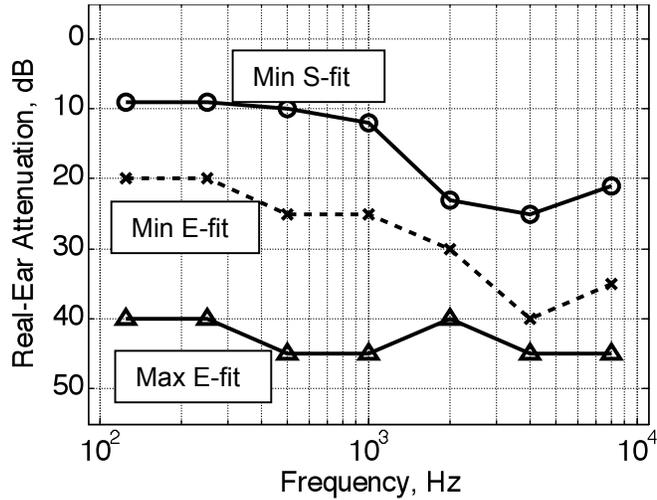


## Attenuation Provided by S14 Insert Earphones

The S14 insert earphones with their Comply™ foam tips act like earplugs. And, like earplugs, their effectiveness in attenuating sound reaching the eardrum depends very much on how deeply and tightly they are inserted in the ear canal. This is a well-known problem with earplugs. Figure 1 has been adapted from measurements summarized by Berger (2000) showing the range of attenuation that can be expected with a foam plug. The curve labeled 'min S-fit' is the minimum attenuation at each frequency from several studies in which inexperienced subjects inserted foam plugs. The next curve, 'min E-fit', is the minimum attenuation when experienced subjects (or an experimenter) inserted the plugs. Finally, max E-fit is the maximum attenuation measured across studies with experienced insertions. This wide range of measurements emphasizes the need to take care when inserting the foam tips (or when instructing subjects to do so).

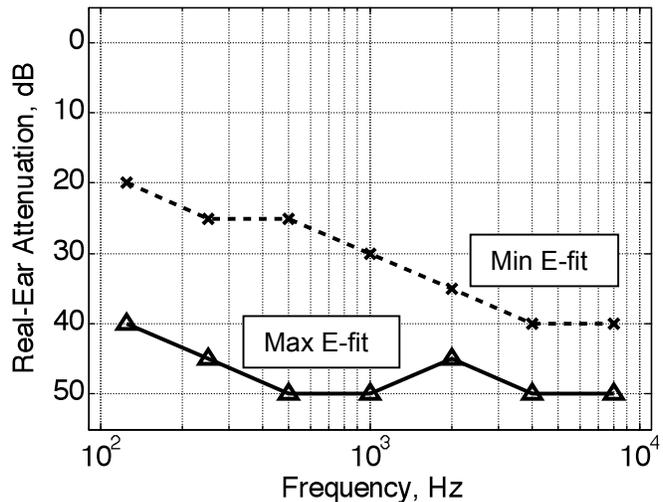
**Figure 1.** Attenuation measurements with foam plugs.



Adding a hearing protector muff to a foam plug will increase the attenuation. Attenuation estimates for this “double protection” condition, also summarized by Berger (2000), are shown in Figure 2 (for E-fit studies only). It is clearly beneficial to use muffs over the insert phones if possible.

NOTE: The measurements shown here are typical of the range of attenuation that can be expected for air-conducted sound. They do not necessarily apply to conditions in which the wearer of the hearing protector is in contact with a vibrating source, as can happen during MRI scans. Steps that can be taken to minimize bone-conducted sound are discussed by Ravicz and Melcher (2001).

**Figure 2.** Attenuation measurements with earmuffs and earplugs.



Berger, E. (2000). “Hearing Protection Devices,” in *The Noise Manual* (5<sup>th</sup> ed.), edited by E.H. Berger, L.H. Royster, J.D. Royster, D.P. Driscoll, and M. Layne (American Industrial Hygiene, Association, Fairfax, Virginia).

Ravicz, M.E. and Melcher, J.R. (2001). “Isolating the auditory system from acoustic noise during functional magnetic resonance imaging: examination of conduction through ear canal, head, and body,” *J. Acoust. Soc. Am.* 109: 216-231.