Instruction Manual

Hearing-Protector Test Fixture Type 45CA

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CONTENTS

1 Introduction

The G.R.A.S. Hearing-Protector Test Fixture Type 45CA (Fig. 1.1) is for testing

- Hearing protection devices such as ear muffs and earplugs
- Sound sources such as headphones (supra-aural, circum-aural) and earphones.

The test fixture can be used with one of the following microphones or ear simulators:

- 1" or ½" pressure microphones. If used with 1" microphones, the test configuration conforms with ISO 4869-3.
- IEC 60711 (IEC 60318-4) Ear Simulator RA0045.
- IEC 60318 (IEC 60318-1) Ear Simulator RA0039.

1.1 Main Features

The Test Fixture Type 45CA provides for reliable and exact measurements and was designed with the following features:

- The test fixture, mounted on a resilient base (Fig. 1.1) that reduces the noise floor to a minimum in a typical test situation. Foam plugs and grease (Fig. 1.1) are supplied to avoid sound leakage along the cable.
- The test fixture head, made for optimizing the acoustic isolation.
- An acoustic cup and plug for testing the acoustic isolation (Fig. 1.1).
- A range of moulded-rubber KEMAR pinnae, e.g. for testing earplugs, can be fitted.

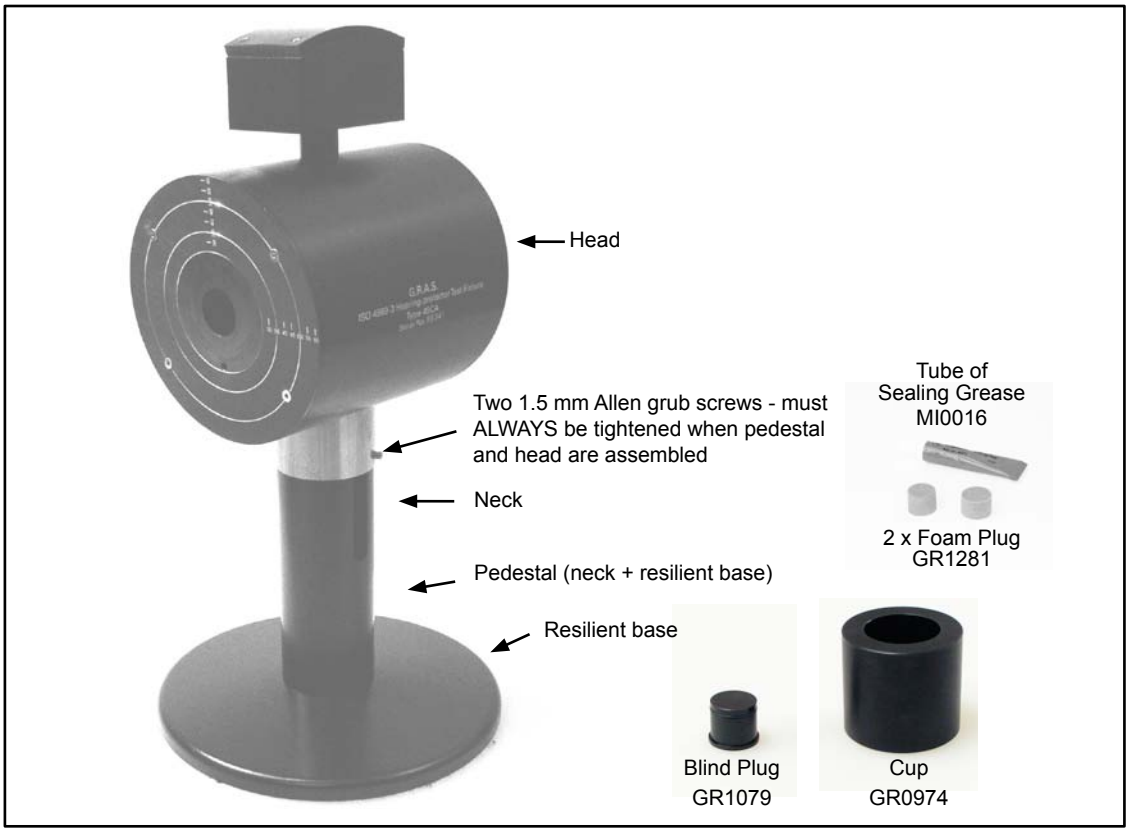


Fig. 1.1 Assembled test fixture Type 45CA including Acoustic Plug and Acoustic Cup.

1.2 Which Configuration to Use

Table 1 shows what each of the three configurations can be used for:

ISO 4869-3 Configuration with 1" (or ½" *) Microphone *

Pressure microphones, both externally and polarized types available.

The configuration is applicable for testing outside-the-ear devices; i.e.

- For measuring the insertion loss of ear muffs
- For testing the sound quality of earphones

IEC 60318 Configuration with Ear Simulator RA0039

RA0039 simulates an ear and is used for measuring the sound pressure at the ear entrance point (EEP).

RA0039 must be configured with a ½" microphone, externally polarized or prepolarized.

IEC 60711 Configuration with Ear Simulator RA0045

These ear simulators are for use with a pinna simulator (artifical ear) for measuring the sound pressure at the eardrum (DRP), thus also applicable for ear inserts. RA0045 available both in externally polarized or prepolarized versions.

Standard		ISO 4869-3 *	IEC 60318	IEC 60711
Test Setup (G.R.A.S. equipment to use)		Pressure Microphone – 1" 40EN or – ½" 40AP/40AD	Ear Simulator RA0039 with ½" microphone: – 40AG (ext. pol.) or – 40AO (pre-pol.)	Ear Simulator – RA0045 (ext. pol.) or – RA0045-S1 (pre-pol.)
Device to test	 Ear muffs	+	+	+
	 Earplugs	-	-	+
	 Headphones	+	+	+
	 Earphones	-	-	+
	 Hearing-aids	-	-	+

Table 1 Providing an overview: Which configuration to use

* The configuration will be in conformity with ISO 4869-3 only if 1" Microphone Type 40EN is used.

2 Delivered Components

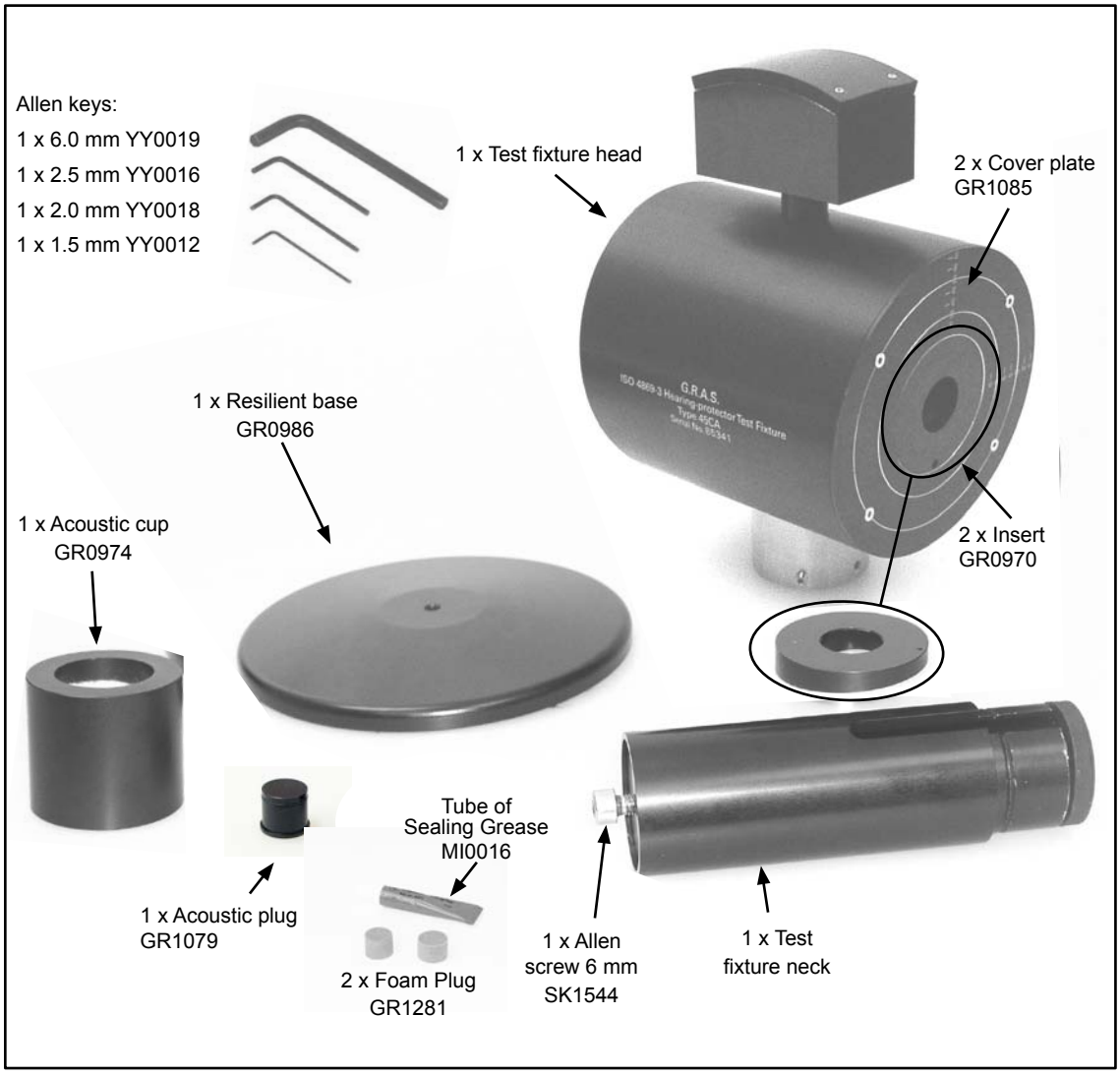


Fig. 2.1 Parts delivered in the Type 45CA box.

3 IMPORTANT! Basic Assembly - Safety instructions

Before proceeding to one of the three configuration options in sections 4, 5, or 6, do the basic assembly of the test fixture according to step 1-4:

1. Place the test fixture neck onto a solid table, and find the supplied screw and 6 mm Allen key (Fig. 3.1).
2. Place the screw into the bottom of the resilient base, and screw the base onto the neck with the Allen key (Fig. 3.2).

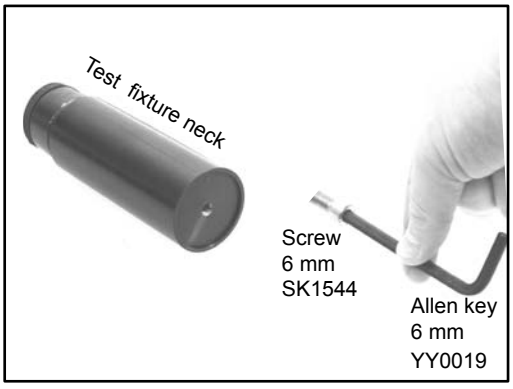


Fig. 3.1

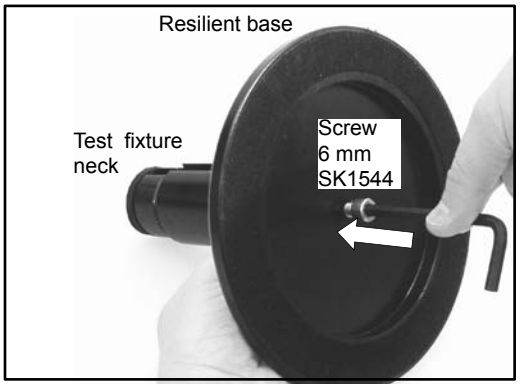


Fig. 3.2

3. After making sure both of the 1.5 mm Allen grub screws in the head's steel tube are loosened to their extreme positions, place the head onto the pedestal and carefully slide the steel tube onto the top of the pedestal's neck (Fig. 3.3).
4. Tighten both of the 1.5 mm Allen grub screws on the steel tube (Fig. 3.4).

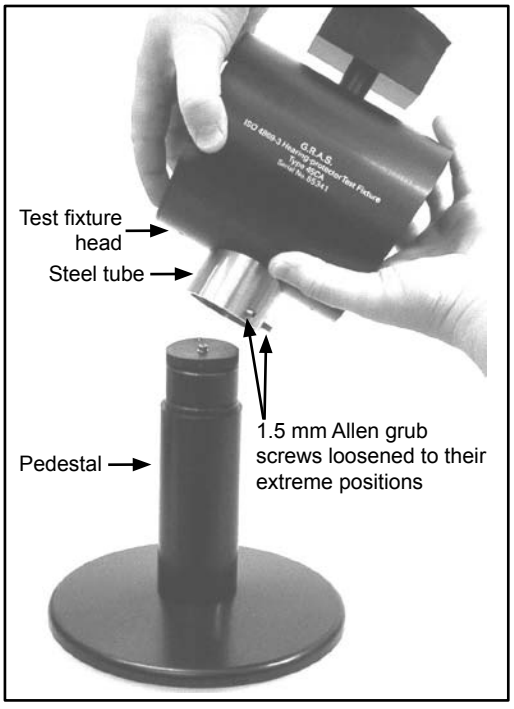


Fig. 3.3

Fig. 3.4

ATTENTION!

When assembling head and pedestal, always make sure to tighten both of the 1.5 mm Allen grub screws in the steel tube as indicated in Fig. 1.1.

4 Configuration with Pressure Microphone, 1" Type 40EN or ½" Type 40AP/40AD

Applications

Insertion Loss of Ear Muffs. If Microphone 1" Type 40EN is used, the configuration is in conformity with ISO 4869-3.

Required Accessories

- The parts shown in Fig. 4.1 (choose one of the three assembly options)
- Pistonphone Type 42AP (recommended) or Type 42AA
- Test instruments such as those shown in Fig. 4.14

4.1 Assembling Microphone and Preamplifier

Fig. 4.1 displays three options for the microphone/preamplifier assembly required for the measurements.

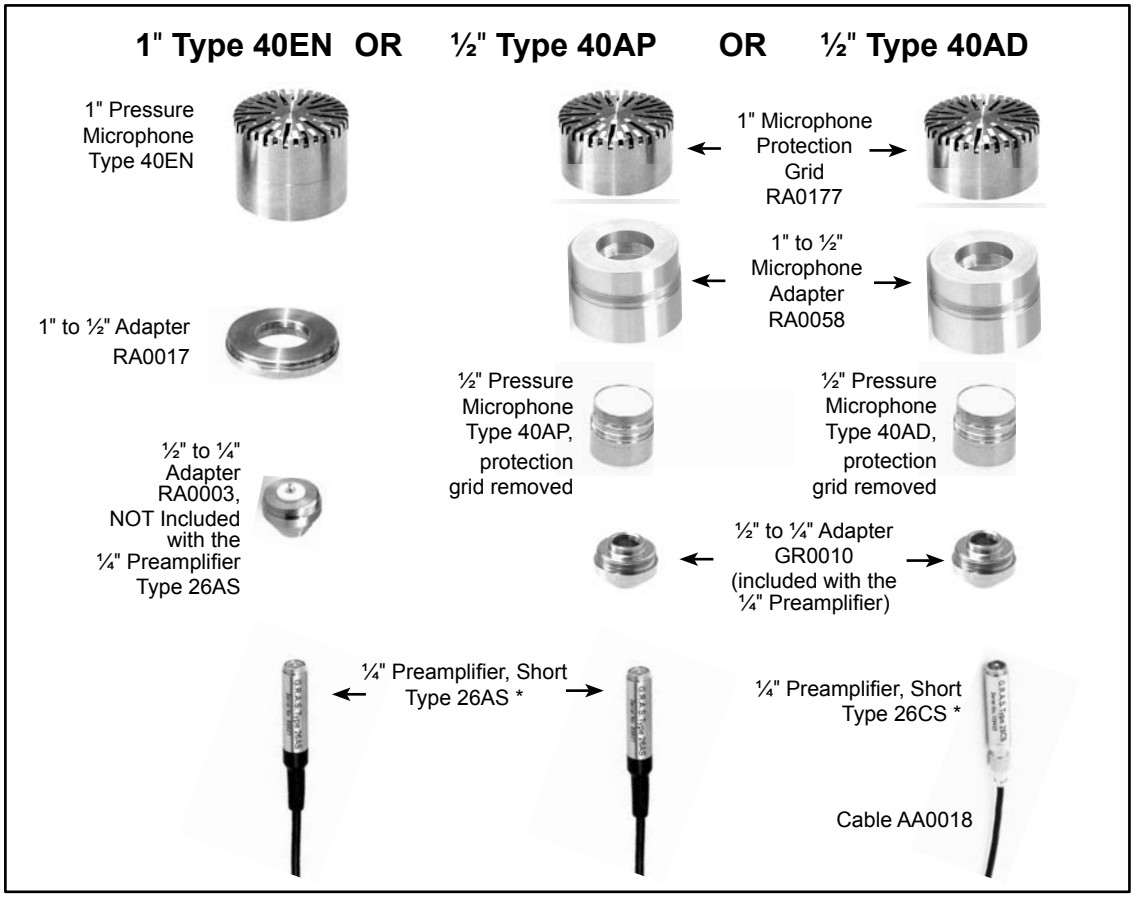


Fig. 4.1 Assembly options (exploded view)

* For space limitations, the super-short ¼" Preamplifier Type 26AS/Type 26CS (shown) is required for binaural measurements. For monaural measurements, replaceType 26AS with Type 26AC and Type 26CS with Type 26CB.

4.2 Calibration

Before mounting the microphone/preamplifier assembly into the test fixture, you must calibrate the assembly using Pistonphone Type 42AP or Type 42AA (with optional 1" coupler adapter)

- For instructions on calibrating the microphone-preamplifier assembly, refer to the pistonphone's instruction manual.
- The Pistonphone Type 42AP is delivered with an adapter for calibrating 1" microphones.

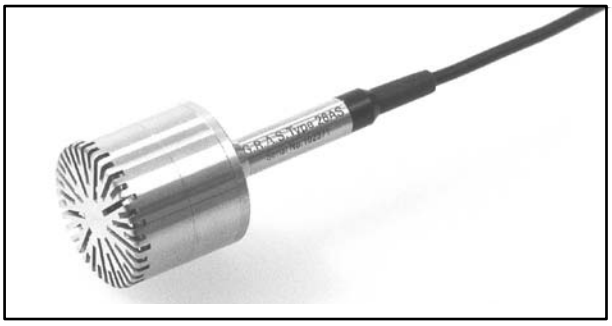


Fig. 4.2 Assembly of 1" microphone and ¼" preamplifier to be calibrated

4.3 Mounting the Assembly into the Test Fixture

1. See Fig. 4.3:

– Mount the Cover Plate GR1085.

– Mount the Insert GR0970.

(Both items are already mounted at delivery).

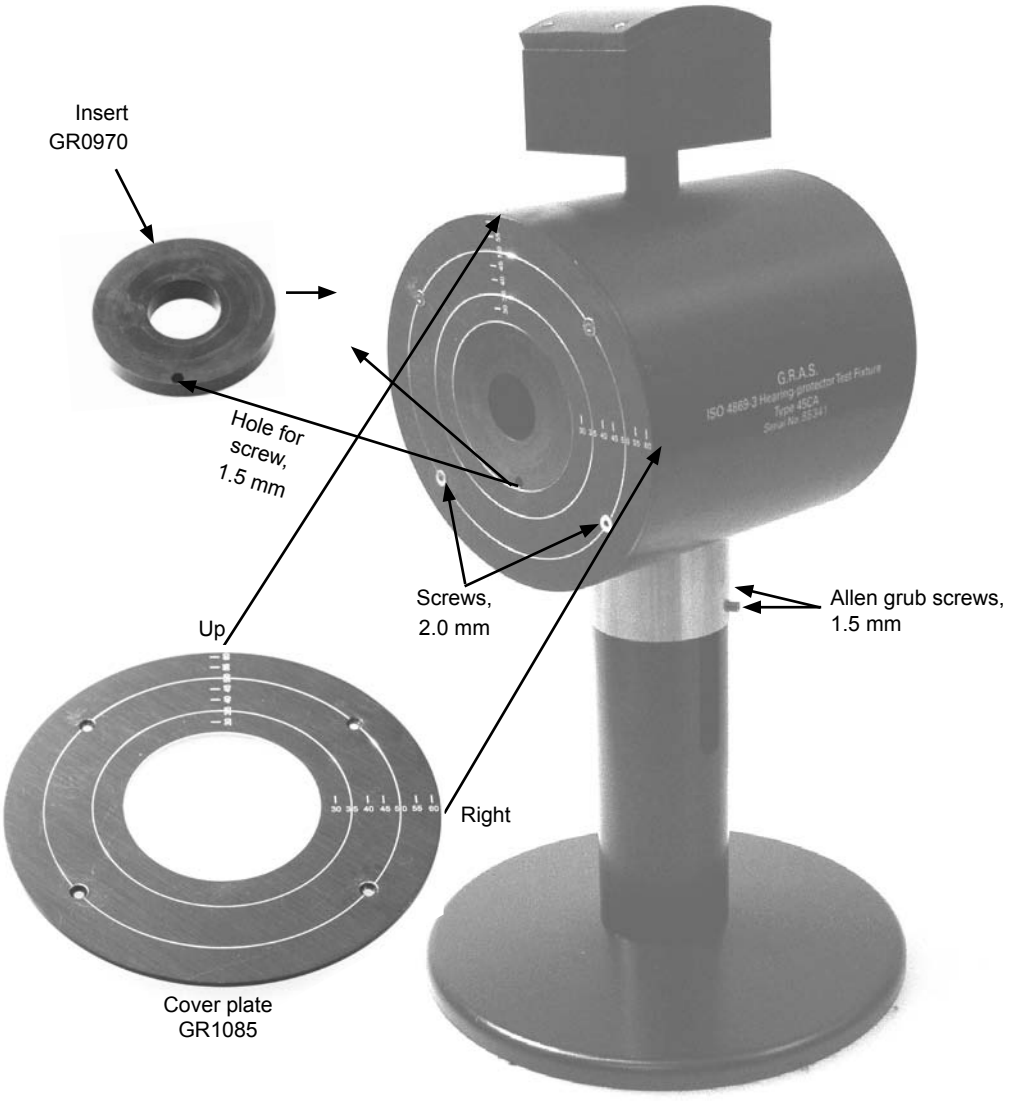


Fig. 4.3 Cover plate and insert to be mounted

2. Using Allen key 1.5 mm, loosen the two 1.5 mm grub screws (Fig. 4.3), and separate the head from the pedestal.

3. Pass the amplifier's LEMO plug end through the side of the head (fig. 4.4) until it drops through the tube (Fig. 4.5).

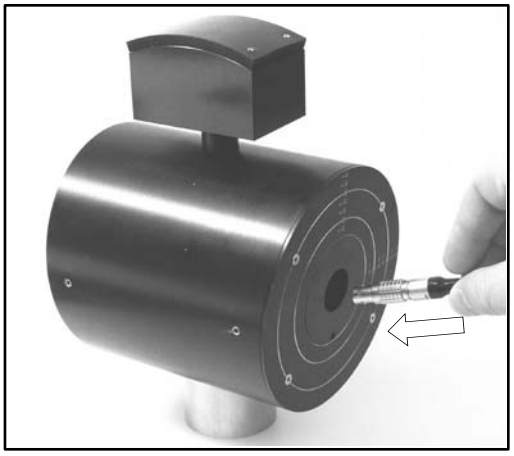


Fig. 4.4

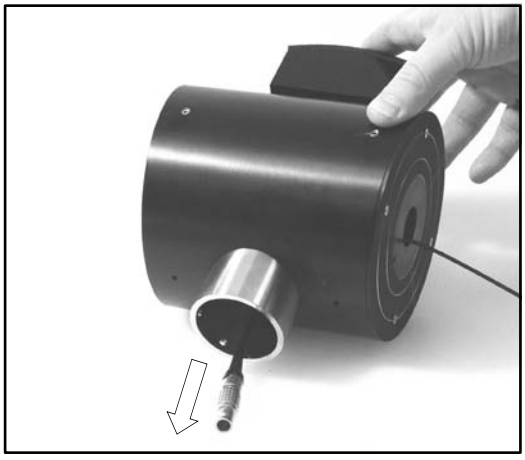


Fig. 4.5

4. Pull the cable through until there is just a manageable amount sticking out of the side of the head (Fig. 4.6).

5. On top of the neck, slide the cable into the inner slot hole of the rubber pad on top (Fig. 4.7).

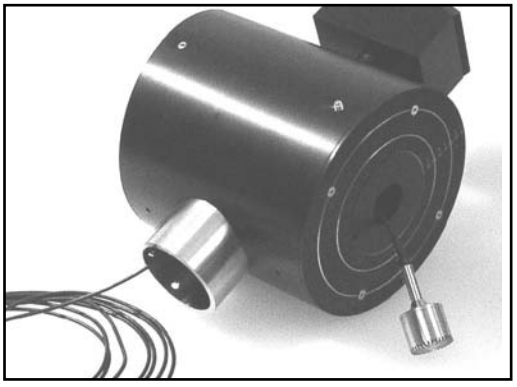


Fig. 4.6

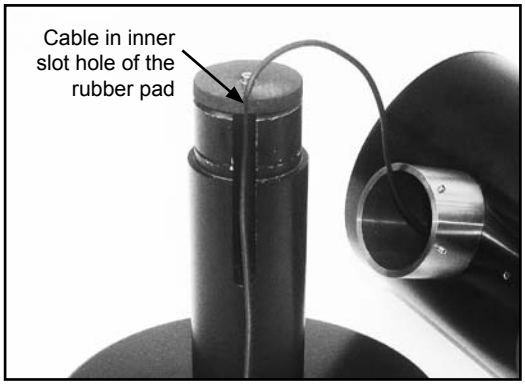


Fig. 4.7

6. Push the two Foam Plugs GR1281 into the cable guide right underneath the rubber pad, one plug on top of the other, while keeping the cable behind the plugs (Fig 4.8).

7. If required for meeting your requirements for acoustic isolation, apply Grease MI0016 to seal leakage points (Fig. 4.9).

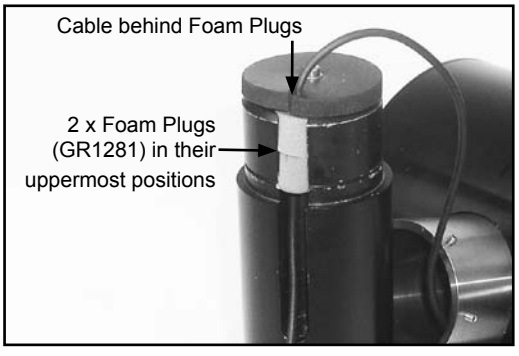


Fig. 4.8

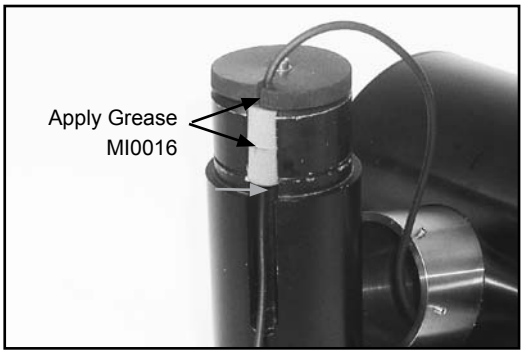


Fig. 4.9

8. Replace the head onto the pedestal (Fig. 4.10)
Note: Do not forget to tighten both of the 1.5 mm Allen grub screws.

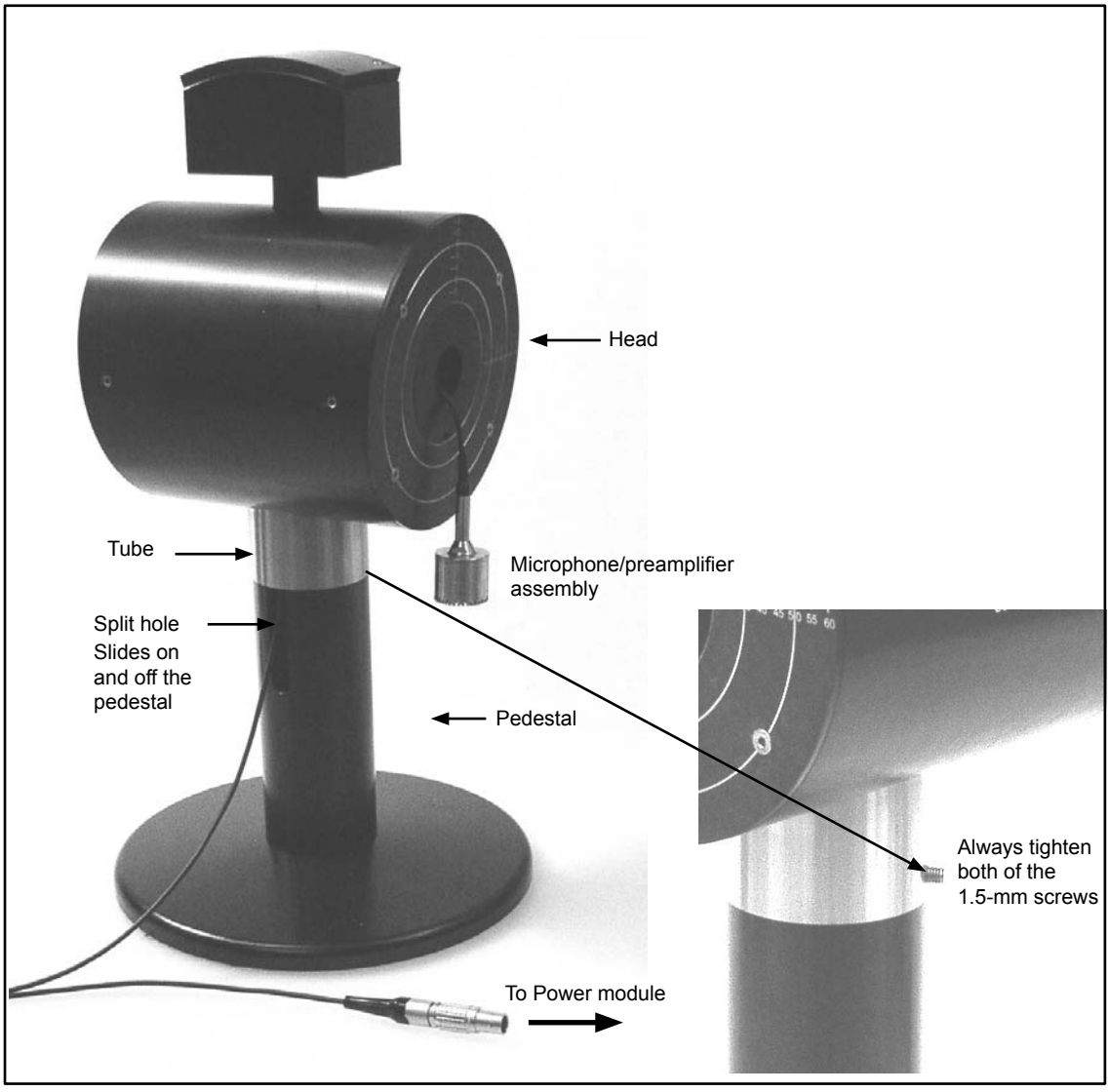


Fig. 4.10 Cabeling for the microphone-preamplifier assembly

9. The last step is to ensure correct microphone positioning:

Figure 4. of ISO 4869-3 shows that the center of the microphone's diaphragm must be level in the vertical plane with the slanting surface of the head.

For Microphone Type 40EN, this will be the case when the center of the protection grids sticks out by 1.89 mm in the vertical plane with the slanting surface of the head.

Use the grub screws to pinch the microphones *lightly* to hold them in position.

Note: If you cannot get the microphone positioned to the correct depth, loosen the four screws on the face and the single screw on the inlay. Then, gently maneuver the microphone into place, taking care not to push it completely into the cavity.

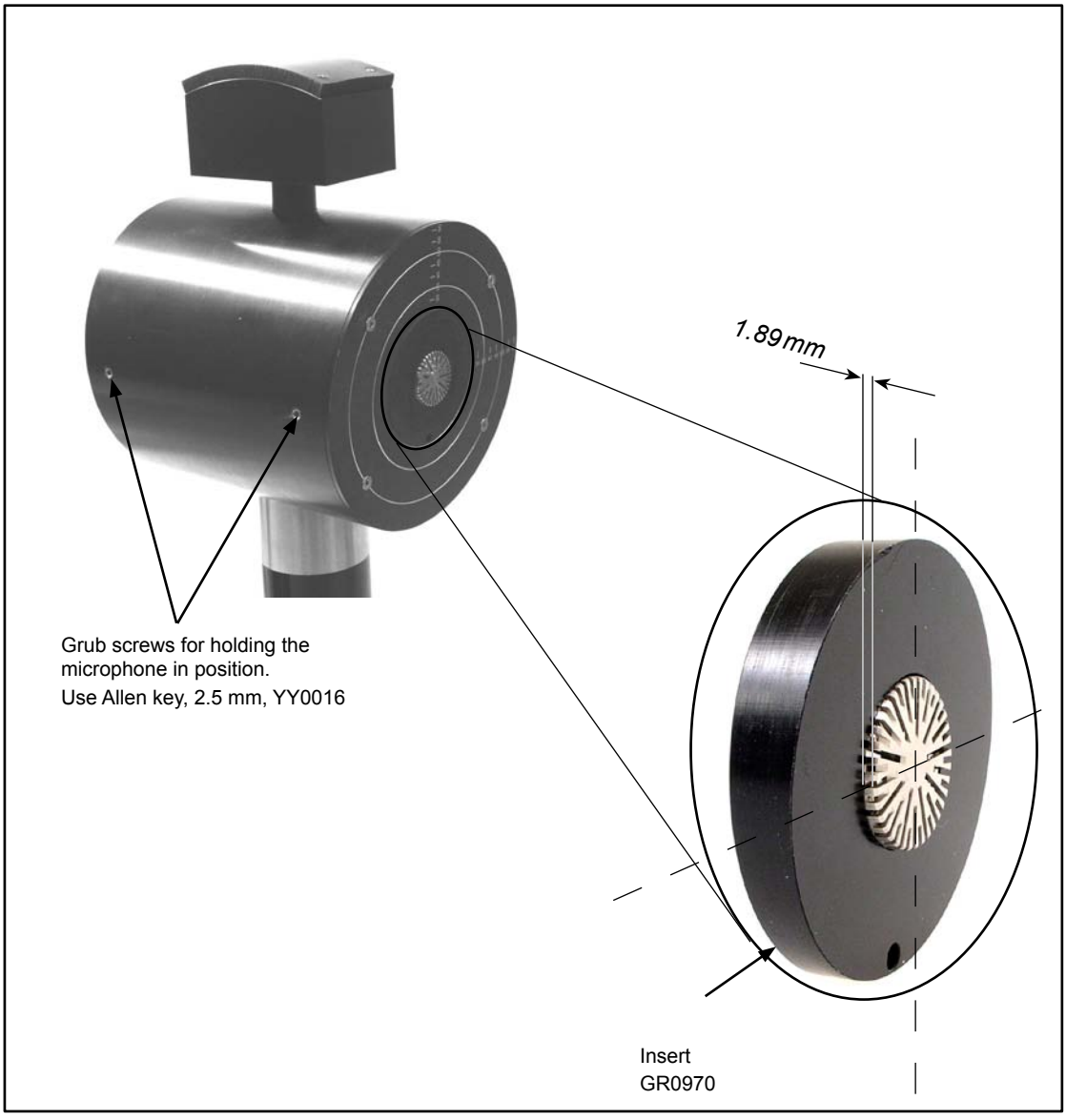


Fig. 4.11 Correct position of the Microphone Type 40EN relative to the slanting plane of the head

4.4 Acoustic Isolation Testing

ISO 4869-3 section 5.1.4 specifies a minimum acoustic isolation for the test fixture. Cup GR0974 and Plug GR1079 (Fig. 2.1) are provided to check this.

1. Start with Type 45CA fitted with a microphone as described in the previous section.

2. Remove the Insert GR0970 surrounding the microphone (Fig. 4.12).

3. Push the Cup GR0974 with its hollow facing the microphone into the recess surrounding the microphone until it makes contact with the base of the recess (Fig. 4.13).

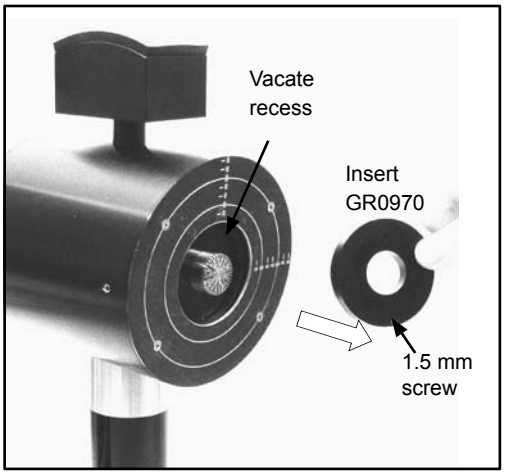


Fig. 4.12

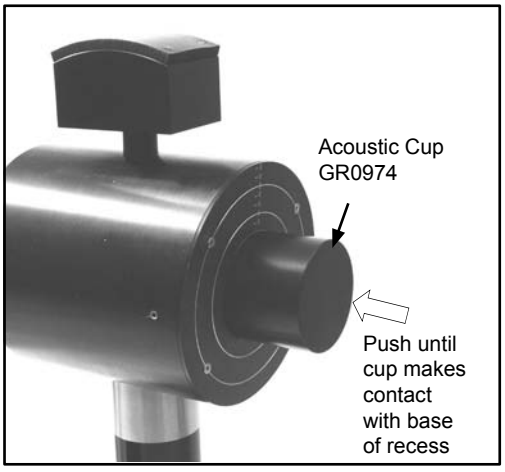


Fig. 4.13

4. Fig. 4.14: On the **opposite** side of the Type 45CA, push Plug GR1079 into the hole as far as it will go. For sound leakage sealing, apply Silicon Grease MI0016 to the plug.

5. Type 45CA is now ready to be tested for acoustic isolation (Fig. 4.15).

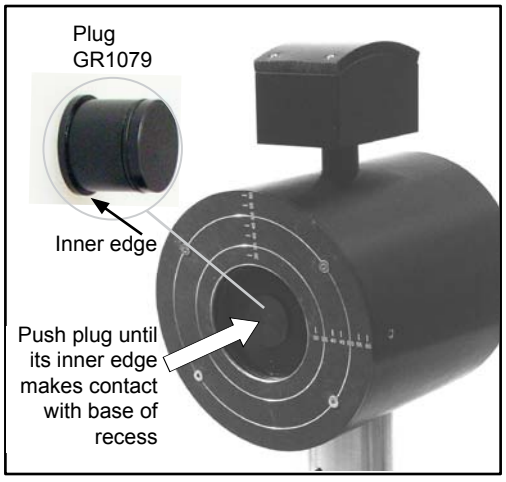


Fig. 4.14

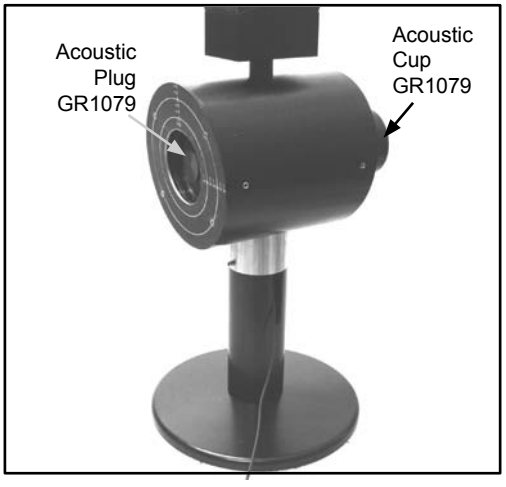


Fig. 4.15

4.5 Typical Application Setup

Fig. 4.16 shows a block diagram of an application setup for testing the insertion loss of a pair of ear-protection muffs.

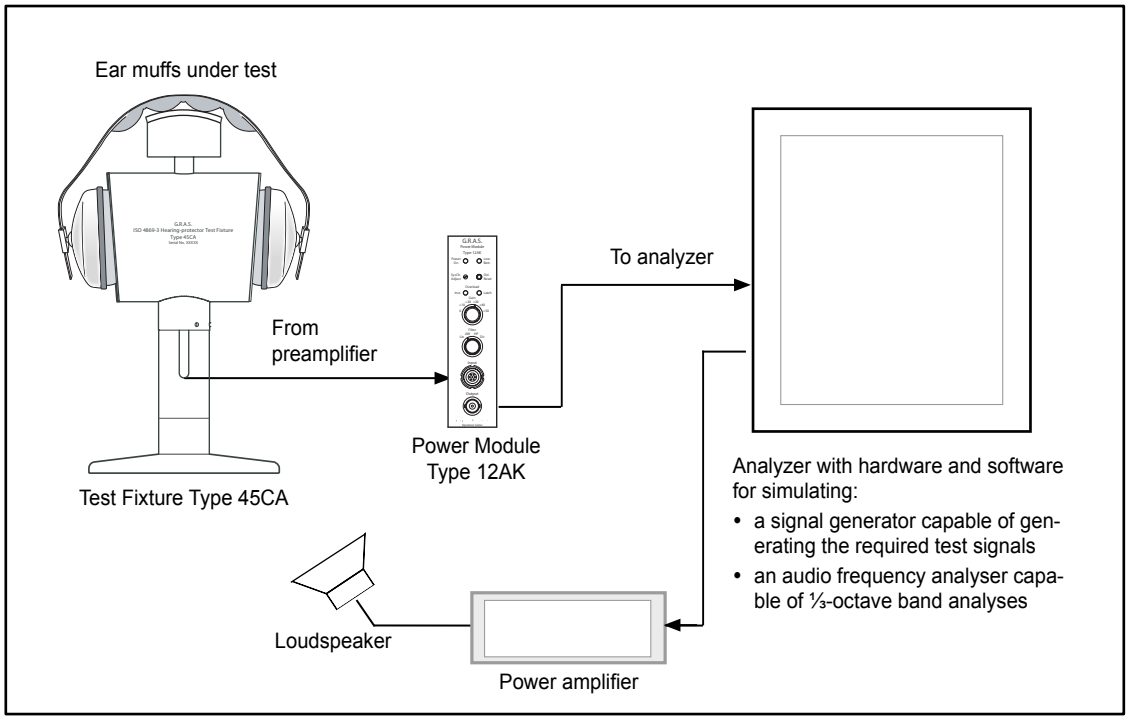


Fig. 4.16 Block diagram of a setup for testing a pair of ear-protection muffs.

For binaural measurements, you can replace the single-channel Power Module Type 12AK with the dual-channel Power Module Type 12AA.

5 Configuration with IEC 60318 Ear Simulator RA0039

This ear simulator can be used with

- ½" Externally Polarized Pressure Microphone Type 40AG
- ½" Prepolarized Pressure Microphone Type 40AO.

Applications

Monaural or binaural measurements of

- Hearing protection devices: Ear muffs (supra-aural, circum-aural)
- Sound sources: Headphones (supra-aural, circum-aural).

Note: As the coupler is not for use with a pinna simulator, it cannot be used for testing ear-inserts (earphones and earplugs).

Required Accessories

- The items of one of the two assembly options shown in Fig. 5.1
- Pistonphone Type 42AP (recommended) or Type 42AA
- Test equipment such as the instruments shown in Fig. 5.15

5.1 Ear Simulator / Preamplifier Assembly

Fig. 5.1 displays the two options for configuration with Ear Simulator RA0039.

Note: Do not assemble the parts yet - proceed to Section 5.2 Calibration.

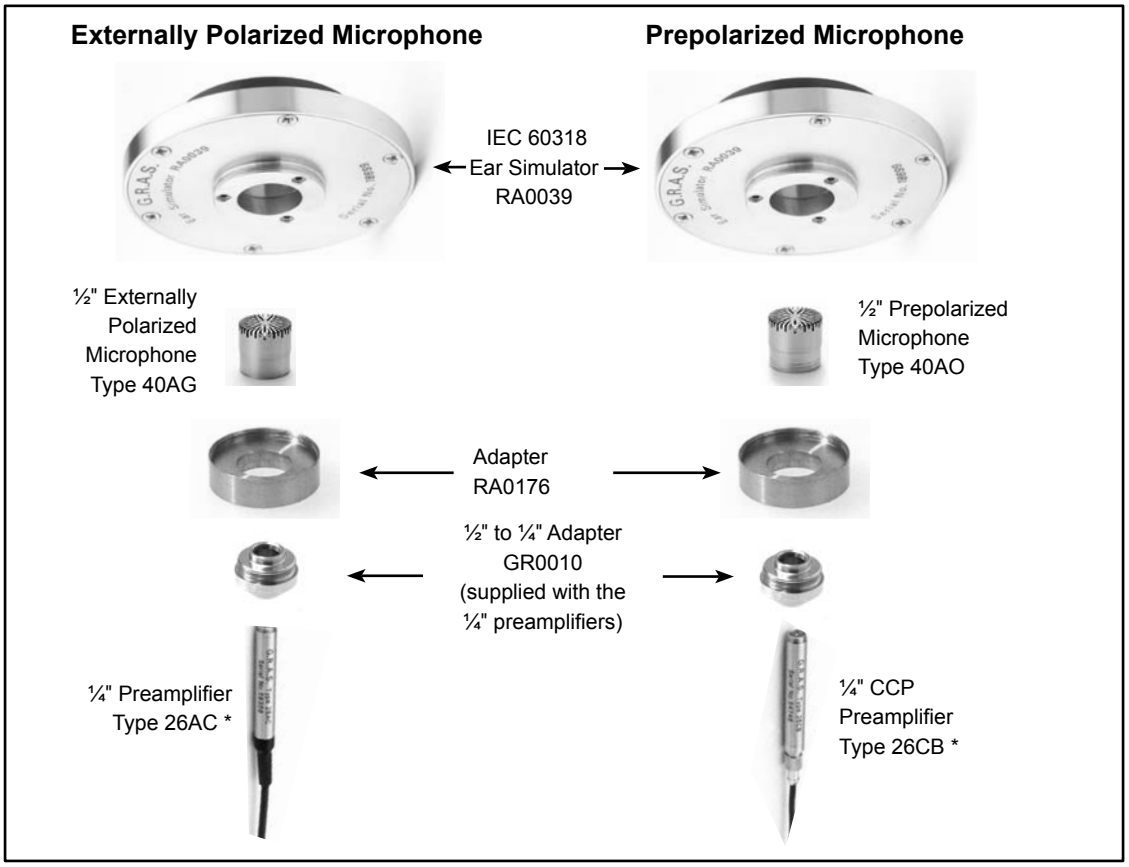


Fig. 5.1 Both assembly options for tests using the IEC 60318 Ear Simulator RA0039

* For space limitations, ¼" Preamplifier Type 26AC / Type 26CB (shown) can be used for monaural measurements only. For binaural measurements, replace Type 26AC with Type 26AS and Type 26CB with Type 26CS.

5.2 Calibration

To calibrate this configuration, use Pistonphone Type 42AP or Type 42AA. Both of them are delivered with an adapter for calibrating ½″ microphones.

1. Assemble the parts shown in Fig. 5.2

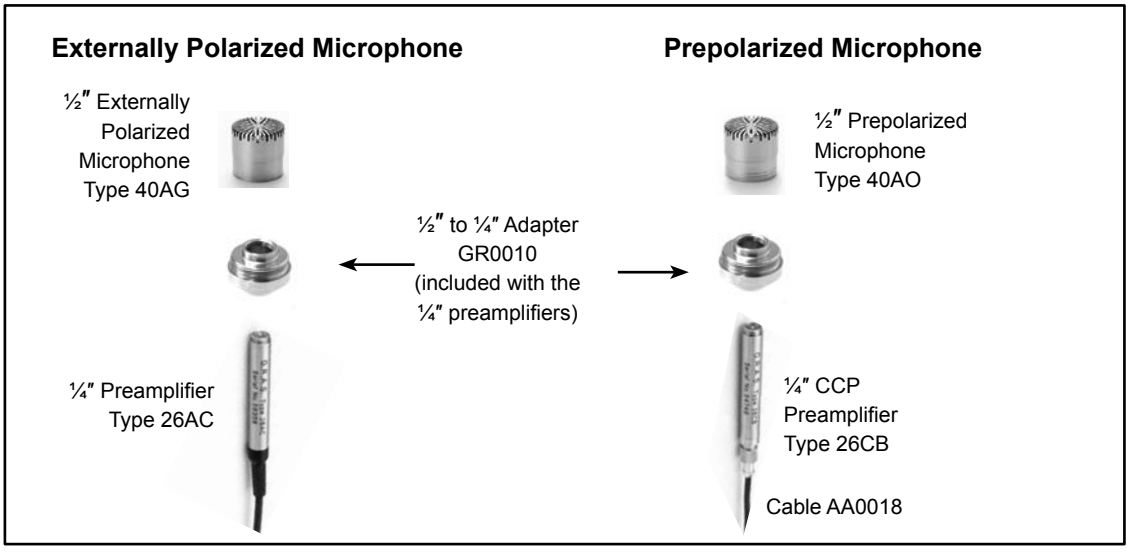


Fig. 5.2 Assembling the parts required for the calibration

2. Perform the calibration.

For instructions on calibrating the microphone-preamplifier assembly (Fig. 5.3), see the Pistonphone Type 42AP or Type 42AA instruction manual.

Fig. 5.3 ½" microphone and ¼" preamplifier to be calibrated

5.3 Completing the Assembly

1. Unscrew the microphone

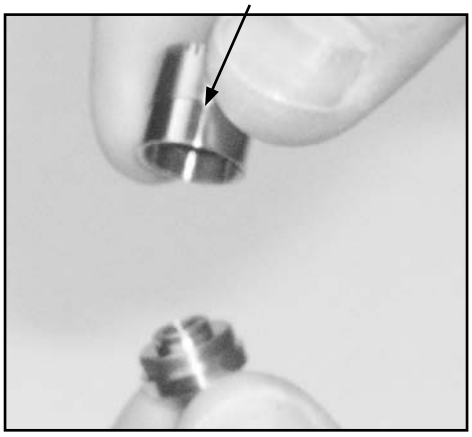


Fig. 5.4

2. Place the adapter RA0176.

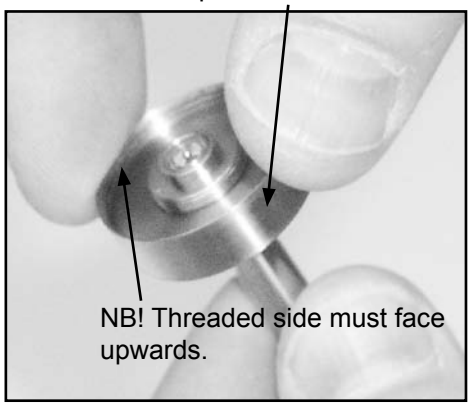


Fig. 5.5

3. Remount the microphone

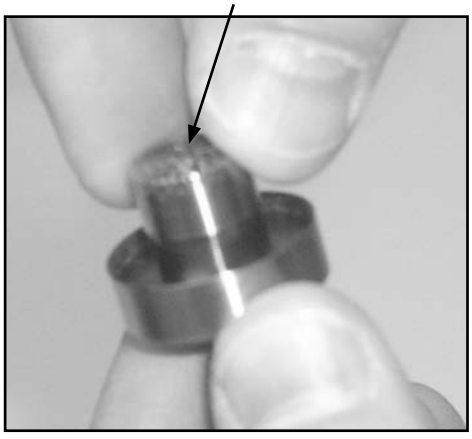


Fig. 5.6

4. Screw Ear Simulator RA0039 onto the assembly

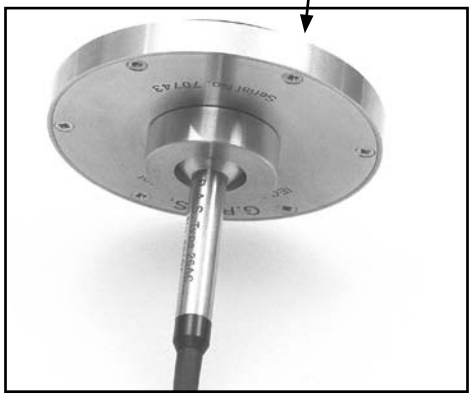


Fig. 5.7 Complete assembly

5.4 Mounting Assembly into Test Fixture

1. See Fig. 5.8:

- Mount Cover Plate GR1085 (already mounted at delivery).
- Remove Insert GR0970.

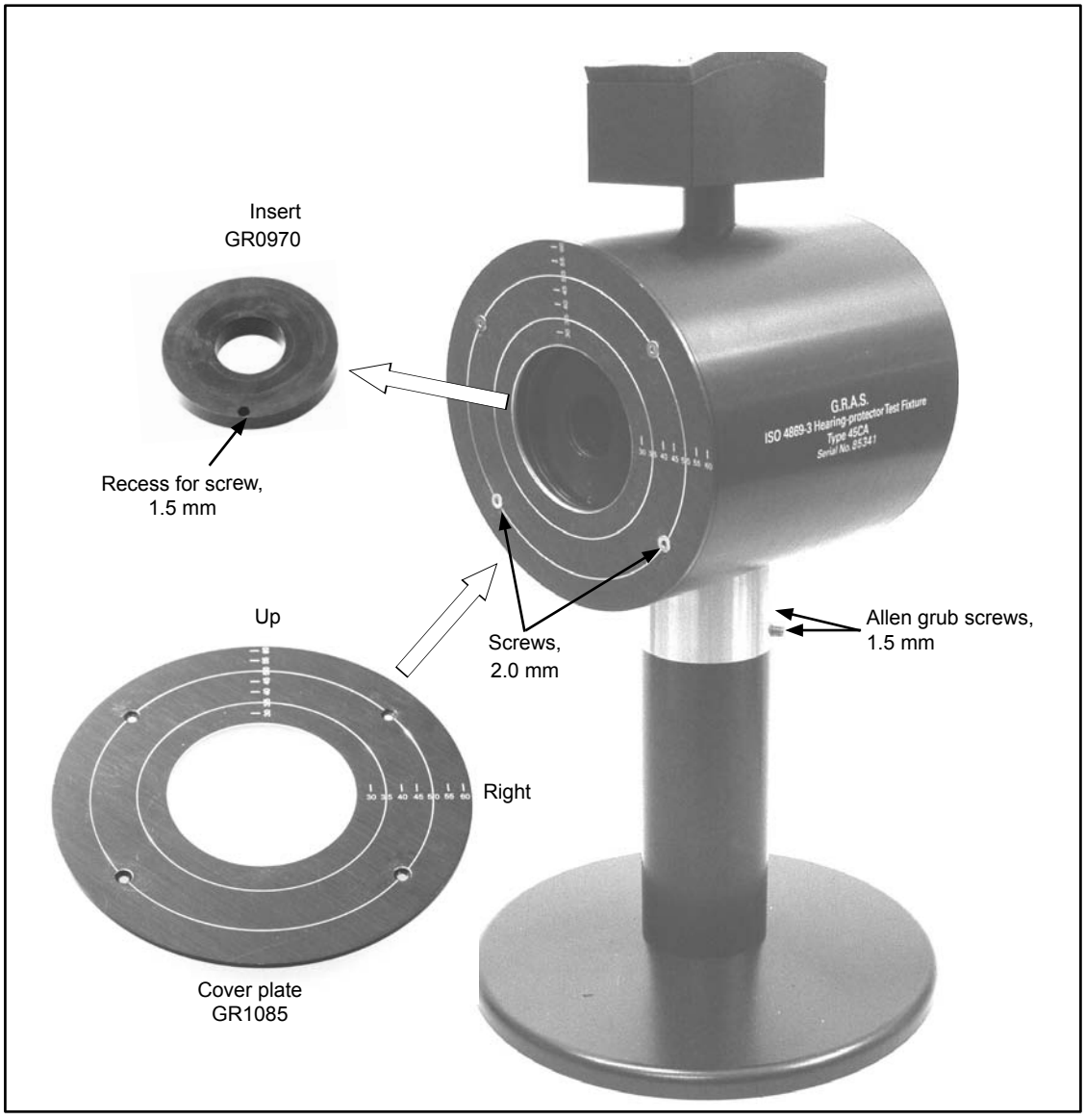


Fig. 5.8 Test-fixture Type 45CA prepared for the RA0039 assembly

2. Using Allen key 1.5 mm, loosen the grub screw (Fig. 5.8), and separate the head from the pedestal.

3. Pass the amplifier's LEMO plug end through the side of the head (fig. 5.9) until it drops through the tube (Fig. 5.10).

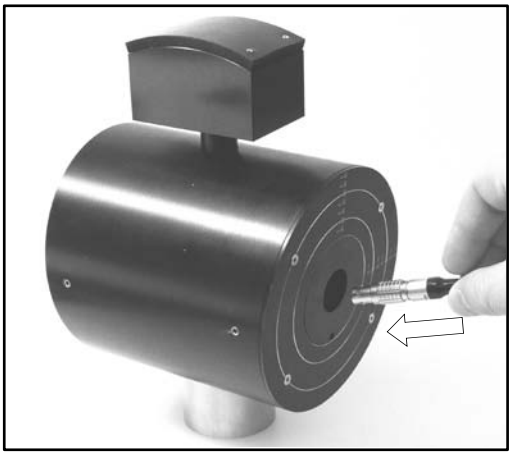


Fig. 5.9

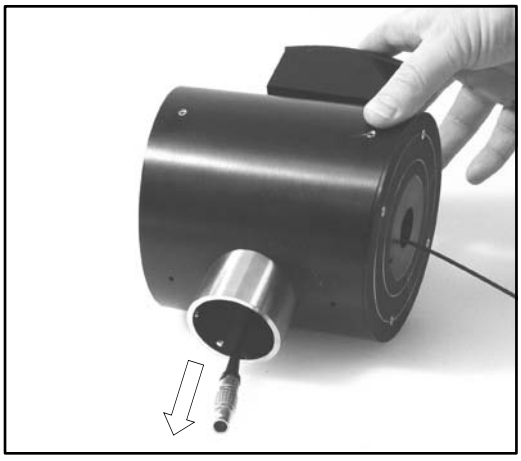


Fig. 5.10

4. Pull the cable through until there is just a manageable amount sticking out of the side of the head (Fig. 5.11).

5. On top of the neck, slide the cable into the inner slot hole of the rubber pad on top (Fig. 5.12).

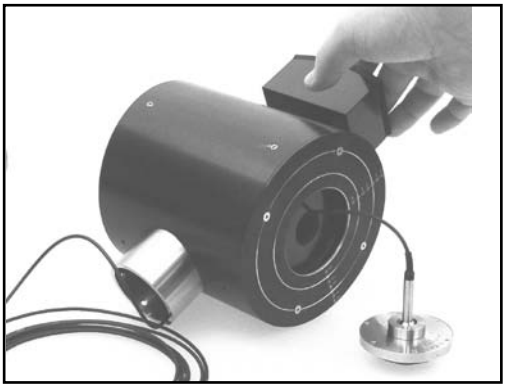


Fig. 5.11

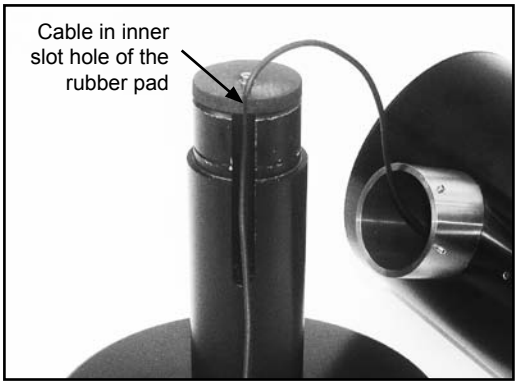


Fig. 5.12

6. Push the two Foam Plugs GR1281 into the cable guide right underneath the rubber pad, one plug on top of the other, while keeping the cable behind the plugs (Fig. 5.13).

7. If required for meeting your requirements for acoustic isolation, apply Grease MI0016 to seal leakage points (Fig. 5.14).

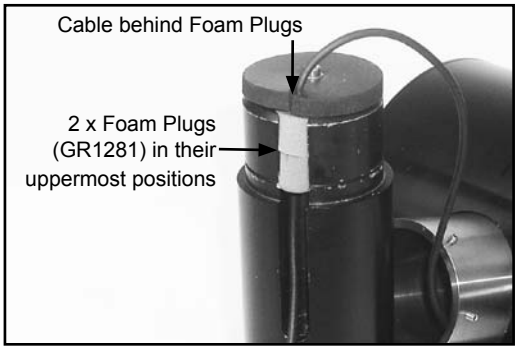


Fig. 5.13

Fig. 5.14

8. Replace the head onto the pedestal (Fig. 5.15)

Note: Do not forget to tighten the two 1.5 mm Allen grub screws.

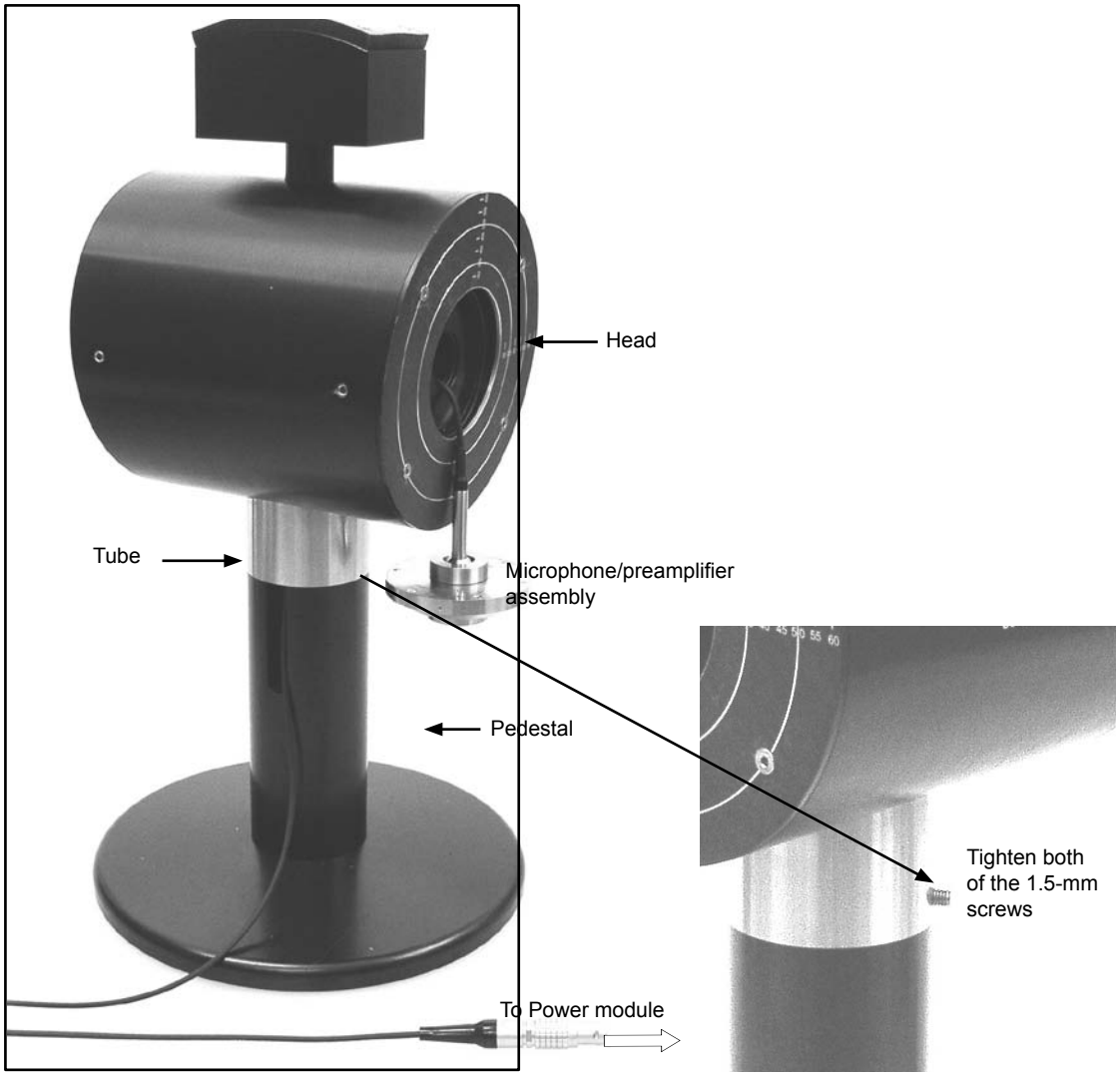


Fig. 5.15

9. Insert the RA0039 assembly firmly into the recess (Fig. 5.16)

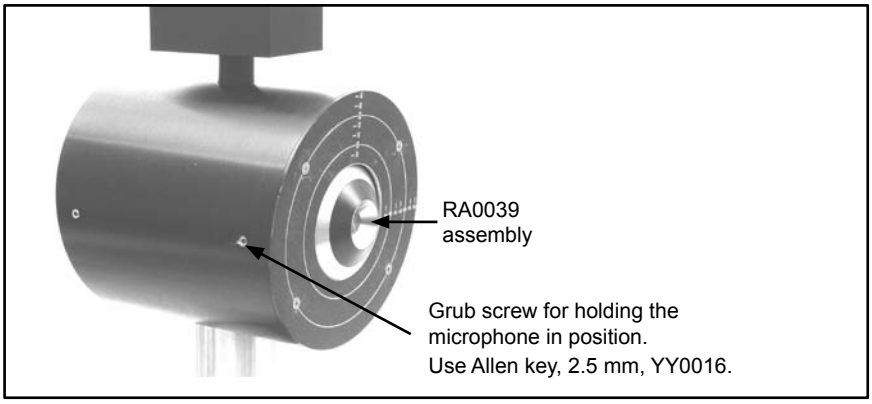


Fig. 5.16

5.5 Typical Application Setup

Fig. 5.17 shows a block diagram of an application setup for testing headphones.

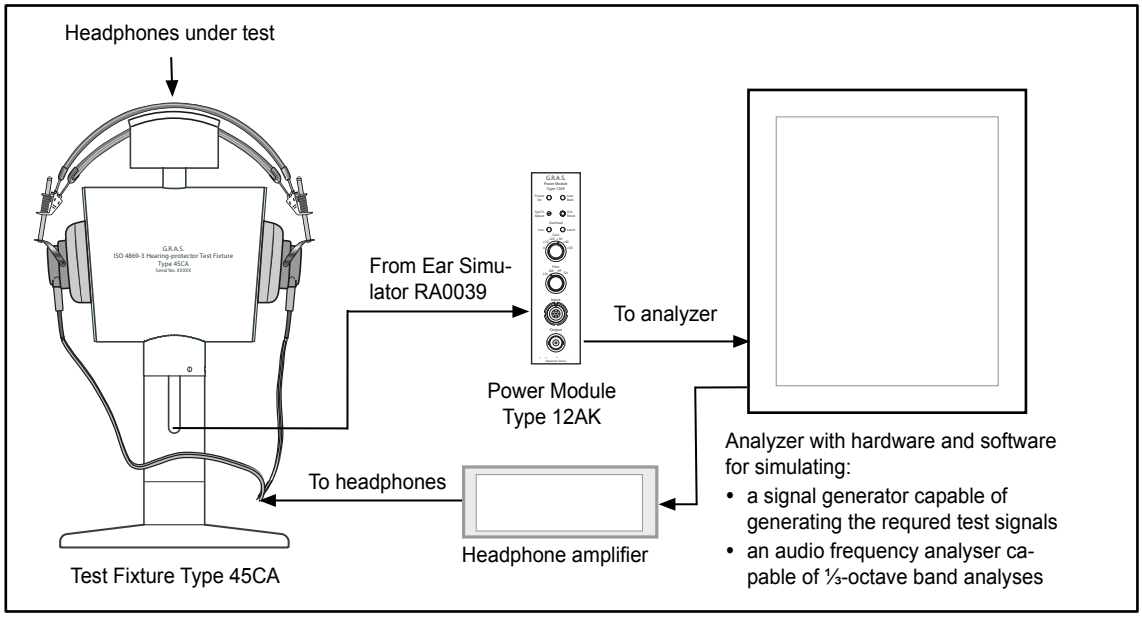


Fig. 5.17 Block diagram of a set-up for testing a pair of headphones

6 Configuration with IEC 60711 Ear Simulator RA0045 or RA0045-S1 and KEMAR Pinna Simulator

- Externally polarized Ear Simulator RA0045 for use with ¼″ preamplifiers
  - Type 26AC (for monaural measurements only)
  - Type 26AS (super-short preamplifier which allows binaural measurements)
- Prepolarized Ear Simulator RA0045-S1 for use with ¼″ preamplifier
  - Type 26CB (for monaural measurements only)
  - Type 26CS (CCP preamplifier allowing binaural measurements).

Applications

- Hearing protection devices: ear muffs, earplugs
- Sound sources: headphones (supra-aural, circum-aural), earphones

Required Accessories

- The parts shown in one of the three assembly options (Fig. 6.1)
- KEMAR Pinna Simulator (artificial ear) - one of the types listed in section 6.4
- Pinna Holder Kit for Type 45CA (RA0172) - see section 6.4
- For Calibration:
  - Pistonphone Type 42AP (recommended) or Type 42AA
  - Calibration Adapter RA0157 (must be ordered separately)
- Test instruments such as those shown in Fig. 6.16

6.1 Assembling Ear Simulator and Preamplifier

Assemble the parts - four options shown in Fig. 6.1.

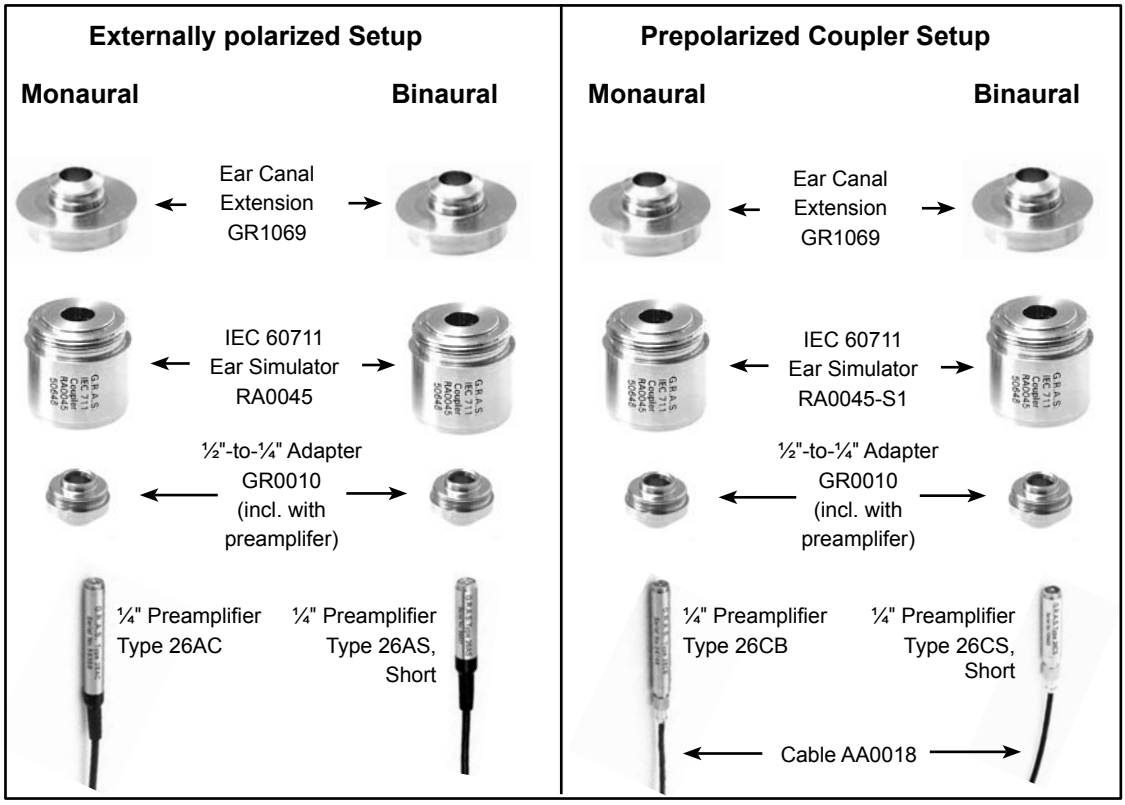


Fig. 6.1 Assembly details

6.2 Mounting the Assembly into the Test Fixture

Next step is to mount the assembly into the test fixture.

1. Remove Cover Plate GR1085 and Insert GR0970 (Fig. 6.2).

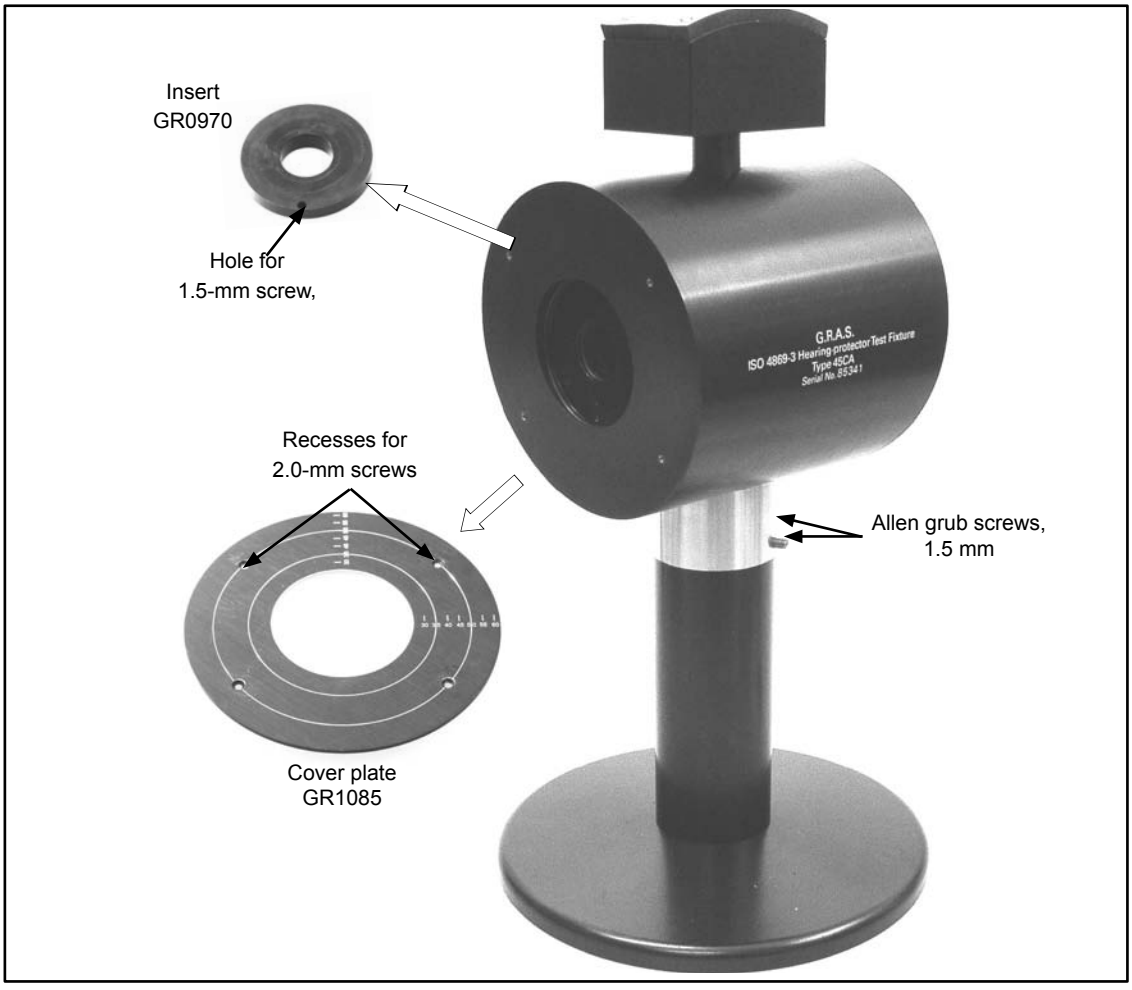


Fig. 6.2 Test-fixture Type 45CA, cover plate and insert removed

2. Replace the 1.5-mm screw in base of recess (Fig. 6.3). The socket headcap screw is used as locator for the pinna.

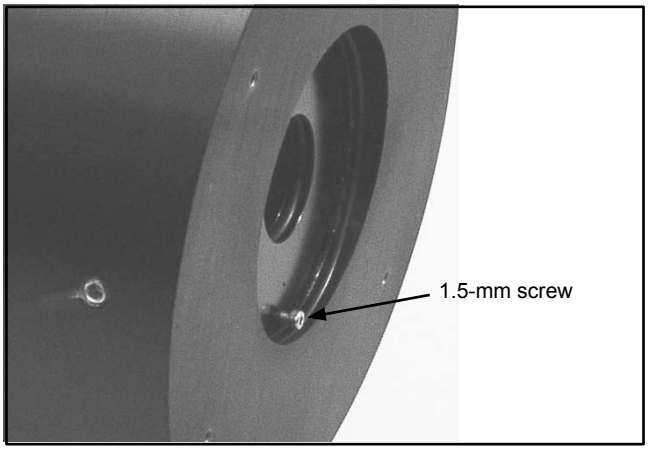


Fig. 6.3

3. Pass the amplifier's LEMO plug end through the side of the head (Fig. 6.4) until it drops through the tube (Fig. 6.5).

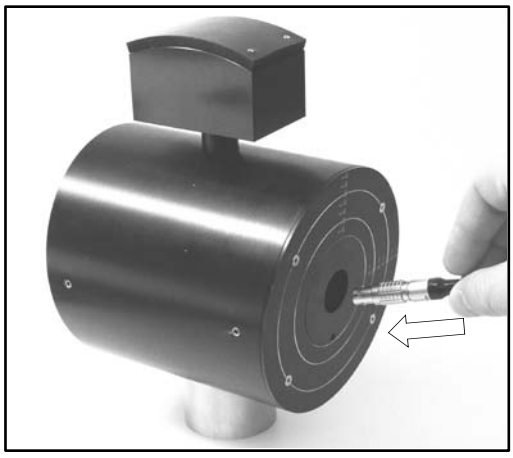


Fig. 6.4

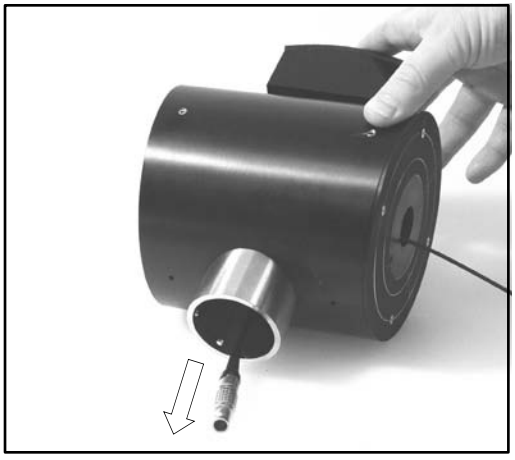


Fig. 6.5

4. Pull the cable through until there is just a manageable amount sticking out of the side of the head (Fig. 6.6).

5. On top of the neck, slide the cable into the inner slot hole of the rubber pad on top (Fig. 6.7).

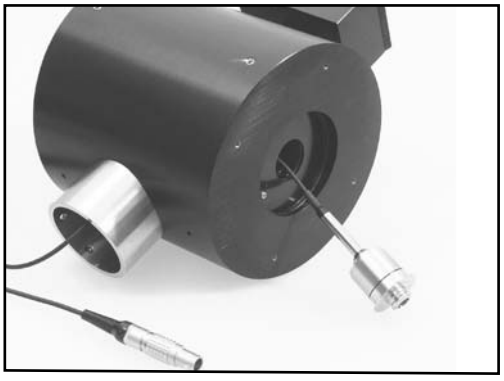


Fig. 6.6

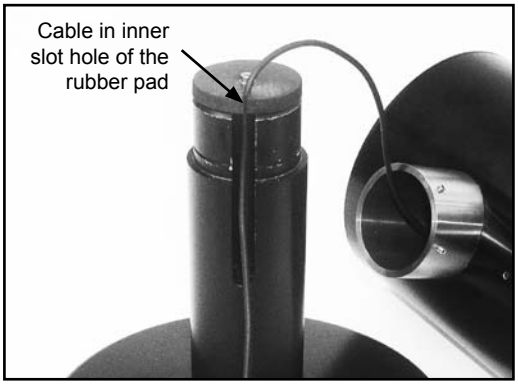


Fig. 6.7

6. Push the two Foam Plugs GR1281 into the cable guide right underneath the rubber pad, one plug on top of the other, while keeping the cable behind the plugs (Fig. 6.8).

.**7.** If required for meeting your requirements for acoustic isolation, apply Grease MI0016 to seal leakage points (Fig. 6.9).

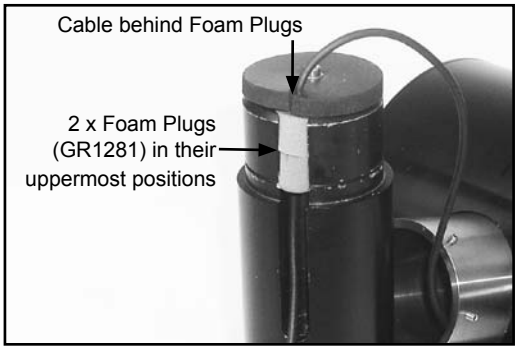


Fig. 6.8

Fig. 6.9

8. Replace the head onto the pedestal,

Note: Do not forget to tighten the two 1.5-mm screws (Fig. 6.10)

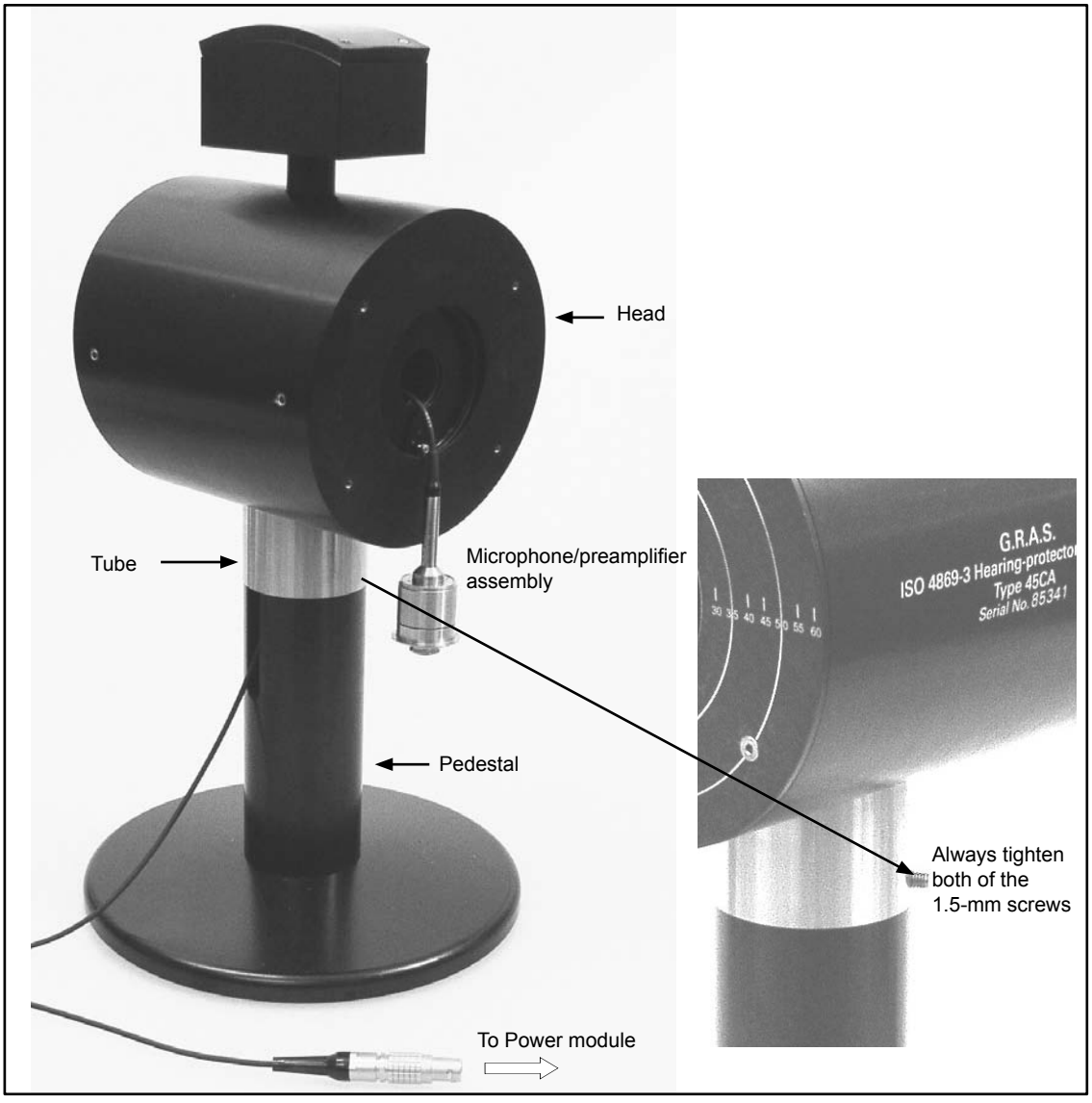


Fig. 6.10

9. Insert the RA0045 assembly into the test fixture.

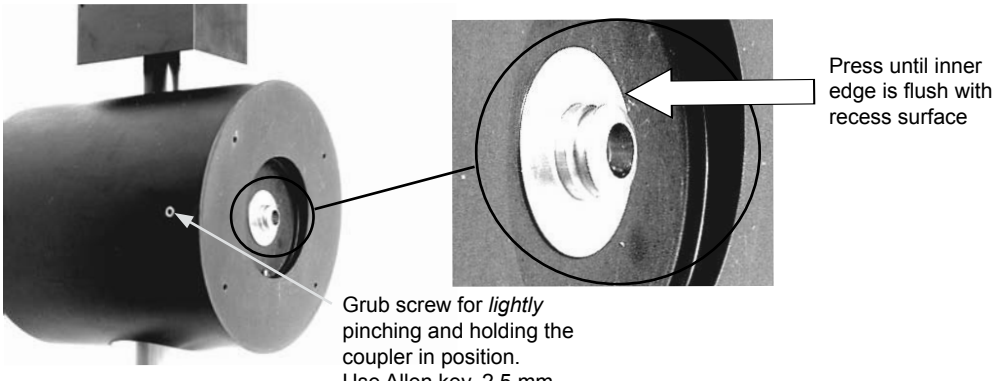


Fig. 6.11

6.3 Calibrating IEC 60711 Ear Simulator Coupler RA0045

Note: Requires a Calibration Adapter RA0157 (must be ordered separately).

1. Loosen the pistonphone's retention collar.

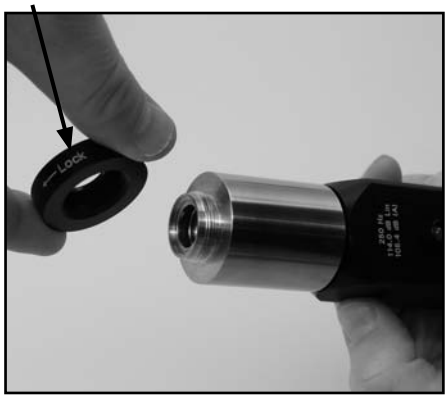


Fig. 6.12

2. Mount the Calibration Adapter RA0157 into the pistonphone:

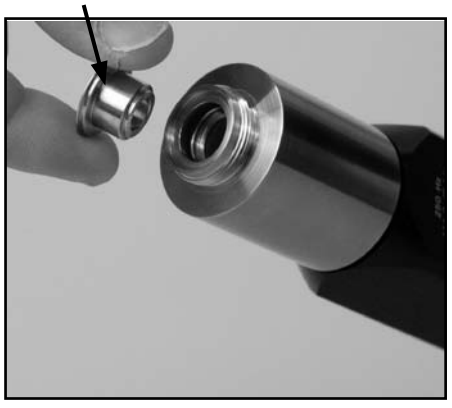


Fig. 6.13

3. a. Switch on the pistonphone via the I/O button.

b. Check that the LED is showing green.

c. Place the pistonphone (Type 42AP shown) carefully onto the ear canal.

Note: Hold the pistonphone strictly horizontally.

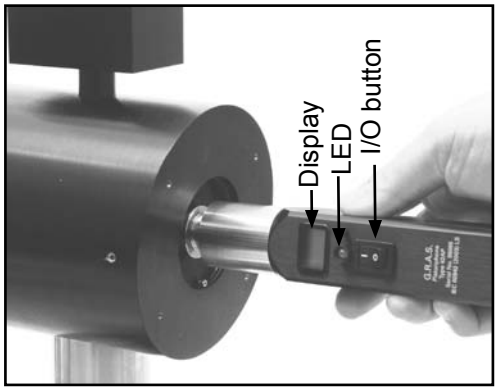


Fig. 6.14

4. When using Pistonphone Type 42AP (42AA), the correction factor for this setup is -0.62 dB. Therefore, your analyzer should ideally read:

114.00 dB - 0.62 dB = 113.38 dB

6.4 Mounting the KEMAR Pinna

The following KEMAR pinnae are available for use with the Type 45CA.

Large Pinna right	KB0070
Large Pinna left	KB0071
Small Pinna right	KB0072
Small Pinna left	KB0073

All have the same hardness, i.e. Shore 00-55

RA0172 – comprising a cover plate, four screws, and an ear holder (GR1069) – is also available from G.R.A.S.

1. Making sure that it locates with the screw in the recess, push the pinna into the recess so that it makes full contact with the base of the recess:

Fig. 6.15

2. Make sure the pinna edge is flush with the test fixture surface all the way around:

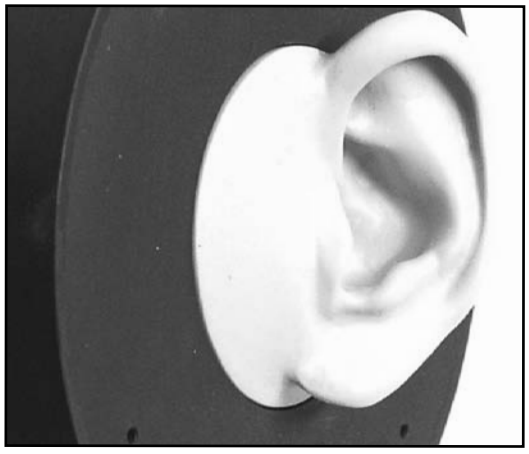


Fig. 6.16

3. Mount the Cover Plate RA0172 (must be ordered separately) using the four 2.0 mm screws supplied with it. This cover plate will keep the pinna in place:

Fig. 6.17

4. The configuration is now completed.

6.5 Typical Application Setup

Fig. 6.16 shows a block diagram of an application setup for testing the insertion loss of an ear-plug.

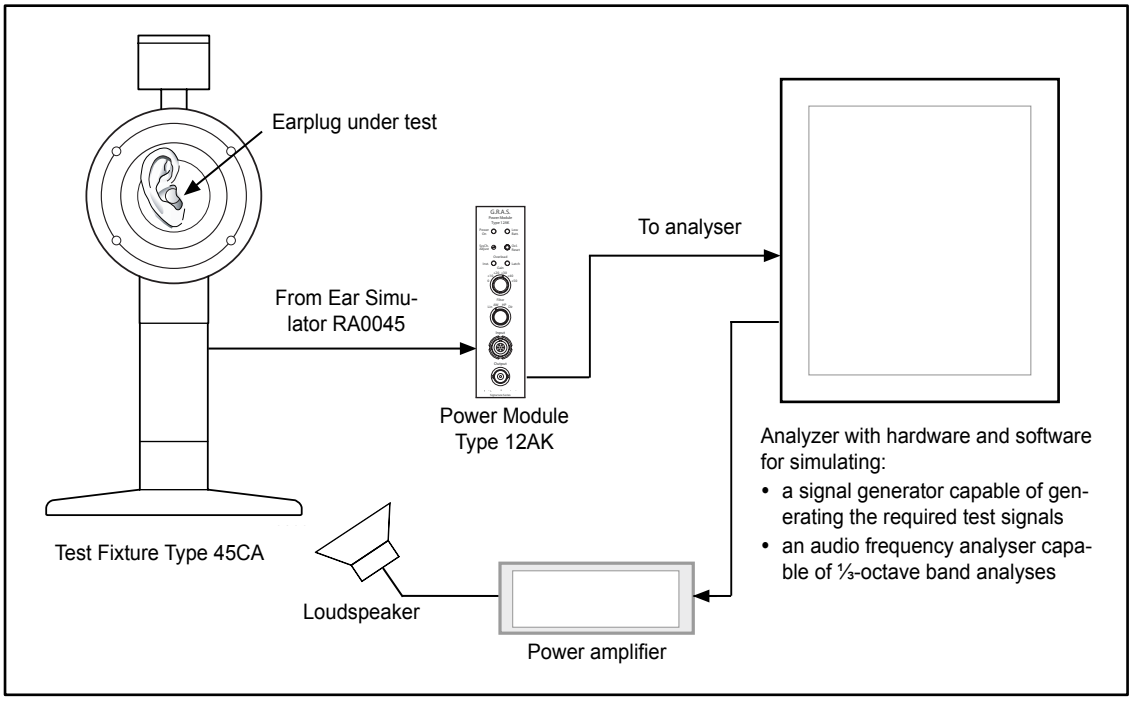


Fig. 6.18 Block diagram of a setup for testing earplugs.
Note: Monaural measurement, i.e. only one side (Left/Right) measured at a time. For binaural testing, use Power Module Type 12AA.

7 Technical Specifications

Built in accordance with:

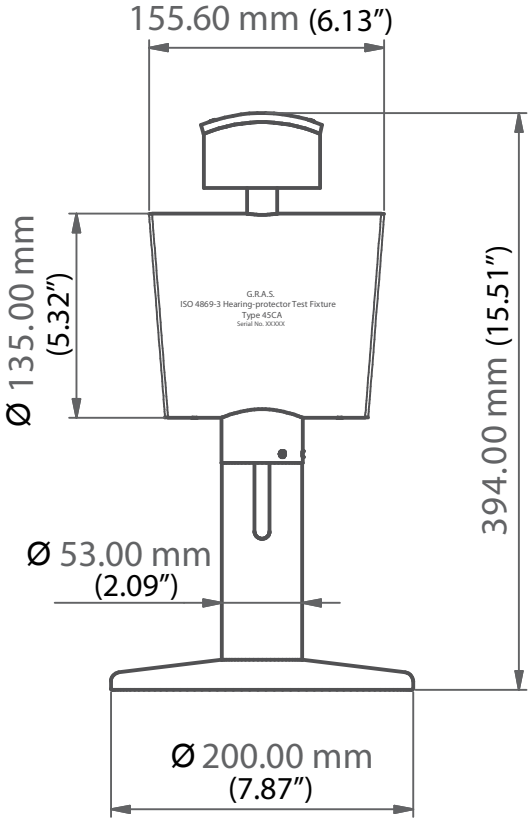
ISO 4869-3

(can also be used with two microphones for binaural testing)

Weight:

11.6 kg

Dimensions (in millimeters and inches):



8 What to Order

The Type 45CA Package

- Hearing-protector Test Fixture . . . . . Type 45CA
- Blind plug GR1079
- Cup GR0974
- 2 x Foam Plug for acoustic isolation . . GR1281
- Silicone grease for leakage sealing . . . MI0016

Configuration-Specific Parts

ISO 4869-3 Configuration

Externally Polarized Configuration*:

- 1" Pressure-field Microphone . . . . . Type 40EN
- 1"-to-½″ Adapter RA0017
- ½"-to-¼″ Adapter RA0003
- ¼" Preamplifier, Short . . . . . Type 26AS**

Configuration with ½" Microphone

Externally Polarized Configuration*:

- 1" Microphone Protection Grid RA0177
- 1"-to-½″ Microphone Adapter RA0058
- ½" Pressure Microphone . . . . . Type 40AP
- ¼" Preamplifier, Short . . . . . Type 26AS**

Prepolarized Configuration*:

- 1" Microphone Protection Grid RA0177
- 1"-to-½″ Microphone Adapter RA0058
- ½" Microphone (prepol.) . . . . . Type 40AD
- ¼" Preamplifier, Short (prepol.) . . . . . Type 26CS**

IEC 60318 Configuration

Externally Polarized Configuration*:

- IEC 60318 Ear Simulator RA0039
- Externally polarized microphone . . . . . Type 40AG
- Adapter RA0176
- ¼" Preamplifier . . . . . Type 26AS**

Prepolarized Configuration*:

- IEC 60318 Ear Simulator RA0039
- ½" Prepolarized microphone . . . . . Type 40AO
- Adapter RA0176
- ¼" Preamplifier, Short (prepol.) . . . . . Type 26CS**

IEC 60711 Configuration

Externally Polarized Configuration*:

- Ear-canal extension GR1069
- IEC 60711 Ear Simulator RA0045
- ¼" Preamplifier, short . . . . . Type 26AS**

Prepolarized Configuration*:

- Ear-canal extension GR1069
- IEC 60711 Ear Simulator, prepol. RA0045-S1
- ¼" Preamplifier, short . . . . . Type 26CS**
- 3 m Microdot-BNC cable, Hi-Temp. AA0018

Pinnae, 55 Shore 00 (hard) and related accessories:

- Cover plate, screws, and ear canal extension (required for holding pinna) RA0172
- Large Pinna right KB0070
- Large Pinna left KB0071
- Small Pinna right KB0072
- Small Pinna left KB0073

Accessories

Power Supply & Signal Conditioning

For both externally and prepolarized configurations:

- Power Module, dual-channel . . . . . Type 12AQ

For externally polarized configurations only:

- Power Module, single-channel . . . . . Type 12AK
- Power Module, two-channel . . . . . Type 12AA
- Power Module with built-in power amplifier . . . . . Type 12AP

Calibration Equipment

- Pistonphone, built-in precision barometer (250 Hz or 251.2 Hz, 114 dB +/− 0.05 dB): (recommended) . . . . . Type 42AP

or

- Pistonphone (250 Hz, 114 dB +/− 0.08 dB): . . . . . Type 42AA

Required for the IEC 60711 Configuration:

- ½" Calibration Adapter for KEMAR pinnae RA0157

* For binaural measurements, you need 2 of each of the items listed for the specific configuration.

** For reasons of space, the short ¼″ preamplifiers are required for binaural measurements, that is,
- Type 26AS for externally polarized configurations
- Type 26CS for prepolarized configurations.

For monaural measurements, you can also use
- Type 26AC for externally polarized configuration
- Type 26CB for prepolarized configuration.

The 26AS and 26AC used for the externaly polarized configurations have an integrated cable. For prepolarized configurations with the 26CS, the AA0018 3 m Microdot - BNC cable, High Temperature is required.

Manufactured to conform with:

CE marking directive: 93/68/EEC

WEEE directive: 2002/96/EC

RoHS directive: 2002/95/EC

G.R.A.S. Sound & Vibration reserves the right to change specifications and accessories without notice.