**ISO~~/PRF~~ 7745:2023(E)**

**ISO TC 28/SC 4/WG 3**

**Secretariat: AFNOR**

~~**Third edition**~~

**Date: 2023-~~10-04~~11-07**

# Hydraulic fluid power — Fire-resistant ~~(FR)~~ fluids — Requirements and guidelines for use

*Transmissions hydrauliques — Fluides difficilement inflammables ~~(FR)~~ — Exigences et principes directeurs pour leur utilisation*

**Style Definition:** zzSTDTitle: Left

**Style Definition:** Hashtag1

**Style Definition:** Mention1

**Style Definition:** Smart Hyperlink1

**Style Definition:** Unresolved Mention1

**Formatted:** Font: Arial

**Formatted:** Font: Arial

**Formatted:** Section start: New page

**Formatted:** Font: Arial, 12 pt

**Formatted:** Font: Arial

**Formatted:** Font: Arial

**Formatted:** Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

**Formatted:** Font: Arial

**Formatted:** Font: Arial, Italic

**Formatted:** Font: Arial

**Formatted:** Font: Arial, Italic

**Formatted:** Font: Arial

**Formatted:** Font: Arial, Bold

Formatted: Font: 11.5 pt

Formatted: Font: 11.5 pt

Formatted: Font: 11 pt, Not Bold

Formatted: Justified, Space Before: 0 pt, Line spacing: At least 12 pt

Formatted

Formatted: Font: Arial, 10 pt

Formatted: Default Paragraph Font, Font: 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Default Paragraph Font, Font: 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

Formatted: Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Formatted: Font: Arial, 10 pt

Formatted: Font: Arial, 10 pt

# Contents

Page

Formatted: Justified, Space Before: 0 pt, Line spacing: At least 12 pt

Formatted: Font: 11.5 pt

Formatted: Font: 11.5 pt

Formatted: Font: 11 pt, Not Bold



 

Formatted: Right: 25 pt, Space Before: 6 pt, After: 12 pt

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 28, *Petroleum and related products, fuels and lubricants from natural or synthetic sources*, Subcommittee SC 4, *Classifications and specifications.*

This third edition cancels and replaces the second edition (ISO 7745:2010), which has been technically revised.

The main changes are as follows:

— addition of Clause 2 “Normative references” and renumbering of subsequent clauses accordingly;

— update of Table 2;

— update of the dated references.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

## Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. The most widely used liquid for hydraulic power systems is mineral oil which has the advantages of excellent lubricity, availability in a wide range of viscosities and reasonable cost.

While not readily ignited in bulk, mineral oil is nevertheless flammable and the high pressures associated with hydraulic systems can lead to a release of fluid which is easily ignited. In circumstances where ignition is likely, such as in a steel mill, or where the released fluid must not propagate a fire, such as in a coal mine, an alternative, fire-resistant, fluid must be used. Fire-resistance and physical properties such as viscosity and lubricity vary widely among the several types of fluid available. It is therefore important to select a fire-resistant fluid which matches its proposed application and the perceived hazards in use.



 

# Hydraulic fluid power — Fire-resistant (FR) fluids — Requirements and guidelines for use

## 1 Scope

This document specifies the operational characteristics for the various categories of fire-resistant fluids defined by ISO 6743-4. It includes requirements and guidelines for use of these fluids and ~~details~~specifies the factors to ~~be considered~~consider when selecting a fluid from these categories for a proposed application.

This document identifies difficulties which can arise from the use of such fluids and indicates how they can be minimized. Procedures are given for replacing one fluid with another from a different category. Health and safety aspects when handling and disposing of fire-resistant fluids are also covered.

This document does not apply to fire-resistant fluids used in the hydraulic systems of commercial or military aircraft.

## 2 Normative references

There are no normative references in this document.



## 3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/



**3.1**
**fire-resistant hydraulic fluid**
hydraulic fluid which is difficult to ignite and shows little tendency to propagate flame

[SOURCE: ISO 5598:2020, 3.2.282]

## 4 Hydraulic systems — Fire hazards

### 4.1 General

Fluid pressures in hydraulic power systems range up to 50 000 kPa (500 bar) and more. Therefore, any lack of integrity in the construction of a system which results in a burst or even a small leak, can in many circumstances give rise to a serious fire hazard.

### 4.2 Fault conditions

Failure of piping (particularly at joints and fittings), valves or gaskets, and rupture of flexible hoses have been principal causes of fluid being released from a system. The period of highest risk of this type of failure is during the commissioning, or after the repair, of a hydraulic system.

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



**Formatted:** Font: Not Bold

**Formatted:** Font: Not Bold

**Formatted:** Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

**Formatted:** Line spacing: At least 12 pt

**Formatted:** Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

**Formatted:** Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers

**Formatted:** English (United Kingdom)

**Formatted:** Font: 11 pt, English (United Kingdom)

**Formatted:** English (United Kingdom)

**Formatted:** Don't adjust space between Latin and Asian text, Don't adjust space between Asian text and numbers, Tab stops: 19.85 pt, Left + 39.7 pt, Left + 59.55 pt, Left + 79.4 pt, Left + 99.25 pt, Left + 119.05 pt, Left + 138.9 pt, Left + 158.75 pt, Left + 178.6 pt, Left + 198.45 pt, Left

**Formatted:** English (United Kingdom)

~~a)~~ a) ignition of hydraulic fluids ejected under pressure from hydraulic systems, in the form of a jet, spray or fog;

~~b)~~ b) ignition of combustible vapours produced by hydraulic fluid;

~~c)~~ c) ignition of hydraulic fluid spilled during transport, or leaking from hydraulic systems, onto absorbent material such as lagging or dust and the subsequent propagation of fire along the fluid-wet absorbent material;

~~d)~~ d) ignition of a fluid stream or pool;

~~e)~~ e) ignition of hydraulic fluid where fire-resistance has been reduced by chemical or physical changes in the fluid caused by service operation.

EXAMPLE 1 Reduction of the fire-resistance of a fluid by evaporation or separation of water from the fluid which relies upon water to confer fire-resistance.

EXAMPLE 2 Ignition of fire-resistant fluid contaminated with more combustible substances such as mineral oil.

NOTE In each case, a source of ignition as described in 4.3 is ~~required~~crucial to initiate combustion.

### 4.3 Sources of ignition

Sources of ignition include, but are not limited to, the following occurrences:

~~a)~~ a) discharge of static electricity;

~~b)~~ b) stray electric currents or discharges from malfunctioning electrical equipment leading to high surface temperatures or sparks;

~~c)~~ c) friction between moving surfaces, either during normal operation (e.g. brakes) or under fault conditions, leading to high surface temperatures;

~~d)~~ d) high surface temperatures due to the presence of hot molten materials or materials undergoing high temperature manufacturing operations;

~~e)~~ e) sparks and open flames from manufacturing operations, such as cutting, welding and grinding;

~~f)~~ f) acoustic and electro-magnetic energy, such as ultrasonic and microwave radiation.

## 5 Requirements for fire-resistant fluids

### 5.1 General fluid requirements

#### 5.1.1 General

To perform satisfactorily in a hydraulic system, a fire-resistant fluid shall have properties and characteristics which match the system requirements. Conversely, if the perceived risk of fire limits the range of fluid types which can be used, the components of the hydraulic system shall be designed to perform adequately with the fire-resistant fluid selected.

#### 5.1.2 Viscosity

The fluid shall be sufficiently viscous at all working temperatures to prevent unwanted leakage across working clearances wherever a pressure differential exists. Where the chosen fluid has a very low viscosity, system components shall be selected which are designed specifically for use with such fluids.

**Formatted:** Font: 11.5 pt

**Formatted:** Justified, Space Before: 0 pt, Line spacing: At least 12 pt

**Formatted:** Font: 11 pt, Not Bold

**Formatted:** Font: 11.5 pt

**Formatted:** Indent: Left: 0 pt, Hanging: 20.15 pt, No bullets or numbering

**Formatted:** Note, Tab stops: 19.85 pt, Left + 39.7 pt, Left + 59.55 pt, Left + 79.4 pt, Left + 99.25 pt, Left + 119.05 pt, Left + 138.9 pt, Left + 158.75 pt, Left + 178.6 pt, Left + 198.45 pt, Left

**Formatted:** Indent: Left: 0 pt, Hanging: 20.15 pt, No bullets or numbering

**Formatted:** Line spacing: At least 12 pt

**Formatted:** Line spacing: At least 12 pt

The functional fluid, however, shall be of sufficiently low viscosity at all working temperatures to flow readily through the system and to accommodate rapid changes in velocity and pressure.

#### 5.1.3 Lubrication

The fluid shall have sufficient viscosity and film strength to lubricate working parts effectively, under both hydrodynamic and boundary conditions, over the working temperature range. Where the chosen fluid has a very low viscosity, and adequate lubrication properties are not conferred by additives, system components ~~shall be selected which~~that operate satisfactorily with the fluid shall be selected.

#### 5.1.4 Compatibility

The fluid shall be compatible with the constructional materials used in the system and ~~be~~ non-corrosive. If necessary, the system or component manufacturer shall be contacted for guidance.

#### 5.1.5 Chemical and thermal stability

The thermal, oxidative and hydrolytic stability of the fluid shall be sufficient to ensure the safe and reliable operation of the system. The service life of the fluid is closely related to the bulk operating temperature as well as the effectiveness of fluid maintenance and the successful control of contamination.

#### 5.1.6 Air release and foaming

The fluid shall release entrained air readily and not produce stable foam.

#### 5.1.7 Shear stability

The fluid shall be shear stable, i.e. its viscosity shall not display a significant permanent change as a result of applied shear in the system.



### 5.2 Other fluid properties which may impact upon system design

#### 5.2.1 General

The following fluid characteristics shall be considered during the course of system design and fluid selection.

#### 5.2.2 Filterability



The fluid shall be filterable at the rating of the finest filter in the system. The rating (fineness) of the system filters is determined by several factors, including type and condition of the fluid, component design, required component life and reliability.

#### 5.2.3 Density

The density of some fire-resistant fluids is greater than that of mineral oil, which can lead to increased pressure drops in circuit components and impose restrictions on the design of the suction line of the pump.

#### 5.2.4 Vapour pressure

The vapour pressure of some fire-resistant fluids, particularly those whose fire-resistance is conferred by the presence of water, is much higher than that of mineral oil and varies with fluid temperature. The design of the system, particularly around the suction of the pump, shall ~~minimise~~minimize the risk of cavitation at the pump inlet. Other than very coarse strainers, filters in suction lines should be avoided, and ideally the pressure at the pump inlet should be greater than 100 kPa (1 bar) absolute.