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Collapsible Drill Steel Enclosure for Reducing Roof Bolting Machine Drilling Noise

Objective

To reduce operator exposure to drilling noise from roof bolting machines.

Background

Noise-induced hearing loss (NIHL) is a prevalent occupational illness in the United States. Studies indicate that 70%–90% of miners have NIHL significant enough to be classified as a hearing disability. Mine Safety and Health Administration studies indicated that roof bolting machine operators are among those overexposed to noise. Field studies support the premise that, on average, drilling is the loudest noise source to which a roof bolting machine operator is typically exposed and contributes greatly to the operator's noise exposure. The National Institute for Occupational Safety and Health (NIOSH) has further determined that the drill steel and chuck radiate a significant amount of noise during drilling. To address this noise hazard, NIOSH developed a collapsible drill steel enclosure (CDSE) to encapsulate the drill steel during the drilling portion of the roof bolting machine duty cycle. In addition, NIOSH is collaborating with J. H. Fletcher & Co. in the continued development of a CDSE.

Technical Approach

A proven method to reduce noise transmission from a source (drill steel/chuck) to a receiver (operator) is to create a barrier around the source. With this in mind, NIOSH developed a CDSE to break the noise path between the drill steel and the operator. The CDSE is composed of a bellows (barrier between the source and operator), spring (to support the CDSE), hinge (to facilitate moving the CDSE for roof bolt installation), cap (acoustic barrier at the top of the CDSE), and mounting hardware (for installation on the roof bolting machine).

The device is simple to use. Before drilling, the operator installs the drill steel through the CDSE and into the chuck. At the beginning of the drilling cycle, the CDSE is fully extended. A gap between the cap and the roof allows the operator to see the drill bit/media interface and start the hole (Figure 1). As the drill chuck rises, the gap closes until the cap is flush with the roof (Figure 2). The CDSE then collapses as drilling continues (Figure 3). When drilling is completed, the operator swings the CDSE to the side and installs the roof bolt as usual (Figure 4).

Results

Laboratory testing in a reverberation chamber (for sound power level) and hemianechoic chamber (for noise source identification and operator ear sound pressure level) showed that

Figure 1.—The CDSE at the start of drilling. The gap above the CDSE allows the operator to see the drill bit/media interface to start the hole. The height of the CDSE can be varied to suit the particular application.

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the CDSE reduces the noise level at the roof bolting machine operator location, thus reducing noise exposure. This was confirmed by field testing at a cooperating mine. NIOSH conducted time-motion studies to determine the effect of using a CDSE on operator noise exposure and drilling noise. Field data shown in Figure 5 confirm that using the CDSE reduces an operator's 8-hour time-weighted exposure from 97 to 91 dB(A), a 6-dB(A) reduction. NIOSH conducted additional analysis of only drilling noise. Using a CDSE reduced the operator drilling noise levels from 107 to 100 dB(A), a 7-dB(A) decrease.

For More Information

For more information on the CDSE for reducing noise exposure, contact J. Shawn Peterson (412-386-4995, JPeterson@cdc.gov) or Lynn A. Alcorn (412-386-6732, LAlcorn@cdc.gov), NIOSH Pittsburgh Research Laboratory, P.O. Box 18070, Pittsburgh, PA 15236-0070.

Figure 2.—The CDSE is now flush with roof.

Figure 3.—As drilling advances, the CDSE collapses.

Figure 4.—Once drilling is completed, the CDSE is moved aside so the roof bolt can be installed.

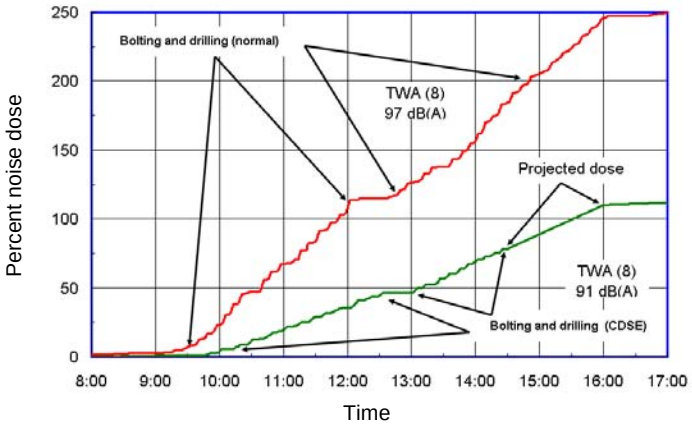

Figure 5.—Field data show that using a CDSE reduced a roof bolting machine operator's 8-hour time-weighted exposure from 97 to 91 dB(A).

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