PORT of vancouver | Vancouver Fraser Port Authority

Non-Road Diesel Emissions Reduction (NRDE) Program

Fact sheets booklet

Canada

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Fuel efficiency plans and idle reduction policies

Overview

The Non-Road Diesel Emissions Program (NRDE) requires all responsible parties to develop a fuel efficiency plan for their operations in order to be eligible for a fee rebate. The purpose of such a plan is to manage fuel costs and improve fuel efficiency. A central component of a fuel efficiency plan is an idle reduction policy. The fuel efficiency plan serves to:

- protect health of operators and people in the vicinity of the equipment
- save money by saving fuel and reducing engine wear
- improve ambient air quality
- reduce emissions and limit contributions to climate change
- conserve energy

Idling

Idling is running an engine for non-operational purposes. Unnecessary idling wastes fuel, contributes to air pollution and climate change and increases engine wear. An idling diesel engine produces much higher emissions than it would while using the same amount of fuel under load. Extended idling causes a build-up of soot inside the engine and results in a puff of black smoke when the engine revs.

Examples of unnecessary idling on port lands include:

- equipment running during staff breaks, while completing paperwork, or making phone calls
- engine warming – modern equipment warms up faster by being used than idling
- permitting equipment to run during breaks in active operation
- unnecessarily leaving equipment on standby

Common myths

It's good for the engine to idle.

Diesel engines don't burn much fuel at idle.

Diesel engines must idle or they won't restart.

Shutting down and restarting your equipment is hard on the engine and uses more fuel.

Did you know?

- excessive idling wastes money and fuel
- idling generates harmful emissions
- idling creates unnecessary noise
- fuel contamination of lube oil is higher at idle
- idling reduces engine life
- idling time of about 3-5 minutes is all that is required to properly cool an engine after being under heavy load
- idling can be minimized through education and implementation of an idle reduction policy

Idle reduction policy

An effective idle reduction policy starts with raising awareness about how small operational changes can lead to reduced fuel and maintenance costs and improved air quality and human health. Port operations are dynamic and unique, requiring consideration of operational context.

Example policy

Definition

Idling means the operation of a vehicle or machine while not in motion or being used to operate auxiliary equipment that is essential to the operation of the vehicle or equipment.

Purpose

The purpose of the policy is to establish guidelines for unnecessary idling of vehicles and equipment. Limiting idling times contributes to a healthier work environment, reduces noise and air pollution, reduces fuel consumption and reduces engine wear.

Procedures

- Always follow the manufacturer's recommendations around idling.
- No operator shall idle the engine in excess of 5 minutes.
- Diesel fueled vehicles should be turned off after enough time has passed to allow the proper circulation and cooling of the engine oil, coolant and turbochargers, not to exceed five minutes.
- If the engine must be left running for any reason the operator should remain in the vehicle.

Exceptions

- Idle times of up to 5 minutes are permitted during initial warm up and when the vehicle or machine is being restarted after prolonged shut down.
- Where engine power is necessary for an associated need such as power take off devices, auxiliary hydraulics, compressed air and/or electrical power.
- As required for defrosting or de-icing windows and/or as may be required for operator warmth, during periods of extreme cold.
- In situations where safety may be compromised by shutting down the engine.
- If required during maintenance and servicing.
- When in accordance with the manufacturer's operations manual or requirements.

Web resources

Natural Resources Canada http://fleetsmart.nrcan.gc.ca/index.cfm?fuseaction=fleetsmart.idle
Idle Free BC http://www.idlefreebc.ca/

FACTS - Tier Classification and Emissions Standards

Emissions Standards are used to classify non-road diesel engines into Tiers based on emission rates of several pollutants, including particulate matter (PM) emissions. The EPA implemented the first non-road diesel engine emissions standards (Tier 1 engines) in 1996. This established emission rates for new non-road engines built for use in the United States. The EPA standards were adopted by Canada, under the *Off-Road Compression-Ignition Engine Emission Regulations*[3], for engines from 2006 and later model year. Port Metro Vancouver recognizes the emission standards defined by the US Environmental Protection Agency (EPA) and European Commission (EC) emission standards[1,2] for non-road diesel engines (Tier 1 to Tier 4).

Engines manufactured for use in Canada, the United States, or European Union before 1996 are referred to as Tier 0 engines. Please note that engines manufactured for sale in other markets are considered Tier 0 engines, unless the emissions can be demonstrated to meet a higher Tier.

Table 1[4] on the following page lists the emission standards for each engine Tier classification by horsepower, and by the year the standard was introduced. Note that the legislation allowed these standards to be phased in over several years; therefore, not all engines purchased in a particular year meet the emissions standards set out for that year. The tier level of an engine is more accurately determined by contacting the manufacturer with the Engine Family Name, which is located on the engine plate. Any engine that is pre-Tier (i.e. Tier 0) does not have an Engine Family Name.

Web Resources:

1. "EPA Non-road Compression - Ignition Engines - Exhaust Emission Standards"
   http://www.epa.gov/otaq/standards/nonroad/nonroadci.htm
2. European Commission, Directives for Emissions from Mobile Non-road Machinery.
   https://ec.europa.eu/growth/sectors/automotive/environment-protection/non-road-mobile-machinery_en
3. Canadian Off-Road Compression-Ignition Engine Emission Regulations
   http://www.ec.gc.ca/lcpe-cepa/eng/regulations/detailReg.cfm?intReg=88
4. Table is adapted from the US EPA information at
   https://www.epa.gov/emission-standards-reference-guide

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FACTS - Diesel Particulate Matter Emissions Standards

PM Emission Standards by Horsepower and Year (g/bhp-hr) Horsepower Groups

Year	25≤49	50≤74	75≤99	100≤174	175≤299	300≤599	600≤749	750≤1199	1200+	Locomotive
1900	0.95	1.2	1.2	1.1	1.1	0.95	0.95	0.95		
1969	0.95	1.2	1.2	1.1	1.1	0.95	0.95	0.95		
1970	0.95	1.2	1.2	0.94	0.94	0.81	0.81	0.81		
1972	0.95	1.2	1.2	0.78	0.78	0.68	0.68	0.68		
1973	0.95	1.2	1.2	0.78	0.78	0.68	0.68	0.68		0.19
1988	0.95	1.2	1.2	0.78	0.54	0.49	0.49	0.5		0.19
1989	0.95	1.2	1.2	0.78	0.54	0.49	0.49	0.5		0.19
1996	0.95	1.2	1.2	0.78	0.4	0.4	0.4	0.5		0.19
1997	0.95	1.2	1.2	0.6	0.4	0.4	0.4	0.5		0.19
1998	0.95	1.09	1.09	0.6	0.4	0.4	0.4	0.5		0.19
1999	0.6	1.09	1.09	0.6	0.4	0.4	0.4	0.5		0.19
2000	0.6	1.09	1.09	0.6	0.4	0.4	0.4	0.4	0.4	0.19
2001	0.6	1.09	1.09	0.6	0.4	0.15	0.4	0.4	0.4	0.19
2002	0.6	1.09	1.09	0.6	0.4	0.15	0.15	0.4	0.4	0.19
2003	0.6	1.09	1.09	0.22	0.15	0.15	0.15	0.4	0.4	0.19
2004	0.45	0.30	0.30	0.22	0.15	0.15	0.15	0.4	0.4	0.19
2005	0.45	0.30	0.30	0.22	0.15	0.15	0.15	0.4	0.4	0.1
2006	0.45	0.30	0.30	0.22	0.15	0.15	0.15	0.15	0.15	0.1
2007	0.45	0.30	0.30	0.22	0.15	0.15	0.15	0.15	0.15	0.1
2008	0.22	0.22	0.3	0.22	0.15	0.15	0.15	0.15	0.15	0.1
2009	0.22	0.22	0.3	0.22	0.15	0.15	0.15	0.15	0.15	0.1
2010	0.22	0.22	0.3	0.22	0.15	0.15	0.15	0.15	0.15	0.1
2011	0.22	0.22	0.3	0.22	0.015	0.015	0.015	0.07	0.07	0.07
2012	0.22	0.22	0.015	0.015	0.015	0.015	0.015	0.07	0.07	0.07
2013	0.02	0.02	0.015	0.015	0.015	0.015	0.015	0.07	0.07	0.07
2014	0.02	0.02	0.015	0.015	0.015	0.015	0.015	0.07	0.07	0.07
2015	0.02	0.02	0.015	0.015	0.015	0.015	0.015	0.03	0.02	0.02
2016	0.02	0.02	0.015	0.015	0.015	0.015	0.015	0.03	0.02	0.02
2017	0.02	0.02	0.015	0.015	0.015	0.015	0.015	0.03	0.02	0.02
2018	0.02	0.02	0.015	0.015	0.015	0.015	0.015	0.03	0.02	0.02
2019	0.02	0.02	0.015	0.015	0.015	0.015	0.015	0.03	0.02	0.02
2020	0.02	0.02	0.015	0.015	0.015	0.015	0.015	0.03	0.02	0.02

Tier 0 Engine | Tier 1 Engine | Tier 2 Engine | Tier 3 Engine | Interim Tier 4 | Tier 4 Engine

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FACTS - Opacity

Opacity is a measure of the amount of light obscured by the particulate matter (PM) or soot in the exhaust from diesel engines, measured under normal operating conditions. Most engines are certified up to a smoke opacity level by the U.S. Environmental Protection Agency (EPA) when they are manufactured, and these levels range between 5% and 55%. If maintained properly, engine exhaust should never exceed the EPA certified level.

The opacity of diesel exhaust can be measured by instruments or visually by certified observers.
High opacity or excessive soot from diesel engines emissions usually indicates that maintenance is required. Some causes of high opacity from diesel engines include:

- Excessive idling
- Clogged, worn, or mismatched fuel injectors
- Faulty or maladjusted fuel injection pump
- Manifold leaks
- Malfunctioning turbocharger
- Defective air fuel controller
- Poor fuel quality
- Clogged after-treatment devices or spent catalyst
- Improper injection timing
- Malfunctioning after cooler
- Improperly adjusted valve lash or governor
- Defective computer controls (sensors, wiring, etc.)
- Restricted air filter

The graphic below provides an illustration of the opacity range in black smoke associated with diesel exhaust.

RINGELMANN TRADITIONAL VISUAL SCALE		
Ringelmann	0%	Opacity (clear)
Ringelmann	20%	Opacity
Ringelmann	40%	Opacity
Ringelmann	60%	Opacity
Ringelmann	80%	Opacity
Ringelmann	100%	Opacity (black)

0% 20% 40% 60% 80% 100%

Web Resources:

1. AirCare ON-ROAD Program *http://www.th.gov.bc.ca/ACOR/*
2. US EPA- Method 9 *https://www3.epa.gov/ttnemc01/promgate/m-09.pdf*

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FACTS - Engine Power and Model Year

Labels and Tags

The horsepower and model year are used to determine the engine Tier classification. Nearly all engines started out with an engine label or an engine data tag. Most engines also have a serial number tag. Tier 1 or higher engines recognized by the US Environmental Protection Agency (EPA) also have an emissions label. If there is no EPA label, then the engine is likely a non-certified (Tier 0) engine.

This engine data tag from a 1992 Caterpillar 14G motor grader shows the engine power rating is 200 hp or 149 kW.

Engine labels and engine data tags usually list the date of manufacture and the power rating of the engine. EPA emissions labels use an alpha-numeric code called the Engine Family Name[1] to convey the engine model year. Engine serial number decoders can also be used to determine the date when an engine was manufactured and the engine power rating.

In addition to the engine and emissions labels, vehicles also have a vehicle data tag. The vehicle data tag usually lists the vehicle serial number and information about the engine originally installed in the vehicle. Some vehicles may have undergone an engine replacement, so extra care is required when using vehicle data tags to determine the engine model year and power rating.

Engine Power Rating

Engine power ratings are usually listed on the engine label, the engine data tag, the vehicle data tag or the owner's manual. The power rating of an engine can be given in either horsepower (hp) or kilowatts (kW).

The engine serial number data plate from a 1992 Caterpillar 14G motor grader. The serial number reads 08Z68216

Engine Model Year

Engine model years are determined by the annual new model production period during which the engine was produced. Some vehicles may have been assembled using engines from previous engine model years. To determine the engine model year and engine power rating:

- Check the engine label and emissions label.
- Check the owner's manual.
- Check the vehicle data tag and model number label.
- Check the sales/service literature.
- Have the engine manufacturer or dealer determine the model year of the engine from the engine's serial number.

Web Resources:

1. California Air Resources Board DOORS User Guide - Engine Family Names
http://www.arb.ca.gov/msprog/ordiesel/documents/doors/enginefamilyname.pdf

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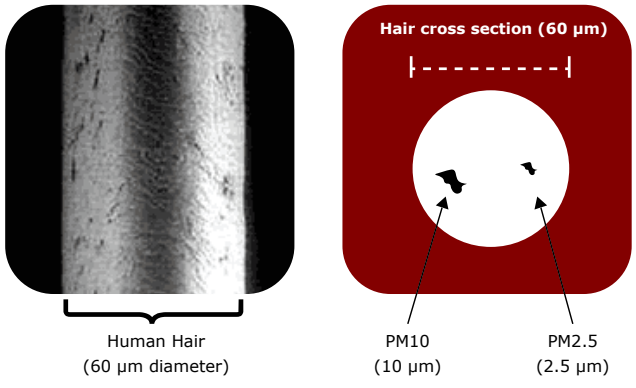
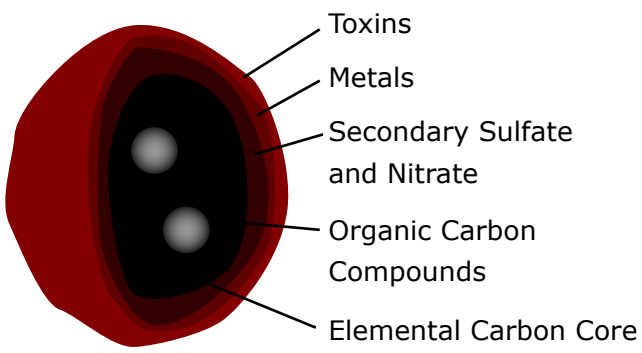
FACTS - Diesel Particulate Matter

Particulate matter (PM) is the term for solid or liquid particles found in the air. Diesel PM, also referred to as diesel soot, is part of a complex mixture that makes up diesel exhaust. Diesel PM is a health concern as it includes very fine particles (PM2.5) that are small enough to be inhaled deeply into the lungs, resulting in impacts to both respiratory and cardiovascular systems.



Source: *http://www.arb.ca.gov/pm/pm.htm*

The health risk is further increased because diesel PM has a very rough surface, which bonds easily with other toxins. When this happens, the particles become a vehicle, carrying those toxins into the body. An example of diesel PM, which is composed of a carbon and ash (diesel soot) core covered by layers of organic compounds, sulphates and nitrates, metals and other trace elements, is shown below.



Source: *http://pghdieselcleanup.wordpress.com*

Diesel PM also causes global warming when it absorbs heat in the atmosphere and when black soot falls on snow and ice. The amount of glacial melting caused by soot is similar to amount of melting caused by carbon dioxide. However, unlike carbon-dioxide, cost effective technology exists that can substantially reduce diesel emissions.

Information on ways to reduce diesel PM emissions can be found on Facts – Emissions Reduction Measures.

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FACTS - Approved Emissions Reduction Measures (ERM)

There are several Emission Reduction Measures available that reduce the levels of Particulate Matter emissions from by diesel equipment. The US Environmental Protection Agency (EPA) and California Air Resource Board (CARB) both maintain lists of ERMs that have been verified to reduce emissions when installed with particular engines (see web pages listed below). Installation of a verified ERM may be eligible for reduced NRDE Fees and/or receive partial rebates of fees paid. More information, including a manual of available ERMs, which is available on the VFPA NRDE website.

Emission reduction measures include replacement, retrofit of a similar device, alteration or technological change that reduces the Particulate Matter (PM) emissions from a non-road diesel engine, or use of alternative fuels such as biodiesel.

- To **replace** means to remove an older Tier 0 or Tier 1 engine and install a less polluting higher Tier engine (Tier 2 or better).
- To **retrofit** means to install devices developed to reduce PM emissions from diesel engines. Most are installed in the exhaust stream of the engine, in place of a muffler. The engine condition and maintenance practices need to be considered before installing a retrofit device. Installing an exhaust retrofit on worn engines or engines not maintained in good working condition can cause power loss, excessive fuel consumption, overheating and the retrofit device generally will not perform as designed. Engine manufacturers and equipment suppliers can assist in selecting an appropriate retrofit device for your equipment and the engine duty cycle.

Exhaust stream retrofits fall into 3 broad categories:

- **Diesel Oxidation Catalysts** (DOCs) can be used on most diesel engines and can reduce PM emissions by 20% or more. A DOC contains a flow-through metal or ceramic core coated with a precious metal catalyst. The catalyst promotes the oxidation of unburned PM, volatile organic compounds (VOC) and carbon monoxide (CO).
- **Flow-Through Filters** (FTFs) can be used on a wide variety of engines and can reduce PM emissions by approximately 50%. An FTF is similar to a DOC, but it uses a different type of core material to hold the catalyst. The core configuration results in greater contact with the catalyst.
- **Diesel Particulate Filters** (DPF) can be either "passive" or "active" devices and can reduce PM emissions by 85% or more. A passive DPF uses the heat from the engine exhaust to oxidize the PM collected in the filter. Active DPFs raise the temperature inside the filter using electricity or by injecting additional diesel fuel into the exhaust stream. Active DPF systems can be used on a much wider range of engines and duty cycles.

Using biodiesel is another way to reduce emissions because the PM emission rate for biodiesel is lower than petroleum based diesel fuel. PM reductions associated with biodiesel are proportional to the amount blended with petroleum based diesel fuel.

Web Resources:

1. EPA National Clean Diesel Campaign (NCDC), Verified Technologies List
   http://www.epa.gov/cleandiesel/verification/verif-list.htm
2. CARB Verification Procedure - Currently Verified
   http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

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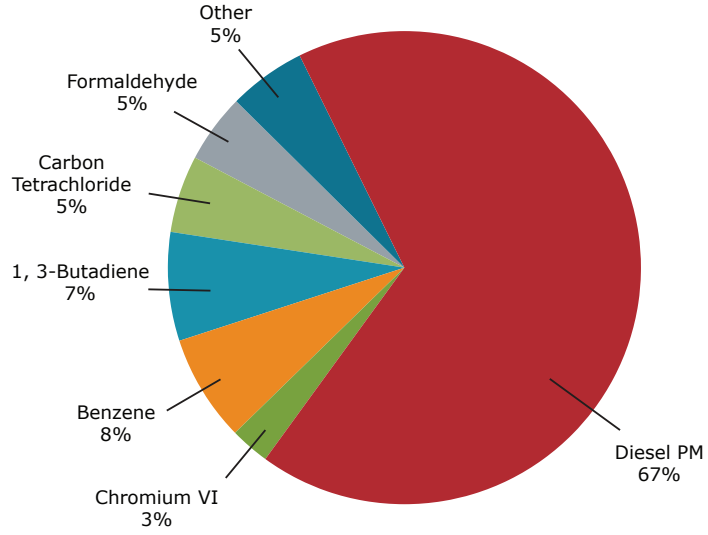
FACTS - Health Concerns

Diesel particulate matter (PM) emissions are responsible for serious short-term and long-term health impacts. When inhaled some of these particles are small enough to get past the body's defences and become embedded deep within the lungs. The smallest particles can potentially enter the bloodstream directly through the lungs. Emissions from diesel engines are linked to premature deaths, increased hospitalizations, and lost work days.

Diesel exhaust is classified as a known human carcinogen by various governmental organizations such as the World Health Organization and US Environmental Protection Agency. A study[1] commissioned by Metro Vancouver shows that PM emissions from diesel engines are responsible for approximately 67% of the lifetime cancer risks from air pollutants in the region. Non-road diesel engines are responsible for approximately 41% of diesel PM emissions.

Apportionment of Lifetime Cancer Risk from Emissions of Air Toxins in Metro Vancouver (overall risk 526 per million)



Diesel PM is linked to many other serious heart and lung diseases including:

- asthma
- chronic obstructive lung disease
- chronic bronchitis
- pneumonia
- cancers
- heart attacks
- arrhythmia

Web Resources:

1. Air Toxics Emissions and Health Risk Assessment Summary Report
http://www.metrovancouver.org/services/air-quality/AirQualityPublications/Air_Toxics_Emission.pdf

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