



NATURAL RESOURCES CANADA - INVENTIVE BY NATURE

Diesel Certification and Approval for Underground Mining Engines in Canada

Brent Rubeli and David Young
CanmetMINING


MDEC 2020




2

Introduction

- Ten out of eleven provincial/territorial jurisdictions in Canada refer to certification testing and approval of diesel engines and equipment intended for underground mining operations.
- Most often this is the CSA M424 family of standards.
 - M424.1-16 - Flameproof non-rail-bound diesel-powered machines for use in gassy underground coal mines.
 - M424.2-16 - Non-rail-bound diesel-powered machines for use in non-gassy underground mines.
 - CAN/CSA-M424.3-M90 (R2016) - Braking Performance - Rubber-Tired, Self-Propelled Underground Mining Machines.

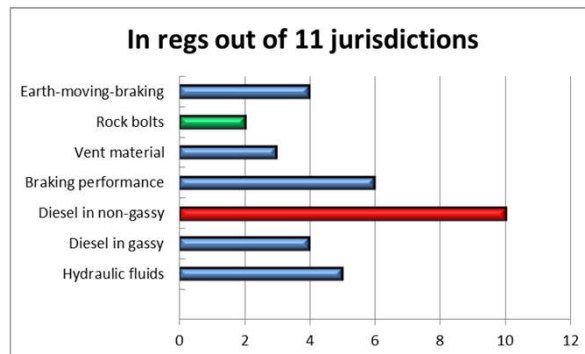


CSA Group
Groupe CSA



Introduction

- These three CSA diesel equipment standards are frequently cited in provincial regulation.
- Compliance testing is performed by the manufacturer except for engine emissions testing and ventilation rate calculation which is performed by CanmetMINING.



Natural Resources Canada / Ressources naturelles Canada



Approval Process

- Engine manufacturer submits an application to CanmetMINING along with a sample engine and all aftertreatment system components.
- CanmetMINING performs the certification test according to the CSA standard. If the engine passes, a ventilation rate prescription is calculated and published on the website.

Engine Manufacturer: **Kubota**
 Engine Model: **V3800-TIEF4ZA6, V3800-TIEF4Z, V3800-TIEF4ZA**
 Governing Standard: **CSA M424.2-16 (Non-Gassy Mines)**

Certificate Number	Engine Rating and Fuel Rate at Sea Level	Sulphur in Fuel - ppm	Ventilation Prescription	
			CFM	m ³ /s
1305	V3800-TIEF4ZA6 105 HP (78 kW) @ 2400 RPM, 38.4 lb/h	15	4100	1.93
	V3800-TIEF4Z 109 HP (81kW) @ 2600 RPM, 40.8 lb/h		4200	1.98
	V3800-TIEF4ZA 113 HP (84kW) @ 2600 RPM, 42.8 lb/h		4200	1.98



Natural Resources Canada / Ressources naturelles Canada



Emissions Testing Process

- Confirmation of engine power and fuel rate as per manufacturer specification
- Setting of engine intake vacuum and back-pressure as per engine specification
- Quick measurement of CO and NOx within engine operating range to determine Pass/Fail condition
- Steady state testing at 18 or more mode points, including ISO 8178-C1 8 modes
- Measure engine parameters, CO, CO2, NO, NO2, O2, DPM
- Calculate SO2, EQI, and ventilation rate at all mode points
- The highest calculated ventilation rate is the minimum vent rate for the engine approval

$$EQI = \frac{CO}{50} + \frac{NO}{25} + \frac{DPM}{2} + 1.5 \times \left\{ \frac{SO_2}{3} + \frac{DPM}{2} \right\} + 1.2 \times \left\{ \frac{NO_2}{3} + \frac{DPM}{2} \right\}$$



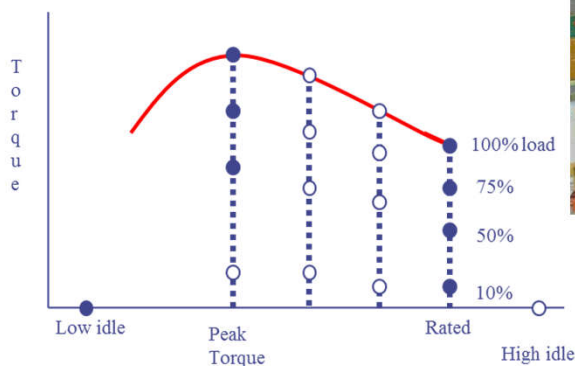
Natural Resources
Canada

Ressources naturelles
Canada

Canada

CSA Test Modes

- Based on ISO8178 with additional modes.
- Special tests for aftertreatment.



Natural Resources
Canada

Ressources naturelles
Canada

Canada

Engine Approval

- Approval letter to engine manufacturer.
- Certificate number.
- Ventilation rate appears on website.
- Conditions such as aftertreatment.
- Manufacturer may apply labels for importation.

- English version: <http://www.diesel.NRCan.gc.ca>
- French version: <http://www.diesel.RNCan.gc.ca>

- CSA (Canada) and MSHA (USA) testing can be performed concurrently at CanmetMINING.

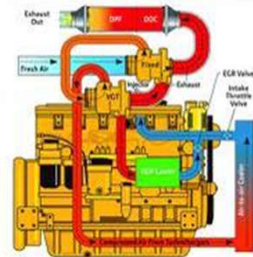
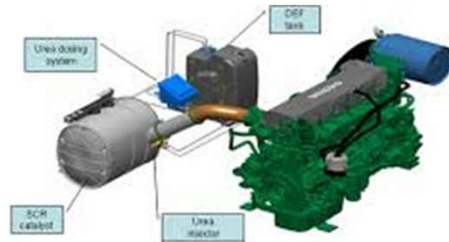
Air Quality vs Quantity

- The CSA standard is an air quality standard.
- Cleaner engines and emissions control technologies drive lower ventilation rates.
- Incentivises adoption of clean diesel technologies and drives competition for clean engines.

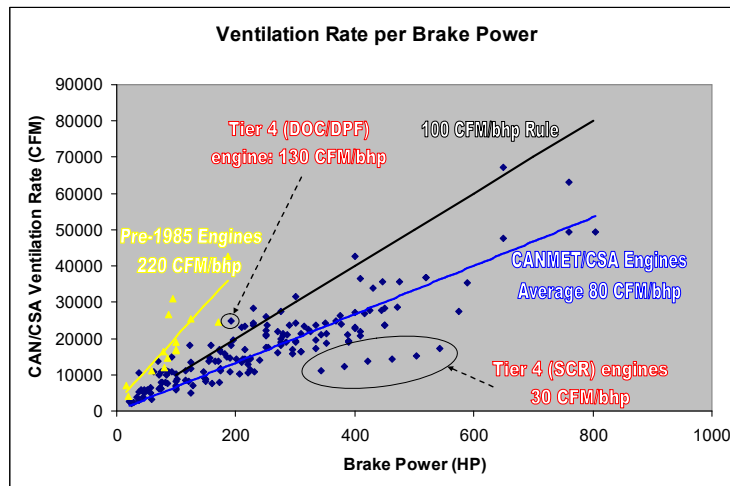


Emissions Technologies

- CSA standard looks at NO and NO₂ separately where surface regulations look at NO_x only.
- This can affect the choice of the most suitable technologies for underground use.
- The CSA standard identifies unsuitable technologies with high ventilation rates.

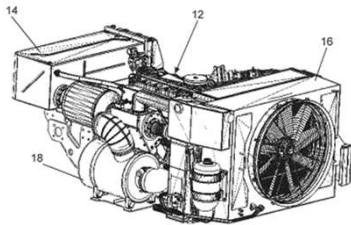


Approved Engines Review



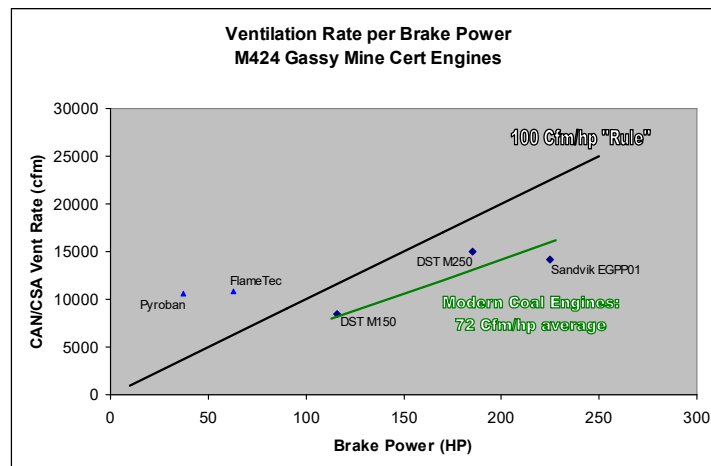
Coal and Gassy Mines

- There are now 5 packages certified under M424.1.
 - Sandvik EGPP01 / Cat 3126B (225hp / 63 cfm/hp)
 - DST M150 / Isuzu 6BG1 (116hp / 73 cfm/hp)
 - DST M250 / Cummins CTAA8.3C (185hp / 81cfm/hp)
 - Pyroban 802507/5 Lister Petter LPWS4 (37hp / 286 cfm/hp)
 - FlameTec 7200085 Lister Petter DWS4 (63hp / 171 cfm/hp)



Modern Coal Engines

- Equipped with DPF emissions control.



Witnessed Certification Tests

- CSA/MSHA tests can be witnessed at an approved facility for the manufacturer's convenience.
- Facility must undergo equipment and calibration record review.
- Data analysis, calculation of ventilation rate, and issuance of approval letter is performed by CanmetMINING.



Diesel Research at CanmetMINING

- This year CanmetMINING has conducted research projects on biodiesel for the OMA and emissions control technology for CanmetENERGY and Vale.



CSA Standards & CanmetMINING

- CanmetMINING works continuously with the CSA to review the current standards.
- CanmetMINING conducts research programs in support of future standards development.
- The CSA standards are specific to underground mining.
 - Quality-based ventilation.
 - Technology evaluation.
- Supported by review at the Chief Inspector's meetings.
- Supported by collaboration at the Mining Diesel Emissions Conference (MDEC).
- Supported by laboratory research and field studies.

Questions?