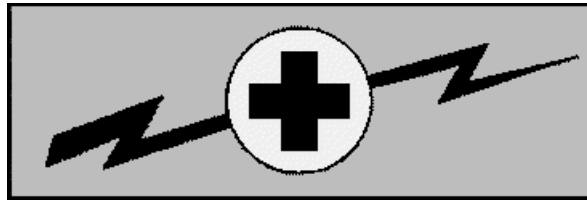


DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR AND ORGANIZATIONAL
MAINTENANCE MANUAL

BINOCULAR M18

This copy is a reprint which includes current pages from
Changes in force. c 3



ORD B5101

WARNING

HIGH VOLTAGE

**is used in the operation
of this equipment**

DEATH ON CONTACT

**may result if personnel fail to observe
safety precautions**

The highest potential used is 16,000-volt dc power required to energize the infrared image converter tubes. Be careful not to contact the output connections of the power supply of the input connections of the converter tubes when operating or maintaining the equipment.

For artificial respiration refer to FM 21-11.

CHANGE }
No. 3 }

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, DC, 30 August 1974

**Operator and Organizational Maintenance Manual
BINOCULAR M18 W/E (6650-863-5657)**

TM 9-6650-215-12, 6 April 1964, is changed as follows:

The title is changed as shown above.

On the inside front cover page, delete the words "DEATH ON CONTACT" and substitute "SEVERE SHOCK".

Page 1, Table of Contents, appendix II, is changed to read "BASIC ISSUE ITEMS LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST."

Page 2, Paragraph 1b, line 1, the sentence begging "appendix II" is changed to read: "appendix II contains the basic issue items list and items troop installed authorized list available to the operator."

Paragraph 1c is superseded as follows:

c. Recommendations for Maintenance Publications Improvements.

You can improve this manual by calling attention to errors and by recommending improvements using DA Form 2028, (Recommended Changes to Publications and Blank Forms) or by a letter, and mailing direct to Commander, Frankford Arsenal, ATTN: SARFA MA, Philadelphia, PA 19137. A reply will be furnished direct to you.

Page 6, paragraph 6b, line 1, "3.5 power" is changed to read "3.3 power".

Page 25, APPENDIX II title is changed to read "BASIC ISSUE ITEMS LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST".

Paragraph 1 is superseded as follow.:

1. General

This appendix contains a basic issue items list, items troop installed or authorized list, and is divided into the following sections:

a. Basic Issue Items List, section II, a list, in alphabetical sequence, of items which are furnished with and which must be turned in with the end item.

b. Items Troop Installed or Authorized List, section II. Not applicable.

Paragraph 3a is superseded as follows:

a. Source, Maintenance and Recoverability Code (Col.1).

(1) *Source (col. 1a).* This column indicates the selection status and source for the listed item. Source codes used in this list are:

<i>Code</i>	<i>Explanation</i>
PA	Requisition from depot system of the responsible supply channel (applies to low mortality parts).

(2) *Maintenance Level (col. 1b).* This column indicates the lowest maintenance echelon authorized to install the listed item. Maintenance level codes used in this area are:

<i>Code</i>	<i>Explanation</i>
C	Crew

(4) *Recoverability (col 1c).* This column indicates whether unserviceable items should be returned for recovery or salvage. When no code is indicated, the item is expendable and not recoverable. Recoverability codes used in this list are:

<i>Code</i>	<i>Explanation</i>
R	Items which are economically repairable at field maintenance activities (3 rd and 4 th echelon) are normally furnished by supply on an exchange basis.

*This change supersedes C1, 14 May 1984 and C3, 20 April 1973

This publication is a courtesy quick copy from the UNITED STATES ARMY PUBLICATIONS CENTER, ST. LOUIS, MISSOURI, to meet your needs while we are replenishing our regular stock.

Page 26. Section II. Basic Issue Items List is superseded as follows:

Section II. BASIC ISSUE ITEMS LIST

(1) Source Maint and Recov Code			(2) Federal Stock No.	(3) Reference No. & Mfr Code Usable on Code	(4) Unit of Meas	(5) Qty Inc in Unit	(6) Qty furn with Equip	(7) Illustration	
(a) source	(b) maint	(c) recov						(a) Fig. No.	(b) Item No.
P	C		6650-850-3312	CASE CARRYING 10514520 (19200)	EA		1	1	
P	C		1240-764-6236	STRAP, NECK 7646236 (19200)	EA		1	5	5

By Order of the Secretary of the Army:

Official:

VERNE L. BOWERS
Major General, United States Army
The Adjutant General

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Distribution:

To be distributed in accordance with DA Form 1241 (qty rqr block No. 7) Organizational Maintenance requirements for Binocular.

BINOCULAR M18

			Paragraph	Page
CHAPTER	1	INTRODUCTION		
Section	I	General	1 - 3	2
	II	Description and data	4 - 6	3 - 5
CHAPTER	2	OPERATING INSTRUCTIONS		
Section	I	Service upon receipt of materiel	7 - 9	7
	II	Controls.....	10 -13	8 ,9
	III	Operation under usual conditions	14 -17	9 ,10
	IV	Operation under unusual conditions	18 - 22	11
CHAPTER	3	MAINTENANCE INSTRUCTIONS		
Section	I	Repair parts, tools, and equipment for operation and organizational maintenance	23 - 26	13
	II	Lubrication and painting.....	27 ,28	13
	III	Preventive maintenance services	29 - 38	13 -16
	IV	Troubleshooting	39 ,40	17
	V	Repair of cable assembly	41 ,42	17 -19
	VI	Repair of eyeshield	43 ,44	19
	VII	Repair of straps	45 ,46	20
	VIII	Adjustment of interpupillary torque	47 ,48	20
	IX	Adjustment of interpupillary distance accuracy.....	49 ,50	21
CHAPTER	4	DOMESTIC SHIPMENT, LIMITED STORAGE, AND DEMOLITION TO PREVENT ENEMY USE		
Section	I	Domestic shipment and limited storage.....	51 ,52	22
	II	Demolition of materiel to prevent enemy use	53 - 57	22 ,23
APPENDIX	I	REFERENCES		24
	II	BASIC ISSUE ITEMS LIST.....		25
	III	MAINTENANCE ALLOCATION CHART		27
INDEX.....				29

CHAPTER 1 INTRODUCTION

Section I. GENERAL

1. Scope

a. This technical manual contains instructions for operation and organizational maintenance of binocular M18 with equipment (fig. 1). The initial application for binocular M18 has been designed for Tank, Combat, Full Track, 105mm Gun, M60 Series. The turret mechanic is responsible for organizational maintenance.

b. Appendix I contains a list of current references, including supply and technical manuals, forms, and other publications applicable to binocular M18. Appendix II lists basic issue items, repair parts, and special tools and equipment available to the operator. Appendix III contains the maintenance allocation chart. TM 9-6650-215-20P lists repair parts and special tools and equipment for organizational maintenance personnel.

c. This first edition is being published in advance of complete technical review. The direct reporting of errors, omissions, and recommendations for improving this equipment manual by the individual user is authorized and encouraged. DA Form 2028 will be used for reporting these improvements. This form may be completed using pencil, pen, or typewriter. DA Form 2028 will be completed in triplicate, and forwarded by the individual using the manual. The original and one copy will be forwarded direct to Commanding Officer, Frankford Arsenal, ATTN: SMUFA-31001,

Philadelphia, Pennsylvania, 19137. One information copy will be provided to the individual's immediate superior.

2. Maintenance Allocation

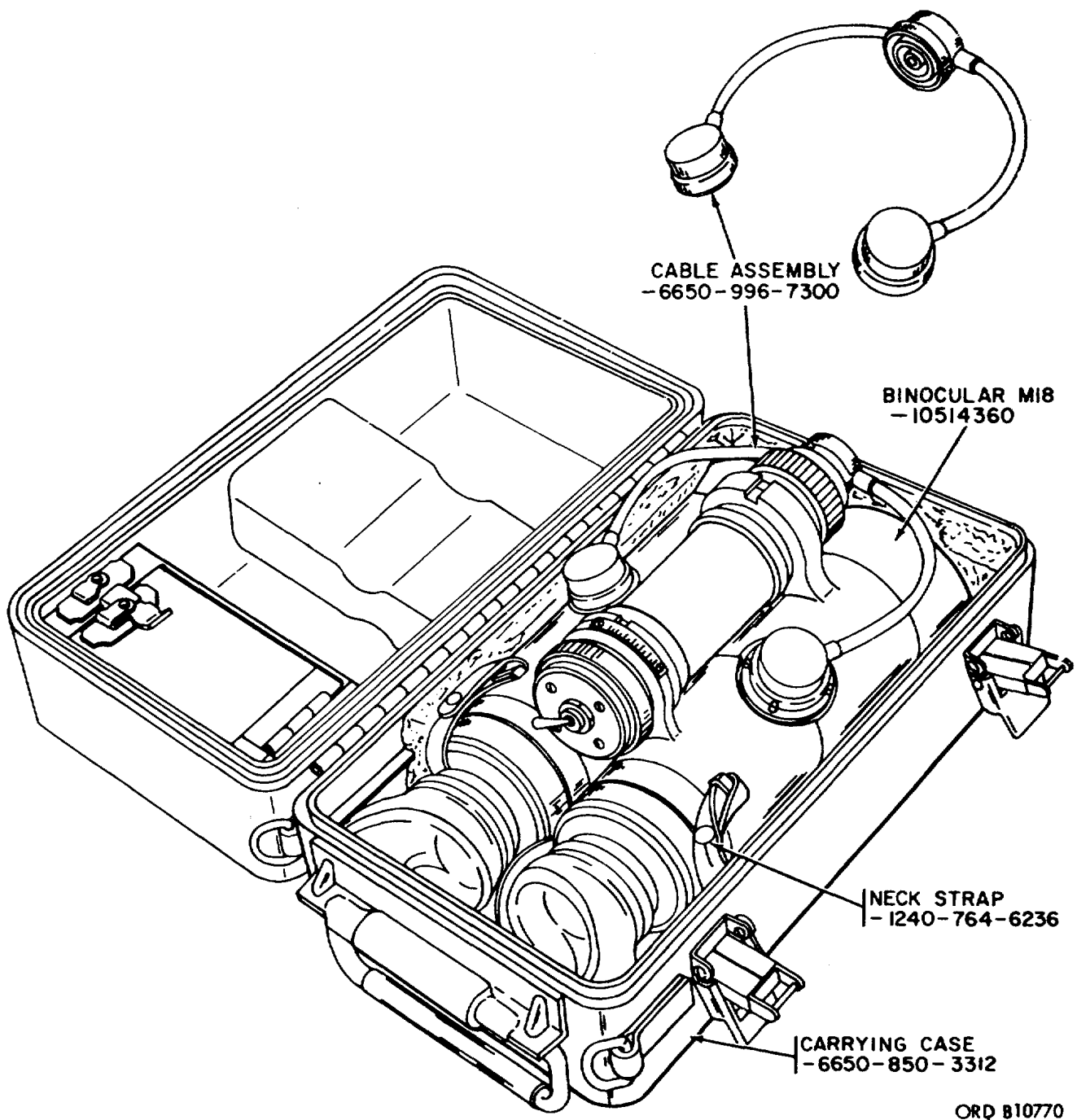
In general, prescribed maintenance responsibilities will apply as reflected in the maintenance allocation chart. In all cases where the nature of the repair, modification, or adjustment is beyond the scope or facilities of the using organization, the supporting maintenance unit should be informed so that trained personnel with suitable tools and equipment may be provided or other instructions issued.

3. Forms, Records, and Reports

a. *Authorized Forms.* The forms generally applicable to units operating or maintaining this materiel are listed in TM 38-750.

b. *Field Report of Accidents.* The reports of the Army safety program are listed in AR 385-40. These reports are required whenever accidents involving injury to personnel or damage to materiel occur.

c. *Equipment Improvement Recommendations.* Deficiencies detected in the equipment or materials should be reported using the Equipment Improvement Recommendation section of DA Form 2407.



ORD 810770

Figure 1. Binocular M18 with equipment 6650-863-5657 in carrying case 6650-850-3312

Section II. DESCRIPTION AND DATA

4. Description

a. Binocular M18 (fig. 2) is an infrared viewing device that enables the user to serve enemy targets at night using an infrared radiation source, such as a xenon search light. The binocular consists of two monocular

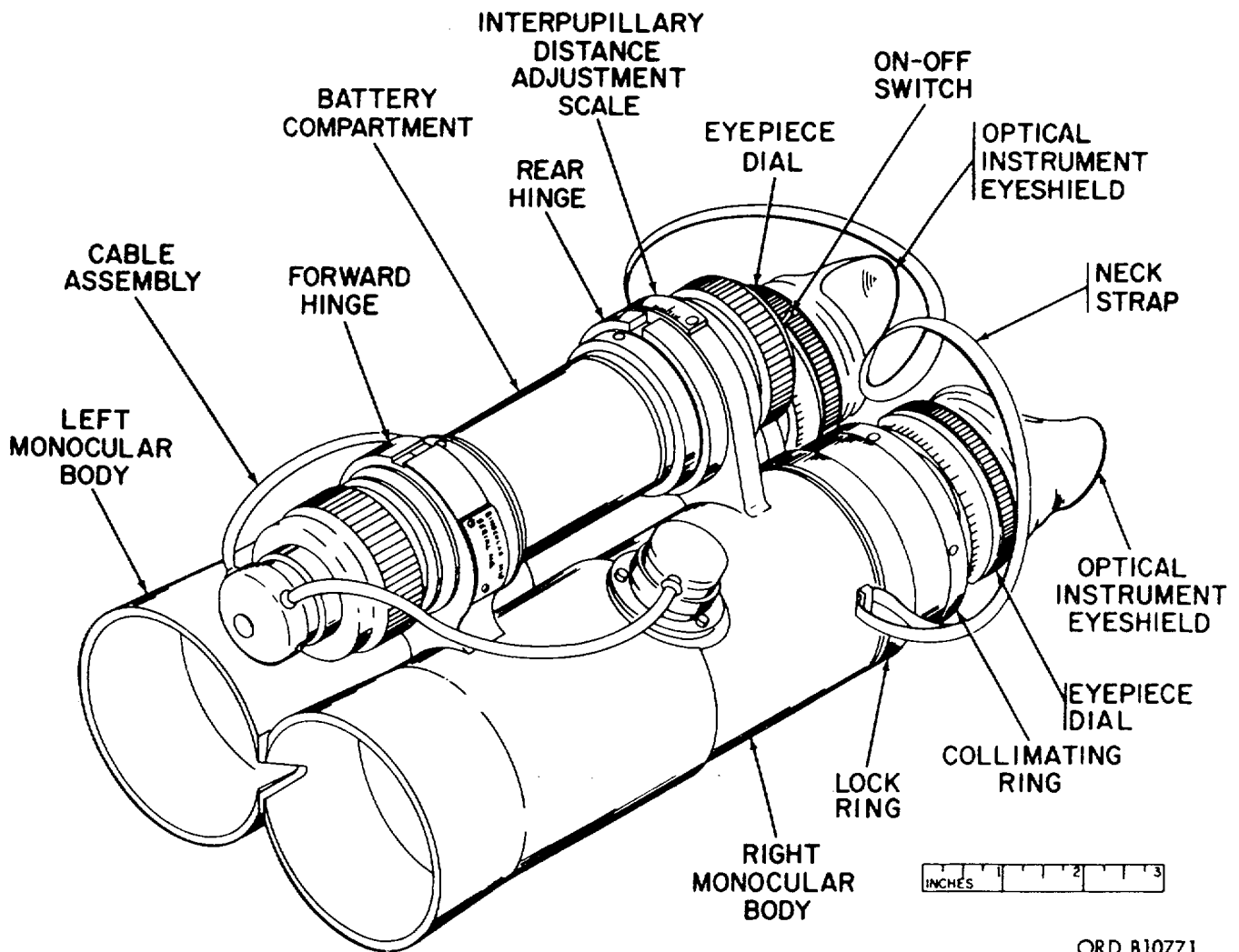
bodies with independent optical systems and a hinge assembly which joins the two monocular bodies. The interior of the hinge assembly provides

a compartment for housing the battery, power supply, and switch assembly.

b. Each independent optical system consists of an eyepiece assembly, an electronic (image converter) tube, and an objective assembly arranged as shown in figure 3. The eyepiece assembly (fig. 3) consists of an aspheric lens, an eyelens, and a field lens. The eyepiece assembly can be focused through a range of $\pm 1\text{-}1/2$ diopters by rotation of the eyepiece dial (fig. 2). The range scale on the eyepiece dial has a range of ± 2 diopters. The electronic (image converter) tube (fig. 3) is an electron tube which converts the invisible infrared image into a visible image on its fluorescent anode. The

objective lens assembly (fig. 3) consists of two objective mirrors and three objective lenses, forming a refractive-reflective combination which folds the light path is indicated in figure 3.

c. Infrared rays from the object being observed enter the objective assembly (fig. 3) of each monocular body. The objective assemblies form the images on the front face (photo-cathode) of the electronic (image converter) tubes. The electronic (image converter) tubes electrostatically transfer these images to the rear face (fluorescent anode) of each tube, where they appear as visible images when viewed through the eyepiece assemblies. To aid in observing the visible images on



ORD B10771

Figure 2. Binocular M18-bottom View.

the rear faces of the electronic (image converter) tubes, the eyepiece assemblies are fitted with optical instrument eyeshields (fig. 2) to exclude stray light.

d. The two monocular bodies are connected by a forward and rear hinge (fig. 2), which permits adjustment of the interpupillary distance from 64 to 75 millimeters. Eccentric rings mounted within the hinge assembly permit angular corrections for partially collimating the optical axis of the monocular bodies. The hinge assembly contains the battery compartment (fig. 2). The battery compartment contains a power supply, a 1-1/2-volt battery, and an ON-OFF switch (fig. 2). Power from the battery compartment is transmitted to the electronic (image converter) tubes in the monocular bodies through a cable assembly (fig. 2). The application of power to the electronic (image converter) tubes is controlled by the ON-OFF switch.

e. The Binocular is equipped with a neck strap (fig. 2) which can be used to carry the binocular when it is being used. The strap is secured through loops on the monocular bodies.

f. When not in use, the binocular is stored in a waterproof carrying case 6650850-3312 (fig. 1). Packing, preformed to the shape of the binocular, protects it from vibration and isolates the binocular from the metal sides of the carrying case. A separate compartment within the carrying case is used to store two spare 1-1/2 volt batteries and a cable assembly.

5. Serial Number Information and Data Plates

The identification plate is located on the forward hinge (fig. 2). In addition to the name and model number, the identification plate contains the serial number of the binocular and the date of its last inspection.

6. Tabulated Data

a. Physical Characteristics.

Binocular:
 Weight (without carrying case and batteries)..... 4 lb 12 oz

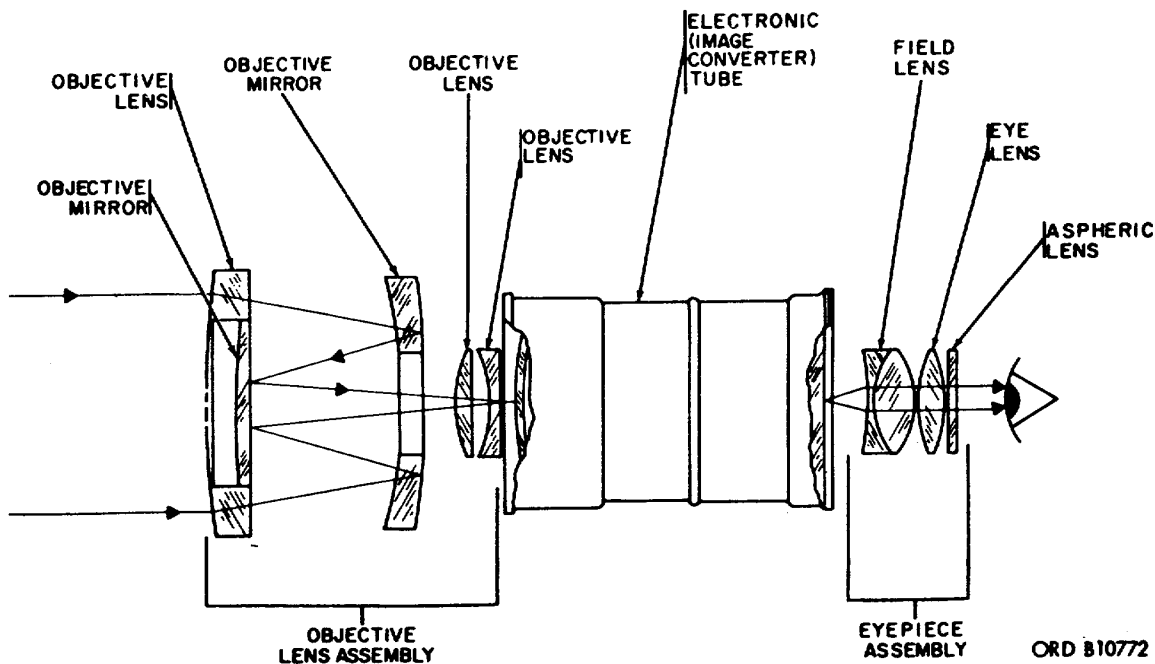


Figure 3. Optical diagram.

Weight (with carrying case
and batteries)9 lb 12 oz
Width 5-3/4 in.
Length..... 10-5/8 in.
Height 4-3/8 in.
Carrying case:
Weight 5 lb
Height 6 in.
Width 7 in.
Length..... 12-3/4 in.

b Optical Characteristics.

Magnification of system 3.5 power
Field of view.....12° 30'

Equivalent focal length (EFL)
objective3.780 in.
Magnification of image con-
verter tube0.77 power
Clear eye distance 0.42-in.
Diopter adjustment ± 1-1/2 diopters
Interpupillary distance ad-
justment 64 to 75 mm

c. Electrical Characteristic.

Power source 1-1/2-v, BA-42
.....dry battery

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIEL

7. General

a. When new, used, or reconditioned materiel is first received by the using organization, it is the responsibility of the officer in charge to determine whether the materiel has been properly prepared for service by the supplying organization and to be sure it is in condition to perform its function.

b. Make a record of any missing parts and equipment and of any malfunctions. Correct any deficiencies as quickly as possible.

8. Duties

The organization mechanic performs the inspection to determine whether the equipment has been properly prepared for service and is in condition to perform its assigned function. A record will be made of deficiencies noted; those within the scope of organizational maintenance will be corrected at this time.

9. Services

The only services required prior to placing the binocular into operation are unpacking and installing the battery. The unpacking procedure is accomplished by removing the binocular from the packing case and does not require detailed explanation. To install the battery, proceed as follows:

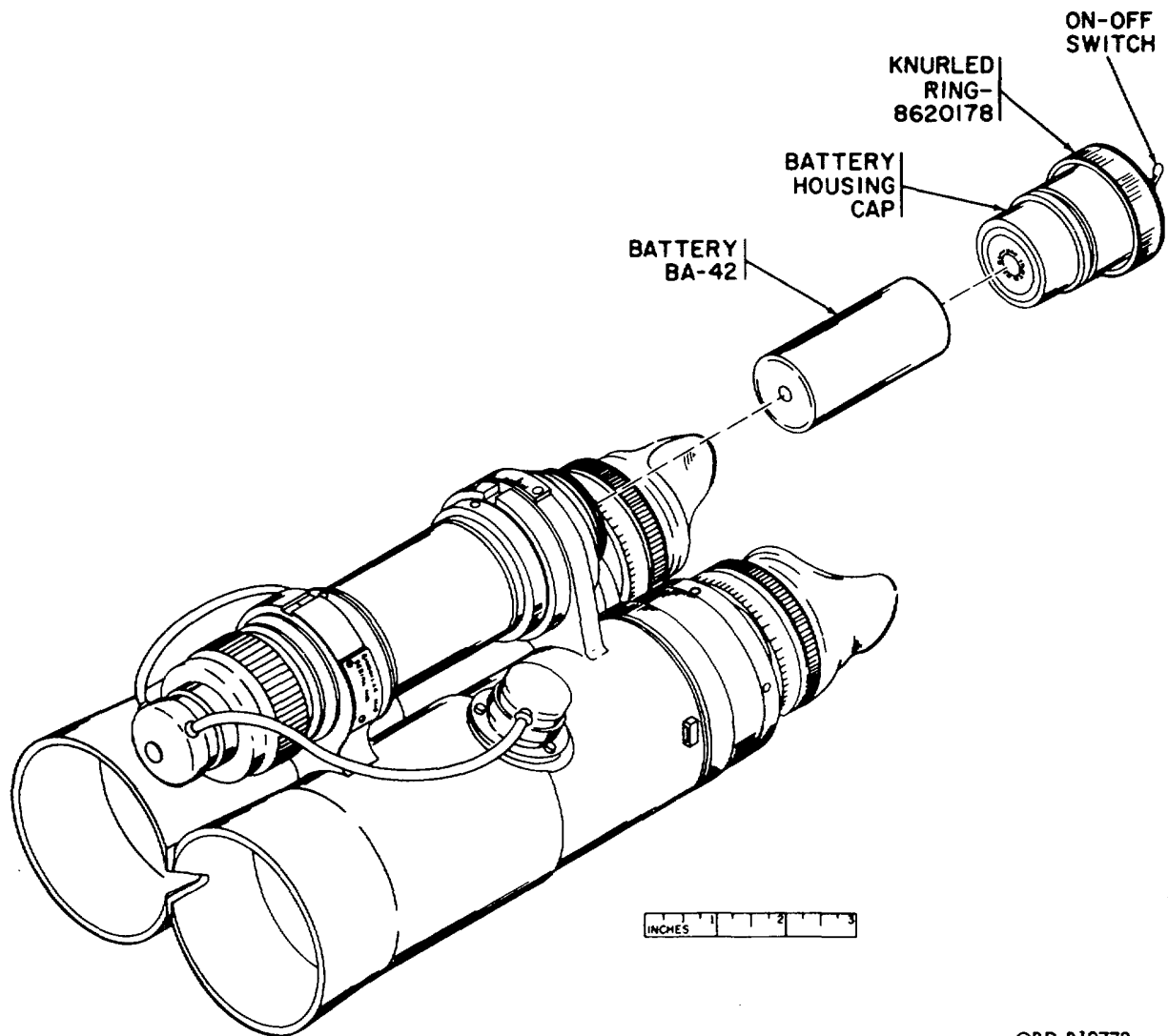
Note. The binocular is shipped and stored without the battery. This is done to prevent damage to the binocular due to possible battery leakage during prolonged storage.

a. Remove battery housing cap (fig. 4) by unthreading knurled ring 8620178.

b. Check battery contacts for cleanliness. If required, clean contacts with a burnishing tool or crocus cloth.

c. Install battery in battery compartment with positive (center) terminal towards ON-OFF switch.

d. Reinstall battery housing cap and secure by tightening knurled ring.



ORD 810773

Figure 4. Installation of battery.

10. General

This section describes, locates, illustrates, and furnishes the operator with sufficient information pertaining to the controls provided for the proper operation of the binocular.

11. ON-OFF Switch

The ON-OFF switch (fig. 2) is located at the rear of the battery compartment. It is a two-position toggle

Section II. CONTROLS

switch which controls the application of power to the electronic (image converter) tubes.

12. Interpupillary Distance Adjustment

The interpupillary distance adjustment scale (fig. 2) is located at the rear of the hinge assembly joining the two monocular bodies. It selects the interpupillary (eye to-eye) setting of the binocular.

13. Eyepiece Dial

Each monocular body is equipped with an eyepiece dial (fig. 2) located in front of the eyeshield.

These eyepiece dials adjust the focus of the eyepiece assemblies to the individual user's eyes. Diopter scales are provided for reference to the individual settings.

Section III. OPERATION UNDER USUAL CONDITIONS

14. General

This section contains instructions for the proper care of the materiel, preparation for operation, and the operation of the binocular under conditions of moderate temperature and humidity. Every organization equipped with this binocular must thoroughly train its personnel in the procedures for operating this equipment (para 17). For operation under unusual conditions, refer to paragraphs 18 through 22.

15. Care in Handling the Binocular

The binocular will not stand rough handling or abuse. Malfunctions will result from mistreatment. Any instrument which cannot be adjusted or corrected by the authorized procedure must be brought to the attention of organizational maintenance personnel for necessary repairs. Adjustments other than those expressly authorized will not be performed by the operator.

- a. Unnecessary turning of parts not incident to the use of the instrument is forbidden.
- b. Stops are provided on instruments to limit the travel of the moving parts. Do not attempt to force the rotation of any knob beyond the stop limit.
- c. Keep the instrument as clean and dry as possible. If the binocular is wet, dry it carefully.
- d. When not in use, keep the binocular covered and protected from dust and moisture.
- e. Do not point the binocular directly at the sun. The focused infrared rays will damage the electronic (image converter) tube and the optical elements.

- f. Keep all exposed surfaces clean and dry to prevent corrosion and/or etching of the optical elements.

16. Preparation for Use

a. *Setting Up.* The procedure for removing the binocular from the carrying case does not require detailed explanation. Install the battery as directed in paragraph 9.

b. *Inspection.*

(1) *General.* Whenever inaccuracies, maladjustment, or any other conditions affecting serviceability are disclosed by the inspection prescribed in table I, the necessary corrective action should be taken if the maintenance required is within the scope of the using organization. If the maintenance required is beyond the scope the using organization, the binocular should be referred to maintenance personnel.

(2) *Procedure.* Visually examine the binocular for completeness and general appearance. The painted surfaces should not have bare spots, scratches exposing bare metal, or chipped or loose paint. There should be no evidence of corrosion on any part. Table I lists the inspections to be performed on the binocular.

Table I. Operator's Inspection Chart for Binocular M18

Point of inspection	Figure No.	Acceptable standard No.
Battery housing cap -----	4	Securely mounted.
Cable assembly -----	2	Not cracked, frayed, twisted, or broken. Connectors and caps securely mounted.

Table 1. Operator's Inspection Chart for Binocular M1 8-Continued

Point of inspection	Figure No.	Acceptable standard
Carrying case -----	1	Rubber seal free of deterioration, tears, and cuts. Locking clamps not damaged. Interior packing free of damage, properly positioned, and securely attached.
Electronic (image converter) tubes	3	Authorized spare parts (two batteries and cable assembly) present and serviceable. With ON-OFF switch set to ON, no evidence of flicker or audible sparking. Image should be in sharp, clear, bright focus. Note. Irregularities in fluorescent screen will cause hot or cold spots to appear as dark or light spots. Do not confuse these spots with dirt.
Eyepiece dials -----	2	Smooth action between stops, no binding or sticking.
Hinge assembly (forward and rear hinge)	2	No binding or sticking over entire adjustment range; holds securely when adjusting torque is not applied.
Identification plate and interpupillary distance adjustment scale	2	Engraved lines, numbers, and indexes clear and distinct.
Neck strap -----	2	Free of deterioration, tears, and cuts; securely fastened to binocular.
ON-OFF switch -----	2	Positive snap action.
Optical elements -----	3	No evidence of moisture or fungus growth when viewed through both ends of binocular. Surfaces free of fingerprints and smears. No chips or fractures that distort image. No evidence of grayness or strain on polished surfaces of optical elements in or near focal plane.
Optical instrument eyeshields -----	2	Free of distortion, deterioration, cuts, and tears. Fit snugly over eyepieces.

17. Operation

Caution: Never operate the binocular under bright daylight conditions. Be especially careful not to point the binocular directly at the sun at any time, as the heat of the focused rays may damage the optical elements, and the severe concentration of infrared rays will destroy the electronic (image converter) tubes whether the ON-OFF switch is set to ON or OFF.

Caution: Do not attempt to adjust the lock ring or the collimating ring (fig. 2). These items are to be adjusted by depot personnel only, because the binocular will become unserviceable if the rings are adjusted without the aid of alinement tools.

a. Operating ON-OFF Switch.

(1) To turn the binocular on, set the ON-OFF switch (fig. 2) to ON. This energizes the electronic

(image 10 converter) tubes immediately (no warm-up time is required).

(2) To turn the binocular off, set the ON-OFF switch to OFF.

Note. After the switch has been set to OFF, the electronic (image converter) tube will maintain operating voltages until the anode voltage has had time to discharge.

b. Adjusting Interpupillary Distance . Hold the binocular with both hands, and raise it to the eyes; then spread the monocular bodies apart or bring them together, as required, by exerting a slight arcing force about the hinge axis until the eyepieces align with the eyes. A properly adjusted binocular should provide a comfortable full field-of-view for each eye. The binocular should maintain this setting during normal handling.

c. Adjusting Eyepiece Focus. Set the ON-OFF switch to ON, and adjust the knurled eyepiece dial (fig. 2) of each eyepiece

piece until the grain of the screen in the electronic image converter) tube is in sharp focus. Note the setting of the diopter scale for future reference to this setting.

Note. If, after adjustment, the image is not sharp and clear or is dim, replace battery (para 9). If faulty image is still obtained, refer binocular to maintenance personnel.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

18. General

In addition to the normal operating procedures for usual conditions described in Section III special instructions for operating under unusual conditions are contained herein. In addition to the normal preventive maintenance services (para 29 through 38), special care in cleaning must be observed where extremes of temperature, humidity, and atmospheric conditions not normally encountered are present. Proper cleaning not only insures proper operation and functioning, but also guards against deterioration of the materiel.

19. Operation in Extreme Cold

In addition to the instructions for operation under usual conditions, the following precautions should be observed when using the binocular in extreme cold:

- a. Avoid breathing on optical elements to prevent the formation of condensation which may freeze.
- b. Do not expose binocular unnecessarily to adverse weather conditions. When not in use, store binocular in carrying case.
- c. Before using binocular in extreme cold conditions, allow electronic (image converter) tube to warmup approximately 1 minute.
- d. Do not use the binocular during the day, as reflected glare from snow or bright sun light is just as damaging to optical elements as the direct rays of the sun.
- e. Be especially careful not to force any moving parts of the binocular, as extreme cold makes parts brittle, causing them to break.

20. Operation in Extreme Heat

In addition to the instructions for operation under usual conditions, the following precautions should be observed when using the binocular in extreme heat:

- a. Place a suitable dehydrating compound in the carrying case to protect the binocular against high humidity and its corrosive effects. When not in use, store the binocular in its carrying case.
- b. Do not use the binocular during the day, as reflected glare is just as damaging to the optical elements as the direct rays of the sun.

21. Operation Under Dusty or Sandy Conditions

In addition to the instructions for operation under usual conditions, the following precautions should be observed when using the binocular under dusty or sandy conditions:

- a. Shield the moving parts of the binocular to prevent the entrance of dust or sand.
- b. Do not point the binocular directly into the wind, unless such action is required by the tactical situation, as wind driven dust or sand may etch the optical elements.
- c. Remove dust or sand from optical elements with an artist's camels-hair brush. Do not use fingers or cloth, as this may scratch elements.

22. Operation under High Humidity Conditions

In addition to the instructions for operations under usual conditions, the following precautions should be observed when using the binocular under high humidity conditions:

- a. Keep the binocular in a warm, dry storage area to protect it against the effects of high humidity.
- b. Place a suitable dehydration compound in the carrying case.

Caution: If the binocular is accidentally

immersed in water, remove battery and dry it and the electrical contacts. Allow the binocular to dry for at

least 12 hours. If the binocular is damaged, return it to the maintenance unit for service or repair.

**CHAPTER 3
MAINTENANCE INSTRUCTIONS**

**Section I. REPAIR PARTS, TOOLS AND EQUIPMENT FOR OPERATION
AND ORGANIZATIONAL MAINTENANCE**

23. General

Repair parts, tools, and equipment are issued to the using organization for operating and maintaining the binocular. Tools and equipment should not be used for purposes other than prescribed and, when not in use, should be properly stored.

24. Repair Parts

Repair parts are supplied to the using organization for replacement of those parts that become worn, broken, or otherwise unserviceable. Repair parts supplied for the operator are listed in appendix II, which is the authority for requisitioning replacements. Repair parts supplied for the organizational mechanic are listed

in TM 9-6650-215-20P, which is the authority for requisitioning replacements.

25. Common Tools and Equipment

Standard and commonly used tools and equipment having general application to this materiel are authorized for issue by tables of allowances and tables of organization and equipment.

26. Special Tools and Equipment

There are no special tools or equipment required for operation or organizational maintenance of the binocular.

Section II. LUBRICATION AND PAINTING

27. General Lubrication Instructions

Certain parts of the binocular require lubrication during replacement and reassembly only. Because these parts are not authorized for replacement by organizational personnel, lubrication is not authorized for organizational maintenance personnel.

28. Painting

Painting is not authorized for organizational maintenance personnel. If painting is required, refer the binocular to field maintenance personnel.

Section III. PREVENTIVE MAINTENANCE SERVICES

29. General

Preventive maintenance is the systematic care, inspection, and servicing of equipment to maintain it in serviceable condition, prevent breakdowns, and assure maximum operational readiness. First echelon preventive maintenance is accomplished by the equipment operator. The operator's role in the performance of preventive maintenance service is:

a. To perform the daily service each day the equipment is operated.

b. To assist the organizational maintenance mechanics in the performance of any other scheduled periodic services specified by pertinent technical manuals.

30. Responsibility

Operators are personally responsible for assigned equipment. Unit and organization commanders are required to insure that equipment issued or assigned to their commands is properly maintained in a

serviceable condition, and that they are properly cared for and used.

31. Recording Repairs

Repairs accomplished will be in accordance with procedures and standards prescribed in appropriate technical manual. The equipment record system provides for recording repairs required and accomplished on specific items of equipment. This will include, but is not limited to, adjusting, cleaning, and replacing. Deficiencies discovered before, during, and after operation that cannot be corrected by the operator will be entered on DA Form 2404. Deficiencies immediately corrected by the operator are not recorded, except when such corrections are made by replacing parts or constitute repairs above first echelon. Such repairs will be recorded as organizational maintenance.

32. General Procedures for all Services and Inspections

a. The following general procedure apply to first-echelon preventive maintenance services and all inspections, and are just as important as the specific procedures.

b. Inspections to see if items are in good condition, correctly assembled or stowed, secure, and not excessively worn apply to most items in the preventive maintenance and inspection procedures. Any or all of these checks that are pertinent to any item will be performed automatically, as general procedures, in addition to any specific procedures given.

- (1) Inspection for "good condition" is usually an external visual inspection to see if the unit is damaged, beyond safe or serviceable limits. Good condition is explained further as meaning: not bent or twisted, not chafed or burred, not broken or cracked, not bare or frayed, not dented or collapsed, not torn or cut, not deteriorated.
- (2) Inspection of a unit to see that it is "correctly assembled or stowed" is usually a visual inspection to see if the

unit is in its normal position in the equipment and if all its parts are present and in their correct relative position.

- (3) By "excessively worn" is meant worn beyond serviceable limits or to a point likely to result in failure if the unit is not replaced before the next scheduled inspection. Excessive wear of mating parts is usually evidenced by too much play (lash or lost motion). It includes illegibility as applied to markings, data and caution plates, and printed matter.
- (4) Such expressions as "adjust if necessary" or "replace if necessary" are not used in the specific procedures. It is understood that whenever inspection reveals the need of adjustment, repairs, or replacement, the necessary action will be taken.

33. Preventive Maintenance by Operator

a. *Purpose.* To assure maximum operational readiness, it is necessary that the equipment be systematically inspected at intervals every day it is operated, so defects may be discovered and corrected before they result in serious damage or failure. Certain scheduled maintenance services will be performed at these designated intervals. Any deficiencies discovered that cannot be corrected by the operator, or corrected by replacing parts, will be reported on DA Form 2404.

b. *Daily Preventive Maintenance Service.* Each piece of equipment will be inspected each day that it is operated. This service is divided into three parts, as indicated in (1) through (3) below.

- (1) *Before-operation service.* This is a brief service to ascertain that the equipment is ready for operation; it is mainly a check to see if conditions affecting the equipment's readiness have changed since the last after-operation service.
- (2) *During-operation service.* This service consists of detecting unsatisfactory performance.

(3) *After-operation service.* This is the basic daily service for the equipment. It consists of correcting, insofar as possible, any operating deficiencies. Thus, the equipment is prepared to operate upon a moment's notice.

c. *General Precautions in Cleaning.*

(1) Under no circumstances should polishing liquids, pastes, or abrasives be used for polishing lenses. For wiping optical parts, use only clean lens tissue paper especially intended for cleaning optical glass. Use of cleaning cloths is not permitted. To remove dust, brush the glass lightly with a clean artist's camels-hair brush.

(2) Exercise particular care to keep optical parts free from oil and grease. Do not touch the lenses with the bare fingers. To remove fingerprints, oil, or grease from optical surfaces, apply alcohol with lens tissue paper, and wipe gently with clean lens tissue paper. If alcohol is not available, and the temperature is above freezing, breathe heavily upon glass, and wipe off with clean lens tissue paper. Repeat this operation until clean.

34. Specific Procedures for First Echelon

Table II gives the specific procedures to be performed on the equipment by the operator for each daily service.

Table II. Preventive Maintenance Checks and Services

<i>Daily schedule</i>					<i>1st echelon</i>
Interval and sequence No.			Item to be inspected	Procedures	Paragraph references
Before operation	During operation	After operation			
		1	Exterior-----	Inspect binocular for cracks, dents, chipped paint, or loose screws. Check cable assembly for frayed or broken insulation and secure connections. Check for loose or missing parts.	
		2-H ¹	Cable connectors	Set ON-OFF switch to OFF. Inspect connectors and terminals for pitting or corrosion.	42 33c
1	---	3	Lenses	Clean eyepiece and objective lenses.	
		4	Focusing ring	Turn focusing ring on each eyepiece. Action should be continuously smooth throughout range.	
		5	Interpupillary distance adjustment	Adjust interpupillary distance throughout range (64 to 75 mm). No binding or sticking should occur. Interpupillary distance remains fixed at any selected setting.	48
		6	Battery-----	Check battery for leaks, cracks, splits, or corrosion	9
		7-H ¹	Battery housing cap.	Check for broken or damaged threads and corroded or pitted battery contacts.	9
2	1	8	Battery performance check.	Set ON-OFF switch to ON. Tube should give bright visible image.	9

35. Preventive Maintenance by Organizational Mechanics

Preventive maintenance is the systematic care, inspection, and servicing of equipment to maintain it in serviceable condition, prevent breakdown, and assure

maximum operational readiness. Second echelon preventive maintenance is accomplished by the organizational mechanics. Their role in the performance

of preventive maintenance services is to perform the quarterly "Q" scheduled periodic services.

36. Recording Repairs

Repairs accomplished will be in accordance with procedures and standards prescribed in appropriate technical manuals. The equipment record system provides for recording repairs required and accomplished on specific items of equipment. This will include, but is not limited to, adjusting, cleaning, replacing, and straightening. Deficiencies and shortcomings not corrected by operators, or those discovered during periodic inspections, will be corrected insofar as possible by organizational maintenance personnel. These repairs will be indicated on DA Form 2404 and recorded on the organizational maintenance record of the equipment log.

37. General Procedures

a. Automatically Applied. All of the general procedures given in the operator's manual will be followed. Organizational mechanics must be so thoroughly trained in these procedures that they apply them automatically at all times in the performance of their duties.

b. First-Echelon Participation. The operator usually assists the organizational mechanics in the performance of second echelon periodic services.

c. Services. Second echelon services are defined by, and restricted to, the following general procedures unless approval has been given by the supporting organization.

(1) *Adjust.* Make all necessary adjustments in accordance with instructions contained in the pertinent sections of the technical manual or technical bulletins.

(2) *Clean.* Clean the unit as outlined in paragraph 32c to remove lubricant, dirt, and other foreign material.

(3) *Modification work order application.* The owning organization will enter on DA Form 2408-5 all required modification work orders (MWO) applicable to the equipment upon receipt of the official MWO, regardless of the echelon responsible for applying the modification.

d. Special Conditions. When conditions make it difficult to perform the complete preventive maintenance procedures at one time, plan to complete all operations within the week, if possible.

38. Specific Procedures for Second Echelon

Table III gives the specific procedures to be performed on the equipment by second echelon personnel for each quarterly, "Q" service.

Table III. Periodic Maintenance Checks and Services - Continued

2nd echelon

Quarterly schedule

Seq. No.	Item to be inspected	Procedures	Paragraph references
1	Exterior -----	Check exterior for dents, cracks, and corrosion.	
2	Cable assembly.	Set ON-OFF switch to OFF. Inspect cable assembly for cracks, frays, or breaks. Disconnect cable assembly, and inspect terminals and connectors for pitting or corrosion.	42
3	Eyeshields-----	Inspect eyeshields for cracks or tears -----	44
4	Web strap -----	Inspect the web strap for frays, cuts, and tears -----	46
5	Battery housing	Remove cap from binocular. Check switch for positive or corrosion. Check threads for nicks, burrs, or breaks.	9
6	Eyepiece dial	Adjust both eyepiece dials to identical diopter setting. Insure that both eyepieces extend equally, within ±1/16-inch, from the binocular body.	17c

Table III. Periodic Maintenance Checks and Services

2nd echelon

Quarterly schedule

Seq. No.	Item to be inspected	Procedures	Paragraph references
7	Interpupillary distance adjustment	Set the interpupillary distance to 70 mm, as indicated on the scale plate. Use an inch scale to measure the actual interpupillary distance. The actual distance should be 2-1/4 in. Hinge assembly should maintain this setting.	48, 50
8	Image -----	Set ON-OFF switch to ON. After a 15-second warmup, the image shall be bright and stable with no flickering.	17c

Section IV. TROUBLESHOOTING

39. Scope

Troubleshooting is a systematic isolation of defective components by means of symptoms, tests for determining the defective component, plus remedies. The tests and remedies provided in this section are governed by the scope of the organizational -level of maintenance level of maintenance.

40. Procedure

The troubleshooting procedure described in table IV is one of determining, upon occurrence of malfunctions noted, the probable cause, then taking the necessary corrective action, which includes notifying maintenance personnel if the tests and -remedies are beyond the scope of the using organization.

Table IV. TROUBLESHOOTING

Table IV. Troubleshooting

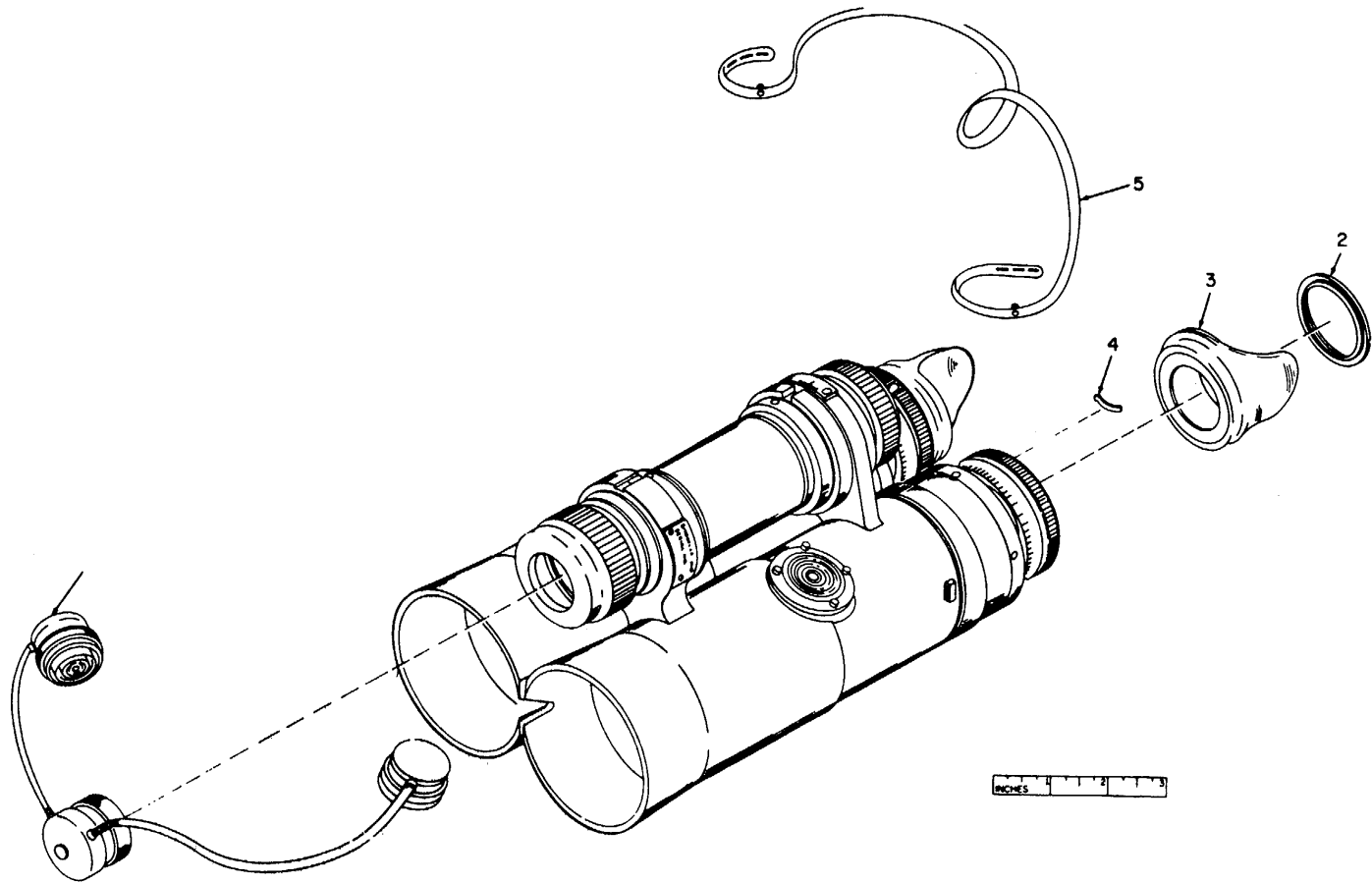
Malfunction	Probable cause	Corrective action
No image through binocular (either side).	Battery defective ----- Cable assembly not connected or defective. Power supply or ON-OFF switch defective.	Replace battery (para 9). Connect or replace cable assembly (para 42). Notify maintenance personnel.
No image through one side of binocular.	Connector to monocular body loose or disconnected. Electronic (image converter) tube defective or lenses broken.	Tighten connector. Notify maintenance personnel.
Binocular images do not superimpose. Images not sharp-----	Binocular not properly collimated. Lenses dirty ----- Subject closer than 25 feet -----	Notify maintenance personnel. Clean lenses (para 33c). Maintain subject distance greater than 25 feet.
Interpupillary distance too difficult to adjust or does not maintain adjustment. Image unstable -----	Focus out of adjustment ----- Tapered rings misadjusted ----- Weak battery ----- High voltage power supply defective or seals broken.	Adjust eyepiece dial (para 17c). Adjust tapered rings (para 48). Replace battery (para 9). Notify maintenance personnel.

Section V. REPAIR OF CABLE ASSEMBLY

41. General

organizational maintenance instructions for the repair of the cable assembly.

This section contains general and specific



ORD B10774

Figure 5. Binocular M18-exploded view.

- 1—Cable assembly 6650-996-7300
- 2—Externally threaded ring
- 3—Optical instrument eyeshield 6650-995-6778
- 4—Flat spring
- 5—Neck strap 1240-764-6236

Figure 5 - Continued.

in the following paragraphs, specific repairs within the scope of the organizational level of maintenance are described in order to restore the cable assembly to a serviceable condition.

42. Maintenance

a. Removal of Cable Assembly. Remove the cable assembly from the binocular as indicated in figure 5.

b. Cleaning Connectors of Cable Assembly. Clean the connectors of the cable assembly as follows:

- (1) Remove dirt and grease with a suitable dry-cleaning compound. Do

not use dry-cleaning compounds containing petroleum products.

- (2) Remove rust, corrosion, and pitting from contacts with fine sandpaper. Make sure that all dust has been removed after contacts are cleaned.

c. Replacement of Cable Assembly. Replace the cable assembly as indicated in figure 5. After the cable assembly has been installed, set the ON-OFF switch to ON, and insure that images are received at both eyepieces. If images are not received at the eyepieces, insure that the connectors of the cable assembly are properly installed.

Section VI. REPAIR OF EYESHIELD

43. General

This section contains general and specific organizational maintenance instructions for the repair of the optical instrument eyeshield. In the following paragraphs, specific repairs within the scope of the organizational level of maintenance are described in order to restore the eyeshield to a serviceable condition.

44. Maintenance

a. Removal of Eyeshield. Remove the optical instrument eyeshield (3, fig. 5) from the monocular body by taking out the externally-threaded ring (2, fig. 5). Inspect the eyeshield for signs of deterioration and replace with a new one if unserviceable.

Note. *Be careful not to lose the two flat springs (4, fig. 5) which may fall out.*

b. Cleaning Eyeshield. If serviceable, clean the eyeshield with mild soap and water. Thoroughly dry the eyeshield after cleaning.

Caution: *Do not use dry-cleaning solvents to clean the eyeshield. Petroleum products in some dry cleaning solvents may deteriorate the eyeshield.*

Note. *Replacement procedure is the same for either old or new eyeshield.*

c. Replacement of Eyeshield. Replace the eyeshield as follows:

- (1) Check that two flat springs (4, fig. 5) are properly installed.
- (2) Install optical instrument eyeshield (3, fig. 5) on monocular body and secure with externally threaded ring (2, fig. 5).

Section VII. REPAIR OF STRAPS

45. General

This section contains general and specific organizational maintenance instructions for the repair of the straps. In the following paragraphs, specific repairs within the scope of the organizational level of maintenance are described in order to -restore the straps to a serviceable condition.

46. Maintenance

- a. *Removal of Straps.* Remove the neck strap

(5, fig. 5). The procedure for removing the strap from the carrying case does not require detailed explanation.

- b. *Cleaning Straps.* Clean the straps with soap and warm water. If necessary, use stiff brush to remove stubborn dirt and grease. Thoroughly dry the straps after cleaning.

- c. *Replacement of Straps.* Replace the straps by reversing the removal procedures.

Section VIII. ADJUSTMENT OF INTERPUPILLARY TORQUE

47. General

This section contains general and specific organizational maintenance instructions for the adjustment of the interpupillary torque. In the following paragraph, the specific adjustment that is within the scope of the organizational level of maintenance is described in order to restore the binocular to a serviceable condition.

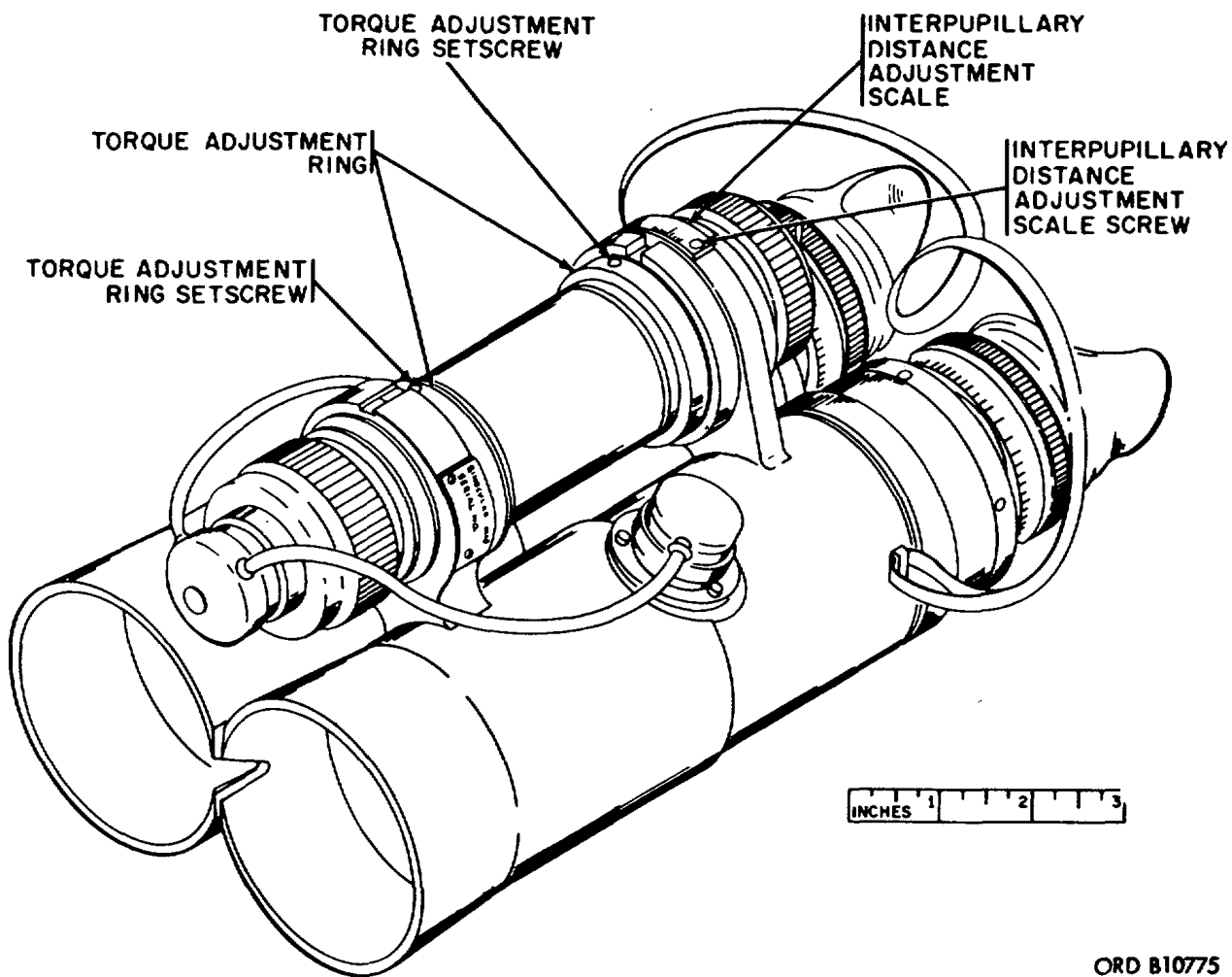
48. Adjustment of Interpupillary Torque

- a. Loosen the four torque adjustment ring

setscrews securing two of four torque adjustment rings (fig. 6).

- b. Adjust the positions of the rings until the approximate interpupillary torque is obtained. It should not be too difficult to adjust the interpupillary distance, yet the torque should be sufficient to hold the interpupillary distance setting during normal handling of the binocular.

- c. Tighten the setscrews.



ORD B10775

Figure 6. Adjusting interpupillary torque and distance accuracy.

Section IX. ADJUSTMENT OF INTERPUPILLARY DISTANCE ACCURACY

49. General

This section contains general and specific organizational maintenance instructions for the adjustment of the interpupillary distance accuracy. In paragraph 50 the specific adjustment that is within the scope of the organizational level of maintenance is described in order to restore the binocular to a serviceable condition.

50. Adjustment of Interpupillary Distance Accuracy

- a. Loosen two interpupillary distance adjustment scale screws securing the interpupillary distance adjustment scale (fig. 6).
- b. Set interpupillary distance to 2-1/4 inches as indicated by inch scale.
- c. Position scale (fig. 6) so that it indicates 70 ± 1 millimeter.
- d. Secure plate by tightening the two screws.

CHAPTER 4

DOMESTIC SHIPMENT, LIMITED STORAGE, AND DEMOLITION TO PREVENT ENEMY USE

Section I. DOMESTIC SHIPMENT AND LIMITED STORAGE

51. General

Packaging is performed prior to shipment and/or storage to insure that the materiel will remain in good operating condition.

52. References

Refer to packing specification MIL-F-14619, drawing P8270115, TM 9-200 for data on packaging binocular M18.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

53. General

a. Destruction of the binocular when subject to capture or abandonment in the combat zone will be undertaken by the using organization only when, in the judgement of the unit commander concerned, such action is necessary in accordance with orders of, or policy established by, the Army Commander.

b. The information which follows is for guidance only. Of the several means of destruction, those most generally applicable are:

- (1) Mechanical. Mechanical destruction requires axe, pick mattock, crowbar, or similar implement.
- (2) Burning. Destruction by burning requires gasoline, oil, or other flammable material.
- (3) Demolition. Destruction by demolition requires ammunition.
- (4) Gunfire. Destruction by gunfire requires machine guns, rifles, or other small arms. Under some circumstances, hand grenades may be used.

c. If destruction to prevent enemy use is resorted to, the binocular must be so badly damaged that it cannot be restored to a usable condition in the combat zone either by repair or by cannibalization. Adequate destruction requires that all parts essential to the operation of the binocular, including essential spare parts, be destroyed or damaged beyond repair.

However, when lack of time and personnel prevents destruction of all parts, priority is given to the destruction of those parts most difficult to replace. Equally important, the same essential parts must be destroyed on all like materiel so that the enemy cannot construct one complete unit from several damaged ones.

54. Method Number 1-Destruction by Burning

a. Using axe, pick mattock, crowbar, rifle butt, or similar implement, break binocular into several pieces.

b. Pour gasoline, oil, or other flammable material over binocular.

c. Ignite gasoline from safe distance.

Note. If other materiel is being destroyed by burning, the binocular can be included in this group to save time.

55. Method Number 2-Destruction by Explosives

The binocular may be destroyed with other materiel being destroyed by explosives. If necessary, the binocular may be destroyed with a hand grenade if the proper precautions are observed.

56. Method Number 3-Destruction by Gunfire

Using rifle or small arm fire, puncture

each of the monocular bodies lengthwise, and the battery compartment several times.

Warning: When using this method, be sure the weapon is not pointed at nearby personnel.

57. Method Number 4-Destruction by Disposal

Break up the binocular as directed in paragraph 54a; then bury the pieces in several different trenches or scatter them over a wide area.

APPENDIX I

REFERENCES

1. Publication Indexes

The following publication indexes should be consulted frequently for latest changes or revisions of references given in the appendix and for new publications relating to materiel covered in this manual.

Military Publications:

Index of Administrative Publications.....	DA Pam 310-1
Index of Blank Forms.....	DA Pam 310-2
Index of Doctrinal Training and Organizational Publications	DA Pam 310-3
Index of Graphic Training Aids and Devices	DA Pam 310-5
Index of Technical Manuals, Technical Bulletins, Supply.....	DA Pam 310-4
Bulletins, Lubrication Orders, and Modification Work Orders.	

2. Forms

Refer to TM 38-750 for all pertinent forms.

3. Other Publications

a. General.

Military Terms, Abbreviations, and Symbols:

Authorized Abbreviations and Brevity Codes.....	AR 320-50
Military Symbols.....	FM 21-30
	AFM 55-3
Principles of Fire Control Materiel	TM 9-3305-2
Safety: Accident Reporting and Records.....	AR 385-40

b. Maintenance.

General Maintenance Procedures for Fire Control Material	TM 9-254
Organizational Maintenance Repair Parts and Special Tool Lists for Binocular M18.	TM 9-6650-215-20P
Technical Procedures: Elementary Optics and Application to Fire Control Instruments.	TM 9-258

**APPENDIX II
BASIC ISSUE ITEMS LIST**

Section I. PREFACE

1. General

This appendix is a list of basic issue list items. It is composed of those items which make up the major end items of equipment and the first echelon tools, supplies, assemblies, and repair parts that are issued with the equipment and are required for stockage.

2. Requisition Notes

Items listed may be requisitioned if required.

3. Explanation of Columns

a. Source, Maintenance, and Recoverability Code (Col. 1).

(1) Materiel Code (col. 1a). This column indicates the code for the type materiel assigned.

<i>Code</i>	<i>Type Materiel</i>
9	Ordnance Materiel
11	Signal Materiel
12	Adjutant (General)

(2) Source (col. 1b). This column indicates the selection status and source for the listed item. Source codes used in this list are:

<i>Code</i>	<i>Explanation</i>
P1	Requisition from depot system of the responsible supply channel (applies to low mortality parts).

(3) Maintenance Level (col. 1c). This column indicates the lowest maintenance echelon authorized to install the listed item. Maintenance level codes used in this area are:

<i>Code</i>	<i>Explanation</i>
O	Organizational Maintenance (1st and 2 nd echelon).

(4) Recoverability (col. 1d). This column indicates whether unserviceable items should be returned for recovery or salvage. When no code is indicated, the item is expendable and not recoverable. Recoverability codes used in this list are:

<i>Code</i>	<i>Explanation</i>
R	Items which are economically repairable at field maintenance activities (3rd and 4th echelon) and are normally furnished by supply on an exchange basis.

b. Federal Stock Number (Col. 2). This column indicates the federal stock number which has been assigned by the Cataloging Division, Defense Logistics Services Center.

c. Description (Col. 3).

(1) This column indicates the federal item name (shown in capital letters) and any additional description required for supply operations. The abbreviation "w/e" (with equipment), when used as a portion of the nomenclature, indicates that the end item (major item) or major combination includes equipment, accessories and repair parts issued with the item. The part number is also included for reference.

d. Unit of Issue (Col. 4). This column indicates the quantity to be requisitioned,

e. Quantity Authorized (Col. 5). This column indicates the quantity of the listed item authorized for stockage to constitute the prescribed load.

f. Illustration (Col. 6). This column indicates the figure number of the illustration that depicts the listed item. When more than one item appears on an illustration, the item number is also indicated.

4. Abbreviations

<i>Abbreviations</i>	<i>Explanations</i>
w/e.....	with equipment

5. Footnotes

¹Dry Batteries are not included in nor packed with the combination. They must be requisitioned separately in accordance with SB-11-6. Space for the storage of two spare batteries is provided in carrying case 10514520.

(1) Source, maintenance, and recoverability code				(2)	(3)	(4)	(5)	(6) Illustration	
(a) Material Code	(b) Source	(c) Maintenance level	(d) Recoverability	Federal stock No.	Description	Unit of Issue	Quantity authorized	(a) Figure No.	(b) Item No.
9	---	---	r	6650-863-5657	MAJOR COMBINATION BINOCULAR: M18 w/e (82700115)-----	1	---	1	
			R	-----	COMPONENTS OF MAJOR COMBINATION BINOCULAR: M18 (10514360)	---	1	2	
9	P1	---	---	6650-850-3312	TOOLS AND EQUIPMENT CASE, CARRYING: 10514520-----	1	1	1	
9	P1	0	---	1240-764-6236	STRAP, NECK: (7646236)-----	1	1	5	5
					REPAIR PARTS				
11	---	---	---	6135-120-1010	BATTERY, DRY: Type BA-42 ¹ -----	---	---	4	
9	P1	0	---	6650-996-7300	CABLE ASSEMBLY, RADIO FREQUENCY (8287003)	1	1	5	1
					OTHER MATERIEL ISSUED				
					The following item is issued by the Adjutant General's Office in accordance with distribution formula and AR 3101. Additional copies, when required, will be requisitioned from the adjutant General's Office.				
12	---	---	---	-----	Technical Manual 9-6650-215-12-----	1	1		

**APPENDIX III
MAINTENANCE ALLOCATION CHART**

Section I. PREFACE

1. General

This appendix lists and identifies groups, components, assemblies and subassemblies which must be maintained to insure serviceability of the major item.

2. Explanation of Columns

a. Column 1. Reference Numbers. Column 1 lists reference numbers, the purpose of which is to identify components, assemblies, and subassemblies with the next higher assembly. Reference numbers are assigned in sequence to components or assemblies listed in Column 2. These begin with reference number 1 for the first component or assembly; 2 for the second, and so on. Parts of assembly are numbered in sequence using a decimal following the number of the assembly. For example, the third maintainable part of an assembly numbered 1 would be numbered 1.3.

b. Column 2. Components and Related Operations. Column 2 lists components, assemblies, subassemblies, and parts on which maintenance can be performed, and lists the maintenance operations which are authorized to be performed on each.

c. Columns 3, 4, 5, 6, and 7 indicate by an "x" the lowest echelon authorized to perform the prescribed maintenance operation.

d. Column 9. Tools Required. Listings of individual tools or tool sets and test equipment are listed at end of chart.

e. Column 10. Remarks used as across reference for a particular maintenance function to any special explanatory notes.

3. Use of Chart

Determine from the chart the echelon that is authorized to perform the required operation.

Maintenance Operations are defined below:

Service	To clean, preserve, and replenish fuel and lubricants.
Adjust	To regulate periodically to prevent malfunction.
Inspect	To verify serviceability and to detect incipient electrical or mechanical failure by scrutiny.
Test	To verify serviceability and detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc.
Replace	To substitute serviceable assemblies, subassemblies and parts of unserviceable component parts.
Repair	To restore an item to serviceable condition through correction of a specific condition. This function includes, but is not limited to, inspecting, cleaning, preserving, adjusting, replacing, welding, riveting, and straightening.
Overhaul	To restore an item to completely serviceable condition as prescribed by serviceability standards developed and published by Commodity Commands. This is accomplished through employment of the technique of "Inspect and Repair Only as Necessary" (IROAN).

Symbol "x" placed in the appropriate column indicates the echelon responsible for performing that particular maintenance operation, but does not necessarily indicate that repair parts will be stocked at that level. Echelons higher than the echelon marked "x" are authorized to perform the indicated operation.

(1) Ref- erence No.	(2) Component and related operations	(3) 1 st	(4) 2 nd	(5)	(6) 3 rd	(7) 4 th	(8) 5 th	(9) Tools required	(10) Remarks
1	BINOCULAR M18 Service----- Inspect----- Replace----- Repair----- Adjust----- Overhaul-----	x x ----- ----- ----- -----	----- ----- ----- ----- ----- -----	x ----- ----- ----- ----- -----	----- ----- ----- x x -----	----- ----- ----- ----- ----- -----	----- ----- ----- ----- ----- x	No special tools required at organizational maintenance.	Binocular M18 is intended for Tank Commander and used With Xenon Search Light
1.1	Power Pack Service----- inspect----- Replace-----	----- ----- -----	----- ----- -----	----- ----- -----	x X x	----- ----- -----	----- ----- -----	----- ----- -----	----- ----- -----
1.2	Image Converter Tube Service----- Inspect----- Replace-----	----- ----- -----	----- ----- -----	----- ----- -----	x x -----	----- ----- -----	----- ----- X	----- ----- -----	----- ----- -----
1.3	Cable Assy Service----- Inspect----- Replace----- Test (continuity)-----	x x ----- -----	----- ----- ----- -----	x ----- ----- -----	----- ----- ----- x	----- ----- ----- -----	----- ----- ----- -----	----- ----- ----- -----	----- ----- ----- -----
1.4	Neck Strap Replace-----	----- -----	----- -----	x -----	----- -----	----- -----	----- -----	----- -----	----- -----
1.5	Eyeshield Replace-----	----- -----	----- -----	x -----	----- -----	----- -----	----- -----	----- -----	----- -----
2	Case, Carrying Service----- inspect----- Replace----- Repair-----	x x ----- -----	----- ----- ----- -----	x ----- ----- -----	----- ----- ----- x	----- ----- ----- -----	----- ----- ----- -----	----- ----- ----- -----	----- ----- ----- -----

INDEX

	Paragraph	Page		Paragraph	Page
Accident reports (See Forms, records, and reports, accidents)			Equipment improvement recommendations (See Forms, records, and reports, equipment improvement recommendations)		
Adjustment:			Eye-piece dial, description	13	9
Eyepiece focus (See Focus adjustment, eyepiece)			Eye-piece focus adjustment (See Focus adjustment, eyepiece)		
Interpupillary distance.....	17b	10	Eyeshield:		
Interpupillary distance accuracy	50	21	Cleaning (See Cleaning, eyeshield)		
Interpupillary torque.....	48	20	Maintenance (See 'Maintenance, eyeshield)		
Authorized forms (See Forms, records, and reports, authorized)			Removal (See Removal, eyeshield)		
Basic issue items (See Appendix 11)			Repair (See Repair, eyeshield)		
Battery, installation	9	7	Replacement (See Replacement, eyeshield)		
Cable assembly:			First echelon procedures	34	15
Cleaning (See Cleaning, cable assembly')			Focus adjustment, eyepiece	17c	10
Maintenance (See Maintenance, cable assembly)			Forms, records, and reports:		
Removal (See Removal, cable assembly)			Accident	3b	2
Repair (See Repair, cable assembly)			Authorized	3a	2
Replacement (See Replacement, cable assembly)			Defective material receipt.....	8	7
Cleaning:			Equipment improvement recommendations	3c	2
Cable assembly	42b	19	Manual improvement recommendations	1c	2
Eyeshield	44b	19	Repairs.....	31,36	14,16
General precautions	33c	15	(See also TM 38-750)		
Straps	46b	20	Handling precautions	15	9
Common equipment (See Equipment, common)			Hinge assemblies	4d	5
Common tools (See Tools, common)			Identification plate (See Plate, identification)		
Data, tabulated	6	5	Improvement recommendations:		
Defective material receipt reports (See Forms, records, and reports, defective material receipt)			Equipment (See Forms, records, and reports, equipment improvement recommendations)		
Demolition:			Manual (See Forms, records, and reports, manual improvement recommendations)		
Burning	54	22	Infrared operation, description)	4c	4
Disposal	57	23	Inspection:		
Explosives	55	22	Assembled correctly	32b(2)	14
General procedures	53	22	Excessive Wear	32b(3)	14
Gunfire.....	56	22	General procedures	16b(2),	9
EIR (See Forms, records, and reports, equipment improvement recommendations)			32	14
Equipment:			Good condition	32b(1)	14
Common	25	13	Secureness	32b	14
Special.....	26	13	Installation, battery (See Battery, installation)		
Use of	23	13			

	Paragraph	Page		Paragraph	Page
Interpupillary distance accuracy adjustment (See Adjustment, interpupillary distance accuracy,			Precautions, handling (See Handling precautions)		
Interpupillary distance adjustment (See Adjustment, interpupillary distance)			Preventive maintenance checks and services (table II)	34	15
Interpupillary distance adjustment scale, description	12	8	Preventive maintenance checks and services (table III)	38	16
Interpupillary torque adjustment (See Adjustment, interpupillary torque)			Preventive maintenance procedures (See Maintenance, preventive)		
Lubrication instructions	27	13	Preventive maintenance services: Operator's participation in	37b	16
Maintenance:			Second echelon responsibilities	35	15
Cable assembly	42	19	Receipt of defective material report (See Forms, records, and reports, defective material receipt)		
Eyeshield	44	19	Receipt of materiel	7	7
Straps	46	20	Recommendations, improvement (See Forms, records, and reports, equipment improvement recommendations and Forms, records, and reports, manual improvement recommendations)		
Maintenance allocation chart (See Appendix III)			Records (See Forms, records, and reports)		
Maintenance, preventive, responsibility	30	13	References (See Appendix I)		
Maintenance, preventive:			Removal:		
After-operation service	33b(3)	15	Cable assembly	42a	19
Before-operation service	33b(1)	14	Eyeshield	44a	19
Daily service	33b	14	Straps	46a	20
During-operation service	33b6(2)	14	Repair:		
Organizational mechanic's responsibility	35	15	Cable assembly	41	17
Procedures	38	16	Eyeshield	43	19
Purpose	33a	14	Parts supply	24	13
Manual improvement recommendations (See Forms, records, and reports, manual improvement recommendations)			Recording (See Forms, records, and reports, repairs)		
Mechanics, organizational general procedures for	37a	16	Straps	45	20
Modification work orders, application	37c(3)	16	Replacement		
ON-OFF switch:			Cable assembly	42c	19
Description	11	8	Eyeshield (old or new)	14c	19
Operation	17a	10	Straps	6	20
Operating precautions	17	10	Reports (See Forms, records, and reports)		
Operation:			Services upon receipt of materiel	9	7
Dusty conditions	21	11	Setting up equipment	16a	9
Extreme heat	20	11	Shipment	51,52	22
General procedures	17	10	Special equipment (See Equipment, special)		
High humidity	22	11	Special tools (See 'Tools, special)		
Sandy conditions	21	11	Storage 51,52	22	
Operator's inspection of binocular M18 (table I)	16b	9	Straps:		
Optical system components	4b	4	Cleaning (See Cleaning, straps)		
Packing	4f	5	Maintenance (See Maintenance, straps)		
Painting instructions	28	13	Removal (See Removal, straps)		
Plate, identification	5	5			

	Paragraph	Page		Paragraph	Page
Repair (See Repair, straps)			Tools:		
Replacement (See Replacement, straps)			Common.....	25	13
			Special	26	13
Tables:			Use of.....	23	13
Operator's inspection of binocular M18 (table I).....	16b	9	Troubleshooting (table IV)	40	17
Preventive maintenance checks and services (table II)	34	15	Troubleshooting:		
Preventive maintenance checks and services (table III)	38	16	Definition	39	17
Troubleshooting (table IV)	40	17	General procedures	40	17
Tabulated data (See Data, tabulated)			Unpacking procedure	9	7
			Use of equipment (See Equipment, use of)		
			Use of tools (See Tools, use of)		
			Use, preparation for.....	16	9
			Warmup	19c	11

By Order of Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

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ARADCOM Rgn (2)	5-46	9-500(Tms BA,FA,ED,LA)	29-105
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NG: State AG (3).

USAR: Same as Active Army except allowance is one copy to each unit.

For explanation of abbreviations used see AR 320-50.

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THE METRIC SYSTEM AND EQUIVALENTS

WEIGHT MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
 1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
 1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
 1 Kilogram = 1000 Grams = 2.2 lb.
 1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
 1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
 1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
 1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
 1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

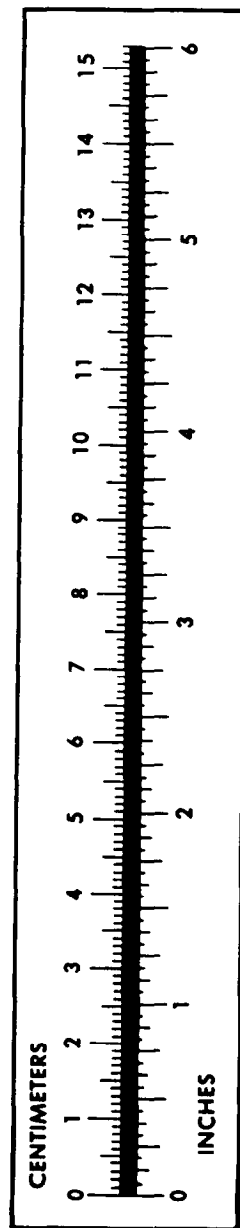
TEMPERATURE

$5/9(^{\circ}\text{F} - 32) = ^{\circ}\text{C}$
 212° Fahrenheit is equivalent to 100° Celsius
 90° Fahrenheit is equivalent to 32.2° Celsius
 32° Fahrenheit is equivalent to 0° Celsius
 $9/5^{\circ}\text{C} + 32 = ^{\circ}\text{F}$

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
its	Liters	0.473
arts	Liters	0.946
allons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
ers	Gallons	0.264
ms	Ounces	0.035
ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
ometers per Liter	Miles per Gallon	2.354
ometers per Hour	Miles per Hour	0.621



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