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Fire-resistant hydraulic fluids - Classification and specification - Guidelines on selection for the protection of safety, health and the environment

Schwer entflammbare Druckflüssigkeiten - Klassifikation und Spezifikation - Auswahlleitlinien zur Wahrung der Sicherheit, der Gesundheit und des Umweltschutzes

Fluides difficilement inflammables - Classification et spécification - Principes directeurs de sélection de fluides et de considération des risques de sécurité et d'environnement

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Schwerentflammbare Druckflüssigkeiten - Klassifikation und Spezifikation - Auswahlrichtlinien ur Gewährleistung von Sicherheit, Gesundheit und Umweltschutz

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Foreword

This CEN Technical Report (CEN/TR 14489:2005) has been prepared by Technical Committee CEN/TC 19 “Petroleum products, lubricants and related products”, the secretariat of which is held by NEN.

This document has been prepared under mandate M/238 given to CEN by the European Commission and the European Free Trade Association along with other standards on fire-resistant hydraulic fluids to be complementary to the regulatory measures contained in various EU Directives.

The mandated work of CEN/TC 19 is to develop European Standards for specifications and testing conditions applicable to fire-resistant hydraulic fluids.

Introduction

The function of this Technical Report is to provide suppliers and users of equipment guidance on how compliance with the essential health and safety requirements (EHSR's) incorporated in both Product (Article 95) and User (Article 137/138) Directives issued by the European Union may be achieved in respect of the use of fire-resistant hydraulic fluids. It builds upon the guidance provided in EN 1050 on the principles of risk assessment. EN 1050 in turn supports Directive 92/104/EEC [1].

The document was considered necessary because the specialised nature of fire-resistant fluids and the tests used to quantify their properties may not in general be familiar to prospective machinery manufacturers and users. Because several Directives deal with the prevention of fire it is necessary to consider other aspects in addition to the tests used to quantify fire properties.

The use of fire-resistant hydraulic fluids is a fire protection measure. A fire occurs if combustible materials or explosive gases, oxygen and an ignition source are all present at the same time. If there is a danger of an ignition source being present when hydraulic installations are in use, one method of improving safety may be to replace more combustible mineral oil by a fire-resistant hydraulic fluid. Fire-resistant fluids provide fire protection. Their use, however, shall not jeopardise other safety measures as, in addition to requirements for fire resistance, there are additionally requirements for assessing effects on the health of workers and, increasingly, on potential effects on the environment. Guidance on the information needed is contained in this Technical Report.

IMPORTANT — This document does not purport to address all of the safety problems associated with the use of hydraulic systems. It is concerned with the use of fire-resistant fluids as a means of reducing the risk of fire. It is the responsibility of the user of this document to establish appropriate safety and health practices to reduce other safety risks and to determine the applicability of regulatory regimes.

1 Scope

This Technical Report gives guidance on the achievement of compliance with Essential Health and Safety Requirements (EHSR) by the selection of fire-resistant fluids or by other means. It includes consideration of the selection of fluids with lower levels of fire resistance and of mineral oil, with appropriate additional safety measures, where this option may be considered to be most satisfactory during operation.

This Technical Report is concerned with assessing the fire resistance, health properties and effects on the environment, but does not cover requirements for their general physical and chemical properties, which are detailed in EN ISO 12922.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1050:1996, *Safety of machinery - Principles for risk assessment.*

EN ISO 2592, *Determination of flash and fire points – Cleveland open cup method (ISO 2592:2000).*

EN ISO 6743-4, *Lubricants, industrial oils and related products (class L) – Classification – Part 4: Family H (Hydraulic systems) (ISO 6743-4:1999).*

EN ISO 12922, *Lubricants, industrial oils and related products (class L) - Family H (Hydraulic systems) - Specifications for categories HFAE, HFAS, HFB, HFC, HFDR and HFDU (ISO 12922:1999, including Technical Corrigendum 1:2001)).*

EN ISO 14935, *Petroleum and related products - Determination of wick flame persistence of fire-resistant fluids (ISO 14935:1998).*

ISO 3448, *Industrial liquid lubricants - ISO viscosity classification.*

ISO 7745, *Hydraulic fluid power – Fire-resistant (FR) fluids – Guidelines for use.*

3 Terms and definitions

For the purposes of this Technical Report, the following terms and definitions apply.

3.1
safety
freedom from unacceptable risk

[ISO/IEC Guide 51:1999]

3.2
risk
combination of the probability of occurrence of harm and the severity of that harm

[ISO/IEC Guide 51:1999]

3.3
harm
physical injury or damage to the health of people, or damage to property or the environment

[ISO/IEC Guide 51:1999]

3.4
hazard
potential source of harm

[ISO/IEC Guide 51:1999]

3.5
hazardous event
event that can cause harm

3.6
safety measure
means that eliminates a hazard or reduces a risk

3.7
risk assessment
overall process comprising a risk analysis and a risk evaluation

[ISO/IEC Guide 51:1999]

3.8
risk analysis
systematic use of available information to identify hazards and to estimate the risk

[ISO/IEC Guide 51:1999]

3.9
risk evaluation
procedure based on the risk analysis to determine whether the tolerable risk has been achieved

[ISO/IEC Guide 51:1999]

3.10
environmental properties
chemical or physical properties of a hydraulic fluid which may interact with the environment

3.11
fire resistance
ability of a fluid to fulfil an expected duty in standard fire resistance tests

3.12
fire-resistant
having the property of fire resistance according to one or more standard test methods

4 General requirements

In circumstances where it is necessary to use hydraulic fluids, an assessment is needed as to whether fire-resistant fluids may be the best option for reducing the risk of fire starting and spreading. Where fire-resistant fluids are chosen they shall make an overall contribution towards improving safety. Hence they shall not only meet requirements for fire resistance but also for the protection of the health of workers and the environment and, shall not jeopardise other safety measures that may be in use. The primary reason for selecting fire-resistant fluids is to protect against the risk of fire: protection of the environment may be achieved by methods other than the properties of the fluids.

In some countries in the European Union (EU) and European Free Trade Association (EFTA) governments operate approval schemes for hydraulic fluids or impose local regulations, which require that particular levels of performance be met in specific tests to allow fluids to be used in certain industrial situations (see Annex A).

Compliance with these schemes and regulations is considered by the regulatory authorities in those countries to constitute compliance with the appropriate EU Directives for the application of hydraulic fluids. It should be noted that such regulations take precedence over CEN standards, and potential suppliers and users of hydraulic fluids should establish whether approval schemes or local regulations exist.

Annex A contains a list of the countries that operate approval schemes for hydraulic fluids or impose local regulations.

Fire-resistant hydraulic fluids shall conform to the specifications laid down for the various industries by the European Authorities and/or the certification authorities of each member state according to the risks arising in each industry, distinguishing if necessary between installations giving rise to greater or lesser hazards. Certification shall be carried out with reference to the specifications and standards issued by the European or national authorities and should be based on the tests contained in Annex B and C of this Technical Report.

5 Classification of fire-resistant fluids

Table 1 lists the main categories of fire-resistant fluids as found in EN ISO 6743-4, their compositions and applications.

Fire-resistant fluids in accordance with EN ISO 6743-4 are hydraulic fluids which are classified as fire-resistant in accordance with particular fire test procedures. They achieve their fire resistance either because they contain water or because their chemical composition confers fire resistance. Only water and fire-resistant fluids of type HFA with water content above 90 % are considered to be non-combustible. Fire-resistant fluids do, however, require a substantially greater input of energy to cause ignition than conventional mineral oil hydraulic fluids and may not sustain combustion after leaving the ignition source.

The level of fire resistance shall be established by the use of a range of standard protocols (for guidance see Annex B). In the event that a test representing the particular circumstance of use is not included in EN ISO 12922 then data from other fire-resistance tests having adequate precision may be invoked, subject to local regulations.

Table 1 — Categories of fire-resistant fluids, their compositions and applications according to EN ISO 6743-4

Type [a] Symbol	Composition	Typical applications and operating temperature range [b]
1. AQUEOUS FLUIDS[e]		
HFAE [b]	Oil-in-water emulsions. Emulsifying oil content less than 20 % by mass and typically in the range 1 % to 5 % by mass.	Hydraulic systems in continuous casting plant, mine roof supports. Operating temperature range 5 °C to 50 °C.
HFAS [c]	Chemical solutions in water. Concentrate content less than 20 % by mass and typically 1 % to 5 % by mass.	Hydraulic systems in continuous casting plant, mine roof supports. Operating temperature range 5 °C to 50 °C.
HFB and HFB LT	Water-in-oil emulsions. Mineral oil content approximately 60 % by mass, "LT" designation indicates emulsions that are stable at low temperatures	Hydrostatic systems in coal mines. Operating temperature range 5 °C to 50 °C.
HFC	Water polymer solutions. Water content not less than 35 % by mass	Hydrostatic systems in steel plant and coal mines. Operating temperature range –20 °C to 50 °C.
2. ANHYDROUS FLUIDS		
HFDR	Synthetic fluids containing no water and consisting of phosphate esters	Hydrodynamic couplings, operating temperature up to 150 °C and hydrostatic transmissions, operating temperature range –20 °C to 70 °C.
HFDU [d]	Synthetic fluids containing no water and of other composition	Hydrostatic transmissions operating temperature range –20 °C to 70 °C.

[a] Viscosity grade according to ISO 3448. The viscosity grades most commonly encountered are 32, 46, 68 and 100.

[b] See ISO 7745 for additional information.

[c] The viscosity of HFAE and HFAS fluids that contain 95 % or more of water is very close to that of water and is usually not measured. These fluids are given the viscosity 1.

[d] Fluids that fall within the HFDU category are defined imprecisely with respect to their chemical compositions. The most widely used group of fluids that currently fall within this classification are the synthetic esters.

[e] Water-containing fluids should not be used when processing magnesium, as explosive gases maybe formed.

6 Compliance with essential health and safety requirements (EHSR)

6.1 General

Where national approval schemes or local regulations exist (Annex A) and where compliance with these schemes or regulations is considered by the regulatory authorities to constitute compliance with the appropriate EHSR's given in EU Directives for the application of the hydraulic fluid, suppliers and users shall ensure that hydraulic fluids are submitted to the appropriate bodies for certification.

Where approval schemes or local regulations do not exist or where compliance with them does not constitute compliance with the appropriate EU Directives, compliance with the EHSR's may be achieved by:

either

- the selection of hydraulic fluids that have fire-resistance, health and environmental properties appropriate to the circumstances of use;

or

- the use of other safety measures in conjunction with, or instead of, certain fire-resistance, health and environmental properties.

Selection of the optimum safe system can be achieved by adopting a risk assessment approach according to the principles in EN 1050.

6.2 Need for detailed information

Because the water content and chemical composition of fire-resistant fluids may vary, not only from type to type, but also from one product to another within a type, levels of fire resistance, health effects and environmental properties may also vary. It follows that a fluid that is suitable for use in one circumstance and provides compliance with the EHSR's may not be suitable for other applications.

The initial step towards compliance with the EHSR's is to carry out a logical examination of the circumstances in which both the hydraulic fluid and the system are to be used so that the hazards that are present may be determined (see Clause 7). Following this, an assessment is carried out to identify the consequences of the hazards in terms of the possible effects of the occurrence of the hazardous event on people, property and the environment (see Clause 8) so that the safety measures that need to be taken to control or to eliminate the hazards or to reduce risks can be determined. These safety measures may include, but may not be confined to, the use of fire-resistant fluids (see Clause 9).

It shall be remembered that other hazards that are not dealt with in this standard may exist and shall be the subject of separate risk assessments. Annex A of EN 1050:1996 gives examples of hazards, hazardous situations and events.

6.3 Information needed

The following basic information is needed for compliance assessment.

a) Circumstances of use for both the hydraulic fluid and the system so that the EHSR's contained in the Directives that are relevant to those circumstances may be ascertained.

b) Performance required of the hydraulic fluid in service by the end user or equipment manufacturer.

c) Determination of all hazards associated with the use, including foreseeable misuse (see Clause 7) and foreseeable failure conditions.

d) Health and Safety Data Sheets for candidate hydraulic fluids.

e) Performance of candidate hydraulic fluids in appropriate tests to assess fire resistance, effects on health and effects on the environment (see Clause 9).

f) Information on procedures for the disposal and waste treatment of candidate fluids.

It is also desirable to have available the following information.

g) Any experience with certified fire-resistant hydraulic fluids in the particular use or in similar circumstances.

h) Any experience in the particular use with other hydraulic fluids of the same chemical type as that under consideration.

i) Any experience with other hydraulic fluids in the particular use or in similar circumstances.

j) Any accident history and any information regarding damage to health or the environment.

Directive 67/548/EEC [3] (as amended by the Seventh Amendment 92/32/EEC [4]) and Directive 1999/45/EC [5] require suppliers of all substances to provide Health and Safety Data Sheets on their products that give information relating to the health and safety of persons and the effect of the product on the environment. Requirements for the general structure and content of Health and Safety Data Sheets are set out in Directive 91/155/EEC [6] (as amended by Directive 93/112/EC [7]).

The Directive requires the data sheets to:

— indicate the presence of components that have adverse health effects;

— give appropriate risk and safety phrases;

— identify the hazards that the product presents both to persons and to the environment;

— provide information on first aid measures, fire-fighting, exposure controls and personal protection;

— provide toxicological and ecological information.

NOTE 1 The data sheets may not contain all of the information needed to comply with the EHSR's and to allow control of all of the hazards that are identified in Clause 7 and that might be associated with hydraulic fluids.

NOTE 2 It is desirable at this stage to consider the use of hydraulic fluids that contain recycled components or readily biodegradable fluids (see ISO 15380 [8]) in order to minimise the impact on the environment where technical requirements permit.

7 Hazard identification

7.1 Fire hazards

The fire hazards potentially present in the situation under examination shall be determined.

The following fire hazards are directly related to the use of hydraulic fluids under fault conditions.

a) Ignition of combustible vapours produced by hydraulic fluid.

b) Ignition of hydraulic fluids ejected under pressure from hydraulic systems in the form of a spray.

c) Ignition of hydraulic fluid spilled during transport or leaking from hydraulic systems on to absorbent material such as lagging or combustible dust and the subsequent propagation of fire along the absorbent material.

d) Ignition of a fluid stream or pool.

e) Ignition of hydraulic fluids when the fire resistance has been reduced by chemical or physical changes in the fluid caused by service operation.

EXAMPLE 1 Reduction of fire resistance due to evaporation or separation of the water content which provides fire resistance for some types of fluid.

f) Ignition of fire-resistant fluid contaminated with more combustible substances.

EXAMPLE 2 Contamination of fire-resistant fluid by mineral oil where system changeover procedures for the conversion to the use of fire-resistant fluid have not been made correctly.

NOTE EN 1710 [9], which contains specifications for equipment intended for use in potentially explosive atmospheres in mines, contains provisions for an allowed maximum temperature of machine surfaces, which are limited not to exceed 150 °C.

7.2 Sources of ignition

The ignition sources potentially present in the situation under examination shall be determined.

Sources of ignition such as spark, flames, electric arcs, high surface temperatures, acoustic energy, optical radiation and electromagnetic waves are potentially present in underground mines[1)] They are also likely to be present in other work situations. Possible situations in which these sources of ignition may occur are given below. The list shall not be taken as being exhaustive:

— discharge of static electricity;

— stray electric currents or discharges from malfunctioning electricity supply equipment, which could produce overheating of surfaces or sparks capable of causing ignition;

— friction between moving surfaces or the entrapment of foreign bodies between moving surfaces caused, for example, by failures of mechanical plant, causing localised overheating;

— high surface temperatures in the workplace arising from the presence of molten materials or materials undergoing high temperature manufacturing operations;

— high surface temperatures present in the braking systems, transmissions, or exhausts of internal combustion engines;

— use of smoking or other materials that may be contraband in some industrial situations;

— existing fires caused by the ignition of other combustible materials in the workplace.

Other ignition sources that may be present include open flames, welding spatter and sparks from grinding operations. The importance of long periods of exposure to low grade sources of heat, which may, for example, remove water from water-containing fluids, shall be considered.

7.3 Consequences of combustion

The risk assessment shall take account of the consequences of combustion in terms of obscuration of exits, increased escape times, exposure to toxic products, local high temperatures and the possibility of the spread of fire.

Combustion may result in:

- the production of smoke and/or steam, which may obscure exits and result in longer escape times;
- the production of toxic gases, the effects of which will depend on the nature of the products, the local ventilation and escape conditions;
- high local temperatures, which may result in personnel being engulfed in flame or suffering immobilisation due to burns; and

1) These sources of ignition have been identified in European Council Directive 92/104/EEC.[1]