APPENDIX F—EVALUATING NOISE EXPOSURE OF WORKERS WEARING SOUND-GENERATING HEADSETS

F.1 Workers at Risk

Workers can be overexposed to noise when they wear communications headsets as part of their work. Clerical personnel, aircraft pilots and other cockpit personnel, air traffic controllers, emergency personnel, reservation clerks, receptionists, and telephone operators are just a few examples of the more than 3 million workers who can be exposed to high noise levels via communications headsets. For a person wearing a sound-generating headset, the sound/noise exists predominantly between the eardrum and the headset. Because of the amplification properties of the human ear, the sound that exists inside the ear while wearing a headset is quite different from ambient levels.

Probe microphones and similar devices allow sound levels to be measured inside the ear. Most people, however, find that inserting a probe microphone into their ear canal is uncomfortable and object to wearing a probe for an 8-hour workday. In addition, a probe can damage the eardrum, meaning that the person inserting it requires professional training. For these reasons, probe microphones should not be used for compliance purposes.

> *A **head and torso simulator** (HATS) is a head-and-shoulder mannequin with calibrated "ears" fitted with sophisticated acoustical sensing instrumentation. Manufacturers produce HATS for various specialized purposes. The HATS should match its intended purpose.*

F.2 Methodology

A method of monitoring worker exposure without invading the ear canal has been developed. This sampling method evaluates the noise dose that a worker receives during the actual workday while wearing an insert-type headset, a monaural or binaural muff, or a monaural or binaural foam headset. The technique involves directly measuring the sound pressure level of a headset similar to the workers using a head and torso simulator (HATS) that can measure acoustic signals at the eardrum point. The electrical signal input to the worker's headset is split into two, both identical to the original. One signal is fed to the worker's headset and the other is fed to the similar headset (the monitoring headset). The monitoring headset is placed on the HATS so that it is being "worn" in the same manner as the worker's headset. The signal measured from the HATS ear is fed to a set of electrical filters (an audio equalizer) that carries out the HATS eardrum-to-diffuse-field transfer function. The output from the electrical filters is then fed to a noise dosimeter. The dosimeter reads the noise exposure dose in percentage. The percentage dose can be then calculated to a time-weighted average (TWA) noise exposure level in dBA.

> *The term diffuse field refers to sound that comes from all directions, such as from a source and also many sound-reflecting surfaces (reverberant sound). Most factory production rooms are diffuse fields.*
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> *In contrast, a free field is a space with no echo or reflected sound, such as a location outdoors, away from any structures. In a free field, all sound comes from a single direction, the point where the sound source is located.*

Note that the monitoring headset must be acquired before sampling can begin. It should be identical in brand and model to the headset worn by the worker. Both the worker's and the monitoring headsets should be characterized (i.e., frequency response and sensitivity) and recorded.

After the TWA level is calculated from the measurement, add to the result the sensitivity difference between the worker's and the monitoring headsets.

Example:

TWA from the measurement = 73 dBA
Sensitivity difference = worker's headset sensitivity – monitoring headset sensitivity = -3 dB
Worker's daily noise exposure level = 73 + (-3) = 70 dBA

Contact the OSHA Salt Lake Technical Center for more information.

F.3 Acoustic Limited Devices

Laboratory evaluations have determined that headsets can be categorized in two basic groups:

Those without any form of electronic limiting device.

Those with some form of limiting device built into the headset.

Most modern telecommunication headsets use sophisticated limiting circuits. Some personal audio headsets (e.g., for MP3 players) also have this capability. Headsets with acoustic limiting devices that are functioning as designed have been shown, in both laboratory and field tests, to provide enough protection to keep worker noise exposures below OSHA permissible noise levels. In some work environments, however, headsets without limiting devices have caused worker noise exposures to exceed the levels permitted by OSHA.

For more information, see OSHA's letter of interpretation dated 4/14/1987—Use of Walkman Radio, Tape, or CD Players and Their Effect When Hearing Protection is in Use.