OMSHR

Office of Mine Safety and Health Research

Silica dust controls for surface mines

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Dust, Ventilation, and Toxic Substances Branch

Best Practices for Controlling Respirable Dust in Coal Mines
October 28, 2014

CDC Workplace Safety and Health NIOSH

Outline

Drilling

Cabs

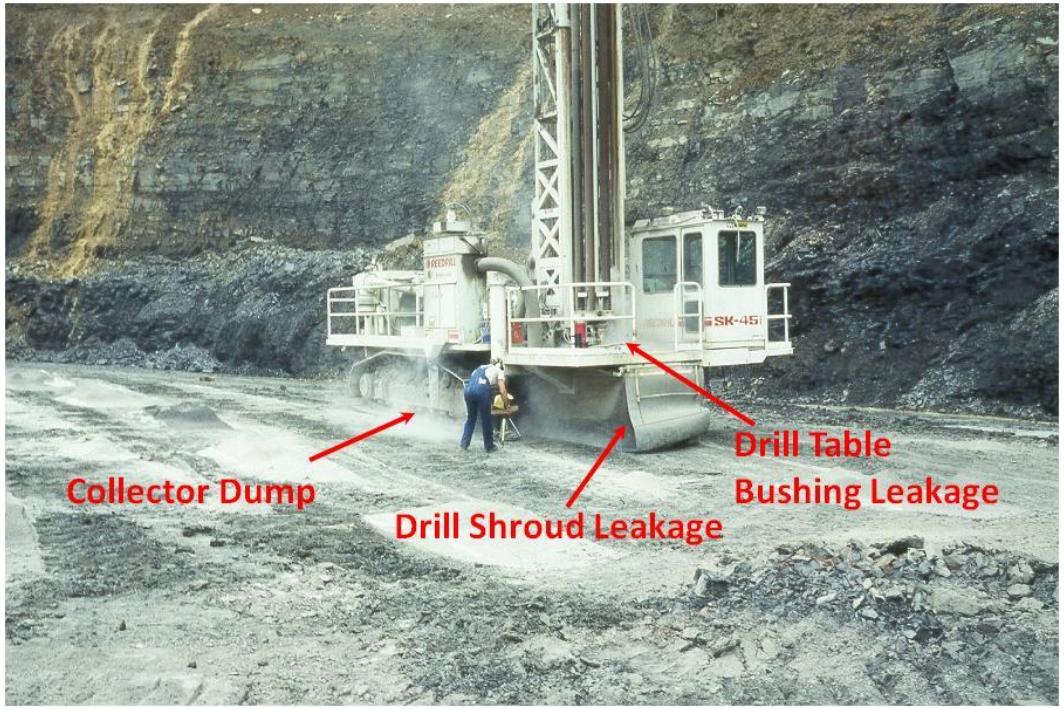
Hauling

Crusher dump point

EVADE/HelmetCAM

Dust Emissions From Blasthole Drills

- 52% - Drill deck
  - 28% shroud
  - 24% table bushing
- 38% - Collector dumping
- 10% - Other mining equipment sources



Typical Dust Concentrations Encountered

- Drill Deck (Shroud & Table Bushing)
  - Peak conc. can reach 98 mg/m^3

- Dust Collector
  - Peak conc. can reach 68 mg/m^3

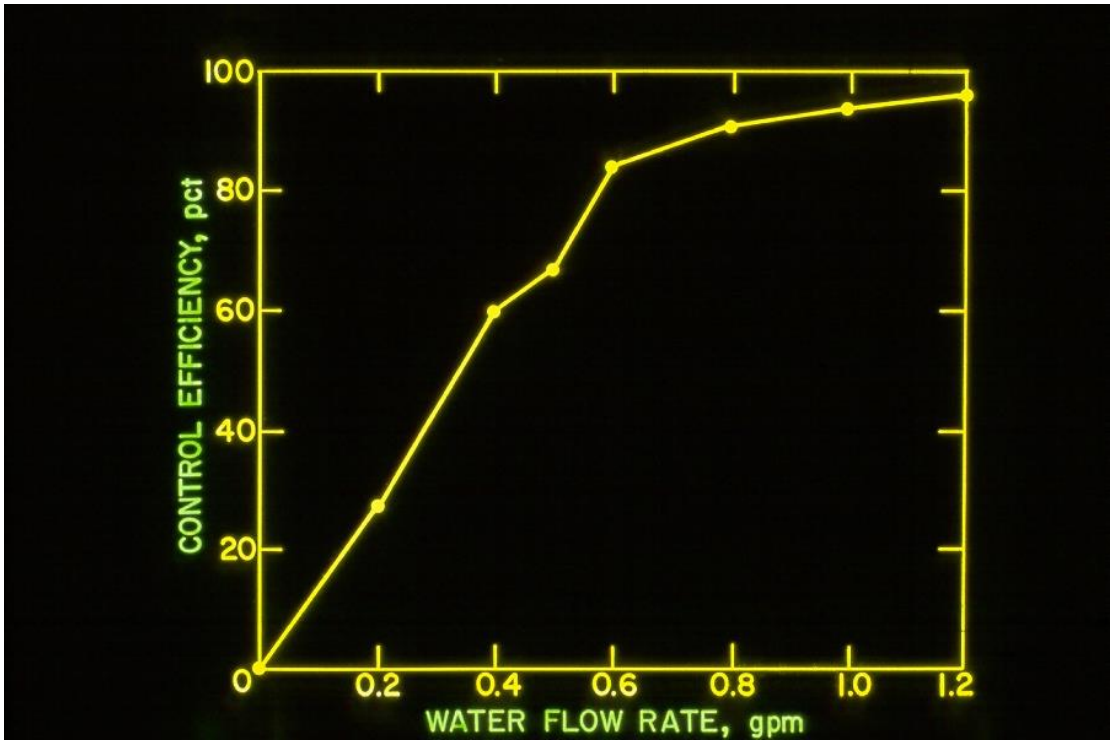
Drilling Dust Control

- Wet Drilling
  - Use of water combined with air to flush drill cuttings
  - Prevents dust generation during drilling
- Dry Drilling
  - No water used in bailing air
  - Use of a dust collector to prevent dust generation

Wet Drilling

- **Best Drilling Dust Control**
- Does not require large amounts of water
- Wet drilling eliminates up to 97% respirable dust
- Rotary bit degradation

Wet Drilling



Potential problems:

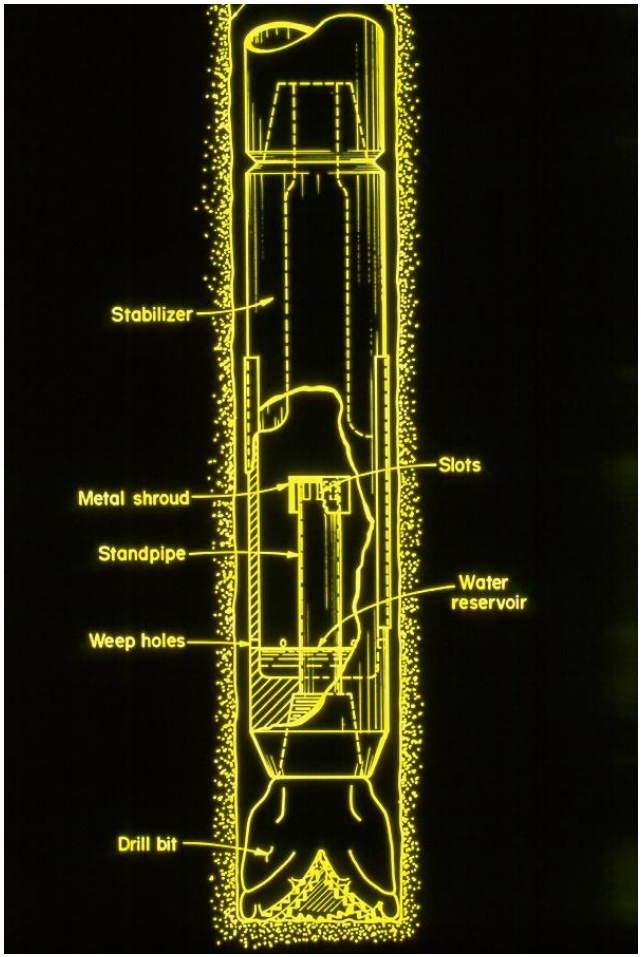
- Bit Degradation (hydrogen embrittlement)
- Cold climates (water freezing)

Water Separator Sub Increases Roller Bit Life

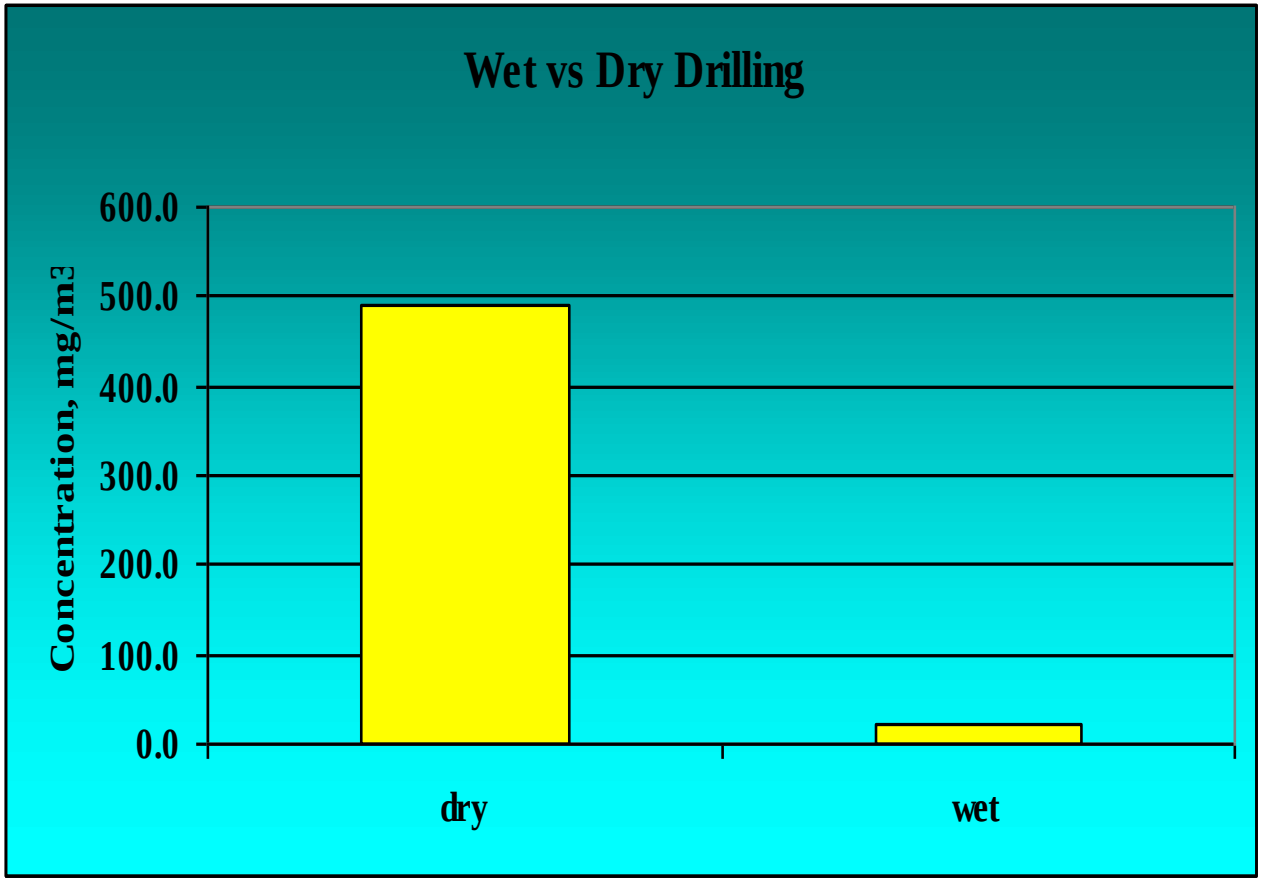
Bit life increased 4.5 times with use of separator sub

9000 ft with sub

2000 ft without sub



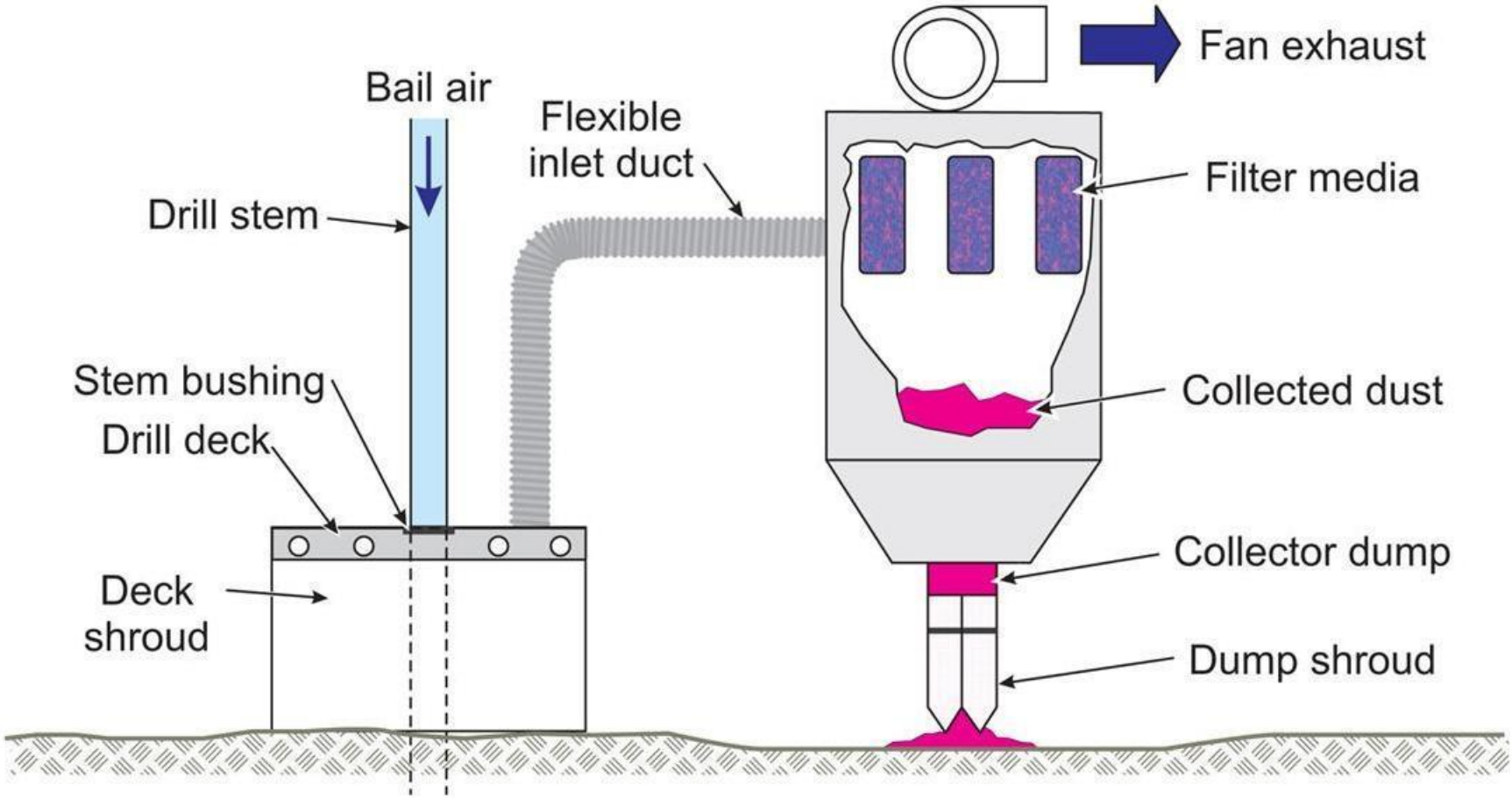
Small Diameter Water Separator Sub Study



Dry Drilling

- Use of dust collector
- Can be up to 99% efficient
  - Properly maintained
  - Operated correctly

Dust Collector System of Blasthole Drill



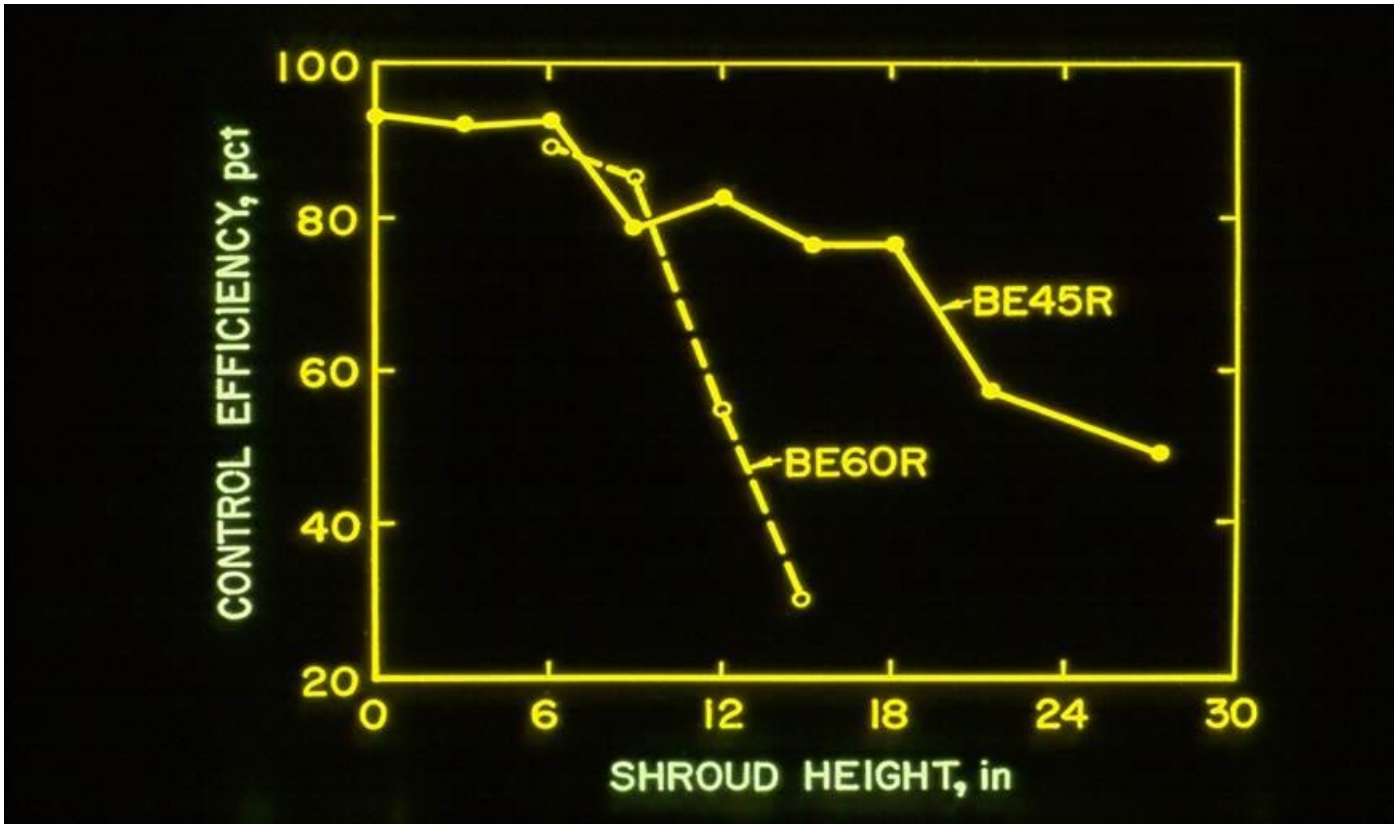
Dry Drilling Dust Control Solutions

- Proper maintenance of dust collector system
- Maintain high collector airflow to bailing airflow ratios
  - 3:1 or more; collector airflow 3 x bailing airflow
- Prevent/reduce drill deck shroud leakage

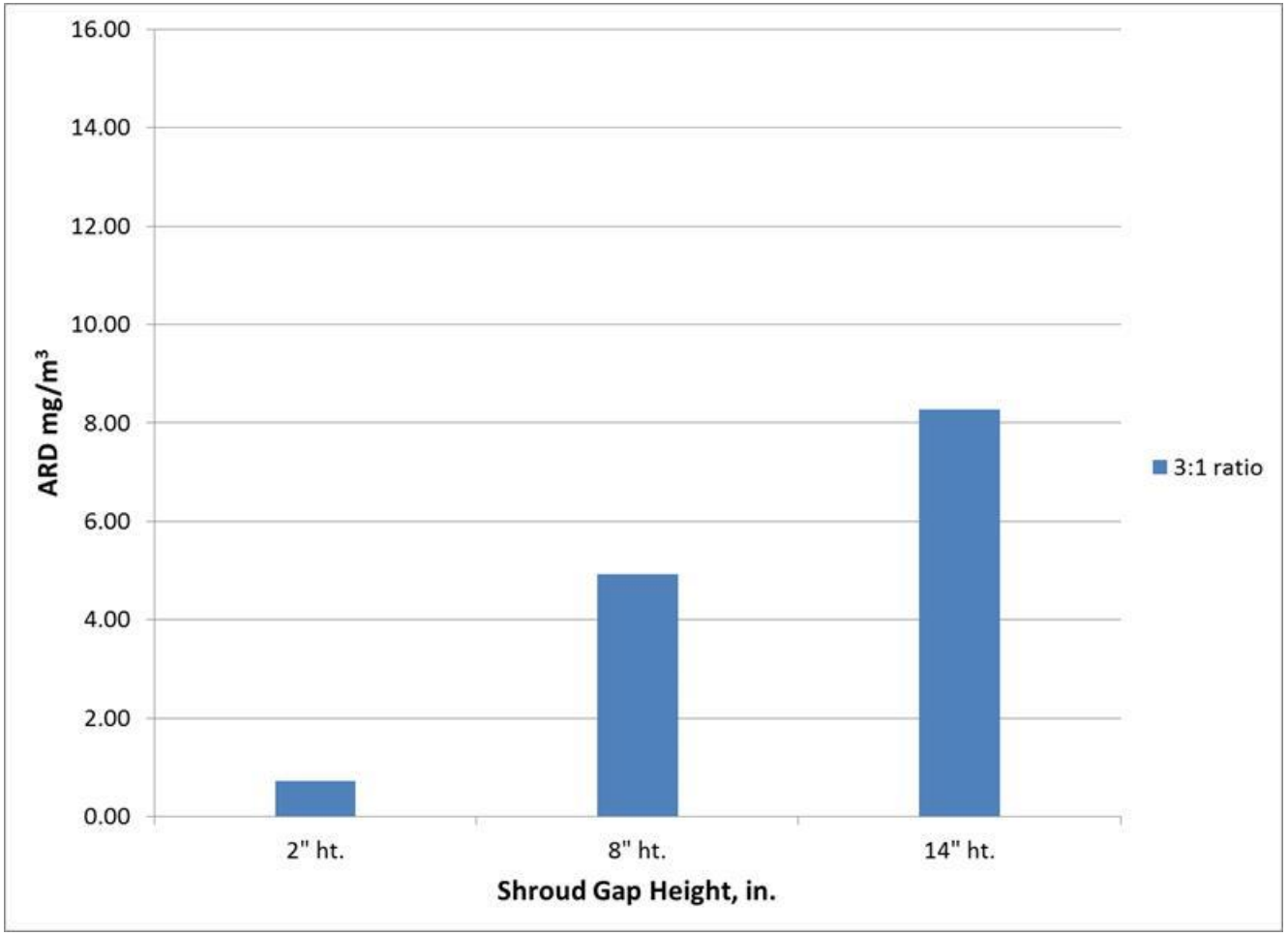
Drill Shroud Leakage

Maintain tight shroud enclosure with the ground
(unlike this example)

Shroud Height Effects



Shroud Height & Airflow Effects



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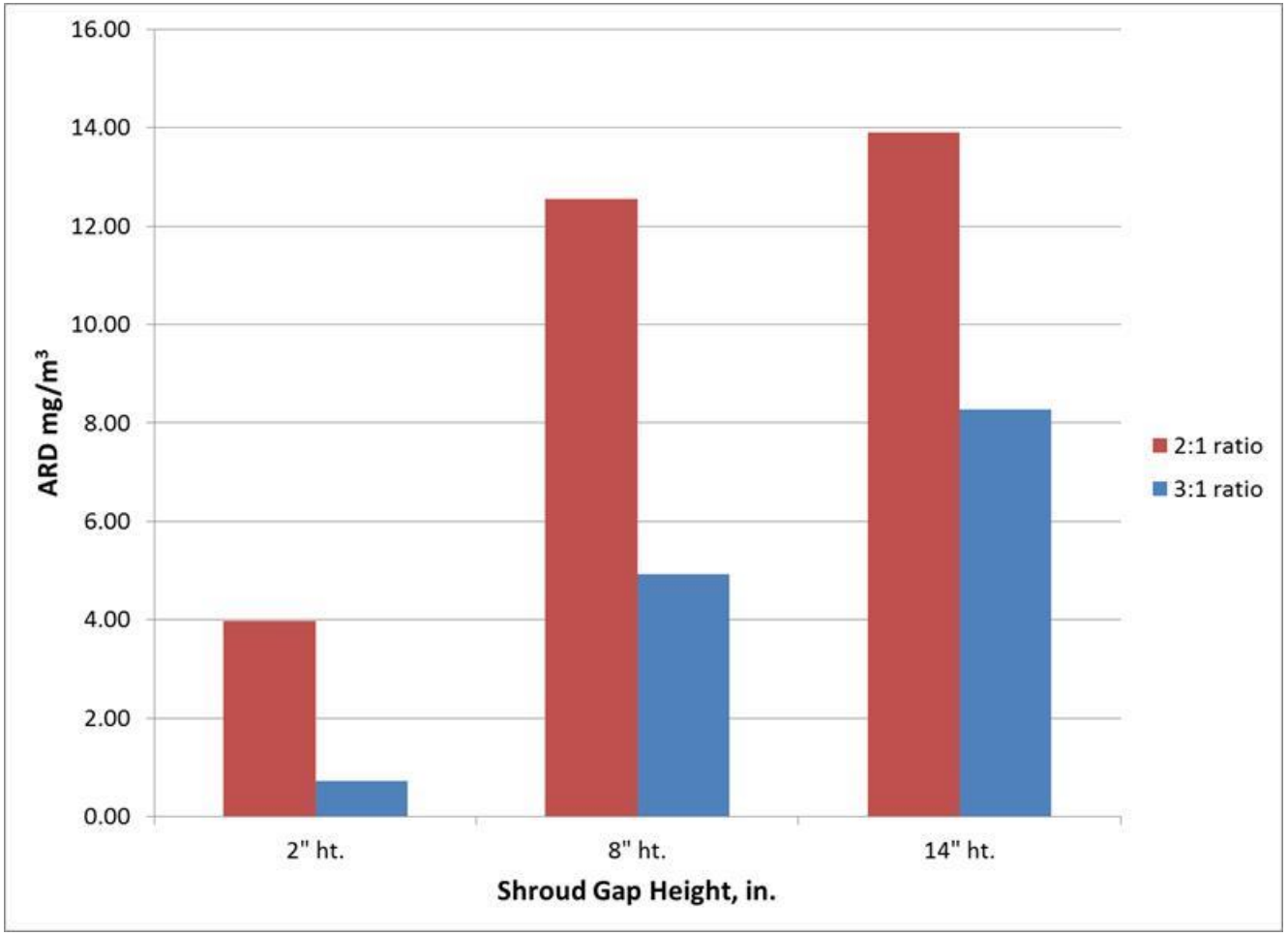

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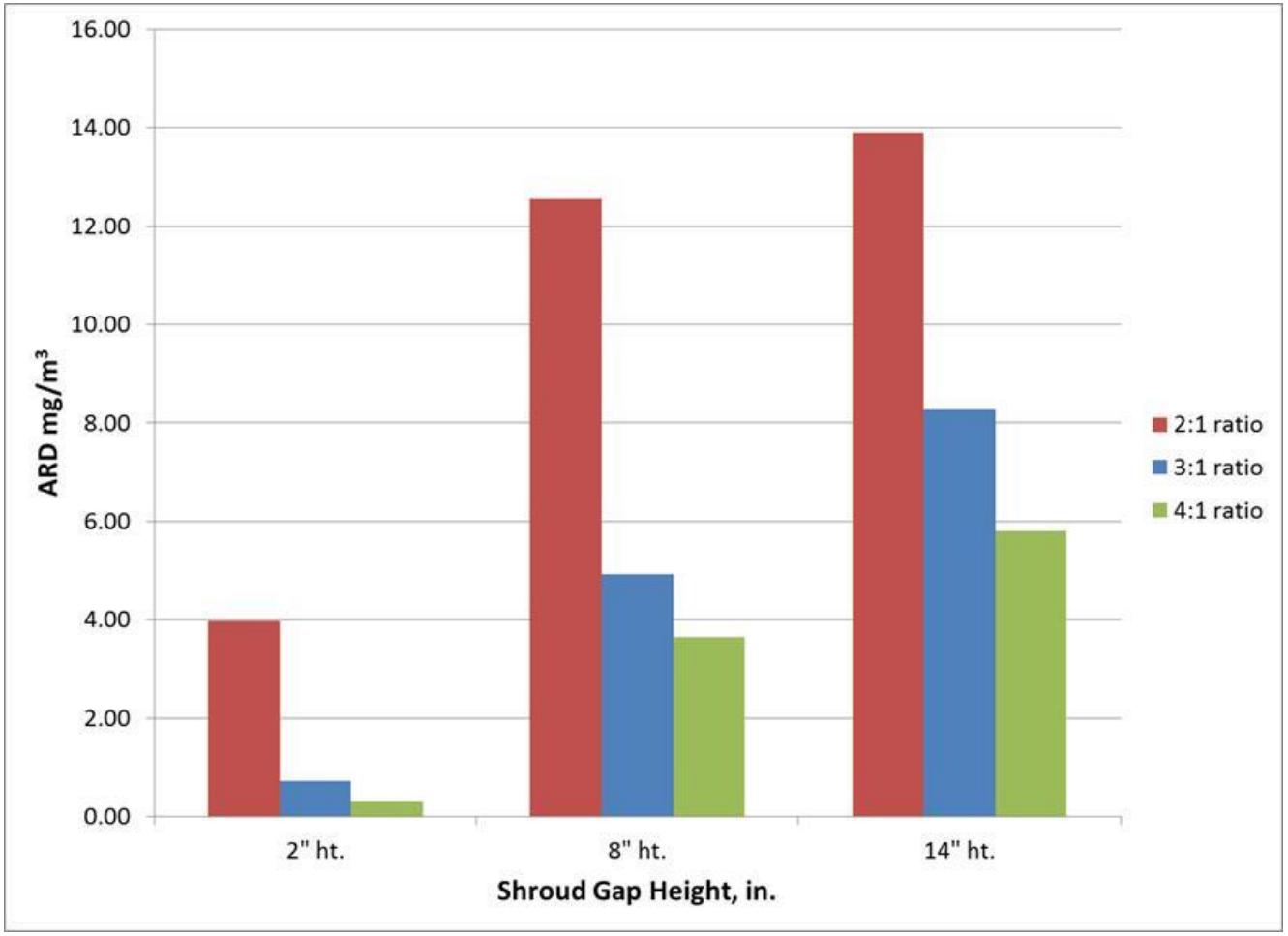
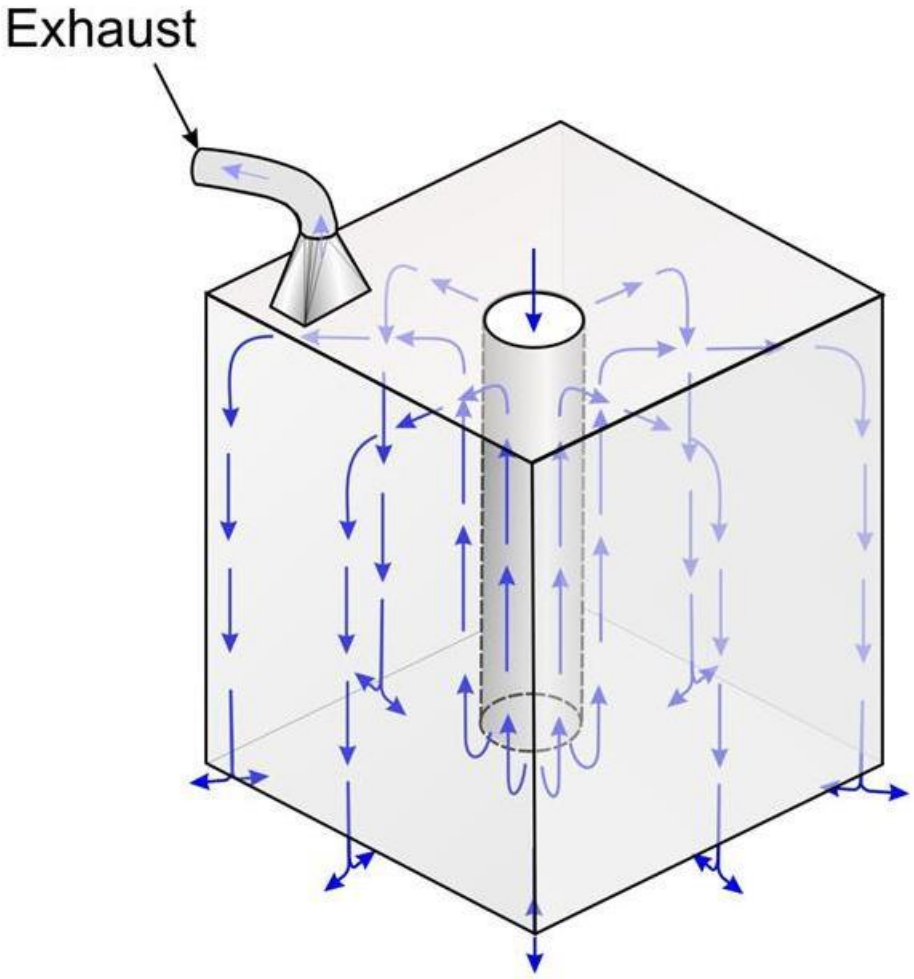
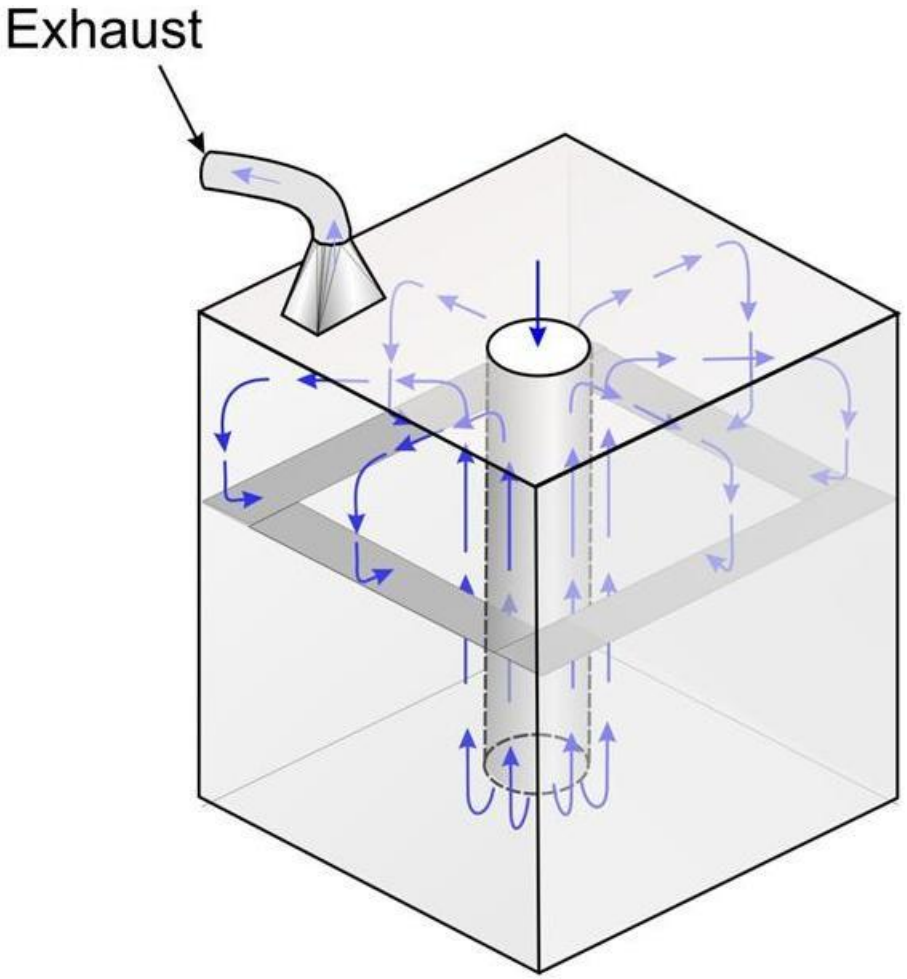


Airflow Patterns Underneath Drill Shroud



Normal airflow patterns



Airflow patterns w/ shelf

Horizontal Shelf

- Mine A
  - 69-70% reductions area surrounding drill
    - Variation dependent upon wind direction
  - 66% reduction at shroud location
- Mine B
  - Low dust concentrations surrounding drill
    - For both shelf-off/shelf-on
  - 81% reduction at shroud location

Adjustable Height Shroud

Dust emissions below 0.5 mg/m^3

Table Bushing Dust Control

- Replace table bushing

Collector Exhaust Port Dust Control

- Replace dust collector filters
- Stand away from drill

Dust Collector Dump Shroud

63 – 88% reduction

Easy installation, **Little** maintenance

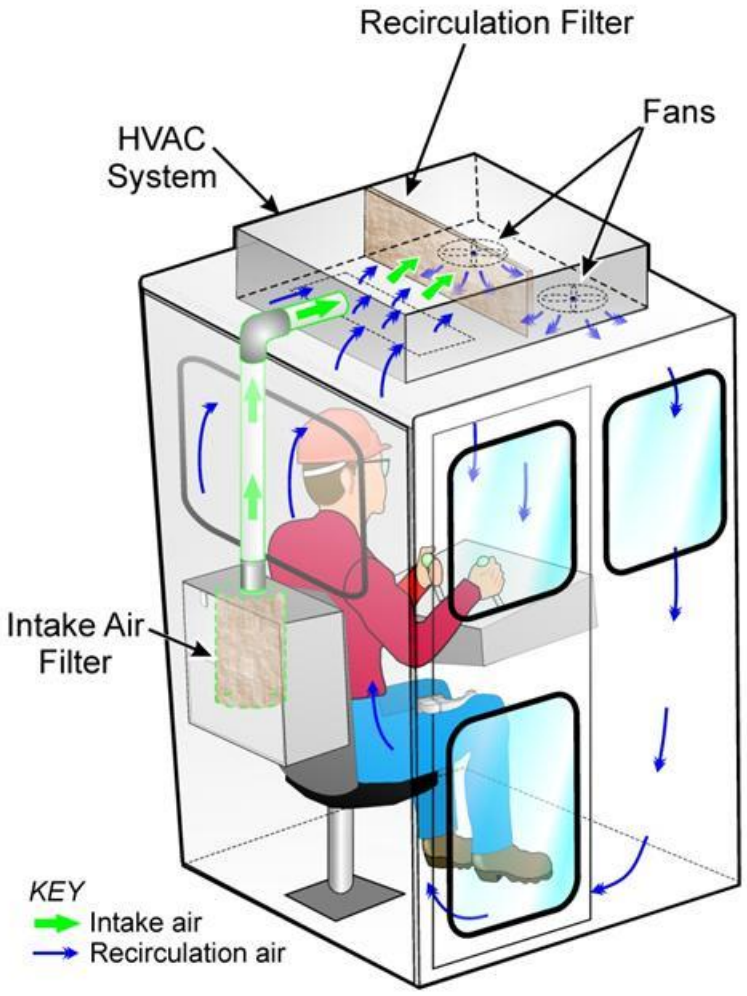
Enclosed Cab Filtration Systems

- Integrated into HVAC Systems
- Protection Factors Vary

  ($PF = C_{outside} / C_{inside}$)

  – Drills 2.5 to 84

  – Bulldozers 0 to 45



Protection Factor, Efficiency, & Penetration

- Protection Factor (PF) = $C_{outside} / C_{inside}$
  - C = dust concentration (mg/m^3)
  - The bigger the number the better
- Efficiency (η) = $(C_{outside} - C_{inside}) / C_{outside}$
  - Range 0 – 1
  - 0 = bad, 1 = good
- Penetration (Pen) = $1 - \eta$
  - Range 0 – 1
  - 1 = bad, 0 = good

Refurbish Cabs

- Ceiling mount heating and AC units
- External filter and fan units
- Improve cab enclosure seals
- Ensure good cab integrity
- Positive pressurization

Utilize High Efficiency Respirable Dust Filters

- Intake filter ≥ 95% on respirable-sized dusts
- **Use an efficient recirculation filter**
  - Improves cab protection factor
  - Reduces stability time

Minimize Dust Sources in Cab

- Use good housekeeping practices
- Remove floor heaters
  - Floor heater use increased dust levels from 0.03 to 0.26 mg/m^3
- Rubber mats better than carpeting
- Gritless sweeping compounds *non-petroleum based*

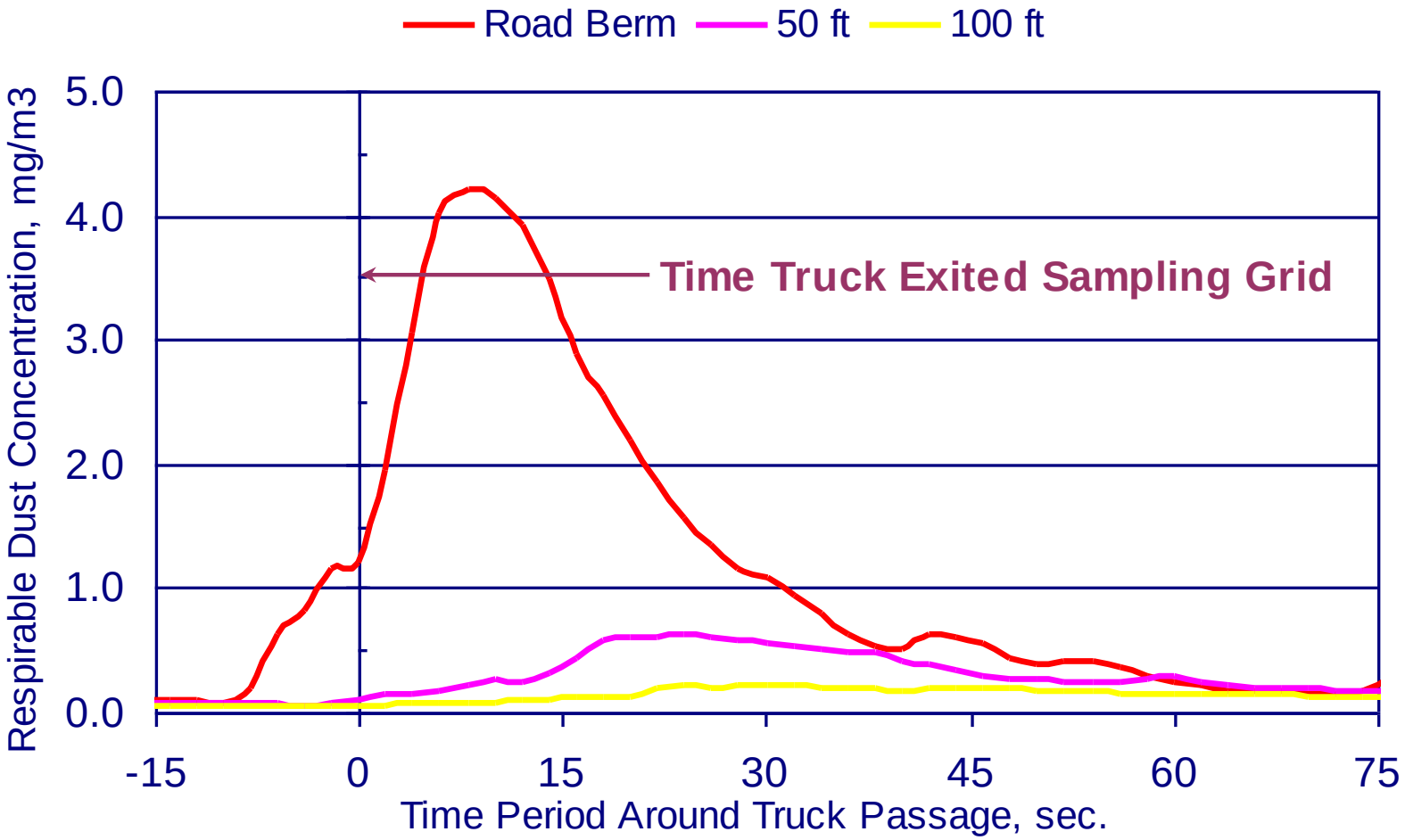
Keep Doors Closed During Equipment Operation

- 0.81 mg/m^3 when briefly opened to add drill steels
- 0.09 mg/m^3 with door closed

Controlling Haul Road Dust

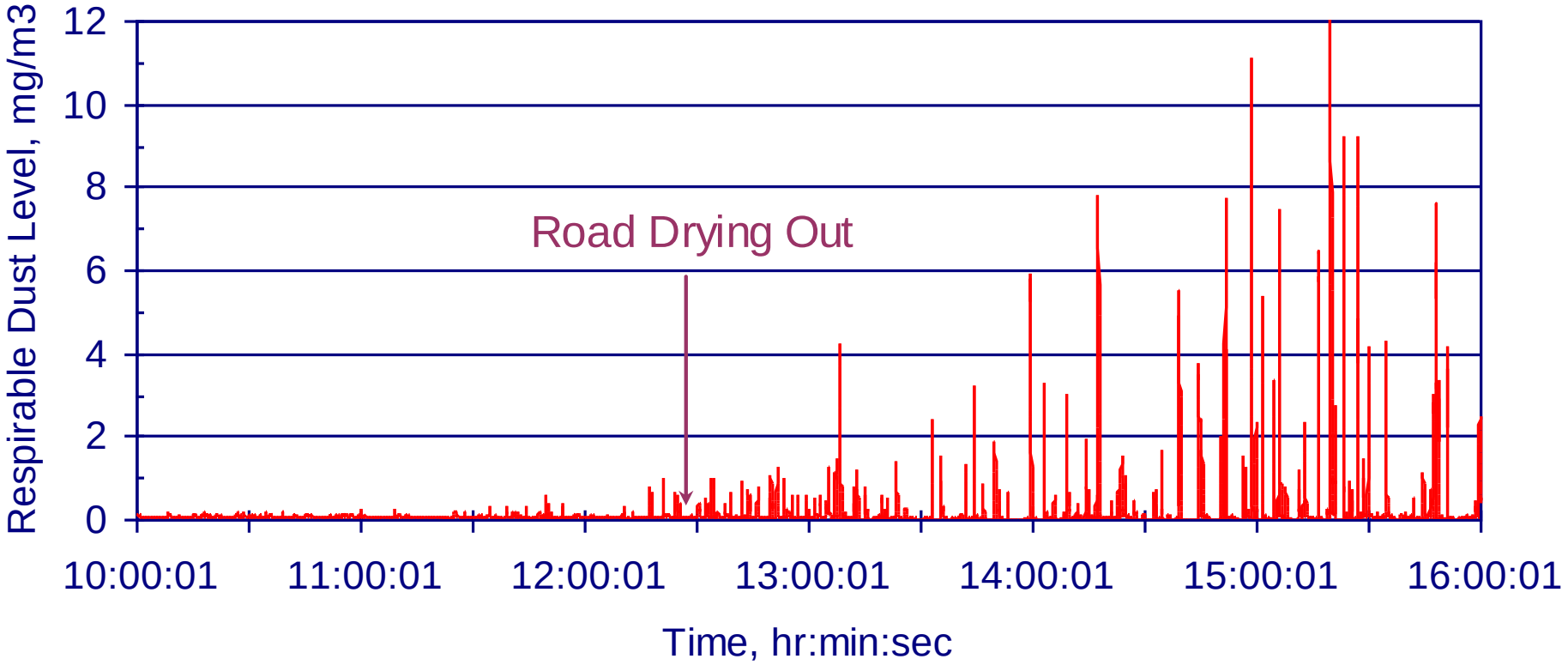
- ≈15% of airborne dust < 10 µm
- ≈4% of airborne dust < 3.5 µm

Dust Dissipation Effect



Increase distance between vehicles

Treatment of Unpaved Road Surface

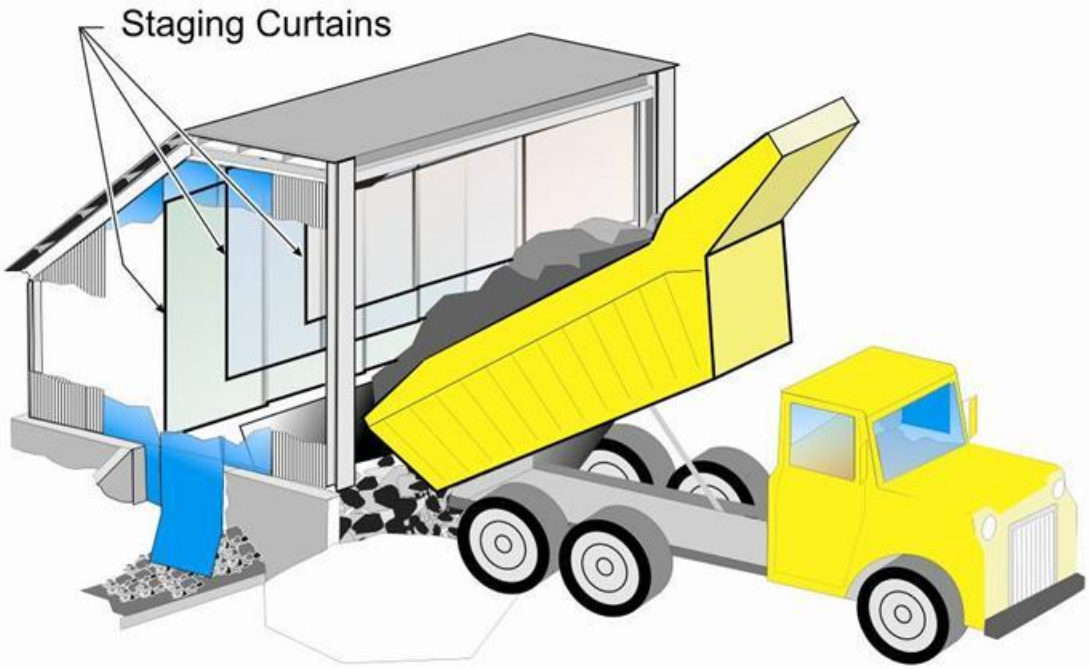


- Water effective with reapplications
- Alternative road treatments
  - Salts, surfactants, soil cements, bitumens, films (polymers) may extend time of effectiveness
  - Application requirements
  - Selection of treatment site specific

Crusher Hopper Dump Points

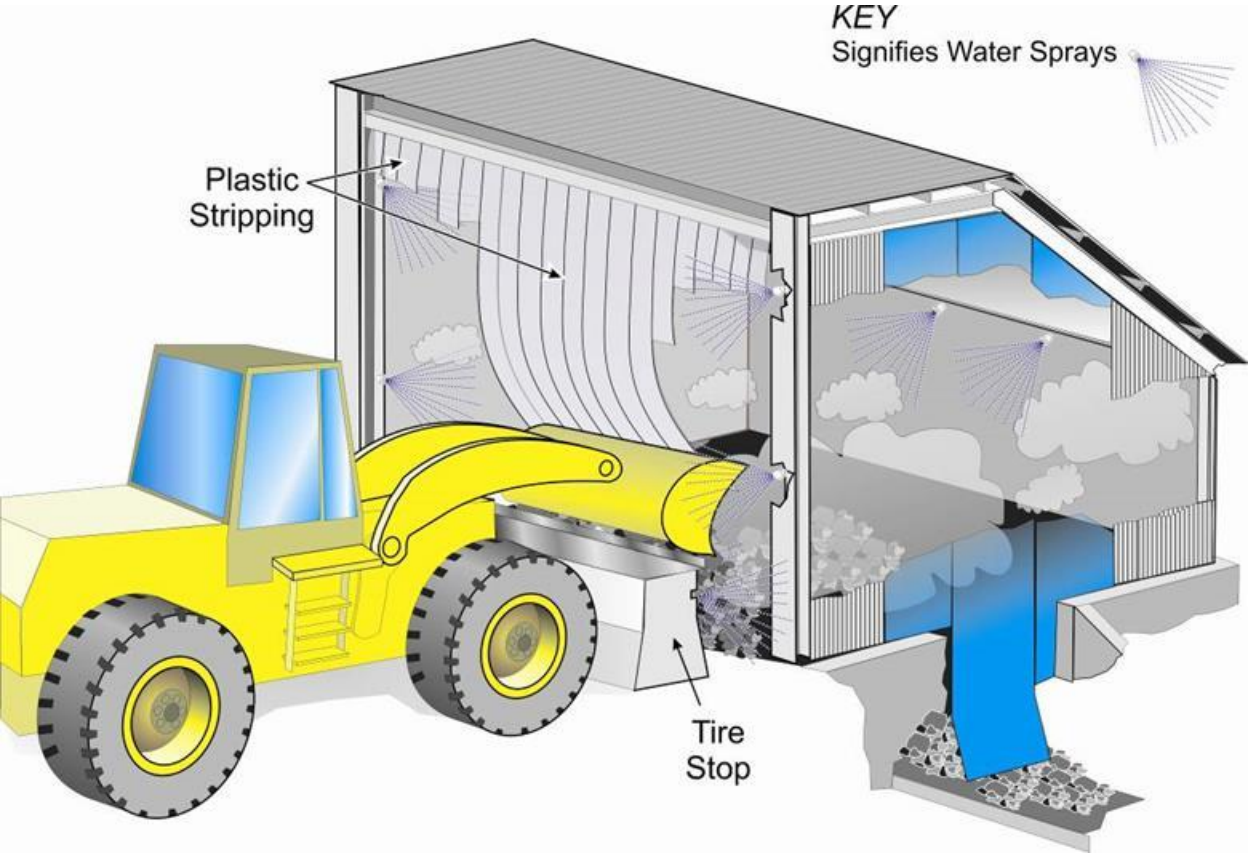
- Enclose dump point
- Water sprays

Enclose Hopper Dump Point



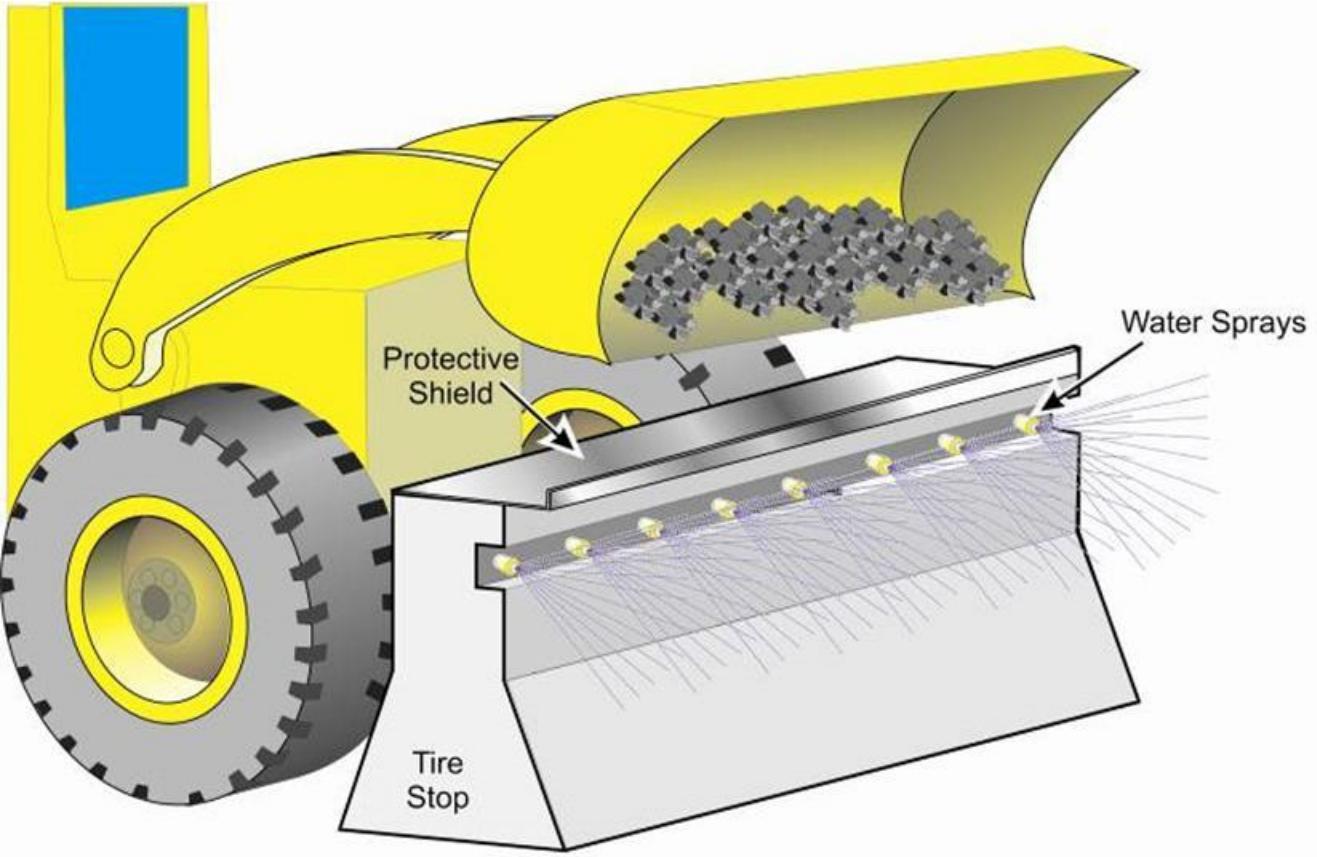
- Staging curtains reduce dust escape
- Exhaust ventilation systems may be used, but must be properly designed

Water Spray Use



- Amount of water to use
  - Initially, apply water to obtain 1% moisture content
- Use automated spray system
  - Conserve water use

Prevent Dust Rollback Underneath Vehicle



- Tire stop reduces dust rollback
- Water sprays redirect dust

EVADE/HelmetCAM

- Dust source identification
  - HelmetCAM field survey
    - Coal miners
    - Metal/nonmetal miners
  - EVADE software for analysis
    - NIOSH developed
- Develop control strategies
  - Target dust sources to reduce over-exposures of miners

EVADE/HelmetCAM

- Video Cameras
  - Attach to hardhat
  - Video length limited to battery life
  - File types *AVI*, *WMV*, or *MP4*

V.I.O.
$300 - $400

Contour
Approximately $200

Go Pro
$200 - $400

Mention of any company or product does not constitute endorsement by the National Institute for Occupational Safety and Health (NIOSH)

EVADE/HelmetCAM

- Dust monitors
  - Worn on belt
  - Provide instantaneous dust concentrations
  - Any device where data can be stored as Excel CSV file

Thermo pDR-1000

Thermo pDR-1500

TSI AM-510

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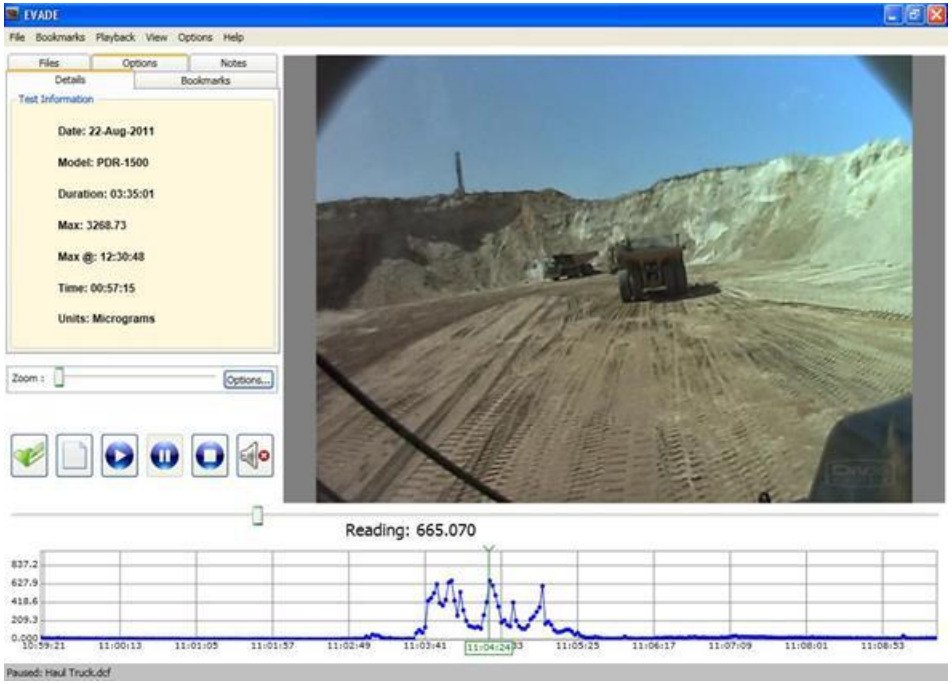
EVADE/HelmetCAM

Three Options to House Helmet-CAM

Backpack/Miner's Safety Belts/Safety Vest

EVADE/HelmetCAM

Mobile Equipment Operators



NIOSH Testing

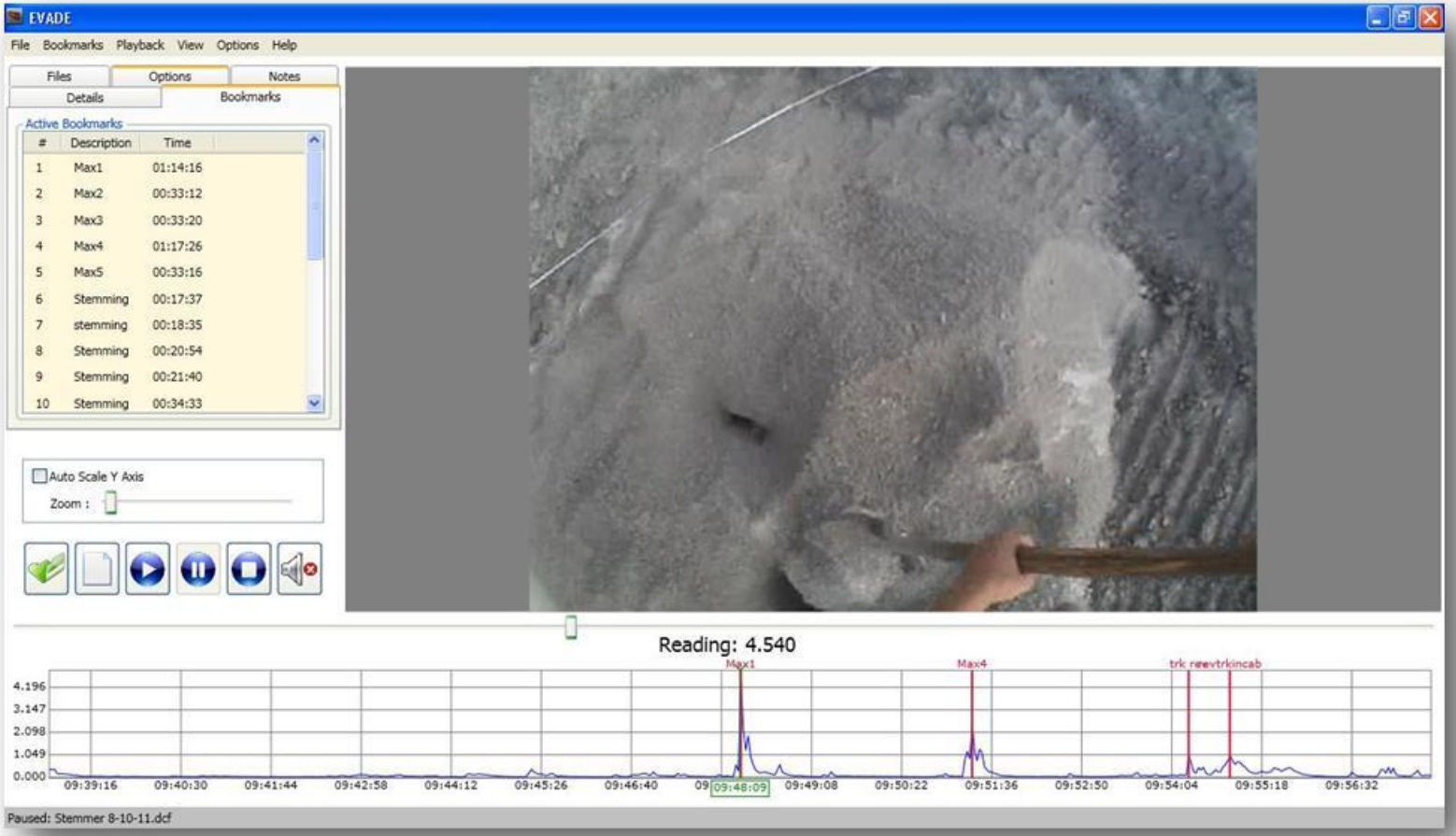
Miners Are Fitted with Helmet-CAM

EVADE

(Enhanced Video Analysis of Dust Exposure)

Blaster

- Stemming



Blaster

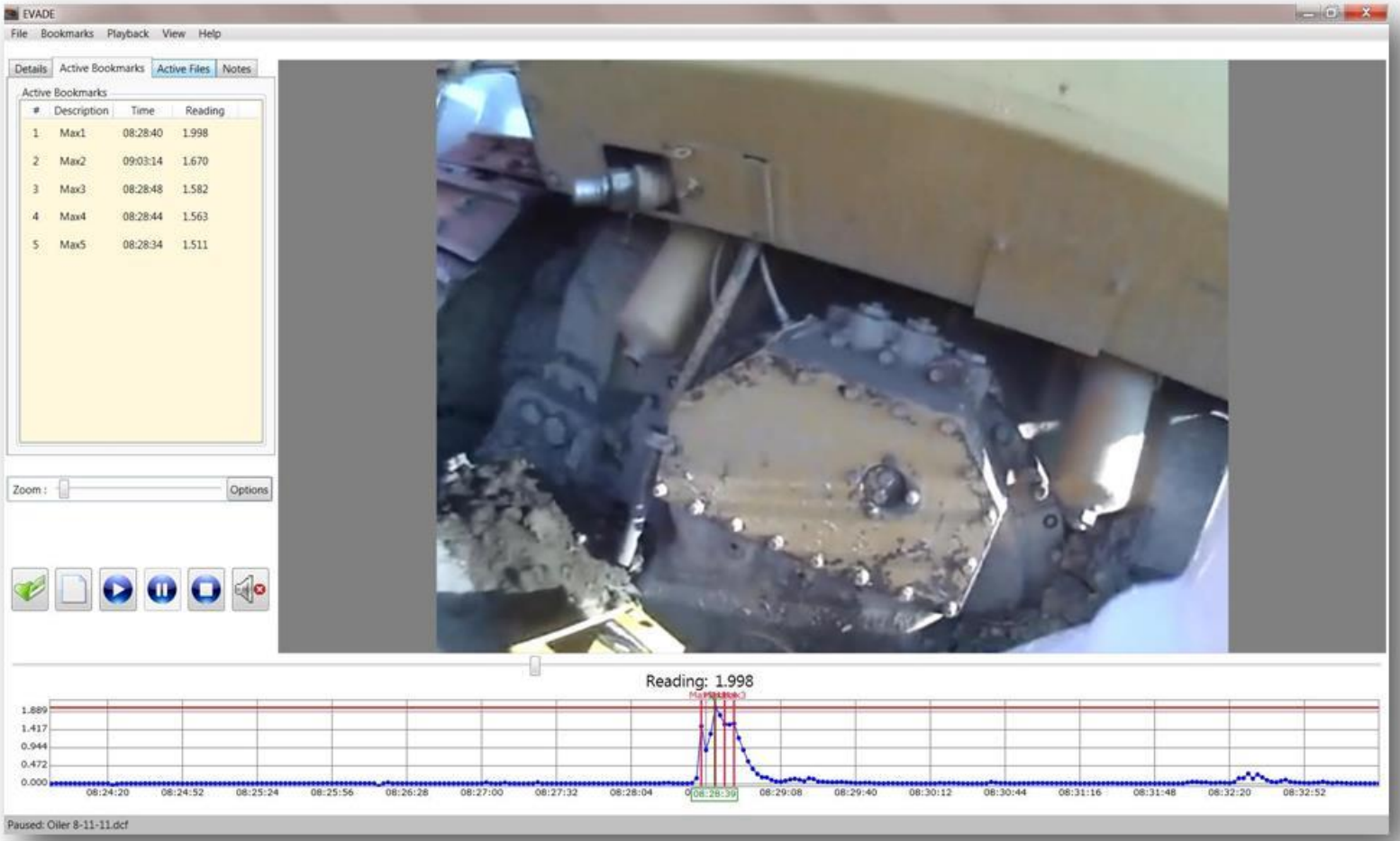
- Loading hole with ANFO

Blaster

- Bulk truck driver backing up with window open

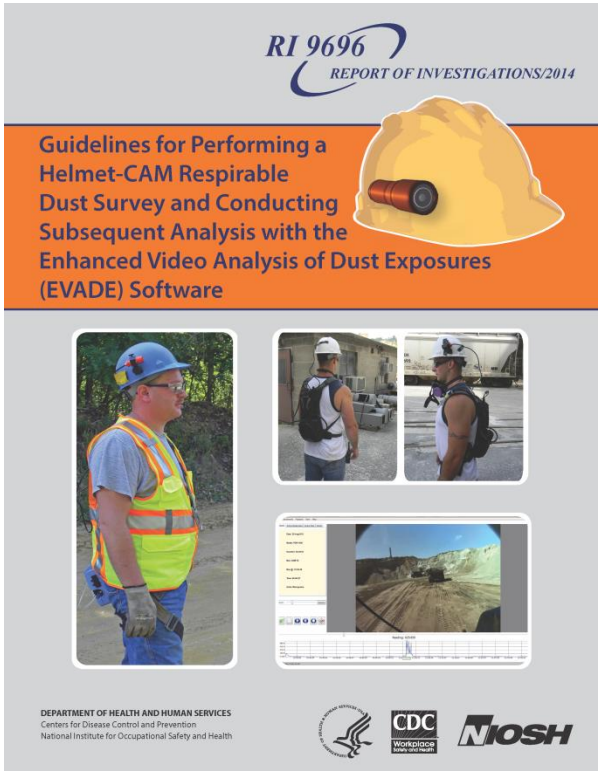
Mechanic

- Working at rear of dozer –change oil filter



EVADE software/HelmetCAM Methodology

http://www.cdc.gov/niosh/mining/Works/coversheet1867.html



Summary

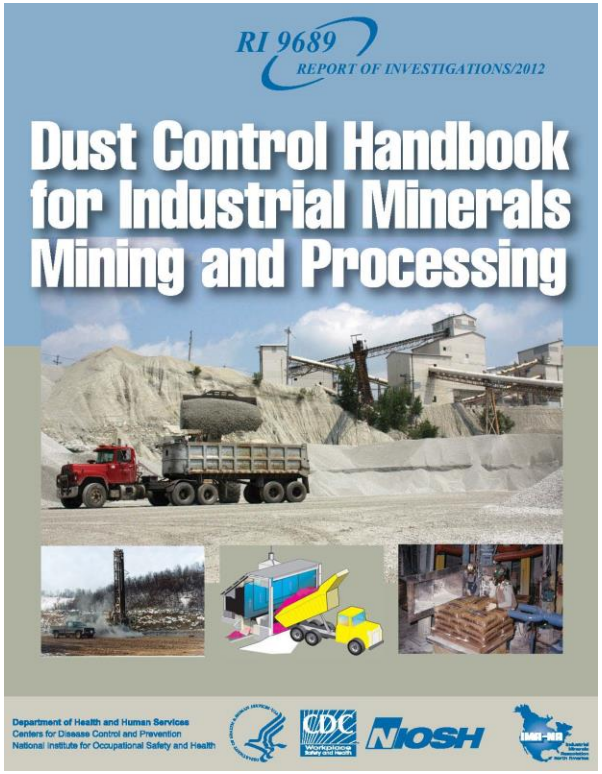
- Wet Drilling
  - Dust control efficiency 97%
    - Little water required
    - Water separator sub
- Dry Drilling
  - Dust control efficiency 99%
    - Properly maintained
    - Operated correctly
      - Minimize leakage
      - 3:1 collector to bailing airflow ratio or greater
      - Horizontal shelf, angle drill shroud, dust collector dump shroud, etc.
- Operator Cabs
  - Properly maintained
    - Maintain seals, filters, etc.
    - Ceiling mount HVAC systems
  - Operate correctly
    - Positive pressure
    - Housekeeping
    - Recirculation filter

Summary

- Hauling
  - Water effectively controls road dust
  - Surfactants may be effective
- Crusher dump point
  - Enclose dump point
  - Use water sprays
- EVADE/HelmetCAM
  - Identify dust sources
  - Target dust control development

Dust Control Handbook for Industrial Minerals Mining and Mineral Processing

http://www.cdc.gov/niosh/mining/works/coversheet1765.html



Questions???

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