

The cover slide features a collage of images at the top: a snowy forest, a modern building, an offshore oil rig, a satellite dish, and a large industrial facility. Below the collage is the text 'NATURAL RESOURCES CANADA - INVENTIVE BY NATURE'. The main title is 'Summary of Worldwide Underground Mine Diesel Regulations' in a large, bold, black font. Below the title is the author's name 'Mahe Gangal' and his title 'Emeritus Scientist, CanmetMINING'. The event information is listed as '25th MDEC Conference', 'Toronto, Ontario, Canada', and 'October 8-10, 2019'. The background of the slide is a landscape with mountains and a body of water. At the bottom left is the code 'CMIN-2020-048-PP'. At the bottom right is the 'Canada' logo.

NATURAL RESOURCES CANADA - INVENTIVE BY NATURE

Summary of Worldwide Underground Mine Diesel Regulations

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25th MDEC Conference
Toronto, Ontario, Canada
October 8-10, 2019

CMIN-2020-048-PP

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The contents slide has a green header bar with the number '2' in the top right corner. The title 'Contents' is centered in a large, bold, black font. Below the title is a list of topics with square bullet points. The first main topic is 'Regulations', which includes sub-topics: 'Diesel Engine Approval', 'Ventilation Requirement', 'Diesel Fuel', 'TWA DPM Exposure', 'TWA Gaseous Exposure', and 'Raw Diesel Exhaust'. The second main topic is 'Countries', which includes sub-topics: 'Canada, USA, EU, Germany, Australia, Switzerland, South Africa, Chile and China'. At the bottom left is the 'Canada' logo. At the bottom right is the 'Canada' logo.

Contents

- Regulations
 - Diesel Engine Approval
 - Ventilation Requirement
 - Diesel Fuel
 - TWA DPM Exposure
 - TWA Gaseous Exposure
 - Raw Diesel Exhaust
- Countries
 - Canada, USA, EU, Germany, Australia, Switzerland, South Africa, Chile and China

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Introduction

- Dr. Rudolph patented his first diesel engine in 1892
- Diesel equipment is used for safety, reliability and high production
- Diesel exhaust contains complex mixture of gases, particulates and must be controlled
- In 2012, International Agency for Research on Cancer classified whole diesel exhaust as a carcinogen to humans
- The use of diesel equipment in underground mines is regulated by various governments

Diesel Engine Approval

- Canada
 - CSA-M424.1-16 for underground coal mines
 - CSA-M424.2-16 for underground non-gassy mines
- USA - Coal Mines
 - 30 CFR Part 7, Subpart E
 - Category engines A for gassy areas
 - Category engines B for all other areas
- USA – Metal/Non-metal Mines
 - 30 CFR Part 57, 57.5067
 - 30 CFR Part 7, Subpart E, approved engines
 - EPA approved Tier 2 (37kW-130kW) or higher engines
 - EPA approved Tier 1 (other power ratings)


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CANADA - Mining Regulation

- Provinces & Territories
 - 9 Provinces (no mining in PEI)
 - 3 Territories

Exemption

- Crown Corporation mines and uranium mines are under the jurisdiction of Federal Government


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USA – Raw DPM Limit for Underground Coal Mine Equipment

- Permissible Equipment
DPM < 2.5 g/h
- Non-permissible Equipment
 - Heavy-Duty Equipment
DPM < 2.5 g/h
 - Light-Duty Equipment
DPM < 5 g/h



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Published US/Canada Approved Engines Ventilation Rate

- Canada
<https://diesel.nrcan.gc.ca>
- <https://diesel.nrcan.gc.ca> (French version)
- USA
<https://lakmshaegov01.msha.gov/ReportView.aspx?ReportCategory=EngineAppNumbers>






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Canada – Ventilation Rates Example

Engine Manufacturer: **Cummins**
 Engine Model: **QSB 6.7 Tier 3**
 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
1302	FR91599, 215 HP (160 kW) @ 2100 RPM, 82.8 lb/h	15	12, 000	5.66
	FR91596, 240 HP (179 kW) @ 2500 RPM, 97.4 lb/h		19, 500	9.20






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USA – Ventilation Rates Example

Approval Number	Engine Manufacturer	Model	HP @ RPM at 1000ft Elevation	Ventilation Rate CFM	Particulate Index CFM	Date Issued
07-ENA030001	MITSUBISHI	S4S	63 @ 2500	3000	4500	10/22/2003



* Six columns are removed in order to make this slide easier to read


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Engine Ventilation Requirement

Mines	Ventilation
British Columbia	Ventilation as per CSA standard, and minimum of 0.06 m ³ /kW.
Alberta	Ventilation as per CSA standard. Minimum air volume of 1.9 m ³ /s at active headings, and minimum air velocity of 0.3 m/s.
Saskatchewan	Ventilation as per CANMET approval, and minimum of 0.06 m ³ /kW.
Manitoba	Ventilation as per CANMET or MSHA approval, or 0.092 m ³ /kW for non-approved engine. 100/75/50 rule for multi-engines and minimum ventilation of 0.045 m ³ /kW.
Ontario	Minimum ventilation of 0.06 m ³ /kW.
Quebec	Ventilation as per CANMET approval or MSHA CFR 30 Parts 31 and 32 or 0.092 m ³ /kW for non-approved engines. 100/75/50 rule for MSHA approved Part 31/32 multi engines, and non-approved multi-engines up to a minimum ventilation of 0.045 m ³ /kW.


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Engine Ventilation Requirement

Mines	Ventilation
New Brunswick	Engine approval is required for engines above 75 kW. Minimum ventilation of 0.067 m ³ /kWs.
Nova Scotia	Engine approval is required. Minimum air velocity of 0.33 m/s for coal mines.
Newfoundland & Labrador	Engine approval is required from Chief Inspector of mines. Minimum ventilation of 0.047 m ³ /kWs.
Northwest & Nunavut	Requires a permit (engine approval) from Chief Inspector of mines. Ventilation as per CANMET or MSHA engine approval, otherwise a minimum ventilation of 0.06 m ³ /kWs.
Yukon	Requires completion of director prescribed application form and approval. Minimum ventilation of 0.06 m ³ /kWs.



Engine Ventilation Requirement

Mines	Ventilation
China	Minimum ventilation of 0.067 m ³ /kWs
Australia	Minimum ventilation greater of 0.05 m ³ /kWs or 3.5 m ³ /s Minimum ventilation greater of 0.06 m ³ /kWs or 3.5 m ³ /s for coal mines
USA	As per MSHA certificate, coal mines
Germany	Minimum ventilation of 0.067 m ³ /kWs
South Africa	Minimum of 0.063 m ³ /kWs based and best practice



Diesel Fuel Regulation

Mines	Sulphur, maximum	Flash Point, minimum
British Columbia	CAN/CGSB-3.16-M88, Mining diesel fuel	
Alberta	CAN/CGSB-3.16-99, Mining diesel fuel	
Saskatchewan	500 ppm	52°C
Manitoba	CAN/CGSB-3.16-99, Mining diesel, special-LS, or CAN/CGSB-3.517-93, Automotive diesel, type A-LS	
Ontario	CAN/CGSB-3.16-99, Mining diesel, special-LS, or CAN/CGSB-3.517, Automotive diesel, type A-LS	
Quebec	500 ppm	--
New Brunswick	--	--
Nova Scotia	CAN/CGSB-3.517 Automotive diesel (for above 30°C use CAN/CGSB-3.16-99, Mining, special-LS)	
NFLD & Labrador	3-GP-6 or latest version of CGSB Mining diesel fuel	
Northwest & Nunavut	2500 ppm	43°C
Yukon	CAN/CGSB-3.16-99, Mining diesel fuel, or similar standard acceptable to director	

Diesel Fuel Quality

	Sulphur Maximum, ppm	Flash Point Minimum, °C
Canada	500 – 5000*	40 - 52
USA	500**	38
Australia	10	61.5
EU	10	55
Switzerland	10	55
Chile	50	--
South Africa	No regulation (10 - 500 ppm used)	

*Only 15 ppm sulphur fuel available now due to Federal Regulation

** 15 ppm sulphur fuel more common in mines

TWA DPM Exposure Limits (mg/m³)

British Columbia	1.5 (RCD)
Alberta	--
Saskatchewan	0.16 (TC)
Manitoba	ACGIH
Ontario	0.4 (TC) or ECx1.3<0.4
Quebec	0.4 (TC)
New Brunswick	1.5 (RCD)
Nova Scotia	1.5 (RCD)
NFLD & Labrador	ACGIH
Northwest & Nunavut	1.5 (RCD)
Yukon	1.5 (RCD)

* Total carbon and Elemental carbon analysis by NIOSH 5040 method

** Respirable combustible dust (RCD) on gravimetric basis



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TWA DPM Exposure Limits (mg/m³)

USA (Metal/non-metal mines)	0.16 (TC)
EU	0.1 (EC)
EU (shall apply from 21February 2026)	0.05 (EC)
Switzerland	0.1 (EC)
Germany (after October 2022)	0.05 (EC)
Australia	0.1 (EC)
South Africa	--

* Total carbon and Elemental carbon analysis by NIOSH 5040 method



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TWA Gaseous Exposure Limits (ppm)

Mines	CO	CO ₂	NO	NO ₂	SO ₂
British Columbia	25	5,000	25	3	2
Alberta	25	5,000	25	3	2
Saskatchewan	25	5,000	25	2	2
Manitoba	ACGIH TLVs				
Ontario	25	5,000	25	3	2
Quebec	35	5,000	25	3	2
New Brunswick	25	5,000	25	3	2
Nova Scotia	25	5,000	25	3	--
NFLD & Labrador	ACGIH TLVs				
Northwest & Nunavut	25	5,000	25	3	2
Yukon	50	5,000	25	5	5
ACGIH	25	5,000	25	0.2	0.25

TWA Gaseous Exposure Limits (ppm)

Mines	CO	CO ₂	NO	NO ₂	SO ₂
EU	20	5,000	2	0.5	0.5
Germany	30	5,000	2	0.5	1
Switzerland	30	5,000	30	3	0.5
Australia	30	5,000	25	3	2
Australia (coal mines)	30	12,500	25	3	2
South Africa	30	5,000	25	3	--
China	24	5,000	25	2.5	0.25
ACGIH	25	5,000	25	0.2	0.25

Gaseous Short Term Exposure Limits (ppm)

Mines	CO	CO ₂	NO	NO ₂	SO ₂
British Columbia	--	30,000	--	5	5
Alberta	--	30,000	--	5	5
Saskatchewan	190	30,000	38	5	5
Manitoba	--	30,000	--	5	0.25
Ontario	100	30,000	--	5	5
Quebec	200	30,000	--	--	5
New Brunswick	--	30,000	--	5	5
Nova Scotia	--	30,000	--	5	0.25
NFLD & Labrador	--	30,000	--	5	5
Northwest & Nunavut	--	30,000	--	5	5
Yukon	400	15,000	35	--	5
EU	100	--	--	1	1
Australia	--	30,000	--	5	5
South Africa	100	30,000	35	5	--
ACGIH	--	30,000	--	--	0.25

Raw Exhaust Engine Test Limits

Mines	CO ppm	NO ppm	NO ₂ ppm	NO _x ppm
Ontario	600	--	--	--
Quebec	750	--	--	--
Australia, new engines, coal mines*	1100	900	100	--
Australia, in service, coal mines	1100	--	100	750
Australia, in service	1100	900	100	1000

* Engine dynamometer testing is not required for engines complying EPA tier II or European EPA Stage 2 or greater

Baseline Engine Test (Australia- NSW)

Raw Exhaust Emissions	Maximum variance (%)
CO and NOx < 500 ppm	25%
CO and NOx > 500 ppm	15%
DPM (cleaner engines)	30%
DPM (dirtier engines)	15%

* As per required test procedures (MDG 29)

Europe (Some General Comments)

- EU: Same engine as non-road emission engine
- EU: Stage V engine (January 2019)
- EU: TWA gaseous exposure limits are the responsibility of the member states
- Switzerland: All engines require VERT certified DPFs (no exception)
- Austria: All engines require VERT certified DPFs (except < 37 kW engines)
- Germany: A suitable exhaust aftertreatment system is required on all engines except very small engines

Australia (New South Wales)

- Mines in New South Wales are governed by the Work Health & Safety (Mines) 2014
- NSW Code of Practice (COP): Mechanical engineering control plan has been developed for NSW, Queensland and Western Australia and forms part of the mining safety legislative framework
- MDG 29 (NSW) for the management of diesel engine pollutants is used by other mining states also (Western Australia & Queensland) as the default information guide
- Engine maintained to reduce emissions to as low as reasonable practical as per baseline exhaust results
- Establish baseline of all engines

References

- CSA, Flameproof non-rail-bound diesel powered machines for use in gassy underground coal mines, M424.1-16
- CSA, Non-rail-bound diesel-powered machines for use in non-gassy underground mines, M424.2-16
- MSHA, Diesel engines intended for use in underground coal mines, 30CFR, Part 7, Subpart E
- EU Directive 2017/164, Occupational exposure limit values, 31 January 2017
- EU Directive 2019/130, Protection of workers from the risks related to exposure to carcinogens or mutagens at work, 16 January 2019
- EU Directive 2016/1628/EC, Requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, 14 September 2016
- EU Directive 2009/30/EC, specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions, 23 April, 2009

References

- Germany, TRGS 900, Occupational exposure limits, 2019
- Germany, TRGS 554, Exhaust gases from diesel engines, January 2019
- Australia (NSW), Work Health and Safety (Mines) Regulation, 2014
- Australia (NSW), MDG 29, Guideline for the management of diesel engine pollutants in underground environments, April 2008
- Australia (NSW), Code of Practice: Mechanical engineering control plan, September 2016



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Comments

- The information in this presentation is provided for general information only, and its accuracy or completeness can not be guaranteed.
- Users should make their own final enquiries with regards to latest relevant information from the proper regulatory authorities prior to taking any decision.

Thank You !

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