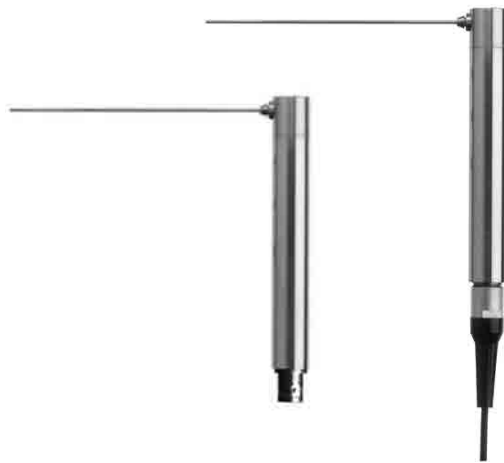


Instruction Manual

40SA/40SC Probe Microphones



Revision History

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

	Date	Description
1	July 2007	First release
2	September 2016	Addition about cleaning; Calibration coupler: new P/N: RA0326
3	October 2019	Page 12: max body temperature changed to 70 °C
4	March 2022	Page 9: Updated text regarding calibration charts

Warning: do not use the Probe Microphone for measurements on the human body. It is neither intended nor approved for measurements on the human body and the internal high voltage may be harmful.

Note: unless individually specified, the term “Probe Microphone” throughout this document refers to both types, i.e. Type 40SA and Type 40SC.

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1. Introduction and Description

The GRAS Probe Microphones Types 40SA and 40SC (Fig. 1.1) are small, compact units for sound-pressure measurements in small enclosures, in harsh environments and in very close proximity to sound sources. The high acoustic input impedance at the tip of their probes minimizes their influence on the acoustic field, while the stainless-steel tubes used in manufacturing these probes can withstand high tip temperatures, up to 800 °C with the 160 mm long probe GR0261.

1.1 Differences between Type 40SA and Type 40SC

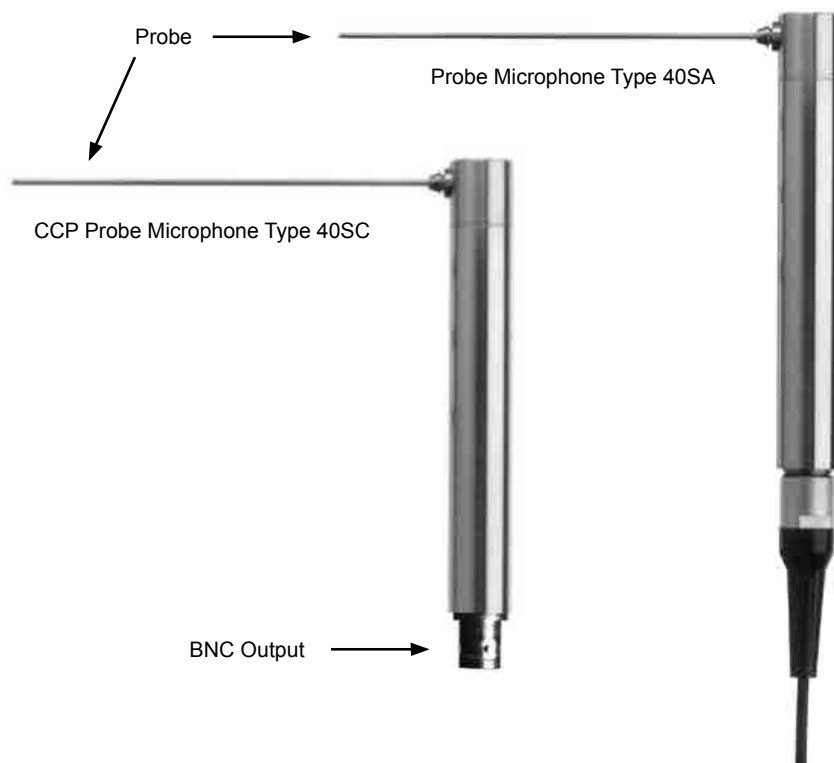
Both types shown in Fig. 1.1 have similar sizes, performances and applications. They differ only in the type of internal microphone and preamplifier used and in the way they are powered.

1.1.1 Probe Microphone Type 40SA

The Type 40SA uses an externally polarized internal microphone with a preamplifier that requires a constant-voltage power supply, e.g., GRAS Power Modules Types 12AA, 12AD or 12AK. It has a 3 m cable terminating in a 7-pin male LEMO plug 1B, which plugs directly into these power modules.

1.1.2 CCP Probe Microphone Type 40SC

The Type 40SC uses a prepolarized internal microphone with a CCP¹ preamplifier that requires a constant-current power supply, e.g., the GRAS CCP Supply Type 12AL, or any other CCP compatible power supply. It has an integrated BNC output for, via a coaxial cable, drawing power from, and delivering the signal to, the constant-current power supply.



*Fig. 1.1 The two GRAS Probe Microphones covered by this document
Left; CCP Type 40SC
Right; Type 40SA*

¹ CCP stands for Constant-current Power and describes GRAS power supplies that maintain a constant level of current for driving IEPE transducers.

1.2 Description

The Probe Microphone is a small robust unit with a smooth frequency response from 2 Hz to 20 kHz (see Fig. 1.2). It can be used with both stainless-steel probes and flexible probes of various lengths. With stainless-steel probes, measurements can be made with temperatures as high as 800 °C at the tip of a 160 mm probe (GR0261).

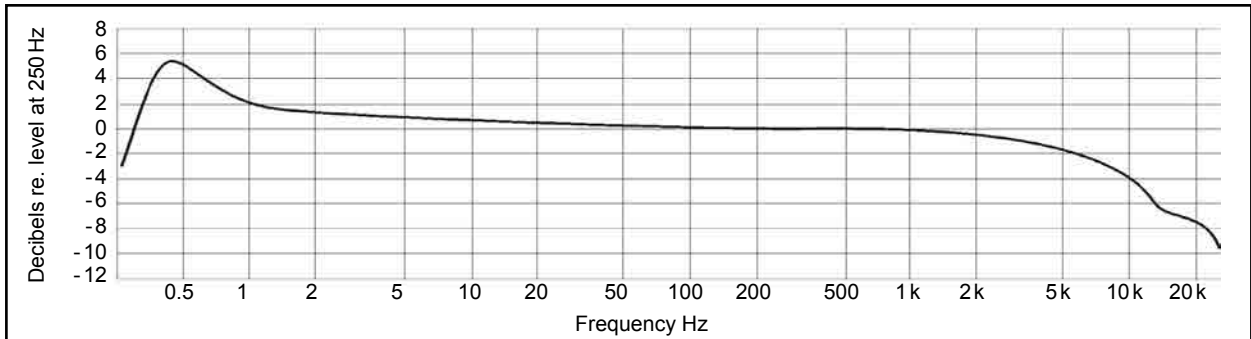


Fig. 1.2 Typical frequency response of the Probe Microphone with a 40 mm probe

The small diameter of the probe ensures a very high acoustic impedance, which minimizes its disturbance to the sound field. For closed-coupler measurements, the Probe Microphone uses internal pressure equalization to balance out static pressure differences.

The Probe Microphone consists of a probe, a 1/4" condenser microphone, a preamplifier and an impedance matching tube (see Fig. 1.3). The sound-pressure fluctuations at the tip of the probe are transmitted through the probe to the condenser microphone within the body of the Probe Microphone. The condenser microphone senses these pressure fluctuations on its diaphragm, and the preamplifier converts the resulting high-impedance output signal from the microphone to a low impedance signal suitable for connection to a standard signal analyzer or other measurement equipment.

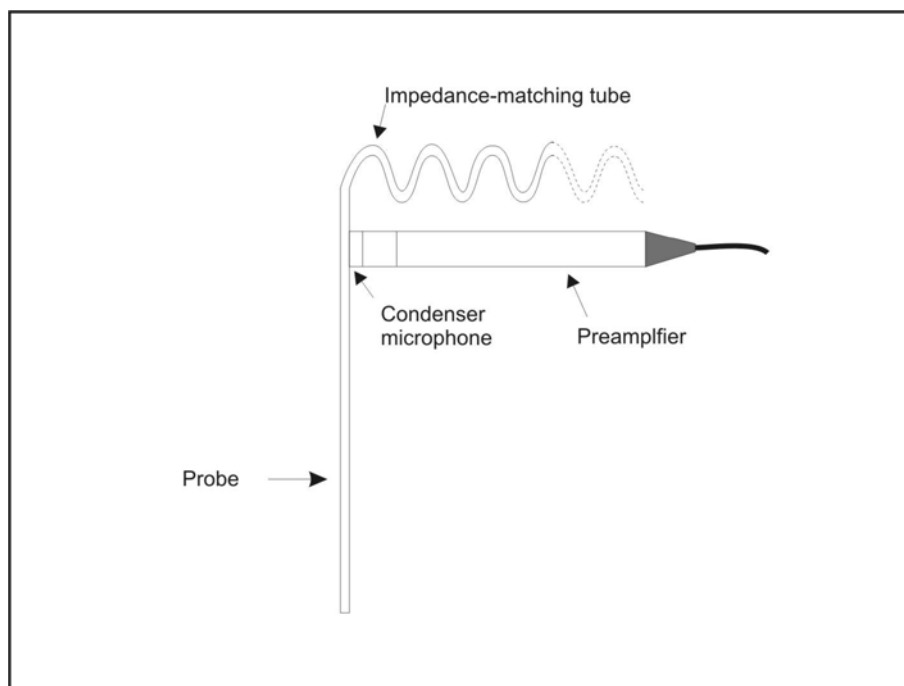


Fig. 1.3 The principle of the Probe Microphone

The sound-pressure fluctuations transmitted through the probe to the microphone continue to an impedance-matching tube. This tube is approximately 1 m long with the same inside diameter as the probe itself. This long tube reduces reflections and ensures that the Probe Microphone has a smooth frequency response. The impedance-matching tube is coiled around the preamplifier within the housing of the Probe Microphone.

The impedance-matching tube terminates in a small opening within the housing thus ensuring that the static pressure within the Probe Microphone is the same as that at the tip of the probe. Consequently, the static pressure within the rear-vented condenser microphone will also be identical to the static pressure at the tip of the probe.

The microphone preamplifier used is based on a standard GRAS preamplifier. In the case of the Type 40SA, similar to Preamplifier Type 26AC with an output cable terminating in a 7-pin LEMO plug for direct connection to any standard preamplifier power supply, e.g., GRAS Power Modules Types 12AA, 12AD or 12AK. In the case of the Type 40SC, similar to Preamplifier Type 26CB with an integrated BNC output socket for connection to a CCP supply, e.g., the GRAS CCP Supply Type 12AL.

The Probe Microphone is ideal for measurements in small enclosures or for measurements in the very near field of a sound source. Fig 1.4 shows an example of a setup for measuring sound pressures inside an exhaust system. The tip of the probe is inserted into the exhaust pipe through a small hole (\varnothing 1.3 mm) in the wall of the exhaust pipe.

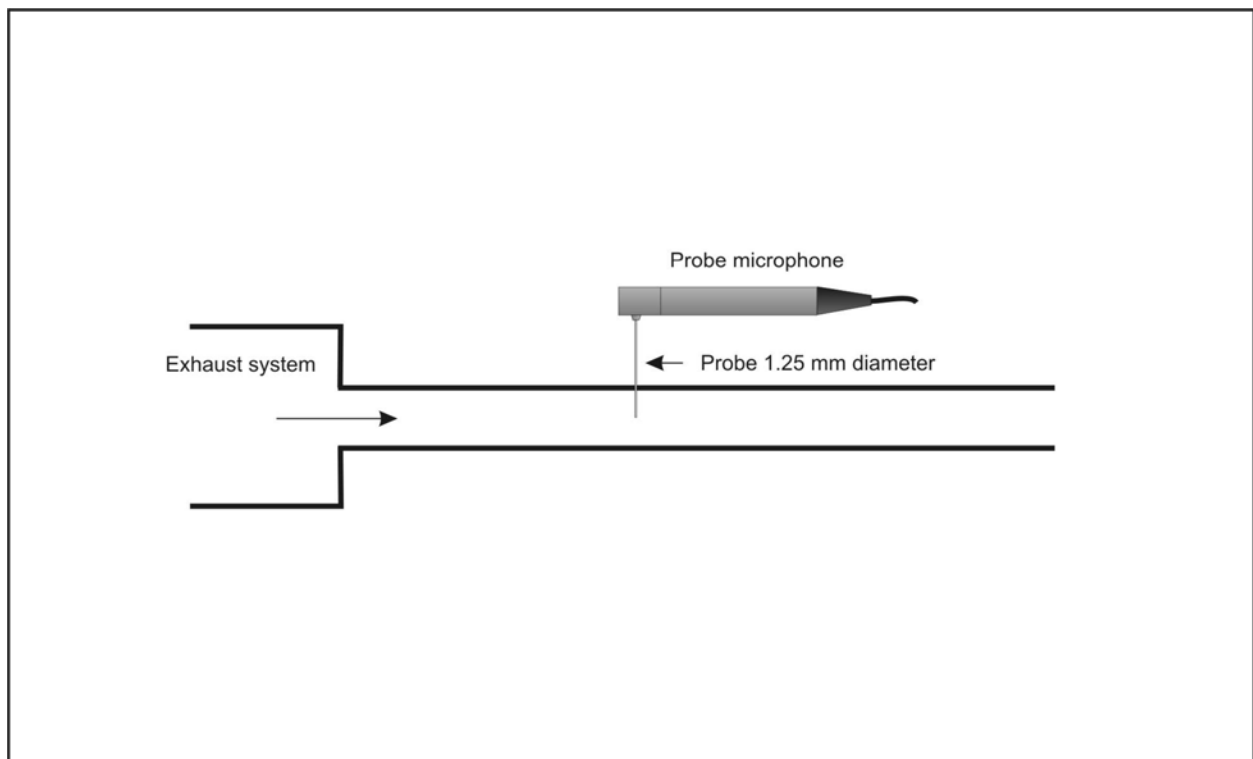


Fig. 1.4 Setup for measuring sound pressures within an exhaust pipe

2. Operation

2.1 Carrying Case and Accessories

The Probe Microphone is supplied with a kit of various accessories and tools for calibrating a probe and for adapting a probe to particular measurement requirements. It is delivered in a carrying case (see Fig. 2.1), which, apart from the Probe Microphone itself, includes five stainless-steel probes of various lengths. There is also a flexible probe and extra flexible tubing for making probes of various lengths and a needle for cleaning the probe.

The lengths of the stainless-steel probes can be shortened for specific applications using the file and pliers supplied (see Fig. 2.2).

The kit includes calibration adapters for both frequency-response calibrations and level-response calibrations. The two level-response calibration adapters fit into the coupler of a pistonphone or calibrator intended for $\frac{1}{2}$ " microphones. They permit precise calibration with both stainless-steel probes and flexible probes. Since the outside diameters of the stainless-steel probes and flexible probes are not the same, two different calibration adapters are provided. There is also a calibration adapter for frequency-response calibration. This is intended for use with two $\frac{1}{2}$ " microphones used respectively as emitter and receiver (these two microphones are not included in the kit).

The aluminum disc doubles as both heat sink and tool for loosening and tightening the probes attached to the Probe Microphone. A tube of silicon grease for O-rings is also included for sealing minor leaks.



Fig. 2.1 The Probe Microphone kit in its carrying case. Shown here the Type 40SA. A needle for cleaning (not shown here, see Fig 2.2) is also part of the delivery.

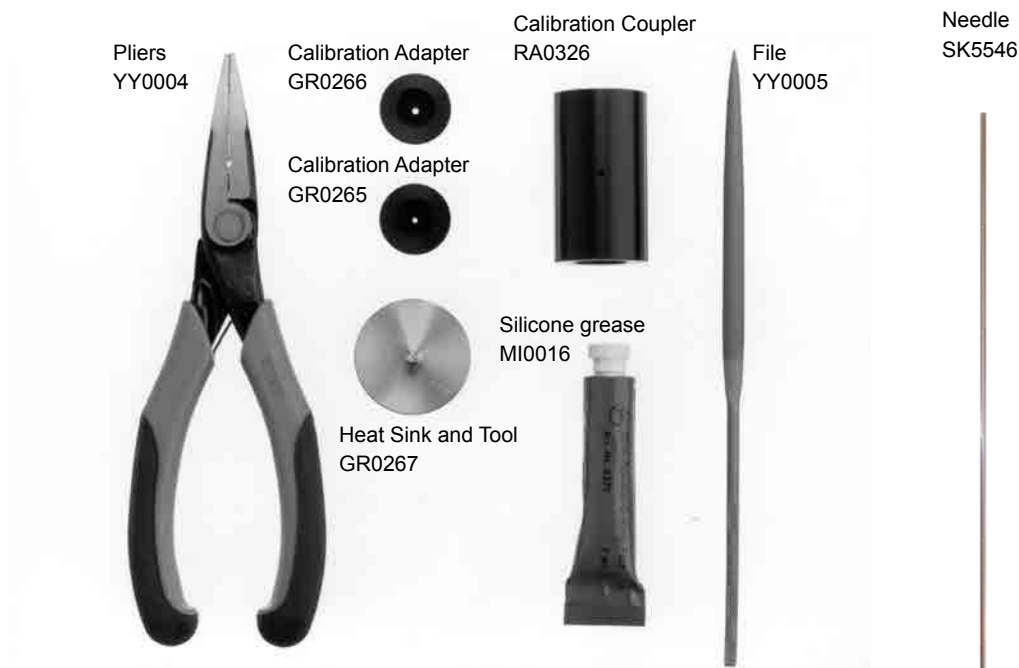


Fig. 2.2 Tools and accessories of the Probe Microphone

2.2 Connection to External Power Supply

2.2.1 Probe Microphone Type 40SA

The Type 40SA contains a standard microphone preamplifier similar to the GRAS Preamplifier Type 26AC. This requires a constant-voltage power supply of 28 V to 120 V and a polarization voltage of 200 V, e.g., from a GRAS Power Module Type 12AK or similar. The wiring diagram of the male 7-pin LEMO 1B plug is shown on Fig. 2.3.

2.2.2 CCP Probe Microphone Type 40SC

The Type 40SC contains a standard microphone preamplifier similar to the GRAS Preamplifier Type 26CB. This requires a constant-current power supply, e.g., from a GRAS CCP Supply Type 12AL or other CCP-compatible power supply. The Type 40SC has an integrated BNC coaxial output socket for this purpose.

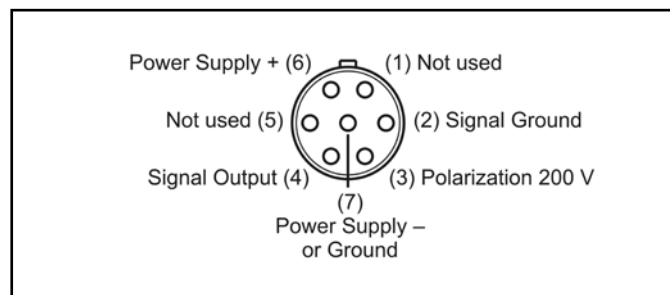


Fig. 2.3 7-pin LEMO female socket 1B (external view)

2.3 Changing the Probe

There is a set of four stainless steel probes of various lengths. To change one of these, use Heat Sink GR0267 as a tool to unscrew the probe from the housing of the Probe Microphone, see Fig. 2.4. Apply a thin smear of silicon grease to the end of the new probe but be careful not to clog the probe hole with the grease. Mount the new probe on the housing and tighten it with the tool. Change flexible probes in the same way.

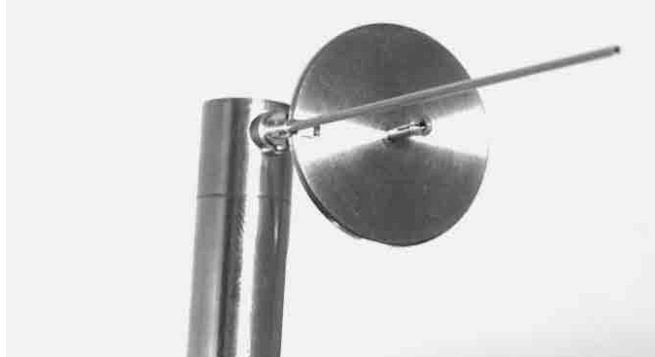


Fig. 2.4 Unscrew the probe using the Heat Sink GR0267 as a tool

2.3.1 Probe Length and Frequency Response

The frequency response of the Probe Microphone depends on the length and diameter of the probe fitted. Because of sound-pressure losses in thin tubes, a probe will, depending on its length, reduce the level of sound, particularly at higher frequencies. Fig. 2.5 shows an example of the frequency response of a Probe Microphone for various lengths of stainless-steel probes. The values are also given in Table 2.1. For lengths other than those given in Table 2.1, interpolate between the given lengths. For the individual responses of a specific probe microphone, use the data from the Calibration Chart for that probe microphone.

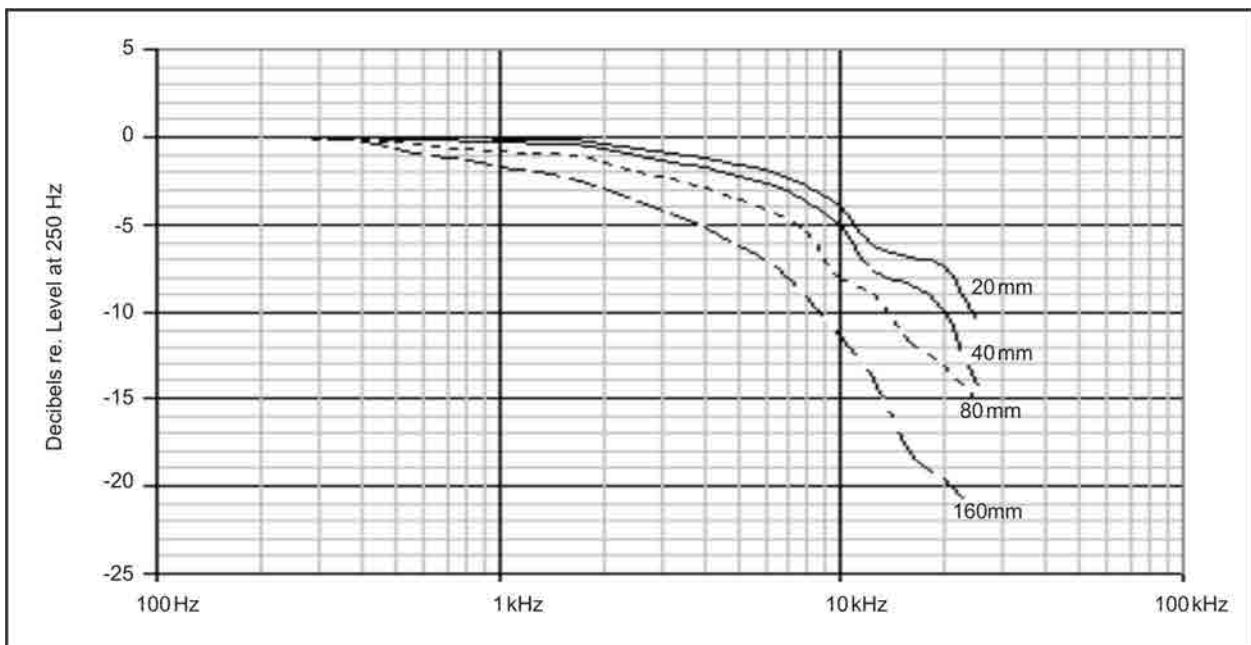


Fig. 2.5 Frequency response for various lengths of stainless-steel probes

Freq. (Hz)	20 mm	40 mm	80 mm	160 mm	Tolerance (±dB)
0.25	-6.25	-6.25	-6.25	-6.25	N/A
0.31	-1.34	-1.34	-1.34	-1.34	N/A
0.4	2.56	2.56	2.56	2.56	N/A
0.5	3.30	3.30	3.30	3.30	N/A
0.63	3.04	3.04	3.04	3.04	N/A
0.8	2.28	2.28	2.28	2.28	N/A
1	1.56	1.56	1.56	1.56	N/A
1.25	1.52	1.52	1.52	1.52	N/A
1.6	1.43	1.43	1.43	1.43	N/A
2	1.38	1.38	1.38	1.38	1.5
2.5	1.34	1.34	1.34	1.34	1.5
3.15	1.29	1.29	1.29	1.29	1.5
4	1.25	1.25	1.25	1.25	1.5
5	1.16	1.16	1.16	1.16	1.5
6.3	0.98	0.98	0.98	0.98	1.5
8	0.89	0.89	0.89	0.89	1.5
10	0.80	0.80	0.80	0.80	1.5
12.5	0.71	0.71	0.71	0.71	1.5
16	0.67	0.67	0.67	0.67	1.5
20	0.63	0.63	0.63	0.63	0.5
25	0.58	0.58	0.58	0.58	0.5
31.5	0.49	0.49	0.49	0.49	0.5
40	0.40	0.40	0.40	0.40	0.5
50	0.31	0.31	0.31	0.31	0.5
63	0.22	0.22	0.22	0.22	0.5
80	0.18	0.18	0.18	0.18	0.5
100	0.13	0.13	0.13	0.13	0.5
125	0.09	0.09	0.09	0.09	0.5
160	0.04	0.04	0.04	0.04	0.5
200	0.04	0.04	0.04	0.04	0.5
250	0.00	0.00	0.00	0.00	Ref.
315	-0.04	-0.06	-0.09	-0.14	0.5
400	-0.03	-0.08	-0.16	-0.32	0.5
500	-0.02	-0.12	-0.31	-0.68	0.5
630	-0.06	-0.19	-0.46	-1.01	0.5
800	-0.04	-0.23	-0.61	-1.37	0.5
1000	-0.08	-0.31	-0.77	-1.69	0.5
1250	-0.11	-0.38	-0.93	-2.02	0.8
1600	-0.14	-0.46	-1.09	-2.34	0.8
2000	-0.36	-0.71	-1.43	-2.86	0.8
2500	-0.65	-1.08	-1.94	-3.65	1
3150	-0.95	-1.44	-2.41	-4.37	1
4000	-1.20	-1.76	-2.88	-5.12	1
5000	-1.57	-2.24	-3.57	-6.24	1.5
6300	-2.01	-2.77	-4.29	-7.32	1.5
8000	-2.72	-3.63	-5.43	-9.05	1.5
10000	-3.93	-4.98	-8.01	-11.27	1.5
12500	-6.20	-7.60	-8.98	-13.79	3
16000	-6.88	-8.48	-11.70	-18.13	3
20000	-7.40	-9.91	-13.13	-19.55	3
25000	-10.41	-14.40	-15.16	-21.49	N/A

Table 2.1 Frequency response of the Probe Microphone (referred to 250 Hz) for various probe lengths

2.4 Cutting Probes down to other Lengths

2.4.1 Stainless-steel Probes

A stainless-steel probe can be cut down to a required length using the pliers and the file. Place the probe into the lower cut-out of the pliers' jaws close to where the tube is to be cut (see Fig- 2.6). Score a groove around the circumference of the tube using the file and gently break off the tube.

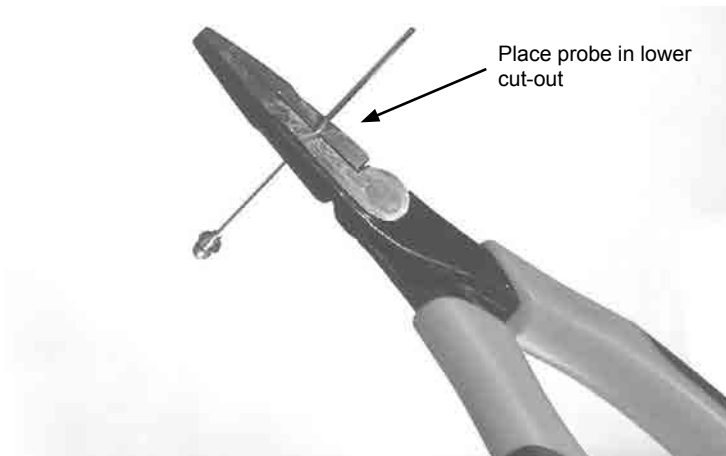


Fig. 2.6 Use the pliers and the file to cut the probe down to the required length

2.4.2 Flexible Probes

Use a pair of scissors to cut a flexible (Teflon) probe down to a required length. The nipple attached to a flexible probe can be removed or fitted as follows. To remove it from the flexible probe, place the flexible probe in the upper cut-out of the pliers' jaws (see Fig 2.7) and unscrew the nipple by turning it anticlockwise. To fit a flexible probe to the nipple, place the flexible probe in the upper cut-out of the pliers' jaws, and screw the nipple onto the flexible probe by turning it clockwise.

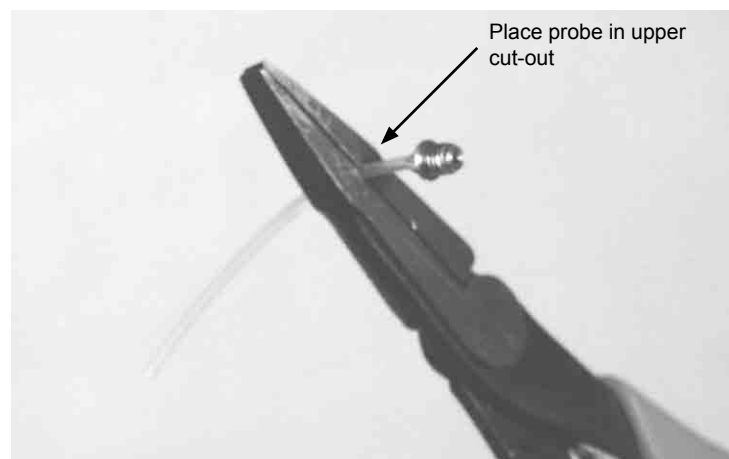


Fig. 2.7 Use the pliers to hold the flexible probe when removing or fitting the nipple

2.5 High-temperature Shielding

For measurements at very high temperatures, use only stainless-steel probes. The temperature of the main body of the Probe Microphone should not exceed 70 °C. To protect the body from heat conducted along the probe, mount the Heat Sink GR0267 on the probe between the hot end of the probe and the main body of the Probe Microphone as shown in Fig 2.8.



Fig. 2.8 Showing the Heat Sink GR0267 mounted on a stainless-steel probe

2.6 Cleaning

If the probe needs to be cleaned, dismantle it and use the needle shown in Fig. 2.2.

With the probe removed from the microphone assembly, gently guide the needle through the probe tube.

3. Calibration

The following explains how to calibrate both the level and frequency responses of the Probe Microphone.

3.1 Level Calibration

To calibrate the Probe Microphone with a pistonphone such as the GRAS Type 42AA, first ensure that the pistonphone is fitted with a coupler for calibrating $\frac{1}{2}$ " microphones (in the case of the Type 42AA, this is standard). The Probe Microphone comes with two $\frac{1}{2}$ " calibration adapters, i.e.:

- GR0265 for stainless-steel probes
- GR0266 for flexible probes

Fit the appropriate adapter to the pistonphone's coupler. Insert the tip of the probe into the calibration adapter² (see Fig 3.1) and turn on the pistonphone. For a Pistonphone Type 42AA, the sound pressure at the probe tip will be 114 dB re. 20 μ Pa. Since the load-volume correction for the probe is 0 dB, the only corrections necessary will be for the barometric pressure.

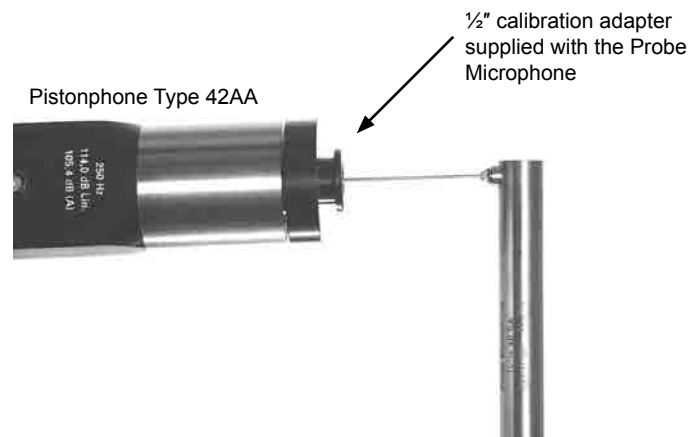


Fig. 3.1 Level calibration using Pistonphone Type 42AA

3.2 Frequency-response Calibration

Frequency-response calibration can be performed either as a free-field calibration using a suitable sound source and $\frac{1}{4}$ " microphone in an anechoic chamber or as a pressure-response calibration using the Calibration Coupler RA0236 included with the Probe Microphone.

3.2.1 Calibration Coupler RA0326

To use this coupler, an emitting microphone and a receiving microphone are required. These are not part of the standard Probe Microphone.

The emitting microphone is inserted in one end of the coupler and the receiving microphone in the other end (see Fig 3.2).

The probe tip is inserted in the appropriate hole in the side of the coupler. There are two of these on opposite sides of the coupler, one for stainless-steel probes and one for flexible probes. The hole not in use should be closed off with an insert pin.

² The probe tip must not make contact with any surface inside the calibration adapter since this will block the entrance to the probe.

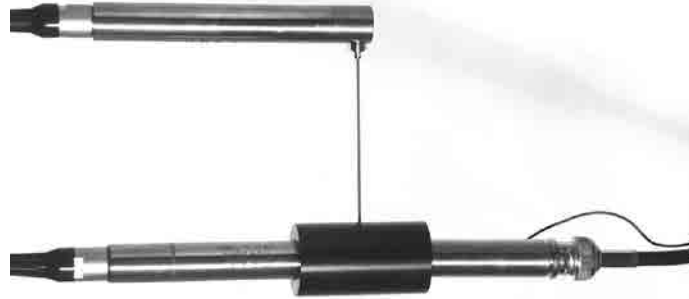


Fig. 3.2 Set up for pressure-frequency response calibration

Apply the test signal to the transmitting microphone and measure the responses of both the receiving microphone Probe Microphone. The response of the Probe Microphone can then be seen as relative to the response of the receiving microphone. Since the sound pressure within the coupler will vary across the diameter of the coupler, make sure that the tip of the probe is positioned at the diametral centre of the coupler³.

³ In any event the probe tip must not make contact with the opposite side of the calibration coupler since this will block the entrance to the probe.

4. Service and Repair

Repairs should be carried out only by qualified personal. The Probe Microphone should not be dismantled with power on because of high-voltage circuits.

5. Specifications

Nominal sensitivity at 250 Hz:

3 mV/Pa (individually calibrated)

Dynamic range:

40 dB to 166 dB (re. 20 μ Pa)

Frequency response (relative to tabular values):

2 Hz - 20 Hz:	± 1.5 dB
20 Hz - 250 Hz:	± 0.5 dB
250 Hz - 1 kHz:	± 0.5 dB
1 kHz - 2 kHz:	± 0.8 dB
2 kHz - 5 kHz:	± 1 dB
5 kHz - 10 kHz:	± 1.5 dB
10 kHz - 20 kHz:	± 3 dB

Electrical Output Impedance:

<50 Ω

Power supply:

Type 40SA:

Single 120 V (2.5 mA) to 28 V (0.7 mA)

Dual ± 60 V (2.5 mA) to ± 14 V (0.7 mA)

Type 40SC:

2 mA to 20 mV (typically 4 mA)

Temperature Range:

Operating: -25°C to 70°C

Probe temp. (with heat sink): max. 800°C

Pressure-equalization time constant:

Internal to tip static pressure: typically 0.1 s

Dimensions:

Length (housing):	83.8 mm
Diameter:	12.7 mm
Weight:	40 g
Probe tube outside diameter:	1.25 mm
Probe tube inside diameter:	1 mm
Cable length:	3 m
Cable diameter:	2.5 mm

Accessories included:

Pistonphone adaptor for 1.25 mm:	GR0265
Pistonphone adaptor for 1.6 mm:	GR0266
Heatsink and tool:	GR0267
Calibration coupler:	RA0326
1.3 mm pin for calibration coupler:	GR0263
1.6 mm pin for calibration coupler:	GR0264
Pair of pliers:	YY0004
File:	YY0005
Silicone grease:	MI0016
Teflon tubing (L: 1 m, Ø: 1.6 mm):	EK0018
20 mm Probe tube:	GR0258
40 mm Probe tube:	GR0259
80 mm Probe tube:	GR0260
160 mm Probe tube:	GR0261
Flexible Probe tube:	GR0401
Needle (for cleaning)	SK5546

Accessories available:

Pistonphone:	Type 42AA
Type 40SA:	
Power modules:	Types 12AA, 12AD or 12AK
Extension cable 3 m:	AA0008
Extension cable 10 m:	AA0009
Type 40SC:	
CCP Supply:	Type 12AL
Power modules:	Types 12AA, 12AD or 12AK (use with CCP Input Adapter AG0002)

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.