

## An Earplug with Uniform 15-dB Attenuation

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### SOMETHING ABOUT MEAD

Based on a patent by Elmer Carlson (1983), Mead sought permission from Knowles to license this idea to provide musicians with safe and effective hearing protection. Knowles was not interested in pursuing this product so Mead commercialized the ER15 earplug as one of Etymotic Research's first products. Unlike previous hearing protectors, the ER15 had two important properties- a flat or uniform attenuation pattern from 63 Hz to 16,000 Hz (with a slight dip in the 6000 Hz region) and "only" 15 dB of attenuation. Mead, being a musician himself was one of the first users. With "only" 15 dB of hearing protection, the musician could still be exposed 32 times as long as without hearing protection, essentially providing a new generation of musicians and music listeners with safe, yet acceptable, hearing protection. These are still available, and even after more than 35 years, serves as the bedrock of my Musicians' Clinics of Canada offerings. Mead was able to "predict the future" because of his technical abilities and his understanding of what a musician or music listener required for safe listening.

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### SUMMARY

This article discusses the limitations of current forms (before 1988) of hearing protectors including modifications that have been used to make them more "musician-friendly", including the use of venting. However, venting only minimizes the degree of low-frequency attenuation, and if the vent is larger, a resonance (or amplification) can occur. Elmer Carlson's innovation used a thin plastic diaphragm that acts as a compliance (C1), coupled to the sound channel, which acts as an acoustic mass (or acoustic inertance) (L1). And since C1 is about 5 times smaller than the C of the residual earcanal volume, this results in a 15 dB attenuation. When these values are set correctly, a 2700 Hz Helmholtz resonance is established that offsets the loss of this real ear unoccluded (or unaided) resonance (REUR) of the earcanal, with the net result being an attenuation pattern that is parallel to the REUR curve, and therefore creating a flat or uniform hearing protector. Mead and his coauthors felt that this uniform attenuation form of hearing protection would be ideal for musicians and industrial workers exposed to sound levels below 100 dBA ( $100 - 15 = 85$  dBA).



Annotated by: Marshall Chasin