GRAS

An Axiometrix Solutions Brand

The importance of measurement microphone venting—

And why there are different vent locations

GRAS Sound & Vibration
Application Note // By Santiago Rayes

APPLICATION NOTE

Introduction: Venting holes

A measurement microphone's venting holes are used for static pressure equalization. This means that the microphone can equalize the internal static pressure behind the diaphragm (Inner volume. See Figure 1) to the same static pressure as outside the microphone. So, the venting hole is basically a small air path that allows the inner volume's pressure to follow the ambient pressure outside the microphone.

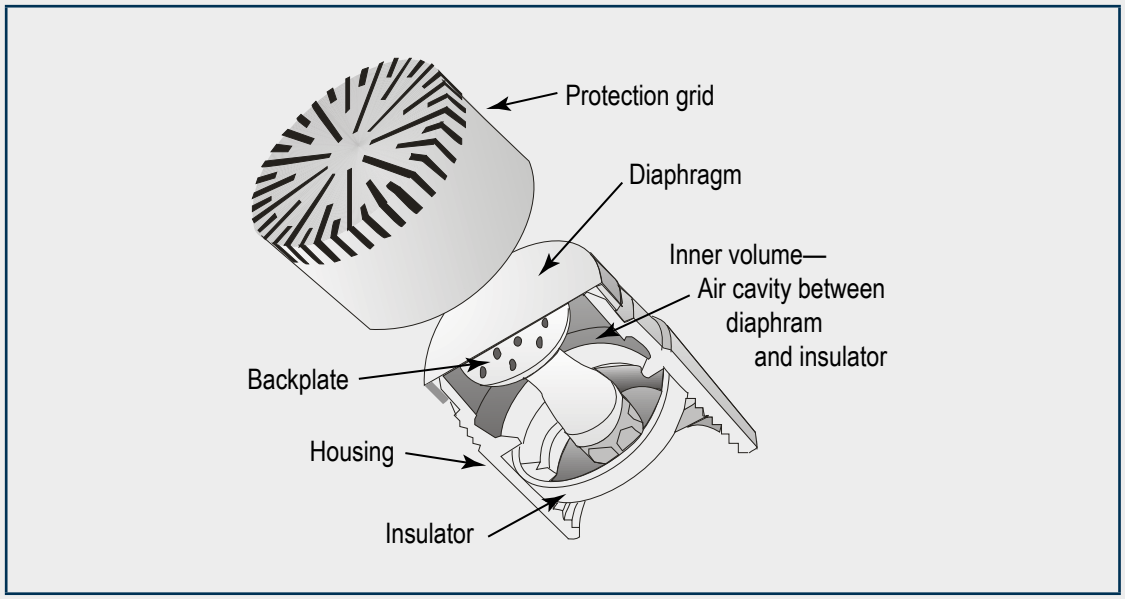

FIGURE 1. *Measurement Microphone capsule with all its parts.*

Proper static pressure equalization is extremely important if we want to make a reliable acoustic measurement. If the static pressure inside the microphone is different than the static pressure outside, the microphone will not only measure acoustical pressure variation but also a static pressure differential between inside and outside the capsule, leading to erroneous results.

Venting holes are also partly responsible of controlling the low-frequency cut-off (the frequency where the microphone's frequency response is down 3 dB) of the measurement microphone, so design changes to the vent will be used to control the low-frequency response of the unit. The venting must be carefully designed so it allows static pressure equalization without affecting the desired low-frequency response of the microphone. In general, the low-frequency cut-off of the microphone set depends on the microphone's capacitance, preamplifier's input impedance, venting design and positioning of the venting in the sound field (directly exposed to, or outside the sound field).

Below 10 – 20 Hz, the frequency response of the microphone is also influenced by its time constant. The time constant for a measurement microphone is around 0.1 s. This is good enough to get a flat frequency response down to 3 – 5 Hz, while getting a microphone that is fast enough to equalize for static pressure changes. When the microphone is exposed to a sudden static pressure change (like when mounted in a sound calibrator/pistonphone for calibration or in a pressure chamber) it is always good practice to wait a couple of seconds to let the microphone equalize its internal static pressure and let the diaphragm return to its normal position.

Why are there different microphone venting locations?

There are two main ways of measurement microphone venting: Front venting (also called side venting) and rear venting. Most GRAS microphones are rear vented but many are available in a front-vented configuration. For example, the GRAS 40AO ½" Prepolarized Pressure Microphone capsule is rear vented but can be found in the 40AO-FV version, which is front vented.

In most cases, front or rear venting will not make any difference in the measurement, but there are some specific applications that require the use of a front-vented microphone.

Rear-vented microphones vent through the back of the microphone (Figure 2), into the preamplifier. The preamplifier will have one or two venting holes (visible on the outer housing; Fig. 3). The holes in the preamplifier are required

to complete the venting path—from the inner cavity of the microphone, going into the preamplifier through the rear of the microphone capsule and finally to the outside through the preamplifier venting hole (Fig. 3). Venting through the preamplifier has the added benefit of increasing protection from particulates because they cannot directly enter the microphone capsule.

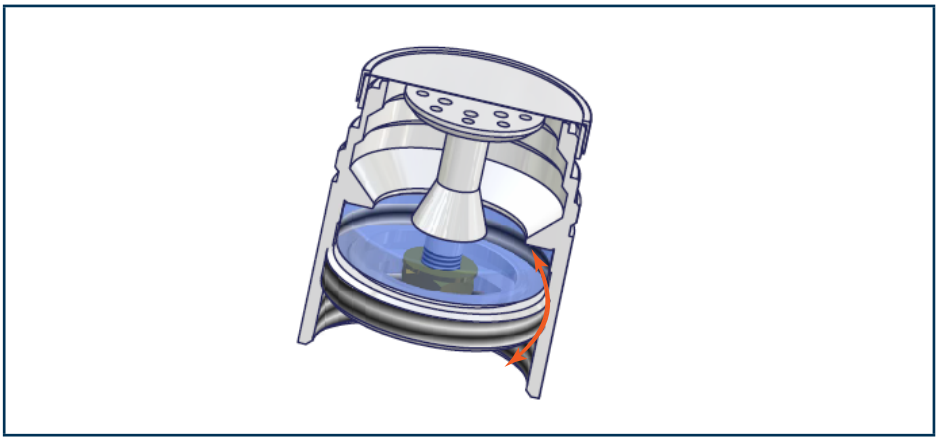

FIGURE 2.
Rear-vented microphone capsule: The microphone vents internally through the rear of the microphone.

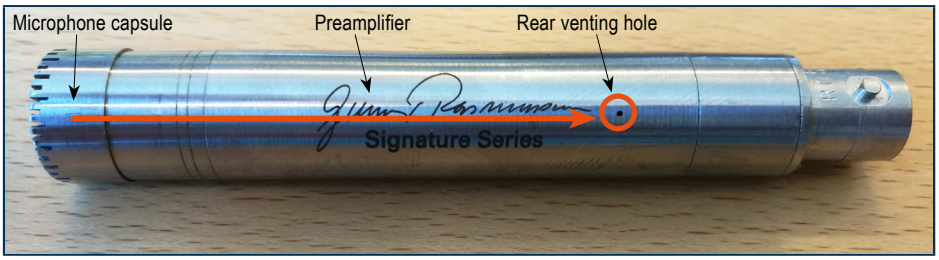

FIGURE 3.
Rear-vented microphone set with venting hole on the preamplifier housing. The orange arrow shows the internal venting path from the microphone to the venting hole on the preamplifier.

On the other hand, front-vented microphones have a venting hole on the side of the microphone capsule, sometimes underneath the protection grid, as can be seen in a variety of microphone capsules in Figure 4.

FIGURE 4.
A) *Front-vented ¼" microphone capsule.*
B) *Front-vented ½" microphone capsule.*
C) *Front-vented flush-mountable microphone set (GRAS 47BX).*

Figure 5 presents a diagram of a front-vented microphone and shows the ventilation path by which pressure inside the microphone (Pin) will be equalized with the static pressure outside the microphone (P2).

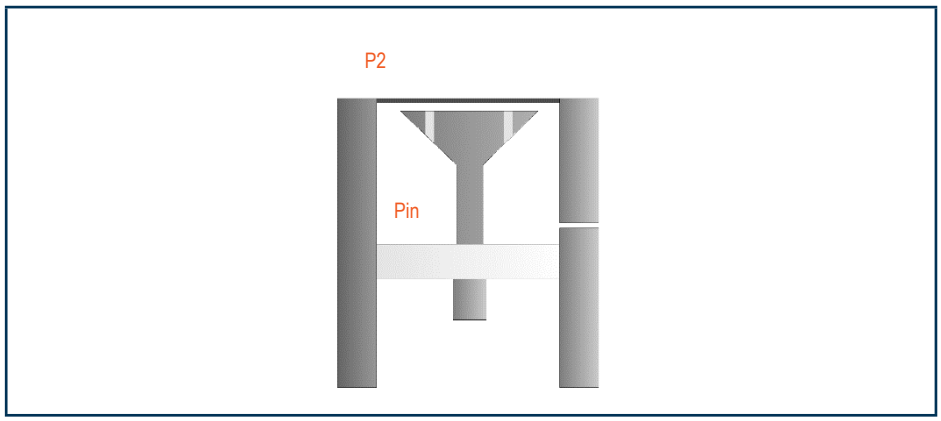

FIGURE 5.
Front/side vented microphone diagram. The internal static pressure (Pin) will be eventually equalized through the venting hole until Pin=P2

Front-vented microphones are extremely useful for applications where the microphone capsule and/or its diaphragm are going to be exposed to a different static pressure than the rest of the unit, such as the scenario presented in Figure 6.

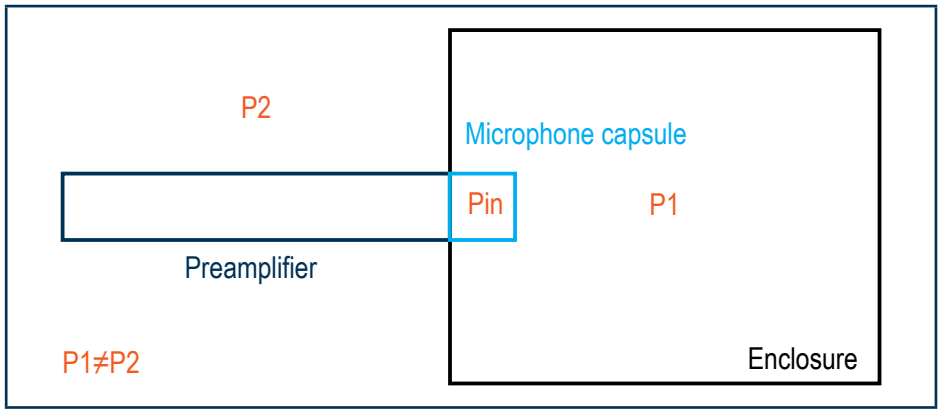

FIGURE 6.
Microphone set mounted in an enclosure with static pressure P1 inside, and P2 outside.

The static pressure inside the enclosure (P1) is different than the one outside (P2). For this setup to work properly, it will be necessary to have a microphone capsule that vents directly inside the enclosure, so the static pressure inside the microphone (Pin) is equal to P1 (the static pressure right in front of the diaphragm).

A similar situation can be found in a wind tunnel, where the static pressure inside the tunnel is different than outside (Figure 7).

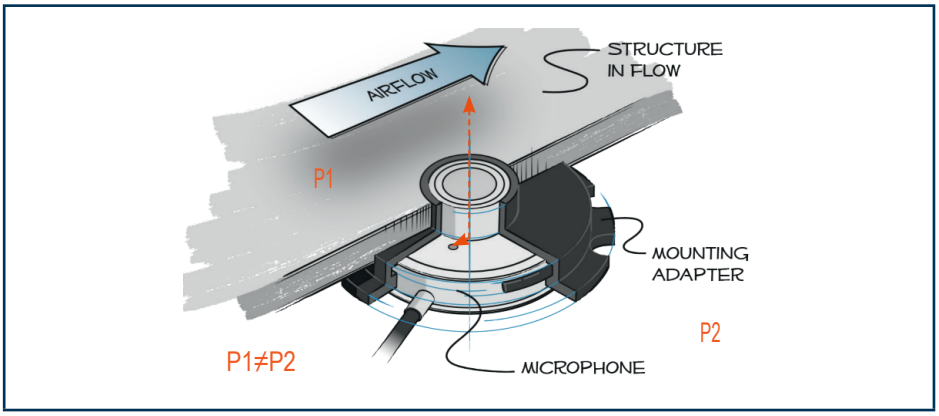

FIGURE 7.
Flush-mount microphone GRAS 47BX mounted on a wind tunnel using RA0502 mounting adapter. The orange arrow shows the venting path.

Figure 7 shows a GRAS 47BX microphone flush-mounted in a wind tunnel using the RA0502 mounting adapter. The position of the venting hole on the microphone and the design of the mounting adapter, allow the microphone to vent to the front. This means that the inner cavity of the microphone behind the diaphragm will equalize to the same static pressure as the front of the diaphragm (i.e., inside the wind tunnel).

A similar case with a 46BD-FV (front vented) microphone set flush-mounted using the RA0345 adapter is shown in Figure 8. The RA0345 adapter allows the microphone to equalize internal pressure with the static pressure found in front of the microphone diaphragm.

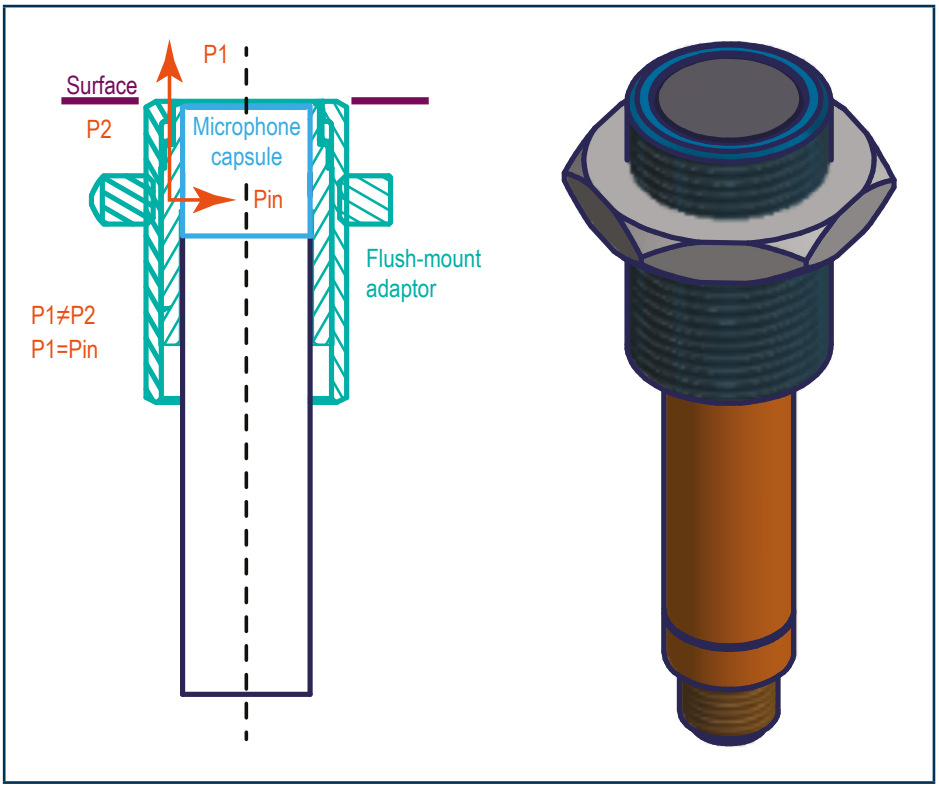

FIGURE 8.
Flush-mounted GRAS 46BD ¼" microphone set using RA0345 flush-mount accessory. The orange arrow shows the venting path.

IP67-rated (water and dust protected) microphones like GRAS 146AE (Figure 9) or 147EB are rear-vented microphones with two venting holes positioned on the preamplifier—close to the joint with the microphone capsule. Having two venting holes can be useful. If, for example, one of the holes gets clogged by water drops or dust particles, the double-vented microphone can still perform the static pressure equalization normally. It is important to mention that on these IP67-rated microphone sets the venting holes are protected, so they allow the air to pass through while preventing the ingress of water and dust.

FIGURE 9.
GRAS 146AE IP67 water and dust protected microphone set. The orange circle is showing the location of one of the set's two venting holes.

Don't block the venting holes!

As detailed above, the venting holes exist and are where they are for good reason. In addition to using a microphone that is vented for the environment in which it shall be used, it is vital that they can function as intended. Sometimes, for example, when labeling microphone sets, protecting the preamplifier from the holder or fixing the microphone set to a surface, users apply tape to the microphone set body as seen in Figures 10 and 11.

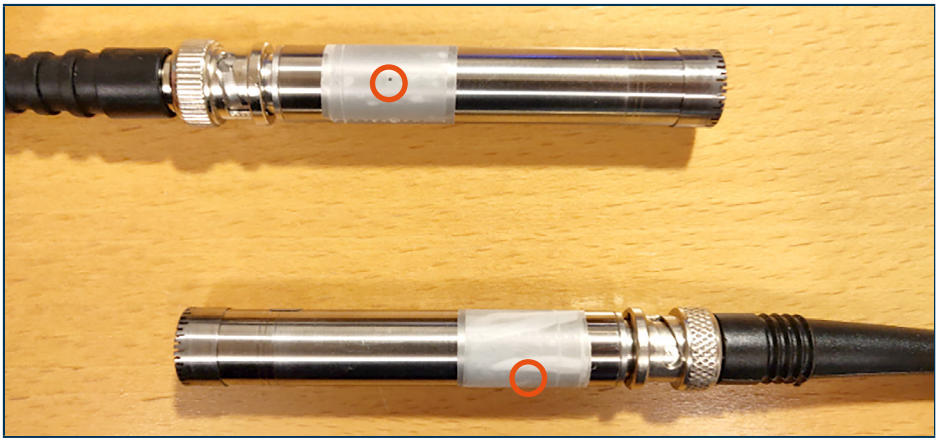

FIGURE 10.
A pair of ½" measurement microphones with tape covering their venting holes. The orange circles show the venting hole location on the preamplifier.

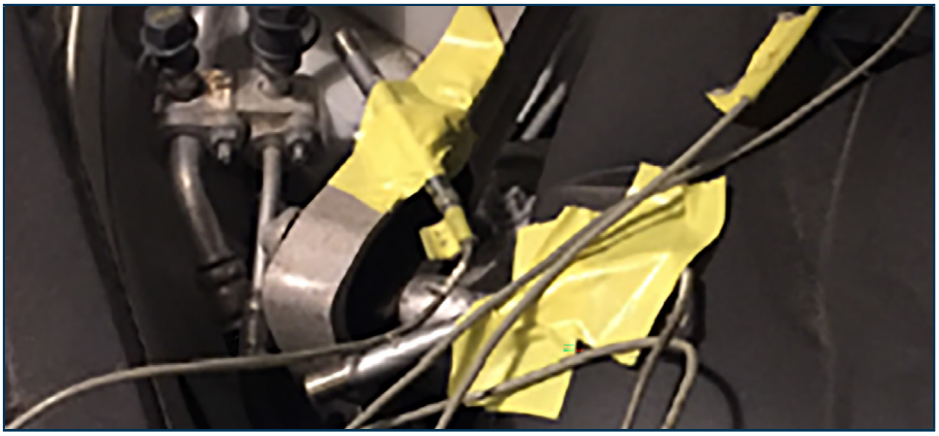

FIGURE 11.
½" measurement microphone sets taped inside an engine bay.

If the venting holes are blocked, no static pressure equalization will be possible. When this happens, static pressure changes can generate a pressure differential on the microphone diaphragm that will displace it. This can generate a signal that might overload the preamplifier and even cause damage to the diaphragm. Under these circumstances, it is not possible to perform reliable acoustic measurements because the sensitivity and frequency response of the microphone will be changed.

So, no matter the measurement microphone set that is being used, it is important to be aware of the location of the venting holes and always avoid blocking them.