

# **ISO Mining Standards to protect worker health in operator enclosures (cabins) from dust and gases**

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**ISO Committee TC-82 – Mining, WG 9**

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# Overview



- Provide an overview of & development of ISO 23875 – Mining – Air quality control systems for operator enclosures - Performance requirements and test methods (2021);
- Purpose/Benefits of the Standard;
- Application in practice (examples);
- 2022 Amendment;
- Other developments e.g. technology;
- Development of a gas related standard;



# ISO 23875:2021 - Purpose

- Developed 2018-2021, Published 2021;
- One tool, as a part of dust exposure risk management;
- Protect worker health – prevent exposure to dusts in cabs that cause occupational lung disease in mobile equipment;
- Monitor and maintain CO<sub>2</sub> levels at a safe level;
- Provide a standardised approach for mining (and other industry e.g. construction, agricultural etc) globally;
- Provide a lifecycle standard from design to maintenance, outcome driven;
- Provide measurable requirements to determine compliance and effectiveness i.e. CO<sub>2</sub> level, decay time, particulate concentration, pressure

# ISO 23875:2021 How was it developed?



- Different approach taken in development;
- Lifecycle approach – end to end;
- Different people involved:- broad cross section, Safety professionals/Industrial Hygienists;
- Reviewed//commented on by OEMs, Operators, Consultants, Regulators for example;
  - EMERST;
  - Qld Inspectorate;

## Cross-Industry Team of Experts

Committee that wrote standard composed of cross-functional members, including:

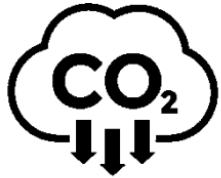
- 22 Subject matter experts
- 10 Countries
- 6 Industrial hygienists
- 6 Mining machine manufacturers
- 3 International mining companies
- 3 Consultants to the mining industry
- 2 Suppliers to the mining industry
- 1 Field engineering company

### Additional comments on draft from:

- TC-42 WG4 – ISO 29463
- Rio Tinto
- Volvo
- EPIROC
- EMERST – Australia
- NIOSH – USA
- MSHA – USA
- OSHA – USA

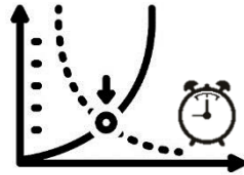
- RSHQ

# ISO 23875: Standardised Machine Requirements



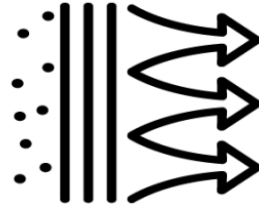
## Maintain Defined CO<sub>2</sub> Levels

Maximum allowable CO<sub>2</sub> = Ambient CO<sub>2</sub>+400ppm



## Recirculation Efficiency

Maximum respirable particulate matter concentration  $\leq 25 \mu\text{g}/\text{m}^3$  at start/end of decay test, maximum of 120 seconds decay time



## Increased Filter Efficiency

A filter that meets more stringent test criteria, typically an ISO 15 E or ISO 35 H HEPA filter, will be required in ISO 23875-compliant operator enclosures



## System Maintains Cab Pressurization

Minimum sustained pressurization, when the machine starting device moves to the "on" position shall be  $\geq 20$  Pa, maximum sustained pressure shall not exceed 200 Pa



## Real-time Operator Cab Monitoring

Cab pressurization and CO<sub>2</sub> levels monitored by permanently installed monitoring system

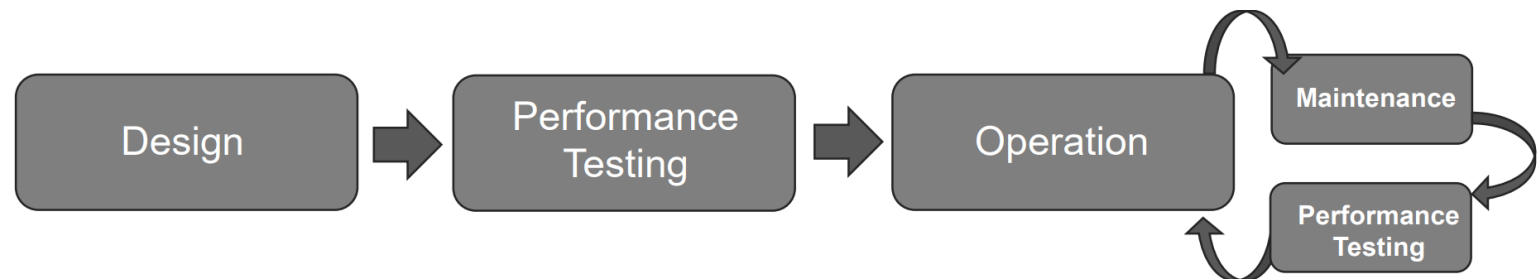
\*Some providers also monitoring particulate real-time

**All engineer controls must be applied to provide supplier's declaration of conformity  
– No short cuts**



# Life Cycle Standard

1. Initial integration into the machine cab (new, retrofit);
2. ISO 23875:2021 Certification of Conformance:
  - a. Performance testing ;
  - b. Operators Maintenance manual;
  - c. Issuance of Declaration of Conformance;
3. Ongoing Recertification:
  - a. Maintenance (in house, contract)
  - b. Updating service parts in Operator's maintenance manual during recertification



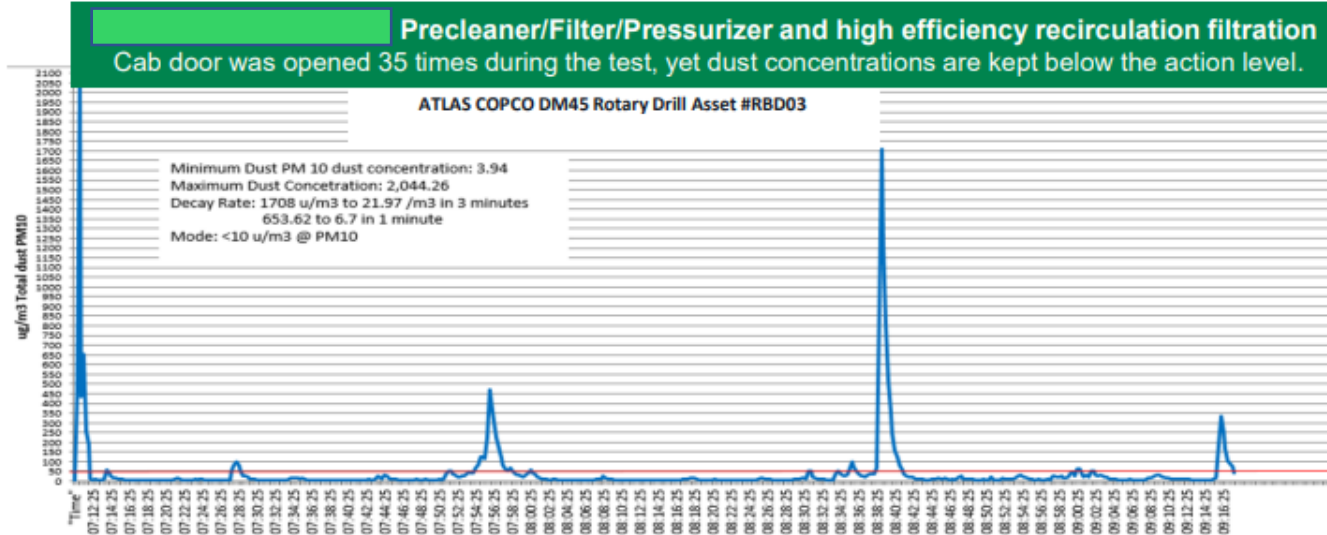
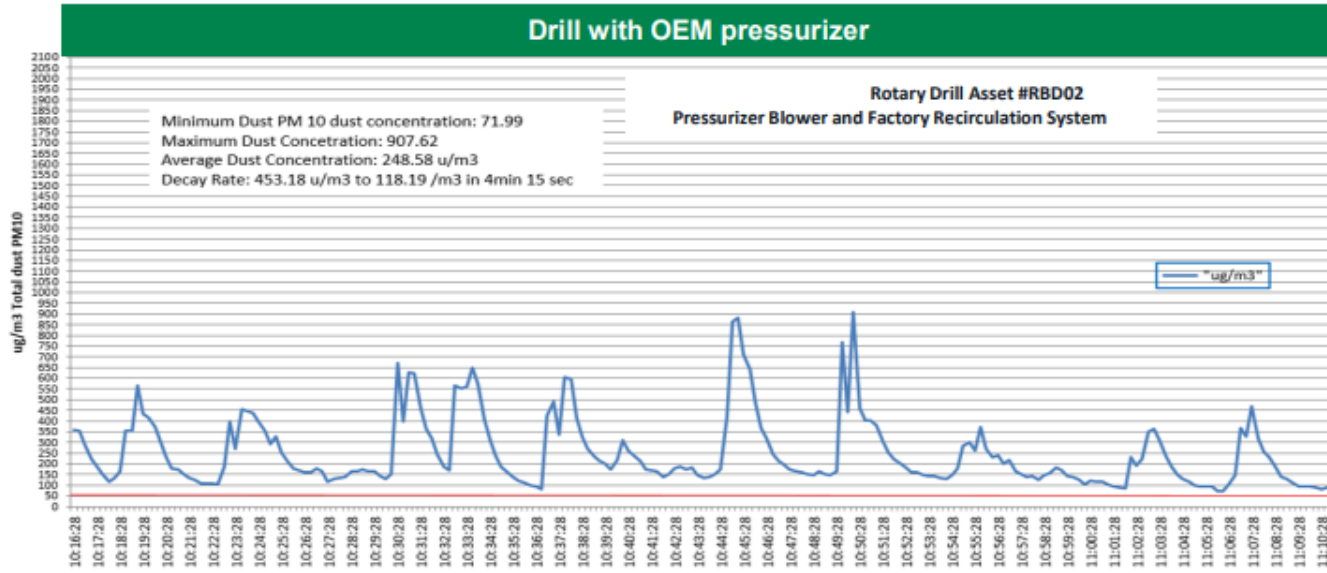
# Benefits of ISO 23875:2021



- Controls dust exposure to reduce incidences of respiratory related illness/disease;
- Establishes requirements that can be consistently monitored, tested and managed by operations;
- Addresses a key health hazard, creating a safer workplace;
- Lowers equipment maintenance costs, e.g. A/C run longer and more effectively with reduction of dust build up on evaporator core;
- Determines maintenance practices and service intervals to maintain required cab performance;
- Creates a consistent global standard and approach to cab air control systems reducing impacts of regional regulations and multiple iterations of machines, platforms, parts



# Case Studies fibrous dust management



## NIOSH 7500 test results for Silica and NIOSH 7400 test results for Asbestos RESPA-CF and FFX2 equipped Drill (Drill 03) vs. similar drill with Traditional pressurizer system

Subject: Drill 03 testing IH results

Hi to All,

We did two days of air quality sampling (Silica and Asbestos) in the Drill 03 versus another similar drill on the same pattern the same day in order to have a good comparison. The variables, environmental conditions and the composition of ore, were pretty much the same except the only possible difference can be the working methods adopted by each driller; such as one driller leaving the door open while getting the sample and the other closing their door. Other differences might be the housekeeping habits of each individuals during or after the shift.

Here are the Regulatory Limits and Action Levels for the contaminants of concern:

Contaminant	ACGIH 1994-95 Adjusted TWA 12h Regulatory Limit	ACGIH 2014 Adjusted TWA 12h Action Level
Silica (quartz)	0.050 mg/m <sup>3</sup>	0.024 mg/m <sup>3</sup>
Asbestos	0.001 f/cc	0.005 f/cc

Here are the results of the comparison sampling of Drill 03, equipped with a pressurization and recirculation system, versus a drill without such system. The results in the table below are ambient in the cabin.

Silica:

Date	Silica Quartz (mg/m3)	
	Drill 03	Similar Drill
10-Mar-15	<0.0040	0.019
13-Mar-15	<0.0047	0.021

The silica result in light green are close to the Action Level (0.024).

Asbestos:

Date	Calculated TWA for Asbestos (f/cc)	
	Drill 03	Similar Drill
10-Mar-15	0.020	0.080
13-Mar-15	0.021	0.251

Therefore as you can see, there is a significant difference between both results.

That is a good news! 😊

Regards,

KM  
Industrial Hygienist

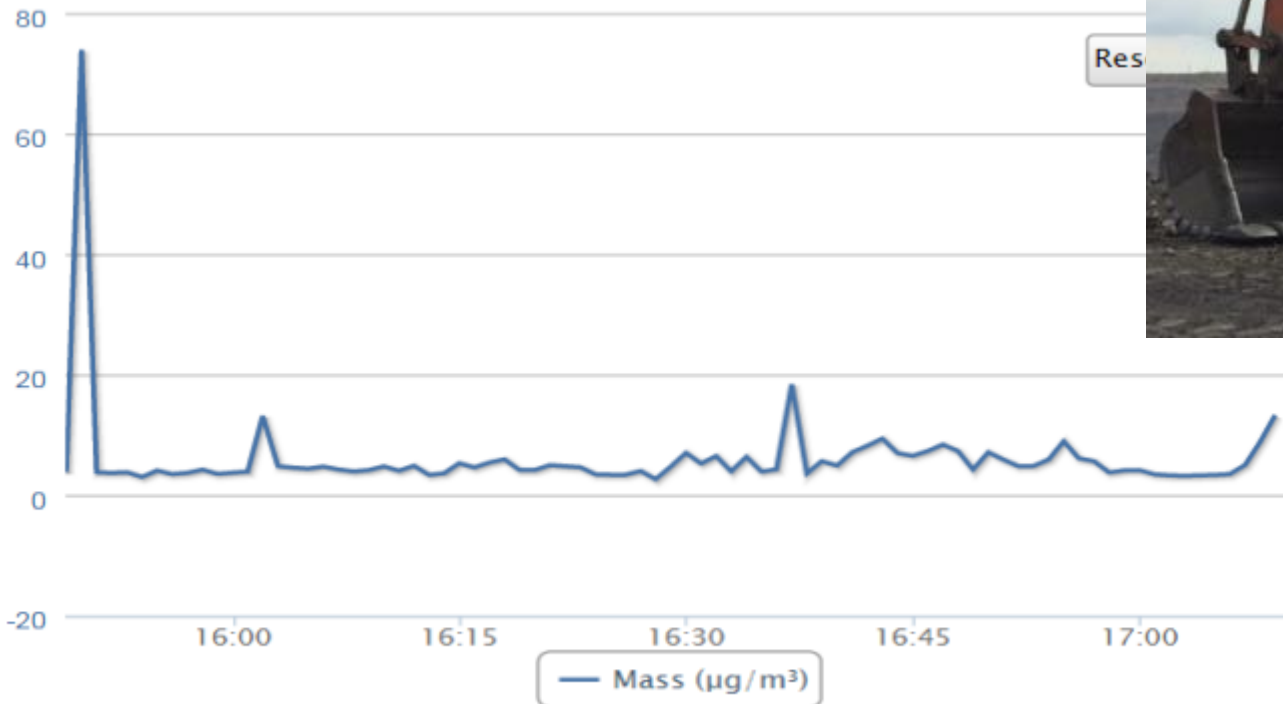




# Case Studies coal dust management



Cab performance evaluated using ISEEE 1.002 In Field Testing Method, on a Hitachi EX3600 actively working in an above ground coal mine, to determine the effectiveness of the cab to protect the operator from total respirable dust exposure. The cab was found to be highly effective with stabilized dust concentrations well below 25  $\mu\text{g}/\text{m}^3$ .



PM10 Data displayed showing last 1 hour and 10 min of test.

# ISO 23875:2021 Pilot Installation

Fresh air and recirculated systems



# ISO 23875:2021 Pilot Installation

Excavators



# ISO 23875:2021 Pilot Installation

Dozers

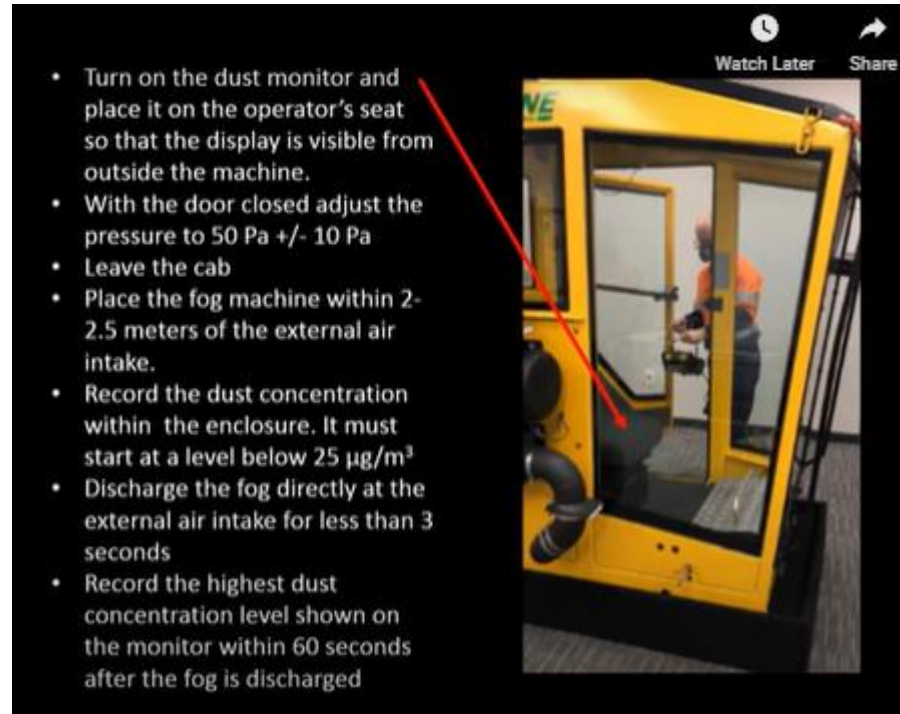


# Practicalities

- Tools, checklists, training materials etc;
- OEM's, Operators integrating Standard into Specs, equipment

Appendix 1: Performance Test Results Report Template

Machine Asset # Make/Model Serial number	External Air Filter Classification <input type="checkbox"/> ISO 15 E <input type="checkbox"/> ISO 35 H <input type="checkbox"/> _____			
Date of Performance Test:	Recirculation Air Filter Classification <input type="checkbox"/> ISO 15 E <input type="checkbox"/> ISO 35 H <input type="checkbox"/> _____			
Equipment Type	Make	Model	Serial #	Calibration Date
Aerosol Generator (fog machine)			N/A	N/A
Dust Monitor				
1) Pressure Test				
Pressure <input type="checkbox"/> Pa <input type="checkbox"/> In-H <sub>2</sub> O	Fan Speed			
	No fan Key "On."	Low	Med	High
2) External Air System Leakage Test				
External air System Leakage	Pressure <input type="checkbox"/> Pa <input type="checkbox"/> In-H <sub>2</sub> O	Max Concentration (required <100 µg/m <sup>3</sup> ) (µg/m <sup>3</sup> )		
3) Decay Time Test				
Decay Time (performed on low fan speed)	Initial Concentration (µg/m <sup>3</sup> )	Max Concentration >2000 µg/m <sup>3</sup> but less than <5000 µg/m <sup>3</sup>	Decay time from Max Concentration to ≤25 µg/m <sup>3</sup> (in seconds)	Pressure (requirement 50 Pa ± 10 Pa) <input type="checkbox"/> Pa <input type="checkbox"/> In-H <sub>2</sub> O
4) CO <sub>2</sub> Levels Test				
Carbon Dioxide Check one: <input type="checkbox"/> One operator <input type="checkbox"/> Two operators <input type="checkbox"/> Three operators	Pressure <input type="checkbox"/> Pa <input type="checkbox"/> In-H <sub>2</sub> O	Ambient concentration (ppm)	Concentration after 15 minutes of CO <sub>2</sub> (ppm) Requirement: (≤ ambient + 400 PPM)	
Additional Comments:				



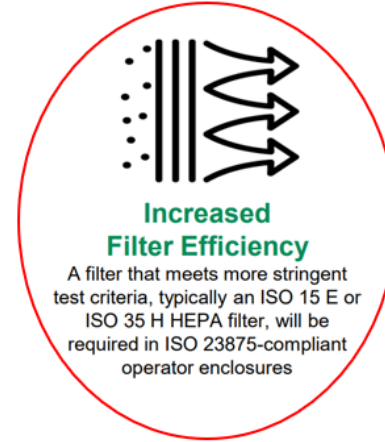
- Turn on the dust monitor and place it on the operator's seat so that the display is visible from outside the machine.
- With the door closed adjust the pressure to 50 Pa +/- 10 Pa
- Leave the cab
- Place the fog machine within 2-2.5 meters of the external air intake.
- Record the dust concentration within the enclosure. It must start at a level below 25 µg/m<sup>3</sup>
- Discharge the fog directly at the external air intake for less than 3 seconds
- Record the highest dust concentration level shown on the monitor within 60 seconds after the fog is discharged

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Appendix 6: Operator Enclosure Planned Maintenance Inspection Form Template

Machine Asset #									
Total hours in the planned maintenance cycle									
	PM Inspection # 1 (within 24 hours)			PM Inspection # 2 (~50%)			PM Inspection # 3 (~80%)		
Date of inspection									
Machine hours at planned maintenance									
Pressure  ____(Pa) ____ (In-H <sub>2</sub> O)	Fan Speed			Fan Speed			Fan Speed		
	Low	Med	High	Low	Med	High	Low	Med	High
Is HVAC airflow at vents unrestricted through all fan speeds?	Yes / No			Yes / No			Yes / No		
Visual inspection of external/recirculation filters?	Good / Fair / Poor			Good / Fair / Poor			Good / Fair / Poor		
Visual evidence of particulate accumulation on surfaces in operator enclosure?	Low / Med / High			Low / Med / High			Low / Med / High		
Visual inspection of operator enclosure integrity – door/window seals, presence of cracks, ability to close all windows and doors tightly	Good / Fair / Poor			Good / Fair / Poor			Good / Fair / Poor		
Operator enclosure housekeeping	Good / Fair / Poor			Good / Fair / Poor			Good / Fair / Poor		
Is HVAC cooling/heating efficiently?	Good / Fair / Poor			Good / Fair / Poor			Good / Fair / Poor		
Notes:									

# Amendment June 22 – Why?



- Standard required filters to comply with ISO 29463;
  - Removed all references to ISO 29463;
  - AS4260 & AS1324 able to be used to achieve standard;
  - Filter label to disclose filter efficiency at 0.3 $\mu$ -0.5 $\mu$ , nominal airflow and filter restriction;
  - Requirement is to pass the air quality system tests;
  - Allows for regional and national filter test standards e.g. Standards Australia, filters to qualify;
  - Being reviewed for Standards Australia Identical Adoption.
- 
- National Institute for Occupational Safety & Health (NIOSH) researching real time particulate monitors (sensors) – finding < \$US 100 as/more accurate than current expensive technologies;
  - Goal to have reliable, affordable real time particulate monitors in cabs



# Standard Development

- The development of an ISO Standard has commenced;
  - Operator enclosures – Gas filtration;
- Covers gas filtration performance and operational integration of gas filtration;
- Expands to include additional industries e.g. waste management;
- Can be applied for gaseous environments e.g. operating cranes in smelting operations;
- Current draft field testing @ Teck Coal, RTA;
- Plan to have draft submitted for review Q4 2022



Thank you