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The Effect of Shooting Glasses on Earmuff Attenuation Measured with Acoustic Test Fixtures and Firearm Impulses

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Firearm users are faced with conflicting or inaccurate information when choosing personal protective equipment. While both ballistic safety glasses and hearing protection are recommended for use with firearms, product labeling does not reflect potential changes in performance when using both devices simultaneously. Safety glasses are designed to protect the eyes from projectiles (e.g., sparks, bullet shavings), and hearing protection, such as earmuffs, reduces the amplitude of potentially hazardous impulse noise. Product labeling for earmuffs only reports measured NRR values for noise reduction when worn in isolation in continuous noise. However, safety glasses worn in combination with earmuffs introduces a leak between the cushion of the earmuff and the head, where the temple of the glasses slips underneath the cushions (Figure 1). Royster et al. (1997) reported that safety glasses, when worn with earmuffs, lowered the noise reduction rating by about 9 or 10 dB for human subjects. Murphy and Tubbs (2007) reported that safety glasses reduced the attenuation of peak impulse level between 10 and 15 dB, when measured with an acoustic test fixture (ATF).

We selected a popular model of earmuffs, sold as a combination of earmuffs, earplugs, and ballistic safety glasses, to test with firearm impulses and a GRAS 45CB ATF. Four positions relative to the firearm muzzle were identified, yielding levels between 155 and 179 dB pSPL as produced by a .300 caliber Browning A-Bolt rifle (Figure 2). Impulse peak levels were reduced from -27.4 dB of attenuation when only wearing earmuffs, to -13.2 dB with earmuffs and safety glasses at the position furthest from the muzzle (155 dB peak level) and -30.4 dB of attenuation (earmuffs only) to -14.6 dB (earmuffs and safety glasses) at the position closest to the muzzle (179 dB peak level) (Figure 3). The spectrum of the Impulse Insertion Loss (IIL) was less than 10 dB below 400 Hz for earmuffs alone, and negligible for the earmuffs and glasses condition. At high frequencies, the leak due to the safety glasses reduced the Impulse Insertion Loss by 15 to 25 dB.

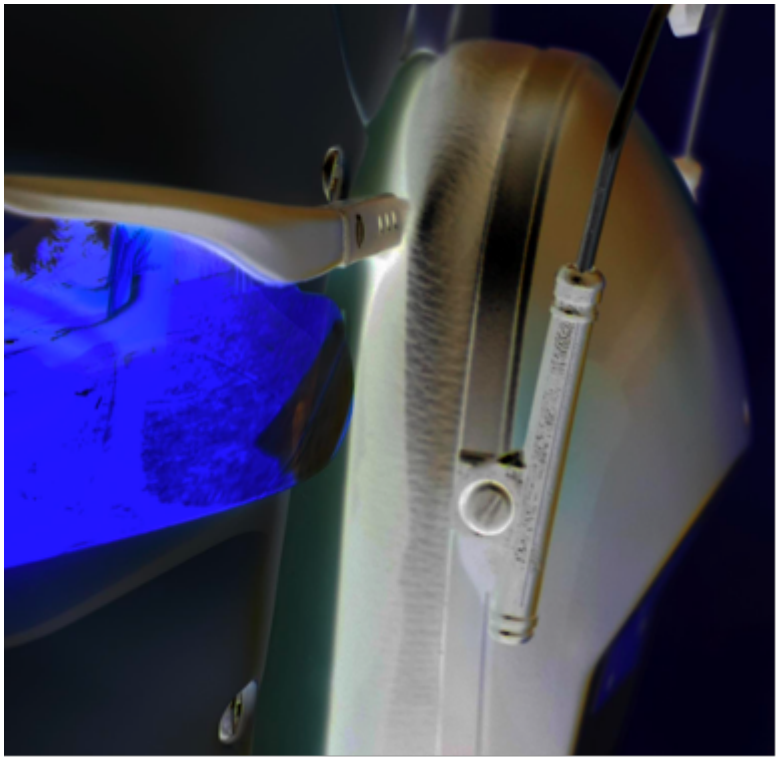

Figure 1. Close-up view of deformation of the earmuff cushion from the ballistic safety glasses resulting in an acoustic leak.

Figure 2. Earmuffs and ballistic safety glasses positioned on the acoustic test fixture (Position 1, 179 dB pSPL). The muzzle of the .300 caliber Browning A-Bolt rifle is shown in the foreground.

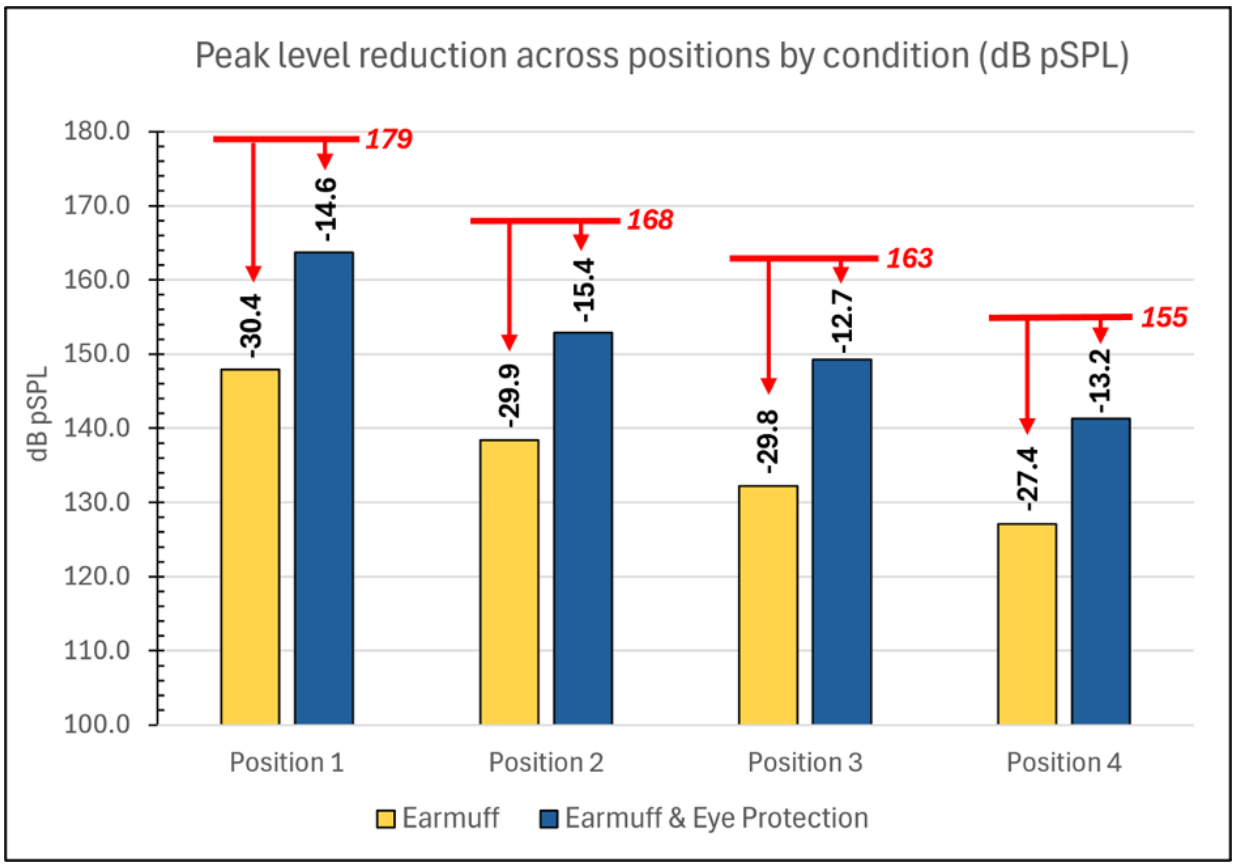

Figure 3. Peak reduction for earmuff-only and earmuff + eye protection conditions at all four measurement positions (Position 1 is closest to the firearm muzzle. Position 4 is furthest from the firearm muzzle).

Dual protection (earmuffs and earplugs) is advisable when firing high-powered firearms. Alternatives to the traditional safety glasses are available with either magnetic connections or straps that do not deform the earmuff's cushion. Hearing conservation programs need to account for the deleterious effect of protective eyewear on earmuffs, and additional studies with broad combinations of earmuffs and eyewear are needed to establish the range over which eyewear can be expected to compromise earmuff attenuation.

References

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