

EZ-Up Curtain Stoppings: A Practical Solution for Directing Ventilation Airflows in Large-opening Metal/Nonmetal Mines

Objective

To identify and evaluate a durable, flexible, and practical stopping to direct ventilation airflows in large-opening metal/nonmetal mines.

Background

Supplying fresh ventilation air to dilute airborne contaminants such as diesel particulate matter, diesel and blasting fumes, and silica dust is vital to protect the health of underground mine workers. Stoppings and other control devices that are used to direct the required airflow to the active working areas are an integral part of the mechanical ventilation systems used in underground mines. Stoppings should be engineered for the pressure dynamics to which they will be subjected at the specific location where they will be installed. In addition, they should be designed for quick installation and minimal maintenance, and they must maintain their structural integrity when subjected to differential air pressures. Due to the size of the entries, stoppings in large-opening mines are difficult to construct and maintain. Flexible curtain stoppings in particular are prone to damage from blast pressures and from repetitive flapping due to varying air movement in these mines.

Description

The EZ-Up curtain stopping (Figure 1) is designed primarily for use as a temporary or portable stopping, although test results indicate that it may remain durable for an extended time. The stopping can be constructed from a variety of fabrics, including standard mine brattice. For these particular tests, stoppings composed of two separate curtain materials were evaluated: (1) a high-density polyethylene woven fabric and (2) a string-reinforced polyethylene film and polyester fabric. The EZ-Up curtain stopping is manufactured with a sewn-in loop so that it can be easily laced onto tubing while on the ground and then hoisted with a strap and ratchet mechanism system to the mine

roof. Because the stopping is constructed mainly on the ground, miners' exposure to the hazards of working at heights (typically 20–40 ft) associated with large-opening mines is reduced. The EZ-Up curtain stopping is constructed in four phases: (1) preparation and ratchet installation, (2) curtain preparation, (3) curtain hoisting, and (4) securing the perimeter.

Phase 1 – Preparation and Ratchet Installation

The walls and roof of the stopping installation area should be fully scaled to prevent injuries from falling rock during construction and to provide a solid foundation to secure the stopping. The stopping is attached to the mine roof with four brackets anchored by roof bolts. Typically, a 9-in-long by 1-in-diam roof bolt anchored in competent roof material will provide the proper support to suspend the curtain. A ratchet assembly is attached to each bracket. The four brackets are positioned in a straight line across the roof of the entry using a string line or laser

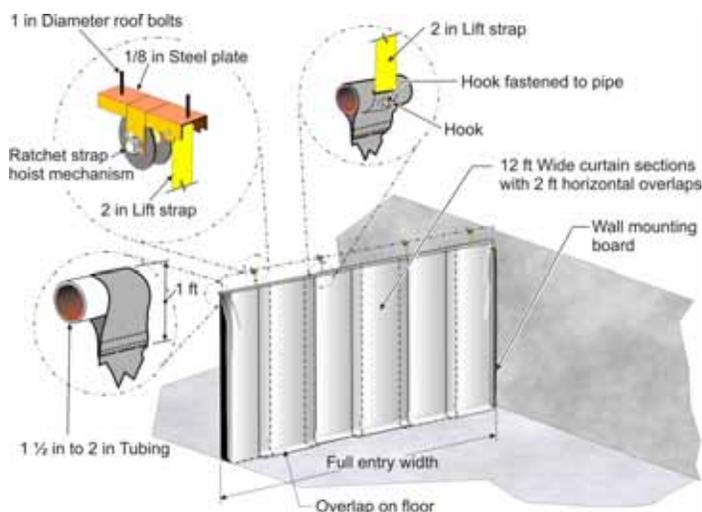


Figure 1.—Schematic of EZ-Up curtain stopping for use in large-opening mines.

device. One bracket should be mounted at each end near the wall, with two additional brackets evenly spaced across the entry. After mounting, the ratchet mechanisms are ready to accept the straps for lifting the curtain.

Phase 2 – Curtain Preparation

The panels used to make the EZ-Up curtain stopping are nominally 12 ft wide; the length is equal to the entry height plus an additional 1–2 ft of material to allow the curtain to drape onto the mine floor to provide a good seal. The fabric along the top edge of each panel is folded over to form a loop through which 1½- to 2-in-diam tubing or conduit is threaded (Figure 1). The individual lengths of tubing can be joined together with either threaded or tapered connections. To limit air leakage, each curtain panel is overlapped approximately 2 ft onto the adjoining panel. The loop at the top of each panel must be cut away on one side to allow for the overlap.

Phase 3 – Curtain Hoisting

The lift straps are suspended from the ratchet mechanisms and attached to the tubing in preparation for lifting. The flat-plate hook ends (sewn into the strap by the manufacturer) are attached to the tubing by notching a narrow slot into the tubing with a small handheld electric grinder.

The flat-plate hook is fitted into the notch and bolted if needed to secure it to the tubing. After attaching all lift straps, the EZ-Up curtain stopping is lifted using the ratchet mechanism. Lifts should be made approximately 5 ft at a time while keeping the curtain tubing as level as practical (Figure 2). The curtain is hoisted until the top of the stopping is near the roof of the mine entry. The ratchets are then secured with the set screws provided to lock the mechanisms in place.

Phase 4 – Securing the Perimeter

The final step in the installation process is to secure the EZ-Up curtain stopping to the walls of the entry. First, 2-in by 4-in nominal boards are bolted vertically to the entry walls from floor to ceiling in line with the edge of the stopping. Excess curtain material on the end of the stopping adjacent to the wall is then wrapped onto a second set of vertical boards. Care must be taken to avoid stretching or wrapping the curtain material too tight, as the stopping should be permitted to yield slightly when subjected to variable pressures. The wrapped curtain boards are then attached to the wall boards using ¼-in by 4-in lag screws.

Test Results

Stoppings in large-opening underground mines must withstand air blasts associated with development and production



Figure 2.—Raising the EZ-Up curtain stopping into position.

blasting. The structural integrity of stoppings can be determined by subjecting them to known blast loads that simulate mine production blasts. Blast pressure tests using unconfined explosive charges were conducted on stoppings composed of two different materials: (1) a high-density polyethylene woven fabric and (2) a string-reinforced polyethylene film and polyester fabric. Both were constructed as described above. The tests were conducted in the large underground entries at NIOSH's Lake Lynn Experimental Mine (LLEM). As a benchmark for evaluating the EZ-Up curtain stopping, in-mine blast pressures at operating underground stone mines were previously measured at approximately 1 psig. The stoppings were subjected to a maximum of 3 psig of blast pressure during the LLEM evaluations, with the integrity of the EZ-Up curtain stoppings remaining intact.

For More Information

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