CDC NIOSH Workplace Safety and Health
Technology News
No. 512 Milestones in Mining Safety and Health Technology October 2005

# Improve Drill Dust Collector Capture Through Better Shroud and Inlet Configurations

## Objective

To improve the effectiveness of dust collector capture on surface mine drills.

## Background

Overexposure to airborne respirable crystalline silica (or quartz) dust can cause serious or fatal respiratory disease. In particular, some of the most severe cases of silicosis have been observed in surface mine rock drillers. A voluntary lung screening study conducted on surface coal mine workers in Pennsylvania concluded that the incidence rate of silicosis is directly related to age and years of drilling experience. Dust sampling data from the Mine Safety and Health Administration show that the drilling machine operator continues to frequently exceed the federally mandated quartz dust standard.

Dry dust collection systems tend to be the most common type of dust control incorporated into drilling machines by original equipment manufacturers because of their capability to operate in various climates. This system includes a self-cleaning (compressed air back pulsing filters) dry dust collector sucking dust from underneath the drill deck shroud, which surrounds the hole being flushed by compressed air (bailing air). Previous drill studies have shown that over half of the dry collector dust emission problems are from the deck shroud and drill stem bushing leakage.

## Approach

An obvious cause for dust escaping collector inlet capture is a breach in the shroud enclosure around the hole. The amount of dust escaping through shroud enclosure openings depends on many factors. These include the opening size, the drill hole flushing airflow, the collector airflow, and the opening location from the inlet duct. Experiments were done at the NIOSH Pittsburgh Research Laboratory to study the effects of these factors in mitigating dust that escapes the dust collector shroud. Between 170 and 179 L/sec (360 and 380 ft$^3$/min) of a dusty mix (rock dust) of compressed air was blown out of a 20.3-cm (8-in) simulated drill hole annulus at discharge velocities between 23.4 and 24.9 m/sec (4,600 and 4,900 ft/min). A 1.52-m-wide by 1.22-m-deep by 1.22-m-high (5-ft by 4-ft by 4-ft) replicate drill deck was shrouded over and around the simulated drill hole. The shroud height was adjustable to allow for 5.1-cm (2-in), 20.3-cm (8-in), and 35.6-cm (14-in) perimeter bottom gaps with the floor (ground). A typical rectangular collector inlet with an area of 929 cm$^2$ (1 ft$^2$) was located at the perimeter of the drill table. The dust collector-to-bailing airflow ratio was varied from 2:1, 3:1, and 4:1 at the different shroud gaps.

A second series of tests was also done at these same parameters with a reconfigured collector inlet hood that moved the inlet plenum closer to and around the drill hole. Figure 1 shows the inlet hood design tested with a drill cuttings deflection plate facing the hole and the intake plenum opening above and around the deflection plate.

## Results

The laboratory dust collector test results show that the two most influential factors on collector dust capture were the collector-to-bailing airflow ratio and the shroud gap height with both inlet configurations (Figure 2). About a one order of magnitude increase in dust leakage or dust concentration was observed when the shroud gap height was increased from 5.1 to 20.3 cm (2 to 8 in) with the conventional inlet configuration. The inlet hood improved drill dust collector system capture over the conventional inlet location, especially with large leakage breaches at the bottom of the shroud enclosure. Inlet hood dust reductions of 63% to 91% were measured for collector-to-bailing airflow ratios of 3:1 to 4:1 at shroud gap heights of 20.3 to 35.6 cm (8 to 14 in).

Additional drill shroud enclosure field testing verified that a tight shroud enclosure minimized the amount of dust that escaped the collector inlet with either the conventional or inlet hood configuration. The test drill had an angle drill curtain shroud design that could be hydraulically raised and adjusted to tightly seal with nonparallel ground surfaces with respect to the drill deck angle. Dust concentrations adjacent to the shroud were 0.18 mg/m$^3$ with the conventional inlet and were slightly

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

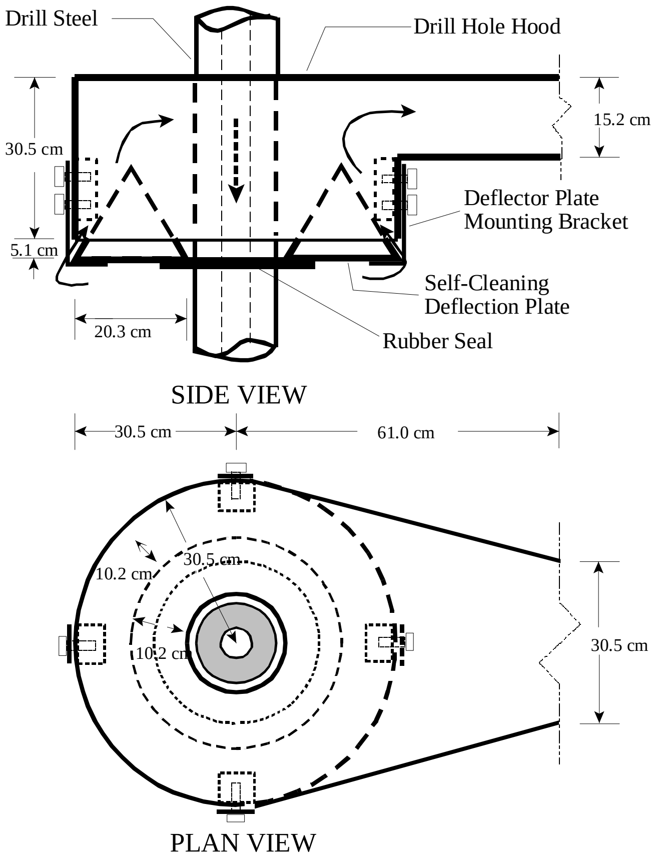


**Figure 1.CInlet hood design tested in laboratory.**

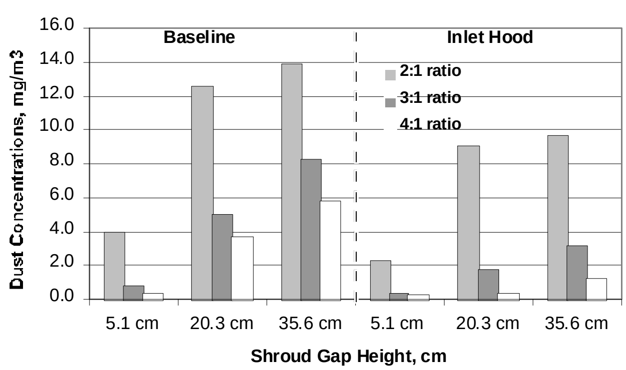


**Figure 2.CDust escaping the laboratory drill shroud.**

reduced to 0.11 mg/m$^3$ with a retrofitted inlet hood. The collector-to-bailing airflow ratio changed from nearly 2.7:1 with the conventional inlet to about 2.1:1 with the inlet hood. Since airflow ratio is such a critical parameter in the 2:1 to 3:1 range, it is important to note that reestablishing the original airflow ratio to 2.7:1 (e.g., a larger fan) with the inlet hood would provide an even greater dust reduction. The functionality of the retrofitted inlet hood showed promise, but it requires some self-cleaning redesign modifications for long-term usage (more than a week). Nearly 1,524 m (5,000 ft) of drilling was done with the inlet hood until internal buildup of coarse dust impeded its operation.

In conclusion, this research showed that a tight shroud is very beneficial for the drill dust collection system, while improvements for a leaky shroud could be achieved with collector-to-bailing airflow ratios ≥3:1 and/or by relocating the inlet.

## For More Information

For more information about drill dust controls, contact John A. Organiscak or Steven J. Page, NIOSH Pittsburgh Research Laboratory, Cochrans Mill Rd., P.O. Box 18070, Pittsburgh, PA 15236B0070, phone: 412B386B6675 or 412B386B6669, respectively; fax: 412B386B4917; e-mail: **JOrganiscak@cdc.gov** or **SJPage@cdc.gov**, respectively.

To receive other information about occupational safety and health topics, call 1B800B35BNIOSH (1B800B356B4674), or visit the NIOSH Website at www.cdc.gov/niosh