

Diesel Emissions, Health and the Law

What are Diesel Engine Exhaust Emissions (DEEE)

When diesel is used as an engine fuel, it is inevitable that you will produce Products of Incomplete Combustion (PICs). Hence, we never just produce carbon dioxide (CO₂) and water (H₂O) alone, but rather a myriad of hydrocarbons including aromatics (e.g. benzene, toluene) aldehydes and poly-aromatic hydrocarbons (PAHs) in a semi-volatile phase or bound with carbonaceous particulate, and some relatively simple inorganic gases; such as carbon monoxide (CO), nitrogen monoxide (NO) and nitrogen dioxide (NO₂). When poor fuel quality is used we might also see oxides of sulphur, however this is very unlikely to be the case in Europe.



Why is this a Risk to Health?

The complexity of the organic components of combustion from diesel fume mean that we are not able to easily define the constituent component or components that cause ill health. However, it is recognised that short term exposure to DEEE is directly associated with irritation to the eyes and respiratory tract. This is particularly noticeable in the workplace in which large diesel vehicles or engines are started from cold in a confined atmosphere; such as a vehicle depo for buses, lorries or trains, but also warehouses in which diesel powered forklift trucks are used. Prolonged exposure to DEEEs can lead to coughing, increased sputum production and breathlessness.

The content of many known carcinogenic substances in DEEE (e.g. aromatics and PAHs) that are easily inhaled, mean that DEEE is defined as a category 1 human carcinogen, with significant evidence indicating that sustained occupational exposure to DEEEs can result in an increased risk of developing lung cancer.

What does the Law Say?

Due to DEEEs containing substances recognised as being hazardous to health (e.g. aromatics, PAHs, CO, NO and NO₂) as defined in the COSHH Regulations 2002 (as amended), they fall under the general provisions of those Regulations. As such, it is required that exposure is prevented or, where this is not reasonably practicable, adequately controlled.

DEEE is recognised as a category 1 human carcinogen (“definite”) by the International Agency for Research in Cancer (IARC) for lung cancer. Nevertheless, under COSHH it is not classified as a human carcinogen, with no specific WEL associated with it, but as a suspect carcinogen a precautionary approach to assessment and control is needed. It is further required under COSHH regulation 3, that the reduction of exposure to DEEE extends to non-employees (including members of the public) so far as is reasonably practicable. Hence, the use of diesel engines in the public transportation sector (road and rail) means that sufficient assessment of the risk be undertaken and control measures put in place.

How do I monitor DEEEs?

As there is no set Workplace Exposure Limit (WEL) for DEEE, it is necessary to undertake an

assessment of the components that pose the most significant risk, which means sampling for constituent gases such as carbon dioxide (CO₂), carbon monoxide, nitrous oxides (NO, NO₂) and respirable dust represented as elemental carbon (EC).

It is preferable to undertake personal monitoring of these hazards, collected in the breathing zone of the employees. These samples must be sufficient to assess the potential for exposure during a working shift and include peak exposures. As such, it is preferable to have time series data so that activities can be assessed alongside average exposure. For the gaseous components this can normally be achieved through use of a multigas monitor such as the MultiRae Lite with electrochemical sensors installed for CO, NO, NO₂ and IR CO₂. As a precautionary measure it may also be worthwhile assessing the levels of oxygen (O₂). Once this information is collected, the individual gases can be compared against their WELs to determine the potential level of exposure. It must be recognised that it is not possible to establish how far controlling exposure to the individual gaseous components to below their WELs will control the carcinogenic risk. Nevertheless, reducing their levels of exposure should reduce exposures to DEEEs in general, and thereby the carcinogenic risk.

In order to collect respirable elemental carbon it is necessary to use take gravimetric samples using MDHS 14-4, "General Methods for the Gravimetric Determination of Respirable and Total Inhalable Dust." As there is no WEL for DEEE particulate, a reference value of 0.15mg/m³ for EC has been used by HSE as indicative of 'high' EC exposure. For such sampling you would use equipment such as a Gilair Plus, personal air sampling pump with appropriate sampling heads.

Where it is not possible to undertake personal monitoring fixed place monitoring may be undertaken to establish the effectiveness of control measures, establishing the background levels of such gases as CO, CO₂, NO and NO₂. Respirable dust may also be assessed using photometric techniques, but it must be understood that the levels measured will include particulates from all sources and not just the DEEEs. This can be undertaken using fixed gas sampling heads such as those from GDS or Honeywell and live dust monitors such as the DustTrak DRX.

DEEEs in the Environment

The contribution from the workplace to DEEEs in the general environment mean that overall levels of nitrous oxides and PM₁₀ and PM_{2.5} are on the increase. However, the vast majority of these primarily arise from road traffic. Higher levels of particulate matter less than 10 µm diameter have been associated with increased cardiovascular or respiratory disease, particularly among the elderly and susceptible individuals.

To monitor this, static sampling of PM₁₀ is averaged over a 24-hour running period (see the environmental DustTrak from TSI) and can be compared against the recommended air quality standard (AQS) for PM₁₀ in the UK. There is no simple method for measuring personal exposure. The AQS is not a workplace standard or WEL. Under COSHH, there is no need to measure PM₁₀ to AQS level. However, a significant drive to reducing the overall levels of these pollutants within urban areas is on the rise with such initiatives as "The Traffic and Health project in London" lead by Kings College London.

For further information on DEEEs please see the following documents:

INDG 286 – "Diesel engine exhaust emissions"

HSG 187 – "Control of diesel engine exhaust emissions in the workplace"

IOSH – "Diesel engine exhaust fumes: The facts."

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