

Australian Standard<sup>®</sup>

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**Fluid power—Fire-resistant  
hydraulic fluids**

**Part 2: Guidance on the selection,  
use and storage**

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Australian Chamber of Commerce and Industry  
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Department of Defence  
Department of Mineral Resources, N.S.W.  
Fluid Power Society of Victoria  
Metal Trades Industry Association of Australia  
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PREFACE

This Standard was prepared by the Standards Australia Committee on Fluid Power Systems and Components. In the preparation of the Standard, consideration was given to ISO 7745:1989, *Hydraulic fluid power—Fire-resistant (FR) fluids—Guidelines for use*, and the assistance gained is acknowledged.

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## STANDARDS AUSTRALIA

## Australian Standard

## Fluid power—Fire-resistant hydraulic fluids

## Part 2: Guidance on the selection, use and storage

**1 SCOPE** This document provides guidelines for the selection and use of fire-resistant hydraulic fluids classified in accordance with AS 3997.1. Operational characteristics of various categories of fire-resistant fluids are given. The advantages and disadvantages in the use of these fluids are included, together with precautions to avoid difficulties during operation and when changing a system to a fluid of another classification.

NOTE: Tests to determine the flammability of fire-resistant hydraulic fluids in different situations are given in Appendix A.

**2 APPLICATION** This Standard is intended to provide guidance to—

- (a) the user, manufacturer or purchaser of fire-resistant hydraulic fluids in defining specific flammability tests to suit specific applications;
- (b) the operator of a hydraulic system in selecting the most acceptable fire-resistant hydraulic fluids to meet the system operating conditions such as pressure, duty, types of equipment and fire risk;
- (c) the operator of a hydraulic system in converting a system from mineral oil to a fire-resistant fluid; and
- (d) regulatory authorities in establishing safety requirements and safe practices in the use of fire-resistant hydraulic fluids.

**3 REFERENCED DOCUMENTS** The following documents are referred to in this Standard:

AS

- 1345 Identification of the contents of piping, conduits and ducts
- 2106 Methods for the determination of the flashpoint of flammable liquids (closed cup)
- 2671 Fluid power—Hydraulic systems and components
- 2700 Colour standards for general purposes
- 3997 Fluid power—Fire-resistant hydraulic fluids
- 3997.1 Part 1: Classification

ANSI

ASTM D3119 Test method for mist spray flammability of hydraulic fluids

ASTM

- E 659 Test method for autoignition temperature of liquid chemicals

BS

- 2000 Methods of test for petroleum and its products
- 2000.35 Part 35: Flash point (open) and fire point of petroleum products by the Pensky-Martins apparatus

CETOP

- RP 65 H Manifold ignition test

CSA

CAN/CSA-M423-M84 Fire resistant hydraulic fluids

Factory Mutual Research

- C6930 Approval standard for less hazardous hydraulic fluid

#### 4 GENERAL CONSIDERATIONS FOR THE USE OF FIRE-RESISTANT HYDRAULIC FLUIDS

**4.1 Fluid flowlines** Flowlines should be installed in accordance with AS 2671. The siting of components and routing of flowlines should be given careful consideration to avoid the possibility of physical damage and proximity to sources of ignition. In many instances, the provision of protective channelling or metal guards is recommended. Wherever possible, flowlines should not be routed adjacent to other services, particularly electrical supplies. Flowlines should be colour coded in accordance with AS 1345.

**4.2 Work on hydraulic systems** All work carried out on hydraulic installations should be undertaken and supervised by competent personnel.

**4.3 Fluid temperature** The operating temperature of a well-designed hydraulic system should not normally be greater than 50°C at the pump inlet. Any deviation from this should be the subject of agreement between the supplier and the purchaser. Operating and ambient temperatures and any other special conditions which apply to the fluid should be specified.

High operating temperatures will reduce fluid viscosity which will greatly increase the potential leakage rate and may render the system less efficient.

**4.4 Fluid degradation** Chemical and physical changes can take place in the fluid during use owing to the effects of oxidation, high temperature operation and mechanical shearing. This degradation process can be greatly accelerated by the presence of contaminants such as moisture, particle matter and metallic corrosion by-products. Where installations require reservoir heating for cold start-up, the rating of the heater should be strictly controlled to avoid thermal degradation of the fluid. Tests should be carried out periodically on the fluid in service to ensure its conformity, particularly to fire resistance.

**4.5 Installation and maintenance** Many failures of hydraulic equipment can be attributed to faulty installation or maintenance, or both. Typical examples are the failure to observe precautions in the storage and handling of the fluid, the failure to take adequate precautions to prevent the ingress of contaminants during servicing and the addition of the incorrect class of fluid.

The periodic testing for fluid degradation should alert the user to the presence of a contaminant which may significantly reduce the fire resistance.

**4.6 Fluid monitoring** The fire resistance of some fluids may be reduced because of the working conditions, and flammability tests should be carried out periodically on working fluids.

**4.7 Evaporation effects** The fire resistance of water containing fluids may be reduced due to evaporation.

**4.8 Equipment performance** Some classes of fire-resistant fluids have properties which differ from those of mineral oils. To achieve satisfactory service, it may be necessary in some instances to derate particular items of hydraulic equipment or modify the circuit or components, or both. Users are strongly advised to hold preliminary consultations with the makers of the equipment and the suppliers of the fluid before converting an existing system to a fire-resistant fluid or commissioning a new system.

**4.9 Strainers and filters** Some fluids have either a high relative density or high viscosity in the cold state, resulting in slow sedimentation of contaminants or high vapour pressure. With these fluids, it is advisable to provide large filters and strainers. In principle, the filtration surface should be two to three times more than that required for mineral oils.

Certain filter elements such as activated earth and absorbent filters should not be used with fire-resistant fluids.

**4.10 Circuit design** When designing a system, care should be taken to ensure that the fluid is not subjected to temperatures incompatible with its properties to ensure that freezing, boiling, loss of water content and cavitation are avoided.

**4.11 Compatibility with metals** Compatibility tests might have to be undertaken with different metals that may be encountered within a hydraulic circuit.

Certain metals are sensitive to the action of fire-resistant fluids and should be avoided. Pairs of metals with a large difference in electrolytic potential should also be avoided.

**4.12 Compatibility with coatings and paint** Internal coatings normally used in circuits operating with mineral oil may be incompatible with fire-resistant fluids, particularly those of classes HFC and HFD.

Where a hydraulic system has been protected during storage by a normal anti-rust product, it may be necessary to remove it before the system is operated. It is possible, however, to treat the surfaces to be protected with an oil which is compatible with certain fire-resistant fluids and the elastomeric materials used in the system.

**4.13 Compatibility with sealing devices** The conventional materials used for seals, packings, hoses and accumulator bladders with mineral oils are not compatible with certain classes of fire-resistant fluids.

It is advisable to check on the compatibility of seals with fluid and component suppliers before making a selection.

Table 1 provides a general guide for the choice of elastomer types.

**TABLE 1**  
**GENERAL GUIDE TO COMPATIBILITY OF ELASTOMERS**  
**WITH FIRE-RESISTANT FLUIDS**

| Fluid class | General name of fluid                                    | Suitable elastomer types                |
|-------------|----------------------------------------------------------|-----------------------------------------|
| HFAE, HFAET | Oil in water emulsion                                    | NBR, FPM                                |
| HFAS, HFAST | Chemical solution in water                               | NBR, FPM                                |
| HFB         | Water in oil emulsion                                    | NBR, FPM                                |
| HFC         | Waterglycols                                             | NBR, SBR, EPDM, 11R, NR                 |
| HFDR        | Phosphate esters                                         | FPM, EPDM, 11R                          |
| HFDS        | Chlorinated hydrocarbons                                 | FPM                                     |
| HFDT        | Mixture of phosphate esters and chlorinated hydrocarbons | FPM                                     |
| HFDU        | Other synthetics                                         | Compatibility test should be undertaken |

**LEGEND:**

|      |                                                   |
|------|---------------------------------------------------|
| NBR  | Nitrile rubbers (acryl-nitrile butadiene, buna N) |
| FPM  | Fluorocarbon rubbers (Viton R)                    |
| SBR  | Styrene butadiene-rubber (neoprene)               |
| EPDM | Ethylene propylene diene-rubbers                  |
| 11R  | Butyl rubbers                                     |
| NR   | Natural rubber                                    |
| AU   | Polyester urethane                                |
| EU   | Polyether urethane                                |

**NOTES:**

- 1 The nomenclature and abbreviations used for elastomers are generic, i.e. a whole variety of different compounds may exist under one name, all of which will have certain general properties. It will therefore be necessary to stipulate in the specification, beside the basic material, e.g. NBR, FPM, EPDM, the required quality specification, e.g. hardness, tensile strength, temperature range and swell performance.
- 2 NBR, FPM, AU are compatible with mineral-based oils.
- 3 Joints which swell or disintegrate in the presence of water should not be used, e.g. leather, paper and cork.
- 4 In some instances, seals may fail following a short service life and hence should always be tested for compatibility prior to selection and use.
- 5 Elastomers based upon polyurethanes (AU and EU) may be damaged by hydrolysis in the presence of water.

## 5 REQUIREMENTS FOR FIRE-RESISTANT HYDRAULIC FLUIDS

**5.1 Properties** To perform satisfactorily in hydraulic systems, the functional fluid should have the following properties:

- (a) Sufficient fluidity at working temperatures to flow readily through the system and to accommodate rapid changes in velocity and pressure.
- (b) Sufficient viscosity at working temperatures to prevent excessive leakage across working clearances.
- (c) Sufficient viscosity and adequate film strength to lubricate working parts effectively under both hydrodynamic and boundary conditions over the working temperature range.
- (d) Compatibility with the materials of construction of the system.
- (e) Thermal stability and be suitable for use at the highest and lowest operating temperatures.
- (f) Chemical and physical stability to give an adequate working life.
- (g) Readily separate from normally encountered contaminants without chemical reactions.
- (h) Surface tension low enough to give 'wettability' but not low enough to make sealing difficult.
- (i) Preferably, shear stability, i.e. its viscosity should not change unduly with applied shear in a system.

Other fluid characteristics to be considered in system design are as follows:

- (i) Ease of filtration.
- (ii) Relative density in relation to suction head of pump.
- (iii) Vapour pressure of an order not to give rise to cavitation at pump suction inlet.
- (iv) Toxicity of the fluid and vapours produced.
- (v) Ability to release entrained air readily and not provide a stable foam.

The user should nominate the physical properties required.

**5.2 Flammability tests** Tests for the flammability of fire-resistant hydraulic fluids are given in Appendix A.

**5.3 Toxicity** Fire-resistant hydraulic fluids and concentrates should not constitute a health hazard to workers handling the fluid under normal working conditions. Where fluids with toxic properties are used, suitable warnings should be displayed at prominent positions on the systems and on containers used for the storage of the fluids.

Upon request, the supplier should provide a materials safety data bulletin listing health and safety information relating to fire-resistant fluids. Examples of materials safety data sheets are given in Appendix B.