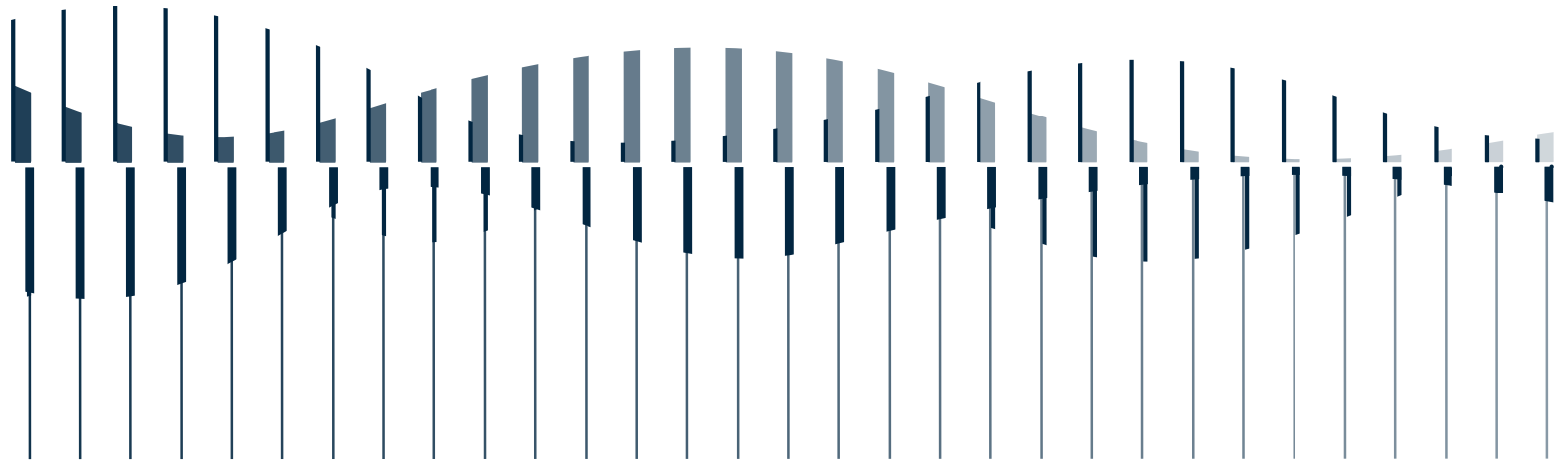
Instruction Manual

GRAS 45CA Headphone/Hearing-protector Test Fixture



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GRAS

An Axiometrix Solutions Brand

Revision History

Any feedback or questions about this document are welcome at **gras@GRASacoustics.com**.

Revision	Date	Description
1	16 February 2016	Manual for 45CA-1 to 45CA-6.
2	4 July 2017	Configurations with anthropometric pinnae added. Section about pressure equalization added.
3	6 February 2018	45CA-7 to 45CA-10 configurations with high-frequency ear simulator added
5	3 May 2019	Table with correction factors added.
6	29 August 2019	Hi-Res Configurations added.
7	1 June 2022	TEDS functionality section added.
8	1 May 2023	Update parts list for -2, -4, -6, -8, -10, and -12
9	23 January 2024	45CA-13 configuration with Low Noise Ear Simulator System added including 42AG calibration

Contents

Introduction

About this Manual

Part 1 describes the items of the configurations. They are ready for use and you will normally not need to disassemble them. However, if you do, Part 2 describes how they are assembled.

Introduction to 45CA

The GRAS 45CA Hearing-protector Test Fixture is for testing:

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

The test fixture is mounted on a resilient base that reduces the noise floor to a minimum in a typical test situation. Foam plugs and grease are used to avoid sound leakage along the cables.

The test fixture is delivered in the following configurations:

Testing of Hearing Protectors according to ISO 4869-3

For testing of ear muffs, two configurations are available, either with 1″ or ½″ microphones:

45CA-1 1″ 40EN Externally Polarized Pressure Microphones, conforms with ISO 4869-3.

45CA-2 ½″ 40AD Prepolarized Pressure Microphones, conforms with ISO 4869-3.

Testing of Headphones

For testing of headphones, two configurations with IEC 60318-1 ear simulators are available, either with externally or prepolarized microphones.

45CA-3 RA0039 IEC 60318-1 Ear Simulators, with 40AG Externally Polarized microphones.

45CA-4 RA0039 IEC 60318-1 Ear Simulators RA0039, with 40AO Pre-polarized Microphones.

Testing of Headphones, Earplugs, and Insert Earphones

For testing of headphones and insert earphones, two configurations with pinnae simulators and IEC 60318-4 ear simulators are available, either externally polarized or prepolarized.

45CA-5 RA0045 IEC 60318-4 Ear Simulators RA0045, externally polarized.

45CA-6 RA0045-S1 IEC 60318-4 Ear Simulators, prepolarized.

45CA-7 RA0045 IEC 60318-4 Ear Simulators, ext. polarized, with anthropometric pinnae.

45CA-8 RA0045-S1 IEC 60318-4 Ear Simulators, prepolarized, with anthropometric pinnae.

High-Frequency/Hi-Re Testing

For testing up to 20 kHz, two configurations with High-Frequency Ear Simulators are available, either with externally or prepolarized microphones and anthropometric pinnae.

45CA-9 RA0401 High-Frequency Ear Simulators, with externally polarized microphones.

45CA-10 RA0402 High-Frequency Ear Simulators, with pre-polarized microphones.

For testing up to 50 kHz, two configurations with Hi-Res Ear Simulators are available, either with externally or prepolarized microphones and anthropometric pinnae.

45CA-11 RA0403 Hi-Res Ear Simulators, with externally polarized microphones.

45CA-12 RA0404 Hi-Res Ear Simulators, with pre-polarized microphones.

Low Noise / ANC testing

45CA-13 Low noise Ear Simulators & anthropometric pinnae

All configurations are 2-channel.

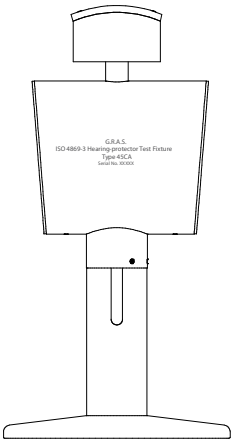
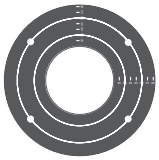
TEDS Compatibility

Test fixtures with constant-current power (CCP) microphone components (configurations -2, -4, -6, -8, -10, and -12) are IEEE 1451.4 TEDS v. 1.0 compliant. If your measurement platform supports Transducer Electronic Data Sheets (TEDS), you will be able to read and write data like properties and calibration data.

Delivered Items

45CA Headphone/Hearing-protector Test Fixture, Non-configured

The components listed below are delivered if you order a 45CA, non-configured. If you order a pre-configured 45CA, the components that comprise the 45CA, non-configured are delivered as part of the pre-configured assembly.

Included Items			
Test Fixture 	Cover Plate 2 x GR1085 	Insert 2 x GR0970 	
	Acoustic Cup	1	GR0974
	Acoustic Plug	1	RA0178
	Foam Plug	2	GR1281
	Sealing Grease	1	MI0016
	Allen Key, 6 mm	1	YY0019
	Allen Key, 2.5 mm	1	YY0016
	Allen Key, 2 mm	1	YY0018
	Allen Key,1.5 mm	1	YY0012

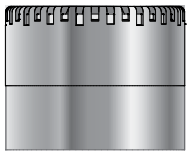
45CA-1 Headphone/Hearing-protector Test Fixture, ISO 4869-3, 1″ Mic. LEMO

The 45CA-1 is a configuration for testing of outside-the-ear devices, i.e. for measuring the insertion loss of earmuffs and the sound quality of headphones. In this configuration, 45CA is configured with two GRAS 40EN 1″ pressure microphones. 40EN is an IEC 61094 WS1P 1″ externally polarized pressure microphone.

This configuration conforms with ISO 4869-3.

45CA-1 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

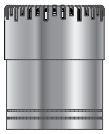
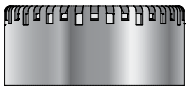
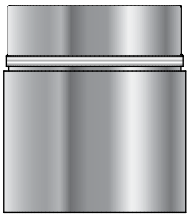
Included Items		
	1″ Externally Polarized Pressure Microphone	2 x 40EN
	1″ to ½″ Adapter	2 x RA0017
	½″ to ¼″ Adapter	2 x RA0003
	¼″ Preamplifier, Short	2 x 26AS

45CA-2 Headphone/Hearing-protector Test Fixture, ISO 4869-3, ½″ Mic. CCP

The 45CA-2 is a configuration for testing of outside-the-ear devices, i.e. for measuring the insertion loss of earmuffs and the sound quality of headphones. In this configuration, 45CA is configured with two GRAS 40AD ½″ pressure microphones. 40AD is an IEC 61094 WS2P ½″ prepolarized pressure microphone.

This configuration conforms with ISO 4869-3. 45CA-2 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

Included Items		
	½″ Prepolarized Pressure Microphone, High Sensitivity (Used without its protection grid)	2 x 40AD
	1″ Microphone protection Grid	2 x RA0177
	½″ to 1″ Microphone Adapter	2 x RA0058
	½″ to ¼″ Adapter	RA0412 (set)
	¼″ CCP Preamplifier with Microdot Connector, Very Short.	2 x 26CB UN
	Microdot to BNC Cable, 3 m	2 x AA0070

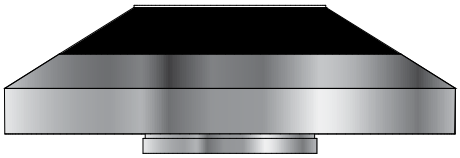
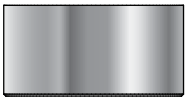
45CA-3 Headphone/Hearing-protector Test Fixture, IEC 60318-1 LEMO

45CA-3 is configured for measurement of insertion loss of circum-aural hearing protectors and the sound quality of headphones, with two RA0039 Ear Simulators with 40AG ½″ externally polarized microphones.

The configuration conforms with IEC 60318-1. The RA0039 cannot be used with a pinnae simulator, and therefore cannot be used for measuring in-ear earphones.

45CA-3 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

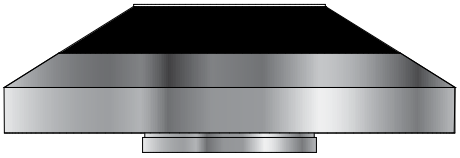
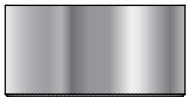
Included Items		
	IEC 60318-1 Ear Simulator	2 x RA0039
	½″ Externally Polarized Pressure Microphone	2 x 40AG
	½″ to 1″ Adapter for RA0039	2 x RA0176
	½″ to ¼″ Adapter	2 x GR0010
	¼″ Preamplifier, short	2 x 26AS

45CA-4 Headphone/Hearing-protector Test Fixture, IEC 60318-1 CCP

The 45CA-4 is configured with two RA0039 Ear Simulators with 40AO ½″ prepolarized microphones. The configuration complies with IEC 60318-1 and is used for measurements of insertion loss of circum-aural hearing protectors and sound quality of headphones. The RA0039 cannot be used with a pinnae simulator, and therefore cannot be used for measuring in-ear earphones.

45CA-4 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

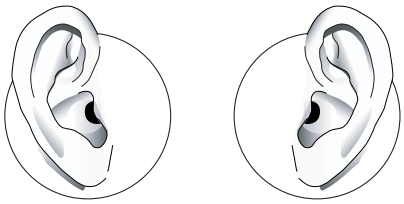
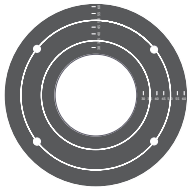
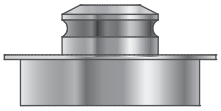
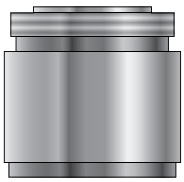
Included Items		
	IEC 60318-1 Ear Simulator	2 x RA0039
	½″ Prepolarized Pressure Microphone	2 x 40AO
	Adapter	2 x RA0176
	½″ to ¼″ Adapter	RA0412 (set)
	¼″ Preamplifier	2 x 26CB UN
	Microdot to BNC Cable, 3 m	AA0070

45CA-5 Headphone/Hearing-protector Test Fixture, IEC 60318-4 LEMO

The 45CA-5 is configured with RA0045 externally polarized ear simulators for use with pinnae simulators. It can be used for measurements of the insertion loss of ear muffs and ear plugs, and the sound quality of earphones and headphones. The configuration complies with IEC 60318-4.

45CA-5 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

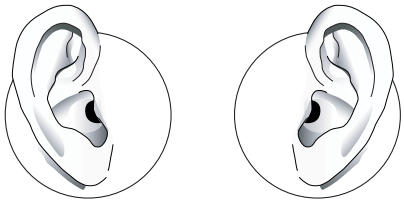
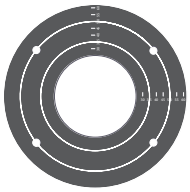
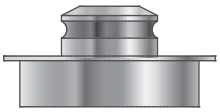
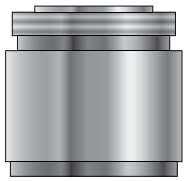
Included Items		
	Large right and left KEMAR pinna	KB0070 KB0071
	Pinnae Holder Plate	2 x GR1075
	Ear Canal Extension	2 x GR1069
	IEC 60318-4 Externally Polarized Ear Simulator	2 x RA0045
	½″ to ¼″ Adapter	2 x GR0010
	¼″ Preamplifier, short	2 x 26AS

45CA-6 Headphone/Hearing-protector Test Fixture, IEC 60318-4 CCP

The 45CA-6 is configured with RA0045-S1 prepolarized ear simulators for use with pinnae simulators. This configuration can be used for measurements of the insertion loss of ear muffs, sound quality of earphones and hearing aids. The configuration complies with IEC 60318-4.

45CA-6 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

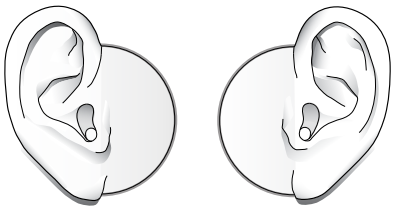
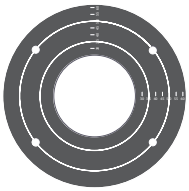
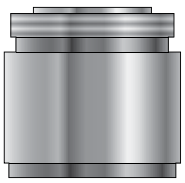
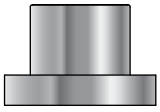
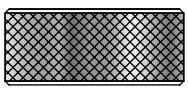
Included Items		
	Large right and left KEMAR pinna	KB0070 KB0071
	Pinnae Holder Plate	2 x GR1075
	Ear Canal Extension	2 x GR1069
	IEC 60318-4 Prepolarized Ear Simulator	2 x RA0045-S1
	½″ to ¼″ Adapter	RA0412（set）
	¼″ Preamplifier, short	2 x 26CB UN
	Microdot to BNC Cable, 3 m	2 x AA0070

45CA-7 Headphone/Hearing-protector Test Fixture, Anthropometric Pinnae, LEMO

The 45CA-7 is configured with RA0045 externally polarized ear simulators and anthropometric pinnae simulators. It can be used for measurements of the insertion loss of ear muffs and ear plugs, and the sound quality of earphones and headphones. The configuration complies with IEC 60318-4.

45CA-7 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

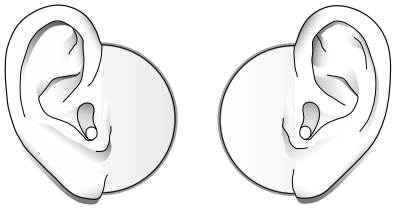
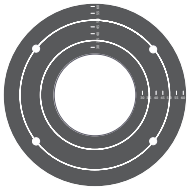
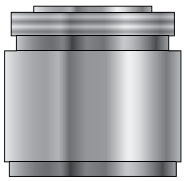
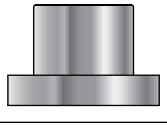
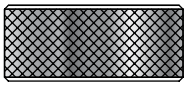
Included Items		
	Large right and left anthropometric pinnae	KB5010 KB5011
	Pinnae Holder Plate	2 x GR1075
	IEC 60318-4 Externally Polarized Ear Simulator	2 x RA0045
	½″ to ¼″ Adapter	2 x GR0010
	¼″ Preamplifier, short	2 x 26AS
	Exterior Ear Canal（for calibration）	GR0408
	Union Nut（for calibration）	GR0409

45CA-8 Headphone/Hearing-protector Test Fixture, Anthropometric Pinnae, CCP

The 45CA-8 is configured with RA0045-S1 prepolarized ear simulators for use with pinnae simulators. This configuration can be used for measurements of the insertion loss of ear muffs, sound quality of earphones and hearing aids. The configuration complies with IEC 60318-4.

45CA-8 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

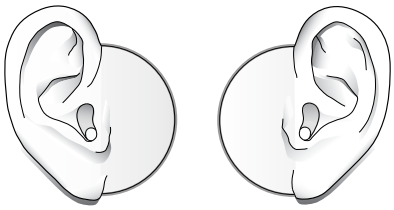
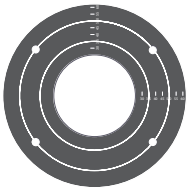
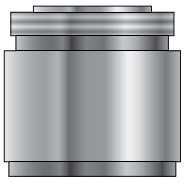
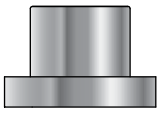
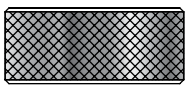
Included Items		
	Large right and left anthropometric pinnae	KB5010 KB5011
	Pinnae Holder Plate	2 x GR1075
	IEC 60318-4 Prepolarized Ear Simulator	2 x RA0045-S1
	½″ to ¼″ Adapter	RA0412 (set)
	¼″ Preamplifier, short	2 x 26CB UN
	Microdot to BNC Cable, 3 m	2 x AA0070
	Exterior Ear Canal (for calibration)	GR0408
	Union Nut (for calibration)	GR0409

45CA-9 Headphone/Hearing-protector Test Fixture, High-Frequency, LEMO

The 45CA-9 is configured with RA0401 externally polarized high-frequency ear simulators and anthropometric pinnae. It can be used for measurements of the insertion loss of ear muffs and ear plugs, and the sound quality of earphones and headphones. The configuration complies with IEC 60318-4.

45CA-9 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

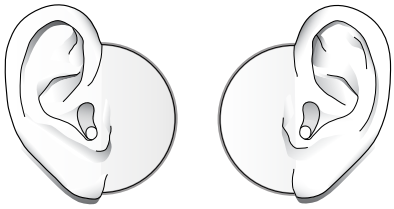
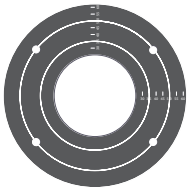
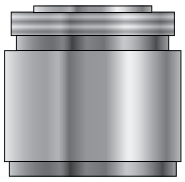
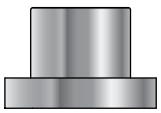
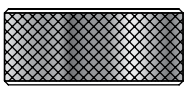
Included Items		
	Large right and left anthropometric pinnae	KB5010 KB5011
	Pinnae Holder Plate	2 x GR1075
	Externally Polarized High-Frequency Ear Simulator	2 x RA0401
	½″ to ¼″ Adapter	2 x GR0010
	¼″ Preamplifier, short	2 x 26AS
	Exterior Ear Canal（for calibration）	GR0408
	Union Nut（for calibration）	GR0409

45CA-10 Headphone/Hearing-protector Test Fixture, High-Frequency, CCP

The 45CA-10 is configured with RA0402 prepolarized ear simulators and anthropometric pinnae. This configuration can be used for measurements of the insertion loss of ear muffs, sound quality of earphones and hearing aids. The configuration complies with IEC 60318-4.

45CA-10 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

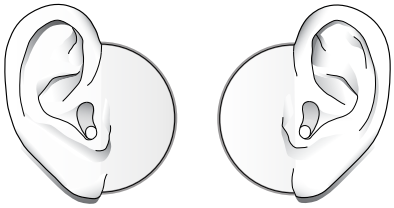
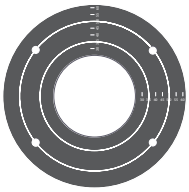
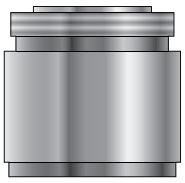
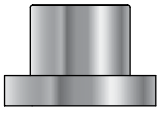
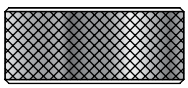
Included Items		
	Large right and left anthropometric pinnae	KB5010 KB5011
	Pinnae Holder Plate	2 x GR1075
	Prepolarized High-Frequency Ear Simulator	2 x RA0402
	½″ to ¼″ Adapter	RA0412（set）
	¼″ Preamplifier, short	2 x 26CB UN
	Microdot to BNC Cable, 3 m	2 x AA0070
	Exterior Ear Canal（for calibration）	GR0408
	Union Nut（for calibration）	GR0409

45CA-11 Headphone/Hearing-protector Test Fixture, Hi-Res, LEMO

The 45CA-11 is configured with RA0403 externally polarized hi-res ear simulators and anthropometric pinnae. It can be used for measurements of the insertion loss of ear muffs and ear plugs, and the sound quality of earphones and headphones. The configuration is compatible with IEC 60318-4.

45CA-11 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

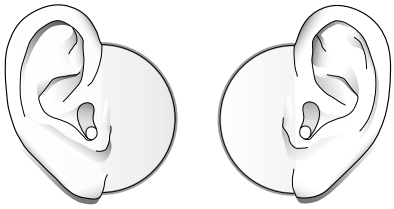
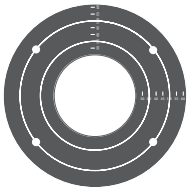
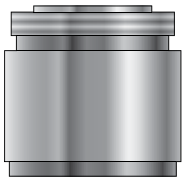
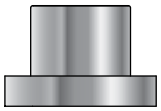
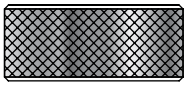
Included Items		
	Large right and left anthropometric pinnae	KB5010 KB5011
	Pinnae Holder Plate	2 x GR1075
	Externally polarized Hi-res Ear Simulator	2 x RA0403
	¼″ Preamplifier, short	2 x 26AS
	Exterior Ear Canal（for calibration）	GR0408
	Union Nut（for calibration）	GR0409

45CA-12 Headphone/Hearing-protector Test Fixture, Hi-Res, CCP

The 45CA-12 is configured with RA0404 prepolarized hi-res ear simulators and anthropometric pinnae. This configuration can be used for measurements of the insertion loss of ear muffs, sound quality of earphones and hearing aids. The configuration compatible with IEC 60318-4.

45CA-12 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

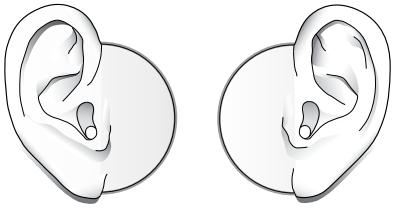
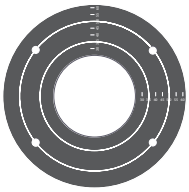
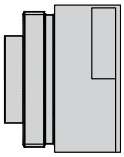
Included Items		
	Large right and left anthropometric pinnae	KB5010 KB5011
	Pinnae Holder Plate	2 x GR1075
	Prepolarized Hi-res Ear Simulator	2 x RA0404
	¼″ Preamplifier, short	2 x 26CS
	Microdot to BNC Cable, 3 m	2 x AA0070
	Exterior Ear Canal（for calibration）	GR0408
	Union Nut（for calibration）	GR0409

45CA-13 HeadphoneTest Fixture - Low noise & Anthropometric Pinnae

The 45CA-13 is configured with 43BB Low Noise Ear Simulator System and anthropometric pinnae. It can be used for measurements of the insertion loss of ear muffs and ear plugs, and the sound quality of earphones and headphones, including ANC devices. The configuration is compatible with IEC 60318-4.

45CA-13 is delivered fully configured, individually calibrated and ready for use.

The following configuration-specific items are included:

Included Items		
	Large right and left anthropometric pinnae	KB5010 KB5011
	Pinnae Holder Plate	2 x GR1075
	Low-noise Ear Simulator System	2 x 43BB
	Kit of 8 degr. angular adapters ½″ to ¼″	RA0412

Accessories

Pinnae	
Pinnae & Ear Simulator Mounting Kit (required to hold a pinna, included in 45CA-5 and -6) Contains a cover plate, ear canal extension, screws and Allen key.	RA0172
KEMAR Large Right Pinnae for GRAS 45CA (Included in 45CA-5 and -6)	KB0070
KEMAR Large Left Pinnae for GRAS 45CA (Included in 45CA-5 and -6)	KB0071
KEMAR Small Right Pinnae for GRAS 45CA	KB0072
KEMAR Small Left Pinnae for GRAS 45CA	KB0073
KEMAR Large Right Pinnae for GRAS 45CA, shore 35	KB1070
KEMAR Large Left Pinnae for GRAS 45CA shore 35	KB1071
KEMAR Right Anthropometric Pinnae for GRAS 45CA	KB5010
KEMAR Left Anthropometric Pinnae for GRAS 45CA	KB5011

Power Modules	
2-Channel Universal Power Module with signal conditioning and PC interface	12AQ
2-Channel Power Module with gain, filters and SysCheck generator	12AA

Calibration Equipment	
Intelligent Pistonphone Class 0	42AP
Pistonphone Class 1	42AA
Multifunction Sound Calibrator	42AG
Coupler for 1″ microphones (included with 42AP but optional for 42AA)	RA0023
Calibration Adapter for RA0039 (for 45CA-3 and -4 only)	RA0287
½" Calibration Adapter for KEMAR Pinnae (For 45CA-5 and -6 only)	RA0157
94 dB Pistonphone Coupler	RA0090

Typical Application Setups

For testing of outside-the-ear devices – the insertion loss of ear muffs and the sound quality of headphones – 45CA-1 (with 1″ microphone) or 45CA-2 (with ½″ microphone) can be used.

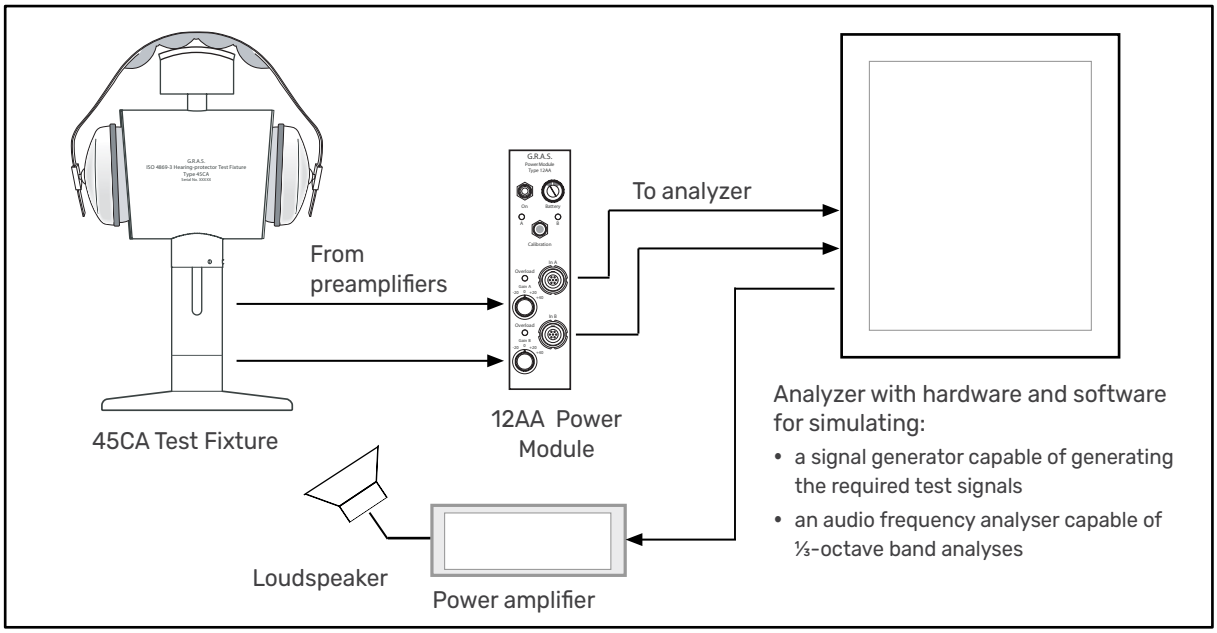


Fig. 1. *A typical measurements setup for testing of the insertion loss of ear muffs.*

For measurement of the sound quality of headphones, 45CA-3 or 45CA-4 can be used. They are configured with RA0039 Ear Simulators and 40AG ½″ externally polarized or 40AO ½″ prepolarized microphones. These configurations comply with IEC 60318-1.

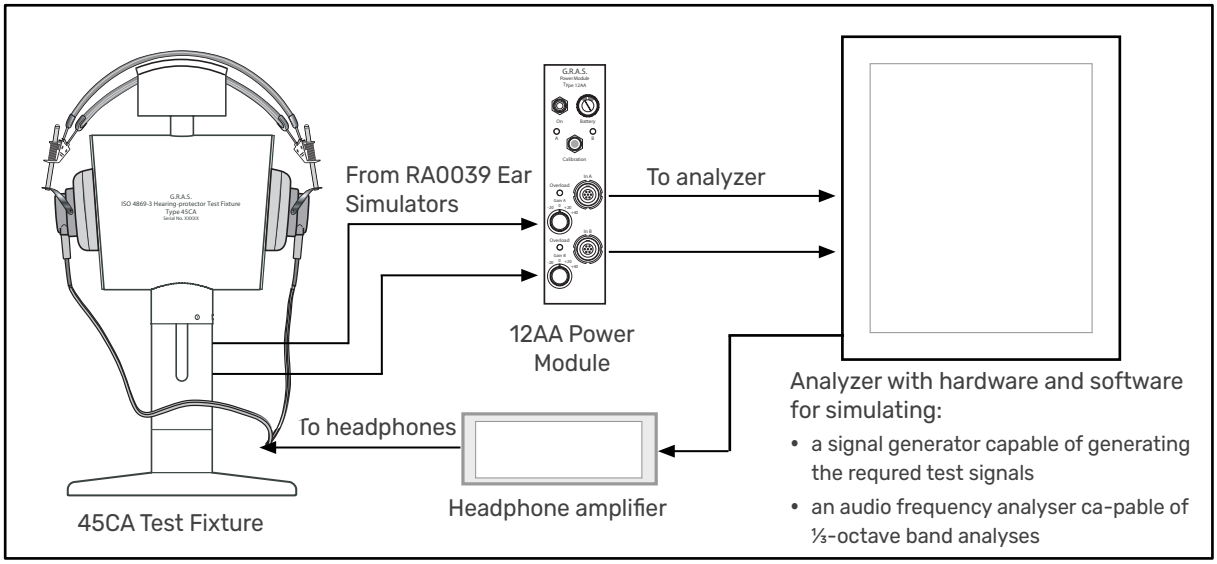


Fig. 2. *A typical measurements setup for headphone testing. Here shown with externally polarized microphones (45CA-4).*

For measurements of the insertion loss of ear muffs and ear plugs, and the sound quality of earphones and headphones, 45CA-5 or 45CA-6 can be used. They are configured with pinnae simulators and either externally polarized or prepolarized ear simulators.

These configurations comply with IEC 60318-4.

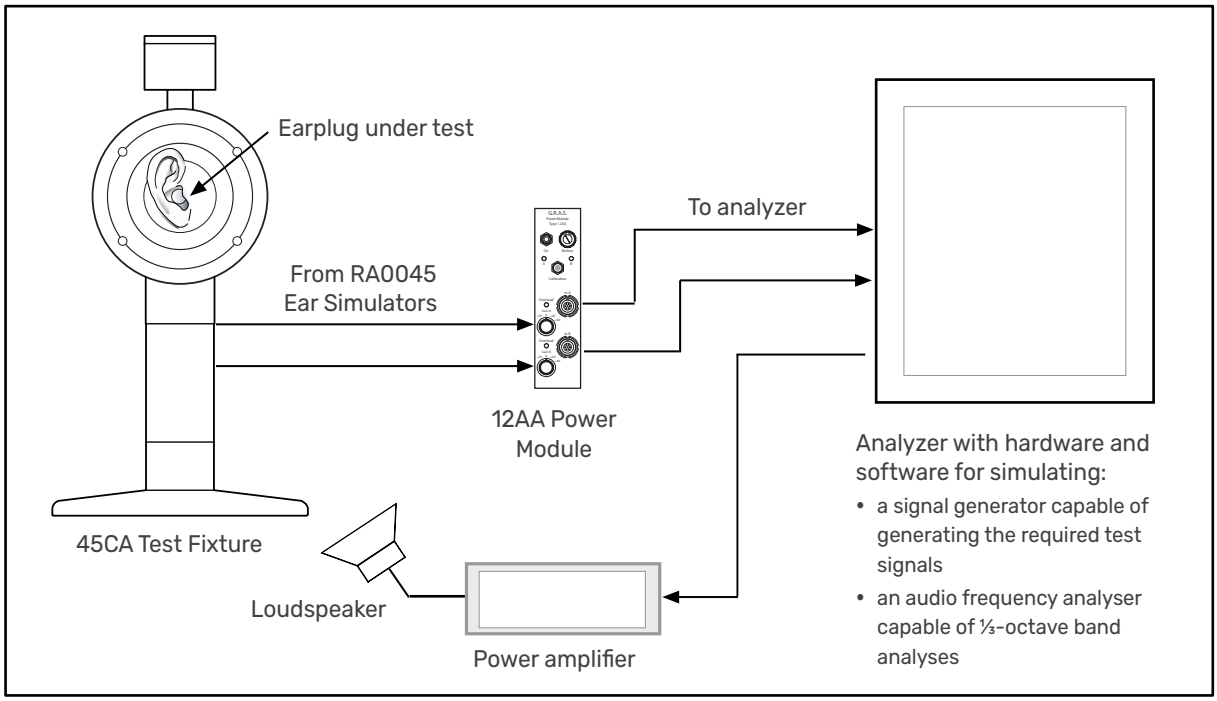


Fig. 3. *Typical application setup for testing of earplugs. Here a configuration with externally polarized ear simulators is shown.*

Test setups for the configurations 45CA-7 till 45CA-12 are similar to the one shown above.

Mounting the Pinnae

Mounting the Traditional Pinnae

The following pinnae are available for 45CA:

Large Pinnae right Shore 55	KB0070
Large Pinnae left Shore 55	KB0071
Small Pinnae right Shore 55	KB0072
Small Pinnae left Shore 55	KB0073
Large Pinnae right Shore 35	KB1070
Large Pinnae left Shore 35	KB1071

The RA0172 Pinnae and Ear Simulator Mounting Kit must be used. This kit is included with 45CA configurations from 45CA-5 to 45CA-10. It comprises a cover plate, four screws, and an ear holder.

1. Make sure that the recess in the pinnae locates with the screw in the recess and push it into the recess until it makes full contact with the base of the recess.
2. Make sure that the pinnae edge is flush with the surface of the test fixture
3. Mount the cover plate.

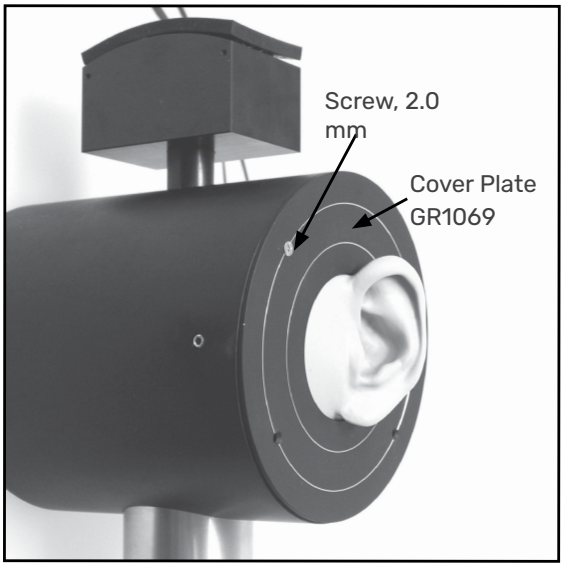


Fig. 4. *Mounting the KEMAR pinnae*

...and the cover plate.

Mounting the Anthropometric Pinnae

Two anthropometric pinnae ara avilable:

Right Pinnae Shore 35	KB5010
Left Pinnae Shore 35	KB5011

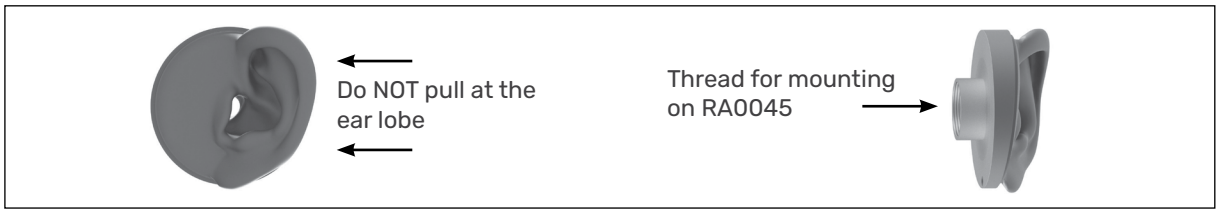


Fig. 5. *Side and front view of a left anthropometric pinna.*

Mounting the Anthropometric Pinna:

1. Slacken the screw holding the Ear Simulator, see Fig. 7.
2. Pull out the Ear Simulator.
3. Screw the Pinnae onto the Ear Simulator, see Fig. 6

Fig. 6. *The pinnae is screw-mounted on the RA0045 Ear Simulator. For clarity, preamplifier and cable are not shown.*

4. Push the assembly into 45CA as far as it will go. Ensure that the pinnae is tilted correctly (as described in the standard, e.g. the 60318-7), see also Fig. 5, the left part.
5. Tighten the locking screw.

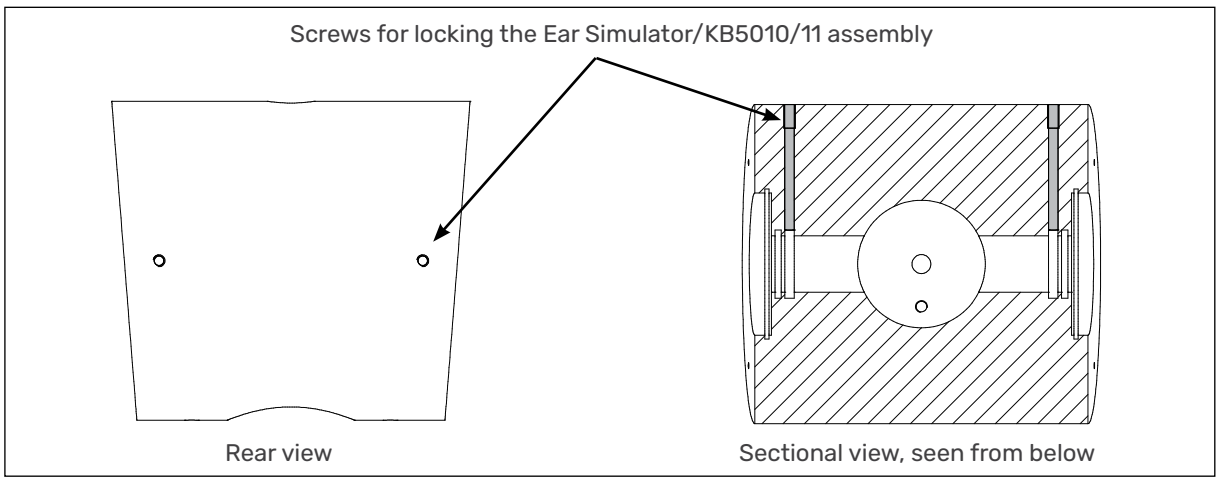


Fig. 7. *Showing the screws for locking the ear simulator (RA0045 or High Resolution Ear Simulator)*

Removing the Anthropometric Pinnae

As the Anthropometric Pinnae is screw-mounted onto the RA0045 Ear Simulator, this assembly must be removed from the 45CA before the pinnae can be separated from the ear simulator.

1. Loosen the screw holding the ear simulator, see Fig. 7 on page 24.
2. Gently pull out the assembly.

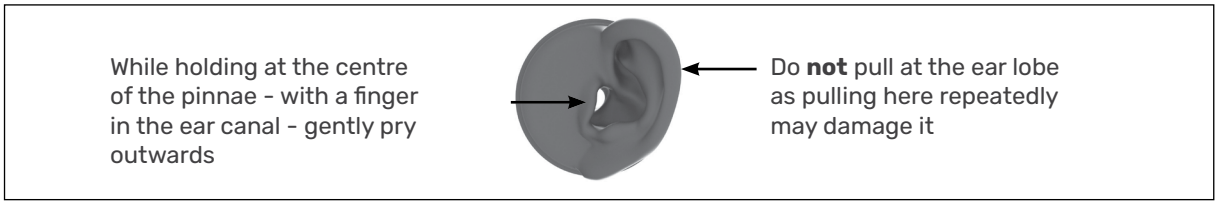


Fig. 8. *Showing where to pull when removing the ear simulator+ anthropometric pinnae from 45CA.*

Pressure Equalization

45CA is furnished with capillary equalization tubes that connect the cavity under the ear muffs to the external air. When these tubes are not sealed, the pressure build-up that will occur when you fit the ear-muffs will be equalized.

However, before measuring according to ISO4869-3 you may have to close the tubes after having fitted the hearing protector. For this purpose, two 6 mm M3 grub screws are part of the delivery. These are mounted at the bottom of the 45CA test fixture head.

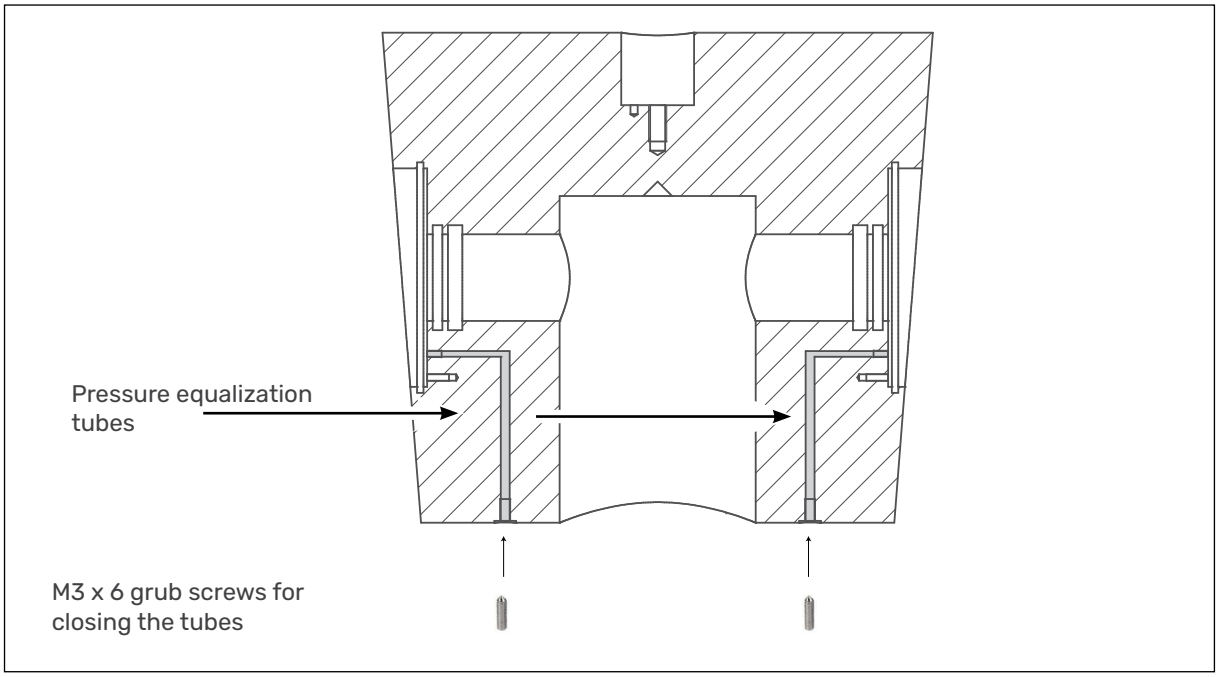


Fig. 9. *Showing where to close and open the pressure equalization tubes.*

The screws seal after a few turns.

Calibration and Verification

45CA-1 and 45CA-2

Before calibration, the microphone and preamplifier must be removed from the 45CA. To get a good hold on the microphone, cover plate and insert must be removed.

45CA-1 - with 1″ microphone

1. Remove the GR1085 cover plate. Remove the four bolts using the 2 mm Allen key.
2. Remove the GR0970 Insert by loosening the screw at the bottom and pulling it out.
3. Using the 2,5 mm Allen key, loosen the two grub screws at the side of the head.

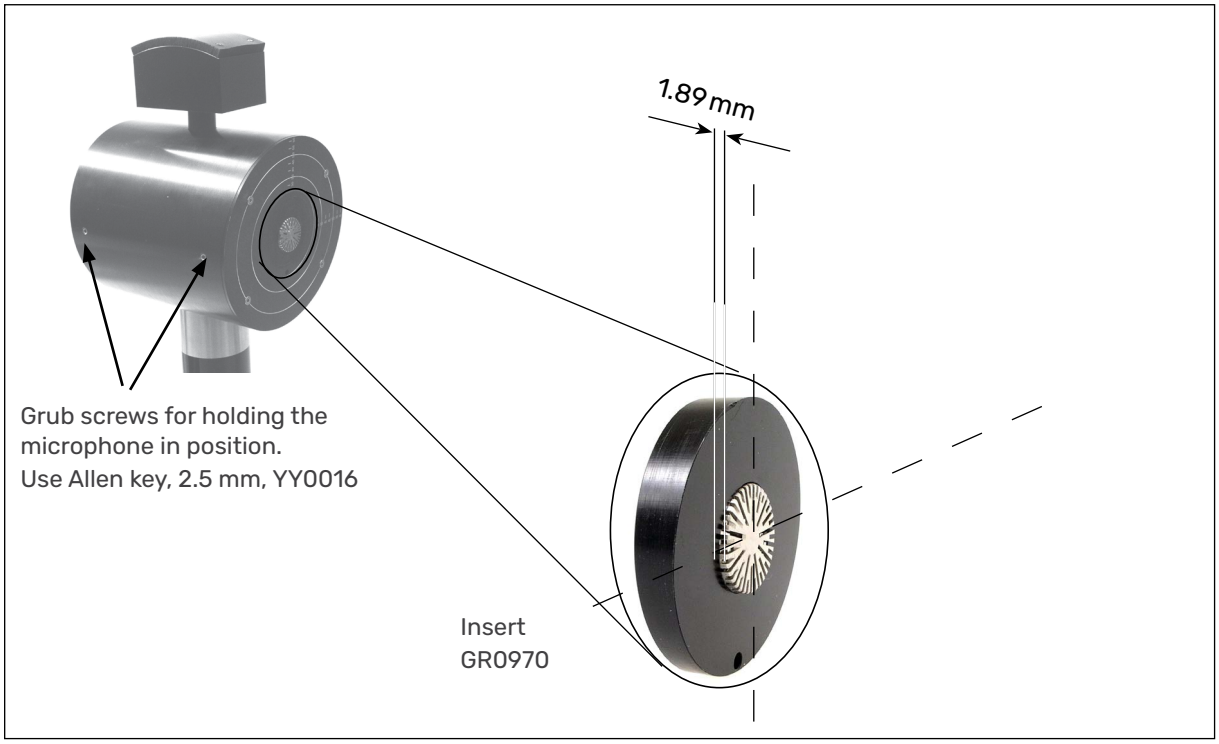


Fig. 10. *The microphone can be removed for calibration when the insert and cover plate have been removed. When reinstalled, it must be located precisely as shown, protruding 1,89 mm at the horizontal center line.*

4. Pull out the microphone.

You are now ready to calibrate. The GRAS RA0023 Coupler for 1″ microphones must be used, it is included with the 42AP and an optional accessory for 42AA.

The correction factor is 0.0 dB, and therefore you analyzer should read 114 dB +/- correction for the static ambient pressure. Refer to your pistonphone manual for detailed calibration instructions.

Reinstalling the Microphones

When calibration has been completed, you must reinstall the microphones in the test fixture.

This is done reversing the steps on the previous page.

When installed correctly, the microphones (with protection grid) must protrude 1.89 mm at the horizontal center line as shown in Fig. 10 on page 26. This will ensure that the microphone diaphragm is flush with the surface of the 45CA at the horizontal center line, as defined in ISO 4869-3.

45CA-2 - with ½″ Microphones

When mounted in the ½″ to 1″ Adapter, the ½″ microphones can be calibrated the same way as the 1″ microphones. Microphone and adapter can be removed as described on page 17.

Place the microphone with its adapter in the pistonphone collar.

The correction factor is 0.0 dB, and therefore you analyzer should read 114 dB +/- correction for the static ambient pressure.

Refer to your pistonphone manual for detailed calibration instructions.

45CA-3 and 45CA-4

45CA-3 and 45CA-4 can be calibrated in-situ without dismantling couplers and microphones. However, the accuracy that can be obtained is no better than ±0.3 dB, so this would rather be a verification. A proper calibration requires that the microphone is dismantled and calibrated separately.

Verification

The 45CA-3 and 45CA-4 can be verified in-situ using the Calibration Adapter RA0287.

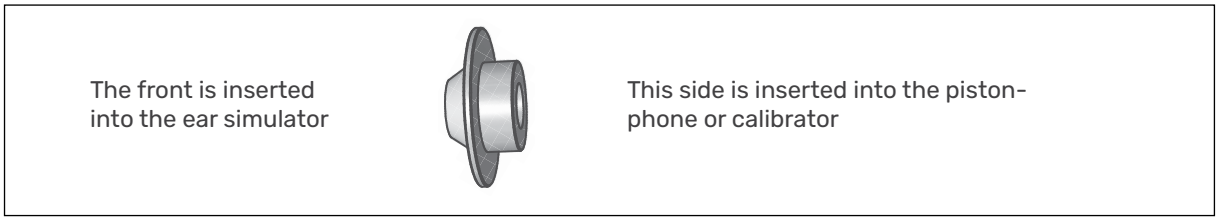


Fig. 11. *The RA0287 Calibration/Verification adapter for the RA0039 Ear Simulator.*

1. Loosen the Pistonphone's collar and mount the verification adapter.
2. Place the pistonphone onto the ear simulator.
3. Hold the Pistonphone strictly horizontally. An accuracy of ± 0.3 dB can be obtained.

Refer to your pistonphone manual for further instructions.

Calibration of 45CA-3 and 45CA-4

To perform a proper calibration, you must dismount the ear simulator from the test fixture.

1. Release the two grub screws on the side of the test fixture, see Fig. 7 on page 24. The screw must be loosened to fully release its pressure on the ear simulator. Removing the cover plate will make removal of the ear simulator easier.
2. Remove the ear simulator unit.
3. Unscrew the microphone from the ear simulator unit.
4. Insert the microphone in the pistonphone.

See your pistonphone manual for further instructions.

The correction factor is 0.0 dB (42AP and 42AA), and therefore you analyzer should read 114 dB +/- correction for the static ambient pressure. Refer to your pistonphone manual for detailed calibration instructions. When calibration has been done, install the microphone in the coupler and the coupler in the test fixture by reversing this procedure.

45CA-5 and 45CA-6

The RA0045/RA0045-S1 Ear Simulators can be calibrated in-situ once the pinnae has been removed.

1. Remove the pinna.

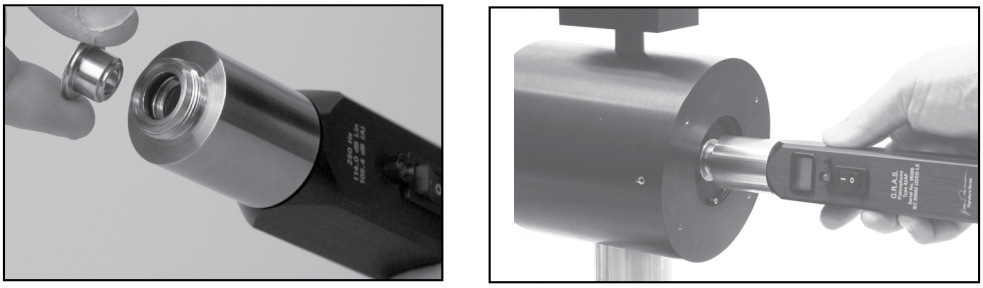


Fig. 12. *In-situ calibration of 60318-4 ear simulator with pistonphone and RA0157 calibration adapter.*

2. Mount the RA0157 Calibration adapter on the pistonphone.

Hold the pistonphone strictly horizontally.

The correction factor is -0.62 dB, and therefore your analyzer should read 114 dB minus 0.62dB at 250 Hz and correction for the static ambient pressure. Refer to your pistonphone manual for detailed calibration instructions.

45CA-7 to -12

As described on page 24 the anthropometric pinnae is mounted directly on the Ear Simulator, without the use of en ear canal extension. Therefore, for calibration with a pistonphone with a ½″ coupler, the ear simulator and the anthropometric pinnae must be removed to allow mounting of the GR0408 External Ear Canal.

Removing the Ear Simulator and Anthropometric Pinna

1. Loosen the screw holding the ear simulator, see Fig. 7 on page 24.
2. Gently pull out the assembly. See also Fig. 8 on page 25.

Important. Do NOT pull at the ear lobe.

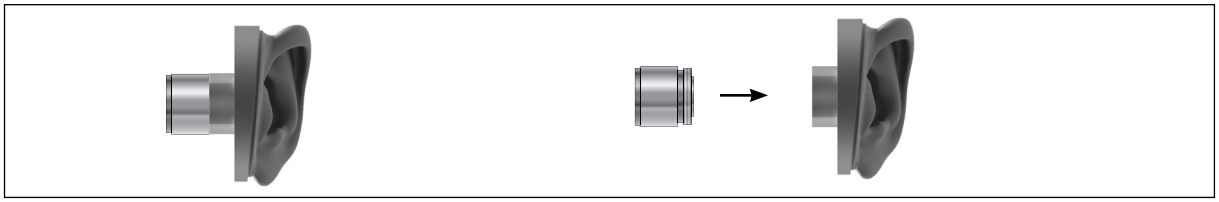


Fig. 13. *Removing the anthropometric pinnae from the ear simulator.*

3. Unscrew the pinnae simulator from the ear simulator
4. Mount the external ear canal with the union nut onto the ear simulator.

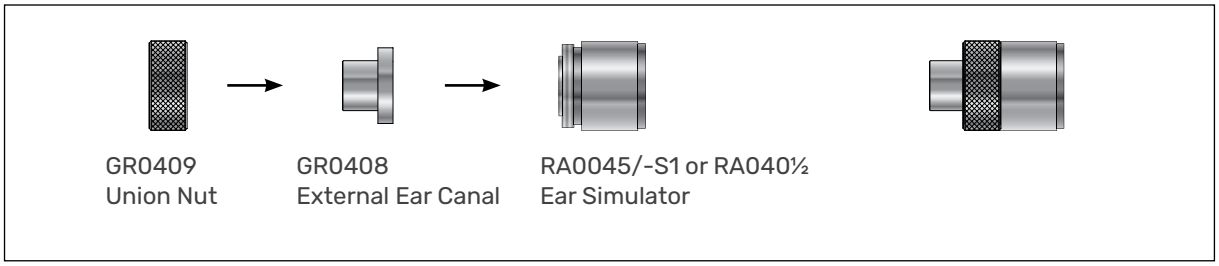


Fig. 14. *Showing the External Ear Canal and Union Nut. For clarity, preamplifier and cable are not shown.*

You are now ready to calibrate. The Ear Simulator fits directly into a 42AG Multifunction Calibrator with a ½″ coupler. Refer to your 42AG manual for further information. See the corrections factors in the table below.

45CA-13

1. Connect the 26HT via its LEMO plug to the LEMO input socket of the 12HF.
2. Connect the BNC output of the 12HF to the analyzer and switch both power module and analyzer on.
3. Push fit the ½″ coupler onto the 1″ coupler of the 42AG. The ½″ is a spare part delivered with the 42AG.
4. Set the 42AG to 250Hz, 94 dB.
5. Mount the RA0234 Low-noise Ear Simulator, including GR0408 External Ear Canal as shown in Fig. 15 below, and switch on the calibrator.

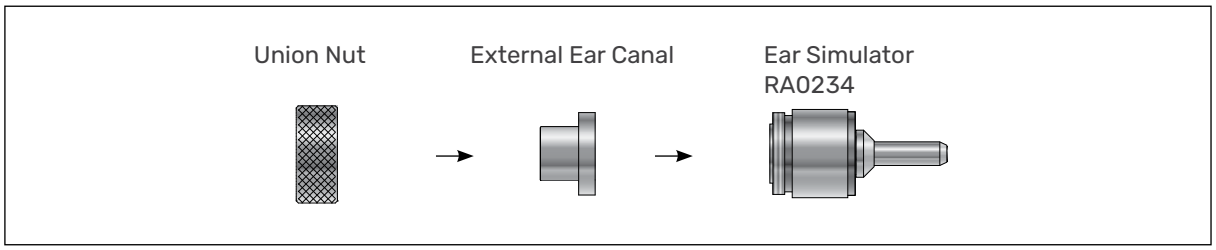


Fig. 15. *Mounting the GR0408 External Ear Canal on the ear simulator.*

6. Adjust the analyzer to indicate 94 dB re. 20 μPa. Adjust this value by a further **–0.09 dB** to account for the additional ear simulator volume.

Refer to your 42AG manual for further information.

Correction Factors

The correction factors for the various calibration options are listed below. The correction factors are needed because the different calibration options introduce varying effective volumes.

The correction factors have nothing to do with the different pinnae used.

45CA-1 to -12 with Standard Ear Simulator (RA0045-series and RA040X-series)		
In-situ calibration, without dismantling		
	Accessories	**Correction factor**
42AP and 42AA	RA0157	-0.62 dB
The cover plate and ear simulator removed		
42AP and 42AA	GR0408	-1.03 dB
42AG @250 Hz, 114 dB	GR0408	-0.09 dB
42AG @250 Hz, 94 dB	GR0408	-0.09 dB
42AG @1KHz, 114 dB	GR0408	-0.2 dB
42AG @1KHz, 94 dB	GR0408	-0.2 dB

Calibration at 1 kHz

At 1 kHz, the frequency response changes from unit to unit. The actual value for the specific ear simulator is stated on the calibration chart and must be added to the correction.

For example:
If the response of the specific ear simulator at 1 kHz is + 1.45 dB (re 500 Hz), the final correction value will be -0.2 + 1.45 = 1.25 dB.

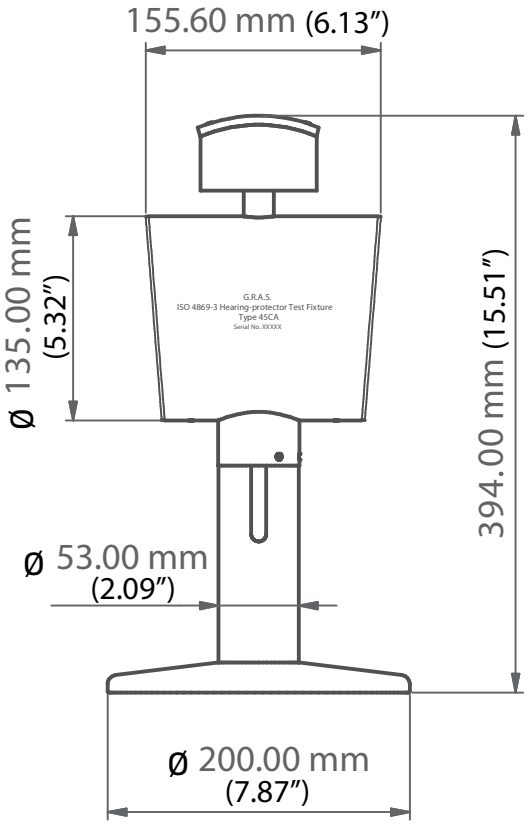
GRAS recommends calibrating at 250 Hz whenever possible.

Technical Specifications

45CA

45CA is built in accordance with ISO 4869-3.

Weight and Dimensions	
Weight	11,6 kg
Dimensions	



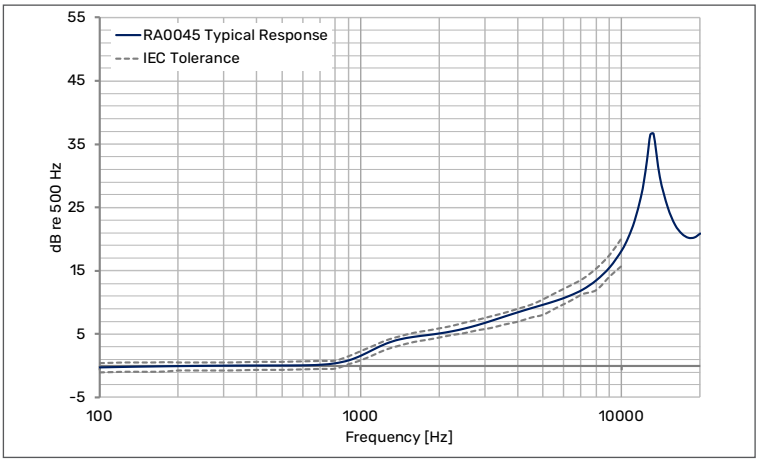
45CA-1 and 45CA-2

Self Insertion Loss, measured with closed ear simulators	
80 - 250 Hz	>50dB
350- 4000 Hz	>65dB
5000- 20000 Hz	>55dB

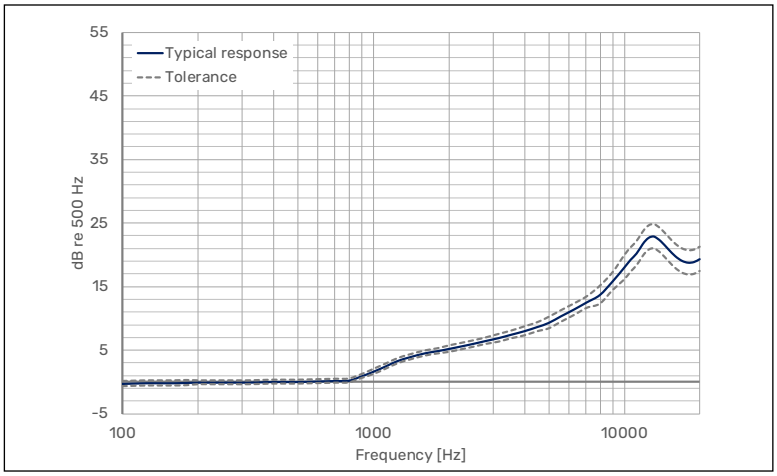
45CA-3 and 45CA-4

RA0039 Ear Simulator	
Standards	
IEC 60318-1	Ear simulator for the calibration of supra-aural and circumaural earphones
ITU-T Recommendation P.57	Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears
Frequency Response	
Typical frequency response	
Sensitivity	
Sensitivity	12.5 mV/Pa
Dynamic Range	
with 40AG	20 dBA to 164 dB
with 40AO	20 dBA to 163 dB
Dimensions	
Height	19.8.0 mm
Diameter	60 mm
Environmental Calibration Conditions	
Temperature	23 °C ±3 °C
Relative humidity	60 % ±20 %
Barometric pressure	101.3 kPa ±3 kPa

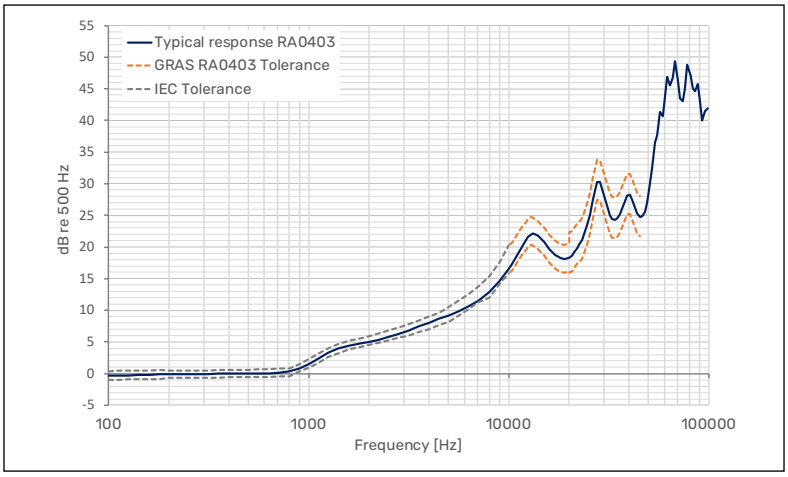
45CA-5 to 45CA-8

RA0045/RA0045-S1 Ear Simulator	
Standards	
IEC 60318-4	Occluded-ear simulators for the measurement of earphones coupled to the ear by ear inserts
ITU-T Recommendation P.57	Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears
ANSI S3.25/ASA-2009	American National Standard For an Occluded Ear Simulator
Frequency Response	
Typical transfer impedance re 500 Hz	
Resonance frequency	13.5 kHz ± 1 kHz
Sensitivity	
Sensitivity	12.5 mV/Pa
Dynamic Range	
RA0045（LEMO）	25 dBA to 164 dB
RA0045-S1（CCP）	25 dBA to 153 dB
Effective Volume	
at 500 Hz	1260 mm^3
Dimensions	
Height	23.0 mm
Diameter	23.75 mm

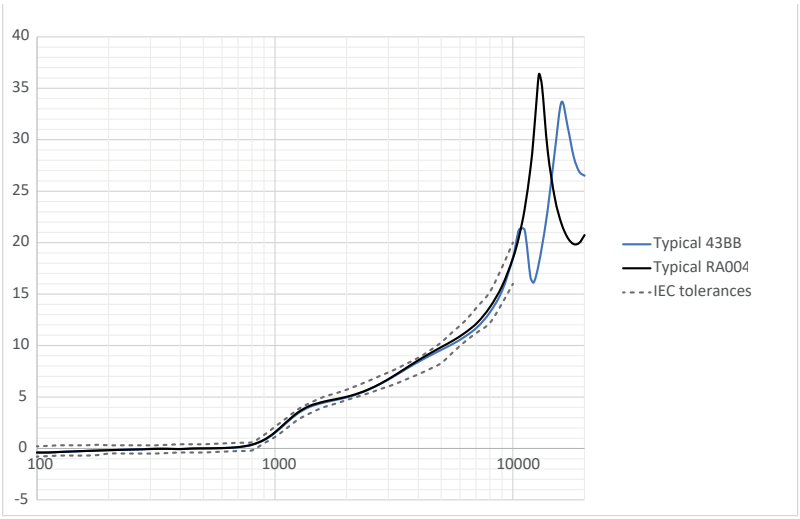
45CA-9 and 45CA-10

RA0401/0402 High-Frequency Ear Simulator	
Standards	
IEC 60318-4	Occluded-ear simulators for the measurement of earphones coupled to the ear by ear inserts
ITU-T Recommendation P.57	Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears
ANSI S3.25/ASA-2009	American National Standard For an Occluded Ear Simulator
Frequency Response	
Typical transfer impedance re 500 Hz	
Resonance frequency	13.5 kHz ± 1 kHz
Sensitivity	
Sensitivity	12.5 mV/Pa
Dynamic Range	
RA0401（LEMO）	25 dBA to 164 dB
RA0402（CCP）	25 dBA to 153 dB
Effective Volume	
at 500 Hz	1260 mm^3
Dimensions	
Height	23.0 mm
Diameter	23.75 mm

45CA-11 and 45CA-12

RA0403/RA0404 Hi-Res Ear Simulator	
Standards, based on:	
IEC 60318-4 (compatible)	Occluded-ear simulators for the measurement of earphones coupled to the ear by ear inserts.
ITU-T Recommendation P.57	Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears
ANSI S3.25/ASA-2009	American National Standard For an Occluded Ear Simulator
Frequency Response	
Typical transfer impedance re 500 Hz	
Resonance frequency	13.5 kHz ± 1 kHz
Sensitivity	
Sensitivity	1.6 mV/Pa
Dynamic Range	
RA0403 (LEMO)	44 dBA to 169 dB
RA0404 (CCP)	46 dBA to 174 dB
Effective Volume	
at 500 Hz	1260 mm^3
Dimensions	
Height	23.0 mm
Diameter	23.75 mm

45CA-13

43BB Low Noise Ear Simulator System	
Standards, based on:	
IEC 60318-4 (compatible)	Occluded-ear simulators for the measurement of earphones coupled to the ear by ear inserts.
ITU-T Recommendation P.57	Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears
ANSI S3.25/ASA-2009	American National Standard For an Occluded Ear Simulator
Frequency Response	
Typical transfer impedance re 500 Hz	
Resonance frequency	13.5 kHz ± 1 kHz
Sensitivity	
Sensitivity	800 mV/Pa
Dynamic Range	
43BB	10.5 dBA to 113 dB
Effective Volume	
at 500 Hz	1260 mm^3
Dimensions	
Height	23.0 mm
Diameter	23.75 mm

Warranty, Service and Repair

Calibration

Before leaving the factory, all GRAS products are calibrated in a controlled laboratory environment using traceable calibration equipment.

We recommend a yearly recalibration at minimum, depending on the use, measurement environment, and internal quality control programs.

Warranty

Damaged ear simulators can be replaced or repaired. The microphone diaphragm, body, and protection grid are made of high-grade stainless steel, which makes the microphone resistant to physical damage, as well as corrosion caused by aggressive air or gasses. This, combined with the reinforced gold-plated microphone terminal which guarantees a highly reliable connection, enables GRAS to offer 5 years warranty against defective materials and workmanship.

The warranty does not cover products that are damaged due to negligent use, an incorrect power supply, or an incorrect connection to the equipment.

Service and Repairs

All repairs are made at GRAS International Support Center located in Denmark. Our Support Center is equipped with the newest test equipment and staffed with dedicated and highly skilled engineers. Upon request, we make cost estimates based on fixed repair categories. If a product covered by warranty is sent for service, it is repaired free of charge, unless the damage is the result of negligent use or other violations of the warranty. All repairs are delivered with a service report, as well as an updated calibration chart.

Manufactured to conform with:

CE marking directive:
93/68/EEC

WEEE directive:
2002/96/EC

RoHS directive:
2002/95/EC

GRAS Sound & Vibration continually strives to improve the quality of our products for our customers; therefore, the specifications and accessories are subject to change.