. If test was satisfactory, instruct operator to change cleaning solution when dirty.</p> <p>If test was not satisfactory, replace circuit board (para 7-13.3).</p>	
2. NO WATER AGITATION.	<p>Step 1. Check if power cord is loose or unplugged.</p> <p>Plug in power cord.</p> <p>Step 2. Check power supply.</p> <p>Reset circuit breaker.</p> <p>Replace power switch (para 7-13.2).</p> <p>Replace circuit board (para 7-13.3).</p>	

7-13 ORGANIZATIONAL MAINTENANCE PROCEDURES.

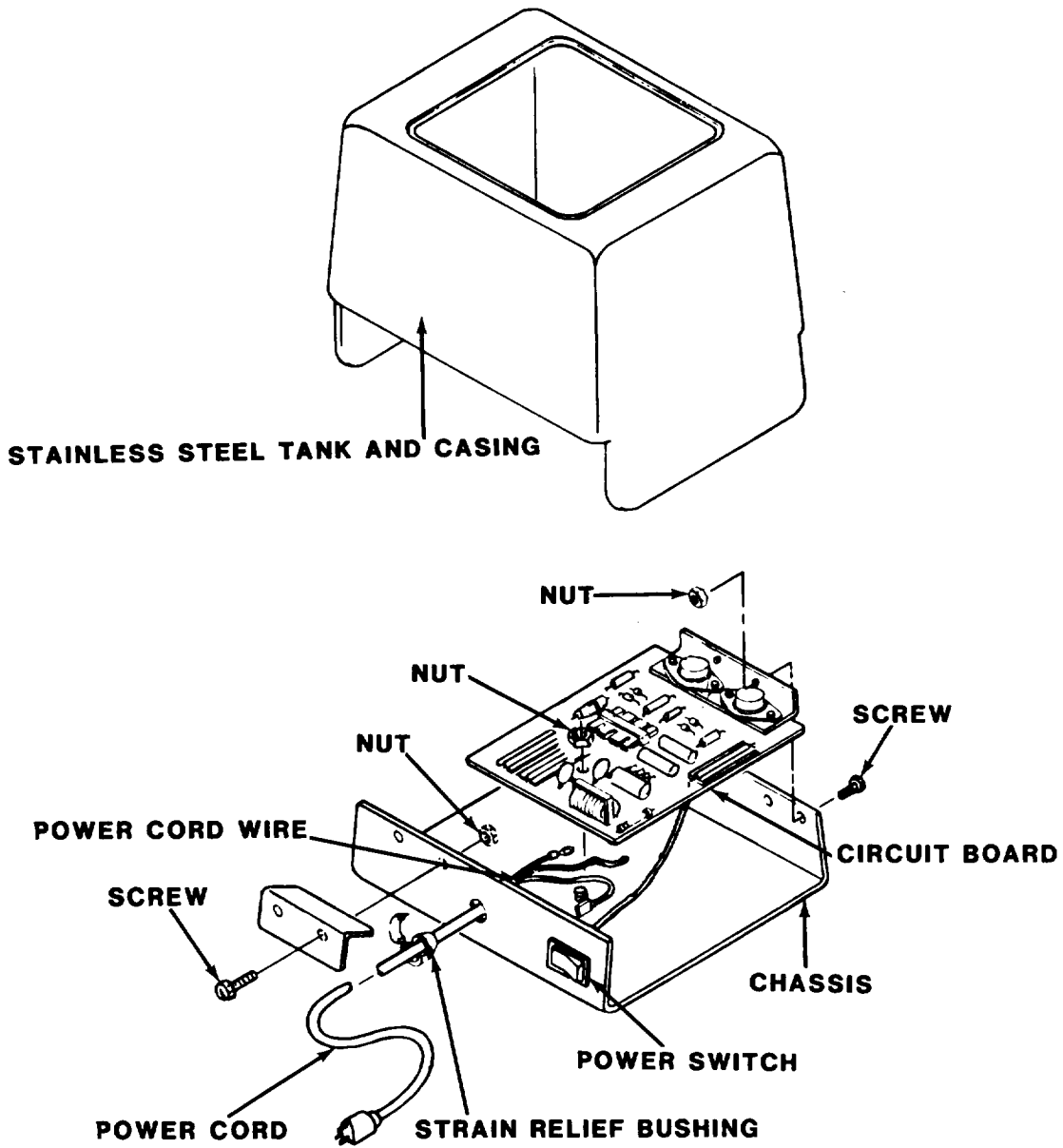
This section contains step-by-step instructions covering organizational maintenance procedures.

7-13.1 Replace Power Cord

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 3/16-in. flat-tip screwdriver

MATERIALS/PARTS: Power cord



7-13.1 Replace Power Cord - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the ultrasonic cleaner. Failure to do so may result in death or serious injury.

- a. Turn power OFF. Unplug power cord.
- b. Remove screws and nuts holding stainless steel tank and casing to chassis.
- c. Lift stainless steel tank and casing free. Set aside.

NOTE

Do not disconnect wires to transducer.

- d. Remove screws and nuts holding circuit board to chassis.
- e. Disconnect power cord wire from power switch.
- f. Disconnect power cord wire from circuit board.
- g. Remove defective power cord from chassis.
- h. Remove strain relief bushing from defective power cord.

INSTALLATION:

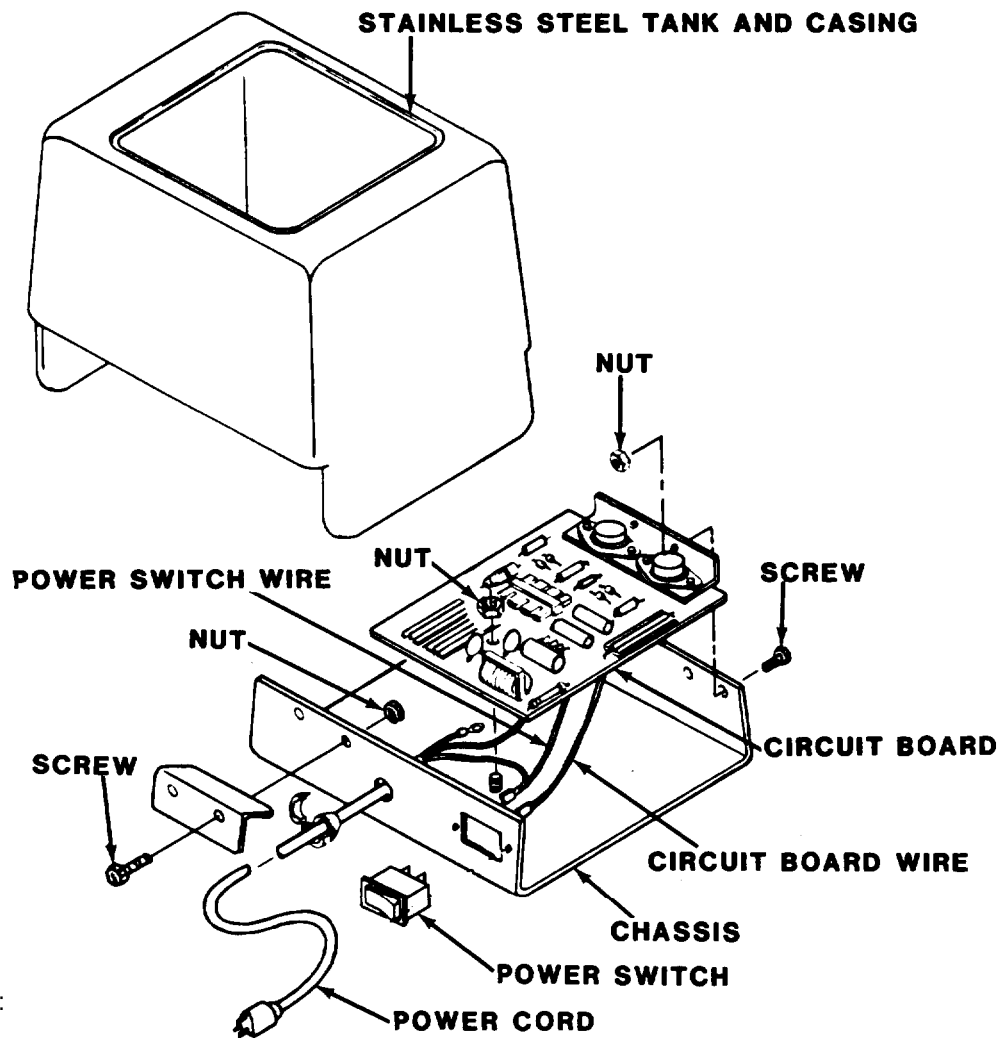
- a. Put strain relief bushing on new power cord. Put terminal ends of cord into chassis.
- b. Fit strain relief bushing into power cord hole.
- c. Reconnect power cord wire to circuit board.
- d. Reconnect power cord wire to power switch.
- e. Secure circuit board to chassis with screws and nuts.
- f. Reinstall stainless steel tank and casing. Secure with nuts and screws.
- g. Fill stainless steel tank 1/3 full with water.
- h. Plug in power cord. Turn power ON. Be sure water surface agitates.

7-13.2 Replace Power Switch

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 3/16-in. flat-tip screwdriver

MATERIALS/PARTS: Power switch



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the ultrasonic cleaner. Failure to do so may result in death or serious injury.

- a. Turn power OFF. Unplug power cord.

7-13.2 Replace Power Switch - Continued

- b. Remove screws and nuts holding stainless steel tank and casing to chassis.
- c. Lift stainless steel tank and casing free. Set aside.

NOTE

Do not disconnect wires to transducer.

- d. Remove screws and nuts holding circuit board to chassis.
- e. Tag and disconnect power cord wire from power switch.
- f. Tag and disconnect circuit board wire from power switch.
- g. Press sides of defective power switch and remove from chassis.

INSTALLATION:

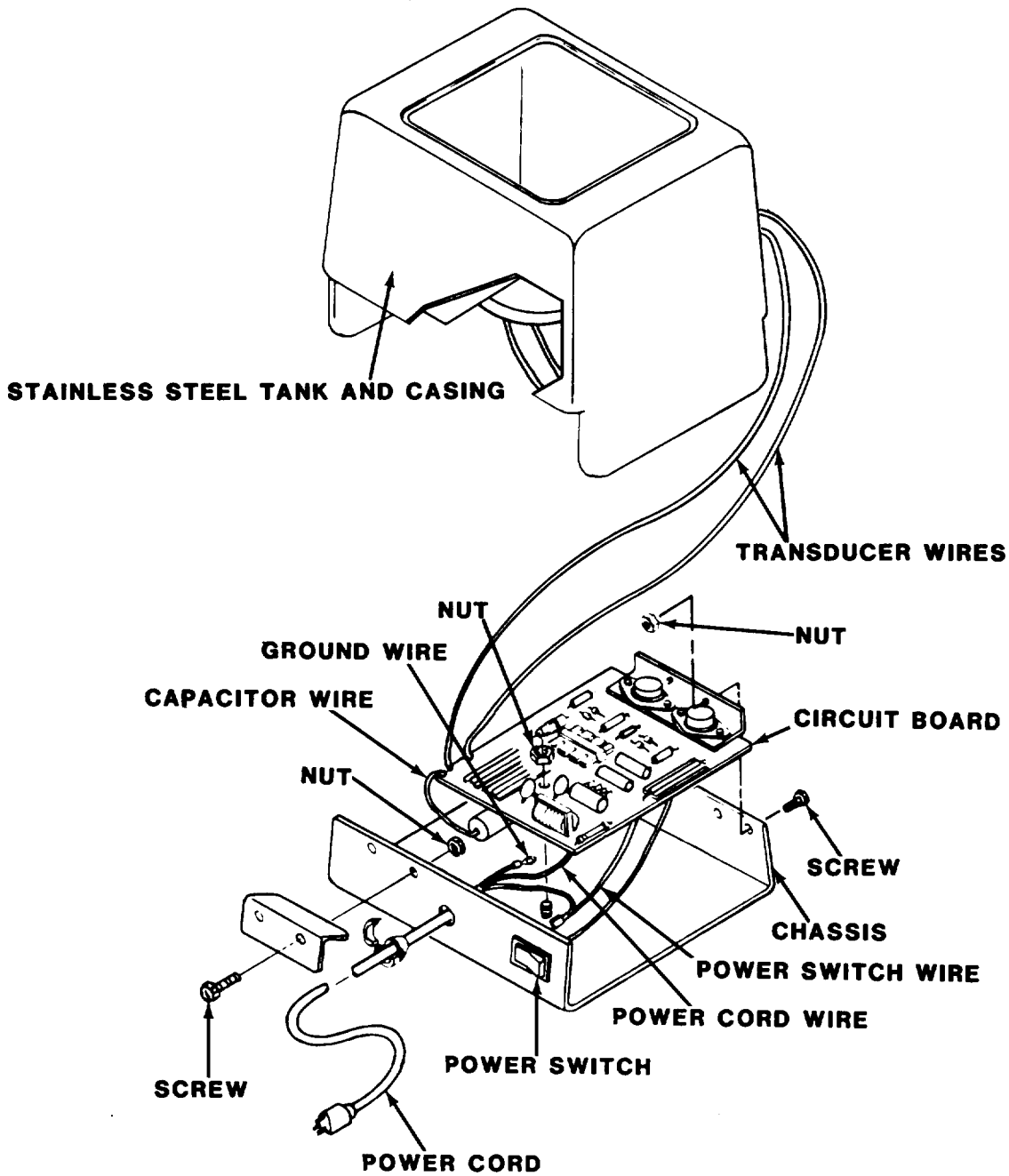
- a. Install new power switch in chassis. Push power switch until tabs lock into hole.
- b. Reconnect circuit board wire to power switch. Remove tag.
- c. Reconnect power cord wire to power switch. Remove tag.
- d. Reinstall circuit board to chassis with screws and nuts.
- e. Reinstall stainless steel tank and casing. Secure with nuts and screws.
- f. Fill stainless steel tank 1/3 full with water.
- g. Plug in power cord. Turn power ON. Be sure water surface agitates.

7-13.3 Replace Circuit Board

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 3/16-in. flat-tip screwdriver

MATERIALS/PARTS: Circuit board



7-13.3 Replace Circuit Board - Continued

REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the ultrasonic cleaner. Failure to do so may result in death or serious injury.

- a. Turn power OFF. Unplug power cord.
- b. Remove screws and nuts holding stainless steel tank and casing to chassis.
- c. Lift stainless steel tank and casing free. Set aside.
- d. Remove nuts and screws holding circuit board to chassis.
- e. Tag and disconnect power cord wire, power switch wire, and ground wire from circuit board.
- f. Disconnect capacitor wire from circuit board.
- g. Disconnect two transducer wires from circuit board.
- h. Remove defective circuit board.

INSTALLATION:

- a. Install new circuit board.
- b. Reconnect two transducer wires to circuit board.
- c. Reconnect capacitor wire to circuit board.
- d. Reconnect ground wire, power switch wire, and power cord wire to circuit board. Remove tags.
- e. Reinstall screws and nuts holding circuit board to chassis.
- f. Reinstall stainless steel tank and casing. Secure with nuts and screws.
- g. Fill stainless steel tank 1/3 full with water.
- h. Plug in power cord. Turn power ON. Be sure water surface agitates.

7-14 PREPARATION FOR STORAGE OR SHIPMENT.

In the event that the ultrasonic cleaner must be removed from the section for repair or replacement, refer to TM 740-90-1 for storage instructions.

Section V. DIRECT/GENERAL SUPPORT MAINTENANCE

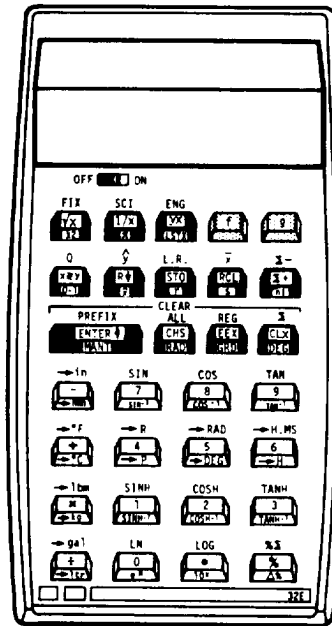
7-15 There are no assigned direct/general support maintenance tasks for this equipment.

CHAPTER 8

POCKET CALCULATOR

Section I. INTRODUCTION

8-1 GENERAL INFORMATION.



8-1.1 Scope

Model Number and Equipment Name:

Model HP-32E Pocket Calculator

Purpose of Equipment: To perform mathematical calculations.

8-2 EQUIPMENT DESCRIPTION AND DATA.

8-2.1 Equipment Characteristics, Capabilities, and Features. Performs mathematical calculations with the following capabilities and features:

- | | |
|-------------------------|----------------------------------|
| trigonometric functions | logarithmic functions |
| ten-digit display | square root |
| automatic memory stack | fixed-point display |
| | automatic overflow and underflow |

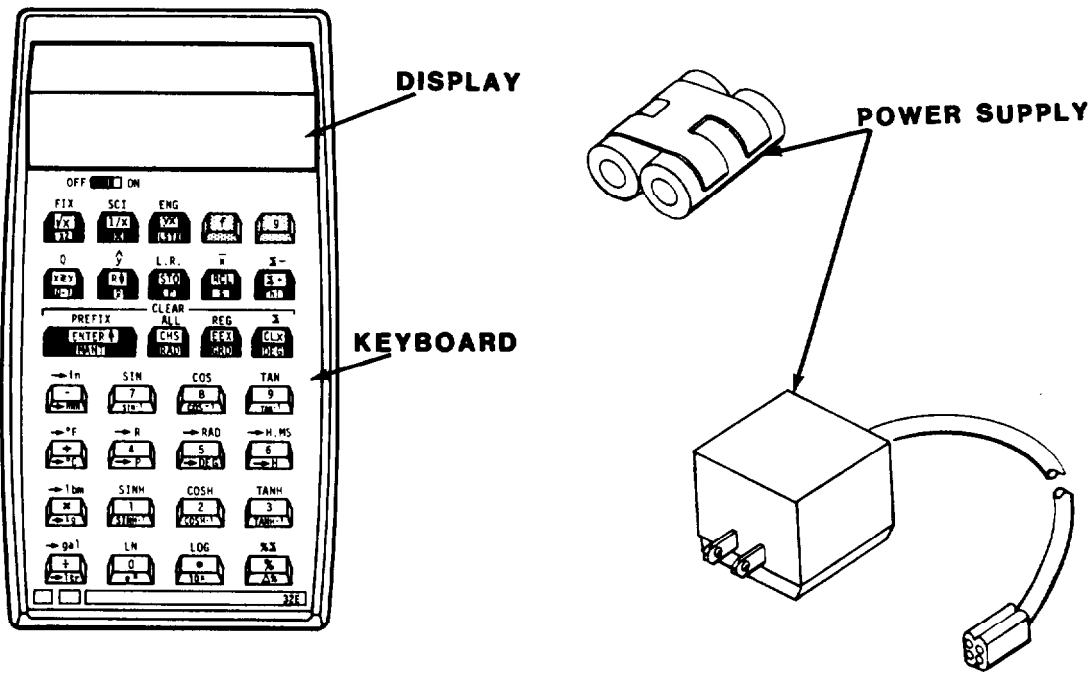
8-2.1 Equipment Characteristics, Capabilities, and Features Continued

- | | |
|---------------------------------|---------------------------|
| scientific notation | rechargeable battery pack |
| error display | ac operation |
| key selected metric conversions | 15 storage registers |
| engineering display | |

8-2.2 Equipment Data

- | | |
|--------------------|--|
| Power requirements | 120 vat, 60 Hz |
| Battery pack | |
| Recharge time | 9 hours, min
(calculator OFF)
17 hours, max
(calculator ON) |
| Operating time | 3 hours |

8-3 TECHNICAL PRINCIPLES OF OPERATION. The purpose of the HP-32E calculator is to assist its user in the performance of complex or simple mathematical equations. Consists of the following functional parts: power supply, keyboard, display, and memory.



8-3.1 Power Supply. Power is provided to the calculator from either the battery pack or ac adapter/recharger. The battery pack consists of two rechargeable nickel-cadmium batteries which give the calculator full portability. The ac adapter/recharger also provides power to the calculator when plugged into a power outlet. When battery pack is in need of recharging, a raised decimal is turned on at the far left of the display. When raised decimal is displayed, there are between 1 and 25 minutes of operating time left.

8-3.2 Keyboard. The keyboard is used to select functions and input numbers into the calculator. All keys, except q and q keys, perform three functions. One function is indicated by the symbol on the flat surface of the key, a second by the symbol on the slanted key face, and a third by the symbol written above the key on the calculator case. Function printed on the flat face of the key is selected by pressing the key. The function printed on the slanted face of the key is selected by first pressing prefix key q and then the function key. Function printed above the key is selected by first pressing prefix key q and then the function key.

8-3.3 Display. The display is the X-register of the automatic memory stack and provides a visual readout of latest numeric entry, operation result, or error message.

8-3.4 Memory. Memory is divided into two parts; storage registers and automatic memory stack.

8-3.4.1 Storage registers. Storage registers are used to set aside numbers for recall in later calculations. Numbers are stored by first pressing **STO** followed by a number **0** through **5** or a decimal point and a number **0** through **5**. The number in displayed X-register is then copied into the selected register. Recalling a number is accomplished by first pressing **RCL** followed by a number **0** through **8** or a decimal point and a number **0** through **5**. The number that is in the selected register will be copied into the displayed X-register without any change to contents of that register. Storage registers R.0 through R.5 are used for accumulation of statistical data. Turning calculator OFF will clear (place zeros in) all storage registers.

8-3.4.2 Automatic Memory Stack. The automatic memory stack is used to store intermediate results during calculations. The stack consists of four registers designated X, Y, Z, and T. The contents of X-register are constantly shown on the calculator display. Numbers are manually entered into memory stack by pressing **ENTER**. During chain calculations (long equations), intermediate answers are automatically entered in the memory stack. Each new entry into the stack is first entered in the X-register and, with each additional entry, the stack rolls up one and the contents that were in the T-register before roll-up, are lost. The contents of the

8-3.4.2 Automatic Memory Stack - Continued

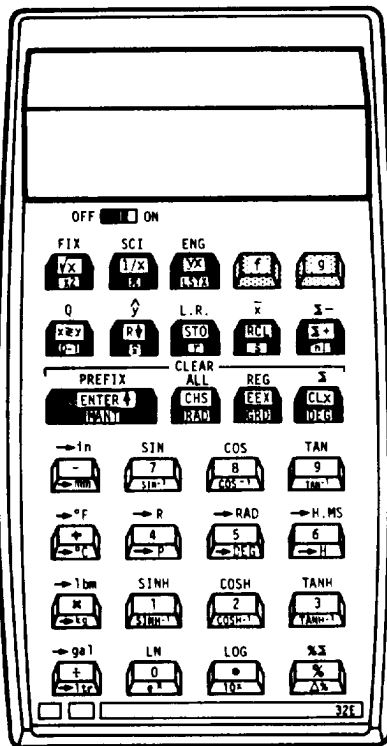
stack can be viewed by press ing **RCL** key four times. The contents of T-register are not lost because the stack forms a continuous loop, i.e., the contents of T-register are shifted to Z-register; Z-register to Y-register; Y-register to X-register; and X-register to T-register. With intermediate answers stored in the stack, operations can be performed with these numbers by pressing the key of the desired operation.

Example: To calculate $(3 \times 5) + 2$, press:

- (1) q (3 enters X-register)
- (2) **ENTER** (3 is copied to Y-register)
- (3) **5** (5 is entered in X-register; 3 stays in Y-register)
- (4) **X** (5 is multiplied by 3; result, 15, is placed in X-register; Y-register becomes 0)
- (5) **2** (15 moves to Y-register; 2 enters X-register)
- (6) **+** (15 added to 2; result, 17, is placed in X-register; Y-register becomes 0).

Section II. OPERATING INSTRUCTIONS

8-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS.



8-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

NOTE

Symbols on flat surface and slanted surface of keys are boxed. Symbols over keys are not boxed.

Key	Control or Indicator	Function
OFF ON	Power Switch	Turns power ON or OFF.
f	Function	Pressed before another key, it selects function printed above key.
g	Function	Pressed before another key, it selects function printed on slanted face of key.
PREFIX	Clear Prefix	<p>Cancels the following key strokes or sequence of key strokes when pressed after each one: f, g, STO, RCL, STO, ., RCL, ., STO, +, STO, -, STO, C, STO, ÷, STO, +, ., STO, -, ., STO, X, ., STO, ÷, ., FIX, SCI, ENG.</p>

DIGIT ENTRY

0 through 9	Digit Keys	Enter digits.
.	Decimal Point	Enters decimal point.
ENTER ↓	Digit Enter	Enters copy of number displayed X-register into Y-register of automatic memory stack. Pressing key also causes contents of Y-register to be shifted to Z-register and Z-register to the T-register. Contents of T-register are lost.
CHS	Change Sign	Changes sign of mantissa or exponent in display (X-register).

8-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
DISPLAY CONTROL		
EE	Enter exponent	After pressing, next numbers keyed in are exponents of 10.
FIX	Fixed Point	Followed by digit key, selects fixed point notation display. Digit entry designates number of digits to be displayed to the right of decimal point.
SCI	Scientific	Followed by digit key, selects scientific notation display. Digit key specifies number of digits to be displayed to right of decimal point.
ENG	Engineering	Followed by digit key, selects engineering notation display. Digit key specifies number of digits to be displayed to right of decimal point.
MANT	Mantissa	Temporarily displays all 10 digits of mantissa of number in X-register.

NUMBER MANIPULATION

X ↔ Y	Exchange Register	Interchanges contents of X- and Y-registers.
R↓	Roll down	Rolls down contents of automatic memory stack for viewing in X-register without loss of data. When pressed, contents of X-register is shifted to T-register, T-register shifts to Z-register, Z-register shifts to Y-register, and Y-register advances to X-register for viewing.





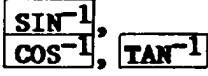




8-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
NUMBER MANIPULATION - Continued		
CLX	Clear X	Clears contents of displayed X-register.
ALL	Clear All	Clears contents of memory stack and all storage registers.
STO	Store	Followed by digit key 0 through 8 or by a decimal point and a digit key 0 through 5 , stores displayed number in that specified location. Also used to perform storage register arithmetic.
RCL	Recall	Followed by digit key 0 through 8 or by a decimal point and a digit key 0 through 5 , recalls value from specified storage register into displayed X-register.
REG	Clear Register	Clears contents of storage registers R ₀ through R ₈ . Contents of registers R ₀ through R ₅ are unaffected.
LSTX	Last X	Recalls number displayed before previous operation back into displayed X-register.
STATISTICAL		
Q	Distribution	Computes area under standard normal distribution curve to left of X.
Q-1	Distribution	Computes X, given area under standard normal distribution curve to left of X.

8-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
STATISTICAL - Continued		
\hat{y}	Linear Estimate	Computes estimated value of Y for a given value of X.
\hat{x}	Linear Estimate	Computes estimated value of X for a given value of Y.
L.R.	Linear Regression	Computes Y-intercept and slope for linear function approximated by X and Y values accumulated using $\Sigma+$. Value of slope is placed in Y-register.
r	Correlation Coefficient	Computes goodness of fit between X and Y values accumulated using $\Sigma+$ and linear function which they approximate.
\bar{x}	Mean	Computes mean (average) of X and Y values accumulated using $\Sigma+$.
s	Standard Deviation	Computes standard deviation of X and Y values accumulated using $\Sigma+$.
$\Sigma+$	Summation	Accumulates statistical data in storage registers R.0 through R.5 using numbers in X- and Y-registers.
$\Sigma-$	Summation Minus	Subtracts from statistical data in storage registers R.0 through R.5 using numbers in X- and Y-registers.
Σ	Clear	Clears statistical storage registers R.0 through R.5.
$n!$	Factorial	Computes n. (n-1) ...3.2.1 where n is number in X-register.











8-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
MATHEMATICAL		
	Square root	Computes square root of number in displayed X-register.
	Square	Computes square of number in displayed X-register.
	Reciprocal	Computes reciprocal of number displayed in X-register.
	Pi	Places value of (3.141592654) into X-register.
SIN, COS, TAN	Sine, Cosine, Tangent	Computes sine, cosine, or tangent of number in displayed X-register.
	Arc Sine, Arc Cosine, Arc Tangent	Computes arc sine, arc cosine, or arc tangent of number in displayed X-register.
	Radians	Sets radians mode for all trigonometric functions.
	Grads	Sets grads mode for all trigonometric functions.
	Degree	Sets decimal degrees mode for all trigonometric functions.
→RAD	To radians	Converts decimal degrees to radians.
	To degrees	Converts radians to decimal degrees.
→H.MS	Hours. Minutes Seconds	Converts decimal hours or degrees to hours, minutes, seconds, or degrees, minutes, seconds.

8-4 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
→H	To Decimal Hours or Degrees	Converts hours, minutes, seconds, or degrees, minutes, seconds to decimal hours or degrees.
SINH, COSH, TANH	Hyperbolic Sine, Cosine and Tangent	Computes hyperbolic sine, hyperbolic cosine, or hyperbolic tangent of number in displayed X-register.
SINH-1 , COSH-1 , TANH-1	Inverse Hyperbolic Sine, Cosine, Tangent	Computes inverse hyperbolic sine, inverse hyperbolic cosine, or inverse hyperbolic tangent of number in displayed X-register.
LOGARITHMIC AND EXPONENTIAL		
y^x	Exponent	Raise number in Y-register to power of number in displayed X-register.
LN	Natural Logarithm	Computes natural logarithm (base e) of number in displayed X-register.
e^x	Natural Antilogarithm	Raise e to power of number in displayed X-register.
LOG	Common Logarithm	Computes common logarithm (base 10) of number in displayed X-register.
10^x	Common Antilogarithm	Raises 10 to power of number in displayed X-register.
→P	To Polar	Converts rectangular (X, Y) or coordinates in X- and Y-registers into polar (r, 0) coordinates. Angle 0 stored in Y-register.
→R	To Rectangular	Converts polar (r, 0) coordinates in X- and Y-registers into rectangular (X, Y) coordinates.

8-4 DESCRIPTION MD USE OF OPERATOR'S CONTROLS AND INDICATORS - Continued

Key	Control or Indicator	Function
METRIC CONVERSIONS		
→in	To Inches	Converts millimeters to inches.
	To Millimeters	Converts inches to millimeters.
→°F	To Fahrenheit	Converts degrees Celsius to degrees Fahrenheit.
	To Celsius	Converts degrees Fahrenheit to degrees Celsius.
lbm	To Pounds Mass	Converts kilograms to pounds mass.
	To Kilograms	Converts pounds mass to kilograms.
→gal	To Gallons	Converts liters to gallons (U.S.).
	To Liters	Converts gallons (U.S.) to liters.
PERCENTAGE		
	Percent	Computes X-percent of Y.
	Percent Difference	Computes percent difference between number in Y-register and number in X-register.
X Σ	Percent Summation	Computes percent that X is of the number (x) in storage register R.1.
ARITHMETIC FUNCTIONS		
	Addition	Arithmetic functions
	Subtraction	
	Multiplication	
	Division	

8-5 OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

8-5.1 General. The pocket calculator must be regularly inspected to find and correct defects.

8-5.1.1 Before you Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your BEFORE (B) PMCS.

8-5.1.2 While You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your DURING (D) PMCS.

8-5.1.3 After You Operate. Be sure to perform your AFTER (A) PMCS.

8-5.1.4 If Your Equipment Fails To Operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

8-5.2 PMCS Procedures

8-5.2.1 PMCS are designed to keep the equipment in good working condition by performing periodic service tasks.

8-5.2.2 Service intervals provide you, the operator, with time schedules that determine when to perform specified service tasks.

8-5.2.3 The Equipment Is Not Ready/Available If" column is used for identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.

8-5.2.4 If your equipment fails to operate after PMCS is performed, immediately report this condition to your supervisor.

8-5.3 PMCS Columnar Entries

8-5.3.1 Item Number Column. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for your "TM number" Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.

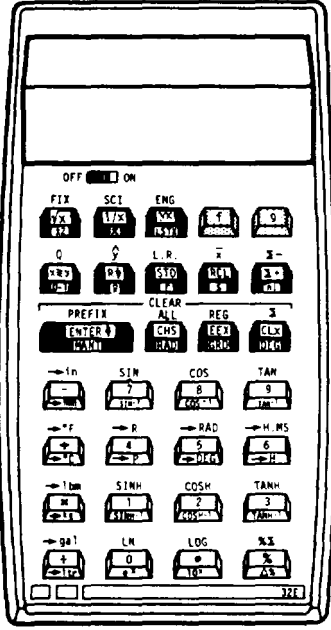
8-5.3.2 Interval Column. This column determines the time period designated to perform your PMCS.

8-5.3.3 Item To Be Inspected and Procedures Column. This column lists functional groups and their respective assemblies and subassemblies as shown in the Maintenance Allocation Chart (Appendix B). The appropriate check or service procedure follows the specific item to be inspected.

8-5.3.4 Equipment Is Not Ready/Available If: Column. This column indicates the reason or cause why your equipment is not ready/available to perform its primary mission.

Table 8-1. Operator Preventive Maintenance Checks and Services

B - Before Operation

Item No.	Interval	ITEM TO BE INSPECTED	Equipment Is Not Ready/Available If:
	B	PROCEDURE	
			POCKET CALCULATOR
1	●	<p>HP-32 POCKET CALCULATOR. Check keyboard, display, and casing for cracks or breaks. Replace calculator if casing or display is cracked or broken.</p> <p>Connect ac adapter/recharger to calculator and plug in. Turn calculator ON. Press STO and ENTER. Display should indicate -8, 8, 8, 8, 8, 8, 8, 8, 8, 8.</p>	<p>Calculator keyboard, display, or casing is damaged.</p> <p>Display does not show -8 8 8 8 8 8 8 8 8 8</p>
2	●	<p>BATTERY PACK. With battery pack in calculator, check operation to be sure calculator turns on. Remove battery pack and check for clean contacts. Wipe clean. Reinstall battery pack.</p>	<p>Battery pack is defective.</p>
3	●	<p>POWER CORD. Check power cord for kinks, frays, or bums.</p>	<p>Power cord is damaged.</p>

8-6 OPERATION UNDER USUAL CONDITIONS.8-6.1 Selecting a Function**NOTE**

Most keys on the keyboard perform three functions. One function is indicated by symbol on top of key, second is above key, and third is on slanted face of key.

- a. To select a function printed on the key, press the key.
- b. To select a function printed above the key, press key **f**, then function key.

Example: To use **LOG** in calculation, press: **f** then LOG.

- c. To select a function printed on slanted face of key, press **g** then function key.

Example: To use **x²** in calculations, press: **g** then **x²**.

8-6.2 Keying in Numbers

- a. Press keys corresponding to digits and decimal point in order that they appear, reading from left to right.
- b. If needed, press **CHS** to make number negative.

8-6.3 One-Number Functions

- a. Key in number on which operation is to be performed.
- b. Select desired function. Press key.

Example: To calculate square root of 5, press **5** and **√x**.

Answer is 2.2361.

8-6.4 Two-Number Functions

- a. Key in first number.
- b. Press **ENTER ↓** to separate first number from second number.
- c. Key in second number.

8-6.4 Two-Number Functions - Continued

d. Select desired function. Press key.

Example: To calculate 5 percent of 35, press **3**, **5**,
ENTER, **5**, and **%**. Answer is 1.75.

8-6.5 Exponent Key Y

NOTE

Exponent key is a two-number function.

- Key in number for Y. Press **CHS** if it is negative.
- Press **ENTER** to send number to Y register in automatic memory stack.
- Key in number for X (exponent for Y). Press **CHS** if it is negative.
- Press **y^x** key.

Example: To calculate 5^3 , press **5**, **ENTER**, **3**, and
y^x

Answer is 125.

8-6.6 Chain Calculations

NOTE

Calculator uses reverse polar notation (RPN) logic for chain calculations.

- If equation has parenthetical expressions, key in numbers and perform function in first parenthesis. press **ENTER**, key in second number, and press function key for that operation.
- Key in numbers and perform function in second parenthesis. Key in first number, press **ENTER**, key in second number, then press function key for that operation.

8-6.6 Chain Calculations - Continued

c* Press function key for operation indicated between parentheses.

Example: To calculate $(3 \times 4) \times (5 + 6)$, press

- (1) $\boxed{3}$, $\boxed{\text{ENTER}\downarrow}$, $\boxed{4}$, and $\boxed{\times}$
- (2) $\boxed{5}$, $\boxed{\text{ENTER}\downarrow}$, $\boxed{6}$, and $\boxed{+}$
- (3) $\boxed{\times}$; answer is 132.

8-6.7 Operations with Powers of 10

- a. Key in number being multiplied by power of 10. Press **CHS** if number is negative.
- b. Press $\boxed{\text{EE}\times}$.
- c. Key in exponent (power) of 10. Press **CHS** if exponent is negative.
- d. Press $\boxed{\text{ENTER}\downarrow}$ and key in exponent.
- e. Press $\boxed{\times}$

Example: To multiply 12.5×10^6 by 6 press

- (1) $\boxed{1}$, $\boxed{2}$, $\boxed{\cdot}$, $\boxed{5}$, $\boxed{\text{EE}\times}$, and $\boxed{6}$
- (2) $\boxed{\text{ENTER}\downarrow}$, $\boxed{6}$, and $\boxed{\times}$; answer is 75×10^6 .

8-6.8 Storage (Memory) Register Arithmetic

NOTE

This procedure performs two-number arithmetic function on number stored in storage register. The displayed X-register is the second number.

- a. Press **STO**
- b. Press appropriate function key $\boxed{+}$, $\boxed{-}$, $\boxed{\times}$, or $\boxed{\div}$.
- c. Press q through q or, $\boxed{\cdot}\boxed{0}$ through $\boxed{\cdot}\boxed{5}$, indicating on which register function will be performed.

Example: Pressing $\boxed{\text{STO}}$, $\boxed{\times}$, and $\boxed{1}$ multiplies value of (displayed) X-register by contents of storage (memory) register 1. The answer is placed into storage (memory) register 1.

NOTE

Value of X-register will not be changed.

8-6.9 Clearing Storage (Memory) Register.

- a. To clear single storage (memory) register, press **0** , **STO** , and location of register to be cleared.

Example: To clear register 2, press **0** , **STO** , and **2** .

- b. To clear registers 0 through 8, press **f** and **REG**. To clear registers .0 through .5, press **f** and **.** . To clear all registers (including the automatic memory stack) press **f** and **ALL**.

8-6.10 Trigonometric Functions

- a. Enter or calculate value of X, number on which trigonometric function is to be performed.
- b. Press **g** key.
- c. Press **DEG**, **RAD**, or **GRD** to select measurement for answer (degrees, radians, or grads).
- d. Press **f** key.
- e. Press needed function (**SIN**, **COS**, **TAN**) key.

Example: To calculate sine 35°, press **3** , **5** , **g** , **DEG** , **f** , and **SIN**. Answer is 0.5736.

8-6.11 Polar/Rectangular Coordinate Conversion8-6.11.1 Convert from Rectangular (X, Y) to Polar Coordinates.**NOTE**

Value for Y is always keyed in first.

- a. Key in value of Y.
- b. Press **|ENTER|**.
- c. Key in value of x.
- d. Press **g** then key in **DEG**, **RAD**, or **GRD** to select measurement for answer (degrees, radians, or grads).
- e. Press **g** and **→P** to get R (magnitude). Press **X↔Y** to get angle in radians.

8-6.11.1 Convert from Rectangular (X, Y) to Polar Coordinates - Continued

Example: To convert rectangular coordinates 4, 3 to polar with angle in radians, press

- (1) $\boxed{3}$, $\boxed{\text{ENTER}}$, and $\boxed{4}$
- (2) \boxed{g} and $\boxed{\text{RAD}}$
- (3) \boxed{g} and $\boxed{\rightarrow P}$; answer is 5.
- (4) $\boxed{X \leftrightarrow Y}$; answer is .64.

8-6.11.2 Convert from Polar to Rectangular Coordinates

- a. Key in angle in radians.
- b. Press $\boxed{\text{ENTER}}$.
- c. Key in value of R (magnitude).
- d. Press \boxed{g} then key in $\boxed{\text{DEG}}$, $\boxed{\text{RAD}}$, or $\boxed{\text{GRD}}$ to select measurement of angle (degrees, radians, or grads).
- e. Press \boxed{f} , $\boxed{\rightarrow R}$ to get X. Press \boxed{X} to get Y.

Example: To convert polar coordinates 5 and .64 to rectangular, press

- (1) $\boxed{.}$, $\boxed{6}$, $\boxed{4}$, $\boxed{\text{ENTER}}$, and $\boxed{5}$
- (2) \boxed{g} and $\boxed{\text{RAD}}$
- (3) \boxed{f} and $\boxed{\rightarrow R}$; answer is 4.01.
- (4) $\boxed{X \leftrightarrow Y}$; answer is 2.986.

8-6.12 Statistical Functions

8-6.12.1 Accumulations

- a. Pressing $\boxed{\Sigma+}$ key computes sums and products of the values in the X- and Y-registers. Results are automatically accumulated in storage registers R.0 through R.5. Before starting to calculate accumulations with a new set of x and y values, clear registers by pressing \boxed{f} and $\boxed{\Sigma}$
 - (1) Key y value into X-register.
 - (2) Press $\boxed{\text{ENTER}}$ to raise y value into Y-register.
 - (3) Key x value into X-register.
 - (4) Press $\boxed{\Sigma+}$.

8-6.12.1 Accumulations - Continued

b. If statistical problem involves only one variable (x), clear storage registers R.

f , **Σ** , and **ENTER↓** .

(1) Key number into X-register.

(2) Press **Σ+** .

NOTE

Unlike storage register arithmetic, the accumulation operation allows overflows (i.e., number whose magnitudes are greater than 9.99999999×10^9) in storage registers R.0 through R.5 without indicating Error 1 in the display.

c. To use any of the accumulations, recall contents of desired storage register into displayed X-register by pressing **RCL** q followed by the number of the register. If this is done immediately after pressing **Σ+** or **Σ-** , the accumulation recalled is written over the number of data pair entries (n) in the display.

To use both **Σx** and **Σy** , press **RCL** **Σ+** . This simultaneously copies **Σx** from R.1 into displayed X-register and copies **Σy** from R.3 into Y-register. If this is done immediately after pressing **Σ+** , **Σ-** , **CLX** , or **ENTER↓** , the number in the Y-register is first lifted into Z-register. Otherwise, the numbers in the X- and Y-registers are first lifted into Z- and T-registers, respectively.

Example: To find **Σx**, **Σx²**, **Σy**, **Σy²**, and **Σxy** for the paired values of x and y listed below, press

y	7	5	9
x	5	3	8

Keystrokes

Display

f

0.0000

Clear statistical storage registers. (Display shown assumes no results remain from previous calculations.)

7 **ENTER↓**

7.0000

8-6.12.1 Accumulations - Continued

<u>Keystrokes</u>	<u>Display</u>	
5	1.0000	First pair is accumulated; n = 1
5 ENTER	5.0000	
3	2.0000	Second pair is accumulated; n = 2
9 ENTER	9.0000	
8	3.0000	Third pair is accumulated; n = 3
RCL . 1	16.0000	Sum of x values from register R.1
RCL . 2	98.0000	Sum of squares of x values from register R.2
RCL . 3	21.0000	Sum of y values from register R.3
RCL . 4	155.0000	Sum of squares of y values from register R.4
RCL . 5	122.0000	Sum of products of x and y values from register R.5
RCL . 0	3.0000	Number of entries (n = 3) from register R.0

8-6.12.2 Deleting and Correcting Data.

- a. If an incorrect value is keyed in and $\Sigma+$ has not yet been pressed, press **CLX** and key in correct value.
- b. To change one of the values, or if after pressing $\Sigma+$ one of the values was erroneous, correct the accumulations by using $\Sigma-$ (summation minus) key as follows:
 - (1) Key incorrect data pair into X- and Y-registers. **LSTX** can be used to return a single incorrect data value to displayed X-register.
 - (2) Press **f** $\Sigma-$ to delete incorrect data.
 - (3) Key in correct values for x and y. If one value of an (x, y) data pair is incorrect, both values must be deleted and reentered.

8-6.12.2 Deleting and Correcting Data - Continued

(4) Press $\Sigma+$

Example: If last data pair (8, 9) in previous example (para 8-6.12.1) should have been (8, 6), correct the accumulation as follows, press

<u>Keystrokes</u>		<u>Display</u>	
9	ENTER	9.0000	Incorrect y value is entered again.
8		8.	Correct x value is entered again.
f		2.0000	Number of entries (n) is now two.
6	ENTER	6.0000	Correct y value is entered.
8		8.	x value is entered again.
		3.0000	Number of entries is again three.

8-6.12.3 Mean. Pressing \hat{x} computes the arithmetic mean (average) of x and y values accumulated in registers R.1 and R.3, respectively.

- a. Pressing **f** \hat{x} causes the following operations to be performed:
- (1) The contents of the stack registers are lifted just as they are when pressing **RCL**.
 - (2) The mean of the x values (\hat{x}) is calculated using data accumulated in registers R.1 (Σx) and R.0 (n). The resulting value for x appears in displayed X-register.
 - (3) The mean of y values (\hat{y}) is calculated using data accumulated in registers R.3 (Σy) and R.0 (n).
 - (4) The resulting value for y is available in Y-register of stack.

Example: Below is a chart of daily high and low temperatures for a winter week. To find average high and low temperatures for week selected, press

	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
High	6	11	14	12	5	-2	-9
Low	-22	-17	-15	-9	-24	-29	-35

8-6.12.3 Mean - Continued

<u>Keystrokes</u>	<u>Display</u>	
f	0.0000	Statistical registers cleared. (Display shown assumes no results remain from previous calculations.)
6 ENTER 2 2	22.	
CHS Σ+	1.0000	Number of data pairs (n) is now 1.
1 1 ENTER 1 7	17.	
CHS Σ+	2.0000	Number of data pairs (n) is now 2.
1 4 ENTER	15.	
CHS Σ+	3.0000	
1 2 ENTER 9	9.	
CHS Σ+	4.0000	
5 ENTER 2 4	24.	
CHS Σ+	5.0000	
2 CHS ENTER	-2.0000	
2 9 CHS Σ+	6.0000	
9 CHS ENTER	-9.0000	
3 5 CHS Σ+	7.0000	Number of data pairs (n) is now 7.
f Σ	-21.5714	Average low temperature.
x ≥ y	5.2857	Average high temperature.

8-6.12.4 Standard Deviation

- a. Pressing **s** computes the standard deviation (a measure of dispersion around the mean) of accumulated data.
- b. When **g** **s** is pressed:
 - (1) The contents of stack registers are lifted just as they are when pressing **RCL**

8-6.12.4 Standard Deviation

- (2) The standard deviation of x values (s_x) is calculated using data accumulated in registers R.2 (Σx), R.1 (Σx^2), and R.0 (n). The result appears in displayed X-register.
- (3) The standard deviation of y values (s_y) is calculated using data accumulated in registers R.4 (y^2), R.3 (y), and R.0 (n). The result appears in Y-register.

Example: To determine the standard deviation of the following test scores: 79, 94, 68, 86, 82, 78, 83, and 89, press

<u>Keystrokes</u>	<u>Display</u>	
f ALL	0.0000	Clear statistical registers and Y-register for new, one-variable problem.
7 9	1.0000	First score is entered. Since this problem involves only one variable, y-value does not have to be entered into Y-register using the ENTER key.
9 4	2.0000	Display shows number of scores entered so far.
6 8	3.0000	
8 6	4.0000	
8 2	5.0000	
7 8	6.0000	
8 3	7.0000	
8 9	8.0000	Last score in sample.
g s	7.8365	Standard deviation of test scores.

8-6.12.5 Linear Regression. Linear regression is a statistical method for finding a straight line that best fits a set of data points, thus providing a relationship between two variables.

- a. To use the linear regression function, first key in a series of data points using the Σ key. Then press **f** **LN**.

8-6.12.5 Linear Regression - Continued

b. When **f** L.R. is pressed:

- (1) The contents of the stack registers are lifted just as they are when you press **RCL $\Sigma+$** .
- (2) The slope (A) of the least squares line of the data is available in the Y-register of the stack.
- (3) The y-intercept (B) of the least squares line of the data appears in the displayed X-register of the stack.

c. To use value for A or to bring it into displayed X-register, simply shift stack contents with the **x \rightrightarrows y** key.

Example: An oil company wishes to know the slope and y-intercept of a least squares line for the consumption of motor fuel in the United States against time since 1945. It knows the data given in the table.

Motor Fuel Demand (Millions of Barrels)	696	994	1330	1512	1750	2162	2243	2382	2484
Year	1945	1950	1955	1960	1965	1970	1971	1972	1973

Solution: Key the data into the calculator using the **$\Sigma+$** key, then press **f** L.R. and press

<u>Keystrokes</u>	<u>Display</u>	
f $\Sigma+$	0.0000	Clear statistical storage registers. (Display shown assumes no results remain from previous calculations.)
6 9 6 ENTER \downarrow	696.0000	
1 9 4 5	1.0000	
9 9 4 ENTER \downarrow	994.0000	
1 9 5 0	2.0000	
1 3 3 0 ENTER \downarrow	1,330.0000	

8-6.12.5 Linear Regression - Continued

1 9 5 5	3.0000
1 5 1 2 ENTER ↓	1,512.0000
1 9 6 0	4.0000
1 7 5 0 ENTER ↓	1,750.0000
1 9 6 5	5.0000
2 1 6 2 ENTER ↓	2,162.0000
1 9 7 0	6.0000
2 2 4 3 ENTER ↓	2,243.0000
1 9 7 1	7.0000
2 3 8 2 ENTER ↓	2,382.0000
1 9 7 2	8.0000
2 4 8 4 ENTER ↓	2,484.0000
1 9 7 3	9.0000
f L.R.	-118,290.6294
x	61.1612

All data pairs have been keyed in.
 The y-intercept of the line.
 Slope of the line.

8-6.12.6 Linear Estimation. With data accumulated in registers R.0 through R.5, a predicted value for y (denoted y) can be calculated by keying in a new value for x and pressing **f** **y**. A predicted value for x (denoted x) can be calculated by keying in a new value for y and pressing **g**

Example: With data intact from previous example in registers R.0 through R.5, to predict demand for motor fuel for the years 1980 and 2000, key in new x values and press **f**. To determine the year that the demand for motor fuel is expected to pass 3,500 million barrels, key in 3,500 (new value for y) and press **g**

Keystrokes Display

1**9****8****0** **f** **y** 2,808.6264

Predicted demand in millions of barrels for the year 1980.

8-6.12.6 Linear Estimation - Continued

<u>Keystrokes</u>	<u>Display</u>	
2 0 0 0 f ↗	4,031.8512	Predicted demand in millions of barrels for the year 2000.
3 5 g ↗	1,991.3041	The demand is expected to pass 3,500 million barrels during 1992.

8-6.12.7 Correlation Coefficient. Both linear regression and linear estimation presume that the relationship between x and y data values can be approximated, to some degree, by a linear function (a straight line). r (correlation coefficient) can be used to determine how closely the data "fits" a straight line. The correlation coefficient can range from $r = 1$ to $r = -1$. At $r = 1$, data falls exactly onto a straight line with positive slope. While at $r = -1$, data falls exactly onto a straight line with negative slope. At $r = 0$, data cannot be approximated by a straight line.

Example: To calculate the correlation coefficient for previous example (para 8-6.12.6) press

<u>Keystrokes</u>	<u>Display</u>	
g r	0.9931	The data very closely approximates a straight line.

Section III. OPERATOR MAINTENANCE

8-7 LUBRICATION INSTRUCTIONS.

This equipment does not need lubrication.

8-8 OPERATOR TROUBLESHOOTING PROCEDURES.

8-8.1 General

8-8.1.1 The table lists the common malfunctions which you may find during the operation or maintenance of the pocket calculator. You should perform the tests/inspections and corrective actions in the order listed.

8-8.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 8-2. Operator Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
1. CALCULATOR DISPLAY IS BLANK.		<p>Step 1. Plug in ac adapter/recharger. Turn calculator ON.</p> <p>If display of zeros comes on, go to step 2.</p> <p>If display is blank, replace adapter/recharger.</p> <p>If problem remains, replace calculator.</p> <p>Step 2. Check for raised decimal point at far left corner of display. Indicates low power condition.</p> <p>If indicator is on, go to step 3.</p> <p>If indicator is off, recharge battery pack.</p> <p>Step 3. Check to see if contacts are dirty.</p> <p>Clean contacts on inside of calculator and battery pack with cotton swab (item 18, appendix E) moistened with alcohol.</p> <p>Replace battery pack. Open battery pack door. Remove defective battery pack. Install new battery pack. Match positive contact to positive, and negative contact to negative.</p> <p>Reinstall battery pack door.</p>
2. CALCULATIONS OR DISPLAY ERRATIC.		<p>Step 1. Check for raised decimal point at far left corner of display. Indicates low power condition.</p> <p>Recharge battery pack.</p> <p>Replace battery pack (malfunction 1, step 3).</p> <p>Replace calculator.</p>

Table 8-2. Operator Troubleshooting - Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 2. Press **STO** and **ENTER↓** to see if display shows -88888888, not ERROR 9.

If ERROR 9 is displayed, replace calculator.

NOTE

For error conditions refer to Operator's Instructions for the HP-32E provided with equipment.

Section IV. ORGANIZATIONAL MAINTENANCE

8-9 There are no assigned organizational maintenance tasks for this equipment.

Section V. DIRECT/GENERAL SUPPORT MAINTENANCE

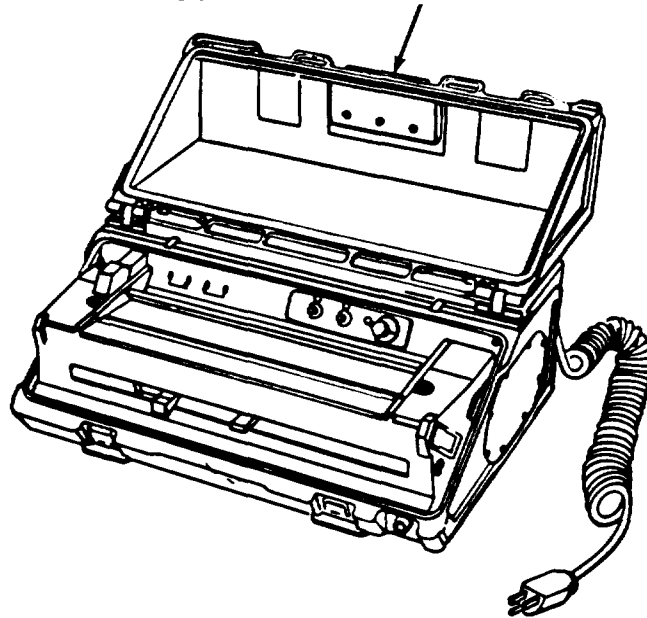
8-10 There are no assigned direct/general support maintenance tasks for this equipment.

CHAPTER 9

FACSIMILE TRANSMISSION AND RECEIVING DEVICE

9-1 GENERAL INFORMATION.

FACSIMILE TRANSMISSION AND RECEIVING DEVICE

9-1.1 ScopeModel Number and Equipment Name:

Model AN/GXC-7A Facsimile Transmission and Receiving Device

Purpose of Equipment: Provides transmission of graphic material from one point to another by electrical means. Maps, photographs, line drawings, printed or typed messages, and handwritten messages can be transmitted.

9-1.2 Reference Information. TM11-5895-1079-14, Operator's Organizational, Direct Support, General Support and Field Maintenance, Model AN/GXC-7A, Facsimile Transmission and Receiving Device, contains the information applicable to this equipment.

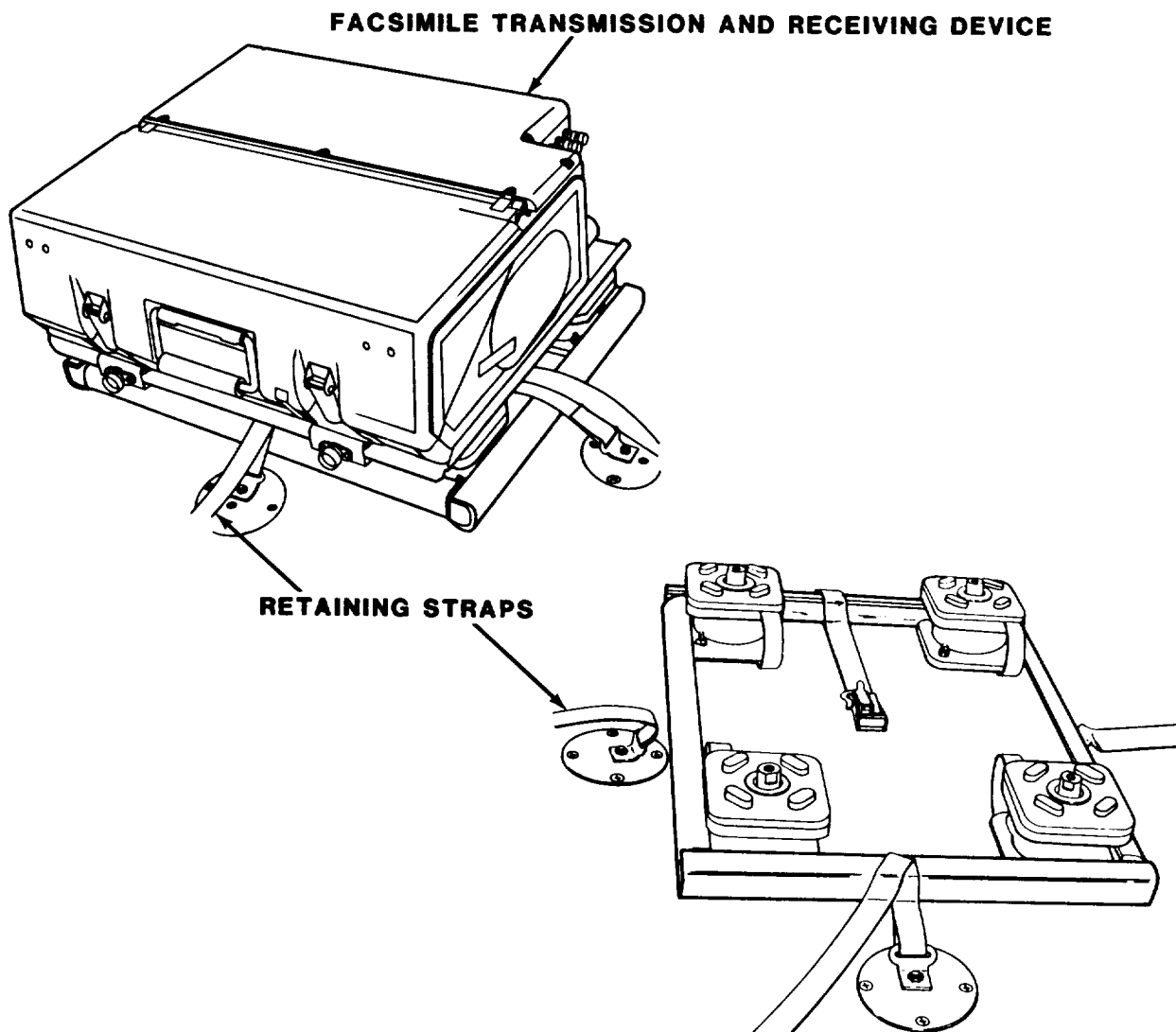
9-2 ORGANIZATIONAL MAINTENANCE.

9-2.1 The organizational maintenance procedure, Replace Facsimile Transmission and Receiving Device, is the only maintenance procedure applicable to this manual. Other maintenance information can be found in the referenced TM. (See paragraph 9-1.2)

9-2.2 Replace Facsimile Transmission and Receiving Device

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

MATERIALS/PARTS: Model AN/GXC-7A Facsimile Transmission and Receiving Device



REMOVAL:

- a. Unhook and remove retaining straps underneath the facsimile transmission and receiving device.
- b. Remove defective equipment.

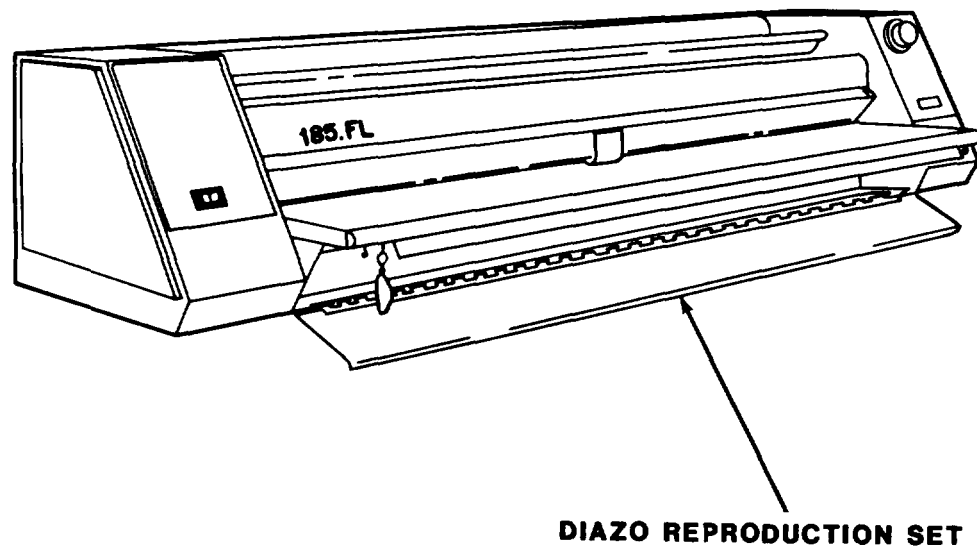
9-2.2 Replace Facsimile Transmission and Receiving Device - Continued

INSTALLATION:

- a. Install new facsimile transmission and receiving device.
- b. Loop retaining straps through bottom of equipment and hook to secure.

CHAPTER 10
DIAZO REPRODUCTION SET

10-1 GENERAL INFORMATION.



10-1.1 Scope

Model Number and Equipment Name:

Model GAF 185.FL Diazo Reproduction Set

Purpose of Equipment: To produce diazo prints from translucent paper, film, or cloth originals.

10-1.2 Reference Information. TM5-3610-256-14, Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Diazo Reproduction Set Model GAF 185.FL; and TM 5-3610-256-24P, Organizational, Direct Support, and General Support Maintenance Manual and Repair Parts and Special Tools List for the Model GAF 185.FL Diazo Reproduction Set contain information applicable to this equipment.

10-2 ORGANIZATIONAL MAINTENANCE

10-2.1 The organizational maintenance procedure, Replace Diazo Reproduction Set, is the only maintenance procedure applicable to this manual. Other maintenance information can be found in the referenced TMs. (See paragraph 10-1.2.)

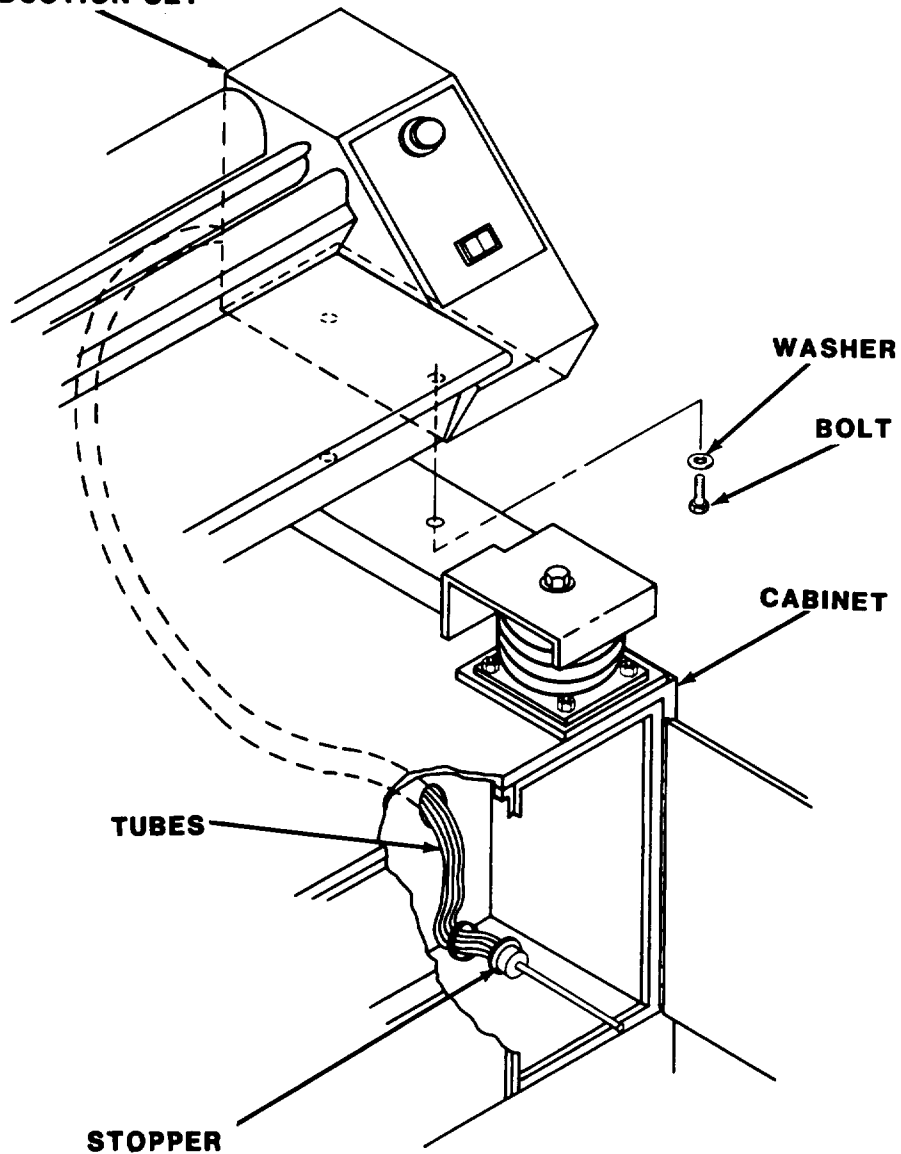
10-2.2 Replace Diazo Reproduction Set

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 1/2-inch drive socket wrench set

MATERIALS/PARTS: Model GAF 185.FL Diazo Reproduction Set

DIAZO REPRODUCTION SET



10-2.2 Replace Diazo Reproduction Set - Continued

REMOVAL:

WARNING

HAZARDOUS CHEMICALS

Do not operate, service, or maintain the diazo reproduction set without reading TM 5-3610-256-14. Improper handling of chemicals may cause personal injury.

- a. Remove two bolts and washers from bottom of each side of diazo reproduction set.
- b. Open right-hand cabinet door. Remove stopper from container. Remove three tubes from stopper.
- c. Remove defective diazo reproduction set from top of cabinet.

INSTALLATION:

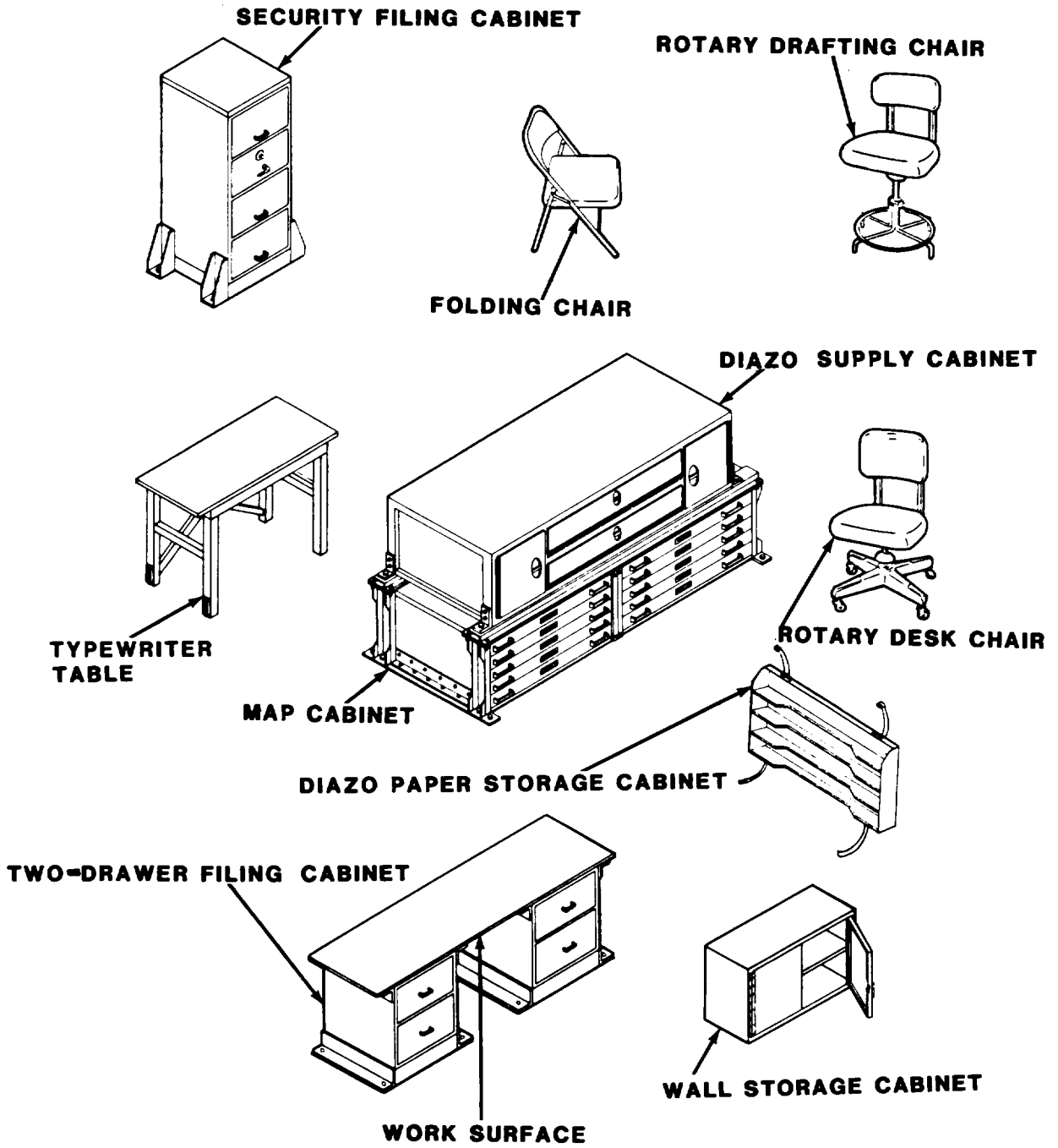
- a. Install new diazo reproduction set on top of cabinet.
- b. Pull three tubes through hole in back of cabinet. Attach tubes to stopper. Replace stopper in container.
- c. Close right-hand cabinet door.
- d. Replace two washers and bolts on bottom of each side of diazo reproduction set.

CHAPTER 11

FURNITURE AND CABINETS

Section I. INTRODUCTION

11-1 GENERAL INFORMATION.



11-1.1 Scope. This chapter contains the description of all furniture and cabinets in this section.

11-2 EQUIPMENT DESCRIPTION AND DATA.

11-2.1 Diazo Supply Cabinet. Provides storage for support items associated with the Diazo Reproduction Set. This cabinet has four separate sections, each with its own door and latch. Dimensions:

Width	69 in. (175.26 cm)
Depth	29.62 in. (75.23 cm)
Height	15.25 in. (38.74 cm)

11-2.2 Two-Drawer Filing Cabinet. Provides storage for legal size documents and office supplies. Cabinet has two individually latching drawers. Dimensions:

Width	18 in. (45.72 cm)
Depth	28 in. (71.12 cm)
Height	29.25 in. (74.30 cm)

11-2.3 Work Surface. Provides flat surface for desk work.

Width	30 in. (76.20 cm)
Depth	1 in. (2.54 cm)
Length	60 in. (152.40 cm)

11-2.4 Typewriter Table. Provides a stable surface for mounting a typewriter. Dimensions:

Width	36 in. (91.44 cm)
Depth	16 in. (40.64 cm)
Height	26.06 in. (66.19 cm)

11-2.5 Security Filing Cabinet. Used for security storage of classified documents. It has four drawers locked by a latch and combination lock located on the second drawer. Dimensions:

Width	20.75 in. (52.71 cm)
Depth	28 in. (71.12 cm)
Height	52 in. (132.08 cm)

11-2.6 Map Cabinet. Used for the flat, horizontal storage of maps, blueprints, charts, and plans of various sizes. The five drawers are held shut by two locking bars located on either side of the front of the cabinet. Dimensions:

Width	40.75 in. (103.51 cm)
Depth	28.62 in. (72.69 cm)
Height	16.3 in. (41.40 cm)

11-2.7 Wall Storage Cabinet. Used for miscellaneous storage. There are two shelves. The two doors are held shut by a handle-type latch. Dimensions:

Width	30 in. (76.20 cm)
Depth	12 in. (30.48 cm)
Height	18 in. (45.72 cm)

11-2.8 Diazo Paper Storage Cabinet. Provides storage for rolled diazo paper or other rolled paper.

Width	43 in. (109.22 cm)
Depth	4 in. (10.16 cm)
Height	21 in. (53.34 cm)

11-2.9 Rotary Desk Chair. Provides seating for personnel working at desk. It has a 3-3/4 in. (9.53 cm) seat height adjustment, ball bearing casters, tilt movement tension adjustment, and adjustable back height. Dimensions:

Width	20 in. (50.80 cm)
Depth	21 in. (53.34 cm)
Height	32 in. (81.28 cm)

11-2.10 Rotary Drafting Chair. Provides seating for drafting personnel. It has adjustable seat height and back position. Dimensions:

Width	17.12 in. (43.48 cm)
Depth	17.12 in. (43.48 cm)
Height	42 in. (106.68 cm), max 36 in. (91.44 cm), min

11-2.11 Folding Chair. Provided for general seating. Folds flat for storage. Dimensions:

Width	18 in. (45.72 cm)
Depth	20 in. (50.80 cm)
Height	32 in. (81.28 cm)

Section II. OPERATING INSTRUCTIONS

There are no operating instructions for the furniture and cabinets.

Section III. OPERATOR MAINTENANCE

11-3 LUBRICATION INSTRUCTIONS.

This equipment does not require lubrication.

11-4 OPERATOR TROUBLESHOOTING PROCEDURES.

There are no operator troubleshooting procedures for the furniture and cabinets.

11-5 OPERATOR MAINTENANCE PROCEDURES.

Inspect cabinets and furniture for structural damage, rust, and proper operation of all latches, hinges, and adjustment mechanisms.

Section IV. ORGANIZATIONAL MAINTENANCE

11-6 REPAIR PARTS; SPECIAL TOOLS; TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT.

11-6.1 For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

11-6.2 Special tools, TMDE, and support equipment used on your equipment are listed in the applicable Repair Parts and Special Tools List and in appendix B of this manual.

11-6.3 Repair parts are listed and illustrated in the repair parts and special tools list (TM5-6675-326-24P) covering organizational maintenance for this equipment.

11-7 ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

There are no PMCS at the organizational level for the furniture and cabinets.

11-8 ORGANIZATIONAL TROUBLESHOOTING.

There is no troubleshooting at the organizational level for the furniture and cabinets.

11-9 ORGANIZATIONAL MAINTENANCE PROCEDURES.

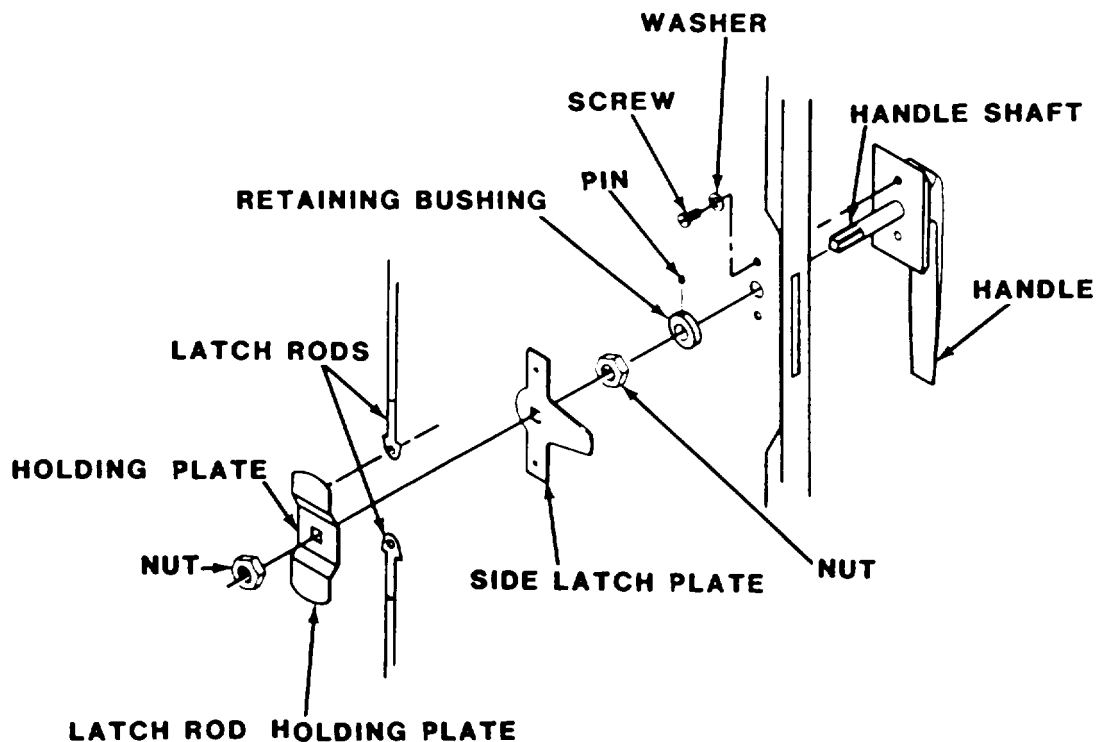
This section contains step-by-step instructions covering organizational maintenance procedures.

11-9.1 Replace Latch (Handle-Type)

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/16 in. socket-head screw key
 9/64 in. flat-tip screwdriver
 Punch and Ball-peen hammer

MATERIALS/PARTS: Handle-type latch
 Upper latch rod
 Lower latch rod



REMOVAL:

- a. Remove nut from holding plate.
- b. Remove latch rod holding plates and latch rods.
- c. Remove side latch plate.

11-9.1 Replace Latch (Handle-Type) - Continued

- d. Remove nut from handle shaft.
- e. Drive out pin securing retaining bushing to handle shaft, and remove bushing.
- f. Remove two screws and washers securing handle to door. Remove handle.

INSTALLATION:

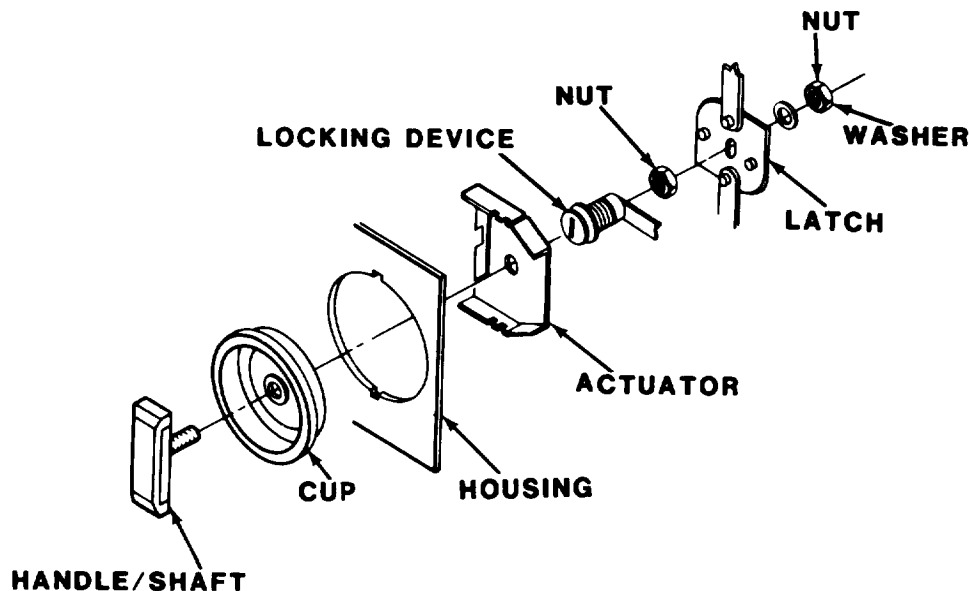
- a. Install new handle, and secure with two screws and washers.
- b. Reinstall retaining bushing with pin.
- c. Reinstall nut.
- d. Reinstall side latch plate.
- e. Reinstall latch rods and holding plates.
- f. Reinstall nut on holding plate.

11-9.2 Replace Latch (Recessed Cup-Type)

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 9/64 in. flat-tip screwdriver
9/16 in. wrench

MATERIALS/PARTS: Cup-type latch



11-9.2 Replace Latch (Recessed Cup Type) - Continued

REMOVAL:

- a. Remove nut and washer from latch.
- b. Remove nut, actuator, and locking device from housing.
- c. Remove handle/shaft and cup.

INSTALLATION:

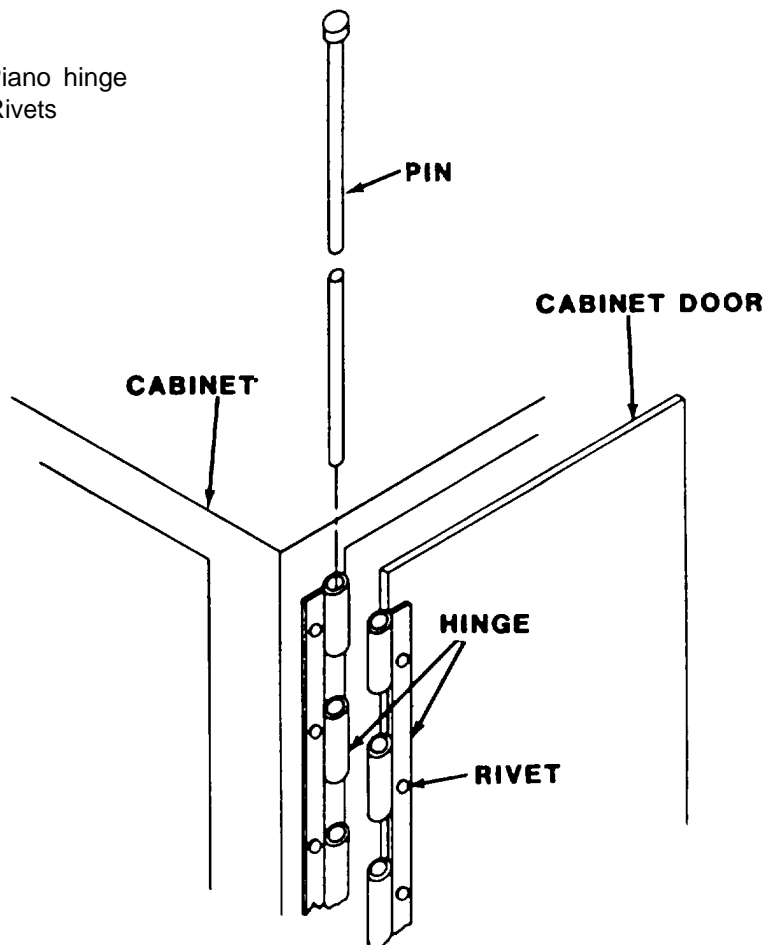
- a. Inspect and replace cup-type latch.
- b. Reinstall handle/shaft and cup. Secure to housing.
- c. Reinstall locking device on actuator. Secure with nut.
- d. Reinstall washer and nut on latch.

11-9.3 Replace Hinge (Piano)

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: 3/8 in. electric drill
 5/32 in. twist drill bit
 Riveter

MATERIALS/PARTS: Piano hinge
 Rivets



11-9.3 Replace Hinge (Piano) Continued

REMOVAL:

- a. Remove pin from hinge.
- b. Drill out rivets which secure hinge to cabinet or cabinet door.
- c. Remove defective hinge.

INSTALLATION:

- a. Install new hinge.
- b. Secure to cabinet door or cabinet with new rivets.
- c. Aline cabinet door to cabinet and reinstall pin.

11-9.4 Replace Map Cabinet

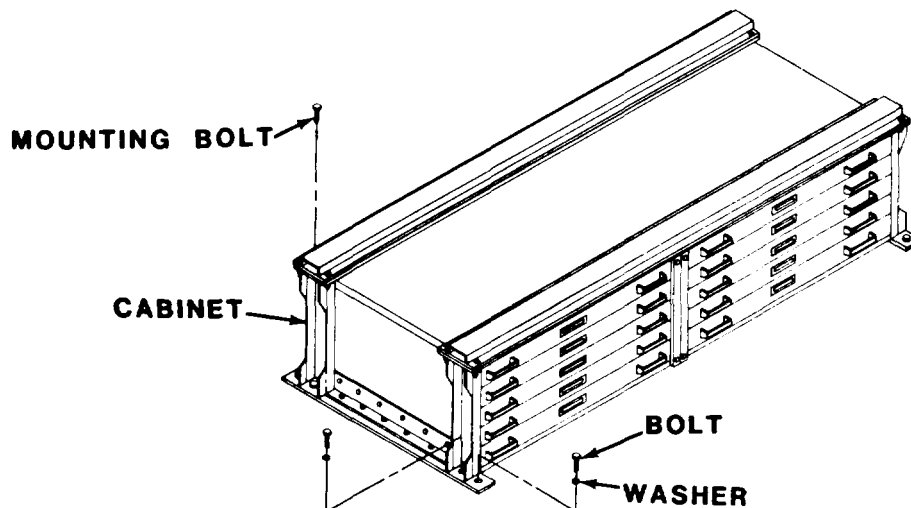
PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: Socket wrench set (1/2 in. drive)

MATERIALS/PARTS: Map cabinet

REMOVAL:

- a. Remove diazo reproduction set (para 10-2.2).
- b. Remove diazo supply cabinet (para 11-9.11).
- c. Remove all contents from map cabinet.
- d. Remove drawers from cabinet.



11-9.4 Replace Map Cabinet - Continued

- e. Remove two mounting bolts at rear of cabinet.
- f. Remove eight bolts and washers securing cabinet to van floor.
Remove defective cabinet.

INSTALLATION:

- a. Install new cabinet. Reinstall eight washers and bolts securing cabinet to van floor.
- b. Reinstall mounting bolts at rear of cabinet.
- c. Reinstall drawers in cabinet.
- d. Reinstall contents in map cabinet.
- e. Reinstall diazo supply cabinet (para 11-9.11).
- f. Reinstall diazo reproduction set (para 10-2.2).

11-9.5 Replace Work Surface

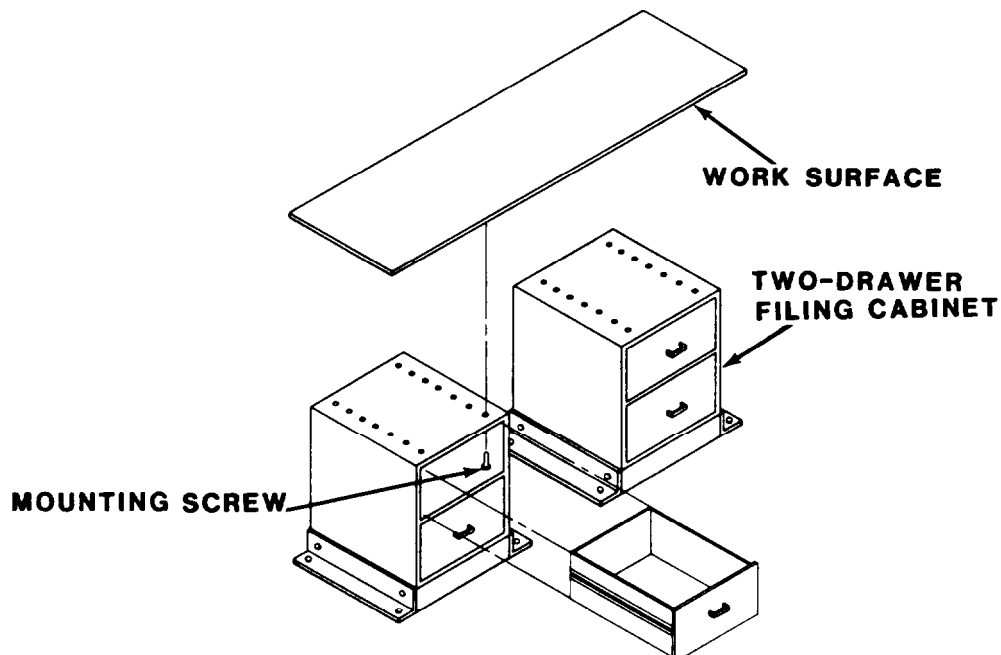
PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: No. 2 cross-tip screwdriver

MATERIALS/PARTS: Work surface

REMOVAL:

- a. Remove and store contents of top drawers of two-drawer filing cabinets.



11-9.5 Replace Work Surface - Continued

- b. Remove top drawers to allow access to mounting screws securing work surface to cabinets.
- c. Remove twelve mounting screws, and remove defective work surface.

INSTALLATION:

- a. Install new work surface, and reinstall twelve mounting screws.
- b. Replace top drawers in two-drawer filing cabinets.
- c. Replace contents in top drawers.

11-9.6 Replace Two-Drawer Filing Cabinet

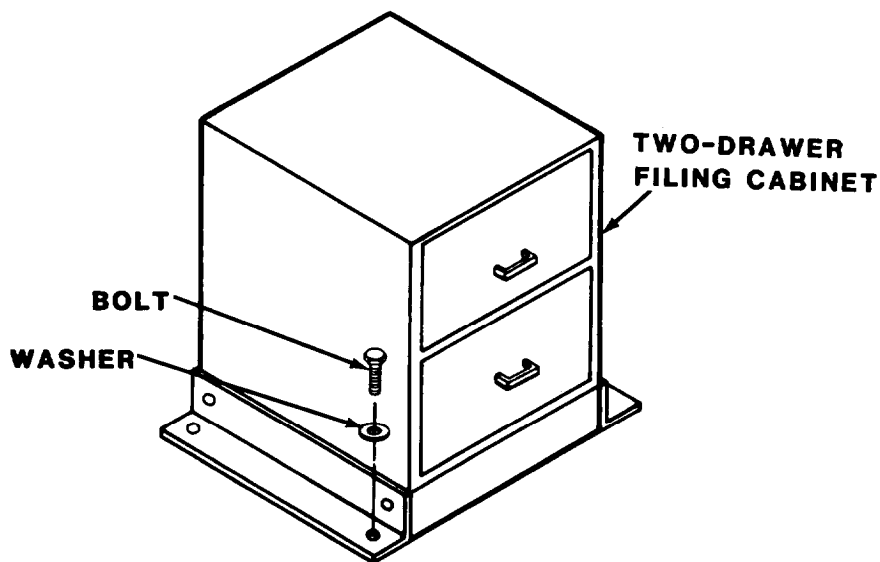
PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: Socket wrench set (1/2 in. drive)

MATERIALS/PARTS: Two-drawer filing cabinet

REMOVAL:

- a. Remove and store contents of drawers.
- b. Remove work surface (para 11-9.5).



11-9.6 Replace Two-Drawer Filing Cabinet - Continued

- c. Remove four bolts and washers securing defective two-drawer filing cabinet to van floor. Remove defective cabinet.

INSTALLATION:

- a. Install new two-drawer filing cabinet and secure to van floor with four washers and bolts.
- b. Reinstall work surface (para 11-9.5).
- c. Replace contents in drawers.

11-9.7 Replace Typewriter Table

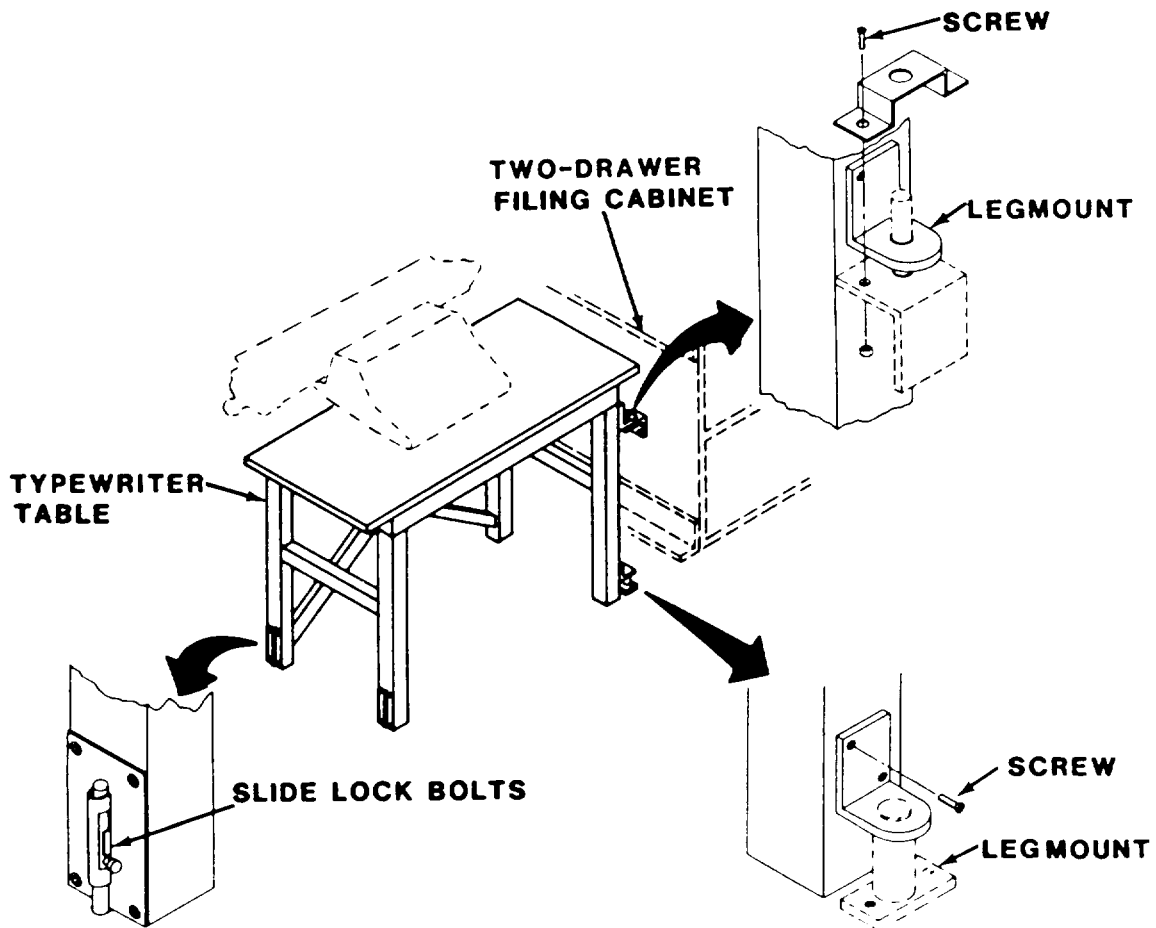
PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: No. 2 Cross-tip screwdriver

MATERIALS/PARTS: Typewriter table

REMOVAL:

- a. Remove typewriter from table (para 12-7.4).



11-9.7 Replace Typewriter Table - Continued

- b. Unlock two slide lock bolts from floor.
- c. Remove two screws from leg mount securing table to floor.
- d. Remove two screws from leg mount securing table to two-drawer filing cabinet.

INSTALLATION:

- a. Install new typewriter table. Replace two screws on leg mount securing typewriter table to filing cabinet.
- b. Replace two screws on leg mount securing typewriter table to floor.
- c* Lock two slide lock bolts to floor.
- d. Reinstall typewriter (para 12-7.4).

11-9.8 Replace Security Filing Cabinet

PERSONNEL REQUIRED: 4 Topographic instrument repair specialists MOS 41B

TOOLS: Socket wrench set (1/2 in. drive)
Materials handling equipment

MATERIALS/PARTS: Security filing cabinet

REMOVAL:

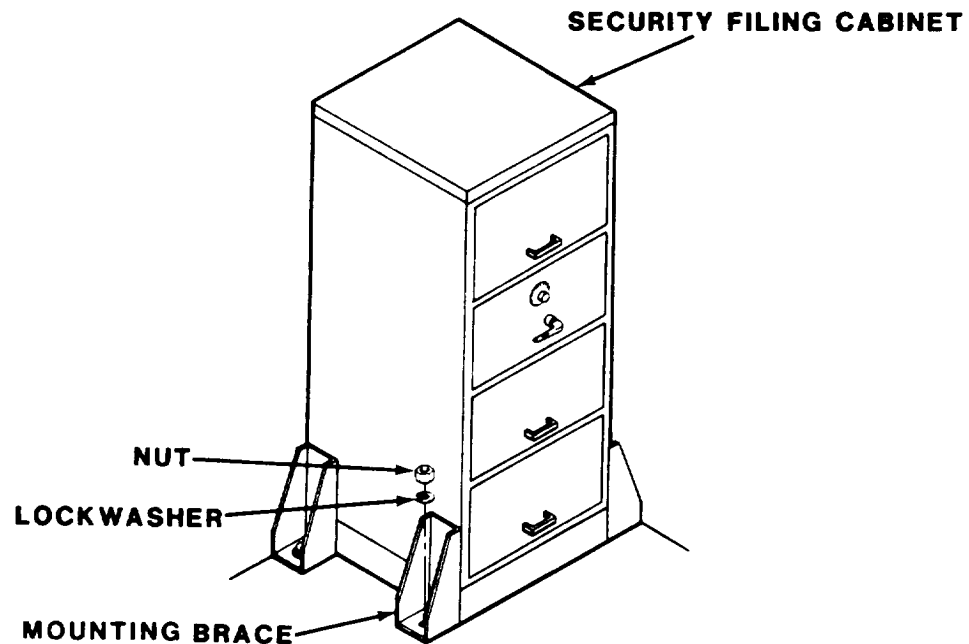
NOTE

The security cabinet weighs approximately 550 pounds, empty. It poses special problems for removal and installation. Organizational support maintenance must employ the best personnel, tools, and equipment available to perform this maintenance function.

- a. Remove work surface (para 11-9.5).
- b. Remove two-drawer filing cabinet as needed (para 11-9.6).
- c. Remove security filing cabinet contents, and store in secure area.

11-9.8 Replace Security Filing Cabinet - Continued

- d. Tape lock combination to outside of security filing cabinet.



- e. Remove four nuts and lockwashers from mounting brace. Remove defective security filing cabinet.

INSTALLATION:

- a. Install new security filing cabinet. Reinstall lockwashers and nuts on mounting hardware.
- b. Change combination lock before replacing contents in cabinet.
- c. Reinstall two-drawer filing cabinet if removed (para 11-9.6).
- d. Reinstall work surface (para 11-9.5).

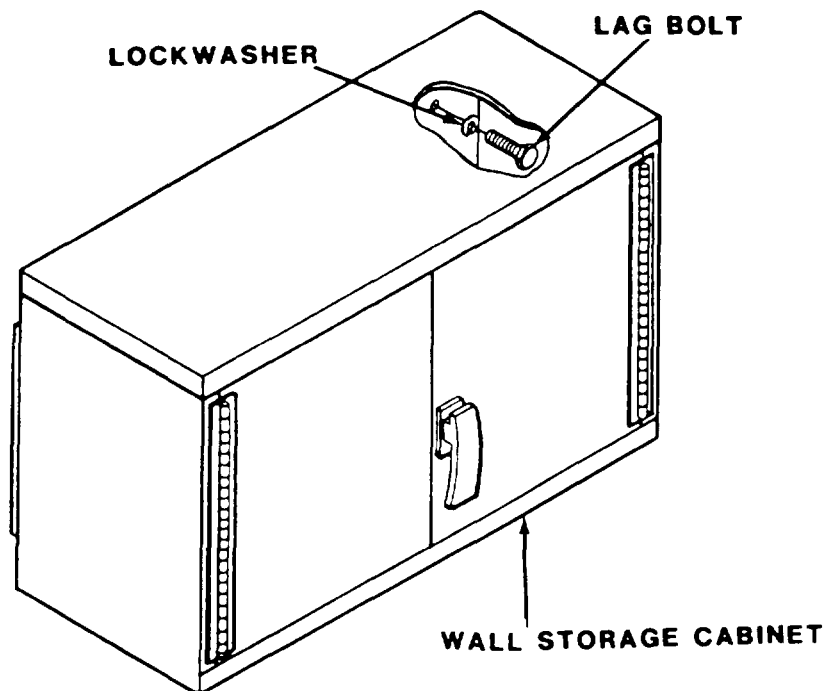
11-9.9 Replace Wall Storage Cabinet

PERSONNEL REQUIRED: 2 Topographic instrument repair specialists MOS 41B

TOOLS: Socket wrench set (1/2 in. drive)

MATERIALS/PARTS: Wall storage cabinet

11-9.9 Replace Wall Storage Cabinet - Continued



REMOVAL:

Remove four lag bolts and lockwashers securing wall storage cabinet to wall. Remove defective cabinet.

INSTALLATION:

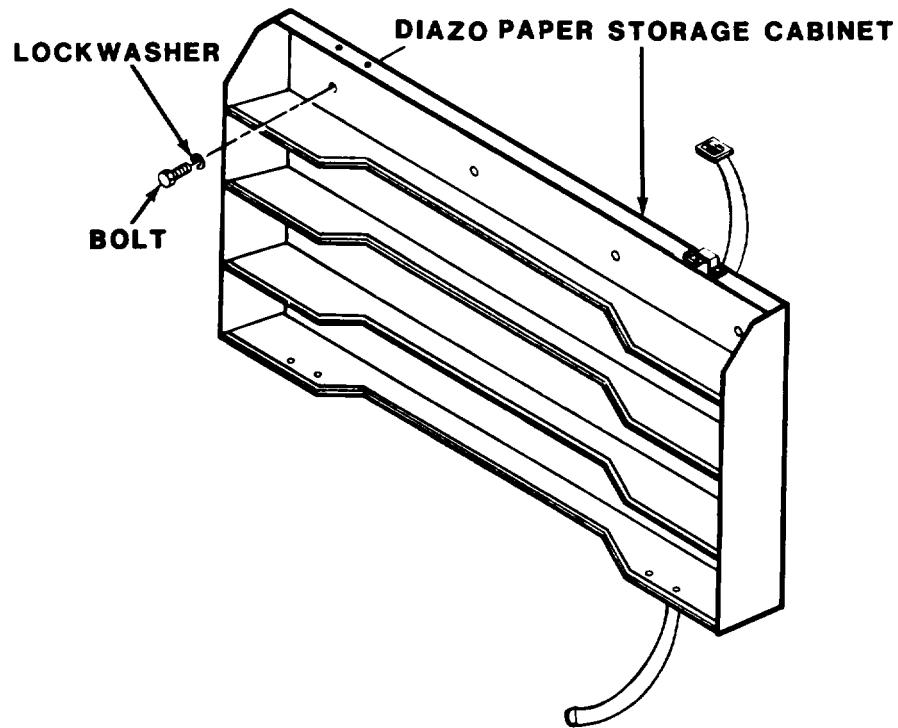
Install new wall storage cabinet. Reinstall four lag bolts and lockwashers securing cabinet to wall.

11-9.10 Replace Diazo Paper Storage Cabinet

PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: Socket wrench set (1/2 in. drive)

MATERIALS/PARTS: Diazo paper storage cabinet

11-9.10 Replace Diazo Paper Storage Cabinet - Continued**REMOVAL:**

Remove four bolts and lockwashers securing diazo paper storage cabinet to wall. Remove defective diazo paper storage cabinet.

INSTALLATION:

Install new diazo paper storage cabinet. Secure to wall with four lockwashers and bolts.

11-9.11 Replace Diazo Supply Cabinet

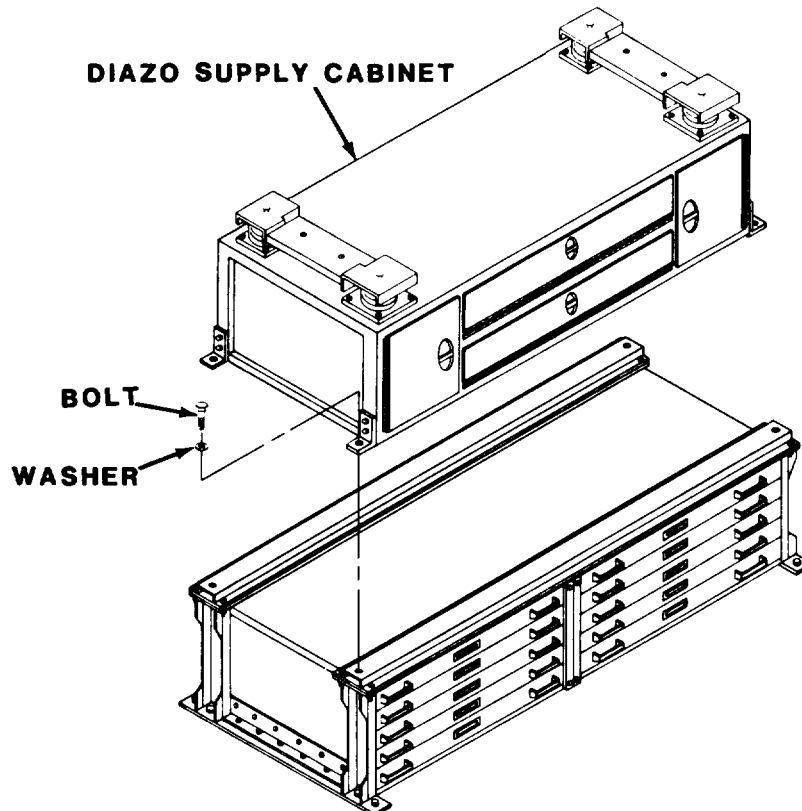
PERSONNEL REQUIRED: 1 Topographic instrument repair specialist MOS 41B

TOOLS: Socket wrench set (1/2 in. drive)

MATERIALS/PARTS: Diazo supply cabinet

REMOVAL:

- a. Remove diazo reproduction set (para 10-2.2).



- b. Remove four bolts and washers securing diazo supply cabinet to map cabinet. Remove damaged diazo supply cabinet.

INSTALLATION:

- a. Install new diazo supply cabinet, and secure to map cabinet with washers and bolts.
- b. Reinstall diazo reproduction set (para 10-2.2).

11-10. PREPARATION FOR STORAGE OR SHIPMENT.

In the event that the furniture and cabinets must be removed from the section for repair or replacement, refer to TM 750-90-1 for storage instructions.

Section V. DIRECT/GENERAL SUPPORT MAINTENANCE

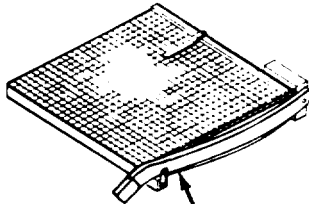
There are no assigned direct/general support maintenance tasks for this equipment.

CHAPTER 12

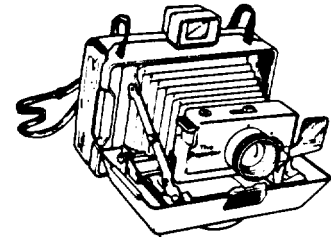
SUPPORT ITEMS

Section I. INTRODUCTION

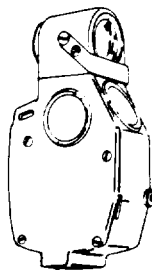
12-1 GENERAL INFORMATION.



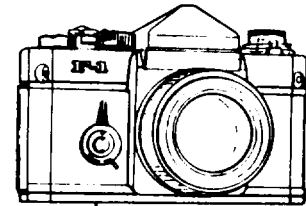
PAPER TRIMMER



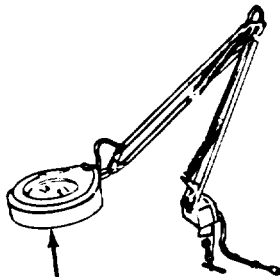
STILL PICTURE CAMERA



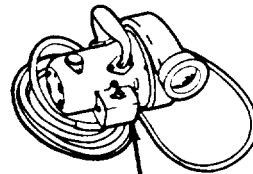
OPTICAL TREE MEASURER



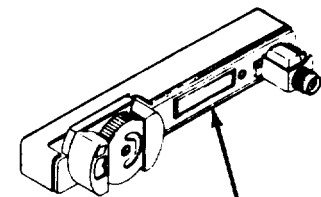
35MM CAMERA



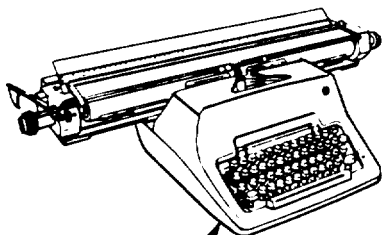
MAGNIFIER LAMP



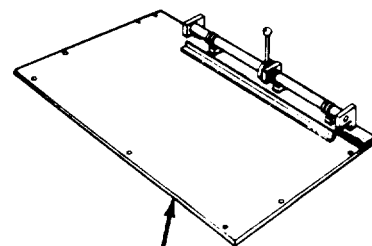
VACUUM CLEANER



OPTICAL RANGE FINDER



MANUAL TYPEWRITER



PIN PUNCH REGISTER

12-1.1 Scope. This chapter covers the support items contained in this section. The support items are listed below.

Model Numbers and Equipment Names:

Model LFM1BX5 Magnifier Lamp LFM-1
Model SG3L24 Manual Typewriter
Ranging 1200 Optical Range Finder
Optical Tree Measurer
Model FED 99-T-678 Paper Trimmer
Special Model Pin Punch Register
Still Picture Camera EE100
Model 3400 Electric Vacuum Cleaner
Model KS-99C Prototype 35mm Camera

Purpose of Equipment: To provide resource equipment necessary for operation of the DSS van as follows:

Magnifier lamp provides means for magnifying images on maps, drawings, blueprints, and photos for clearer interpretation.

Manual typewriter provides source for typing required records and documentation.

Optical range finder provides means of determining distances between observer and selected positions.

Optical tree measurer provides means of determining range, height, slope, diameter, and basal area of tree stand.

Paper trimmer provides means for trimming paper with straightedges.

Pin punch register provides means for punching holes in records and documents for binding.

Still picture camera provides means for taking instant photographs.

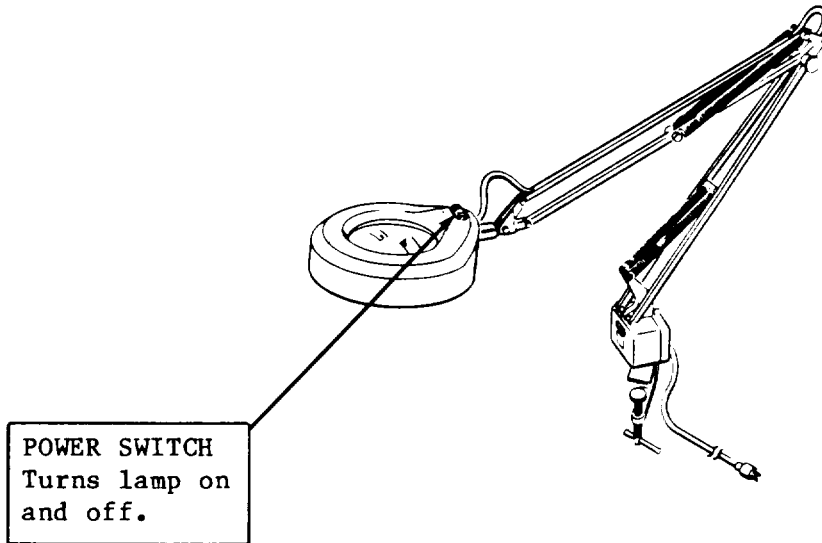
Electric vacuum cleaner provides means for cleaning dust and dirt from interior of van.

Prototype 35 mm camera provides means for taking clear image photographs.

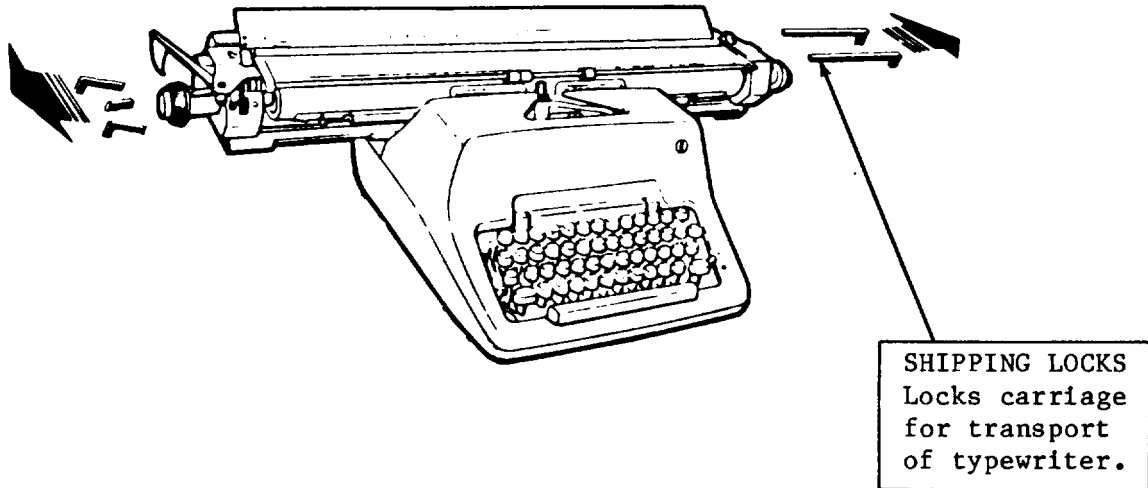
Section II. OPERATING INSTRUCTIONS

12-2 DESCRIPTION AND USE OF OPERATOR'S CONTROLS AND INDICATORS.

12-2.1 Magnifier Lamp

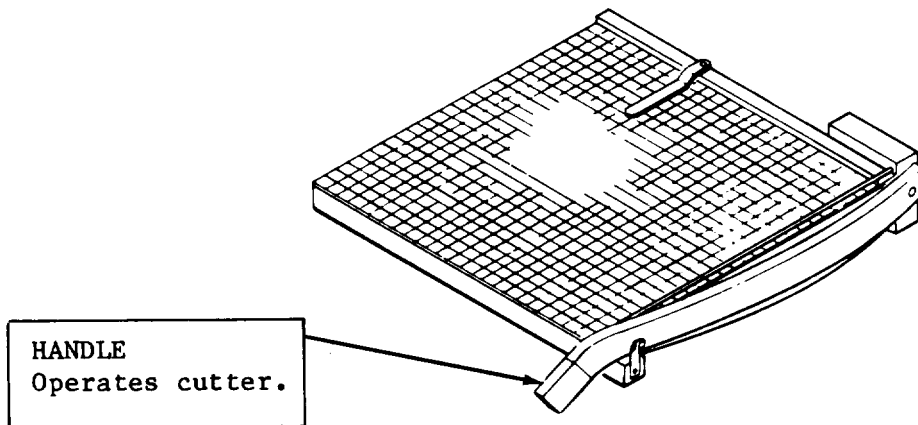


12-2.2 Manual Typewriter

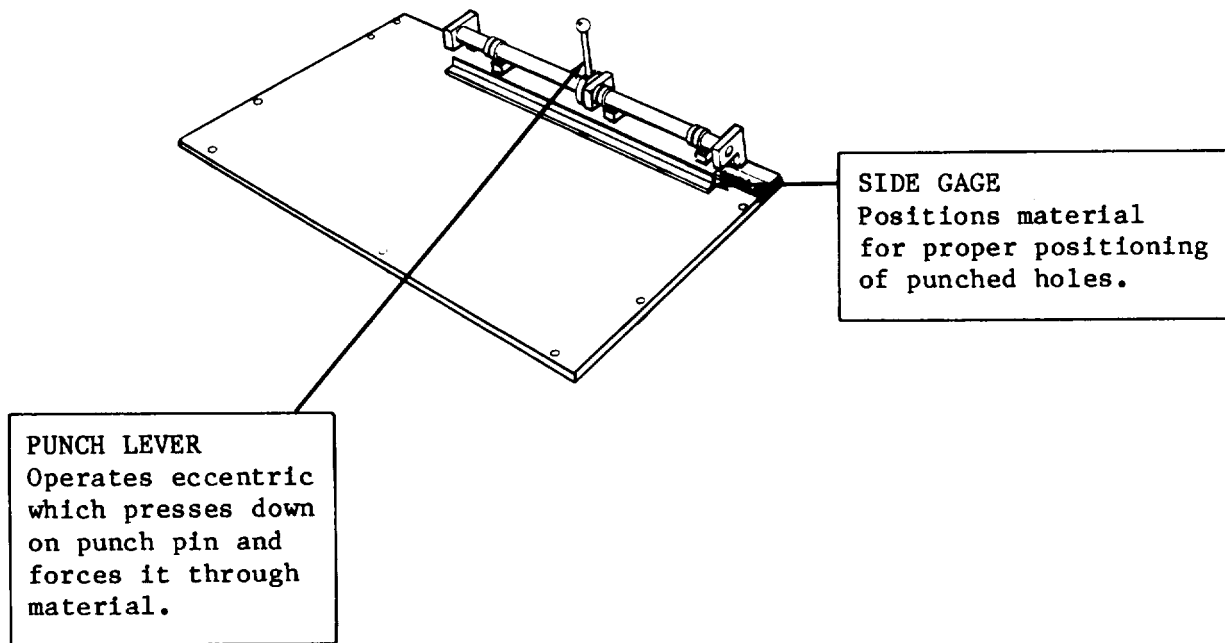


Refer to Operating Instructions, Olympia Model SG3L24, for further descriptions of controls and indicators.

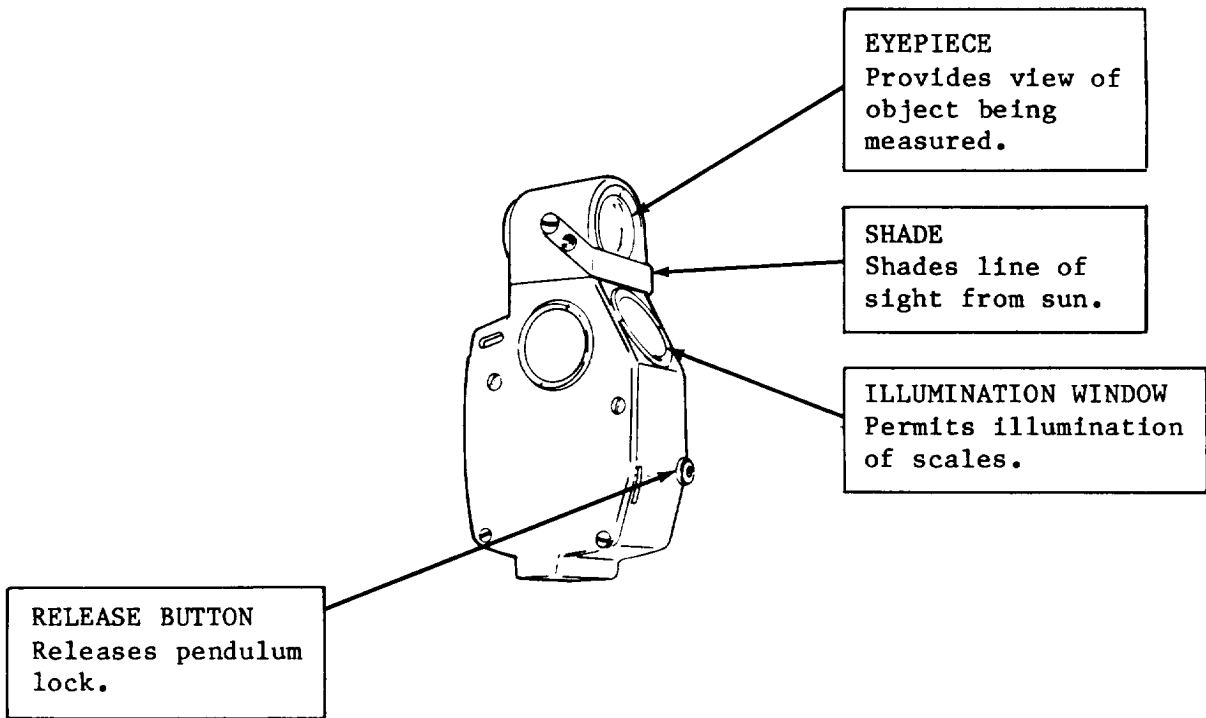
12-2.3 Paper Trimmer



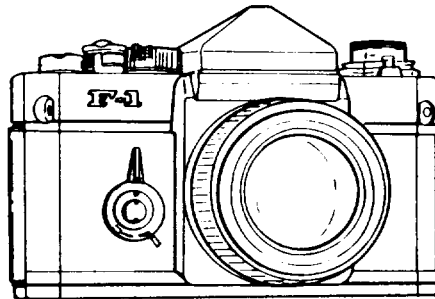
12-2.4 Pin Punch Register



12-2.5 Optical Tree Measurer

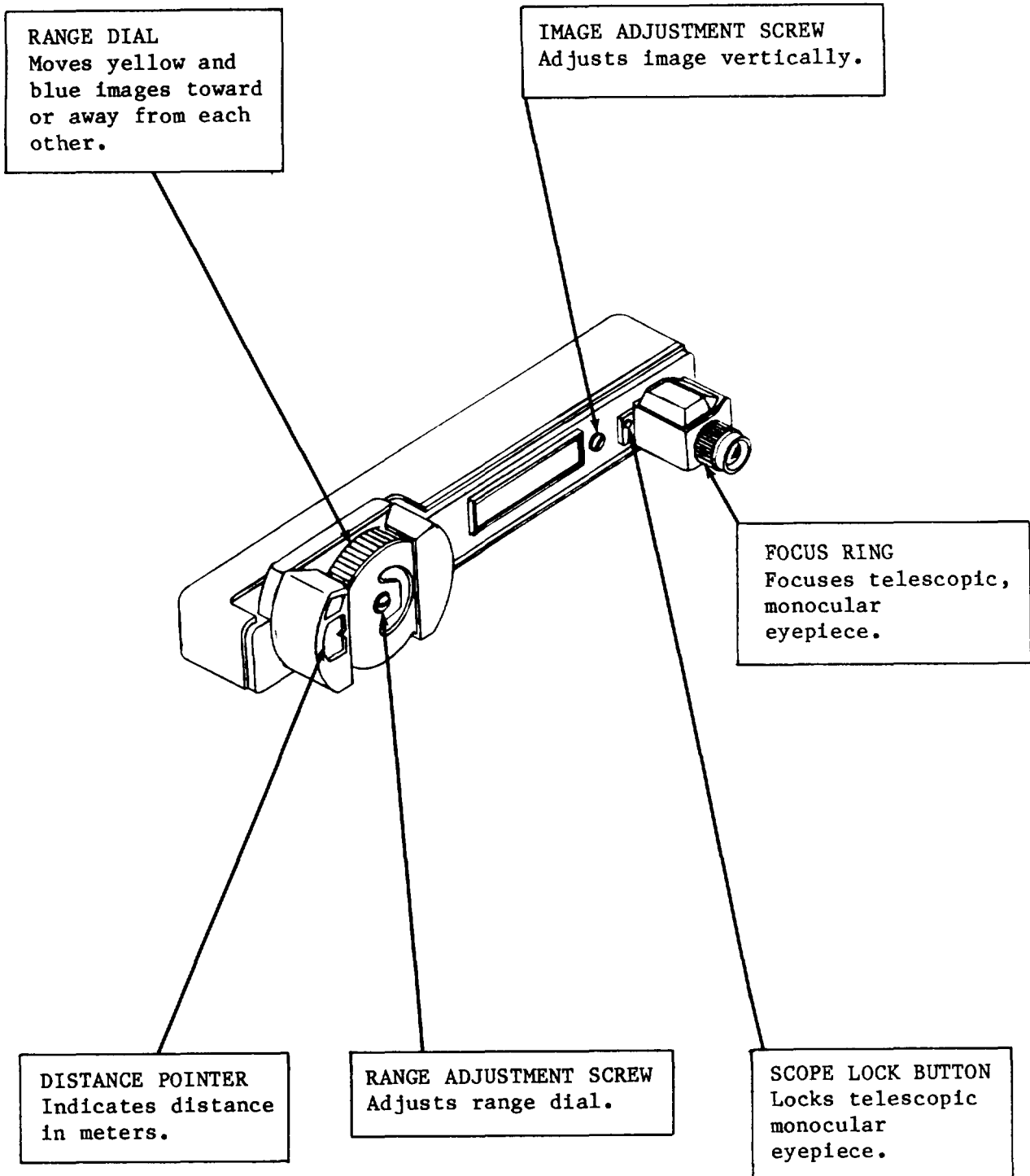


12-2.6 Prototype 35mm Camera

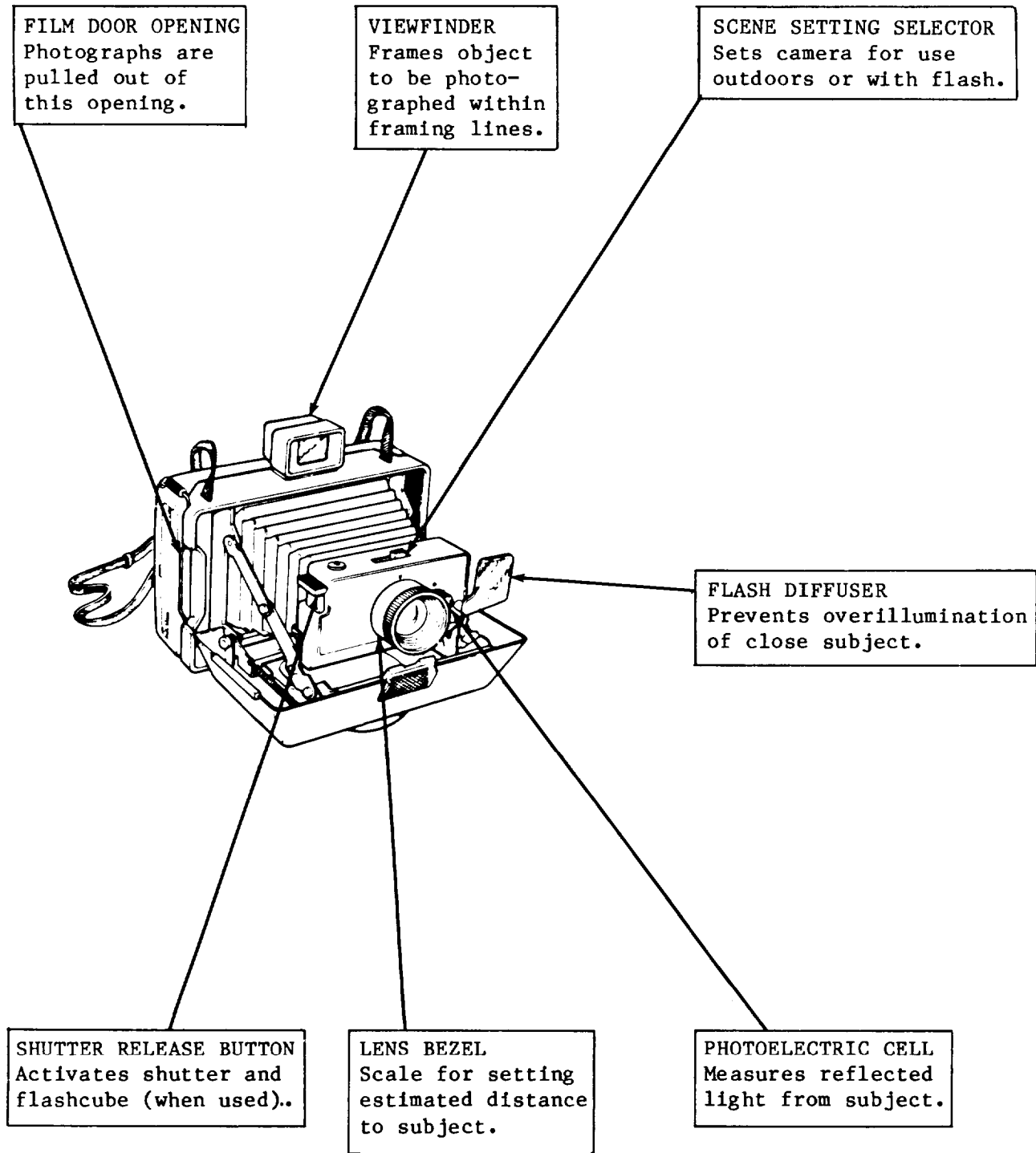


See TM11-6720-253-10 for description of controls and indicators and operating instructions.

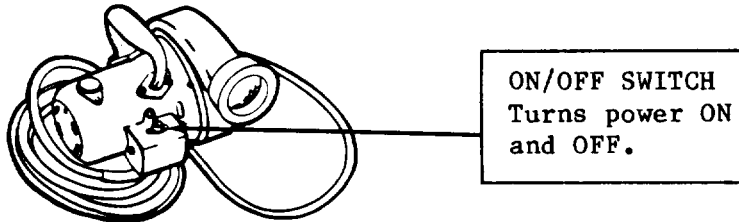
12-2.7 Optical Range Finder



12-2.8 Still Picture Camera Set



12-2.9 Vacuum Cleaner



12-3 OPERATOR PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS).

12-3.1 General. The support items must be regularly inspected to find and correct defects.

12-3.1.1 Before You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your BEFORE (B) PMCS.

12-3.1.2 While You Operate. Always keep in mind the WARNINGS and CAUTIONS. Perform your DURING (D) PMCS.

12-3.1.3 After You Operate. Be sure to perform your AFTER (A) PMCS.

12-3.1.4 If Your Equipment Fails To Operate. Troubleshoot with the proper equipment. Report any deficiencies using the proper forms. See DA Pam 738-750.

12-3.2 PMCS Procedures

12-3.2.1 PMCS are designed to keep the equipment in good working condition by performing service tasks.

12-3.2.2 Service intervals provide you, the operator, with time schedules that determine when to perform specified service tasks.

12-3.2.3 The "Equipment Is Not Ready/Available If" Column Is used for identification of conditions that make the equipment not ready/available for readiness reporting purposes or denies use of the equipment until corrective maintenance is performed.

12-3.2.4 If your equipment fails to operate after PMCS is performed, immediately report this condition to your supervisor.

12-3.3 PMCS Columnar Entries

12-3.3.1 Item Number Column. Item numbers are assigned in chronological ascending sequence regardless of interval designation. These numbers are used for "TM number" Column on DA Form 2404, Equipment Inspection and Maintenance Worksheet in recording results of PMCS.

12-3.3.2 Interval Column. This column determines the time period designated to perform your PMCS.

12-3.3.3 Items To Be Inspected and Procedures Column. This column lists functional groups and their respective assemblies and subassemblies as shown in the Maintenance Allocation Chart (Appendix B). The appropriate check or service procedure follows the specific item to be inspected.

12-3.3.4 Equipment Is Not Ready/Available If: Column. This column indicates the reason or cause why your equipment is not ready/available to perform its primary mission.

Table 12-1. Operator Preventive Maintenance Checks and Services

B - Before Operation W - Weekly M - Monthly Q - Quarterly AN - Annually

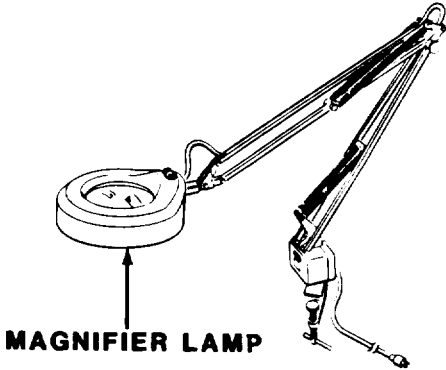
Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	W	M	Q	AN		
1	•					 <p>MAGNIFIER LAMP. Inspect lens for dirt. Clean by applying lens cleaning fluid (item 13, appendix E) to both sides of lens. Wipe clean with cloth (item 16, appendix E).</p>	Cracks or breaks are present.
		•				Inspect lens, arms, and base for cracks or breaks.	
2		•				<p>MAMUAL TYPEWRITER. Check for secure mounting. Check typewriter ribbon for weak or frayed sections.</p>	Typewriter ribbon is defective.
					•	Replace typewriter ribbon. Refer to manufacturer's Operating Instructions for ribbon replacement.	

Table 12-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation W - Weekly M - Monthly Q - Quarterly AN - Annually

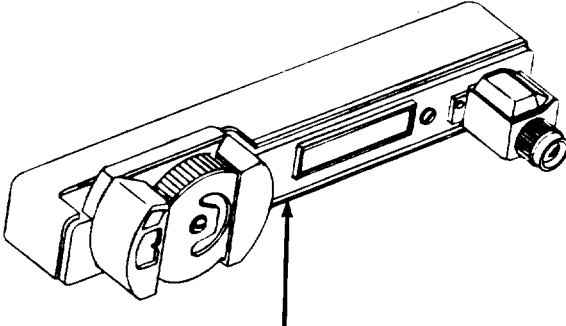
Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	W	M	Q	AN		
3	•					 <p style="text-align: center;">OPTICAL RANGE FINDER</p> <p>OPTICAL RANGE FINDER. Check for broken case or missing parts. Check range dial for freedom of movement.</p> <p>Clean optical range finder. Moisten lens paper (item 62, appendix E) with lens cleaning fluid (item 35, appendix E) and gently wipe lens, using a circular motion. Wipe lens dry with clean lens tissue. Use fresh tissues for each lens.</p>	Any parts are missing or broken.

Table 12-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation W - Weekly M - Monthly Q - Quarterly AN - Annually

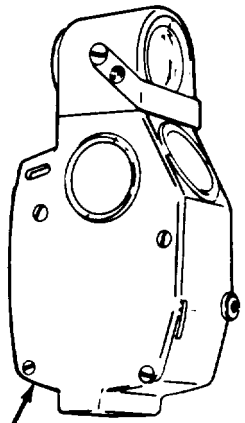
Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	W	M	Q	AN		
4						 <p>OPTICAL TREE MEASURER</p>	Screws are missing or lens is cracked.
	o					<p>OPTICAL TREE MEASURER. Check carrying strap for secure attachment to instrument. Check tree measurer for missing screws or cracked lenses. Check shade for freedom of movement.</p>	
5						<p>Clean optical tree measurer. Brush dust or dirt from lens surfaces with soft brush. Moisten lens paper (item 62, appendix E) with lens cleaning fluid (item 35, appendix E). Wipe lenses with tissue, using circular motion and working toward center. Wipe lens dry with clean tissue. Use fresh tissues for each lens.</p>	Blade is too tight, too loose, or damaged.
	o					<p>PAPER TRIMMER. Inspect for structural damage and proper operation of blade.</p>	

Table 12-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation W - Weekly M - Monthly Q - Quarterly AN -Annually

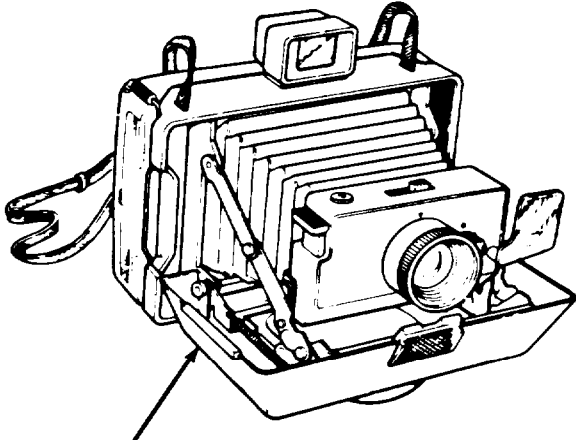
Item No.	Interval	ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
6	●	<p>PIN PUNCH REGISTER. Check punch dies for buildup of material. Clean by removing buildup of punched holes.</p>  <p>STILL PICTURE CAMERA</p>	
7	● ●	<p>STILL PICTURE CAMERA. Inspect for broken or missing parts.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Do not open camera door when film pack is loaded. Exposure to light will ruin film. Check that no paper tabs show in slot before opening camera door.</p> <p>Inspect film rollers for dirt or residue. Inspect batteries for corrosion, bulges, or damage. Hold lens of camera toward light and inspect bellows. Check for light leaks. Check that cold plate is on back of camera.</p>	<p>Parts are missing or broken. Camera will not operate.</p> <p>Light leaks are present inside camera.</p>

Table 12-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation W - Weekly M - Monthly Q - Quarterly AN -Annually

Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	W	M	Q	AN		
7 (cont)	•					<p>Test shutter on still picture camera.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Do not open camera door when film pack is loaded. Exposure to light will ruin film. Check that no paper tabs show in slot before opening camera door.</p> <p>Open camera door. Set scene setting selector to 75. Cover photoelectric cell lens with finger or cloth to block light. Press shutter release button and check that shutter opens and remains open. Uncover photoelectric cell and check that shutter closes. If shutter does not close, replace batteries and repeat test.</p> <p>Clean still picture camera.</p> <p style="text-align: center;"><u>CAUTION</u></p> <p>Do not open camera door when film pack is loaded. Exposure to light will ruin film. Check that no film tabs show in slot before opening camera door.</p> <p>Open camera door and lay camera on working surface. Remove roller assembly. Moisten cotton swab (item 18, appendix E) in alcohol (item 3, appendix E) and swab rollers until residue is removed from rollers. Let rollers air dry. Blow dust and</p>	<p>Shutter fails with new batteries.</p> <p>Rollers are damaged.</p>

Table 12-1. Operator Preventive Maintenance Checks and Services - Continued

B - Before Operation W - Weekly M - Monthly Q - Quarterly AN - Annually

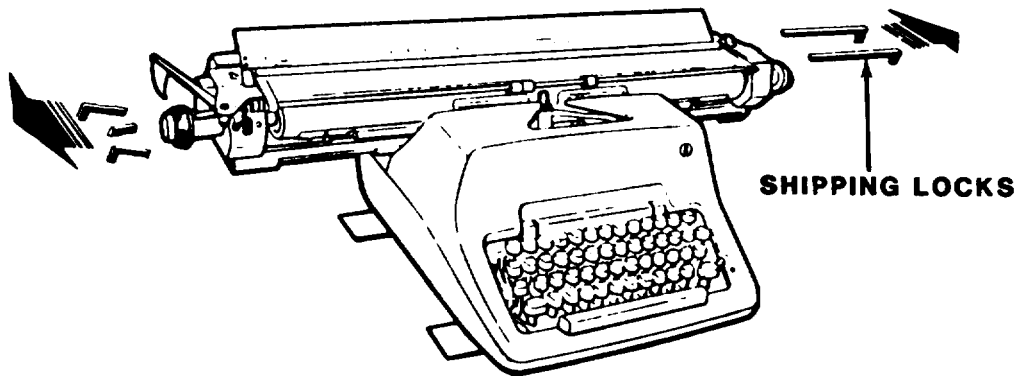
Item No.	Interval					ITEM TO BE INSPECTED PROCEDURE	Equipment Is Not Ready/Available If:
	B	W	M	Q	AN		
(Cont)						dirt from inside camera with watchmaker's blower. Reinstall roller assembly. Close camera door.	
			•			Wipe viewfinder (both sides), main lens, and photoelectric cell lens with lens tissue (item 62, appendix). Use fresh tissue for each lens.	
8				•		VACUUM CLEANER. Check if power cord is frayed or worn. Check housing for damage. Check for proper operation of motor.	Power cord is damaged, or motor is not operating.
9			•			PROTOTYPE 35mm CAMERA. Check for proper operation of camera. Refer to TM11-6720-253-10 for service and maintenance instructions.	Camera is not operating.

12-4 OPERATION UNDER USUAL CONDITIONS.

12-4.1 Assembly and Preparation for Use. Each support item is unpacked and prepared for use as needed. The assembly and preparation for use instructions are included as part of the operating procedures for each item.

12-4.2 Operating Procedures

12-4.2.1 Manual Typewriter

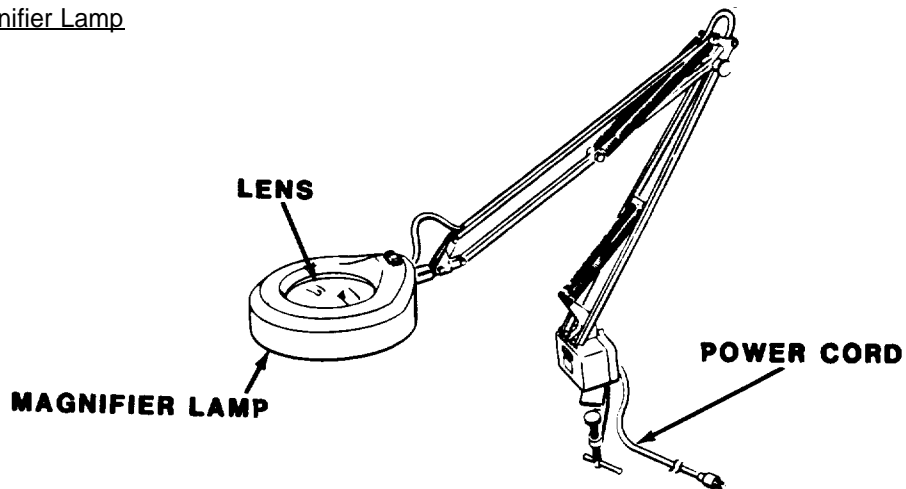


- a. Remove dust cover. Remove shipping locks.
- b. Refer to Operating Instructions, Olympia Model SG3L24, for operating procedures.

12-4.2.2 Prototype 35mm Camera

Refer to TM11-6720-253-10 for operating procedures for the 35mm camera.

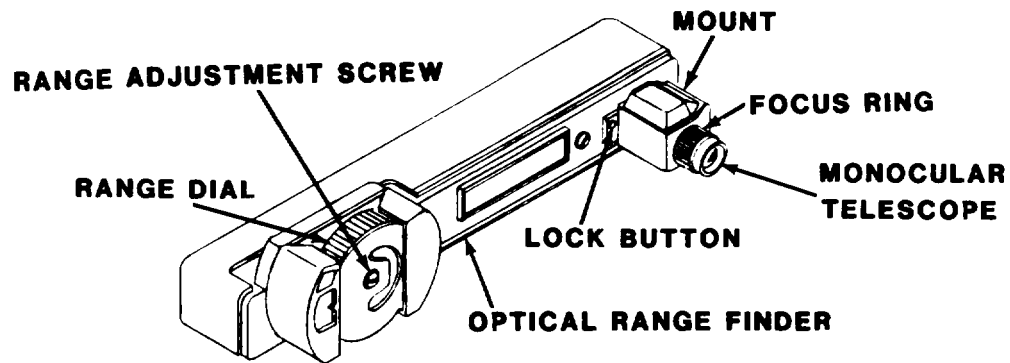
12-4.2.3 Magnifier Lamp



- a. Move magnifier lamp from mounting bracket. Position over object to be examined.
- b. Plug in power cord.

12-4.2.3 Magnifier Lamp - Continued

- c. Turn lamp ON.
- d. Examine object through lens.

12-4.2.4 Optical Range Finder

- a. Focus optical range finder.
 - (1) Place monocular telescope into mount.
 - (2) Lock telescope by pressing down on lock button.
 - (3) Look through telescope, and adjust focus ring until vision is clear.
- b. Measure range.
 - (1) Observe yellow and blue images.
 - (2) Rotate range dial until images merge.
 - (3) Turn range adjustment screw to right or left until images are same height and merge. Adjustment screw can be turned with flat-tip screwdriver or coin.
- c. Read range dial. Scale is shown in meters.

NOTE

If observed range does not equal known or measured range, the range dial must be reset.

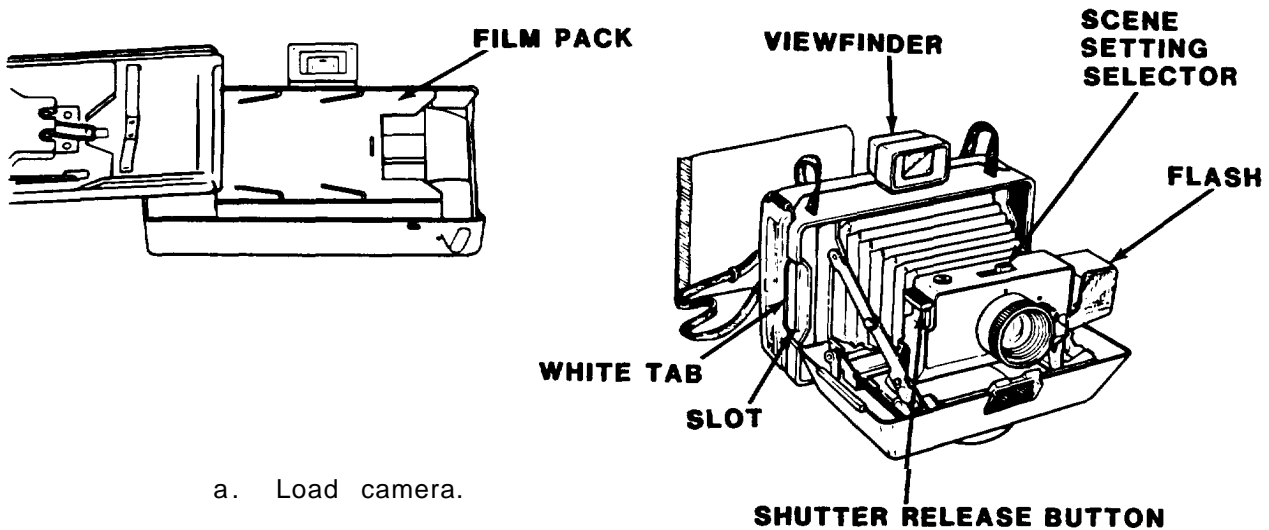
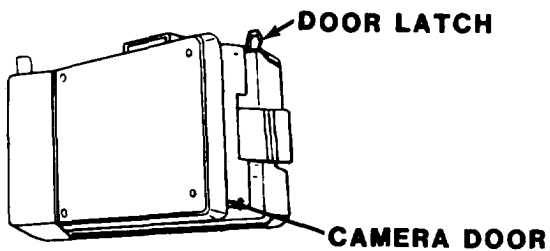
12-4.2.4 Optical Range Finder - Continued

- d. Reset range dial.
 - (1) Rotate range dial until images merge.
 - (2) Place coin or flat-tip screwdriver in range adjustment screw slot.
 - (3) Hold screw position, and move range dial to right or left until correct range is indicated.

12-4.2.5 Pin Punch Register

- a. Remove from wall mount. Place on work surface. Attach punch lever.
- b. Set side gage to proper position.
- c. Insert material to be punched.
- d. Press punch lever down, and punch holes.

12-4.2.6 Still Picture Camera



- a. Load camera.
 - (1) Unhook door latch from door.

12-4.2.6 Still Picture Camera - Continued

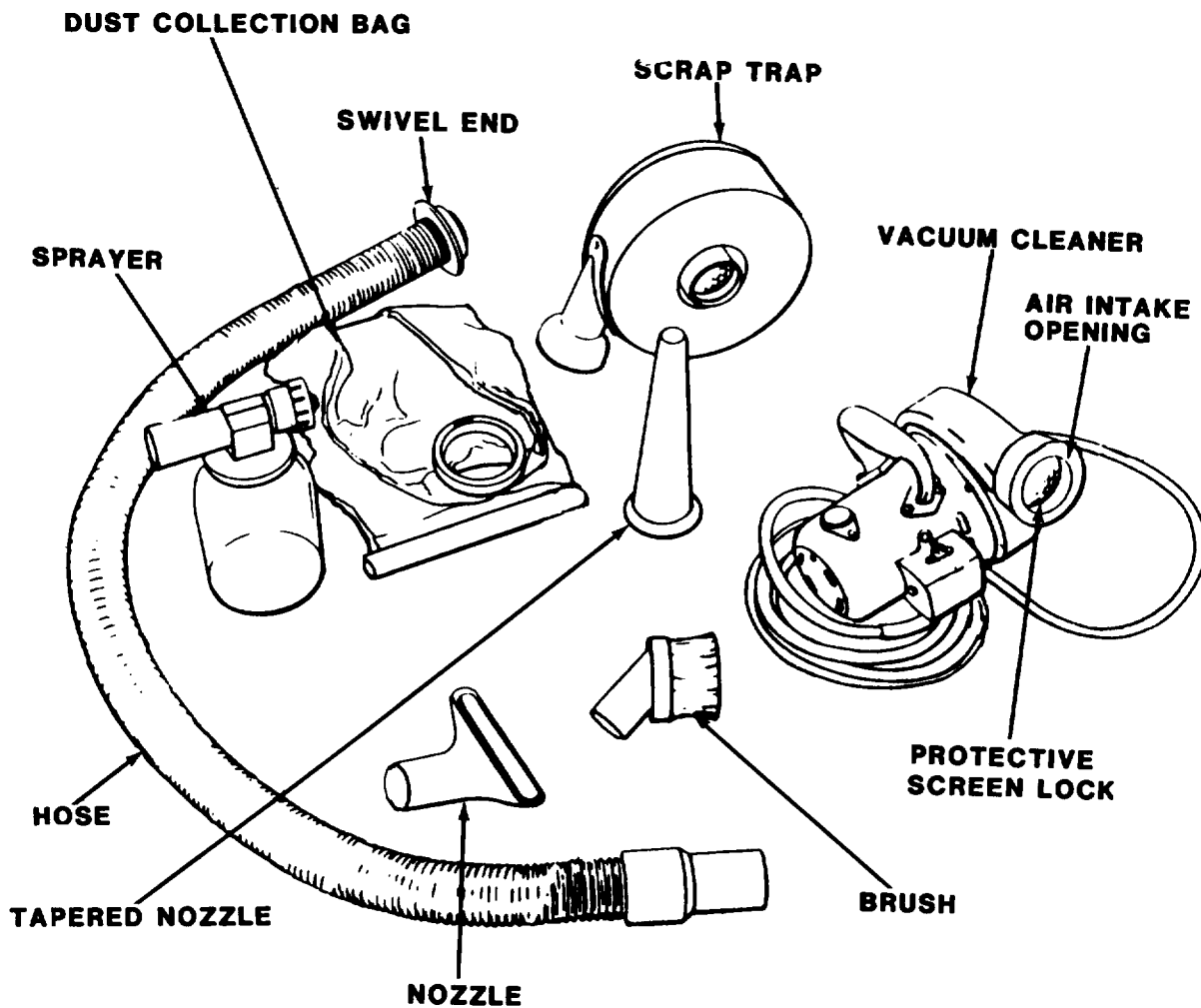
- (2) Choose film type. Open film pack.
 - (3) Load film pack by opening camera back all the way and pressing film pack down into camera.
 - (4) Close camera back. Make sure both sides latch.
 - (5) Pull black tab of safety cover all the way out of the camera. A white tab should now show in slot.
- b. Change scene setting selector by pushing lever to left or right.

NOTE

For outdoor or flash picture, set to 3000 for black and white film. For dim light, set to 3000 ER. Set to 75 for color film.

- c. Attach flashcube by pressing into flash socket. Wind flashcube until a stop is felt.
- d. Observe object in viewfinder, and frame desired object in appropriate lines.
- e. Estimate range in feet to object, and set lens to estimated range.
- f. Press shutter release button.
- g. Remove exposed film with a firm, steady pull.
- h. Wait 60 seconds before removing paper backing.
- i. Coat black and white prints with sealer.
- j. To operate still picture camera in cold (under 65°F, 18°C) weather use the cold pack on the back of the camera.
 - (1) Remove cold pack from back of camera, and place in inner pocket.
 - (2) When exposed film is removed from the camera, put it in cold pack. Put cold pack back in pocket.
 - (3) After 60 seconds, remove exposed film.

12-4.2.7 Vacuum Cleaner



- a. Remove vacuum cleaner and needed attachments from storage box.
- b. For use as a vacuum cleaner:
 - (1) Attach dust collection bag to air discharge opening.
 - (2) Remove protective screen lock from air intake opening, and attach scrap trap.

12-4.2.7 Vacuum Cleaner - Continued

- (3) Attach swivel end of hose to scrap trap by turning lock to right.
 - (4) Attach brush or nozzle to other end of hose.
 - (5) Plug vacuum cleaner into 110 vac wall outlet. Turn switch ON.
- c. For use as a blower:
- (1) Attach tapered nozzle to air discharge opening.
 - (2) Attach protective screen lock to air intake opening.
 - (3) Plug vacuum cleaner into 110 vac wall outlet. Turn switch ON.
- d. For use as a sprayer:
- (1) Attach protective screen lock to air intake opening.
 - (2) Attach swivel end of hose to air discharge opening by turning lock to right.
 - (3) Attach sprayer to other end of hose.
 - (4) Plug vacuum cleaner into 110 vac wall outlet. Turn switch ON.

12-4.2.8 Paper Trimmer

- a. Remove paper trimmer from wall mount.
- b. Position on level work surface.
- c. Aline paper or film with guide on paper trimmer.

WARNING

SHARP BLADE

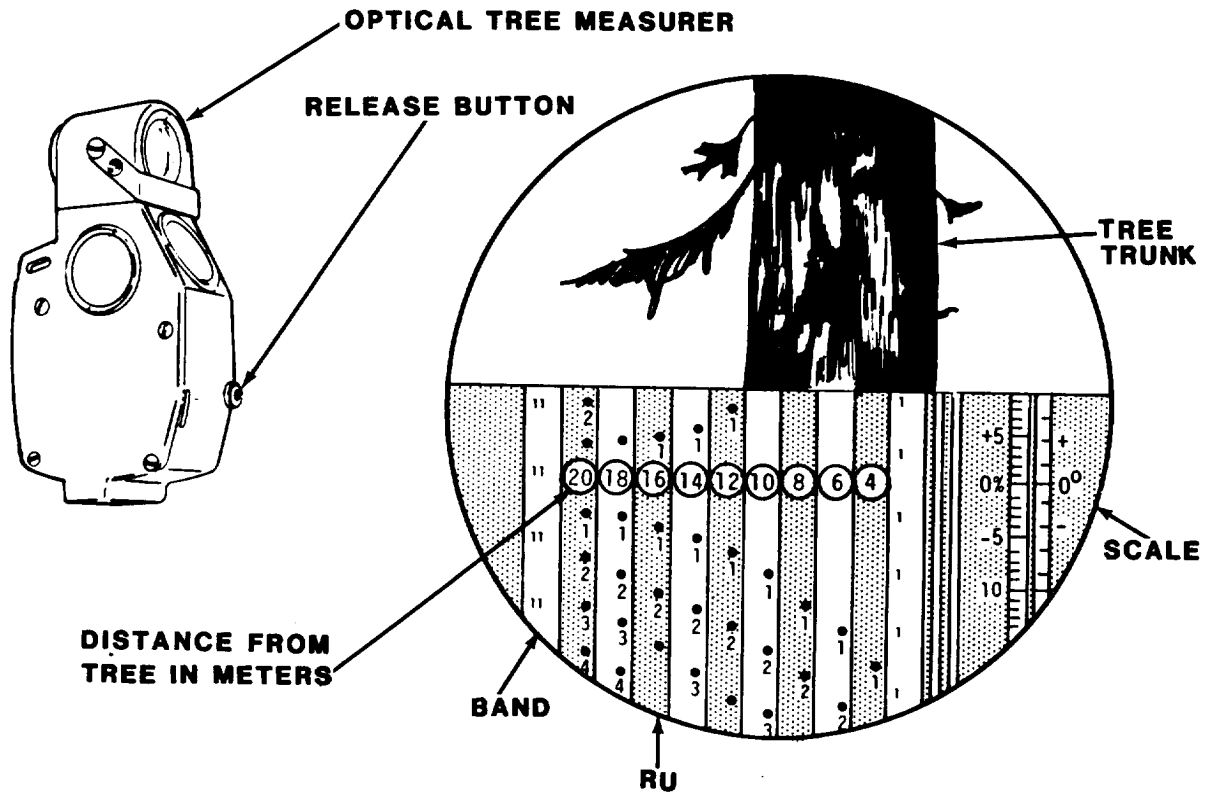
Use caution when cutting. Blade on paper trimmer can seriously cut fingers and hands.

- d. Cut paper carefully by lowering blade handle over edge of paper.

12-4.2.9 Optical Tree Measurer

a. Measure tree diameter.

- (1) Stand at premeasured distance away from tree. The distance must be 4 meters, 6 meters, or even number of meters up to 20 meters.



- (2) Press release button to align scale in tree measurer with tree trunk so that one side of tree is in line with edge of one band shown in scale. Release button to freeze scale movement and take readings.

NOTE

Each band is equal to 1 relascope unit (RU).

The RU is 2% of premeasured distance from tree.

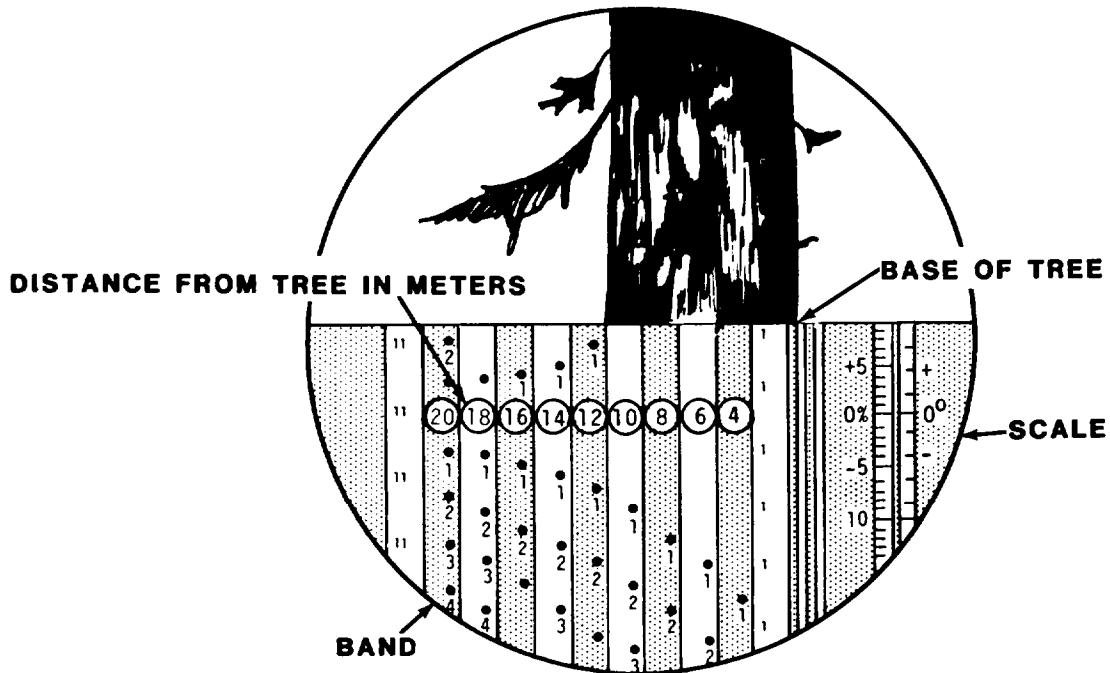
Example: If observation is made from 18 meters and tree is 7.4 RU's; 2% of 18 m = 36 cm.

7.4 RU's = 36 cm x 7.4 = 266 cm diameter of tree (approximate diameter)

12-4.2.9 Optical Tree Measurer - Continued

b. Measure tree height.

- (1) Stand at premeasured distance away from tree. The distance must be 4 meters, 6 meters, or even number of meters up to 20.



- (2) Press release button to align scale in tree measurer with base of tree. Release button to freeze scale. Take reading on band that has measurement of distance away from tree.
- (3) Repeat measurement at top of tree. Add two readings to obtain approximate tree height.

NOTE

Readings above zero on scale are positive.
Readings below zero are negative.

Section III. OPERATOR MAINTENANCE

12-5 LUBRICATION INSTRUCTIONS.

This equipment does not require lubrication.

12-6 OPERATOR TROUBLESHOOTING PROCEDURES.

12-6.1 General

12-6.1.1 The table lists the common malfunctions which you may find during the operation or maintenance of the support items and their components. You should perform the tests/inspections and corrective actions in the order listed.

12-6.1.2 This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

Table 12-2. Operator Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
-------------	--------------------	-------------------

1. FLUORESCENT LAMP IN MAGNIFIER LAMP WILL NOT WORK.

Check to see if magnifier lamp is plugged into active power outlet.

If outlet is active, replace fluorescent lamp.

If magnifier lamp still does not work, replace magnifier lamp.

2. FLASHCUBE ON STILL PICTURE CAMERA WILL NOT FLASH.

Check for loose battery latch.

Close battery latch.

Replace flashcube.

Replace batteries (para 12-7.3).

Table 12-2. Operator Troubleshooting - Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
3. SHUTTER ON STILL PICTURE CAMERA IS NOT OPERATING.	Check shutter operation.	Replace batteries (para 12-7.3). Replace still picture camera.
4. PICTURE FROM STILL PICTURE CAMERA IS TOO DARK OR TOO LIGHT.	Step 1. Check for correct film speed selection.	Correct setting.
	Step 2. Check for dirty photoelectric cell lens.	Clean photoelectric cell lens with lens tissue.
	Step 3. Check for dirty main lens.	Clean main lens with lens tissue. Replace battery (para 12-7.3). Replace camera.
5. PICTURE FROM STILL PICTURE CAMERA NOT CLEAR.	Step 1. Check for dirty lenses.	Clean lenses with lens tissue.
	Step 2. Check for improper focus of camera.	Correct focus. Replace camera.

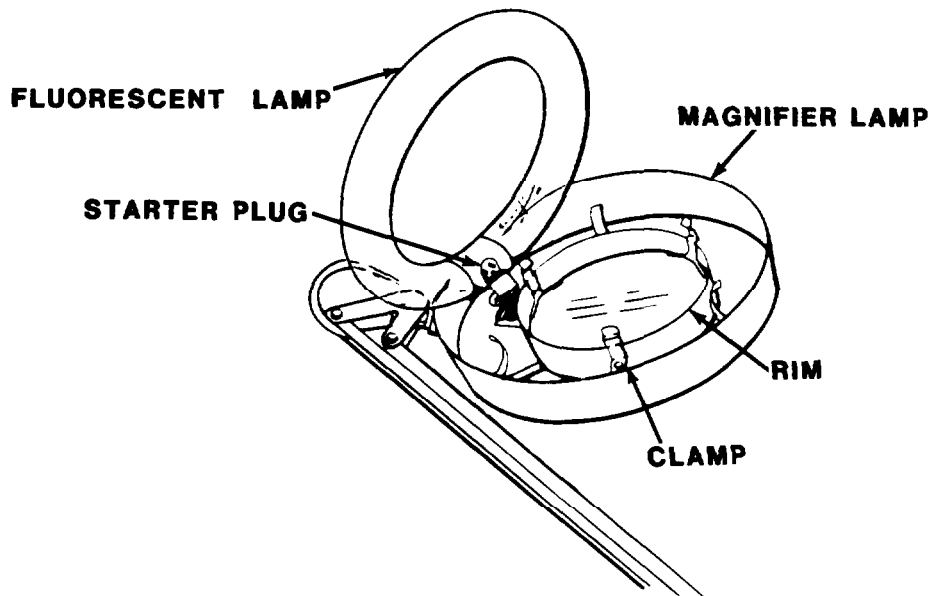
12-7 OPERATOR MAINTENANCE PROCEDURES.

This section contains step-by-step instructions covering operator performed maintenance functions.

12-7.1 Replace Fluorescent Lamp in Magnifier Lamp

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

MATERIALS/PARTS: Fluorescent lamp



REMOVAL:

WARNING

ELECTRICAL SHOCK

Unplug power cord before servicing the magnifier lamp. Failure to do so may result in death or serious injury.

- a. Unplug magnifier lamp.
- b. Grasp fluorescent lamp at starter plug. Loosen clamps.
- c. Pull fluorescent lamp up gently until it pops free from rim.

12-7.1 Replace Fluorescent Lamp in Magnifier Lamp - Continued

INSTALLATION:

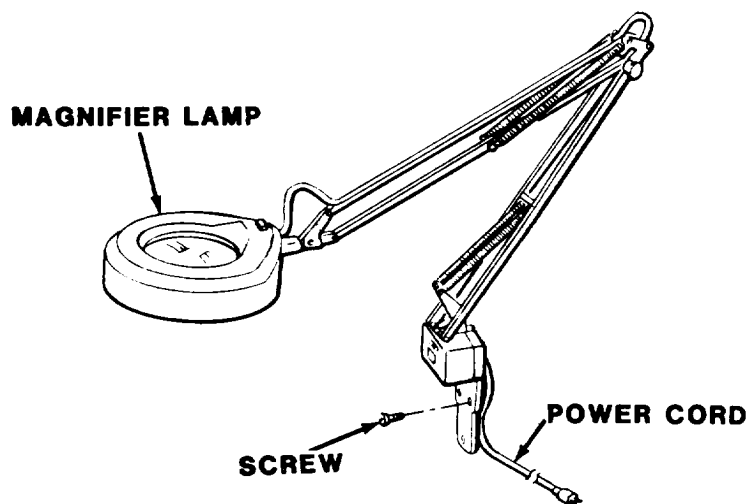
- a. Aline starter plug of new fluorescent lamp with power jack. Press lamp gently into rim.
- b. Secure with clamps.
- c. Plug in magnifier lamp, and turn ON.

12-7.2 Replace Magnifier Lamp

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: No. 2 cross-tip screwdriver

MATERIALS/PARTS: Magnifier lamp



REMOVAL:

WARNING**ELECTRICAL SHOCK**

Unplug power cord before servicing the magnifier lamp. Failure to do so may result in death or serious injury.

- a. Unplug power cord.

12-7.2 Replace Magnifier Lamp - Continued

- b. Remove three screws mounting magnifier lamp to wall. Remove defective magnifier lamp.

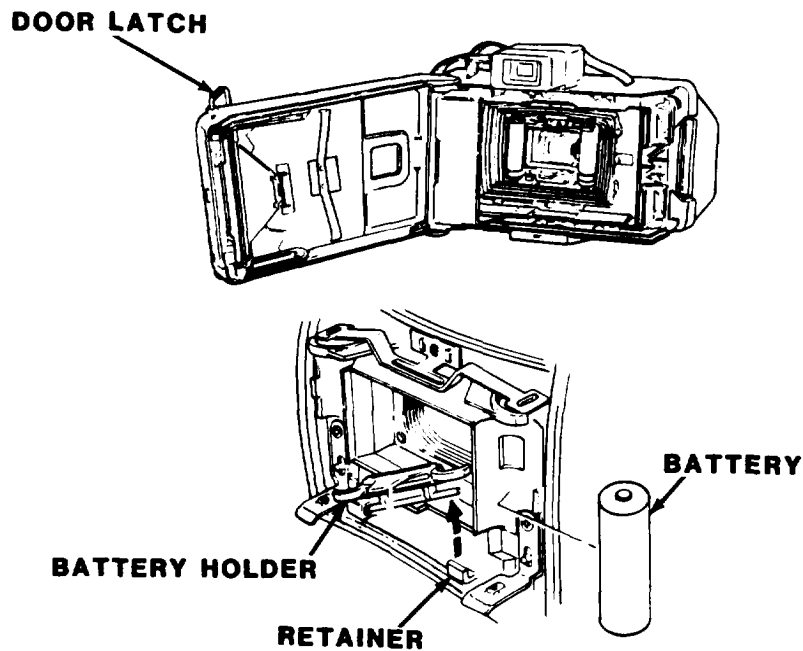
INSTALLATION:

- a. Install new magnifier lamp.
- b. Secure to wall with three screws.
- c. Plug in power cord. Turn power ON.

12-7.3 Replace Batteries in Still Picture Camera

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

MATERIALS/PARTS: Two 15 v, AA batteries



REMOVAL:

- a. Release door latch, and open camera door.
- b. Lift right end of battery holder, and remove holder from retainer.

12-7.3 Replace Batteries in Still Picture Camera - Continued

- c. Note position of each battery and pull batteries out of holder.

INSTALLATION:

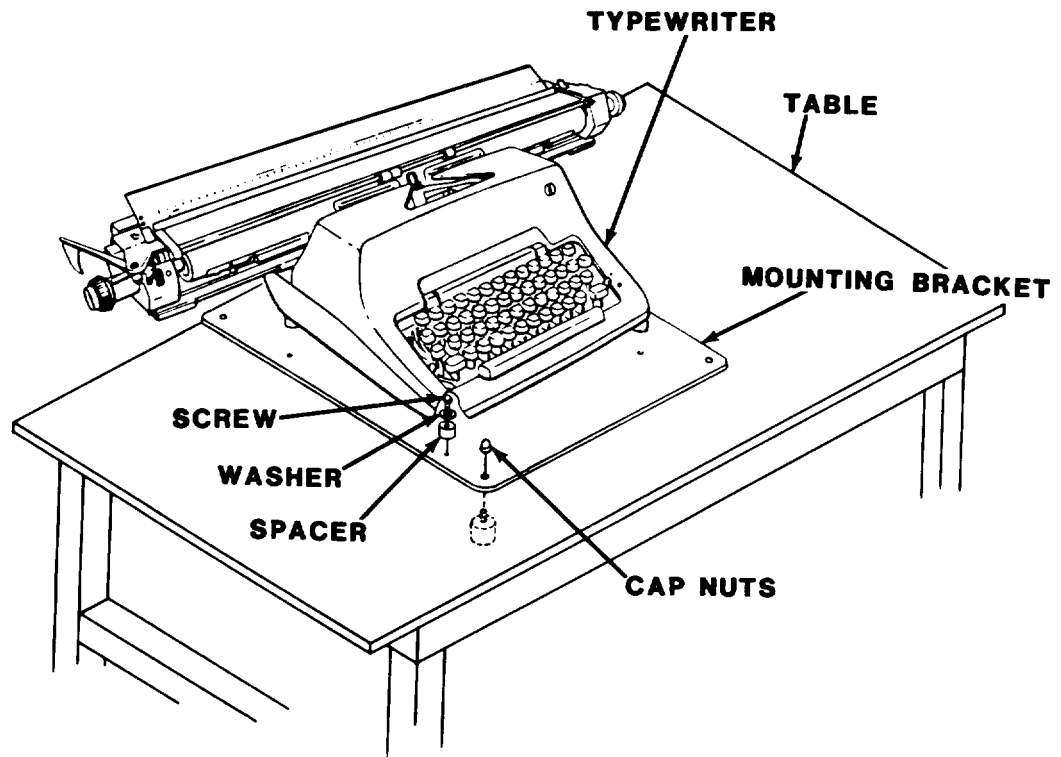
- a. Place new batteries in correct position in holder.
- b. Reinstall battery holder by sliding left edge into slot and pushing right end into retainer.
- c. Close and latch camera door.

12-7.4 Replace Manual Typewriter

PERSONNEL REQUIRED: 1 Terrain analyst MOS 81Q

TOOLS: 1/2-inch combination box and open end wrench
5/16-inch flat-tip screwdriver

MATERIALS/PARTS: Manual Typewriter Model SG3L24



12-7.4 Replace Manual Typewriter - Continued

REMOVAL:

- a. Remove cap nuts securing mounting bracket to table.
- b. Remove typewriter and mounting bracket from table.
- c. Remove four screws, washers, and spacers securing typewriter to mounting bracket.

INSTALLATION:

- a. Secure typewriter to mounting bracket with four spacers, washers, and screws.
- b. Install new typewriter and bracket on table.
- c. Reinstall cap nuts securing mounting bracket to table.

Section IV. ORGANIZATIONAL MAINTENANCE

12-8 There are no assigned organizational maintenance tasks for this equipment.

12-9 PREPARATION FOR STORAGE OR SHIPMENT.

In the event that the support items must be removed from the section for repair or replacement, refer to TM 750-90-1 for storage instructions.

Section V. DIRECT/GENERAL SUPPORT MAINTENANCE

There are no assigned direct/general support maintenance tasks for this equipment.

APPENDIX A

REFERENCES

A-1 SCOPE.

This appendix lists all forms, technical manuals, field manuals, miscellaneous publications, and the commercial manual required for operation and maintenance of the Direct Support Section.

A-2 FORMS.

Hand Receipt/Annex Number	DA Form 2062
Equipment Daily Log	DA Form 2408-1
Equipment Inspection and Maintenance Worksheet	DA Form 2404
Maintenance Request	DA Form 2407
Recommended Changes to Equipment Technical Publications	DA Form 2028-2
Recommended Changes to Publications and Blank Forms	DA Form 2028

A-3 TECHNICAL MANUALS.

Administrative Storage of Equipment	TM740-90-1
Chemical, Biological, and Radiological (CBR) Decontamination	TM3-220
Cooling Systems for Tactical Vehicles	TM750-254
Direct Support and General Support Maintenance Manual, Truck Chassis: for Direct Support Section, Topographic Support System (TSS)	TM9-2320-281-34
Hand Receipt Covering Contents of Components of End Item (COEI), Basic Issue Items (BII), and Additional Authorization List (AAL) for Topographic Support System Direct Support Section	TM5-6675-326-14-HR
Hand Receipt Covering Contents of Components of End Item (COEI), Basic Issue Items (BII), and Additional Authorization List (AAL), for Truck Chassis, Direct Support Section, Topographic Support System	TM9-2320-281-10-HR

TM5-6675-326-14

Image Interpretation Handbook, Vol. I TM30-245

Inspection, Care, and Maintenance of Antifriction Bearings TM9-214

Operation and Maintenance of Ordnance Material in Extreme Cold Weather (0° to -65°F -- -18° to -54°C) TM9-207

Operator's Manual for Camera Set, Still Picture, KS-99C and KS-99C (1) TM11-6720-253-10

Operator's Manual, Truck Chassis: for Direct Support Section, Topographic Support System (TSS) TM9-2320-281-10

Operator's, Organizational, Direct Support, and General Support Maintenance Manual, Air Conditioner, Horizontal, Compact, 208-Volt, 3-Phase, 18,000 BTUH Cooling, 12,000 BTUH Heating TM5-4120-367-14

Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Facsimile Transmitting and Receiving Device, Magnavox Model AN/GXC-7A TM11-5895-1079-14

Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Diazo Reproduction Set TM5-3610-256-14

Operator's, Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Facsimile Receiving Device TM11-5895-1079-14

Organizational Care, Maintenance, and Repair of Pneumatic Tires, Inner Tubes, and Radial Tires TM9-2610-220-20

Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Air Conditioner/Heater TM5-4120-367-24P

Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (RPSTL) (Including Depot Maintenance Repair Parts and Special Tools) for Topographic Support System, Direct Support Section TM5-6675-326-24P

Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Diazo Reproduction Set TM5-3610-256-24P

Organizational, Direct Support, and General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Truck Chassis, Direct Support Section, Topographic Support System TM9-2320-281-24P

Organizational Maintenance Manual, Truck Chassis: for Direct Support Section, Topographic Support System (TSS) TM9-2320-281-20

Painting Instructions for Field Use TM43-0139

Principles of Automotive Vehicles TM9-8000

Procedures for Destruction of Equipment to Prevent Enemy Use TM750-244-3

Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use TM750-244-6

Use and Care of Hand Tools and Measuring Tools TM9-343

Welding Theory and Application TM9-237

A-4 FIELD MANUALS.

Army Motor Transport Units and Operations FM55-30

Basic Cold Weather Manual FM31-70

Camouflage FM5-20

Manual for the Wheeled Vehicle Driver FM21-305

Metal Body Repair and Related Operations FM43-2

Northern Operations FM31-71

Nuclear, Biological, and Chemical (NBC) Defense (Reprinted with Basic Inc1. C1) FM21-40

A-5 MICELLANEOUS PUBLICATIONS.

TM5-6675-326-14

Consolidated Index of Army Publications
and Blank Forms DA Pam 310-1

Lubrication Order, Direct Support Section L05-6675-326-12

Lubrication Order, Truck Chassis: Direct
Support Section, Topographic Support
System (TSS) (2320-01-113-3616) L09-2320-281-12

The Army Maintenance Management System
(TAMMS) DA Pam 738-750

A-6 COMMERCIAL MANUAL.

Operating Instructions, Olympia Model SG3B

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1 GENERAL.

B-1.1 This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.

B-1.2 The Maintenance Allocation Chart (MAC) in section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

B-1.3 Section III lists the special tools and test equipment required for each maintenance function as referenced from section II.

B-1.4 Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B-2 MAINTENANCE FUNCTIONS. Maintenance functions will be limited to and defined as follows:

B-2.1 Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound, or feel).

B-2.2 Test. To verify serviceability by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

B-2.3 Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

B-2.4 Adjust. To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

B-2.5 Aline. To adjust specified variable elements of an item to bring about optimum or desired performance.

B-2.6 Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipment used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

B-2.7 Remove/Install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

B-2.8 Replace. To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and is shown as the 3d position code of the SMR code.

B-2.9 Repair. The application of maintenance services¹, including fault location/troubleshooting², removal/installation, and disassembly/assembly³ procedures, and maintenance actions⁴ to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

B-2.10 Overhaul. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

B-2.11 Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc) considered in classifying Army equipment/components.

¹Services - Inspect, test, service, adjust, aline, calibrate, and/or replace.

²Fault locate/troubleshoot - The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (UUT).

³Disassemble/assemble- Encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its least component identified as maintenance significant (i.e., assigned an SMR code) for the category of maintenance under consideration.

⁴Actions - Welding, grinding, riveting, straightening, facing, remachinery and/or resurfacing.

B-3 EXPLANATION OF COLUMNS IN TEE MAC, SECTION II.

B-3.1 Column 1, Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00."

B-3.2 Column 2, Component/Assembly. Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

B-3.3 Column 3, Maintenance Function. Column 3 lists the functions to be performed on the item listed in Column 2. (For detailed explanation of these functions, see paragraph B-2.)

B-3.4 Column 4, Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function varies at different maintenance categories, appropriate work time figures will be shown for each category. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance categories are as follows:

C	. . . . .	Operator or Crew
O	. . . . .	Organizational Maintenance
F	. . . . .	Direct Support Maintenance
H	. . . . .	General Support Maintenance
D	. . . . .	Depot Maintenance

B-3.5 Column 5, Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

B-3.6 Column 6, Remarks. This column shall, when applicable, contain a letter code, in alphabetical order, which shall be keyed to the remarks contained in Section IV.

B-4 EXPLANATION OF COLUMNS IN TOOL AND TEST REQUIREMENTS, SECTION III.

B-4.1 Column 1, Reference Code. The tool and test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

B-4.2 Column 2, Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.

B-4.3 Column 3, Nomenclature. Name or identification of the tool or test equipment.

B-4.4 Column 4, National Stock Number. The National stock number of the tool or test equipment.

B-4.5 Column 5, Tool Number. The manufacturer's part number.

B-5 EXPLANATION OF COLUMNS IN REMARKS, SECTION IV

B-5.1 Column 1, Reference Code. The code recorded in Column 6, Section II.

B-5.2 Column 2, Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

**Section II. MAINTENANCE ALLOCATION CHART
FOR
DIRECT SUPPORT SECTION**

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment	(6) Remarks
			C	O	F	H	D		
00	DIRECT SUPPORT SECTION								
01	VAN BODY (ISO CONTAINER)	Inspect Service	0.4 1.1						
0101	VENTILATION DUCTS	Inspect Service	0.1 0.3				3,10		
0102	BLACKOUT/DOME LIGHT	Replace	0.1				1,3,11,12		
0103	FLUORESCENT CEILING LAMP	Inspect Replace	0.1 0.1				11		
0104	FLUORESCENT LAMP BALLAST	Replace		0.4			1,3		
0105	RADIO FREQUENCY (RF) FILTER	Replace		0.4			1		
0106	FLUORESCENT LIGHT SWITCH	Replace		0.2			1,2,3		
0107	ELECTRICAL ON/OFF SWITCH	Replace		0.2			1		
0108	ELECTRICAL RECEPTACLE	Replace		0.2			1		
0109	CONDUIT BASE AND COVERING	Inspect Repair		0.3 1.4			2,3		
0110	TELEPHONE BINDING POST	Inspect Replace		0.1 0.1			3,1		
0111	VENTILATION FAN	Inspect Replace	0.1	0.4			3		
0112	VENTILATION FAN COVER	Replace		0.3					
0113	EMERGENCY LIGHT ASSEMBLY	Inspect Replace		0.1 0.1			3,2		

**Section II. MAINTENANCE ALLOCATION CHART
FOR
DIRECT SUPPORT SECTION - Continued**

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
0114	BLACKOUT CURTAIN	Inspect Replace	0.1	0.2				3	
0115	VAN BODY SKIN (TEMPORARY)	Inspect Repair	0.1	0.5				3,2	
0116	TIEDOWN SOCKET	Replace		0.2				3	
0117	LEVEL INDICATOR	Inspect Replace	0.1	0.3				7,3,1	
0118	AIR VENT DOOR	Replace		0.1				2,4	
0119	PERSONNEL LADDER	Inspect Repair Replace	0.1	0.3 0.1				4,2	
0120	PERSONNEL/CARGO DOOR HANDLE	Repair			0.5			3,2	
0121	CARGO DOOR LATCH ASSEMBLY	Replace			0.3			2	
0122	PERSONNEL/CARGO DOOR GASKET	Replace			0.5			1	
0123	PERSONNEL/CARGO DOOR	Replace			1.4			4,2	
0124	CIRCUIT BREAKER	Inspect Replace	0.1		0.3			1	
0125	FUSE	Inspect Replace	0.1 0.1						
0126	FLOOR COVERING	Inspect Repair			0.1 0.7			1,3	
0127	VAN BODY SKIN (PERMANENT)	Inspect Repair			0.2 1.0			4,2	
0128	AIR CONDITIONER/ HEATER	Replace			1.1			3,2	C
0129	AIR CONDITIONER SUPPORT BRACKET	Replace			1.3			2,3	C

**Section II. MAINTENANCE ALLOCATION CHART
FOR
DIRECT SUPPORT SECTION — Continued**

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment	(6) Remarks
			C	O	F	H	D		
0130	VENTILATION DUCT	Replace			0.7			2,4,3	
02	SPLIT-STAGE LIGHT TABLE	Inspect Service Adjust Repair Replace	0.1 0.2		1.0			6,2,3,16	
0201	FUSE	Replace	0.1						
0202	FILM ROLLERS	Replace	0.1					3,13	
0203	ON/OFF SWITCH	Replace		0.2				3,1,2	
0204	GRID INTENSITY CONTROL POTENTI- OMETER	Replace		0.5				2,1,3	
0205	MAIN POWER SWITCH	Replace		0.1				2	
0206	DIMMER CIRCUIT ASSEMBLY	Replace			0.2			3,2	
0207	BRUSH	Replace		0.2				3,2,1	
0208	LIGHT GRID ASSEMBLY	Inspect Adjust Replace	0.1		0.4 1.1			2,8 3,2,1	
0209	X-AXIS CHAIN	Inspect Adjust	0.1		0.1			3	
0210	Y-AXIS CHAIN	Inspect Adjust	0.1		0.1			3	
0211	Z-AXIS CHAIN	Inspect Service Adjust	0.1		0.2 0.1			2	
0212	MOMENTARY SWITCH	Replace			0.2			2,1	
0213	CARRIAGE CLUTCH SWITCH	Replace			0.2			1,2	
0214	FAN	Replace			0.2			2	
0215	TRANSFORMER	Replace			0.2			2,1	

**Section II. MAINTENANCE ALLOCATION CHART
FOR
DIRECT SUPPORT SECTION — Continued**

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment	(6) Remarks
			C	O	F	H	D		
03	ZOOM STEREOSCOPE 95R	Inspect	0.2					1	
		Service	0.2					1	
		Replace	0.1					1	
04	ZOOM TRANSFER SCOPE ZT4-H	Inspect	0.1						
		Service	0.2						
		Adjust	0.1					3	
0401	BULB	Replace	0.1						
0402	ATTACHMENT LENS, STAGE LENS	Inspect	0.1					19	
		Service	0.2						
0403	FUSES	Replace	0.1						
0404	POWER SWITCH	Replace			0.1			2,3	
0405	PILOT LIGHT	Replace			0.1			2,3	
0406	POWER CORD	Replace	0.2					2,3	
0407	FOOT SWITCH	Replace			0.2			2,3	
0408	ILLUMINATOR CONTROL POTENTIOMETER	Inspect	0.1						
		Replace			0.1			2,3,1	
0409	FUSE HOLDERS	Replace			0.1			2	
0410	ILLUMINATOR PLUG RECEPTACLES	Replace			0.3			2	
0411	ILLUMINATOR SELECTOR SWITCHES	Inspect	0.1						
		Replace			0.1			3,1	
0412	OPTICAL SYSTEM	Inspect	0.2						
		Service	0.2						
		Replace			0.2			3	
05	PORTABLE TRACING/ SCRIBING BOARD	Inspect	0.1						
		Service	0.2					3	
		Repair	0.7	0.7					
0501	GLASS SURFACE	Replace	0.3					3,11	

**Section II. MAINTENANCE ALLOCATION CHART
FOR
DIRECT SUPPORT SECTION — Continued**

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment	(6) Remarks
			C	O	F	H	D		
0502	FLUORESCENT LAMP	Inspect Replace	0.1 0.1					3	
0503	STARTER	Replace		0.1				3	
0504	POWER SWITCH	Replace		0.2				3	
0505	POWER CORD	Replace		0.1				3	
0506	BALLAST TRANSFORMER	Replace		0.2				3	
06	QUALITY PROCESSING SYSTEM	Inspect Service Adjust Aline Repair	0.1 0.3 0.2 0.5	0.3 0.2		0.2 1.5			
0601	PLANIMETER	Inspect Service	0.3 0.5						
0602	TEFLON GUIDE WASHER	Replace	0.1					2,3,14,18, 19	
0603	COMPRESSION SPRING	Replace	0.2					3,19	
0604	PAPER DISK	Inspect Replace	0.1 0.2						
0605	PLANIMETER ENCODER	Aline Replace			0.2 0.4			2,3,1,5,6, 14 3,1,2	
0606	MAIN LOGIC PC BOARD	Test Replace			0.1 0.3			2,3	A,B
0607	FRONT DISPLAY PC BOARD	Test Replace			0.1 0.3			2,3	A,B
0608	REAR INPUT PC BOARD	Test Replace			0.1 0.3			2,3	A,B
0609	AUTO-SCALER PC BOARD	Test Replace			0.1 0.3			2,3	A,B
0610	CALCULATOR HP-97	Inspect Service Replace	0.1 0.1 0.1						

**Section II. MAINTENANCE ALLOCATION CHART
FOR
DIRECT SUPPORT SECTION — Continued**

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment	(6) Remarks
			C	O	F	H	D		
0611	BATTERY PACK	Inspect Replace	0.1 0.1						
07	ULTRASONIC CLEANER	Inspect Service Repair Replace	0.1 0.5	0.7 0.1					
0701	POWER CORD	Inspect Replace	0.1	0.2			2		
0702	POWER SWITCH	Replace		0.2			2		
0703	CIRCUIT BOARD	Replace		0.3			2		A,B
08	POCKET CALCULATOR	Inspect Service Replace	0.1 0.1 0.1						
0801	BATTERY PACK	Inspect Replace	0.1 0.1						
0802	AC RECHARGER/ POWER CORD	Inspect Replace	0.1 0.1						
09	FACSIMILE TRANSMISSION AND RECEIVING DEVICE	Replace		0.2					D
10	DIAZO REPRODUCTION SET	Replace		0.3			9		E
11	FURNITURE AND CABINETS	Inspect	0.1						
1101	WORK SURFACE	Replace		0.5			3		
1102	TWO-DRAWER FILING CABINET	Replace		0.2			9		
1103	TYPEWRITER TABLE	Replace		0.1			9		
1104	SECURITY FILING CABINET	Replace		0.3			9		

**Section II. MAINTENANCE ALLOCATION CHART
FOR
DIRECT SUPPORT SECTION — Continued**

(1) Group Number	(2) Component/Assembly	(3) Maintenance Function	(4) Maintenance Category					(5) Tools and Equipment	(6) Remarks
			C	O	F	H	D		
1105	WALL STORAGE CABINET	Repair Replace		0.4 0.3				9	
1106	DIAZO PAPER STORAGE CABINET	Replace		0.3				3,9	
1107	DIAZO SUPPLY CABINET	Repair		0.5				9	
1108	MAP CABINET	Replace		0.3				9	
1109	LATCH (HANDLE TYPE)	Replace		0.4				3,2	
1110	LATCH (RECESSED CUP TYPE)	Replace		0.4				2,3	
1111	HINGE (PIANO)	Replace		0.3				2,4	
12	SUPPORT ITEMS	Inspect Service	0.4 0.5						
1201	MAGNIFIER LAMP	Inspect Repair Replace	0.1 0.2 0.1					3,11	
1202	FLUORESCENT LAMP IN MAGNIFIER LAMP	Replace	0.2						
1203	STILL PICTURE CAMERA SET	Inspect Service	0.1 0.3						
1204	BATTERIES	Replace	0.1						
1205	MANUAL TYPEWRITER	Inspect Replace	0.1 0.3					2,15,17	
1206	OPTICAL RANGE FINDER	Inspect Service	0.1 0.2						
1207	OPTICAL TREE MEASURER	Inspect Service	0.1 0.2						
1208	PAPER TRIMMER	Inspect	0.1						

**Section II. MAINTENANCE ALLOCATION CHART
FOR
DIRECT SUPPORT SECTION - Continued**

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQUIPMENT	(6) REMARKS
			C	O	F	H	D		
1209	PIN PUNCH REGISTER	Inspect Service	0.1 0.1						
1210	VACUUM CLEANER	Inspect	0.1						
1211	PROTOTYPE 35 MM CAMERA	Inspect	0.1						

**Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
DIRECT SUPPORT SECTION**

Tool or Test Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
1	O	ELECTRONIC EQUIPMENT TOOL KIT	5180-00-610-8177	TK-105/G
2	O	ELECTRONIC EQUIPMENT TOOL KIT	5180-00-605-0079	TK-100/G
3	O	PRECISION INSTRUMENT TOOL KIT	5180-00-596-1538	
4	O	RIVETER	5120-00-756-5569	
5	F	DIP CLIP (14 PIN)	5999-01-039-6778	
6	F	MULTIMETER	6625-01-118-9914	3466A-115 (28480)
7	O	CARPENTER'S LEVEL AND PLUMB	5210-00-241-8305	
8	C	PHOTOMETER	6695-00-548-8067	
9	C	SOCKET WRENCH SET (1/2 IN. DRIVE)	5120-00-081-2307	
10	C	SCREWDRIVER, NO. 1 CROSS-TIP	5120-00-764-8080	
11	C	SCREWDRIVER, NO. 2 CROSS-TIP	5120-00-234-8913	
12	C	SCREWDRIVER, 1/4-IN. FLAT-TIP	5120-00-293-0314	
13	C	SCREWDRIVER, 9/64-IN. FLAT-TIP	5120-00-287-2504	
14	C	SCREWDRIVER, 3/16-IN. FLAT-TIP	5120-00-236-2127	
15	C	SCREWDRIVER, 5/16-IN, FLAT-TIP	5120-00-234-8910	
16	F	AUTOCOLLIMATOR	6760-00-161-2532	
17	C	1/2-IN, COMBINATION BOX AND OPEN-END WRENCH	5120-00-228-9506	
18	C	POCKET KNIFE	5110-00-240-5943	
19	C	WRENCH SET ALLEN JACKET, 9 BITS		644 (73120)

Section IV. REMARKS

REFERENCE CODE	REMARKS
A	<p>Direct Support Maintenance will provide printed circuit board diagnosis and fault isolation which can readily be accomplished with assigned tools and test, measurement, and diagnostic equipment (TMDE).</p>
B	<p>Replacement of printed circuit boards authorized by the MAC are those identified as damaged or otherwise defective which</p> <ul style="list-style-type: none"> a) Can readily be removed/installed with easy-to-use tools. b) Do not require critical adjustment, calibration, or alinement before or after installation.
C	<p>See TM5-4120-367-14 for maintenance procedures.</p>
D	<p>See TM11-5895-1079-14 for maintenance procedures.</p>
E	<p>See TM5-3610-256-14 for maintenance procedures.</p>

APPENDIX C
COMPONENTS OF END ITEM AND BASIC ISSUE ITEMS LISTS

Section I. INTRODUCTION

C-1 SCOPE.

This appendix lists components of end item and basic issue items for the Direct Support Section to help you inventory items required for safe and efficient operation.

C-2 GENERAL.

The Components of End Item and Basic Issue Items lists are divided into the following sections:

C-2.1 Section II. Components of End Item. This list is for informational purposes only and is not authority to requisition replacements. These items are part of the end item, but are removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

C-2.2 Section III. Basic Issue Items. These are the minimum essential items required to place the Direct Support Section in operation, to operate it, and to perform emergency repairs. Although shipped separately packaged, BII must be with the Direct Support Section during operation and whenever it is transferred between property accounts. The illustrations will assist you with hard-to-identify items. This manual is your authority to request/requisition replacement BII, based on TOE/MTOE authorization of the end item.

C-3 EXPLANATION OF COLUMNS.

The following provides an explanation of columns found in the tabular listings:

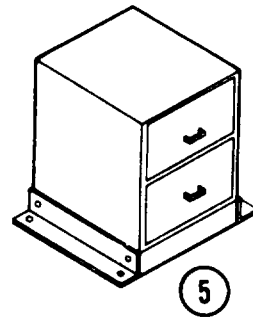
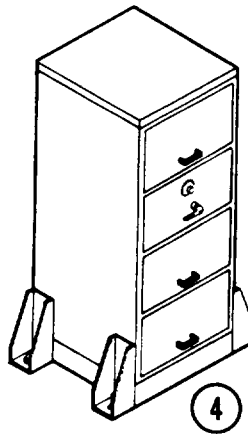
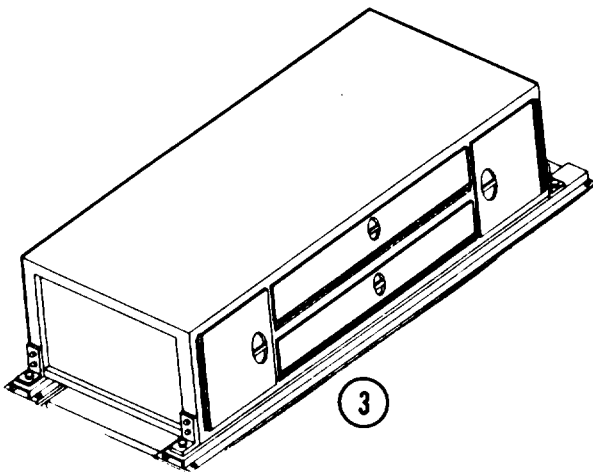
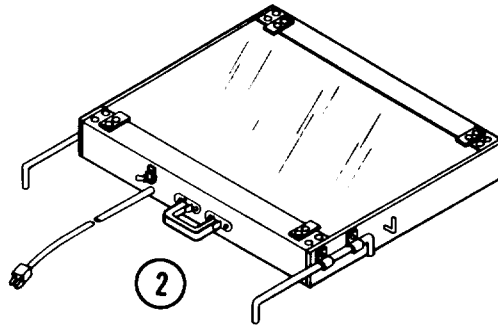
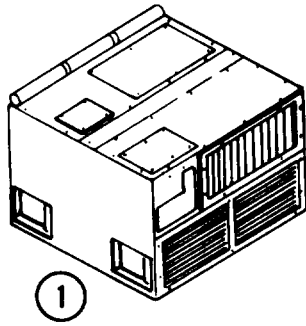
C-3.1 column (1) - Illustration Number (Illus Number). This column indicates the number of the illustration in which the item is shown.

C-3.2 Column (2) - National Stock Number. Indicates the National stock number assigned to the item and will be used for requisitioning purposes.

C-3.3 Column (3) - Description. Indicates the Federal item name and, if required, a minimum description to identify and locate the item. The last line for each item indicates the FSCM (in parentheses) followed by the part number.

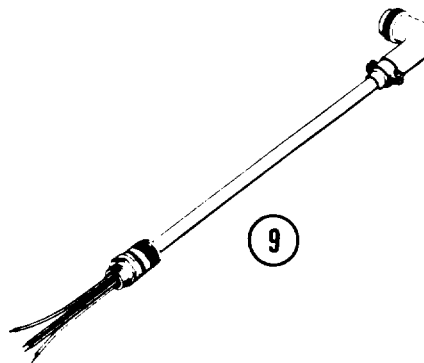
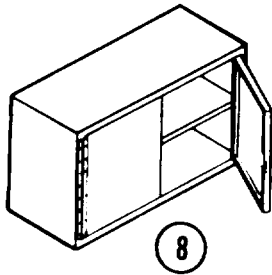
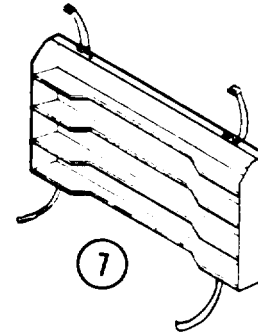
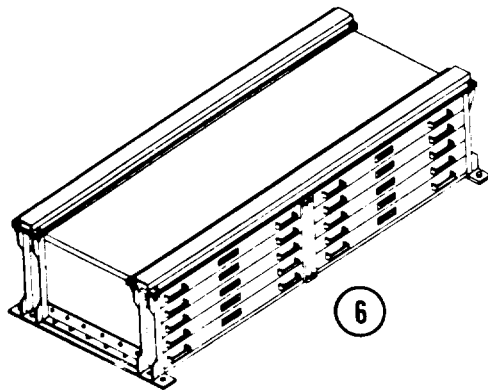
C-3.4 Column (4) - Unit of Measure (U/M). Indicates the measure used in performing the actual operational/maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g. , ea, in. in., pr).

Section II. COMPONENTS OF END ITEM



(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
1	4120-00-974-7206	AIR CONDITIONER (81349) MIL-A-52767	EA	2
2	6675-00-221-7121	BOARD, PORTABLE TRACING/ SCRIBING (26954) 51J3	EA	1
3		CABINET, DIAZO SUPPLY (97403) 13225E4223	EA	1
4	7110-00-920-9320	CABINET, FILING, SECURITY	EA	1
5	7110-00-551-5487	CABINET, FILING, TWO- DRAWER (97403) 13225E4114	EA	4

Section II. COMPONENTS OF END ITEM - Continued

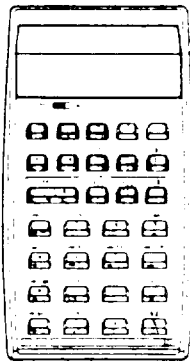


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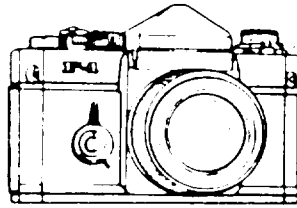


(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
6		CABINET, MAP (51745) ADC-1856	EA	2
7		CABINET, PAPER STORAGE, DIAZO (97403) 13225E4185	EA	2
8	7125-00-286-5259	CABINET, WALL STORAGE (97403) 13225E3150	EA	4
9	7150-00-134-0847	CABLE ASSEMBLY, POWER, ELECTRICAL, 50 FOOT (19207) 11601643	EA	2
10	2590-00-134-0848	CABLE ASSEMBLY, SPECIAL PURPOSE (19207) 11601641	EA	

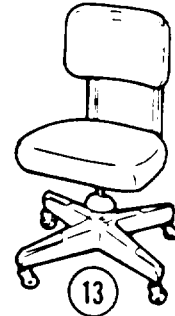
Section II. COMPONENTS OF END ITEM - Continued



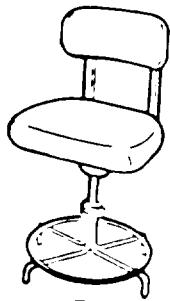
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12



13



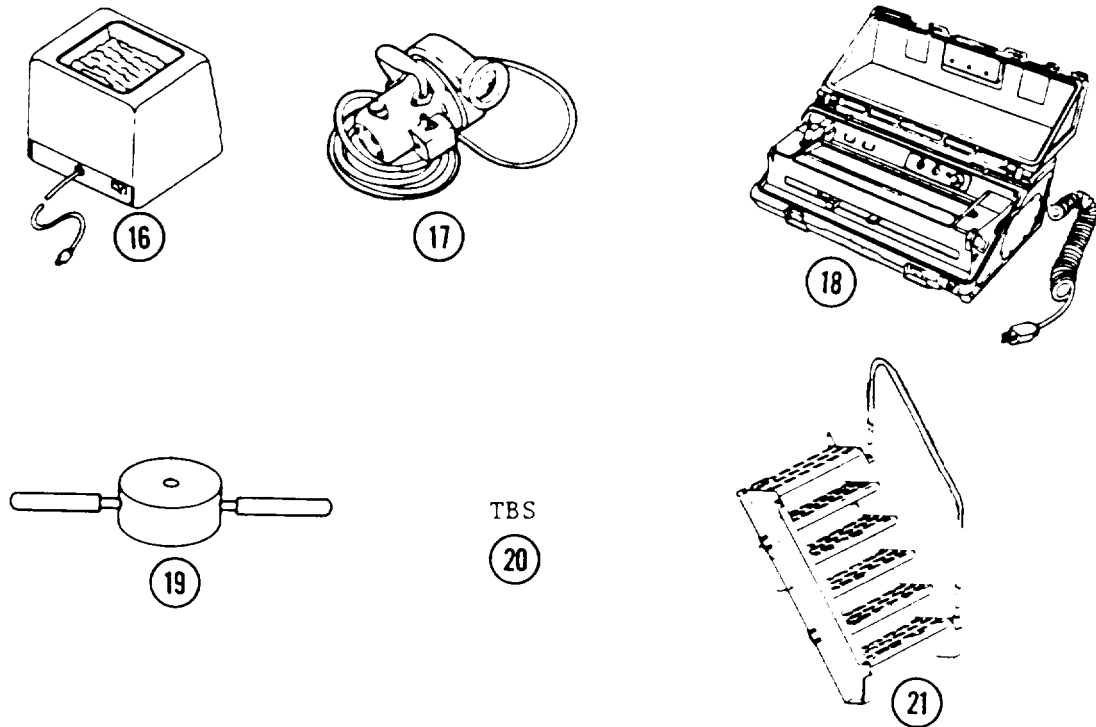
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15

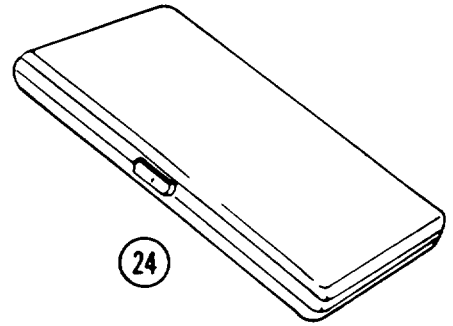
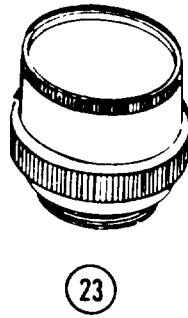
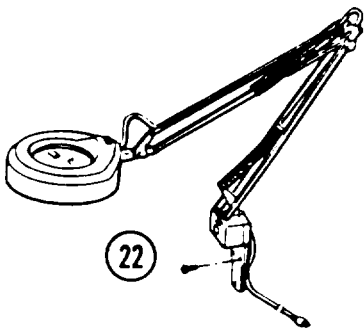
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M
11	7420-01-NNIIN	CALCULATOR, POCKET (28480) HP-32E	EA
12	6720-01-064-8071	CAMERA SET (29556) EE-100	EA
13	7110-01-019-7854	CHAIR, DESK, ROTARY (59177) S-21	EA
14	7110-00-281-4472	CHAIR, DRAFTING, ROTARY (59177) D-42	EA
15	7110-00-269-8463	CHAIR, FOLDING (21858) 210	EA

Section II. COMPONENTS OF END ITEM - Continued



(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
16	4940-01-NNIIN	CLEANER, ULTRASONIC (75364) 3069USC3	EA	1
17	7910-00-205-3400	CLEANER, VACUUM, ELECTRIC (61901) 3400	EA	1
18	5815-00-067-4655	FACSIMILE TRANSMISSION AND RECEIVING DEVICE (12813) AN/GXC-7A	EA	1
19	5120-01-013-1676	HAMMER, SLIDE, GROUND ROD EMPLACEMENT: FIIG A23900	EA	1
20	6675-00-733-7444	HEIGHT FINDER, OBLIQUE PHOTOGRAPH (81349) MIL-I-52295	EA	2
21	2540-01-133-9726	LADDER, BOARDING (97403) 13225E3074	EA	2

Section II. COMPONENTS OF END ITEM - Continued

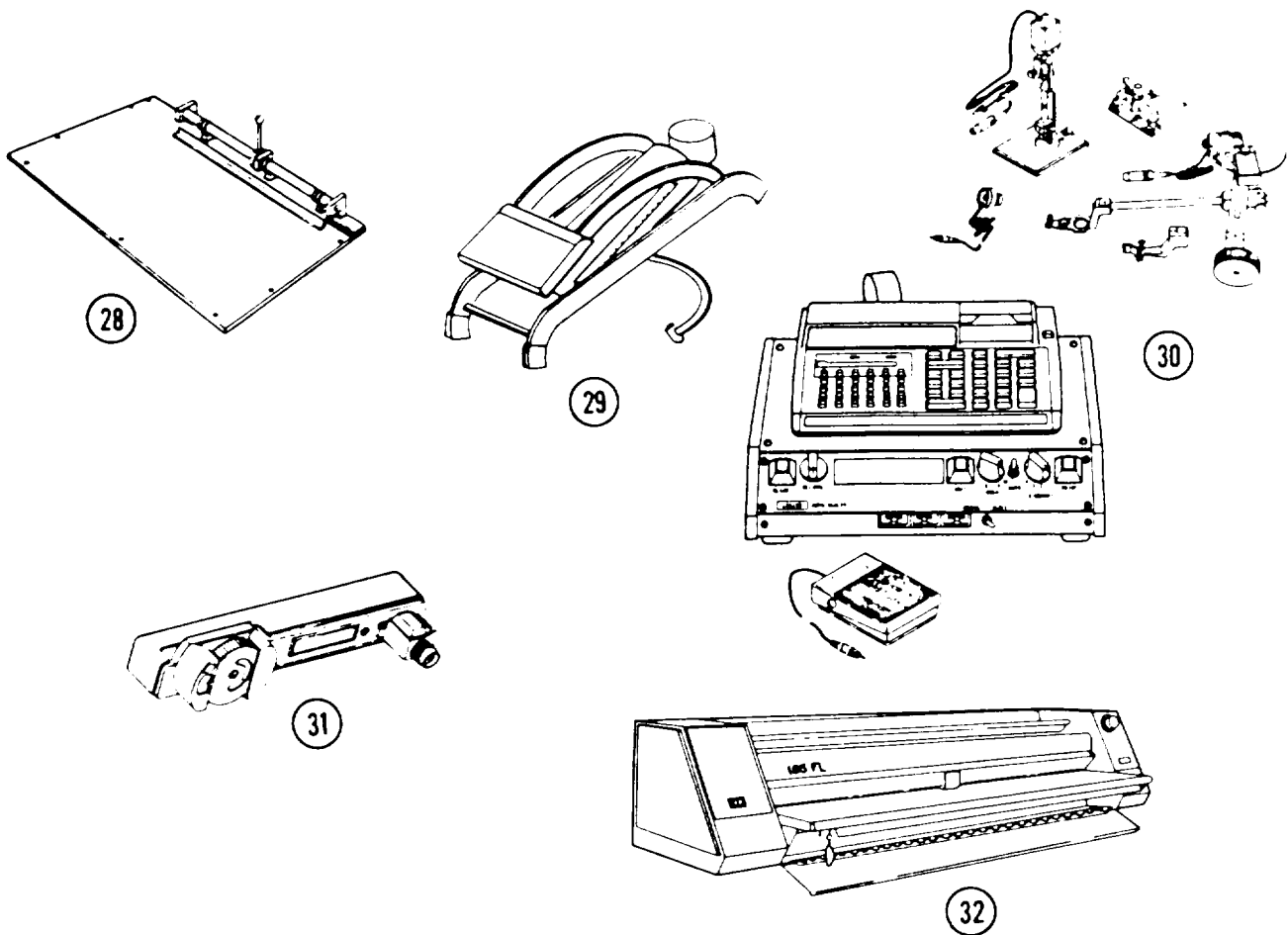


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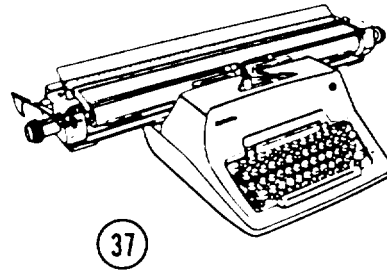
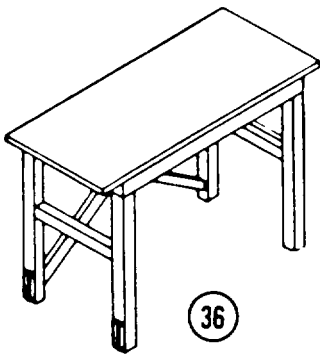
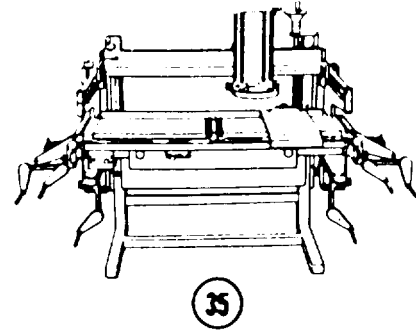
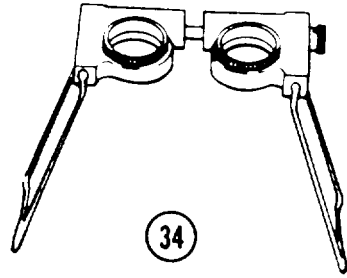
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
22		LAMP, MAGNIFIER	EA	2
23	6675-01-NNIIN	LENS, 2X ATTACHMENT (06175) 53-70-97-02	PR	1
24	6675-01-034-3110	LETTERING SET, VERTICAL (75364) 4001JS9	SE	1
25		LIFTING AND TIEDOWN DEVICE, LEFT HAND (52555) 1390-4	EA	2
26		LIFTING AND TIEDOWN DEVICE, RIGHT HAND (52555) 1390-3	EA	2
27		MAGNIFIER, MONOCULAR (deleted)		

Section II. COMPONENTS OF END ITEM - Continued



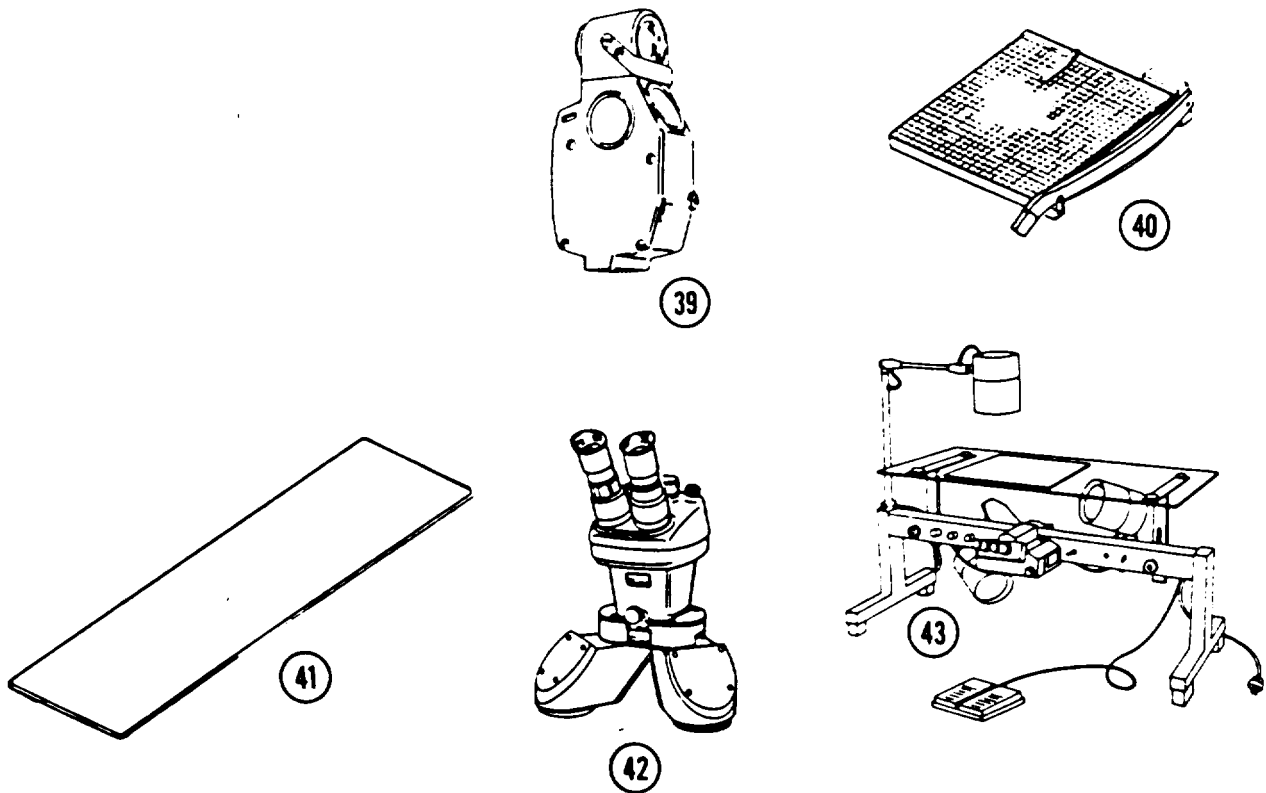
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
28	6675-01-NNIIN	PIN PUNCH REGISTER (25042) BP-051-0247	EA	1
29	4320-01-NNIIN	PUMP, AIR, FOOT OPERATED (53800) 28G1114	EA	1
30	6675-01-NNIIN	QUANTITY PROCESSING SYSTEM (36970) L2501	EA	1
31	7920-00-291-5812	RANGE FINDER, OPTICAL (35643) 8031-31	EA	1
32	3610-00-061-0621	COPY MACHINE, DIAZO PROCESS (90917) GAP 185.FL	EA	1

Section II. COMPONENTS OF END ITEM - Continued



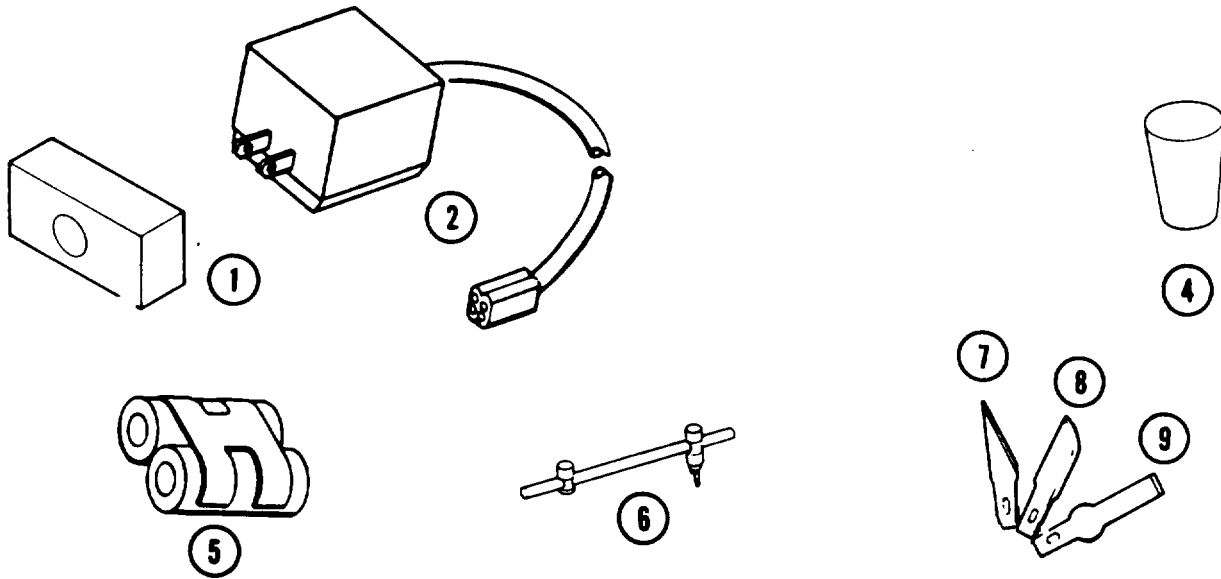
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
33		ROD, GROUND (deleted)		
34	6675-00-64-3561	STEREOSCOPE, POCKET (88997)	EA	4
35	6740-00-165-7267	TABLE, LIGHT, SPLIT-STAGE (021 45) MIM 3-35100	EA	1
36		TABLE, TYPEWRITER (97403) 13225E4138	EA	1
37	7430-00-663-9102	TYPEWRITER, MANUAL, 24 IN. (61634) S27	EA	1

SectionII. COMPONENTS OF END ITEM - Continued



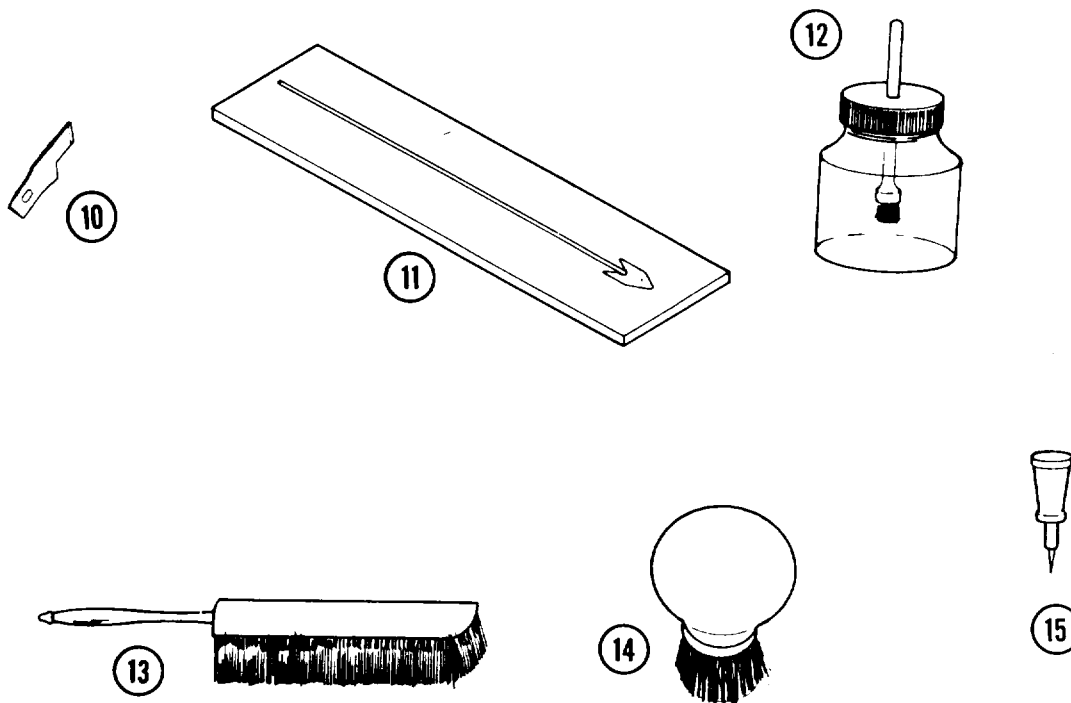
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
38		TOOLBOX, PORTABLE deleted)		
39	6675-01-168-4229	TREE MEASURER, OPTICAL (04024) 43865	EA	1
40	7520-00-224-7621	TRIMMER, PAPER (09177) 89-560	EA	1
41	7110-00-262-6663	TABLE, OFFICE FIIG A123	EA	1
42	6675-00-944-4579	ZOOM STEREOSCOPE 95R (06175) 53-70-96-02	EA	1
43	6675-00-586-6649	ZOOM TRANSFER SCOPE ZT4-H (06175) 53-05-04-03	EA	1
	2320-01-113-3616	BODY, VAN (14109) KA2-20ST	EA	1

Section III. BASIC ISSUE ITEMS



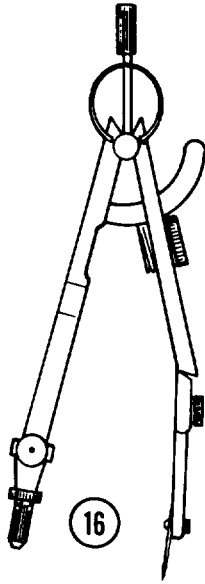
(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
1	3610-01-50-4534	ABSORBER, DIAZO PROCESS (90917) 892-400	CS	1
2	6130-01-094-5527	ADAPTER. RECHARGEABLE. AC (28480) 82087B	EA	1
5	6140-01-077-5153	BATTERY PACK, RECHARGEABLE (28480) 82109A	EA	1
6	6675-00-904-1947	BEAM ATTACHMENT, DRAFTING COMPASS (75364) 3175B	EA	2
7	5110-00-359-6478	BLADE, BEVELED (99941) 11	PG	4
8	5110-00-595-8408	BLADE, CURVED (99941) 10	PG	2
9	5110-00-541-2044	BLADE, SQUARE (99941) 17	PG	2

Section III. BASIC ISSUE ITEMS - Continued

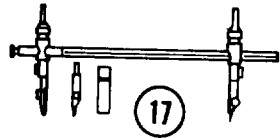


(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
10	5110-00-765-4144	BLADE, STENCIL-CUTTING (99941) 16	PG	2
11		BOARD, CALIBRATION (36970) 20188	PG	2
12	8040-00-262-9040	BOTTLE, DISPENSER, ADHESIVE (87719) 500G	EA	1
13	7920-00-291-5812	BRUSH, DUSTING, DRAFTSMAN'S	EA	4
14	7920-00-205-0565	BRUSH, DUSTING, LENS AND PHOTOGRAPHIC	EA	2
15	6675-01-071-0912	COMPASS ATTACHMENT, DRAFTING LEAD (75364) 3175LA	EA	2

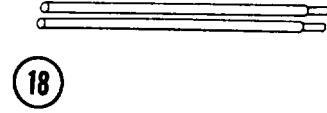
Section III. BASIC ISSUE ITEMS - Continued



16



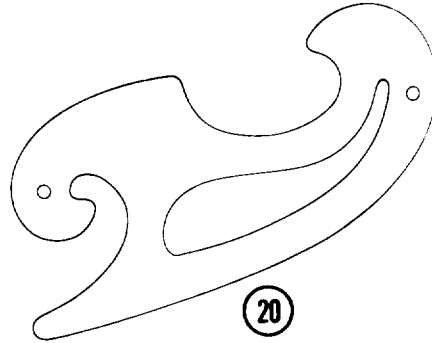
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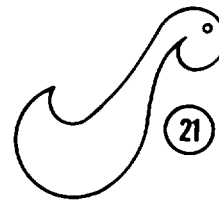
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19



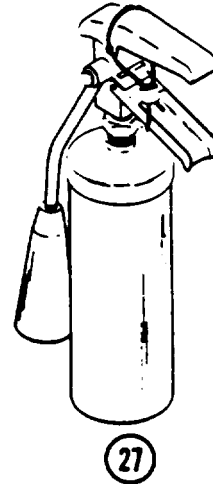
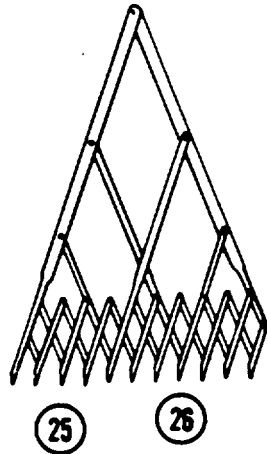
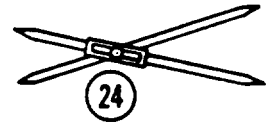
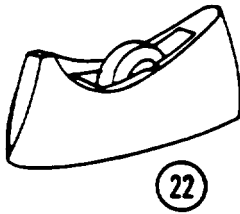
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21

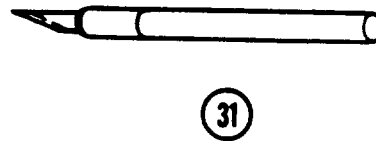
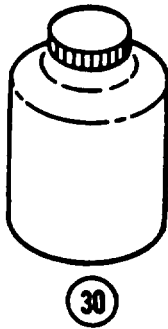
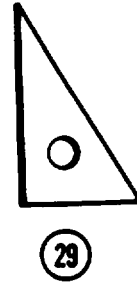
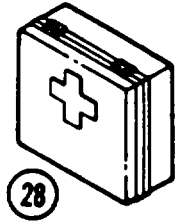
(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
16	6675-00-459-8935	COMPASS, DRAFTING BEAM (75364) 3175	EA	2
17		COMPASS, FREE BEAM (33363) 55-1806	EA	2
18		COMPASS FREE EXTENSION BAR (33363) 55-1818	EA	2
19		COVER, DUST	EA	1
20	6675-00-250-2509	CURVE, DRAFTING, IRREGULAR, MED	EA	4
21	6675-00-250-2508	CURVE, DRAFTING, IRREGULAR, SM	EA	4

Section III. BASIC ISSUE ITEMS - Continued



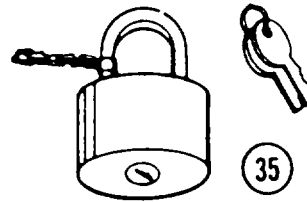
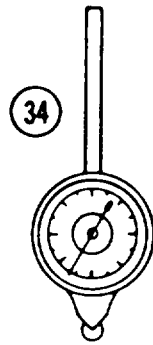
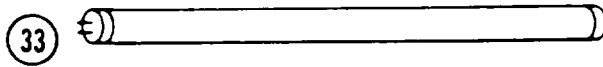
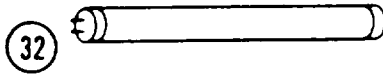
(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
22	7520-00-285-1772	DISPENSER, TAPE	EA	2
23	6675-00-641-3512	DIVIDERS, DRAFTING, PLAIN, 4 IN.	EA	1
24	6675-00-240-2049	DIVIDERS, DRAFTING, PROPORTIONAL	EA	2
25	6675-00-599-8880	DIVIDERS, EQUAL-SPACING (83077) 11-1118	EA	L
26	6675-00-599-8879	DIVIDERS, EQUAL-SPACING (83077) 11-1119	EA	1
27	4210-00-555-8837	EXTINGUISHER, FIRE (06535) FH-900-2	EA	2

Section III. BASIC ISSUE ITEMS Continued



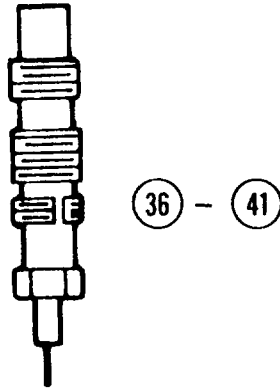
(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
28	6545-00-922-1200	FIRST AID KIT (81348) A-A-92	EA	1
29	6675-00-190-5854	GUIDE, LINE LETTERING (83077) 31-4018	EA	6
30	8125-01-227-6038	JAR, SCREW CAP (20005) 33128	EA	7
31	5110-00-595-8400	KNIFE, CRAFTSMAN'S (99941) 3001	EA	4

Section III. BASIC ISSUE ITEMS - Continued



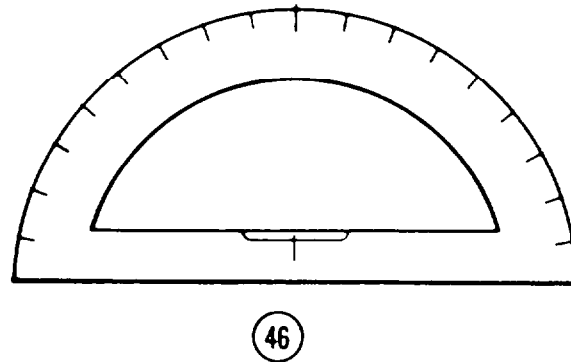
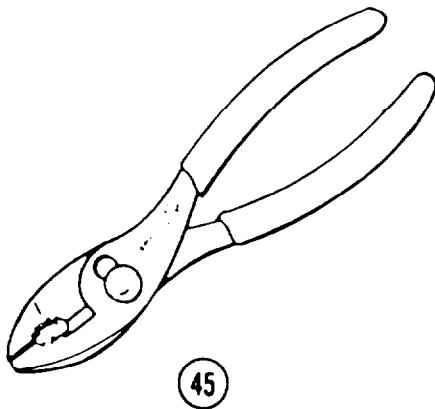
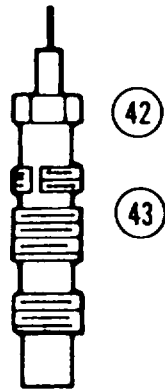
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
32	6240-00-556-8655	LAMP, FLUORESCENT	EA	2
33	6240-01-NNIIN	LAMP, FLUORESCENT, DIAZO (08805) 33026	EA	5
33A		MANUALS, TECHNICAL: LO 5-6675-326-14, LUBRICATION ORDER, TSS, Section 17 TM 5-6675-326-14, Operator's, Organizational, Direct Support and General Support Maintenance Manual for TSS, Section 17 TM 5-6675-326-24P, Repair Parts and Special Tools List for TSS, Section 17	EA	1
34	6675-00-222-2542	MEASURER, MAP (83077) 55-1104	EA	2
35	5340-00-682-1505	PADLOCK SET (96906) MS21313-52	SE	1

Section III. BASIC ISSUE ITEMS - Continued



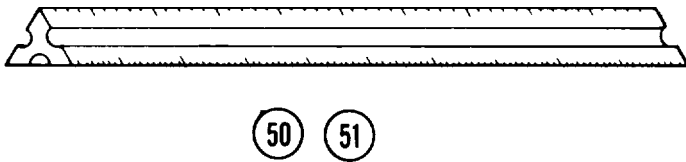
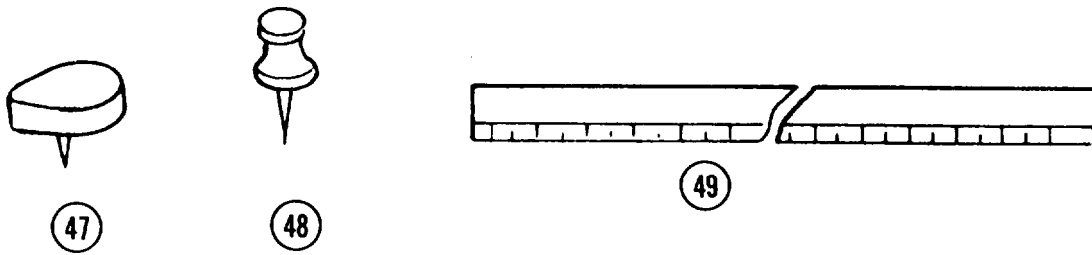
(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
36	6675-01-107-9678	PEN POINT, RAPIDOMETRIC (75364) 91J.0.13mrn	EA	2
37	6675-01-098-1219	PEN POINT, RAPIDOMETRIC (75364) 91J.0.18mm	EA	2
38	6675-01-098-1220	PEN POINT, RAPIDOMETRIC (75364) 91J.0.25mm	EA	2
39	6675-01-107-9679	PEN POINT, RAPIDOMETRIC (75364) 91J.0.35mm	EA	2
40	6675-01-098-1221	PEN POINT, RAPIDOMETRIC (75364) 91J.0.50mm	EA	2
41	6675-01-099-3440	PEN POINT, RAPIDOMETRIC (75364) 91J.0.70mm	EA	2

Section III. BASIC ISSUE ITEMS - Continued



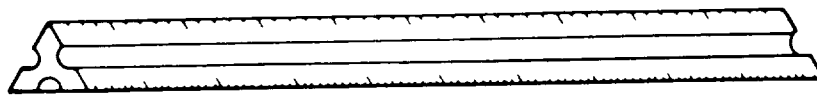
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4)	(5) Qty Rqr
42	6675-01-098-0308	PEN POINT, RAPIDOMETRIC (75364) 91J.1.00mm	E A	2
43	6675-01-097-4516	PEN POINT, RAPIDOMETRIC (75364) 92J.2.00mm	EA	2
44	7520-01-047-3741	PEN SET, FOUNTAIN (75364) 3165-JDCS9	SE	4
45	5120-00-223-7396	PLIERS, SLIP-JOINT (93389) 246	EA	1
46	6675-00-222-2535	PROTRACTOR, SEMICIRCULAR	EA	4

Section III. BASIC ISSUE ITEMS - Continued



(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
47		REGISTER PIN, OBLONG (25042) 04325110	EA	8
48	7510-00-174-7343	REGISTER PIN, ROUND (25042) 04250110	EA	8
49		RULE, MACHINIST'S STEEL, 36 IN. (96508) 1261ME	EA	1
50	6675-00-641-5727	SCALE, DRAFTING CM/IN	EA	4
51	6675-00-283-0035	SCALE, PLOTTING	EA	4

Section III. BASIC ISSUE ITEMS - Continued



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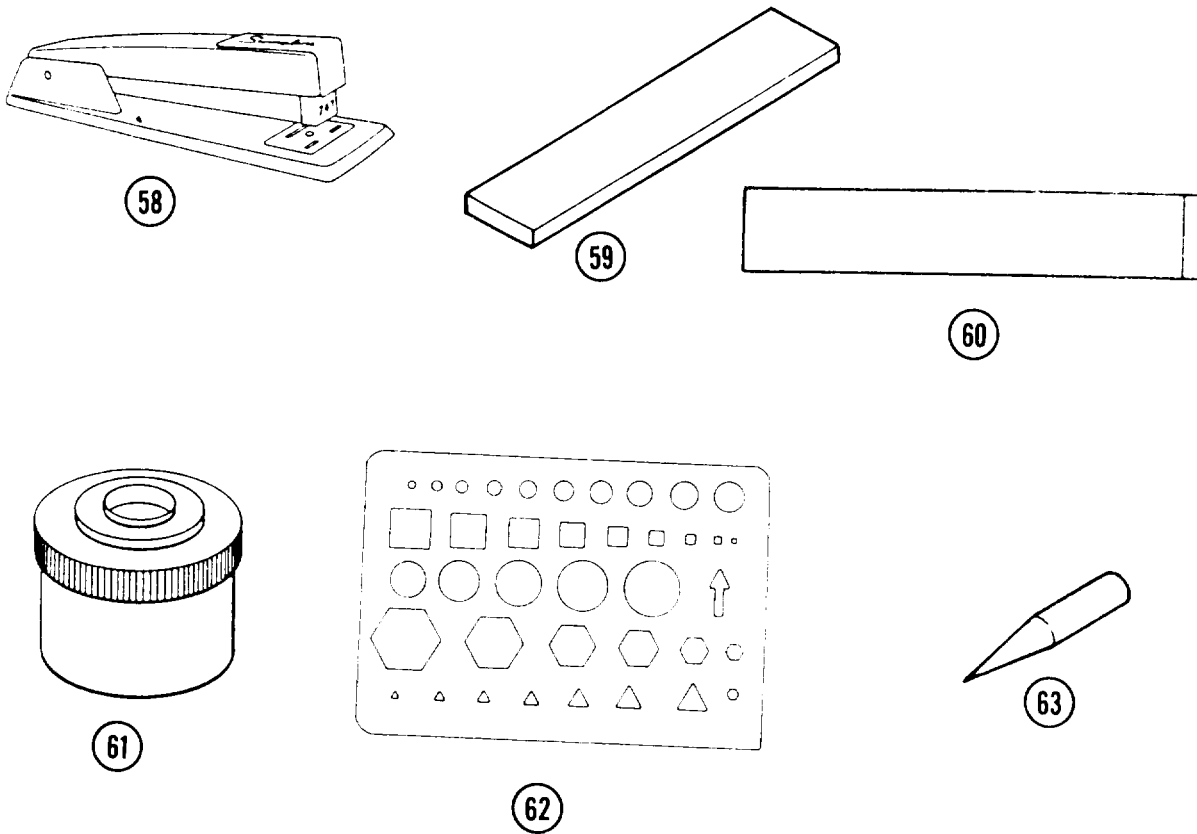
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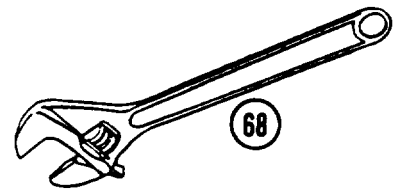
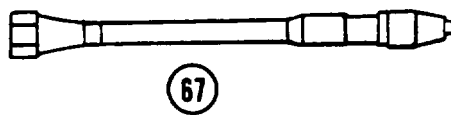
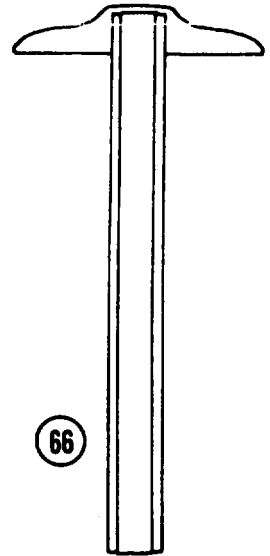
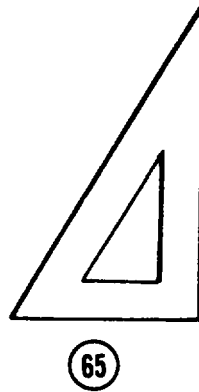
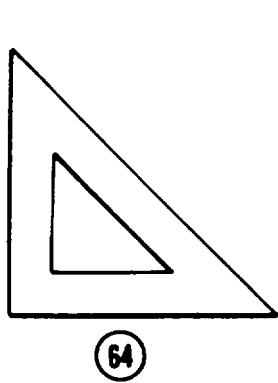
(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
52	6675-00-283-0037	SCALE, PLOTTING	EA	4
53	6675-00-283-0027	SCALE, PLOTTING	EA	4
54	5120-00-764-8080	SCREWDRIVER, CROSS-TIP (28356) SSDP31	EA	1
55	5120-00-764-8102	SCREWDRIVER, FLAT-TIP (28356) SSDP63	EA	1
56	5120-00-234-8910	SCREWDRIVER, FLAT-TIP (28356) SSD6	EA	1
57		SHEARS (deleted)		

Section III. BASIC ISSUE ITEMS - Continued



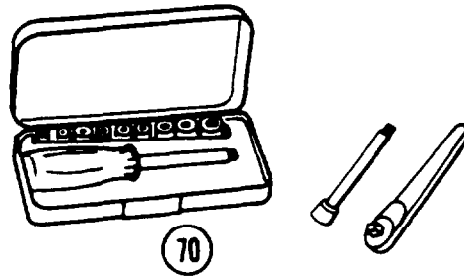
(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
58	7520-00-281-5895	STAPLER, PAPER FASTENING	EA	2
59	5345-00-265-3126	STONE, SHARPENING	EA	1
60	6675-01-NNIIN	STRAIGHTEDGE (09058) 599-516-60	EA	2
61	6675-01-NNIIH	TANK, MINIATURE ROLL FILM (19139) 152-0873	EA	2
62	6675-01-253-5501	TEMPLATE, DRAFTING	EA	4
63	6675-01-NNIIN	TRACER NEEDLE (36970) NK 1260	BX	1

Section III. BASIC ISSUE ITEMS - Continued



(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION FSCM AND PART NUMBER	(4) U/M	(5) QTY RQR
64	6675-00-190-5863	TRIANGLE, DRAFTING, 45°	EA	4
65	6675-00-190-5867	TRIANGLE, DRAFTING, 30° and 60°	EA	4
66	6675-00-183-6487	T-SQUARE, 48 IN.	EA	2
67	5120-00-224-7271	WISE, PIN (57163) 162A	EA	2
68	5120-00-240-5328	WRENCH, ADJUSTABLE	EA	1

Section III. BASIC ISSUE ITEMS - Continued



(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
69	5120-00-228-9516	WRENCH, COMBINATION BOX AND OPEN END, 1 -1/8 IN.	EA	1
70	5120-00-081-2307	WRENCH SET, SOCKET 1/2 IN. DRIVE	EA	1
71	5120-00-128-7914	WRENCH, SOCKET 1-1/8IN.	EA	1

Section III BASIC ISSUE ITEMS UNILLUSTRATED — Cont

(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
		DELETED		
	6675-01-034-3110	LETTERING SET: FIIG T144	SE	1
	6675-00-190-5854	LINE GUIDE, LETTERING,	EA	6
		DELETED		
	6650-00-255-8268	MAGNIFIER: FIIG T271-B	EA	2
	6675-00-222-2542	MEASURER, MAP: FIIG T144	EA	2
		DELETED		

Section III BASIC ISSUE ITEMS UNILLUSTRATED — Cont

(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
		DELETED		
	5975-00-878-3791	ROD, GROUND: 97403	EA	1
		DELETED		

Section III BASIC ISSUE ITEMS UNILLUSTRATED — Cont

(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
		DELETED		
	7510-00-224-7242	SHIELD, ERASING	DZ	1
		DELETED		

Section III BASIC ISSUE ITEMS UNILLUSTRATED — Cont

(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
		DELETED		
	5975-00-074-2072	TIE WRAP		1
	5140-00-331-5496	TOOL BOX, PORTABLE: FIIG T294	EA	1
		DELETED		

Section III BASIC ISSUE ITEMS UNILLUSTRATED — Cont

(1) Illus Number	(2) National Stock Number	(3) Description FSCM and Part Number	(4) U/M	(5) Qty Rqr
	4020-00-241-8892	DELETED TWINE, HEMP: FIIG A153	LB	1
	6145-00-643-0956	DELETED WIRE, ELECTRICAL: FIIG A007	LB	2
		DELETED		

APPENDIX D
ADDITIONAL AUTHORIZATION LIST

Section I. INTRODUCTION

D-1 SCOPE.

This appendix lists additional items you are authorized for the support of the Direct Support Section.

D-2 GENERAL.

This list identifies items that do not have to accompany the Direct Support Section and that do not have to be turned in with it. These items are-all authorized to you by CTA, MTOE, TDA, or JTA.

D-3 EXPLANATION OF LISTING.

National stock numbers, descriptions, and quantities are provided to help you identify and request the additional items you require to support this equipment. The items are listed in alphabetical sequence by item name under the type document (i.e., CTA, MTOE, TDA, or JTA) which authorizes the item(s) to you.

Section II. ADDITIONAL AUTHORIZATION LIST

NATIONAL STOCK NUMBER	DESCRIPTION FSCM AND PART NUMBER	(3) U/M	(4) QTY AUTH
6720-00-935-3799	Camera, Still Picture	ea	1
1080-00-623-7295	Camouflage Screen Support System	ea	
1080-00-103-1246	Camouflage Screen System		
6675-00-641-3610	Drafting Equipment Set, Battalion	ea	1
6115-00-395-9577	Generator Set, Gas Engine, 15 kw	ea	1
6115-00-017-8237	Generator Set, Gas Engine, 3 kw	ea	1
6675-00-202-8542	Interpretation Kit, Photographic	ea	1

Section II. ADDITIONAL AUTHORIZATION LIST - Continued

NATIONAL STOCK NUMBER	DESCRIPTION FSCM AND PART NUMBER	(3) U/M	(4) QTY AUTH
6230-00-299-7077	Light Set, General Illumination (25 outlets)	ea	1
6675-00-556-0202	Table, Tracing Drafting	ea	1
5805-00-543-0012	Telephone Set TA-312/PT	ea	2

APPENDIX E

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E-1 SCOPE.

This appendix lists expendable/durable supplies and materials you will need to operate and maintain the Direct Support Section. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items), or CTA 8-100, Army Medical Department Expendable/Durable Items.

E-2 EXPLANATION OF COLUMNS.

E-2.1 Column (1) - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, appendix E').

E-2.2 Column (2) - Level. This column identifies the lowest level of maintenance that requires the listed item.

- C Operator/Crew
- O Organizational Maintenance
- F Direct Support Maintenance
- H General Support Maintenance

E-2.3 Column (3) - National Stock Number. This is the National stock number assigned to the item"; use it to request or requisition the item.

E-2.4 Column (4) - Description. Indicates the Federal item name and, if required, a description to identify the Item. The last line for each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses followed by the part number.

E-2.5 Column (5) - 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.

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST - Cont

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	F	6810-00-223-2739	Acetone, Technical	Cn
2	C C	6810-00-753-4993 7520-00-281-5911	Alcohol, Isopropyl Basket, Wastepaper	Bt Ea
3	C	6140-01-077-5153	Battery, 1.5v AA	Pg
	C	5110-00-359-6478	Blade, Craftsman Knife: Beveled (99941) 11	pk
	C	5110-00-542-2043	Blade, Craftsman Knife: Curved (99941)10	pk
	C	5110-00-542-2044	Blade, Craftsman Knife: Square (99941)17	pk
	C	5110-00-765-4144	Blade, Craftsman Knife: Stencil (99941)16	pk
	C	8330-00-965-1722	Chamois Leather, Sheepskin	Ea
4	O	6850-00-587-2370	Cleaner, Bearing	
5	C		Cleaning Fluid	
6	C	7920-00-165-7195	Cloth, Cotton	
7	O	9150-00-261-8326	Compound, Heat Sink	
8	C	7930-00-619-9575	Detergent, Dishwashing Liquid	Bt
	C		Film, Diazo Type, Sensitized; 40.0 in. min., 42.0 in. max w; 150 ft. lg. roll, clear base; color image	
9	C	6750-01-124-3183	Film, Blue (61106) 202 BL	Ro
10	C	6750-01-124-3181	Film, Brown (61106) 402 BR	Ro
11	C	6750-01-124-3184	Film, Clear (61106) 104AS	Ro
1 2	C	6750-01-124-3180	Film, Green (61106) 602 GN	Ro
13	C	6750-01-124-3182	Film, Red (61106) 302 RD	Ro

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST - Cont

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
14	C	6750-01-124-3179	Film, Violet (61 106) 702	Ro
15	C		Film, Drafting (33363) 191253	Pg
16	C		Fluid, Lens Cleaning	
	C	7510-01-028-2877	Ink, Drawing (79819) 3072-F1	bt
	C	7510-01-070-8947	Ink, Drawing (79819) 3084-F1	bt
	C	7510-01-039-5075	Ink, Drawing: Carmine (79819) 3080-F1	bt
	C	7510-01-035-8133	Ink, Drawing: Blue (79819) 3080-F1	bt
	C	7510-01-035-8131	Ink, Drawing: Brown (79819) 3080-F1	
	C	7510-01-035-8132	Ink, Drawing: Green (79819) 3080-F1	bt
	C	7510-01-036-3726	Ink, Drawing: Orange (79819) 3080-F1	bt
	C	7510-01-070-1481	Ink, Drawing: Red (79819) 3080-F1	bt
	C	7510-01-036-3725	Ink, Drawing: Violet (79819) 3080-F1	bt
	C	7510-01-035-8130	Ink, Drawing: Yellow (79819) 3080-F1	bt
17			Oil, Lubricating, 30 wt (delete)	
	O	8010-01-131-6254	Paint, Black	kt
	O	8010-01-160-6745	Paint, Brown	kt
	O	8010-01-162-5578	Paint, Green	kt
	O	8010-01-193-0520	Primer	kt

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST - Cont

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
18	O	8040-00-828-7385	Sealant, Silicone	Tu
19	O	3439-00-555-4629	Solder	Sl
20	O	6850-00-110-4498	Solvent, PD-680	
			NOTE: THE FOLLOWING ITEMS ARE NOT LISTED IN THE NARRATIVE PORTION OF THE MANUAL BUT ARE NEEDED.	
	C	8040-00-262-9040	ADHESIVE: FIIG T106; rubber, natural, or synthetic; liquid; 1 gal can; FED MMM-A-185	CN
	C	7520-00-935-7136	BALL POINT PEN: FIIG T392-A; pocket type; medium point, retractable; replaceable cartridge; black ink color; FED GG-B-60, type I	DZ
	C	7510-00-616-7471	BINDER AND FILLER, LOOSE LEAF	EA
	C	5110-01-026-8754	Multi-purpose; beveled, razor-sharp pointed blade	PG
	C	8125-01-NNIIN	BOTTLE, ADHESIVE-DISPENSER: FIIG T116; polyethylene	EA
	C	7510-00-223-6706	Composition 1; White	GR
	C	7510-00-223-6702	Composition 3; Blue	GR
	C	7510-00-223-6705	Composition 3; Red	GR
	C	7510-00-223-6707	Composition 3; Yellow	GR

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST - Cont

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
	C	6850-01-007-8073	CLEANING CONCENTRATE: FIIG T329	BT
	C	7510-00-927-8685	CLEANING KIT: FIIG A239	KT
	C	7510-00-161-4281	CLIP, PAPER: FIIG T302-A	BX
	C	7510-00-257-3411	CLOTH, TRACING: FIIG T314	RO
	C	8220-00-299-8625	COTTON, NONSTERILE: FIIG T141	PG
	C	6750-01-189-9362	DEVELOPER, AMMONIA 26° B; used Copying Machine, Diazo Process, 6 gal per case GAF #892-045	CS
	C	7520-00-285-1772	DISPENSER, PRESSURE SENSITIVE, ADHESIVE TAPE: FIIG T302-B	EA
	C	7530-00-268-3994	ENVELOPE, WALLET: FIIG A111	BX
	C	7510-01-034-1278	ERASER, FILM: FIIG A239	BX
	C	7510-01-035-1317	ERASER KIT: FIIG A239	KT
	C	7510-00-058-2352	Eraser: drafting film	EA
	C	7510-01-099-3953	ERASER, LIQUID, Super-Strength (75364) 292-F	BT
	C	7510-00-634-5034	ERASER, RUBBER	DZ
	C	6750-00-868-7901	FILM: PHOTOGRAPHIC, RAPID PROCESS (29556), 108 Polacolor 2	pk
	C	6750-00-260-1252	FILM, PHOTOGRAPHIC, 35 mm, (19139), PLUS-X PAN 5062	RO

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST - Cont

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
	C	7510-00-281-2143	LEAD, PENCIL	BX
	C	7510-00-285-5865	LEAD, PENCIL	BX
	C	7510-00-285-5863	LEAD, PENCIL	BX
	C	7510-00-272-9820	LEAD, PENCIL	BX
	C	7510-00-285-5864	LEAD, PENCIL	BX
	C	7510-00-285-5866	LEAD, PENCIL	BX
	C	7510-00-285-5862	LEAD, PENCIL, GRAPHITE General Purpose	PG
	C	7510-00-285-5847	LEAD, PENCIL, GRAPHITE General Purpose	PG
	C	7520-01-008-7640	LEAD REPOINTER, PENCIL: FIIG T302-A	EA
	C	9150-00-273-2389	LUBRICATING OIL, General Purpose: FIIG A416	CH
	C	7530-01-124-5660	PAD, WRITING PAPER	PG
		5340-00-682-1505	PADLOCK SET: FIIG T373H	SE
		6750-00-201-0892	PAPER, COPYING, DIAZO Process (90917)100S	RO
		6750-00-663-0771	PAPER, COPYING, DIAZO Process (90917) 200 SE	RO
		7530-00-871-8310	PAPER, DRAWING (33363) 48-5094	PG
		7530-01-NNIIN	PAPER, GRAPH	RO
		7530-01-NNIIN	PAPER, GRAPH (33363) 48-6002	RO
		6640-00-559-1384	PAPER, LENS	PG
		7530-01-006-4496	PAPER, TRACING	PG
		7510-00-286-6985	PAPERWEIGHT	EA

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST - Cont

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
	C	7520-00-935-7136	PEN, BALL-POINT	DZ
	C	7510-00-233-2027	PENCIL, BLUE, THIN LEAD	DZ
	C	7510-00-264-4610	PENCIL, GREEN, THIN LEAD	DZ
	C	7510-00-240-1526	PENCIL, MARKING, GLAZED Surface, Black, Extra Thick Lead	DZ
	C	7510-00-436-5210	PENCIL, MARKING, GLAZED Surface, Blue, Extra Thick Lead	DZ
	C	7510-00-275-7212	PENCIL, MARKING, GLAZED Surface, Green, Extra Thick Lead	DZ
	C	7510-00-174-3205	PENCIL, MARKING, GLAZED Surface, Red, Extra Thick Lead	
	C	7520-00-161-5664	PENCIL, MECHANICAL Automatic	EA
	C	7520-00-551-3654	PENCIL, MECHANICAL Nonautomatic	EA
	C	7510-00-233-2021	PENCIL, RED, THIN LEAD	DZ
	C	7510-00-264-4608	PENCIL, YELLOW, THIN LEAD	
	C		PEN POINTS: RAPIDOMETRIC: FIIG T302; jewel point; chemical resistant plastic; for Koh-I-Noor No. 3095 Rapidometric Pen; 12 of one size in plastic sieve, w/nib keys;	DZ
	C	7510-00-174-7343	PEN, STRAIGHT	DX
	C	6750-01-223-3178	PLASTIC SHEET, CLEAR (33363) 44-1037	PG
	C	9330-00-606-5462	PLASTIC SHEET, MATTE ONE Side (33363) 44-1057	PG
	C	9330-00-618-2440	PLASTIC SHEET, MATTE ONE Side; pencil and ink; 0.0075 in. thk	PG

Section II. EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST-Cont

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
	C	7510-00-543-6792	REFILL, PEN, BALL-POINT	DZ
	C	7520-01-008-7640	REPOINTER, LEAD PENCIL	EA
			RESIN, ACRYLIC ORANGE	EA
	C	7510-00-264-5987	RIBBON, TYPEWRITER: FIIG T392-H	EA
	C	7510-00-926-9146	RIBBON, TYPEWRITER (U0270) 4518188	EA
	C	5975-00-878-3791	ROD, GROUND: 97403	EA
	C	7510-00-243-3435	RUBBER BAND ASSORTMENT	BX
	C	7520-00-281-5895	STAPLER, PAPER FASTENING Office: FIIG T302-G	EA
	C	7510-00-272-9662	STAPLES, PAPER FASTENING	BX
	C	7530-01-061-2301	TAPE, PAPER, COMPUTING (23480) 82045A	RO
	C		TAPE, PRESSURE SENSITIVE ADHESIVE: FIIG T265-G;	RO
	C	7510-00-550-7126	Cellophane backing; opaque; red; 72 yd roll; .500 in. w; 3.000 in. id core; FEDL-T-90, type I, class B	RO
	C	7510-00-234-7960	Cellophane backing; transparent; clear; 72 yd roll; 2.00 in. w; 3.000 in id core; FEDL-T-90, type I, class A	RO
	C	7510-00-551-9824	Cellulose backing; transparent; clear; 72 yd roll; .750 in. w; 3.000 in. id core; FEDL-T-90, type II, class A	RO
	C	7510-00-198-5831	Paper backing; opaque; 60 yd roll; 1.000 in. w; 3.000 in id core; FED UU-T-93	RO
	C	7510-00-272-6887	THUMB TACK	HD
	C	7920-00-823-9772	TOWEL, PAPER	BX

*U.S. GOVERNMENT PRINTING OFFICE: 1991 554-123/20252

INDEX

Subject	Paragraph
DIAZO REPRODUCTION SET	
D	
Diazo Reproduction Set, Replace	10-2.2
G	
General Information	10-1
I	
Information, General	10-1
Information, Reference	10-1.2
O	
Organizational Maintenance	10-2
R	
Reference Information	10-1.2
Replace Diazo Reproduction Set	10-2.2
S	
Scope	10-1.1
DIRECT SUPPORT SECTION	
A	
Air Conditioner/Heater, Replace	1-19.8
Air Conditioner/Heater Support Bracket, Replace	1-19.9
Air Vent Door, Replace	1-15.16
Assembly and Preparation for Use	1-6.1
B	
Ballast, Fluorescent Lamp, Replace	1-15.2
Blackout Curtain, Replace	1-15.12
Blackout/Dome Light, Replace	1-10.3
Breaker, Circuit, Replace	1-19.5
C	
Characteristics, Capabilities, and Features, Equipment	1-2.1

Subject **Paragraph**

DIRECT SUPPORT SECTION - Continued

Circuit Breaker, Replace	1-19.5
Components, Location and Description of Major	1-2.2
Conditions, Operation Under Unusual	1-7
Conditions, Operation Under Usual	1-6
Cover, Ventilation Fan, Replace	1-15.10
Curtain, Blackout, Replace	1-15.12

D

Data, Equipment	1-2.3
Description and Data, Equipment	1-2
Description and Use of Operator's Controls and Indicators	1-4
Destruction of Army Materiel to Prevent Enemy Use	1-1.3
Direct/General Support Maintenance Procedures	1-19
Direct/General Support Preventive Maintenance Checks and Services	1-17
Direct/General Support Troubleshooting	1-18
Door, Air Vent, Replace	1-15.16
Door, Personnel/Cargo, Replace	1-19.4
Duct, Ventilation, Replace	1-19-10
Ducts, Ventilation, Service	1-10.2

E

Emergency Light Assembly, Replace	1-15.11
Emergency Procedures	1-7.6
Equipment Characteristics, Capabilities, and Features	1-2.1
Equipment Data	1-2.3
Equipment Description and Data	1-2

F

Fan, Ventilation, Replace	1-15.9
Filter, Radio Frequency (RF), Replace	1-15.3
Floor Covering, Repair	1-19.6
Fluorescent Ceiling Lamp, Replace	1-10.1
Fluorescent Lamp Ballast, Replace	1-15.2
Fluorescent Light Switch, Replace	1-15.4
Forms, Records, and Reports, Maintenance	1-1.2

G

Gasket, Personnel/Cargo Door, Replace	1-19.3
General Information	1-1

Subject	Paragraph
DIRECT SUPPORT SECTION - Continued	
H	
Handle, Personnel/Cargo Door, Repair	1-19.1
Hand Receipt (-HR) Manuals	1-1.5
I	
Indicator, Level, Replace	1-15.15
Information, General	1-1
Instructions, Lubrication	1-8
L	
Ladder, Personnel, Repair	1-15.17
Lamp, Fluorescent Ceiling, Replace	1-10.1
Level Indicator, Replace	1-15.15
Light Assembly, Emergency, Replace	1-15.11
Light, Blackout/Dome, Replace	1-10.3
Location and Description of Major Components	1-2.2
Lubrication Instructions	1-8
M	
Main Power Fuse, Replace	1-10.4
Maintenance Form, Records, and Reports	1-1.2
Manuals, Hand Receipt (-HR)	1-1.5
O	
ON/OFF Switch, Replace	1-15.5
Operation in Cold Weather	1-7.2
Operation in Desert Conditions	1-7.5
Operation in Extreme Heat	1-7.3
Operation in High Wind or Storm Conditions	1-7.1
Operation in Tropical Conditions	1-7.4
Operation, Technical Principles of	1-3
Operation Under Unusual Conditions	1-7
Operation Under Usual Conditions	1-6
Operator Maintenance Procedures	1-10
Operator Preventive Maintenance Checks and Services (PMCS)	1-5
Operator's Controls and Indicators, Description and Use of	1-4
Operator Troubleshooting Procedures	1-9
Organizational Preventive Maintenance Checks and Services (PMCS)	1-13
Organizational Troubleshooting	1-14

Subject **Paragraph**

DIRECT SUPPORT SECTION - Continued

P

Personnel/Cargo Door Gasket, Replace	1-19.3
Personnel/Cargo Door Handle, Repair	1-19.1
Personnel/Cargo Door Latch Assembly, Replace	1-19.2
Personnel/Cargo Door, Replace	1-19.4
Personnel Ladder, Repair	1-15.17
Preparation for Movement	1-6.2
Preparation for Storage or Shipment	1-4.4, 1-20
Preventive Maintenance Checks and Services (PMCS), Operator	1-5
Preventive Maintenance Checks and Services (PMCS), Organizational	1-13

R

Radio Frequency (RF) Filter, Replace	1-15.3
Receipt, Service Upon	1-12
Receptacles, Electrical, Replace	1-15.6
Repair:	
Conduit Base and Cover	1-15.7
Personnel/Cargo Door Handle	1-19.1
Personnel Ladder	1-15.17
Van Body Skin (Permanent)	1-19.7
Van Body Skin (Temporary)	1-15.13
Repair Parts; Special Tools; Test, Measurement, and Dianostic Equipment (TMDE) ; and Support Equipment	1-11
Replace:	
Air Conditioner/Heater	1-19.8
Air Conditioner/Heater Support Bracket	1-19.9
Air Vent Door	1-15.16
Blackout Curtain	1-15.12
Blackout/Dome Light	1-10.3
Circuit Breaker	1-19.5
Electrical Receptacles	1-15.6
Emergency Light Assembly	1-15.11
Flouoresent Ceiling Lamp	1-10.1
Flourescent Lamp Ballast	1-15.2
Flourescent Light Switch	1-15.4
Level Indicator	1-15.15
Main Power Fuse	1-10.4
ON/OFF Switch	1-15.5
Personnel/Cargo Door	1-19.4
Personnel/Cargo Door Gasket	1-19.3
Personnel/Cargo Door Latch Assembly	1-19.2
Radio Frequency (RF) Filter	1-15.3
Telephone Binding Post	1-15.8
Tiedown Scket	1-15.14

Subject	Paragraph
DIRECT SUPPORT SECTION - Continued	
Ventilation Duct	1-19.10
Ventilation Fan	1-15.9
Ventilation Fan Cover	1-15.10
Reporting Equipment Improvement Recommendations (EIRs)	1-1.6
S	
Scope	1-1.1
Service Upon Receipt	1-12
Semite Ventilation Ducts	1-10.2
Shipment, Preparation for Storage or	1-1.4, 1-20
Socket, Tiedown, Replace	1-15.14
Switch, Fluorescent Light, Replace	1-15.4
Switch, ON/OFF, Replace	1-15.5
T	
Technical Principles of Operation	1-3
Telephone Binding Post, Replace	1-15.8
Tiedown Socket, Replace	1-15.14
Troubleshooting Procedures, Operator	1-9
V	
Van Body Skin, Repair (Permanent)	1-19.7
Van Body Skin, Repair (Temporary)	1-15.13
Ventilation Duct, Replace	1-19.10
Ventilation Ducts, Service	1-10.2
Ventilation Fan Cover, Replace	1-15.10
Ventilation Fan, Replace	1-15.9
FACSIMILE TRANSMISSION AND RECEIVING DEVICE	
F	
Facsimile Transmission and Receiving Device, Replace	9-2.2
G	
General Information	9-1
I	
Information, General	9-1
Information, Reference	9-1.2

Subject **Paragraph**

FACSIMILE TRANSMISSION AND RECEIVING DEVICE - Continued

O

Organizational Maintenance 9-2

R

Reference Information 9-1.2

Replace Facsimile Transmission and Receiving Device 9-2.2

S

Scope 9-1.1

FURNITURE AND CABINETS

D

Diazo Paper Storage Cabinet, Replace 11-9.10

Diazo Supply Cabinet, Replace 11-9.11

E

Equipment Description and Data 11-2

F

Filing Cabinet, Security, Replace 11-9.8

Filing Cabinet, Two-Drawer, Replace 11-9.6

G

General Information 11-1

H

Hinge (Piano), Replace 11-9.3

I

Information, General 11-1

Instructions, Lubrication 11-3

L

Latch (Handle-Type), Replace 11-9.1

Latch (Recessed Cup-Type), Replace 11-9.2

Lubrication Instructions 11-3

Subject	Paragraph
FURNITURE AND CABINETS - Continued	
M	
Map Cabinet, Replace	11-9.4
P	
Preparation for Storage or Shipment	11-10
O	
Operator Maintenance Procedures	11-5
Operator Troubleshooting Procedures	11-4
Organizational Maintenance Procedures	11-9
Organizational Preventive Maintenance Checks and Services (PMCS)	11-7
Organizational Troubleshooting	11-8
R	
Repair Parts; Special Tools; Test, Measurement, and Diagnostic Equipment (TMDE); and Support Equipment	11-6
Replace:	
Diazo Paper Storage Cabinet	11-9.10
Diazo Supply Cabinet	11-9.11
Hinge (Piano)	11-9.3
Latch (Handle-Type)	11-9.1
Latch (Recessed Cup-Type)	11-9.2
Map Cabinet	11-9.4
Security Filing Cabinet	11-9.8
Two-Drawer Filing Cabinet	11-9.6
Typewriter Table	11-9.7
Wall Storage Cabinet	11-9.9
Work Surface	11-9.5
S	
Scope	11-1.1
Security Filing cabinet, Replace	11-9.8
T	
Table, Typewriter, Replace	11-9.7
Two-Drawer Filing Cabinet, Replace	11-9.6
Typewriter Table, Replace	11-9.7

Subject **Paragraph**

FURNITURE AND CABINETS - Continued

W

Wall Storage Cabinet, Replace	11-9.9
Work Surface, Replace	11-9.5

POCKET CALCULATOR

C

Conditions, Operation Under Usual	8-6
---	-----

D

Data, Equipment Description and	8-2
Description and Use of Operator's Controls and Indicators	8-4

E

Equipment Characteristics, Capabilities, and Features	8-2.1
Equipment Data	8-2.2
Equipment Description and Data	8-2

G

General Information	8-1
---------------------------	-----

I

Information, General	8-1
Instructions, Lubrication	8-7

L

Lubrication Instructions	8-7
--------------------------------	-----

O

Operation, Technical Principles of	8-3
Operation Under Usual Conditions	8-6
Operator Preventive Maintenance Checks and Services (PMCS)	8-5
Operator's Controls and Indicators, Description and Use of	8-4

Subject **Paragraph**
 POCKET CALCULATOR - Continued

P

Preventive Maintenance Checks and Services (PMCS),
 Operator 8-5

S

Scope 8-1.1

T

Technical Principles of Operation 8-3
 Troubleshooting Procedures, Operator 8-8

PORTABLE TRACING/SCRIBING BOARD

A

Assembly and Preparation for Use 5-5.1

B

Ballast Transformer, Replace 5-12.3

C

Clean Reflector 5-8.1
 Conditions, Operation Under Usual 5-5

D

Description and Data, Equipment 5-2
 Description and Use of Operator's Controls and
 Indicators 5-3

E

Equipment Characteristics, Capabilities, and Features 5-2.1
 Equipment Data 5-2.2
 Equipment Description and Data 5-2

F

Fluorescent Lamp, Replace 5-8.2

Subject	Paragraph
PORTABLE TRACING/SCRIBING BOARD - Continued	
G	
Glass Surface, Replace	5-8.4
I	
Instructions, Lubrication	5-6
L	
Lubrication Instructions	5-6
O	
Operation Under Usual Conditions	5-5
Operator Preventive Maintenance Checks and Services (PMCS)	5-4
Operator's Controls and Indicators, Description and Use of	5-3
Operator Troubleshooting Procedures	5-7
P	
Power Cord, Replace	5-12.2
Power Switch, Replace	5-12.1
Preparation for Movement	5-5.2
Preparation for Storage or Shipment	5-13
Preventive Maintenance Checks and Services (PMCS), Operator	5-4
R	
Reflector, Clean	5-8.1
Repair Parts; Special Tools; Test, Measurement, and Diagnostic Equipment (TMDE); and Support Equipment	5-9
Replace:	
Ballast Transformer	5-12.3
Fluorescent Lamp	5-8.2
Glass Surface	5-8.4
Power Cord	5-12.2
Power Switch	5-12.1
Starter	5-8.3

Subject	Paragraph
PORTABLE TRACING/SCRIBING BOARD - Continued	
S	
Scope	5-1.1
Starter, Replace	5-8.3
T	
Troubleshooting Procedures, Operator	5-7
QUANTITY PROCESSING SYSTEM	
A	
Aline Planimeter Encoder	6-14.2
Assembly and Preparation for Use	6-6.1
B	
Battery Pack, Replace	6-9.1
Board, Front Display PC, Replace	6-14.4
Board, Main Logic PC, Replace	6-14.3
c	
Characteristics, Capabilities, and Features, Equipment	6-2.1
Components, Location and Description of Major	6-2.2
Compression Spring, Replace	6-9.3
Conditions, Operation Under Usual	6-6
D	
Data, Equipment	6-2.3
Data, Equipment Description and	6-2
Description and Use of Operator's Controls and Indicators	6-4
E	
Equipment Characteristics, Capabilities, and Features	6-2.1
Equipment Data	6-2.3
Equipment Description and Data	6-2
F	
Front Display PC Board, Replace	6-14.4

Subject **Paragraph**

QUANTITY PROCESSING SYSTEM - Continued

G

General Information	6-1
Glossary	6-1.3

I

Information, General	6-1
Information, Reference	6-1.2
Instructions, Lubrication	6-7

L

Location and Description of Major Components	6-2.2
Lubrication Instructions	6-7

M

Main Logic PC Board, Replace	6-14.3
------------------------------------	--------

O

Operatiing Procedures	6-6.2
Operation, Technical Principles of	6-3
Operation Under Usual Conditions	6-6
Operator Preventive Maintenance Checks and Services (PMCS)	6-5
Operator's Controls and Indicators, Description and Use of	6-4
Operator Troubleshooting Procedures	6-8

P

Paper Disk, Replace	6-9.4
Planimeter Encoder, Aline	6-14.2
Planimeter Encoder, Replace	6-14.1
Preparation for Movement	6-6.3
Preparation for Storage or Shipment	6-15
Preparation for Use, Assembly and	6-6.1
Preventive Maintenance Checks and Services (PMCS), Operator	6-5
Procedures, Operating	6-6.2

R

Rear Input PC Board, Replace	6-14.5
Reference Information	6-1.2

Subject	Paragraph
QUANTITY PROCESSING SYSTEM - Continued	
Repair Parts; Special Tools; Test, Measurement, and Diagnostic Equipment; and Support Equipment	6-11
Replace:	
Battery Pack	6-9.1
Compression Spring	6-9.3
Front Display PC Board	6-14.4
Main Logic PC Board	6-14.3
Paper Disk	6-9.4
Planimeter Encoder	6-14.1
Rear Input PC Board	6-14.5
Scaler PC Board	6-14.6
Teflon Guide Washer	6-9.2
S	
Scaler PC Board, Replace	6-14.6
Scope	6-1.1
Shipment, Preparation for Storage or	6-15
T	
Technical Principles of Operation	6-3
Teflon Guide Washer, Replace	6-9.2
Troubleshooting Procedures, Operator	6-8
SPLIT-STAGE LIGHT TABLE	
A	
Adjust :	
Light Grids	2-19.1
X-Axis Chain	2-19.2
Y-Axis Chain	2-19.3
Z-Axis Chain	2-19.7
Assembly and Preparation for Use	2-6.1
B	
Brush, Replace	2-14.4
C	
Carriage Clutch Switch, Replace	2-19.6
Characteristics, Capabilities, and Features, Equipment	2-2.1
Collimation	2-10.3
Components, Location and Description of Major	2-2.2

Subject	Paragraph
SPLIT-STAGE LIGHT TABLE - Continued	
Conditions, Operation Under Unusual	2-7
Conditions, Operation Under Usual	2-6
D	
Data, Equipment	2-2.3
Data, Equipment Description and	2-2
Description and Use of Operator's Controls and Indicators	2-4
Diagram, Wiring	2-3.1
Dimmer Circuit Card, Replace	2-19.8
Direct/General Support Maintenance Procedures	2-19
Direct/General Support Troubleshooting	2-18
E	
Equipment Characteristics, Capabilities, and Features . .	2-2.1
Equipment Data	2-2.3
Equipment Description and Data	2-2
F	
Fan, Replace	2-19.10
Fuse, Replace	2-10.1
G	
General Information	2-1
Glossary	2-1.2
Grid Intensity Control Potentiometer, Replace	2-14.2
I	
Information, General	2-1
Instructions, Lubrication	2-8
L	
Light Grid Assembly, Replace	2-19.11
Light Grids, Adjust	2-19.1
Location and Description of Major Components	2-2.2
Lubrication Instructions	2-8
M	
Main Power Switch, Replace	2-14.3
Maintenance Procedures, Direct/General Support	2-19
Maintenance Procedures, Operator	2-10

Subject	Paragraph
SPLIT-STAGE LIGHT TABLE - Continued	
Maintenance Procedures, Organizational	2-14
Momentary Switch, Replace	2-19.5
Movement, Preparation for	2-6.3
0	
ON/OFF Switch, Replace	2-14.1
Operating Procedures	2-6.2
Operation, Technical Principles of	2-3
Operation Under Unusual Conditions	2-7
Operation Under Usual Conditions	2-6
Operator Maintenance Procedures	2-10
Operator Preventive Maintenance Checks and Services (PMCS)	2-5
Operator's Controls and Indicators, Description and Use of	2-4
Operator Troubleshooting Procedures	2-9
Organizational Maintenance Procedures	2-14
Organizational Troubleshooting	2-13
P	
Preparation for Movement	2-6.3
Preparation for Storage or Shipment	2-15
Preparation for Use, Assembly and	2-6.1
Preventive Maintenance Checks and Services (PMCS), Operator	2-5
Procedures, Operating	2-6.2
R	
Repair Parts; Special Tools; Test, Measurement, and Diagnostic Equipment (TMDE); and Support Equipment . . .	2-11, 2-16
Replace:	
Brush	2-14.4
Carriage Clutch Switch	2-19.6
Dimmer Circuit Card	2-19.8
Fan	2-19.10
Film Rollers	2-10.2
Fuse	2-10.1
Grid Intensity Control Potentiometer	2-14.2
Light Grid Assembly	2-19.11
Main Power Switch	2-14.3
Momentary Switch	2-19.5
ON/OFF Switch	2-14.1
Split-Stage Light Table	2-14.5
Transformer	2-19.9

Subject **Paragraph**

SPLIT-STAGE LIGHT TABLE - Continued

S

Scope	2-1.1
Service Z-Axis	2-19.4
Shipment, Preparation for Storage or	2-15
Split-Stage Light Table, Replace	2-14.5

T

Technical Principles of Operation	2-3
Transformer, Replace	2-19.9
Troubleshooting, Direct/General Support	2-18
Troubleshooting, Operator	2-9
Troubleshooting, Organizational	2-13

W

Wiring Diagram	2-3.1
----------------------	-------

X

X-Axis Chain, Adjust	2-19.2
----------------------------	--------

Y

Y-Axis Chain, Adjust	2-19.3
----------------------------	--------

Z

Z-Axis Chain, Adjust	2-19.7
Z-Axis, Service	2-19.4

SUPPORT ITEMS

A

Assembly and Preparation for Use	12-4.1
--	--------

B

Batteries, Still Picture Camera, Replace	12-7.3
--	--------

D

Description and Use of Operator's Controls and Indicators:

Magnifier Lamp	12-2.1
Manual Typewriter	12-2.2

Subject	Paragraph
SUPPORT ITEMS - Continued	
Optical Range Finder	12-2.7
Optical Tree Measurer	12-2.5
Paper Trimmer	12-2.3
Pin Punch Register	12-2.4
Prototype 35mm Camera	12-2.6
Still Picture Camera Set	12-2.8
Vacuum Cleaner	12-2.9
F	
Fluorescent Lamp in Magnifier Lamp, Replace ..	12-7.1
G	
General Information	12-1
I	
Information, General	12-1
Instructions, Lubrication	12-5
L	
Lubrication Instructions	12-5
M	
Magnifier Lamp, Description and Use of Operator's Controls and Indicators	12-2.1
Magnifier Lamp, Operating Procedures	12-4.2.3
Magnifier Lamp, Replace	12-7.2
Manual Typewriter, Description and Use of Operator's Controls and Indicators	12-2.2
Manual Typewriter, Operating Procedures	12-4.2.1
Manual Typewriter, Replace	12-7.4
O	
Operating Procedures	
Magnifier Lamp	12-4.2.3
Manual Typewriter	12-4.2.1
Optical Range Finder	12-4.2.4
Optical Tree Measurer	12-4.2.9
Paper Trimmer	12-4.2.8
Pin Punch Register	12-4.2.5
Prototype 35mm Camera	12-4.2.2
Still Picture Camera	12-4.2.6
Vacuum Cleaner	12-4.2.7

Subject	Paragraph
SUPPORT ITEMS - Continued	
Operator Maintenance Procedures	12-7
Operator Preventive Maintenance Checks and Services (PMCS)	12-3
Operator Troubleshooting Procedures	12-6
Optical Range Finder, Description and Use of Operator's Controls and Indicators	12-2.7
Optical Range Finder, Operating Procedures	12-4.2.4
Optical Tree Measurer, Description and Use of Operator's Controls and Indicators	12-2.5
Optical Tree Measurer, Operating Procedures	12-4.2.9
P	
Paper Trimmer, Description and Use of Operator's Controls and Indicators	12-2.3
Paper Trimmer, Operating Procedures	12-4.2.8
Pin Punch Register, Description and Use of Operator's Controls and Indicators	12-2.4
Pin Punch Register, Operating Procedures	12-4.2.5
Preparation for Storage or Shipment	12-9
Preventive Maintenance Checks and Services (PMCS), Operator	12-3
Prototype 35mm Camera, Description and Use of Operator's Controls and Indicators	12-2.6
R	
Replace:	
Batteries, Still Picture Camera	12-7.3
Fluorescent Lamp in Magnifier Lamp	12-7.1
Magnifier Lamp	12-7.2
Manual Typewriter	12-7.4
S	
Scope	12-1.1
Still Picture Camera, Operating Procedures	12-4.2.6
Still Picture Camera Set, Description and Use of Operator's Controls and Indicators	12-2.8
T	
Troubleshooting Procedures, Operator	12-6
V	
Vacuum Cleaner, Description and Use of Operator's Controls and Indicators	12-2.9
Vacuum Cleaner, Operating Procedures	12-4.2.7

Subject	Paragraph
ULTRASONIC CLEANER	
c	
Circuit Board, Replace	7-13.3
D	
Data, Equipment Description and	7-2
Description and Use of Operator's Controls and Indicators	7-4
E	
Equipment Characteristics, Capabilities, and Features	7-2.1
Equipment Data	7-2.3
Equipment Description and Data	7-2
G	
General Information	7-1
I	
Information, General	7-1
L	
Location and Description of Major Components	7-2.2
Lubrication Instructions	7-7
O	
Operating Procedure	7-6.1
Operation, Technical Principles of	7-3
Operation Under Usual Conditions	7-6
Operator Preventive Maintenance Checks and Services (PMCS)	7-5
Organizational Troubleshooting	7-12
P	
Power Cord, Replace	7-13.1
Power Switch, Replace	7-13.2
Preparation for Storage or Shipment	7-14
Preventive Maintenance Checks and Services (PMCS), Operator	7-5

Subject **Paragraph**

ULTRASONIC CLEANER - Continued

R

Replace:

Circuit Board	7-13.3
Power Cord	7-13.1
Power Switch	7-13.2

S

Scope	7-1.1
Shipment, Preparation for Storage or	7-14

T

Technical Principles of Operation	7-3
Troubleshooting, Organizational	7-12

ZOOM STEREOSCOPE 95R

A

Assembly and Preparation for Use	3-5.1
--	-------

C

Conditions, Operation Under Usual	3-5
---	-----

D

Data, Equipment	3-2.2
Data, Equipment Description and	3-2
Description and Use of Operator's Controls and Indicators	3-3

E

Equipment Characteristics, Capabilities, and Features	3-2.1
Equipment Data	3-2.2
Equipment Description and Data	3-2

G

General Information	3-1
---------------------------	-----

I

Information, General	3-1
Instructions, Lubrication	3-6

Subject **Paragraph**

ZOOM STEREOSCOPE 95R - Continued

L

Lubrication Instructions 3-6

M

Movement, Preparation for 3-5.3

O

Operating Procedures 3-5.2

Operation Under Usual Conditions 3-5

Operator Preventive Maintenance Checks and Services (PMCS) 3-4

Operator Troubleshooting Procedures 3-7

P

Preparation for Movement 3-5.3

Preparation for Storage or Shipment 3-9

Preventive Maintenance Checks and Services (PMCS), Operator 3-4

Procedures, Operating 3-5.2

S

Scope 3-1.1

Shipment, Preparation for Storage or 3-9

ZOOM TRANSFER SCOPE ZT4-H

A

Adjust Drag 4-9.1

Assembly and Preparation for Use 4-6.1

B

Bulb, Replace 4-9.2

C

Components, Location and Description of Major 4-2.2

Conditions, Operation Under Usual 4-6

Subject	Paragraph
ZOOM TRANSFER SCOPE ZT4-H - Continued	
D	
Data, Equipment	4-2.3
Data, Equipment Description and	4-2
Description and Use of Operator's Controls and Indicators	4-4
Diagram, Wiring	4-3.2
Direct/General Support Maintenance Procedures	4-14
Drag, Adjust	4-9.1
E	
Equipment Characteristics, Capabilities, and Features ..	4-2.1
Equipment Data	4-2.3
Equipment Description and Data	4-2
F	
Foot Switch, Replace	4-14.4
Fuse Holder, Replace	4-14.6
Fuse, Replace	4-9.3
G	
General Information	4-1
I	
Illuminator Control Potentiometer, Replace	4-14.5
Illuminator Plug Receptacle, Replace	4-14.7
Illuminator Selector Switch, Replace	4-14.8
Information, General	4-1
Instructions, Lubrication	4-7
L	
Location and Description of Major Components	4-2.2
Lubrication Instructions	4-7
O	
Operating Procedure	4-6.2
Operation, Technical Principles of	4-3
Operation Under Usual Conditions	4-6
Operator Maintenance Procedures	4-9
Operator Preventive Maintenance Checks and Services (PMCS)	4-5

Subject	Paragraph
ZOOM TRANSFER SCOPE ZT4-H - Continued	
Operator's Controls and Indicators, Description and Use of	4-4
Operator Troubleshooting Procedures	4-8
Optical System, Replace	4-14.9
P	
Pilot Light, Replace	4-14.2
Power Cord, Replace	4-14.3
Power Switch, Replace	4-14.1
Preparation for Movement	4-6.3
Preparation for Storage or Shipment	4-15
Preventive Maintenance Checks and Services (PMCS), Operator	4-5
Procedure, Operating	4-6.2
R	
Repair Parts; Special Tools; Test, Measurement, and Diagnostic Equipment (TMDE); and Support Equipment	4-11
Replace:	
Bulb	4-9.2
Foot Switch	4-14.4
Fuse	4-9.3
Fuse Holder	4-14.6
Illuminator Control Potentiometer	4-14.5
Illuminator Plug Receptacle	4-14.7
Illuminator Selector Switch	4-14.8
Optical System	4-14.9
Pilot Light	4-14.2
Power Cord	4-14.3
Power Switch	4-14.1
S	
Scope	4-1.1
Shipment, Preparation for Storage or	4-15
T	
Technical Principles of Operation	4-3
Troubleshooting Procedures, Operator	4-8
W	
Wiring Diagram	4-3.2

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PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO
6	2-1 a		
B1		4-3	
125	line 20		

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

In line 6 of paragraph 2-1a the manual states the engine has 6 Cylinders. The engine on my set only has 4 Cylinders. Change the manual to show 4 Cylinders.

Callout 16 on figure 4-3 is pointing at a bolt. In key to figure 4-3, item 16 is called a shim - Please correct one or the other.

I ordered a gasket, item 19 on figure B-16 by NSN 2 910-00-762-3001. I got a gasket but it doesn't fit. Supply says I got what I ordered, so the NSN is wrong. Please give me a good NSN

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

JOHN DOE, PFC (268) 317.7111

SIGN HERE

JOHN DOE

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1 JUL 79

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PUBLICATION DATE
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PUBLICATION TITLE Topographic Support System (6675-01-105-5764)

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TEAR ALONG PERFORATED LINE

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
 1 decimeter = 10 centimeters = 3.94 inches
 1 meter = 10 decimeters = 39.37 inches
 1 dekameter = 10 meters = 32.8 feet
 1 hectometer = 10 dekameters = 328.08 feet
 1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
 1 decigram = 10 centigrams = 1.54 grains
 1 gram = 10 decigrams = .035 ounce
 1 dekagram = 10 grams = .35 ounce
 1 hectogram = 10 dekagrams = 3.52 ounces
 1 kilogram = 10 hectograms = 2.2 pounds
 1 quintal = 100 kilograms = 220.46 pounds
 1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
 1 deciliter = 10 centiliters = 3.38 fl. ounces
 1 liter = 10 deciliters = 33.81 fl. ounces
 1 dekaliter = 10 liters = 2.64 gallons
 1 hectoliter = 10 dekaliters = 26.42 gallons
 1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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PIN: 020484-000