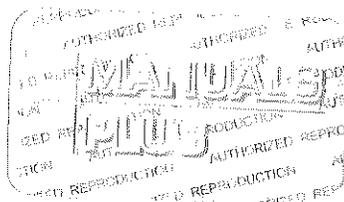
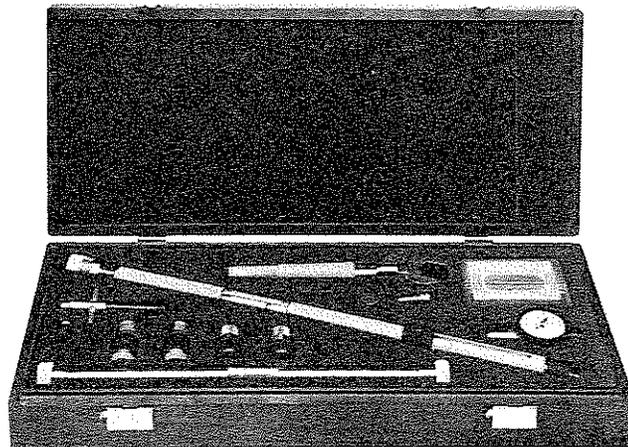


OPERATING AND SERVICE MANUAL

# HP 85050A 7mm CALIBRATION KIT

OPTION 010  
30cm BEADLESS AIRLINE



**HEWLETT  
PACKARD**

## CERTIFICATION

*Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.*

## WARRANTY

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

HP warrants that its software and firmware designated by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

## LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

## EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

## ASSISTANCE

*Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.*

*For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.*

# HP 85050A 7mm CALIBRATION KIT

OPTION 010  
30cm BEADLESS AIRLINE

This manual pertains to calibration kits that have a serial number prefix of 2340A. For kits having other prefixes, obtain a Manual Changes supplement from Hewlett-Packard.

Some devices in this kit have their own unique serial numbers. Refer to the SERIAL NUMBERS paragraph for more information.

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Microfiche Part Number 85050-90002

Printed: APRIL 1984  
Printed in U.S.A.



HEWLETT  
PACKARD

## SAFETY CONSIDERATIONS

### GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation. This product has been designed and tested in accordance with international standards.

### SAFETY SYMBOLS



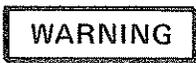
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (refer to Table of Contents).



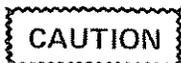
Indicates hazardous voltages.



Indicates earth (ground) terminal.

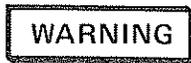


The **WARNING** sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed could result in personal injury. Do not proceed beyond a **WARNING** sign until the indicated conditions are fully understood and met.



The **CAUTION** sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a **CAUTION** sign until the indicated conditions are fully understood and met.

### SERVICING



*Any servicing, adjustment, maintenance, or repair of this product must be performed only by qualified personnel.*

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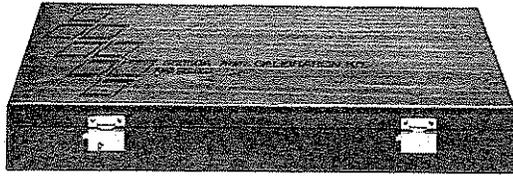
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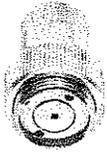


**STORAGE CASE**  
HP Part Number 85050-80001 CD 3

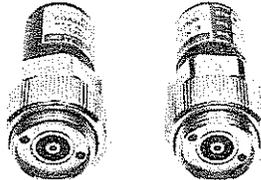
NOT SHOWN  
OPERATING AND SERVICE MANUAL  
HP Part Number 85050-90001  
DATA ENVELOPE  
HP Part Number 9230-0223 CD 7  
PLASTIC PROTECTIVE CAPS (TERMINATIONS)  
HP Part Number 1401-0123 CD 1



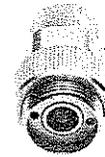
**SLIDING LOAD**  
HP Part Number 1250-1890 CD 0  
( CENTER CONDUCTOR TIP )  
Maury Part Number 2600-75



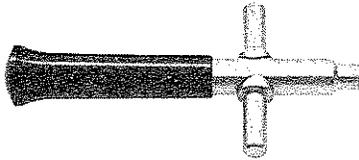
**SHORT CIRCUIT TERMINATION**  
HP Part Number 1250-1872 CD 8



**FIXED LOAD TERMINATION**  
HP Part No. 85050-60001 CD 1 (Qty: 2)  
HP 909C



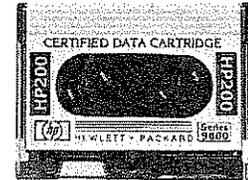
**OPEN CIRCUIT TERMINATION**  
HP Part Number 1250-1873 CD 9



**CENTER CONTACT EXTRACTOR**  
HP Part Number 5060-0236 CD 7

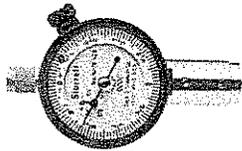


**CENTER CONDUCTOR COLLETS**  
HP Part Number 85050-20001 CD 7  
(Qty: 4)



**DATA CARTRIDGE**  
HP Part Number 08510-10007 CD7

**DELETED IN OPTION 020**

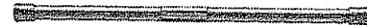


**CONNECTOR GAGE KIT**  
HP Part Number 1250-1875 CD 1



**TORQUE WRENCH**  
HP Part Number 1250-1874 CD 0

**ADDED IN OPTION 010**



**30cm BEADLESS AIRLINE**  
HP Part Number 1250-1877 CD 3



**ALIGNING PIN**  
Maury Part Number 024-4



**PIN WRENCH**  
Maury Part Number 024-5



**CALIBRATION BLOCK**  
Maury Part Number 028-2

( CENTER CONDUCTOR TIP )  
Maury Part Number 2600-75

Figure 1. HP 85050A 7mm Calibration Kit

## HP 85050A 7mm CALIBRATION KIT

### INTRODUCTION

The Hewlett-Packard Model 85050A 7mm calibration kit consists of a number of precision devices specially designed to calibrate the HP 8510 network analyzer. Complete information on calibrating the HP 8510 appears in Section III (Operating and Programming) of the HP 8510 Operating and Service Manual. This manual describes the devices in the calibration kit, it explains the best ways to use and care for them, and it introduces new Hewlett-Packard recommended procedure for making connections. The HP 85050A calibration kit can also be used to calibrate other network analyzers, and the connection procedures described here will be useful in a wide range of microwave applications.

### OPTIONS

The composition of the HP 85050A calibration kit you have received depends on which options were ordered:

**OPTION 010 adds** a 30cm beadless airline, HP part number 1250-1877 CD 3, which is used for time domain applications.

**OPTION 020 deletes** the connector gage kit and torque wrench, HP parts numbers 1250-1875 CD 1 and 1250-1874 CD 0. Both a connector gage and a torque wrench (12 lb-inches, 136 N-cm) are essential, and should be deleted only if you already have equivalent tools.

### INCOMING INSPECTION

Figure 1 shows the complete contents of an HP 85050A 7mm calibration kit. Use Figure 1 to verify that your shipment is complete.

The foam-lined storage case provides ample protection for the calibration components during shipping. If the case arrives in good condition, the components are probably also in good condition. However, if the case or components have been damaged, set aside the calibration kit and all packaging materials and contact the nearest Hewlett-Packard sales/support office (listed inside the back cover of this manual) for further instructions.

Hewlett-Packard will arrange for repair or replacement of incomplete or damaged shipments without waiting for a settlement from the transportation company.

### SERIAL NUMBERS

Attached to this calibration kit is a serial number label. A typical serial number label is shown in Figure 2. The serial number is in two parts: the first four digits followed by a letter comprise the serial number prefix; the last five digits are the sequential suffix unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix as those listed on the Title Page of this manual.

A calibration kit manufactured after the printing of this manual may have a serial number prefix that is not listed on the Title Page. This indicates that the calibration kit is different from those documented in this manual. The manual for such kits is supplied with a Manual Changes supplement that explains the differences.

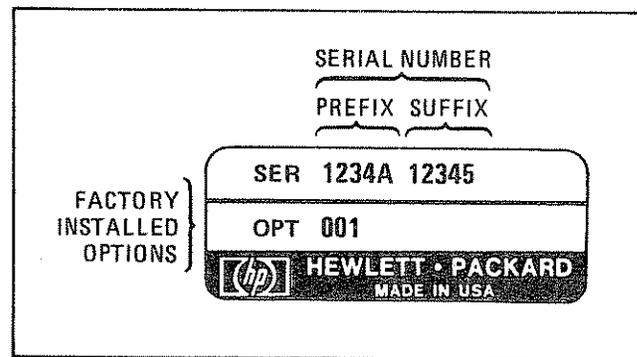


Figure 2. Typical Serial Number Label

In addition to change information, the Manual Changes supplement contains information for correcting errors in the manual. The supplement is keyed to the manual's print date and part number, both of which appear on the Title Page. Complimentary copies of the Manual Changes supplement are available from Hewlett-Packard.

The airline, sliding load, and fixed terminations all have individual serial numbers, imprinted on the device, which link each device to a data information sheet. The data envelope, with the device serial numbers printed on the front, contains the information sheets for all four devices.

#### EQUIPMENT REQUIRED BUT NOT SUPPLIED

All precision 7mm connectors must be examined visually before use, and cleaned (or replaced) as needed. The following equipment is required for inspection and cleaning:

**AN ILLUMINATED, 4-POWER MAGNIFYING GLASS** is necessary for the visual examination. The exact power of the glass is not critical, but the type of illumination is very important. Ordinary room lighting, or oblique lighting from a desk lamp, casts shadows that can easily mask the small defects that you are trying to see. Therefore, make sure that the magnifying glass has built-in lighting that provides axial, shadowless illumination. (Illuminated magnifying glasses are available from most general equipment suppliers. HP does not sell or recommend any particular model.)

**COMPRESSED AIR** in a small, pressurized can, HP part number 92193Y, is used to gently blow dust and lint from the connectors. Alternatively, any source of low-pressure air can be used if it has an effective oil-vapor filter and condensation trap placed just before the air outlet hose.

#### CAUTION

When using compressed air from a pressurized can, such as HP 92193Y, the can must be held upright. If the can is tilted or inverted the liquid propellant might spray out along with the air. The propellant instantly evaporates when it contacts the connector surface, which causes the connector to become very cold – too cold for the calibration to continue. If this happens, you must wait until thermal equilibrium has been restored in the connector before continuing with the calibration.

Permanent connector damage from the propellant is unlikely.

LIQUID FREON (trichlorotrifluoroethane), HP part number 8500-1914 CD 7, is the only cleaning solvent that HP will recommend for 7mm connectors. Liquid Freon is preferred over Freon sprays because the liquid can be applied sparingly and selectively (if a spray must be used, spray the cleaning swab only – not the connector). Do not use other solvents: some can leave oily residues (isopropyl “rubbing” alcohols), react with the plated metals (some halogenated solvents), or erode the plastic dielectric support (several hydrocarbon compounds). Along with your supply of liquid Freon keep a microscope slide or similar piece of clear glass, to check the Freon periodically for contamination (as shown in Figure 10). Liquid Freon is the preferred solvent for cleaning audio and video magnetic heads, so this cleaner can also be obtained at most stores that sell audio or video tape recorders.

**CAUTION**

Several variations of “Freon” are available, and some contain chemicals that are harmful to 7mm connector materials. Make sure that the Freon you use is 100% trichlorotrifluoroethane.

PLASTIC-FOAM SWABS, HP Part number 9300-0468 CD 1, are used along with the trichlorotrifluoroethane (liquid Freon) to clean the connector surfaces. These swabs resemble common cotton swabs, but have lint-free plastic foam tips. They are also commonly used to clean the heads in video tape recorders.

**NOTE**

Since trichlorotrifluoroethane and plastic-foam swabs are also used to clean the magnetic heads on the HP 8510's tape-drive mechanism, you may already have these items.

**EQUIPMENT AVAILABLE**

The HP 85051A 7mm verification kit contains four two-port standards (20 dB and 50 dB pads, 10 cm 50-ohm airline, and a 10 cm stepped mismatch airline also known as a Beatty standard) which can be used to verify system integrity. The components of the verification kit, which have known device characteristics, are measured immediately after the network analyzer has been calibrated. If the calibration was done correctly, the network analyzer will reiterate those known device characteristics. The stepped mismatch airline (Beatty standard), which contains sharp impedance discontinuities (50-ohm to 25-ohm steps), is especially useful for time domain applications.

If you use 3.5mm-to-7mm adapters, you will also need gages and a torque wrench for the 3.5mm connections. The gages and torque wrench are contained in the HP 85052A 3.5mm calibration kit, or they can be ordered separately. The 3.5mm gage kit, consisting of two gages (male, female) and a calibration block, can be ordered as HP part number 1250-1862 CD 6. The 3.5mm wrench, having a torque of 8 pound-inches (90 Newton-cm), can be ordered as HP part number 1250-1863 CD 7.

Also available is the HP 11591A 7mm connector repair kit, which contains an open-end wrench, spanner wrench, extractor tool, center conductor collets and other accessories that can be used to repair and adjust some (but not all) 7mm connectors. The “standard quality” center conductor collets in this repair kit **must not** be used with HP 85050A calibration connectors, because seriously degraded performance will result. Use **only** premium, 6-slot collets (shown in Figure 13).

## REPLACEABLE PARTS

Figure 1 shows the HP or Maury Microwave Corporation part numbers for all components of the HP 85050A 7mm calibration kit. Components having a Maury part number must be ordered from Maury, not from HP. Maury is the original equipment manufacturer for some items in this kit.

To order an HP part, list the description, HP part number with check digit (CD), and quantity desired. Send your order to the nearest Hewlett-Packard sales/support office listed inside the back cover of this manual.

To order a Maury part, list the description, Maury part number, quantity desired, and indicate that these parts are for use in an HP 85050A 7mm calibration kit. Send your order to Maury Microwave Corporation 8610 Helms Avenue, Cucamonga, California 91730 (telephone 714-987-4715; TWX 910-581-3408).

## SAFETY CONSIDERATIONS

The Safety Considerations page, located before the Table of Contents, explains precautions that apply generally to Hewlett-Packard equipment and to the HP 85050A 7mm calibration kit. There are two aspects to safety: protection for the operator, and protection for the instruments.

These calibration devices are not mechanically, electrically, or chemically hazardous, so no special precautions are necessary to protect the operator. However, two precautions must be observed to protect the instruments.

First, use great care in handling and storing these calibration devices. Their performance and accuracy depends upon very precise mechanical tolerances, sometimes on the order of a ten-thousandth of an inch (a few microns). Therefore, they must be handled and stored much more carefully than ordinary 7mm connectors.

The foam-lined storage case provided is the best place to store calibration kit components whenever you are not actually using them. Never store them loose in a desk drawer, for example, or place them contact-end down on a table-top. The lid of the storage case is detachable (see Figure 3) and allows convenient storage even in a shallow desk drawer.

The second instrument precaution concerns the network analyzer. When you are cleaning test set connectors, or when you are using the airline or sliding load, you are touching exposed center conductors which have a direct electrical link to the sensitive internal circuits of the instrument. Touching the center conductor, especially with a wiping or brushing motion, can cause an electrostatic discharge (ESD) that might severely damage those sensitive circuits. The test set's return port sampler circuit diodes, in particular, are sensitive to ESD. Consequently, make sure that you ground yourself (by wearing a grounded, conductive wrist strap) and your equipment (by working on a grounded, conductive pad) before touching a center conductor.

### CAUTION

Your body nearly always has a static charge to some degree. You are usually not aware of this charge, because the human threshold for the perception of a static-discharge shock occurs at approximately 3000 volts (the large shocks you get during the cold, dry winter months can be 15,000 volts or higher). You would not feel a static discharge of a few hundred volts, but such a discharge could damage sensitive microcircuits.

Always assume that your body is statically charged, and take appropriate safeguards. The most effective single safeguard is to always grasp the body of the test set connector just prior to making a connection; any static electricity on your body will discharge to earth through the instrument's ac power cord ground wire.

## DEVICE PERFORMANCE

The performance of these calibration devices is described in terms of specifications, characteristics, and mechanical dimensions. Specifications are the performance values that are guaranteed by Hewlett-Packard, while characteristics are typical, or nominal, values. Dimensions are included because mechanical measurements can establish traceability to most national standards laboratories. These three topics are covered in the next several sections of this manual.

## SPECIFICATIONS

The principal electrical specifications for the components of the HP 85050A 7mm calibration kit are listed in Table 1. Hewlett-Packard guarantees that the performance of your components will equal or exceed those specifications. Correct operating procedures and conditions must be followed if these specifications are to be met, however.

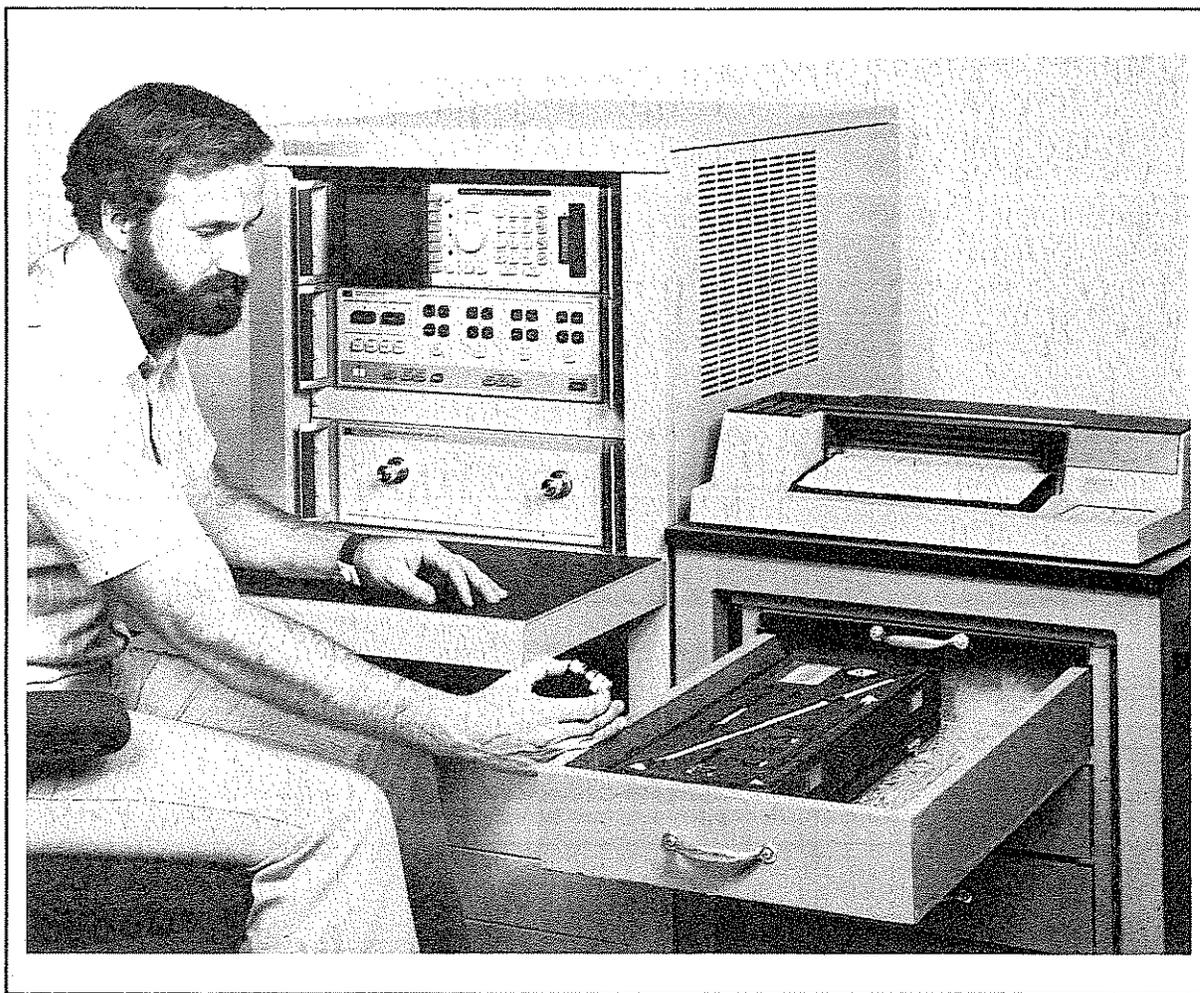


Figure 3. Calibration Kit Storage, Cover Removed

**OPERATOR SKILL** in making good connections is essential. The mechanical tolerances for the connectors used in the calibration kit, and the resultant electrical performance, are much better than most other precision 7mm connectors. Therefore, slight errors in operator technique that would go unnoticed with regular connectors often appear when the calibration connectors are used. Lack of repeatability is the major symptom of incorrect operator technique. Study the connection techniques that are explained in this manual, and practice them until your calibration measurements are satisfactory. A recommended practice procedure is described later in this manual.

**TEMPERATURE** of the calibration devices is critical, because the dimensions of the devices (and hence their electrical characteristics) change with temperature. Figure 4 shows the allowable environmental conditions for using the HP 85050A calibration kit. Notice especially that the temperature during calibration must be between 20°C (68°F) and 26°C (79°F). Afterwards, the operating temperature must be within  $\pm 1^\circ\text{C}$  (1.8°F) of the calibration temperature for the network analyzer to meet all specifications. Thus, for example, if the calibration was done at 22°C (71.6°F) then the operating temperature must be 21-23°C (69.8-73.4°F).

The temperature of the devices must be stable before use. Typically, devices kept with the network analyzer are at a stable temperature and are ready for use immediately. Devices that have been shipped from one location to another might require several hours to reach thermal stability. Also, remember that your fingers are a heat source (37°C or 98.6°F) and avoid unnecessary handling of the devices during calibration. Some devices have a plastic jacket over the connector body to provide thermal insulation during handling.

Barometric pressure and relative humidity also affect device performance, although to a lesser extent than temperature. Air exists between the inner and outer conductors of these devices (hence their name, air-dielectric devices), and the dielectric constant of air depends on pressure and humidity.

**WEAR** of the connectors will eventually degrade their performance. The calibration components, which are typically used only a few times each day, should have a very long life. A network analyzer's connectors, however, might undergo a hundred or more connections each day, and are subject to rapid wear. Therefore, it is essential that the connectors be examined regularly both visually (with a magnifying glass), and mechanically (with a connector gage), and replaced as necessary. Procedures for visual and mechanical examination are given later in this manual. For test sets used in high-volume work, place an adapter on the input and output ports. It is much faster, and less expensive, to replace a worn adapter than it is to replace a worn test set connector.

## DEVICE CHARACTERISTICS

Table 2a lists the device characteristics for these calibration components, and it is to be used with the calibration procedure described in Section II (Operating and Programming) of the

*Table 1. Specifications*

Device	Frequency Range	Specification
30cm Airline 1250 - 1877	45 MHz - 18 GHz	$\geq 54$ dB Return Loss
Sliding Load 1250 - 1890	2 GHz - 18 GHz	$\geq 52$ dB Return Loss
Fixed Load Termination 85050-60001 (HP 909C)	dc - 2GHz	$\geq 52$ dB Return Loss

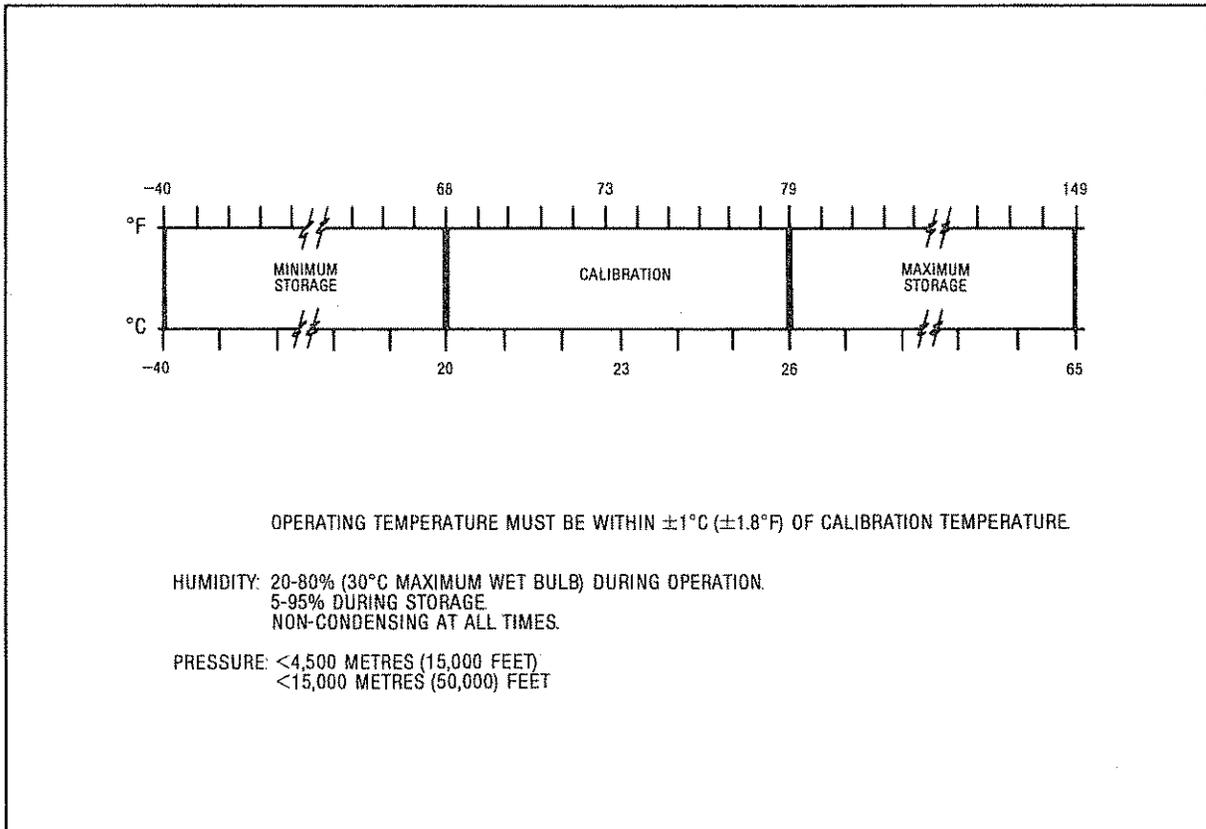


Figure 4. Allowable Temperature, Humidity, and Pressure

HP 8510 manual. The use of Table 2b, a blank version of Table 2a, is also described in Section III. Hewlett-Packard has released the copyright to this blank table, so you may copy it as needed.

## VERIFYING THE SPECIFICATIONS

Two fundamental methods are used to verify the specifications of these calibration components: (1) electrically comparing the HP 85050A components with components of significantly higher quality; and (2) precisely measuring the physical dimensions of these components, then theoretically determining their expected performance.

The electrical comparison method is more difficult to perform than the physical measurement, for two principal reasons. First, it is difficult to obtain calibration components that are **significantly** better than the HP 85050A components ("significant" enough that the measurement uncertainties between the standard and test devices can be resolved). The second, and most severe limitation of the electrical comparison method is the difficulty of making a repeatable port connection. The errors caused by even a slightly imperfect mating of connectors tends to obscure the intended measurement. Consequently, Hewlett-Packard recommends that direct electrical comparison be used only as a secondary method of confirming the HP 8505A's specifications.

## MECHANICAL DIMENSIONS: STANDARDS LAB TRACEABILITY

The best method for validating the specifications of a calibration component is to measure the device physically, using non-contact measuring tools. If these tools have been calibrated with United States National Bureau of Standards (NBS) certified gage blocks, a traceable link between the components and NBS is established. Hewlett-Packard measures outside diameters with a laser micrometer, inside diameters with an air gage, and length with an interferometric micrometer.

STANDARD DEFINITIONS

CALIBRATION KIT LABEL  
TAPE FILE NUMBER

7mm

1 Open, Short, Load, Delay/Thru, or Arbitrary Impedance.

2 Load or Arbitrary Impedance Only.

3 Arbitrary Impedance Only, Device Terminating Impedance. (Defaults: Short =  $0\Omega$ , Open =  $\infty\Omega$ , Load =  $50\Omega$ .)

4 Skin loss factor, Normalize at 1 GHz.

5 For Waveguide, lower frequency is same as  $F_{CO}$ .

6 Shorts 3-7 not supplied in the HP 85050A Calibration Kit.

STANDARD DEFINITIONS

STANDARD <sup>1</sup> NO.	TYPE	C0 $\times 10^{-15} F$	C1 $\times 10^{-27} F/HZ$	C2 $\times 10^{-36} F/HZ^2$	C3 $\times 10^{-45} F/HZ^3$	FIXED OR <sup>2</sup> SLIDING	TERMINAL IMPEDANCE <sup>3</sup> $\Omega$	OFFSET			FREQUENCY (GHz)		COAX OR WAVEGUIDE	STANDARD <sup>6</sup> LABEL	
								DELAY ps	Z <sub>0</sub> $\Omega$	LOSS <sup>4</sup> G $\Omega$ /s	LOWER <sup>5</sup>	UPPER			
1	SHORT					FIXED			0	50	0.0	0	999	COAX	SHORT
2	OPEN	92.55	0	26.0	3.65	FIXED			0	50	0.0	0	999	COAX	OPEN
3	SHORT					FIXED			166.67	50	$7 \times 10^6$	0.749	2.001	COAX	SHORT #3
4	SHORT					FIXED			83.3374	50	$7 \times 10^6$	1.999	4.001	COAX	SHORT #4
5	SHORT					FIXED			41.656	50	$7 \times 10^6$	3.999	8.001	COAX	SHORT #5
6	SHORT					FIXED			24.493	50	$7 \times 10^6$	7.999	12.001	COAX	SHORT #6
7	SHORT					FIXED			17.518	50	$7 \times 10^6$	11.999	18.601	COAX	SHORT #7
8															
9	LOAD					FIXED			0	50	0.0	0	999	COAX	BROADBAND
10	LOAD					SLIDING			0	50	0.0	1.999	999	COAX	SLIDING
11	THRU					FIXED			0	50	0.0	0	999	COAX	THRU
12	LOAD					FIXED			0	50	0.0	0	2.001	COAX	LOWBAND
13															
14															
15															
16	OPEN	79.4	0	40.0		FIXED			0.0	50	0.0	0	999	COAX	OLD OPEN
17															
18															
19															
20															
21															
22															

Table 2a. Device Characteristics (1 of 2)

CALIBRATION KIT LABEL  
TAPE FILE NUMBER

Standard Class Assignments. 7mm Calibration Kit									
Standard Class Label	Standards								
	A	B	C	D	E	F	G		
S11A	2								OPEN
S11B	1								SHORT
S11C	9	10	12						LOADS
Standard Class Label	Standards								
	A	B	C	D	E	F	G		
S22A	2								OPEN
S22B	1								SHORT
S22C	9	10	12						LOADS
Standard Class Label	Standards								
	A	B	C	D	E	F	G		
Forward Transmission	11								THRU
Reverse Transmission	11								THRU
Standard Class Label	Standards								
	A	B	C	D	E	F	G		
Frequency Response	1	2	11						RESPONSE

Table 2a. Device Characteristics (2 of 2)

7mm

**CALIBRATION KIT  
TAPE FILE NUMBER**

**STANDARD DEFINITIONS**

**NOTES**

- 1 Open, Short, Load, Delay/Thru, or Arbitrary Impedance
- 2 Load or Arbitrary Impedance Only.
- 3 Arbitrary Impedance Only, Device Terminating Impedance. (Defaults: Short =  $0\Omega$   
Open =  $\infty\Omega$   
Load =  $50\Omega$ .)
- 4 Skin loss factor, Normalize at 1 GHz
- 5 For Waveguide, lower frequency is same as  $F_{CO}$
- 6 Shorts 3-7 not supplied in the HP 85050A Calibration Kit.

STANDARD <sup>1</sup> NO.	TYPE	C0 $\times 10^{-15}F$	C1 $\times 10^{-27}F/Hz$	C2 $\times 10^{-36}F/Hz^2$	C3 $\times 10^{-45}F/Hz^3$	FIXED OR <sup>2</sup> SLIDING	TERMINAL IMPEDANCE <sup>3</sup> $\Omega$	OFFSET			FREQUENCY (GHz)		COAX OR WAVEGUIDE	STANDARD <sup>6</sup> LABEL
								DELAY ps	$Z_0$ $\Omega$	LOSS <sup>4</sup> G $\Omega/s$	LOWER <sup>5</sup>	UPPER		
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
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15														
16														
17														
18														
19														
20														
21														
22														

Table 2b. Device Characteristics (1 of 2)

CALIBRATION KIT LABEL  
TAPE FILE NUMBER

Standard Class Assignments. 7mm Calibration Kit	
Standard Class Label	Standards
S11A S11B S11C	A B C D E F G
S22A S22B S22C	A B C D E F G
Forward Transmission Reverse Transmission	A B C D E F G
Frequency Response	A B C D E F G

Table 2b. Device Characteristics (2 of 2)

Figures 5 through 7 show the critical mechanical dimensions that must be measured if you need to establish independent NBS traceability, or to establish traceability to any other national standards laboratory. After obtaining the measurements, **using non-contact measuring tools**, the expected electrical performance of the devices can be calculated from the equations in these two publications:

Nelson, Robert E., and Marlene R. Coryell, "Electrical Parameters of Precision, Coaxial, Air-Dielectric Transmission Lines," U.S. National Bureau of Standards Monograph No. 96.

Somlo, P.I., "The Computation of Coaxial Line Step Capacitances," IEEE Transactions on Microwave Theory and Techniques, Volume MTT-15, No. 1, January, 1967.

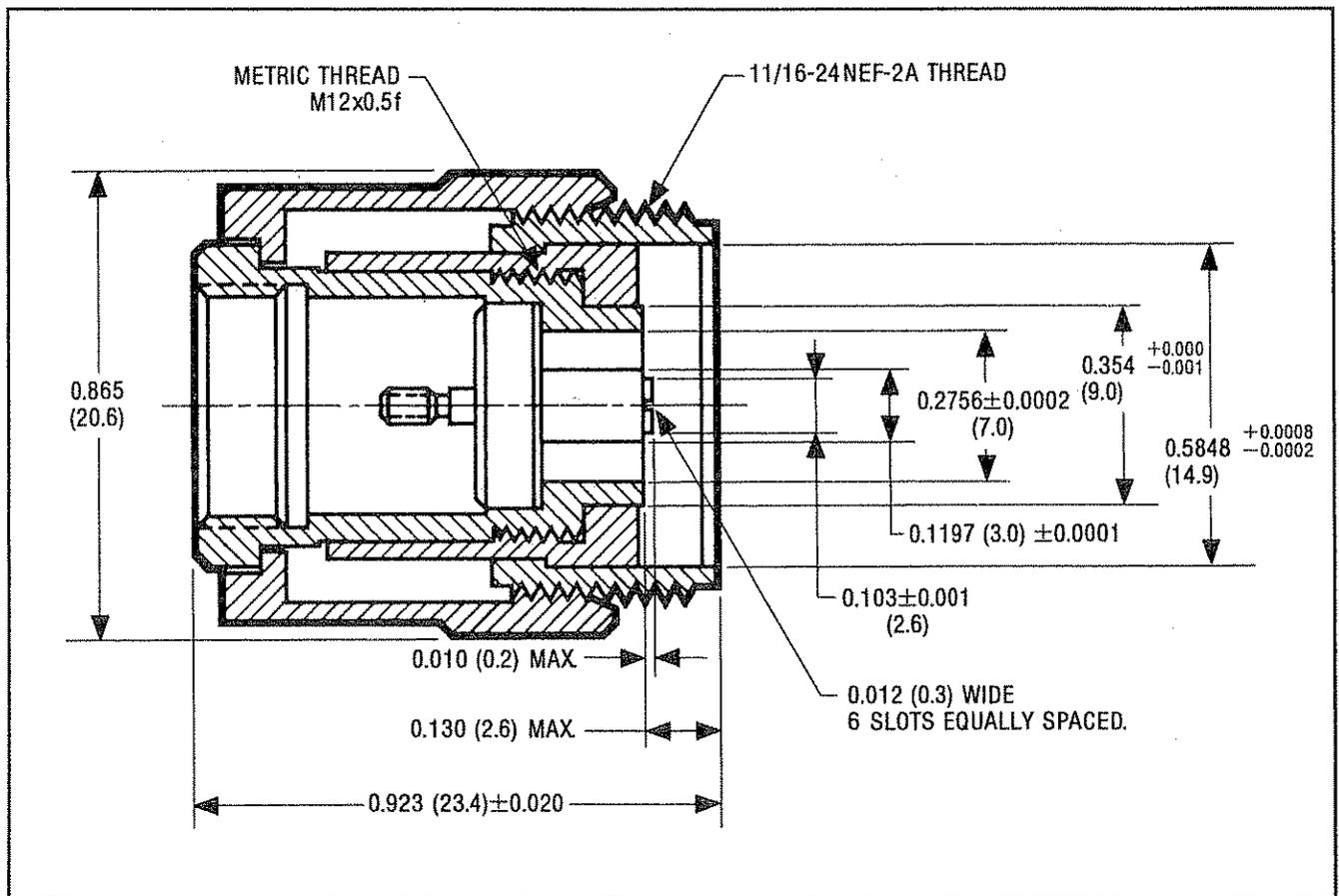
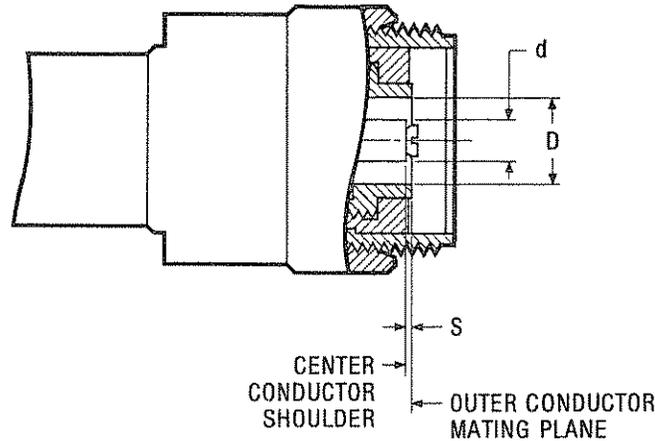


Figure 5. Connector Face Dimensions  
(Reproduced by permission of Amphenol, a Bunker Ramo subsidiary of the Allied Corporation)

**OPERATING PROCEDURES**

The next part of this manual explains the operating procedures that should be used to obtain an accurate calibration. Please study these procedures carefully. In particular, notice that the counterrotation technique for seating outer conductors (Figure 19), and the procedure for connecting the sliding load (Figure 21) differ from the methods commonly used in the microwave industry.



COMPONENT	S	d	D	LENGTH	
		Center Conductor	Outer Conductor	Outer Conductor	Center Conductor
<b>SHORT 1250-1872</b>	0.000	—	—	—	—
<b>SLIDING LOAD 1250-1890</b>	0.0000 <sup>+0.0000*</sup> -0.0003	0.1197±0.0002	0.2756±0.0004	—	—
	0.000 <sup>+0.000*</sup> -0.008mm	3.040±0.005mm	7.000±0.010mm		
	*This dimension is set by the operator	<b>STRAIGHTNESS</b>			
		0.0003/inch	0.0002/inch		
		0.003mm/cm	0.002mm/cm		
		<b>UNIFORMITY (difference between largest and smallest measured values)</b>			
		0.0002	0.0004		
	0.005mm	0.010mm			
<b>30cm AIRLINE 1250-1877</b>		0.1197±0.0002	0.2756±0.00025	Length of Center Conductor in relation to length of outer conductor:  0.0000 <sup>+0.0000</sup> -0.0005    0.000 <sup>+0.000</sup> -0.013mm	11.799 <sup>+0.0005</sup> -0.0000
		3.040±0.005mm	7.000±0.006mm		299.69 <sup>+0.013</sup> -0.000mm
		<b>STRAIGHTNESS</b>			
		0.0003/inch	0.0002/inch		
		0.003mm/cm	0.002mm/cm		

Figure 6. Dimensions for the Short, Sliding Load, and Airline

**CAUTION**

IMMEDIATELY set aside any bad connector; either discard it, or have it repaired. If a bad connector is accidentally attached to a good connector (or precision standard), the good connector could be damaged.

A connector is bad if it fails the visual examination, the mechanical examination, or when an experienced operator complains that the connector "doesn't feel right" (due to unusual friction or roughness, for example). The time and expense involved in replacing test set connectors warrants considerable caution in using any connector that might be less than perfect.

If you have doubts about the quality of any connector, contact your Hewlett-Packard representative. Although some HP field offices are not equipped to evaluate a connector thoroughly, all can offer limited professional advice and, if necessary, can contact the factory for further information.

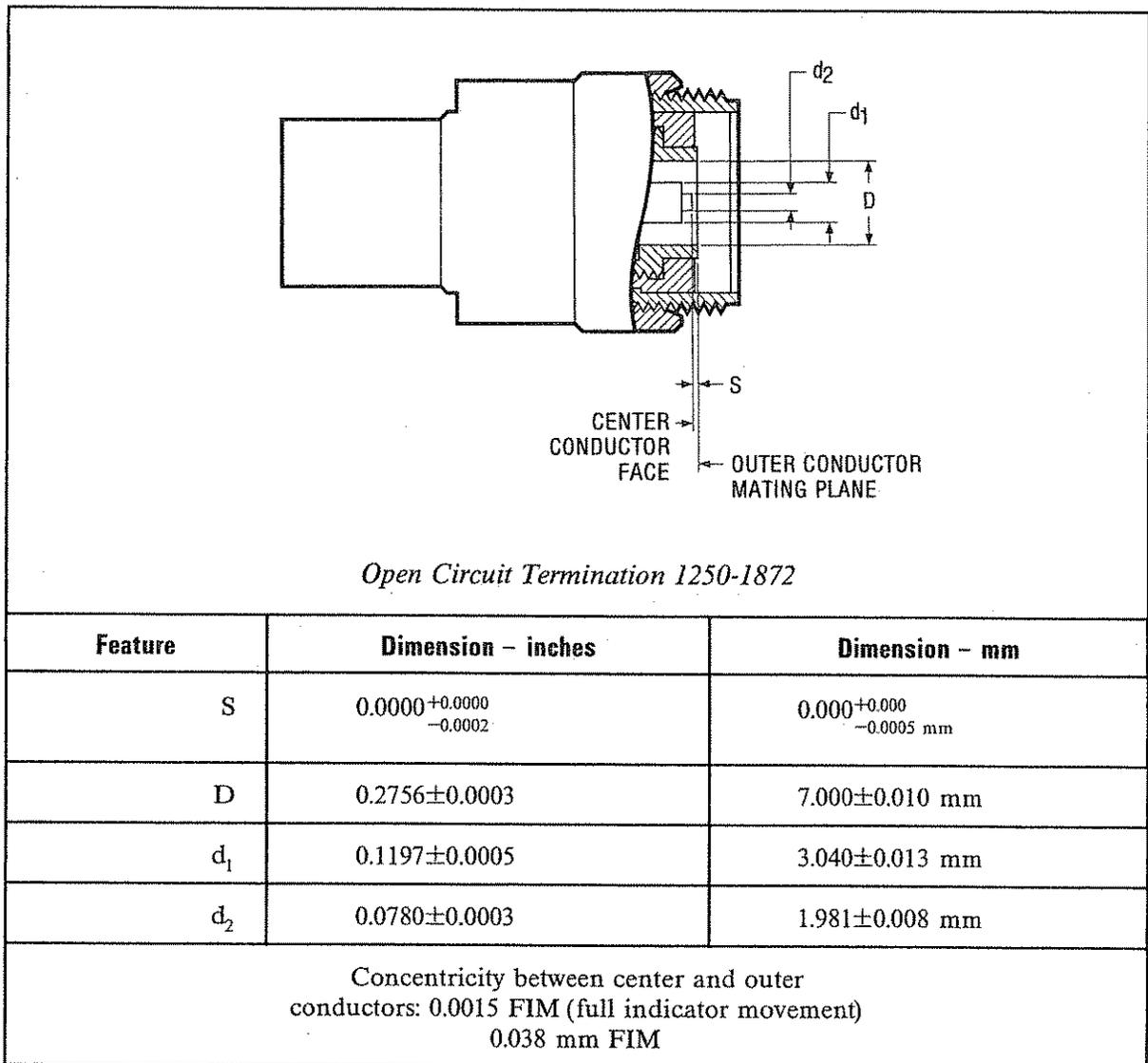


Figure 7. Dimensions for the Open Circuit Termination

## INSPECTING THE CONNECTORS

A calibration always begins with a visual and mechanical examination of the connectors.

A visual examination requires an illuminated, 4-power magnifying glass, as shown in Figure 8. First, turn off all power to the network analyzer and its test set, and make sure that you are grounded to prevent electrostatic discharge. Then examine the connectors generally for such obvious problems as deformed threads, contamination, or corrosion, concentrating especially on the contacting surfaces. Look for burrs, scratches, rounded shoulders, and similar signs of wear or damage. Any problem that you can see with a 4-power magnifying glass is sufficient to cause degraded performance, and the connector must be repaired or replaced. If only the center conductor collet is damaged it can be replaced easily, as shown in Figure 13; any other damage requires removal and replacement of the entire connector.

In harsh environments the connectors might accidentally become dirty and need to be cleaned. It is safe to brush or wipe dirt from the surface carefully, as long as you and your cleaning equipment are grounded to prevent electrostatic discharge. And it is safe to use trichlorotrifluoroethane (liquid Freon) sparingly as a cleaning solvent, as shown in Figure 9. However, it is not safe to use abrasives of any kind (such as a pencil eraser) or any other solvent, because of possible damage to the thin metal plating or the plastic dielectric supporting element.

The mechanical examination follows the visual examination, and consists of checking the plane of the inner conductor in relation to the plane of the outer conductor. The mechanical examination requires a special connector gage, and the procedure is explained in the next section and Figure 11-15.

### MECHANICAL EXAMINATION: USING THE CONNECTOR GAGE

Mechanical examination of a connector consists of measuring the amount of protrusion (+, black numbers on gage) or recession (–, red numbers) of the connector's center conductor, in relation to its outer conductor.

The shoulder of the inner conductor (collet removed) should be coplanar with the outer conductor. A very slight recession of the inner conductor (0.0000 to –0.0005 inch, 0.000 to –0.013 mm for calibration devices; –0.0002 to –0.0008 inches, –0.005 to –0.020 mm for test port connectors) is allowable, because the spring-loaded center collets will still maintain good contact. However, **no protrusion** of the inner conductor is allowable because the inner conductor will buckle when mated with another connector; buckled conductors will have poor electrical performance, and the connectors might be permanently damaged.

Figures 13 and 14 show the procedures for using the connector gage to measure a center conductor, both with and without the center collet in place.

#### CAUTION

Use only **precision** collets, HP part number 85050-20001 CD 7. Do not use the “standard quality” collets typically used with 7mm connectors.

Precision collets give better electrical performance, and are much more durable than standard collets. If extracted carefully, precision collets can be used again – which is not true of standard collets (the standard collets tend to be “squared-off” by the extraction tool, thus ruining them).

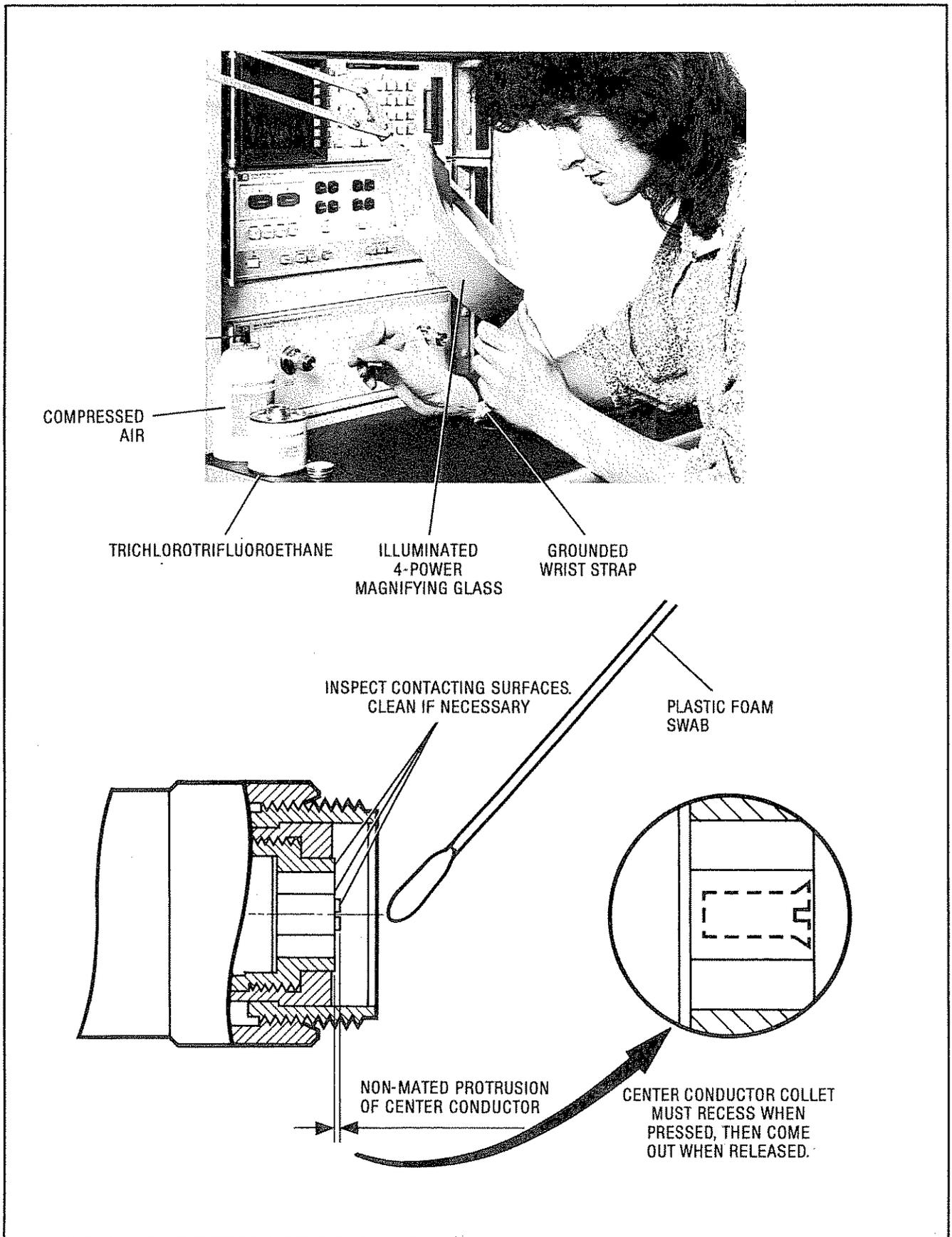


Figure 8. Visual Examination and Cleaning of 7mm Connectors

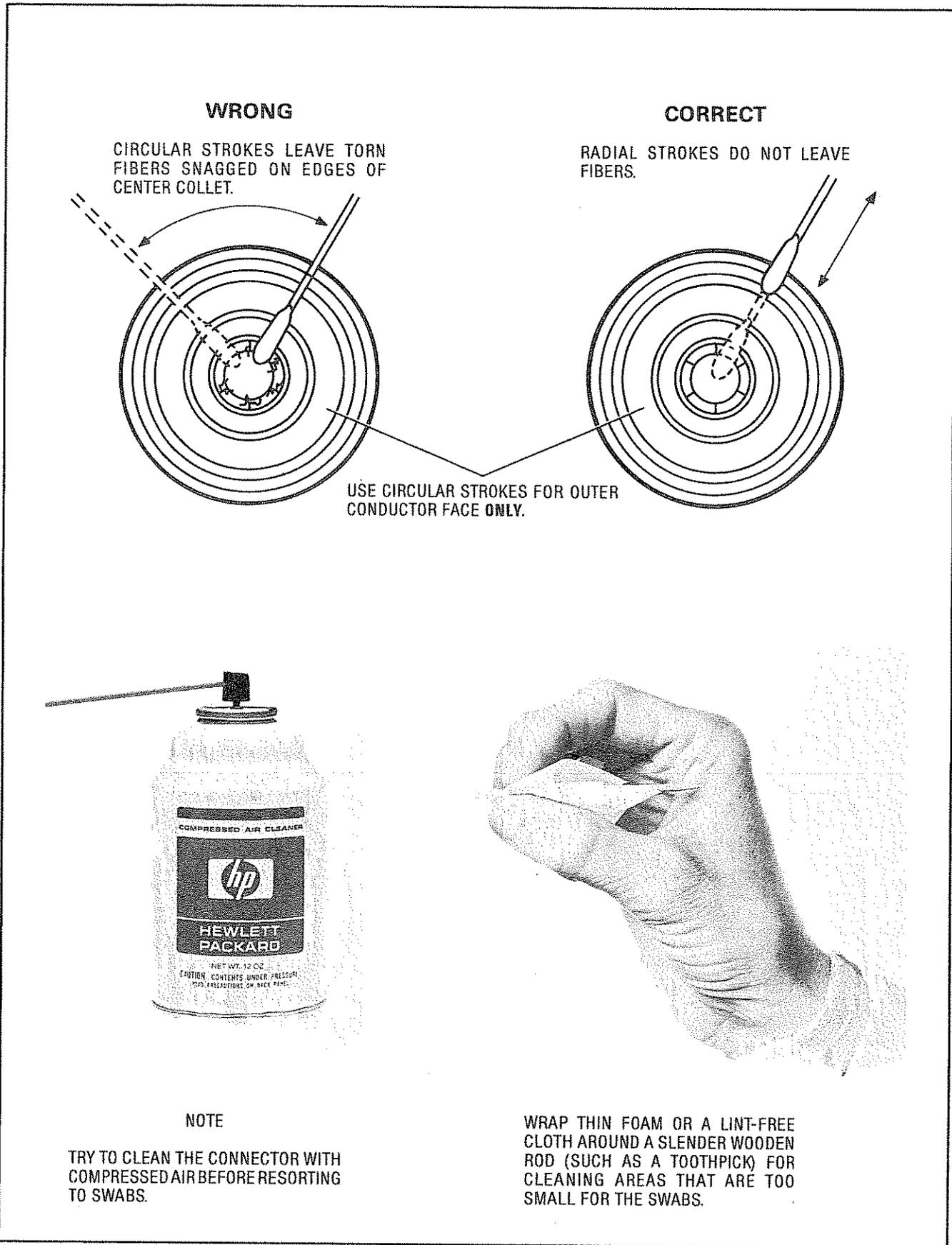
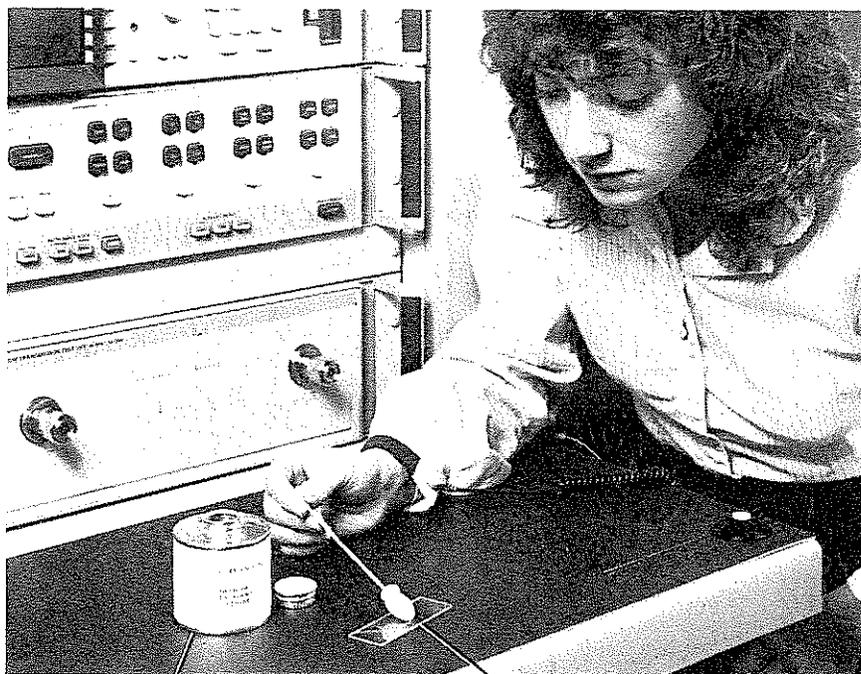


Figure 9. Cleaning 7mm Connectors



TRICHLOROTRIFLUOROETHANE

APPLY TRICHLOROTRIFLUOROETHANE TO A CLEAN GLASS PLATE (A MICROSCOPE SLIDE). ALLOW TO DRY.



NO RESIDUE MAY REMAIN AFTER EVAPORATION OF THE SOLVENT — NO OILY FILM, NO STREAKS, NO LINT OR PLASTIC FIBERS.

CHECK FOR CONTAMINATION USING REFLECTED LIGHT.

Figure 10. Checking Trichlorotrifluoroethane for Contamination

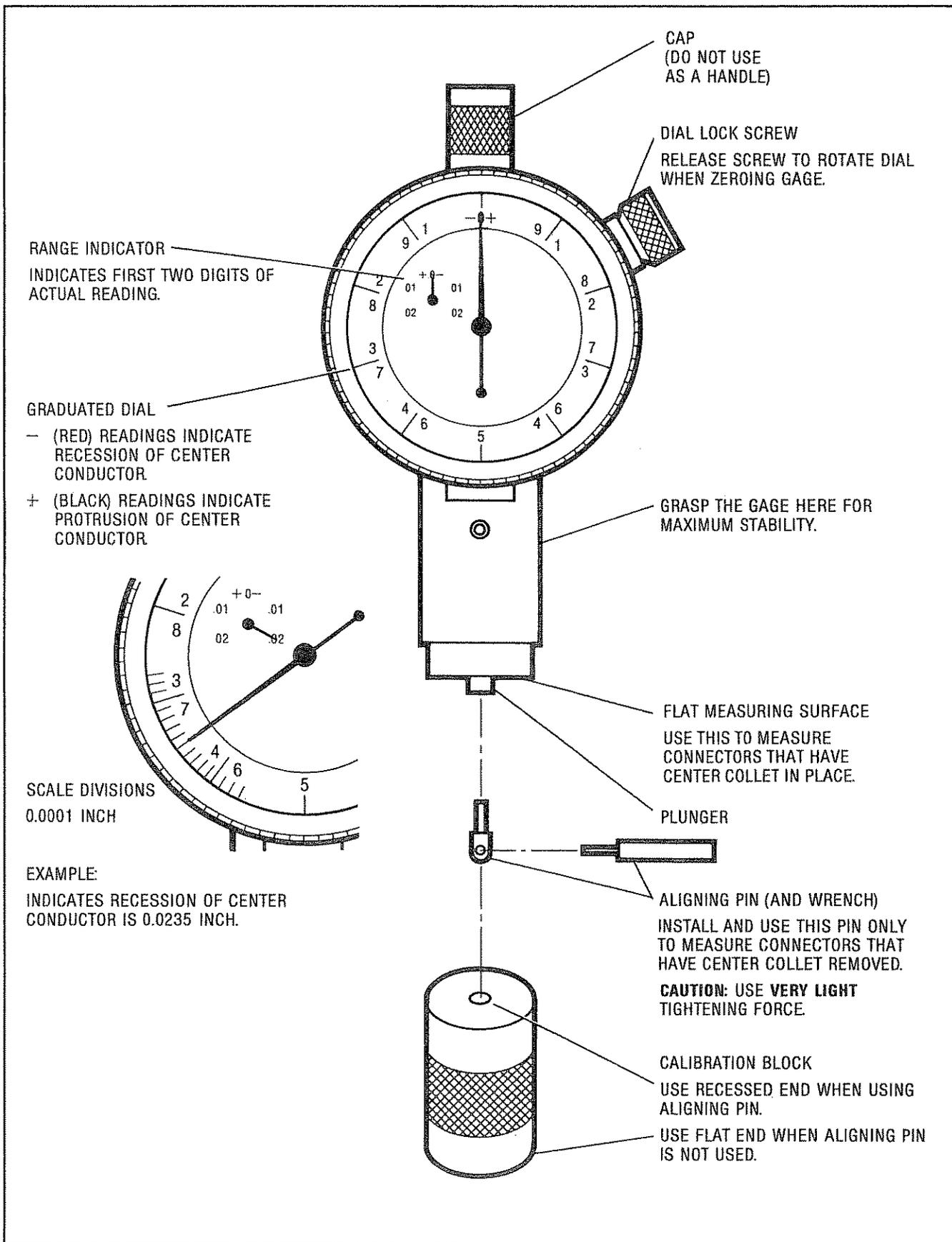


Figure 11. The 7mm Connector Gage

Before measuring a connector, visually examine the end of the gage in the same manner that you examined the connectors. Dirty or damaged gages can cause a dirty or damaged connector!

The gage in this kit can only measure 7mm connectors. Use the gages in the HP 85052A 3.5mm calibration kit to measure any 3.5mm adapters that you might be using (or order the separate 3.5mm gage kit: HP part number 1250-1862 CD 6).

Neither the 7mm nor 3.5mm connector gages require any periodic servicing or maintenance other than an occasional cleaning of the external surface.

### LOADING THE CALIBRATION TAPE

If the connectors are visually and mechanically sound, load the calibration data cartridge into the HP 8510 network analyzer (figure 16). This data cartridge contains the electrical characteristics for each calibration device, and the loading procedure is described in Section III (Operating and Programming) of the HP 8510 manual.

### CONNECTING THE CALIBRATION DEVICES

After loading the data tape, proceed with the calibration as described in Section III (Operating and Programming) of the manual. Instructions will appear on the HP 8510's CRT telling you when to connect the calibration devices.

Figures 17 through 24 show the Hewlett-Packard recommended methods for making connections with these calibration components. Notice that several of these recommended procedures depart from the traditional procedures used by operators of microwave equipment – in particular the counter-rotation technique, and the method for connecting the sliding load.

The counter-rotation technique used for all calibration components involves a small rotation of the connector body just before the final tightening of the connector's nut, as shown in Figure 19. This eliminates the very small air wedge between the outer conductors that frequently occurs when the body is held stationary (as it is in the traditional procedure). The HP 8510 is sufficiently sensitive to detect the reflections caused by such small air wedges.

The gold plating on the outer conductor surface of counter-rotated connectors becomes burnished in time. This is normal, and the connector is still good as long as the surface remains smooth. After a great deal of use the gold plating might wear through to expose the beryllium-copper substratum; if smooth, the connector is still good, although the beryllium-copper might oxidize if the connector is used infrequently.

If the burnished surface is rough (scratches, ripples), excessive preliminary tightening force is being used. The connector is ruined if the roughness is severe. Mild roughness, or oxidation, can be corrected by fine-grinding the surface on a honing stone: Lightly grind the surface by using figure-8 strokes on a fine-grit honing stone, and **thoroughly** clean the connector before returning it to service.

The sliding load should first be connected to the 7mm short circuit calibration device, to establish precise physical alignment of the center and outer conductors. The short is then removed, and the sliding load – with the center conductor aligned and locked in place – is connected to the test set. Traditionally, the sliding load is connected directly to the test set with the center conductor fully compressing the collet of the test port connector. Unfortunately, this is not the condition of the test port collet during device measurements. This difference in conditions produces a systematic error which is large enough to compromise the performance specifications of the HP 8510. The short is the best device to use in this procedure, because its center is a completely flat reference plane. This procedure is shown in Figure 21.

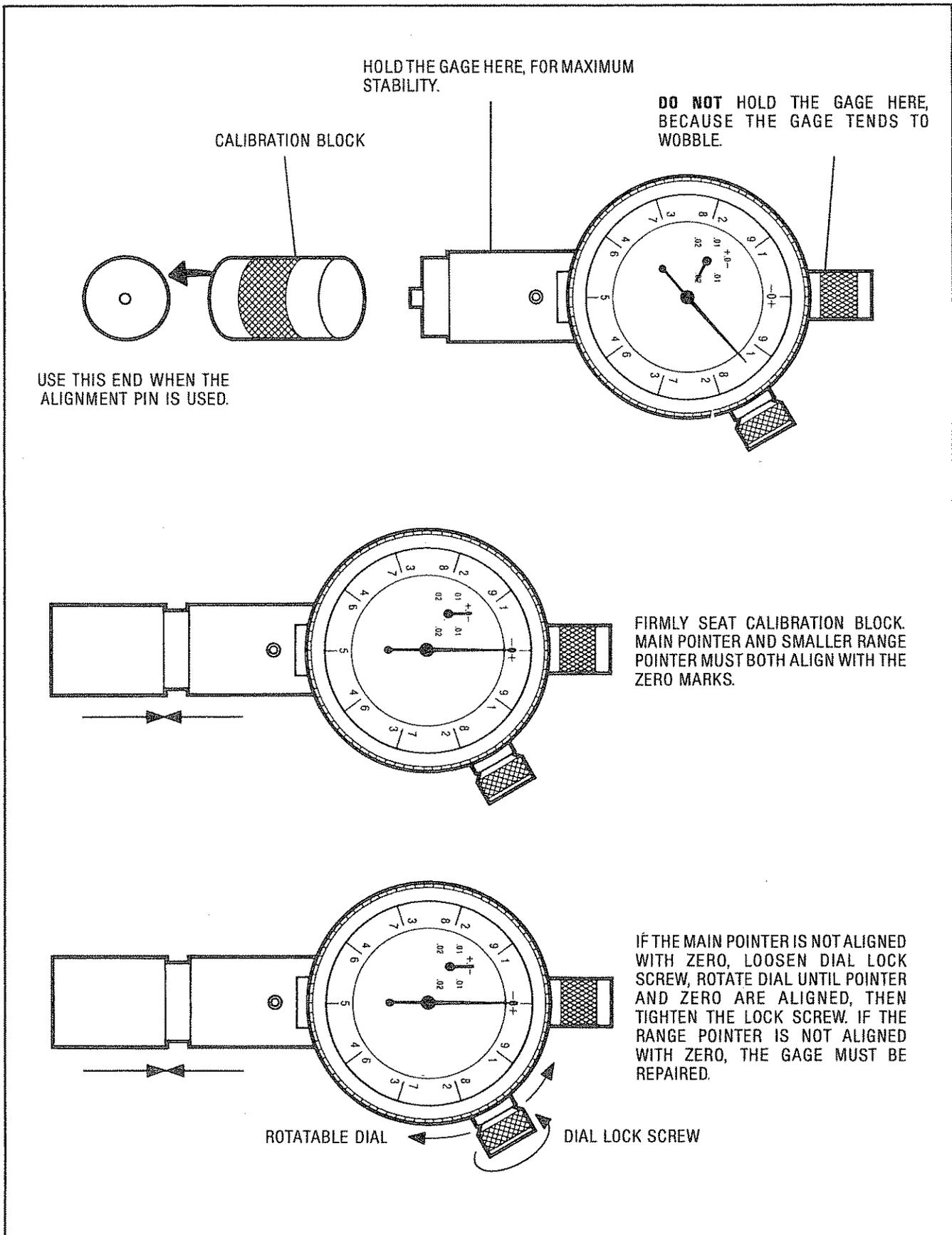
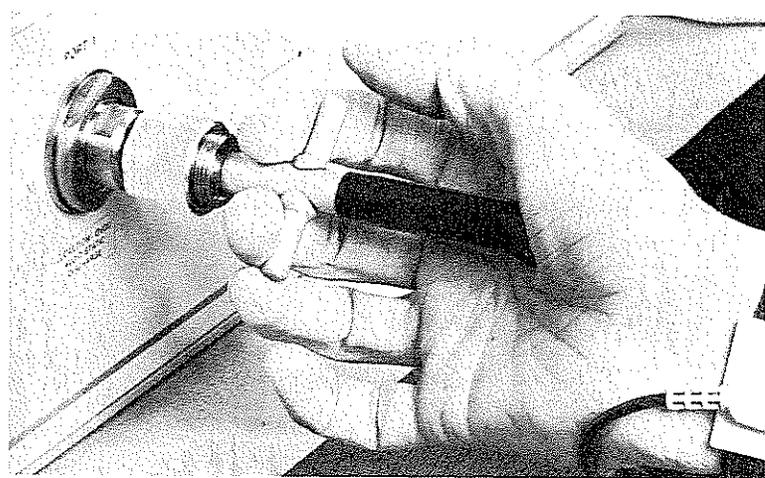
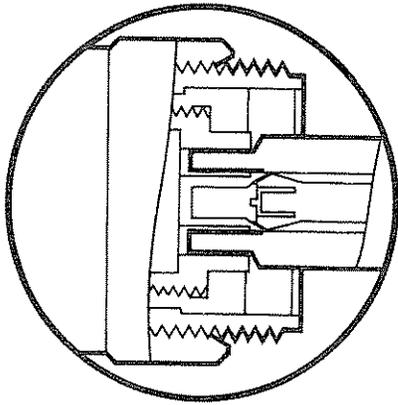


Figure 12. Zeroing the Gage

**REMOVING OLD COLLET.**



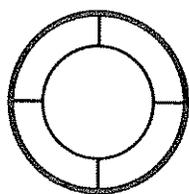
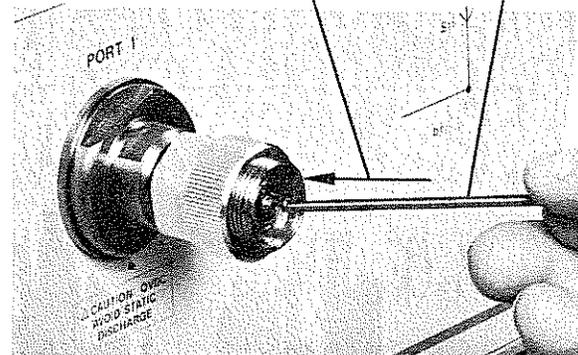
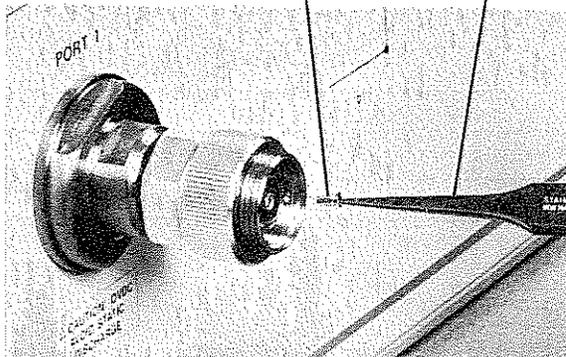
**REPLACING OLD COLLET, OR INSERTING NEW COLLET.**

HP PART NUMBER  
85050-20001 CD7  
**ONLY**

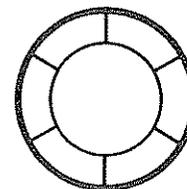
FORCEPS

PUSH LIGHTLY TO  
SNAP INTO PLACE.

BLUNT  
PLASTIC  
ROD



4-SLOT  
STANDARD COLLET  
**DO NOT USE**



6-SLOT  
PRECISION COLLET  
HP PART NUMBER 85050-20001 CD7  
**USE THIS COLLET ONLY**

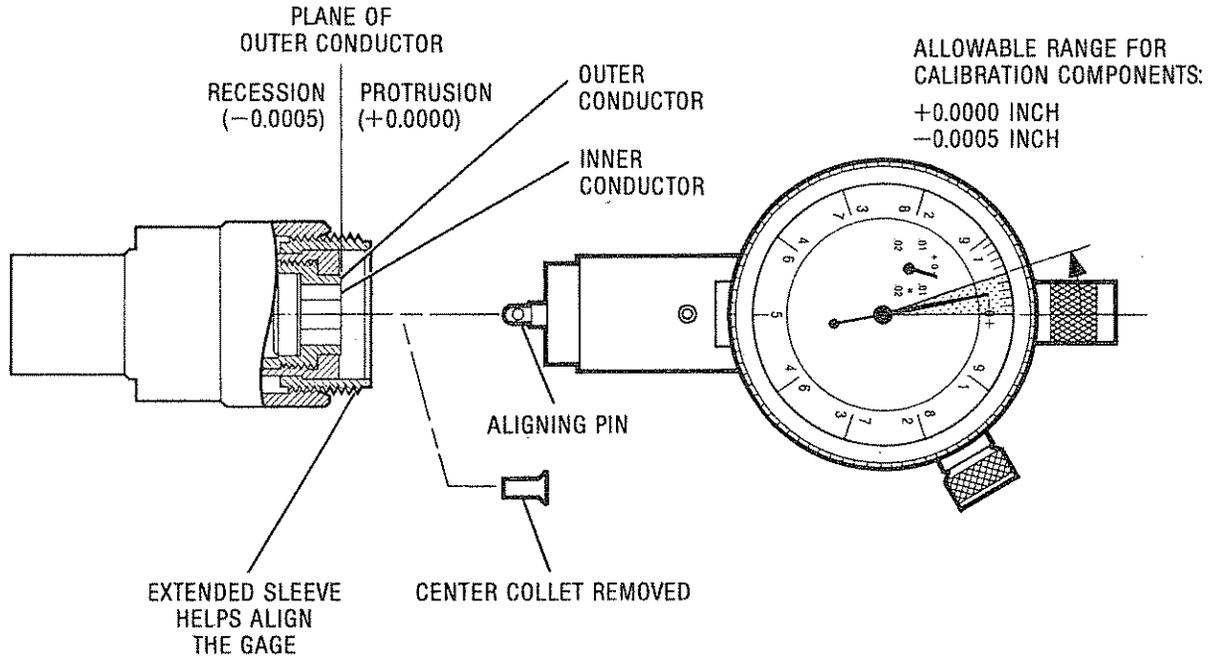
**COLLET IDENTIFICATION**

Figure 13. Collet Removal and Replacement

**CENTER COLLET REMOVED**

**ALLOWABLE RANGE FOR CALIBRATION COMPONENTS:**  $0.0000^{+0.0000}_{-0.0005}$  INCH

INNER CONDUCTOR **MUST NOT** PROTRUDE BEYOND PLANE OF OUTER CONDUCTOR (+0.0000).  
 ALLOWABLE RECESSON OF INNER CONDUCTOR IS  $\leq 0.0005$  INCH (0.013mm).



**ALLOWABLE RANGE FOR TEST PORT CONNECTORS:**  $0.0005 \pm 0.0003$  INCH ( $-0.013 \pm 0.008$ mm)

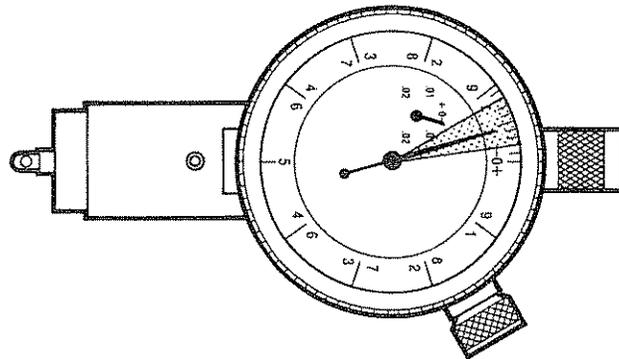


Figure 14. Gaging 7mm Connectors, Collet Removed

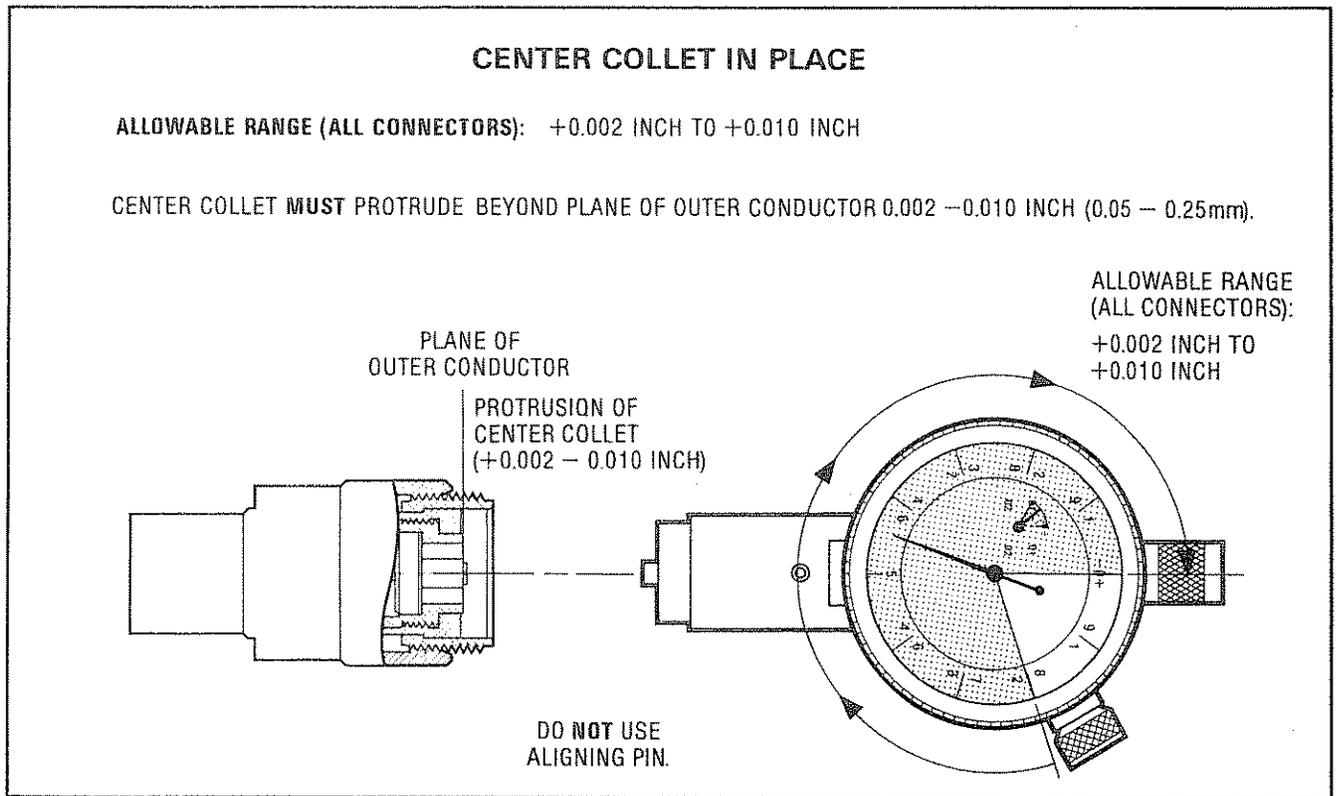


Figure 15. Gaging 7mm Connectors, Collet in Place

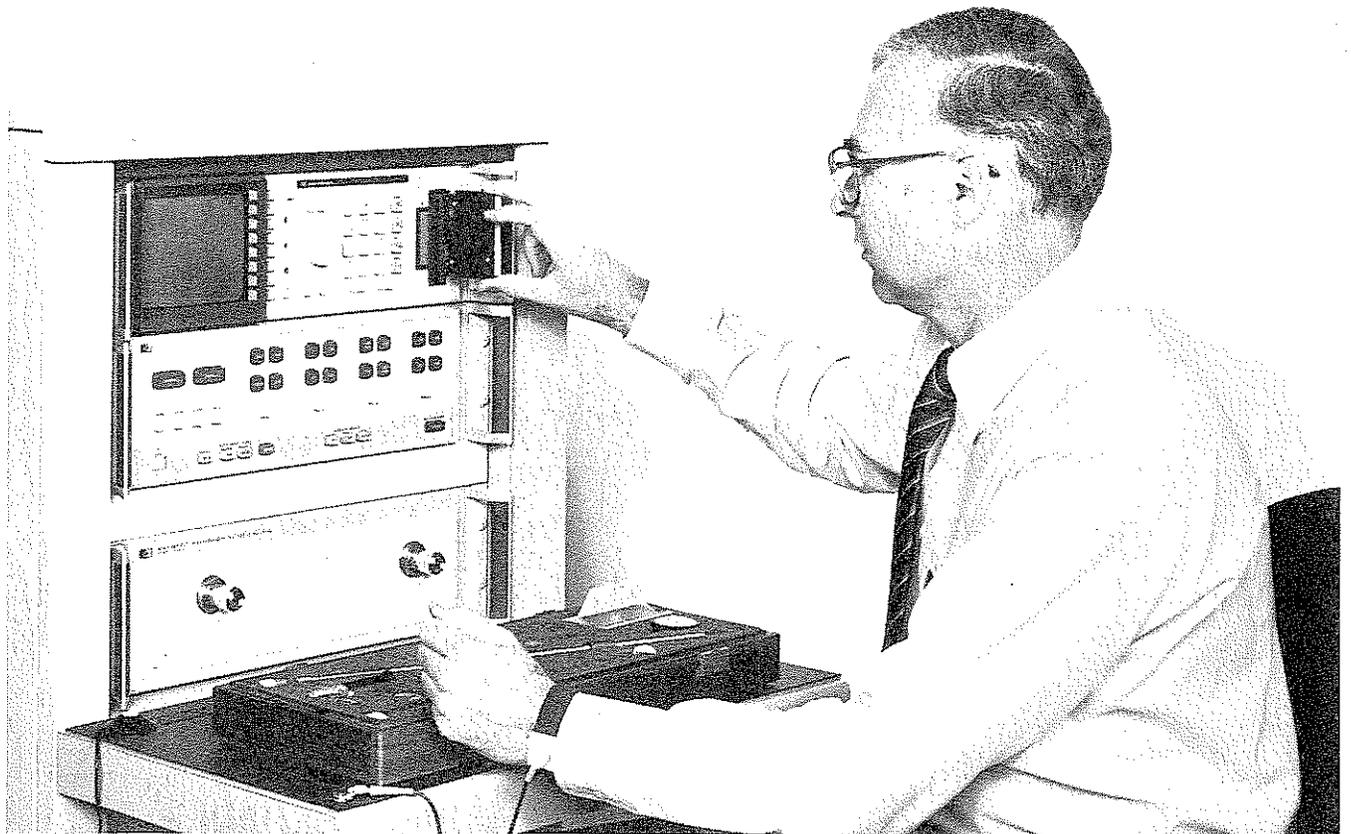
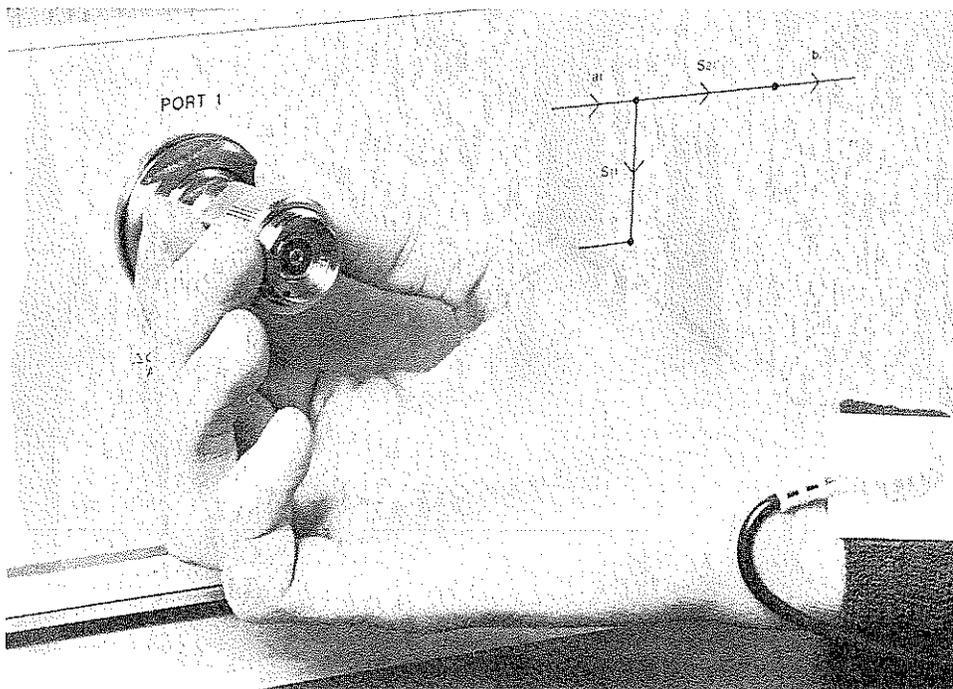
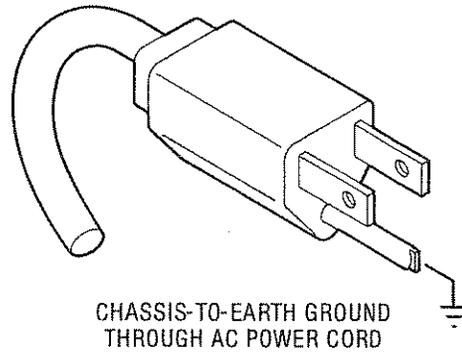


Figure 16. Inserting the Calibration Data Tape



**ALWAYS GRASP THE OUTER SHELL OF THE TEST SET CONNECTOR (NOT THE INNER ELEMENTS) JUST PRIOR TO MAKING A CONNECTION. THIS WILL DISCHARGE ANY STATIC ELECTRICITY ON YOUR BODY BY PROVIDING A CONDUCTIVE PATH TO AN EARTH GROUND.**

**THIS IS THE MOST EFFECTIVE SINGLE SAFEGUARD YOU CAN USE TO PREVENT ESD DAMAGE TO YOUR INSTRUMENTS.**

*Figure 17. ESD Safeguard*

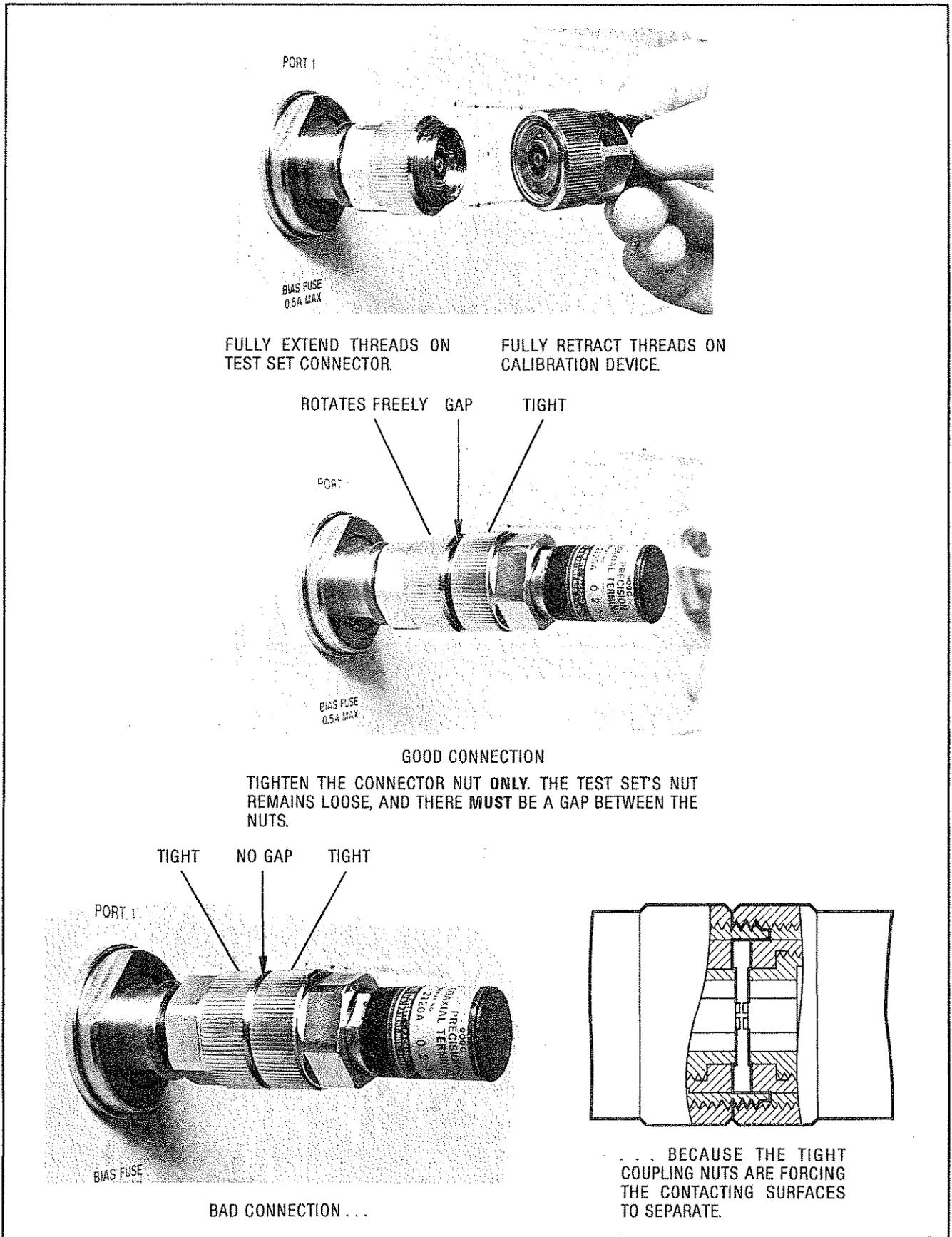
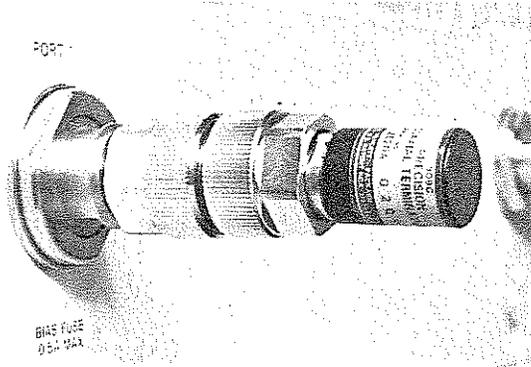
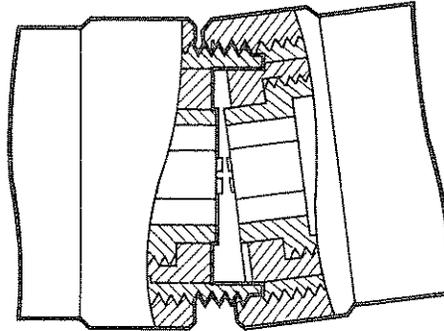


Figure 18. Starting the Connection



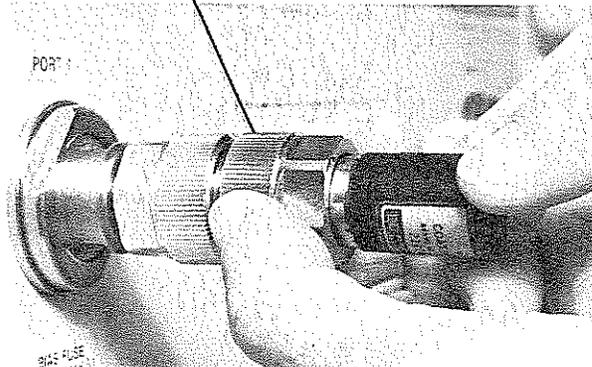
THE PRELIMINARY CONNECTION IS MADE USING LIGHT FINGER PRESSURE. RECOMMENDED TORQUE FOR THIS CONNECTION IS 1 LB-INCH (2 LB-INCH MAXIMUM).

(EXAGGERATED)

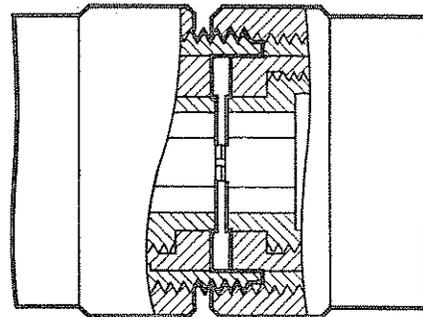


TYPICALLY, THE ALIGNMENT IS IMPERFECT.

HOLD THE COUPLING NUT STATIONARY

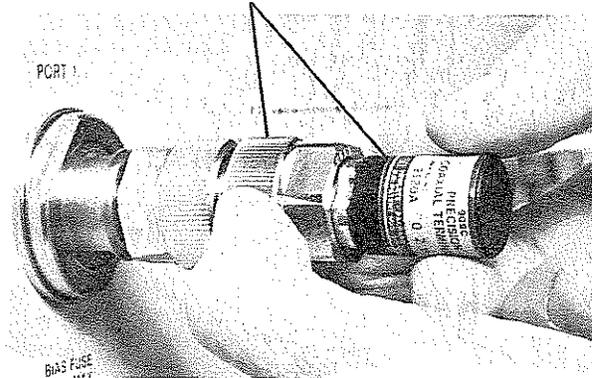


ROTATE THE CONNECTOR BODY  $\frac{1}{4}$  -  $\frac{1}{3}$  TURN COUNTERCLOCKWISE, UNTIL THE CONNECTION FEELS SMOOTH AND FLUSH. NOTE: LIGHT FRICTION SHOULD BE ENCOUNTERED - TOO MUCH OR TOO LITTLE INDICATES AN IMPROPER PRELIMINARY CONNECTION.

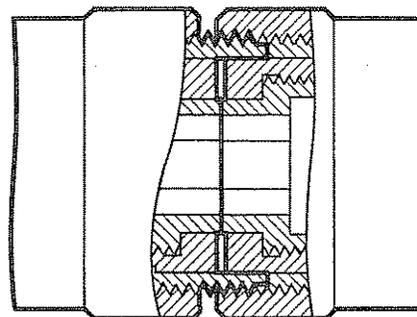


THIS IS THE RESULT. A SLIGHT DECLINE IN TURNING FRICTION SIGNIFIES GOOD ALIGNMENT HAS BEEN ACHIEVED.

SIMULTANEOUSLY ROTATE **BOTH** THE COUPLING NUT...



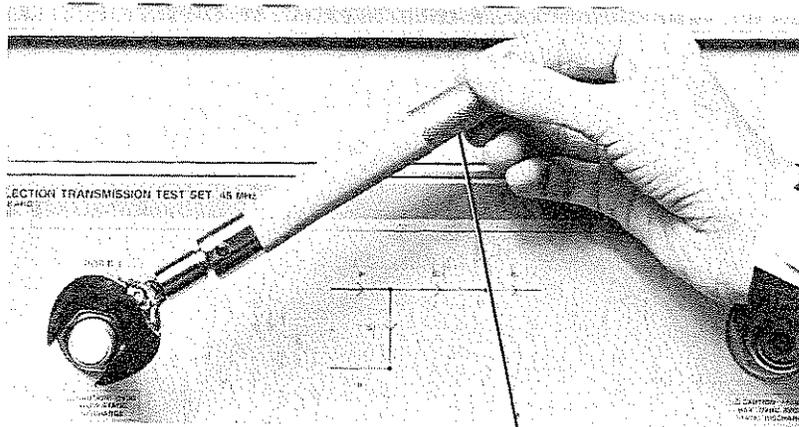
... **AND** THE CONNECTOR BODY CLOCKWISE TO RESTORE A MODERATELY TIGHT CONNECTION. USE THE TORQUE WRENCH FOR FINAL TIGHTENING. (12 LB-INCH).



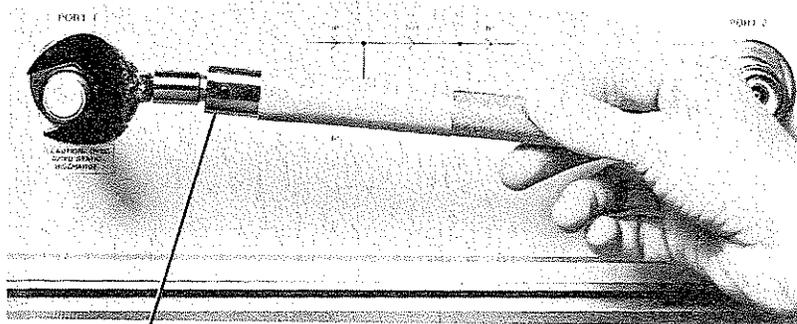
THE RESULTANT GOOD CONNECTION.

Figure 19. Counter-Rotation Technique

### TORQUE WRENCH



HOLD THE KNURLED END ONLY — THIS POSITION REQUIRES THE LEAST FORCE APPLIED FROM THE HAND AND CONTROLS TORQUE MOST ACCURATELY.



PROPER TORQUE ACHIEVED.  
DO NOT OVERTIGHTEN.

#### PREFERRED ORIENTATION



#### NOTE

DO NOT ALTERNATE ORIENTATIONS, BECAUSE TORQUE BREAK POINTS MIGHT NOT BE EXACTLY THE SAME.

#### NOT RECOMMENDED

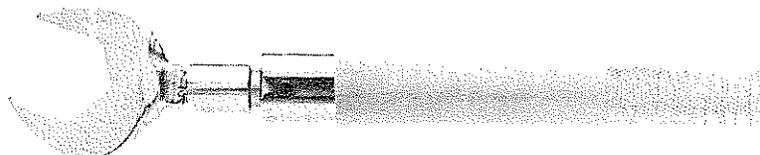
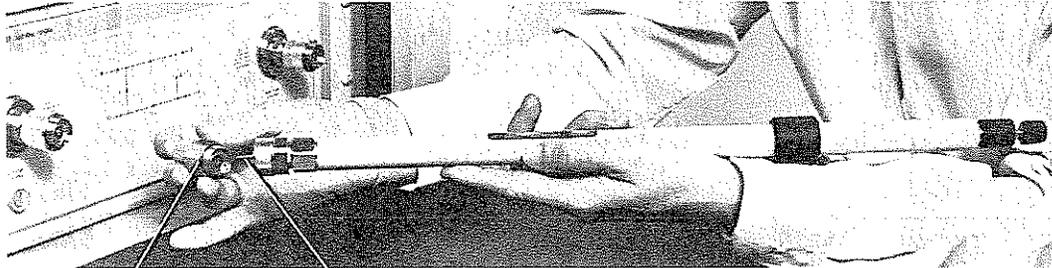


Figure 20. Using the Torque Wrench

**CAUTION**

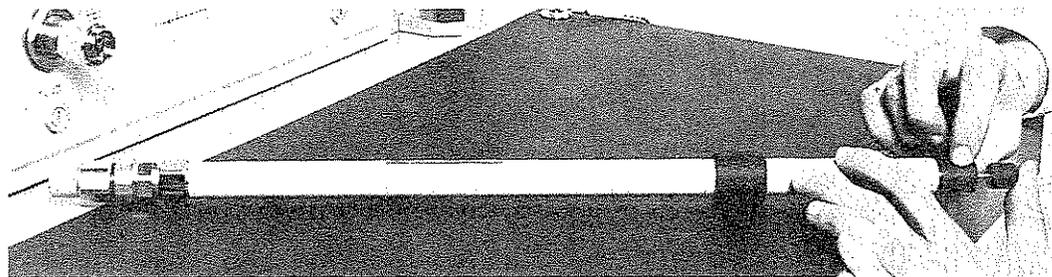
**YOU ARE TOUCHING AN EXPOSED CENTER CONDUCTOR. GROUND YOURSELF TO AVOID ELECTROSTATIC DISCHARGE (ESD).**

**SLIDING LOAD**

7mm SHORT CIRCUIT CALIBRATION DEVICE

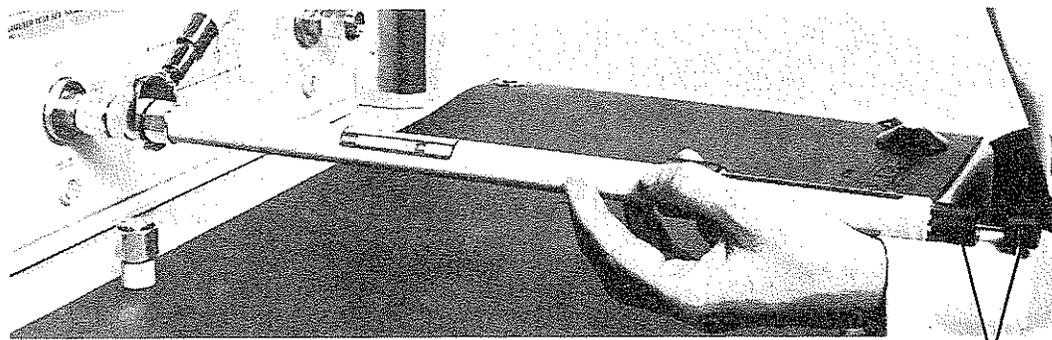
CENTER PIN EXTENDED

- ① LOOSEN KNURLED LOCK NUT UNTIL CENTER CONDUCTOR DRAW PIN MOVES FREELY. PUSH IN DRAW PIN AND LEAVE CENTER PIN EXTENDED, AS SHOWN.



- ② CONNECT SHORT CIRCUIT DEVICE TO SLIDING LOAD, MAKING SURE THAT THE CENTER PIN ENTERS THE HOLE IN THE CENTER OF THE SHORT CIRCUIT DEVICE. HOLD THE BODY OF THE SLIDING LOAD WHILE TIGHTENING THE CONNECTION WITH THE TORQUE WRENCH.

- ③ PRESS THE CENTER CONDUCTOR TO COMPRESS FULLY THE SPRING-LOADED TIP (YOU WILL FEEL IT BOTTOM-OUT). WHILE MAINTAINING PRESSURE ON THE CENTER CONDUCTOR, TIGHTEN THE LOCK NUT. PRESSURE ON THE CENTER CONDUCTOR MUST ASSURE GOOD CONTACT WITH THE SHORT CIRCUIT DEVICE, BUT MUST NOT RESULT IN ANY BENDING OF THE CONDUCTOR ELEMENT.



- ④ REMOVE THE SHORT CIRCUIT DEVICE, BUT DO NOT CHANGE THE SETTING OF THE SLIDING LOAD'S CENTER PIN. ATTACH THE SLIDING LOAD TO THE TEST PORT CONNECTOR, USING THE COUNTER-ROTATION PROCEDURE. USE THE TORQUE WRENCH FOR THE FINAL TIGHTENING.

NO CHANGES

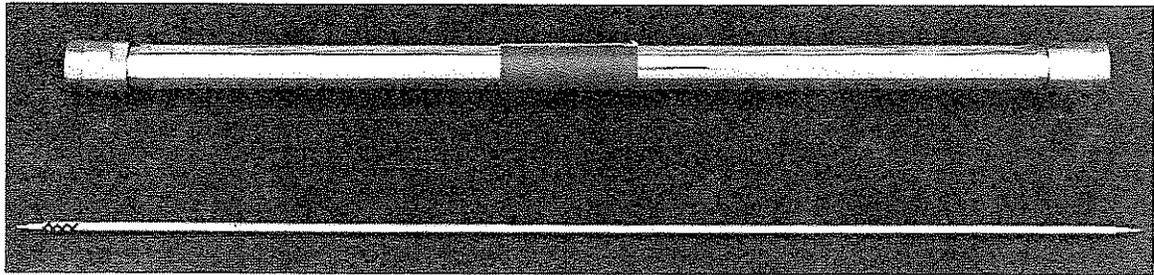
*Figure 21. Connecting the Sliding Load*

**CAUTION**

**YOU ARE TOUCHING AN EXPOSED CENTER CONDUCTOR. GROUND YOURSELF TO AVOID ELECTROSTATIC DISCHARGE (ESD).**

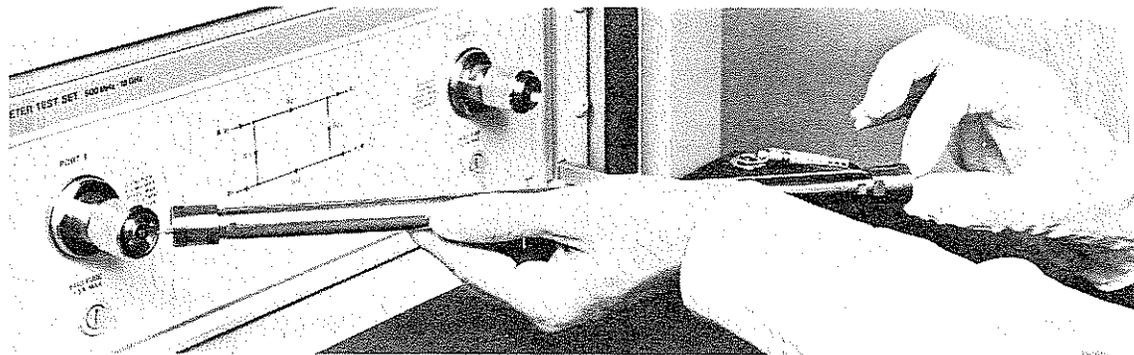
**A**

**B**



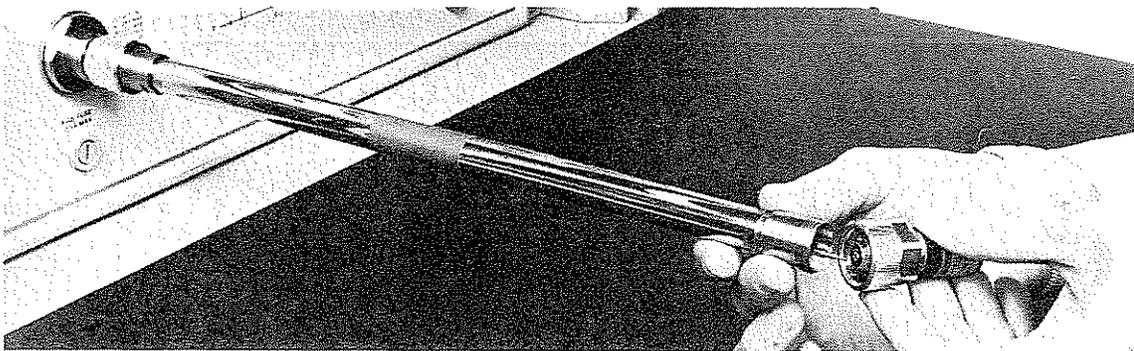
BLUE END OF INNER CONDUCTOR CORRESPONDS TO "A" END OF OUTER CONDUCTOR REVERSAL CHANGES DEVICE CHARACTERISTICS.

BOTH CENTER TIPS ARE SPRING LOADED.



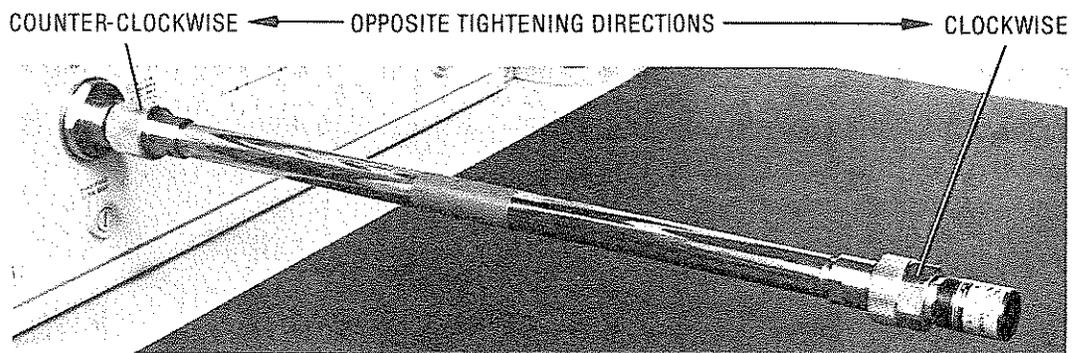
- ① FULLY RETRACT TEST SET CONNECTOR'S THREADS. ALIGN CENTER ELEMENTS. LIGHTLY CONNECT OUTER CONDUCTORS.

SEE FIGURE 24 FOR CORRECT HANDLING PROCEDURE.

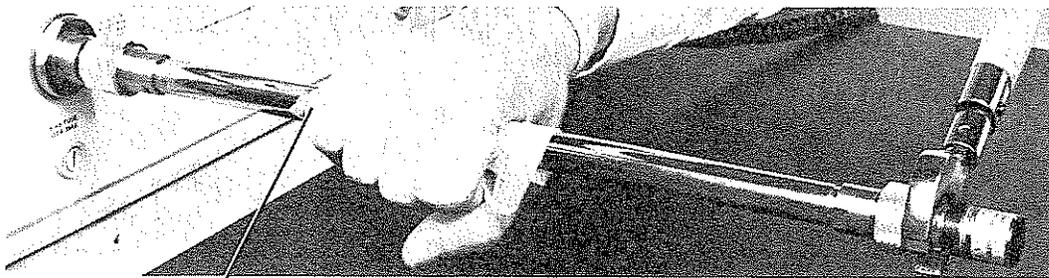


- ② ALIGN CENTER ELEMENTS OF AIRLINE AND TERMINATION DEVICE, THEN LIGHTLY CONNECT OUTER CONDUCTORS.

Figure 22. Preliminary Connection of the Airline

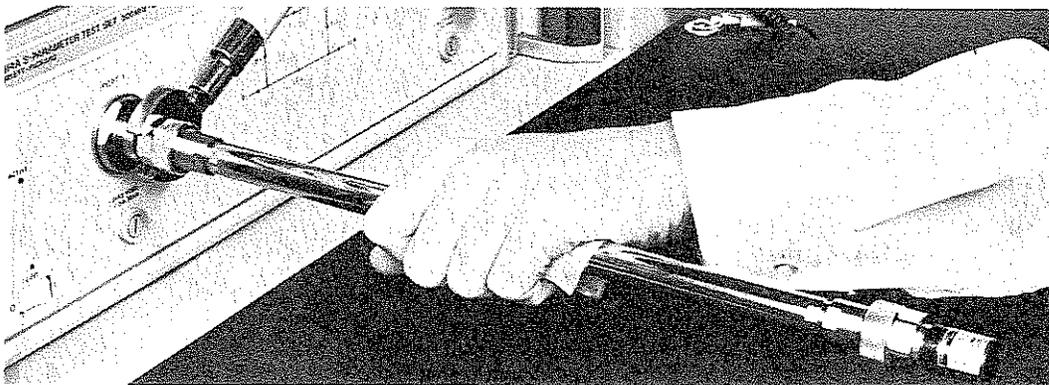


SINCE THE TIGHTENING DIRECTIONS OPPOSE EACH OTHER, THE SEQUENCE OF FINAL TIGHTENING IS IMPORTANT.



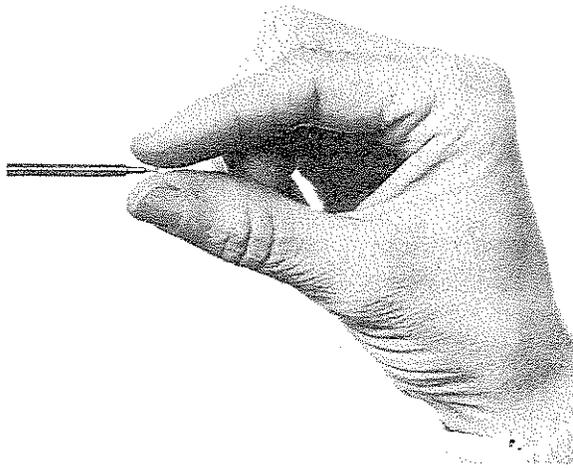
A RUBBERIZED CLOTH HELPS YOU TO HOLD THE AIRLINE BODY.

- ① TIGHTEN THE TERMINATION DEVICE **FIRST**. COUNTER-ROTATE THE DEVICE, THEN USE THE TORQUE WRENCH. IN THE PROCESS YOU MIGHT LOOSEN THE TEST PORT CONNECTION, BUT THAT IS NOT IMPORTANT AT THIS TIME.

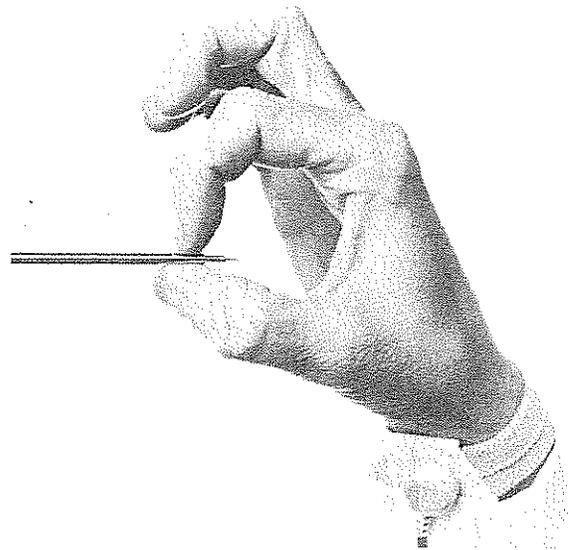


- ② TIGHTEN THE TEST PORT CONNECTOR **LAST**: COUNTER-ROTATE THEN TORQUE. THE TERMINATION DEVICE REMAINS PROPERLY TIGHTENED.

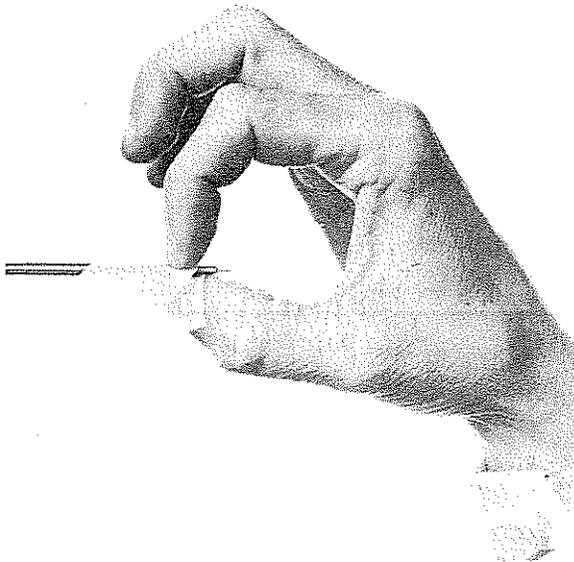
Figure 23. Final Connection of the Airline



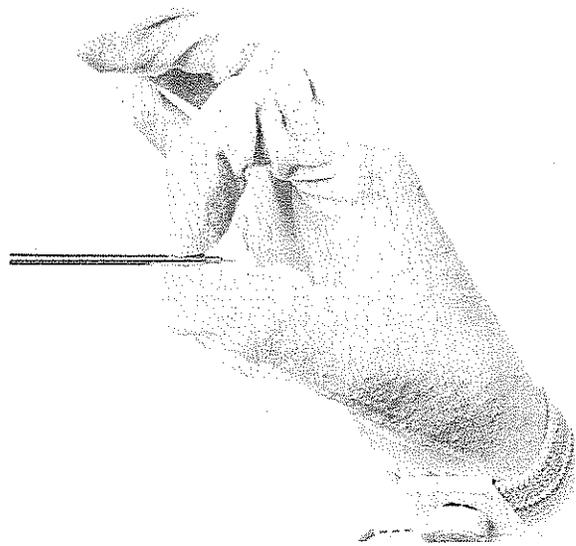
**WRONG**  
FINGER PRINTS ON CENTER CONDUCTOR  
CAN RAPIDLY DEGRADE ELECTRICAL  
PERFORMANCE.



**ACCEPTABLE**  
CLEAN PERIODICALLY TO REMOVE THE  
ACCUMULATION OF FINGER PRINTS.



**BETTER**  
HANDLE WITH A THIN, LINT-FREE CLOTH OR  
PAPER. LENS CLEANING PAPER (USED BY  
PHOTOGRAPHERS) WORKS WELL.



**BEST**  
THIN, LINT-FREE GLOVES OR FINGER COTS  
ARE BEST FOR FREQUENT HANDLING.

*Figure 24. Handling the Airline Center Conductor*

## PRACTICE

You should practice these connection procedures until you can consistently make good measurements. Practice with the fixed load termination first, and when you have mastered that move on to the 30 cm airline with a short circuit attached. The airline with short circuit is the most challenging type of calibration measurement, and mastery of that indicates a high level of competence.

Figure 25 shows a typical practice session with the fixed load, following this procedure:

1. Measure  $S_{11}$  magnitude of the fixed load over the stepped-sweep frequency range of 2-18 GHz, and store the resultant data in the HP 8510 memory.
2. Disconnect the fixed load. Then reconnect the load, wait a few minutes for the device to reach thermal equilibrium (your fingers probably created local temperature gradients), and measure  $S_{11}$  again. Subtract the stored data from the current data ("data minus memory" function) to see any large scale measurement differences.
3. Store data from the second measurement in memory, writing over the previously stored data.
4. Repeat this sequence several times (recommended: 10 times) until **all** of your measurements from 2-17.5 GHz are at least  $-60$  dB from the reference level, with a uniform measurement difference. At 18 GHz, the recommended frequency limit for 7mm connectors,  $-55$  dB is satisfactory.

Figure 26 shows the repeatability of a fixed load that had a standard, 4-slot collet instead of a precision 6-slot collet. Notice the inferior overall performance, and the pronounced collet resonance, as compared to Figure 25.

Figure 27 shows the results of a typical practice session where a short-circuited, 30 cm airline was measured repeatedly. The vertical scale is 50 millidegrees/division ( $0.05^\circ/\text{div}$ ). The practice procedure for the airline is similar to the procedure for the fixed load, with two exceptions: measure the phase of  $S_{11}$ , and plot the data/memory ratio. Make sure that you completely disconnect the airline and short between trials, and that you wait for thermal equilibrium to be restored after making a connection. Practice until your repeatability is within  $0.1^\circ$  ( $0.05^\circ$  is desirable, but difficult).

## FURTHER INFORMATION

This HP 85050A 7mm calibration kit manual contains a very limited subset of information about operating the HP 8510 system. For complete information, refer to the HP 8510 Operating and Service Manual – especially Section III (Operating and Programming).

If you need additional information, contact either your local HP representatives (their business cards are in the HP 8510 manual), or the nearest HP sales/support office listed inside the back cover.

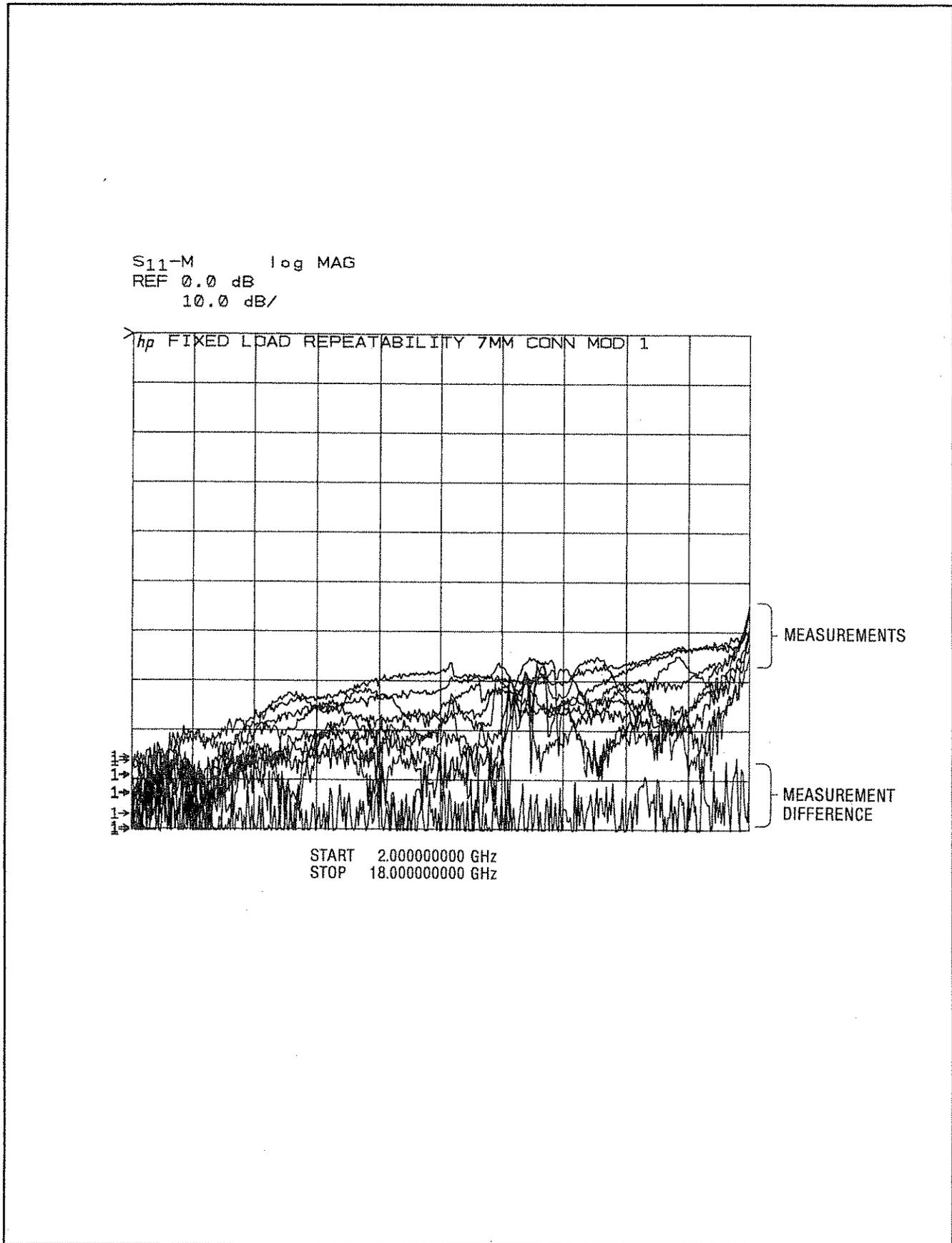


Figure 25. Typical Fixed Load Repeatability with a Precision Collet

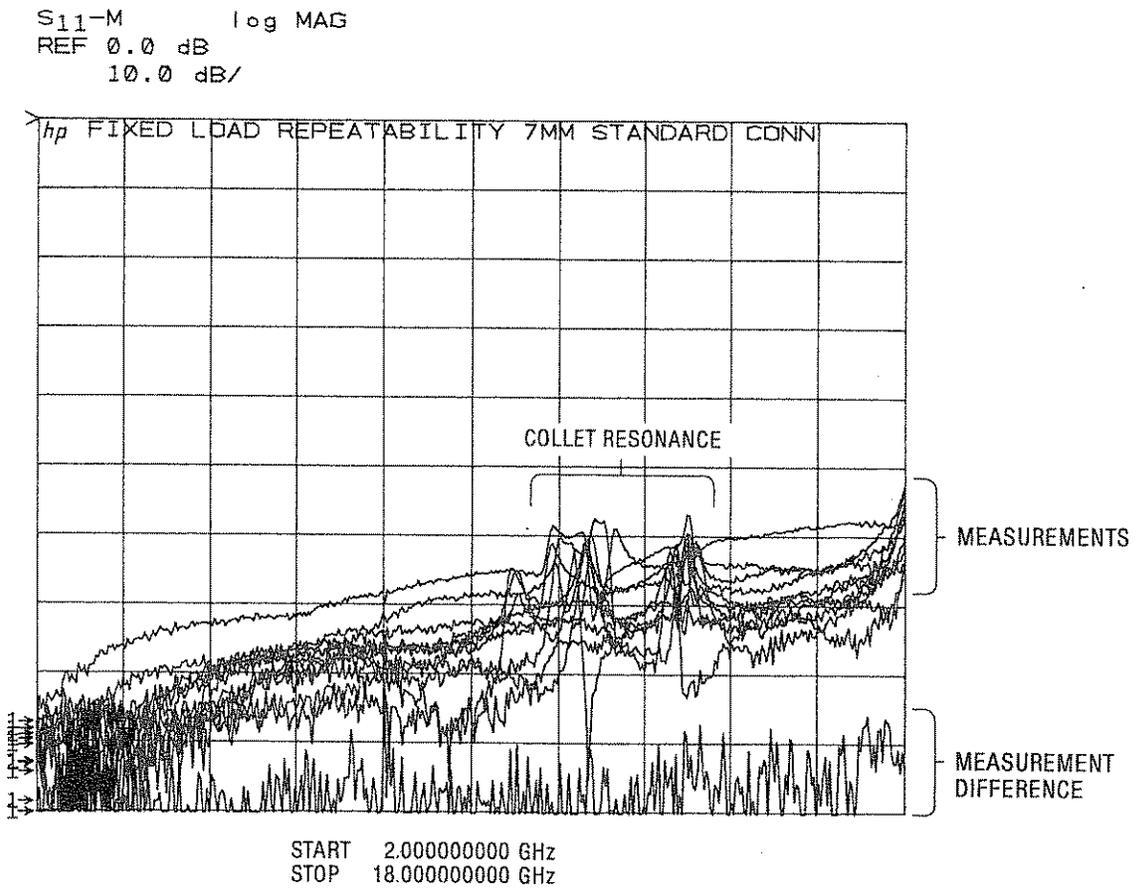


Figure 26. Typical Fixed Load Repeatability with a Standard Collet

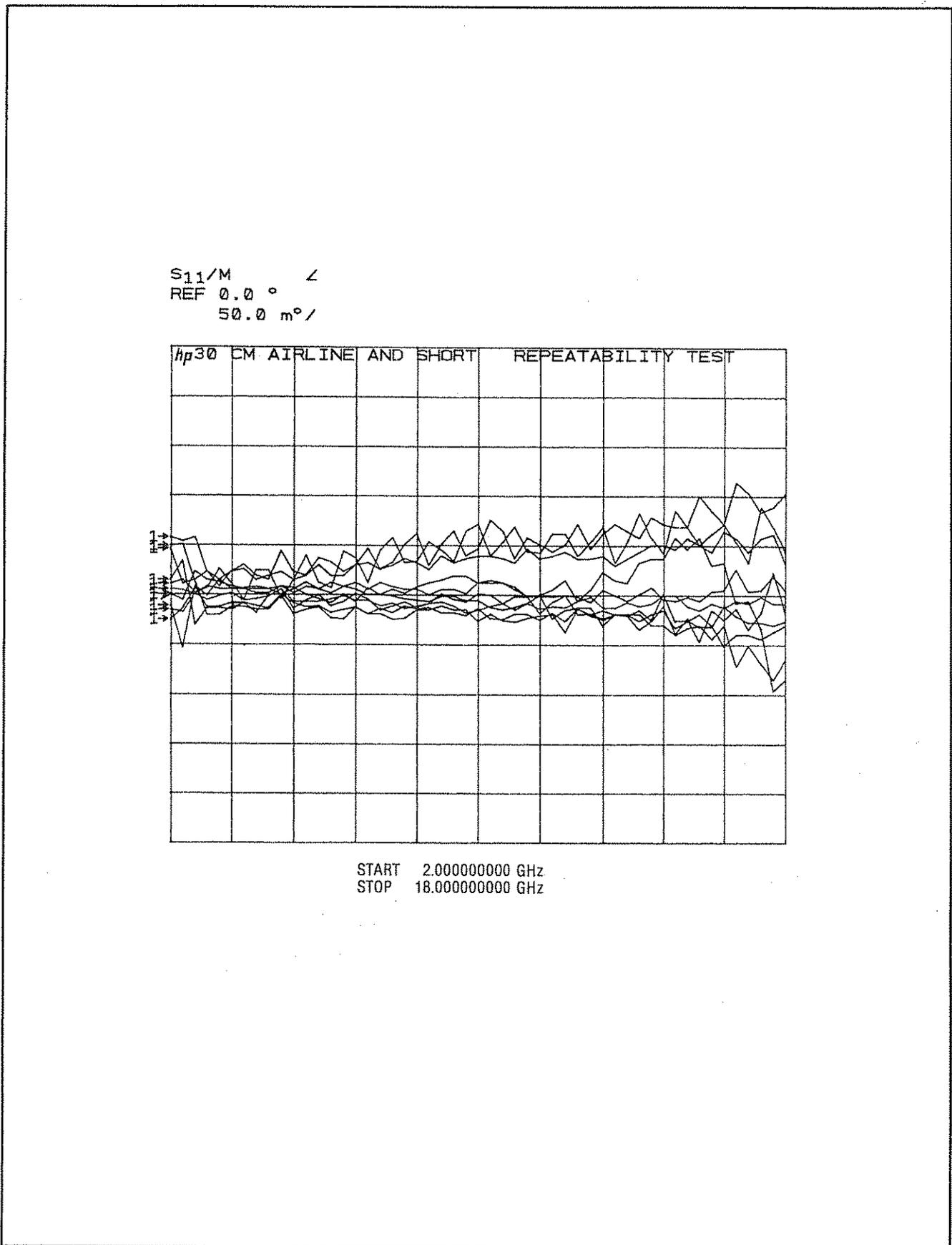


Figure 27. Typical Short-Circuited Airline Repeatability

## REGIONAL SALES AND SERVICE OFFICES

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7, Rue du Bois-du-Lan  
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Telex: 27835 hpse  
Cable: HEWPACKSA Geneve

**ASIA**

Hewlett-Packard Asia Ltd.  
6th Floor, Sun Hung Kai Centre  
30 Harbour Rd.  
G.P.O. Box 795

**HONG KONG**

Tel: 5-832 3211

*After Jan. 1, 1984*

47th Floor, China Resources Bldg.  
26 Harbour Rd., Wanchai

**HONG KONG**

Telex: 66678 HEWPA HX

Cable: HEWPACK HONG KONG

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MISSISSAUGA, Ontario L4V 1M8  
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Paradissos-Amarousion, **ATHENS**  
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3939 Lankershim Blvd.  
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**OTHER INTERNATIONAL AREAS**

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MANUAL IDENTIFICATION

Model Number	HP 85050A
Manual Date	April 1984
Manual Part Number	85050-90001

**MANUAL CHANGES**  
**HP 85050A 7mm Calibration Kit**

This Manual Changes supplement will bring you up to date on all new information, changes, and corrections that apply to the manual originally supplied with your HP 85050A 7mm calibration kit. The information in this supplement applies to manuals which have the manual part number and date of printing given above. These should be the same as those on the manual you have. If not, you should request the Manual Changes supplement that does apply to your manual.

The information in this supplement applies to all HP 85050A 7mm calibration kits. There are no serial-related changes.

[NEW] preceding an entry indicates that this information is appearing for the first time in a Manual Changes supplement, or that it has been changed or corrected since the last Manual Changes supplement was issued for the HP 85050A 7mm calibration kit, on 11 February 1985.

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*Manual Changes supplements are revised as often as necessary to keep all Hewlett-Packard manuals as current and accurate as possible. Free copies are available from all HP offices, and it is recommended that you periodically request the latest Manual Changes supplements for all HP equipment that you are using. In each case, please give the model number, the date of the manual, and the manual part number given on the title page of your original manual. This information also appears at the top of the first page of all Manuals Changes supplements.*

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## GENERAL NOTES - ALL SERIALS

### Inspection and Cleaning, Counter-rotation Technique

Recent work at Hewlett-Packard has shown even more clearly that *it is essential to inspect and clean all connectors if accurate measurements are to be made.* Dirt and contamination on connectors is the most important single source of measurement problems.

In addition, it has been found that while the counter-rotation technique (10 to 20 degrees) described in this manual and in the HP 85052A 3.5mm calibration kit manual is required for the most demanding measurements (40 dB or more return loss, for example) it can be omitted if this degree of accuracy is not required (20 dB return loss, for example). Doing so will also reduce the slight connector wear that is naturally caused by the counter-rotation technique.

### Mechanical Dimensions: Inner Conductor Setback

Several references are made in this manual to an inner conductor setback of 0.0000 to 0.0005 inches (0.000 to 0.013 mm) for 7mm connectors. This is a general guideline to consider when selecting precision devices, but there are many exceptions. Test port connectors have a greater recommended setback, sliding loads have a smaller setback, and some verification kit devices and most low-frequency devices have an extended allowable range for the setback values.

The 50-ohm fixed loads used in this calibration kit have an allowable setback of 0.0000 to 0.0020 inches (0.000 to 0.050 mm), because those devices are generally used at  $\leq 2$  GHz. Protrusion of an inner conductor, however, is never allowable on any 7mm connector.

### 3.5mm-to-7mm Adapters

If you wish to use 7mm calibration or verification devices with an HP 3.5mm test set (e.g. HP 8513A or HP 8515A), use only HP 85130A special 3.5mm (F) to 7mm adapters on the test ports for best results. The correct sequence is 3.5mm test set port - HP 85130A adapter - HP 85132A/B 7mm cable - 7mm calibration and verification devices.

The HP 85130A adapters have two special features: (1) the 3.5mm side is a special "NMD-3.5" connector designed specifically to mate with HP 3.5mm test set ports, and (2) the 7mm side has an inner conductor setback that matches the setback on HP 7mm test set ports. Other adapters may be used at non-port connections, to connect ordinary 7mm devices to ordinary 3.5mm devices.

The adapters in the HP 85052A 3.5mm calibration kit can, however, be used on 7mm test set ports (HP 8512A and HP 8514A test sets). These adapters were designed for a 7mm-to-3.5mm test port conversion, but not for a 3.5mm-to-7mm test port change.

**Part Numbers**

The identifying labels or markings on many of the items in this calibration kit have an HP or original equipment manufacturer's part number which differs from the replacement part number for the same item given in the manual.

The labels and markings on these items are correct, but in ordering replacement parts you should always use the number given in the manual, not the number that appears on the item itself. Doing so will expedite your order and will assure that you receive the correct replacement part for this calibration kit.

For shipment verification only, these are the label part numbers of the devices in this kit of which this is true. MMC stands for Maury Microwave Corporation; STARRETT stands for the L. S. Starrett Company, Athol, Mass.

Terminations

Label Part Number

Short Circuit . . . . .	MMC 2615D
Fixed Load . . . . .	HP 909C
Open Circuit . . . . .	MMC 2616D
Sliding Load . . . . .	MMC 2517H
30cm Airline . . . . .	MMC 2563S30

Other Items

Torque wrench . . . . .	MMC 2698C
Connector gage . . . . .	MMC 299-D-009 or STARRETT 81-111-624

**CORRECTIONS - ALL SERIALS**

Page 0, Figure 1. The correct part number for the foam-lined storage case is HP 85050-80004 CD 6. This includes both the case and the foam inserts.

**[NEW]**

The correct part number for the center conductor tip for the HP 1250-1890 sliding load is Maury Part Number 2600-65.

The correct part number for the center conductor tip for the HP 1520-1877 30cm beadless airline is Maury Part Number 2600-65.

Pages 9 and 10, Table 2a: Standard Class Assignments, Capacitance Coefficients. Revision A.02.00 of the HP 8510 operating system software adds standard class assignments for forward match and reverse match and includes new capacitance coefficients for the open circuit device in the HP 85050A 7mm calibration kit. These coefficients improve effective source match when 1-Port or 2-Port error correction is used. In addition, kits are identified by a release letter and a revision number (for example, A.1).

A revised Table 2a (pages 9 and 10) is included at the end of this Manual Changes supplement.

Page 13, Figure 5. The collet diameter and several metric conversions are incorrect. A corrected Figure 5 is included at the end of this Manual Changes supplement.

Page 15, Figure 7. The correct dimensions of S and D on the open circuit termination are:

$$S = 0.0000 + 0.0000 \quad 0.000 + 0.000 \\ \quad \quad \quad - 0.0005 \text{ in} \quad \quad - 0.013 \text{ mm}$$

$$D = 0.2756 \pm 0.0003 \text{ in} \quad 7.000 \pm 0.008 \text{ mm}$$

Page 25, Figure 15. On the drawing, the allowable range given under the label PROTRUSION OF CENTER COLLET is correct and is the same as appears elsewhere. No recession or negative protrusion is allowed.

The label should therefore use the word to rather than a dash (-):

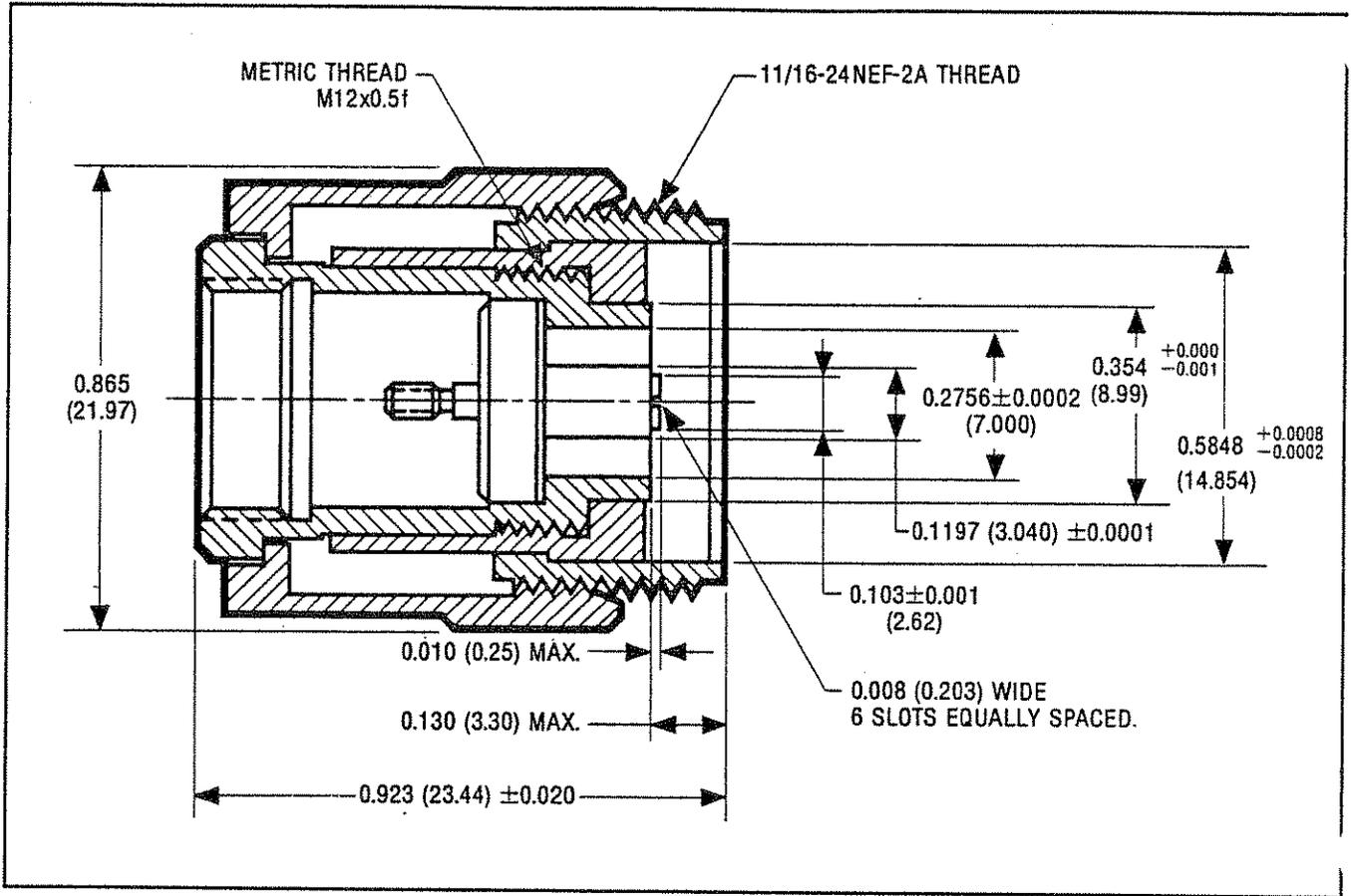
PROTRUSION OF  
CENTER COLLET  
(+0.002 to +0.010 INCH)

TYPOGRAPHICAL ERROR

Page 7/8, line 17. HP 8505A's was printed by mistake for: HP 85050A's.

PAGES 6, 7, AND 8 OF THIS SUPPLEMENT  
ARE REPLACEMENTS OF  
FIGURE 5 (MANUAL PAGE 13)  
AND  
TABLE 2a (MANUAL PAGES 9 and 10).

BOTH WERE LAST REVISED ON  
11 FEBRUARY 1985



Replacement Figure 5. Connector Face Dimensions

STANDARD DEFINITIONS

CALIBRATION KIT LABEL 7 mm  
TAPE FILE NUMBER 1

STANDARD <sup>1</sup> NUMBER	TYPE	C0 x10 <sup>-15</sup> f	C1 x10 <sup>-27</sup> f/Hz	C2 x10 <sup>-36</sup> f/Hz <sup>2</sup>	C3 x10 <sup>-45</sup> f/Hz <sup>3</sup>	FIXED or SLIDING <sup>2</sup>	TERMINAL IMPEDANCE <sup>3</sup> ohms	DELAY ps	OFFSET Z <sub>0</sub> ohms		LOSS <sup>4</sup> ohms/s	FREQUENCY (GHz)		COAX or WAVEGUIDE	STANDARD LABEL <sup>6</sup>
									LOWER <sup>5</sup>	UPPER		LOWER <sup>5</sup>	UPPER		
1	SHORT							0	50	0.0	0.0	0	999	COAX	SHORT
2	OPEN	92.85	0.0	7.2	4.3			0	50	0.0	0.0	0	999	COAX	OPEN
3	SHORT							166.67	50	7x10 <sup>8</sup>	0.749	2.001	999	COAX	SHORT #3
4	SHORT							83.3374	50	7x10 <sup>8</sup>	1.999	4.001	999	COAX	SHORT #4
5	SHORT							41.656	50	7x10 <sup>8</sup>	3.999	8.001	999	COAX	SHORT #5
6	SHORT							24.493	50	7x10 <sup>8</sup>	7.999	12.001	999	COAX	SHORT #6
7	SHORT							17.518	50	7x10 <sup>8</sup>	11.999	18.601	999	COAX	SHORT #7
8															
9	LOAD					FIXED		0	50	0.0	0.0	0	999	COAX	BROADBAND
10	LOAD					SLIDING		0	50	0.0	0.0	1.999	999	COAX	SLIDING
11	THRU							0	50	0.0	0.0	0	999	COAX	THRU
12	LOAD					FIXED		0	50	0.0	0.0	0	2.001	COAX	LOWBAND
13															
14															
15															
16	OPEN	79.4	0.0	40.0				0	50.0	0.0	0.0	0	999	COAX	OLD OPEN
17															
18															
19															
20															
21															
22															

<sup>1</sup> Open, Short, Load, Delay/Thru, or Arbitrary Impedance.  
Only standards 1, 2, 10, 11, and 12 are included in the HP 85050A 7mm calibration kit.  
<sup>2</sup> Load or Arbitrary Impedance only.  
<sup>3</sup> Arbitrary Impedance only. Device Terminating Impedance.  
Defaults: Short = 0 Ω; Open = ∞ Ω; Load = 50 Ω.  
<sup>4</sup> Skin loss factor; normalize at 1 GHz.  
<sup>5</sup> For waveguide, Z<sub>0</sub> = 50 Ω; lower frequency is same as FCO.

Replacement Table 2a. Device Characteristics (1 of 2)

STANDARD CLASS ASSIGNMENTS

CALIBRATION KIT LABEL 7 mm

HP 85050A 7mm A.1 Calibration Kit

TAPE FILE NUMBER 1

	A	B	C	D	E	F	G	STANDARD CLASS LABEL
S <sub>11</sub> A	2							OPEN
S <sub>11</sub> B	1							SHORT
S <sub>11</sub> C	9	10	12					LOADS
S <sub>22</sub> A	2							OPEN
S <sub>22</sub> B	1							SHORT
S <sub>22</sub> C	9	10	12					LOADS
Forward Transmission	11							THRU
Reverse Transmission	11							THRU
Forward Match	11							THRU
Reverse Match	11							THRU
Frequency Response	1	2	11					THRU

*Replacement Table 2a. Device Characteristics (2 of 2)*

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