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DIESEL ENGINE EXHAUST EMISSIONS: THE FACTS

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DIESEL ENGINE EXHAUST FUMES

WHAT ARE THEY?

Diesel engine exhaust fumes are a mixture of gases, vapours, liquid aerosols and particles created by burning diesel fuels. Diesel fumes may contain over 10 times the amount of soot particles than in petrol exhaust fumes, and the mixture includes several carcinogenic substances, meaning they have the potential to cause cancer.

Breathing in high quantities of diesel exhaust fumes can cause irritation in the respiratory tract within a few minutes of exposure, but prolonged exposure over many years may be more harmful. The health effects will depend on the type and quality of diesel fuel being used (for example, whether it's low sulphur), the type and age of the engine, where and how it's used and maintained, and whether a combination of different diesel-powered engines are contributing to overall exposure. Blue or black smoke can mean there's a problem with the engine, which could mean that more toxic fumes are being produced. Diesel quality and emission standards vary, depending on the local situation – check your local standards.

Diesel exhaust fumes were classified as "probable carcinogens" back in 1988, but the International Agency for Research on Cancer, part of the World Health Organization, has recently upgraded them to a Group 1 carcinogen, so these emissions are now treated as a definite cause of cancer in humans. The IARC has said that people regularly exposed to diesel exhaust fumes at work can be up to 40 per cent more likely to develop lung cancer.

WHO IS AFFECTED?

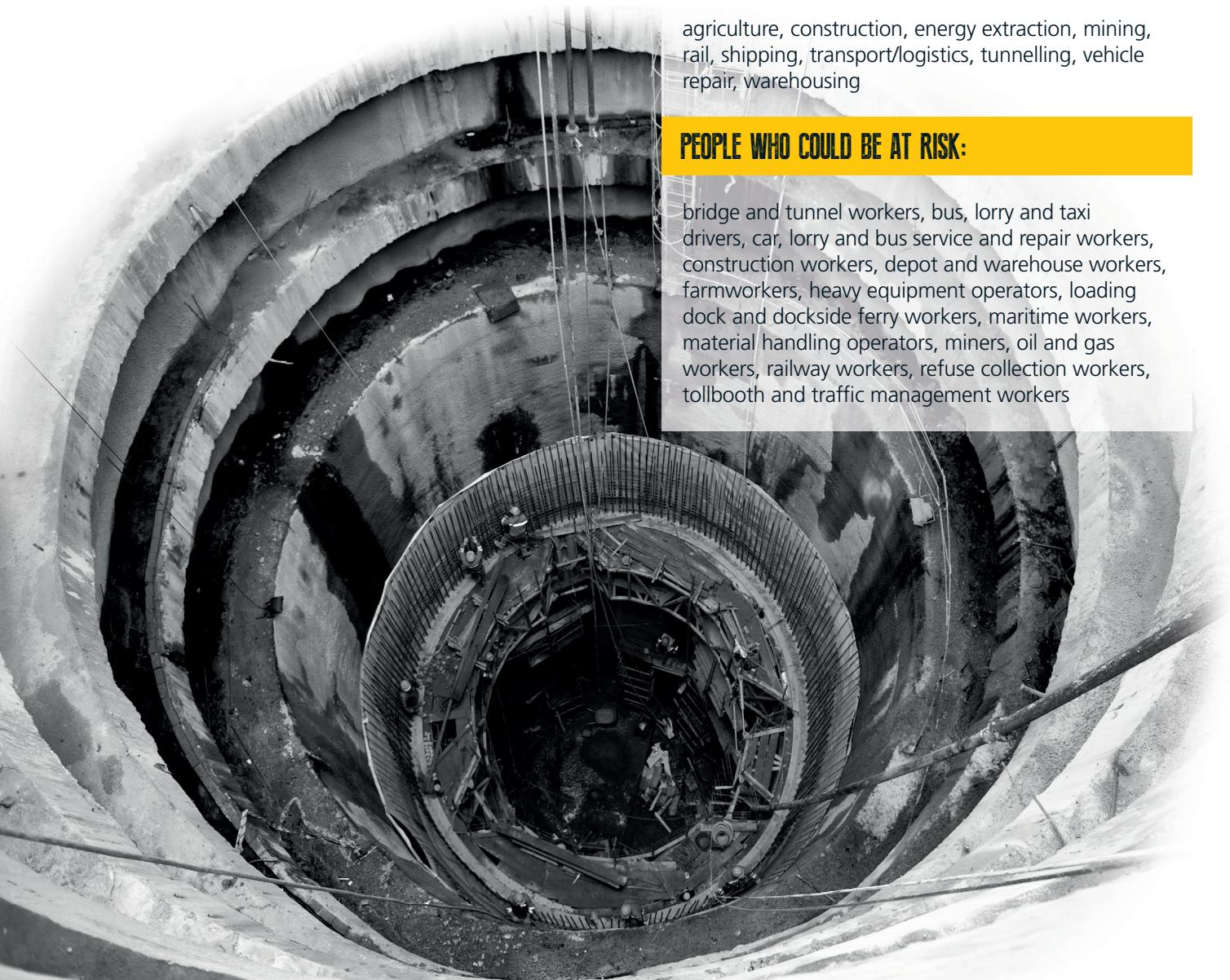
Anyone working with or around diesel-powered equipment or vehicles can be affected. Emissions from diesel vehicles such as forklifts, lorries, buses, trains and tractors – particularly in enclosed spaces like garages or workshops – can cause a problem. People working with fixed power sources such as compressors, generators or power plants – in sectors like tunnelling, mining or construction – could also be at risk.

MAIN RISK EMPLOYMENT AREAS:

agriculture, construction, energy extraction, mining, rail, shipping, transport/logistics, tunnelling, vehicle repair, warehousing

PEOPLE WHO COULD BE AT RISK:

bridge and tunnel workers, bus, lorry and taxi drivers, car, lorry and bus service and repair workers, construction workers, depot and warehouse workers, farmworkers, heavy equipment operators, loading dock and dockside ferry workers, maritime workers, material handling operators, miners, oil and gas workers, railway workers, refuse collection workers, tollbooth and traffic management workers



HOW?

At the very least, short term, high level exposures to diesel exhaust fumes can irritate the eyes and lungs. Continuous exposure to diesel exhaust fumes can cause long term, or chronic, respiratory ill health with symptoms including coughing and feeling breathless. At worst, if people are exposed to diesel engine exhaust fumes regularly and over a long period, there is an increased risk of getting lung cancer. This is the same type of cancer that's caused by asbestos and some other industrial chemicals, and doesn't just affect people who smoke. There is limited evidence to suggest that chronic exposure is also linked to a higher chance of suffering bladder cancer.

Scientists agree that the risk of cancer is linked with the particulate emissions in the fumes – the soot, rather than the gases or vapours. The particulates are easily inhaled and drawn deep into the lungs. Diesel engine exhaust exposure is now often measured by the elemental carbon concentrations in the air inhaled by workers.

Even if people lead a healthy life, don't smoke and don't have a strong history of cancer in the family, exposure to diesel exhaust fumes may still cause lung cancer, depending on the amount of airborne particulate.

HOW MANY?

Around the world, there are limited statistics about the number of workers exposed to diesel exhaust fumes, and the number of cancer cases caused by exposure.

In Europe, the Institute of Occupational Medicine has estimated that there may be more than 3.6 million workers exposed to diesel engine exhaust emissions above the background levels found in our cities. In a single recent year, it was estimated that in the EU there were nearly 4,700 cases of lung cancer, and more than 4,200 deaths, and over 1,000 cases of bladder cancer, with more than 300 deaths, all linked to diesel exhaust exposure.

In the UK, the Health and Safety Executive estimates that more than 100,000 workers could be exposed to high levels of diesel engine exhaust fumes, but Imperial College, the IOM and others put the figure closer to 500,000. It's estimated that in Britain, more than 650 people a year die of lung or bladder cancer as a result of being exposed to diesel exhaust fumes at work. Around 800 new cases of cancer linked to diesel exhaust fume exposure are registered each year.

While people are more likely to be diagnosed with a cancer caused by long term exposure to diesel exhaust fumes in later life, many workers will suffer respiratory symptoms much younger – and they can seriously affect quality of life.

HOW DANGEROUS ARE YOUR DIESEL FUMES?

It depends on the standards in the country you operate in.

For example, in EU countries, there should be higher standards – since 1992/93 there has been a steady reduction in allowable emissions on new vehicles including cars, trucks, trains, tractors and barges. Reductions were made in 2008/09 with the Euro 5/V standard, and in 2013/14 with the Euro 6/VI standard. In other parts of the world, for example Africa and Asia, standards for diesel are lower.

Different equipment will have different standards too – for example, a diesel generator would not be covered by some vehicle exhaust emission standards, and seagoing ships are excluded. In addition, remember that more recent vehicle emission standards only apply to new vehicles so older vehicles are likely to be producing higher emissions.

Higher standards mean that the risks are reduced but not eliminated.

WHAT YOU NEED TO DO

Assess the risks of diesel exhaust fume exposure to your employees – you'll need to work out if they are exposed to fumes:

- are diesel engines or equipment being used in the workplace?
- are diesel exhaust fumes being released into enclosed working areas like garages?
- are diesel exhaust fumes being drawn into the workplace through ventilation inlets?
- are diesel exhaust fumes concentrating in confined spaces or areas in buildings where there's limited air movement?
- are there clear soot deposits on surfaces in the workspace?
- is there a visible haze?
- is there white, blue or black smoke? Sometimes or always?
- do people suffer from irritated eyes or lungs?

If you answer 'yes' to some or all of these basic questions there could be a risk of people being harmed by diesel exhaust fumes. If so, you'll need to arrange formal assessment of the hazard, which could include measuring elemental carbon concentrations. Depending on the results of the assessment, you may need to either prevent or control the potential exposure.

Typical actions to control exposure include:

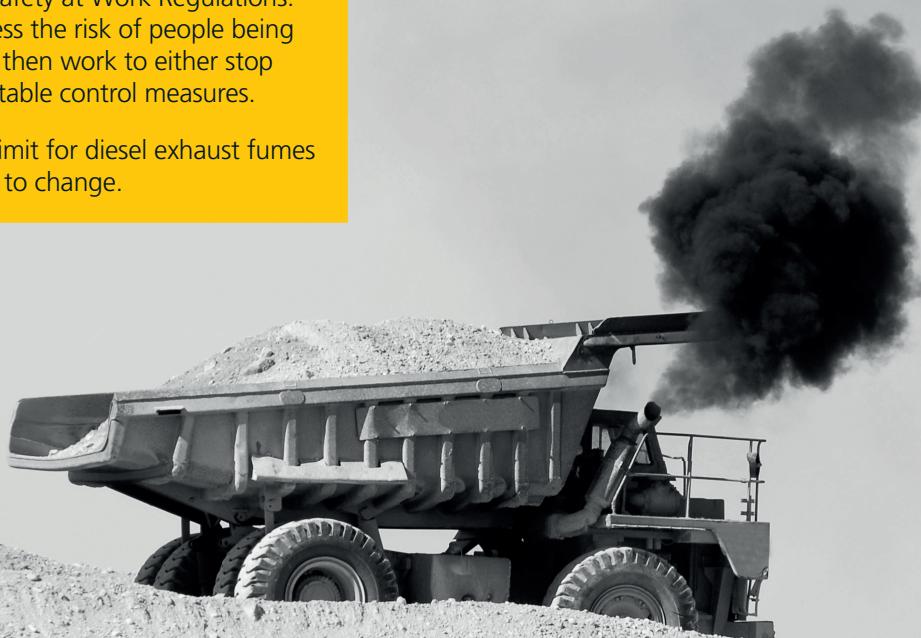
- switching to other forms of fuel where possible, eg gas or electric
- replacing old engines with newer versions with lower emissions
- making sure that engines are maintained properly – especially fuel delivery systems
- making sure diesel engine exhausts have filters
- using 'local exhaust ventilation' and good general ventilation in fixed or enclosed workplaces
- using forced ventilation to draw fresh air into the workplace
- using connecting extraction pipes for vehicle exhausts in workshops
- filtering air in vehicle cabs
- making sure that engines are turned off when they're not needed
- if engines have to be left running, making sure the vehicle or equipment is moved outside (checking that no-one else is then exposed)
- making sure cold engines are warmed up in spaces with good ventilation
- keeping building doors and windows open if it's practical
- rotating jobs between different employees to minimise exposure.

THE LAW

In many countries, exposure to hazardous substances is covered under the law.

In the UK, employers are legally required to consider the risk of cancer. Diesel fumes are covered by the Control of Substances Hazardous to Health Regulations, as well as by the more generic Health and Safety at Work Act and Management of Health and Safety at Work Regulations. By law, employers should assess the risk of people being affected by diesel fumes, and then work to either stop exposure or reduce it with suitable control measures.

There is no current exposure limit for diesel exhaust fumes in the EU, but this may be set to change.



Respiratory protective equipment, designed to protect the wearer from inhaling harmful dusts, fumes, vapours or gases, should only be used as a last resort. It's better to control exposure using other actions, for example ventilation systems and good engine management. However, for some jobs or work tasks respiratory protective equipment may be the only practicable solution.

If you do have to use respiratory protective equipment, it will generally be sufficient to select a filtering facepiece (disposable) respirator for particulates. Follow regulatory or manufacturers' guidance for selecting the correct type. Don't forget that if your employees use respiratory protective equipment, they'll need face-fit testing, and training in how to use it properly. If people don't wear their respiratory protective equipment in the right way it won't prevent exposure. If it's reusable, make sure that the equipment is checked, maintained and stored correctly. For reusable kit, make sure that records are kept of these monthly checks. Don't use 'nuisance' dust masks, as they won't protect people effectively from diesel exhaust emissions – it's the very fine soot particles that are harmful.

If your employees have to wear respiratory protective equipment to help cut down diesel exhaust fume exposure, make sure the equipment fits properly and comfortably – it's a common reason not to bother wearing it. You also need to make sure workers wear the equipment at the right times. Most manufacturers will offer guidance posters showing how to use equipment in the right way

Some exposure controls rely on changing the way people do things – for example, switching off engines when they're not needed rather than leaving them running, connecting ventilation pipes or wearing respiratory protective equipment. You should explain to your employees why these actions are necessary to protect their health – if people understand why you're making changes to their work they're more likely to comply. It's worth carrying out observational assessments to see if the controls are working, and that people are doing what they've been asked to do.

Any local exhaust ventilation equipment you use to control exposure should be examined and tested at least every 14 months to make sure it's still working properly – just as you regularly service a car. Filters on local exhaust ventilation systems should be checked every month in a formal programme.

After you've put new control measures in place you should assess the risk again to see if the actions you've taken have made a difference – for example, has the amount of soot or visible smoke been cut down or are people still suffering from irritated eyes and lungs?

You may need to monitor levels of diesel exhaust fumes to find out whether the controls are working. This sort of monitoring should be done by someone who is competent in occupational hygiene monitoring techniques – if you don't have this sort of expertise, then you'll need to ask a properly qualified professional. In the UK, contact the British Occupational Hygiene Society or the Occupational Safety and Health Consultants Register to find the right person.

In the UK, health surveillance is compulsory for workers exposed to carcinogens. Surveillance should be carried out or supervised by a qualified occupational health professional. Remember that health surveillance of workers alone is the least effective strategy in terms of preventing new cases of cancer.

You should also give people who could be at risk from exposure to diesel exhaust fumes information about the possible risk and how exposure can be cut down – download or order copies of our **free leaflet, pocket card and posters**. And you need to instruct or train affected employees too – use our **worker presentation or toolbox talk** as the basis for your training programme.

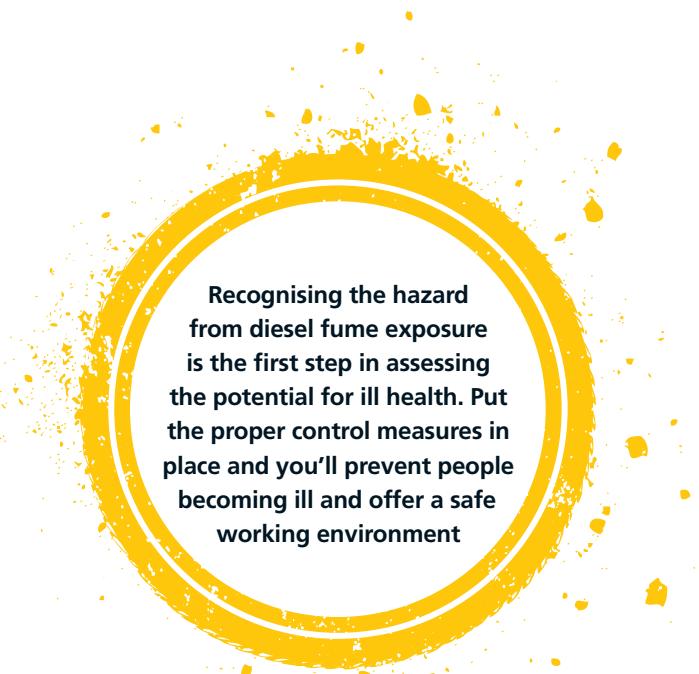
If you need to brief your senior management team about the risks from diesel fumes, then use our **management presentation**.

A LITTLE KNOWLEDGE IS A DANGEROUS THING

Are you 'competent' to manage this area? Assessing and managing exposure to harmful substances are specialist areas and if you don't have the right training, knowledge and experience then you could make a fatal mistake. Know your own limits and get expert advice if you need to

MORE INFO

- Hear Dr Christopher Wild, Director at the International Agency for Research on Cancer, on the carcinogenic risks to humans associated with diesel exhaust emissions, at www.iarc.fr/en/media-centre/iarcnews/2012/mono105-videocast_Wild.php
- The Health and Safety Executive has practical guidance on controlling emissions. Download 'Diesel engine exhaust emissions' at www.hse.gov.uk/pubns/indg286.pdf, the basic HSE guide, to get an overview of the issue, and the detailed guide aimed at employers called 'Control of diesel engine exhaust emissions in the workplace', at www.hse.gov.uk/pubns/priced/hsg187.pdf, to get more information. Remember that this guidance was prepared before the IARC classified diesel engine exhaust as a definite human carcinogen
- The American Cancer Society has information on diesel exhaust and how exposure can affect people at www.cancer.org/cancer/cancercauses/othercarcinogens/pollution/diesel-exhaust
- CAREX Canada gives basic information on diesel engine exhaust exposure at www.carexcanada.ca/en/diesel_engine_exhaust
- The Occupational Safety and Health Administration focuses on the issue in a hazard alert at www.osha.gov/Publications/OSHA-3590.pdf
- The Australian Institute of Occupational Hygienists has published a position paper on diesel and occupational health issues at www.aioh.org.au/downloads/documents/PositionPapers/AIOHPositionPaper_DPM.pdf
- Read a literature review on diesel engine exhaust exposure by Pronk *et al.* at www.ncbi.nlm.nih.gov/pubmed/19277070
- Find out about research into diesel engine exhaust exposure in the UK at www.hse.gov.uk/research/rrpdf/rr800.pdf
- Find out about research in the USA at www.cdc.gov/niosh/topics/cancer/diesel
- Research into diesel engine exhaust and lung cancer in the US trucking industry and mining sector suggests that diesel exhaust levels pose "substantial excess lifetime risks of lung cancer, above the usually acceptable limits in the United States and Europe" – read more at ehp.niehs.nih.gov/1306880
- Find out about a study focusing on the health effects of diesel-powered traffic on pedestrians at www.nejm.org/doi/full/10.1056/NEJMoa071535. The study, examining lung function in mild and moderate asthmatics, focuses on short and long term health effects of exposure to different particles and other constituent elements of diesel exhaust emissions
- Download a webinar hosted by IOSH's Retail and Distribution Group on the risks from diesel fumes in the logistics sector at www.iosh.co.uk/Membership/Our-membership-network/Our-Groups/Retail-and-Distribution-group/Download-our-webinars.aspx
- The Construction Plant-hire Association has published a position statement and guidance on diesel-powered off-road equipment. Download the documents at cpa.uk.net/occupational-health



Recognising the hazard from diesel fume exposure is the first step in assessing the potential for ill health. Put the proper control measures in place and you'll prevent people becoming ill and offer a safe working environment



Download IOSH's free pack on diesel engine exhaust emissions at www.notimetolose.org.uk. In the pack you'll find:



this factsheet covering the risks and how to tackle them



a presentation to help you brief managers or directors on the issue



a presentation giving workers the basics



a toolbox talk to share headline information with workers



a leaflet to hand out to workers



a pocket card to distribute to workers



a range of posters – choose the one that best suits your workplace

All our materials are available free as hard copies too – please contact campaigns@iosh.co.uk to find out more.

Sources: American Cancer Society, European Commission, Health and Safety Executive, Institute of Occupational Medicine, International Agency for Research on Cancer, Occupational Safety and Health Administration (part of US Department of Labor), Dr Lesley Rushton (Imperial College, London).

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