DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE

TELESCOPE, ELBOW M16A1D, M16A1F, M16A1G, M116, AND M116C

This copy is a reprint which includes current pages from Change 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY

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CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 6 October 1967

Direct Support, General Support, and Depot Maintenance

TELESCOPE, ELBOW M16A1D, M16A1F, M16A1G, M116, AND M116C

TM 9-1240-288-35, 18 March 1964, is changed as follows:

The title is changed as shown above.

Change the refer “field maintenance" to "direct support and general support maintenance", respectively, wherever it appears throughout the technical manual.

Page 2. Paragraph 2 is superseded as follows:

2. Comments

Report of errors, omissions and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding Officer, Frankford Arsenal, ATTN: AMSWE-SMF-W3100, Philadelphia, Pa. 19137.

Page 6.

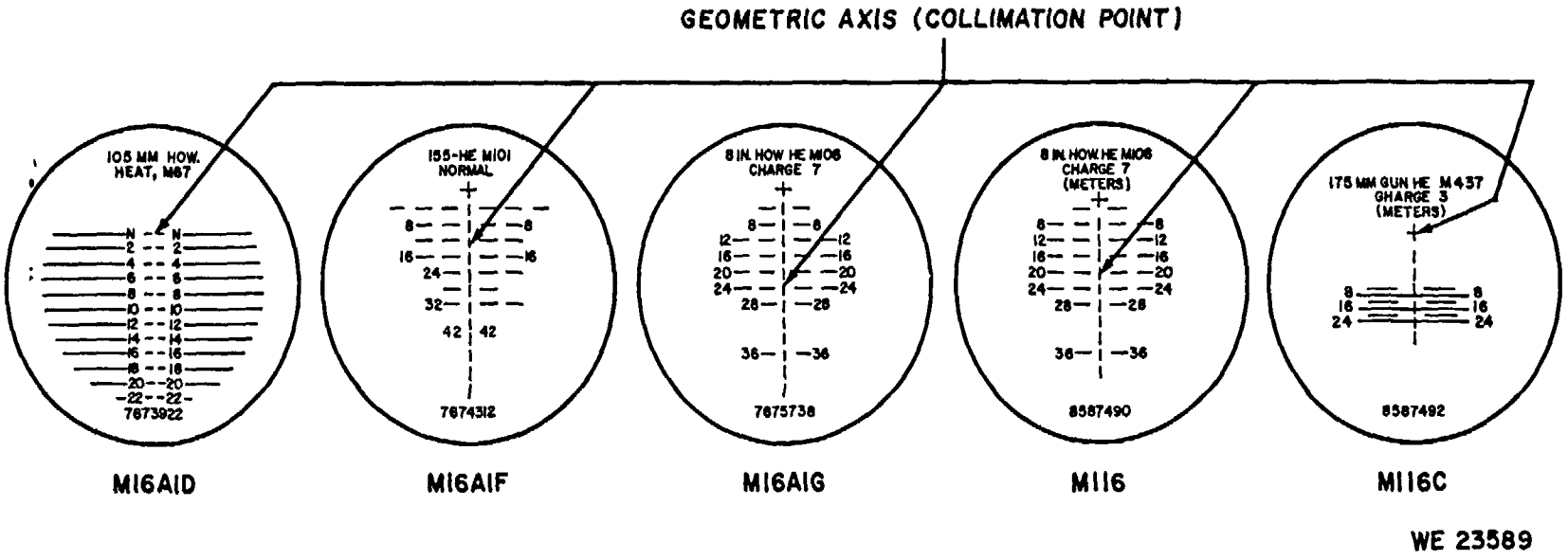

Figure 4. (Superseded) Reticle patterns

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff.

Official:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12-41, requirements for direct and general support maintenance applicable to the Telescope, Elbow.

Technical Manual
No. 9-1240-288-35

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., 18 March 1964

TELESCOPE, ELBOW M16A1D, M16A1F, M16A1G, M116, AND M116C

*** This manual supersedes so much of TM 9-1604, 6 June 1952, as pertains to telescope, elbow M16A1D, M16A1F, and M16A1G.**

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for field and depot maintenance of telescope, elbow M16A1D, M16A1F, M16A1G, M116, and M116C, which is beyond the scope of the tools, equipment, or supplies normally available to using organizations.

b. A description of the item, use of special tools and equipment, inspection procedures, troubleshooting procedures, repair and overhaul operations of elbow telescope are presented in this manual.

c. The appendix contains a list of current references, including supply and technical manuals, forms, and other available publications applicable to elbow telescope.

2. Comments

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3. Maintenance Allocation and Parts

a. Direct support and general support maintenance responsibilities prescribed in this manual will apply as reflected in the maintenance allocation chart in change 2 of TM 9-325 and as reflected by the allocation of repair parts and tools listed in TM 9-1240-288-35P.

b. Depot maintenance responsibilities will provide for complete overhaul of elbow telescope as reflected by the IROAN concept for overhauling an unserviceable item.

c. Maintenance repair parts and special tools are listed in TM 9-1240-288-35P. Unlisted parts will be supplied, if available, when complete justification is included on the requisition. Unavailable parts may be fabricated.

4. Maintenance Technique

a. The maintenance technique, IROAN (Inspect, Repair, Only As Necessary), will be used to restore this materiel to serviceable condition.

b. IROAN is the systematic isolation and remedy of a malfunction or defective component through tests, diagnosis, and singular repair. No segment of the materiel is disassembled before the definite need for disassembly has been established.

5. Forms, Records, and Reports

a. General. Responsibility for the proper execution of forms, records, and reports rests upon the commanding officers of all units maintaining this equipment. However, the value of accurate records must be fully appreciated by all persons responsible for their compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the type, quantity, and condition of materiel to be inspected, to be repaired, or to be used in repair. Properly executed forms convey authorization and serve as records of work performed. The forms, records, and reports establish the work required, the progress of the work, and the status of the materiel upon completion of its repair.

b. Authorized Forms. The forms generally applicable to field and depot maintenance shops maintaining this materiel are listed in the appendix. Refer to current DA Pamphlet 310-2 for complete listing of all forms. For instructions on use of these forms, refer to FM 9-3 and FM 9-4.

c. Report of Accidents. Injury to personnel and/or damage to materiel must be reported. See AR 385-40 for detailed requirements of the Army safety program.

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

Section II. DESCRIPTION AND DATA

6. Description

a. Elbow telescope M16A1 and M116 series (Fig. 1) are used for direct sighting in elevation as a part of a two-sight, two-man system. They are of the fixed-focus type without filters. The telescope is positioned in a telescope mount with the range lines of its reticle horizontal. The telescope mount is secured to the carriage of the weapon so that the telescope mount and the telescope move with the weapon in elevation. The gunner aims the weapon with the range line of the reticle which represents the desired range.

b. Elbow telescope M16A1D issued with 105-MM howitzer M2A1 and 105-MM howitzer carriages M2A1 and M2A2.

c. Elbow telescope M16A1F is used with 155-MM guns M2 and M2A1.

d. Elbow telescope M16A1G is used with 8-inch howitzer cannons M2 and M2A1 and 8-inch howitzer carriage M1.

e. Elbow telescope M116 is used with 8-inch full-tracked self-propelled howitzer M110 (T236E1).

f. Elbow telescope M116C is used with 175-MM full-tracked self-propelled gun M107 (T235E1).

g. Elbow telescopes are fixed focus instruments and are provided with soft rubber eyeshields. The eyeshield is engaged by an eyeshield adapter (fig. 1) which slips onto the telescope body. The eyeshield protects the eyes of the observer

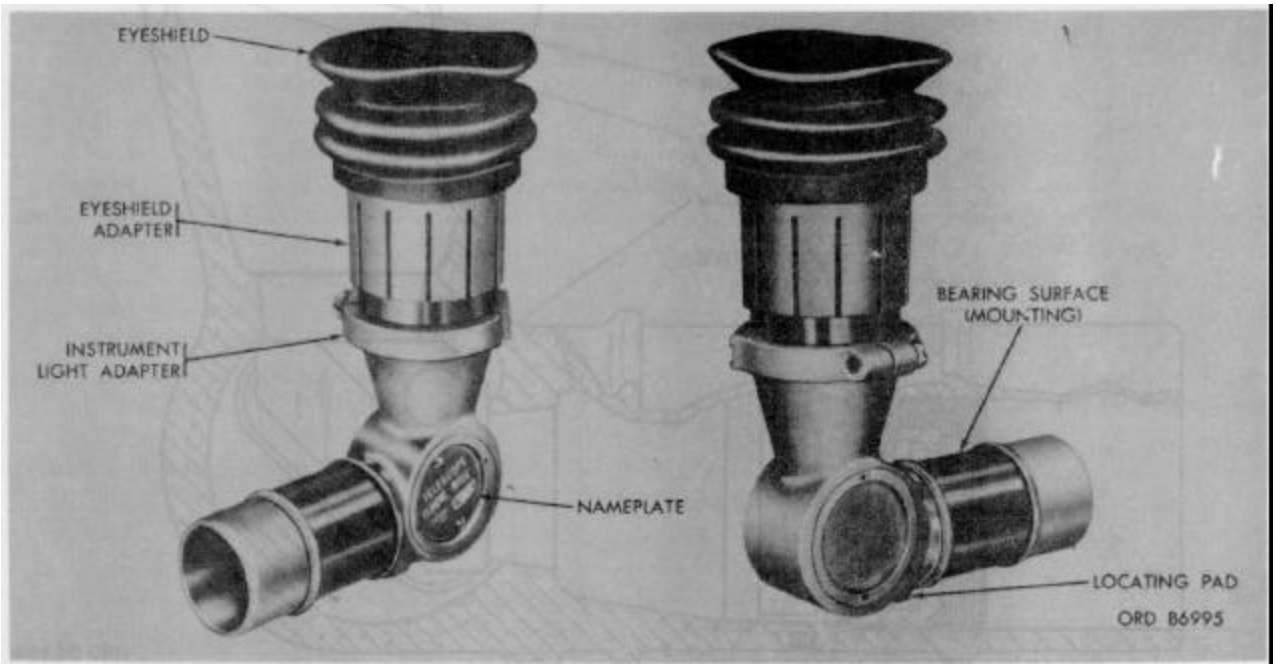


Figure 1. Elbow telescope M16A1 or M116 series-left front and right rear views.

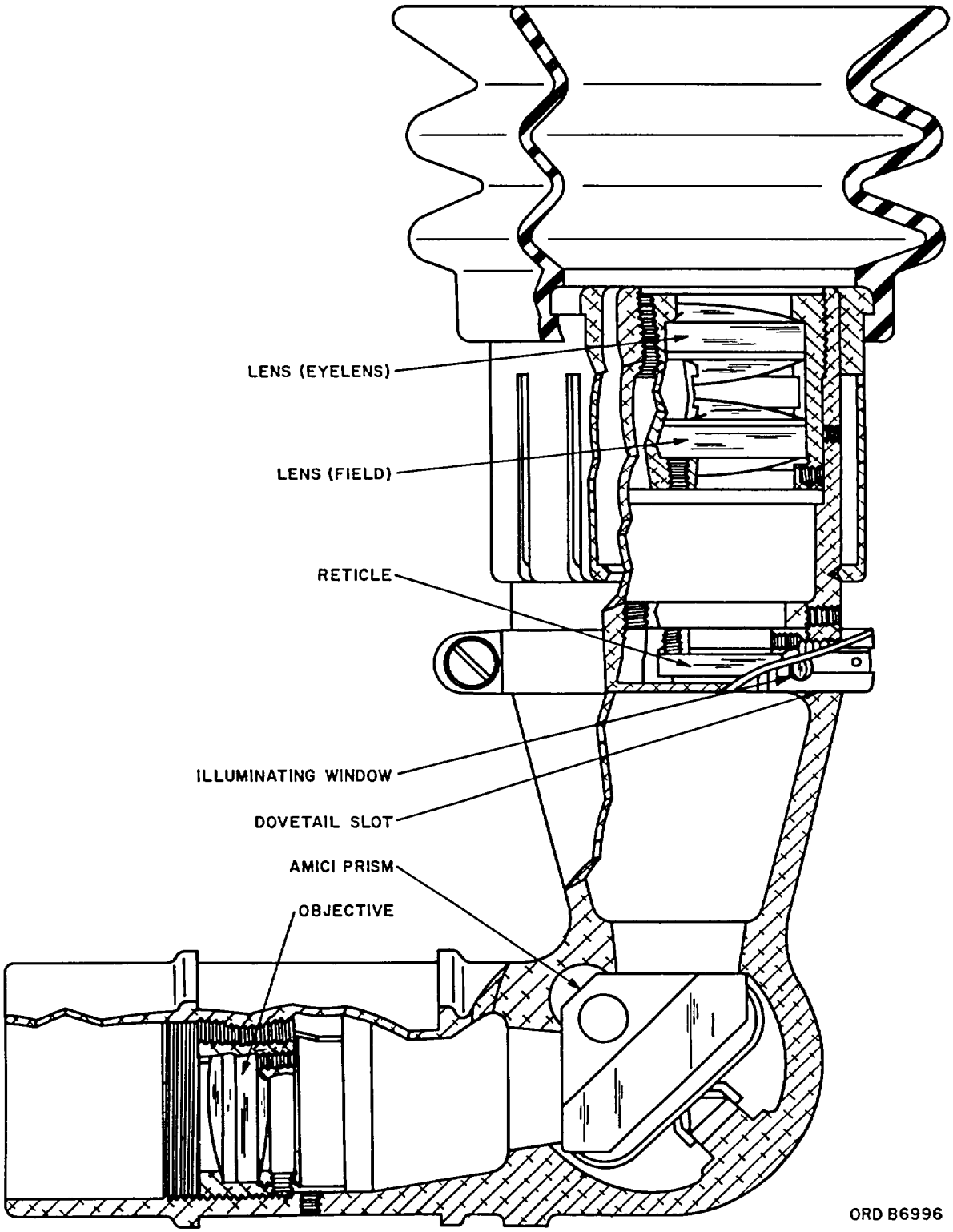


Figure 2. Elbow telescope M16A1 or M116 series-cutaway view.

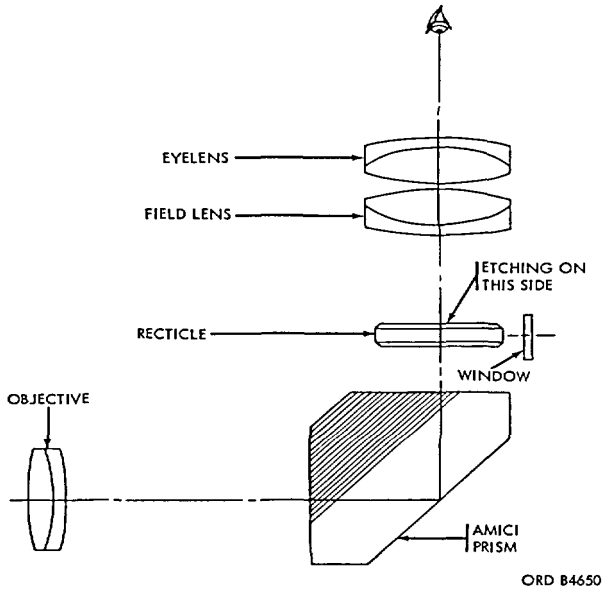


Figure 3. Elbow telescope M16A1 or M116 series-optical system.

from stray light and wind and helps to maintain proper eye distance.

h. Magnification of the reticle pattern and target image by the eyepiece assembly (figs. 2 and 3) is accomplished through two identical compound type lenses. The two lenses, their spacer, and retaining ring are mounted in an eyepiece cell.

i. The reticle (figs. 2 and 3) is seated in a cell and secured in position by a retaining ring. The reticle cell is slotted for illumination. Form adjusting setscrews provide lateral and vertical movement of the assembly when collimating; the assembly can be rotated when plumbing the reticle.

j. An instrument light adapter (fig. 1) is designed with a dovetail slot for engaging a lamp bracket. This adapter is positioned so that the opening in the slot is directly over the window in the telescope body.

k. The amici prism (figs. 2 and 3) is mounted in the elbow portion of the telescope body. It is a one-piece prism which deviates the light rays through a 90-degree angle and, at the same time, erects the image.

l. The compound type objective lens (figs. 2 and 3) is mounted in a cell and secured in place with a retaining ring. The objective assembly is located inside the telescope body.

7. Data

a. Optical Characteristics.

Magnification	3X
Field of view	13°, 20 min.
Effective focal length:	
Objective	4.123 in.
Eyepiece	1.374 in.

b. Physical Characteristics.

Length	4-1/4 in.
Height	5-3/4 in.
Weight	2.35 lb

8. Differences Between Models

Elbow telescopes M16A1D, M16A1F, M16A1G, M116, and M116C are identical except for differences in reticle patterns and name plate designations. See figure 4 for various reticle patterns.

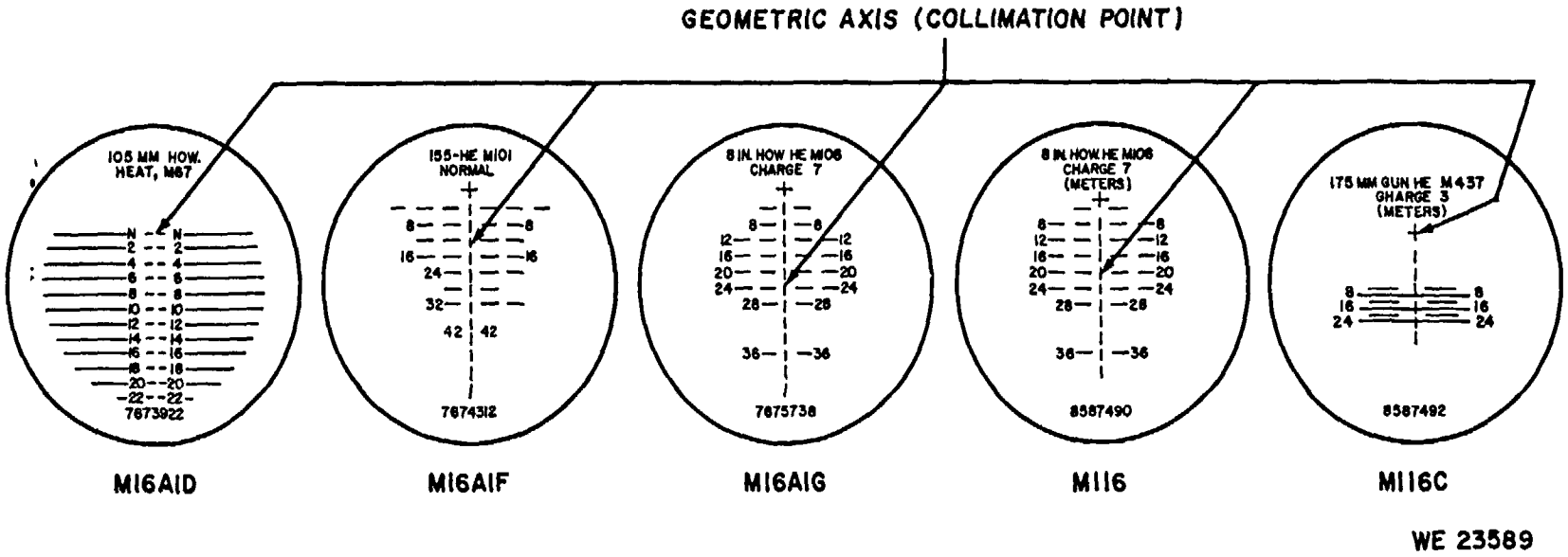


Figure 4. Reticle patterns

CHAPTER 2
TOOLS AND EQUIPMENT

9. General

Tools and equipment over and above those available to the using organization are supplied to direct support and general support maintenance units for repair and adjustment of elbow telescope. Tools and equipment over and above those available to direct support and general support maintenance units are supplied to depot shops for overhauling.

10. Common Tools and Equipment

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

11. Special Tools and Equipment

Table I lists the special tools and equipment which are necessary to perform the operations described in this technical manual is included for information only, and is not to be used as a basis for requisitions. Requisitioning data will be obtained from TM 9-1240-288-35P, SM 9-4-4931-J40, SM 9-4-4931-J48, SM 9-44931-J51, and SM 9-4-4931-J52. Special tool sets are authorized by the applicable TA and TOE.

Table I. Special Tools and Equipment for Field and Depot Maintenance

Item	Federal stock No.	References Fig.	References Par.	Use
ADAPTER, VIBRATION-------	4931-986-9900 (8565354)	16	44	Supports telescope for vibration test.
COLLIMATOR, TELESCOPE	4931-554-9108 (5549108)	17	45	Checks optical accuracy of telescopes.
DIOPTOMETER ----------	4931-536-5557 (7680631)	8	51	For checking eyepiece focus.
FIXTURE, TELESCOPE, TEST.	4931-508-5434 (7197944)	5, 18	45	Supports telescope for accuracy test.
GUN, HAND, SEALING COMPOUND.	4931-764-3117 (7648117)	-------	57	For applying sealing compound to heads of external screws,
GUN, HYDRAULIC, SEALING COMPOUND.	4931-764-3134 (7648134)	-------	57	For injecting sealing compound into eyepiece and objective ends of telescope.
TESTER, UNIVERSAL, VIBRATION.	4931-536-5555 (7560085)	7	44	Performs vibration test on telescope.
WRENCH, ADJUSTABLE, SPANNER.	5120-561-0855 (41W03248-115)	-------	34, 38, 40	For removal or installation of covers.
WRENCH SET, TUBULAR, SPANNER.	4931-580-0012- (5800012)	-------	----------	For assembly or disassembly.
WRENCH, TUBULAR, SPANNER.	5120-345-1396 (3726080)	-------	35, 39	For installation or removal of retaining ring (objective cell).
WRENCH, TUBULAR, SPANNER.	5120-345-1398 (3726090)	-------	33, 41	For installation or removal of retaining ring (reticle cell).
WRENCH, TUBULAR, SPANNER.	5120-345-1339 (3726093)	-------	35, 39	For installation or removal of objective assembly.
WRENCH, TUBULAR, SPANNER.	5120-345-1406 (3726123)	-------	32, 33 41, 42	For installation or removal of retaining ring (eyepiece cell) or ring (body).
WRENCH, TUBULAR, SPANNER.	5120-345-1411 (3726155)	-------	32, 42	For Installation or removal of eyepiece assembly.

12. Telescope Test Fixture 4931-508-5434 and Associated Equipment

a. The telescope test fixture 4931-5085434 And associated equipment (fig. 5) consists of a machined base mounting, a collimator projector, and two telescope supports. The collimator projector is fixed rigidly on one end of the base, and one telescope support is fixed on the opposite end. Various adapters are issued with fixture to accommodate all straight tube and elbow telescopes. Setup gage blocks and locating block is are also provided to properly position the particular telescope being tested. The adapters, setup gage blocks, and locating blocks are all marked with a lettering system, and a chart is furnished to give the proper combination of accessories to be used with the various telescopes.

b. The, projector collimator is an optical device similar to an ordinary straight tube telescope except that it does not have an erecting system. When in use, the collimator is sighted into through the objective instead of the eyepiece end as in other telescopes. The projector collimator serves as a convenient indoor testing target in connection with the adjustment and inspection, of elbow telescopes. The target it provides is' always uniform insofar as intensity of illumination and clarity of image are concerned.

c. The projector collimator is a telescope with its eyepiece end machined and is designed to accommodate a lamp housing which is provided with a clamping screw so that it may be secured to the collimator. The lamp housing is equipped with a 7-1/2-watt lamp assembly, an extension cord with a plug, and switch for use with a 110-volt source of current that provides' illumination for the collimator. The reticle of the collimator is shown in figure 6. The reticle pattern is graduated in mils, and the one mil square at the center is positioned so that any adjust mentor inspection necessitating 1/2-mil tolerance can be' accurately made. The positioning of the objective lens of the projector collimator is controlled by the adjustable objective scale. This knurled scale is graduated so that the objective can be accurately positioned. setting the projector collimator to the correct parallax distance for the telescopes. The scale is graduated with an infinity mark and four other marks representing 500, 200, 100 and 75 yards.

13. Universal Vibration Tester

a. General. The universal vibration tester 4931-536-5555 (fig. 7) in conjunction with an appropriate adapter for telescope is used to simulate conditions of shock and vibration normally encountered in the use of sighting and fire-control material 1. Through its use, loose dirt and improperly secured components which would affect the efficient operation of the instrument are revealed.

b. Adjustments. The amplitude and frequency of the tester are adjusted as required by the specifications for the equipment to be tested. Frequency of vibration is controlled by adjusting the rotational speed of the tester indicated by the frequency meter. Varying the rotational speed is accomplished by adjustment of the belt-driven variable speed pulley through the use of a handwheel. Amplitude is adjusted through use of the tee-handle screw on the side of the tester. A timer switch is used to set the required time of vibration. Refer to instruction and caution plates attached to the vibration tester.

14. Dioptometer

The dioptometer 4931-536-5557 (fig. 8) is a small calibrated collimating telescope. It has a conventional type focusing eyepiece with an attached diopter scale, a stationary reticle pattern consisting of two lines intersecting at right angles, and an adjustable objective with a diopter scale and attached index. The eyepiece diopter scale ranges, from +4 to -4 diopters and the objective scale is graduated from +1 to -1 diopter. The objective scale indicates the various settings at which parallax is eliminated.

15. Collimating Telescope 4931-554-9108

a. The collimating telescope (fig. 17) is a small, straight tube telescope whose outside surface is carefully machined so that its optical or mechanical axis is alined .Because its optical or geometric axis is in

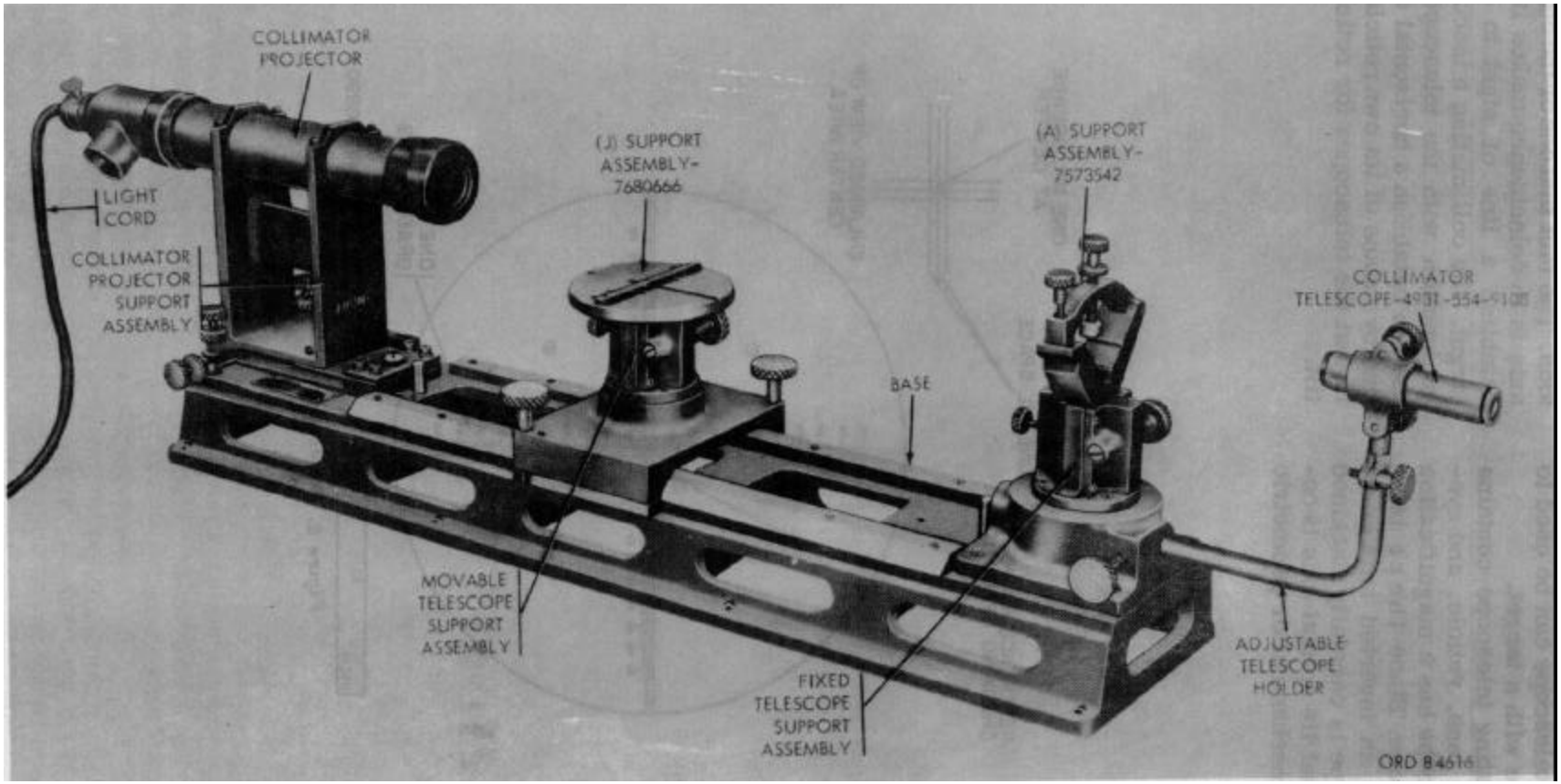


Figure 5. Telescope test fixture 4931-608-5434 and associated equipment.

coincidence, this telescope can be used to aline a test fixture with a target.

b. The collimating telescope contains only an objective lens, reticle, and eyepiece. This telescope has a magnification of 3 power or more. Since there is no electing system, an inverted image is seen. The telescope is carefully machined and adjusted so that its optical axis is coincident with its mechanical or geometric axis. The fact that one or the other of these axis is in coincidence makes it possible to establish a line of sight to a distant target. The collimating telescope, when in conjunction with the telescopes, can be used to establish a horizontal and vertical line by means of its own reticle with which to test the telescopes for reticle. or image tilt.

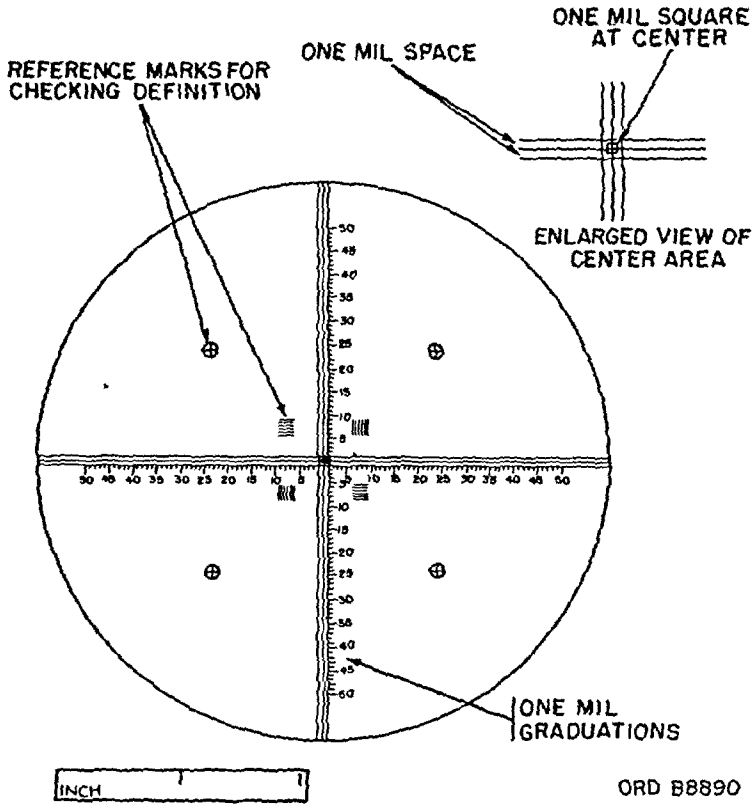


Figure 6. Projector collimator reticle.

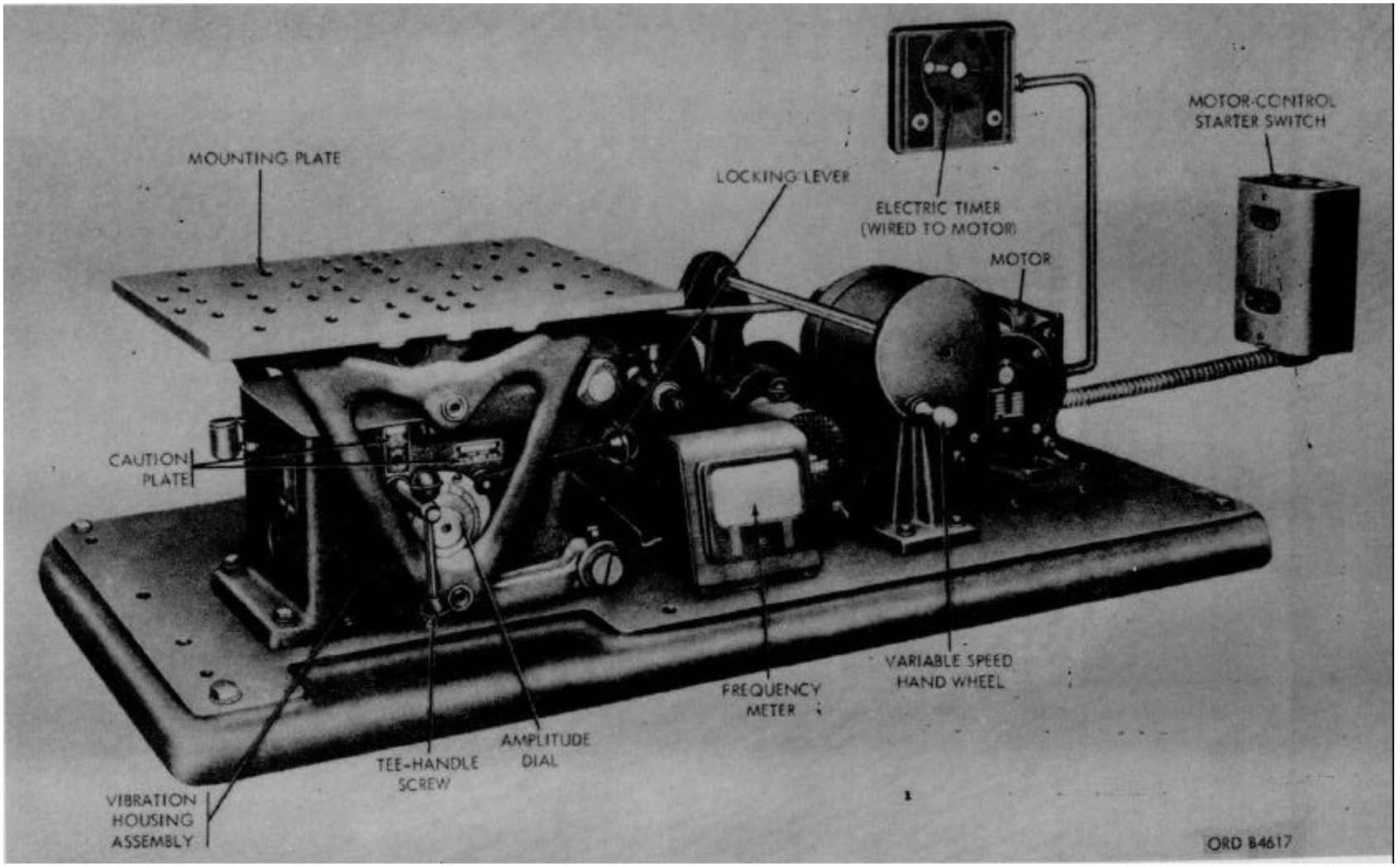


Figure 7. Universal vibration tester 4931-536-5665.

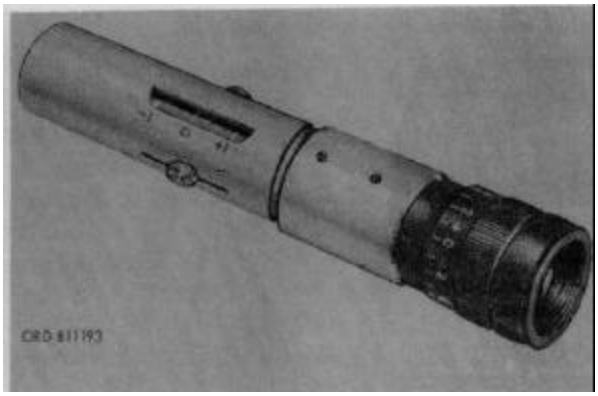


Figure 8. Dioptometer 4931-536-5557

CHAPTER 3
INSPECTIONS

Section I. GENERAL

16. Scope

This chapter provides specific instructions for technical inspection of elbow telescope M16A1 and M116 series in the hands of troops and when received for repair in a direct support and general support maintenance shop.

17. Purpose

a. Inspection in the Hands of Troops.
- (1) Insure that preventive maintenance services are being performed and are effective.
- (2) Ascertain the serviceability, completeness, or readiness of materiel in the hands of troops.
- (3) Render any necessary assistance to the using organizations.
- (4) Provide instructions for organizational supply and maintenance.
- (5) Determine the most prevalent deficiencies in maintenance of materiel.
- (6) Anticipate unusual supply demands.
- (7) Make a record of conditions of materiel in the hands of troops.

b. Inspection in Direct Support and General Support Maintenance Shops.
- (1) Determine the nature of the required repair.
- (2) Determine the extent of repair required to return the materiel to serviceability in order that its disposition may be planned.
- (3) Assure that work in process is being performed properly.
- (4) Insure that work performed complies fully with approved standards.

Section II. INSPECTION OF ELBOW TELESCOPE M16A1 AND M116 SERIES IN THE HANDS OF TROOPS

18. General

This section provides specific instructions for the technical inspection by direct support and general support maintenance personnel of elbow telescope M16A1 and M116 series in the hands of troops. in general, if the elbow telescope is complete and performs its intended function properly, if all modification work orders classified as urgent have been applied, and if all defects as disclosed by the inspection have been corrected, the elbow telescope may be considered serviceable.

19. Forms and Reports

Authorized forms and reports for technical inspection by direct support and general support maintenance personnel are listed in the appendix. Preventive maintenance logs, if available, will be examined to determine the maintenance background of the materiel.

20. Modification Work Orders

All urgent modification work o r de r s must have been applied. Check on application of all authorized modifications to see that no unauthorized alterations have been made, or that work beyond the authorized scope of the unit is being attempted. Check DA Pamphlet 310-4 and the current modification work order files for any modification work orders that must be applied.

21. General Inspection

a. Completeness. Examine the instrument carefully to be sure that all components parts are present. Particularly check for the presence of telescope eyeshield, instrument light adapter, set-A screws and nameplates.

b. Appearance. The appearance of telescopes are an indication of their general

condition and will shown the treatment they have received. Examine for dented surfaces, bent or broken parts, and other evidence of damage or misuse which might indicate need for repair.

(1) *Nameplates.* Inspect lettering on name plates to insure that they are clearly defined and easily read.

(2) *Paint and finish.* Inspect for bare spots or damaged finish which expose bare metal surfaces and lead to corrosion. If finish is too badly damaged a complete refinishing will be necessary.

22. Inspection of Optical Elements

a. General. When inspection is made through the eyepiece and objective ends of the telescope, there shall be no objectionable dirt, smears, scratches, digs, condensate, fungus growth, chips, fractures or cement separations.

b. Rubber Eyeshield. The rubber shall be free of deterioration, cuts or tears, and shall fit properly with its mating part.

c. Reticle Illumination Window. The reticle illumination window shall not be broken, and shall be securely sealed and fastened in the body.

d. Sealing. The sealing shall be free of apparent leaks or openings.

e. Illumination. The Lighting, when turned on, shall illuminate the reticle pattern so that the markings are clearly defined when observed in a darkened room.

f. Definition. The telescope shall produce a sharp and clear image at the center of the field of view, when observing a distant target.

g. Parallax. Parallax is apparent motion of the reticle pattern with respect to the image of a distant target as seen through the eyepiece. If parallax is present, it can be seen if the eye of the observer is shifted slightly up and down or from side to side. It is caused by incorrect positioning of the objective assembly so that the eyepiece is not focused to produce a short reticle pattern and a sharp image at the same time. If not corrected, parallax will render all reticle measurements inaccurate. Refer to the sections covering overhaul and assembly when checking parallax.

h. Collimation. A telescope is collimated when its optical axis coincides with its mechanical or geometric axis

Section III. SHOP INSPECTION

23. General

Technical inspection performed by the repair shop on receipt of materiel turned in for repair, determines the extent of the repairs required and provides the basis for requisitioning the parts, assemblies, or supplies necessary to accomplish the repairs. Often the inspection in the shop may be the same as that performed by inspectors in the field. It may disclose additional necessary repairs not indicated by the using organization during the field inspection. See FM 9-3 and FM 9-4 for additional information on inspection. See also the final inspection portion of this manual.

24. Inspection

The inspection given for telescopes in the hands of troops, paragraph 18 through 22, are pertinent also to the repair shop.

CHAPTER 4
TROUBLESHOOTING

25. Purpose

Troubleshooting is a systematic isolation and remedy of malfunctions and defective components by means of symptoms and tests. Close adherence to the procedures covered herein will materially reduce the time required to locate trouble and restore the equipment to normal operations.

Caution

Operation of materiel without a preliminary examination can cause further damage to a disabled component. Be careful during inspection and troubleshooting, so that damage can be avoided.

26. Scope

This chapter covers troubleshooting which is peculiar to field and depot maintenance operations. For troubleshooting procedures performed by lower echelons of maintenance, refer to the pertinent lower echelon technical manual.

27. Procedure

The troubleshooting procedure outlined in table II is one of determining, upon occurrence of malfunctions noted, the probable cause, then talking the necessary corrective action.

Table II. Troubleshooting

Malfunction	Probable cause	Corrective action
Incorrect eyepiece focus.	*a.* If eyepiece focus is above minus 0.75 diopter, eyepiece assembly is positioned too far away from reticle	*a.* Rotate eyepiece assembly clockwise, positioning eyepiece closer to reticle, (para. 51).
	b. If eyepiece focus is minus more than 0.1 diopter, eyepiece assembly is positioned too close to reticle.	*b.* Rotate eyepiece assembly counterclockwise, positioning eyepiece further away from reticle (para. 49).
	c. If reticle is not sharp and clear at any eyepiece focus setting, the eyepiece assembly contains a defective optical element or lens is reversed in the eyepiece cell or retaining ring is too tight against lens.	*c.* Refer to assembly procedures (para. 41).
Faulty definition----	*a.* Objective positioned so that image is formed outside or inside effective focal length of eyepiece.	*a.* Rotate objective assembly positioning image in relation to eyepiece focal length (para. 51).
	b. Defective objective lens or amici prism---------	*b.* Replace defective component.
	c. Objective lens reversed in cell----------	*c.* Refer to assembly procedures (para. 39).
	d. Retaining ring too tight against objective lens---	*d.* Refer to assembly procedures (para. 39).
Out of collimation	Reticle assembly not positioned correctly with respect to geometric axis of body.	Refer to adjustment procedures (para. 51f).
Parallax----------	*a.* Objective lens not spaced correctly in relation to reticle.	*a.* Rotate objective assembly superimposing image on reticle (para 52a(8)).
	b. Retaining ring too tight against objective lens, causing strain (apparent parallax).	*b.* Refer to assembly procedures (para. 39).
	c. Objective lens fits too tightly in cell, causing strain (apparent parallax).	*c.* Refer to assembly procedures (para 39).
Reticle not plumb	Reticle assembly improperly positioned----------	Refer to adjustment procedures (para 49d).
Faulty illumination	*a.* Slot in reticle cell not alined with window--------	*a.* Refer to assembly procedures (para 41).
	b. Dirt, sealing compound, and/or grease accumulated on or under window.	*b.* Remove accumulations.

CHAPTER 5
REPAIR AND OVERHAUL

Section I. GENERAL

28. Scope

This chapter contains specific maintenance instructions for the repair and overhaul of elbow telescope M16A1 and M116 series. When it is found during inspection, that equipment does not meet the required performance characteristics, overhaul in accordance with the IROAN concept. (In spect, Repair, Only as Necessary). This technique will be used as defined in paragraph 4, involving a minimum of disassembly in order to replace or repair a defective component.

29. General Maintenance Procedures

Operator and organizational maintenance of telescopes are covered in change 2 of TM 9-325, which also contains boresighting and installation procedures. General maintenance procedures are furnished in TM 9-254 and personnel should become familiar with its contents before attempting the procedures described in this manual.

Section II. DISASSEMBLY

30. General

This section describes disassembly of elbow telescope M16A1 and M116 series completely to its smallest component. If repair or overhaul is confined to one assembly, remove only the components necessary to effect the repair and overhaul.

31. Removal of Eyeshield, Adapter, and Related Parts (fig. 9)

Note

The key numbers shown below in parenthesis refer to figure 9.

a. Remove eyeshield (1) from adapter (2). Turn adapter slightly and remove from telescope body.

b. Remove fillister-head screw (3) and lockwasher (4). Remove instrument light adapter (5) from telescope body. It maybe necessary to pry adapter fingers out of groove.

32. Removal and Disassembly of Eyepiece Assembly (fig. 10)

Note

The key numbers shown below in parenthesis refer to figure 10, unless otherwise indicated.

a. Removal.
- (1) Measure and record distance from end of telescope body to eyepiece cell.
- (2) Remove flat point setscrew (1).
- (3) Using tubular spanner wrench 5120-345-1411, remove eyepiece assembly (Fig. 11) from telescope body.

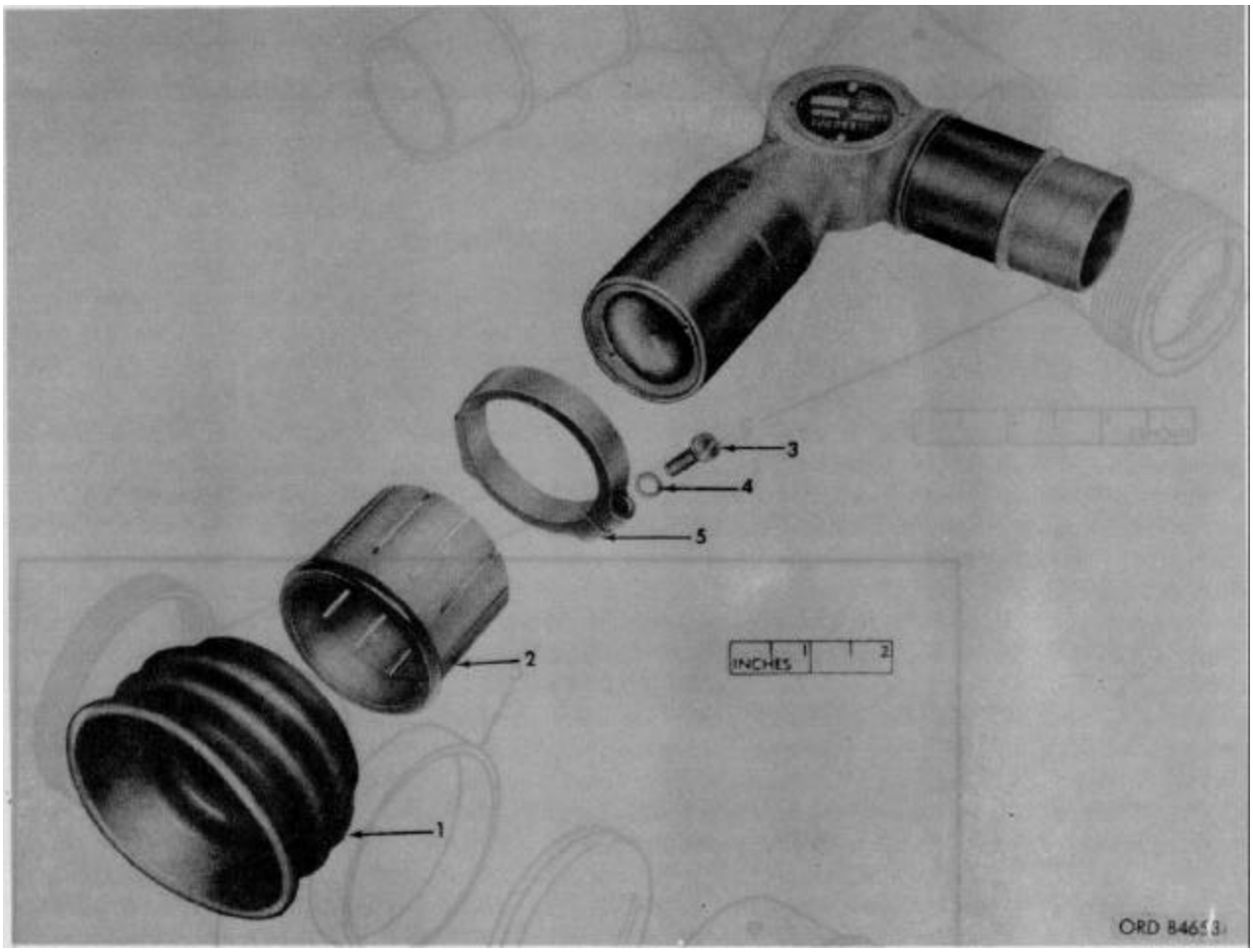
b. Disassembly.
- (1) Using tubular spanner wrench 5120-345-1406, remove externally threaded ring (2A).
- (2) Remove optical instrument lens (2B) optical element spacer (2C) and lens (2D) from optical element cell (2E).

33. Removal and Disassembly of Reticle Assembly (fig. 12)

Note

The key numbers shown below in parenthesis refer to figure 12.

a. Removal.
- (1) Remove flat point setscrew (1).
- (2) Using tubular spanner wrench



1-Eyeshield 1240-613-5751
2-Adapter 1240-613-5750
3-No. 10 x 3/4 fillister-head
screw 5305-022-4588
4-No. 10 lockwasher 5310-054-1831
5-Adapter 1240-763-7795

Figure 9. Removal of eyeshield, adapter and related parts-partial exploded view.

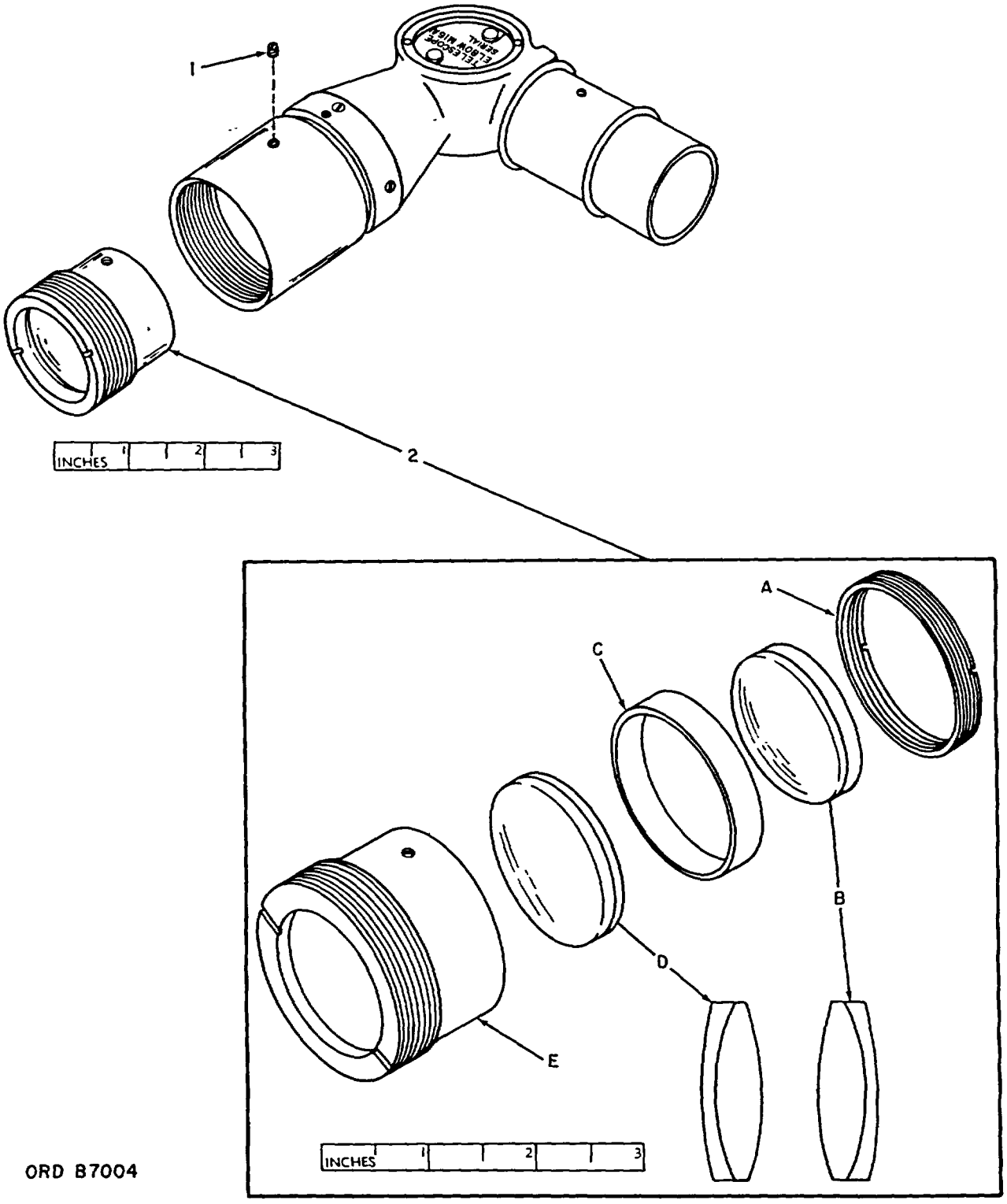


Figure 10. Removal and disassembly of eyepiece assembly-partial exploded view.

1-No. 2 x 3/32 flat point setscrew 5305-282-7644
2-Eyepiece assembly 6139342
A-Externally threaded ring 5340-285-7901
B-Optical instrument lens 1240-504-5960
C-Optical element spacer 1240-504-5961
D-Optical instrument lens 1240-504-5960
E-Optical element cell 1240-613-6408

Figure 10-Continued.

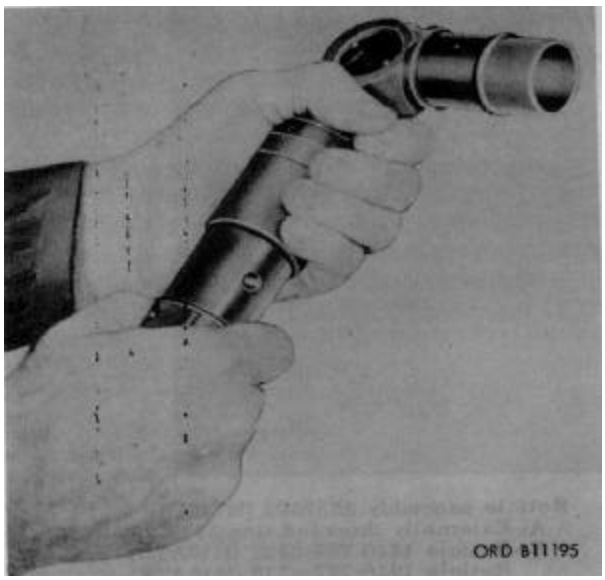


Figure 11. Removal of eyepiece assembly.

5120-345-1406, remove externally threaded ring (2).
(3) Remove flat point setscrew (3).

Note

Setscrew (3) may not be present on all telescopes as it was not used for telescopes of early manufacture.

(4) Remove four flat point setscrews (4).
(5) Invert telescope body, allowing reticle assembly (5) to drop out. It may be necessary to gently tap body to free reticle assembly.

Note

Observation window (6) should be removed or when telescope body needs repair.

(6) Remove any metal that extends over window (6). Apply solvent or alcohol around edge of window, insert a small diameter wood dowel into the telescope body and press window out of port.

b. Disassembly. When reticle (5B) or cell (5C) is damaged so as to require replacement, disassemble as describe in (1) through (3) below.
(1) If cell (5C) is to be re-used, scribe to indicate plumb position of reticle (5B).
(2) Using tubular spanner wrench 5120-345-1398, remove externally threaded ring (5A).
(3) Invert cell and allow reticle (5B) to drop gently out of cell (5C).

34. Removal and Disassembly of Covers, Amici Prism and Related Parts (Fig. 13)

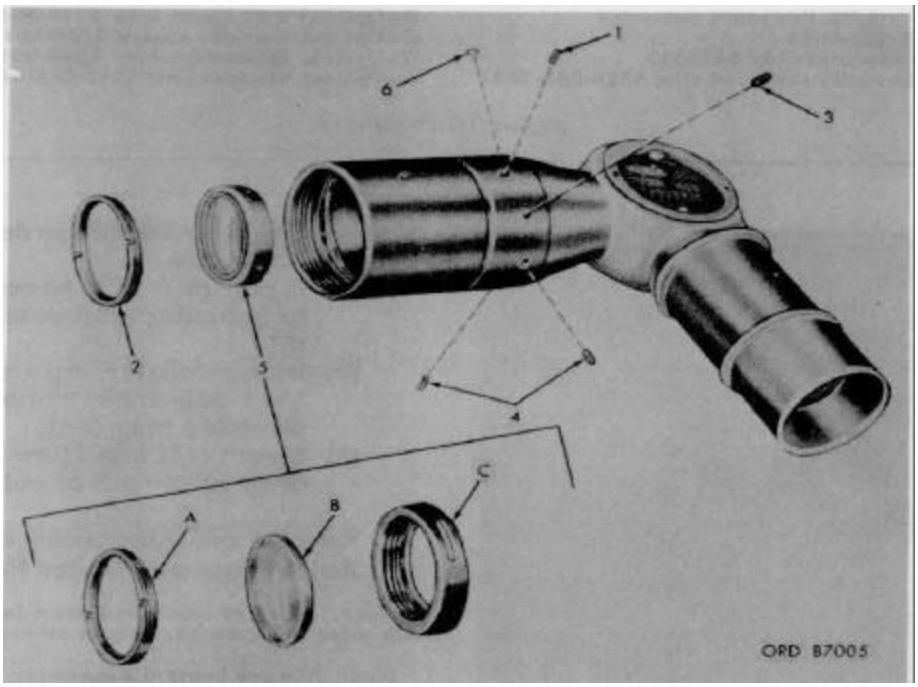
Note

The key numbers shown below. in parenthesis refer to figure 13, unless otherwise indicated.

Note

Always begin disassembly of this portion of telescope on left side. It may be necessary to remove right cover. The telescope is assembled so that the extraction hole in prism clip is toward the cover with the nameplate.

a. Removal.
(1) Remove flat head screw (1).
(2) Using adjustable spanner wrench 5120-561-0855, remove cover (fig. 14).
(3) Extract spring tension clip (3) by inserting a pointed tool into extraction hole and lifting up. Place thumb or finger on cushioning pad (6) and optical instrument prism (5) as a brace so that prism will not slip out of position and be damaged.
(4) Lift out optical element holder (4) keeping prism in position.
(5) Hold prism in position, turn telescope body over, let prism drop gently onto several thickness of lens tissue in palm of hand. Pads (6) should be firmly attached to prism and, unless the prism requires coating, are not removed. However, when necessary, pads may be removed by inserting a sharp cutting edge between pad



1-No. 2 x 1/8 flat point setscrew 5305-282-7645
2-Externally threaded ring 5340-285-7927
3-No. 10 x 1/8 flat point setscrew 5305-282-7656
4-No. 2 x 1/8 flat point setscrew 5305-282-7645
5-Reticle assembly, 7641312 (M16A1D)
Reticle assembly 7641826 (M16A1F)
Reticle assembly 7641971 (M16A1G)
Reticle assembly 8587499 (M116)
Reticle assembly 8587503 (M116C)
A-Externally threaded ring 5340-292-3620
B-Reticle 1240-767-3922 (M16A1D)
Reticle 1240-767-4312 (M16A1F)
Reticle 1240-767-5738 (M16A1G)
Reticle 1240-898-6790 (M116)
Reticle 1240-898-6788 (M116C)
C-Cell 1240-757-9883
6-Observation window 1240-503-5616

Figure 12. Removal and disassembly of reticle assembly-partial exploded view.

and prism and carefully shave pad from the prism.

(6) If telescope body requires repair, removal of right cover may be advantageous. Remove other screw (1) and remove cover (fig. 14) as indicated in (2) above.

b. Disassembly. The name plate (2B) is riveted to the left cover (2C) and is not normally removed. If necessary, remove rivets (2A) and name plate (2B).

35. Removal and Disassembly of Objective Assembly (fig. 15)

Note

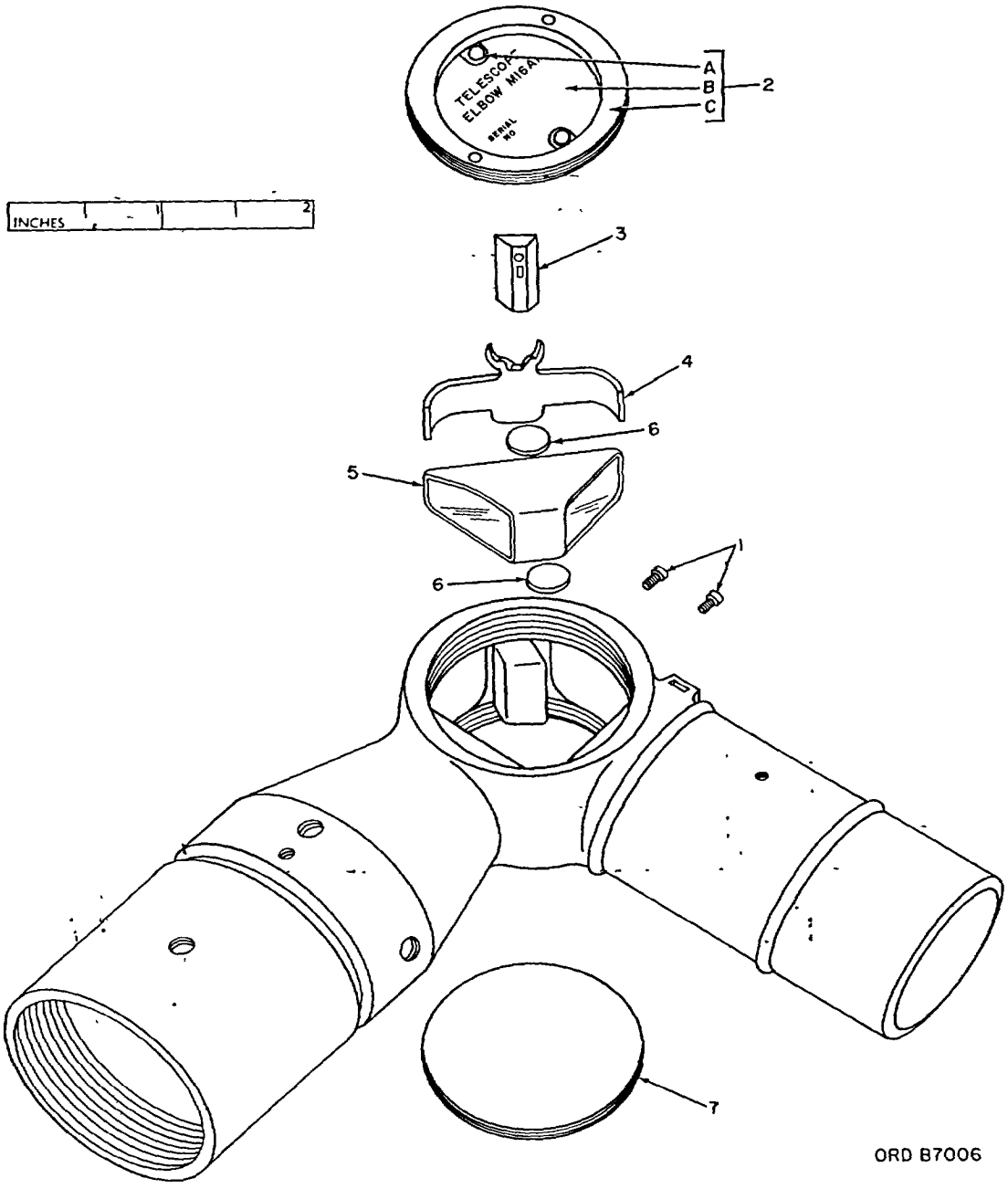
The key numbers shown below in parenthesis refer to figure 15.

a. Removal.

(1) Measure and record the distance from end of telescope body to objective cell.
(2) Remove flat point setscrew (1).
(3) Using tubular spanner wrench 5120-345-1399, remove objective assembly (2).

b. Disassembly.

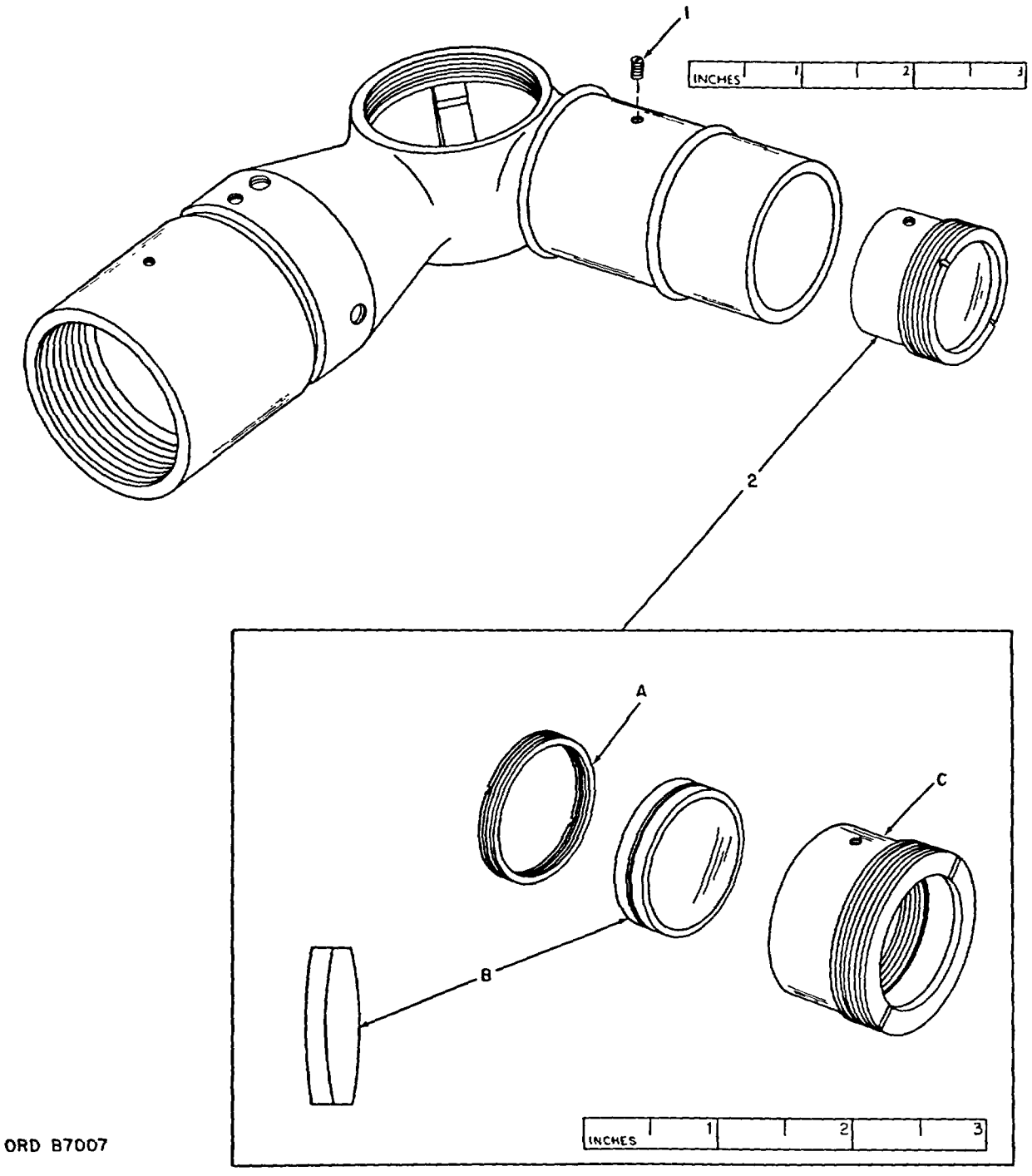
(1) Using tubular spanner wrench 5120-345-1396, remove externally threaded ring (2A).
(2) Remove optical instrument lens (2B) from optical element cell (2C).



1-No. 1 x 3/16 flat head screw 5305-050-3933
2-A-Rivet 5320-014-1768
B-Plate 7584096 (M16A1D)
Plate 7586902 (M16A1F)
Plate 7587222 (M16A1G)
Plate 8587501 (M116)
Plate 8587504 (M116C)
C-Cover 76409.59 (M16A1D)
Cover 7641825 (M16A1F)
Cover 7641970 (M16A1G)
Cover 8587498 (M116)
Cover 8587502 (M116C)
3-Spring tension clip 5340-503-7821
4-Optical element holder 1240-503-7820
5-Optical instrument prism 1240-503-6234
6-Cushioning pad 1240-503-2820
7-Cover 1240-759-6333

Figure 13. Removal and Disassembly of covers, amici prism and related parts-partial exploded view.

Figure 14. Removal of cover.



1-No. 2 x 3/32 flat point setscrew 5305-282-7644
2-Objective assembly 6139342

A-Externally threaded ring 5340-597-8890
B-Optical instrument lens 1240-504-5963
C-Optical element cell 1240-613-6409

Figure 15. Removal and disassembly of objective assembly-exploded view.

Section III. ASSEMBLY

36. General

This section provides specific instructions for assembly and installation of assemblies and groups of related parts of elbow telescope M16A1 and M116 series.

37. Installation of Observation Window

a. Clean seat in window port with alcohol and lay thin spaghetti of sealing compound on seat. Burnish spaghetti to seat using a small wood dowel.

b. Insert window (6, fig. 12), press window in place making certain window is seated. Remove excessive sealing compound. Stake window in place.

38. Installation of Right Cover

a. If necessary, apply sealing compound to inner flange of cover (7, fig. 13).

b. Using adjustable spanner wrench 5120-561-0855, install cover. Screw cover in until flange is flush with telescope body. Remove excessive sealing compound.

c. Install No. 1 x 3/16 flat point screw (1, fig. 13) securing cover (7, fig. 13).

39. Assembly and Installation of Objective Assembly

Note
The key numbers shown below in parenthesis refer to figure 15.

a. Assembly.
- (1) If necessary, apply sealing compound to lens seat of cell (2C).
- (2) Clean optical instrument lens (2B) and insert in cell (2C). Make certain crown glass (more convex side) faces lens seat.
- (3) Using tubular spanner wrench 5120-345-1396, install externally threaded ring (2A).
- (4) Inspect assembly to make certain objective lens is seated correctly, is not damaged, and that seal is complete.

b. Installation.
- (1) Apply a light coat of grease to the back two thirds of the threads of objective assembly (2).
- (2) Using tubular spanner wrench 5120-345-1399, install objective assembly in telescope body to the depth recorded in disassembly.
- (3) Install No. 2 x 3/32 flat point setscrew (1) in telescope body.

40. Assembly and Installation of Left Cover, Amici Prism, and Related Parts

Note
The key numbers shown below in parenthesis refer to figure 13.

a. Apply adhesive to each cushioning pad (6), position pad on optical instrument prism (5), and press firmly; allow adhesive to dry before attempting to install prism.

b. Assemble left cover (2C), place name plate (2B) in recess with holes alined with holes in cover (2C). Secure with rivets (2A).

c. Clean prism (5) and insert in elbow housing. Hold prism in position against locating surfaces and insert holder (4). Make certain holder clears sharp roof edge of prism and that fingers of holder are flush.

d. Insert clip (3) in guide of holder (4). Make certain that the extraction hole is facing the prism. Press clip down until flush with holder.

e. If necessary, apply sealing compound to inner flange of cover (2C). Using adjustable spanner wrench 5120-561-0855, install cover (2C) until flange is flush with telescope body.

f. Inspect prism (5) for cleanliness and for possible damage incurred during installation. Make certain prism is not loose in housing.

g. Install No. 1 x 3/16 flat head screw (1) in housing securing cover 420).

41. Assembly and Installation of Reticle Assembly and Related Parts

Note
The key numbers shown below in parenthesis refer to figure 12.

a. Install four No. 2 x 1/8 flat point setscrews (4) in telescope body so that flat points are just visible on the inside.

b. Clean and insert reticle (5B) in cell (5C), alining reticle with scribe marks on cell, made during disassembly. If new cell is being used, position reticle so that cell

illumination slot is centered in upper left quadrant of reticle. Etching on reticle faces ring (5A).

c. Using tubular spanner wrench 512034,5-1398, install externally threaded ring (5A).

d. Install reticle assembly (5) in telescope body. Aline illumination slot in reticle cell (5C) with window in telescope body. Tighten four No. 2 x 1/8 flat point setscrews (4) until they are just touching reticle cell (5C) and the cell is approximately centered in telescope body.

e. Using tubular spanner wrench 5120-345-1406, install ring (2). Tighten ring (2) enough to keep the reticle assembly (5) from being loose or tilting. Turning the setscrew (4) should cause the reticle assembly (5) to move.

f. Inspect reticle assembly for cleanliness, proper installation, and possible damage incurred during installation. Install No. 10 x 1/8 flat point setscrew (3) and No. 2 x 1/8 flat point setscrew (1) in housing.

42. Assembly and Installation of Eyepiece Assembly

Note

The key numbers shown below in parenthesis refer to figure 10.

a. To be sure the lenses do not become cocked during assembly, one method is outlined in (1) through (7) below.

(1) Clean an extra spacer which will be used as a holder and guide for the eyepiece parts.
(2) Clean field lens (2B); place lens with crown glass (more convex side) up on the extra spacer.
(3) Clean optical element spacer (2C) and place on eyelens (2D).
(4) Clean eyelens (2D); place eyelens with crown glass (more convex side) down on optical element spacer (2C).
(5) Using even pressure, push optical element cell (2E) down on the stack. When rim of cell has reached the extra spaces, invert the entire assembly. (The extra spaces are now on top.) Place a block of hardwood on spacer and press until eyelens is seated. Remove extra spacer.
(6) Using tubular spanner wrench 5120-345-1406, install externally threaded ring (2A).
(7) Inspect eyepiece assembly (2) for cleanliness and for damage incurred during assembly.

b. Using tubular spanner wrench 5120-345-1411, install eyepiece assembly (2) in telescope body to depth recorded in disassembly.

c. Install No. 2 x 3/32 flat point setscrew (1) in telescope body.

Section IV. TESTS AND ADJUSTMENTS

43. Scope

The tests and adjustments that follow are performed after elbow telescope M16A1 and M116 series have been completely assembled. The tools and equipment necessary to perform these tests and adjustments are listed in table I.

44. Vibration Test

a. Prior to other inspections, elbow telescope M16A1 and M116 series must be vibrated for 15 seconds at a constant frequency of 30 cycles per second with an amplitude of 1/6-inch (1/8-inch maximum excursion) on universal vibration tester 4931-536-5555.

b. Secure vibration adapter 4931-9869900 in center mounting plate surface of tester with 3/8-16 x 1-3/4 screws and lockwashers.

c. Refer to instruction and caution plates on tester.

d. Install two elbow telescopes in vibration adapter as shown in figure 16.

e. After being subjected to the vibration test, the elbow telescopes should show no evidence of dirt, chips, fractures, loose components, or cement separation in the system when viewed through the eyepiece and objective end. If any of the mentioned defects are present, they must be corrected and the elbow telescopes vibrated again.

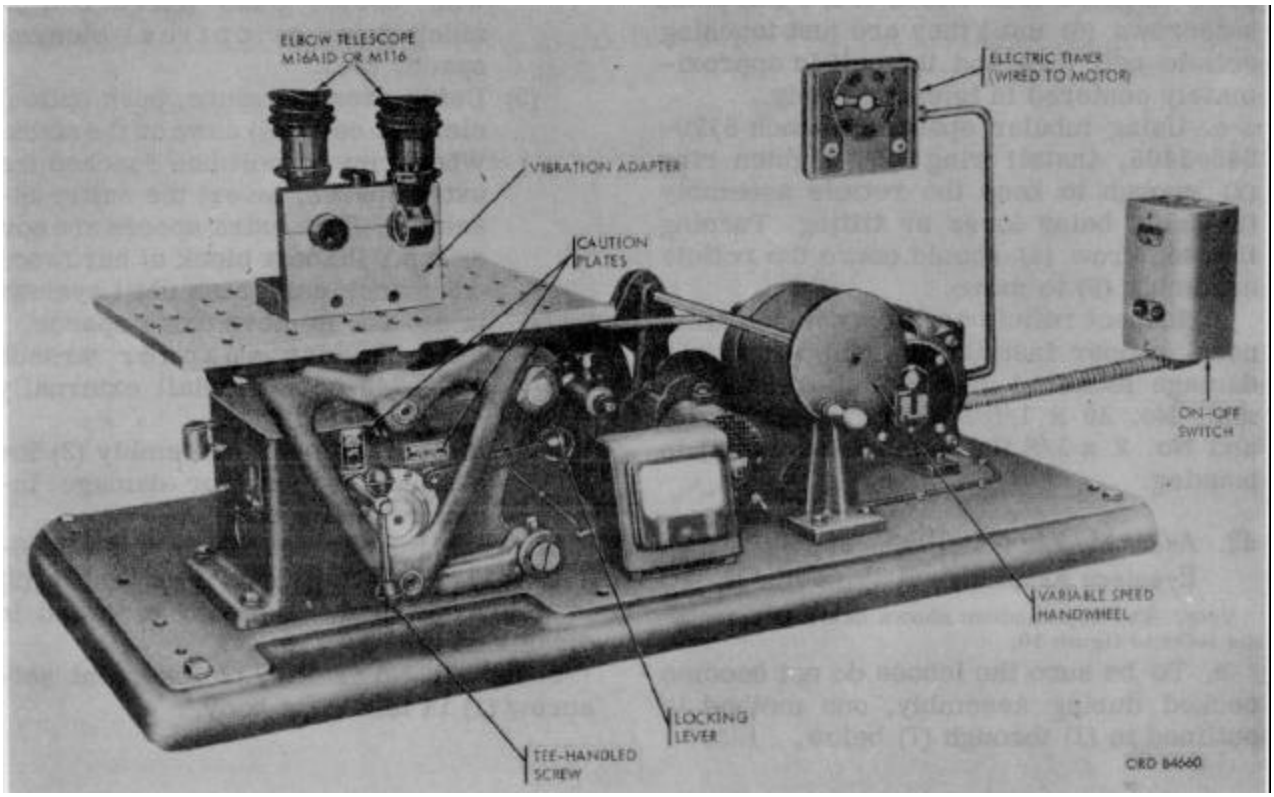


Figure 16. Universal vibration tester vibration test setup.

45. Setup of Telescope Test Fixture 4931-508-5434

a. Plumb collimating telescope reticle. Place collimating telescope 4931-5549108 (fig. 17) in V block with clamp 41B-4165.

b. Place V block with collimating telescope on a leveled surface plate.

c. Hang a plumb line in sight of collimating telescope.

d. Look through eyepiece of collimating telescope and rotate telescope in V block until one of the reticle lines of collimating telescope coincides with plumb line. Tighten clamp screws of V blocks to secure collimating telescope.

e. After tightening clamp screw of V block, recheck to make sure that vertical line of reticle of collimating telescope is still plumb.

46. Plumbing Reticle of Projector Collimator (fig. 18)

a. Place telescope test fixture 4931508-5434 on a sturdy metal bench or table of a convenient working height.

b. Position movable telescope support

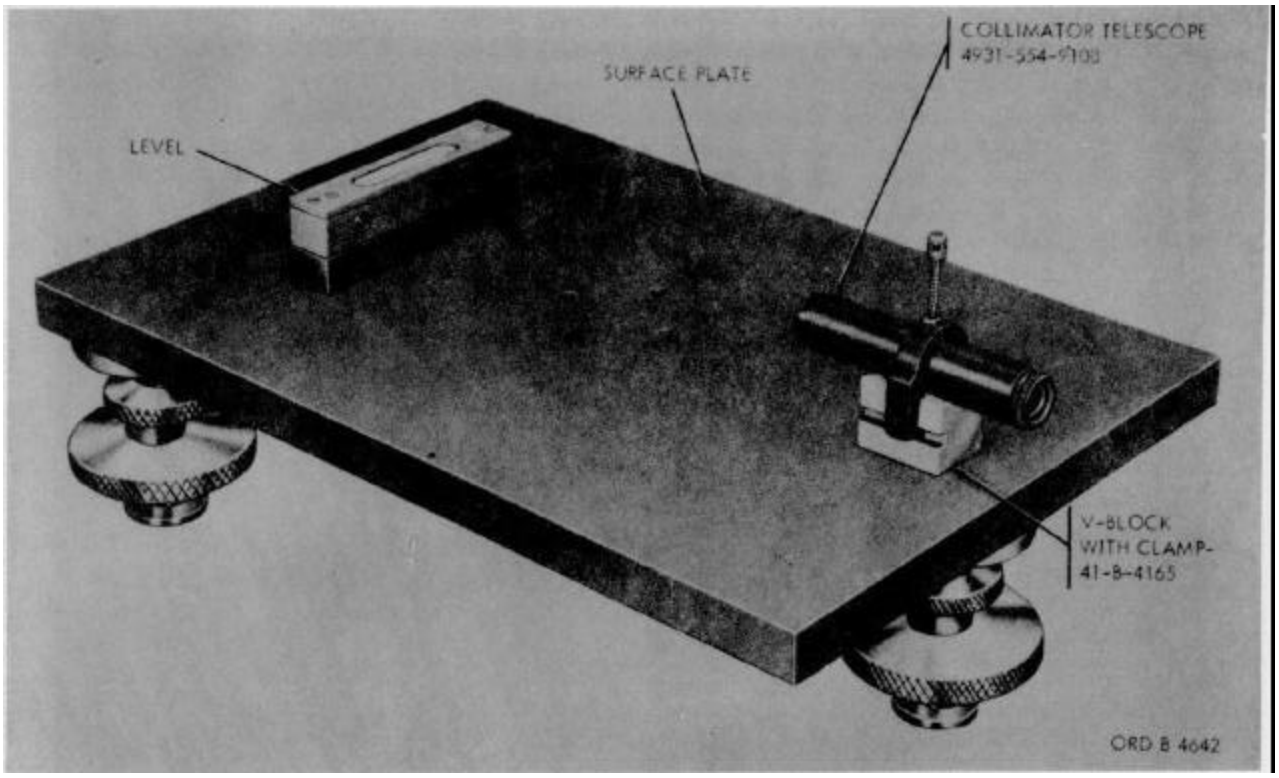


Figure 17. Collimating telescope mounted in V block.

assembly in middle of base, and lock in place with two knurled thumb screws.

c. Install (J) support assembly 7680666 in movable telescope support assembly.

d. Place V block with collimating telescope on (J) support assembly flush against key.

e. Loosen four socket head cap screws of projector collimator support assembly clamps. Set scale of projector collimator at infinity, and center projector collimator in its support assembly clamp.

f. Look through eyepiece of collimating telescope, and rotate projector collimator until vertical line of projector coincides with vertical line of collimating telescope. Tighten four socket head cap screws to secure projector collimator in its support assembly.

g. Look through eyepiece of collimating telescope and recheck to see if vertical line of projector is still in coincidence with vertical reticle line of collimating telescope.

47. Collimation Arrangement (fig. 19)

a. Remove lamp housing and install diffusion screen. Install lamp housing to projector tube with light source at rear end of lamp housing. Connect light cord to a 110-volt source current.

b. Remove V block with collimating telescope and (J) support assembly from movable telescope support assembly.

c. Install (A) support assembly 7573542 on movable telescope support assembly. Establish height of (A) support assembly by installing No. 7 set-up gage 7572714 between bottom of (A) support assembly and flat surface of movable telescope support assembly.

d. Remove collimating telescope from V block and place piece of collimating telescope at projector collimator reticle. Cross hair intersection point of collimating telescope should be alined with middle cross hair intersection point of projector collimator reticle (fig. 6). If not, adjust reticle of projector collimator to aline

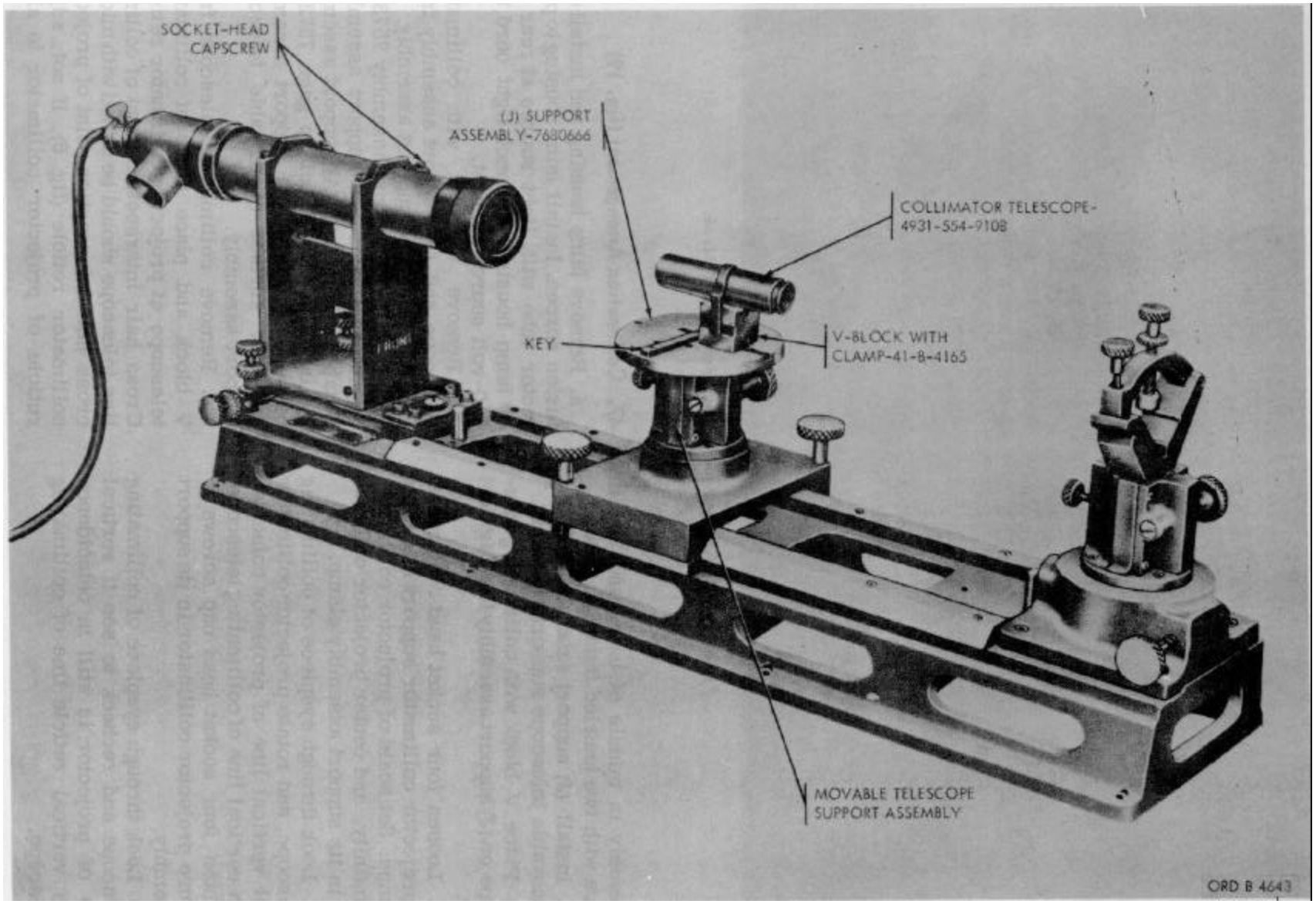


Figure 18. Telescope test fixture 4931-508-5434 plumbing reticle of projector-collimator setup.

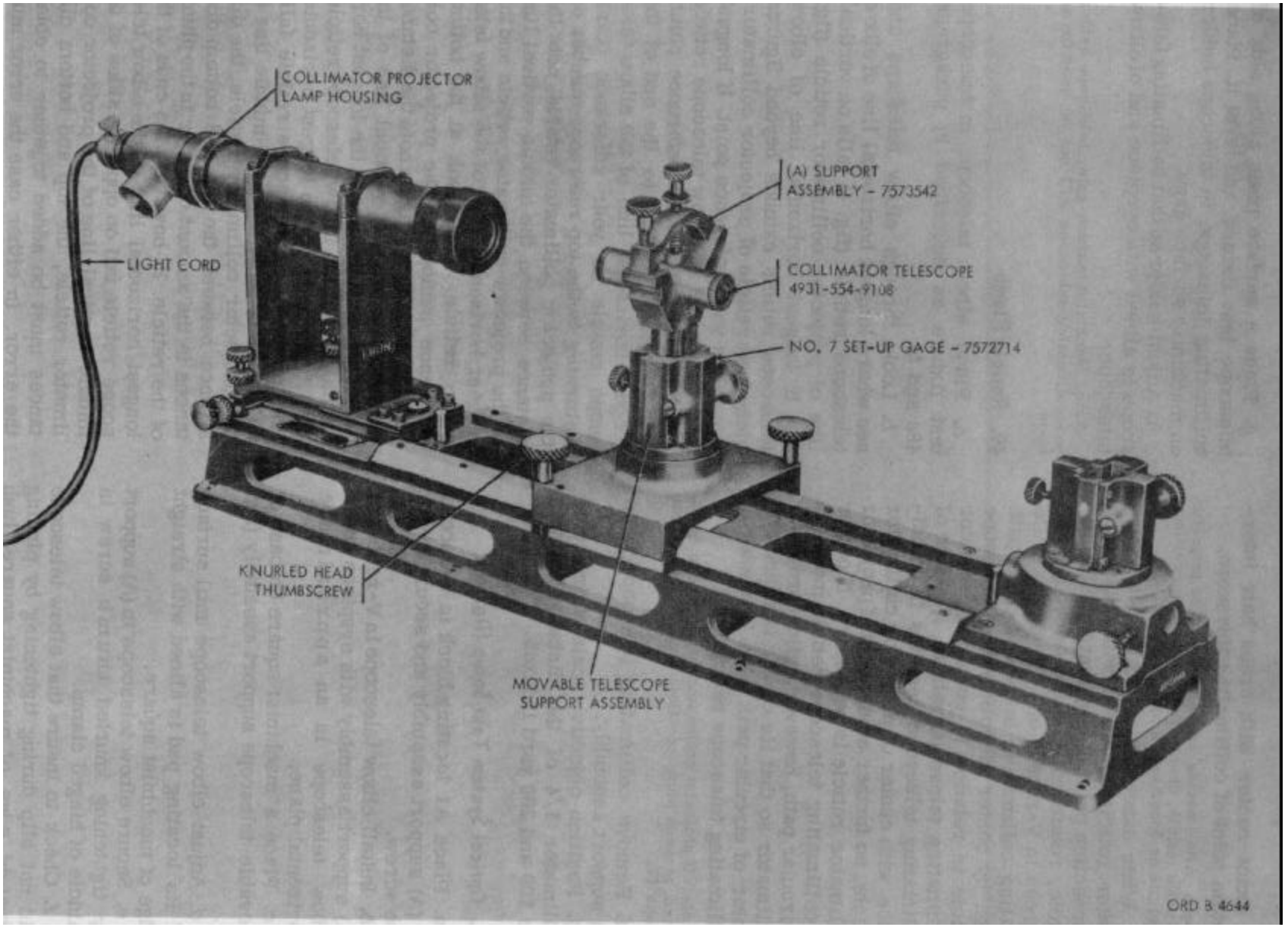


Figure 19. Telescope test fixture 4931-508-5434-collimation.

its exact center with cross hair intersection point of collimating telescope.

Note

After making any adjustment of projector, collimator reticle, cheek plumb of projector collimator reticle as described in paragraph 46.

e. When exact center of projector collimator reticle is alined with cross hair intersection point of collimatting telescope reticle, rotate collimating telescope 360 degrees An V-recess of (A) support. While rotating collimating telescope, note path taken by center of collimating telescope reticle in relation to center of projector collimating telescope reticle. If center of collimating telescope remains in coincidence with center of projector collimator reticle, no further adjustment of projector collimator reticle is necessary. If center of collimating telescope reticle moves in a circular path, however, adjust projector collimator so that its center is alined with center of circular path taken by center of collimating telescope reticle.

Note

If projector collimator reticle has to be adjusted, recheck plumb of reticle as described in paragraph 46.

f. Remove collimating telescope from (A) support assembly.

g. Position objective scale of projector collimator 1/4 of the distance between the 100 and 200 yard indexes.

48. Optical System Test Setup (fig. 20)

a. Place A1 locating block in V-recess of (A) support assembly and secure it with one screw.

b. Install elbow telescope in V-recess of (A) support assembly with eyepiece end of elbow telescope in an approximate horizontal plane.

c. Place a machinist square on base of movable telescope support assembly (fig. 5).

d. Adjust elbow telescope until surface of its locating pad is alined with straight edge of machinist square.

e. Secure elbow telescope in (A) support by tightening knurled thumb screw in middle of hinged clamp.

f. Check to insure that elbow telescope did not slip during tightening by placing straight edge of machinist square flush against locating pad.

g. Place a surface plate along side of telescope test fixture, and level it. Place collimating telescope in telescope holder on machinist surface gage.

h. Adjust holder so that collimating telescope is alined with eyepiece end of elbow telescope.

Note

Machinist surface gate, telescope holder, and collimating telescope will not be used for all tests.

49. Reticle Plumb

a. Place elbow telescope in telescope test fixture as described in paragraph 48*a* and *b*.

b. Look through elbow telescope and see where longest horizontal line of elbow telescope reticle (fig. 4) falls on vertical tine of projector collimator reticle (fig. 6). If longest horizontal line of elbow telescope reticle extends beyond figures etched on reticle of projector collimator, use 50 as your reference point. If longest horizontal line of elbow telescope reticle falls between figure 50 reference point, use the number next to the end of the longest horizontal line of the elbow telescope reticle as your reference point. Returning to the top reference number on the projector collimator reticle, note the distance between the middle vertical line of the projector collimator reticle and the longest horizontal line of the elbow telescope reticle. Then look at the bottom reference number on the projector collimator reticle, and again note the distance between the middle vertical line of the projector collimator and the longest horizontal line of the elbow telescope reticle.

c. If the ends of the longest horizontal line of the elbow telescope reticle falls on the same side from the middle line of the projector collimator reticle, the difference between the top and bottom distances is the amount of error in the plumb of the reticle. If, however, the ends of the longest horizontal line of the elbow telescope reticle fall on opposite sides of the middle vertical line of the projector collimator reticle, the top and bottom distances must be added together to obtain the error. In either case the error must not exceed 0.5 mil.

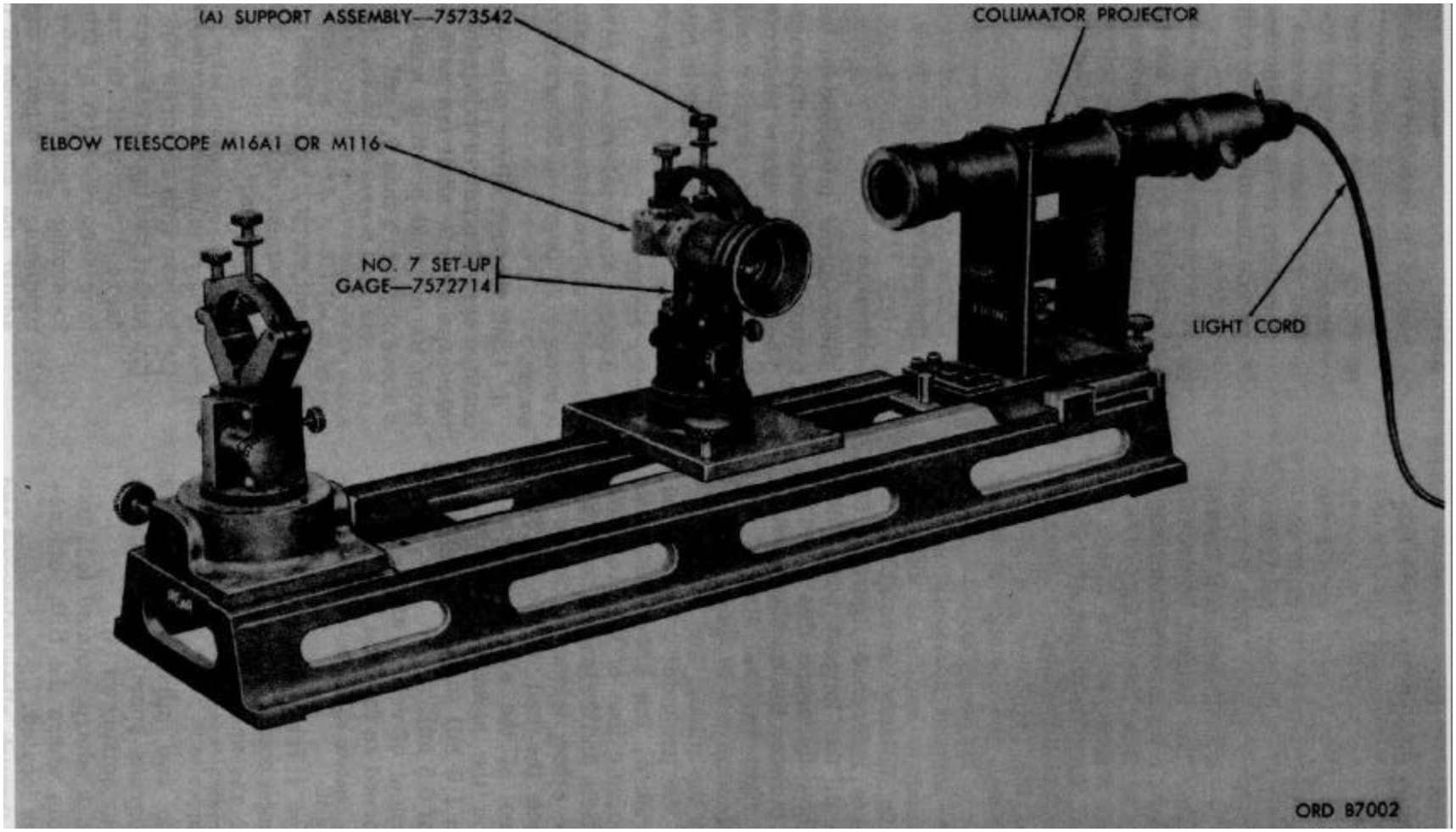


Figure 20. Telescope test fixture 4931-508-5434-optical system test setup.

d. When looking through the elbow telescope, the longest horizontal line extends beyond the etched figures of the projector collimator reticle, therefore, select the top and bottom 50 figure on the right vertical line of the projector collimator reticle as reference points. With the two reference figures established, note the top reference figure. The longest horizontal line of the elbow telescope reticle intersects the right vertical line of the projector collimator reticle at the figure 50 reference point. Since the distance between the middle vertical line and the right vertical line of the projector collimator reticle is 1.0 mil, the distance between the middle line of the projector collimator reticle and the longest horizontal line of the elbow telescope reticle is also 1.0 mil. Once this distance is established, note the bottom reference figure, a 50 reference point, the longest horizontal line of the elbow telescope lies directly in the center between the middle vertical line and the right vertical line of the projector collimator reticle. Since the distance between the middle and right vertical line's of the projector collimator is 1.0 mil, therefore, the known distance between the middle line of the projector collimator reticle and the longest horizontal line of the elbow telescope reticle is 0.5 mil. Since the end of the longest horizontal line of the elbow telescope reticle fall on the same side, subtract 0.5 mil from 1.0 mil to get the reticle plumb error of 0.5 mil.

e. If adjustment of reticle assembly is necessary proceed as follows:

Note

The key numbers shown below in parenthesis refer to figure 12

(1) Remove fifth setscrew (3) from telescope body.

Note

The fifth setscrew referred to is that screw which does not have another setscrew opposite it.

(2) Loosen two adjacent setscrews (90 degrees apart) of the remaining four setscrews (4).
(3) Insert a sharp, pointed tool into the hole where the fifth setscrew (3) was located.
(4) Sight through elbow telescope and note position of elbow telescope reticle in relation to the position of the projector collimator reticle.
(5) Using inserted tool, turn reticle assembly until longest horizontal line of elbow telescope reticle parallels, or is in coincidence with middle line of projector collimator reticle.
(6) Withdraw inserted tool.
(7) Carefully tighten the two previously loosened setscrews.
(8) Sight through elbow telescope and check to ensure that tightening has not disturbed reticle assembly position.
(9) Install fifth screw (3), and tighten it against reticle assembly.
(10) Check collimation of reticle as described in paragraph 50.

50. Collimation

a. Place elbow telescope in telescope test fixture as described in paragraph 48.

b. Look through elbow telescope using unaided eye at projector collimator reticle. Note position of elbow telescope reticle geometric axis point in relation to the 1 mil square center of projector collimator reticle.

c. Loosen elbow telescope in (A) support assembly, and rotate eyepiece end of elbow telescope 90 degrees. Secure elbow telescope.

d. Look through elbow telescope using unaided eye. Geometric axis point of elbow telescope reticle shall not have deviated from its original position, noted in step b above, by more than 0.5 mil.

Note

Note total movement distance of elbow telescope reticle geometric axis point to assist, if necessary, in adjustment of reticle assembly.

e. Repeat steps c and d above.

f. If adjustment of reticle is necessary proceed as follows:

Note

The key numbers shown below in parenthesis refer to figure 12, unless otherwise indicated.

(1) Loosen fifth setscrew (3).
(2) Adjust two opposite setscrews (180 degrees apart) of the remaining four setscrews (4) by alternately loosening one setscrew and tightening the other. Continue to adjust the setscrews in pairs to split the difference of the total

movement distance of the geometric axis point noted during step *d* above.

(3) If setscrew adjustment is not sufficient to correct condition, remove prism (5, fig. 13) as described in paragraph 34 and reverse prism. Replace prism as described in paragraph 40.

(4) Repeat step (2) above.

(5) If prism reversal and setscrew adjustment still is not sufficient to correct condition, remove and replace prism, and repeat step (2) above.

(6) Install fifth screw (3) and tighten against reticle assembly.

(7) Check plumb of reticle as described paragraph 49.

51. Eyepiece Focus

a. Place elbow telescope in telescope test fixture as described in paragraph 48.

b. Use a calibrated dioptometer focused at infinity with objective diopter scale reading zero.

c. Point dioptometer at an illuminated white background and, while peering into eyepiece, rotate until reticle cross line is brought into sharp focus.

d. Set diopter scale on objective end at zero, dioptometer is now ready for use.

e. Place a sheet of white paper a few inches in front of objective end of elbow telescope.

f. Sight through dioptometer, after positioning is between eyepiece of elbow telescope and eye, and aline reticle of dioptometer with reticle of elbow telescope. Slide objective diopter scale (moving dioptometer objective) in or out until elbow telescope reticle is sharp and clear.

g. Read objective diopter scale on dioptometer. It should read between minus 0.75 and minus 1.00 diopter.

h. If adjustment of eyepiece assembly is necessary, proceed as follows:

(1) Loosen setscrew (1, fig. 10).

(2) Adjust objective diopter scale of dioptometer until index reads minus 0.875.

(3) While looking at elbow telescope reticle through dioptometer, turn eyepiece assembly to move inward or outward until reticle appears in sharp focus in the center of the field.

(4) Tighten setscrew (1, fig. 10) to lock eyepiece assembly in place.

52. Parallax

a. Preferred Method.

(1) Place elbow telescope in telescope test fixture as described in paragraph 48.

(2) Take a calibrated dioptometer focused at infinity with objective diopter scale reading zero.

(3) Point dioptometer at an illuminated white background, and while peering into eyepiece, rotate eyepiece until reticle cross line is brought into sharp focus. Dioptometer is now ready for use.

(4) Sight through dioptometer, after positioning it between eyepiece of elbow telescope and eye, and observe cross hair intersection point of elbow telescope reticle.

(5) Slide objective diopter scale in or out until cross hair intersection point of elbow telescope reticle is sharp and clear.

(6) Note objective diopter scale index reading which should be between minus 0.75 and minus 1.00.

(7) Sight through dioptometer, after positioning it between eyepiece of elbow telescope and eye, and observe projector collimator reticle, disregarding elbow telescope reticle.

(8) Slide objective diopter scale in or out until projector collimator reticle is sharp and clear.

(9) Note objective diopter scale index reading.

(10) Compare the two readings taken in steps (6) and (9) above. The two readings must coincide.

Note

The difference between the two readings is the amount of parallax present.

(11) If the two readings do not coincide,

adjustment of the objective assembly is necessary as follows:

(a) Loosen setscrew (1, fig. 15).

(b) Set objective diopter scale of dioptometer to index reading noted in step (6) above.

Note

Reading noted in step (8) above must be between minus 0.75 and minus 1.00 diopters. If not, adjust eyepiece assembly first, as described in paragraph 51.

(c) While sighting through elbow telescope with dioptometer, turn objective assembly inward or outward until projector collimator reticle is sharp and clear.

(d) Tighten setscrew (1, fig. 15) to lock objective assembly in place.

b. Alternate Method.

(1) Look through elbow telescope, using unaided eye at projector collimator reticle. Select geometric axis as a reference point on reticle pattern of elbow telescope near the center of the field, and select a corresponding reference point on reticle pattern of projector collimator. Move head slowly up and down, and side to side. There must be no more than 0.1 mil parallax between reference point of projector collimator in relation to geometric axis point of reticle pattern of elbow telescope.

(2) If adjustment of objective assembly is necessary, proceed as follows:

(a) Loosen setscrew locking objective assembly in place.

(b) While looking through elbow telescope turn objective assembly to move inward or outward until parallax is eliminated.

Note

If, when observing the reference point of projector collimator reticle pattern, the point appears to move in the same direction as the movement of the observer's head, the objective assembly must be moved toward the elbow telescope reticle. If the reference point appears to move in the opposite direction to the movement of the observer's head, the objective assembly must be moved away from the elbow telescope reticle.

(c) Tighten setscrew (1, fig. 15) to lock objective assembly in place.

53. Definition

a. Place elbow telescope in telescope test fixture as described in paragraph 48.

b. Using collimating telescope, look through elbow telescope at projector collimating reticle. Reference marks for definition checking on projector collimator reticle (fig. 6) shall be sharp and clear in the center of the field.

Note

If objective assembly has been adjusted to eliminate parallax, adjustment for definition will have been accomplished at the same time. If, however, the four definition reference circles on projector collimator reticle do not appear equally in focus, amici prism may be loose. Refer to paragraph 34 for repair of prism.

CHAPTER 6

FINAL INSPECTION

54. General

Final inspection is performed after repair or overhaul has been completed to insure that the materiel is serviceable according to established serviceability standards. Any item containing defects disclosed by the final inspection will be returned to the shop for repair or adjustment.

55. Visual Inspection

Visually inspect elbow telescope M16A1 and M116 series in accordance with paragraph 56 below.

56. Final Inspection for Acceptance

a. Vibration. The telescopes shall be vibrated in the same manner as described in paragraph 44. Subsequent to vibration, the telescopes shall show no evidence of loose or damaged parts.

b. Condition of Optics. Viewing through the eyepiece and objective ends of the telescope, there will be no objectional dirt, smears, scratches, digs, condensate, fungus growth, chips, fractures, or cement separation. The shading or shadowing technique will be used to determine the presence of objectionable condensate or smears. Shadowing is the technique of looking into the eyepiece or objective end of the telescope, sight obliquely so as to obtain reflections from a particular surface in the optical system. With this method, the surfaces of the internal optical elements are drab gray in appearance and all defects (condensate, scratches, etc) show up as white particles.

c. Eyepiece Focus. The eyepiece focus will be performed in accordance with paragraph 51

d. Definition of Field. The elbow telescope must produce a sharp and clear image at the center of the field when checked with the aid of an auxiliary telescope.

e. Parallax. Parallax between the image and the reticle lines shall not exceed 0.125 diopter when viewing a target (125 $\pm$ meters distant).

f. Reticle Plumb. With the elbow telescope positioned, the verticle center line of the reticle pattern shall not deviate from the image of the projector collimator vertical line by more 0.5 mil.

g. Collimation. The optical axis will coincide with the geometric axis of the telescope within 0.5 mil.

h. Illumination. With the reticle illuminated, the reticle scale must appear clearly defined when observed in a dark room.

57. Application of Sealing Compound

a. Apply sealing compound MIL-S-11031A to heads of external screws.

b. Inject sealer MIL-S-11031A into eyepiece and objective ends of telescope.

58. Installation of External Parts

Note

The key numbers shown below in parenthesis refer to figure 9.

a. Install instrument light adapter (5) and secure in place with No. 10 lockwasher (4) and No. 10 x 3/4 fillister-head screw (3).

b. Install eyeshield adapter (2). Make certain fingers snap into groove, and adapter will turn on body.

c. Attach eyeshield (1) to outer rim of eyeshield adapter (2).

CHAPTER 7

PROCESSING AND PACKAGING

59. General

Refer to packaging specification MIL-P-14232/P7597780, TM 9-200 (boxed materiel) and TB 9-299/1 (unboxed materiel) for processing and packaging instructions.

60. Optical Components

Cover all windows or optical elements with at least four thicknesses of neutral lens tissue and secure in place with water resistant pressure-sensitive adhesive tape. Cover lens tissue with cellulosic cushioning materiel and secure. In place with pressure-sensitive tape.

APPENDIX

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.

Index of Army Motion Pictures, Film Strips, Slides, and Phono-Recordings. DA Pam 108-1
Military Publications:
Index of Administrative Publications ..... DA Pam 310-1
Index of Blank Forms ..... DA Pam 310-2
Index of Graphic Training Aids and Devices ..... DA Pam 310-5
Index of Supply Manuals; Ordnance Corps ..... DA Pam 310-29
Index of Technical Manuals, Technical Bulletins, Supply ..... DA Pam 310-4
Bulletins, Lubrication Orders, and Modification Work Orders.
Index of Doctrinal Training and Organizational Publications ..... DA Pam 310-3

2. Supply Manuals

The following supply manuals of the Department of the Army pertain to this materiel:

a. Destruction to Prevent Enemy Use.

Ammunition and Explosives (Class 1375 Explosives, Solid Propellants and Explosive Devices). SM 9-5-1375

b. Repair and Overhaul.

Brushes, Paints, Sealers, and Adhesives ..... SM 5-1-C5-1
Fuels, Lubricants, Oils and Waxes ..... SM 10-1-C4-1
Hardware and Abrasives ..... SM 9-1-C5300
Fire Control Maintenance and Repair Shop Specialized Equipment: Tool Set, Depot Maintenance, Supplementary Tools, Fixtures, and Equipment (4931-798-7583). SM 9-4-4931-J40
Fire Control Maintenance and Repair Shop Specialized Equipment: Tool Set, Special Depot Maintenance, Optical Cleaning, Coating, Cementing, and Decementing (4931-535-7827). SM 9-4-4931-J48
Fire Control Maintenance and Repair Shop Specialized Equipment: Tool Set, Field and Depot Maintenance, General Purpose, Special Tools (4931-574-6433). SM 9-4-4931-J51
Fire Control Maintenance and Repair Shop Specialized Equipment: Wrench Set, Spanner, Field and Depot Maintenance: Tubular, Double-End Concave, Inserted Blade, Set of 76 Wrenches (4931-580-0012). SM 9-4-4931-J52
Tool Kit, Fire Control Repairman (5180-357-7735) ..... SM 9-4-5180-A61
Tool Kit, Instrument Repairman's (5180-357-7743) ..... SM 9-4-5180-A62
Maintenance and Repair Shop Equipment ..... SM 9-1-4910

3. Forms

The following forms pertain to this materiel:

DA Form 5-31, Shop Job Order Register

DA Form 9-1, Materiel Inspection Tag
DA Form 9-79, Parts Requisition
DA Form 9-80, Job Order File
DA Form 828, Job Time Ticket - Individual
DA Form 829, Rejection Memorandum
DA Form 1296, Stock Accounting Record
DA Form 1297, Title Insert Formal Accountability
DA Form 1546, Request for Issue or Turn-In
DA Form 2028, Recommended Changes to DA Technical Manual Parts List or Supply Manual 7, 8, or 9.
DA Form 2402, Exchange Tag
DA Form 2407, Maintenance Request
DD Form 6, Report of Damaged or Improper Shipment
DD Form 250, Materiel Inspection and Receiving Report

4. Other Publications

a. Camouflage.

Camouflage, Basic Principles and Field Camouflage ..... FM 5-20

b. Decontamination.

Chemical, Biological, and Radiological Decontamination ..... TM 3-220

c. Destruction to Prevent Enemy Use.

Explosives and Demolitions ..... FM 5-25
Ordnance Ammunition Service ..... FM 9-5
Ordnance Service in the Field ..... FM 9-1
Safety: Regulations for Firing Ammunition for Training, Target Practice, and Combat. ..... AR 385-63, AFR 50-13

d. General.

Dictionary of United States Army Terms ..... AR 320-5
Logistics (General) :
Malfunctions Involving Ammunition and Explosives ..... AR 700-1300-8
Military Symbols ..... FM 21-30, AFM 55-3
Military Terms, Abbreviations, and Symbols:
Authorized Abbreviations and Brevity Codes ..... AR 320-50
Military Training ..... FM 21-5
Ordnance Direct Support Service ..... FM 9-3
Ordnance General and Depot Support Service ..... FM 9-4
Safety: Accident Reporting and Records ..... AR 385-40
Shop Mathematics ..... TM 9-2820
Principles of Fire Control Materiel ..... TM 9-3305-2
Techniques of Military Training Instruction ..... FM 21-6
The Army Equipment Record System and Procedures ..... TM 38-750

e. Maintenance.

Grease, Aircraft and Instrument for Low and High Temperature MIL-G-3278A
Lubricating Oil: Aircraft Instrument, Low Volatility ..... MIL-L-6085A(2)
Maintenance of Supplies and Equipment:
Cleaning of Ordnance Materiel ..... TM 9-208-1
Command Maintenance Inspections ..... AR 750-8
General Maintenance Procedures for Fire Control Materiel. ..... TM 9-254
Lubrication of Ordnance Materiel ..... TM 9-273

Materials Used for Cleaning, Preserving, Abrading and Cementing Ordnance Materiel; and Related Materiel including Chemicals.	TM 9-247
Ordnance Maintenance: Operation and Maintenance of Optical Coating Equipment.	TM 9-1501
Organization, Policies, and Responsibilities for Maintenance Operation.	AR 750-5
Painting and Finishing Systems For Fire Control Instruments.	MIL-STD-194 (ORD)
General Specification for Soldering Process	MIL-S-6872A
105MM Howitzer M2A1, Carriages M2A1 and M2A2 and Combat Vehicle Mounts M4 and M4A1.	TM 9-325
Ordnance Maintenance: Elbow Telescopes M1A1, M6A1, M16, M16A1C, M16A1D, M16A1F, M16A1G, M16A1N, M17, M24A1, M26A1, M62, M75C, and M75D.	TM 9-1604
Field and Depot Maintenance Repair Parts and Special Tool Lists for Telescope Elbows M16A1D, M16A1F, M16A1G, M116 and M116C.	TM 9-1240-288-35P
Sealing Compound	MIL-S-11031A (ORD)
Preparation, Painting, and Finishing For Metal and Wood Surfaces.	MIL-STD-171A (ORD)
Painting Instructions For Field Use	TM 9-213
Technical Procedures: Elementary Optics and Application to Fire Control Instruments.	TM 9-258
Use and Care of Hand tools and Measuring Tools	TM 9-243
f. Operations.	
Operation and Maintenance of Ordnance Materiel in Extreme Cold Weather, 0° to -65° F.	TM 9-207
Auxiliary Sighting and Fire Control Equipment	TM 9-575
Ordnance Corp Equipment Data Sheets	TM 9-500
Special Operations: Northern Operations	FM 31-71
g. Shipment and Storage.	
General Packaging Instructions for Ordnance General Supplies.	TM 9-200
Logistics (General) : Preservation, Packaging and Packing	AR 700-15
Logistics (General) : Report of Damaged or Improper Shipment.	AR 700-58
Paper, Lens, Tissue, Antitarnish, Wrapping	MIL-P-13988 (ORD)
Preservation, Methods of	MIL-P-116D
Protection of Ordnance General Supplies in Open Storage	TB ORD 379
Standards for Oversea Shipment and Domestic Issue of Ordnance Materiel Other Than Ammunition and Army Aircraft.	TB ORD 385
Storage of Supplies and Equipment Storage and Materiels Handling.	TM 743-200-1
Requisitioning, Receipt, and Issue System	AR 725-50
Processing of Unboxed Self-Propelled and Towed Class II Ordnance General Supplies and Related Materiel for Shipment and Storage.	TB 9-299/1

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NG: None.
USAR: Units-Same as Active Army except allowance is one copy for each unit.
For explanation of abbreviations used, see AR 320-50.