

# GRAS 45CA

Headphone/Hearing-protector  
Test Fixture



ISO: 4869-3  
IEC: 60318-1 and 60318-4  
depending on configuration

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The GRAS 45CA is a versatile test fixture for measuring sound isolation of hearing-protectors according to ISO 4869-3 and ear- and headphones according to IEC60318-1 or 60318-4. For testing hearing-protectors according to ANSI/ASA S12.42, choose [GRAS 45CB](#).

## Introduction

GRAS 45CA provides the basis for reliable and exact measurements and is designed with

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

The 45CA's robust design is ideally suited for binaural testing of active and passive earplugs, as well as circumaural hearing protectors.

It is primarily intended for testing the performance of hearing-protection devices such as earplugs and earmuffs (supra-aural and circum-aural) but can also be used for testing sound sources such as earphones and headphones. It is fitted with either microphones or ear simulators, depending on the device to test and the standard to comply with.

Compliance with ISO 4869-3, IEC 60318-1, and IEC 60318-4 assures technicians, decision-makers, and authorities of repeatability and transparent data when developing and verifying hearing protectors.

The pinnae for the 45CA are the same as the standardized KEMAR pinnae but rounded to fit the large 45CA base plate. This large base plate reduces or eliminates the risk of leakage.

The 45CA includes two plugs for measuring the acoustic isolation in a closed ear.

We recommend calibration before each use to

ensure the accuracy of your measurements. The [GRAS 42AP](#) Intelligent Pistonphone or the [GRAS 42AA](#) Pistonphone are ideally suited for this task.

## Configurations for typical applications and use

45CA Headphone/Hearing-protector Test Fixture, Non-configured is a versatile test platform that you can configure to suit specific needs. The most common configurations can be ordered fully assembled, calibrated and tested from GRAS These are:

*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. The configuration complies with ISO 4869-3.

*45CA-2 Headphone/Hearing-protector Test Fixture, ISO 4869-3 1/2" 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 1/2" pressure microphones. This configuration complies with ISO 4869-3

*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 1/2" externally polarized microphones. The configuration complies with IEC 60318-1. The RA0039 cannot be used with a pinna

simulator, and therefore cannot be used for measuring in-ear earphones.

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

The 45CA-4 is configured with two RA0039 Ear Simulators with 40AO 1/2" 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 pinna simulator, and therefore cannot be used for measuring in-ear earphones.

### *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 pinna simulators. It can be used for measurements of the insertion loss of earmuffs and earplugs, and the sound quality of earphones and headphones. The configuration complies with IEC 60318-4.

### *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 pinna 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-7 Headphone/Hearing-protector Test Fixture, IEC 60318-4 LEMO, with Anthropometric Pinnae*

The 45CA-7 is configured with RA0045 externally polarized 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-8 Headphone/Hearing-protector Test Fixture, IEC 60318-4 CCP, with Anthropometric Pinnae*

The 45CA-8 is configured with RA0045-S1 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-9 Headphone/Hearing-protector Test Fixture, High-Frequency Ear Simulator and Anthropometric Pinnae, LEMO*

The 45CA-9 is configured with RA0401 externally polarized high-frequency ear simulators and anthropometric pinnae. It can be used for measurements of hearing aids, earphones and headphones up to 20 kHz. The configuration complies with IEC 60318-4.

### *45CA-10 Headphone/Hearing-protector Test Fixture, High-Frequency Ear Simulator and Anthropometric Pinnae, CCP*

The 45CA-10 is configured with RA0402 prepolarized ear simulators and anthropometric pinnae. It can be used for measurements of hearing aids, earphones and headphones up to 20 kHz. The configuration complies with IEC 60318-4.

### *45CA-11 Headphone/Hearing-protector Test Fixture, Hi-Res Ear Simulator and Anthropometric Pinnae, LEMO*

The 45CA-11 is configured with RA0403 externally polarized hi-res ear simulators and anthropometric pinnae. It can be used for measurements of hearing aids, earphones and headphones up to 50 kHz. The configuration is compatible with IEC 60318-4.

*45CA-12 Headphone/Hearing-protector Test Fixture, Hi-Res Ear Simulator and Anthropometric Pinnae, CCP*

The 45CA-12 is configured with RA0404 prepolarized hi-res ear simulators and anthropometric pinnae. It can be used for measurements of hearing aids, earphones and headphones up to 50 kHz. The configuration compatible with IEC 60318-4.

The application-specific items for each of these configurations are listed under the tab Ordering Information.

### System verification

For daily verification and check of your measurement setup, we recommend using a calibrator like [GRAS 42AG](#) Multifunction Sound Calibrator. For proper sensitivity calibration, we recommend using a pistonphone like [GRAS 42AP](#) Intelligent Pistonphone.

### Service

If you accidentally damage the Ear Simulator, we can—in most cases—replace and repair it at a very reasonable cost and with short turn-around time. This not only protects your investment but also pleases your quality assurance department because you don't have to worry about new serial numbers, etc.

### Calibration

Before leaving the factory, all products are calibrated in a controlled laboratory environment using traceable calibration equipment. Depending on the use, measurement environment, and internal quality control programs, we recommend recalibrating the system at least once a year.

### Performance and warranty

The GRAS 45CA is made of components from our standard portfolio and are all manufactured of high-quality material and branded parts that were chosen and processed to ensure life-long stability and robustness. This enables us to offer 5 years warranty against defective materials and workmanship.

Exceptions: The warranty period for cables is 6 months.

IEC standard		Dep. on conf.
ITU-T recommendations		P.380
CE/RoHS compliant/WEEE registered		Yes/Yes/Yes
Weight	g / oz	11.6 k / 409.18
<b>45CA-1 and 45CA-2</b>		
Self Insertion Loss, measured with closed ear simulators	> 50 dB	80 - 250 Hz
Self Insertion Loss, measured with closed ear simulators	> 65 dB	350 - 4000 hz
Self Insertion Loss, measured with closed ear simulators	> 55 dB	5000 - 20000 Hz
Specs for the GRAS 40EN 1" Externally Polarized Pressure Microphone can be found <a href="#">here</a> .		
Specs for the GRAS 40AD 1/2" Prepolarized Pressure Microphone can be found <a href="#">here</a> .		
<b>45CA-3 and 45CA-4</b>		
GRAS RA0039 Ear Simulator	Specs can be found <a href="#">here</a> :	<a href="http://www.gras.dk/RA0039">www.gras.dk/RA0039</a>
GRAS 40AG 1/2" Externally Polarized Pressure Microphone	Specs can be found <a href="#">here</a> :	<a href="http://www.gras.dk/40AG">www.gras.dk/40AG</a>
GRAS 40A0 1/2" Prepolarized Pressure Microphone	Specs can be found <a href="#">here</a> :	<a href="http://www.gras.dk/40A0">www.gras.dk/40A0</a>
<b>45CA-3 and 45CA-4</b>		
GRAS RA0039 Ear Simulator	Specs can be found <a href="#">here</a> :	<a href="http://www.gras.dk/RA0039">www.gras.dk/RA0039</a>
GRAS 40AG 1/2" Externally Polarized Pressure Microphone	Specs can be found <a href="#">here</a> :	<a href="http://www.gras.dk/40AG">www.gras.dk/40AG</a>
GRAS 40A0 1/2" Prepolarized Pressure Microphone	Specs can be found <a href="#">here</a> :	<a href="http://www.gras.dk/40A0">www.gras.dk/40A0</a>
<b>45CA-5 to 45CA-8</b>		
GRAS RA0045 Ear Simulator	Specs can be found <a href="#">here</a> :	<a href="http://www.gras.dk/RA0045">www.gras.dk/RA0045</a>
GRAS RA0045-S1 Ear Simulator	Specs can be found <a href="#">here</a> :	<a href="http://www.gras.dk/RA0045-s1">www.gras.dk/RA0045-s1</a>
<b>45CA-9 to 45CA-10</b>		

GRAS RA0401 Ear Simulator	Specs can be found <a href="#">here:</a>	<a href="http://www.gras.dk/RA0401">www.gras.dk/RA0401</a>
GRAS RA0402 Ear Simulator	Specs can be found <a href="#">here:</a>	<a href="http://www.gras.dk/RA0402">www.gras.dk/RA0402</a>

GRAS Sound & Vibration reserves the right to change specifications without notice.

## Included items with GRAS 45CA

### Common to all configurations - and delivered when ordered non-configured

GRAS GR1085	Cover Plate, 2 pcs
GRAS GR0970	Insert
GRAS GR0974	Acoustic Cup (for acoustic isolation testing)
GRAS RA0178	1" Acoustic Plug
GRAS GR1281	Foam plug for leakage sealing (2 pcs)
GRAS MI0016	7 ml Silicon grease for leakage sealing
GRAS YY0019	Allen Key, 6 mm
GRAS YY0016	Allen Key, 2.5 mm
GRAS YY0018	Allen Key, 2 mm
GRAS YY0022	Allen Key, 1.5

## Configurations

12 different pre-configurations of 45CA are available. Each of these are sold fully assembled and tested, ready for use.

### 45CA-1 1" Headphone/Hearing-Protector Test Fixture, ISO 4869-3 1" Mic. LEMO - for test of earmuffs

<a href="#">GRAS 40EN</a>	1" Ext. Polarized Pressure Microphone (2 pcs)
<a href="#">GRAS RA0017</a>	Adapter for 1" microphone and 1/2" preamplifier (2 pcs)
<a href="#">GRAS RA0003</a>	Adapter for 1/2" microphone and 1/4" preamplifier (2 pcs)
<a href="#">GRAS 26AS</a>	1/4" Standard Preamplifier with 3 m integrated cable, very short (2 pcs)

### 45CA-2 1/2" Headphone/Hearing-Protector Test Fixture, ISO 4869-3 1/2" Mic. CCP - for test of earmuffs

<a href="#">GRAS 40AD</a>	1/2" Prepolarized Pressure Microphone, High Sensitivity (2 pcs)
GRAS RA0177	1" Microphone protection grid (2 pcs)

<a href="#">GRAS RA0058</a>	1/2" to 1" Microphone Adapter (2 pcs)
<a href="#">GRAS GR0010</a>	1/2" to 1/4" Adapter (2 pcs)
<a href="#">GRAS 26CS</a>	1/4" CCP Preamplifier with Microdot connector, very short (2 pcs)
GRAS AA0018	3 m Microdot - BNC Cable, High Temp

## **45CA-3 Headphone/Hearing-Protector Test Fixture, IEC 60318-1 LEMO - for test of earmuffs and headphones**

<a href="#">GRAS RA0039</a>	Ear Simulator according to IEC 60318-1 (2 pcs)
<a href="#">GRAS 40AG</a>	1/2" Ext. Polarized Pressure Microphone (2 pcs)
<a href="#">GRAS RA0176</a>	1/2" to 1" Adapter for RA0039 (2 pcs)
<a href="#">GRAS GR0010</a>	1/2" to 1/4" Adapter (2 pcs)
<a href="#">GRAS 26AS</a>	1/4" Standard Preamplifier with 3 m integrated cable, very short (2 pcs)

## **45CA-4 Headphone/Hearing-Protector Test Fixture, IEC 60318-1 CCP - for test of earmuffs and headphones**

<a href="#">GRAS RA0039</a>	Ear Simulator according to IEC 60318-1 (2 pcs)
<a href="#">GRAS 40AO</a>	1/2" Prepolarized Pressure Microphone (2 pcs)
<a href="#">GRAS RA0176</a>	1/2"-1" Adapter for RA0039 (2 pcs)
<a href="#">GRAS GR0010</a>	1/2" to 1/4" Adapter (2 pcs)
<a href="#">GRAS 26CS</a>	1/4" CCP Preamplifier with Microdot connector, very short (2 pcs)
GRAS AA0018	3 m Microdot - BNC Cable, High Temp

## **45CA-5 Headphone/Hearing-Protector Test Fixture, IEC 60318-4 LEMO - for test of earmuffs, earplugs, headphones and earphones**

<a href="#">GRAS KB0070</a>	Large Right KEMAR Pinna, 55 Shore 00
<a href="#">GRAS KB0071</a>	Large Left KEMAR Pinna, 55 Shore 00
GRAS GR1075	Pinna Holder Plate
GRAS GR1069	Ear Canal Extension



<a href="#">GRAS RA0045</a>	Externally Polarized Ear Simulator according to IEC 60318-4 (60711) (2 pcs)
<a href="#">GRAS GR0010</a>	1/2" to 1/4" Adapter (2 pcs)
<a href="#">GRAS 26AS</a>	1/4" Standard Preamplifier with 3 m integrated cable, very short (2 pcs)

## **45CA-6 Headphone/Hearing-Protector Test Fixture, IEC 60318-4 CCP - for test of earmuffs, earplugs, headphones and earphones**

<a href="#">GRAS KB0070</a>	Large Right KEMAR Pinna, 55 Shore 00
<a href="#">GRAS KB0071</a>	Large Left KEMAR Pinna, 55 Shore 00
GRAS GR1075	Pinna Holder Plate
GRAS GR1069	Ear Canal Extension
<a href="#">GRAS RA0045-S1</a>	Prepolarized Ear Simulator according to IEC 60318-4 (60711) (2 pcs)
<a href="#">GRAS GR0010</a>	1/2" to 1/4" Adapter (2 pcs)
<a href="#">GRAS 26CS</a>	1/4" CCP Preamplifier with Microdot connector, very short (2 pcs)
<a href="#">GRAS AA0018</a>	3 m Microdot - BNC Cable, High Temp (2 pcs)

## **45CA-7 Headphone/Hearing-Protector Test Fixture, IEC 60318-4 LEMO, with Anthropometric Pinnae - for test of earmuffs, earplugs, headphones and earphones**

<a href="#">GRAS KB5010</a>	Large Right Anthropometric KEMAR Pinna 35 Shore 00
<a href="#">GRAS KB5011</a>	Large Left Anthropometric KEMAR Pinna 35 Shore 00
GRAS GR1075	Pinna Holder Plate
<a href="#">GRAS RA0045</a>	Externally Polarized Ear Simulator according to IEC 60318-4 (60711) (2 pcs)
<a href="#">GRAS GR0010</a>	1/2" to 1/4" Adapter
<a href="#">GRAS 26AS</a>	1/4" Standard Preamplifier with 3 m integrated cable, very short (2 pcs)
GRAS GR0408	Exterior Ear Canal (for calibration)
GRAS GR0409	Union Nut (for calibration)

## **45CA-8 Headphone/Hearing-Protector Test Fixture, IEC 60318-4 CCP, with Anthropometric Pinnae - for test of earmuffs, earplugs, headphones and earphones**

<a href="#">GRAS KB5010</a>	Large Right Anthropometric KEMAR Pinna 35 Shore 00
<a href="#">GRAS KB5011</a>	Large Left Anthropometric KEMAR Pinna 35 Shore 00
GRAS GR1075	Pinna Holder Plate
<a href="#">GRAS RA0045-S1</a>	Prepolarized Ear Simulator according to IEC 60318-4 (60711) (2 pcs)
<a href="#">GRAS GR0010</a>	1/2" to 1/4" Adapter
<a href="#">GRAS 26CS</a>	1/4" CCP Preamplifier with Microdot connector, very short (2 pcs)
<a href="#">GRAS AA0018</a>	3 m Microdot - BNC Cable, High Temp (2 pcs)
GRAS GR0408	Exterior Ear Canal (for calibration)
GRAS GR0409	Union Nut (for calibration)

**45CA-9 Headphone/Hearing-Protector Test Fixture, High-Frequency Ear Simulator with Anthropometric Pinnae, LEMO - for test of headphones and earphones up to 20 kHz**

<a href="#">GRAS KB5010</a>	Large Right Anthropometric KEMAR Pinna 35 Shore 00
<a href="#">GRAS KB5011</a>	Large Left Anthropometric KEMAR Pinna 35 Shore 00
GRAS GR1075	Pinna Holder Plate
<a href="#">GRAS RA0401</a>	Externally Polarized High-Frequency Ear Simulator (2 pcs)
<a href="#">GRAS GR0010</a>	1/2" to 1/4" Adapter
<a href="#">GRAS 26AS</a>	1/4" Standard Preamplifier with 3 m integrated cable, very short (2 pcs)
GRAS GR0408	Exterior Ear Canal (for calibration)
GRAS GR0409	Union Nut (for calibration)

**45CA-10 Headphone/Hearing-Protector Test Fixture, High-Frequency Ear Simulator with Anthropometric Pinnae, CCP - for test of headphones and earphones up to 20 kHz**

<a href="#">GRAS KB5010</a>	Large Right Anthropometric KEMAR Pinna 35 Shore 00
<a href="#">GRAS KB5011</a>	Large Left Anthropometric KEMAR Pinna 35 Shore 00
GRAS GR1075	Pinna Holder Plate
<a href="#">GRAS RA0402</a>	Prepolarized High-Frequency Ear Simulator (2 pcs)
<a href="#">GRAS GR0010</a>	1/2" to 1/4" Adapter

<a href="#">GRAS 26CS</a>	1/4" CCP Preamplifier with Microdot connector, very short (2 pcs)
<a href="#">GRAS AA0018</a>	3 m Microdot - BNC Cable, High Temp (2 pcs)
GRAS GR0408	Exterior Ear Canal (for calibration)
GRAS GR0409	Union Nut (for calibration)

**45CA-11 Headphone/Hearing-Protector Test Fixture, Hi-Res Ear Simulator with Anthropometric Pinnae, LEMO - for test of headphones and earphones up to 50 kHz**

<a href="#">GRAS KB5010</a>	Large Right Anthropometric KEMAR Pinna 35 Shore 00
<a href="#">GRAS KB5011</a>	Large Left Anthropometric KEMAR Pinna 35 Shore 00
GRAS GR1075	Pinna Holder Plate
<a href="#">GRAS RA0403</a>	Externally Polarized Hi-Res Ear Simulator (2 pcs)
<a href="#">GRAS 26AS</a>	1/4" Standard Preamplifier with 3 m integrated cable, very short (2 pcs)
GRAS GR0408	Exterior Ear Canal (for calibration)
GRAS GR0409	Union Nut (for calibration)

**45CA-12 Headphone/Hearing-Protector Test Fixture, Hi-Res Ear Simulator with Anthropometric Pinnae, CCP - for test of headphones and earphones up to 50 kHz**

<a href="#">GRAS KB5010</a>	Large Right Anthropometric KEMAR Pinna 35 Shore 00
<a href="#">GRAS KB5011</a>	Large Left Anthropometric KEMAR Pinna 35 Shore 00
GRAS GR1075	Pinna Holder Plate
<a href="#">GRAS RA0404</a>	Prepolarized Hi-Res Ear Simulator (2 pcs)
<a href="#">GRAS 26CS</a>	1/4" CCP Preamplifier with Microdot connector, very short (2 pcs)
<a href="#">GRAS AA0018</a>	3 m Microdot - BNC Cable, High Temp (2 pcs)
GRAS GR0408	Exterior Ear Canal (for calibration)
GRAS GR0409	Union Nut (for calibration)

**Optional accessories**

**KEMAR Pinnae for configurations with using IEC 60318-4 Ear Simulator**



<a href="#">GRAS RA0172</a>	Pinna & Ear Simulator Mounting Kit (required to hold a pinna) Included with 45CA-5 and -6. Note: Contains a cover plate, ear canal extension, screws and Allen key
<a href="#">GRAS KB0070</a>	KEMAR Large Right Pinna Shore 55 Hearing Protector. Included with 45CA-5 and 6.
<a href="#">GRAS KB0071</a>	KEMAR Large Left Pinna Shore 55 Hearing Protector. Included with 45CA-5 and 6.
<a href="#">GRAS KB1070</a>	KEMAR Large Right Pinna Shore 35 Hearing Protector
<a href="#">GRAS KB1071</a>	KEMAR Large Left Pinna Shore 35 Hearing Protector
<a href="#">GRAS KB0072</a>	KEMAR Small Right Pinna Shore 55 Hearing Protector
<a href="#">GRAS KB0073</a>	KEMAR Small Left Pinna Shore 55 Hearing Protector
<a href="#">GRAS KB5010</a>	KEMAR Large Right Anthropometric Pinna for 45CA, Shore 35. Included with 45CA-7 and 8
<a href="#">GRAS KB5011</a>	KEMAR Large Left Anthropometric Pinna for 45CA, Shore 35. Included with 45CA-7 and 8

## Cables for LEMO configurations

<a href="#">GRAS AA0008</a>	3 m LEMO 7-pin - LEMO 7-pin Cable
<a href="#">GRAS AA0009</a>	10 m LEMO 7-pin - LEMO 7-pin Cable
<a href="#">GRAS AA0020-CL</a>	Customized length LEMO 7-pin - LEMO 7-pin Cable (specify length in cm, e.g. -CL0500 for a 5 m cable)

## Cables for CCP configurations

<a href="#">GRAS AA0035</a>	3 m BNC - BNC Cable
<a href="#">GRAS AA0037</a>	10 m BNC - BNC Cable
<a href="#">GRAS AA0039-CL</a>	Customized length BNC - BNC Cable (specify length in cm, e.g. -CL0500 for a 5 m cable)
GRAS AE0074	BNC - BNC adapter

## Power modules

<a href="#">GRAS 12AQ</a>	For all configurations (dual channel LEMO/CCP)
<a href="#">GRAS 12AA</a>	For externally polarized configurations only (dual channel)

## Power Supply +15 VDC (provides +15 VDC power to the Power Module)

GRAS AB0002	Mains/line power supply, 230 VAC (EU mains connector)
GRAS AB0006	Mains/line power supply, 230 VAC (UK mains connector)
GRAS AB0003	Mains/line power supply, 120 VAC (US mains connector)

## Calibration Equipment

<a href="#">GRAS 42AP</a>	Intelligent Pistonphone, Class 0
<a href="#">GRAS 42AA</a>	Pistonphone, Class 1
<a href="#">GRAS RA0023</a>	Coupler for 1" microphones (Note: RA0023 is included with 42AP but optional for 42AA)
<a href="#">GRAS RA0287</a>	Calibration Adapter (for in-situ verification of RA0039)
<a href="#">GRAS RA0157</a>	1/2" Calibration Adapter for KEMAR Pinna (For the IEC60318-4 configuration only)
GRAS 42AG	Multifunction Sound Calibrator, Class 1

GRAS Sound & Vibration reserves the right to change accessories without notice.

# GRAS Worldwide

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than 40 countries

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## About GRAS Sound & Vibration

GRAS is a worldwide leader in the sound and vibration industry. We develop and manufacture state-of-the-art measurement microphones to industries where acoustic measuring accuracy and repeatability is of utmost importance in R&D, QA and production. This includes applications and solutions for customers within the fields of aerospace, automotive, audiology, and consumer electronics. GRAS microphones are designed to live up to the high quality, durability and accuracy that our customers have come to expect and trust.

**GRAS** Sound  
& Vibration