

Welcome to Mammoth Equipment and Exhausts

The Underground Emissions Balancing Act: Ventilation, DPFs and NO₂

Presented by
Ralph Deayton

Today's agenda

- 01** Ventilation essentials and evolution
- 02** Canmet C15 testing
- 03** NO₂, light-duty vehicles and DPFs
- 04** Understanding your fleet's emissions

This presentation examines how retrofit diesel particulate filters can change the emissions profile and ventilation requirements of Tier 2 and Tier 3 engines, particularly when the original CANMET certification did not include aftertreatment. It will also explore the tradeoff between using NO₂ to support passive DPF regeneration and controlling worker exposure to this harmful pollutant.

More Engines = More Emissions

More Emissions = More Ventilation Requirements

More Ventilation Requirements = Less Equipment in the Area

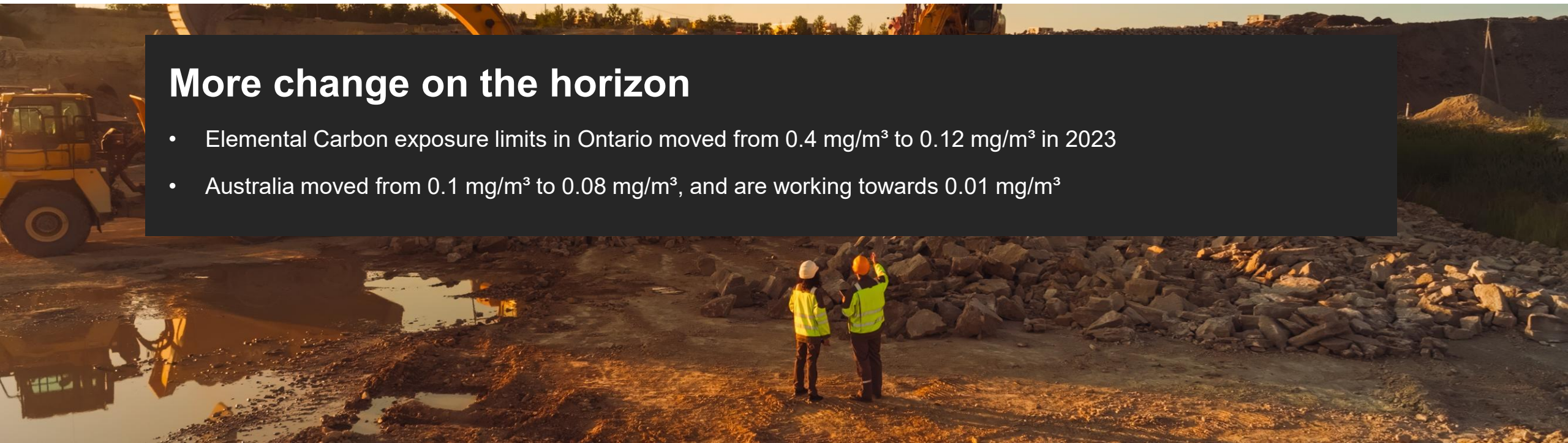


MOL Reg 854 – Sep 2023

- The traditional 100 CFM/hp rule was industry-standard from 2012-2023
- Engines have gotten cleaner since, but the most recent update was 2023 (almost 5 years ago)
- NEW Canmet certifications are lower than the traditional rule, but it's an engine-only certification, meaning aftertreatment systems and their emissions benefits were not taken into consideration.

More change on the horizon

- Elemental Carbon exposure limits in Ontario moved from 0.4 mg/m³ to 0.12 mg/m³ in 2023
- Australia moved from 0.1 mg/m³ to 0.08 mg/m³, and are working towards 0.01 mg/m³



The evolution of ventilation

- Previously, Canmet certifications have been for engines only and there has not been any certifications of engines with retrofit exhaust aftertreatment packages
- The new Reg 854 made provision for sites to determine their own airflow vent rate, however it wasn't straight forward and put a lot of responsibility back on the site

Machine	Horsepower	Traditional Rule	Canmet Update	Option 3
CAT AD30 (C15) - Tier 2	409 hp	40,900 CFM	20,700 CFM	?
CAT AD30 (C15) – Tier 3	409 hp	40,900 CFM	36,500 CFM	?

Canmet C15 Testing



Canmet C15 Testing

- Prior to testing, there was nothing reputable to confirm adding a DPF doesn't negatively impact another component in the engine/emissions system.
- **Mammoth is one of the first aftermarket vendors to get DPF certified.**

Engine Manufacturer: Caterpillar

Homologation requested by: Mammoth Equipment

Engine Model: CAT C15 T2 (AD30) PN# 319-7503, Arrg# 377-5438

Required accessories: Mammoth DPF PN# DPF84079, with ultra-low sulphur fuel (15ppm)

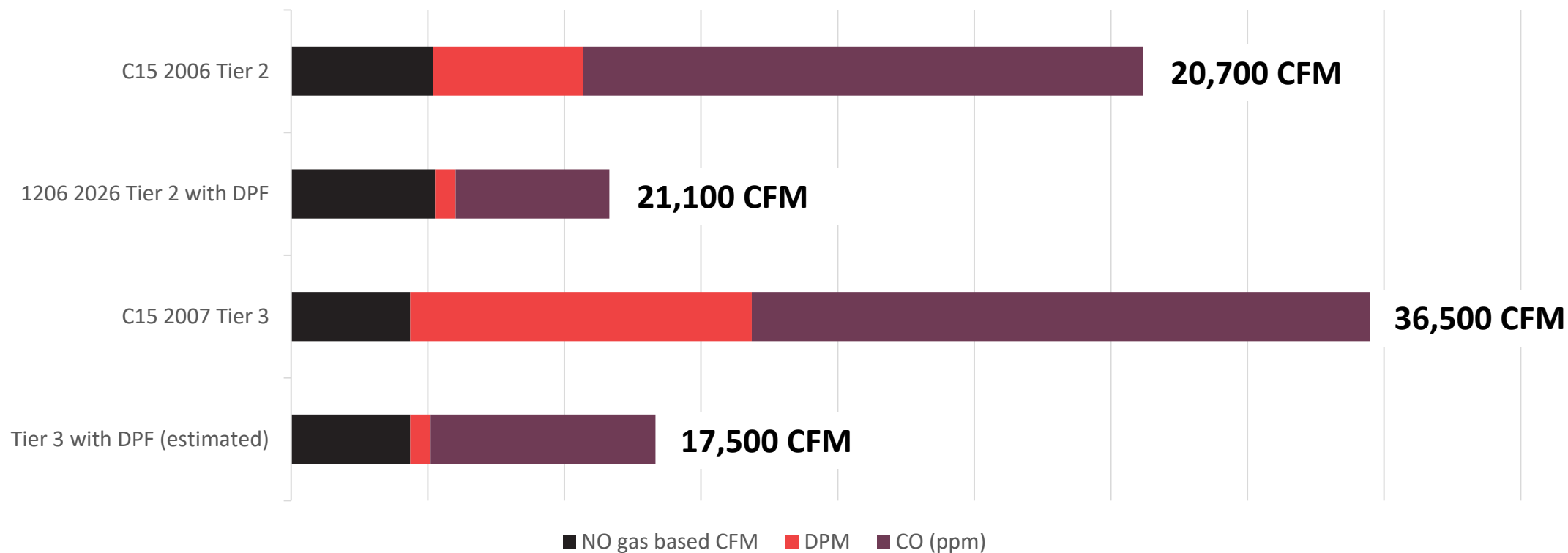
Governing Standard: CSA M424.2-M90 (Non-Gassy Mines)

Certificate Number	Engine Rating and Fuel Rate at Sea Level	Fuel Sulphur Fuel - ppm	Ventilation Prescription	
			CFM	m3/s
1367	409 HP (305 kW) @ 1800 RPM, 150.8 lb/h	15	21,100	9.96

Tier 2 vs Tier 3

With Canmet testing, the engines are run through multiple different load points and sampled for the worst-case scenario. The goal is to find what volume of airflow is required to dilute this worst case.

- Tier 2 worst case is determined by NO gas
- Tier 3 worst case is determined by CO and DPM





NO₂, light-duty vehicles and DPFs

- NO₂ is the necessary ingredient that causes DPFs to regenerate at lower temperatures
- Light-duty vehicles don't get hot enough passive DPF regeneration
- The temptation is to load the DOC coating, creating more NO₂ for passive regeneration

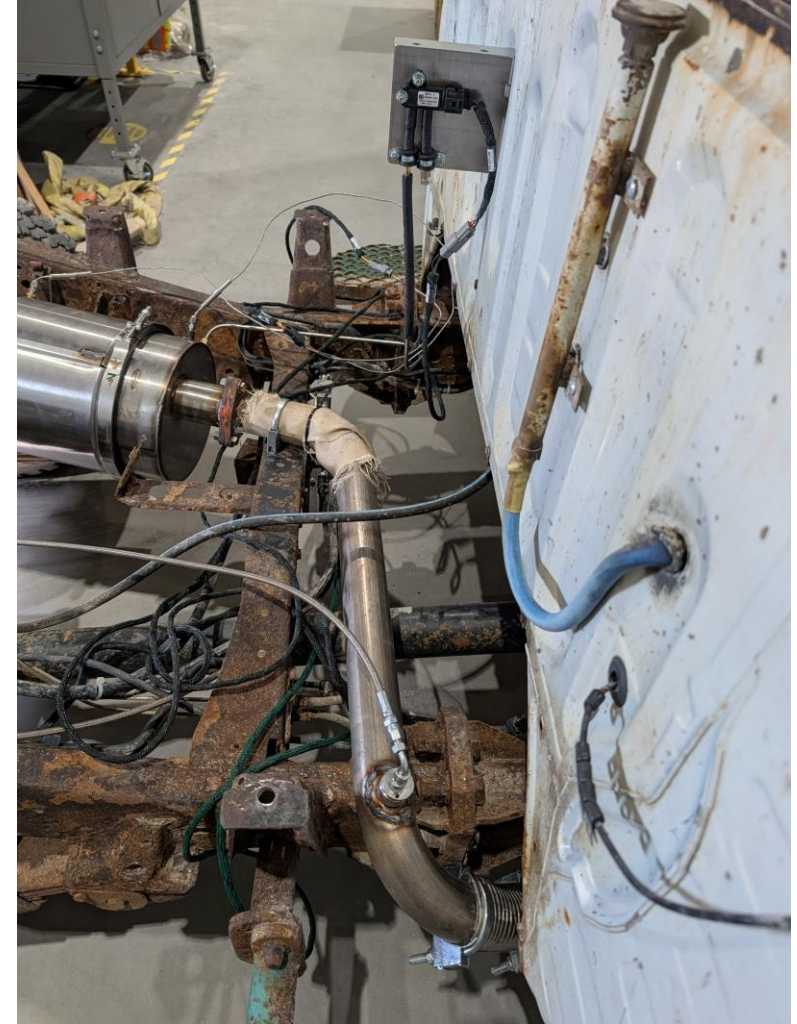
- The 2023 update to MOL Reg 854 set a new tailpipe maximum – 60ppm
- NO₂ is an aggressive oxidizer
- Too much exposure to NO₂ causes lung irritation, respiratory infections



Emissions solutions for light-duty vehicles

What we're working on:

- Active DPF system – utilize a moderately coated DOC to boost temperatures through fuel dosing
- Highly coated DOC with a retrofit SCR system to reduce NO_x emissions



Understanding your emissions data is critical.

Underground mine ventilation protects workers by diluting diesel exhaust, but it can also restrict equipment use and production. The “Underground Emissions Balancing Act” is being able to interpret test data, identify abnormal equipment performance, and make better-informed decisions about ventilation rates and aftertreatment strategies.



What will your emissions test numbers tell you?

DPM-RT-2 results | Concentrations in mg/m³

Type	Vehicle	Asset #	Engine	Test Avg.	Test Max.	Comments
Stall Test	Atlas Copco MT42	TRK-17	Cummins QSX15	39.42	161.94	DPM emissions 2-3x other machines with the same engine in fleet – combustion factors should be evaluated.
Stall Test	Atlas Copco MT42	TRK-12	Cummins QSX15	23.20	80.10	Average running engine – no DPF fitted
Stall Test	Atlas Copco MT42	TRK-11	Cummins QSX15	20.41	82.32	Average running engine – no DPF fitted
Stall Test	Cat AD30	TRK-0018	CAT C15	17.70	70.79	Average running engine – no DPF fitted
Stall Test	Atlas Copco MT42	TRK-25	Cummins QSX15	8.34	124.79	Average running engine – no DPF fitted
Stall Test	Cat AD30	TRK-0024	CAT C15	2.10	10.58	Lower than expected DPM levels for a machine without a DPF – higher than typical with a DPF – expected that the DPF might be damaged/cracked.
Stall Test	Cat AD30 (fuel truck)	FLT-0002	CAT C15 ACERT	0.00	0.00	Typical results from an engine with a wall flow DPF fitted.
Stall Test	Cat AD30	TRK-0008	CAT C15	0.00	0.00	Typical results from an engine with a wall flow DPF fitted.



Let's get started!



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