



## Frequently Asked Questions

### How are engine emissions regulated?

In general, regulations related engine emissions fall into four categories:

1. *Tailpipe-emission regulations* specify the maximum amount of pollutants allowed in the exhaust. In the USA, the Environmental Protection Agency (EPA) sets these standards, while similar regulatory authorities set their own standards worldwide. It is the responsibility of the diesel engine manufacturer to certify that their engine meets applicable emissions standards before it is commercially sold.
2. *Ambient-air-quality standards* specify the maximum concentration of air contaminants that are allowed in the workplace. In the USA, these regulations are set by the Occupational Safety and Health Administration (OSHA) or the Mining Safety and Health Administration (MSHA), and by similar regulatory authorities worldwide. It is the responsibility of the engine user, such as the mine or warehouse operator, to comply with ambient-air-quality standards. To ensure ambient air quality standards are met, and to minimize unpleasant exhaust gas fumes, it is often necessary to ensure that adequate ventilation in the work area is maintained. The use of an emission control device also improves the workplace environment.
3. *Local regulations* sometimes set more stringent tail-pipe standards than federal regulations. In the USA, the main driver often is the state's requirement to meet federal air quality standards.
4. *Site-specific regulations* often apply for stationary source emissions, such as those from larger stationary engines. In the USA the environmental permitting processes are administered at the state level or by a regional air quality board. Emission standards are determined on a case-by-case basis, depending on site-specific conditions, patterns for previous approvals and available emission control technology.

### What do I need to know if running an engine indoors?

Operating internal combustion engines in a warehouse, underground mine or other enclosed environment can be dangerous and should be avoided if possible. Your company's health and safety officer should be consulted before conducting any activities. If it is necessary to run an engine in an enclosed environment, ensure adequate ventilation of air, and that the engine is well maintained. An exhaust purifier (oxidation catalyst or three-way catalyst with air-fuel ratio controller) will significantly reduce some of the engine-out exhaust pollutants.

### What types of emissions are produced by diesel engines?

Diesel fuel is injected under pressure into the engine cylinder, where it mixes with air and combustion occurs. Compared to gasoline-powered engines, the lean nature of the diesel-air mixture results in a cooler combustion with smaller volumes of carbon monoxide (CO) and hydrocarbons (HC) being produced. However, diesel engines do produce relatively high levels of gaseous emissions of nitrogen oxides (NOx) and diesel particulate matter. These pollutants are particularly troublesome when diesel-powered engines are operated in enclosed spaces, such as underground mines, construction zones, tunnels or warehouses.



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## What are the available options for emission control of a diesel engine?

1. Diesel oxidation catalysts for control of CO, hydrocarbons, diesel smell and the soluble organic fraction of diesel particulate matter
2. Particulate filters for control of diesel particulate matter

## What types of emissions do gasoline, LPG and natural gas engines produce?

The major emissions from spark-ignited gasoline, LPG and natural gas engines are carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NO<sub>x</sub>). Unlike diesel engines, particulate emissions are very low.

For spark-ignited engines, emissions depend heavily on engine tune-up and air-fuel ratio. In engines tuned overly rich, carbon monoxide levels can far exceed those found in diesel engines. Carbon monoxide levels in rich tuned spark-ignited engines can exceed 2% CO at the tailpipe, a potentially dangerous level if the engine operates in a poorly ventilated confined space.

Starting in 2004, many spark-ignited engines over 25 hp for off-road machinery came factory equipped with a three-way catalyst and closed loop air-fuel ratio control. For older vehicles operating in confined spaces, retrofit of an oxidation catalyst or three-way catalyst with air-fuel ratio controller is worth considering.

## What are the available options for emission control of a spark-ignited engines (gasoline, LPG and natural gas):

1. Oxidation catalysts for control of carbon monoxide and hydrocarbons
2. Three-way catalysts for control of NO<sub>x</sub>, carbon monoxide and hydrocarbons

## What is diesel particulate matter (DPM)?

Particulate matter is formed during combustion of liquid fuels and engine lubricating oil. Particulate levels from diesel engines are high compared to particulate levels from spark ignited and gaseous-fueled engines. Diesel particulates are very small and have diameters of 0.01 to 1 microns. Smaller size diesel particulates penetrate deep into lungs when inhaled and have significant health impacts. Particulates from diesel engine exhaust are known to increase the risk of heart and respiratory disease, and have been labeled as either a "human carcinogen" or "probable human carcinogen" by several regulatory agencies. DPM is a complex mixture of solid and liquid materials that include:

- Dry carbon particles, commonly known as soot
- Engine lube oil ash
- Hydrocarbons adsorbed and condensed on the carbon particles, called soluble organic fraction (SOF)
- Water and sulfuric acid

## What is the difference between a flow-through diesel particulate filter and a wall-flow diesel particulate filter?

### MINE-X® Flow-Through Filter (FTF)

The FTF is constructed of alternating layers of corrugated metal foil and sintered metal fibres. The FTF is a non-blocking filter that allows some of the exhaust stream to exit the device unfiltered. Typical conversion efficiency of diesel particulate matter (soot) for the FTF ranges from 30-70%, depending on the engine duty cycle, and averages 50%. The DCL MINE-X® FTF has been extensively tested and has been verified in several



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European countries for retrofit of older diesel vehicles. The FTF is mechanically extremely robust and provides low back-pressure even under worst case, low duty cycle, operating conditions. The FTF is a passively regenerating device, meaning it is installed in the exhaust system and works continuously without the need for external soot regeneration devices such as heating elements, burners, etc...

### **MINE-X SOOTFILTER Diesel Particulate Filter (DPF)**

The DPF is a two stage device with the first stage a metal pre-filter containing alternative layers of corrugated metal foil and sintered metal fibers, and the second stage a cordierite wall flow filter. The DPF is a fully blocking filter that filters the entire exhaust stream. Conversion efficiency of diesel particulate matter (soot) for the DPF exceeds 85% on a mass basis and exceeds 99.9% on a particle count basis. The DPF has been extensively tested and has been verified through the European VERT program and the California Air Resources Board program. The **MINE-X® SOOTFILTER** DPF is passively regenerating device, meaning it is installed in the exhaust system and works continuously without the need for external soot regeneration devices such as heating elements, burners, etc... A back-pressure monitor device is installed with the DPF to alert the vehicle operator if maintenance is required.



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