Occupational Health Clinics for Ontario Workers Inc.

2nd Annual Mining Vehicle Powertrain Workshop (MVPC) 2024

Introduction to Diesel Emissions Exposure in the Mining Environment

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What this presentation will cover:

- Recap on previous MDEC / MVPC presentations.
- Occupational exposure limits are not fine dividing lines.
- Need to consider all exposures not only diesel particulate matter.
- Statistical analysis is important for similar exposure groups and trending.
- Health effects, epidemiology and recent research.
- Reduce diesel emissions “as low as reasonably practicable” (ALARP), and as part of an overall Airborne Hazard Management Program, required in Regulation 854
- The diesel risk calculator can be used to advocate for change.
- When measuring and evaluating airborne hazards, it is also important, that the risk assessment be carried out for a mixture.

Previous presentations / webinars

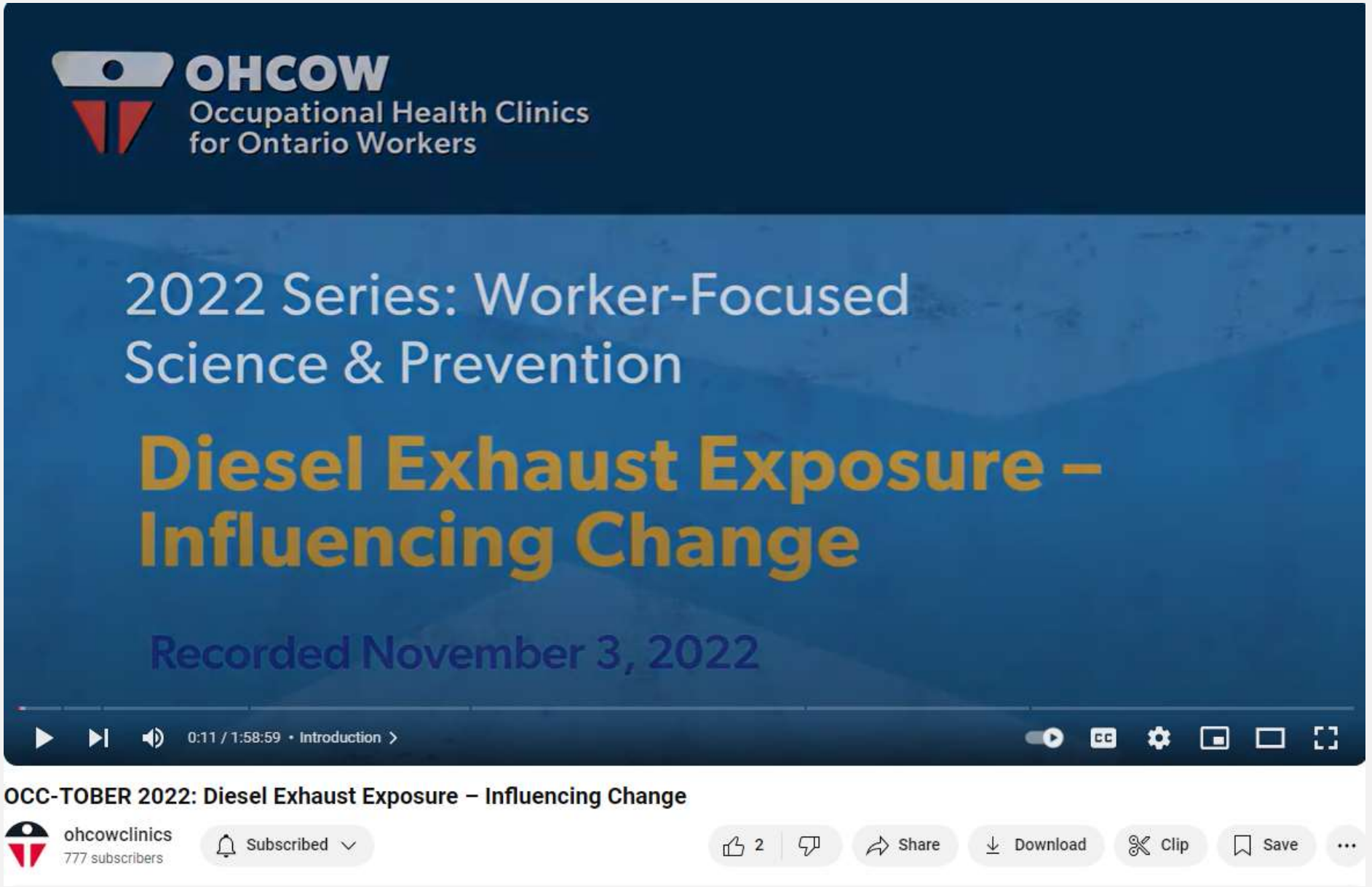
Year	Title
2013	Diesel emission in underground mining—A program for control, shared learning from Queensland, Australia Kevin Hedges, former Senior Principal Occupational Hygienist, Queensland Mines Inspectorate
2017	Is setting a suitably protective occupational exposure limit (OEL) for diesel particulate matter (DPM) a “key driver” to reduce exposure Kevin Hedges, Occupational Health Clinics for Ontario Workers Inc.
2017	Diesel Exhaust - Need to monitor exposure and further reduce occupational exposure limit. WSN Mining Conference.
2018	Occupational disease action plan (ODAP)and collaboration between system partners
2019	Diesel Emission Reduction
2022	The Past, Present & Future: Diesel Exhaust Exposures in Mining – A Tool to Assess Lung Cancer Risk
2022	Diesel Exhaust Exposure – Influencing Change. Collaboration between CROSH, OHCOW & USW presented via OHCOW
2023	Reduction of Diesel Emissions as part of an overall Airborne Hazard Management Program.

Via OHCOW webinars

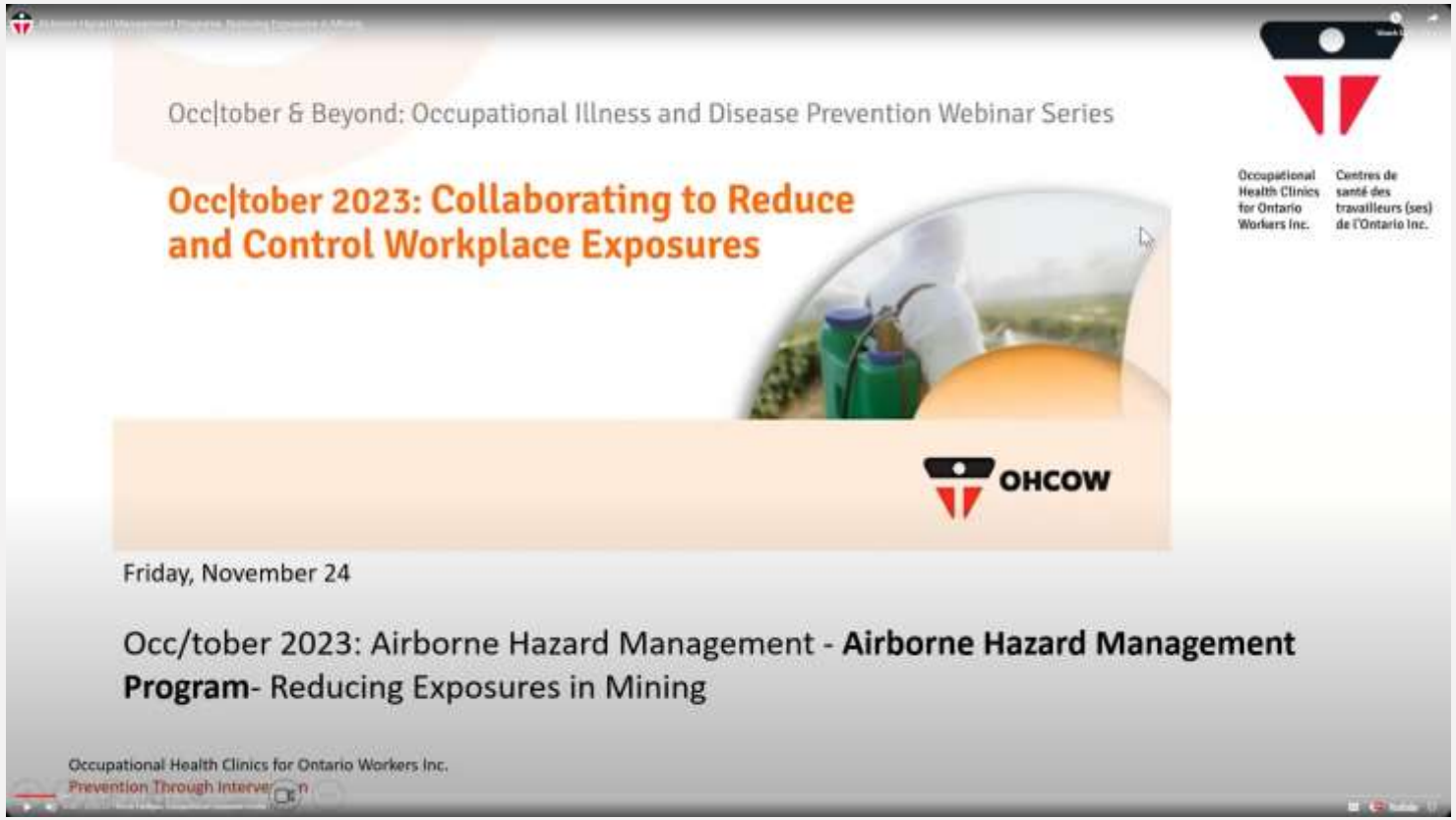
https://www.ohcow.on.ca/posts/emissions-based-diesel-engine-maintenance/

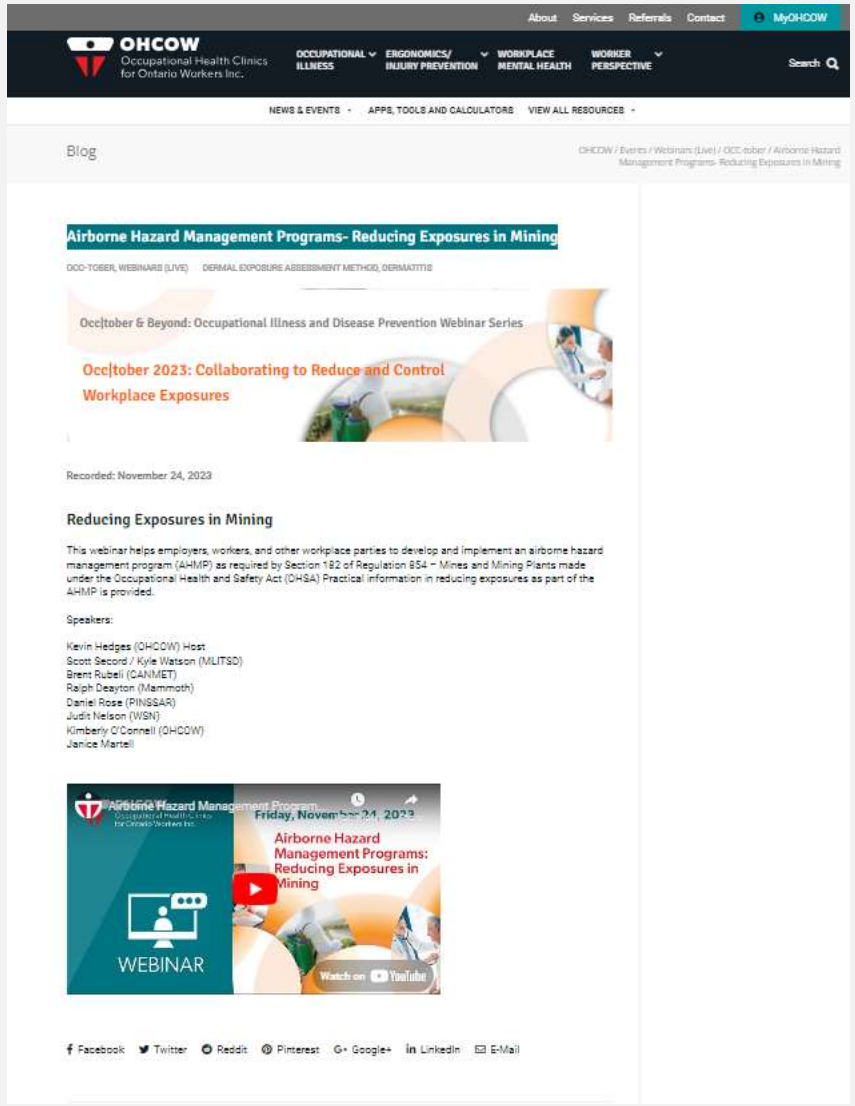
Diesel Exhaust Exposure and Health Risk in Transportation and the Community

- OCC-TOBER, WEBINARS (RECORDED)
- 2021, COMMUNITY, EXPOSURE, RISK FACTORS, TRANSPORTATION



https://www.youtube.com/watch?v=7auq9YOqc00





https://www.ohcow.on.ca/posts/airborne-hazard-management-programs-reducing-exposures-in-mining/

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Prevention Through Intervention

New requirements under the revised mining legislation require mines to have an **airborne hazard management program** (AHMP), developed in consultation through the Mining Legislative Review Subcommittee (MLRC), - “ventilation and hygiene”

> airborne hazard management program (AHMP) as required by Section 182 of *Regulation 854 – Mines and Mining Plants* made under the *Occupational Health and Safety Act* (OHSA).

183.2 Where diesel-powered equipment is operated in an underground mine, the time-weighted average exposure of a worker elemental carbon shall not be more than 0.12 milligrams per cubic metre of air. O. Reg. 69/23, s. 26.

183.4 (1) At an underground mine, an employer shall test the undiluted exhaust discharging from diesel-powered equipment into the atmosphere to ensure that it contains,

(a) less than 600 parts per million by volume of carbon monoxide; and

(b) less than 60 parts per million by volume of nitrogen dioxide. O. Reg. 69/23, s. 26.

(2) The testing in subsection (1) must be done,

(a) immediately after repairs are made to the engine or the exhaust system or both; and

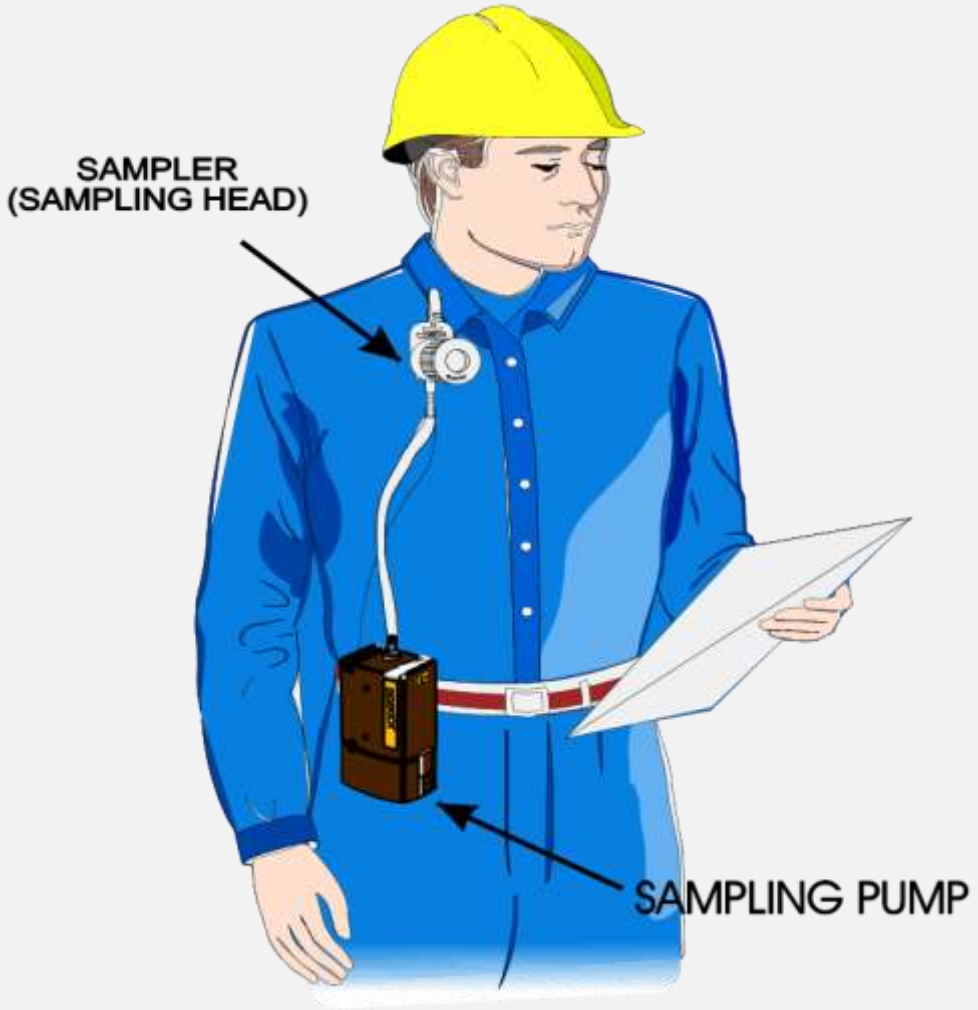
(b) at routine intervals for maintenance as the manufacturer recommends or, if there is no such recommendation, at least once a month. O. Reg. 69/23, s. 26.

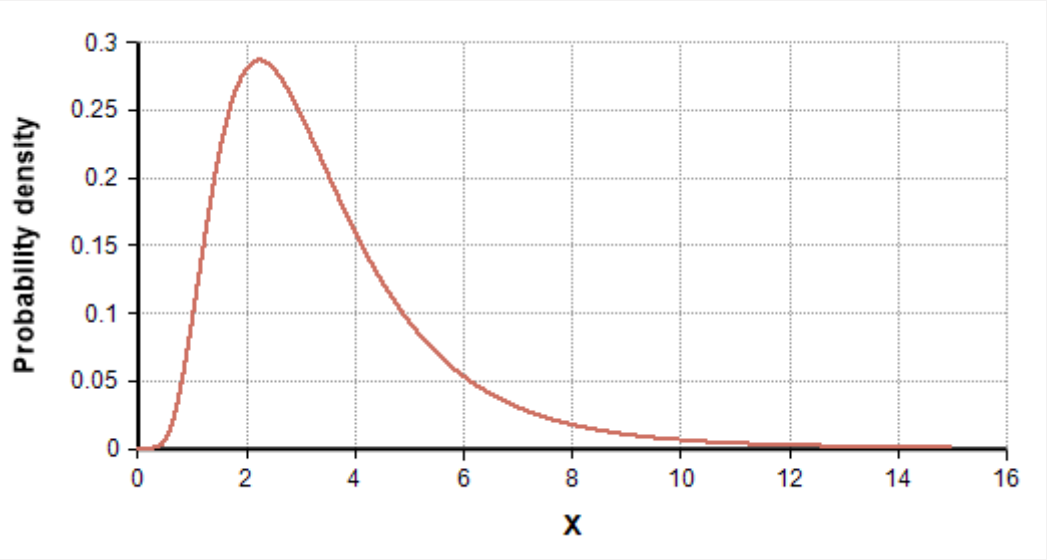
(3) The employer shall ensure that,

(a) testing measures and procedures are developed in consultation with, and take into consideration any recommendations made by, the joint health and safety committee or health and safety representative, if any;

(b) each individual piece of equipment is tested under consistent conditions so that results from different tests can be compared;

Personal exposure monitoring





https://wiki.analytica.com/index.php?title=Log-normal_distribution

- Exposures (typically) are **log-normally** distributed.
- Enough samples have to be collected to enable statistical analysis and ensure exposures are representative.
- There may be situations where “worst case” monitoring is required.

http://www.ohlearning.com/training/training-materials/w501-measurement-of-hazardous-substances.aspx

SKC

Operating Instructions

863 Valley View Road, Eighty Four, PA 15330 USA
Tel: 724-941-9701 • www.skcinc.com

DPM Cassette with Impactor
Cat. No. 225-317

SKC Diesel Particulate Matter Cassettes are designed for sampling in atmospheres where it is necessary to separate DPM, carbon nanotubes (CNTs), and carbon nanofibers (CNFs) from other respirable dust (such as coal dust). Single-use disposable SKC DPM Cassettes are tamper-evident sealed to ensure sample integrity. Each streamlined plastic cassette comprises an impactor with precision sapphire orifice, impaction substrate, and two heat-treated, binder-free quartz filters. The impactor screens out respirable particles ≥ 1.0 µm. Particles less than 1.0 µm are collected on the first filter, and the second filter serves as a dynamic blank for correction of absorbed organic carbon. Samples are analyzed for organic and elemental carbon content of DPM per NIOSH Method 5040 or for CNTs and CNFs; *see NIOSH CIB 65.*

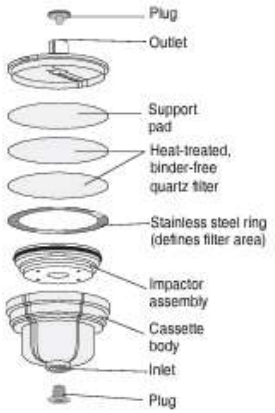


Figure 1. Exploded view of DPM Cassette (Cat. No. 225-317)

Performance Profile

Cassette Size:	37 mm
Filter:	Two heat-treated, binder-free quartz fiber with cellulose support pad
Filter Collection Area:	8.04 cm²
Impactor:	Four-nozzle, precision sapphire orifices
Flow Rate:	Calibrated at 1.7 and 2 L/min for sampling of submicron particles
Analysis:	For organic and elemental carbon using evolved gas analysis (EGA) with thermal-optical analyzer (NIOSH 5040) and electron microscopy (NIOSH CIB 65)

Sampling Equipment

The SKC DPM Cassette is designed for use with an appropriate sample pump and cyclone that pre-selects non-respirable particles.* An SKC Universal XR or AirChek® Series sample pump can provide the specified flow rate. Use SKC Cassette/Cyclone Holder Cat. No. 225-1 to secure the cassette when used with the GS-1 Cyclone.

* *A cyclone is not necessary in all sampling situations. It should be used in settings where larger particulate is likely to clog the impactor.*

Setting Up the Sampling Train with Cyclone and Holder

1. Insert stem of GS-1 Cyclone into large hole in cassette holder.
2. Orient cyclone in holder until the small round nodule on the bowl adapter rim fits into the notch in the cassette holder.
3. Remove inlet and outlet plugs from a DPM Cassette, pull back spring-loaded hold-down plate on cassette holder, and gently push inlet of cassette onto top of cyclone.
4. Position small hole in hold-down plate over cassette outlet.
5. Insert Luer adapter on the holder's rubber tubing into cassette outlet.

Figure 2. DPM Sampling Train with GS-1 Cyclone, Cassette Holder, and Universal PCXR4 Pump

Setting Up the Sampling Train Without a Cyclone

1. Remove the plug from the outlet of the cassette *(Figure 1).*
2. Attach one end of a length of Tygon® tubing to the cassette outlet and the other end to the inlet of an air sample pump capable of maintaining the desired flow rate.
3. Secure the cassette on a worker by using a cable tie and collar clip.
4. Remove plug from the cassette inlet immediately before sampling.

NMAM

DIESEL PARTICULATE MATTER (as Elemental Carbon) 5040

C MW: 12.01 CAS: none RTECS: none

METHOD: 5040, Issue 4 EVALUATION: FULL Issue 1: 15 May 1998 Issue 2: 10 March 2016

OSHA: None NIOSH: None PROPERTIES: nonvolatile solid

SYNONYMS: diesel particulate matter, diesel exhaust, diesel soot, diesel emissions

SAMPLING		MEASUREMENT	
SAMPLER:	FILTER: quartz fiber, 37-mm or 25-mm; size selective sampler may be required [1]	TECHNIQUE:	Thermal optical analysis, flame ionization detector (FID)
FLOW RATE:	2 to 4 L/min (typical)	ANALYTE:	Elemental carbon (EC). Total carbon is determined, but an EC exposure marker was proposed. See [1] for details.
VOL-MIN:	142 L @ 40 µg/m³		
-MAX:	19 m³ (for filter load of ~ 90 µg/cm²)	FILTER PUNCH SIZE:	1.5 cm² (or other [1])
SHIPMENT:	Routine	CALIBRATION:	Methane injection
SAMPLE STABILITY:	Stable	RANGE:	1 to 100 µg per filter portion (See also [1].)
BLANKS:	2 to 10 field blanks per set	ESTIMATED LOD:	0.3 µg per filter portion
		PRECISION ($\bar{S}_{r_1}$):	0.19 @ 1 µg/C, 0.01 @ 10 to 72 µg/C

ACCURACY	
RANGE STUDIED:	23 to 240 µg/m³ (See also ref. [1].)
BIAS:	None (See also ref. [1].)
OVERALL PRECISION ($\bar{S}_{r_T}$):	0.07
ACCURACY:	± 16.7% at 23 µg/m³ (See also ref. [1].)

APPLICABILITY: The working range is approximately 6 to 600 µg/m³, with an LOD of ~ 2 µg/m³ for a 960-L air sample collected on a 37-mm filter with a 1.5 cm² punch from the sample filter. If a lower LOD is desired, a larger sample volume and/or 25-mm filter may be used (e.g., a 1920-L sample on 25-mm filter gives an LOD of 0.4 µg/m³). The split between organic carbon (OC) and EC may be inaccurate if the sample transmittance is too low. The EC loading at which this occurs depends on laser intensity. In general, the OC-EC split may be inaccurate when EC loadings are above 20 µg/cm². High loadings can give low (and variable) EC results because the transmittance remains low and relatively constant until some of the EC is oxidized. The split should be reassigned (prior to EC peak) in such cases [2]. An upper EC limit of 800 µg/m³ (90 µg/cm²) can be determined. Low EC loadings (e.g., near the LOD) also may require a manual split to improve accuracy [1].

INTERFERENCES: Total carbon (as OC and EC) is determined by the method, but EC was recommended as a measure of workplace exposure because OC interferences may be present [1,2]. Cigarette smoke and carbonates ordinarily do not interfere in the EC determination. Less than 1% of the carbon in cigarette smoke is elemental. If heavy loadings of carbonate or organic dusts are anticipated, a size selective sampler (impactor and/or cyclone) should be used [1]. For measurement of diesel-source EC in coal mines, a cyclone and impactor with a submicrometer cutpoint are required to minimize collection of coal dust. A cyclone and/or impactor may be necessary in other workplaces if EC-containing dusts are present.

OTHER METHODS: Other methods for determination of EC and OC have been employed, but these are not equivalent to the method described herein. Information on other methods is summarized elsewhere [1]. The method procedures are unchanged from the 4th edition supplement to NMAM, but the corresponding diesel guidance chapter was updated for the 5th edition.

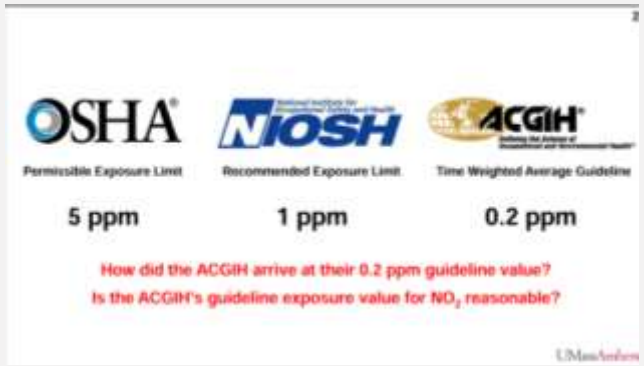
NIOSH Manual of Analytical Methods (NMAM), Fifth Edition

https://www.skcinc.com/products/diesel-particulate-matter-dpm-cassettes-1

https://www.cdc.gov/niosh/nmam/default.html

Don’t forget about other exposures such as nitrogen dioxide.

https://mdec.ca/2015/S1P1_pollitt.pdf



https://www.ontario.ca/page/current-occupational-exposure-limits-ontario-workplaces-under-regulation-833

What is the Ontario Occupational Exposure Limit

		TWA 8-hr	Short Term Exposure Limit
Ontario Table	Nitrogen dioxide [10102-44-0]	3 ppm	5 ppm

The ACGIH’s TWA value for NO_2 of 0.2 ppm was set to ensure **sensitive individuals** were protected from adverse effects • The exposure limit was set based on short-term controlled NO_2exposures conducted with **asthmatics**

• Concern raised for adults surviving cardiac events.

An example of why occupational exposure limits are not fine dividing lines between safe and unsafe.

Dust particles

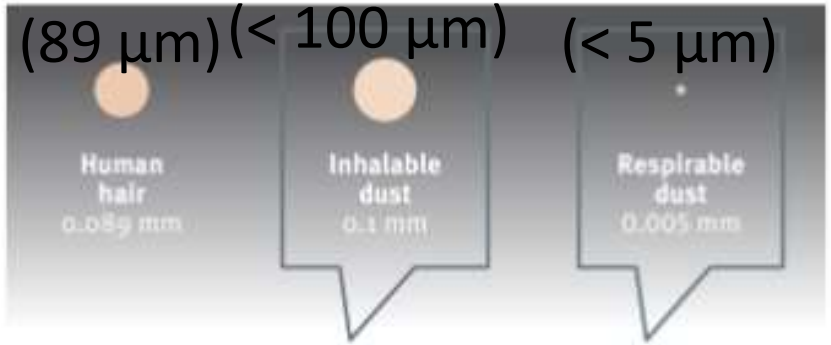
Dust is a word often used to describe fine, dry particles on the ground and in the air.

Dust particles fall into two categories, according to their size:

- *inhalable dust* (less than 0.1 mm or 100 µm diameter)
- *respirable dust* (less than 0.005 mm or 5 µm diameter).

To give you an idea of these sizes, the following diagram compares both types of dust with the diameter of a single human hair.

Dust particle size comparison



	Inhalable dust	Respirable dust
Size	Dust particles of all sizes (typically less than 0.1 mm diameter)	Smallest dust particles (typically less than 0.005 mm diameter)
Visibility	Can be seen with the naked eye	Cannot be seen with the naked eye

https://www.rshq.qld.gov.au/miners-health-matters/media/documents/airborne-dust-exposure.pdf

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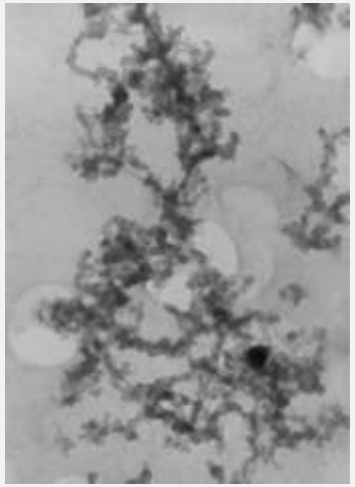
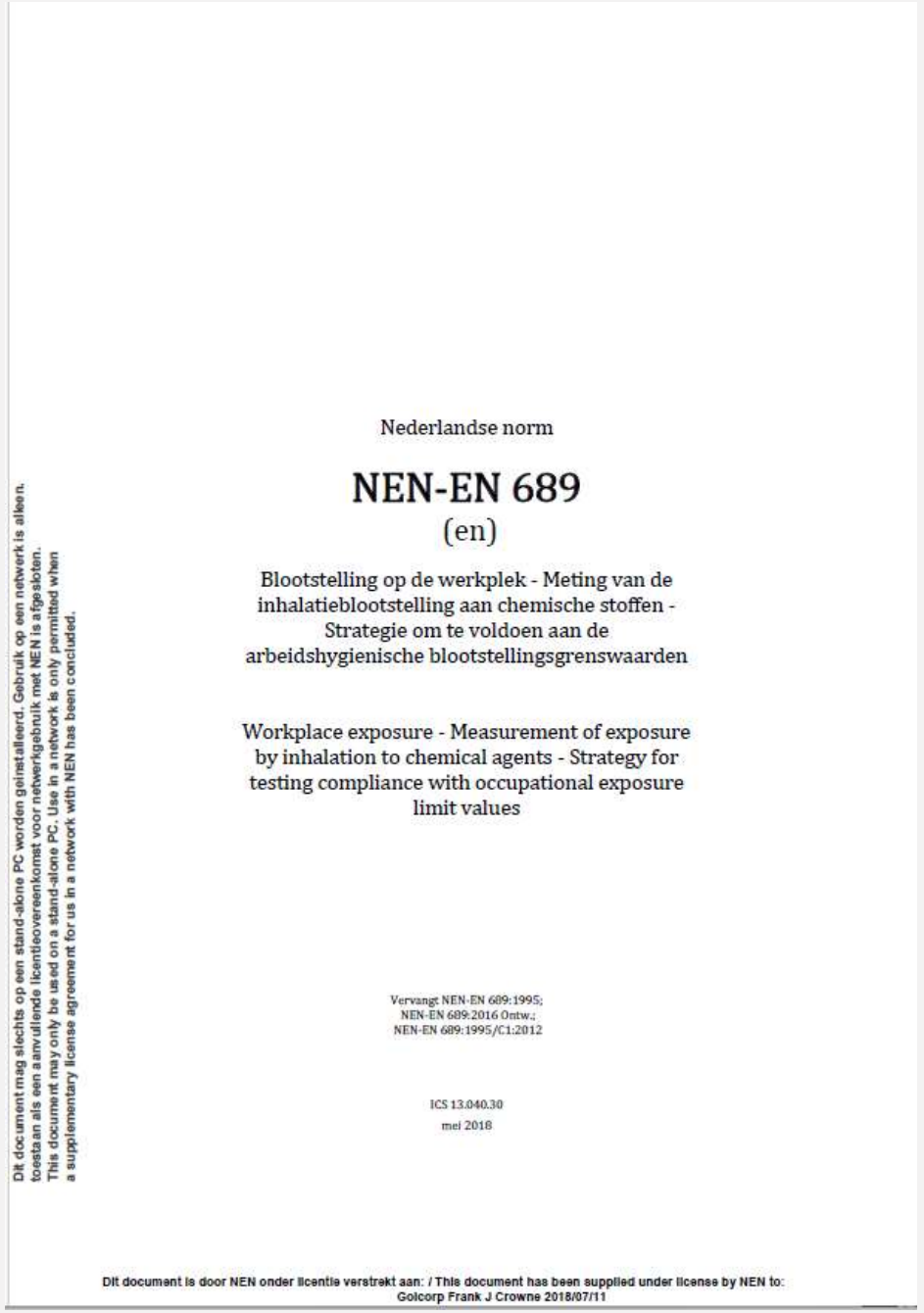
Workplace Safety North™

PM 2.5 (< 2.5 µm) typically associated with air pollution – an environmental measure
https://www.iqair.com/newsroom/pm2-5

PM 0.1 (< 0.1 µm or 100 nm) are also called nanoparticles / ultra fines



A useful resource



Nederlandse norm

NEN-EN 689

(en)

Blootstelling op de werkplek - Meting van de inhalatieblootstelling aan chemische stoffen - Strategie om te voldoen aan de arbeidshygienische blootstellingsgrenswaarden

Workplace exposure - Measurement of exposure by inhalation to chemical agents - Strategy for testing compliance with occupational exposure limit values

Vervangt NEN-EN 689:1995;
NEN-EN 689:2016 Ontw.;
NEN-EN 689:1995/C1:2012

ICS 13.040.30
mei 2018

A useful resource

EN 689:2018

Workplace exposure. Measurement of exposure by inhalation to chemical agents. Strategy for testing compliance with occupational exposure limit values

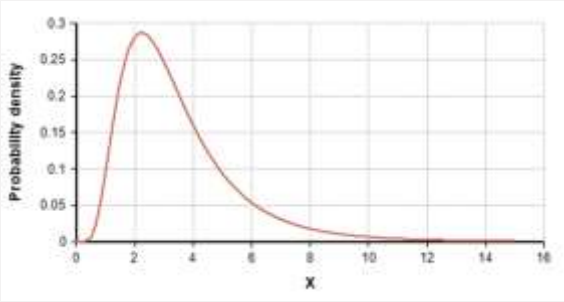
The strategy described gives a procedure to overcome the problem of variability and to use a relatively small number of measurements to demonstrate with a high degree of confidence that workers are unlikely to be exposed to concentrations exceeding the OELVs.

Errico et al. 2022.
Is the New EN689 a Better Standard to Test Compliance With Occupational Exposure Limits in the Workplace?

To reduce the number of exposure measurements, and therefore the cost of assessment, personal air samples are collected among workers within similar exposure groups (SEGs). A single measurement or even several measurements below the limit value can be insufficient to reliably demonstrate compliance without using a statistical test like the one proposed in this European Standard.

Ann Work Expo Health
. 2022 Mar 15;66(3):412-415. doi: 10.1093/annweh/wxab111

"The new EN-689 also takes into consideration simultaneous exposure to several chemicals, and workshift durations higher than 8 hours. The informative annexes give recommendations to determine for example: sampling duration, statistical distribution of exposure measurements results and treatment of representative results lower than the limit of quantification (LoQ)" (Raymond Y Vincent BMJ the new European standard on testing compliance with occupational exposure limit values).



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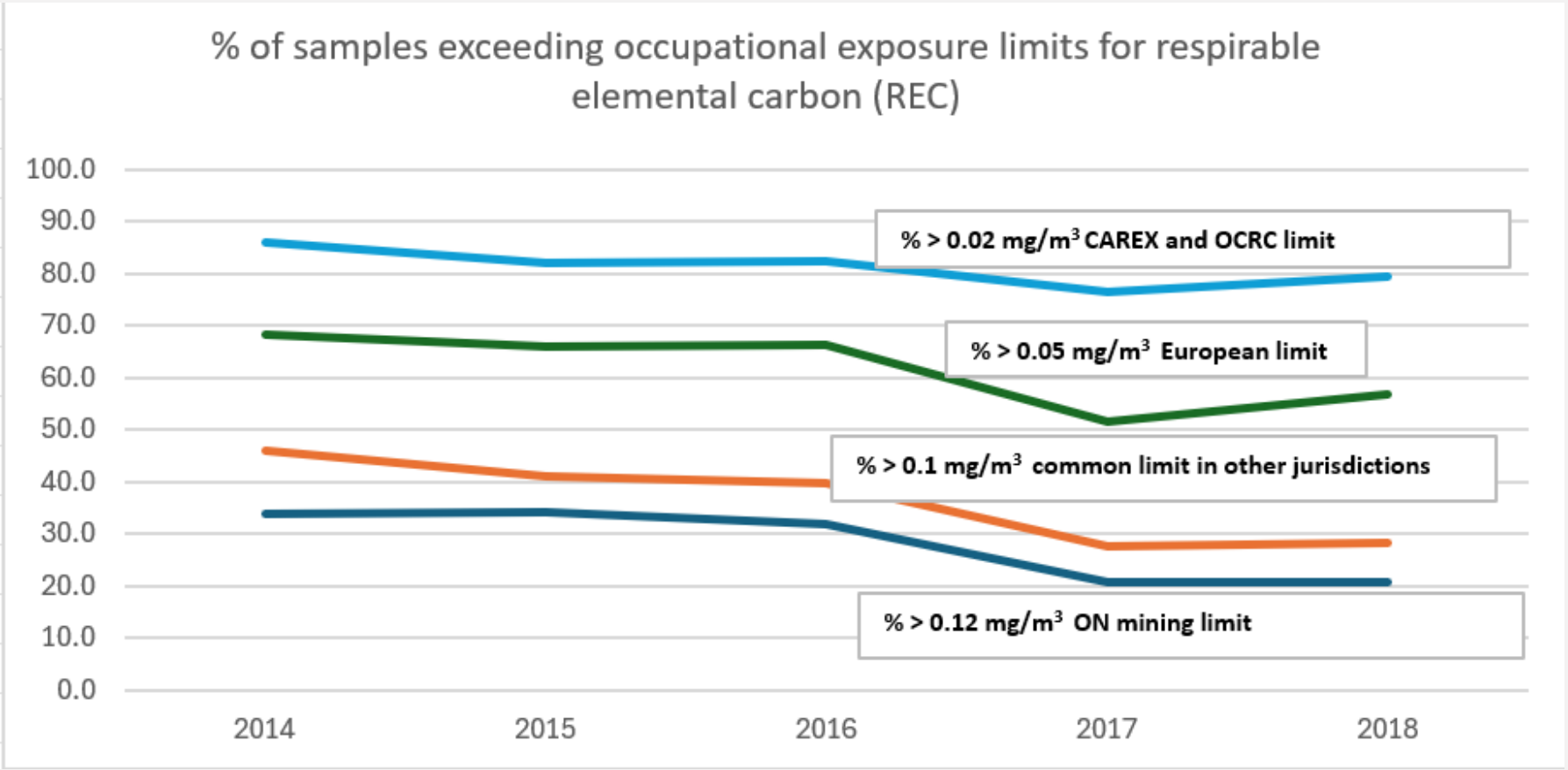
Diesel Engine Exhaust (DEE) as respirable elemental carbon (REC)



The Ontario Mining occupational esposure limit of 0.12 mg/m³ is

6 X

the Occupational Cancer Research Centre (OCRC) policy recommended limit of 0.02 mg/m³.

Exposure to - vapours, dusts, gases and fumes (VDGF) is also getting much more attention.

Refer to Arrandale et al. 2024 "Exposure to Vapours, Gases, Dusts, and Fumes at Work in Relation to Chronic Bronchitis, Emphysema, and Chronic Obstructive Pulmonary Disease: A Systematic Review With Meta-analyses".

The annual decrease in EC concentration was significant, suggesting approximately a 10% decrease per year. This is encouraging and may reflect the focus on reducing exposure to diesel engine exhaust in mining specifically.

However, many measurements were still above the current exposure limit for mining in Ontario which is set at 0.12mg/m^3 EC, and well above the health-based limit suggested by the Health Council of the Netherlands (0.00001mg/m^3) (Vermeulen & Portengen, 2016).

The Ontario mining occupational exposure limit is

12,000 X

higher than the Netherlands health based suggested limit.

Vermeulen, R., & Portengen, L. (2016). Is diesel equipment in the workplace safe or not? *Occupational and Environmental Medicine*, *73*(12), 846–848. https://doi.org/10.1136/oemed-2016-103977

OCC-TOBER 2022: Diesel Exhaust Exposure – Influencing Change

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CROSH CRRST
OHCOW
UWS

https://www.ohcow.on.ca/posts/occ-tober-worker-focused-science-prevention-webinars-kickoff-event-2/

See also the OHCOW submission to the ACGIH submitted 2023

Date Submitted March 31, 2023

Chemical Substance **Diesel Exhaust**
(8 pages + citable materials)

Name of Group/Individual Submitting Comments Occupational Health Clinics for Ontario Workers Inc. (OHCOW)
Authored by: Kevin Hedges, PhD, MAppSc, BSc, DipEd, COH, CIH
Reviewed by: Krista Thompson, MHSc, ROH, CRSP Occupational Hygienist; Kimberly O'Connell, M.Sc.(A), CIH, ROH, CRSP Executive Director

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Executive Summary *(limit 250 words)*

Elemental carbon (EC) is used as an indicator for diesel exhaust by most jurisdictions. The European Union has decided on an occupational exposure limit of 0.05 mg/m^3 EC, in effect from 2023, which is the same limit in Germany and Sweden. The Australian Institute of Occupational Hygiene recommends a limit of 0.1 mg/m^3 EC, though Cherrie 2019 noted that a limit of 0.1 mg/m^3 "would do little to reduce the predicted death toll from occupational exposure to diesel exhaust particulate."

Long et al (2022) studied controlled human exposure to diesel exhaust from traffic air pollution and reported findings including a controlled human experiment which included 40 volunteers, who had an acute exposure of PM2.5 at 25 µg/m^3 (0.025 mg/m^3). At this level, adverse effects on endothelial function, vascular walls, and heart rate variability even at 24 h post-exposure were reported. In addition, the study by Chen et al (2017), between 2001 and 2012, in Ontario, Canada, found an adjusted incident dementia hazard ratio (HR) of 1.07 for people living less than 50 m from a major traffic road (95% CI 1.06–1.08).

Based on shorter term acute exposures, we recommend a TLV®-TWA for EC of 10 µg/m^3 EC with (L) notation as an evidence-based limit for all workplaces.

As diesel exhaust is in the "under study" list, we provide the following recommendation: a TLV®-TWA of 60 pg/m^3 for 1-nitropyrene (1-NP) especially where EC is at relatively low levels of exposure / approaching the limit of quantitation using NIOSH 5040.

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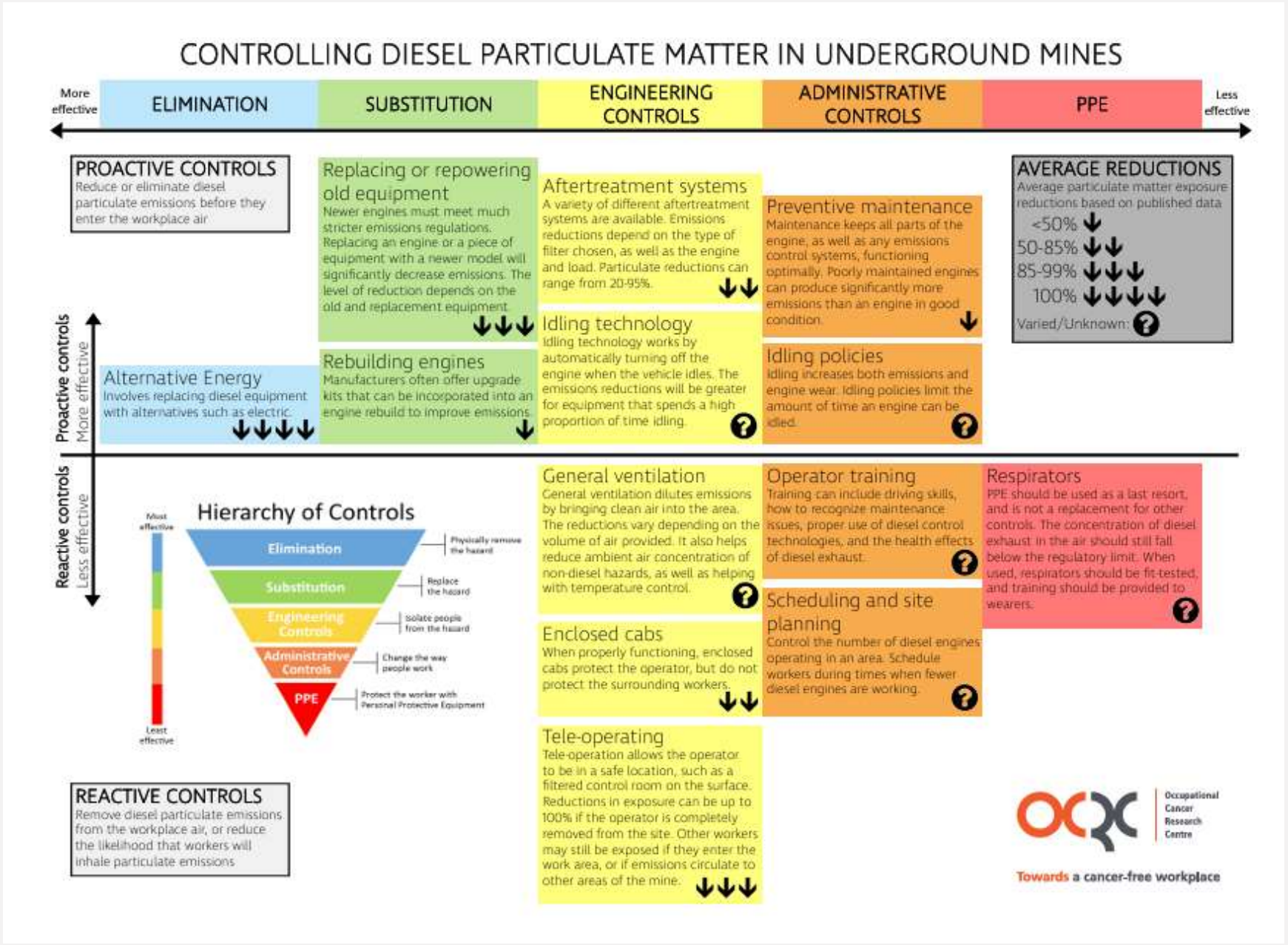
https://www.ohcow.on.ca/posts/submission-to-the-acgih-tlv-and-bei-committee/

WSN (2022)
Guideline for reducing diesel particulate matter in underground mines



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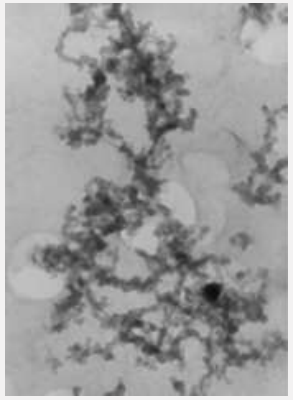
https://www.occupationalcancer.ca/wp-content/uploads/2023/04/Mining_Diesel-Particulate-Control-Strategies.pdf

Respirators

Full protection offered by filtering face piece **respirators** against diesel particulate matter, containing **ultrafine particles** (particle midpoint diameter <100nm) **is questionable.**

Burton K A (2023), PhD., thesis;
Do AS/NZS Respiratory Protection Standards for Filter Penetration Ensure that Worker Health is Protected Against Nanoparticle Sized Diesel Particulate Matter? https://ro.uow.edu.au/theses1/1563/

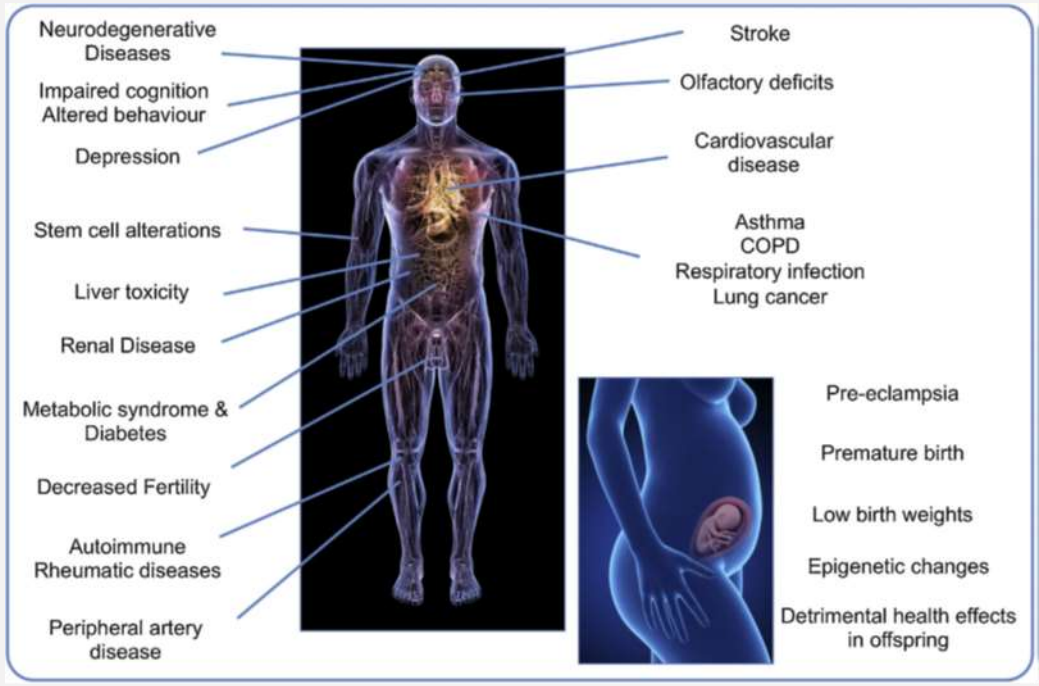
Even Respirators May Not Be Completely Effective



Jennifer B. Raftis, Mark R. Miller (2019)
University/BHF Centre for Cardiovascular Science, University of Edinburgh, Edinburgh, United Kingdom

Nano Today, Vol. 26, pp.8 – 12

Nanoparticle translocation and multi-organ toxicity: A particularly small problem



Recent research

Diesel Exhaust in Miners Study updated literature

The Diesel Exhaust in Miners Study (DEMS) II: Temporal Factors Related to Diesel Exhaust Exposure and Lung Cancer Mortality in the Nested Case–Control Study (August, 2023)
https://ehp.niehs.nih.gov/doi/10.1289/EHP11980

Diesel Exhaust Exposure and Cause-Specific Mortality in the Diesel Exhaust in Miners Study II (DEMS II) Cohort (August 2023)
https://ehp.niehs.nih.gov/doi/full/10.1289/EHP12840

Invited Perspective: Diesel Exhaust and Lung Cancer—Delayed Findings Confirmed, but Consequences Continue (August 2023)
https://ehp.niehs.nih.gov/doi/full/10.1289/EHP13258

ehp Environmental Health Perspectives

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Vol. 131, No. 8 | Research

The Diesel Exhaust in Miners Study (DEMS) II: Temporal Factors Related to Diesel Exhaust Exposure and Lung Cancer Mortality in the Nested Case–Control Study

is companion of

Debra T. Silverman, Bryan A. Bassig, Jay Lubin, Barry Graubard, Aaron Blair, Roel Vermeulen, Michael Attfield, Nathan Appel, Nathaniel Rothman, Patricia Stewart, and Stella Koutros

Published: 7 August 2023 | CID: 087002 | https://doi.org/10.1289/EHP11980 | Cited by: 2

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Vol. 131, No. 8 | Research

Diesel Exhaust Exposure and Cause-Specific Mortality in the Diesel Exhaust in Miners Study II (DEMS II) Cohort

is companion of

Stella Koutros, Barry Graubard, Bryan A. Bassig, Roel Vermeulen, Nathan Appel, Marianne Hyer, Patricia A. Stewart, and Debra T. Silverman

Published: 7 August 2023 | CID: 087003 | https://doi.org/10.1289/EHP12840 | Cited by: 1

Cumulative REC

Tripling of risk for exposures of about 950 to less than 1700 micrograms per meter cubed per year~950 to<1,700 µg/m3-y (equivalent to an exposure of 0.05mg/m^3 to < 0.08 mg/m^3. for a period of 20 years).

[odds ratio equals 3.23 OR=3.23; 95% confidence interval (CI): 1.47, 7.10]

Also observed a significant trend in non-Hodgkin lymphoma (NHL) risk with increasing 20-y lagged cumulative REC.

Excesses in deaths for diseases of the respiratory and cardiovascular system, including ischemic heart disease and cerebrovascular disease, warrant further study and provide evidence of the potential widespread public health impact of diesel exposure.

DIESEL EXHAUST LUNG CANCER RELATIVE RISK CALCULATOR

[15 Year Lag]

A calculator designed to assist you in determining your risk of developing lung cancer from exposure to diesel fumes.

The International Agency for Research on Cancer (IARC) has concluded that Diesel Engine Exhaust (DEE) is a cause of lung cancer (Group 1: carcinogenic to humans). CAREX Canada estimates that approximately 897,000 Canadians are currently exposed to diesel engine exhaust at work. Approximately 2.4% (OCRC) to 6% (Vermeulen et al 2014) of annual lung cancer deaths may be due to DEE exposure.

Combined data from three U.S. occupational cohort studies including more than 40,000 workers in the trucking and mining industries (Vermeulen et al 2014) have provided a powerful estimate of the risk of lung cancer based on the level and duration of exposure to DEE. The truckers' study Garshick et al. (2012) and miners' studies Silverman et al. (2012), (Attfield et al. 2012), (Stewart et al. 2010) combined, allows for a determination of the risk of lung cancer based on the level of exposure to diesel particulate matter (DPM). DPM measured as elemental carbon (EC) is the best surrogate of exposure.

The following calculator, created by OHCOW, can be used as a guide to communicate the risk from DEE exposure and lead to prevention.

The tool requires either an ***estimate*** of exposure, as **EC** (NIOSH 5040) and duration of exposure.
Where the only measures available are total carbon (NIOSH 5040) or Respirable Combustible Dust (RCD) conversion factors have been provided.

The Calculator

You can use this calculator in **two** ways:

1. Let the calculator automatically enter data by selecting an occupation and entering your exposure period.
2. If you have actual readings, you can leave the occupation blank and enter the data manually.

Occupation

Exposure Period

20 Years

Average Respirable Elemental Carbon (REC) Exposure

100 in µg/m³

CONVERSION FACTORS for MINERS

CALCULATE

CLEAR

https://www.ohcow.on.ca/resources/apps-tools-calculators/diesel-exhaust-relative-risk-calculator/

In addition, as respirable crystalline silica (RCS) and diesel particulate matter (DPM) are both confirmed lung carcinogens a mixture formula should apply.

$$\frac{\text{Exposure to DPM}}{\text{(OEL)}} + \frac{\text{Exposure to RCS}}{\text{(OEL)}} \quad \text{Must be} < 1$$

If > 1 *"the occupational exposure limit of the mixture should be considered as exceeded"* (ACGIH Threshold Limit Values)

In addition, for extended shifts either daily and / or weekly the occupational exposure limit may require adjustment.

https://www.aioh.org.au/media/2021/05/dev-of-tool-for-adjustment-of-wes-for-contaminants-due-to-extended-work-shifts-firt.pdf

Current occupational exposure limits for Ontario workplaces under Regulation 833

Read this page to learn about current exposure limits to specific biological or chemical substances for workers in Ontario.

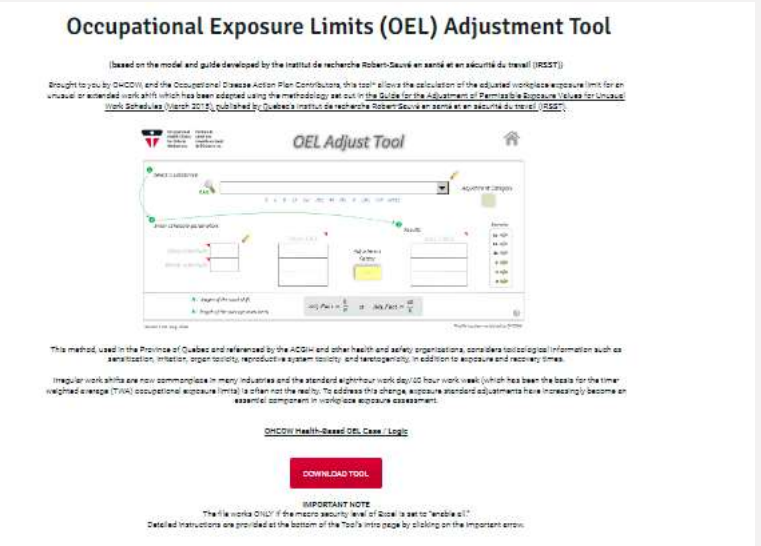
On this page

Resources

OEL adjustment tool for irregular work shifts (“Quebec model”)
Use this tool to calculate the adjusted workplace exposure limit for an unusual or extended work shift.

Code for medical surveillance for designated substances
Learn how physicians should conduct surveillance programs of designated substances.

Determining occupational exposure limits for certain refined hydrocarbon solvent vapour mixtures
Learn about the recommended method for determining occupational exposure limits for certain refined hydrocarbon solvent vapour mixtures like petroleum ether, rubber solvent and VM&P Naphtha.



https://www.ohcow.on.ca/resources/apps-tools-calculators/oel-adjust-tool/

If you need more information, please contact me

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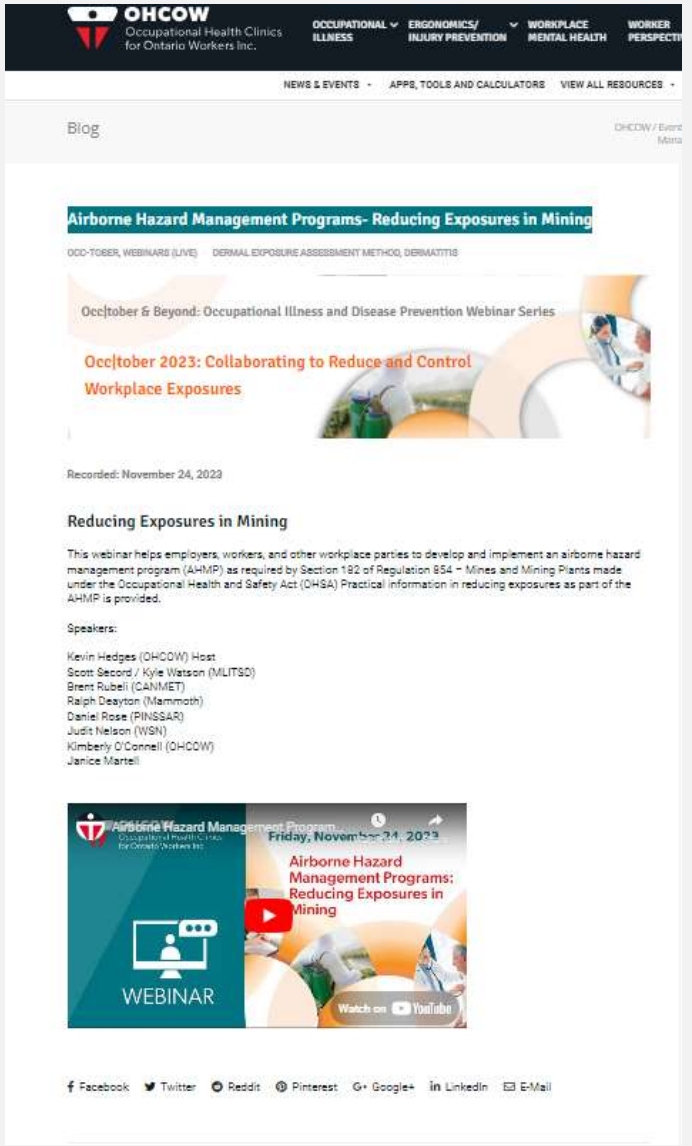
See also:



https://www.ohcow.on.ca/posts/airborne-hazard-management-programs-reducing-exposures-in-mining/