DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-6675-200-10
TO 49A1-1-101

OPERATOR'S MANUAL

THEODOLITES

ML-47-C THROUGH ML-47-R
ML-247 AND ML-247-A AND
DOUBLE CENTER THEODOLITE
ML-474/GM

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

SEPTEMBER 1958

TM 11-6675-200-10
C 7

CHANGE
No. 7

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *17 December 1973*

Operator's Manual

THEODOLITES ML-47-C THROUGH ML-47-R, ML-247 AND ML-247-A, AND DOUBLE CENTER THEODOLITE ML-474/GM AND ML-474A/GM

TM 11–6675–200–10, 4 September 1958, is changed as follows:

Page 5. Paragraph *2d* is rescinded.
Add paragraph 2.1 after paragraph 2.

2.1. Reporting of Equipment Publication Improvements

The reporting 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 Publications), and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-S Fort Monmouth, NJ 07703.

Page 6, paragraph 5. Change heading "Table of Components" to read "Components and Dimensions.

Add paragraph 5.1 after paragraph 5.

5.1. Items Comprising an Operable Equipment

FSN	*Qty*	*Nomenclature, part No., and mfr code*	*Usable on code*	*Figure No.*
6660-498-9773		Theodolites, Double Center ML-474/GM and ML-474A/GM which includes: NOTE The part number is followed by the applicable 5-digit Federal supply code for manufacturers (FSCM) identified in SB 708-42 and used to identify manufacturer, distributor, or Government agency, etc. NOTE Dry batteries shown are used with the equipment but are not considered part of the equipment. They will not be preshipped automatically but are to be requisitioned in quantitied necessary for the particular ***or***ganization in accordance with SB 11–6. NOTE Number 1 in the usable on code column refers to components comprising an operable		

FSN	Qty	Nomenclature, PartNo., and mfr code	Usable on code	Figure No.
		ML-474/GM and number 2 refers to ML-474A/GM.		
6135-120-1020		Battery: BA-30	1,2	
6760-22%0178	1	Cap, Protective: SM–B-531735, 80063	1,2	1,4
6660-448-8296	1	Eyeshield: SM-B-531509, 80063	1,2	
6660-356-5228	1	Hood, Lens: SM-C-531790,80063	1,2	1
4930-277-1044	1	Oiler, Hand: SM-B-88257,80063	1,2	
6675-634-9312	2	Pin, Straight Headless: SC–B-88251, 80063	1,2	
5120-180-0571	1	Screwdriver: 5/32 in. wide tip, 1–1/2 in. long blade fed spec, GGG-S-121, type 1, class 5, style 2, MSS5120-9,81349	1,2	1
5120-232-9506	1	Wrench, Spanner: 7012-104,65263	1	
5120-908-3103	1	Wrench, Double Spanner: SM-B-531789,80063	2	
5120-627-3500	1	Wrench, SM-B-531791, 80063	2	

Page 32. Appendix III is superseded as follows:

APPENDIX III

BASIC ISSUE ITEMS LIST (BIIL) AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST (ITIAL)

Section 1. INTRODUCTION

A3-1. Scope

This appendix lists only basic issue items required by the crew/operator for installation, operation, and maintenance of Theodolites ML-474/GM and ML-474A/GM.

A3-2. General

This Basic Issue Items and Items Troop Installed or Authorized List 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 III. Not applicable.

A3-3. Explanation of Columns

The following provides an explanation of columns found in the tabular listings:

a. *Illustration.* This column is divided as follows :

(1) *Figure Number.* Indicates the figure number of the illustration in which the item is shown.

(2) *Item Number.* Not applicable.

b. Federal Stock Number, Indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. *Part Number.* Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements, to identify an item or range of items.

d. Federal Supply Code for Manufacturer (FSCM). The FSCM is a 5-digit numeric code used to identify the manufacturer, distributor, or Government agency, etc., and is identified in SB 708-42.

e. Description. Indicates the Federal item name and a minimum description required to identify the item.

f. Unit of Measure (U/M). Indicates the standard of basic quantity of the listed item as used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation, (e.g., ea, in., pr, etc.). When the unit of measure differs

from the unit of issue, the lowest unit of issue that will satisfy the required units of measure will be requisitioned.

g. Quantity furnished with Equipment (Basic Issue Items Only,). Indicates the quantity of the basic issue item furnished with the equipment,

A3-4. Special Information

Usable on codes are included in Column 5. Uncoded items are applicable to all models. Identification of the usable on codes are as follows:

Code	*Used on*
1	ML-474/GM
2	ML-474A/GM

Section II. BASIC ISSUE ITEMS LIST

(1) Illustration (A) Fig. No.	(1) Illustration (B) Item No.	(2) Federal stock number	(3) Part number	(4) FSCM	(5) Description Usable on code	(6) Unit of meas	(7) Qty furn with equip
1		6660-911-2302	SM-C-531787	80063	BASEBOARD ASSEMBLY, THEODOLITE: (POSITIONS THEODOLITE IN CARRYING CASE) 1,2	EA	1
1		6660–498-9772	SM-C-531782	80063	CASE, THEODOLITE CY-787A/U 1,2	EA	1
1		6675–356-5225	SC-B-88249	80063	HOOD, CANVAS 1,2	EA	1

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
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Chief of Staff

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

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Active Army:

USASA (2)
CNGB (1)
ACSC (2)
Dir of Trans (1)
COE (1)
TSG (1)
USAARENBD (1)
USAMB (10)
AMC (1)
TRADOC (2)
ARADCOM (2)
ARADCOM Rgn (2)
OS Maj Cored (4
LOGCOMDS (3)
MICOM (2)
TECOM (2)
USACC (4)
MDW (1)
Armies (2)
Corps (2)
HISA (ECOM) (21)
Svc Colleges (1)
USASESS (5)
USAADS (2)
USAFAS (10)
USAARMS (10)
USAIS (10)
USAES (2)
USAINTS (3)
WRAMC (1)
USACDCEC (10)
ATS (1)
Instl (2) except
Fort Gordon (10)
Fort Huachuca (10)
Fort Carson (5)
Ft Richardson (ECOM Oft) (2)
WSMR (1)

Army Dep (2) except
LBAD (14)
SAAD (30)
TOAD (14)
ATAD (10)
USA Dep (2)
Sig Sec USA Dep (2)
Sig Dep (2)
Sig FLDMS (1)
USAERDAA (1)
USAERDAW (1)
MAAG (1)
USARMIS (1)
Units org under fol TOE:
(1 copy each)

6-100 11-97
6-185 11-98
6-186 11-117
6-200 11-158
6-201 11-500 (AA-AC)
6-300 17
6-302 17–1 00
6-525 29-134
6–526 29-136
6-575 37
6–577 37-100
6-700 39-51
6-701 57
7
7-100

NG: None.

USAR: None

For explanation of abbreviations used, see AR 310-50.

TM 11-6675-200-1O
*C 6

CHANGE
No. 6

HEADQUARTERS
DEPARTMENT OF THE ARMY
*WASHINGTON, D. C., 21 September **1970***

Operator's Manual

THEODOLITES ML-47–C THROUGH ML–47–R, ML–247 AND ML–247–A, AND DOUBLE CENTER THEODOLITE ML–474/GM AND ML–474A/GM

TM 11–6675–200–10, 4 September 1958, is changed as follows:

NOTE

The parenthetical reference to a previous change (example: page 1 of C 4) indicates that pertinent material was published in that change.

Page 5, paragraph 1.1 (page 1 of C 4). Delete paragraph 1.1 and substitute:

1.1. Indexes of Equipment Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

Paragraph 2 (page 1 of C 4). Delete paragraph 2 and substitute:

2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions given in TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packaging and Handling Deficiencies) as prescribed in AR 7000-58 (Army), NAVSUP PUB 378 (Navy) AFR 71-4 (Air Force) and MCO P4030.29 (Marine Corps).

c. Discrepancy in Shipment Report (DISREP) SF361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF361) as prescribed in AR 55-38 (Army) NAVSUP PUB 459 (Navy)/ AFM 75-34 (Air Force) and MCO P461O.19 (Marine Corps).

d. Reporting of Equipment Publication Improvements. The reporting 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 Publications) and forwarded direct to Commanding General, U.S. Army Electronics Command, ATTN: AMSEL -ME-NMP-EM, Fort Monmouth, N. J., 07703.

Page 31, appendix I (page 3 of C 4). Add the following reference. DA Pam 310-7 U.S. Army Equipment Index of Modification Work Orders

Page 32, appendix III (page 1 of C 5).

Delete appendix III and substitute:

APPENDIX III
BASIC ISSUE ITEMS LIST
Section 1. INTRODUCTION

A3-1, Scope

This appendix lists items which accompany the ML-474/GM and ML-474A GM or are required for installation operation, or operator's maintenance.

A3–2. General

This Basic Issue Items List is divided into the following sections:

a. Basic Issue Items-Section II. A list of items which accompany the ML–474/GM and ML-474A/GM and are required by the operator crew

*This change supersedes C 5, 2 November 1966.

for installation, operation, or maintenance.

b. Maintenance and Operating Supplies-Section III. Not Applicable.

A3–3. Explanation of Columns

The following provides an explanation of columns in the tabular list of Basic Issue Items, Section II.

a. Source, Maintenance, and Recoverability Codes (SMR), Column 1.

(1) Source code indicates the selection status and source for the listed item. Source codes are—

Code	*Explaination*
P	—Repair parts which are stocked in or supplied from the GSA DSA, or Army supply system, and authorized for use at indicated maintenance categories.
P2	– Repair parts which are procured and stocked for insurance purposes because the combat or military essentiality of the end item dictates that a minimum quantity be available in the supply system.
P9	—Assigned to items which are NSA design controlled: unique repair parts, special tools, test, measuring and diagnostic equipment, which are stocked and supplied by the Army COMSEC logistic system, and which are not subject to the provisions of AR 380--41.
P10	— Assigned to items which are NSA design controlled: special tools, test, measuring and diagnostic equipment for COMSEC support, which are accountable under the provisions of AR 380-41, and which are stocked and supplied by the Army COMSEC logistic system.
M	Repair parts which are not procured or stocked, but are to be manufactured in indicated maintenance levels.
A	---Assemblies which are not procured or stocked as such, but are made up of two or more units. Such component units carry individual stock numbers and descriptions, are procured and stocked separately, and can be assembled to form the required assembly at indicated maintenance categories.
X	– Parts and assemblies which are not procured or stocked and the mortality of which normally is below that of the applicable end item or component. The failure of such part or assembly should result in retirement of the end item from the supply system.

Code	*Explanation*
Xl	—Repair parts which are not procured or stocked. The requirement for such items will be filled by use of the next higher assembly or component.
X2	—Repair parts which are not stocked. The indicated maintenance category requiring such repair parts will attempt to obtain same through cannibalization. Where such repair parts are not obtainable through cannibalization, requirements w-ill be requisitioned with accompanying justification, through normal supply channels.
C	—Repair parts authorized for local procurement. Where such repair parts are not obtainable from local procurement, requirements will be requisitioned through normal supply channels accompanied by a supporting statement of nonavailability from local procurement.
G	-- Major assemblies that are procured with PEMA funds for initial issue only as exchange assemblies at DSU and GSU level. These assemblies will not be stocked above DS and GS level or returned to depot supply level.

(2) Maintenance code indicates the lowest category of maintenance authorized to install the listed item. The maintenance level codes are --

Code	*Explanation*
C.	Operator crew
O.	Organizational maintenance

(3) Recoverability code indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are expendable. Recoverability codes are—-

Code	*Explanation*
R	---Repair parts and assemblies that are economically reapairble at DSU and GSU activities and are normally furnished by supply on an exchange basis.
S	—Repair parts and assemblies which are economically repairable at DSU and GSU activities and which normally are furnished by supply on an exchange basis. When items are determined by a GSU to be uneconomically repairable, they will be evacuated to a depot for evaluation and analysis before final disposition.

code	*Explanation*
T	—High dollar value recoverable repair parts which are subject to special handling and are issued on an exchange basis. Such repair parts normally are repaired or overhauled at depot maintenance activities.
U	—Repair parts specifically selected for salvage by reclamation units because of precious metal content, critical materials, or high dollar value reusable casings or castings.

b. Federal Stock Number, Column 2. This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. *Description), Column 3.* This column indicates the Federal item name and any additional description of the item required. A part number or other reference number is followed by the applicable five-digit Federal supply code for manufacturers in parentheses.

d. Unit of Measure (U/M), Column 4. A 2-character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based; e.g., ft, ea, pr, etc.

e. Quantity Incorporated in Unit, column 5. This column indicates the quantity of the item used in the ML-474/GM and ML-474A/GM.

j. Quantity Furnished With Equipment, Column 6. This column indicates the quantity of an item furnished with the equipment.

g. Illustration, Column 7. Not Applicable.

A3-4. Explanation of Columns in the Tabular List of Maintenance and Operating Supplies — Section III

Not Applicable.

A3-5. Special Information

a. Identification of the usable on codes in this appendix are-

Code	*Used On*
1	ML-474/GM
2	ML-474A/GM

b. Dry batteries shown are used with the equipment but are not considered part of the equipment. They will not be preshipped automatically but are to be requisitioned in quantities necessary for the particular organization, in accordance with SB 11-6.

A3–6. Federal Supply Codes for Manufacturers

Code	*Manufacture*
80063	Army Electronics Command
81349	Military Specifications

SECTION II. BASIC ISSUE ITEMS

(1) SMR CODE	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION Reference Number & Mfr Code	USABLE ON CODE	(4) UNIT OF MEAS			(7) ILLUSTRATIONS (b) ITEM NO. OR REFERENCE DESIGNATION
	[illegible]	THEODOLITE, DOUBLE CENTER ML-474/M AND ML-474A/GM: (This item is nonexpendable) TM1-6675-200-12 For technical manuals the quantity indicates the maximum number of copies authorized for packing (or issue) with the equipment. Where a number of these equipments are concentrated in a small area, the quantity on hand may be reduced to the minimum actual requirements as determined by the commanding officer of the unit.		EA			
-C	66-[illegible]	BASEBOARD ASSEMBLY, THEODOLITE: (Positions theodolite in carrying case) SM-C-[illegible]787 (80063)	1,2	EA			
-C	6135-[illegible]	BATTERY BA-30	1,2				
-C	76[illegible]	CAP, PROTECTIVE: SM-B-[illegible] (80063)	1,2	EA			
C-K	6665-[illegible]	CASE, THEODOLITE CY-76/A/G: SM-C-[illegible]762 (80063) (This item is nonexpendable)	1,2	EA			
C	5975-[illegible]	HOOD, CANVAS: SC-B-[illegible] (80063)	1,2	EA			
C	5[illegible]	EYESHIELD: SM-B-[illegible] (80063)	1,2	EA			
C	5[illegible]	HOOD, LENS: SM-C-[illegible] (80063)	1,2	EA			
C	6[illegible]	LAMP: 2.5V; 0.3 amp; SM-C-[illegible] (80063)		EA			
		"ACCESSORIES, TOOLS, AND TEST EQUIPMENT"					
	[illegible]	FILER, HAND: SM-B-[illegible] (80063) (This item is nonexpendable)	1,2	EA			
	7520-[illegible]	PEN, STRAIGHT HEADLESS: C-B-[illegible] (80063)	1,2	EA			
	[illegible]	SCREWDRIVER: 5/32 in wide tip; 4 1/2 in long blade; ea spec GGG-S-121; type 1; class 2, style 2; MS[illegible] (81349) (This item is nonexpendable)	1,2	EA			
	[illegible]	BENCH, SHANNEN: [illegible] (80063)	1	EA			
	[illegible]	BENCH, DOUBLE SHANNEN: SM-B-[illegible] (80063) (This item is nonexpendable)	2	EA			
	[illegible]	BENCH: SM- B-[illegible] (8[illegible]	2	EA			

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

Official:

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

Distribution:

Active Army:
- USASA (2)
- CNGB (1)
- ACSC-E (2)
- Dir of Trans (1)
- TSG (1)
- CofEngrs (1)
- CofSpts (1)
- USAARENBD (2)
- USACDCED (10)
- USACDC Agcy (1)
- USAMC (1)
- USAMICOM (4)
- USASTRATCOM (4)
- USATECOM (2)
- USCONARC (5)
- ARADCOM (5)
- ARADCOM Rgn (2)
- OS Maj Comd (4)
- LOGCOMD (2) except
  - 1st LOGOMD (10)
  - 9th LOGCOMD (10)
- MDW (1)
- Armies (2)
- Corps (2)
- 1st Cav Div (5)
- Instl (2) except
  - Ft Carson (23)
  - Ft Knox (12)
  - Ft Gordon (10)
  - Ft Huachuca (10)
  - WSMR (5)
- Svc Colleges (2)
- USASCS (10)
- USASESS (10)
- USAF.AS (10)
- USAARMS (10)
- USAIS (10)
- USAINTS (3)
- USAADS (2)
- USAES (2)
- USATC Armor (2)
- USATC Inf (2)
- USASTC (2)
- USATOPOCOM (1)
- Army Dep (2) except
  - SAAD (30)
  - LBAD (14)
  - TOAD (14)
  - ATAD (10)
  - LEAD (7)
  - NAAD (5)
  - SVAD (5)
  - CHAD (3)
  - SHAD (3)
- Gen Dep (2)
- Sig See, Gen Dep (5)
- Sig Dep (12)
- DPG (5)
- MAAG (1)
- USARMIS (1)
- WRAMC (1)
- USAERDAA (2)
- USAERDAW (13)
- USACRREL (2)
- Sig FLDMS (2)
- Units org under fol TOE (2 ea.):
  - 6-100
  - 6-185
  - 6-186
  - 6-200
  - 6-201
  - 6-300
  - 6-302
  - 6-385
  - 6-386
  - 6-525
  - 6-526
  - 6-575
  - 6-576
  - 6-577
  - 6-700
  - 6-701
  - 7
  - 7-100
  - 11-97
  - 11-98
  - 11-117
  - 11-1.58
  - 11-500(AA-AC)
  - 17
  - 17-100
  - 37
  - 37-100
  - 39-51
  - 57

ARNG: Nine

USAR: None.

For explanation of abbreviations used, see AR 310-50.

☆U.S. GOVERNMENT PRINTING OFFICE 1970-431-122/307

TM 11-6675-200-10
C4

CHANGE
No. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON. D C., 27 January1966

Operator's Manual

THEODOLITES ML-47-C THROUGH ML-47-R, ML-247, AND ML-247-A, AND DOUBLE CENTER THEODOLITE ML-474/GM, AND ML-474A/GM

TM 11–6675–200–10, 4 September 1958, is changed as follows:

The title is changed as shown above.

Page 5, paragraph lc, last line as changed by C 3, 13 Aug 63). Delete TM 11–6675-200 and substitute TM 11–6675-200–20.

Add paragraph 1.1 after paragraph 1 (as added by C 3, 13 Aug 63).

1.1 Index of Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to this equipment. DA Pam 310-4 is an index of current technical manuals, technical bulletins, supply bulletins, lubrication orders, and modification work orders that are available through publications supply channels. The index lists the individual parts (–10, –20, –35P, etc.) and the latest changes to and revisions of each equipment publication.

Delete paragraph 2 (as changed by C 3, 13 Aug 63) and substitute:

2. Forms and Records

a. Reports of Maintenance and Unrsatisfactory Equipment. Use equipment forms arid records in accordance with instructions in TM 38-750.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700–58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

c. Report of Errors, Omissions, and Recommendations. The direct reporting of errors, omissions, and recommendations for improving this manual by the individual user, is authorized and encouraged. DA Form 2028 (Recommended Changes to DA Publications) will be used for reporting these improvements: This form will be completed using pencil, pen, or typewriter and forwarded direct to Commanding General, U. S. Army Electronics Command, ATTN: AMSEL-MR-(NMP)-MA, Fort Monmouth, N. J. 07703.

Page 26, chapter 4 (as changed by C 3, 13 Aug 63). Delete the heading and substitute:

MAINTENANCE INSTRUCTIONS.

Delete paragraphs 32 through 34 and substitute:

32. Scope of Operator's Maintenance

The maintenance duties assigned to the operator of the theodolite set are listed below, together with a reference to the paragraphs covering the specific maintenance functions. The duties assigned do not require tools other than those issued with the equipment.

a. Daily preventive maintenance checks and services (para 34.2).

* This change supersedes C 2, 4 November 1959, and C3, 13 August 1963.

b. Weekly preventive maintenance checks and services (para *34.3).*

c. Cleaning (para *34.4).*

d. Lubrication (para 35).

e. Equipment performance checklist (para 36).

f. Replacement of batteries and lamps (para 37).

33. Tools and Materials Required for Maintenance

a. Tools. Only the tools supplied with the equipment are required.

b. Materials.

(1) Camel's-hair brush.
(2) Lint free cloth.
(3) Lens tissue.
(4) Lens cleaner.
(5) Lubricating oil, general purpose, preservative (PL special), *4* oz can/ spout.
(6) Lubricating oil, watch (OCW), 5 cc bottle/fine dropper.
(7) Cleaning compound, liquid form (Federal stock No. *7930–395–9542).*

34. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

a. Systematic Care. The procedures given in paragraphs 34.2 through 34.4 cover systematic care essential to proper upkeep and operation of the equipment. The cleaning operations (para 34.4) should be performed once a day. If the equipment is not used daily, however, the cleaning operations must be performed before operation after any extended shutdown, or once a week while the equipment is kept in *standby* condition. The other items must be checked before the equipment is placed in operation after a shutdown, during operation, or after it is turned off, as specified in the applicable paragraph.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and services charts (paras 34.2 and 34.3) outline functions to be performed at specific intervals. These checks and services are to maintain Army electronic equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and what the normal conditions are; the *References* column lists the illustrations, paragraphs, or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by the operator, higher level maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

Add paragraphs 34.1 through 34.4 after paragraph 34.

34.1 Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of the theodolite set are required on a daily and weekly basis. Paragraph 34.2 specifies checks and services that must be performed daily and paragraph 34.3 specifies checks and services that must be accomplished on a weekly basis.

34.2 Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	Reference
1	Exterior surfaces	Clean the carrying case, theodolite, and baseplate (fig. 1).	Para 34.4.
2	Moving parts	Inspect all moving parts for smooth operation.	
3	Batteries	Inspect batteries for leakage or bulging .	Replace batteries (para 37a).
4	Lamps	Check for broken, missing, or defective lamps.	Replace lamps (para 37 b).

34.3 Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	Reference
1	Exterior surfaces ----------	Inspect exposed metal surfaces for rust and corrosion.	Para 34.4.
2	Canvas cover ----------	Inspect cover (fig. 1) for fungus, fraying, and tears.	
3	Carrying case ----------	Inspect handle, latches, and hinges for looseness.	
4	Hardware ----------	Check for worn, loose, or missing parts and screws; tighten all loose screws except the adjustment screws.	
5	Lubrication ----------	Lubricate the equipment (para 35 and fig. 4).	
6	Operational check ----------	Perform equipment performance checklist (para 36); be alert for any unusual operating conditions.	Para 36.

34.4 Cleaning

a. Carefully remove all dust, dirt, and foreign matter from the exposed optical surfaces of the lenses; use a camel's-hair brush, or a gentle blast of moisture free compressed air.

Caution: Do not use lens tissue that contains silicone to clean optical surfaces. Any residue deposit that would be left on the optical surfaces by this kind of lens tissue could affect the performance of the optical parts.

b. Slightly dampen a wad of lens tissue with lens cleaner.

c. Gently wipe the exposed optical surfaces of the theodolite set with the moistened lens tissue; use a circular motion starting from the edge of the glass and work toward the center.

d. Dry the cleaned optical surfaces with a fresh lens tissue; use the same circular motion described in *c* above.

e. Clean all exposed metal parts of the theodolite set with a dry, lint free cloth.

f. Use a camel's-hair brush to remove dust and foreign matter from hard-to-reach parts on the equipment.

Warning: Cleaning compound is flammable and its fumes toxic. Provide adequate ventilation; do not use near a flame.

Caution: Do not allow cleaning compound to come in contact with optical or lubricated surfaces. Use cleaning compound sparingly.

g. If foreign matter cannot be removed from the mechanical parts of the equipment by normal wiping, use a clean, lint free cloth moistened with cleaning compound to remove stubborn grime. Wipe the cleaned parts dry with a clean, lint free cloth immediately after cleaning.

Page 27, paragraph 36 (as changed by C 3, 13 Aug 63), chart, "Corrective measures" column. Make the following changes:

Line 4, change (para 34f) to (para 34.4).

Line 10, change (para 34f) to (para 34.4).

Page 31, appendix I (as changed by C 3, 13 Aug 63). Add the following references:

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders
TB SIG 364	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 38-750	Army Equipment Record Procedures.

Delete TM 11–2426 Meteorological Station AN/TMQ4 and substitute:

TM 11-6660-218-15	Operator's Organizational, Field, and Depot Maintenance Manual for Meteorological Station AN/TMQ4

Page 32. Delete appendix III (as changed by C 2,4 Nov 59) and substitute:

APPENDIX III
BASIC ISSUE ITEMS

Section 1. INTRODUCTION

1. General

a. This appendix lists items supplied for initial operation and for running spares. The list includes tools, parts, and material issued as part of the major end item. The list includes all items authorized for basic operator maintenance of the equipment. End items of equipment are issued on the basis of allowances prescribed in equipment authorization tables and other documents that are a basis for requisitioning.

b. Columns areas follows:

(1) *Federal stock number.* This column lists the n-digit Federal stock number.

(2) *Designation by model.* The dagger (t) indicates the equipment and/or model in which the part is used.

(3) *Description.* Nomenclature or the standard item name and brief identifying data for each item are listed in this column. When requisitioning, enter the nomenclature and description.

(4) *Unit of issue.* The unit of issue is each unless otherwise indicated and is the supply term by which the individual item is counted for procurement, storage, requisitioning, allowances, and issue purposes.

(5) *Expendability.* Nonexpendable items are indicated by NX. Expendable items are not annotated.

(6) *Quantity authorized.* Under "Items Comprising an Operable Equipment", the column lists the quantity of items supplied for the initial operation of the equipment. Under "Running Spare Items" the quantities listed are those issued initially with the equipment as spare parts. The quantities are authorized to be kept on hand by the operator for maintenance of the equipment.

(7) *Illustration.* The "Item No." column lists the reference designations that appear on the part in the equipment. These same designations are also used on any illustrations of the equipment. – The numbers in the "Figure No." column refer to the illustrations where the part is shown.

2. Batteries

Dry batteries shown are used with the equipment but are not considered part of the equipment. They will not be preshipped automatically but are to be requisitioned in quantities necessary for the particular organization, in accordance with SB 11–6.

Section II. FUNCTIONAL PARTS LIST (THEODOLITE, DOUBLE CENTER ML–474/GM; ML–474A/GM THEODOLITE ML–247; ML–247A)

FEDERAL STOCK NUMBER	DESIGNATION BY MODEL				DESCRIPTION	UNIT OF ISSUE	EXP	QTY AUTH	ILLUSTRATION	
									FIGURE NO.	ITEM NO.
6660-498-9773					THEODOLITE, DOUBLE CENTER ML-474/GM; ML-474A/GM; THEODOLITE ML-247; ML-247A:		NX			
					NOTE: Model column 1 refers to ML-247; column 2 refers to ML-247-A; column 3 refers to ML-474/GM; column 4 refers to ML-474A/GM					
					ITEMS COMPRISING AN OPERABLE EQUIPMENT					
ORD THRU AGC					TECHNICAL MANUAL TM 11-6675-200-10			2		
6675-219-7206	†	†	†	†	BASE PLATE, THEODOLITE: positions theodolite in carrying case ECOM Dwg. SM-C-531788 (Mounted in equip)			1		
6135-120-1020	†	†	†	†	BATTERY BA-30: (Not installed) (Not mounted)					BT1,BT2
6760-222-0178	†	†	†	†	CAP, LENS: used as dust cover; Warren Knight #6061-20 ECOM Dwg SCB-52304 or SM-B-531735 (Not installed) (Not mounted)			1	4	MP3
6660-498-9772	†	†	†	†	CASE CY-787/U; CY-787A/U: equip carrying case; (Not installed) (Not mounted)		NX	1		
6675-356-5225	†	†	†	†	COVER: dust, canvas; ECOM Dwg SM-B-531785 (Not installed) (Not mounted)			1		
6660-448-8296	†	†	†	†	GUARD, EYEPIECE: black rubber; white D #6061-73 (Installed in equip)			1		MP5
6660-356-5228	†	†	†	†	HOOD, LENS: brass, white D #6061-92 (Mounted in equip)			1		MP23
6240-797-2650	†	†	†	†	LAMP, INCANDESCENT LM-19: 2.5 v, 0.3 amp (Installed in equip)			3		DSS1, DSS2, DSS3
4930-536-3481	†	†	†	†	OILER, HAND: 2.5 cc; white D #10280 (Mounted in equip)		NX	1		
6675-634-9312		†	†	†	PIN, STRAIGHT HEADLESS: adjustment pin; white D #10260 (Mounted in equip)			2		MP101
6675-234-7048	†				PIN, STRAIGHT; HEADLESS: adjustment pin; white D #7012-101-A (Mounted in equip)			2		MP101
5120-180-0571	†	†	†	†	SCREWDRIVER: 5/32 in w tip; 1-1/2 in lg blade; Fed Spec GGG-S-121, type 1, class 5, style 2		NX	1		

SECTION II. BASIC ISSUE ITEMS

(1) SMR CODE	(2) FEDERAL STOCK NUMBER	(3) DESCRIPTION Reference Number & Mfr Code	USABLE ON CODE	T AS	) CY NC N IT	)) P I	ILLUSTRATIONS) S. .	(b) ITEN NO. 017 REFERENCE DESIGNATION
	6660-498-9773	THEODOLI TES, DOUBLE CENTER ML-474/GM AND ML-474A/GM: (l'his item is nonexpendable)						
		TM 11-6675 -2s0-10		A				
		For technical manuals the quantity indicates the maximum number of copies authorized for packing (or issue) with the equipment. Where a number of these equipments are concentrated in a small area, the quantity on hand may be reduced to the minimum actual requirements as determined by the commanding officer of the unit.						
	50-911-230(	BASEBOARD ASSEMBLY, THEODOLITE: (Positions theodolite in carrying case) SM-C-531787 (80063)	1,2	A	L			
	35-120-1021	BATTERY BA-30	1,2					
	60-222-017	CAP, PROTECTIVE: SM-B-531735 (80063)	1,2	A	L	L		
)-R	60-4%-977	CASE , THEODOLI TE CY-787A/U : SM-C-531782 (80063) (This item is nonexpendable)	1,2	A	1	L		
	75-356-522	HOOD, CANVAS: SC-B-88249 (80063)	1,2	A	1	1		
	60-448-829	EYESHIELD: SM-B-531509 (80063)	1,2	A	1	1		
	60-356-522	HOOD, LENS: SM-C-531790 (80063)	1,2	A	1	1		
)	40-797-265	LAMP: 2.5V; 0.3 amp; SM-C-5317844 **(80063)**	1,2	A	3			
		"ACCESSORIES, TOOLS, AND TEST EQUIPMENT"						
c	13W277-104	OILER, HAND: SM-B-88257 (80363) (This item is nonexpendable)	1,2	A	1	1		
C	,75-634-931	PIN, STRAIGHT HEADLESS: SC-B-88251 (80063)	1,2	A	2			
c	.20-180-057	SCREWDRIVER: 5/32 in wide tie; 1 1/2 in long blade; fed spec ~-s-121; type 1; class 5, style 2; MSS5120-9 (81349) (This item is nonexpendable)	1,2	A	1			
c	.20-232-95(	WRENCH, SPANNER: 7012-104 (65263)	1	A	1			
c	123-938-31(	WRENCH, DOUBLE SPANNER: SM-B-531789 (80063) (This item is nonexpendable)	2	A	1			
c	120-627-3500	WRENCH: SM-B-531791 (80063)	2	A	1			

By Order of the Secretary of the Army:

HAROLD K. JOHNSON,
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Chief of Staff.

Official:

J. C. LAMBERT,
Major *General, United, States A Army,*
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USATC Inf (2)
WRAMC (1)
Army Pic Cen (2)
APG (5)
DPG (5)
YPG (5)
Sig Fld Maint Shops (2)
AMS (1)
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11-500 (AA-AC)
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NG: None.

USAR: None

For explanation of abbreviations used, see AR 320-50.

☆ U.S. Government Printing Office: 1966—200-508/6317A

TECHNICAL MANUAL
No. 11–6675–200–10
TECHNICAL ORDER
No. 49A1-1–101

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE

WASHINGTON 25, D. C., *4 September 1958*

THEODOLITES ML-47-C THROUGH ML-47-R ML-247 AND ML-247-A AND DOUBLE CENTER THEODOLITE ML-474/GM

• This manual supersedes so much of TM 11–423, 7 October 1944, including C 1, 4 January 1954, C 2, 15 May 1954, and C 3, 5 April 1956, as pertains to operating instructions.

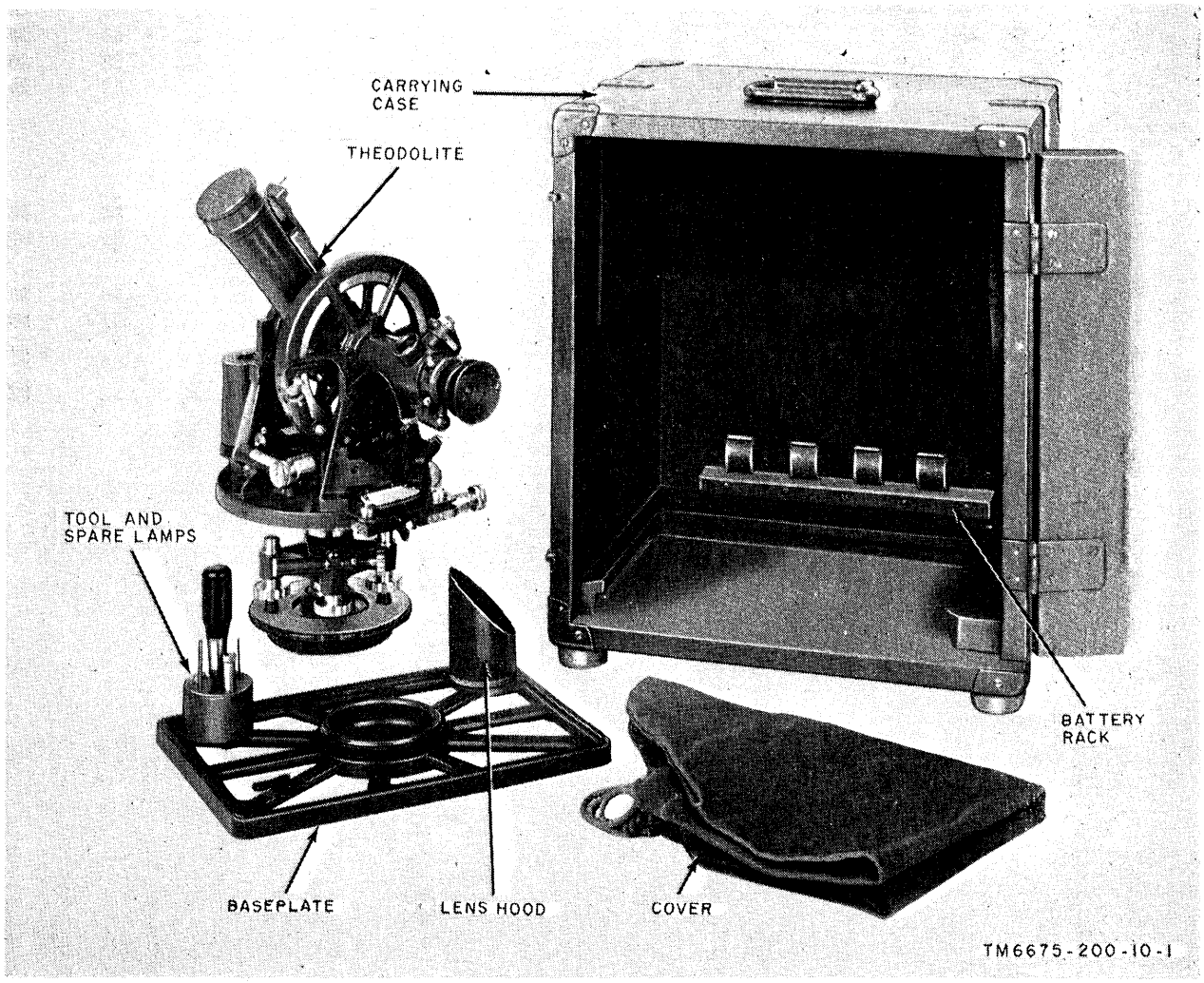

Figure 1. Double Center Theodolite ML-474/GM

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope
(fig. 1)

a. This manual describes Theodolites ML-47– (*) and ML-247-(*) and Double Center Theodolite ML-474/GM and covers their installation, operation, and operator's maintenance. It includes operation under usual and unusual conditions, cleaning and inspection of the equipment, and replacement of parts available to first echelon maintenance.

b. Official nomenclature followed by (*) is used to indicate all models of an item equipment covered in this manual. Thus, Theodolites ML-47-(*) represents Theodolites ML-47-C, through ML-47-R. Theodolite ML-247– (*) represents Theodolites ML-247 and ML-247-A.

c. The Maintenance Allocation Charts are published in TM 11–6675–200.

2. Forms and Records

a. Unsatisfactory Equipment Reports.

(1) Fill out and forward DA Form 468 (Unsatisfactory Equipment Report) to the Commanding Officer, U. S. Army Equipment Support Agency, Fort Monmouth, N. J., as prescribed in AR 700–38.

(2) Fill out and forward AF TO Form 29 (Unsatisfactory Report) to the Commander, Air Materiel Command, Wright-Patterson Air Force Base, Ohio, as prescribed in AF TO 00-35D-54.

b. Report of Damaged or improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700–58 (Army) and AFR 71–4 (Air Force).

c. Parts List Form. Forward DA Form 2028 (Recommended Changes to DA Technical Manual Parts Lists or Supply Manuals 7, 8, and 9) directly to the Commanding Officer, U. S. Army Signal Equipment Support Agency, Fort Monmouth, N. J.,

d. Comments on Manual. Forward all other comments on this publication directly to the Commanding Officer, U. S. Army Signal Publications Agency, Fort Monmouth, N. J.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

The theodolite set (fig. 1) provides a weather station operator with azimuth and elevation measurements of an object in space. It is used primarily to follow and measure the movement of pilot balloons.

4. Technical Characteristics

Tracking telescope:
- Magnification . . . . . .19 to 24 power.[1]
- Angle of view . . . . . .2.1° to 1.7°
- Optical system . . . . . Right-angle, using prism.

Finder telescope:
- Magnification . . . . . .3.75 to 5 power.[1]
- Angle of view. . . . . .4.3° to 3.2°.
- Optical system. . . . . Right-angle, using mirror.

Azimuth scale:
- Range . . . . . .360°.
- Calibration . . . . . .1°.

Elevation scale:
- Range. . . . .240°.
- Calibration . . . . . .1°.

Power requirements., ... 3 volts dc (two 1½-volt batteries).

1 The magnification of the tracking telescope and the finder telescope is a fixed characteristic.

5. Table of Components

The components of Double-Center Theodolite ML–474/GM and Theodolites ML-247–(*) and ML-47– (*) are listed below.

Quantity	Item	Dimensions (in.)	Unit weight
1	Theodolite, including:	15¼ x 12¾ x 11	19 lb 10 oz
	2 lamp shades.	1 1/16 x ½	
	3 Lamps LM–19.		
	1 lens hood.	231/32 X 2	
	1 lens cap.	11/16 X 2 3/32	
1	Base plate.	11 X 7 21/32	2 lb
1 set	Tools, including:		
	1 spanner wrench.	13/16 X 19/32 X 5/32	
	1 hand oiler.	2X3/8	
	1 screwdriver TL-22.	1½ X 4¼ X 3/16 X 1/32	
	1 adjusting pin.	2½ x .097	
1	Cover	21¾ X 17½ X 3/16	9 Oz
1	Carrying case.	17 x 14¾ x 11¾	19 lb 9 Oz
3	Lamps LM-19 (running spares).		

6. Common Names

Nomanclature	Common name
Theodolite MP47–(*), Theodolite ML-247-(*), and Double Center Theodolite, ML-474/GM.	Theodolite set
Tripod ML-78-(*) or Surveying Tripod Mount 1309/GM.	Tripod
Compass ML-197	Compass
Telescope ML-146	Finder telescope
Main theodolite telescope	Tracking telescope

7. Description

The theodolite set (fig. 1) consists principally of the theodolite, base plate, and carrying case.

a. The theodolite (fig. 2) consists of a dual telescope, an azimuth and elevation mounting, and a leveling assembly. The operating controls are located on the telescope, the azimuth mounting, and the elevation mounting. The orientation controls are located on the leveling assembly. The battery compartment is located on the azimuth and elevation mounting.

b. The base plate secures the theodolite in the carrying case. Two wooden blocks, mounted on the base plate, hold tools, spare lamps, and the lens hood.

c. The carrying case is made of wood and has a hinged, door and an interior rack for holding spare Batteries BA–30.

8. Additional Equipment Required

a. Surveying Tripod Mount MT–1309/GM or Tripod ML-78– (*) is used to support the theodolite during operation.

b. Timing and Telephone Set ML-11O (TM 11–334) is required to furnish timing signals to the theodolite operator and intercom between the theodolite operator and the recorder.

c. Plumb-bob, Federal stock No. 5210-238-3298 enables the theodolite to be exactly positioned over an observation point.

d. Four Batteries BA–30 (two for running spares) are required for night operation.

9. Differences in Models

All models of the theodolite are similar in size, shape, and general appearance. The differences among the models discussed in this manual are given in the chart below.

Item	ML-47-(*) or ML-247-(*)	ML-474/GM
Cross hair lamp switch	Turns cross hair lamp on and off.	Not used
Brightness control.	Controls Brightness of Cross hair lamp.	Turns cross hair lamp on and off and also controls its brightness.

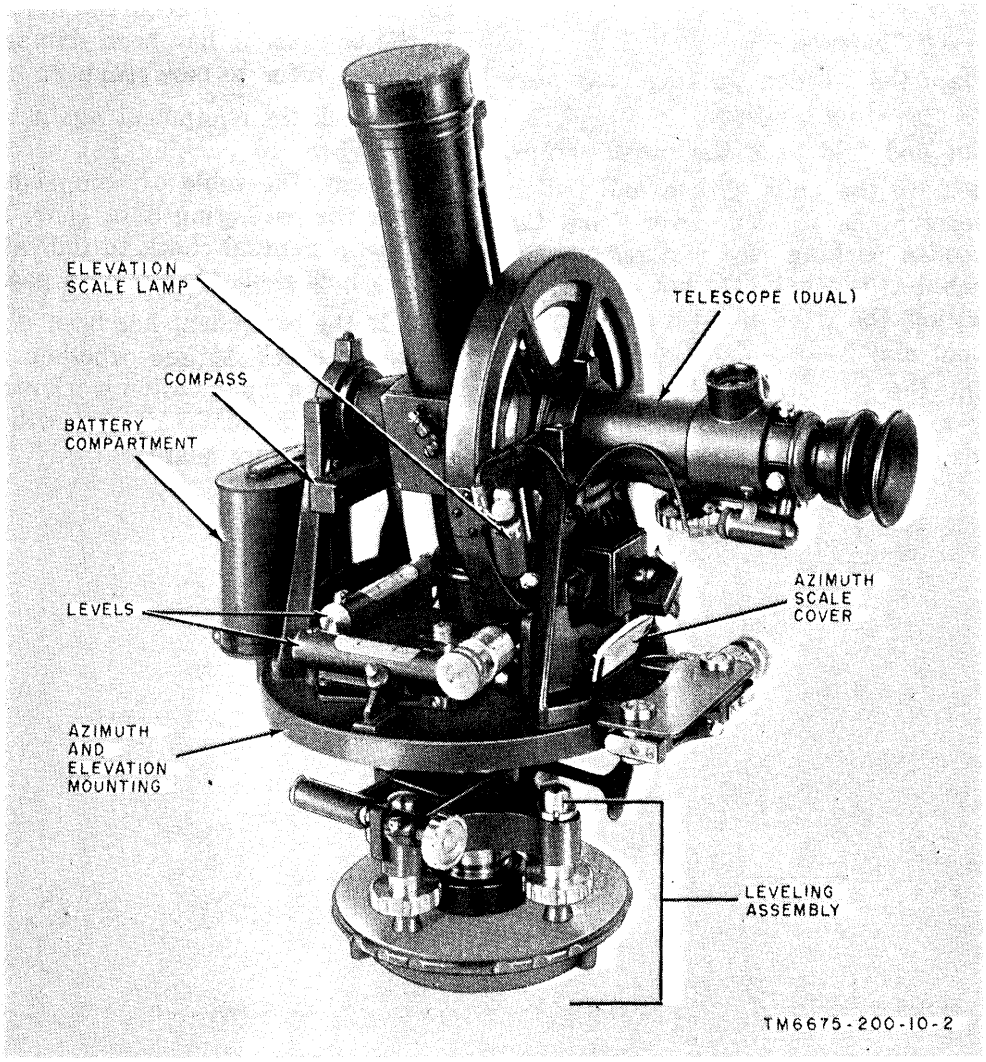

Figure 2. Theodolite, view of telescope, azimuth and elevation mounting, and leveling assembly.

CHAPTER 2

SERVICE UPON RECEIPT OF EQUIPMENT

10. Unpacking

a. Packaging Data. When packaged for shipment, the theodolite set is placed in a wooden box which is 20 inches by 16¼ inches by 13¼ inches. The volume is 2.5 cubic feet and the total weight is 85 pounds.

b. Removing Contents.

(1) Place the wooden packing case near the operating position.

(2) Cut and fold back the metal straps.

(3) Remove the nails with a nail puller. Remove the wooden cover from the wooden packing case and remove the technical manual. Do not attempt to pry off the wooden cover; the equipment may become damaged.

(4) Slit the pressure-sensitive tape and open the water-resistant fiberboard box.

(5) Remove the fiberboard pads and the theodolite set.

11. Checking Unpacked Equipment

a. Inspect the equipment for any loss or damage that might have occurred during shipment. If the equipment has been damaged or is incomplete, refer to paragraph 2.

b. Check the equipment against the packing list. When no packing list accompanies the equipment, the table of components (par. 5) and/or the packaging data (par. 10a) may be used as a general check to indicate the equipment which *probably* has been packed.

c. If the equipment has been used or reconditioned, check to see whether it has been changed by a modification work order (MWO). If modified, the MWO number will appear near the nomenclature plate.

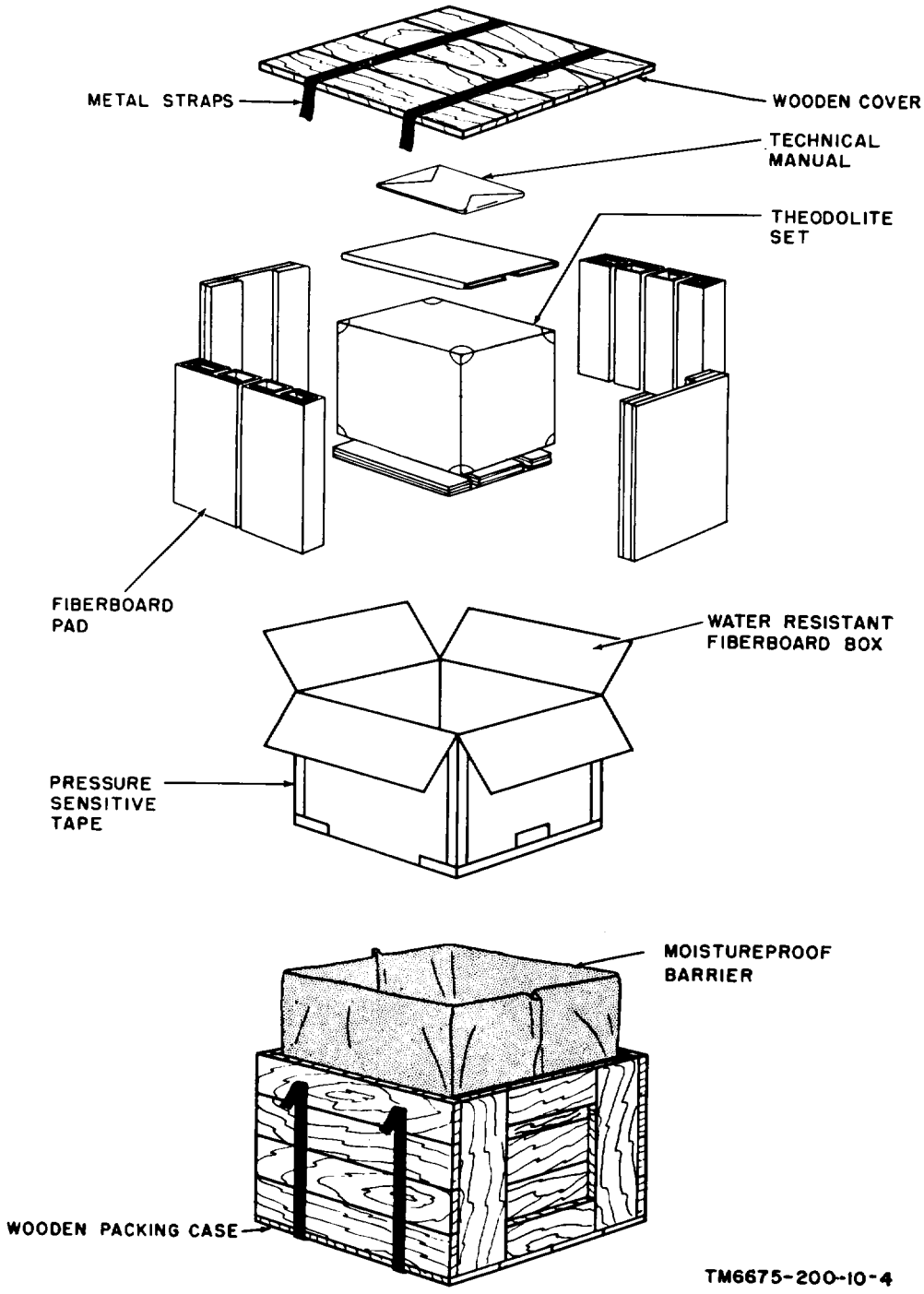

Figure 3. Packaging and packing diagram.

CHAPTER 3

OPERATION

Section 1. CONTROLS, SCALES, AND INDICATORS

12. Orienting Controls and Indicators (fig. 4)

The chart below lists the controls and indicators used when orienting the theodolite.

Control	Function
Azimuth calibration clamp.	Locks azimuth and elevation mounting to centering shaft.
Azimuth calibration adjustment.	Provides fine azimuth adjustment.
Leveling screws.	Adjust leveling of theodolite.
Compass (fig. 2).	Indicates direction of magnetic north.
Levels (fig. 2).	Indicate when theodolite is level.

13. Operating Controls and Scales (fig. 4)

The chart below lists the controls used when the theodolite is operated.

Control or scale	Function
Short sights.	For rapid location of object.
Extension sights.	For rapid location of near-vertical object.
Finder-tracking lever.	Rear position (away from focusing eyepiece) selects finder telescope. Forward position (towards focusing eyepiece) selects tracking telescope.
Focusing knob.	Focuses tracking telescope.
Focusing eyepiece.	Focuses cross hairs on telescope.
Elevation scale.	Indicates elevation of object in degrees.
Elevation tracking control.	Adjusts elevation scale and telescope 1° per turn and indicates readings in .1°.
Azimuth scale.	indicates azimuth of object in degrees.
Azimuth tracking Control.	Adjusts azimuth scale and tele scope 1° per turn and indicates readings in .1°.
Scale lamp switch (SPDT toggle switch).	*Position* OFF — *Function* Turns scale lamps off. ON (momentary action) (ML-47-(*) and ML-247–(*)). — Lights scale lamps. ON (normal action). — Lights scale lamps.
Cross hair lamp switch (ML-47-(*) or ML-247-(*)) (not shown) (SPDT toggle switch)	*Position* OFF — *Function* Turns cross hair lamp off. ON (momentary action) — Lights cross hair lamp. ON (normal action) — Lights cross hair lamp.
Brightness control (ML-47-(*) or ML-247-(*))	Varies dc voltage to cross hair lamp.
Brightness control (ML-474/GM)	Variable resistor: *Position* — *Function* Extreme clockwise — Turns cross hair lamp off. Other than extreme clockwise position — Lights and varies brightness of cross hair lamp.

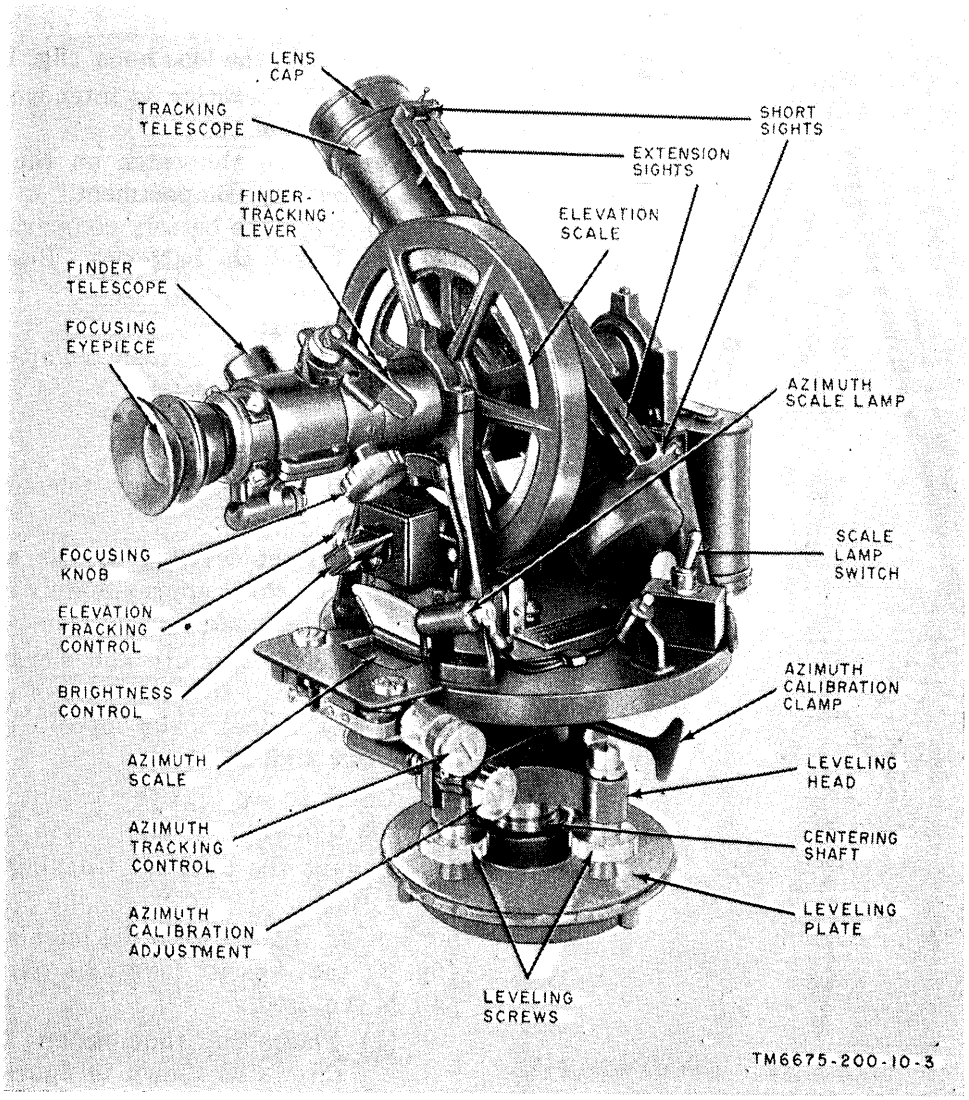

Figure 4. Theodolite, view of controls, scales, and indicators.

Section II, PRELIMINARY PROCEDURES

14. Erecting Tripod (fig. 5)

a. Unfasten the belt that holds the legs together.

b. Loosen the thumbscrews.

c. Spread the legs of the tripod until the mount is approximately 9 inches below eye level, If the surface is smooth and hard, spread the legs until the chain is tight to prevent slipping,

d. Tighten the thumbscrews.

e. If the tripod is to be used on the ground, dig the cleats of the legs into the ground so that the tripod stands firm.

f. Unscrew and remove the protector cap by turning it counterclockwise.

15. Setting Up Theodolite

To remove the theodolite from the carrying case and secure it to the tripod, proceed as follows:

a. Disengage the azimuth tracking control (fig. 4) by pulling it away from the azimuth scale.

b. Pull the theodolite (fig, 1) and base plate.

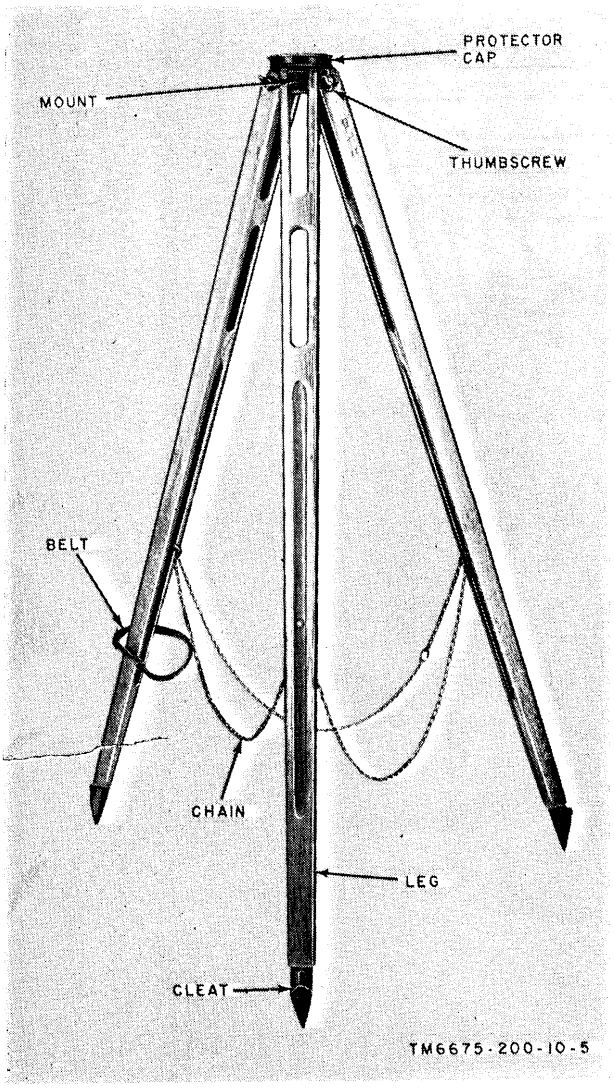

Figure 5. Tripod.

from the carrying case by pulling on the base plate.

c. Place the theodolite and base plate on a firm, level surface.

d. Be sure that the azimuth calibration clamp (fig. 4) is tight.

e. Unscrew the theodolite from the base plate (fig. 1) by turning the leveling plate (fig. 4) counterclockwise.

f. Screw the theodolite to the tripod mount (fig. 5) by turning the leveling plate clockwise.

g, Remove the lens cap (fig. 4) from the tracking telescope.

h. Place the lens hood (fig. 1) on the tracking telescope.

i. Place the lens cap (fig. 4) on the base plate block that held the lens hood (fig. 1).

j. If night operation is intended, install the batteries as follows:

(1) Loosen the catch on the top of the battery compartment.
(2) Open the battery compartment.
(3) Install the batteries, Be sure that the base of each battery contacts the springs.
(4) Close the battery compartment and secure the catch.

16. Leveling

a. Position the tracking telescope (fig. 4) vertically.

b. Loosen the leveling screws and position the centering' shaft approximately in the center of the leveling plate.

c. Rotate the azimuth and elevation mounting (fig. 2) until the long axis of each level is parallel to a diametrically opposite pair of leveling screws (fig. 6).

d. Check to see that the azimuth calibration clamp is tight.

e. Engage the azimuth tracking control.

f. Adjust a pair of diagonally opposite leveling screws (fig. 6) until the bubble of the level (fig, 2) that has its long axis parallel to this pair is centered.

(1) Place the thumbs on the left cling screws as shown in figure 6.
(2) Move the thumbs either toward or away from each other simultaneously.
(3) The bubble will move in the direction of the left thumb.
(4) The screw pressure on the leveling plate should always be sufficient to prevent the upper portion from shifting or rocking.

g. Repeat the procedures given in *f* above for the other pair of leveling screws and the other level.

h. Repeat the procedures given in both *f* and *g* above for fine adjustment to exactly center the level bubbles.

i. Disengage the azimuth tracking control and rotate the azimuth and elevation mounting until the levels are 180° from their original position. The bubbles should remain centered.

j. If the bubbles do not remain centered in the levels, repeat the procedures given in *f* through *i* above until they do. If leveling cannot be accomplished, the theodolite requires adjustment by higher echelon maintenance.

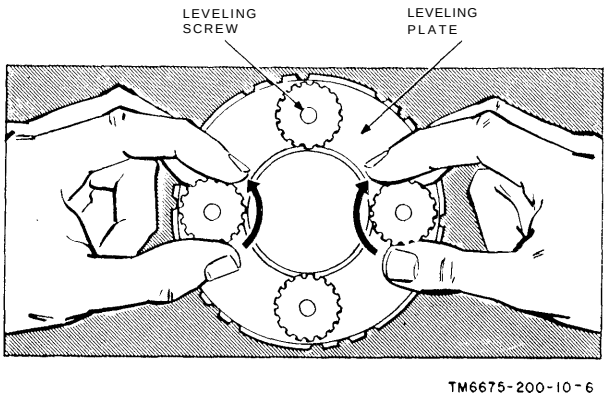

Figure 6. Leveling screw adjustment.

17. Focusing
(fig. 4)

a. Cross Hairs. The cross hairs should be focused to adjust the focusing eyepiece to the operator's eye, The finder-tracking lever may be in either position for this operation.

(1) Look through the focusing eyepiece and direct the telescope toward a source of uniform light.

(2) Rotate the focusing eyepiece until the cross hairs arc sharp and distinct.

b. Telescope.

(1) Position the finder-tracking lever toward the focusing eyepiece.

(2) Look through the focusing eyepiece and point the telescope at an object at least 100 feet away.

(3) Adjust the focusing knob until the object is sharp and distinct.

18. Orienting by Compass
(figs. 2 and 4)

a. Disengage the azimuth tracking control (fig. 4) by pulling it away from the azimuth and elevation mounting.

b. Determine the deviation between magnetic north and true north for the theodolite location.

c. If the deviation is minus, subtract it from 360. If the deviation is plus, add it to zero.

d. Rotate the azimuth and elevation mounting (fig. 2) until the fiducial marker of the azimuth scale lines up with the number determined in *c* above.

e, Engage the azimuth tracking control (fig. 4) by pushing it toward the azimuth and elevation mounting.

f. Loosen the azimuth calibration clamp.

g. Lower the lock lever (not shown) on the side of the compass,

h. Rotate the azimuth and elevation mounting until the compass needle is approximately over the *S* mark on the compass face.

i. Tighten the azimuth calibration clamp and turn the azimuth calibration adjustment (fig. 4) until the compass needle lines up exactly over the *S* mark on the compass face.

j. Raise the compass lock lever to its upper position to secure the internal mechanism.

Note. Do not touch the azimuth calibration clamp or the azimuth calibration adjustment after the theodolitc has been oriented.

k. Establish datum lines (par. 24).

19. Orienting by Sun

The following method of orientation applies only to theodolite locations bet between 22½ ^{0}north latitude and 22½° south latitude. The orientation must take place at solar noon,

a. Use the following procedure to determine the local standard time at which solar noon will occur.

(1) Use the equation-of-time graph (fig, 7) and determine the mean time, by the following procedure:

(a) Locate the applicable vertical date line.

(b) Note the point where the vertical date line intersects the curved line,

(c) Follow the horizontal line from the point of intersection to find the correction in minutes.

Example 1. Date=l June
Correction in minutes= —3
Mean time=l157

Example 2. Date=l August
Correction in minutes +6
Mean time=1206

(2) Convert the mean time into local standard time.

(a) Determine the difference in longitude between the theodolite location
(b) and the standard meridian for the area.

(c) Mulultiply the difference by 4.

If the longitude of the theodolite location is greater than the standard meridian, subtract; if less, add the correction obtained in step *(b)* above.

Example 1. Theodolite location=73° longitude
Standard meridian=75° longitude
Difference in degrees= 2°
Difference in minutes= 8 minutes (4 minutes per degree)
Mean time=1157
Local standard time= 1205

Example 2. Theodolite location=77° longitude
Standard meridian=75° longitude
Difference in degrees= 2°
Difference in time=8 minutes (4 minutes per degree)
Mean time= 1206
Local standard time= 1158

Notc. If daylight saving time is in effect, add 1 hour to the local standard time.

b. Prepare the theodolite. Do not sight the theodolite on the sun until some provision has been made to reduce the intense light, such as placing a smoked glass or one or more dense photographic negatives over the lens.

Warning: **Permanent injury to the eyes can be caused by viewing the sun through the theodolite unless a protective measure *(b* above) is taken.**

c. Sight the sun as follows:

(1) Set the azimuth scale as indicated below:

(a) North of the tropic zone-set the scale at 1800.
(b) South of the tropic zone-set the scale at 0°.

(2) Engage the azimuth tracking control.
(3) Loosen the azimuth calibration clamp.
(4) Sight the telescope on the sun (fig. 8) several minutes before solar noon.
(5) About 30 seconds before solar noon, tighten the azimuth calibration clamp.
(6) Track the sun by turning the azimuth calibration adjustment. Position the cross hairs as shown in figure 8.
(7) Stop turning the azimuth calibration adjustment at exactly solar noon.

Note. The theodolite is now oriented. Do not loosen the azimuth calibration clamp or turn the azimuth calibration adjustment.

(8) Establish datum lines (par. 24).

20. Orienting by Polaris

Note. The following method of orientation applies only to theodolite locations between 10° and 70° north latitude. Refer to paragraph 21 for theodolite locations in southern latitudes.

a. Use the Polaris culmination time graph (fig. 9) and determine the local standard time for Polaris at upper culmination.

Note. If upper culmination occurs during daylight hours, use lower culmination.

b. Disengage the azimuth tracking control (fig. 4) and turn the azimuth and elevation mounting (fig. 2) until the fiducial marker of the azimuth scale (fig. 4) lines up with O ± the azimuth variation of Polaris from true north *(j* below) and engage the azimuth tracking control.

c. Loosen the azimuth calibration clamp.

d. Locate Polaris as follows:

(1) Open the technical manual to figure 10, face north and hold the technical manual in a reading position.
(2) Rotate the technical manual until the appropriate month is at the top of figure 10 to determine the appearance of the northern sky at 2100 hours local standard time.

Note. To determine the appearance of the sky for local standard time at times other than 2100 hours, count off one radial line for each hour and hold figure 10 with the final radial line pointing to the top of the figure and ignore the month.

(3) Locate Polaris.

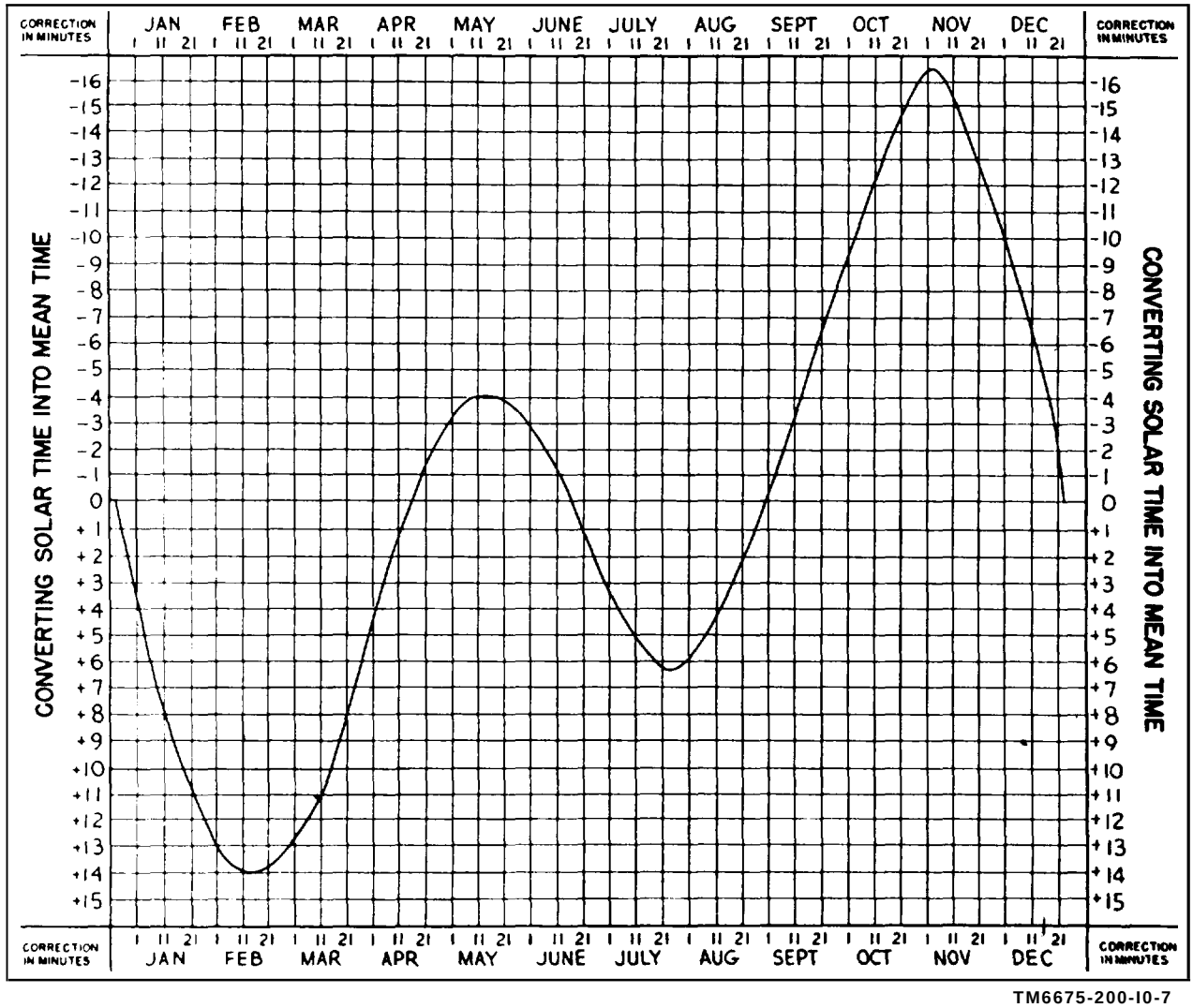

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Figure 7. Equation-of-time graph.

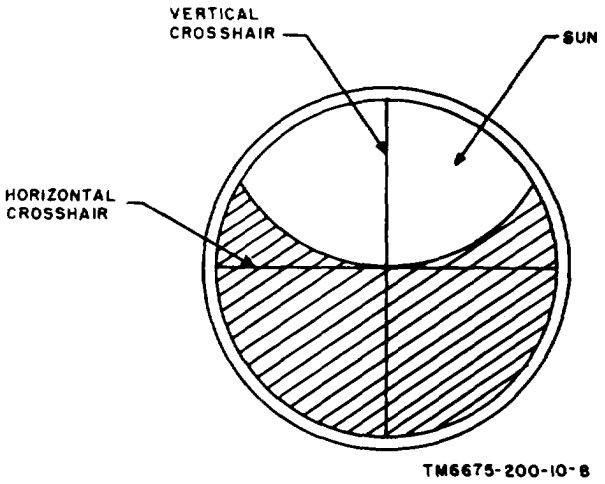


Figure 8. Cross hair tracking of sun..

e. Sight the telescope on Polaris several minutes before culmination *(a* above).

f. Position the cross hairs of the telescope directly on Polaris.

g. About 30 seconds before culmination, tighten the azimuth calibration clamp (fig. 4).

h. Track Polaris by adjusting the azimuth calibration adjustment.

i. Stop adjusting the azimuth calibration adjustment exactly at culmination.

Note. Do not touch the azimuth calibration clamp or the azimuth calibration adjustment after the theodolite has been oriented.

j. To determine the azimuth variation of Polaris from true north, refer to tables I, II, III, or IV. Each table gives the variation of Polaris quarterly for specified latitudes and times. The same variation that applies to a given time on any one day will apply 3.93 minutes earlier each successive day.

Problem: Referring to table III, we find that on July 1, Polaris is .8" east of north at 2217 hours on latitude 40°. At what time will Polaris be .8° east of north on July 11?

Solution: Number of days later=10
Correction for each day=3.93 minutes earlier
10 x3.93 minutes=39.3 minutes
22 hours 17 minutes minus 39.3 minutes=21 hours 37.7 minutes
Polaris will be .8° east of north at 2137.7 hours July 11 on latitude 40°.

k. Establish datum lines (par. 24).

Table I. Azimuth of Polaris From True North, First Quarter

Date and Universal Time (Greenwich mean time) a			Latitude b										
Jan. 1	Feb 1	Mar 1	10°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
1912	1709	1518	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	().0	0.0
2211	2009	1818	+0.7	+0.7	+0.8	+ 0.8	+0.9	+0.9	+1.0	+1.1	+1.3	+ 1.6	+ 2.0
0115	2308	2118	+0.9	+1.0	+1.1	+1.1	+1.2	+1.3	+1.4	+1.6	+1.8	+2.2	+2.7
0414	0212	0021	+0.7	+0.7	+0.8	+0.8	+0.8	+0.9	+ 1.0	+1.1	+ 1.3	+1.5	+1.8
0714	0511	0320	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1013	0811	0620	—0.7	—0.7	—0.8	—0.8	—0.8	—0.9	−1.0	—1.1	—1.3	—1.5	—1.8
1313	1110	0920	—0.9	—1.0	—1.1	—1.1	—1.2	—1.3	—1.4	—1.6	—1.8	—2.2	—2.7
1612	1410	1219	—0.7	—0.7	—0.8	—0.8	—0.9	—0.9	−1.0	—1.1	—1.3	—1.6	—2.0

See footnotes at end of table IV.

Table II. Azimuth of Polaris From True North, Second Quarter c

Date and Universal Time (Greenwich mean time) a			Latitude b										
Apr. 1	May 1	Jun 1	10°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70"
1316	1118	0917	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1616	1418	1216	+0.7	+0.7	+0.8	+0.8	+0.9	+0.9	+1.0	+1.1	+1.3	+1.6	+ 2.0
1915	1717	1516	+0.9	+1.0	+1.1	+1.1	+1.2	+1.3	+1.4	+ 1.6	+ 1.8	+2.2	+2.7
2215	2017	1815	+0.7	+0.7	+0.8	+0.8	+0.8	+0.9	+1.0	+1.1	+ 1.3	+1.5	+1.8
0118	2316	2115	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0418	0220	0018	-0.7	-0.7	-0.8	-0.8	—0.8	-0.9	—1.0	—1.1	—1.3	—1.5	—1.8
0717	0519	0318	-0.9	—1.0	—1.1	—1.1	—1.2	—1.3	—1.4	—1.6	—1.8	—2.2	—27
1017	0819	0617	-0.7	-0.7	-0.8	-0.8	-0.9	-0.9	—1.0	—1.1	—1.3	—1.6	—2.0

See footnotes at end of table IV.

Table III. Azimuth of Polaris From True North, Third Quarter [c]

Date and Universal Time (Greenwich mean time) [a]			Latitude [b]										
Jul 1	Aug 1	Sep 1	10°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°
0720	0518	0317	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1019	0818	0616	+0.7	+0.7	+ 0.8	+0.8	+0.9	+0.9	+1.0	+1.1	+1.3	+ 1.6	+ 2.0
1318	1117	0916	+0.9	+1.0	+1.1	+1.1	+ 1.2	+ 1.3	+1.4	+1.6	+1.8	+ 2.2	+ 2.7
1618	1417	1216	+0.7	+ 0.7	+0.8	+0.8	+0.8	+ 0.9	+1.0	+1.1	+1.3	+1.5	+1.8
1918	1716	1515	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2217	2016	1814	—0.7	—0.7	—0.8	—0.8	—0.8	—0.9	—1.0	—1.1	—1.3	—1.5	—1.8
0120	2315	2114	—0.9	—1.0	—1.1	—1.1	—1.2	—1.3	—1.4	—1.6	—1.8	—2.2	—2.7
0420	0219	0018	—0.7	—0.7	—0.8	—0.8	—0.9	—0.9	—1.0	—1.1	—1.3	—1.6	—2.0

See footnotes at end of table IV.

Table IV. Azimuth of Polaris From True North, Fourth Quarter

Date and Universal Time (Greenwich mean time) [a]			Latitude [b]										
Oct 1	Nov 1	Dec 1	10°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70"
0120	2314	2116	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0419	0217	0019	+0.7	+0.7	+0.8	+0.8	+0.9	+ 0.9	+1.0	+1.1	+ 1.3	+1.6	+2.0
0718	0517	0319	+0.9	+1.0	+1.1	+1.1	+ 1.2	+ 1.3	+1.4	+ 1.6	+1.8	+2.2	+2.7
1018	0816	0618	+0.7	+0.7	+0.8	+0.8	+0.8	+0.9	+1.0	+1.1	+1.3	+1.5	+1.8
1318	1116	0918	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1617	1415	1217	—0.7	—0.7	—0.8	—0.8	—0.8	—0.9	—1.0	—1.1	—1.3	—1.5	—1.8
1916	1715	1517	—0.9	—1.0	—1.1	—1.1	—1.2	—1.3	—1.4	—1.6	—1.8	—2.2	—2.7
2216	2014	1816	—0.7	—0.7	—0.8	—0.8	—0.9	- 0 . 9	—1.0	—1.1	—1.3	—1.6	—2.0

[a] Universal time (Greenwich mean time), counted from midnight; on any other meridian of longitude, subtract 0.16 minutes per hour of west longitude, add 0.16 minutes per hour of east longitude, to obtain time of the given azimuth.

[b] When the sign is plus (+), Polaris is west of north; when it is minus (—), it is east of north.

[c] Tables I, II, III, IV apply to the period of 1955 to 1965, inclusive.

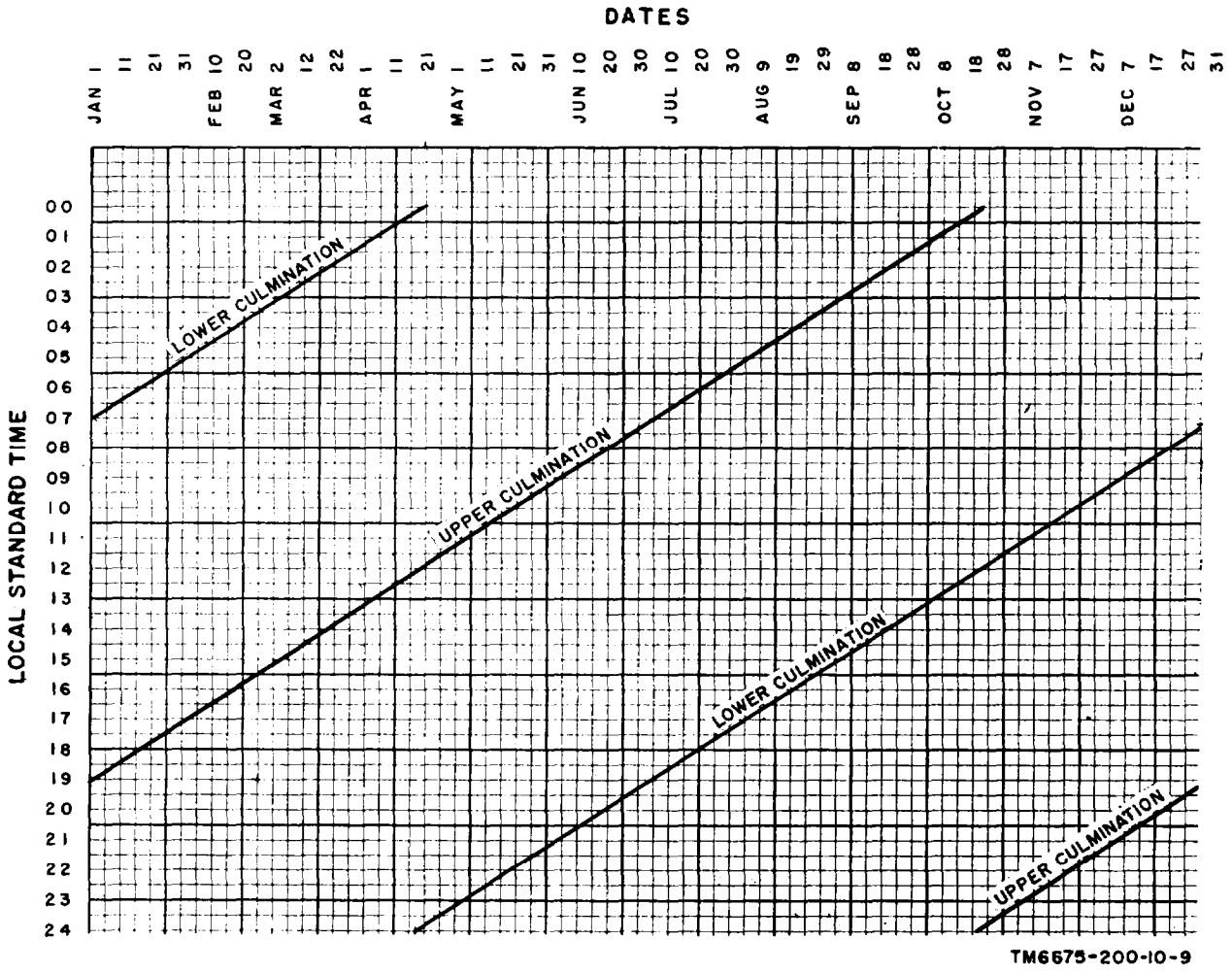


Figure 9. Polaris culmination time graph.

Orienting by Equal Angles

Northern Hemisphere.

(1) Disengage the azimuth tracking control (fig. 4) by pulling it away from the elevation scale.

(2) Turn the azimuth and elevation mounting until the fiducial marker of the azimuth scale lines up with O. Engage the azimuth tracking control.

(3) Loosen the azimuth calibration clamp and sight a nearby easily visible reference point by rotating the azimuth and elevation mounting.

(4) Tighten the azimuth calibration clamp and adjust the azimuth calibration adjustment until the cross hairs of the telescope are centered on the reference point ((3) above).

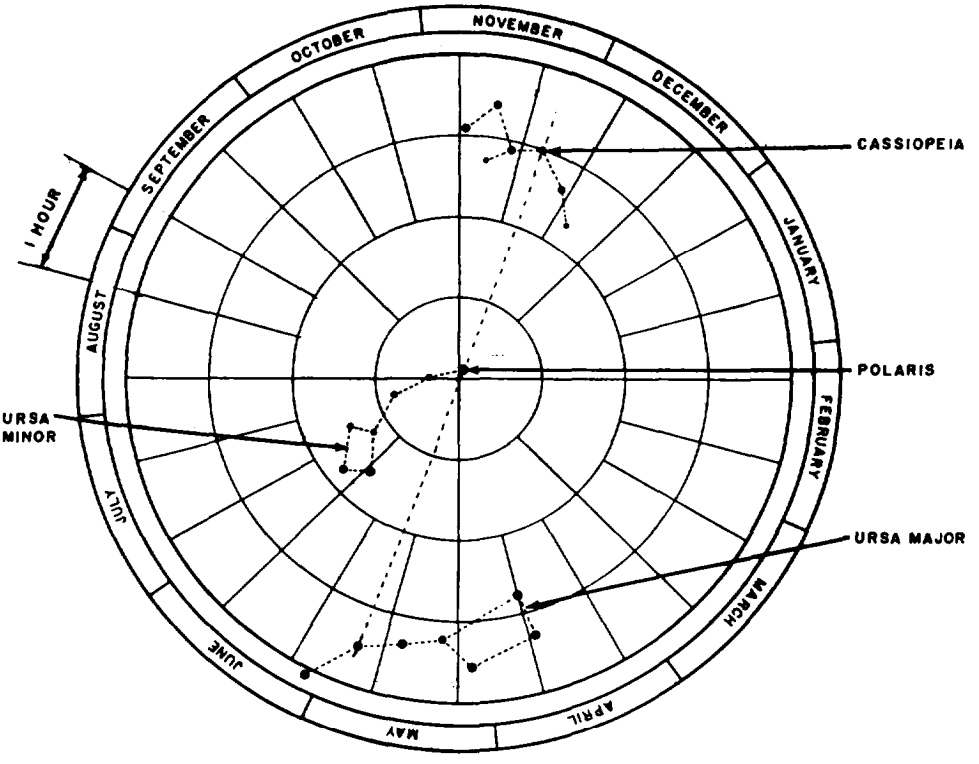
Note. Do not touch the azimuth calibration clamp and the azimuth calibration adjustment after performing the procedure given in (4) above.

(5) Disengage the azimuth tracking control and the elevation tracking control.

(6) Select a conspicuous star in the north-northwestern sky that is approximately 30° or 40° from Polaris.

Note. The star selected for observation must be used throughout the series of observations.

(7) Sight the star through the telescope and engage the azimuth tracking con-



NOTE:
EACH RADIAL LINE DENOTES 2100 HOURS LOCAL STANDARD TIME FOR PORTION OF MONTH IN WHICH IT TERMINATES

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Figure 10. Method of locating Polaris

trol and the elevation tracking control.

(8) Track the star (fig. 11) and note the azimuth and elevation when the star is approximately 2 hours from culmination during its descent.

(9) Make two additional observations at 20-minute intervals and note the azimuth and elevation.

(lo) Track the ascent and note the azimuth when the elevation of the star is exactly the same as the third observation, the second observation and the first observation.

(11) Determine the midpoint of each of the following azimuths noted in (8) through (10) above:

(a) First observation to sixth observation.

(b) Second observation to fifth observation.

(c) Third observation to fourth observation.

(12) Determine the average azimuth of the three midpoints ((11) above). Subtract the average azimuth of the three midpoints from 360°.

(13) Disengage the azimuth tracking control (fig. 4) and turn the azimuth and elevation mounting (fig. 2) until the fiducial marker of the azimuth scale lines up with the difference obtained as indicated in (12) above.

(14) Engage the azimuth tracking control (fig. 4) and loosen the azimuth calibration clamp.

(15) Rotate the azimuth and elevation mounting and sight the reference point ((14) above).

(16) Tighten the azimuth calibration clamp.

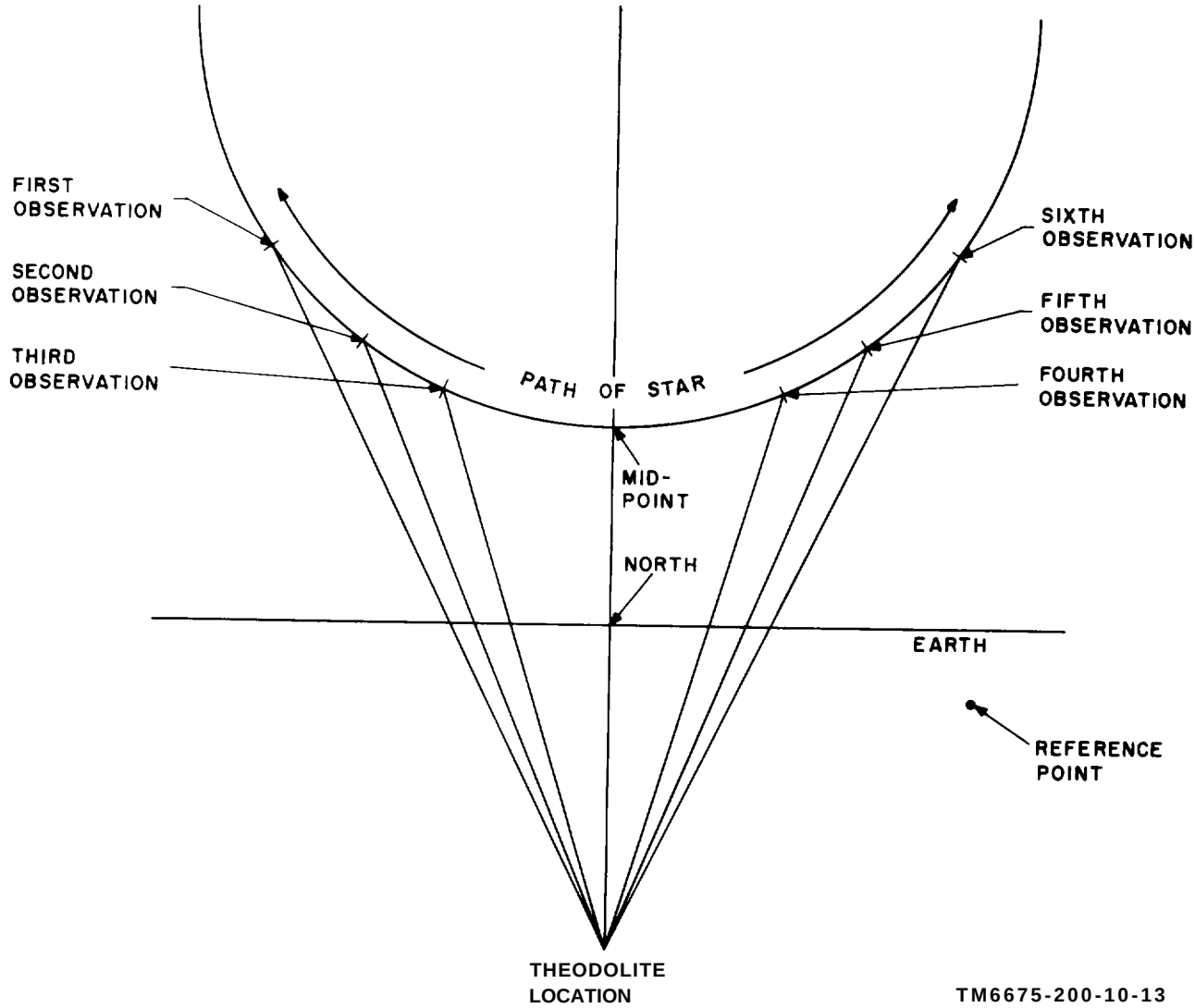

Figure ***11.*** *Determination of true north by equal angles.*

(17) Adjust the azimuth calibration adjustment until the cross hairs of the telescope are directly centered on the reference point.

Note. Do not touch the azimuth calibration clamp and the azimuth calibration adjustments or the orientation will be thrown

(18) Establish datum lines (par. 24).

b. Southern Hemisphere.

(1) Perform the procedures given in *a (1)* through (5) above.

(2) Select a conspicuous star in the south-southwestern sky for use throughout the series of observations.

(3) Perform the procedures given in *a* (7) through (18).

c. *Sun.* The equal-angles method may be used also in observations of the sun. The first three observations, however, must be made on the sun as it rises toward culmination and the last three observations as it descends. The sun occupies a large portion of the field of the theodolite, and it cannot be centered in the field as accurately as a star. To increase the accuracy of the observation, position the cross hairs over the sun (fig. 12). If the observation is being taken in the morning, place the right edge of the sun tangent to the vertical cross hair; if the observation is being taken in the

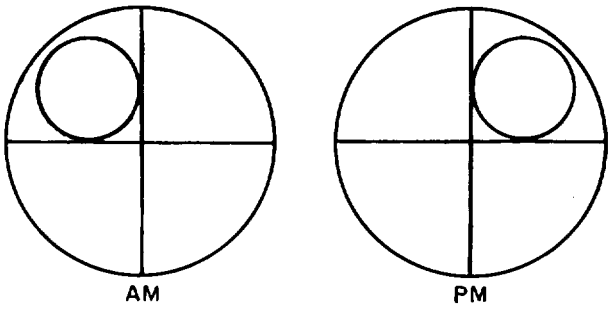

Figure 12. Method of sighting sun for equal angles.

afternoon, place the left edge of the sun tangent to the vertical cross hair.

22. Orienting by Datum Lines

Datum lines must be established previously (par. 24) to perform the following:

a. Erect the tripod (par. 14).

b. Set up the theodolite (par. 15).

c. Attach a plumb-bob string to the eyelet under the leveling plate (fig. 4).

d. Center the tripod and the attached theodolite until the tip of the plumb-bob is directly over the observation point.

e. Perform the leveling procedures (par. 10).

f. Adjust the azimuth tracking control until the fiducial marker of the azimuth scale lines up with the azimuth of the first reference point (par. *23f).*

g. Adjust the elevation tracking control until the fiducial marker of the elevation scale lines up with the elevation of the first reference point.

h. Loosen the azimuth calibration clamp.

i. Rotate the azimuth and elevation mounting (fig. 2) until the cross hairs of the telescope are centered on the first reference point.

j. Tighten the azimuth calibration clamp (fig.2).

k. Adjust the azimuth calibration adjustment until the cross hairs of the telescope are centered on the first reference point.

Note. Do not touch the azimuth calibration clamp and the azimuth calibration adjustment after performing the procedure in *j* above.

l. Adjust the azimuth tracking control until the fiducial marker of the azimuth scale is lined up with the azimuth of the second reference point (par. *23g).*

m. Adjust the elevation tracking control until the fiducial marker of the azimuth scale is lined up with the elevation of the second reference point.

n. Check to see that the cross hairs of the telescope are centered on the second reference point.

o. If a third reference point (par. *23g)* is available, perform the procedures given in *k* through *m* above.

Note. If the cross hairs of the telescope do not line up with the second or third reference point, repeat the procedures given in *a* through *n* above,

23. Orienting by Transference

To transfer the theodolite location, after the theodolite has been oriented (pars. 18, 19, 20, 21, 22, or 24), proceed as follows:

a. Sight the telescope on a marker held at a new location.

b. Adjust the azimuth tracking control and the elevation tracking control until the cross hairs of the telescope are centered on the marker.

c. Note the azimuth of the marker.

d. Determine the azimuth of the observation point (par. *24e)* from the marker. If the azimuth of the marker is greater than 180" subtract 180°. If the azimuth is less than 180°, add 180°.

e. Transfer the theodolite and tripod to the location of the marker.

f. Center the tripod and theodolite over the location of the marker.

g. Perform the leveling procedures (par. 16) .

h. Adjust the azimuth tracking control until the fiducial marker of the azimuth scale lines up with the azimuth of the observation point *(d* above).

i. Loosen the azimuth calibration clamp and sight the original observation point by rotating the azimuth and elevation mounting (fig. 2).

j. Tighten the azimuth calibration clamp (fig. 4).

k. Adjust the azimuth calibration adjustment until the cross hairs of the telescope are centered on the observation point.

Note. Do not touch the azimuth calibration clamp and the azimuth calibration adjustment after performing the procedures given in *k* above.

l. Establish datum lines (par. 24).

24 Establishing Datum lines (fig. 4)

When the theodolite is oriented, establish datum lines as follows.

a. Attach the plumb-bob string to the eyelet under the leveling plate.

b. Adjust the plumb-bob cord until the plumb-bob is approximately one-half inch from the ground or hard surface.

c. Establish an observation point at the tip of the plumb-bob and remove the plumb-bob.

d. Mark the observation point. If the tripod is set up on the ground, a small stake can be used. If the tripod is set up on a hard surface, a painted spot can be used.

e. Select a permanent landmark for a reference point.

f. Adjust the azimuth tracking control and the elevation tracking control until the cross hairs of the telescope are centered on the reference point.

g. Note the azimuth and elevation and a complete description of the reference point as an established datum line.

h. Repeat the procedures given in d through *f* above a second reference point and, if possible, on a third reference point.

Note. When establishing datum lines at night (e-g above), select a fixed light source for a reference point.

i. Post the established datum line information in a convenient place, such as the door of the carrying case or in the weather station.

25. Presetting Controls (fig. 4)

a. Disengage the azimuth tracking control by pulling it out from the azimuth and elevation mounting.

b. Disengage the elevation tracking control by pushing it down on the azimuth and elevation mounting.

c. Position the finder-tracking lever away from the focusing eyepiece.

d. If night operation is intended, preset the additional controls:

(1) On the ML-474/GM, proceed as follows :

(a) Operate the scale lamp switch (fig. 4) to the ON position.

(b) Operate the rheostat (fig. 4) from the OFF position to "the position that gives the desired cross hair illumination.

(2) On the ML-47-(*) and ML-247-(*), proceed as follows:

(a) Operate the scale lamp switch and the cross hair lamp switch to the ON position.

(b) Operate the rheostat to the position that gives the desired cross hair illumination.

Section III. OPERATION UNDER USUAL CONDITIONS

26. Tracking Object

a. Grasp the theodolite as shown in figure 13.

b. Aline the short sights (fig. 4) on the object and track the object by hand until its course becomes apparent.

Note. If the base of the azimuth and elevation mounting interferes with the rear sight, raise the extension sights (fig. 4) and track the object.

c. Engage the azimuth tracking control (fig. 4) and the elevation tracking control.

d. Shift the eye to the focusing eyepiece and track the object by operating the azimuth tracking control and the elevation tracking control (fig. 14).

e. Center the cross hairs of the telescope on the object and operate the finder-tracking lever (fig. 4) toward the focusing eyepiece.

f. Keep the cross hairs centered on the object and read the scales (par. 27) until the tracking is complete.

Note. If the object is lost from the field of view, operate the finder-tracking lever away from the focusing eyepiece. When the cross hairs are again centered on the object, operate the finder-tracking lever toward the focusing eyepiece and continue tracking.

Figure 13. Tracking object using sights.

27. Reading Scales

a. Operate Timing and Telephone Set ML-110 (TM 11–334) to provide time interval signals.

Note. If Timing and Telephone Set ML-110 is not available, use a stopwatch or a clock.

b. At the beginning of the tone, be certain that. the cross hairs of the telescope are centered on the object.

c. While listening to the tone, observe the position of the fiducial marker on the azimuth and elevation scales (fig. 4).

d. When the tone stops, call out the exact reading indicated on the azimuth scale, the azimuth tracking control, the elevation scale, and the elevation tracking control.

Note. The azimuth scale and elevation scale indicate azimuth and elevation in degrees, Tenths of degrees are indicated on the azimuth tracking control and elevation tracking control,

28. Stopping Procedures

At the completion of the observation proceed as follows:

a. Operate the scale lamp switch and the rheostat to the OFF position (ML-474/GM), or operate the scale lamp switch and the cross hair lamp switch to the OFF position (ML-47-(*) or ML-247-(*)).

b. Replace the lens cap on the telescope lens and the sunshade on the base plate block.

c, Place the cover on the theodolite if it is to be kept in readiness for a later observation.

d. If no more observations are intended, place the theodolite in the carrying case as follows :

(1) Unscrew the theodolite from the tripod mount by turning the leveling plate (fig. 4) counterclockwise.

(2) Screw the theodolite to the base plate by turning the leveling plate clockwise.

(3) Disengage the azimuth tracking control by pulling it out from the azimuth scale.

(4) Disengage the elevation tracking control by pulling it down from the elevation scale,

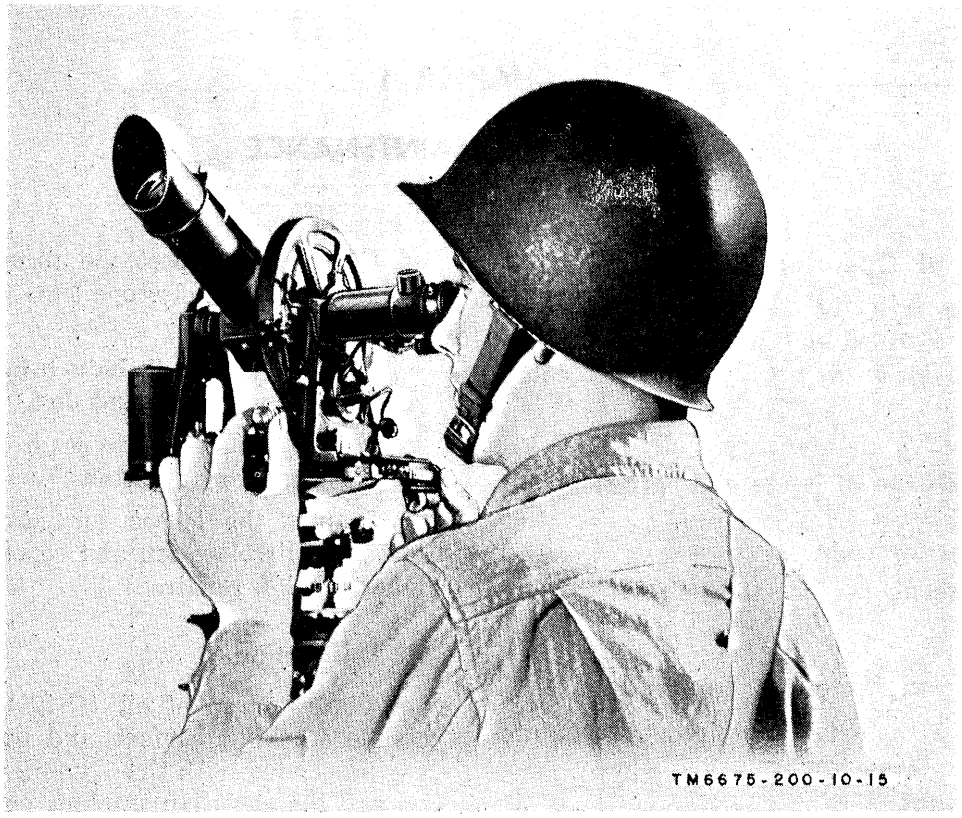

Figure 14. Tracking object using focusing eyepiece

(5) Swing tile tracking telescope vertitally to invert it so that the sights are on the bottom.

(6) Place the theodolite in its carrying case by sliding the base plate into its groove in the bottom of the case. The trackiug telescope lens will fit into the left rear corner of the case.

(7) Close the carrying case door and secure the catches.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

29, Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the operation of the theodolite. If equipment that has been exposed to the cold is brought into a warm room, moisture will gather on it and cause changes in operating characteristics. Dry the equipment thoroughly.

30. Operation in Tropical Climates

Moisture conditions are more acute in tropical, swampy areas. The high relative humidity causes moisture condensation on the equipment when the temperature of the equipment drops below that of the surrounding air. Adequate ventilation will minimize this condition, Dry tile equipment thoroughly before operating it.

31. Operation in Desert Climates

Provide means for keeping dust and sand from entering the moving parts of the theodolite. Grit, resulting from the mixture of lubricant and sand, will damage the equipment. Clean the equipment often and cover it when not in use. Protect the equipment from the direct rays of the sun if possible.

CHAPTER 4

PREVENTIVE MAINTENANCE

32. Scope of Operator's Maintenance

Following is a list of maintenance duties normally performed by the theodolite operator. These procedures do not require test equipment.

a. Preventive maintenance (par. 34).

b. Replacement of lamps and batteries (par. 37).

c. Lubrication (par. 35).

d. Equipment performance checklist (par. 36) .

33. Tools and Materials Required

Tools and materials required for maintenance of the theodolite are listed below.

a. Furnished.

Screw Driver TL-22

Hand oiler, 2.5 cc, 2 inches high by 3/& inch diameter.

b. Not Furnished.

Camel's-hair Brush TL-72 (½ in. flat)
Wiping cloth, FSN 8305–170-5063
Lens tissue, FSN 6640–393–2090

Lubricating oil, general purpose, preservative (PL Special), 4 oz. can/spout, FSN 9150–273–2389

Lubricating oil, watch (OCW), 5 cc, bottle/fine dropper FSN 9150–252–6382

34. Preventive Maintenance

a. Check the equipment for agreement with the table of components (par. 5).

b. Check for worn, loose, or missing parts and screws.

c. Tighten all loose screws, except the adjustment screws.

d. Inspect all moving parts for smooth operation and report any malfunction to higher echelon for repair.

e. Clean and dust all exterior surfaces.

f. Clean and inspect the focusing eyepiece lens, the tracking telescope lens, and the finder telescope lens.

(1) Use a camel's-hair brush to remove all loose dust and dirt.

(2) Use lens tissue to remove any remaining foreign matter.

g. Inspect the lenses for scratches, chips, cracks, or discoloration and report defects for higher echelon repair.

35. Lubrication

a. Place a drop of oil (OCW) on each accessible working surface and on each worm gear associated with the azimuth tracking control and the elevation tracking control.

b. Moisten a cloth with oil (PL Special) and carefully apply a film of oil to the elevation scale.

c. Moisten a cloth with oil (PL Special) and apply a film of oil to all the metallic and painted surfaces.

d. Remove all excess oil with a clean cloth.

36. Equipment Performance Checklist

Use the equipment performance checklist to check equipment performance systematically. All corrective measures which the operator can perform are given in the corrective measures column. If the action does not correct the fault, additional maintenance must be performed by higher echelon maintenance personnel. The operator should note on the repair tag how the equipment performed and what corrective measures were taken. In using the checklist, start at the beginning and follow each step in order to locate trouble. If trouble is suspected in a particular area, however, start checking at that point and continue the steps sequentially.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Set up tripod (par. 14).			
	2	Set up theodolite (par. 15).			
	3	Level theodolite (par. 16).	Adjust leveling screws.	Bubble in each level center.	Turn in equipment for higher echelon repair.
	4	Focus theodolite (par. 17).	Adjust focusing eyepiece while viewing through focusing eyepiece.	cross hairs become sharp and distinct.	Clean lens of focusing eyepiece and finder telescope (par. Turn in equipment for higher echelon repair.
			Adjust focusing control while viewing object.	Object becomes sharp and distinct.	Place finder-tracking level in opposite position. Clean lens of tracking telescope (par. Turn in equipment for higher echelon repair.
	5	Batteries.	Install batteries in battery compartment.		
START	6	Azimuth tracking control (fig. 4).	Disengage.	Pulls outward from azimuth and elevation mounting.	Turn in equipment for higher echelon repair.
	7	Elevation tracking control.	Disengage.	Pulls downward from azimuth and elevation mounting.	Turn in equipment- for higher echelon repair.
	8	Tinder-tracking lever.	Move toward focusing eyepiece and then away from focusing eyepiece.	Moves freely.	Turn in equipment for higher echelon repair.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	9	Azimuth calibration adjustment.	Adjust for approximate center position.	Turns without binding.	Turn in equipment for higher echelon repair.
	10	Azimuth calibration clamp.	Loosen.	Turns without binding.	Turn in equipment for higher echelon repair.
	11	Azimuth and elevation mounting (fig. 2).	Slowly rotate through 360°.	Rotates without binding.	Turn in equipment for higher echelon repair.
	12	Orient theodolite (par. 18, 19, 20, 21 or 22).			
	13	Sights.	Rotate azimuth and elevation mounting and sight an object.		
	14	Azimuth tracking control and elevation tracking control (fig. 4).	Engage both controls and adjust them until sights are lined up on object (13 above).	Telescope will move to proper position.	Turn in equipment for higher echelon repair.
	15	Focusing eyepiece.	View object through focusing eyepiece.	Cross hairs should be centered on object.	Turn in equipment for higher echelon repair.
	16	Finder-tracking lever.	Move lever toward focusing eyepiece.	Cross hairs should be centered on object.	Turn in equipment for higher echelon repair.
	17	Scale lamp switch.	Operate to ON position.	Scale lamps will light.	Replace batteries (par. *37a).* Replace scale lamps (par. *37b).*
	18	Cross hair lamp switch. (ML-47-(*) or ML-247-(*)).	Operate to ON position.	Cross hairs will glow when viewed through focusing eyepiece.	Replace cross hair lamp (par. *37 b).*
	19	Brightness control:			
		ML-47-(*) or ML--247-(*).	Vary position of control.	Glow on cross hairs will increase and decrease.	Turn in equipment for higher echelon repair.
		ML-474/GM.	Vary from extreme counterclockwise to clockwise position.	Cross hairs will glow and vary in brillance.	Turn in equipment for higher echelon repair.
	20	Compass.	Adjust the azimuth tracking control until fiducial marker of azimuth scale lines up with bearing to true north.	Needle of compass is centered over *S* mark.	Turn in equipment for higher echelon repair.
STOP	21	Scale lamps switch.	Operate to OFF position.	Scale lamp will extinguish.	Turn in equipment for higher echelon repair.
	22	Cross hair lamp switch (ML-47-(*) or ML-247-(*)).	Operate to OFF position.	Cross hair lamp will extinguish.	Turn in equipment for higher echelon repair.
	23	Brightness control (ML-474/GM).	Turn completely clockwise.	Cross hair lamp will extinguish.	Turn in equipment for higher echelon repair.

37. Replacement of Batteries and Lamps

a. Batteries.

(1) Loosen the catch on the top of the battery compartment.

(2) Open the battery compartment and remove the batteries.

(3) Install new batteries. Be sure that the base of each battery contacts the springs.

(4) Close the battery compartment and fasten the catch.

b. Lamps.

(1) Twist the scale lamp covers on the bayonet bases and remove the covers.

(2) Remove the old scale lamps and install the new lamps.

(3) Twist the cross hair lamp socket base and pull the cross hair lamp base and lamp from the cross hair lamp cover.

(4) Remove the old cross hair lamp and install the new lamp.

(5) Insert the cross hair lamp and lamp socket into the cross hair lamp cover. Lock in place by twisting the socket in the bayonet base lock.

CHAPTER 5

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

38. Disassembly of Equipment (figs. 1, 2, 4, and 5)

The following instructions are recommended as a guide for preparing the theodolite set for shipment and storage. The actual procedure and extent of disassembly will depend on the situation. The disassembly procedure reverses the assembly procedure given in paragraph 15.

a. Remove the batteries from the battery compartment (fig. 2) and the battery racks (fig. 1).

b. Remove the lens hood (fig. 1) from the tracking telescope (fig. 4),

c. Place the lens cap (fig. 4) on the tracking telescope (fig. 4).

d. Place the lens hood (fig. 1) on the block provided on the base plate and remove the screwdriver from the other block.

e. Unscrew the theodolite (fig. 4) from the mount (fig. 5) by turning the leveling plate counterclockwise.

f. Screw the theodolite to the base plate (fig. 1) by turning the leveling plate clockwise.

g. Disengage the elevation tracking control.

h. Lower the extension sights (fig. 4) and position the telescope with the short sights and the extension sights underneath.

i. Disengage the azimuth tracking control and rotate the azimuth and elevation mounting until the tracking telescope is pointing toward the left rear.

j. Replace the screwdriver *(d* above).

k. Slide the base plate and attached theodolite into the carrying case so that the tracking telescope lens is to the left rear of the carrying case.

l. Engage the azimuth tracking control and the elevation tracking control.

m. Close the carrying case door and fasten the catches.

39. Repacking for Shipment or limited Storage

The exact procedure in repacking for shipment or limited storage depends on the materials available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph *10b* and reverse the sequence of operation given for unpacking the equipment.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

40. Authority for Demolition

Demolition of the equipment will be accomplished only upon the order of the commander. The destruction procedures outlined in paragraph 41 will be used to prevent further use of the equipment.

41. Methods of Destruction

Use any of the following methods:

a. Smash. Smash the controls, lenses, levels and scales; use sledges, axes, handaxes, pickaxes, hammer, or crowbars.

b. Cut. Cut the wiring harness; use axes, handaxes, *or* machetes.

c. Burn. Burn the carrying case and technical manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend battery compartment and lamp covers.

e. Explode. If explosives are necessary, use firearms, grenades, or TNT.

f. Dispose. Bury or scatter the destroyed parts in slit trenches, fox holes, or throw them into streams.

APPENDIX I

REFERENCES

The following publications contain information applicable to the operator of Theodolites ML47– (*), ML-247– (*), and Double Center Theodolite ML-474/GM.

TM 11-334	Timing and Telephone Set ML-11O
TM 11-415	Dry Batteries
TM 11-487G	Directory of Signal Corps Equipment; Meteorological Equipment
TM 11–2406	Meteorological Station AN /TMQ-l
TM 11–2426	Meteorological Station AN /TMQ-4

APPENDIX II

GLOSSARY

Culmination. Uppermost and lowermost points of an orbit.

Meridian. Line of longitude.

Standard Meridian. The line of longitude in the exact center of a time zone.

Local Standard Time. The time established for a particular time zone.

Mean Time. The time established when correction is applied to solar time for a specific time of year.

Solar Noon. Sun culmination time over a specific point.

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Corps (2)
Div (2)
Ft & Camp (2)
SVC College (5)
Br. Svc Sch (5) except USASCS (25)
Gen Depot (z) except Atlanta Gen Depot (None)
Sig See, Gen Depot (10)
Sig Depot (17)
Port of Emb (OS) (2)
OS SUP Agcy (2)
Sig Fld Maint Shop (3)
Sig Lab (5)
USA Sig pub Agcy (8)
USA Arty & Msl Cen (100)
Army Pictorial Cen (2)
USASSA (Phila, Pa) (13)
SP Wpn Cored (5)
White Sands Sig Agcy (13)
USA Elct PG (1)
Dugway PG (5)
Jefferson PG (5)
USA Corn Agcy (2)
Redstone Arsenal (5)
WRAMC (1)
USAMS (1)
Engr Maint Cen (1)
AFIP (1)
USA Sig Com Engr Agcy (1)
Mil Dist (1)
USA Corps (Res) (1)
Sectors, USA Corps (Res) (1)
JBUSMC (2)
Units org under the fol TOE:
6-100 (2)
6-101 (2)
6-200 (2)
6-201 (2)
6-300 (2)
6-301 (2)
6-525 (2)
6–575 (2)
6-576 (2)
6-577 (2)
11-7 (2)
11-16 (2)
11–57 (2)
11-127 (2)
11-128 (2)
11–500 (AA-AE) (2)
11-557 (2)
11-587 (2)
11-592 (2)
11-597 (2)
39–61 (2)
44-12 (2)
44-16 (2)
44-36 (2)
44-101 (2)
44-112 (2)
44-116 (2)
44-201 (2)

NG: State AG (6) ; units—same as Active Army except allowance is one copy to each unit.

USAR : None.

For explanation of abbreviations used, see AR 320-50.

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