

45BC KEMAR Head and Torso with Mouth Simulator

Applications

- Headset testing (incl. Bluetooth headsets)
- Telephone testing
- Hearing aid test and validation
- Sound quality recordings

Standards

- ANSI S3.36/ASA58-2012
- ANSI S3.25/ASA80-1989
- IEC 60318-7:2011 Head and Torso Simulator
- IEC 60318-4 (60711) Ear Simulator
- ITU-T Rec. P.57 Type 3.3 Pinna Simulator
- Based on ITU-T Rec P.58

Features

- Geometry similar to a real person
- Accurate in-situ simulation of the effects of a human head and torso in a sound field
- Both sound transmission and pick-up characteristics simulation
- Built-in mouth simulator and power amplifier
- Configurable with prepolarized or externally polarized microphone-preamplifier assemblies
- 55 Shore OO, 35 Shore OO pinnae, and three different ear canal extensions are available
- Can be mounted with ½" or ¼" pressure microphones for sound quality applications
- Accommodates Handset Positioning System 45EA, a flexible positioning system for measurements of mobile telephones and smartphones according to ITU-T recommendations
- Easy calibration: The pistonphone calibration can be performed from the outside
- Standard connectors for many types of analyzers



Fig. 1. 45BC KEMAR Head and Torso with Mouth Simulator

Background

The KEMAR head and torso simulator was introduced by Knowles in 1972 and quickly became the industry standard for hearing-aid manufacturers and research audiologists. It is based on worldwide average human male and female head and torso dimensions. It meets the requirements of ANSI S3.36/ASA58-2012 and IEC 60318-7:2011.

The G.R.A.S. 45BC KEMAR Head and Torso with Mouth Simulator has the same dimensions and acoustical properties as the original KEMAR, but has been developed further by G.R.A.S. to enable realistic measurements of communication devices. It is based on the requirements of ITU-T P58, Head and Torso Simulator for Telephonometry.

It provides acoustic diffraction similar to that encountered around the median human head and torso, both in the proximity and in the far field. It simulates both the sound emissions and pick-up characteristics, as well as the free-field acoustic diffraction.

Description

The 45BC KEMAR Head and Torso (Fig. 1) is an acoustic research tool with built-in mouth and ear simulators that simulates the changes that occur to sound waves as they pass a human head and torso.

Mouth Simulator

The built-in mouth simulator simulates the sound field around the human head at close quarters and the far field. It is based on ITU-T Rec. P.58.

At the mouth reference point (MRP) – 25 mm from the lip plane – the mouth simulator can be equalized to produce a signal from 100Hz to 10kHz up to a level of minimum 100 dB re. 20 μ Pa.

The internal amplifier provides 10 dB amplification. If switched off, it is bypassed.

Fig. 3 shows a typical frequency response curve for a swept-sine signal 100 Hz – 20 kHz and the corresponding equalized response.

Calibration of the Mouth Simulator

The 45BC KEMAR Head and Torso is supplied with a jig for calibration of the mouth according to ITU-T Rec. P.58. It uses a ¼" pressure-field microphone (e.g. 40BP) and a ¼" preamplifier (e.g. 26AC). As shown in Fig. 2, the tube supplied holds the preamplifier at 90° incidence to the mouth simulator.

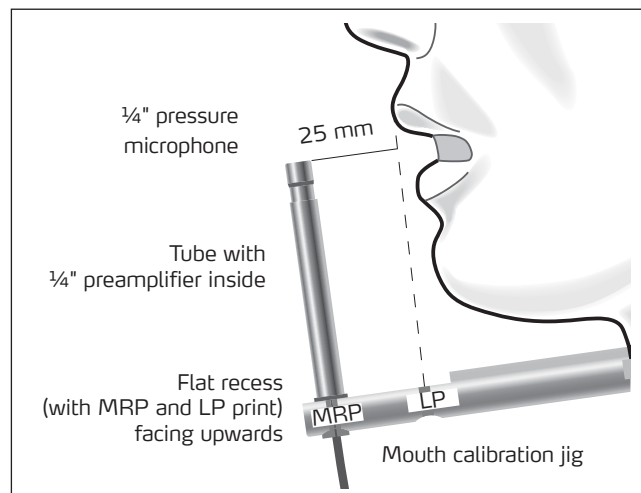


Fig. 2. Calibration Jig for calibration of mouth simulator

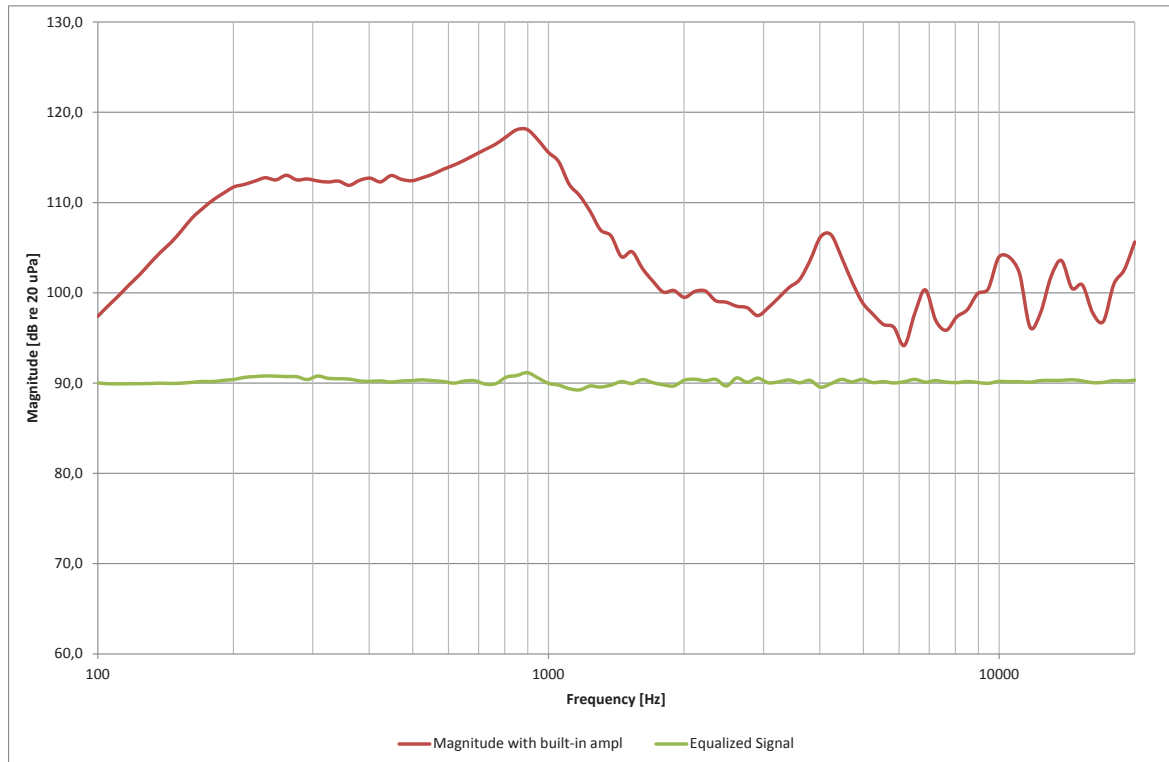


Fig. 3. Typical frequency response measurements using the ITU-T Rec. P.58 setup shown in Fig. 2. The upper curve is the frequency response for an input signal of 1 V RMS with the internal amplifier switched on. The lower curve shows the same response equalized at 90 dB.

Artificial Ears

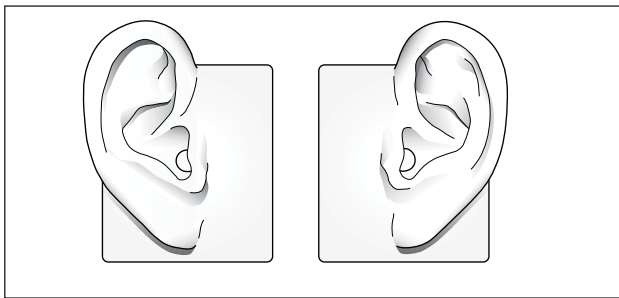


Fig. 5. Standard pinnae (normal or soft hardness available)

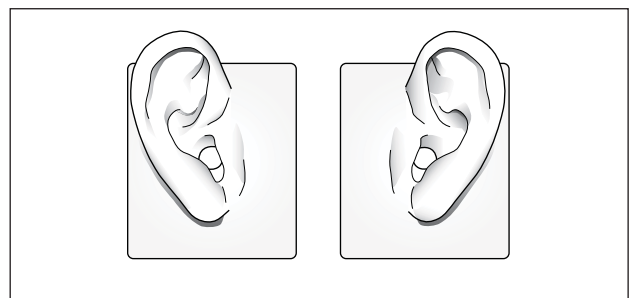


Fig. 6. Small pinnae (normal or soft hardness available)

KEMAR fitted with pinna simulator (outer part), ear canal extension (middle part), and IEC 60711 Ear Simulator (inner part) resembles the acoustic impedance of the human ear.

Pinna Simulators

Twelve (six pairs) different types of pinnae are available from G.R.A.S. for KEMAR. They come in two sizes (standard and small), two Shore hardnesses, normal (55 Shore OO (IEC 60959) and soft, 35 Shore OO), and a VA-style (55 Shore OO and 35 Shore OO). They are designed for an easy push-fit into the ear recesses on the sides of the KEMAR Head.

- Small ears are typical of American and European females as well as Far-eastern males and females
- Large ears have pinna sizes typical of American and European males (Fig. 5)
- VA-style (Veterans Administration) for use with a tapered ear canal extension. They are used for hearing aid testing, testing of in-ear headphones (earbuds) and sound quality recordings.

For telephone testing, pinnae with 35 Shore OO are most often used to obtain the desired sealing conditions. For other applications, the 55 Shore OO is normally used.

KEMAR Ear Canal Extension

The standardized Ear Canal Extension RA0237 conforms with the requirements of the IEC 60318-7 standard. It is made of steel and will not deform when testing devices in the concha or devices that are pressed against the pinnae, e.g. telephone handsets, earphones, and headphones. This ensures a leakage-free interface to the IEC 60318-4 (60711) Ear Simulator resulting in a high degree of repeatability.




Available Ear Canal Extensions	
	RA0237 Ear Canal Extension, Ø 7.5 mm, 8.3 mm long
	RA0238 Ear Canal Extension with VA-style pinna-extension tube, Ø 9.85 tapering down to Ø 7.5 mm, 7.4 mm long
	RA0239 Ear Canal Extension with silicon rubber lining, Ø 7.5 mm, 14 mm long

Fig. 4. Three types of ear Canal extensions are available. They are screwed onto the ear simulator and easily push-fitted into KEMAR's holders

The IEC 60318-4 Ear Simulator

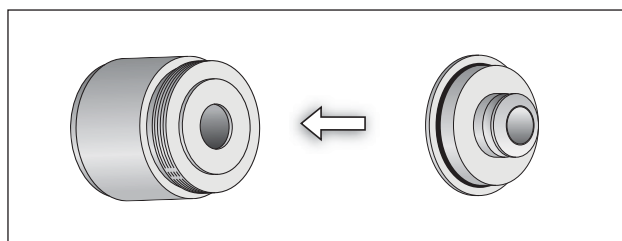


Fig. 7. The IEC 60318-4 (711) Ear Simulator and RA0237 Ear Canal Extension

The G.R.A.S. Ear Simulator according to IEC 60318-4 is an ear simulator with an input impedance that closely resembles that of the human ear.

It meets the requirements of

- IEC 60318-4:2007 "Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts."
- ITU-T P. 57 (08/96) "Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears."

It embodies a number of carefully designed volumes connected via well defined and precisely tuned resistive grooves. Its input impedance

resembles that of the human ear and therefore it loads the device under test in a way very similar to the human ear. The acoustic impedance of the ear simulator is measured at the ear reference point using an impedance probe, in accordance with the ITU-T Recommendations P57 (08/96).

The ear simulator comes in two versions, an externally polarized version, RA0045 and a prepolarized version, RA0045-S1.

Externally Polarized Ear Simulator RA0045

It is based on the G.R.A.S. 40AG ½" Ext. Polarized Pressure Microphone and is supplied with an individual calibration chart for the coupler-microphone combination. It requires a traditional 200 V polarization voltage. Connection is via 7-pin LEMO.

Prepolarized Ear Simulator RA0045-S1

It is based on the G.R.A.S. 40AO ½" Prepolarized Pressure Microphone and is supplied with an individual calibration chart for the coupler-microphone combination. It requires a CCP supply. Connection is via a BNC cable.

45BC KEMAR Head and Torso with Mouth Simulator

Easy to Use and Maintain

Thanks to user-friendly assembly solutions, the 45BC KEMAR is easy to use, maintain and calibrate.

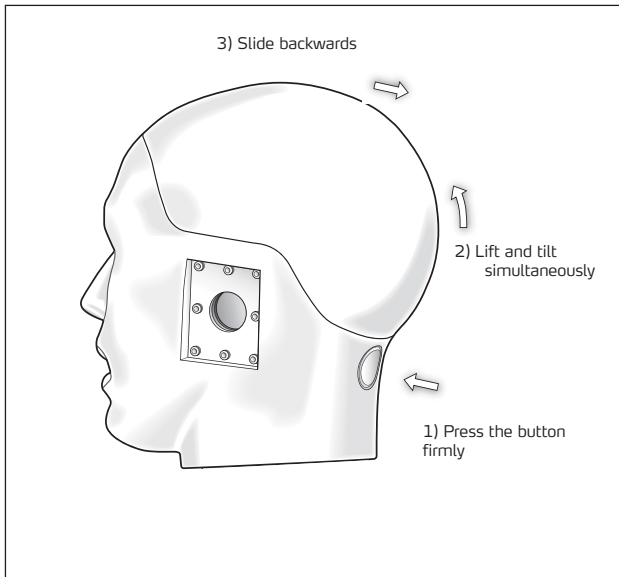


Fig. 8. The top of the head is released by a push of a button

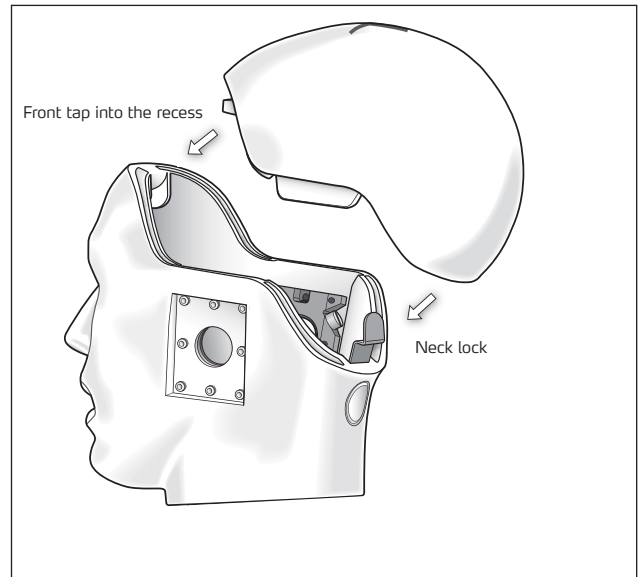


Fig. 9. The top of the head is mounted without tools

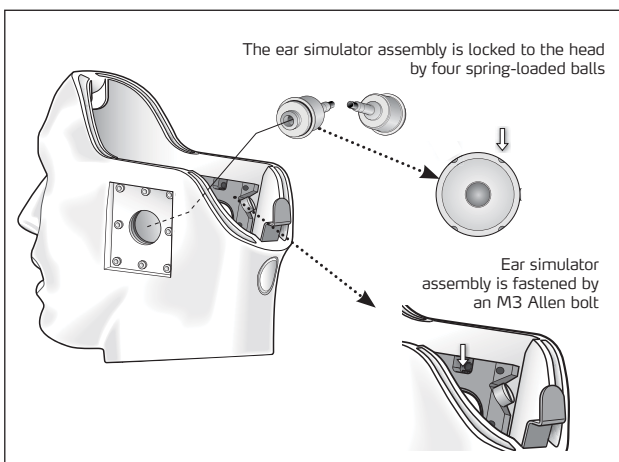


Fig. 10. Ear simulators are easy to remove and install

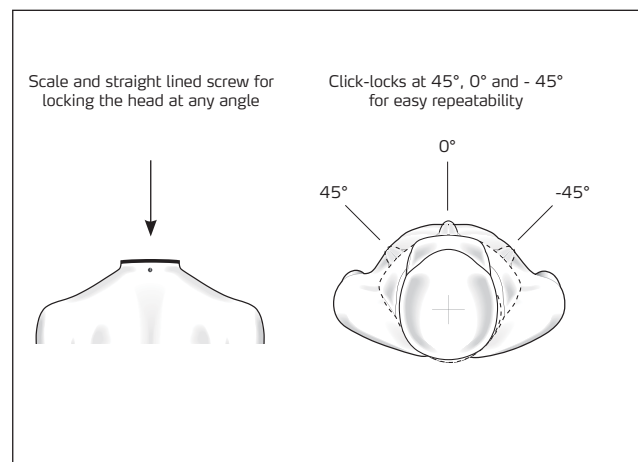


Fig. 11. Adjustable neck angle

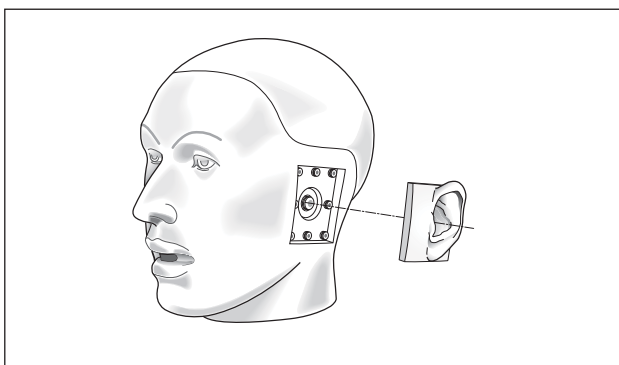


Fig. 12. The pinnae are push-mounted on 8 studs

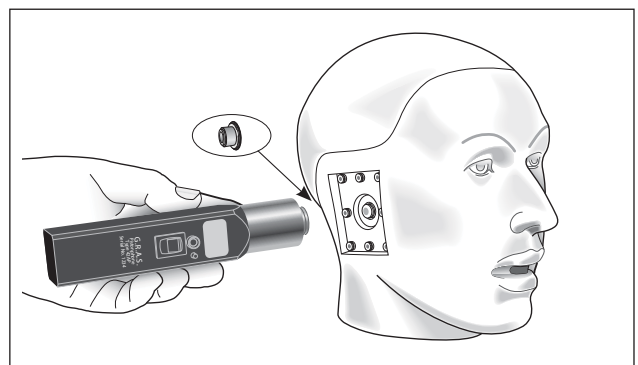


Fig. 13. Calibration can be done from the outside

45BC KEMAR Head and Torso with Mouth Simulator

Easy to Connect

As delivered, KEMAR is fully assembled and tested, ready for use. All you need to do is to make the external connections for mouth and microphones at the lower back of the torso.

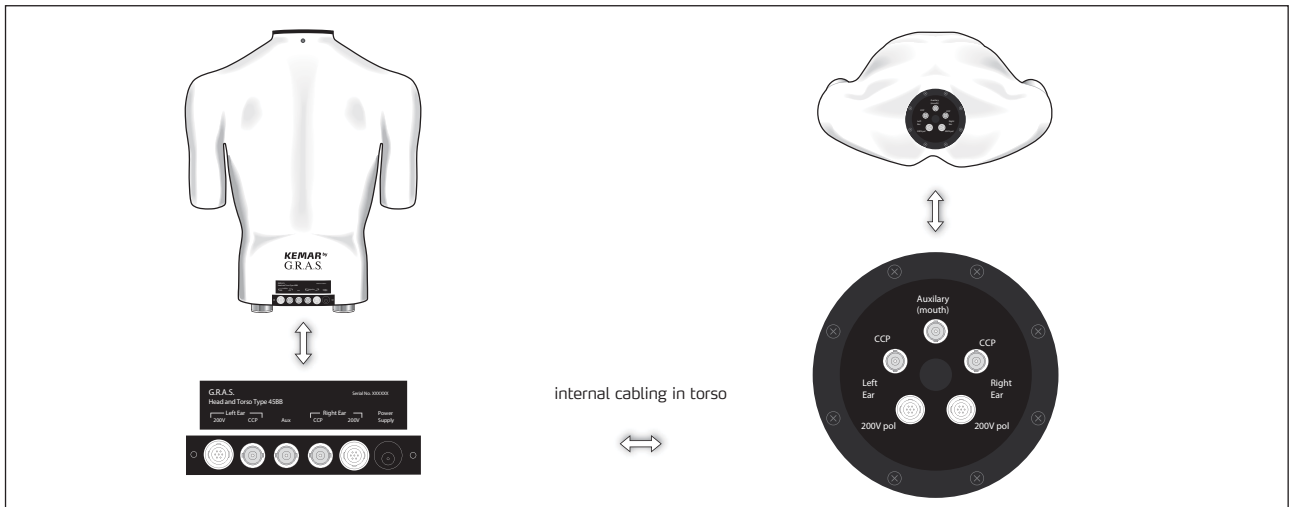


Fig. 14. KEMAR's sockets. All internal cabling is factory-mounted

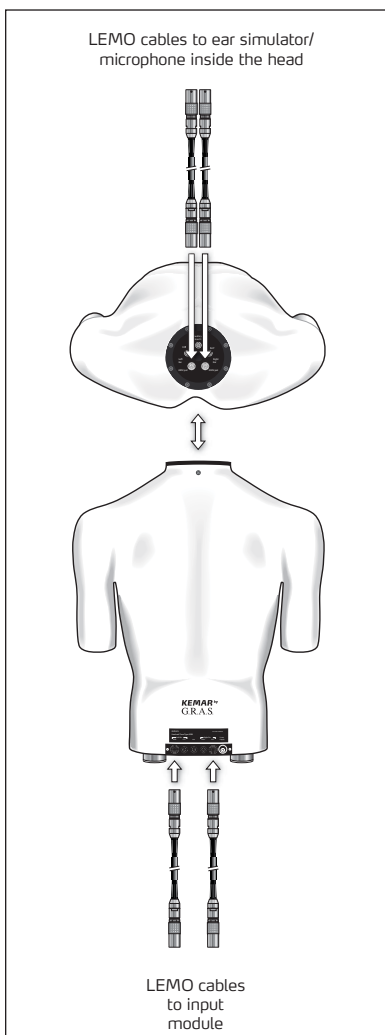


Fig. 15. Ext.polarized ear-simulators

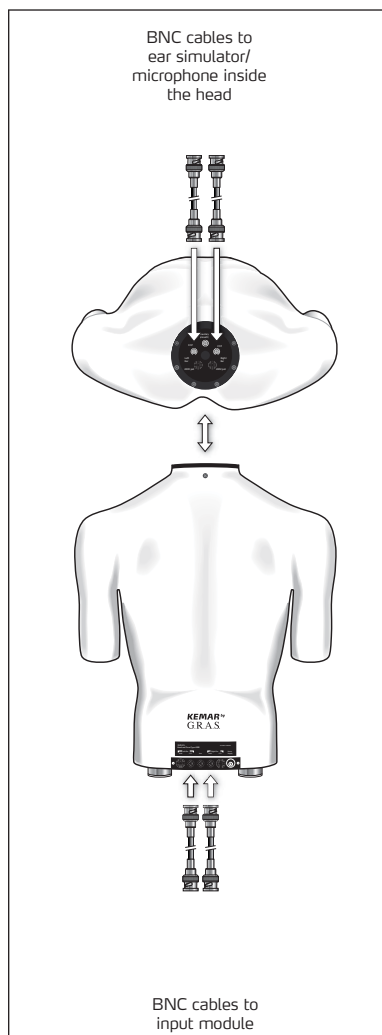


Fig. 16. Pre-polarized ear-simulators

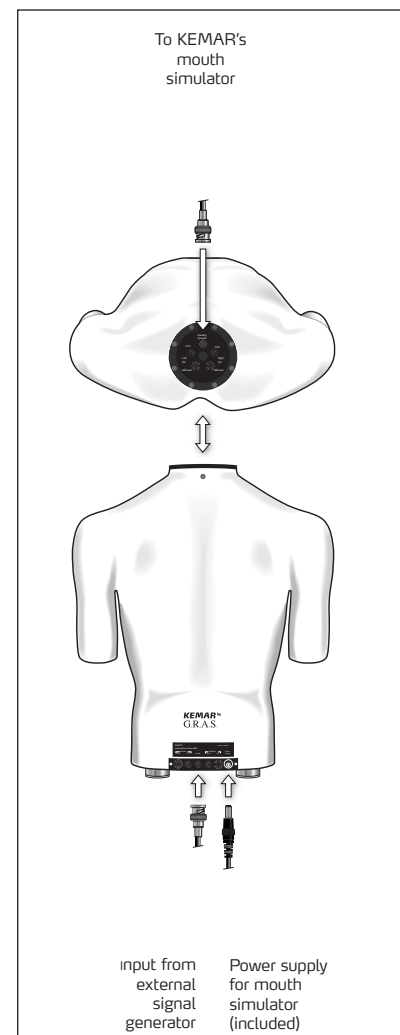


Fig. 17. Mouth simulator

45BC KEMAR Head and Torso with Mouth Simulator

45BC KEMAR Configurations

45BC KEMAR Head and Torso with Mouth Simulator comes in a number of preassembled configurations as shown below.

All preconfigured versions come fully assembled, ready for use. They are individually calibrated and delivered with a system calibration certificate.

The items that are part of the 45BC KEMAR Head and Torso with Mouth Simulator, non configured are shown in Fig. 18. This basic version is also part of the pre-configured 45BC KEMARs.

45BC KEMAR Configurations	Order number
KEMAR Head and Torso with Mouth Simulator, non-configured The delivered items are listed on page 13	45BC
KEMAR Head & Torso with Mouth Simulator for Headset Test, 2-Ch LEMO The delivered items are listed on page 13	45BC-1
KEMAR Head & Torso with Mouth Simulator for Headset Test, 2-Ch CCP The delivered items are listed on page 14	45BC-2
KEMAR Head & Torso with Mouth Simulator for Telephone Test, 1-Ch LEMO The delivered items are listed on page 14	45BC-3
KEMAR Head & Torso with Mouth Simulator for Telephone Test, 1-Ch CCP The delivered items are listed on page 14	45BC-4

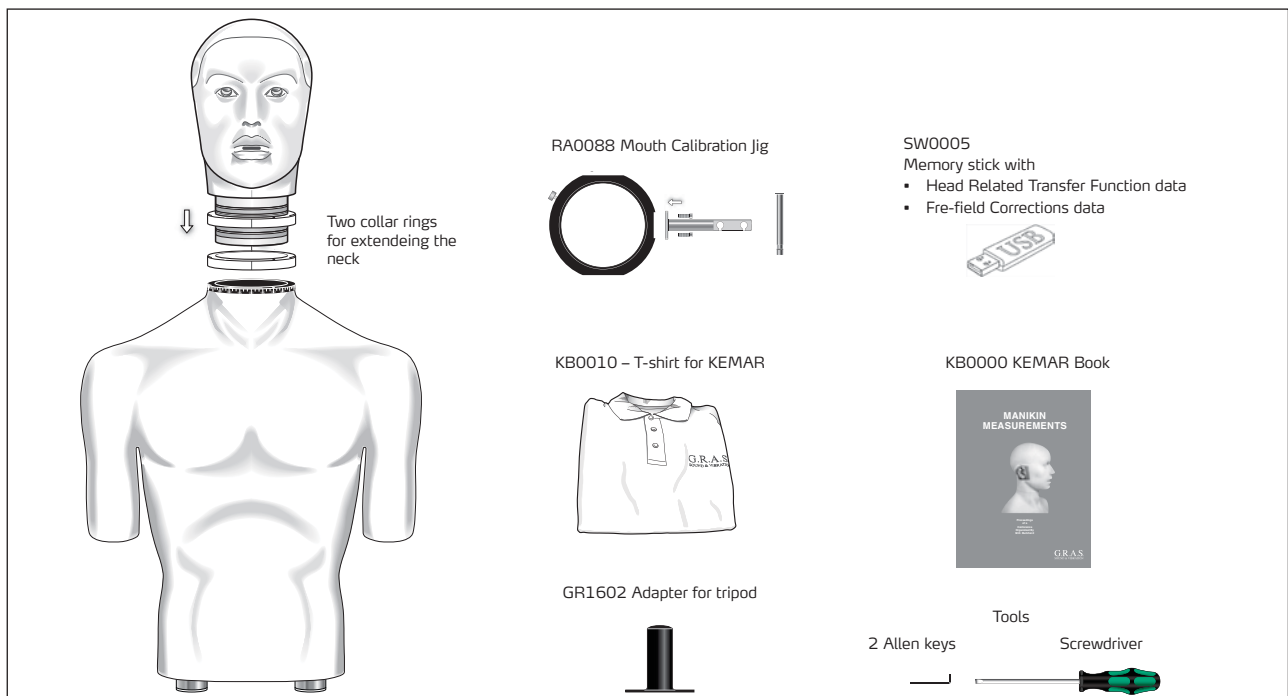


Fig. 18. The 45BC Head and Torso with Mouth Simulator, non-configured. Pinnae are not part of the delivery.

Specifications

Standards	
ANSI S3.36/ASA58-2012	Specification for a Manikin for Simulated in situ Airborne Acoustic Measurements
ANSI S3.25/ASA-2009	American National Standard for an Occluded Ear Simulator
IEC 60318-7:2011	Head and Torso Simulator for the Measurement of Hearing Aids
IEC 60318-4	Ear Simulator, Occluded-ear simulator for the measurement of earphones coupled to the ear by means of ear inserts
ITU-T Rec. P.57	Type 3.3 Artificial Ears

Weight and Dimensions	
Weght	13 kg
<p>KEMAR Dimensions</p>	

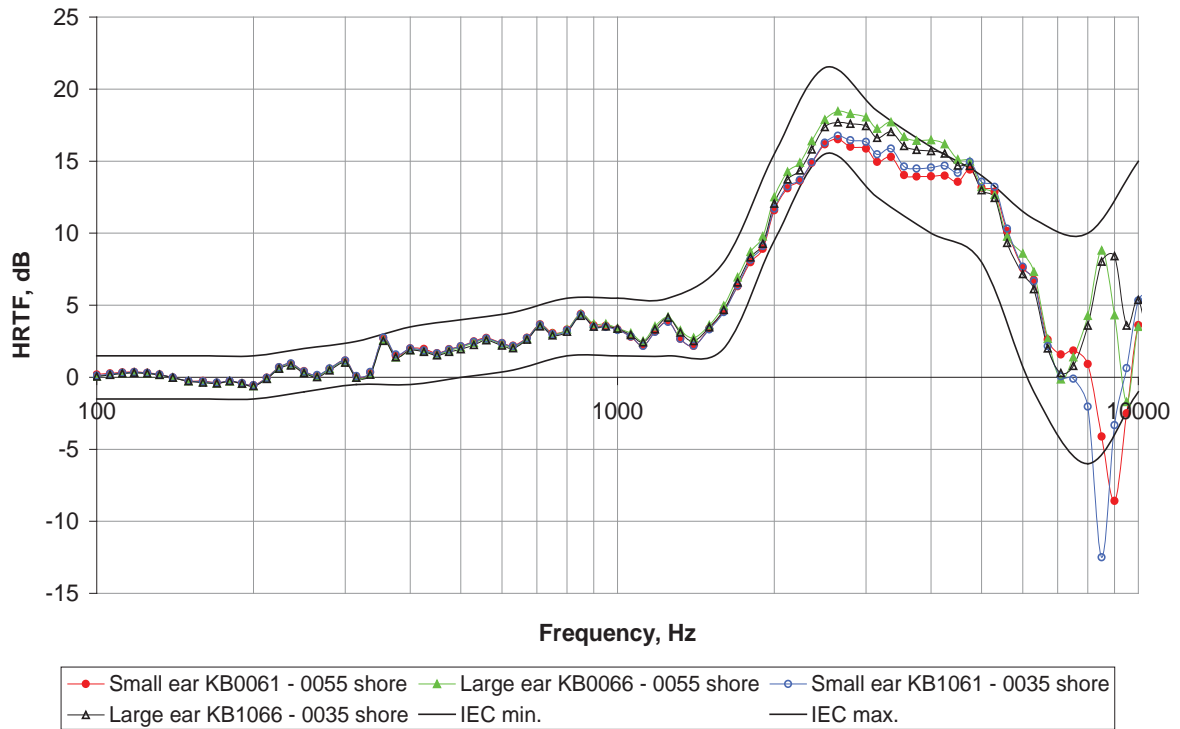
KEMAR Base	
Base	$\frac{3}{8}$ " UNC-20 standard threaded hole.
Adapter for tripod	GR1602 Adapter with 35 mm hole for Loudspeaker stand/Tripod (AL0026)
Feet	5 feet, unscrewable

45BC KEMAR Head and Torso with Mouth Simulator

KEMAR External Connectors	
2 × 7-pin LEMO	For externally polarized microphones
3 × BNC	2 for prepolarized microphones (CCP), 1 for signal to mouth simulator
DC-socket	For mouth simulator amplifier, 24 V DC, max 1A

KEMAR Pinnae	
Standard	
IEC 60318-7: 2011	Head and Torso Simulator for the Measurement of Hearing Aids

Head Related Transfer Function	
Standard IEC 60318-7:2011	Head and Torso Simulator for the Measurement of Hearing Aids



Head-related Transfer Function (HRTF) measurements for four different types of pinnae (soft/hard - large/small), in 0° azimuth, performed with a sound source at a distance of 1.4 m from the KEMAR.

45BC KEMAR Head and Torso with Mouth Simulator

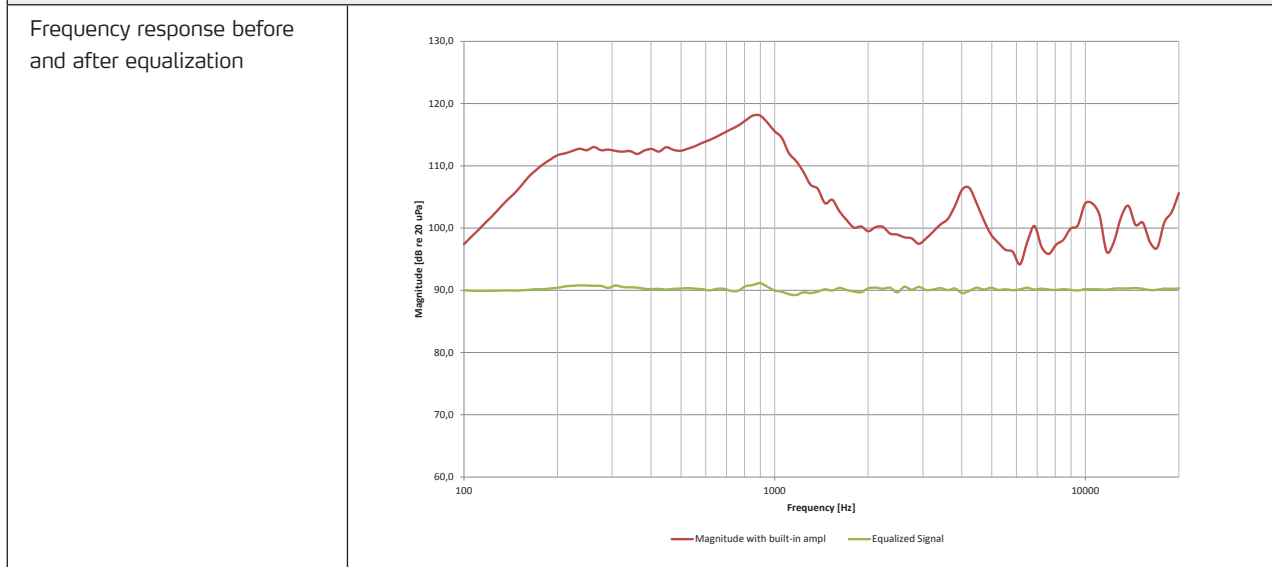
Ear Simulator	
Standards	
IEC 60318-4	Occluded-ear simulators for the measurement of earphones coupled to the ear by ear inserts
ITU-T Recommendation P.57	Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears
ANSI S3.25/ASA-2009	American National Standard For an Occluded Ear Simulator
Frequency Response	
Typical frequency response re. 500 Hz	<p>The graph, titled 'Typical Frequency Response', plots Magnitude (dB) on the y-axis (ranging from -10 to 40) against Freq (Hz) on the x-axis (logarithmic scale from 100 to 100,000). The curve starts near 0 dB at 100 Hz, remains flat until about 1000 Hz, then rises to a peak of approximately 35 dB at 13.5 kHz, before settling around 15 dB at 100,000 Hz.</p>
Resonance frequency	13.5 kHz ± 1 kHz (At reference point)
Sensitivity	
Sensitivity	12.5 mV/Pa
Dynamic Range	
RA0045 (LEMO)	27 dBA to 160 dB
RA0045-S1 (CCP)	27 dBA to 147 dB
Effective Volume	
at 500 Hz	1260 mm ³
Dimensions	
Height	23.0 mm
Diameter	23.75 mm
Weight	52 g
Environmental Calibration Conditions	
Temperature	23 °C ±3 °C
Relative humidity	60 % ±20 %
Barometric pressure	101.3 kPa ±3 kPa

45BC KEMAR Head and Torso with Mouth Simulator

Ear Canal Extensions	
RA0237	Straight Ear Canal Extension, Ø 7.5 mm, 8.3 mm long
RA0238	VA-tapered Ear Canal Extension, Ø 9.85 mm tapering down to Ø 7.5 mm, 7.4 mm long
RA0239	Straight, rubber lined Ear Canal Extension, Ø 7.5 mm, 14 mm long

Mouth Simulator

Frequency Response



Maximum Continuous Output Level at MRP

200 Hz – 6 kHz	110 dB re. 20 µPa
100 Hz – 10 kHz	100 dB re. 20 µPa

Total Harmonic Distortion (equalized, 90 dB re 20 µPa at MRP)

200 Hz - 5 kHz	Typically 1 %, max. 1.5 %
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Mouth to Ear Crosstalk Attenuation (closed ear, 1/3 octave band)

100 Hz - 1 kHz	50 dB
1 kHz - 8 kHz	40 dB

Loudspeaker

Impedance	8 Ω
Continuous	10 W
Pulsed	50 W (for 2 sec.)

Power Amplifier

Gain	10 dB
Input impedance	20 kΩ
Power supply	24 V
Max. input voltage	2V RMS

45BC KEMAR Head and Torso with Mouth Simulator

Temperature	
Operation	-5 °C to + 50 °Celsius
Storage	-5 °C to + 50 °Celsius

Relative Humidity	
Operation	Up to 95%, non condensing
Storage	Up to 95%, non condensing

CE Conformity	
Safety	EN/IBC 61010
EMC Emission	EN/IBC 61010-1
EMC immunity	EN/IBC 61010-6

Warranty	
2 years	The warranty does not cover damages due to negligent use or incorrect connections to the equipment.

Service and Repair
<p>All repairs are made at G.R.A.S. 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.</p> <p>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.</p>

45BC KEMAR Head and Torso with Mouth Simulator

Ordering Information

45BC KEMAR – non configured

KEMAR Head and Torso with Mouth Simulator, non-configured		Order number
<i>KEMAR Head and Torso with Mouth Simulator, non-configured</i>		45BC
Delivered items		Part number
KEMAR Head Assembly with Mouth Simulator	1	45BH-S1
KEMAR Torso	1	45BT-S1
Neck Extension Ring, 11 mm	2	GR1589
T-Shirt	1	KB0010
USB memory stick with HRTF and Free-field corrections data	1	SW0005
Mouth Calibration Jig	1	RA0188
BNC-to-BNC Cable, 50 cm	1	AA0032
Mouth Simulator Extension Cable, BNC-BNC, 3 m	1	AA0035
Power supply for mouth simulator's amplifier	1	AB0012
KEMAR Book	1	KB0000
Allen key, 2 mm	1	YY0018
Allen key, 4 mm	1	YY0013
Screwdriver	1	YY0039
Bottom plate with 3/8" thread	1	GR1573
Adapter with 35mm hole for loudspeaker stand (AL0026)	1	GR1602

45BC KEMAR - Pre-configured

45BC-1 KEMAR for Headset Test, 2-Ch LEMO		Order number
<i>KEMAR Head & Torso with Mouth Simulator for Headset Test, 2-Ch LEMO</i>		45BC-1
Delivered items		Part number
KEMAR Head and Torso with Mouth Simulator, non-configured	1	45BC
Large Right Pinna	1	KB1065
Large Left Pinna	1	KB1066
Ear Canal Extension Kit (2 pcs)	1	RA0237
Ear Simulator	2	RA0045
¼" Preamp., short, incl. 35 cm cable	2	26AS-S3
Microphone Extension Cable, 3 m	2	AA0008
¼" Pressure Microphone Set for calibration of mouth	1	46BP

45BC KEMAR Head and Torso with Mouth Simulator

45BC-2 KEMAR for Headset Test, 2-Ch CCP		Order number
KEMAR Head & Torso with Mouth Simulator for Headset Test, 2-Ch CCP		45BC-2
Delivered items		Part number
KEMAR Head and Torso with Mouth Simulator, non-configured	1	45BC
Large Right Pinna	1	KB1065
Large Left Pinna	1	KB1066
Ear Canal Extension Kit (2 pcs)	1	RA0237
Ear Simulator	2	RA0045-S1
¼" Preamp., short, incl. 35 cm cable	2	26CS
Microphone Extension Cable, 3 m	2	AA0035
¼" Pressure Microphone Set for calibration of mouth	1	46BD

45BC-3 KEMAR for Telephone Test, 1-Ch LEMO		Order number
KEMAR Head & Torso with Mouth Simulator for Telephone Test, 1-Ch LEMO		45BC-3
Delivered items		Part number
KEMAR Head and Torso with Mouth Simulator, non-configured	1	45BC
Large Right Pinna	1	KB1065
Large Left Pinna	1	KB1066
Ear Canal Extension Kit (2 pcs)	1	RA0237
Ear Simulator	1	RA0045
¼" Preamp., short, incl. 35 cm cable	1	26AS-S3
Microphone Extension Cable, 3 m	1	AA0008
Handset Positioning System	1	45EA
¼" Pressure Microphone Set for calibration of mouth	1	46BP

45BC-4 KEMAR for Telephone Test, 1-Ch CCP		Order number
KEMAR Head & Torso with Mouth Simulator for Telephone Test, 1-Ch CCP		45BC-4
Delivered items		Part number
KEMAR Head and Torso with Mouth Simulator, non-configured	1	45BC
Large Right Pinna	1	KB1065
Large Left Pinna	1	KB1066
Ear Canal Extension Kit (2 pcs)	1	RA0237
Ear Simulator	1	RA0045-S1
¼" Preamp., short, incl. 35 cm cable	1	26CS

45BC KEMAR Head and Torso with Mouth Simulator

Microphone Extension Cable, 3 m	1	AA0035
Handset Positioning System	1	45EA
¼" Pressure Microphone Set for calibration of mouth	1	46BD

Additional Accessories Available for All Applications

Power Modules for Externally Polarized Ear Simulators and Microphones	Order number
1-Channel Power Module with gain, filters and SysCheck generator	12AK
1-Channel Power Module	12AD
2-Channel Power Module with gain, filters and SysCheck generator	12AA
2-Channel Power Module	12AR
2-Channel Universal Power Module with signal conditioning and PC interface	12AQ

Power Modules for Pre-polarized Ear Simulators and Microphones	Order number
1-Channel CCP Power Module with A-weighting filter	12AL
2-Channel Universal Power Module with signal conditioning and PC interface	12AQ

For Ear Simulator Calibration	Order number
Intelligent Pistonphone (250 Hz or 251.2 Hz, 114 dB +/- 0.05 dB)	42AP
Pistonphone (250 Hz, 114 dB +/- 0.08 dB)	42AA
½" Calibration Adapter for KEMAR Pinna	RA0157

Ear Mould Simulators	Order number
Ear Mould Simulator for 2 mm inner diameter tubing	KB0110
Ear Mould Simulator for 3 mm inner diameter tubing	KB0111

45BC KEMAR Head and Torso with Mouth Simulator

Ear Canal Extension and Microphone Holder Kits (kits with 2 pcs and O-rings)	Order number
Straight Ear Canal Extension Kit for KEMAR	RA0237
VA-tapered Ear Canal Extension Kit for KEMAR	RA0238
Ear Canal Extension Kit with silicone lining for KEMAR	RA0239
Holder for long ½" microphone Kit for KEMAR	RA0240
Holder for short ½" microphone Kit for KEMAR	RA0241
Holder for ¼" mic. Kit for KEMAR	RA0243
O-ring kit (2 pcs)	RA0244

Pinna Simulators	Order number
KEMAR Small Right Ear 55 Shore OO	KB0060
KEMAR Small Left Ear 55 Shore OO	KB0061
KEMAR Large Right Ear 55 Shore OO	KB0065
KEMAR Large Left Ear 55 Shore OO	KB0066
KEMAR Small Right Ear 35 Shore OO	KB1060
KEMAR Small Left Ear 35 Shore OO	KB1061
KEMAR Large Right Ear 35 Shore OO	KB1065
KEMAR Large Left Ear 35 Shore OO	KB1066
KEMAR Large Right Ear (VA-Style/SQ) 55 Shore OO	KB0090
KEMAR Large Left Ear (VA-Style/SQ) 55 Shore OO	KB0091
KEMAR Large Right Ear (VA-Style) 35 Shore OO	KB1090
KEMAR Large Left Ear (VA-Style) 35 Shore OO	KB1091

Extension Cables	Order number
<i>For externally polarized ear simulators and microphones (LEMO - LEMO)</i>	
3 m	AA0008
10 m	AA0009
xx m	AA0020-xx
<i>For prepolarized ear simulators and microphones (BNC-BNC)</i>	
2 m	AA0034
3 m	AA0035
5 m	AA0036
10 m	AA0037
xx m	AA0039-xx

45BC KEMAR Head and Torso with Mouth Simulator

Flight Case	Order number
PELI Case for KEMAR	KM0094

Stand for KEMAR	Order number
Tripod (loudspeaker) stand for KEMAR, Ø 35 mm	AL0026

Miscellaneous	Order number
KEMAR Handbook (can also be downloaded from www.gras.dk)	KB0000
T-Shirt for KEMAR	KB0010

G.R.A.S. Sound & Vibration continually strives to improve the quality of our products for our customers; therefore, the specifications and accessories are subject to change.
KEMAR® is a trademark of G.R.A.S. Sound & Vibration A/S.