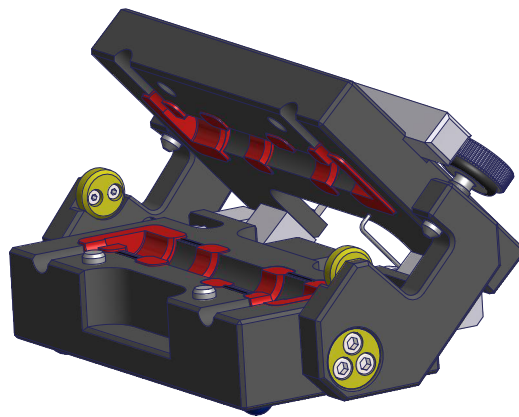


Instruction Manual

*G.R.A.S. 51AC Sound Intensity Calibration Kit
for 50AI-LP*



Revision History

Any feedback or questions about this document are welcome at gras@gras.dk.

Revision	Date	Description
1	27 March 2015	First publication

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Introduction

The G.R.A.S. 51AC Sound Intensity Calibration Kit for 50AI-LP is a ready to use calibration solution for the G.R.A.S. 50AI-LP Rugged CCP Sound Intensity Probe.

The kit consists of a G.R.A.S. RA0301 Two-port Calibration Adapter for 50AI-LP, a G.R.A.S. 42AA Pistonphone, Class 1, and a G.R.A.S. ZC0002K Barometer.

With this kit it is possible to calibrate the 50AI-LP intensity probe without dismantling it, provided it is assembled with a 50 mm spacer. The 51AC is therefore well suited for calibration outside a laboratory environment.

Delivered Items	
<p>Two-port Calibration Adapter for 50AI-LP RA0301</p>	
<p>Pistonphone 42AA Pistonphone, Class 1</p>	
<p>Barometer ZC0002K</p>	

If you already have a pistonphone and a barometer, you can order 51AC-S1. It consists of the RA0301 Two-port Calibration Adapter only.

The RA0301 Calibration Adapter is designed and calibrated to be used with either a G.R.A.S. 42AA Pistonphone, Class 1 or G.R.A.S. 42AP Intelligent Pistonphone, Class 0. Use with other calibration devices is not recommended.

The Design

The G.R.A.S. RA0301 Two-port Calibration Adapter for 50Al-LP consists of a base and a lid, both with two cavities lined with silicone rubber inserts. The cavities function as receptacles for the intensity probe's microphones. When the lid is closed, the silicone rubber parts are pressed together, forming two identical, acoustically sealed measurement chambers.

In the open position, a spring prevents the lid from accidentally closing and damaging the microphones.

The measurement chambers are shown in Fig. 1 below.

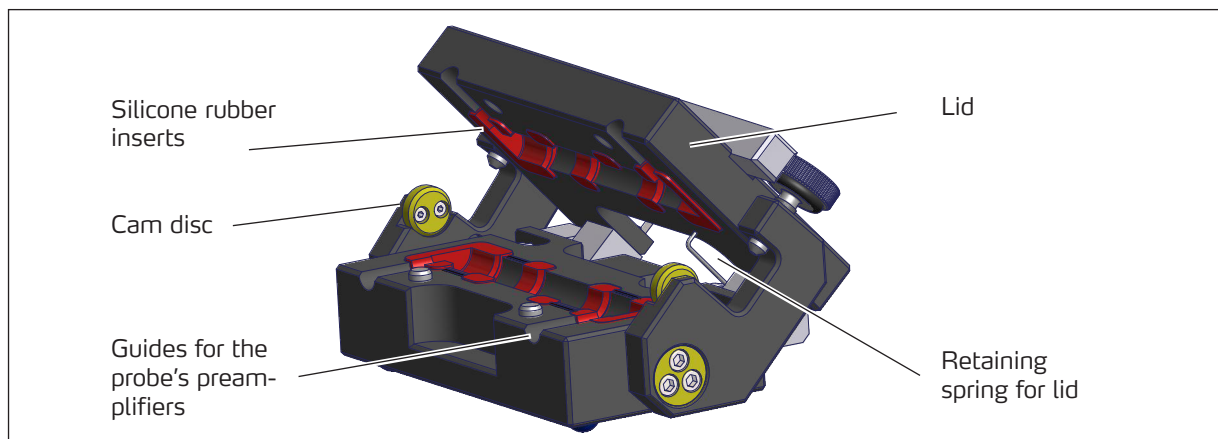


Fig. 1. The RA0301 Two-port Calibration Adapter with its silicone lined measurement chambers.

Two finger screws on the levers at the side of the adapter ensure that the lid can be closed tightly. A transversal bar on the lid's top face distributes the force and thus ensures that the measurement chambers are sealed evenly when the lid is closed.

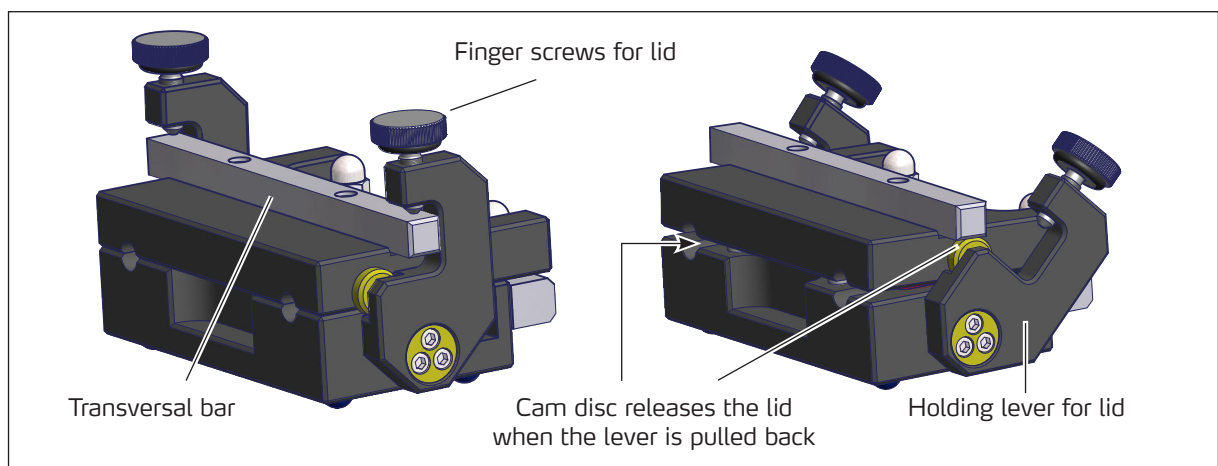


Fig. 2. The RA0301 Two-port Calibration Adapter with its locking mechanism.

The coupling for the pistonphone is located on the rear. This coupling receives the calibration signal from the pistonphone and distributes it to the two measurement chambers.

When the calibration adapter and the pistonphone both are resting on a flat surface, the calibration adapter's coupling for the pistonphone will be flush with the pistonphone's collar opening.

Therefore, a correct and stable fit between pistonphone and adapter is easy to obtain.

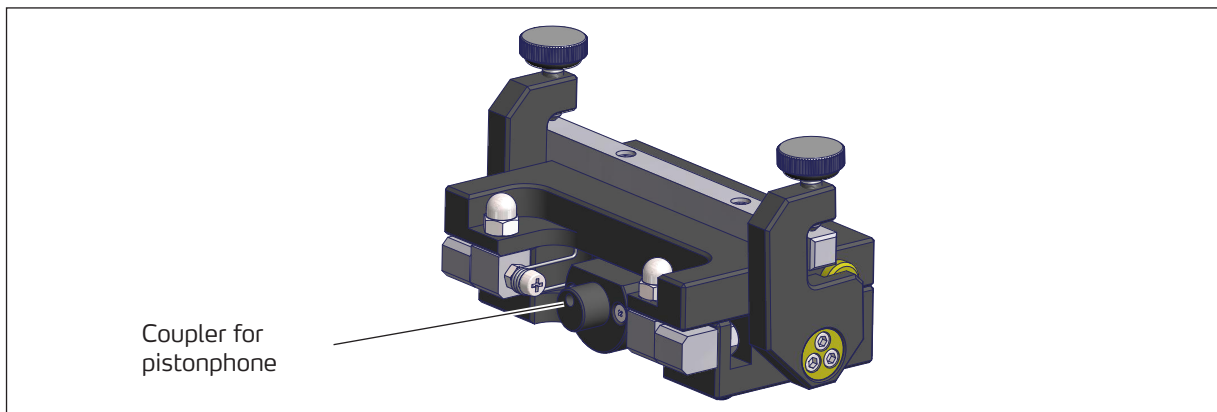


Fig. 3. Rear view of the calibration adapter and the coupling for the pistonphone.

Mounting

Mounting the Pistonphone

1. Place the calibration adapter on a plane surface with the rear facing towards you.
2. Place the pistonphone on the same plane surface, with the on/off button facing upwards.
3. Loosen the pistonphone's collar by turning it counterclockwise.
4. Slide the pistonphone over the calibration adapter's pistonphone coupling and push it as far as it will go.
5. Tighten the pistonphone's collar by turning it clockwise.

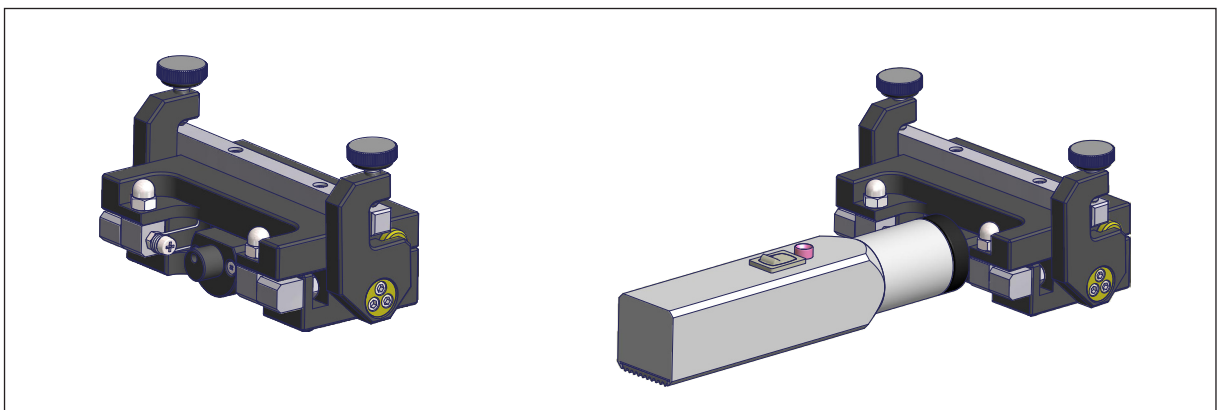


Fig. 4. Mounting a pistonphone onto the RA0301 Two-port Calibration Adapter.

Opening the Adapter

1. If the lid is closed, unscrew the two finger screws until only 2-3 millimeters of the tip is visible at the underside of the lid, as shown in Fig. 5.
2. Push the two levers backwards simultaneously.

The cam discs on the levers will push the lid up. The spring at the rear will keep it open.

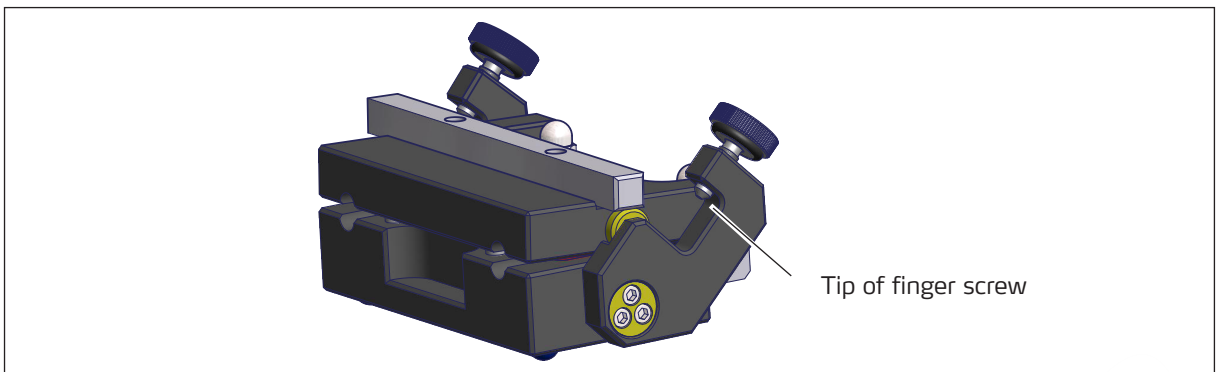


Fig. 5. Opening the RA0301.

Placing the Probe Head in the Adapter

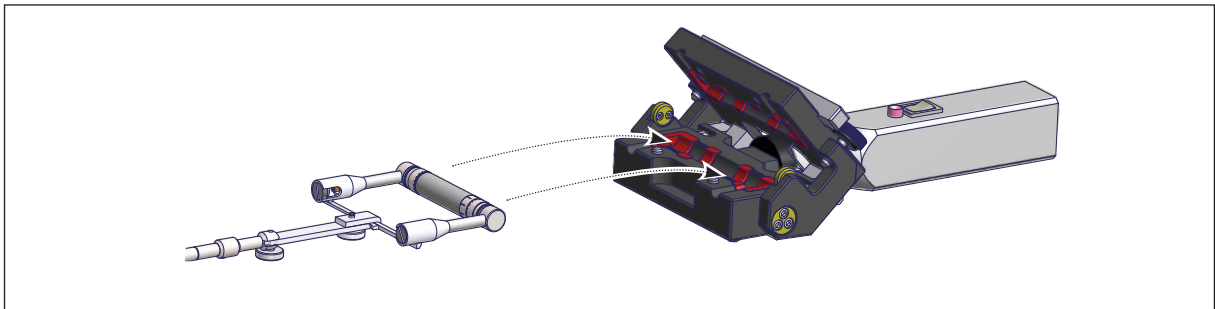


Fig. 6. Placing the probe head in the calibration adapter.

1. Lift the probe head and place it gently into the rubber inserts, as indicated by the arrows in Fig. 6.
2. Ensure that the probe head is properly seated in the rubber inserts. You can do this by gently pressing the microphones downwards.

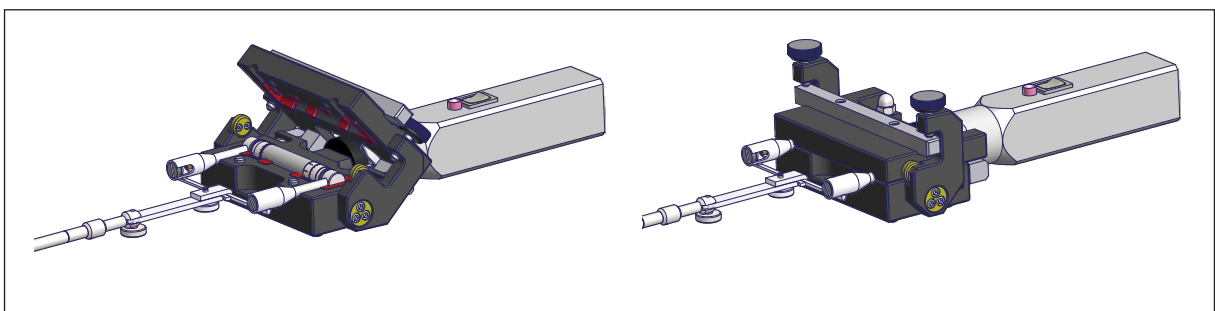


Fig. 7. Closing the lid over the probe head.

Closing the Adapter

When the lid is closed, the silicone rubber inserts will be compressed, ensuring that the microphones are inside identical, acoustically sealed chambers.

1. Press the lid down over the probe head.
2. Slide both levers forwards until they will go no further.
3. Tighten the finger screws.

When tightening the finger screws, you will first force the rubber parts to compress. When they are compressed as much as is possible, only a little further tightening is called for as you are now forcing metal against metal. At this point, the “feel” of finger screw changes as the resistance to further tightening increases.

When mounted in the coupler, the intensity probe and its microphones are held firmly in place, ready for the calibration signal from the pistonphone.

Calibrating with 51AC

The RA0301 Calibration Coupler is designed and calibrated for use with a G.R.A.S. 42AA Pistonphone, Class 1 or a G.R.A.S. 42AP Intelligent Pistonphone, Class 0. Use with other calibration devices is not recommended.

Calibrating with 51AC results in a sensitivity and phase calibration at 250 Hz. With the analyzer used for calibration set to intensity mode, the measured intensity will indicate the probe's phase accuracy at 250 Hz. The calibrated phase accuracy of the calibration adapter is stated in the calibration chart for the RA0301. Typically it is $<1^\circ$.

The nominal SPL produced by the G.R.A.S. 42AA pistonphone is 114 dB at reference conditions, i.e. at a static ambient pressure of 1013 hPa. However, the actual SPL is highly dependent on the ambient pressure. If the ambient pressure during calibration differs from the reference conditions, the SPL changes. This change must be added to or subtracted from the pistonphone's calibrated output.

The calibrated level produced by the pistonphone will typically be about 114 dB +/- 0.01 dB at 250 Hz.

The influence of the pistonphone's coupler volume is accounted for as part of the pistonphone's calibration, but the volume of the calibration adapter's volume must be corrected for. The correction factor will typically be about 1.27 dB, the exact value is stated on the calibration chart for the RA0301 Calibration Adapter.

The table below shows how the corrected SPL for a calibration with the 51AC is calculated. The SPL for the pistonphone is taken directly from its calibration chart. The same is true for the value used to correct for the calibration adapter's volume. The correction value for the static ambient pressure is measured during calibration. It is shown next to the corresponding values for ambient static pressure on the barometer. The influence of the relative humidity is negligible and can be disregarded.

An uncertainty budget for the calculation is shown in Fig. 9.

Calculation of SPL – an Example		
	Source	Value
Pistonphone	Calibration chart	113.99 dB
Calibration coupler volume correction	Calibration chart	1.27 dB
Static ambient pressure	Barometer reading	0.10 dB
Corrected SPL		115.74 dB

Fig. 8. Example of a calculation of the corrected SPL. All values in the example are arbitrary and used as examples.

As mounting the pistonphone and microphones may cause an overpressure inside the measurement chamber, allow some time for the pressure to stabilize. About half a minute will normally be adequate.

When calibrating, the microphone pair of the probe must be oriented in the same way in each consecutive calibration – for example the A-microphone always in the left chamber and the B always in the right hand chamber – to ensure that calibrations are comparable and a calibration history can be maintained.

When calibrating, you should check that the two measurement chambers are within specifications. A convenient way of doing this is to switch the position of the microphones in the adapter, i.e. microphone A in B's position and vice versa, and compare the results. If the silicone rubber lining of one of the chambers has been damaged, this will immediately influence the pressure inside the chamber and will reveal itself as an increase in difference between the two chambers. The two chambers should be identical within <0.15 dB.

If a measurement chamber is faulty, the RA0301 coupler must be sent to G.R.A.S. for service and recalibration.

Uncertainty Budget

Below you will find an example of how the combined uncertainty can be estimated. The uncertainty values in Fig. 9 are the actual values for this type of calibration and can be used to estimate the uncertainty.

Uncertainty Budget		
	Calibration value (from calibration chart)	Uncertainty
Coupler volume correction	1.27 dB	0.05 dB
Repeatability		0.05 dB
Combined standard uncertainty		0.07 dB

Fig. 9. Uncertainty budget for calibration with 51AC.

The combined standard uncertainty is the root sum square of the individual standard uncertainties. The uncertainty for the pistonphone is not important for phase calibration because we are only interested in the difference between the two channels. For the same reason, the uncertainty for correction for the ambient pressure can also be ignored.

The above calculation translates into a confidence level of 99%.

Technical Specifications

Typical Performance

Data was collected at a temperature of 23 °C (± 3 °C) and at a relative humidity of 60 % ± 20 %.

Calibration adapter volume correction, typical	1.27 dB
Repeatability	< 0.15 dB
Phase match (difference between the two measurement chambers)	< 1°

Ordering Information

51AC

Included Items	GRAS Number
Two-port Calibration Adapter for 50AI-LP	RA0301
Pistonphone	42AA
Barometer	ZC0002K

51AC-S1

Item	GRAS Number
Two-port Calibration Adapter for 50AI-LP	RA0301

Warranty, Service and Repair

Calibration

Before leaving the factory, all G.R.A.S. products are calibrated in a controlled laboratory environment using traceable calibration equipment.

Warranty

All G.R.A.S. products are made of high-quality materials that will ensure life-long stability and robustness. The 51AC kit is delivered with a 3-year warranty.

The warranty does not cover products that are damaged due to negligent use.

Service and Repairs

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. 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



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.