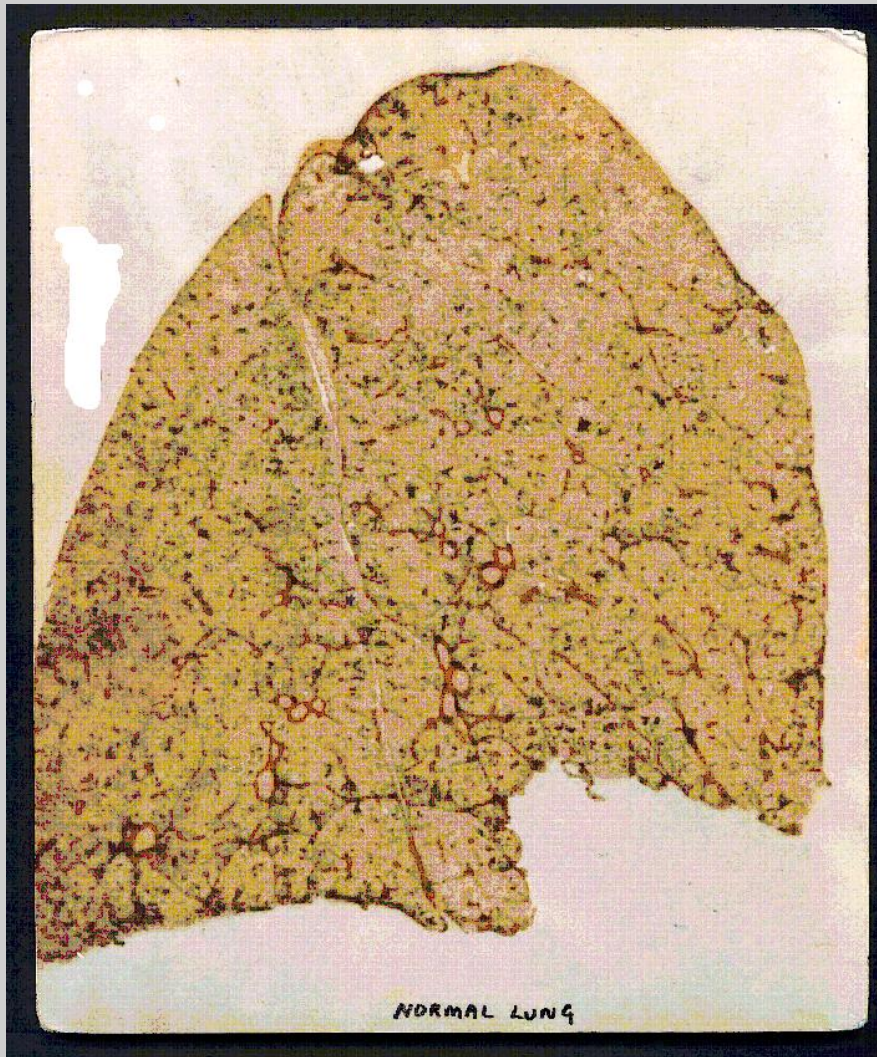


SILICA DUST CONTROLS FOR SURFACE MINES



By John A. Organiscak

NORMAL



SILICOSIS



2004-2008 MSHA Dust Samples

Mining Commodity	% of Dust Samples Exceeding the Standard Due to Quartz
Coal	11 %
Metal	21 %
Nonmetal	18 %
Stone	13 %
Sand & Gravel	12 %

****Equipment operators most frequently exceed the standard.*

Surface Mining Equipment



Drills



Bulldozers



Trucks & Loaders

BEST PRACTICES FOR SURFACE MINE DUST CONTROL

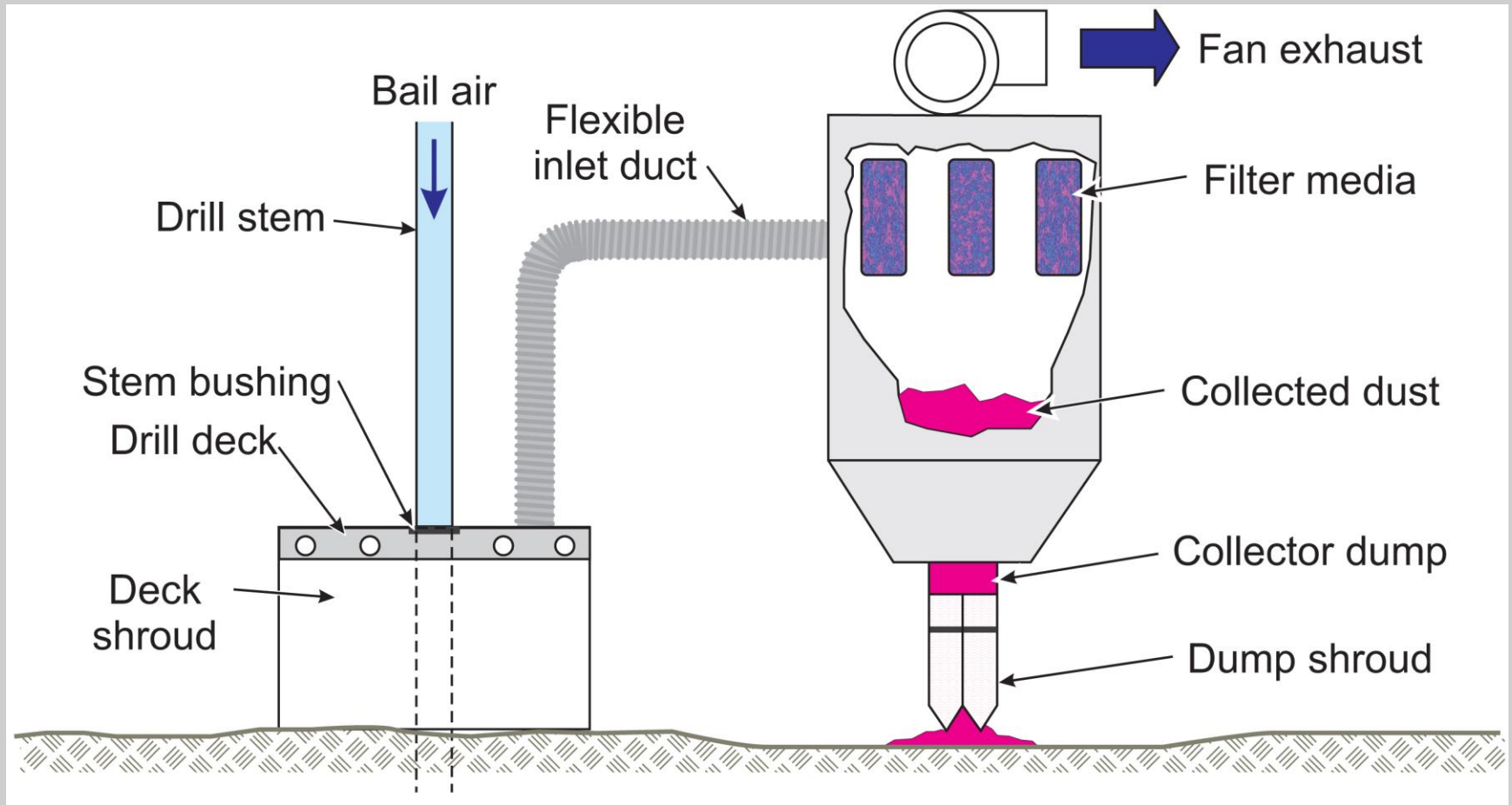
- Drill Dust Collection Systems
- Enclosed Cab Filtration Systems
- Controlling Haulage Road Dust
- Controlling Dust at the Primary Hopper Dump

DRILL DUST COLLECTION SYSTEMS



1. Dry Dust Collector System
2. Wet Suppression

1. Dry Dust Collector Systems



Dust Emissions From Dry Collection Systems



➤ Drill Shroud Leakage

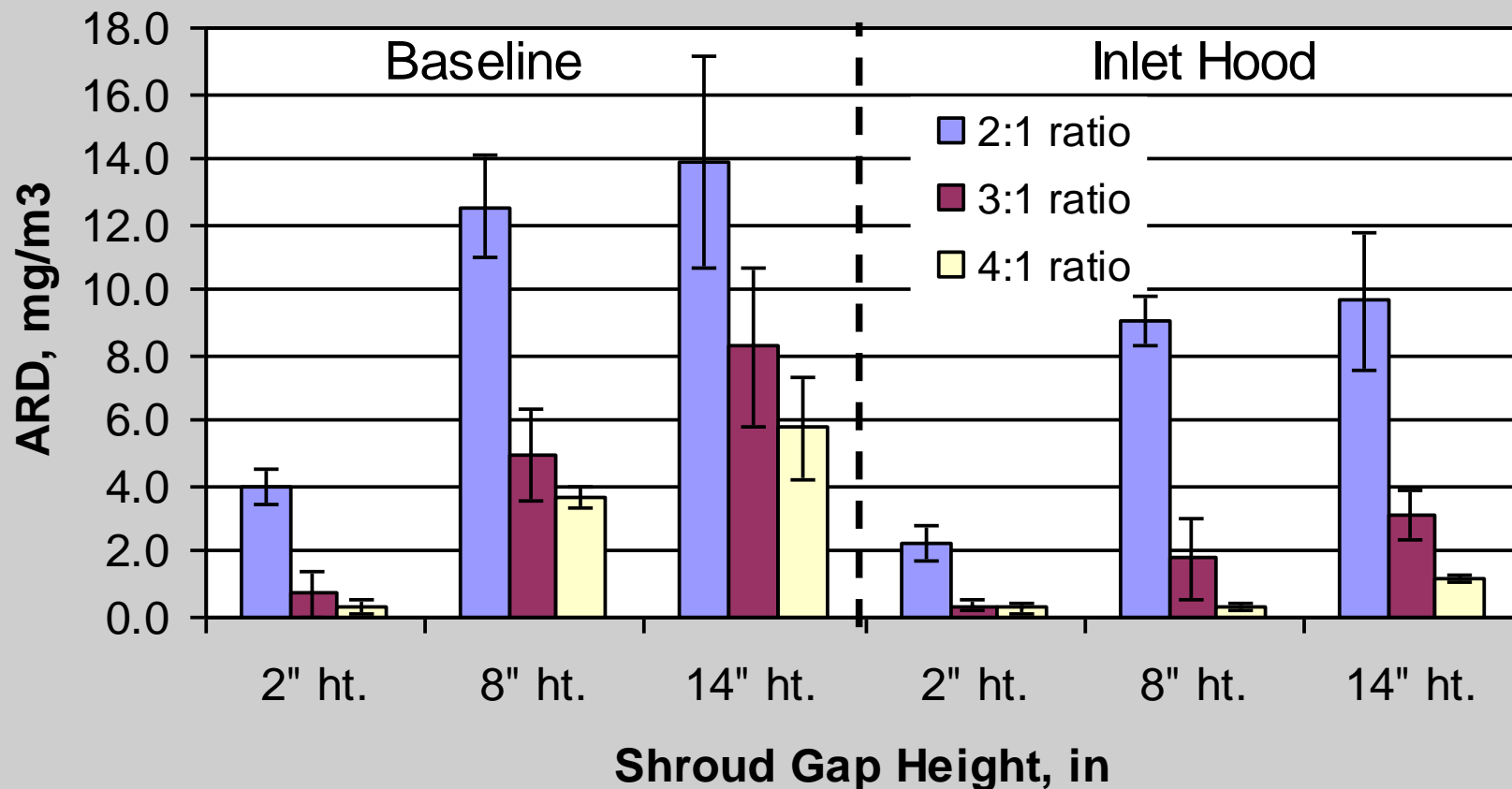


- ✓ Maintain tight shroud enclosure with the ground
- ✓ Maintain at least 3:1 collector-to bailing airflow ratio

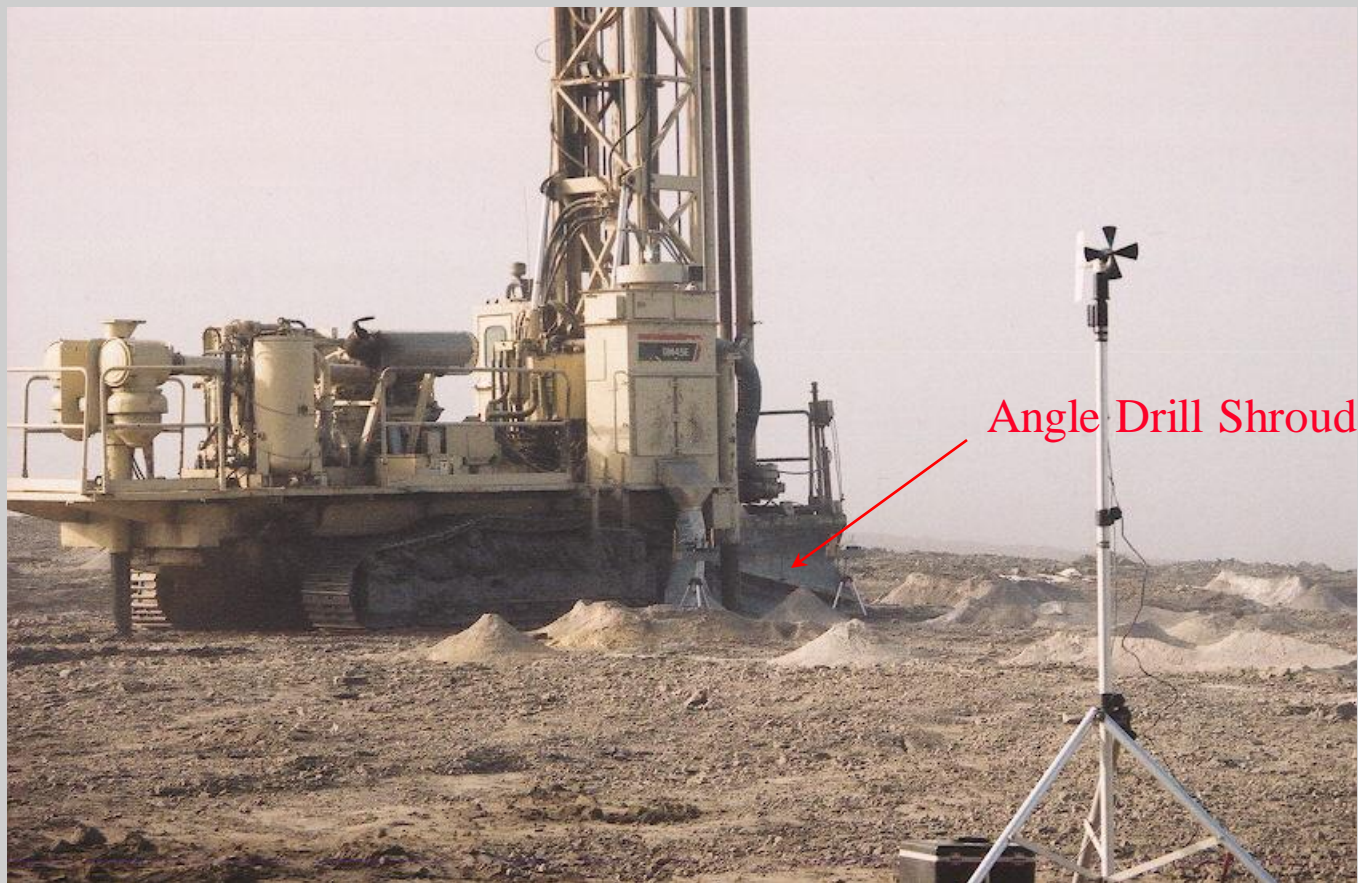
Shroud Height Effects



Shroud Height & Airflow Effects

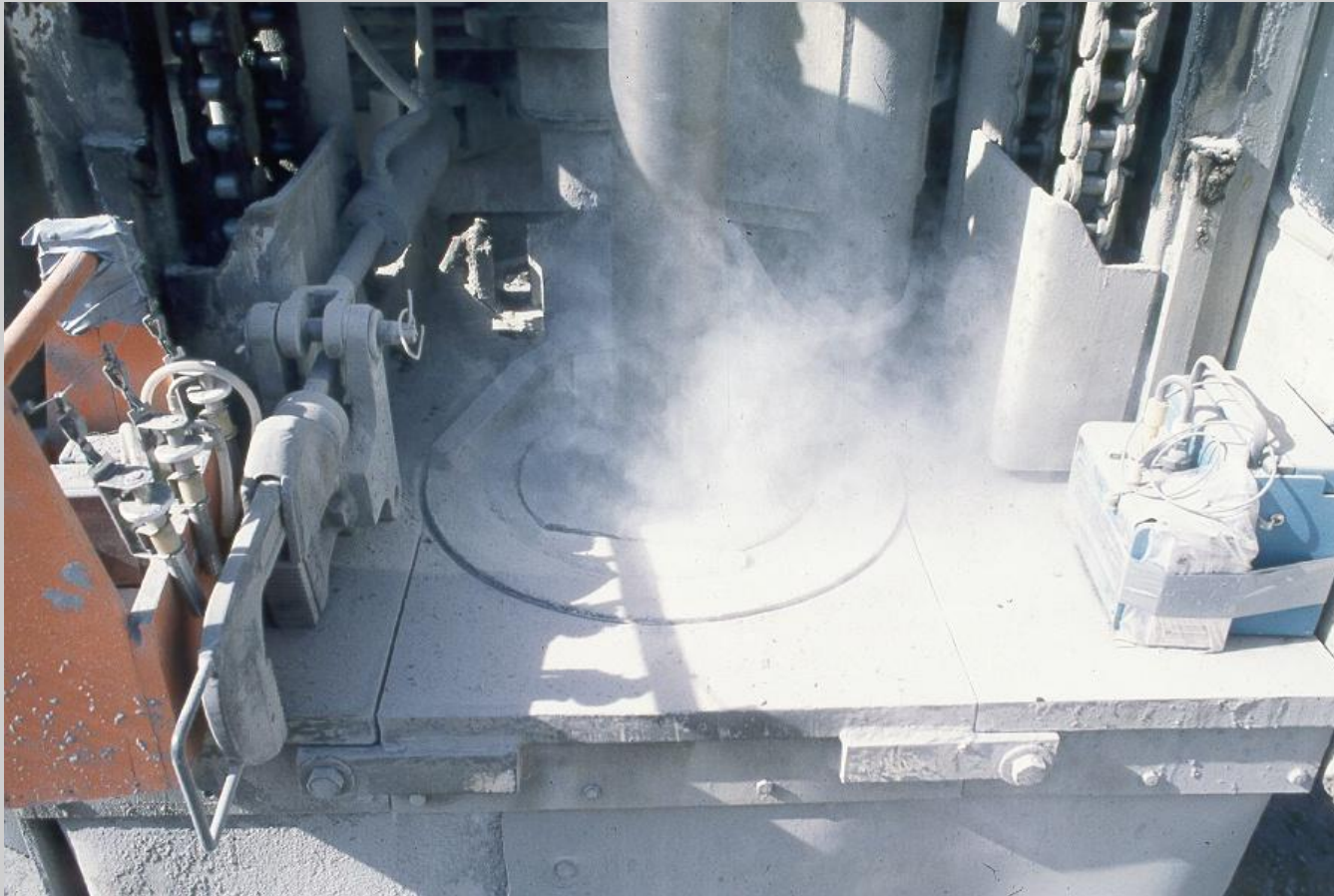


Adjustable Height Shroud



✓ Dust emissions below 0.5 mg/m^3

➤ Drill Stem Leakage

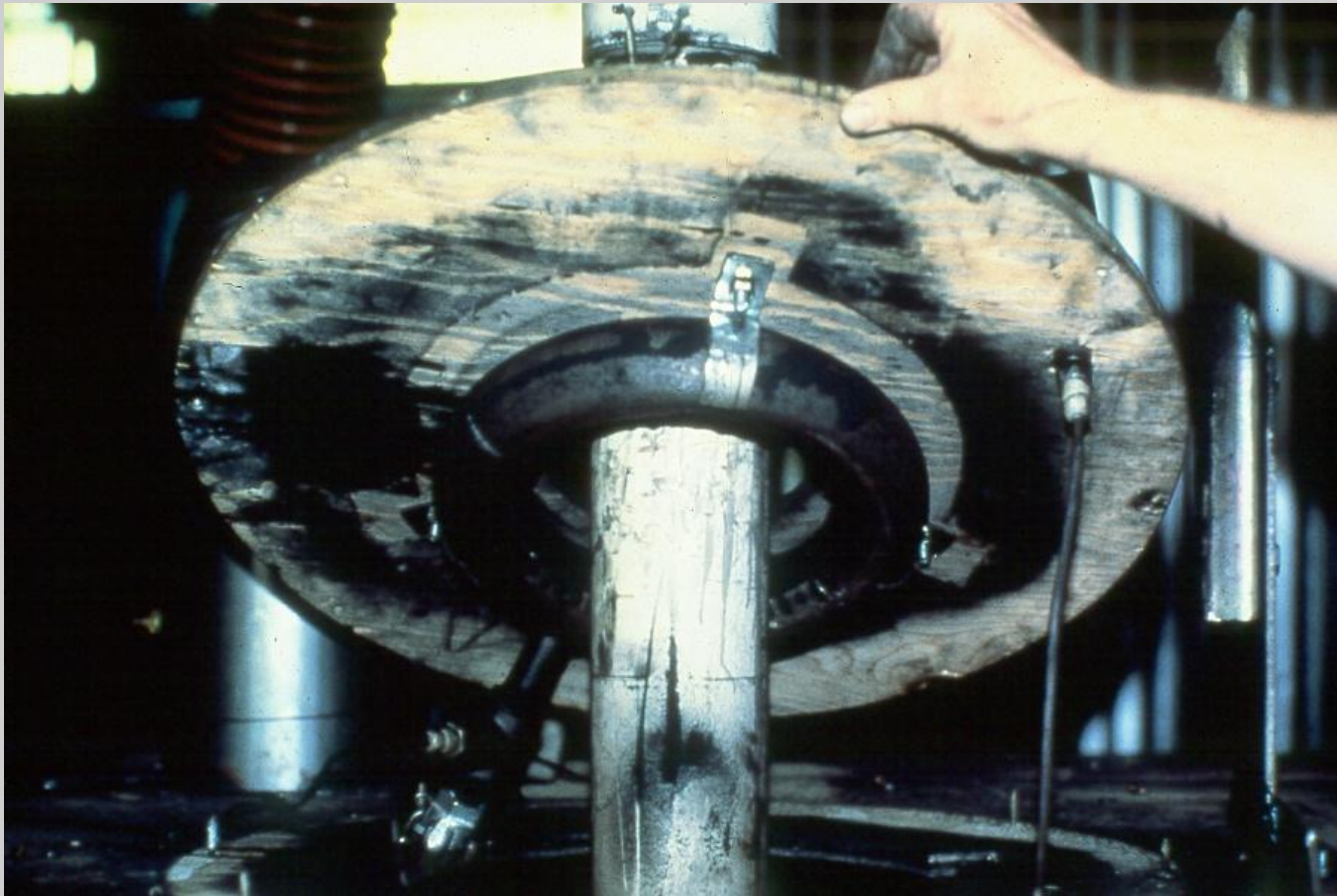


- ✓ Maintain good seal between drill stem and table
- ✓ Use air ring seal

Maintain Good Drill Stem and Table Seal



Air Ring Seal



- ✓ 41 – 70 % Dust Reduction
- ✓ Large Chip Elimination

➤ Collector Dump



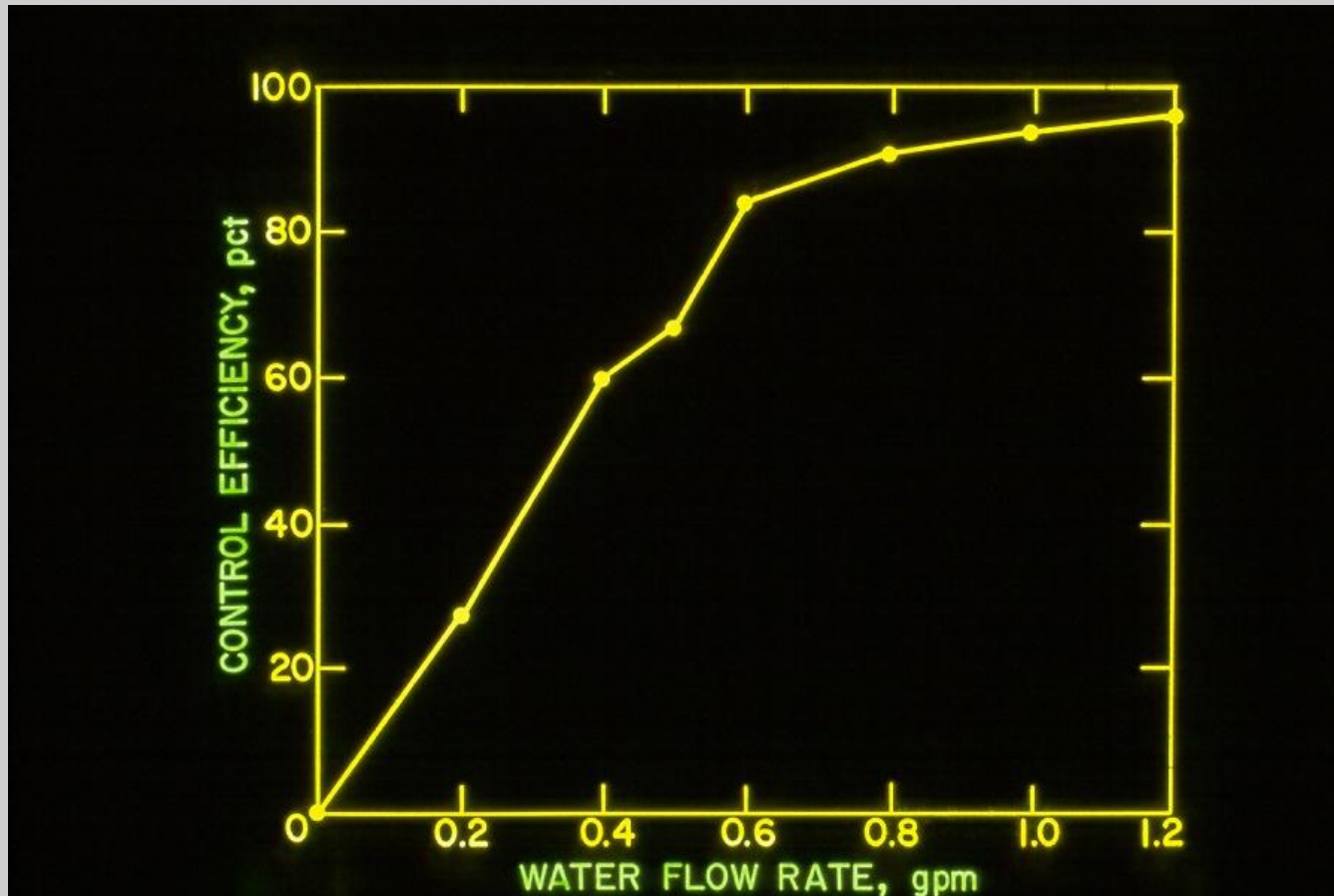
✓ Shroud dump discharge close to the ground

Maintain Dust Collector as Specified by Manufacturer

- ✓ 51% dust reduction after replacing broken collector fan belt
- ✓ 83% dust reduction from replacing torn deck shroud



2. Wet Suppression

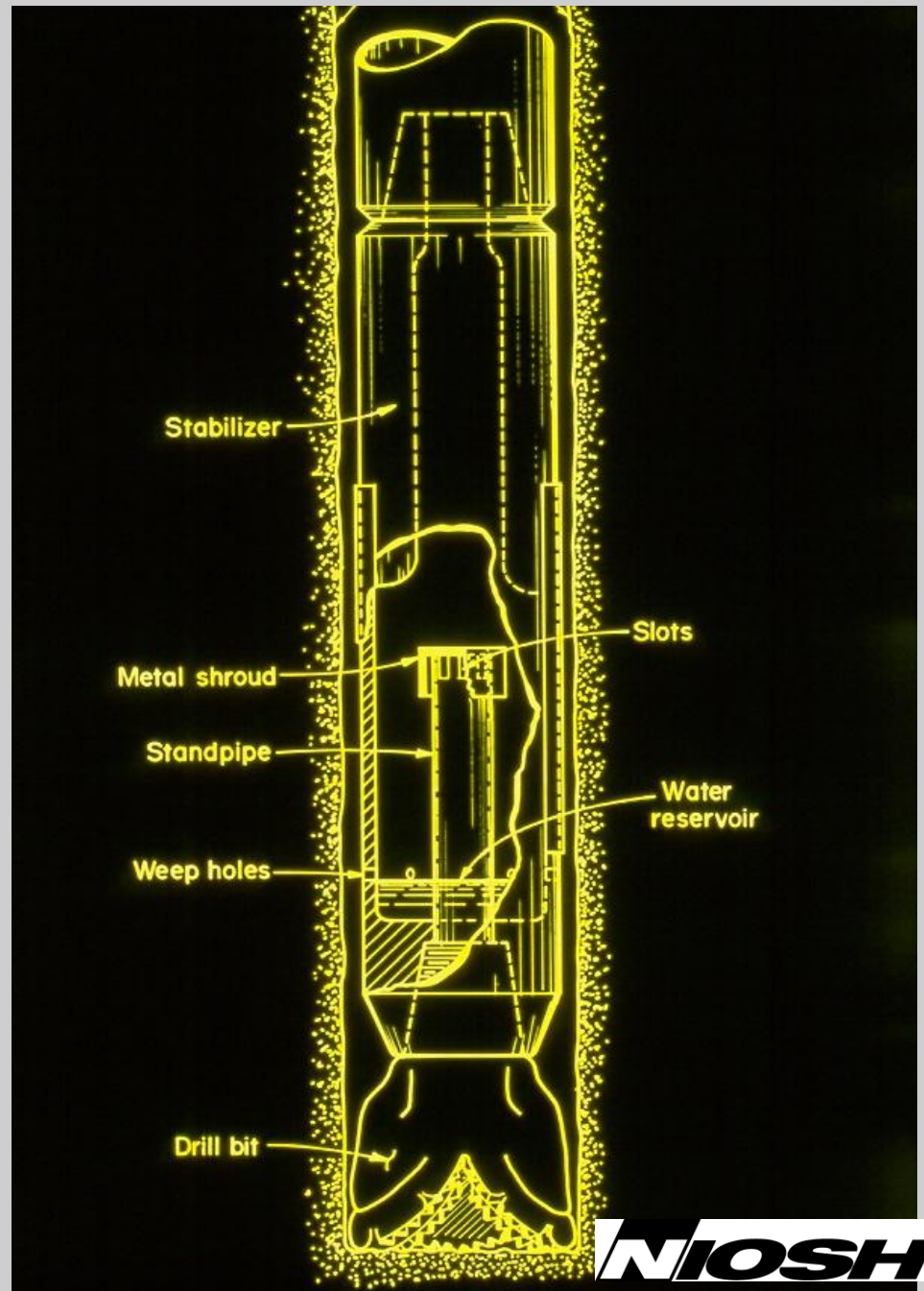


- ✓ Add small amounts of water to reduce visible dust cloud
- ✓ Operational problems from excessive water

Water Separator Increases Roller Bit Life

- ✓ 98 % With Separator
- ✓ 96% Without Separator
- ✓ Bit life increased 4.5 times

Limited to large drill stems

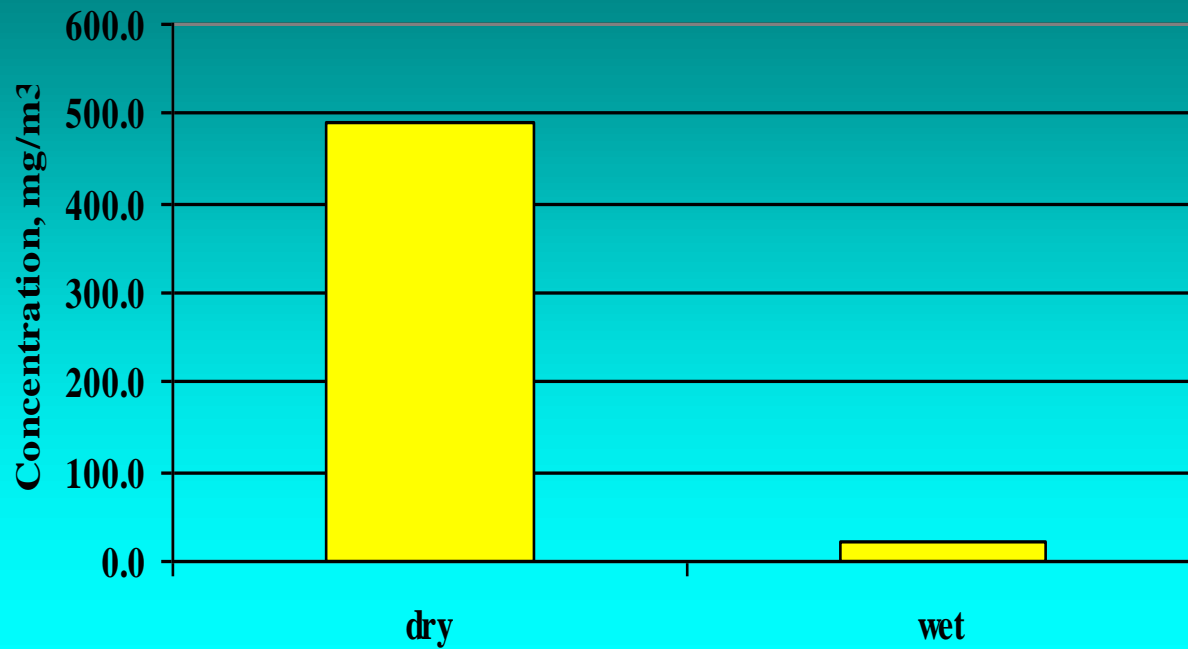


Smaller Drill Stem Water Separator



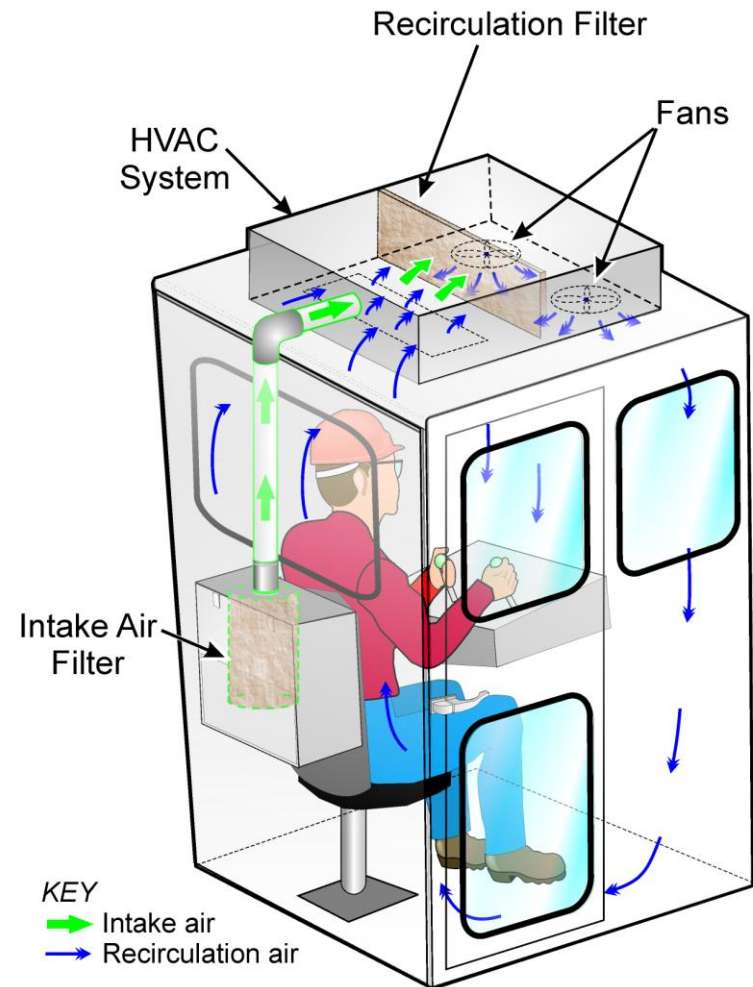
Smaller Drill Stem Water Separator Study

Wet vs Dry Drilling



ENCLOSED CAB FILTRATION SYSTEMS

- Integrated into HVAC Systems
- Protection Factors Vary
 - Drills 2.5 to 84
 - Bulldozers 0 to 45
- Field Studies of Refurbishing Old Cabs
- Laboratory Study of Cab Filtration systems



Refurbish Cabs



- Ceiling mounted heating and AC units
- External filter and fan units
- Improve cab enclosure seals

Enclosed Cab Field Studies

Cab Evaluation	Cab Pressure Inches w.g.	Equivalent Wind Vel. mph	Inside Dust Level mg/m ³	Outside Dust Level mg/m ³	Protection Factor Out/In
Rotary Drill	None Detected	0	0.08	0.22	2.8
Haul Truck	0.01	4.5	0.32	1.01	3.2
Front-End Loader	0.015	5.6	0.03	0.30	10.0
Rotary Drill	0.20 – 0.40	20.3 – 28.7	0.05	2.80	56.0
Rotary Drill	0.07 – 0.12	12.0 – 15.7	0.07	6.25	89.3

Ascending



Ensure Good Cab Integrity & Positive Pressurization



Hard to Seal Gaps



Utilize High Efficiency Respirable Dust Filters



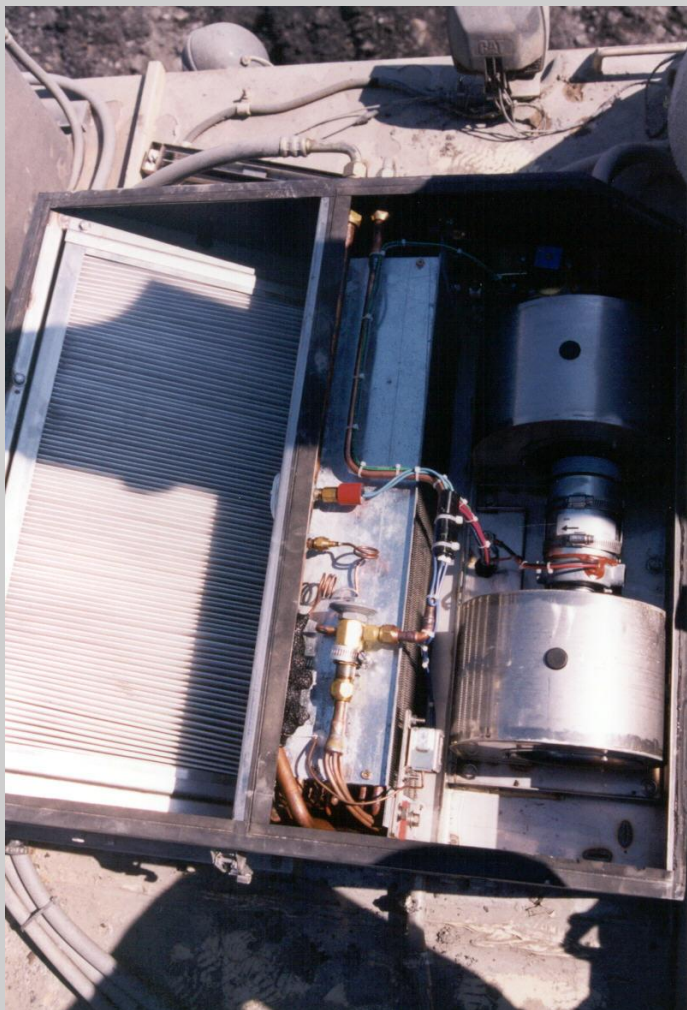
- ✓ Intake filter $\geq 95\%$ on respirable-sized dusts
- ✓ Use an efficient recirculation filter

Key Results of Laboratory Cab Testing

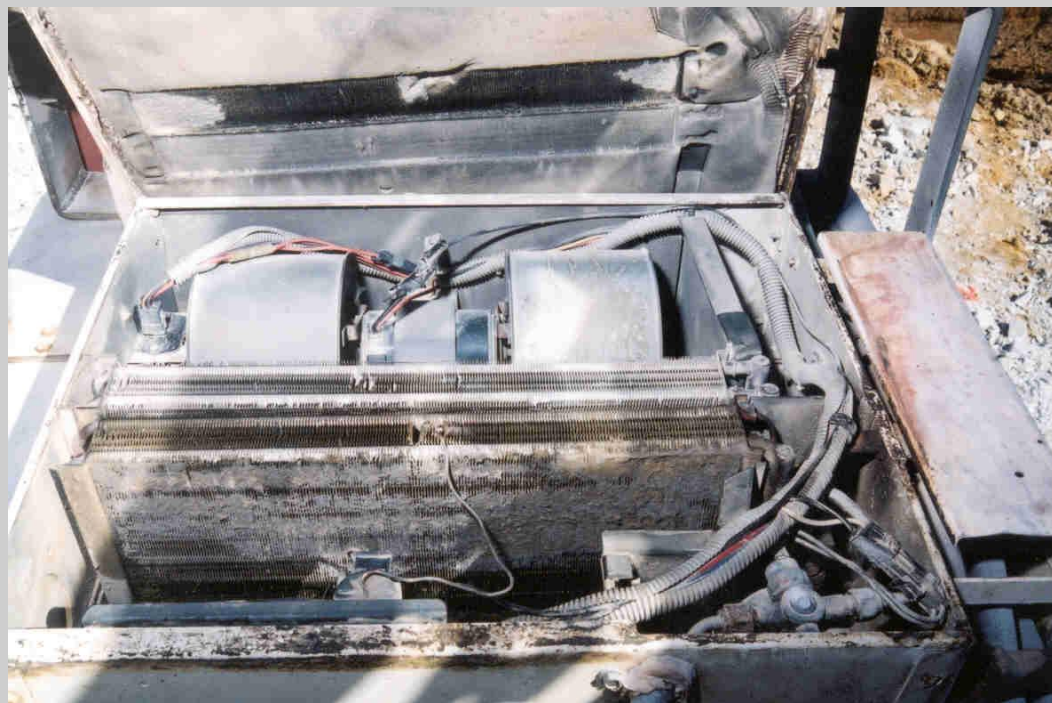
Filters		Average Cab Performance Parameters						
Intake	Recirculation ?	PF C_{out}/C_{in}	Q_{intake} cfm	Δp_{filter} “w.g.”	L % Q_i	Q_{recir} cfm	Δp_{cab} “w.g.”	Stability min
Low E_I 38%	No	1.7	37.3	0.30	2.0	366	0.17	17
Low E_I 38%	Yes	13.4	41.0	0.47	2.6	328	0.19	8
High E_I 99%	No	13.3	18.1	0.52	3.6	386	0.07	29
High E_I 99%	Yes	168.4	23.2	0.70	4.9	338	0.08	8

90% Efficient Recirculation Filter Improved Both Cab Protection Factor
& the Time to Reach It After the Door is Closed

Additional Benefits of Good Filtration



Clean HVAC



Dirty HVAC

Minimize Dust Sources in Cab

- Seasonal dust level increased from 0.04 to 0.68 mg/m³
 - Floor heater use increased dust levels from 0.03 to 0.26 mg/m³
-
- ✓ Use good housekeeping practices
 - ✓ Remove floor heaters
 - ✓ Rubber mats better than carpeting
 - ✓ Gritless sweeping compounds
- *non-petroleum based**



Keep Doors Closed During Equipment Operation

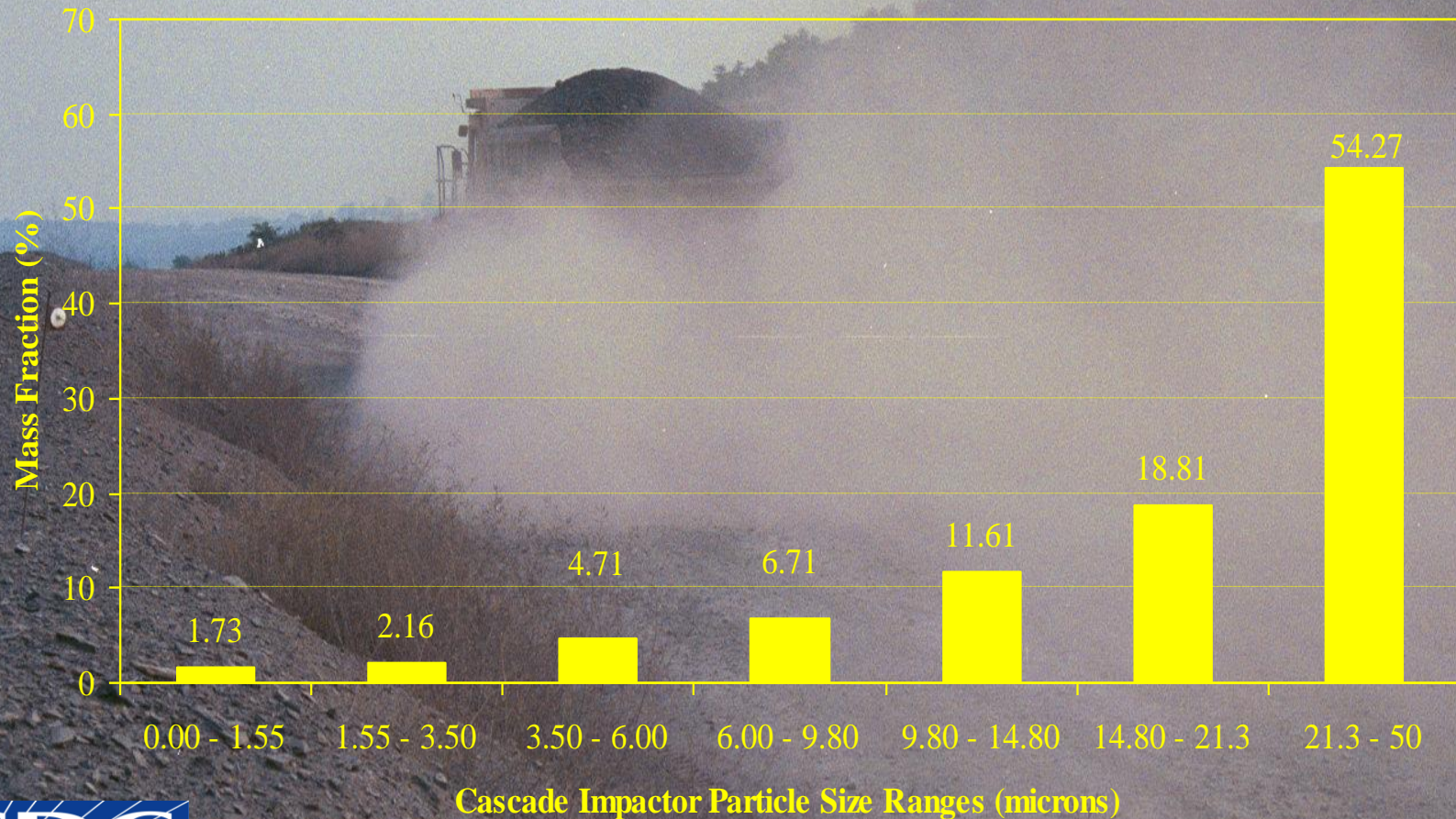


- ✓ 0.81 mg/m³ when briefly opened to add drill steels
- ✓ 0.09 mg/m³ with door closed

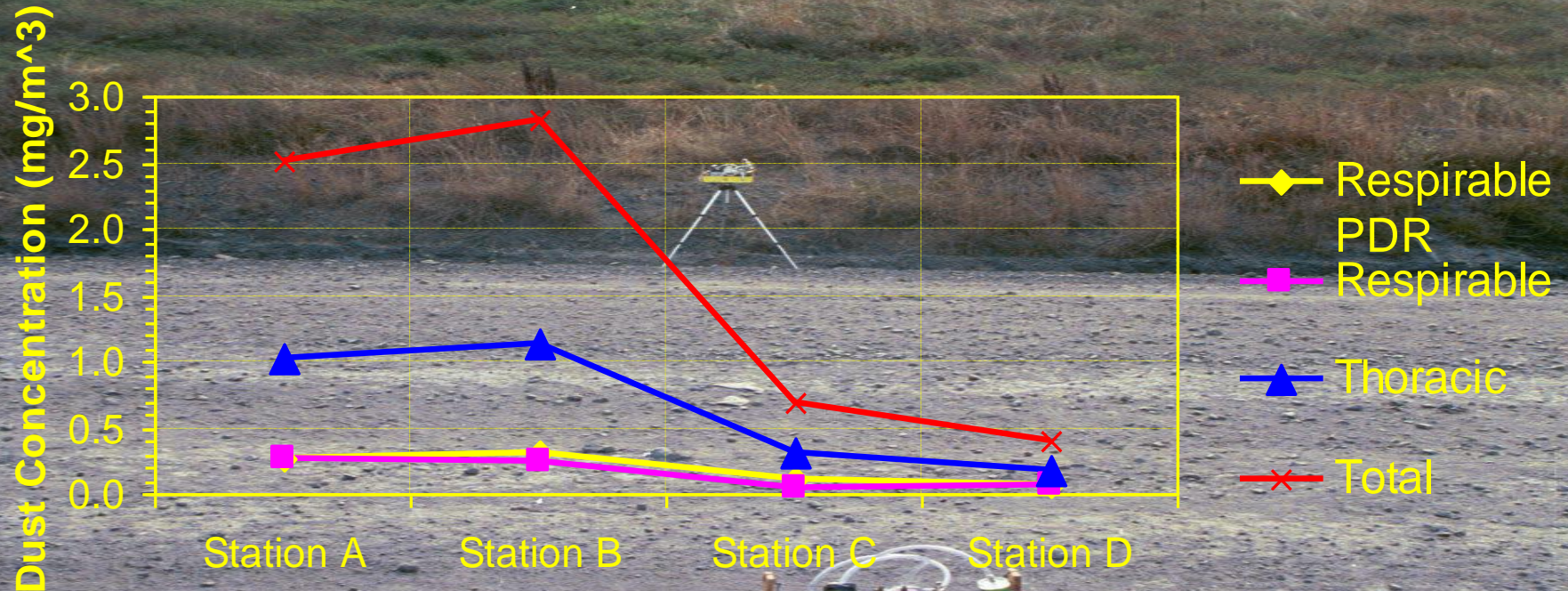
CONTROLLING HAULAGE ROAD DUST



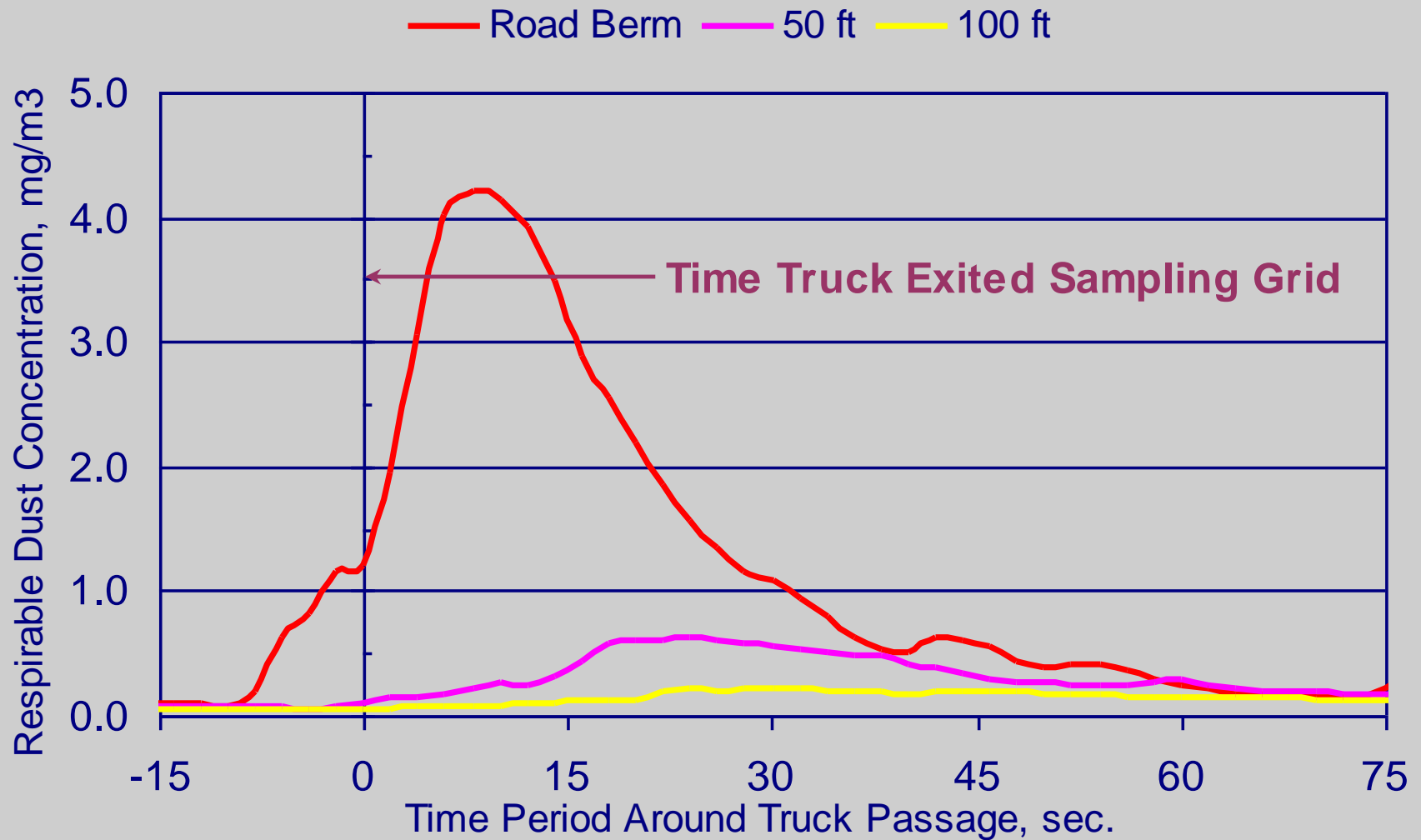
Average Airborne Particle Size Distribution



Typical Gravimetric Dust Concentrations

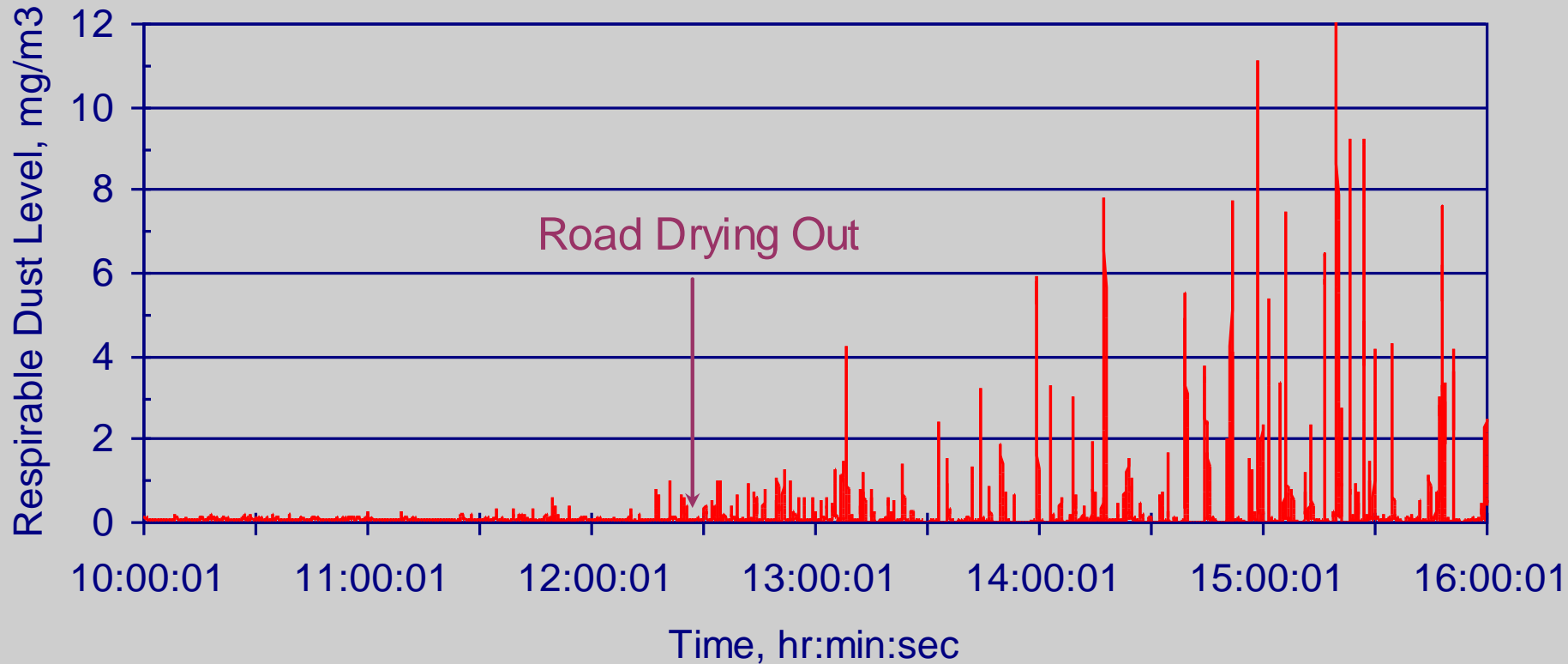


Dust Dissipation Effect



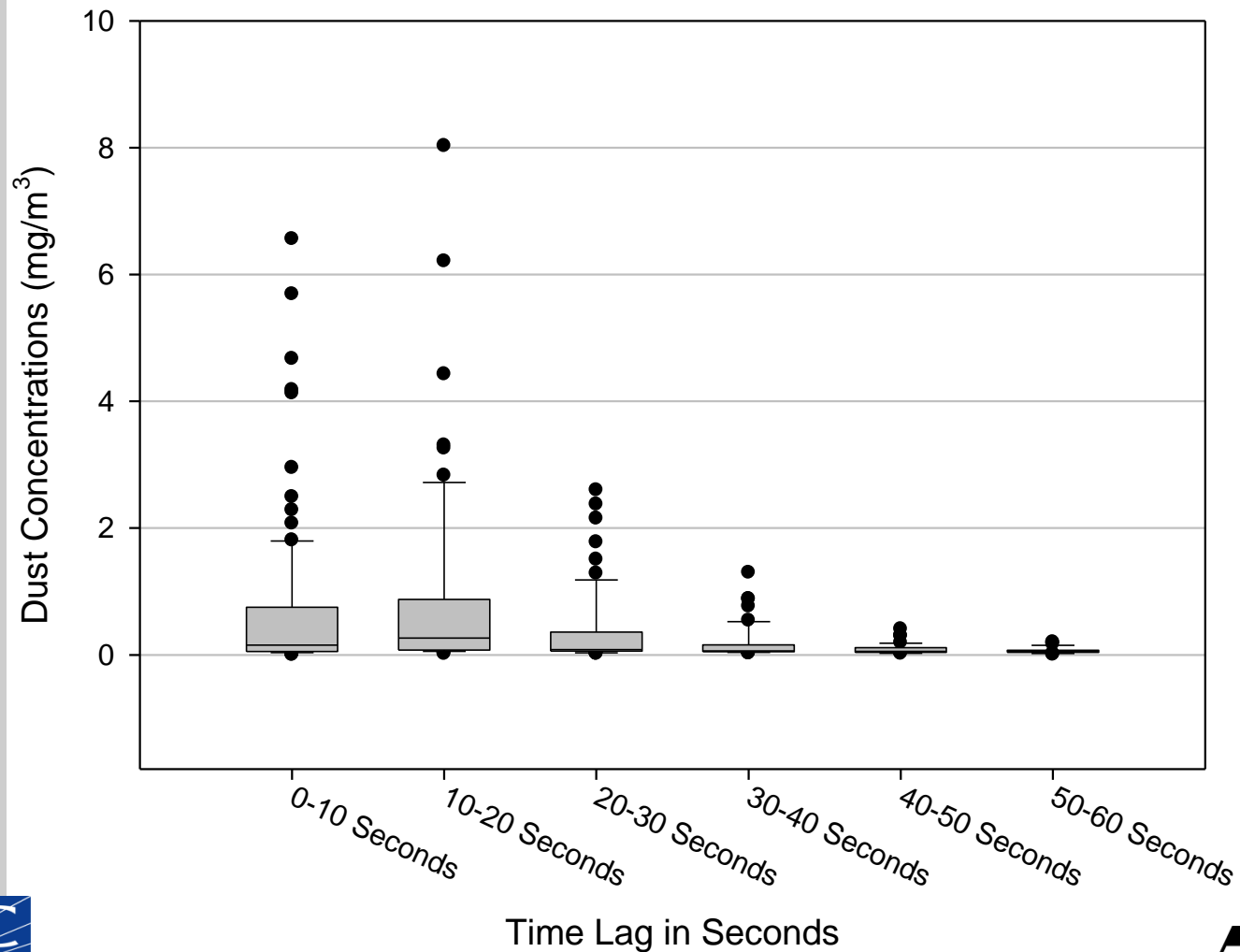
Total:Resp. \approx 8 to 10:1 Thoracic:Resp. \approx 3 to 4:1

Treatment of Unpaved Road Services



- ✓ Water effective with reapplications
- ✓ Salts, surfactants, soil cements, bitumens
films (polymers) extend time of effectiveness

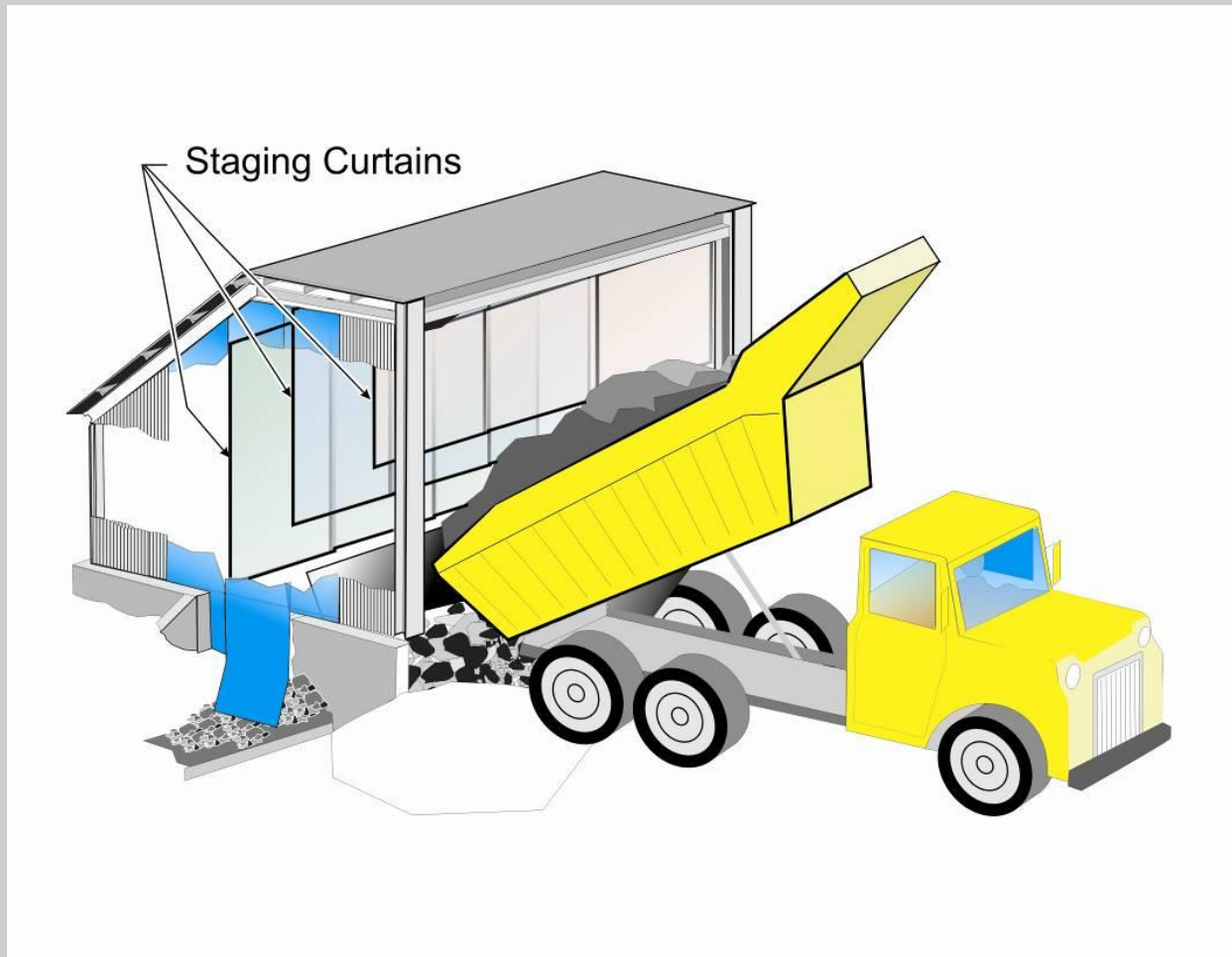
Increase Distance Between Vehicles



PRIMARY CRUSHER HOPPER DUMP

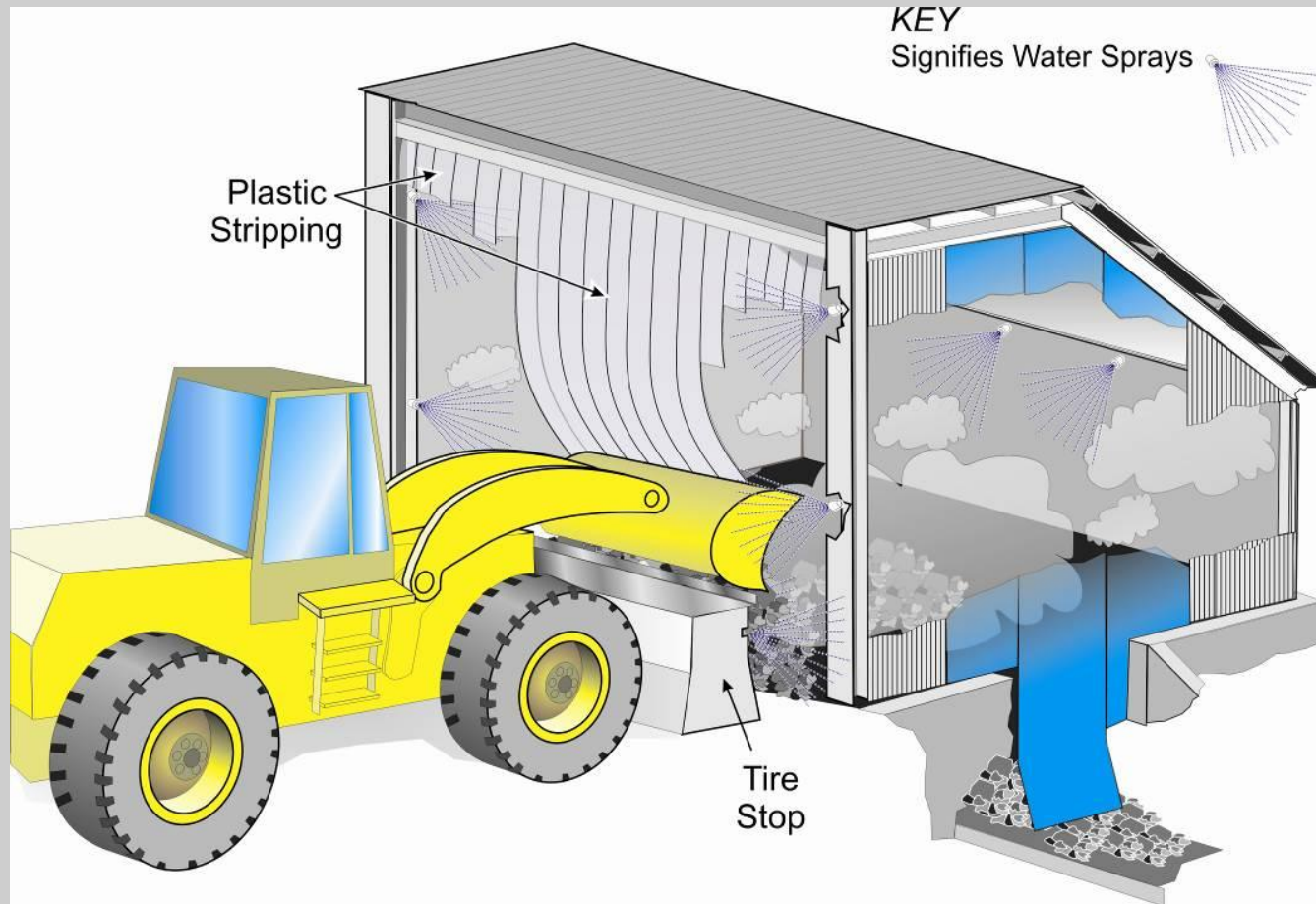


Enclose the Primary Hopper Dump



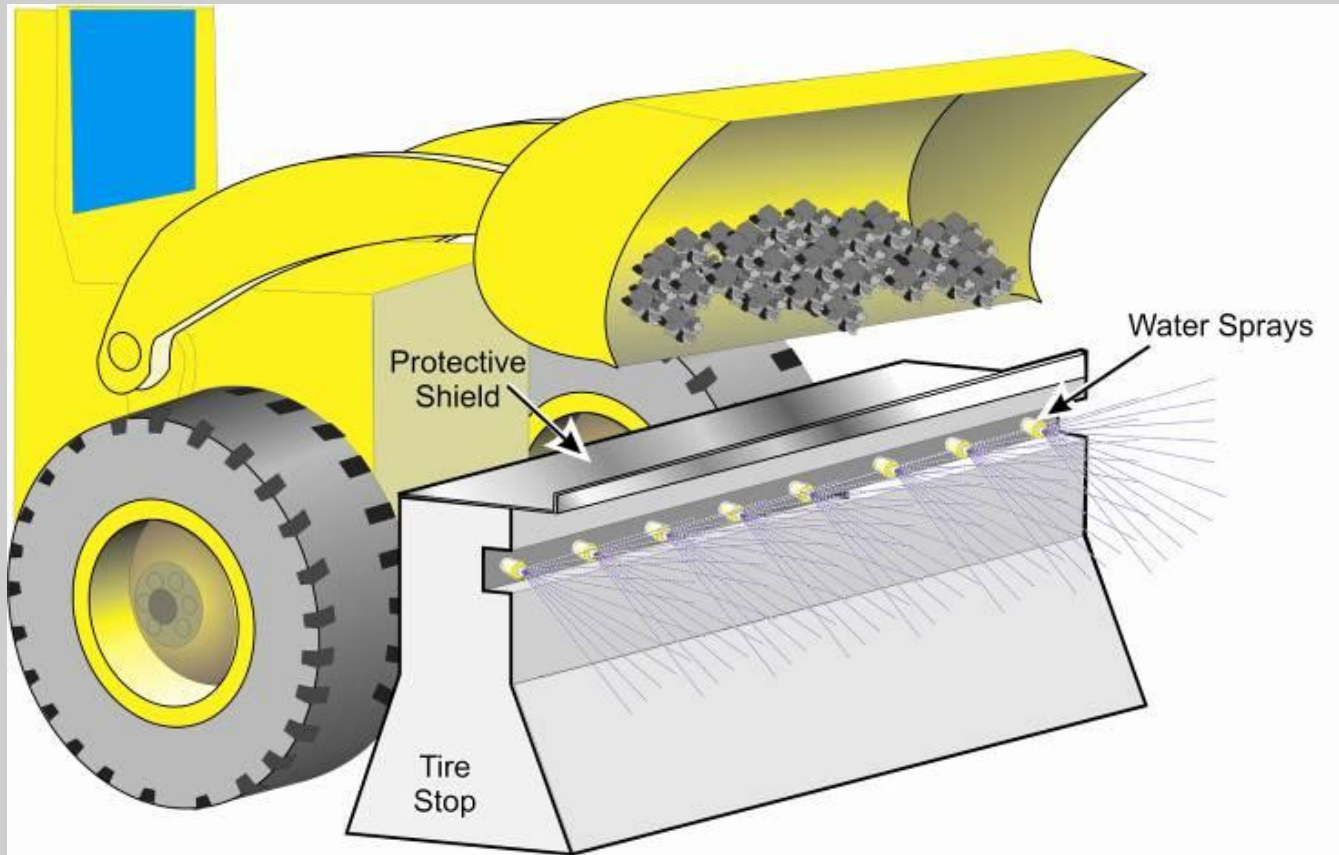
✓ Staging Curtains Reduce Dust Billowing Out

Use Water Sprays to Suppress the Dust



- ✓ Start by adding 1% moisture by weight
- ✓ Use photo cell or mechanical controlled sprays

Prevent Dust Roll Back Under Vehicle



- ✓ Tire stop reduces rollback underneath equipment
- ✓ Water sprays knockdown and redirect dust

CONCLUSIONS

- Dry and Wet Drill Dust Collection Systems Very Effective
 - ✓ Tightly sealed shroud around drill hole critical for dry systems
 - ✓ Wet systems can increase bit wear, problematic in cold climates
 - ✓ Assumes quality control and maintenance programs
- Cabs Can Provide a 10- to 50-Fold Dust Reduction
 - ✓ Good filtration system
 - ✓ Tightly sealed cab for achieving positive pressurization
 - ✓ Assumes quality control and maintenance programs
- Road Dust Can Effectively be Mitigated by Routine Wetting
- Enclosed Hopper Dumps Contain Dust → Spray Capture



Questions or Comments?

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