

HP 85052A
3.5 mm CALIBRATION KIT

OPTION 010
15 cm BEADLESS AIRLINE

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**HEWLETT
PACKARD**

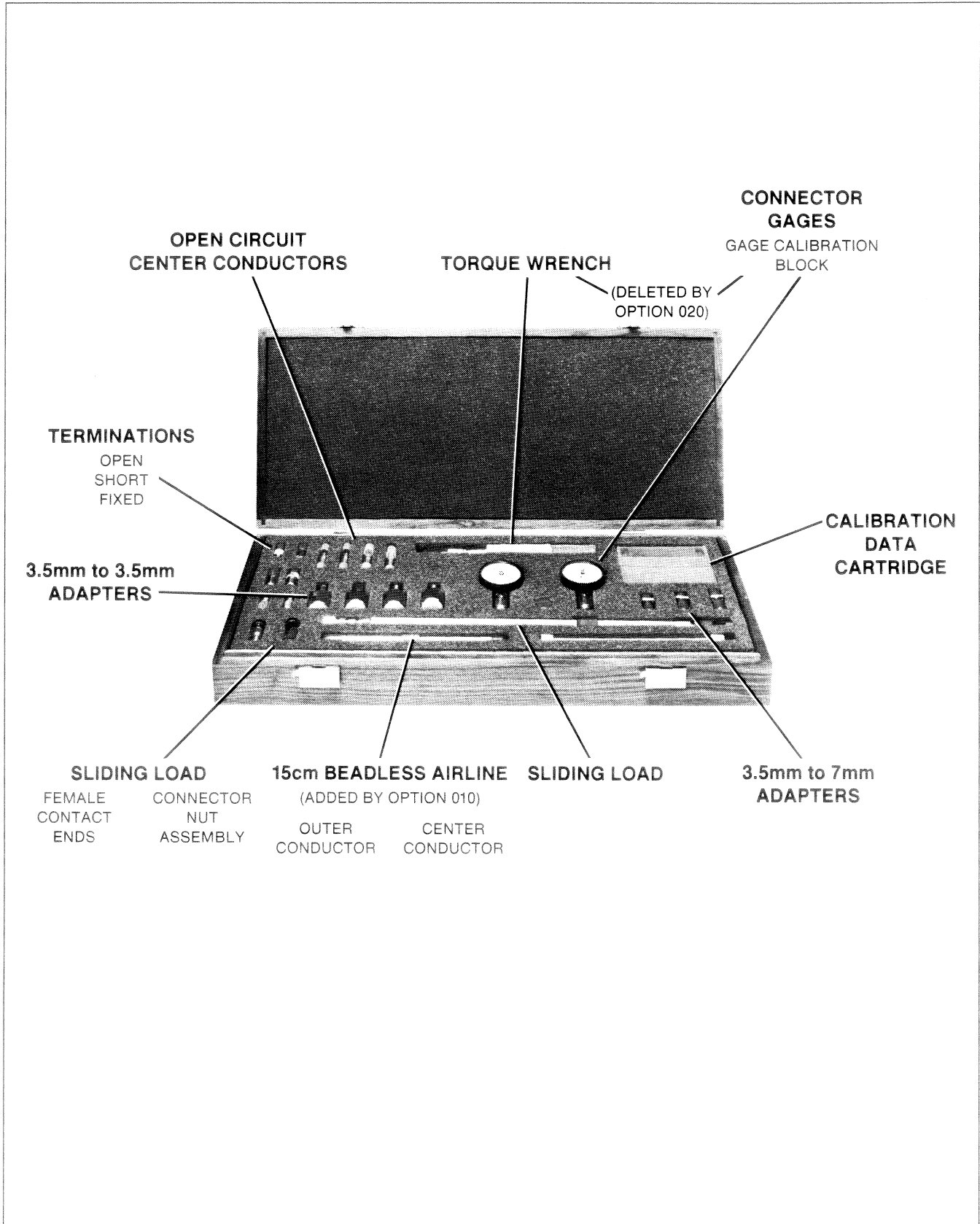


Figure 1-1. HP 85052A 3.5mm Calibration Kit

Section 1. General Information

INTRODUCTION

The Hewlett-Packard 85052A 3.5 mm calibration kit (Figure 1-1) is designed to be used with the HP 8510 network analyzer system. It consists of open, short and fixed load terminations, various adapters, a sliding load termination and a data cartridge containing the calibration constants for the termination devices in the kit. Also included is a 3.5 mm connector gage kit and a 5/16" torque wrench for use on the 3.5 mm connections. Both of these can be deleted by ordering Option 020. Option 010 adds a 15 cm beadless airline.

This manual describes the devices in the HP 85052A 3.5 mm calibration kit, gives their mechanical and electrical specifications and the electrical characteristics of each device. It also shows how to make connections with the open circuit and sliding load terminations and the 15 cm beadless airline.

Complete instructions for performing measurement calibration of the HP 8510 system (in order to make error-corrected measurements) appear in the HP 8510 Operating and Service Manual, section III (Operating and Programming).

NOTE: The content of this manual is limited. It is assumed that proper cleaning, gaging and connection skills are known by the operator. There are two Hewlett-Packard publications available to help you learn these skills:

Microwave Connector Care (HP part number 08510-90064) explains in detail how to care for, inspect, clean, gage and make connections with coaxial microwave connectors. It is designed to be helpful regardless of the application or the kind of measurement being made.

HP Application Note 326, *Principles of microwave connector care*, summarizes the key points in *Microwave Connector Care*. A copy of this publication is included with each calibration kit.

OPTIONS

OPTION 010 *adds* a 15 cm beadless airline, HP part number 1250-1876, which is especially useful for calibrating time-domain applications.

OPTION 020 *deletes* the connector gage kit and the torque wrench. The gages and the torque wrench are essential, and should be deleted only if you already have equivalent tools.

EQUIPMENT REQUIRED BUT NOT SUPPLIED

- 1/4" open end wrench for the wrench flats on 3.5 mm devices (HP part number 8720-0014)
- 5/16" open end wrench for the nuts on the 3.5 mm devices (HP part number 8720-0015)
- 7/16" open end wrench for the wrench flats on the 3.5 mm female short (HP part number 8720-0009)
- Spanner wrench for the test port connectors (HP part number 08513-20014)

Using 3.5 mm to 7 mm Adapters

A 7 mm connector gage, aligning pin, gage calibration block, and a torque wrench for 7 mm connectors are required if you will be using the 3.5 mm to 7 mm adapters included in the HP 85052A 3.5 mm calibration kit. A 7 mm connector gage kit is available as HP part number 1250-1875. A torque wrench for 7 mm connectors (12 lb-in, 136 N-cm) is available as HP part number 1250-1874.

Using SMA Connectors

The 3.5 mm connector gages can be used to measure SMA connectors if the dielectric in the SMA connector does not protrude beyond the shoulder of the outer conductor. Protrusion of the dielectric can give false gage readings and damage the 3.5 mm connector.



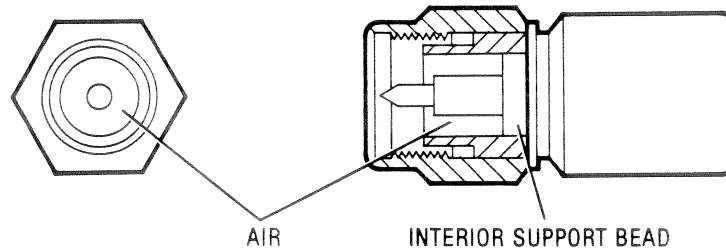
SMA connectors will mate with precision 3.5 mm connectors if extreme caution is used. Damaged or worn SMA connectors can destroy 3.5 mm connectors the first time they are mated. Hewlett Packard recommends that you keep two points in mind when you mate SMA and precision 3.5 mm connectors.

1. SMA connectors are not precision mechanical devices. They are not designed for repeated connections and disconnections and they are susceptible to mechanical wear.

Before mating SMA and 3.5 mm connectors inspect the SMA connector carefully (visually and mechanically).

2. Important structural and dimensional differences exist between these two types of connectors (Figure 1-2). Precision 3.5 mm connectors are air dielectric devices. Only air exists between the center and outer conductors. The male and female center conductor is supported by a plastic "bead" within the connector body. In SMA connectors a plastic dielectric supports the entire length of the center conductor. The diameters of both the center and the outer conductors differ between SMA and precision 3.5 mm connectors. Because of these structural and dimensional differences the connection will exhibit a discontinuity mismatch (SWR).

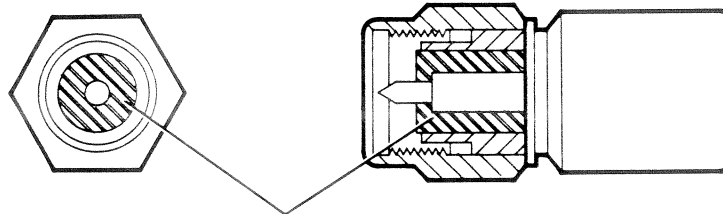
PRECISION 3.5mm CONNECTOR



AIR

INTERIOR SUPPORT BEAD

SMA CONNECTOR



PLASTIC DIELECTRIC SUPPORT

Figure 1-2. Precision 3.5 mm and SMA Connectors

SERIAL NUMBERS

A serial number label is attached to this calibration kit. A typical serial number label is shown in Figure 1-3. 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 calibration kit.

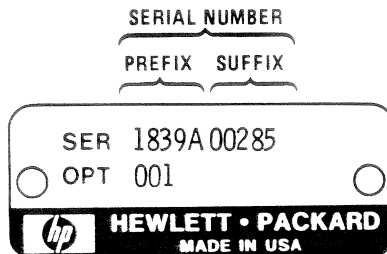


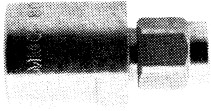
Figure 1-3. Typical Serial Number Label

The fixed load terminations, the sliding load termination and the airline also have individual Hewlett-Packard or Maury Microwave Corporation serial number labels attached to them.

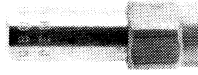
Table 1-1. HP 85052A Calibration Kit Replaceable Parts

Description	Quantity Per Kit	HP Replacement Part Number
Terminations		
Short Circuit, Male, 3.5 mm	1	1250-1768
Open Circuit with Male Center Conductor Element, 3.5 mm	1	1250-1766
Center Conductor Element, Male	1	1250-1784
Fixed Load, Male, 3.5 mm	1	85052-60001
Short Circuit, Female, 3.5 mm	1	1250-1769
Open Circuit with Female Center Conductor Element, 3.5 mm	1	1250-1767
Center Conductor Element, Female	1	1250-1785
Fixed Load, Female, 3.5 mm	1	85052-60002
Sliding Load	1	1250-1891
Center Conductor	1	1250-2017
Contact End, Male	1	1250-2008
Contact End, Female	1	1250-2007
Connector Nut Assembly, Male	1	1250-2029
Connector Nut Assembly, Female	1	1250-2028
Protective End Cap	1	1250-2027
Adapters		
7 mm to 3.5 mm (Male) Adapter	2	85052-60004
7 mm to 3.5 mm (Female) Adapter	2	85052-60003
3.5 mm (Male) to 3.5 mm (Male) Adapter	1	1250-1864
3.5 mm (Female) to 3.5 mm (Female) 1 Adapter	1	1250-1865
3.5 mm (Male) to 3.5 mm (Female) Adapter	1	1250-1866
Options		
15 cm Beadless Airline (added by ordering Option 010)	1	1250-1876
Connector Gage Kit (deleted by ordering Option 020)	1	1250-1862
3.5 mm Connector Gage, Male	1	Maury A034B-M
3.5 mm Connector Gage, Female	1	Maury A034B-F
3.5 mm Gage Calibration Block	1	Maury 027-3
3.5 mm Connector Torque Wrench (deleted by ordering Option 020)	1	1250-1863
Miscellaneous Items		
3.5 mm Calibration Constants Tape	1	85052-90001
Operating and Service Manual	1	85052-90011
Calibration Kit Storage Case	1	85052-80006
3.5 mm Protective End Cap, Male	10	1401-0208
3.5 mm Protective End Cap, Female	10	1401-0202
7 mm Protective End Cap	4	1401-0123
Additional Items – Not Supplied With Kit		
7 mm Connector Gage Kit		1250-1875
7 mm Connector Torque Wrench		1250-1874
7 mm Center Collets, 6 slot		85050-20001
Foam Swabs		9300-1270
Grounding Wrist Strap		9300-0970
Conductive Bench Mat		9300-0797

TERMINATIONS - Male



Short

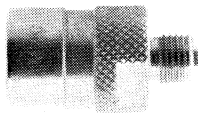


Open

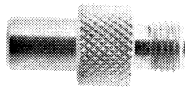


Fixed Load

TERMINATIONS - Female



Short

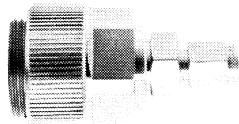


Open

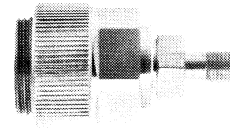


Fixed Load

ADAPTERS

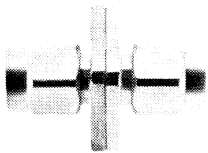


7 mm to 3.5 mm (Male)
(2 adapters supplied)

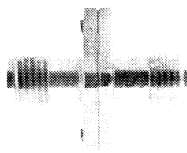


7 mm to 3.5 mm (Female)
(2 adapters supplied)

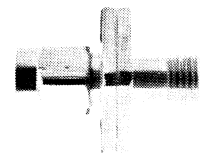
3.5 mm to 3.5 mm ADAPTER SET



3.5 mm (Male) 3.5 mm (Male)



3.5 mm (Male) 3.5 mm (Female)



3.5 mm (Female) 3.5 mm (Female)

Figure 1-4. HP 85052A Calibration Kit Replaceable Parts (1 of 2)



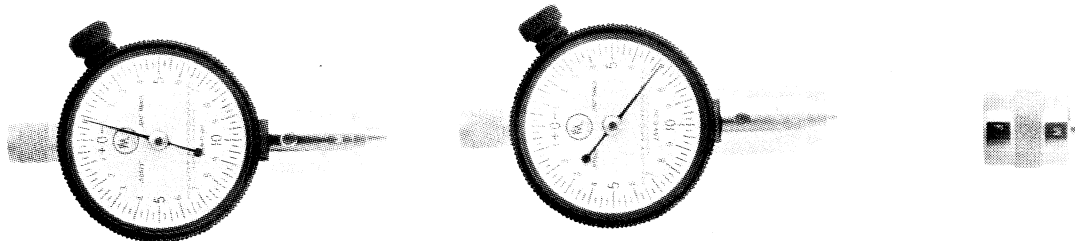
SLIDING LOAD
(Added by Option 010)



15cm BEADLESS AIRLINE
(Deleted by Option 020)



3.5mm CONNECTOR TORQUE WRENCH
(Deleted by Option 020)



CONNECTOR GAGE KIT

NOT SHOWN: Calibration Constants Tape, Operating and Service Manual, Calibration Kit Storage Case

Figure 1-4. HP 85052A Calibration Kit Replaceable Parts (2 of 2)

Section 2. Specifications

This section provides the environmental, mechanical and electrical specifications for the devices in the HP 85052A 3.5 mm calibration kit.

ENVIRONMENT

Table 2-1 lists the environmental specifications for the devices in the HP 85052A 3.5 mm calibration kit.

Table 2-1. Environmental Specifications

Calibration Temperature	+20° to +26° (+68° to +79°F)
Accuracy Enhanced Operating Temperature	Calibration Temperature $\pm 1^{\circ}\text{C}$ (1.8°F)
Barometric Pressure Operation Storage	<4,500 metres (15,000 feet) <15,000 metres (50,000 feet)
Relative Humidity Operation Storage	Non-Condensing at All Times 20-80% (26°C maximum dry bulb temperature) 5 to 95%

Temperature

Temperature of the calibration devices is critical because device dimensions (and therefore electrical characteristics) change with temperature. The temperature of the calibration devices and all connectors must be stable before use.

After measurement calibration, performance verification and actual device measurements must be made within the accuracy enhanced operating temperature specification. This is true even if the accuracy enhanced operating temperature falls outside of the calibration temperature window.

Example. If measurement calibration is performed at +20°C (+68°F), verification and measurements must be made between +19°C (+66.2°F) and +21°C (+69.8°F). Also, if the accuracy enhanced operating temperature deviates from the allowable range a new measurement calibration must be performed to assure optimum accuracy.

Remember that your fingers are a heat source, so avoid unnecessary handling of the devices during calibration.

Barometric Pressure and Relative Humidity

Barometric pressure and relative humidity also affect device performance. Air exists between the inner and outer conductors of these devices and the dielectric constant of air depends on pressure and humidity.

MECHANICAL SPECIFICATIONS

Table 2-2 lists and Figure 2-1 shows the allowable center conductor recessions for the devices in the HP 85052A 3.5 mm calibration kit.

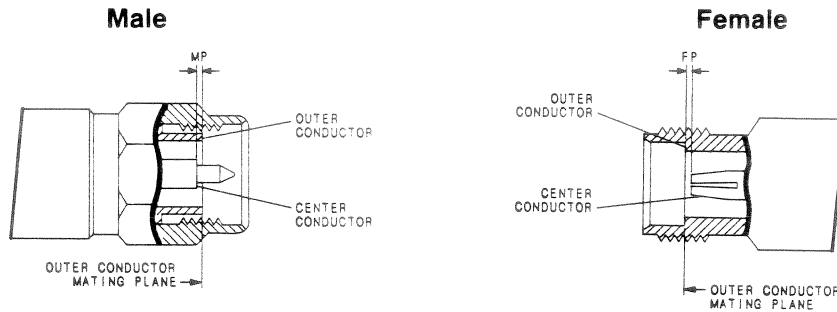
Table 2-2. Mechanical Specifications

3.5 mm Connectors	Allowable Recession
Devices and adapters (unless stated otherwise)	0.000 to +0.003 in 0.000 to +0.08 mm
Sliding Load	set by user
15 cm Airline* (Option 010)	0.0000 to +0.0005 in 0.000 to +0.013 mm
*The recession of the airline is predetermined from the relationship between the length of the outer conductor to the length of the inner conductor.	

No protrusion of the shoulder of the male conductor pin or of the tip of the female contact fingers in front of the outer conductor mating plane is allowable on any 3.5 mm connectors.

Note that a positive number shows a recession for 3.5 mm connectors while a negative number shows a recession for 7 mm connectors.

Fixed Load Terminators



Short Circuit

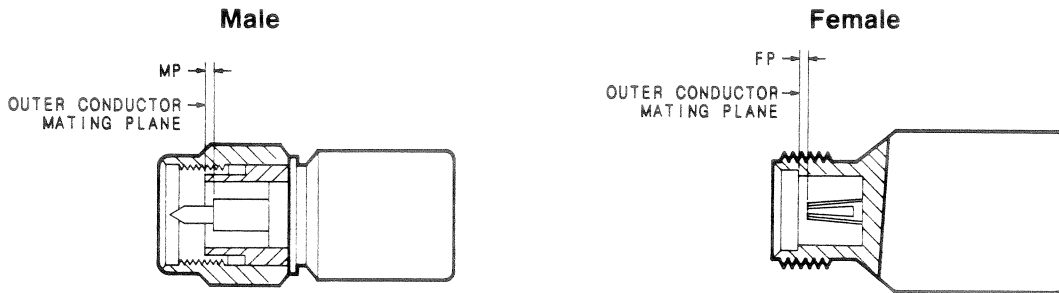


Figure 2-1. 3.5 mm Short Circuit and Fixed Load Terminations

MP = recession of the male contact pin shoulder behind the outer conductor mating plane.

FP = recession of the end of female center pin behind the outer conductor mating plane.

Figures 2-2 and 2-3 illustrate the mechanical dimensions of the open circuit termination, the sliding load termination and the 15 cm beadless airline that are included in the HP 85052A 3.5 mm calibration kit.

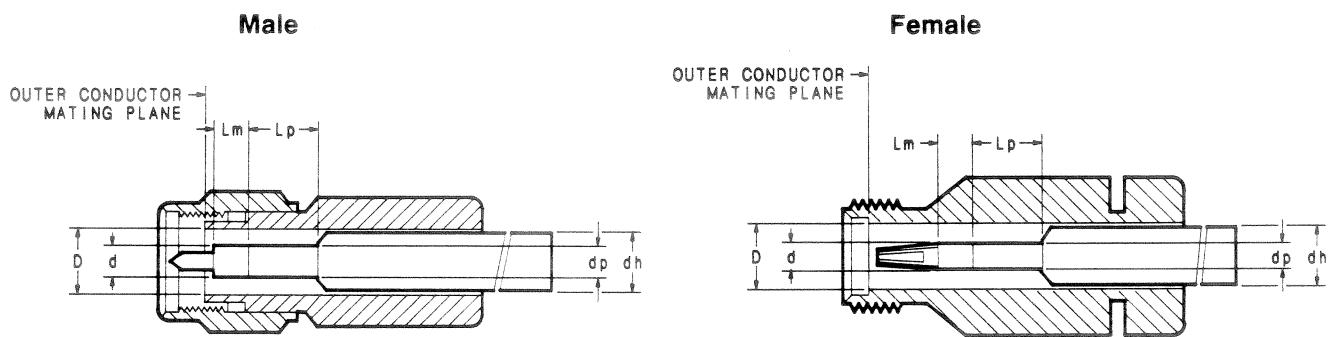
If you wish to make the measurements shown in Figures 2-2 or 2-3, the expected electrical performance of the devices can be calculated from the equations in these two publications:

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.

This measurement method may be used for a general idea of the expected device characteristic impedance. Variations in connector interfaces can have a large effect on your actual electrical measurements.

Open Circuit



Mechanical Dimensions	
$D = 0.1378 \pm 0.0003$ in 0.500 ± 0.008 mm	$L_m = 0.171 \pm 0.001$ in 4.343 ± 0.025 mm
$d = 0.05984 \pm 0.0003$ in 1.520 ± 0.008 mm	
$d_p = 0.060 \pm 0.002$ in 1.52 ± 0.05 mm	$L_p = 0.250 \pm 0.005$ in 6.35 ± 0.13 mm
$d_h = 0.1370 \begin{matrix} + 0.0000 \\ - 0.0010 \end{matrix}$ in $3.480 \begin{matrix} + 0.000 \\ - 0.025 \end{matrix}$ mm	
Concentricity < 0.003 FIM(TIR)	

Figure 2-2. Open Circuit Termination

SLIDING LOAD (HP 1250-1891)

Diameters

D (outer conductor)	0.1378 ± 0.0003 in 3.500 ± 0.008 mm
d (center conductor)	0.05984 ± 0.0002 in 1.520 ± 0.005 mm

Straightness

D (outer conductor)	0.0002/in	0.002 mm/cm
d (center conductor)	0.0003/in	0.003 mm/cm

15 cm BEADLESS AIRLINE (HP 1250-1876)

Diameters

D (outer conductor)	0.1378 ± 0.00025 in 3.500 ± 0.008 mm
d (center conductor)	0.05984 ± 0.0002 in 1.520 ± 0.005 mm

Outer Conductor Length

Length	5.899 ± 0.0005 in 149.83 ± 0.013 mm
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Straightness

D (outer conductor)	0.0002/in	0.002 mm/cm
d (center conductor)	0.0003/in	0.003 mm/cm

Length Difference

Length of center conductor in relation to outer conductor	0.0000 to +0.0005 in 0.000 to +0.013 mm
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Figure 2-3. Sliding Load and Airline Dimensions

ELECTRICAL SPECIFICATIONS

The electrical specifications of the devices in the HP 85052A 3.5 mm calibration kit are listed in Table 2-3. Note that the specifications for the 15 cm airline and the sliding load termination include the airline portions *only*.

Table 2-3. Electrical Specifications

Device	Specification
Fixed Loads	> 36 dB Return Loss, DC to 2 GHz
Sliding Load	> 42 dB Return Loss, 2 to 26.5 GHz airline portion <i>only</i> *
15 cm Airline (Option 010)	> 44 dB Return Loss, 2 to 26.5 GHz airline portion <i>only</i> *
Short Circuit	± 2.6 degrees, DC to 26.5 GHz $\pm 1^\circ$ average deviation
Open Circuit	± 2.6 degrees, DC to 26.5 GHz $\pm 1^\circ$ average deviation
* The connector interfaces on the sliding load termination and the airline, and the sliding load element on the sliding load are excluded from these specifications.	