

MNM DPF Glossary

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Introduction

This document is a listing of terms used in the Diesel Particulate Filter selection guide for underground Metal and Nonmetal Mines.

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Active Regeneration

The term “Active” regeneration refers to the requirement for the active involvement of a person or mechanism to accomplish the DPF [regeneration](#). Active regenerating DPFs must be used when the engine exhaust temperature is not hot enough during the work cycle to burn off the soot being collected. Go [here](#) for a full discussion.

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Ash

Ash is the noncombustible part of diesel (DPM). Diesel fuel itself contains little ash, but crankcase oil and fuel borne [catalysts](#) contain metals that produce ash.

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Bosch/Bacharach smoke number

See [Smoke number](#)

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Catalyst

A catalyst is a substance which promotes a chemical reaction without itself being consumed in the reaction. Some compounds of metals such as platinum, iron, cerium, and vanadium, to name a few, increases the rate of combination of organic and solid carbon with oxygen. The result is that the oxidation of soot can occur at a lower temperature with the catalyst present than with out it.

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Cleaning

Cleaning is used to describe the removal of ash from a DPF. Various methods are used including from blowing out with compressed air, washing with hot water and detergent, and a vacuum system that is a step in a routine [regeneration](#) cycle.

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Combustion analyzer

A combustion analyzer is an instrument that measures several gases that are the products of combustion and indicative of the completeness of the combustion process whether it be from natural gas or fuel fired boilers or diesel engines. Combustion analyzers employ electrochemical cells as sensors for O₂, from which they compute the CO₂ content based on the type of fuel being burned, NO (nitric oxide), NO₂ (nitrogen dioxide), and sometimes SO₂ (sulfur dioxide). At least one instrument includes a means to get the [smoke number](#). Most have sample conditioning systems and temperature measurement built into high temperature probes. Most have a means of logging data and/or interfacing to a computer for continuous data logging or downloading of stored data.

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Cordierite

A cream-colored porous ceramic (clay-like) material manufactured as an extruded honeycomb and used as substrates for diesel oxidation catalysts and as diesel particulate filter (DPFs). For use as a DPF, alternate channels are plugged forcing the exhaust to pass through the walls of the channels creating what is termed as a “wall-flow monolith.”

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Critical temperature ($T_{30\%}$)

The critical temperature, $T_{30\%}$, is the exhaust temperature that is exceeded 30% of the operating time of the engine over a shift. It is a benchmark temperature used to select passive DPFs which vary in their exhaust temperature requirement for [regeneration](#) based upon their use of catalytic washcoats and [fuel-borne catalysts](#).

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DPM

Diesel particulate matter, the solid aerosol component of diesel exhaust consisting primarily of soot on which organic material is adsorbed, ash, sulfates, and water. By definition it is the substance that is collected by a Teflon-coated fiberglass filter held below 150° F during engine certification testing. There is no procedure for the measurement of DPM in the workplace air, however a surrogate is used, namely either the total or elemental carbon collected on a tissue quartz filter and analyzed by NIOSH method 5040.

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Emissions-based maintenance

An engine maintenance procedure which uses the engine tailpipe emissions of CO and smoke obtained while the engine operates at full throttle against the torque converter load. The University of Minnesota and DEEP have developed guidelines for this type of maintenance.

Below are two references on emissions-based maintenance:

An Emissions-Assisted Maintenance Procedure for Diesel-Powered Equipment -- University of Minnesota

<http://www.cdc.gov/niosh/mining/eamp/eamp.html>

Emissions Based Maintenance - DEEP Report

[Instructors Manual](#)
[Mechanic's Manual](#)

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Exhaust Temperature Profiles/Traces

An exhaust temperature profile is a set of temperature recordings or logs of the exhaust temperature taken in the exhaust tailpipe at the intended location of the DPF while the equipment is operating over the set of shifts which represent all work scenarios of this equipment.

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Fuel-borne catalyst (FBC)

A chemical compound of an organic and a metal added to the fuel to make a metal ash that promotes the combust of soot collected with it in a diesel particulate filter (DPF). The metals

used are platinum, iron, cerium, and others. Copper is not a suitable metal for a fuel-borne catalyst. Fuel containing fuel-borne catalysts should not be used in an engine which does not have a DPF. Any fuel additive used in the mine must be approved by the EPA.

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MSHA MNM DPM Estimator

MSHA has devised a spreadsheet which uses engineering calculations to determine the reduction of DPM emissions from the equipment or increases to ventilation needed to attain compliance from an out of compliance level determined from either baseline DPM measurements or from engine emission rate data. A description of the procedure can be found here, [MSHA MNM Estimator](#).

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Passive regeneration

“Passive” [regeneration](#) occurs when the soot in the DPF spontaneously combusts (burns off) during the normal work cycle because the exhaust temperatures are sufficiently hot. This topic is more fully discussed [here](#).

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Regeneration

A process applied to the removing of diesel exhaust soot from a diesel particulate filter (DPF) by combusting the soot.

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Regeneration Station

A regeneration station is a device for burning off the soot accumulated on the DPF. The DPF is removed from the equipment and brought to the regenerating station. The station commonly consists of a platform which holds a set of heater coils upon which the DPF is placed. A regeneration controller controls the temperature of the heater and the flow of air needed to combust the soot.

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Silicon Carbide

A grayish porous ceramic material used in diesel particulate filters (DPFs) as an alternative to [Cordierite](#). It can tolerate higher temperatures but has a higher thermal expansion compared to Cordierite. It is a honeycomb extrusion with alternate channels plugged forcing the exhaust to pass through the ceramic. A DPF is constructed by bundling and cementing several extruded lengths together. As with [Cordierite](#), it is a “wall-flow monolith.”

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Smoke Number

Variouly called the Bosch or Bacharach smoke number, it is the number obtained by comparing the soot spot on a filter paper to a gray scale that ranges from white (#=0) to black (#=9) in unit steps. The filter spot can be obtained using hand-operated pump designed for the purpose, or the Smoke Number function included in some combustion analyzers.

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Soot

The black carbon portion of diesel exhaust particulate matter ([DPM](#)). It is very similar to “lampblack,” the black soot from a smoking candle or kerosene lantern. Soot particles are extremely fine and carry organic material on its surface that is harmful to humans. The fine particles are retained by the lung and cause an irritation, which itself causes some health effects, but also which increases the potential harm caused by the organic material on the particle.

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Temperature Profile

See [Exhaust temperature profile](#) (link)

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Thermocouple

A thermocouple is a temperature sensor that generates a small voltage related to the temperature at the junction of two wires made of different materials. The composition of the wires has been standardized into type K and type J thermocouples. Type K are suitable for exhaust temperature measurements.

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Uncontrolled regeneration

Uncontrolled regeneration, runaway regeneration, and thermal runaway, all refer to uncontrolled burning of a large quantity of soot accumulated in the filter media of a diesel particulate filter. It is caused by a series of events starting with overloading the DPF with soot at exhaust temperatures not sufficient to cause regeneration, followed by a period of high exhaust temperature that ignites the soot, and followed finally by low power or idle operation of the diesel which raises the oxygen level of the exhaust. The overloading of the DPF can be easily detected by back pressure monitoring. Thermal runaway can easily cause filter temperatures that will melt the filter media or cause thermal stresses (high localized temperatures surrounded by cool temperatures) that crack the filter, or both.

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Acknowledgments

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