TM 11-5820-753-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORGANIZATIONAL, DS, 6S, AND DEPOT

MAINTENANCE MANUAL (INCLUDIN6)

REPAIR PARTS AND SPECIAL

TOOLS LIST)

FILTER AND- MATCHING GROUP:

TUNER, RADIO FREQUENCY

TN-422/MRC-85(V)2

FILTER, BAND PASS

F-940/FRC-39A(V)

HEADQUARTERS, DEPARTMENT OF THE ARMY

MARCH 1979

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USAR: None

For explanation of abbreviations used; see AR 310–50.

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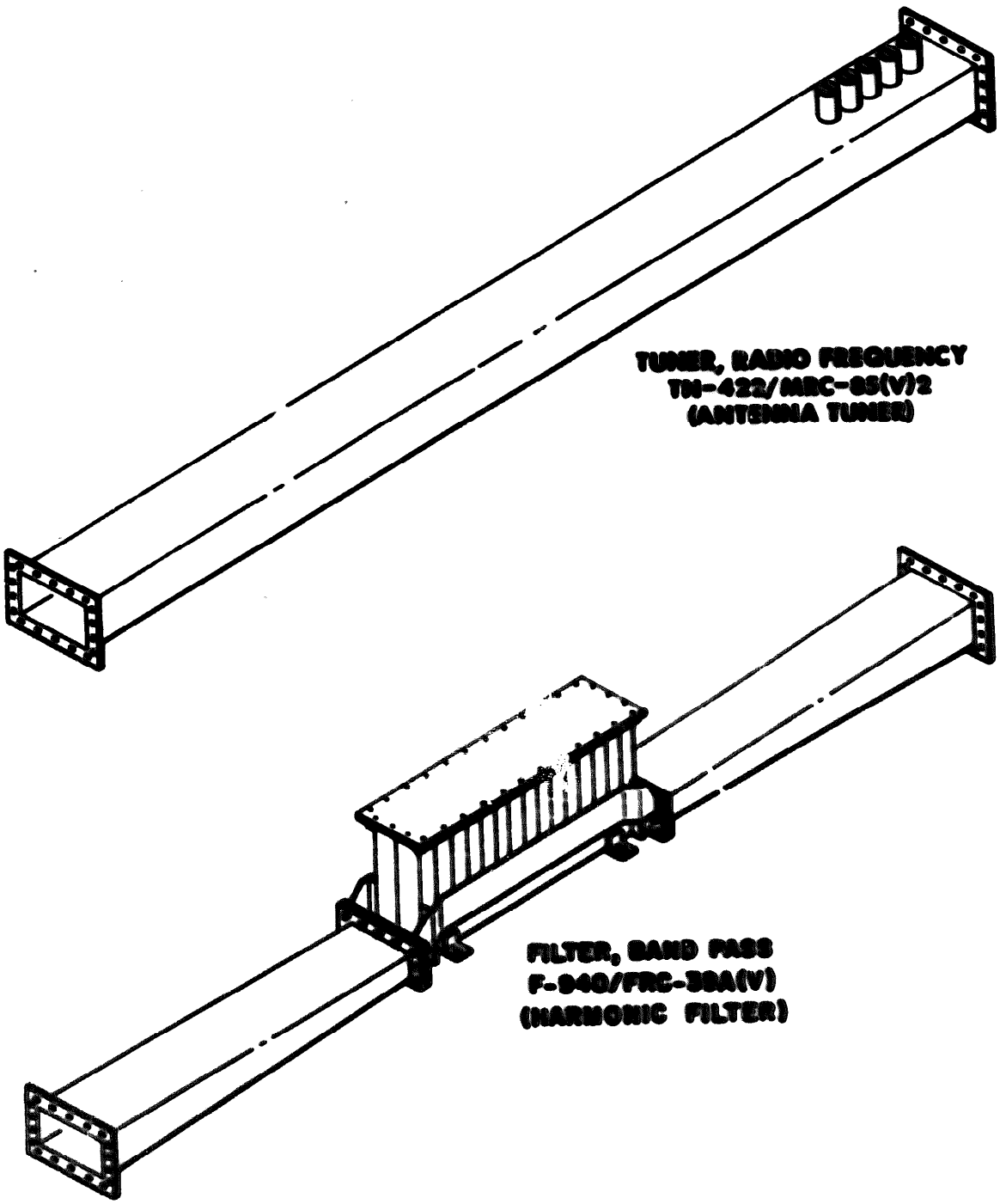

Figure 1-1. Filter and Matching Group

CHAPTER 1

GENERAL INFORMATION

1-A.1. Scope

a. This manual includes installation and operation instructions and covers operator's, organizational, direct support (DS), general support (GS) and depot maintenance. It describes Filter and Matching Group: Tuner Radio Frequency TM-422/MRC-85(V)2 and Filter Band Pass E940/FRC-39A(V) (ITE Circuit Breaker Co. part numbers 604661-901, respectively).

b. Appendix A contains the basic issue items list; appendix B contains the allocation chart; appendix C lists the repair parts.

c. Appendixes A and C are current as of 22 October 1968.

1-A.2. Indexes of Publications

a. 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. Refer to DA Pam 310-7 to determine whether there are any Modification Work Orders pertaining to the equipment.

1-A.3. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions given in TM38-750

b. Report of Packing and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packing and Handling Deficiencies) as prescribed in AR 700-58 (Army) NAVSUP Publication 378 (Navy), AFR 71-4 (Air Force), and MCO P4610-5 (Marine Corps).

c. Discrepancy in Shipment Report (DISREP) (SF361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF361) as prescribed in AR55-38 (Army) NAVSUP Pub 459 (Navy), AFM 75-34 (Air Force), and MCO P4610.19 (Marine Corps).

d. Reporting Equipment Manual Improvements. Report of errors, omissions, and recommendations for improving this manual by the individual user is encouraged. Reports should be submitted on DA FORM 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding General, U.S. Army Electronics Command, ATTN: AMSEL-ME-FMP-AD, For Monmouth, N.J. 07703.

1-1. General

1-2. The Filter and Matching Group consists of two separate equipments: Tuner, Radio Frequency. TN-422/MRC-55(V)2 (antenna tuner), and a harmonic filter. Figure 1-1 shows the antenna tuner, ITE part no. 604605-901, and the filter ITE part no. 604661-901.

1-3. DESCRIPTION AND PURPOSE

1-4. ANTENNA TUNER.

1-5 The antenna tuner is constructed of heliarc welded high strength aluminum alloy. The fine tuning probes are constructed of stainless steel and utilize a National extra fine thread to permit very fine tuning.

1-6. The metal caps covering the tuning probes have a threefold purpose: to prevent moisture from entering the tuner; to prevent waveguide pressure from escaping; and to prevent damage to the probes through handling.

1-7. The antenna tuner is utilized in the transmission line of communications systems where large reductions in standing wave ratio are desired.

1-8. The antenna tuner reduces mismatches at frequencies over a 1OO-megacyclc range in the 755- to 985-megacycle frequency band. The five tuning probes, when properly tuned, reduce the standing wave ratio from 1.3:1 maximum to 1.05:1, or less.

1-9. HARMONIC FILTER.

1-10. The harmonic filter basically consists of two linear tapered waveguide assemblies and the harmonic filter subassembly. The harmonic filter subassembly consists of tubes cut to a predetermined length and coated with an absorptive material.

1-11. The harmonic filter **characteristics of design are such that the second harmonic of** the fundamental transmitting frequency is attenuated by 20 db and the third harmonic is **attenuated by 10 db.**

1-12. INFORMATION AND REFERENCE DATA.

1-13. Table 1-1 gives the leading particulars of the antenna tuner and harmonic filter, and table 1-2 gives their capabilities and limitations. Table 1-3 lists the equipment supplied and table 1-4 lists the equipment required but not supplied.

Table 1-1. Leading Particulars

Transportability:	
Air	Small transport
Ground	Pickup Truck or Equivalent
Physical Characteristics:	
Antenna tuner:	
Weight	70 lb (approximate)
Dimensions	1 45-5/8 in. long, 13-6/16 in. wide, 7-5/16 in. high
Harmonic filter:	
Weight	78 lb.
Dimensions (overall)	143-5/8 in. long, 19-5/16 in. wide, 31-3/8 in. high (approx)
Mechanical storage:	
Antenna tuner	indicator in horizontal position, adequately supported every 6 to 10 ft.
Harmonic filter	Indoors in an upright position with taper transformer sections removed. Tapered waveguide assemblies must be stored in a horizontal position, adequately supported at each end.

Table 1-2. Capabilities and Limitations

Antenna tuner:	
Frequency range	755-935 mc
Impedance matching characteristics	Reduces mismatches at frequencies over a 100-mc range in the 755-935-mc frequency band
Standing wave ratio	Reduces the standing wave ratio from 1.3:1 maximum at any phase to 1.05:1, or less
Harmonic filter:	
Frequency Range	755-935 mc
Second harmonic attenuation	20 db
Third harmonic attenuation	10 db
Standing wave ratio	Less than 1.1:1 over the frequency range
Insertion loss	±0.2 db over the range
Ambient temperture:	
Antenna tuner	-65-185° F -54-85° C
Harmonic filter	-65-185° F -54-85° C

Table 1-3. Equipment Supplied

Official Nomenclature	Manufacture	Part Number	Common Name	Qty	Usable On Code	Description
Tuner, Radio Frequency TN-422/MRC 85(V)2	ITE Circuit Breaker Company	004605-901	Antenna Tuner consisting of:	1		The antenna tuner matches the antenna feed horn to the transmission line
		602719-903	Weldment	1		
		602705-1	Boss	5		
		600915-3	Probe	5		
		601350-301	O ring	5		
		601350-278	Washer	5		
		600916-1	Nut, hex	5		
		602706-1	Cap, probe	5		
Filter, Band pass F-940/FRC-39A(V)	ITE Circuit Breaker Company	604661-901	Harmonic filter consisting of:	1		The harmonic filter attenuates the transmission of harmonic frequencies
		604650-501	Harmonic filter subassembly	1		
		604660-501	Tapered waveguide assembly	2		
		604622-1	Gasket	2		
		604514-3	Gasket	1		
		605002-211	Hex-head bolt	24		
		605040-107	Washer, flat	48		
		605042-107	Lockwasher	24		
		6055019-107	Nut, hex	24		

Table 1-4. Equipment Required but Not Supplied

Federal Stock Number	Description	Quantity
5120-811-3329	Wrench, torque, dial indicating, 250 lb-in. rated capacity	1
5120-222-1498-CX	Wrench, socket, hex shape, 3/8 in.	1
6625-557-0308	Signal Generator AN/URM-49	1
	Frequency Counter 7170 (Berkeley)	1
4931-656-5915	Standing Wave Detector Model 219	1
6625-519-1755	Indicator, standing wave 415B	1
6625-086-7165	Generator, sweep, wideband 900B	1
6625-676-1302	Oscilloscope 317-S1 (Tektronix)	1
5985-792-9280	Adapter, 3-1/8 in. coaxial to GR-874 connector 874-QUSA (General Radio)	1
	Test transition, 3-1/8 in. coaxial to WR-975 waveguide 602707-903 (ITE Circuit Breaker Company)	1
	Low pass filter 874-F1000L (General Radio)	1
5985-445-6952	Attenuator, fixed AD-10N (Microlab)	1
6625-887-3892	Attenuator AD-20T (Microlab)	1
	Coaxial termination, short circuit TS-5MN (Microlab) or equivalent	1
	Waveguide dissipative termination, WR-975 waveguide 602790-903 (ITE Circuit Company)	1
	Bolt, hex head, cap, 3/8-16 by 1-3/4 in. long, cadmium plated	28
	Nut, hex, 3/8-16	28
	Lockwasher, 3/8	28
	Flatwasher, 3/8	56
	Waveguide gasket WR-975	3
5210-267-2760-CX	6-in. metal machinist's rule graduated in 1/32-in. increments	1
	RF cable RG-9/U, terminated on both ends with type N male connectors, 16 ft long	1
	RF cable RG-9/U, terminated on both ends with type N male connectors, 12 ft long	1
	RF cable RF-9/U, terminated on both ends with type N male connectors, 30 ft long	1
6625-862-3479	Frequency Converter Amplifier (Berkeley)	1
	Frequency Converter 7571 (Berkeley)(must be used with Frequency Converter Amplifier 7570)	1
	Frequency converter 7573 (Berkeley) (must be used with Frequency Converter Amplifier 7570)	1

CHAPTER 2

INSTALLATION

2-1. INTRODUCTION. This chapter furnishes all of the information needed to install the antenna tuner and harmonic filter. Section I contains data you will need in installation planning; Section II provides logistical data such as receiving data and ma handling; installation procedures a Section III; and Section IV contains tion you will need regarding prepar the equipment for reshipment.

SECTION I

INSTALLATION PLANNING

2-2. DETAILED SITE PLANS.

2-3. You should become familiar with the detailed site plans for your particular station prior to installation of the Filter and Matching Group. These plans will give you the installation layout requirements for the antenna tuner and harmonic filter.

2-4. ANTENNA TUNER LOCATION.

2-5. The antenna tuner should be installed in the transmission line as close to the antenna feedhorn as possible. A typical location for the antenna tuner is in the transmission line at the base of the feedhorn tower, as shown in figure 2-1. This location not only allows a close proximity to the antenna feedhorn but also affords an ease of accessibility for tuning and alignment.

2-6. ANTENNA TUNER SUPPORTS.

2-7. The antenna tuner is essentially a section of WR-975 waveguide with adjustable tuning probes. The waveguide section is a relatively thin-walled structure and must be adequately supported to insure that undue stresses will not be placed on the waveguide or its flanges. These supports are specified on the detailed site plans for your particular station. However, their governing c isties are given below. See figure 2- typical outdoor waveguide suprort.

a. Outdoor supports must be stur rigid enough to support the weight of antenna tuner and the wind load witho cuable deflection.

b. Supports must be adjustable lat vertically to accommodate the norma facturing tolerances in line trueness antenna tuner is coupled to other wave sections in the transmission line.

c. Clamping arrangements used sh constructed and applied so that no cru deforming of the waveguide occurs.

d. When the antenna tuner is suppo stanchions without rigid clamping, suit insulating material should be secured waveguide surface by gluing or wrappi provides a cushioned surface for the tu that movement due to temperature cha wind vibration will not result in damag abrasion.

e. The spacing between supports sh specified on your detailed site plans (f antenna tuner approximately 6 to 10 fe

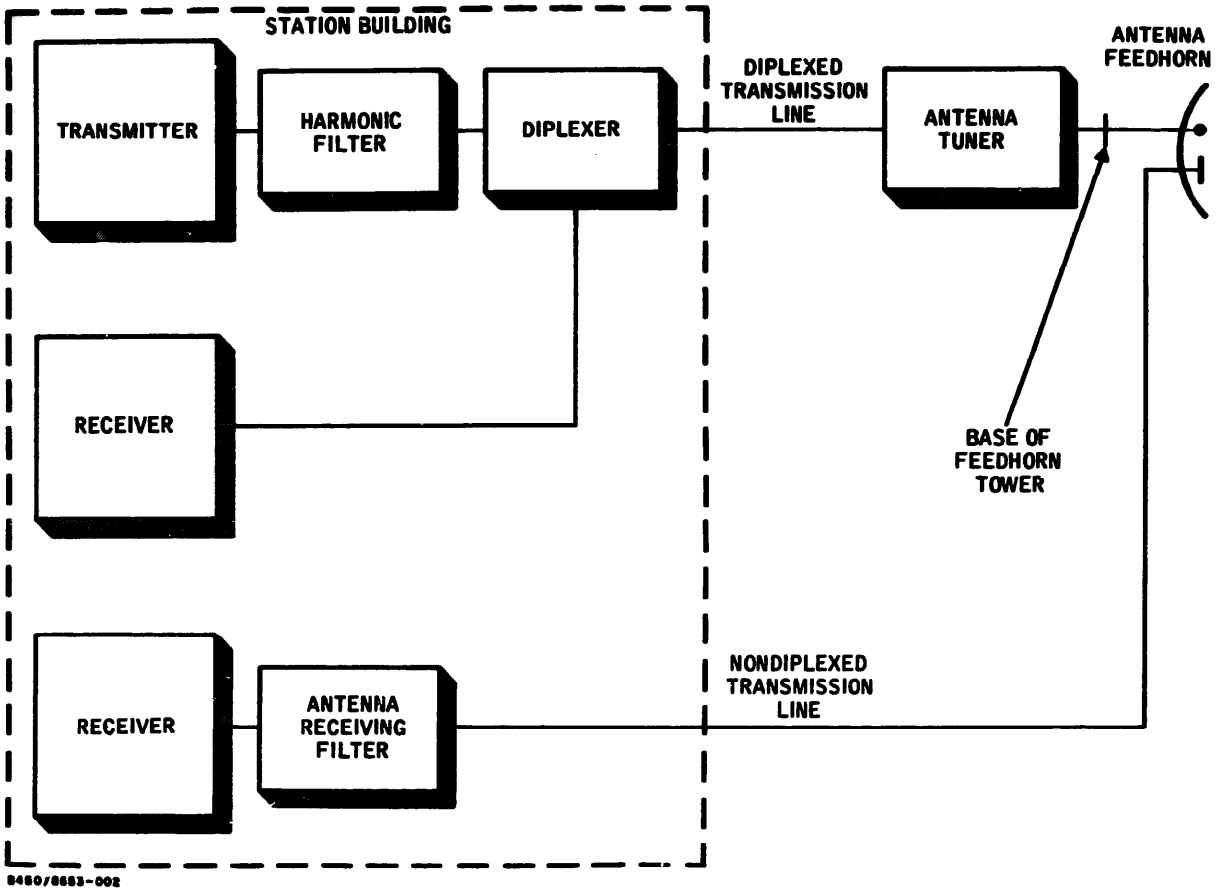

Figure 2-1. Location of Antenna Tuner and Harmonic Filter in a Typical Communications Station.

2-8. ANTENNA TUNER PROTECTION.

2-9. The antenna tuner will be installed outdoors and, therefore, will be subject to damage from falling objects, wind-carried debris, or snow and ice accumulation, depending on local conditions in the area in which it is installed. Also, heating caused by the sun's rays will expand the size of the antenna tuner and change its characteristics, as well as add to the internal heating caused by the transmitted power loss in the antenna tuner. Some type of cover protection for the antenna tuner is therefore desirable. This can be achieved in various ways. For the antenna tuner, a preferable solution in one similar to that shown in figure 2-2 in which a sheet of corrugated and galvanized steel-sheet roofing material is used. This should be secured by clamps or bolts to each antenna tuner support to prevent being lifted by the wind. Provision should be made for easy removal of the protective cover in sections to facilitate examination of the antenna tuner and for any adjustments which may be required.

2-10. HARMONIC FILTER *LOCATION.*

2-11. The harmonic filter should be housed in a temperature-controlled building along with the transmitting and receiving equipment.

2-12. The harmonic filter must be installed in the transmission line between the transmitter output and the diplexer, as depicted functionally in figure 2-1.

2-13. HARMONIC FILTER MOUNTING.

2-14. The harmonic filter may be installed in any convenient location by using a system of waveguide hangers and supports. *A* typical waveguide hanger is shown in figure 2-3.

2-15. WORE AREA FOR HARMONIC FILTER ASSEMBLY.

2-16. The harmonic filter is shipped disassembled. Prior to installation in the transmission line it is necessary to assemble the

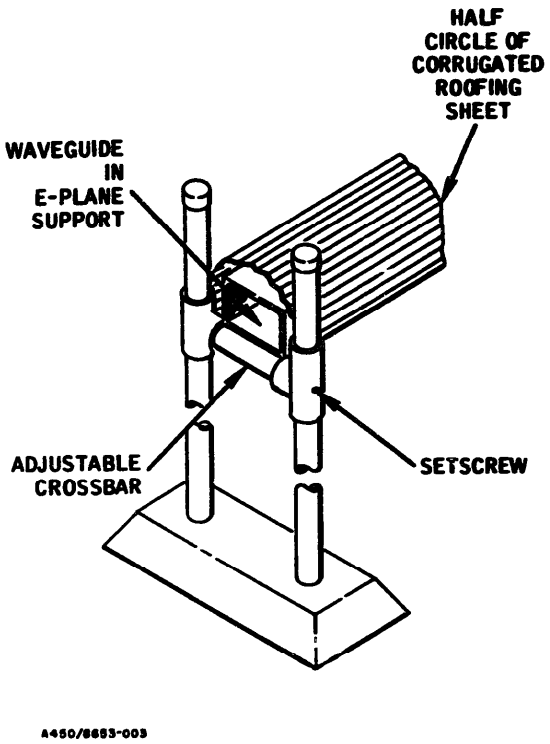

Figure 2-2. Typical Outdoor Waveguide Support

two tapered waveguide assemblies to the harmonic filter subassembly. A work area of approximately 14 by 6 feet is necessary for this operation. The work area should be chosen at a point as close as possible to where the harmonic filter is to be installed in the transmission line and should be free from dirt and dust. Detailed assembly instructions for the harmonic filter are given in Section III of this chapter.

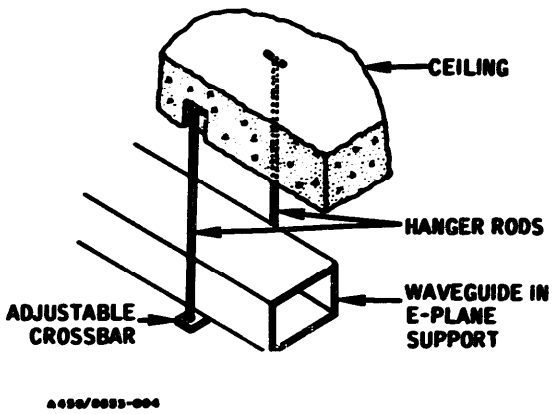

Figure 2-3. Typical Indoor Waveguide Hanger Support

SECTION II
LOGISTICS

2-17. RECEIVING DATE.

2-18. **Table 2-1 lists the equipment shipped to make up the Filter and Matching Group.**

2-19. TRANSPORTABILITY AND MATERIAL HANDLING.

2-20. **The Filter and Matching Group may be transported to any given site by air, rail or truck.**

2-21. **When moving the crated component within the station, a conventional mover's dolly should be used. If a dolly is not available, the equipment should not be lifted unless four men are available for this purpose.**

CAUTION

Use extreme care when moving the equipment to avoid severe shock and damage to the equipment.

2-22. UNPACKING AND INSPECTION.

2-23. **Carefully unpack the equipment so as not to dent or otherwise distort either the sides or flanges of the waveguide sections.**

2-24. **Inspect each component for damage which may have been caused during shipment. If the equipment is damaged in any way, save all of the packing material, including the shipping crate, and notify the proper authorities.**

2-25. **Inspect the sealed coverings of the waveguide ends of the equipment to insure that they are still intact, but do not remove the covers until time for installation. If covers have been damaged, they should be removed and the interior of the waveguide checked for corrosion, cleaned (if necessary) and resealed to prevent contamination.**

2-26. **After unpacking, the antenna tuner and harmonic filter should be stored indoors until needed for installation.**

CAUTION

Use extreme care when handling the uncrated components. Do not drop, dent or twist the equipment.

2-27. Retain all shipping crates and insulation material used for shipment of the equipment. The crates and insulation can be reused in the event it becomes necessary to reship the equipment.

Table 2-1. Equipment Shipped

Crate No.	Items Shipped	Crated			Uncrated	
		Wt	Dim.	Vol	Wt	Dim.
1	Two tapered waveguide assemblies	130 lbs	59x24x20 in.	16.4 cu ft	44 lbs	52-5/16x13-5/16 x7-5/16 in. (app)
2	Harmonic filter subassembly	170 lbs	47-1/2x21-1/4x30 in.	17.5 cu ft	78 lbs	39x19-1/8x13-5/16 in. (app)
3	Antenna tuner	120 lbs (app)	145-5/8x15-5/16 x9-5/16 in.(app)	12.2 cu ft (app)	70 lbs (app)	143-5/8x13-5/16 x7-5/16 in.

SECTION III
INSTALLATION PROCEDURES

2-28. GENERAL PRECAUTIONS.

2-29. **Installation of the antenna tuner and harmonic filter should not be started until supports have been placed or can be installed concurrently with the equipment.**

2-30. As the installation progresses, a **careful quality check should be made on mechanical alignment and flange fittings to insure freedom from physical damage. Insertion loss and vswr tests should be performed on the equipment prior to installation. (Refer to Chapter 5 for preinstallation test procedures.)**

2-31. TOOLS AND TEST EQUIPMENT

2-32. Installation and alignment procedures **are performed using the tools and test equipment given in table 1-4.**

2-33. ANTENNA TUNER INSTALLATION.

2-34. The following steps comprise the pro**cedure for installation of the antenna tuner in the transmission line. Figure 2-4 shows a typical installation of the antenna tuner.**

a. Remove the protective coverings from the antenna tuner waveguide flanges. Insure that the antenna tuner is internally clean and free of visible damage.

b. Position the antenna tuner so that when it is installed, the end with the tuning probes will be nearest to the antenna feedhorn tower with the tuning probes in an upright position.

c. With adequate assistance, guide the antenna tuner into place and provide temporary support as required until it is time to be secured by the permanent supports. Avoid straining, distorting, or damaging the antenna tuner in any way.

d. Carefully position the end of the antenna tuner nearest the antenna feedhorn tower so that its flange is aligned with, but not touching, the flange of the waveguide section to which it is to be secured.

e. Place a 3/8-inch flat washer on each of four 3/8-16 by 1-3/4-inch long hex-head bolts ((A) of fig. 2-4).

f. Insert each of the four bolts through the mounting hole that is closest to each corner of the antenna tuner waveguide flange.

g. Place a WR-975 waveguide gasket on the flange of the antenna tuner. Carefully guide the shanks of the four bolts through the holes in the gasket so that the gasket is not damaged in any way.

CAUTION

Use extreme care when joining waveguide flanges to insure that the waveguide gasket is not damaged.

h. Join the flange of the antenna tuner to the flange of the adjoining waveguide section. Use care to guide the shanks of the four bolts through the corresponding mounting holes in the flange of the adjoining waveguide section.

i. Install a 3/8-inch flat washer, a 3/8-inch lockwasher and a 3/8-16 nut onto the threaded end of each of the four bolts. Finger tighten the nuts.

CAUTION

To prevent damage to the waveguide gasket, insure that the waveguide gasket mounting holes are properly aligned with the waveguide flange mounting holes.

j. Install the required bolts, washers, lockwashers and nuts in the 10 remaining

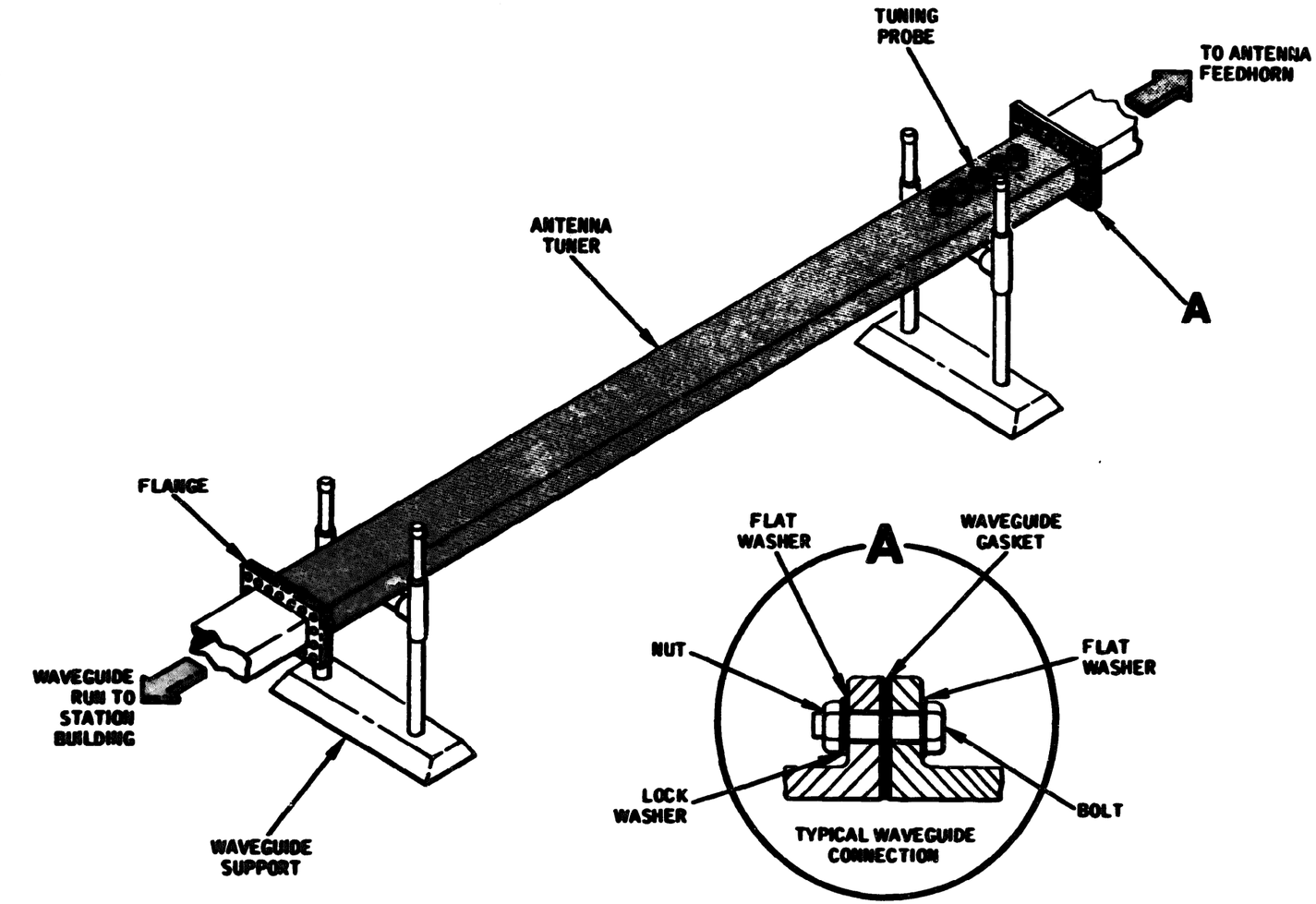

Figure 2-4. Typical Installation of Antenna in Transmission Line

mounting holes of the waveguide flanges. Finger tighten the nuts.

k. Partially wrench tighten each bolt trying to get equal tightness on all bolts. Finish by succesively tightening each bolt with a torque wrench to the torque value of 216 pound-inches (18 pound-feet).

l. Group the antenna tuner at its free (unconnected) end and carefully move it up and down in a vertical direction. A position will be found where the free and of the tuner offers minimum opposition to the moving force. adjust the waveguide support crossbar so that it supports the antenna tuner at the position of minimum opposition.

N o t e

The antenna tuner alignment test must be performed before proceeding any further with installation of the antenna tuner. The alignment testis contained in paragraph 5-28 of Chapter 5. After the alignment test is performed, proceed with step m of this procedure.

m. Guide the waveguide section which is to be joined to the free end of the antenna tuner into place and provide temporary support as required until it is time to be secured by the permament supports.

n. Align the waveguide flange with the antenna tuner waveguide flange but do not join the two together.

o. Place a 3/8-inch flat washer on each of four 3/8-16 by 1-3/4-inch long hex head bolts ((A) of fig. 2-4).

p. Insert each of the four bolts through the mounting hole that is closest to each corner of the waveguide section waveguide flange.

q. Place a WR-975 waveguide gasket on the flange of the waveguide section. Carefully guide the shanks of the four bolts through the holes in the gasket so that the gasket is not damaged in any way.

Use extreme care when joining waveguide flanges to insure that the waveguide gasket is not damaged.

r. Join the flange of the waveguide section to the flange of the antenna tuner, using care to guide the shanks of the four bolts through the corresponding mounting holes on the flanges of the antenna tuner.

s. Install a 3/8-inch flat washer, a 3/8-inch lockwasher, and a 3/8-16 nut onto the threaded of each of the four bolts. Finger tighten the nuts.

To prevent damage to the waveguide gasket, insure that the waveguide gasket mounting holes are properly aligned with the waveguide flange mounting holes.

t. Install the required bolts, washers, lockwashers and nuts in the 10 remaining holes of the waveguide flanges. Finger tighten the nuts.

u. Partially wrench tighten each bolt, try ing to get equal tightness on all bolts. Finish by successively tightening each bolt with a torque wrench to the torque value of 216 pound-inches (18 pound-feet).

v. Grasp the waveguide at its free (unconnected) end carefully move it up and down in a vertical direction. A position will be found where the free end of the waveguide offers minimum opposition to the moving force. Adjustment the waveguide support crossbar so that it supports the waveguide at the position of minimum opposition.

2-35. ASSEMBLY OF THE HARMONIC FILTER.

2-36. The harmonic filter must be assemblies prior to installation in the transmission line Assembly of the harmonic filter consists joining the two tapered waveguide assemblies to the harmonic filter subassembly.

2-37. Perform the following steps to assembly ble the harmonic filter (fig. 2-5).

a. Remove the protective coverings from the harmonic filter subassembly waveguide flanges and from the flanges of the tapered waveguide assemblies. Insure that the interiors of the tapered waveguide assemblies and the harmonic filter subassembly are clean and free of visible damage.

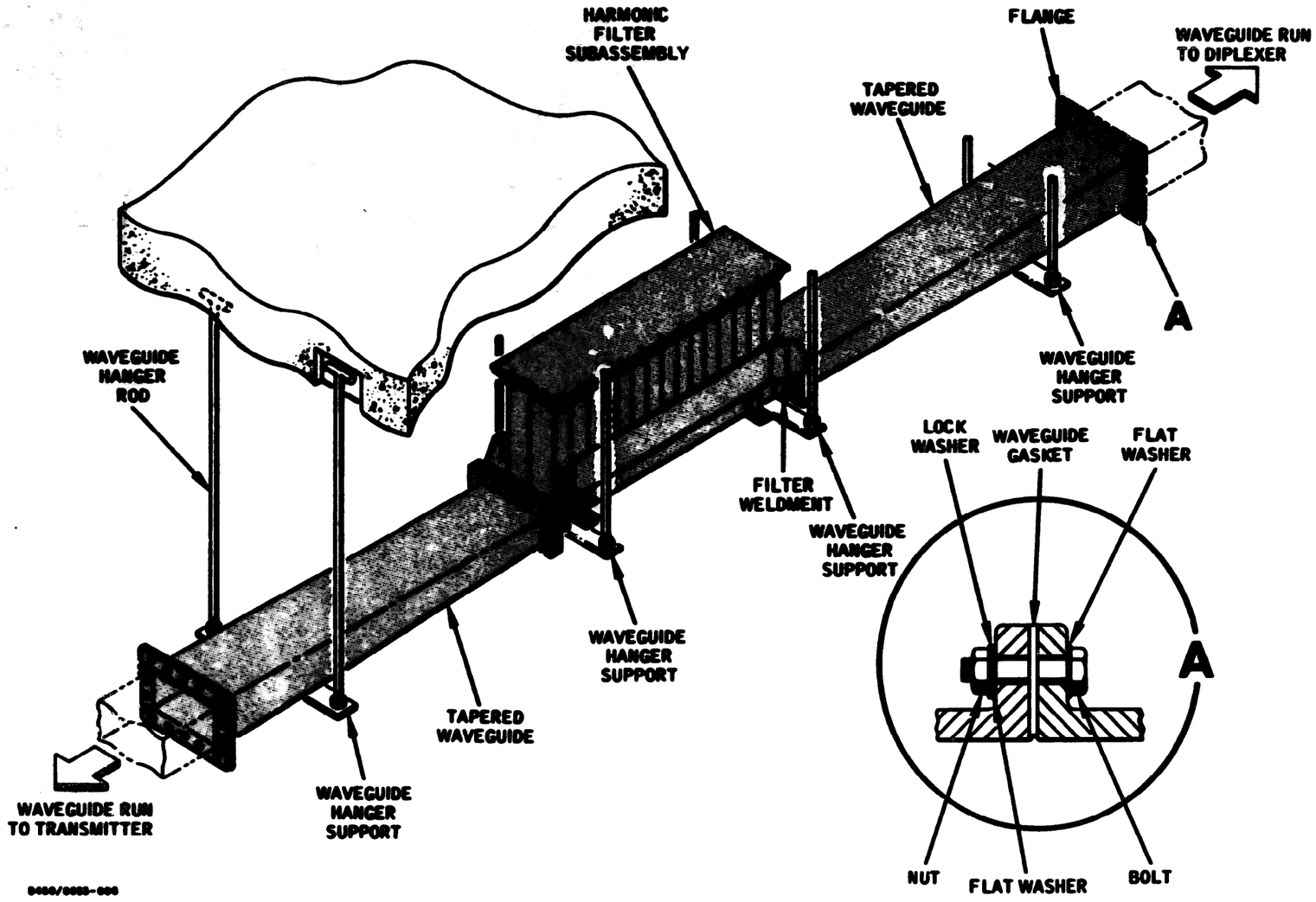

Figure 2-5. Typical Installation of Harmonic Filter in Transmission Line

b. Place a waveguide gasket ((A) of fig. 2-5) over the flange of the tapered waveguide assembly.

c. Insert 12 bolts with flat washers through the flange of the tapered waveguide assembly.

d. Join the tapered waveguide assembly to the filter weldment and insert the 12 bolts through the flange of the filter weldment.

e. Fasten the tapered waveguide assembly to the filter weldment using 12 nuts with lockwashers and washers. Finger tighten the nuts.

f. Using a torque wrench, tighten the 12 nuts to 216 pound-inches (18 pound-feet) of torque.

g. Join the other tapered waveguide assembly to the harmonic filter subassembly by performing steps a through f of this procedure.

2-38. HARMONIC FILTER INSTALLATION

2-39. The following steps comprise the procedure for installation of the harmonic filter in the transmission line. Figure 2-5 shows a typical installation of the harmonic filter in the transmission line.

a. With adequate assistance, position the harmonic filter between the waveguide hanger support rods.

b. Install the waveguide hanager support crossbars onto the hanger rodes and fasten the crossbars in place using the required nuts and washer.

c. Align the waveguide flange of the harmonic filter with the waveguide flange of the waveguide section to which it is supposed to be joined. Adjust the waveguide hanager support crossbars up or down as necessacry to effect waveguide flange alignment.

d. Place a 3/8-inch flat washer on each of four 3/8-16 by 1-3/4 inch long hex-head bolts ((A) of fig. 2-5).

e. Insert each of the four bolts through the mounting hole that is closest to each corner of the tapered waveguide assembly flange.

f. Place a WR-975 waveguide gasket on the flange of the tapered waveguide assembly.

Carefully guide the shanks of the four bolts through the holes in the gasket so that the gasket is not damaged in any way.

CAUTION

Use extreme care when joining waveguide flanges to insure that the waveguide gasket is not damaged.

g. Join the flange of the tapered waveguide assembly to the flange of the adjoining waveguide section. Use care to guide the shanks of the four bolts through the corresponding mounting holes in flange of the adjoining waveguide section.

h. Install a 3/8-inch flat washer, a 3/8-inch lockwasher and a 3/8-16 nut onto the threaded end of each of the four bolts. Finger tighten the nuts.

CAUTION

To prevent damage to the waveguide gasket, insure that the waveguide gasket mounting holes are properly aligned with the waveguide flange mounting holes.

1. Install the required bolts, washers, lockwashers and nuts in the 10 remaining mounting holes of the waveguide flanges. Finger tighten the nuts.

j. Partially wrench tighten each bolt, trying to get equal tightness on all bolts. Finish **by successively tightening each bolt with a** torque wrench to the torque value of 216 pound-inches (18 pound-feet).

k. Secure the other end of the harmonic filter into the transmission line by performing steps c through j of this procedure.

l. This completes the installation procedure for the harmonic filter.

2-40. POSTINSTALLATION TEST PROCEDURES.

2-41. There are no postinstallation test procedure for the harmonic filter or the antenna tuner after they have been installed in the transmission line.

SECTION IV
PREPARATION FOR RESHIPMENT

2-42. Remove the antenna tuner from the transmission line by reversing the installation procedures contained in paragraph 2-34.

2-43. Remove the harmonic filter from the transmission line by reversing the installation procedure contained in the paragraph 2-39. Disassemble the tapered waveguide assemblies from the harmonic filter subassembly by reversing the assembly procedures contained in paragraph 2-36.

2-44. Recrate the antenna tuner and harmonic filter in the reusable packing crates, being careful no to damage the equipment.

2-45. Secure the crates in the approved manner for shipment.

CHAPTER 3
OPERATION

NOT APPLICABLE

CHAPTER 4
PRINCIPLES OF OPERATION

4-l. INTRODUCTION. The information provided in this chapter will help you understand the electronic principles involved in the operation the antenna tuner and harmonic filter. Section I of this chapter provides a functional description of the equipment. Sections II and Ill functional operation of electronic circuits and mechanical assemblies, are not applicable.

SECTION I
FUNCTIONAL SYSTEM OPERATION

4-2. ANTENNA TUNER.

4-3. When the chacteristic impedance of the transmission. The is not matched by the impedance of the antenna feedhorn, standing waves exist on the transmitter.

4-4. In order to eliminate standing waves on the line, which results in increased losses, it is desirable to match the antenna feedhorn to the transmission line. A practical way of obtaining this match is by the use of the antenna tuner connected in the transmission line with its tuning probes located as close the antenna feedhorn as possible.

4-S. The purpose of the tuning probes is to introduce a reactance into the transmission line at point Y ((A) fig. 4-1) at such as spacing (L1) from the antenna (ZR) that the main transmission line, L2, sees an impedance looking into pointY equal to the characteristic impedance of the transmission line (ZO). This impedance, for all practical purposes, is a pure resistance. Reflection and standing waves will thereby be eliminated on the main transmission line, L2.

4-6. L1 is of such length that its impedance at point Y is made up of the antenna feedhorn impedance (ZR) and the characteristic **impedance of L1 and Z0 in combination. This impedance has a resistive component equal to Z0 plus some reactive component. This reactive component is shown in (B) of figure 4-1 as XL. Figure 4-1 (B) shows the equivalent circuit.**

4-7. The tuning probe presents an impedance that is almost pure reactance. Therefore, the tuning probe can be adjusted at point Y to resonate with the reactive component due to L1. This reactive component is shown as Xc. The result is that the reactances cancel and leave only the resistive component R equal to characteristic impedance of the line (Zo). Therefore, a resistance of Zo remains across the transmission line at point Y and the line L2 is matched at this point. It is assumed that the generator will match the line and that the line and generator can be represented as L2.

4-8. If only a single tuning probe is used, the location of point Y can be found by a cut-and-try method, but this operation is rather tedious. Therefore, it is customary to use two or more fixed tuning probes to avoid the problem of moving one probe along the transmission line. The other probe(s) add

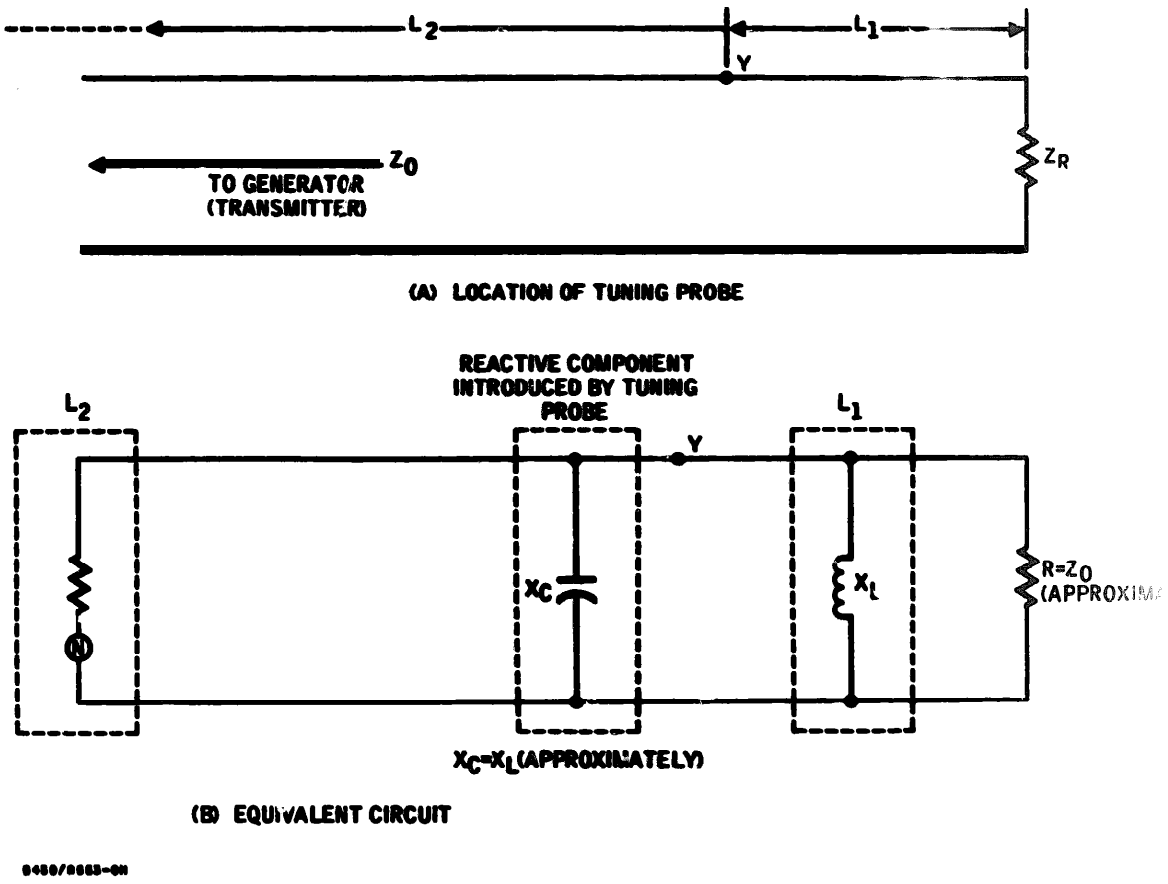

Figure 4-1. Tuning Probe Matching

capacitance or inductance to the transmission line and thus vary the position of the standing waves. This produces the same effect as if the first probe was moved along the transmission line.

4-9. The antenna tuner contains five tuning probes which allow the antenna feedhorn to be matched to the transmission line at a band of frequencies which include the transmit frequency and the receive frequency.

4-10. HARMONIC FILTER.

4-11. Figure 4-2 shows an equivalent circuit of the harmonic filter.

4-12. The characteristics of design of the harmonic filter are such that the second harmonic of the fundamental transmitting frequency is attenuated by 20 db and the third harmonic is attemiated by 10 db.

4-13. This attenuation is accomplished by the physical and electrical properties incorporated in the harmonic filter. The electrical

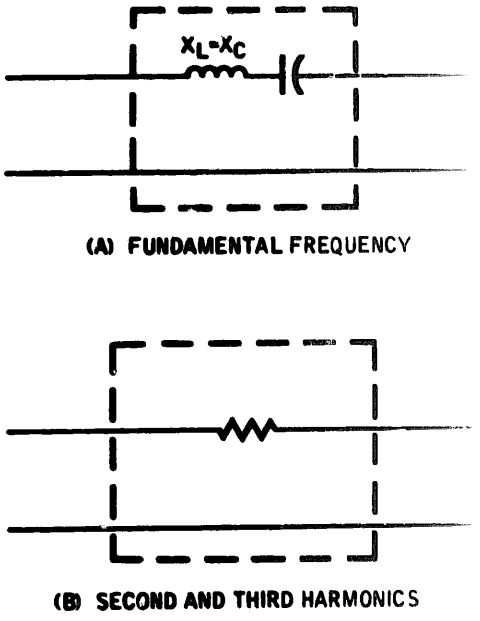

Figure 4-2. Harmonic Filter Equivalent Cir

length of the tubes which comprise the harmonic filter are cut so that they effect a bandpass filter network.

4-14. The fundamental frequency passes through the filter with very little attenuation while the second and third harmonics are directed into the absorptive material in the tubes and attenuated. The fundamental frequency sees an effective series resonant circuit while the second and third harmonics see a resistance.

4-15. The tapered waveguide assemblies effect an impedance match between the harmonic filter and the transmission line.

SECTION II
FUNCTIONAL OPERATION OF ELECTRONIC CIRCUITS

NOT APPLICABLE

SECTION III
FUNCTIONAL OPERATION OF MECHANICAL ASSEMBLIES

NOT APPLICABLE

CHAPTER 5
MAINTENANCE

5-1. INTRODUCTION This chapter contains the instructions needed to maintain the antenna tuner and harmonic filter. of this chapter gives instructions for organizational/field maintenance procedures; Section II, Special Maintenance, is not applicable

SECTION I
ORGANIZATIONAL/FIELD MAINTENANCE

5-2. **TEST EQUIPMENT AND TOOLS.**

5-3. Table 5-1 lists the test equipment you will need to perform the organizational/field maintenance instructions given in this section, **The test equipment characteristics given are those which are applicable to the testing of this equipmnt and do not necessarily represent the maximum capabilities of the test equipment.**

5-4. **No special tools are required for the maintenance of the antenna tuner or harmonic filter. The tools required but not supplied are listed in table 1-4.**

5-5. **SAFETY PRECAUTIONS.**

5-6. Proper safety precautions must be **observed when performing maintenance on the antenna tuner and harmonic filter.**

WARNING

Radio-frequency energy applied at any level of power to the antenna tuner or harmonic filter will be considered dangerous to maintenance personnel. Turn off ALL power to the transmitter.

5-7. **TEST EQUIPMENT SETUP CALIBRATION,**

5-8. **GENERAL.**

5-9. The following paragraphs give the details for the test setup calibration of the test equipment used for organizational/field maintenance of the antenna tuner and harmonic filter. These procedures 3 will help you become familiar with the test equipment and will assure you that it is in good operating order.

NOTE

Perform all test and calibration procedures in the sequence presented in this chapter. Failure to do so may result in erroneous test **results.**

5-10. **TEST EQUIPMENT CHECKOUT.**

5-11. Check out the test equipment in accordance with the following steps (fig. 5-1):

a. Turn on the signal generator and allow it to warm up for approximately one hour.

b. Set the attenuator on the signal generator to 0 db and adjust the output level until the needle on the output meter indicates +4 dbm.

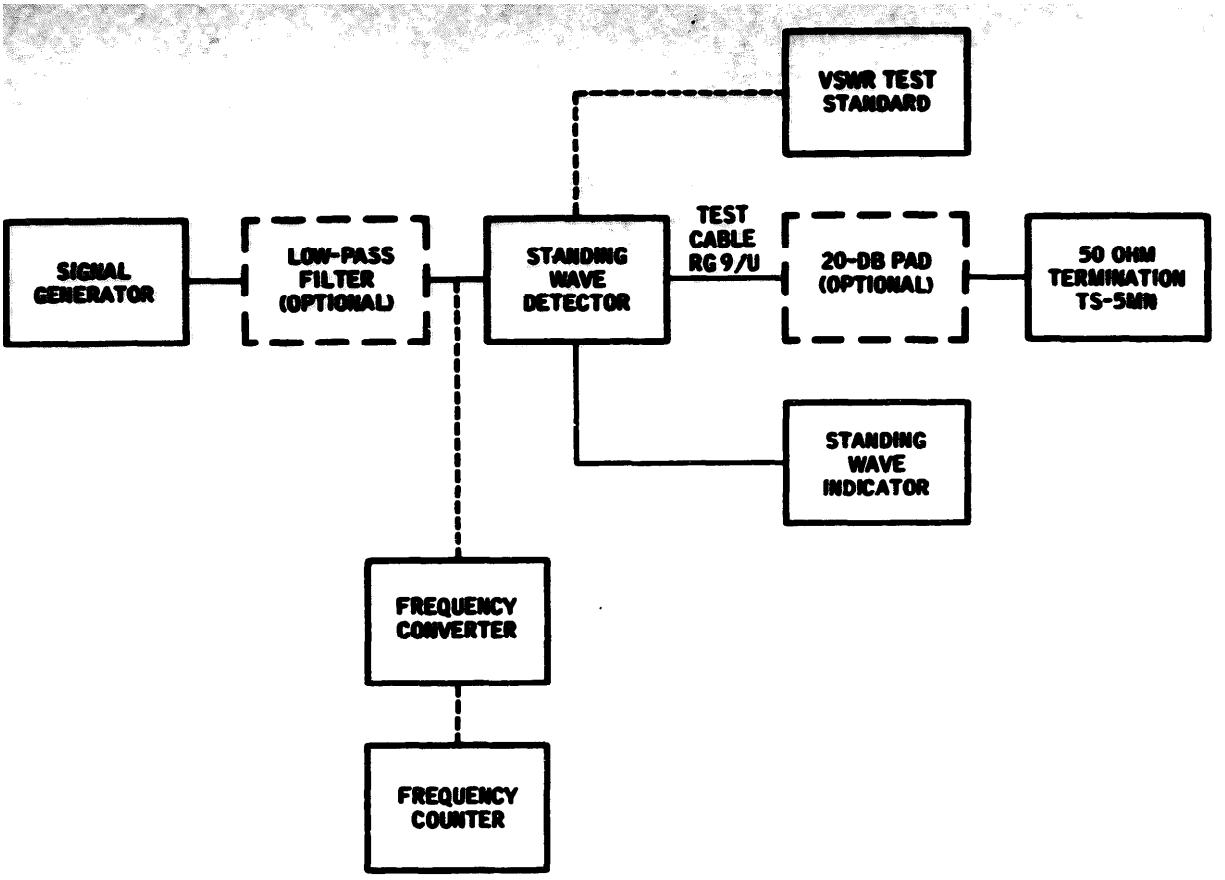

Figure 5-1. Setup for checking out VSWR Measuring Equipment

Table 5-1. Test Equipment Required

Federal Stock Number	Test Equipment	Characteristics
6635-557-03308	**Signal generator, AN/URM-49**	**Frequency range: 450-1230 mc** **Accuracy: ±1%** **Internal impedance: 50Ω** **Internal modulation: 400 cps and 1000 cps ±10%** **Output voltage: 0.1μv to 0.5 v into 50Ω load**
4931-656-5915	**Standing wave detector, Model 219 (PRD Electronics)**	**Residual vswr: Less than 1.03 (residual)** **Minimum input: 1 v at 100 mcs, 0.1 v at 1000 mcs** **Accuracy of voltage reflection coefficient angle: ±5°**
6625-519-1755	**Standing wave indicator, 415B (Hewlett-Packard)**	**Frequency: 1000 cps ±2%** **Sensitivity: 0.1μv at 200Ω level for full scale deflection** **Noise level: Less than 0.03μv** **Calibration: Square law meter indicates swr and db**

Table 5-1. Test Equipment Required (cont)

Federal Stock Number	Test Equipment	Characteristics
6225-086-7165	Wide band sweep frequency generator, 900B (Jerrold)	Frequency range: 0.500-1200 mc Output voltage: vhf, 0.25 v rms or more into a 50Ω line; uhf, 0.5 v rms or more into a 50Ω line Output voltage variation: vhf ±0.5 db at maximum sweep width, uhf ±0.5 db to 800 mc and ±1.5 db from 800-1000 mc
None	Frequency counter 7170 (Berkeley)	Frequency range: 10 cps to 11.5 mc Display time: 0.05 to 5 sec Accuracy: ±3 counts in 10^7 per week Sensitivity: 100 mv Input impedance: 1 megohm
6625-676-1302	Oscilloscope, 317-S1 (Tektronix)	Passband: dc to 10 mc at 0.1 to 125 v per division Rise time: 0.035μsec continuous variable sweep: 0.04μsec per division to 6 sec per division, 0.25μsec delay
5985-792-9280	Adapter, coaxial 874-QU3A (General Radio)	3-1/8-in. coaxial to GR-874 connector VSWR: less than 1.03:1 to 920 mc Impedance: 50Ω
5985-445-6952	Attenuator, fixed AD-10N (2 each) (Microlab)	Accuracy: ±0.5 db Frequency range: dc to 4000 mc Attenuation: 10 db Impedance: 50Ω
None	Coaxial termination, short circuit TS-5MN (Microlab)	Frequency range: 755-985 mc Impedance: 50Ω
None	Frequency converter 7573 (Berkeley) (must be used with Type 7570, 7571)	Frequency range: 220-1000 mc Sensitivity: 1 mw Impedance: 50Ω Measurement accuracy: 0.00004%
None	Low pass filter 874-F1000L (General Radio)	Accuracy: -0% +10% at cut-off frequency
None	Test transition 602707-903 (ITE Circuit Breaker)	3-1/8-in. coaxial to WR-975 waveguide Adjustable vswr to less than 1.02:1 at a specific frequency within 755-985-mc frequency band and less than 1.04:1 over ±1% of the band
None	Waveguide dissipative termination 602790-903 (ITE Circuit Breaker)	Residual vswr: less than 1.02:1
6625-887-3892	Attenuator Type AD-20T (Microlab)	Accuracy: ±0.5 db Frequency range: dc to 4000 mc Attenuation: 20 db Impedance: 50Ω

Table 5-1. Test Equipment Required (cont)

Federal Stock Number	Test Equipment	Characteristics
6625-38-3479	Frequency converter amplifier 7570 (Berkeley)	Frequency range: 10 kc to 10 mc Sensitivity: 2 mv Input impedance: 1 megohm Measurement accuracy: 0.0004% above 1 mc Gain: 100 Output: 100 mv rms
None	Frequency converter 7571 (Berkeley) (must be used with Type 7570)	Frequency range: 10-110 mc Sensitivity: 1 mv Input impedance: 50Ω Measurement accuracy: 0.0004%

c. Set the signal generator for the unmodulated or cw mode.

d. Connect the signal generator to the frequency counter through the frequency converter.

(1) Determine the exact signal generator dial settings for each of the center frequencies to be used. (Note the approximate frequency on the drum dial and the exact setting on the vernier dial.)

(2) Using the relative frequency calibration on the drum dial, determine the number of divisions on the vernier dial required to change the frequency plus or minus 5 mc from the center frequency in 1.0-mc intervals. Record this information for future reference.

NOTE

If the signal generator is operating normally and has been warmed up, it may be assumed that the repeatability of the settings just determined are adequate for measurements for approximately 8 hours. However, the frequency of the signal generator should be checked at the beginning and end of a series of measurements to determine that the frequency has not drifted by more than 100 kc.

e. Attach the vswr test standard (provided with the standing wave detector) and the standing wave indicator to the standing wave detector.

f. Adjust the modulation level of the signal generator to 100 percent with 1000 cps.

g. Install and remove the low-pass filter to see if there is any difference in the vswr obtained with the test standard at each of the transmit and receive frequencies for your particular site. If there is no appreciable difference, leave the low-pass filter out of the circuit.

h. Using the standard at each of the operating frequencies, experimentally determine the setting of the reactance arm of the standing wave detector (the one calibrated in frequency) that gives the minimum vswr reading. Record the difference between the indicated frequency shown on this arm and the actual frequency measured. Apply this difference as a linear frequency correction when vswr readings are taken of external loads.

i. Connect a 50-ohm termination directly to the standing wave detector and measure the vswr. The measured vswr should be less than 1.025. If not, connect a 20-db pad in series with the termination. If it is necessary to use the 20-db pad, it should be left in the test setup for all subsequent test procedures.

j. Prepare test cables 6, 12, and 30 feet long. Connect the 50-ohm termination at the end of each cable and measure, in turn, the vswr of each cable and the termination. The vswr with each cable in the circuit should not be substantially different than that with the termination applied directly as in step i. The vswr should not exceed 1.05:1. The equipment is now ready for making vswr measurements.

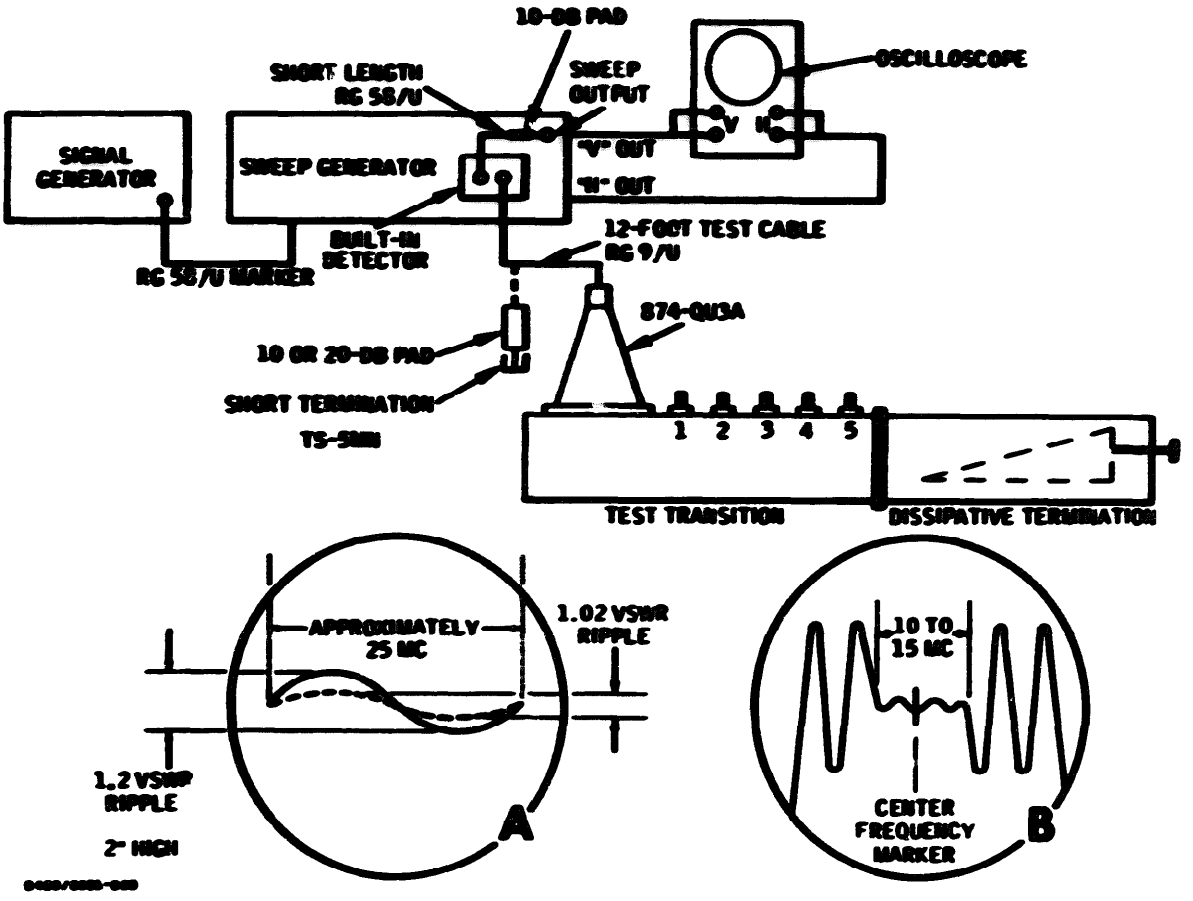

Figure 5-2. Tuning Test Transition (Sweep Method)

NOTE

Twist the cable to see that plug connections are tight.

Considerable care must be taken in correctly applying fittings to lengths cut from bulk cable. It is recommended that cables already provided with other test equipment be used when available.

It is advisable to avoid the use of a separate test cable whenever possible, by connecting the standing wave detector directly at the point of measurement with an adapter cone or similar device.

5-12. TEST TRANSITION TUNING.

5-13. The transition, used for connecting the test equipment to the waveguide line is time so that it will not introduce residual vswr to the waveguide measurements.

5-14. INITIAL ADJUSTMENT BY SWEEP METHOD. **Connect the equipment as shown in figure 5-2 and perform the following procedures:**

a. Connect a 10-db pad and a short termination to the end of the 12-foot test cable, and set the vertical gain and vertical positioning controls on the oscilloscope until a ripple pattern is approximately 1-1/2 inches high and is centered along the scope horizontal centering line. Adjust the vertical balance control so that the pattern axis does not move up or down when the vertical gain is increased or decreased.

b. Reset the gain of the scope so that the observed pattern is about 2 inches high which corresponds to a vswr of 1.2:1. Substitute

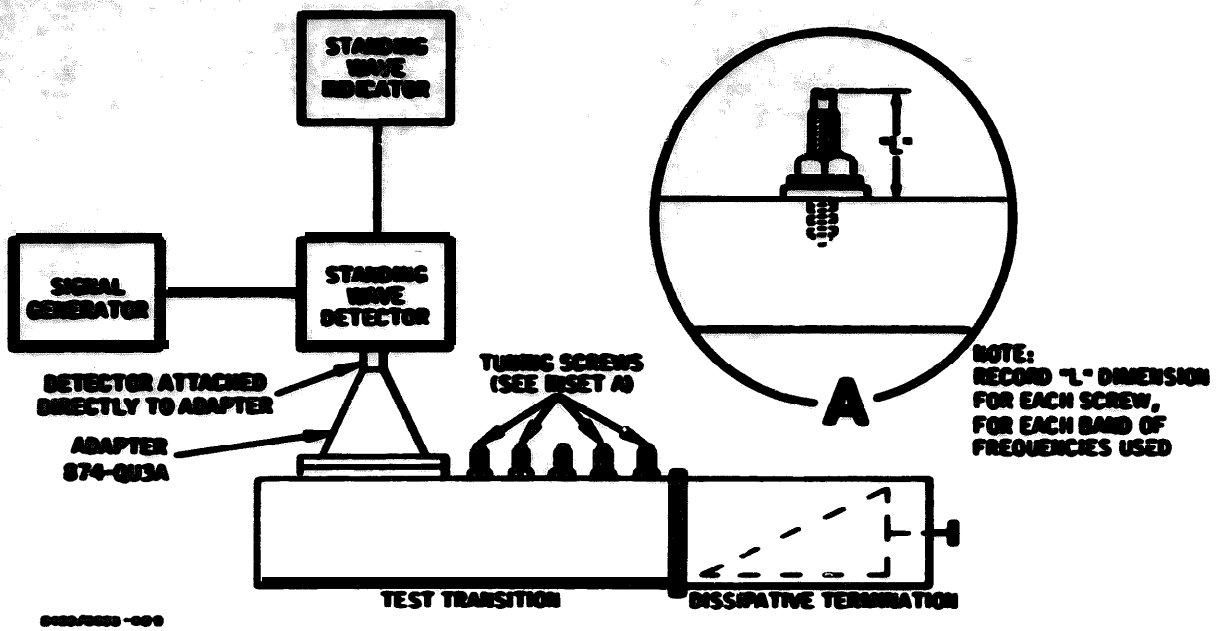

Figure 5-3. Tuning Test Transition (Point-by-Point Method)

a 20-db pad in place of the 10-db pad to observe the ripple height corresponding to a vswr of approximately 1.02:1 ((A) of fig. 5-3).

c. Remove the 20-db pad and short termination from the 12-foot test cable and then connect the cable to the reducing cone (adapter 874-QU3A) of the transition. If the vertical pattern produced is off scale, reduce the vertical gain by 10 db or more with the step attenuator of the oscilloscope, but leave the vernier gain control unchanged so that the initial gain setting can be restored conveniently.

d. Position the five tuning screws on the test transition so that they do not penetrate through the waveguide wall. Screw in one screw at a time to determine which screw has the most effect in obtaining a flat sweep pattern about the desired center frequency, as illustrated in inset (B) of figure 5-3.

e. After determining the single screw that produces the most effect, run in the two screws on both sides of that screw as required to obtain the 1.02:1 vswr ripple height previously observed at standard vertical gain.

5-15. The sweep technique is used to minimize the vswr within the desired passband around the center frequency. If the height of the ripple pattern with the test transition under test is exactly equal to that obtained when using the 20-db pad and short termination ((A) of fig. 5-3), the technique would give an accurate indication that the vswr within the set passband was less than 1.02:1. However, it has been found that the scope observation may not be accurate enough to determine precise equality when establishing vswr's less than about 1.1:1 due to pattern instability and insufficient gain in the scope. It is, therefore, necessary to touch up the adjustment of the screws and check the vswr within the desired band by a point-by-point measurement technique.

5-16. FINAL ADJUSTMENT BY POINT-BY-POINT METHOD. Connect the equipment as shown in figure 5-3 and perform the following steps:

a. Measure the vswr at various points within the desired passband of the test transition.

b. Set the signal generator to the required frequencies using the information recorded in paragraph 5-11 d(2) and adjust the screws set in paragraph 5-14 in small increments so that the maximum vswr within ±5 mc around the center frequency is less than 1.03:1.

c. Slide the dissipative termination in and out for at least 6 inches. Note the difference in the maximum and minimum vswr readings at counter frequency and at the lead edges. If these differ by more than 0.01, set the sliding lead to the position of maximum vswr and readjust all screws until the vswr variation is within this limit.

d. Accurately record the adjustment screw settings for the test frequencies. This can be conventently done by measuring the distance from the top of the Tuning screw to the surface of the waveguide with a machinist's rule. Designate the screws as numbers 1 through 5 starting at the reducing cone (adapter (974-QU3A) and, tabulate the screw settings along with the vswr readings obtained for future reference.

5-17. PREINSTALLATION TEST PROCEDURES.

5-18. ANTENNA TUNER VSWR MEASUREMENT.

5-19. Perform the following steps to insure that the antenna tuner vswr is within tolerable limits prior to installation in the transmission line. This procedure assumes that the test equipment has been properly calibrated as described in paragraphs 5-7 through 5-16.

a. Set up the test equipment as shown in (A) of figure 5-4.

b. Connect the test transition to one end of the antenna and a dissipative termination to the other end

c. Remove the metal caps which cover the five antenna tuner tuning probes. Loosen the tuning probe locknuts and adjust all five tuning probes counterclockwise to a point where there is no insertion into the waveguide.

d. Determine the vswr at several points within the frequency range of 755 to 985 mc.

c. Verify each vswr measurement bythe point-by-point method ((B) of fig. 5-4).

f. The vswr should not exceed 1.02:1 within the frequency range of 755 to 985 mc.

5-20. HARMONIC FILTER VSWR MEASUREMENT.

5-21. Perform the following steps to measure the vswr of the harmonic filer prior to installation in the transmission line.

a. Set up the test equipment as shown in (A) of figure 5-4.

b. Connect the test transition to one end of the harmonoic filter and a dissipative termination to the other end.

c. Determine the vswr at several points within the frequency range of 755 to 985

d. Varify each vswr measurement by the oint-by-point method ((B) of fig. 5-4).

e. The vswr should not exceed 1.1 within the frequency of 755 to 985 mc.

5-22. HARMONIC FILTER INSERTION LOSS MEASUREMENT.

5-23. Perform the following steps to measure the insertion loss of the harmonic filter prior to installation in the transmission line.

a. Set up the text equipment as shown in (c) of figure 5-4.

b. Set the signal generator to any frequency within the 785-mc frequency range Adjust the output level until the output meter indicates +3 dim. Modulate 100 percent with 1000 cps.

c. Set the standing wave indicator for expanded scale and maximum gain.

d. Set the output attemiator of the signal generator so as to produce a steady 0-db reading on the standing wave indicator expanded meter scale. The indication on the signal generator should be about 60 + 5 db, depending upon the condition and type of crystal detector. Operate the detector band switch on the standing wave indicator to the position which gives the best result (i. e., highest signal generator attenmator setting which will give 0 reading).

NOTE

The ground pins on the ac line plugs for both the signal generator and standing wave indicator must be isolated from ground. Otherwise, either an unstable reading will be obtained on the standing wave indicator at low signal inputs to the detector or the isolation test results will be in error.

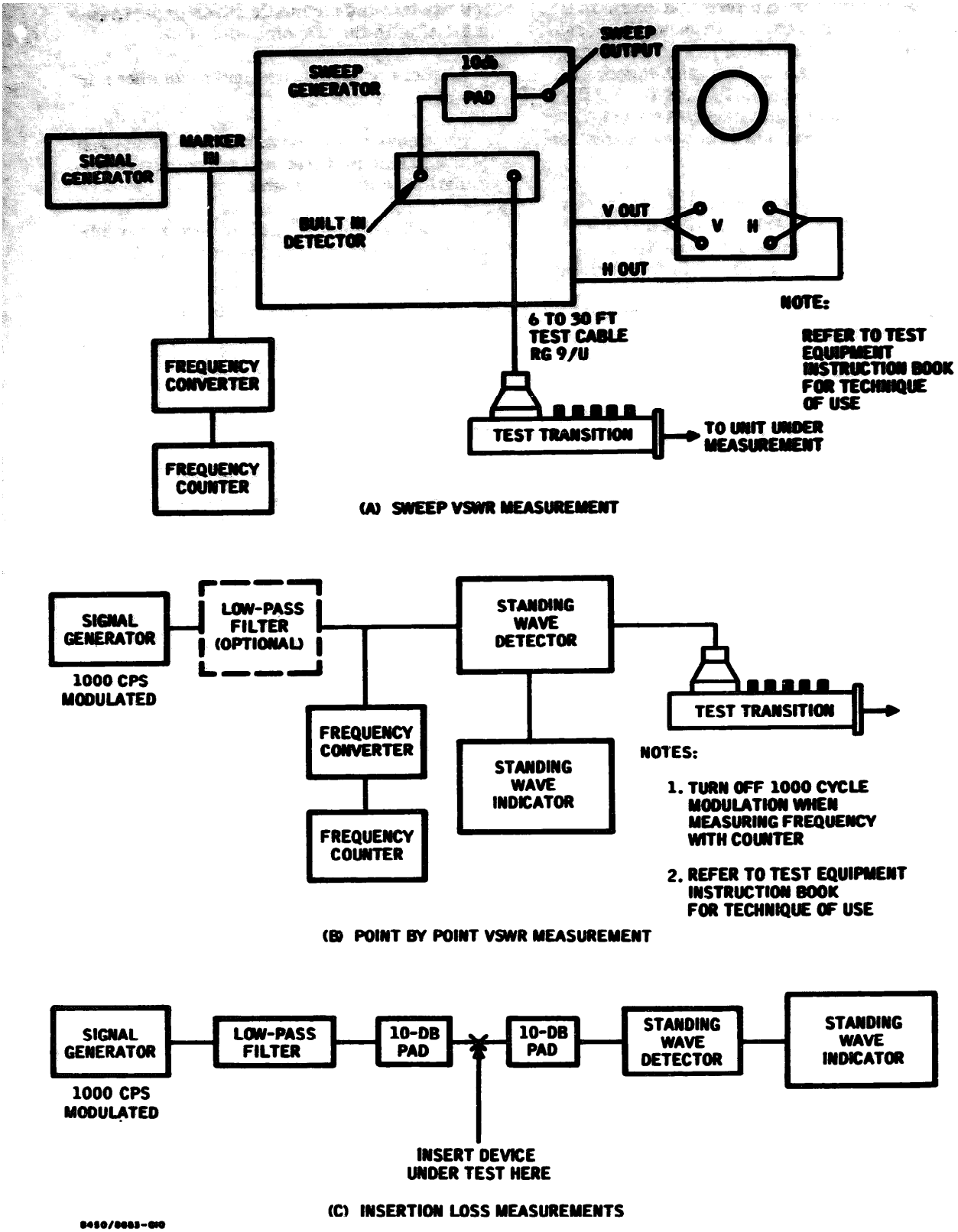

Figure 5-4. RF Measuring Setups

e. Separate the two 10-db pads and connect them to the harmonic filter.

f. Reduce the attenuator setting on the signal generator until 0-db reading is restored on the standing wave indicator. The difference in attenuator settings represents the insertion loss of the harmonic filter. Record the harmonic filter insertion loss.

g. Repeat steps b through f at several points within the 755- to 965-mc frequency range. The insertion loss of the harmonic filter should not exceed 0.2 db within this band.

5-24. ALIGNMENT AFTER CONNECTION TO ANTENNA FEEDHORN.

5-25. GENERAL.

5-26. The antenna tuner must be aligned after installation connection to the antenna feedhorn. Alignment of the antenna tuner reduces the impedance mismatch between the antenna feedhorn and the transmission line and thus reduces the transmission line vswr.

5-27. There are no alignment procedures or other adjustments that can be performed on the harmonic filter after installation in the transmission line.

5-28. ANTENNA TUNER ALIGNMENT.

5-29. Alignment of the antenna tuner is accomplished after the antenna feedhorn, its associated waveguide, and the antenna tuner have been installed and are in operable condition. The sweep method of vswr measurement is used for initial alignment of the antenna tuner and the point-by-point method for the final alignment. The following procedure assumes that the test equipment has been properly calibrated as described in paragraphs 5-7 through 5-16. Align the antenna tuner in accordance with the following steps:

a. Connect the test equipment to the antenna tuner as shown in (A) of figure 5-4.

b. Remove the metal caps which cover the five antenna tuner tuning probes.

c. Loosen the tuning probe locknuts and adjust all five tuning probes counterclockwise to a point where there is no probe insertion into the waveguide.

d. Set the output of the signal generator to the transmit frequency.

e. Select one of the five tuning probes and screw it in while observing the effect on the vswr. If a decrease is observed, adjust the probe for a moderate decrease in vswr and continue with step g. If little or no effect is observed, reset the tuning probe to its original position and continue with step f.

f. Select another tuning probe and adjust it while observing the effect on the vswr. If this probe has no effect, reset it to its original position and keep selecting probes until one is found that decreases the vswr. Adjust this probe to decrease the vswr a moderate amount. Record the setting of the tuning probe.

g. Set the output of the signal generator to the receive frequency and observe the vswr.

h. Using the tuning probe previously adjusted in step e or step f, vary it and observe the oscilloscope for a decrease in vswr. If a decrease in vswr is noted, proceed to step j. If there is little or no effect on the vswr, reset the tuning probe to its previously adjusted position and proceed with step i.

i. Select another tuning probe and vary it while observing the vswr on the oscilloscope. If this tuning probe has no effect, reset it to its original position and keep selecting tuning probes until one is found that decreases the vswr. Adjust this tuning probe to decrease the vswr a moderate amount. Record the setting of this tuning probe.

j. Set the output of the signal generator to the transmit frequency and observe the vswr. The vswr may have increased or decreased at this point or, due to interaction of the tuning probes, remained constant.

NOTE

Remember to reset the tuning probes to their previous positions if their effect on vswr reduction is negligible.

k. Vary the probe or probes previously adjusted and note the effect. If it is not possible to decrease the vswr a moderate amount, try another tuning probe. Keep

adjusting tuning probes on a trial and error basis until the desired tuning probe is located. Decrease the vswr a moderate amount.

l. Set the output of the signal generator to the receive frequency and repeat step k.

m. Repeat steps j, k and l until a vswr of 1.1:1 is obtained.

n. Remove the test equipment which was connected in step a from the antenna tuner.

o. Connect the test equipment to the antenna tuner as shown in (B) of figure 5-4 for the point-by-point method of vswr measurement.

p. Continue to adjust the tuning probes at the transmit frequency setting of the signal generator and at the receive frequency setting of the signal generator in the manner previously described until a vswr of 1.05:1 or less is obtained at both frequencies.

NOTE

When approaching a vswr of 1.05:1 tuning becomes very sensitive. The tuning probes should be adjusted in increments of one-eighth turn or less at this point. The tuning probe should be locked after each adjustment by properly adjusting its locknut. Monitor the vswr while this is accomplished to maintain the desired vswr.

q. When a vswr of 1.05:1 or less at both the transmit and receive frequencies is obtained, the alignment procedure for the antenna tuner is considered complete. After completion of the alignment procedure the tuning probes must be locked in place with their locknuts. Locking of the tuning probes tends to change the vswr and, therefore, it is necessary to maintain an opposite force on the tuning probes to eliminate this action.

r. Replace the metal caps over the five tuning probes. This completes the alignment procedure for the antenna tuner.

5-30. REPAIR AND REPLACEMENT.

5-31. Repair of the harmonic filter is not applicable. Replacement of the harmonic filter is required if found to be malfunctioning or faulty.

5-32. Repair of the antenna tuner is limited to replacement of tuning probes. Replacement of tuning probes is obvious. (See fig. 5-5, 5-6, 5-7, and appendixes A and C.)

5-33. PREVENTIVE MAINTENANCE.

5-34. Preventive maintenance of the antenna tuner and harmonic filter consists of making a periodic inspection of the equipments. The time interval between inspections must be determined by maintenance personnel, giving consideration to general environmental conditions at the site.

5-35. To maintain a protective coating on the exterior of the equipments, touch up all areas showing the need of paint.

5-36. If inspection reveals corrosion on the equipment, remove the corrosion as follows:

a. Remove all lacquer with lacquer remover.

WARNING

Exercise extreme care to prevent skin and clothing from coming in contact with muriatic acid.

b. Dip the component into a solution of 30 percent muriatic acid and 70 percent water until the corrosion loosens.

c. Remove the component from the solution and rinse it thoroughly under running water.

d. Apply a protective coat of lacquer.

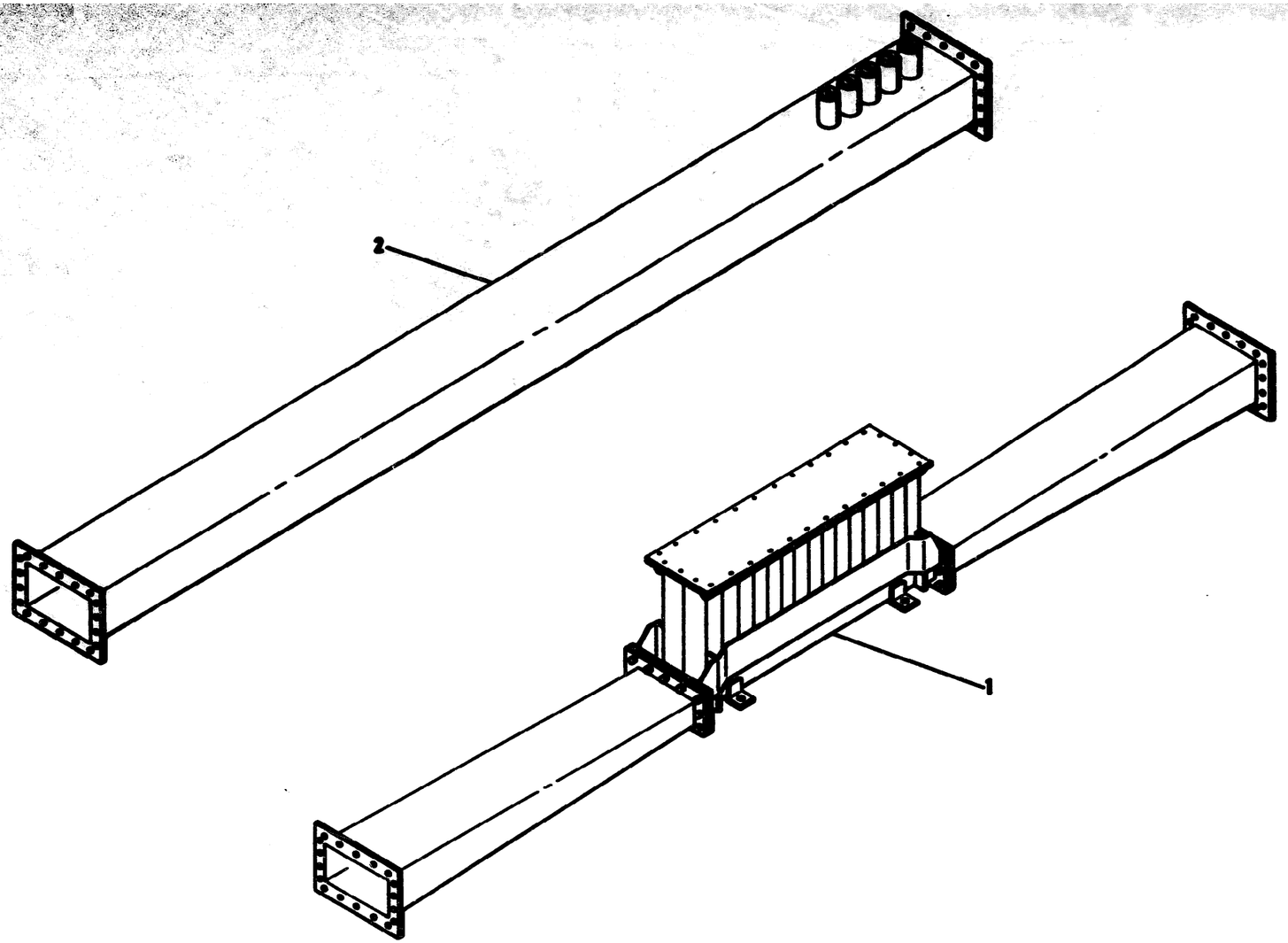

Figure 5-5. Filter and Matching Group

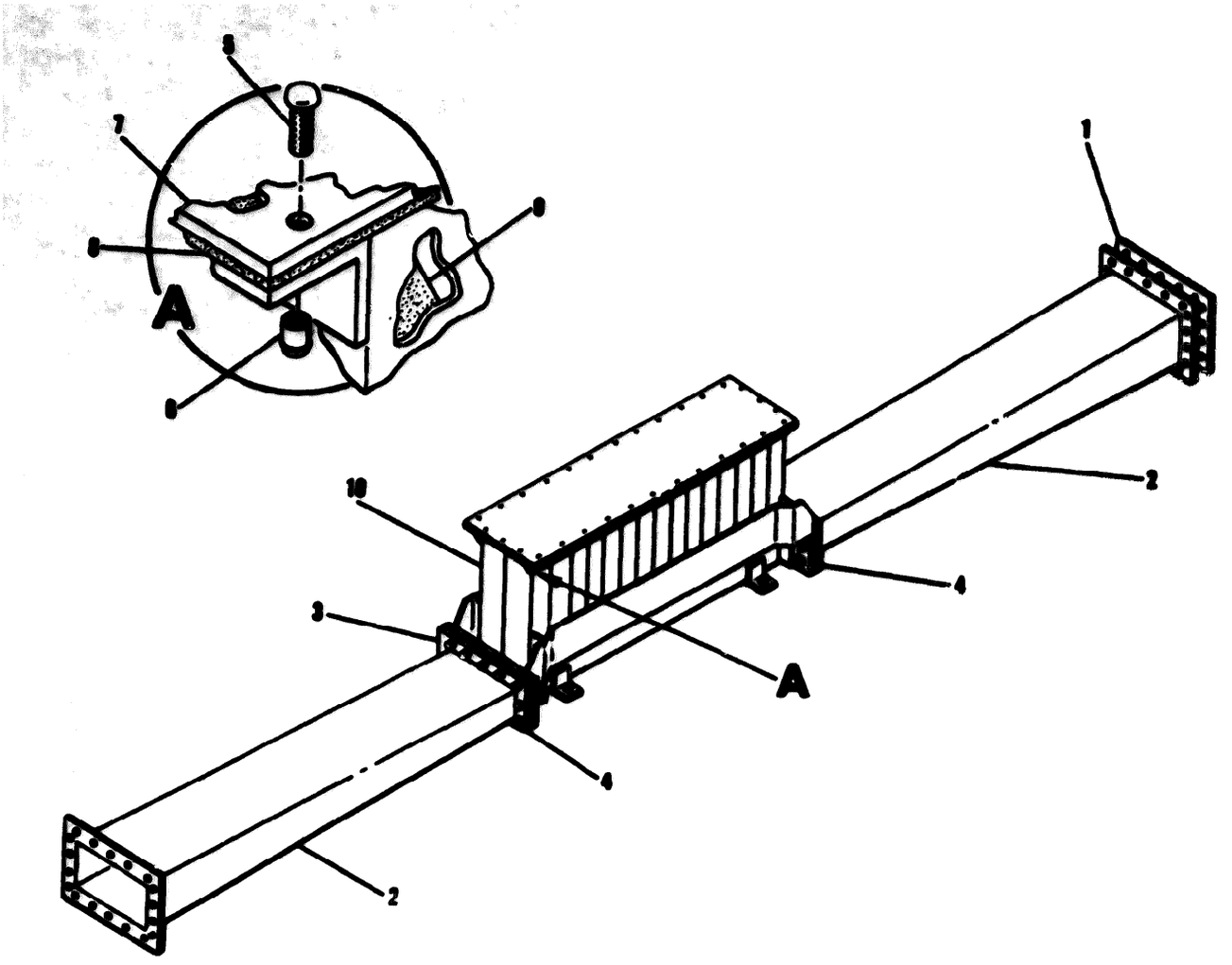

Figure 5-6. Band Pass Filter

SECTION III. INDEX FEDERAL STOCK NUMBER CROSS REFERENCE

TO INDEX NUMBER

FEDERAL STOCK NUMBER	INDEX NO.	FEDERAL STOCK NUMBER	INDEX NO.	FEDERAL STOCK NUMBER	INDEX NO.
5310-816-6954	A003				
5320-878-7184	A014				
5330-584-1581	A021				
MFR NUMBER	INDEX NUMBER				
CL2806-5	A013				
600315-3	A022				
602706-1	A020				
604514-3	A005				
604605-501	A003				
604659-501	A018				
604660-501	A006				
604661-1	A017				
604661-501	A002				
604662-1	A011				
604663-1	A016				

SECTION IV. INDEX-FIGURE AND ITEM NUMBER CROSS REFERENCE TO INDEX NUMBER

FIG. NO.	ITEM NO. OR REFERENCE DESIGNATION	INDEX NO.	FIG. NO.	ITEM NO. OR REFERENCE DESIGNATION	INDEX NO.
5-5	1	A002			
	2	A003			
5-6	1	A005			
	2	A006			
	3	A007			
	4	A011			
	5	A013			
	6	A014			
	7	A015			
	8	A016			
	9	A017			
	10	A018			
5-7	1	A020			
	2	A021			
	3	A022			
	4	A023			
	5	A024			
	6	A025			

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL AND TEST EQUIPMENT REQUIREMENTS					
TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE Recommended in Manual	NOMENCLATURE Available on Site	FEDERAL STOCK NUMBER	TOOL NUMBER
1	F,H,D	SIGNAL GENERATOR, AN/URM-49 LAVOIE LABS	H.P., #612A		
2	F,H,D	COAXIAL TERMINATION, SHORT CKT. MICROLAB, #TS-50N	COAXIAL TERMINATION, SHORT CKT. MICROLAB, #TS-50N		
3	F,H,D	LOW PASS FILTER GENERAL RADIO, #874-F1000L			
4	F,H,D	TEST TRANSITION, TYE CIRCUIT BREAKER, #602707-903			
5	F,H,D	WAVEGUIDE DISSIPATIVE TERMINATION TYE CIRCUIT BREAKER, #602790-903			
6	F,H,D	STANDING WAVE DETECTOR, FXD, #219	STANDING WAVE DETECTOR, FXD, #219		
7	F,H,D	STANDING WAVE INDICATOR H.P. #415B	H.P., #416B		
8	F,H,D	SWEEP GENERATOR, JERROLD, #900B	SWEEP GENERATOR JERROLD		
9	F,H,D	FREQUENCY COUNTER, BERKELEY, #7170	H.P., #5245L		
10	F,H,D	OSCILLOSCOPE, TEKTRONIC, #317-S1	OSCILLOSCOPE, TEKTRONIC, #561A		
11	F,H,D	ATTENUATOR, MICROLAB, #AD-10N	ATTENUATOR, MICROLAB, #AD-10N		
12	F,H,D	ATTENUATOR, MICROLAB, #AD-20T			
13	F,H,D	FREQUENCY CONVERTER AMPLIFIER BERKLEY, #7570 AND #7571			
14	F,H,D		SITE TOOL KIT		

APPENDIX C

DS, GS, AND DEPOT MAINTENANCE REPAIR PARTS

Section I. INTRODUCTION

C–1. Scope

This appendix contains a list of repair parts required for the performance of direct support, general support, and depot maintenance for Filter and Matching Group.

NOTE

No special tools, test, and support equipment are required.

C–2. General

This repair parts list is divided into the following sections:

a. Repair Parts for Direct Support, General Support, and Depot Maintenance, Section II. Repair parts authorized for direct support, general support, and depot maintenance are included in this section.

NOTE

All indexes noted below are cross-referenced to index numbers. The index numbers appear in ascending sequence in column 3 of the repair parts list (para B-3*c*). The index number for the particular item will be the same for the item in all sections of this appendix.

b. Federal Stock Number Cross-Reference to Index Number, Section III. This is a cross-reference index of Federal stock numbers to index numbers.

c. Figure and Item Number Cross-Reference to Index Number, Section IV. This is a cross-reference index of figure number and item number to index number. The figure numbers are listed in numerical sequence; item numbers are listed for each figure.

C–3. Explanation of Columns

An explanation of the columns is given below.

a. Source, Maintenance, and Recoverability Codes, Column 1.

(1) *Source code, column 1a.* The selection status and source for the listed item is noted here. Source codes and their explanations are as follows:

Code	Explanation
A	Applies to assemblies that are not procured or stocked as such but are made up of two or more units, each of which carries an individual stock number and description and is procured and stocked and can be assembled by units at indicated maintenance categories.
X1	Applies to repair parts that are not procured or stocked, the requirement for which will be supplied by the use of next higher assembly or component.
X2	Applies to repair parts that are not stocked. The indicated maintenance category requiring such repair parts will attempt to obtain them through cannibalization; if not obtainable through cannibalization, such repair parts will be requisitioned with supporting justification through normal supply channels.
C	Applies to repair parts authorized for local procurement. If not obtainable from local procurement, such repair parts will be requisitioned through normal supply channels with a supporting statement of nonavailability from local procurement.

(2) *Maintenance code, Column 1b.* The lowest category of maintenance authorized to install the listed item is noted here.

Code	Explanation
O	Organizational Maintenance
F	Direct Support Maintenance
H	General Support Maintenance

(3) *Recoverability code, column 1c.* The information in this column indicates whether unserviceable items should be returned for recovery or salvage. Recoverability code and its explanation is as follows:

NOTE

When no code is indicated in the recover-

ability column, the part will be considered expendable.

Code	Explanation
B	Applies to repair parts and assemblies which are economically repairable at DSU and GSU activities and normally are furnished by supply on an exchange basis.

b. Federal Stock Number Column 2. The Federal stock number for the item is listed in this column.

c. Description, Column 3. The model designators, index number, Federal item name, a five-digit manufacturer's code and a part number are included in this column. For subsequent appearances of the same item, the manufacturer's code and part number are omitted. The words "same as" followed by the sequence number assigned to the item when it first appeared in the list will follow the item name, e.g., "RESISTOR, FIXED, COMPOSITION: SAME AS A298."

d. Unit of Issue, Column 4. The unit used as a basis of issue, (e.g., ea, pr, ft, yd, etc) is indicated in this column.

e. Quantity Incorporated in Unit Pack, Column 5. Not used.

f. Quantity Incorporated in Unit, Column 6. The quantity of repair parts in an assembly is given in this column.

g. Maintenance Allowances, Column 7. Not used.

h. One-Year Allowances Per 100 Equipments/ Contingency Planning Purposes, Column 8. Not used.

i. Depot Maintenance Allowance Per 100 Equipments, Column 9. Not used.

j. Illustrations, Column 10.

(1) *Figure number (A).* The number of the illustration in which the item is shown is indicated in this column.

(2) *Item or symbol number (B).* The callout number used to reference the item in the illustration appears in this column.

C–4. Location of Repair Parts

a. This appendix contains two cross-reference indexes (sect. III and IV), to be used to locate a repair part when either the Federal stock number, reference number (manufacturer's part number), or figure number is known. The first column in each cross-reference is prepared, as applicable, in numerical or alphanumerical sequence. The last column of each cross-reference index lists the index number assigned to the part.

b. Refer to the appropriate cross-reference index (para B–2*b*, and *c*) and note the index number in the last column; then refer to the repair parts list to locate the index number which is listed in ascending order in column 3 of the repair parts list.

C–4. Federal Supply Codes

This paragraph lists the Federal supply code and the associated manufacturer's name.

Code	Manufacturer's Name
29666	Huck Mfg. Co.
30066	I-T-E Circuit Breaker Co.
96906	Military Standards

Section II. REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE

(1) Source Code	Maint. Code	Rec. Code	(2) Federal Stock Number	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Code	(3) Description	(4) Unit of Issue	(5) Qty	(6) Qty	(7) DS 1-20	DS 21-50	DS 51-100	GS 1-20	GS 21-50	GS 51-100	(8) 1 Yr. Alw. per 100 Equip. Contgcy.	(9) Depot Maint. Alw. per 100 Equip.	(10) Figure Number	Item or Symbol Number
A	F	R								A	A001 FILTER AND MATCHING GROUP 30086 (This item is nonexpendable)			1									5-5	
A	F	R								[illegible]	A002 FILTER,BAND PASS 30086 601461-901			957									5-5	1
A	F	R								[illegible]	A003 TUNER,RADIO FREQUENCY TN-422/GRC-85(V)2 SEE FIG. 3 30086 601485-901			957									5-5	2
A	F	R								[illegible]	A004 FILTER,BAND PASS SAME AS A002			REF									5-6	
A2	F									C	A005 GASKET 30086 604514-3			1									5-6	1
A2	F									C	A006 WAVEGUIDE ASSEMBLY 30086 601460-501			2									5-6	2
C	F									[illegible]	A007 BOLT,MACHINE,HEX., NO.3/8-16 BY 2-1/4 IN.LG. COML			24									5-6	3
C	F									[illegible]	A008 WASHER,FLAT,1/2 IN.ID COML			48										
C	F									[illegible]	A009 WASHER,LOCK,1/2 IN. ID COML			24										

(1) SMR CODE			(2) REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE								(7) UNIT OF MEAS	(8) QTY INC IN UNIT	(9) QTY PER ASSY	(10) 30 DAY MAINT. ALW.						(11) 1 YR. ALW. PER 100 EQUIP. CATEGY PL.	(12) DEPOT MAINT. ALW. PER 100 EQUIP.	(13) ILLUSTRATION	
			(3) FEDERAL STOCK NUMBER	FEDERAL						(4) DESCRIPTION				CO			DS					(a) FIGURE NUMBER	(b) ITEM OR SYMBOL NUMBER
				1	2	3	4	5	6	SUPP. CD				1-20	21-60	61-100	1-20	21-60	61-100				
C	F									P	A010 NUT,PLAIN, HEX., 3/8-16 CUNL		24									5-6	
A2	F									C	A011 GASKET 30086 604683-1		2									5-6	4
A2	F									P	A012 COVER ASSEMBLY, FILTER 30086 604683-901		1									5-6	
C	H									P	A013 PIN,RIVET 79800 CLPRCO-5		30									5-6	5
C	H		5320-878-7184							P	A014 COLLAR,RIVET PIN 29066 LCR6		30									5-6	6
A2	H									P	A015 GASKET 30086 604683-3		1									5-6	7
A2	H									P	A016 COVER,FILTER 30086 604683-1		1									5-6	8
A2	H									C	A017 GASKET 30086 604681-1		60									5-6	9
A	H									P	A018 FILTER,HARMONIC 56086 604659-501		1									5-6	10
A	F	A								P	A019 TUNER,RADIO FREQUENCY TH-422/VRC-85(V)2 SAME AS A003		REF									5-7	

(1) SOURCE CODE	(2) MAINT. CODE	(3) USABLE ON CODE	REPAIR PARTS FOR DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE (4) FEDERAL STOCK NUMBER	(5) MODEL 1 2 3 4 5 6	(6) REF. NO.	(7) DESCRIPTION	(8) UNIT OF ISSUE	(9) QTY INC IN UNIT	(10) QTY REQD	(11) 30 DAY MAINT. ALLOC. CO 1-20	CO 21-50	CO 51-100	CO 1-20	CO 21-50	CO 51-100	(12) 1 YR. ALLOC. FOR 100 OPERS. OR CATEGORY PL	(13) DEPOT MAINT. ALLOC. FOR 100 OPERS.	(14) ILLUSTRATION FIGURE NUMBER	ITEM NUMBER
X2	H				C	A020 CAP,PROBE 30006 602706-1			5									5-7	1
X2	H		5330-584-1581		C	A021 PACKING 96906 MS90021-129			5									5-7	2
X2	H				C	A022 PROBE 30006 600915-3			5									5-7	3
C	H		5310-616-6354		•	A023 WASHER 80044 AN935A916			5									5-7	4
C	H				•	A024 NUT,PLAIN,HEX.. CRES,9/16-24 COML			5									5-7	5
X1					C	A025 TUNER,ANTENNA 30006 NO NUMBER			1									5-7	6

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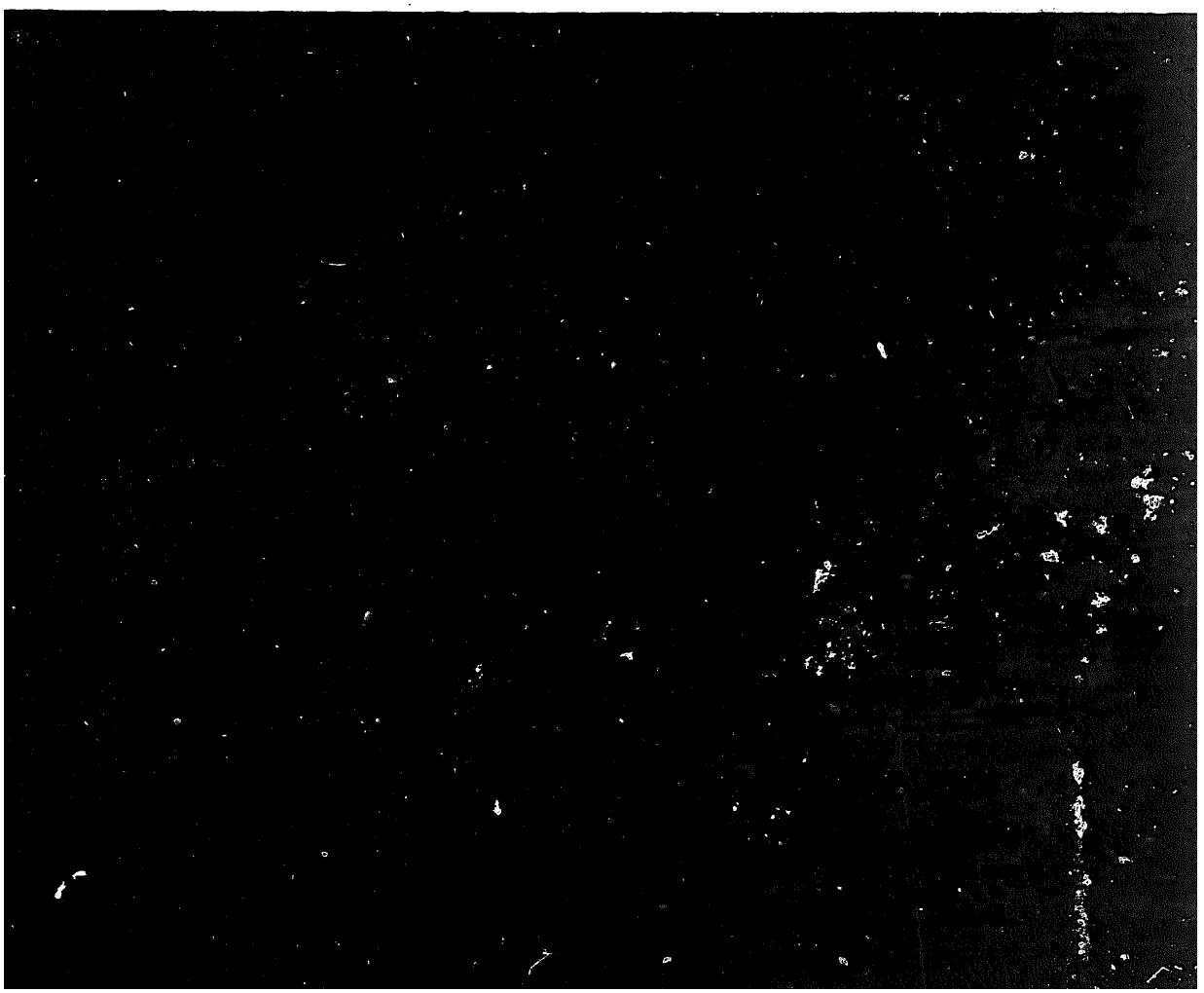

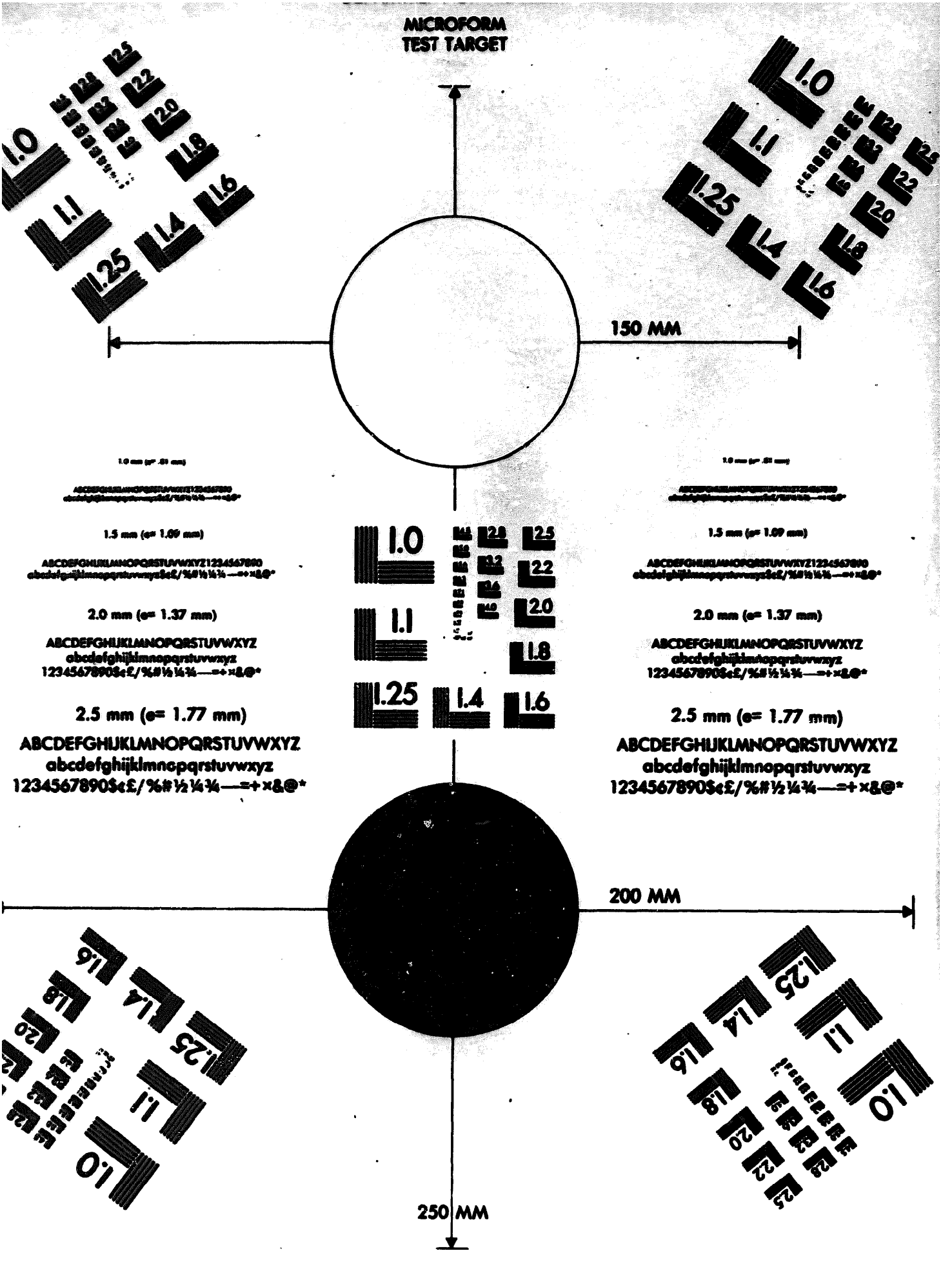
MICROFORM
TEST TARGET
150 MM
200 MM
250 MM
1.5 mm (e= 1.09 mm)
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz&¢£/%#½¼¾—=+×&@*
2.0 mm (e= 1.37 mm)
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*
2.5 mm (e= 1.77 mm)
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
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Change No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 25 October 1973

Operator's, Organizational, Direct Support, General Support, and Depot Maintenance Manual Including Repair Parts and Special Tools List FILTER AND MATCHING GROUP: TUNER, RADIO FREQUENCY TN-422/MRC-95(V)2 FILTER, BAND PASS F-940/FRC-39A(V)

TM 11-5820-753-15, 20 March 1970, is changed as follows:

1. The title of this manual is changed as shown above.
2. A vertical bar appears opposite changed material.
3. Remove and insert pages as indicated in the page list below:

Revise pages	Insert pages
i and ii	i and ii
1-0.1 and 1-0.2	1-0.1
1-1 and 1-2	1-1 and 1-2
A-1 and A-2	None

4. File this change sheet in front of the manual for reference purposes.

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
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Chief of Staff

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The Adjutant General

Distribution:
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USASTRATCOM-EUR (3)
USASTRATCOM-PAC (3)
USASTRATCOM-SIG-GP-T (5)
USASTRATCOM SIG GP-Okinawa (3)
USASTRATCOM SIG GP-Japan (5)
USASTRATCOM Comm Op Fac, Korea (3)
USASTRATCOM Sig Bde, Korea (3)
USASTRATCOM SIG GP-Taiwan (2)
LOGCOMDS (5)
Eighth USA (5)
Sig FLDMS (PAC) (1)
SAAD (10)
TOAD (10)
LEAD (7)
USACSA (2)
TECOM (2)
HISA (ECOM) (8)
USA Ascom Depot (3)
USA Cp Carroll Depot (3)
Units org under fol TOE (1 copy each):
11-15
11-45
11-97
11-98
11-158
11-302
11-308
11-347
11-357
11-367
11-368
11-377
11-500 (AA-AC)
29-118
29-134
29-136
29-137

NG: None
USAR: None
For explanation of abbreviations used, see AR 310-50.

TABLE OF CONTENTS

SECTION Page

CHAPTER 3 OPERATION

NOT APPLICABLE

CHAPTER 4. PRINCIPLES OF OPERATION

NOT APPLICABLE

NOT APPLICABLE

CHAPTER 5. MAINTENANCE

NOT APPLICABLE

CHAPTER 1

GENERAL INFORMATION

1-A.1. Scope

a. This manual includes installation and operation instructions and covers operator's, organizational, direct support (DS), general support (GS), and depot maintenance. It describes Filter and Matching Group: Tuner, Radio Frequency TN-422/MRC-85(V)2 and Filter, Band Pass F940/FRC-39A(V) (ITE Circuit Breaker Co. part numbers 604605-901 and 604661-901, respectively).

b. Appendix B contains the maintenance allocation chart; appendix C lists the repair parts.

c. Appendix B is current as of 22 October 1968.

1-A.2. 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.

1-A.3. 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)/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).

1-A.4. 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-C, Fort Monmouth, NJ 07703.

1-1. GENERAL.

1-2. The Filter and Matching Group consists of two separate equipments: Tuner, Radio Frequency TN-422/MRC-85(V)2 (antenna tuner), and a harmonic filter. Figure 1-1 shows the antenna tuner, ITE part no. 604605-901, and the harmonic filter, ITE part no. 604661-901.

1-3. DESCRIPTION AND PURPOSE.

1-4. ANTENNA TUNER.

1-5. The antenna tuner is constructed of heliarc welded high strength aluminum alloy. The fine tuning probes are constructed of stainless steel and utilize a National extra fine thread to permit very fine tuning.

1-6. The metal caps covering the tuning probes have a threefold purpose: to prevent moisture from entering the tuner; to prevent waveguide pressure from escaping; and to prevent damage to the probes through handling.

1-7. The antenna tuner is utilized in the transmission line of communications systems where large reductions in standing wave ratio are desired.

1-8. The antenna tuner reduces mismatches at frequencies over a 100-megacycle range in the 755- to 985-megacycle frequency band. The five tuning probes, when properly tuned, reduce the standing wave ratio from 1.5:1 maximum to 1.05:1, or less.

1-8.1. ITEMS COMPRISING AN OPERABLE EQUIPMENT.

FSN	Qty	Nomenclature, part No., and mfr code	Fig. No.
		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.	
		Filter and Matching Group (This item is nonexpendable)	5-5
		which includes:	
		Filter, Bandpass: 604661-901, 30086	
		Tuner, Radio Frequency TN-422/MRC-85(V)2: 604605-901, 30086	

1-9. HARMONIC FILTER.

1-10. The harmonic filter basically consists of two linear tapered waveguide assemblies and the harmonic filter subassembly. The harmonic filter subassembly consists of tubes cut to a predetermined length and coated with an absorptive material.

1-11. The harmonic filter characteristics of design are such that the second harmonic of the fundamental transmitting frequency is attenuated by 20 db and the third harmonic is attenuated by 10 db.

1-12. INFORMATION AND REFERENCE DATA.

1-13. Table 1-1 gives the leading particulars of the antenna tuner and harmonic filter, and table 1-2 gives their capabilities and limitations. Table 1-3 lists the equipment supplied and table 1-4 lists the equipment required but not supplied.

Table 1-1. Leading Particulars

Transportability:	
Air	Small transport
Ground	Pickup truck or equivalent
Physical characteristics:	
Antenna tuner:	
Weight	70 lb (approximate)
Dimensions	143-5/8 in. long, 13-5/16 in. wide, 7-5/16 in. high
Harmonic filter:	
Weight	78 lb
Dimensions (overall)	143-5/8 in. long, 13-5/16 in. wide, 21-3/8 in. high (approx)
Mechanical storage:	
Antenna tuner	Indoors in a horizontal position, adequately supported every 6 to 10 ft
Harmonic filter	Indoors in an upright position with taper transformer sections removed. Tapered waveguide assemblies must be stored in a horizontal position, adequately supported at each end

Table 1-2. Capabilities and Limitations

Antenna tuner:	
Frequency range	755-985 mc
Impedance matching characteristics	Reduces mismatches at frequencies over a 100-mc range in the 755-985-mc frequency band
Standing wave ratio	Reduces the standing wave ratio from 1.3:1 maximum at any phase to 1.05:1, or less
Harmonic filter:	
Frequency range	755-985 mc
Second harmonic attenuation	20 db
Third harmonic attenuation	10 db
Standing wave ratio	Less than 1.1:1 over the frequency range
Insertion loss	±0.2 db over the frequency range
Ambient temperature:	
Antenna tuner	-65-185° F -54-85° C
Harmonic filter	-65-185° F -54-85° C

★ U.S. GOVERNMENT PRINTING OFFICE: 1973-768111/872

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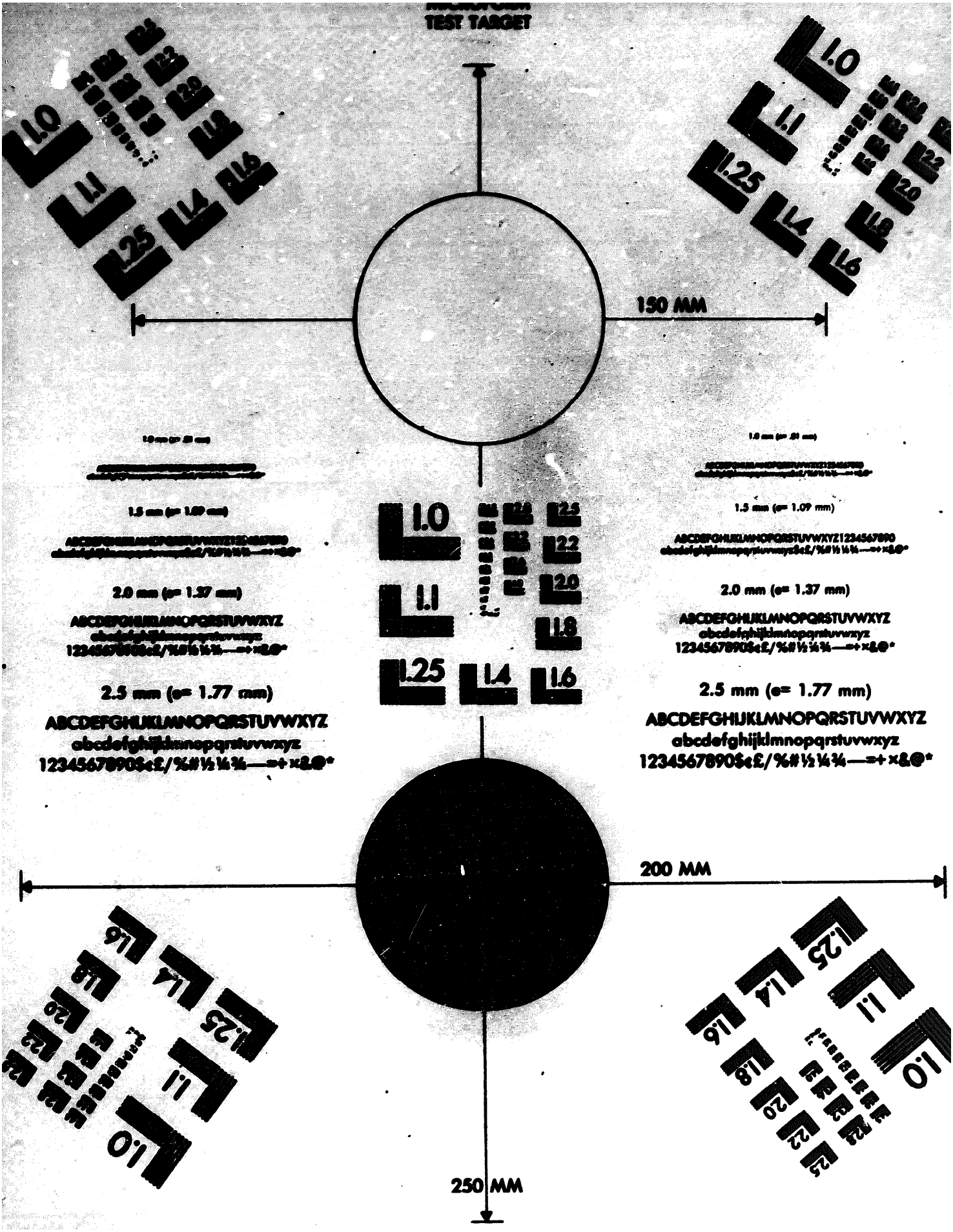
TEST TARGET
150 MM
200 MM
250 MM
2.5 mm (e= 1.77 mm)
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
12345678905¢£/%#½¼¾—=+×&@*