

# Health Council of the Netherlands

## Kerosene Engine Exhaust

### Executive summary



Kerosene engine exhaust (KEE) is a complex mixture that is emitted due to the combustion of kerosene jet fuel by aircraft engines. The composition and concentration of the combustion products of KEE are mainly influenced by the type of aircraft engine, the type of fuel and varying conditions, such as power settings and weather conditions. The health risks of occupational exposure to KEE were evaluated by the Dutch Expert Committee on Occupational Safety (DECOS), the Dutch subcommittee on the Classification of Carcinogenic Substances of the Health Council of the Netherlands, and the Nordic Expert Group for Criteria Documentation of Health Risks from Chemicals (NEG). The hazard evaluation was carried out at the request of the Dutch Ministry of Social Affairs and Employment, and the regulatory authorities of Denmark, Finland, Norway and Sweden.

#### **Evaluation of hazardous substances and mixtures to protect workers**

The committees have the permanent task of carrying out hazard evaluations to protect workers against negative health effects due to their work. When there are indications that a substance or a mixture is a hazard, the committees propose a classification in an EU-hazard category and decide on a recommendation for a health-based occupational exposure limit (hb-OEL) for the substance or mixture. The national authorities can use

these recommendations as a basis for setting legally binding occupational exposure limits (OELs). More information about the committees and their tasks can be found on [healthcouncil.nl](http://healthcouncil.nl) and [nordicexpertgroup.org](http://nordicexpertgroup.org).

This advisory report contains an evaluation of the genotoxicity and carcinogenicity of KEE, and an evaluation of the toxicity and health effects as a basis for setting a hb-OEL for KEE.

#### **KEE particles can penetrate deep into the lungs**

KEE contains numerous components, such as carbonaceous particles (containing elemental carbon and organic carbon), polycyclic aromatic hydrocarbons (PAHs), metals, sulphur oxides and nitrogen oxides. KEE is generally characterised by high concentrations of very small (ultrafine) combustion-generated particles. These ultrafine particles (UFP), and particle-bound substances like PAHs, can penetrate deep into the lungs when inhaled, reaching the lung alveoli. If deposited, these UFP can pass biological membranes, enter cells and the systemic blood circulation.

Workers with activities related to operating kerosene-fuelled aircrafts are exposed to KEE, for example baggage handlers, flight officers, fuel opera-

tors, mechanics, engineers and personnel responsible for catering or towing/pushback. The highest concentrations of KEE particles in air have been reported at the apron of airfield and airport.

Exposure to KEE has been linked to several adverse health effects, such as inflammation, reduction of lung function, and worsening of respiratory diseases. In addition, several of the components of KEE are known, probable, or suspected carcinogens and/or have legally binding OELs. These components include some of the PAHs and metals.

#### **Analogy approach used for classification**

The committees evaluated the genotoxic and carcinogenic properties of KEE by using the criteria based on the CLP Regulation (Classification, Labelling and Packaging of chemicals). Currently, there is limited scientific data on KEE. The available data for KEE are (on itself) not sufficient to serve as a basis for a classification. However, the committees consider diesel engine exhaust (DEE) to be a substantially similar mixture to KEE. For DEE a large amount of data is available. Both KEE and DEE are complex mixtures derived from the combustion of crude oil, have a (relatively) similar composition of combustion products and similar physicochemical properties. Because of these similarities, the committees infer that they also have similar toxicological effects, which allows for an analogy approach. This means proposing a classification for a substance based on data on KEE supplemented with data on DEE.

#### **Classify KEE for germ cell mutagenicity**

The committees evaluated whether KEE can cause genotoxicity. There is no data on germ cell mutagenicity (a measure for genotoxicity) for KEE and insufficient data on germ cell mutagenicity for DEE. There is limited evidence for genotoxic properties of KEE in somatic tissues. Evidence from toxicological studies on DEE supports that KEE has genotoxic potential in somatic tissues. Because there are no strong indications for mutagenicity in germ cells, the committees recommend classification for germ cell mutagenicity of KEE in EU-hazard category 2 (see text box on page 4).



#### **Classify KEE for carcinogenicity**

The committees evaluated whether KEE can cause carcinogenicity. There is limited evidence for the carcinogenic properties of KEE, but there is ample evidence from epidemiological and toxicological studies on DEE. In addition, KEE and DEE both contain several known carcinogenic components, and DEE has been classified as carcinogenic to humans (Group 1) by the International Agency for Research on Cancer (IARC). Based on the limited evidence for KEE and the analogy with DEE, the committees recommend a classification for carcinogenicity of KEE in EU-hazard category 1B, presumed (or probably) carcinogenic to humans (see text box on page 4).

**Health-based OEL for KEE could not be derived**

For the (quantitative) exposure assessment of KEE, for the benefit of establishing a hb-OEL, a selective and measurable indicator of exposure is needed. However, no suitable indicator for KEE could be identified.

Additional research is needed to establish a suitable indicator for KEE.

To recommend a hb-OEL, the committees also require quantitative exposure response data. The committees consider the available human data as insufficient to derive a hb-OEL for KEE. In this case, an analogy with DEE was not deemed feasible, because it is uncertain whether the quantitative exposure-response relationship for DEE, which is based on elemental carbon, can be applied to KEE. Moreover, although there is evidence for the presence of elemental carbon in KEE particles, the concentrations of elemental carbon in KEE particles have not yet been established in relation to potential adverse health effects.

**Apply existing OELs**

Although a hb-OEL for KEE could not be derived, the available data for KEE indicate that occupational exposure can lead to several health effects.

Furthermore, KEE shows similarities with DEE, which has been classified as carcinogenic to humans. Also, several components of KEE are known, probable or suspected carcinogens, and for some of these components of KEE, OELs have been established. This gives reason for concern. Therefore, the committees recommend that existing occupational exposure limits for DEE as well as for components of KEE, such as PAHs, metals and

others, be applied for KEE to protect workers with activities related to operating kerosene-fuelled aircrafts. However, it is uncertain whether existing OELs are sufficient to protect these workers against potential health effects of the entire KEE mixture. Therefore, the committees also recommend further research to establish an exposure response relationship based on data for KEE, to allow for the derivation of a hb-OEL for KEE.

**More research needed**

To establish a hb-OEL, high quality epidemiological studies, such as occupational cohort or case-control studies, are needed with sufficient follow-up time, thorough exposure (which requires a suitable indicator for KEE) and health assessment and relevant information on potential confounders. Such further research should also include studies comparing DEE and KEE, including studies particularly focussing on particles and (quantitative) elemental carbon content. Together, these findings could support the derivation of a hb-OEL for KEE and/or scientifically demonstrate the applicability of the OEL for DEE to KEE.

### Classification for mutagenicity and carcinogenicity

The Health Council performs classification and labelling of substances according to the guidelines of the European Union (Regulation (EC) 1272/2008). The hazard categories described below indicate the strength of the evidence for hazardous properties of the substance. The substance is labelled using an EU Hazard statement code that can be used on packaging.

#### EU hazard categories for mutagenicity in germ cells

- Category 1A Known to induce heritable mutations in human germ cells (EU Hazard statement H340)
- Category 1B Presumed to induce heritable mutations in human germ cells (H340)
- Category 2 Suspected to induce heritable mutations in human germ cells (H341)

#### EU hazard categories for carcinogenicity

- Category 1A Known to be carcinogenic to humans (H350)
- Category 1B Presumed to be carcinogenic to humans (H350)
- Category 2 Suspected to be carcinogenic to humans (H351)

#### Implications for the workplace

According to the Dutch Working Conditions Act, employers are legally required to prevent or minimize the health and safety risks of working with hazardous substances as much as possible. Based on the Health Council's recommendations for classification, the State Secretary of Social Affairs and Employment can decide to add substances to the official list of substances that are carcinogenic, mutagenic or toxic to reproduction (CMR-substances). This list includes carcinogenic and mutagenic substances in categories 1A and 1B, and substances toxic to reproduction in categories 1A, 1B and 2. Depending on the classification, the government asks the employer to take additional measures to protect employees.

Nordic countries have similar regulations for CMR-substances, employers are required to prevent (by replacing CMR-substances) or to minimize the health and safety risks of working with hazardous substances as much as possible.

This publication can be downloaded from [healthcouncil.nl](https://healthcouncil.nl).

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