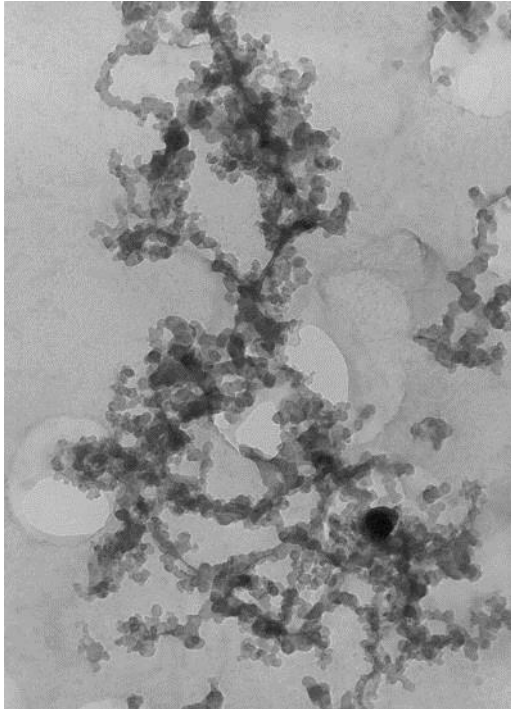




Let's Talk:
**Diesel Exhaust in
Underground Mines**



Electron micrograph DPM
(Source: A Rogers)

What is the concern about Diesel Particulate?

Diesel Particulate Matter (DPM) is the solid part of the exhaust material from diesel engines. It consists of small carbon particles and significant quantities of hydrocarbons such as oils and lubricants absorbed onto the solid as well as metals from engine wear.

DPM is a respirable sized particle, allowing it to penetrate deep into the lungs.

IARC classified diesel engine exhaust as a Class 1 carcinogen in 2012. Diesel exhaust is both the particulate matter and gases combined.

Diesel exhaust is an underground mine issue, however can be an issue anywhere diesel equipment is used including workshops and warehouses



Image: Jen Hines

What are the health effects?

Acute effects related to diesel exhaust emissions:

- Eye irritation
- Respiratory irritation
- Dizziness

Chronic effects related to diesel exhaust emissions:

- Lung cancer
- Bladder cancer
- Cardiovascular effects

Health risks from exposure

Underground Coal Mines

Diesel engines are commonly used in underground coal mines due to requirements for explosion protection and intrinsic safety. They are used as the main workhorse in the mines.

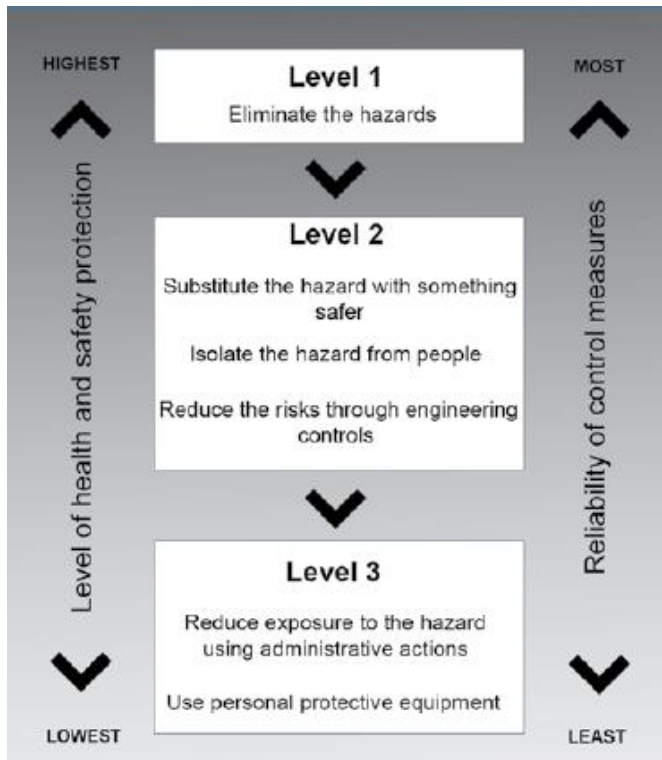


Image: Jen Hines

Underground Metalliferous Mines

Whilst underground metalliferous mines do not have the same restrictions for spark ignition, heavy equipment is still predominantly diesel based due the power load available.

Using diesel engines without proper controls within underground mines and confined areas is not good practice



High use of diesel engines within areas with dead ends or poor ventilation can result in high concentrations of vehicle emissions.

Often more than one control is needed to mitigate the risk and reduce personal exposure. Using the hierarchy of controls will help.

Engineering controls must be implemented to reduce the risk to as low as possible.

Respirators can be used where necessary to help protect the workers.

DPM filters

Diesel Particulate Filters (DPF) and Disposable Diesel Particulate Filters (DDEF) are used in the exhaust pathway on diesel equipment to capture the solid portion of the exhaust.

They can be retro-fitted or purpose built into the machines, and are either reusable and regenerating, or disposable.

These have been shown to have a high efficiency rating for filtering DPM from the exhaust of engines providing filter housing and filter systems are well maintained.

Different filters have different efficiencies.



Image: Jen Hines

Ultra Low Sulphur Fuel

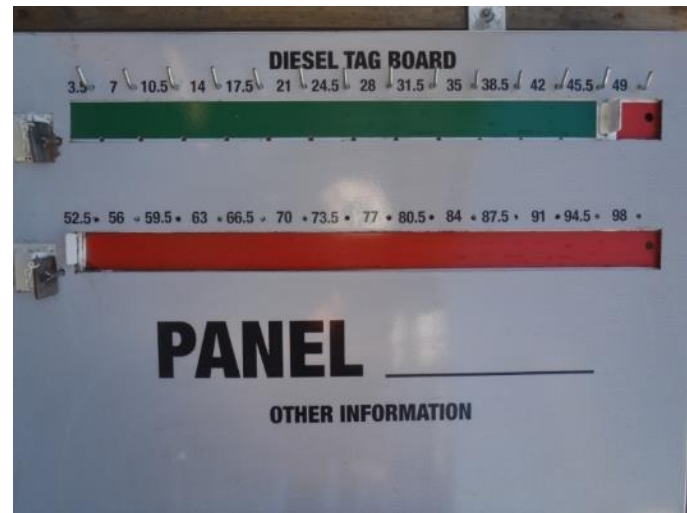
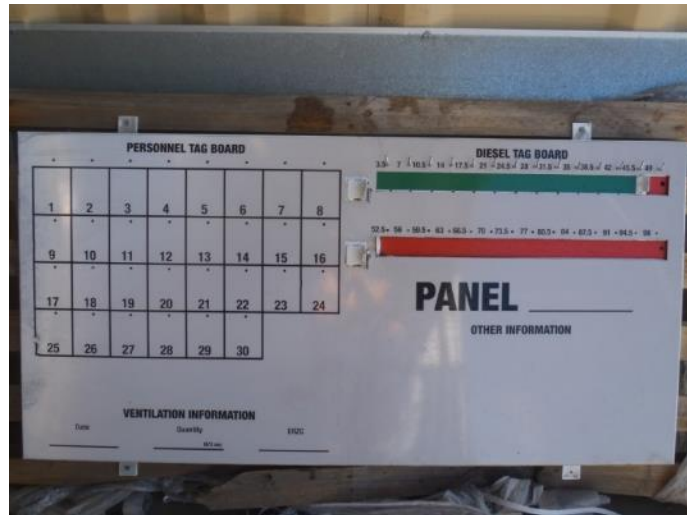
Ultra low sulphur fuel (ULSF) is used to help reduce gases and the particulate amount within diesel exhaust emissions.

It does this by reducing the number of nuclei for diesel particulate to form on.

There are various types of low sulphur fuels available. Fuels that are aliphatic based reduce the odour, and eye and respiratory irritation to workers.



Image: Jen Hines

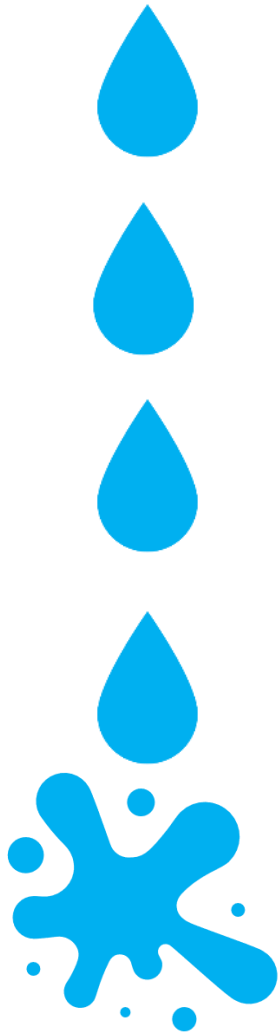


Diesel Tag Boards

Tag boards can be used as a visual aid to show the amount of air available and the amount of air required for diesel equipment to enter areas. This is based on equipment exhaust calculations and the statutory airflow requirements.

These boards use a tag system, with each vehicle assigned a certain number of tags depending on the amount of air required to sufficiently dilute the exhaust to a statutory level.

It provides a physical representation for all to easily see both the mine capacity and the number of vehicles in use.



Wet Scrubber Systems

Wet scrubber systems are commonly found within diesel engine systems in the underground coal mining industry as these help reduce the temperature of the emitted exhaust.

Their primary role is for spark suppression.

They assist in reducing the amount of particulate matter by up to 10%.



Image: Jen Hines

Vehicle Maintenance and Emissions-Based Maintenance

Testing engine exhaust and providing regular emissions-based maintenance **in addition to** original engine manufacturer (OEM) requirements improves the efficiency of the engine.

- It reduces emissions from the vehicles
- It provides cost savings by using less fuel and filters
- It improves productivity by having a more reliable fleet
- It improves health to workers by exposing them to less emissions

Work Practices



When using diesel equipment, where possible:

- Don't use diesel equipment in dead headings, single entry spaces, enclosed spaces
- Drive to the conditions, don't overload the engines unnecessarily (use appropriate gear)
- Don't drive in convoy

This will help reduce the exposure for workers.

New Development in Hard Rock Mines

DPM is a key risk when developing new mines where the ventilation system is still being developed and limited in its capacity.

- All vehicles must have exhaust filters and exhaust emissions meet regulatory requirements
- Maintain door seals and air conditioners to prevent leakages.
- Operate closed cabin vehicles to protect the worker
- Control and limit the number of vehicles underground.
- Ensure ventilation system and including vent bags extend to the face, and meeting regulatory requirements.

Respiratory Protection Equipment (RPE)



Image: Coal Services

- Diesel exhaust is thermally generated
- Thermally generated contaminants have a minimum requirement for RPE of a P2 respirator as per AS1716
- These can have a charcoal layer to remove the nuisance smell associated with diesel exhaust
- RPE can be either re-usable or disposable
- Research has shown that not all respirators are efficient in removing DPM – check with the supplier
- Fit-testing should be conducted before wearing tight-fitting RPE with a pass result from either quantitative or qualitative testing
- Facial hair can stop RPE from sealing correctly, clean shaven is best practice

RPE Training

When issuing RPE, training is required to ensure that workers correctly use and maintain RPE.

Training must be provided by a competent person, and cover the following topics:

- Why RPE is required
- When RPE is required to be worn
- How RPE works
- The limitations of RPE
- How to correctly put on and take off RPE
- How to conduct a FIT CHECK
- How to clean and maintain RPE
- When and how to replace filters
- How and where to store RPE when not in use.



Workers need to be clean shaven when wearing tight fitting half face or full face respirators

Summary Diesel Exhaust Hazard Management

1. Identify workers exposed to diesel exhaust. Conduct risk assessments to determine potential risk. Conduct air monitoring if necessary and communicate results to workers
2. Implement use of filters on vehicles to reduce particulate emissions
3. Ensure there is sufficient ventilation in work areas to ensure good dilution of engine exhaust and to satisfy statutory requirements
4. Conduct emissions-based maintenance after measuring exhaust emissions in addition to OEM required maintenance
5. Use diesel tag boards and tag system to limit the number of vehicles present within workings
6. Minimise work in closed headings/work areas to reduce accumulation of exhaust and diesel exhaust exposure to workers
7. Use only appropriate RPE with a properly implemented RPE programme including fit testing, training and maintenance
8. Maintain records of instruction, risk assessments, training and air monitoring results

Reference Material

- Safe Work Australia
<https://www.safeworkaustralia.gov.au/media-centre/dangers-diesel-exhaust-fumes-business>
- New South Wales
https://www.resourcesandgeoscience.nsw.gov.au/_data/assets/pdf_file/0011/419465/MDG-29.pdf
- Queensland
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