How is a measurement microphone affecting the sound field?

Any object that is placed in a sound field will cause a disturbance due to its size and shape. A microphone is no different. A standardized IEC-61094-4 WS2P ½” pressure measurement microphone has a diaphragm diameter of 12.6 mm. Let´s imagine a situation where we place the mentioned microphone in a free-field environment (like an anechoic chamber) pointing at 0 degree incidence of an ideal sound source with a flat frequency response (Figure 1).

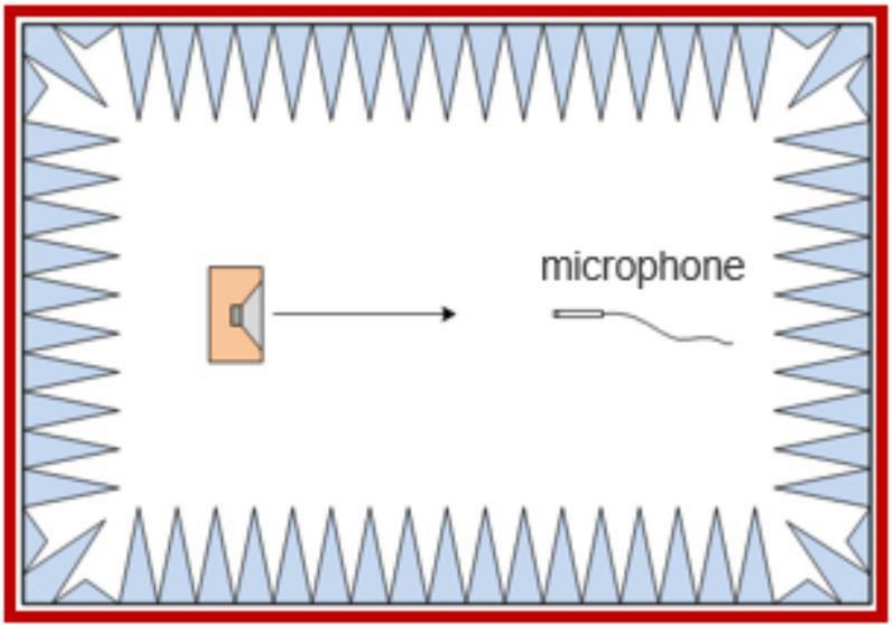


Figure 1. Pressure measurement microphone pointed at 0-degree incidence from a sound source inside an anechoic chamber (Free-field environment).

If we expose this microphone to 100 Hz sine wave coming from the sound source the microphone will be practically “invisible” for this sound wave due to the small size of the microphone (Figure 2) compared to the wavelength of a 100 Hz sine wave (3.4 meters).

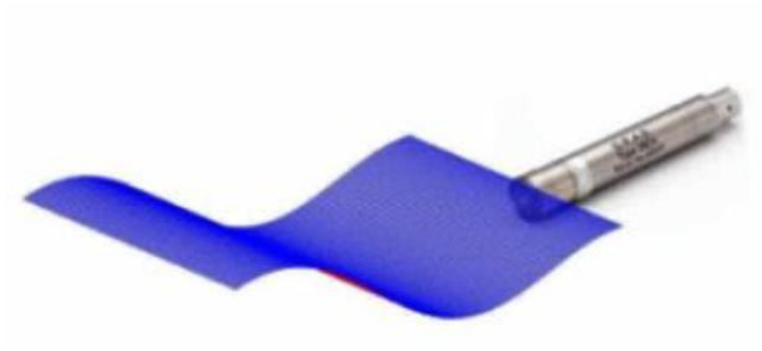
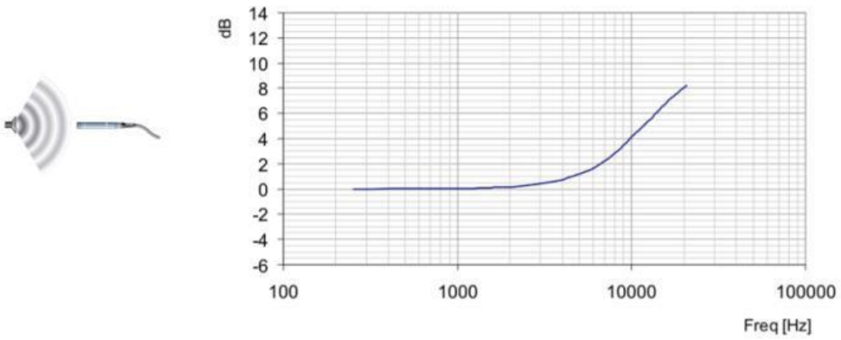


Figure 2. ½” Pressure microphone set exposed to low frequency sound wave with big wavelength.

If we increase the frequency of our reference signal, the wavelength of the signal will start becoming shorter until it starts being comparable with the size of the microphone. For example, a 10000 Hz signal has a wavelength of approx. 34 mm (considering a speed of sound in air of 344 m/s). Under these conditions, we will start noting a diffraction effect happening in front of the microphone diaphragm (Figure 3).

Figure 3. ½" pressure microphone set exposed to high frequency sound wave with short wavelength. Diffraction effect appears.

This diffraction effect will keep increasing with frequency, as the wavelength of the reference signal gets more comparable to the microphone size. The diffraction effect will cause a pressure increase in front of the diaphragm that will be measured by the microphone (Figure 4).



Diameter of a ½" microphone is **12.6 mm**

Frequency	Wavelength
100 Hz	3.4 m
1000 Hz	34 cm
10000 Hz	3.4 cm
20000 Hz	1,7 cm

Figure 4. Pressure build-up for a ½" pressure microphone pointing at 0-degree incidence from sound source in a free-field environment.

The higher the frequency, the shorter the wavelength. The shorter the wavelength, the more comparable will be to the size of the microphone and therefore the more diffraction effect. The more diffraction effect, the more pressure build up the microphone will measure. It is important to understand that this measured pressure increase is only a consequence of the microphone being placed in this sound field, and not the frequency response of the loudspeaker (which in this ideal situation has a flat frequency response) or due to reflections (we are supposing a free-field environment, so no reflections are affecting the measurement).