

Roof Hazard Alert Modules

Objective

To discourage miners from going inby unsupported mine roof by developing intrinsically safe devices that render the attendant hazard more evident, direct a person's attention to read the warning message on the module, and thus avoid the hazard beyond the device.

Background

Some miners unknowingly venture beyond the last row of roof bolts in an underground coal mine. The new permissible-type, intrinsically safe design modules described here represent an engineering intervention strategy toward improving miners' ability to recognize and avoid the hazardous zone of unsupported mine roof.

These devices are designed to improve the miner's recognition of the unsupported roof by marking the end of roof support with a flashing red light and a written message warning miners to avoid the unsupported area ahead.

How It Works

Two different types of battery-powered roof hazard alert modules (RHAM's) have been designed, fabricated, and initially evaluated at our facilities. One type of module features a rechargeable cap lamp battery for its energy source; the other type uses disposable 9-V alkaline batteries.

As shown in figure 1, the rechargeable RHAM was fabricated from a conventional 4-V cap lamp battery unit. A special in-house circuit interrupts the conventional incandescent bulb to flash through a red lens at about 3 Hz. The basic part of the prototype unit is a commercially available cap lamp with remote control adapter powered by a 4-V, two-cell, lead-acid battery.

The new features added by NIOSH Pittsburgh Research Center (PRC) personnel include (1) a solid-state timing circuit and three-position mode switch that are situated within the existing remote adapter and battery cover case, (2) a metal bracket and hook assembly to coil the cable, attach the lamp to the bracket, and suspend the entire unit from a mine roof bolt plate eyelet, (3) a red lens, (4) a warning decal affixed below the lamp, and (5) a mode switch decal.

The added electrical circuit is of low power and energy storage design and is ultimately expected to be amenable to an MSHA-certified, intrinsically safe design for operation inby the last open crosscut in a gassy mine. PRC personnel plan to apply for an experimental permit for this device and others described below, which will signify an intrinsically safe design.

At an underground coal mine, one or more of these RHAM's would be removed from the battery-charging station aboveground and the new three-position switch moved from the "CHARGE" to the "OFF" mode. The unit(s) would be carried by someone to a mine transport vehicle and later to the underground working area. At those places underground where mining has progressed beyond 4 ft of the last row of roof bolts, one of the new RHAM units is suspended from a roof plate eyelet within the last row of roof bolts and rotated so that the lamp is facing outby. The unit hangs down from the mine roof about 1 ft, which allows for most personnel and equipment movements underneath in high coal seams, but would restrict equipment movements in lower seams. In lower seams, the compact RHAM (figure 2) is recommended instead.

Once the high-coal RHAM is in place, suspended from the roof bolt plate eyelet, it is activated into a flashing mode as follows: (1) the common three-position lamp switch is selected for the forward (-) arrow and (2) the new three-position toggle switch (located atop the battery cover case) is selected for the "FLASH" mode. With both





Figure 1.—Rechargeable roof hazard alert module (4-V).



Figure 2.—Disposable magnetic-mount roof hazard alert module (9-V).

switches set as above, the unit will then be activated and produce a 3-Hz (approximately three flash bursts/second cycle) red flashing light. This bright red flashing light should provide ample warning to mine personnel and visitors of the unsupported mine roof area hazard just ahead. Because the duty cycle of the RHAM light unit is approximately half-on and half-off, it is expected that the unit will consume much less energy and last for more than a shift of operation (>10 h). In practice, the RHAM could be left on until the hazardous roof area is bolted or replaced with a recharged unit.

Similarly, the low-coal RHAM unit shown in figure 2 was designed to be used in thinner seams and features a much shorter profile and compact package. Two different types of this design were fabricated; one featured a hook mount similar to the high-coal version shown in figure 1, whereas the other, shown in figure 2, features an internal magnetic mount that minimizes the projection down below the mine roof bolt (the extension below the roof bolt head is about 2 in). The prototype units were fabricated from machined aluminum stock, but other types of case material are possible. These units are constructed to be dust- and water-resistant and should withstand rough treatment. The intended method of use is similar to the high-coal RHAM's discussed above, except that disposable 9-V batteries power a red flashing light-emitting diode (LED).

Table 1 summarizes the two different types of RHAM units and the three prototype units that were fabricated at PRC laboratories.

For More Information

For more information regarding this new technology, contact:

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Mention of any company name or product does not constitute endorsement by the National Institute for Occupational Safety and Health.

To receive additional information about mining issues or other occupational safety and health problems, call **1-800-35-NIOSH (1-800-356-4674)**, or visit the NIOSH Home Page on the World Wide Web at <http://www.cdc.gov/niosh/homepage.html>

As of October 1996, the safety and health research functions of the former U.S. Bureau of Mines are located in the National Institute for Occupational Safety and Health (NIOSH).

Table 1.—Roof hazard alert modules

Module	Rechargeable	Disposable No. 1	Disposable No. 2
Type	Modified cap lamp	Mechanical hook mount	Magnetic-mount
Battery voltage	One 4-V lead-acid	Three 9-V dc alkaline	Two 9-V dc alkaline
Battery life	1 shift+	487 h	360 h
No. of shifts@4 h/shift	3+	121	90
Weeks@5 shifts/week	NAP	24	18
Operating life	5-6 years	5.6 months	4.1 months
Extension below roof bolt head	11.5 in	4 in	2 in
Weight	5 + 1.2 = 6.2 lb	1.1 lb	1.5 lb
Overall dimensions	12.5 in by 7.5 in by 6 in	5.25 in by 5.25 in by 1.25 in	5.25 in by 3.25 in by 1.25 in

NAP Not applicable.