Quick Guide

RA0357 146AE Random-Incidence Corrector

Description

RA0357 is a random-incidence corrector for use with GRAS 146AE with the blue protection grid mounted. When the RA0357 random-incidence corrector is mounted on the grid of the 146AE free-field microphone, the combination complies with ANSI Standard S1.4 Type 1 for diffuse field measurements in the audio-frequency range.

The combination is designed to measure the sound pressure as it existed before the microphone and corrector were introduced into a diffuse sound field. At higher frequencies, the presence of the microphone/corrector combination in the sound field will change the sound pressure. In general, this sound pressure will increase due to reflections and diffraction, but will vary with incidence angle. The RA0357 random-incidence corrector is designed so that its combination with a GRAS 146AE free-field microphone results in a diffraction response that compensates for the mechanical response of the free-field microphone, assuming that the sound waves arrive at random from all directions.

Definition of Diffuse Field Sensitivity

The following definition is taken from IEC 60651 1979+A1:1993+A2:2000 – Appendix B.

The sensitivity, S, of the complete instrument in a diffuse sound field is defined as the RMS value of the sensitivities for all orientations in a free field. For this purpose, it will generally suffice to measure the sensitivity at angles of incidence of 0°, 30°, 60°, 90°, 120°, 150°, and 180° from an axis of symmetry of the microphone and to obtain S from the following formula which takes account, for each orientation, of the area of the corresponding surface element

$$S = \sqrt{K_1 S_0^2 + K_2 S_{30}^2 + K_3 S_{60}^2 + \cdots + K_7 S_{180}^2} \qquad (1)$$

where S_0, S_{30}, S_{60}, … S_{180} are the sensitivities expressed in linear units [e.g. mv/Pa] at the respective angles[, and]

$K_1 = K_7$=0.018; $K_2 = K_6$ = 0.129; $K_3 = K_5$ = 0.224;and K_4 = 0.258

GRAS RA0357

146AE Random-incidence

Corrector

Background

We write the microphone sensitivity, S, at an arbitrary angle, θ, as the series combination of the microphone's mechanical response and acoustic response:

$$S_\theta = S_\theta\{mechanical\} \times S_\theta\{diffraction\}. \qquad (2)$$

The mechanical response is as calibrated by an actuator and the acoustic response is due to diffraction.

Noting, however, that the microphone's mechanical response is independent of incidence angle, θ, equation (1) consequently writes:

$$S = S\{mechanical\} \times S\{diffraction\}, \qquad (3)$$

where

$$S\{diffraction\} \equiv \sqrt{K_1 S_0^2\{diffraction\} + \cdots}. \qquad (4)$$

In logarithmic units (dB), equation (3) becomes:

$$S^{dB} = S^{dB}\{mechanical\} + S^{dB}\{diffraction\}. \qquad (5)$$

For a constant, frequency independent sensitivity curve (that is, $S^{dB}(\omega) = 0$, we therefore require that

$$S^{dB}\{diffraction\} = -S^{dB}\{mechanical\}, \qquad (6)$$

That is, the diffraction about the microphone in a diffuse field is balanced by the mechanical response of the microphone

The following graph shows the diffuse field frequency response of the combination of random-incidence corrector RA0357 and a 146AE microphone. The lower curve, S{mechanical}, is a typical pressure response of a 146AE microphone as measured with an actuator. The upper curve, S{diffraction}, is the pressure increase due to diffraction about the combination microphone and corrector. The middle curve, S, is the resulting frequency response when measuring in a diffuse field.