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Welcome to

Mammoth Equipment and Exhausts

The Underground Emissions Balancing Act: Ventilation, DPFs and NO_2

Presented by

Ralph Deayton

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Today's agenda

01 Ventilation essentials and evolution

02 Canmet C15 testing

03 NO_2, 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 NO_2 to support passive DPF regeneration and controlling worker exposure to this harmful pollutant.

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More Engines = More Emissions

More Emissions = More Ventilation Requirements

More Ventilation Requirements = Less Equipment in the Area

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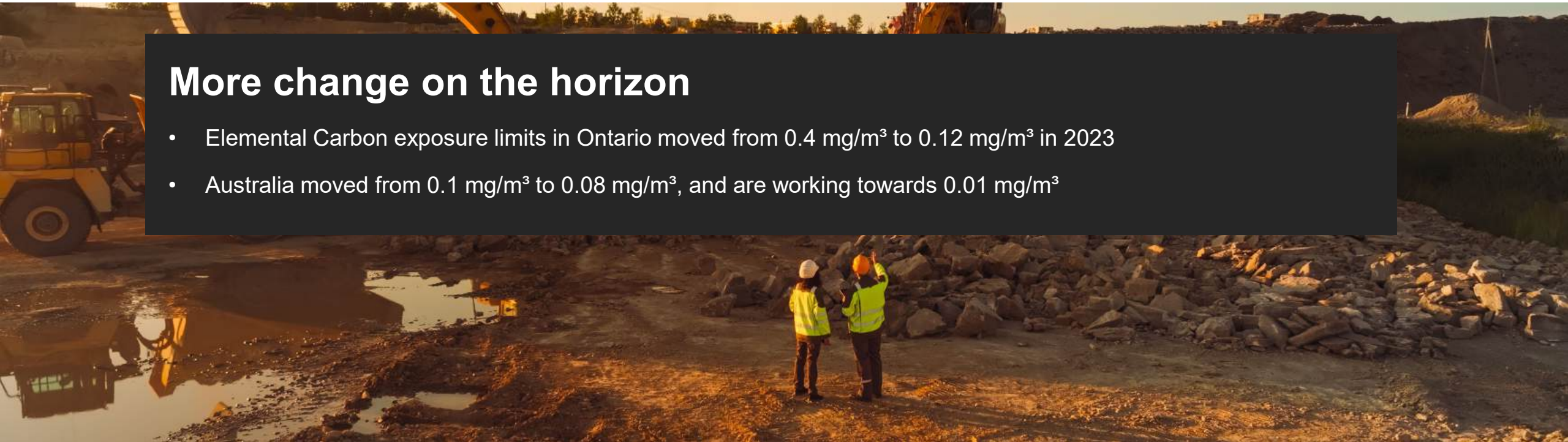
MOL Reg 854 – Sep 2023

- 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	?

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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

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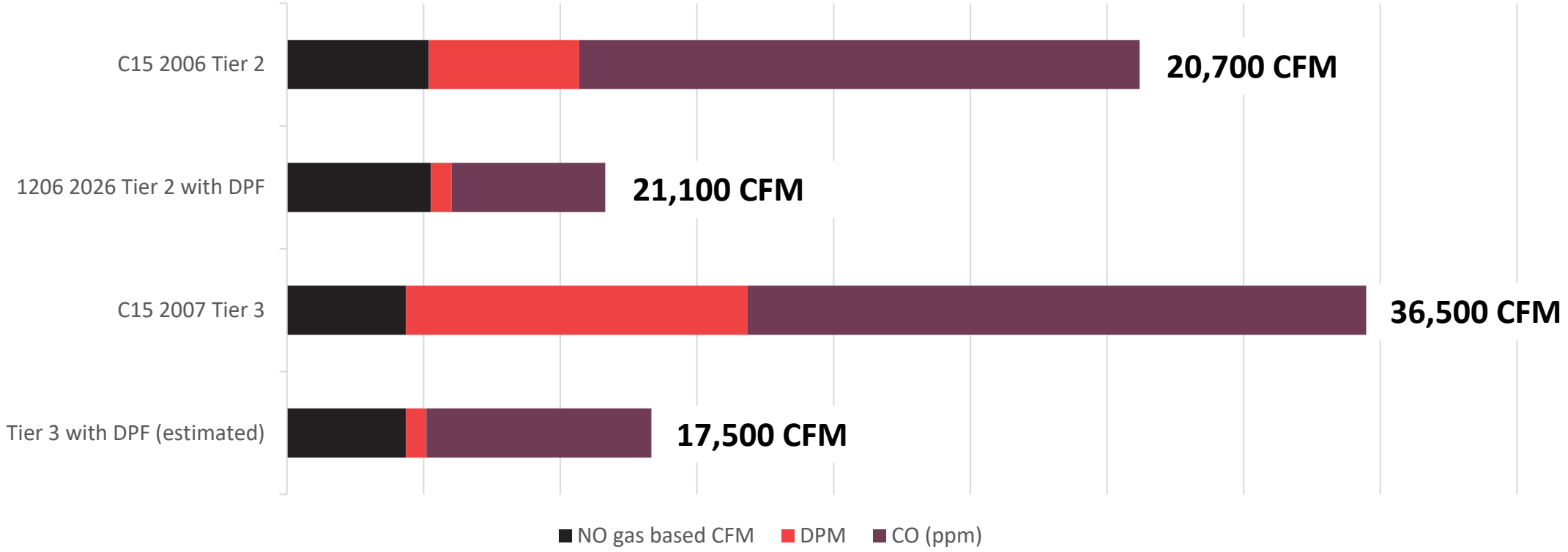
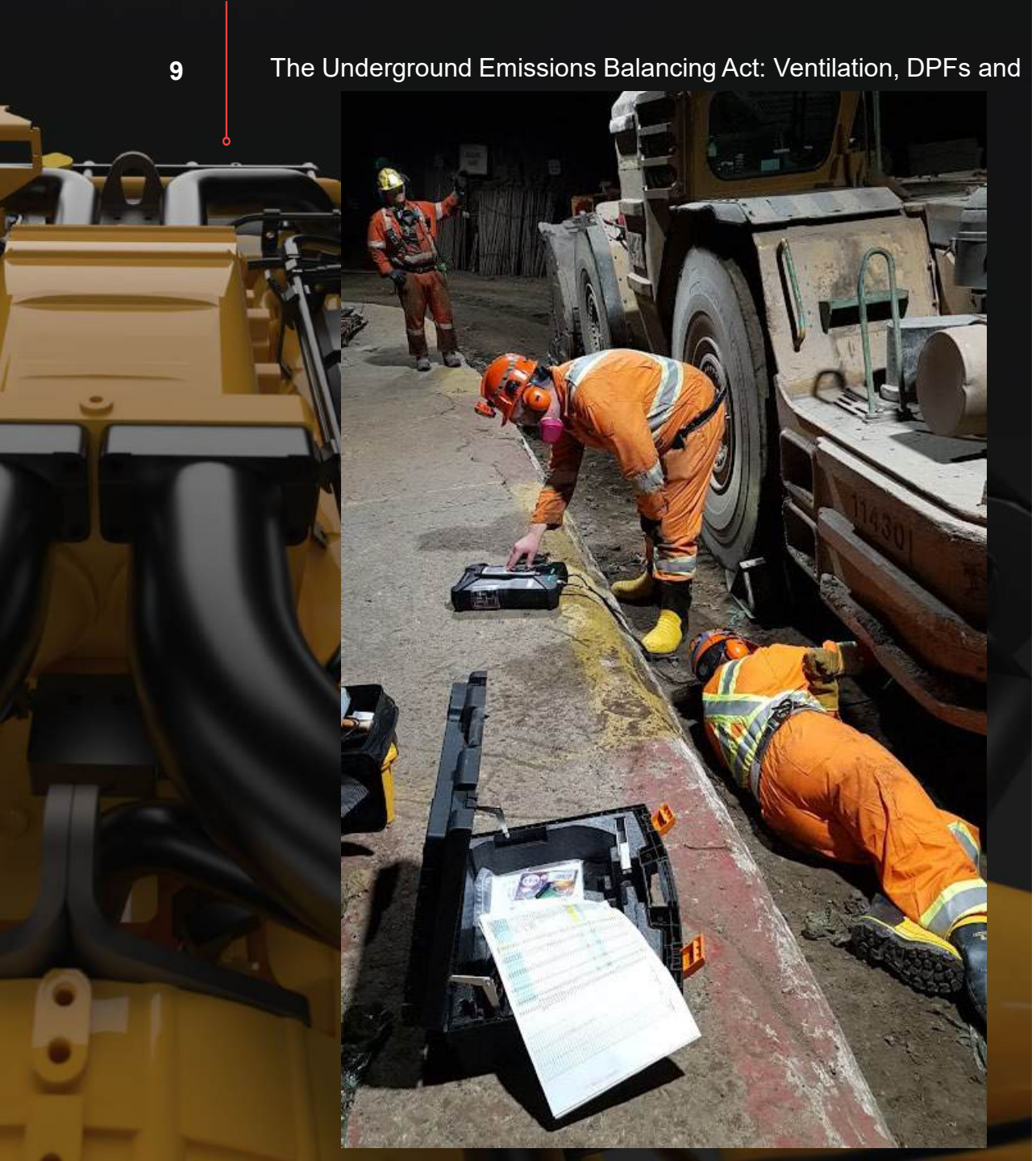
Tier 2 vs Tier 3

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





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NO_2, light-duty vehicles and DPFs

- NO_2 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 NO_2 for passive regeneration

- The 2023 update to MOL Reg 854 set a new tailpipe maximum – 60ppm
- NO_2 is an aggressive oxidizer
- Too much exposure to NO_2 causes lung irritation, respiratory infections

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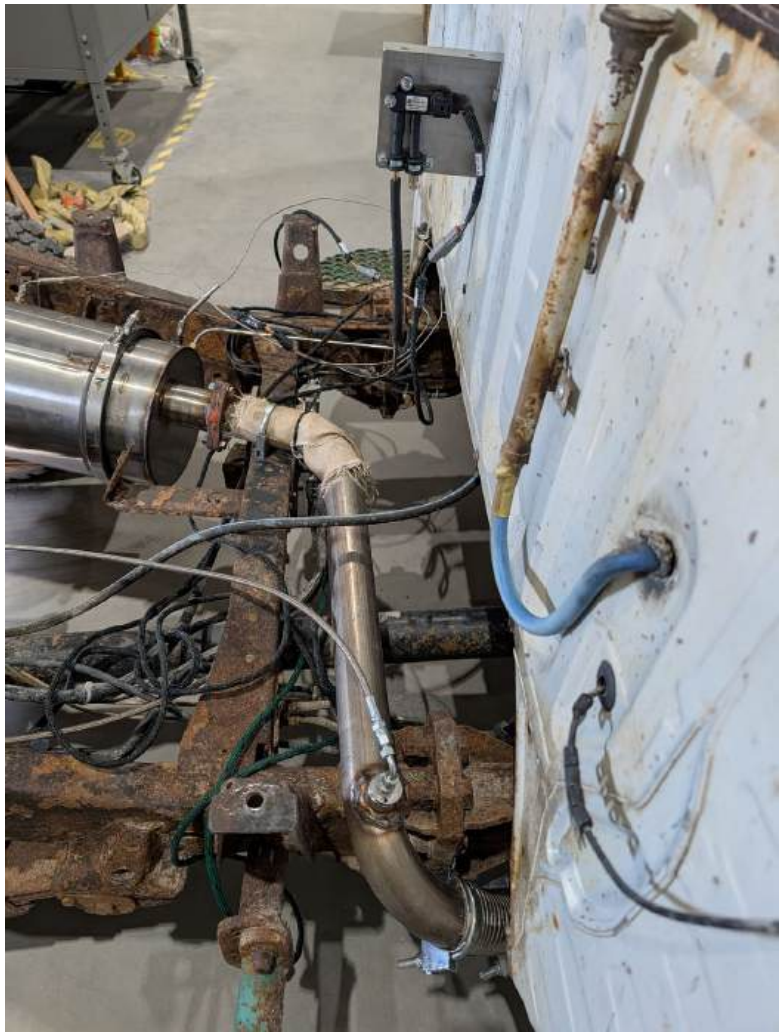
Emissions solutions for light-duty vehicles

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 NOx emissions



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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.**

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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.

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Let’s get started!

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