

Guide for

# The use of fire-resistant hydraulic fluids

# Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Machinery and Components Standards Policy Committee (MCE/-) to Technical Committee MCE/18, upon which the following bodies were represented:

- Advanced Manufacturing Technology Research Institute
- Association of British Mining Equipment Companies
- Bath University Library
- British Compressed Air Society
- British Fluid Power Association
- British Hydromechanics Research Association
- British Steel Industry
- Department of Trade and Industry (National Engineering Laboratory)
- Electricity Supply Industry in England and Wales
- Health and Safety Executive
- Institution of Mechanical Engineers
- Ministry of Defence

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# National foreword

This British Standard has been prepared under the direction of the Machinery and Components Standards Policy Committee. It is identical with ISO 7745:1989 “Hydraulic fluid power — Fire-resistant (FR) fluids — Guidelines for use” published by the International Organization for Standardization (ISO).

**Cross-references**

| International Standard | Corresponding British Standard                                                                                                                                 |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ISO 1629:1987          | BS 3502 <i>Schedule of common names and abbreviations for plastics and rubbers</i><br>Part 3:1978 <i>Rubbers and latices</i><br>(Identical)                    |
| ISO 3448:1975          | BS 4231:1982 <i>Classification for viscosity grades of industrial liquid lubricants</i><br>(Identical)                                                         |
| ISO 6072:1986          | BS 4832:1987 <i>Specification for compatibility between elastomeric materials and hydraulic fluids</i><br>(Identical)                                          |
| ISO 6743-4:1982        | BS 6413 <i>Lubricants, industrial oils and related products (class L)</i><br>Part 4:1983 <i>Classification for family H (hydraulic systems)</i><br>(Identical) |

The Technical Committee has reviewed the provisions of ISO 5598, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

**Summary of pages**

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

## 0 Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. One kind of fluid is a fire-resistant fluid (see clause 3 for definition). Fire-resistant properties vary widely among the types of fluids.

## 1 Scope and field of application

This International Standard provides guidelines detailing, for the various categories of fire-resistant fluids, operational characteristics, advantages and disadvantages, and the factors affecting the choice to be made amongst these various categories.

This International Standard also specifies precautions which should be adopted to reduce difficulties arising from the use of such fluids, as well as the precautions which are necessary when replacing fluids with fluids from different categories.

The installation of hydraulic circuits with respect to, fire-resistant fluids is also described in this International Standard.

## 2 References

ISO 1629, *Rubber and latices — Nomenclature*.

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

ISO 5598, *Fluid power systems and components — Vocabulary*.

ISO 6072, *Hydraulic fluid power — Compatibility between elastomeric materials and fluids*.

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

## 3 Definitions

For the purposes of this International Standard, the definitions given in ISO 5598 and the following definition apply.

### fire-resistant (FR) fluid

fluid difficult to ignite which shows little tendency to propagate flame

NOTE The definition of “fire-resistant fluid” given is taken from ISO 5598, but it is repeated here for the sake of convenience.

## 4 Hydraulic systems — Applications, hazards and general precautions

### 4.1 General

Normal fluid pressures in hydraulic power systems range up to 4 000 kPa<sup>1)</sup> (400 bar). It follows that any lack of integrity in the construction of a system or any burst or even small leak can lead to a projection of fluid over a considerable distance. Should the fluid be flammable, this can in many circumstances give rise to a serious fire hazard.

### 4.2 Causes of fire

Failure of piping (particularly at joints), failure of valves, gaskets or fittings, pulling out of tubing from fittings, and rupture of flexible hoses have been the principal causes of fluid being released from a system.

The release of fluid under pressure where there is an ignition source, for example molten metal, gas burners, sparks, electrical equipment and hot metal surfaces have been the cause of many hydraulic fluid fires. Even frictional heating may produce temperatures sufficient to cause spontaneous combustion (auto-ignition) of fluid. Fires have occurred due to the accidental or mistaken disconnection of hydraulic piping or hose while under pressure. Slow leaks into absorbent surfaces, such as lagging, may also support combustion.

### 4.3 General precautions

#### 4.3.1 Major hazards

It will be appreciated that the summary of major hazards given below is not exhaustive and also that the comment is merely good engineering practice applicable equally to systems where either mineral oils or fire-resistant fluids are in use. The following constitute major hazards:

- a) leaks (see 4.3.2);
- b) high fluid temperature (see 4.3.3);
- c) fluid degradation (see 4.3.4);
- d) faulty installation and maintenance (see 4.3.5).

#### 4.3.2 Leaks

Leaks can be caused by the following occurrences:

- a) failure of a sealing device (see 8.7.3);
- b) failure of the fluid conductor — pipes, hoses, couplings, etc.;
- c) faulty assembly work.

<sup>1)</sup> 1 Pa = 1 N/m<sup>2</sup>; 1 bar = 10<sup>5</sup> Pa

#### 4.3.2.1 *Sealing materials*

Only sealing materials that are compatible with the fluid shall be used. Such devices shall be installed and used correctly in accordance with the supplier's recommendations.

#### 4.3.2.2 *Fluid conductors*

Conductors shall be mounted and secured in such a way as to reduce the effect of vibration. Careful consideration shall be given to the siting of components and routing of conductors to avoid the possibility of physical damage. In many instances the provision of protective channelling or metal guards is recommended. Wherever possible conductors should not be routed adjacent to other services, particularly electrical supplies.

#### 4.3.2.3 *Assembly work*

It is essential that work carried out on hydraulic installations be undertaken and supervised by competent staff.

#### 4.3.3 *High fluid temperature*

The operating temperature of a well-designed hydraulic system should not normally exceed 50 °C (pump inlet temperature). Any deviation from this shall be the subject of agreement between the supplier and the purchaser and in any such agreement the fluid type, operating and ambient temperature and any other special conditions which apply should be specified.

High operating temperatures reduce fluid viscosity which greatly increases the potential leakage rate and may render the system less efficient. It is recommended that thermal shut-off devices be incorporated within the hydraulic reservoir to operate in the event of high fluid temperatures occurring.

#### 4.3.4 *Fluid degradation*

Chemical changes can take place in the fluid during use, particularly at abnormal operating temperatures. The presence of contaminants accelerates the degradation process. When installations require reservoir heating for cold start-up, the rating of the heater shall be strictly controlled to avoid thermal degradation.

#### 4.3.5 *Faulty installation and maintenance*

Many failures of hydraulic equipment can be attributed to faulty installation and/or maintenance.

Failure to observe basic precautions in the storage and handling of fluid, failure to take adequate precautions to prevent the ingress of contaminants during servicing, etc. are typical examples.

#### 4.3.6 *Fluid disposal*

Fire-resistant fluids shall be disposed of in accordance with the national regulations in force.

### 5 Requirements for fire-resistant hydraulic fluids

#### 5.1 Property requirements

To perform satisfactorily in hydraulic systems the functional fluid shall be fire-resistant and possess the properties specified in 5.1.1 to 5.1.10.

**5.1.1** The functional fluid shall be fluid enough at all working temperatures to flow readily through the system and to accommodate rapid changes in velocity and pressure.

**5.1.2** At the same time the fluid shall be viscous enough at all working temperatures to prevent unwanted leakage across working clearances wherever a pressure differential exists across them.

**5.1.3** The fluid shall be of sufficient viscosity and adequate film strength to lubricate working parts effectively under both hydrodynamic and boundary conditions over the working temperature range.

**5.1.4** The fluid shall be compatible with construction materials used in the system and shall be non-corrosive.

**5.1.5** The fluid shall have thermal stability and be suitable for use at the highest expected operating temperature.

**5.1.6** The fluid shall have chemical stability to give adequate working life.

**5.1.7** The fluid shall release entrained air readily and not provide a stable foam.

**5.1.8** The fluid shall separate readily from contaminants encountered in normal use without chemical reaction.

**5.1.9** The surface tension of the fluid shall be low enough to give "wettability" but not low enough to make sealing difficult.

**5.1.10** The fluid should preferably be shear stable, i.e. its viscosity should not permanently change unduly with applied shear in a system.

#### 5.2 Other requirements

The following fluid characteristics, at first use and in the course of use, shall be considered in system design:

- a) case of filtration;
- b) relative density in relation to suction head of pump;
- c) vapour pressure which should not give rise to cavitation at pump suction inlet;
- d) fire-resistant qualities;
- e) non-toxicity of the fluid and vapours produced.