TM 11-6625-446-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, FIELD AND DEPOT MAINTENANCE MANUAL

WATTMETER AN/URM-120

This copy is a reprint which includes current pages from Changes 3, 4 and 5.

HEADQUARTERS, DEPARTMENT OF THE ARMY

09 OCTOBER 1961

TM 11-6625-446-15
C 5

Change No. 5

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, *17 November 1981*

Operator's, Organizational, Direct Support, General SUPPORT, AND DEPOT MAINTENANCE MANUAL WATTMETER AN/URM-120 (NSN 6625-00-813-6430)

TM 11-6625-446-15, 9 October 1961, is changed as follows: change title of the manual as shown above.

Page 1, paragraphs 1-2.1, 1-2.2, and 1-2.3 are superseded as follows:

1-2.1. Index of Technical Publications

Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, modification work orders (MWO's) or additional publications pertaining to the equipment.

1-2.2. Maintenance Forms, Records, and Reports

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750, The Army Maintenance Management system (Army).

b. Report of Packaging and Handling Deficiencies. Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/NAVMATINST 4355.73/AFR 400-54/MCO 4430.3E.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33B/AFR 75-18/MCO P4610.19C/DLAR 4500.15.

1-2.3. Reporting Errors and Recommending Improvements

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to Commander, US Army Communications-Electronics Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. In either case, a reply will be furnished direct to you.

Page 3. Add the following note after paragraph 4-2.

NOTE

Dummy loads DA-75, produced on contract DAAB07-75 C-2450, require Coaxial Adapter UG-999A (NSN-5935-00-501-8025) to match the LC type connector on the load to the N type connector on the wattmeter.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with special mailing list.

TM 11-6625-446-15
C 4

CHANGE NO. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, *30 January 1974*

Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual WATTMETER AN/URM-120

TM 11-6625-446-15, 9 October 1961, is changed as follows:

Page 1, paragraph 1-2. Delete the note following paragraph 1-2 and substitute:

NOTE

The maintenance allocation chart is given in appendix III and is current as of 5 January 1971.

Paragraph 1-2.2. Delete paragraph 1-2.2 and substitute:

1-2.2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by 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 700-58 (Army)/NAVSUP PUB 378 (Navy)/AFR 71-4 (Air Force)/MCO P4030.29 (Marine Corps), and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38 (Army)/NAVSUPINST 4610.33/AFM 75-18/MCO P4610.19A (Marine Corps), and DSAR 4500.15.

After paragraph 1-2.2 add:

1-2.3. Reporting of Errors

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-C, Fort Monmouth, NJ 07703.

After paragraph 1-3, add:

1-3.1. Items Comprising an Operable Wattmeter AN/URM-120

FSN	*Qty*	*Nomenclature, part No., and mfr code*	*Fig. No.*
6625-813-8430	.....	Wattmeter AN/URM-120, consisting of:	1-1
5935-505-5142	1	Adapter, Connector UG-146A/U	
5995-753-2098	1	Cable Assembly, Radio Frequency CG-56D/U (8 in.)	
6625-965-1476	1	Case, Wattmeter CY-2606/URM-120, includes:	9-1
6625-826-7020	1	Coupler-Detector CU-754/URM-120	
6625-826-2538	1	Coupler-Detector CU-755/URM-120	
6625-790-0210	1	Coupler-Detector CU-753/URM-120	9-1
6625-826-7020	1	Coupler-Detector CU-754/URM-120	9-1
6625-826-2538	1	Coupler-Detector CU-755/URM-120	9-1
6625-177-1639	1	Dummy Load, Electrical DA-75/U	9-1
6625-865-1477	1	Wattmeter TS-1285/URM-120	9-1

Page 21, appendix II. Delete appendix II.

By Order of the Secretary of the Army:

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

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

Distribution:
Active Army:

USASA (2)	WSMR (1)	29-15
CNGB (1)	Ft Carson (5)	29-16
ACSC-E (2)	Ft Richardson(ECOM Ofc) (2)	29-21
Dir of Trans (1)	Army Dep (2) except	29-25
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Svc Colleges (1)	11-16	30-34
USASESS (5)	11-19	31-105
USAADS (2)	11-117	37
USAFAS (2)	11-137	37-100
USAARMS (2)	11-158	44-8
USAIS (2)	11-215	55-89
USAES (2)	11-216	55-99
USAINTS (3)	11-225	55-405
WRAMC (1)	11-226	55-406
USACDCEC (10)	11-303	55-407
ATS (1)	11-347	55-457
ARADMAC (5)	11-368	55-458
USAASTA (5)	11-500(AA-AC)	55-500
USAATC (4)	17	57
Instl (2) except	17-100	57-100
Ft Gordon (10)	29-1	67
Ft Huachuca (10)	29-11	77-100

NG: State AG (3).
USAR: None.
None explanation of abbreviations used, see AR 310-50.

Change No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., *9 June 1971*

Operator's, Organizational, DS, GS, and Depot Maintenance Manual WATTMETER AN/URM-120

TM 11-6625-446-15, 9 October 1961, is changed as follows:

The title of the manual is changed as shown above.

Page 1, paragraph 1-2. At the end of the paragraph add:

NOTE

The basic issue items list is shown in appendix II, and the maintenance allocation chart is given in appendix III. Appendixes II and III are current as of 5 January 1971.

Paragraph 1-2-1. Delete paragraph 1-2.1 and substitute:

1-2.1. Indexes of 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 1-2.2 Delete paragraph 1-2.2 and substitute:

1-2.2. 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 700-58 (Army)/NAVSUP PUB 378 (Navy)/AFR 71-4 (Air Force)/ and MCO P4030.29 (Marine Corps).

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38 (Army)/NAVSUP PUB 459 (Navy) / AFM 75-34 (Air Force)/ and MCO P4610.19 (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, US Army Electronics Command, ATTN: AMSEL-ME-NMP-EM, Fort Monmouth, N. J., 07703.

Paragraph 1-8. After paragraph 1-8, add:

1-8.1. Adapter Connector UG-146B/U, Cables, Radio Frequency CG-56D/U and DA-75/U are required for initial operation of the AN/URM-120.

Paragraph 1-10. After paragraph 1-10, add:

1-10.1. The DA-75/U, with the above adapter connector and radiofrequency cable, prevents excessive radiation and provides the necessary load for bench testing.

Page 7, section V. Delete section V and substitute:

*This change supersedes C 1, 9 October 1963, and C 2, 9 September 1964.

Section V. ORGANIZATIONAL MAINTENANCE

5-1. Scope of Maintenance

The maintenance duties assigned to the operator and organizational repairman of Wattmeter AN/URM-120 are listed below together with a reference to the paragraphs covering the specific maintenance functions.

a. Daily preventive maintenance checks and services (para 5-4).

b. Weekly preventive maintenance checks and services (para 5-5).

c. Monthly preventive maintenance checks and services (para 5-6).

d. Quarterly preventive maintenance checks and services (para 5-7).

e. Cleaning (para 5-8).

f. Touchup painting (para 5-9).

g. Lubrication (para 5-10).

5-2. Preventive Maintenance

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

a. Systematic Care. The procedures given in paragraphs 5-4 through 5-8 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and services charts (para 5-4 through 5-7) 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 performing the corrective actions listed, higher category 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.

5-3. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of Wattmeter AN/URM-120 are required daily, weekly, monthly, and quarterly.

a. Paragraph 5-4 specifies the checks and services that must be accomplished daily (or at least once each week if the equipment is maintained in standby condition).

b. Paragraphs 5-5, 5-6, and 5-7 specify *additional* checks and services that must be performed on a weekly, monthly, and quarterly basis.

5-4. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Completeness	Check to see that the equipment is complete (fig. 1-1).	
2	Exterior surfaces	Clean the exterior surfaces, including the panel and meter glass (para 5-8). Check meter glass for cracks.	
3	Connector	Check the tightness of the connector.	
4	Controls and indicators.	While making the operating checks (item 5), observe that the mechanical action of the dial is smooth and free of external or internal binding, and that there is no excessive looseness. Also, check the meter for sticking or bent pointer.	
5	Operation	During operation, be alert for unusual performance or conditions.	

5-5. Weekly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Handle	Inspect handle for looseness. Replace or tighten as necessary.	
2	Metal surfaces	Inspect exposed metal surfaces for rust and corrosion. Touch up paint as required (para 5-9).	

5-6. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Lubrication	Lubricate the equipment (para 5-10).	
2	Gaskets and insulators.	Inspect gaskets, insulators, bushing, and sleeves for cracks, chipping, and excessive wear.	
3	Interior	Clean interior of chassis and cabinet.	

5-7. Quarterly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Publications	Check to see that all publications are complete, serviceable, and current.	DA Pam 310-4
2	Modifications	Check DA Pam 310-7 to determine if new applicable MWO's have been published. ALL URGENT MWO's must be applied immediately. ALL NORMAL MWO's must be scheduled.	TM 38-750 and DA Pam 310-7
3	Spare parts	Check all spare parts (operator and organizational) for general condition and method of storage. There should be no evidence or overstock, and all shortages must be on valid requisitions.	

5-8. Cleaning

Inspect the exterior of Wattmeter AN/URM-120. The exterior surfaces should be free of dust, dirt, grease, and fungus.

a. Remove dust and loose dirt with a soft, clean cloth.

WARNING

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of the fumes to an open flame converts the fumes to highly toxic, dangerous gases.

b. Remove grease, fungus, and ground-in dirt from the cases; use a cloth dampened (not wet) with trichloroethane.

c. Remove dust or dirt from plugs and jacks with a brush.

CAUTION

Do not press on the meter face (glass) when cleaning; the meter may become damaged.

d. Clean the meter, and control knobs; use a soft, clean cloth. If necessary, dampen the cloth with water; mild soap may be used.

5-9. Touchup Painting Instructions

Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TB 746-10.

5-10. Lubrication

After disassembly or calibration of the wattmeter, add a dab of approved lubricant to the head of each adjustment screw.

Page 21, appendix I. Delete appendix I and substitute:

APPENDIX I
REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U. S. Army Equipment Index of Modification Work Orders.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 38-750	The Army Maintenance Management System (TAMMS)

Appendix II. Delete appendix II and substitute:

APPENDIX II
BASIC ISSUE ITEMS LIST

Section I. INTRODUCTION

A2-1. Scope

This appendix lists items which accompany the AN/URM-120 or are required for installation, operation, or operator's maintenance.

A2-2. 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 AN/URM-120 and are required by the operator/crew for installation, operation, or maintenance.

b. Maintenance and Operating Supplies — Section III. Not applicable.

A2-3. 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 — *Explanation*

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.

X1— 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. Where such repair parts are not obtainable through cannibalization, requirements will 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

Code	Explanation
	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 repairable 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.
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 two-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 AN/URM-120.

f. Quantity Furnished With Equipment, Column 6. Not applicable.

g. Illustrations, Column 7. This column is divided as follows:

(1) *Figure number, Column 7a.* This column indicates the figure number of the illustration in which the item is shown.

(2) *Item number or reference designation.* This column indicates the item number used to identify the item in the illustration.

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	(5) QTY INC IN UNIT	(6) QTY FURN WITH EQUIP	(7) ILLUSTRATIONS (a) FIG NO.	(7) ILLUSTRATIONS (b) ITEM NO. OR REFERENCE DESIGNATION
	6625-813-8430	WATTMETER AN/URM-120 (This item is nonexpendable)				1-1	
		"Consisting of the following items required to have a complete operable equipment".					
	5935-505-5142	ADAPTER, CONNECTOR UG-146A/U (1 EA)					
	5995-753-2098	CABLE ASSEMBLY, RADIO FREQUENCY CG-56D/U (8 in) (1 EA)					
	6625-965-1476	CASE, WATTMETER CY-2606/URM-120 (1 EA)				9-1	3
	6625-790-0210	COUPLER-DETECTOR CU-753/URM-120 (1 EA)				9-1	2
	6625-826-7020	COUPLER-DETECTOR CU-754/URM-120 (1 EA)				9-1	2
	6625-826-2538	COUPLER-DETECTOR CU-755/URM-120 (1 EA)				9-1	2
	6625-177-1639	DUMMY LOAD, ELECTRICAL DA-75/U (1 EA)					
	6625-965-1477	WATTMETER TS-1265/URM-120 (1 EA)				9-1	1
		TECHNICAL MANUAL TM 11-6625-446-15	EA	1			
		Requisition through pinpoint account number if assigned; otherwise through nearest Adjutant General facility.					
		A quantity of one technical manual is packed with each equipment. Where a valid need exists, additional copies may be requisitioned and kept on hand.					
		NO PARTS AUTHORIZED OPERATOR/CREW					
		THE FOLLOWING ITEMS AND THEIR QUANTITIES ARE MOUNTED IN OR ON EQUIPMENTS FOR STORAGE PURPOSES					
		CASE, WATTMETER CY-2606/URM-12					
--C-S	6625-826-7020	COUPLER-DETECTOR CU-754/URM-120: 1	EA				
--C-S	6625-826-2538	COUPLER-DETECTOR CU-755/URM-120: 1	EA				

APPENDIX III
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

A3-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for the AN/URM-120. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

A3-2. Maintenance Functions

Maintenance functions will be limited to and defined as follows:

a. INSPECT. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

b. TEST. To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc. This is accomplished with external test equipment and does not include operation of the equipment and operator type tests using internal meters or indicating devices.

c. SERVICE. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

d. ADJUST. to rectify to the extent necessary to bring into proper operating range.

e. ALIGN. To adjust two or more components or assemblies of an electrical or mechanical system so that their functions are properly synchronized. This does not include setting the frequency control knob of radio receivers or transmitters to the desired frequency.

f. CALIBRATE. To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

g. INSTALL. To set up for use in an operational environment such as an encampment, site, or vehicle.

h. REPLACE. To replace unserviceable items with serviceable like items.

i. REPAIR. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes, but is not limited to welding, grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

j. OVERHAUL. Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

k. REBUILD. The highest degree of materiel maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours or miles the equipment, or component thereof, has been in use.

l. SYMBOLS. The uppercase letter placed in the appropriate column indicates the lowest level at which that particular maintenance function is to be performed.

A3-3. Explanation of Format

a. Column 1, Group Number. Not applicable.

b. Column 2, Functional Group. Column 2 lists the noun names of components, assemblies, subassemblies and modules on which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories. The codes used represent the various maintenance categories as follows:

Code	*Maintenance category*
C	Operator/crew
O	Organizational maintenance
F	Direct support maintenance
H	General support maintenance
D	Depot maintenance

d. Column 4, Tools and Equipment. Column 4 specifies by code, those tools and test equipment required to perform the designated function. The numbers appearing in this column refer to specific tools and test equipment which are identified in table I.

e. Column 5, Remarks. Self-explanatory.

A3-4. Explanation of Format of Table I (Tool and Test Equipment Requirements)

The columns in table I are as follows:

a. Tools and Equipment. The numbers in this column coincide with the numbers used in the tools and equipment column of the Maintenance Allocation Chart. The numbers indicate the applicable tool for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

d. Federal Stock Number. This column lists the Federal stock number of the specific tool or test equipment.

e. Tool Number. Not used.

SECTION II. MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS											TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD		
	WATTMETER AN/URM-120	O											6	
			D										1 thru 5	
					D								1 thru 5	
						D							1 thru 5	
										D			1 thru 5	
											D		1 thru 5	
	COUPLERS, DETECTOR CU-753/URM-120, CU-754/URM-120, CU-755/URM-120		D										1 thru 5	Couplers are not readily interchangeable with those of other units
					D								1 thru 5	
						D							1 thru 5	
										D			1 thru 5	

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE	FEDERAL STOCK NUMBER	TOOL NUMBER
		AN/URM-120 (cont)		
1	D	FILTERS, LOW PASS NARDA 3000-10, NARDA 3010-10		
2	D	WATTMETER AN/URM-98	6625-566-4990	
3	D	POWER SIGNAL SOURCE MICRO DOT 408, MICRO DOT 410		
4	D	MULTIMETER TS-352B/U	6625-553-0142	
5	D	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/G	5180-610-8177	
6	O	TOOLS AND TEST EQUIPMENT ISSUED TO OPERATOR BY VIRTUE OF HIS ASSIGNED DUTIES		

By Order of the Secretary of the Army:

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

Official:

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

Distribution:
Active Army:
USASA (2)
CNGB (1)
ACSC-E (2)
Dir of Trans (1)
CofEngrs (1)
TSG (1)
CofSptS (1)
USAARENBD (2)
USAMB (10)
USAAESWBD (2)
USARADBD (2)
USAAVNTBD (2)
USACDC (2)
USACDC Agcy (1)
USAJFKCENMA (5)
USAMC (1)
CONARC (5)
ARADCOM (2)
ARADCOM Rgn (2)
OS Maj Comd (4)
LOGCOMD (5)
USAMICOM (4)
USATECOM (2)
USASTRATCOM (4)
USAESC (70)
MDW (1)
Armies (2)
Corps (2)
1st Cav Div (3)
Svc Colleges (2)
USASESS (5)
USAADS (2)
USAFAS (2)
USAARMS (2)
USAIS (5)
USAES (2)
USAINTS (3)
WRAMC (1)
USACDCEC (10)
ARADMAC (5)
USAASTA (5)
USAATC (4)
Instl (2) except
Fort Gordon (10)
Fort Huachuca (10)
Fort Carson (21)
WSMR (3)
Army Dep (2) except
LBAD (14)
SAAD (30)
TOAD (14)
LEAD (7)
NAAD (5)
SVAD (5)
ATAD (10)
Gen Dep (2)
Sig Sec Gen Dep (5)
Sig Dep (10)
Sig FLDMS (2)
ATS (3)
USAERDAA (2)
USAERDAW (5)
USACRREL (2)
MAAG (1)
USARMIS (1)
AAF (1)
Units org under fol TOE
(2 copies each):
1-307
6-615
6-616
7
7-100
9-247
11-15
11-16
11-19
11-117
11-137
11-158
11-215
11-216
11-225
11-226
11-303
11-347
11-368
11-500 (AA-AC)
17
17-100
29-1
29-11
29-15
29-16
29-21
29-25
29-26
29-36
29-35
29-41
29-51
29-55
29-57
29-75
29-79
29-85
29-86
29-87
29-105
29-109
29-134
29-136
29-138
29-205
29-206
20-207
29-245
29-247
29-427
29-500
30-34
31-105
32-97
37
37-100
44-8
55-89
55-99
55-405
55-406
55-407
55-457
55-458
55-500
55-510
57
57-100
67
77-100

NG: State AG (3); units — same as active Army except allowance is one (1) copy to each unit.
USAR: None.
For explanation of abbreviations used, see AR 310-50.

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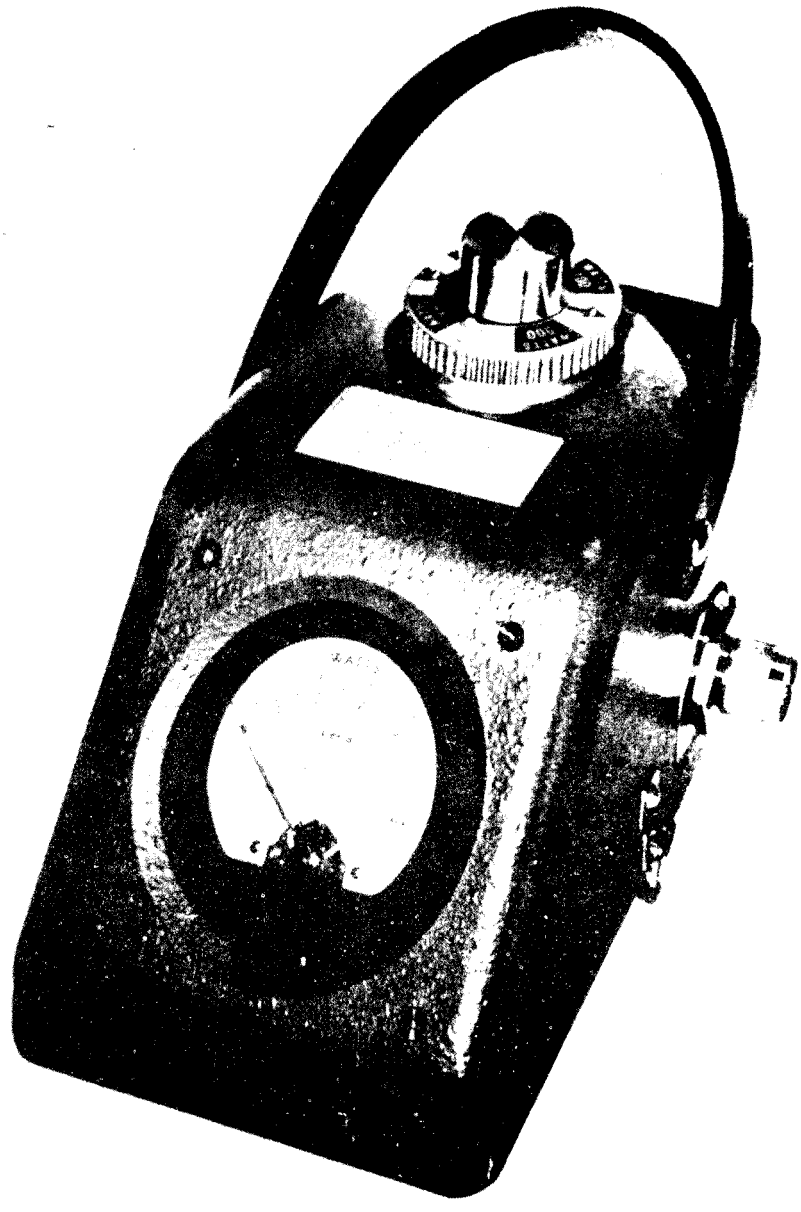

Figure 1-1. Wattmeter AN/URM-120

SECTION I

INTRODUCTION AND DESCRIPTION

1-1. IDENTIFICATION OF EQUIPMENT.

1-2. This publication contains instructions for operation and maintenance of Wattmeter AN/URN-120, manufactured by Sierra Electronics Company, Menlo Park, California, under Bureau of Aeronautics Contract NOas 59-0238-f.

1-3. GENERAL DESCRIPTION.

1-4. Wattmeter AN/URM-120 (figure 1-1) is designed to measure incident and reflected r-f power from 10 to 1000 watts within a frequency range of 2 to 1000 mc. Three coupler-detectors, each rated to cover a portion of this frequency range (table 1-1), are supplied with the wattmeter.

1-5. The wattmeter is housed in a small metal case weighing about 6-1/2 pounds and is about 7 inches wide, 6-5/8 inches high and 7-1/2 inches deep. It contains a coaxial primary line, indicating meter, and cable for interconnecting the meter to a coupler-detector. The coupler-detector has a knurled knob which projects through a hole in the top of the wattmeter case. On the knurled knob is a nameplate to indicate power range, and centered on the nameplate is the power range knob which can be rotated 360 degrees to any desired power range. The coupler-detector rotates only 180 degrees along the coaxial line. Two type-N connectors, one male and one female, are located on either side of the wattmeter case for connection between the power source and load.

1-6. Upper and lower parts of the wattmeter case are held together with quick acting fasteners, which permit easy access to the coupler-detector, the primary line, and the indicating meter. The primary line is held by four screws to the lower part of the case, and the meter yoke is held against the inside front slope of the case by four screws. Three plastic wedges, circled by a metal band and clamp, keep the coupler-detector seated above the primary line.

1-7. The coupler-detector is considered a separate part of the wattmeter only in the sense that it can be removed from the wattmeter case and replaced with a similar unit differing only in frequency and power characteristics. Three separate coupler-detectors are supplied with the wattmeter. Selection of a particular unit will depend upon the power source to be measured. Characteristics of each coupler-detector are tabulated in table 1-1.

1-8. Although the watt meter case assembly and coupler-detector function together, they can be stored separately when not in use. Principle elements of the case assembly are the indicating meter and primary line of the directional coupler.

1-9. PRINCIPLES OF OPERATION.

1-10. Power measurements are made by inserting the proper coupler-detector and connecting the wattmeter in series with the coaxial transmission line between the load and the r-f power source. To determine incident power, the arrow on the coupler-detector is rotated toward the load and the power range knob is positioned for peak meter reading. The reading is taken directly from the graduated meter scale which is made to correspond to the power range selected. Reflected power is also determined by peak meter reading, but the coupler-detector is rotated in the opposite direction toward the r-f source.

1-11. In effect, rotation of the coupler-detector orients the directional coupler which responds only to a wave traveling in a particular direction on the primary transmission system, while being unaffected by a wave traveling in the opposite direction on the primary line. A standard diode rectifier in the coupler-detector rectifies the energy picked up by the coupler. This energy is then measured across a known 50-ohm impedance system and metered as incident or reflected power. (See figure 1-2.)

TABLE 1-1. Coupler-Detector Characteristics

			Insertion VSWR (Max. value with type-N connectors on primary line)	
Model No.	Freq. Range (MC)	Power Range (Watts)	Lowest Power Range	3 Highest Power Ranges
CU-753/URM-120	2-30	50, 100, 500, 1000	1.08	1.08
CU-754/URM-120	25-250	10, 50, 100, 500	1.08	1.05
CU-755/URM-120	200-1000	10, 50, 100, 500	1.08	1.05

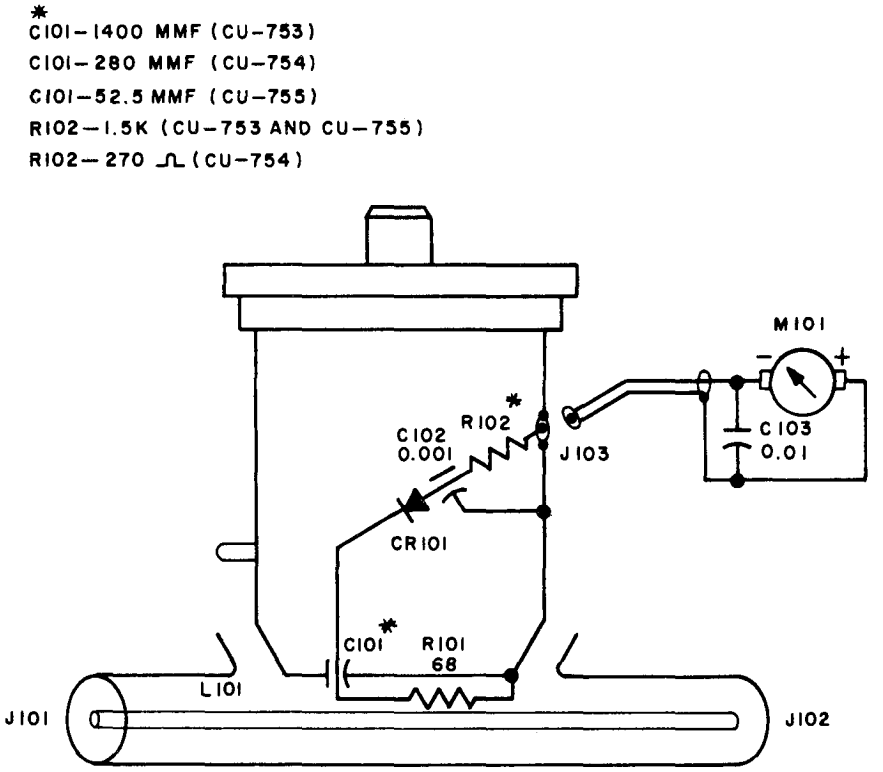

Figure 1-2. Wattmeter AN/URM-120, Schematic Diagram

SECTION II

SPECIAL SERVICE TOOLS

2-1. SPECIAL TOOLS.

2-2. No special tools are required other than a standard screw driver and Allen wrench set.

SECTION III

PREPARATION FOR USE, STORAGE, AND SHIPMENT

3-1. PREPARATION FOR USE.

3-2. In preparing the wattmeter for use, open the case and visually inspect the meter and directional coupler for damage and dirt. If the unit does not appear in good condition and cannot be corrected by following the procedure outlined in Chapter V, the unit should be replaced.

3-3. PREPARATION FOR STORAGE.

3-4. When storing the wattmeter, cover with a plastic all-purpose cover or place wattmeter in a carrying case, if one is supplied. The coupler-detectors must be stored with a plastic cup placed over the secondary line.

3-5. PREPARATION FOR SHIPMENT.

3-6. Special precautions against possible damage must be taken when shipping the wattmeter. Make certain that the unit is well wrapped and padded. A "fragile" stamp must appear on the outside of the box.

SECTION IV

OPERATION INSTRUCTIONS

4-1. INTRODUCTION.

4-2. After determining that the r-f power source has been turned off, connect the wattmeter in the transmission line either at the load or r-f source. Make certain that connections are tight.

4-3. CONNECTION OF COUPLER-DETECTOR.

4-4. Use the following procedure for inserting the coupler-detector:

a. Disengage the two quick action fasteners on sides of wattmeter case.

b. Remove case cover.

c. Select proper coupler-detector from table 1-1.

d. Insert coupler-detector into receptacle on primary line.

e. When coupler-detector appears to be properly seated, snap receptacle clamp fastener closed.

f. Remove wire shunt from meter terminals.

g. Connect meter cable and replace cover on case.

4-5. PURPOSE OF OPERATING CONTROLS.

4-6. Only two controls are necessary to operate the wattmeter. One is the knurled-topped coupler-detector itself which can be rotated 180 degrees. The large arrow on top of the coupler-detector will point in the direction of power flow. For example, if the arrow points toward the load it is in position for incident power measurement. A circular nameplate with power ranges etched on its surface is attached to the top of each coupler-detector.

4-7. The power range knob, on top and in the center of the nameplate, rotates within but independently of the coupler-detector. The knob can be rotated 360

degrees to any desired power range shown on the circular nameplate. The power range knob adjusts the distance between the secondary and primary lines by extending or retracting the secondary line. For example, the secondary line is moved closer to the primary line for a 10-watt measurement than for a 1000-watt measurement.

4-8. WATTMETER OPERATION

4-9. Use the following procedure to operate the wattmeter:

a. Place power range knob in position higher than rated power of r-f source.

NOTE

It is assumed that rated power of the r-f source is known. If the rated power is not known, place the power range knob in the highest power position before the power source is turned on.

b. To measure incident power, rotate coupler-detector so that power flow indicating arrow points toward load.

c. Apply r-f power to line under test.

d. Rotate power range knob from original power range toward next lower power range, selecting proper power range for measuring power of r-f source under test.

e. Observe point at which meter peaks and record incident power reading.

f. To measure reflected power, set power range knob to highest position and rotate coupler-detector so that arrow points toward r-f source.

g. Repeat steps a through e. Record reading.

h. To check consistency of readings, repeat procedure for incident power measurement and compare results to reading originally obtained.

i. After power measurements have been completed, replace wire shunt on meter terminals.

4-10. INTERPRETING POWER MEASUREMENTS.

4-11. In measuring r-f power, the wattmeter functions as a test instrument to determine the efficiency of an entire antenna system. This is done in two ways. The first calculates the voltage standing wave ratio (VSWR) of the load. The other method calculates the power absorbed by the load.

4-12. VSWR MEASUREMET. The VSWR of the load may be determined from the chart (figure 4-1) after incident and reflected power meter readings have been obtained. As an example, if the incident power is 50 watts and the reflected power is 5.5 watts, the VSWR of the load is 2.0. This result is obtained by reading the diagonal line which crosses the intersection of the Pi vertical and Pr horizontal lines. For a more precise answer, the following formula can be used:

$$VSWR = \frac{\sqrt{Pi} + \sqrt{Pr}}{\sqrt{Pi} - \sqrt{Pr}}$$

4-13. POWER ABSORBED BY LOAD. The r-fpower absorbed by the load can be determined by subtracting the reading of the reflected power from the reading of the incident power. For example, if the incident power reading is 50 watts and the reflected power reading is 5.5 watts, the power absorbed by the load is 50 watts minus 5.5 watts or 44.5 watts.

4-14. ERRORS INCORPORATED IN MEASUREMENTS. Because the wattmeter employs a peak reading type of metering circuit calibrated on the basis of a sinsoidal r-f waveform, it is subject to errors produced by harmonic distortion and by imperfect directivity of the directional coupler. Harmonic distortion can be minimized by using a low-pass filter, but not too much can be done about imperfect directivity.

4-15 To compensate for errors caused by imperfect directivity and harmonic distortion, a ±5 percent full-scale tolerance is used in calculations of reflected power. Percentage of error due to imperfect directivity in incident power measurements is for all practical purposes negligible. However, error caused by harmonic distortion is appreciable and is taken into account. For example, suppose conditions indicate an incident power of 40 watts and a reflected power of 2 watts. If the incident power is read on the 50-watt scale, the error will not exceed ± 2.5 watts (± 5 percent times 50 watts full scale), regardless of the directivity of the coupler-detector.

4-16. The following is an example of how error is accounted for in reflected power readings:

incident power = 40 watts

reflected power = 2 watts (reading taken with a coupler-detector having a directivity of 25db (300:1) on the 5-watt scale)

$$\text{error} = \pm\left[5 \text{ percent full scale} \times 5W + \frac{\text{measured incident power}}{300}\right]$$

$$= \pm\left[0.05 \times 5W + \frac{40W}{300}\right]$$

$$= \pm 0.38 \text{ watt.}$$

If the reflected power reading is taken with a coupler-detector having a directivity of 20db (100:1) and is indicated on the 5-watt scale, its error will be:

$$\pm\left[5 \text{ percent full scale} \times 5W + \frac{\text{measured incident power}}{100}\right]$$

$$= \pm 0.65 \text{ watt}$$

See table 4-1 for calculation of error in reflected power measurement.

4-17. In addition to measuring incident and reflected power, the wattmeter can also be used to determine the percent of modulation by measuring power under modulated conditions (Pm) and power under c-w conditions

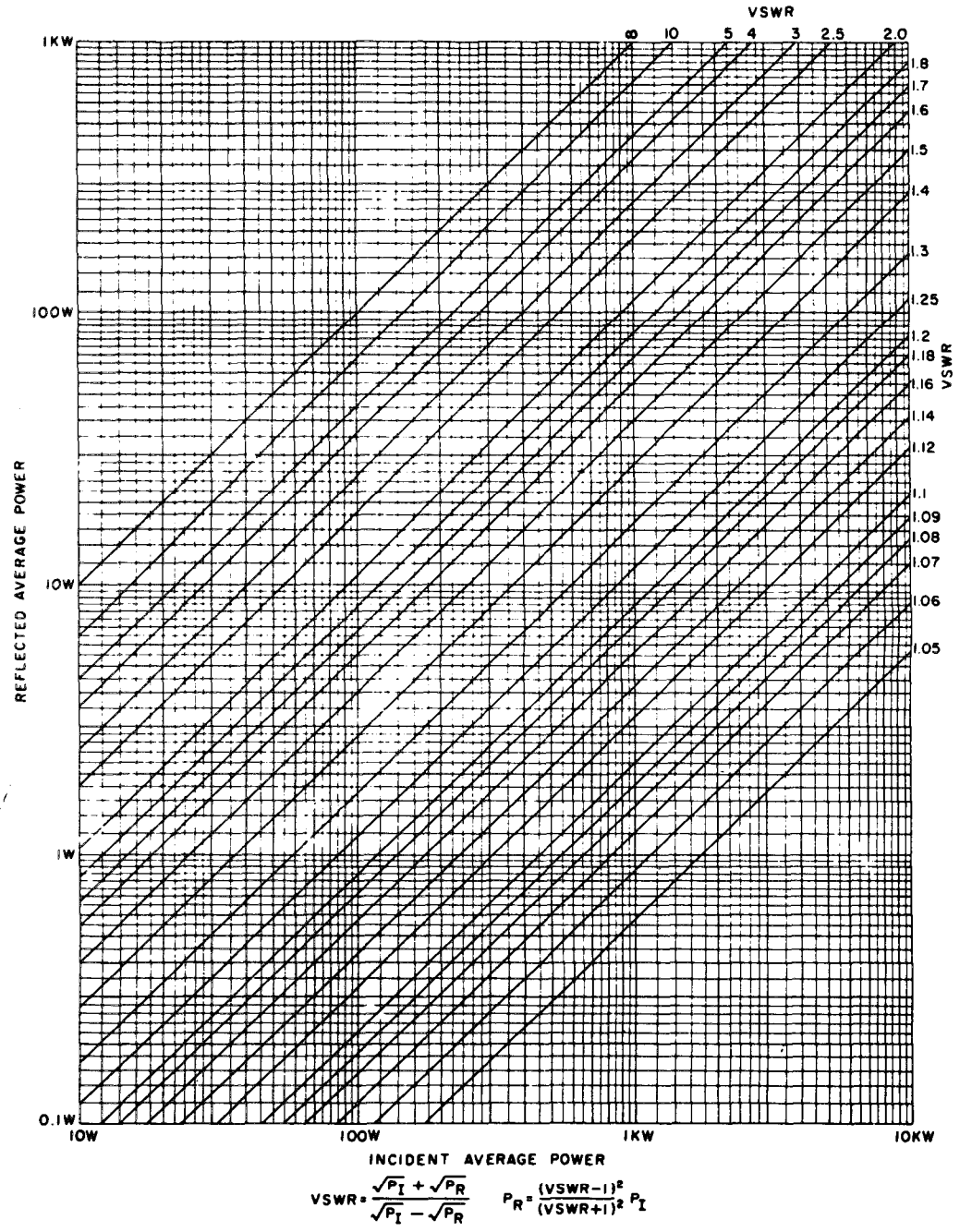

Figure 4-1, Graph of Relation Between Incident Power, Reflected Power, and VSWR.

(Pcw). Percent of modulation can then be calculated by the following formula:

$$\text{percent of modulation} = 141 \left(\frac{Pm}{Pcw} - 1\right).$$

This formula is based on the principle that the average power of a symmetrical wave modulated carrier increases over the c-w level because of the additional power developed in the side bands. The wattmeter is capable of measuring this increase in power because of the detector square law characteristic and the linear power scale.

TABLE 4-1 Reflected Power Error Calculations

Coupler-Detector Model No.	Reflected Power Error Calculations
CU-753/URM-120	± 5% of full scale + $\frac{\text{measured incident power}}{500}$
CU-754/URM-120	± 5% of full scale + $\frac{\text{measured incident power}}{500}$
CU-755/URM-120	± 5% of full scale + $\frac{\text{measured incident power}}{500}$

SECTION V

MAINTENANCE AND LUBRICATION

5-1 MAINTENANCE.

5-2. Normal maintenance only should be required on this instrument providing it receives normal use. When the coupler-detector is removed, care must be taken to prevent dirt or grit particles from entering the primary line. Foreign particles should not be allowed to collect on the mating surfaces between the coupler-detector and the primary line.

CAUTION

The coupling loop should not be cleaned because any distortion in shape will destroy meter calibration.

Wherever the coupler-detector is removed from the primary line, the power range knob should be set to the highest power range.

Use plastic cap provided to protect end of the coupler-detector when it is not in use.

5-3. LUBRICATION

5-4. After disassembly or calibration of the wattmeter, add a small dab of approved lubricant to the head of each adjustment screw.

SECTION VI

TROUBLE SHOOTING

6-1 TROUBLE SHOOTING ANALYSIS.

6-2. Under certain conditions insertion of the power wattmeter between the r-f source and the r-f load may cause a change in the r-f power delivered to the load. This occurs when the transmission line is mis-matched at the r-f load. The result is an extension of the effective line length when the wattmeter is inserted. The short section of line contained in the wattmeter changes the electrical length of the system and therefore causes a change in the impedance into which the power source must work. This condition may be handled by one of the following methods:

a. Retune or readjust r-f power source for normal delivery.

b. Add section of transmission line to power wattmeter such that combined length of added section and wattmeter equals one-half wavelength for frequency in use. Remove added section when wattmeter is removed from system. The electrical length of wattmeter primary line with type-N connectors is 19.7 cm.

c. Permanently include short section of transmission line in r-f load equal to electrical length of line contained within wattmeter. When using wattmeter, remove short section of line to maintain over-all electrical length of system transmission line.

6-3. TROUBLE SHOOTING PROCEDURE.

6-4. The following malfunctions (table 6-1) which can occur in the watt meter are not the complete list, and should be used only as a guide:

TABLE 6-1. Trouble Shooting Table (See figure 1-2)

Trouble	Probable Cause	Remedy
No meter indication for incident or reflected power.	1. Open resistor R102 in coupler-detector.	Replace part.
	2. Shorted capacitor C101 or C102.	Replace part.
	3. Shorted meter capacitor C103.	Replace part.
	4. Meter shunt not removed.	Remove shunt.

TABLE 6-1. Trouble Shooting Table (Cont)

Trouble	Probable Cause	Remedy
	5. Coaxial cable from meter to coupler-detector disconnected or broken.	Repair cable.
	6. Faulty diode CR101 in coupler-detector.	Replace diode.
	7. Transmitter inoperative.	Turn on power.
High VSWR	1. Defective load.	Repair or replace.
	2. Short or open transmission line.	Repair.
	3. Corroded connectors.	Repair.
Intermittent or inconsistent meter reading.	1. Faulty load.	Replace.
	2. Faulty transmission line.	Replace or repair.
	3. Meter needle sticks.	Check for bearing damage.

SECTION VII

OVERHAUL INSTRUCTIONS

7-1. SPECIAL OVERHAUL TOOLS.

7-2. No special overhaul tools are required to overhaul the wattmeter. The only tools used include an ordinary screwdriver, a No. 4 Allen wrench, and a 1/2-inch hexagonal socket wrench.

7-3. REASSEMBLY.

7-4. The indicating meter, coupler-detector, and primary line of the wattmeter can be removed only after the case has been opened. To open the case (figure 9-1), release the quick-acting fasteners that hold the upper and lower sections of the wattmeter case together.

7-5. METER.

7-6. To remove the meter from the upper section (figure 9-2), remove the four mounting screws that secure the meter yoke and lift both the yoke and meter from the case.

7-7. COUPLER-DETECTOR.

7-8. Three plastic wedges hold the coupler-detector in the primary line. To remove the coupler-detector, disconnect the meter cable from the side of the unit and release the clamp holding the three plastic wedges against the unit. Twist the unit and carefully pull up. If the unit does not come free immediately, check the plastic wedges to see that they are not interfering with removal.

7-9. Refer to figure 9-3 and disassemble the coupler-detector in accordance with the following procedure:

a. Using a small screwdriver, loosen setscrew in power range knob (1) and remove knob.

b. Remove the two screws (2) and lockwashers (3) that hold nameplate (4) machined knob (6) and remove nameplate.

c. Using a l/2-inch hexagonal socket wrench, remove the crystal diode assembly (23 through 34) from the machined slug (11).

d. Using a No. 4 Allen wrench, remove the four screws (5) that hold the machined knob (6) to the sleeve (21).

e. Lift cam (9) from top of machined slug (11).

f. Lift machined slug (11) and its contents from sleeve (21).

g. Remove the four screws (19) that secure the loop mounting plate (15) to the bottom of machined slug (11).

h. Remove the two spring-retaining caps (13) and the two slug-loading springs (12).

i. Using a low-wattage soldering iron, unsolder pickup loop (18) from capacitor (14) and resistor (17) and remove pickup loop.

j. Remove capacitor (14) from insert in loop mounting plate (15).

k. Remove resistor (17) from resistor mounting cup (16) on loop mounting plate (15).

7-10. PRIMARY LINE.

7-11. The primary line is separated from the case by removing the four mounting screws at the bottom of the case.

7-12. CRYSTAL DIODE ASSEMBLY.

7-13. Refer to figure 9-3 and disassemble the crystal diode in accordance with the following procedure:

a. Remove diode insulating washer (23) from crystal diode (25).

b. Remove diode cap (24) from end of crystal diode (26).

NOTE

The diode cap is used only on coupler-detectors No. 180-1000 and No. 181-1000.

c. Remove crystal diode (26); resistor-capacitor assembly consisting of capacitor (27), resistor (28), and resistor insulating bushing (29); and tubing (31).

NOTE

When replacing the crystal diode, be sure to wrap upper portion of diode with short strip of l/4-inch Scotch tape.

7-14. CLEANING.

7-15. Periodically clean all internal and external surfaces of the wattmeter using a clean, lint-free cloth. No attempt should ever be made, however, to clean the coupling loop as any distortion in shape would destroy meter calibration and accuracy.

7-16. INSPECTION.

7-17. Periodically inspect the wattmeter for evidence of damage or wear. Special attention should be given to the coupling loop and to the plastic inserts that hold

the coupler-detector in place. The loop must not be displaced from its calibrated position.

7-18. REPLACEMENT.

7-19. The crystal diode is the only part requiring special instructions for replacement. Replace the diode in accordance with the following procedure:

a. Using a 1/2-inch hexagonal socket wrench, remove crystal diode assembly from side of the coupler-detector.

b. Lightly tap side of coupler-detector assembly to remove crystal diode.

c. Refer to Section IX for replacement crystal diode part.

NOTE

When replacing a crystal diode be sure to wrap upper portion of diode with short strip of l/4-inch Scotch tape.

7-20. REASSEMBLY.

7-21. All reassembly procedures are made by reversing the order of disassembly as outlined in paragraph 7-3.

7-22. CALIBRATION.

7-23. The wattmeter may be recalibrated or checked for accuracy by using the following equipment:

a. Appropriate power signal source.

b. Low-pass filter (Sierra Model 184 Series or Hewlett-Packard 360 Series).

c. Fifty-ohm terminations (Sierra Model 160 series).

d. Directional coupler (Sierra Model 138A or 150 with special coupling factor calibration to ±0.16 db).

e. Power meter (Hewlett-Packard 430C special calibration at ±2 percent accuracy). This or any other combination of power measuring equipment having equivalent accuracy and standards may be used.

7-24. CALIBRATION PROCEDURE .

7-25. Calibration may be checked at any frequency within the range of the coupler-detector involved. Connect the coupler-detector into the test setup shown in figure 7-1 and proceed as follows:

a. Remove power range knob and circular nameplate from top of coupler-detector.

b. Replace power range knob, being certain that set screw is tightened on shaft flat.

c. Rotate knob to proper power range using circular nameplate as guide. Arrow on nameplate should point toward side of coupler-detector which contains meter cable plug.

d. Rotate coupler detector to read power flowing toward termination.

e. Apply power from signal source and adjust level until bolometer-power meter combination gives desired reading. Be sure to take into account the coupling factor of the directional coupler at the frequency being used.

f. Note reading on wattmeter meter.

NOTE

The reading on the wattmeter meter can be adjusted within narrow limits by means of an adjustment screw provided for each power range. The adjustment screws are inside the coupler-detector and are accessible through holes in the top of coupler-detector. The appropriate adjustment screw is adjacent to the dot or arrow on the power range knob.

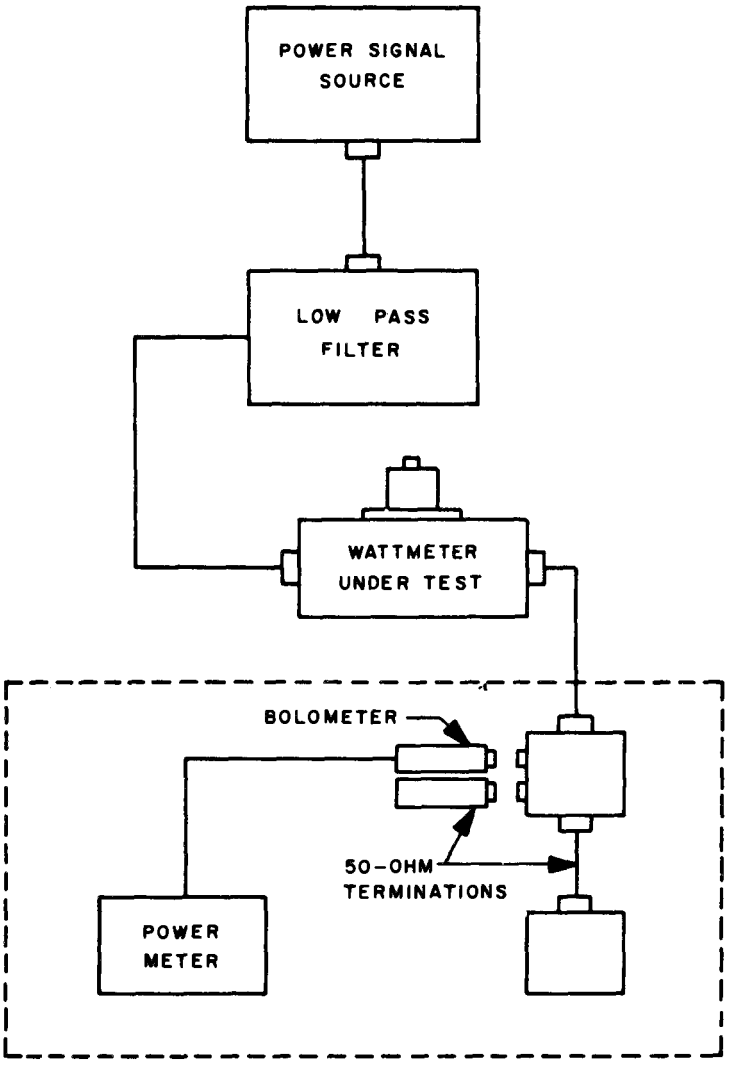

Figure 7-1. Coupler-Detector Test Set-up

SECTION VIII

INTRODUCTION TO ILLUSTRATED PARTS BREAKDOWN

8-1. PURPOSE OF BREAKDOWN.

8-2. This Illustrated Parts Breakdown provides information on components, assemblies, and detail parts of Wattmeter AN/URM-120 for identification, requisitioning, issuance of parts, and for illustrating assembly and disassembly relationships which can be used in conjunction with Section VII of this handbook. This breakdown is divided into four main categories; the Introduction, the Parts List, the Numerical Index, and the Reference Designation Index.

8-3. SCOPE OF BREAKDOWN.

8-4. This breakdown incorporates all details of the nomenclatured item. The contract number, serial number, and NAVAER type designation appear on the name plate of the Wattmeter.

8-5. GROUP ASSEMBLY PARTS LIST.

8-6. GENERAL.

8-7. Each assembly listed is followed immediately by its detail parts, properly indented thereunder to show their relationship to the assembly. Detail parts of the complete wattmeter which are not included in any assembly but which are used in conjunction with, which attach to or which mount a certain assembly are listed, in line with the major assembly, either preceding the first detail part or following the last detail part of the assembly.

8-8. EXPLANATION OF COLUMN DETAILS.

8-9. FIGURE AND INDEX NUMBERS. The figure and index numbers, which are numerically arranged in the Group Assembly Parts List, are used mainly to assist in locating a part in the Group Assembly Parts List after it has been found in the Numerical Index.

8-10. PART NUMBERS. JAN or AN part numbers are used, wherever available, to identify parts. Since this instrument is a commercial item rather than one which has been designed in accordance with JAN or AN standards, most of the parts do not carry JAN or AN identifying numbers. For those parts, the manufacturer's identity is located in parentheses following the description of the item.

8-11. DESCRIPTION. The description consists, principally, of a manufacturer's, and JAN or AN drawing title to identify each part.

8-12. UNITS PER ASSEMBLY. In the case of assemblies, the quantities listed in the "Units per Assy" column of the Group Assembly Parts List are the total quantities used per wattmeter at the location indicated, while the detailed parts indented under the assemblies are the quantities used per assembly. The quantities specified, therefore, are not necessarily the total used per wattmeter. Refer to the Numerical Index (Section X) for the total quantities used per wattmeter.

8-13. USABLE ON CODE. Part variations within the components of the wattmeter, due to slight differences within the coupler-detector plug in assemblies are identified by the letters A, B, or C, immediately following the description in the "Usable on Code" column. In the cases where this column is left blank, the parts listed are common to all wattmeters produced and delivered as part of this contract.

Item		Usable on Code
Coupler-Detector	CU-753/URM-120	A
Coupler-Detector	CU-754/URM-120	B
Coupler-Detector	CU-755/URM-120	C

8-14 NUMERICAL INDEX.

8-15. The Numerical Index (Section X) lists all the identifying part numbers given in the Group Assembly Parts List.

8-16. PART NUMBER LISTING.

8-17. The part numbers are listed in accordance with the following numerical part-number filing system:

a. The order of precedence in beginning the part-number arrangement on the extreme left hand position of the part number is as follows:

Letters A through Z
Numerals 0 through 9

NOTE

Alphabetical O's are considered as numerical zeros.

b. The order of precedence in continuing the part-number arrangement on the second and succeeding positions of the part number from left to right is as follows :

Space (blank column)
Diagonal (/)
Point (.)
Dash (-)
Letters A through Z
Numerals 0 through 9

8-18. SOURCE CODES. MAITENANCE CODES, AND RECOVERABILITY CODES.

8-19. Source codes are codes which indicate to a consumer a source for a part required in the maintenance or repair of an article. Specifically, these codes indicate whether the material is to be requisitioned from the supply system; to be manufactured; to be obtained from salvage; not to be replaced since the next higher assembly is to be installed; not to be replaced due to the impracticability of replacement; to be procured for the specific requirement: to use local discretion regarding obtaining a replacement; or failure of the part indicates a requirement for complete overhaul or scrapping of the assembly or equipment.

8-20. CODE “P” -- ITEMS PURCHASED, SUPPLY SYSTEM STOCK. Code “P” is applied to items which are purchased in view of known or anticipated usage and which are relatively simple to manufacture within the Navy, if necessary.

8-21. Code “P1” is applied to items which are purchased in view of known or anticipated usage and which are very difficult, impractical, or uneconomical to manufacture within the Navy.

8-22. Code “P2” is applied to items for which little usage is anticipated but which are purchased in limited quantity for insurance purposes. Items coded “P2” are difficult to manufacture, require special tooling and/or stock not nor really available within the Naval establishment, or require long production lead time.

8-23. Code “P3” is applied to detail items which are purchased in quantity in accordance with the life expectancy of the part. Items coded “P3” are deteriorative in nature and may require special storage conditions.

8-24. Code "P4" is applied to end items which are procured for initial outfitting only and which are replaced by salvage, manufacture or assembly at the lowest capable level of maintenance.

8-25. CODE “M” MANUFACTURE - ITEMS NOT PURCHASED. Code “M-F” is applied to items which are capable of being manufactured within Class “C”, “D”, “E” or “F” activities. Items coded “M-F” have no anticipated or relatively low usage, or possess restrictive installation or storage factors. Code "M-F" will not be applied to an item when the same item is coded in the “P” series for other applications and system support is maintained; when the item appears in the Navy Stock List of Federal Stores or the Electronic Supply Office List of Common Electronic Parts in the Electronic Supply System; or when supply support responsibility for the item has been vested in another inventory manager. With respect to support equipment, the manufacturing activity may alter the design, material and processes provided that fit, function, use, and safety are not impaired.

8-26. Code “M-O” is applied to items which are capable of being manufactured within Class “A” or “B” activities. Items coded “M-O” have no anticipated or relatively low usage, or possess restrictive installation or storage factors. Code “M-O’ will not be applied to an item when the same item is coded in “P” series for other applications and system support is maintained, when the item appears in the Navy Stock List of Federal Stores or the Electronic Supply Office List of Common Electronic Parts in the Electronic Supply System; or when supply support responsibility for the item has been vested in another inventory manager. With respect to support equipment, the manufacturing activity may alter the design, material and processes provided that fit, function, use, and safety are not impaired.

8-27. CODE “A” -- ASSEMBLE-ASSEMBLY NOT PURCHASED. Code “A-F” is applied to assemblies which are not purchased but which are to be assembled within Class “C”, “D”, “E” or “F” activities prior to installation. At least one of the items in the assembly must be a coded “P” series item which carries an individual part number and description.

8-28. Code “A-O” is applied to assemblies which are not purchased but which are to be assembled within Class “A” or “B” activities prior to installation. At least one of the items in the assembly must be a coded “P” series item which carries an individual part number and description.

8-29. CODE “N” - NOT STOCKED - WILL BE PURCHASED ON DEMAND. Code “N” is applied to items which do not meet established criteria for stocking and which are normally readily available from commercial sources. Items coded “N” will be purchased on demand in accordance with applicable procedures. This type item is for immediate consumption and will not be stock numbered. With respect to support equipment, equivalent items may be substituted for specific “N” coded items provided fit, function, use, and safety are not impaired.

8-30. CODE ‘X”. Code “X” is applied to main structural members or similar items which, if required, would suggest extensive repair. The need for an item, or items, coded “X” will normally result in a recommendation for complete overhaul or retirement of equipment from service.

8-31. Code “Xl” is applied to items for which purchase of the next larger assembly source coded in the “P” series is justified; e.g., an internal detail item, such as welded segments inseparable from the assembly, an item which must be machined and installed with other items in a matched set, or an item of an assembly which, if required, would suggest extensive reconditioning of each assembly.

8-32. Code “X2” is applied to items which are not purchased for stock but may be acquired for use through salvage or one time purchase. Activities requiring such items will attempt to obtain from salvage; if not obtainble from salvage, reasonably locally manufactured or procurable, such items will be requisitioned through normal supply channels with supporting justification. Repeated requests may justify a change to the “P” series code.

8-33. CODE “U”. Code “U” is applied when not of supply significance.

8-34. MAINTENANCE CODE DEFINTIONS. Maintenance codes as applied to purchased items are codes which reflect known or anticipated usage at levels of maintenance as defined in reference (b). Maintenance code “O” indicates Class “A” or “B”. Maintenance code “F” indicates Class “C”, “D”, "E" or "F". Maintenance codes shall be omitted from end item support equipment. Maintenance codes as applied to manufacture and/or assembly are to be assigned as directed by this instruction.

8-35. RECOVERABILITY CODE DEFINITIONS. Recoverability codes are codes which reflect the recoverability characteristics of items removed from equipment at time of maintenance, repair or overhaul; i.e., repairable, salvageable or consumable.

a. Code "R" - Repairable. Items which are economical and practical to repair on a scheduled basis. Replacements are obtained from the supply system on an ex-

be lost or damaged beyond recognition.

b. Code “S” - Salvageable. Items which are economical and practical to salvage and which may be placed in “Ready for Issue” condition. “S” coded items are not normally scheduled in the overhaul program and may contain items or materials which are usable, valuable or critical, and which may be placed in the supply system for issue.

c. Code “C” - Consumable. Items that are neither repairable nor salvageable.

8-36. TOTAL QUANTITY.

8-37. The “Total Quantity” column in the Numerical Index lists the total units required per wattmeter. where more than one detail part, subassembly, or assembly of a component is covered in the Illustrated Parts Breakdown, the largest total quantity will be shown.

8-38. REFERENCE DESIGNATION INDEX.

8-39. This index lists all reference designations shown on the schematic diagram.

8-40. REFERENCE DESIGNATION.

8-41. A reference designation consists of one or two capital letters followed by a group of numbers. These combinations are used in order to identify a detail part, subassembly, or assembly with respect to its location in a photograph, schematic, or wiring diagram.

8-42. ALPHABETICAL PORTION OF REFERENCE DESIGNATION. The following is an alphabetically arranged list showing the type of part indicated by the letters.

Letter	Part
A	Structural parts (panels, frames, castings, etc.)
C	Capacitors of all types.
CR	Rectifiers
E	Miscellaneous electrical parts (terminal boards, insulators, knobs, brushes, etc.)
J	Jacks and receptacles (fixed connectors)
L	Inductors (r-f and a-f)
M	Meters of all types
O	Mechanical parts (bearings, shafts, etc.)
R	Resistors (fixed, variable, potentiometers)
Y	Crystals, mechanical oscillators

8-43. NUMERICAL PORTION OF REFERENCE DESIGNATION. Normally, more complex electronic instruments and systems have reference designators assigned in such a manner that a quick identity can be made to either an assembly, subassembly, or component. This wattmeter is relatively simple, having very few electrical parts, and the reference symbols begin at 100.

8-44. EXPLANATION OF TERMS, ABBREVIATIONS, AND SYMBOLS.

8-45. TERMS.

8-46. The term “AR” in the quantity column indicates bulk parts used “as required, ” while the term “Ref” in the quantity column indicates that the item is listed for “reference purposes” only.

8-47. ABBREVIATIONS.

8-48. The abbreviations used in this breakdown are listed in ANA Bulletin No. 261.

8-49. MANUFACTURERS’ NAME CODE SYMBOLS.

8-50. Normally, each part supplied by the manufacturer for use by the prime contractor is identified as to its manufacturer by a code symbol in parentheses following the description of the part in the Group Assembly Parts List. This code will be furnished as a part of the first revision of this handbook when source codes, etc. are assigned.

8-51. HOW TO USE THE ILLUSTRATED PARTS BREAKDOWN.

8-52. To permit complete identification of all parts, the procedure in table 8-1 is to be followed:

TABLE 8-1. Parts Identification Procedure

Given	To Find:	Use Applicable Procedure
Reference Designation	Figure Stock Number Part Number	a. Refer to Section XI. b. Locate reference designation c. Figure index, stock number, and part number are listed opposite reference designation
	Source Code Figure Index Quantity per Article	a. Refer to Section XI. b. Locate reference designation. c. Part number is listed opposite reference designation. d. Refer to Section X, using part number. e. Source code, figure index, and quantity per article are listed opposite part number.
	Illustration Part Number Description Units per Assembly Usable on Code	a. Refer to Section XI. b. Locate reference designation. c. Figure index is listed opposite reference designation. d. Refer to Section IX, using figure index. e. Part number, description, units per assembly, and usable on code are listed opposite the part number.
Part Number	Stock Number Source Code Figure Index Quantity per Article	a. Refer to Section X. b. Locate part number. c. Stock number, source code, figure index, and quantity per article are listed opposite the part number.
	Illustration Description Units per Assembly Usable on Code	a. Refer to Section X. b. Locate part number. c. Figure index is listed opposite part number. d. Refer to Section IX, using figure index. e. Description, units per assembly, and usable on code are listed opposite figure index.
Location of Part	Illustration Figure Index Part Number Description Units per Assembly	a. Refer to Table of Contents. b. Locate Group Assembly. c. Page number is listed opposite Group Assembly. d. Refer to Section IX, using page number. e. Locate figure index of part in illustration. f. Refer to Group Assembly Parts List following illustration, using figure index. g. Part number, description, units per assembly, and usable on code are listed opposite figure number.
	Stock Number Source Code Quantity per Article	a. Refer to Table of Contents. b. Locate Group Assembly. c. Page number is listed opposite Group Assembly. d. Refer to Section IX, using page number. e. Locate figure index of part in illustration. f. Refer to Group Assembly Parts List following illustration, using figure index. g. Part number is listed opposite figure index. h. Refer to Section X, using part number. i. Locate part number. j. Stock number, source code, and quantity per article are listed opposite part number.

8-53. ORDERING SPARE PARTS.

8-54. Each Service using this list has established certain depots and service groups for the storage and issuance of spare parts to its organizations requiring them. Tbe regulations of each Service should be studied to determine the method and source for requisitioning spare parts. The information in this list, as to manufacturer's or contractor's name, or the type, model, or drawing number, is not to be interpreted as authorization to field agencies to attempt to purchase identical or comparable spare parts directly from the manufacturer, or from wholesale or retail store, except under emergency conditions, as covered by existing regulations of the Service concerned. The parts chosen for use in this instrument have probably been chosen for special qualities not available in standard components, and the use of a standard component may result in decreased life or lowered performance.

SECTION IX

GROUP ASSEMBLY PARTS LIST

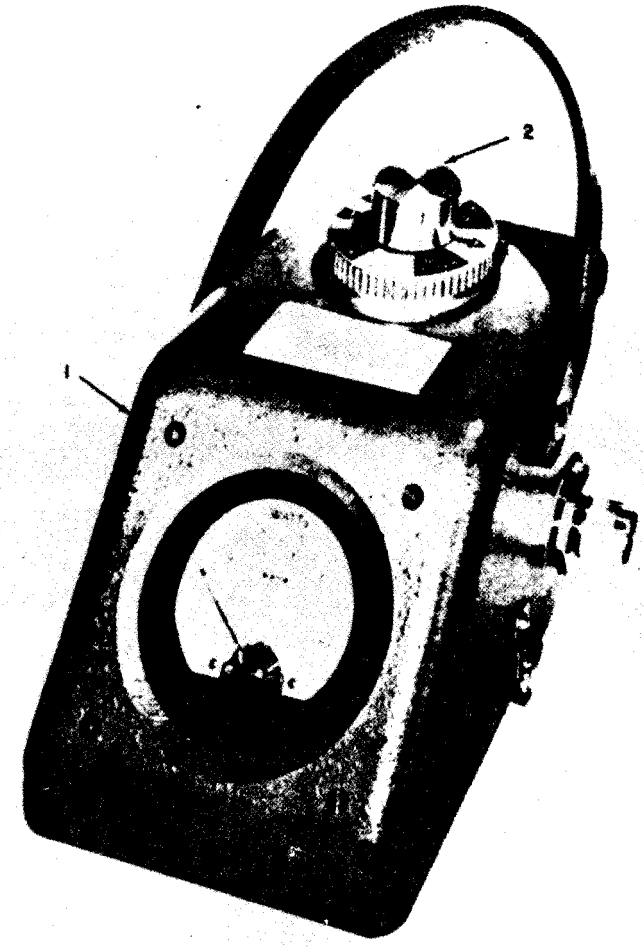

Figure 9-1. Wattmeter AN/URM-120, Oblique View

FIG. & INDEX NO.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE CODE
9-1	AN/URM-120	WATTMETER AN/URM-120	1	
-1	TS-1285/URM-120	. WATTMETER TS-1285/URM-120 : : : :	1	
-2	CU-753/URM-120	. . COUPLER-DETECTOR CU-753/URM-120 .	1	
-2	CU-754/URM-120	. . COUPLER-DETECTOR CU-754/URM-120 .	1	
-2	CU-755/URM-120	. . COUPLER-DETECTOR CU-755/URM-120 .	1	
-3	CY-2606/URM-120	. . CASE, Wattmeter CY-2606/URM-120 . .	1	

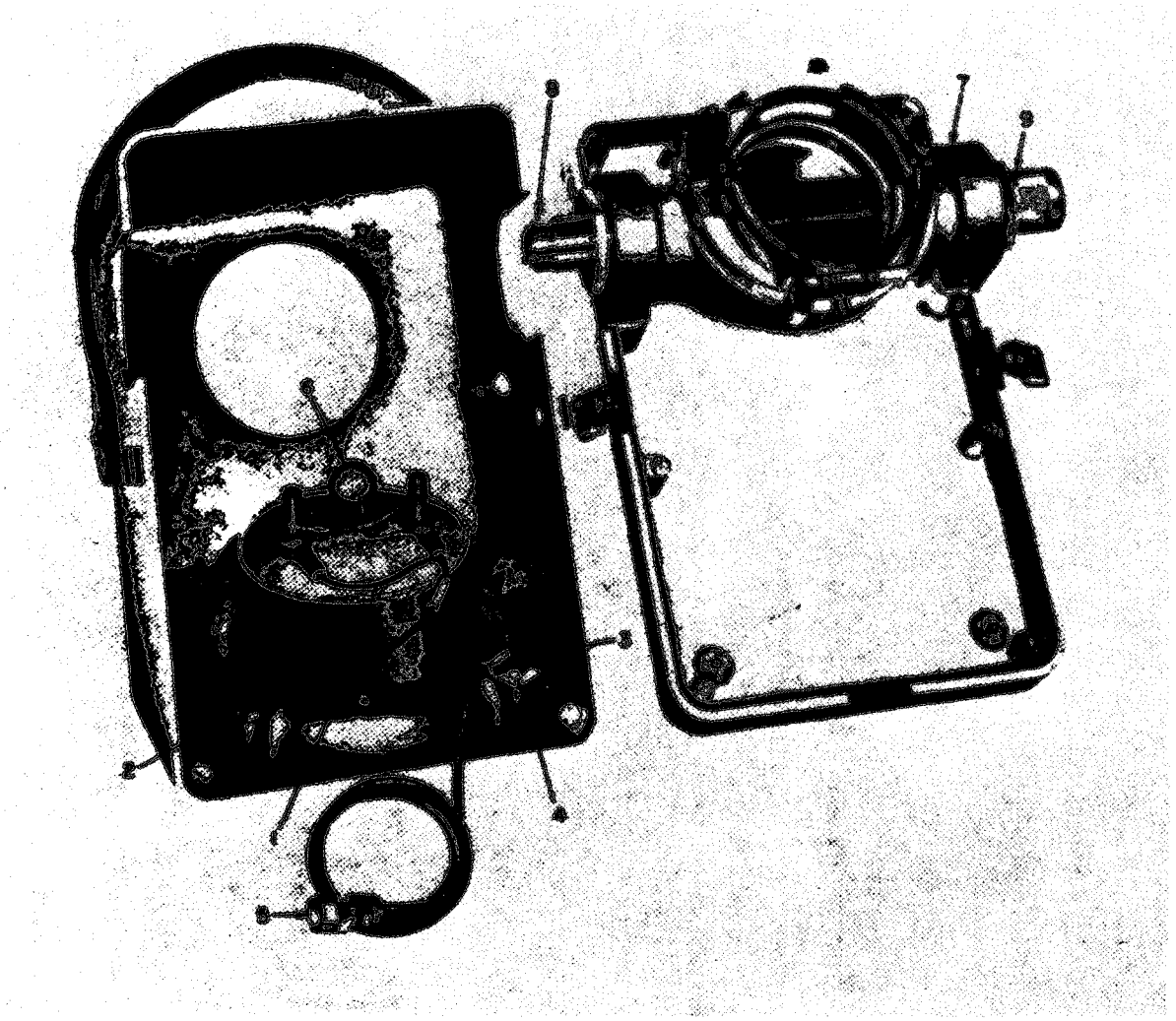

Figure 9-2. TS-1285 URM-120, Internal Views

FIG. & INDEX No.	PART No.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
9-2-1	118X5	METER, Power (see figure 9-1, item 1 for next higher assembly)	1	
		(ATTACHING PARTS)		
-2		YOKE, Meter	1	
-3		SCREW, Rd hd, No. 6-32 by 1 in. lg . . .	4	
-4		NUT, Hex, No. 6-32	4	
		---*---		
-5	146X1O	. . CONNECTOR, Coaxial, female, type MB .	1	
-6	14X103	CAPACITOR, Fixed, ceramic, 0.01 mfd, 450V dc	1	
-7		PRIMARY LINE		
-8	146X12	. . CONNECTOR, Coaxial, male, type N . .	1	
-9	146X13	. . CONNECTOR, Coaxial, female, type N .	1	

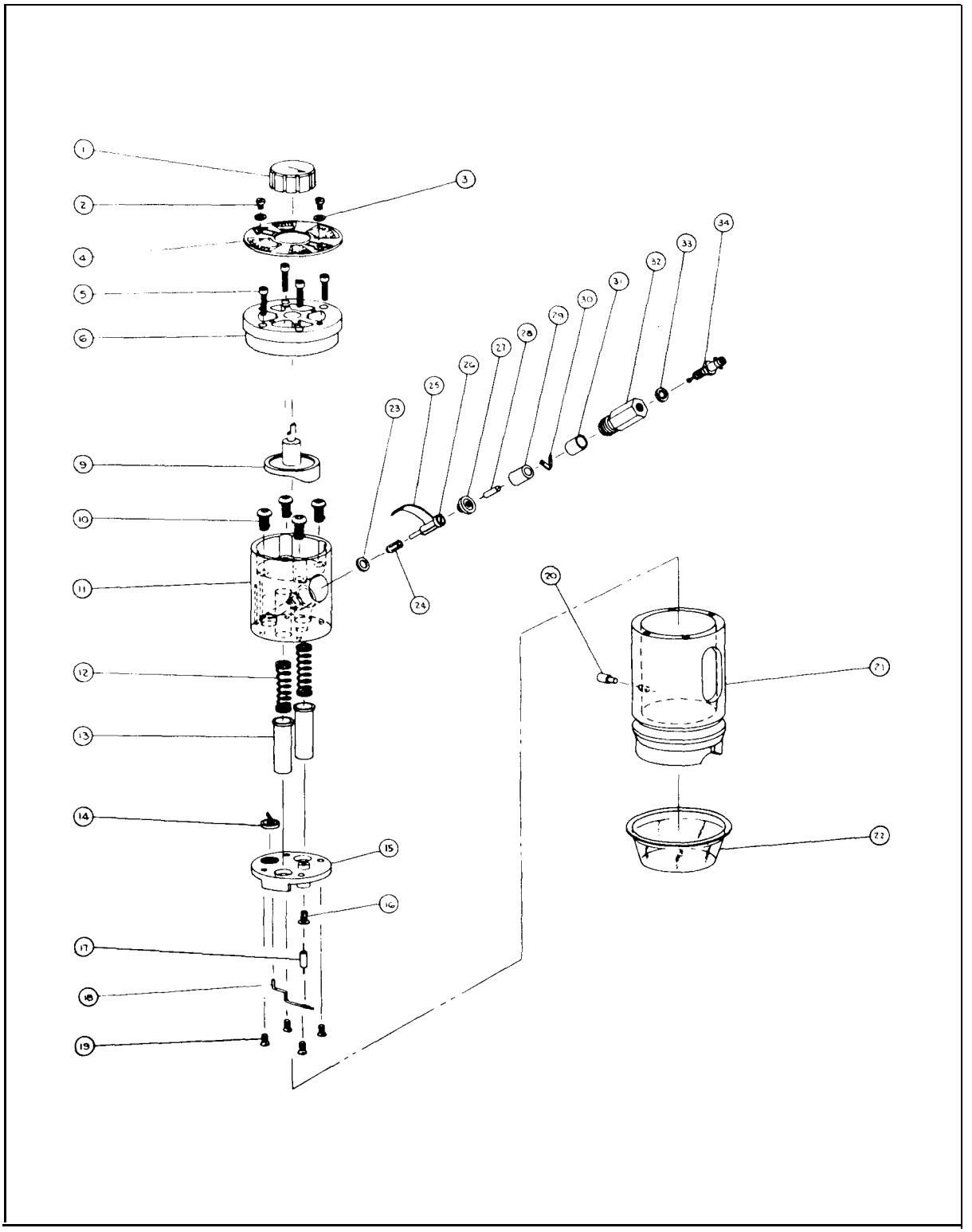

Figure 9-3. Coupler-Detector, Exploded View

FIG. & INDEX No.	PART NO.	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
9-3		COUPLER-DETECTCOR CU- /URM-120	1	
-1	160X10	. . KNOB, 1-1/4 in. OD	1	ABC
		(ATTACHING PARTS)		
-2		. . SCREW, Fil hd No. 2-56 by 3/16 in. lg .	1	ABC
-3		. . LOCKWASHER, Int tooth, No. 2 . . .	1	ABC
-4	SP-10176-2	. . NAMEPLATE	1	A
-4	195X14	. . NAMEPLATE	1	B
-4	195X15	. . NAMEPLATE	1	C
		(ATTACHING PARTS)		
-5		. . SCREW, Soc hd, cap, No. 4-40 by 3/4 in. lg	4	ABC
-6	SP-7288-3	. . KNOB	1	ABC
-9	SP-10438-3	. . CAM	1	ABC
		(ATTACHING PARTS)		
-10	SP-4987-1	. . SCREW, Modified	4	ABC
-11	SP-10080-3	. . SLUG	1	A
-11	SP-7287-3	. . SLUG	1	BC
-12	SP-4872-1	. . SPRING, Slug loading	2	ABC
-13	SP-4855-1	. . CAP, Spring retaining . . .	2	ABC
-14	18A142-SS	. . CAPACITOR, Fixed, mica, button 1400 mmfd 500V dc	1	A
-14	18A281	. . CAPACITOR, Fixed, mica, button 280 mmfd 500V dc	1	B
-14	18A500	. . CAPACITOR, Fixed, mica, button 52.5 mmfd 500V dc	1	C
-15	SF-10078-2	. . PLATE, Loop mounting, machined . .	1	A
-15	SP-4850-2	. . PLATE, Loop mounting, cast . . .	1	B
-15	SP-7285-2	. . PLATE, Loop mounting, machined . .	1	C
-16	SP-7583-1	. . CUP, Adj. resistor mounting . . .	1	A
-16	SP-6832-2	. . CUP, Adj, resistor mounting	1	C
-17	50X680	. . RESISTOR, Fixed, comp, 68 ohms, 1/2 w, 5%	1	ABC
-18	SP-7545-2	. . LOOP, Power pickup, 4 turns . . .	1	A
-18	SP-6557-1	. . LOOP, Power pickup, 1 turn	1	B
-18	SP-6556-1	. . LOOP, Power pickup, 1 turn	1	C
		(ATTACHING PARTS)		
-19		. . SCREW, Flt hd, No. 4-40 by 1/4 in. lg .	4	A B C
-20	SP-4864-1	. . PIN, stop	1	A B C
-21	SP-7543-2	. . SLEEVE	1	A
-21	SP-4857-2	. . SLEEVE	1	BC
-22	SP-10095-2	. . CAP	1	AB
-22	SP-10095-1	. . CAP	1	C
		. . DIODE, Crystal, subassembly . . .	1	ABC
-23	SP-4985-1	. . . WASHER, Diode insulating . . .	1	ABC
-25		. . . TAPE, Scotch cellophane, 1/4 in. wd by 1 in. lg	1	ABC
-26	105X4	. . . DIODE, Silicon, cartridge . . .	1	AC
-26	105X2	. . . DIODE, Silicon, cartridge . . .	1	
-27	26B102	. . . CAPACITOR, Fixed, ceramic, button, 1000 mmfd, 500v dc	1	ABC
-28	52X182	. . . RESISTOR, Fixed, comp 1500 ohms, 1/2 w 10%	1	AC
-28	52X271	. . . RESISTOR, Fixed, comp 270 ohms 1/2 w 10%	1	B
-29	SP-4847-1	. . . BUSHING, Resistor insulating . .	1	ABC
-30	SP-4848-1	. . . CONTACT, Connector	1	ABC
-31		. . . TUBING, Vinyl, black, 1/4 in. lg . .	1	ABC
-32	SP-4845-1	. . . ADAPTER, Connector	1	ABC
-33		. . . LOCKWASHER, Int tooth . . .	1	ABC
-34	146X11	. . . CONNECTOR, Coaxial, male, type MB	1	ABC

SECTION X

NUMERICAL INDEX

STOCK NO.	PART NO.	FIGURE AND INDEX NO.	SOURCE CODE	TOTAL QUANTITY
	CU-753/URM-120	9-2-10		1
	CU-754/URM-120	9-2-10		1
	CU-755/URM-120	9-2-10		1
	SP-4845-1	9-3-32		3
	SP-4847-1	9-3-29		3
	SP-4848-1	9-3-30		3
	SP-4850-2	9-3-15		1
	SP-4855-1	9-3-13		6
	SP-4857-2	9-3-21		2
	SP-4864-1	9-3-20		3
	SP-4872-1	9-3-12		6
	SP-4985-1	9-3-23		3
	SP-4987-1	9-3-10		12
	SP-6556-1	9-3-18		1
	SP-6557-1	9-3-18		1
	SP-6832-2	9-3-16		1
	SP-7285-2	9-3-15		1
	SP-7287-3	9-3-11		2
	SP-7288-3	9-3-6		3
	SP-7543-2	9-3-21		1
	SP-7545-2	9-3-18		1
	SP-7583-1	9-3-16		1
	SP-10078-2	9-3-15		1
	SP-10080-3	9-3-11		1
	SP-10095-1	9-3-22		1
	SP-10095-2	9-3-22		2
	SP-10176-2	9-3-4		1
	SP-102438-3	9-3-9		3
	TS-1285/URM-l20	9-1		1
	14X103	9-2-6		1
	18A142-SS	9-3-14		1
	18A281	9-3-14		1
	18A500	9-3-14		1
	26B102	9-3-27		3
	50X680	9-3-17		3
	52X182	9-3-28		2
	52X271	9-3-28		1
	105X2	9-3-26		1
	105X4	9-3-26		2
	118X5	9-2-1		1
	146X10	9-2-5		1
	146X11	9-3-34		3
	146X12	9-2-8		1
	146X13	9-2-9		1
	160X10	9-3-1		3
	195X14	9-3-4		1
	195X15	9-3-4		1

SECTION XI

REFERENCE DESIGNATION INDEX

REFERENCE DESIGNATION	FIGURE INDEX	STOCK NO.	PART NO.
C101	9-3-14		18A142-SS
			18A281
			18A500
C102	9-3-27		26B102
C103	9-2-3		14X103
CR101	9-3-26		105X2
			105X4
J101	9-2-9		146X13
J102	9-2-8		146X12
J103	9-3-34		146X11
L101	9-3-18		SP-6556-1
			SP-6557-1
			SP-7545-2
M101	9-2-1		118X5
P101	9-2-5		146X10
R101	9-3-17		50X680
R102	9-3-28		52X182
			52x271

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GENDEP (2) except
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Sig Sec, GENDEP (5)
Sig Dep (12)
Ft Monmouth (63)
USA Corps (1)
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WRAMC (1)
AFSSC (1)
USAEPG (2)
EMC (1)
USACA (2)
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USA Carib Sig Agcy (1)
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USA Trans Tml Comd (1)
Army Tml (1)
POE (1)
OSA (1)
AMS (1)
Sig Fld Maint Shops (2)
JBUSMC (2)
Units org under fol TOE:
11-7 (2)
11-16 (2)
11-57 (2)
11-97 (2)
11-117 (2)
11-155 (2)
11-500 (A A-AE) (4)
11-557 (2)
11-587 (2)
11 592 (2)
11-597 (2)

NG: None.

USAR: None.

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

GPO 822-735 1

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

TEAR ALONG PERFORATED LINE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

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

WEIGHTS

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

LIQUID MEASURE

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

SQUARE MEASURE

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

CUBIC MEASURE

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

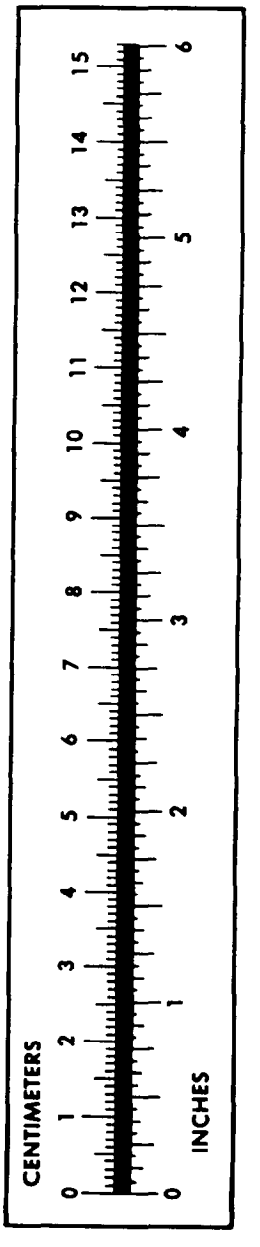
TEMPERATURE

5/9(°F - 32) = °C
212° Fahrenheit is evuivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5C° + 32 =°F

APPROXIMATE CONVERSION FACTORS

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

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



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