S&V Questions and Answers

How to Check Condenser Microphones for Damage

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Question: **How should a measurement grade condenser (capacitance type) microphone periodically be checked for damage?**

Answer: The key to understanding the characteristics of a condenser microphone is that the sensitivity of the microphone and the frequency response are related. Thus, by checking for changes in one, changes in the other can be predicted (the opposite is true for an accelerometer – the subject of next month's column). Measurement microphones are manufactured in a way to provide for long term stability of their sensitivity and frequency response characteristics. Under normal use it has been estimated that it would take over one hundred years for a microphones sensitivity to change by as much as 1 dB. Therefore, by checking the microphone's sensitivity or frequency response characteristics, damage can be detected. Depending on the type of microphone, damage to the high and/or low frequency response characteristics can be affected.

High Frequencies Response Problems. The high frequency response and sensitivity of a microphone is controlled by the microphone's diaphragm tension (see Figure 1), typically designed to be more than 99% of the yield strength of the diaphragm material. When a microphone is shocked (dropped) or the diaphragm is touched or stretched, it loosens – the resonant frequency of the microphone goes down (thus, its frequency response is flat to a lower maximum frequency), and its sensitivity goes *up* (due to the looser diaphragm)!

Thus, a microphone can be monitored in one of two ways to check for high frequency response problems:

1. Continuously monitor the sensitivity of the microphone with a fixed tone calibrator. If an *increase* in sensitivity is detected greater than, say 0.5 dB, diaphragm tension decrease should be suspected and thus the high frequency response should be checked.

2. Check the high frequency response with a high frequency pressure coupler or with an electrostatic actuator. Calibration labs will typically use an electrostatic actuator, whereas sound and vibration labs typically use the less expensive high frequency pressure coupler.

Low Frequency Response Problems. The low frequency response of a microphone is controlled by the venting hole characteristics (see Figure 1). A completely sealed microphone would respond down to static (atmospheric) pressure and would act like a barometer. The frequency response of a typical measurement grade microphone will be 3 dB down at 3 to 4 Hz. Low frequency response problems (below 100 Hz) usually occur with the "traditional" series of microphones that use nickel based diaphragms. In some situations microphones with nickel diaphragms will develop "pin holes" in the diaphragms which causes an extra air leakage path and a reduced low frequency response.

Thus a microphone should be monitored in one of two ways to check for a low frequency response problems:

1. Check the low frequency response with a low frequency pressure coupler (preferably one that exposes the microphone venting to the pressure environment) or with an electrostatic actuator.

2. Continuously monitor the sensitivity of the microphone with a pistonphone at 250 Hz (a 1 kHz acoustic calibrator is too high in frequency and not stable enough to detect the small changes in the sensitivity necessary to detect low frequency response problems). If a *decrease* in sensitivity at 250 Hz is noticed, then the low frequency response may be suspect and should be checked as above.

Summary. The frequency response of a measurement grade microphone can either be monitored directly or alternatively, the microphone sensitivity can be monitored. One can't change without effecting the other.

Next months Q&A column answers the question: **How do I detect a damaged piezoelectric accelerometer?**

Send your questions or comments to:

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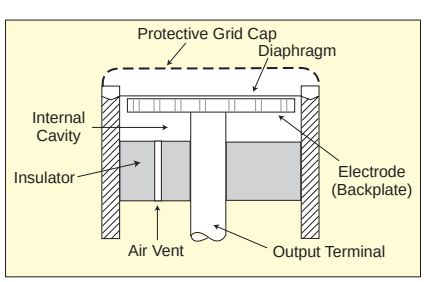

Figure 1. Microphone schematic.