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AN INDUSTRY STANDARD FOR FLUID POWER

**Recommended practice – Hydraulic fluid power –  
Fluids – Viscosity selection criteria for hydraulic motors and pumps**

Descriptors: hydraulic fluid power viscosity selection criteria motors pumps

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## Foreword

This Foreword is not part of National Fluid Power Association (NFPA) *Recommended practice – Hydraulic fluid power – Fluids – Viscosity selection criteria for hydraulic motors and pumps*, NFPA/T2.13.13-2002.

On 20 May 1999, NFPA/T2.13 members reviewed a draft copy of the document and the Title, Scope and Purpose (TSP) for changes. Table 1 of draft no. 1 was not complete and members were to seek out additional manufacturers to be added to the table.

On 23 September 1999, Mr. Herzog discussed the information he had tabulated to date and reviewed his presentation on viscosity selection criteria. Information from IMO, Oilgear, Danfoss, Dynex/Rivett and Poclain were to be added to the list of equipment builders. Members were asked to continue to add manufacturers' viscosity recommendations to table 1. Members also discussed shear stability, non-Newtonian fluids, viscosity index improvers and the possible impact of these properties on establishing viscosity recommendations.

On 10 February 2000, Mr. Herzog reported that the data from equipment manufacturers had been collected and that the document was ready for review by the committee. Mr. Herzog also reported that this project was a paper and presentation at IFPE 2000's National Conference on Fluid Power.

On 18 May 2000, members reviewed draft no. 1, suggested a few editorial changes and approved a recommendation for general review.

On 21 September 2000, members reviewed and resolved comments received from the general review ballot circulated 25 August 2000.

At the 8 February 2001 NFPA/T2.13 meeting, Mr. Herzog reported that the commentators were contacted and changes arising from the ballot review were incorporated in the second general review draft, which was circulated to the committee via e-mail. However, not all members of the committee received a copy of the document, due to the size. A motion was approved for Headquarters to recirculate the second general review ballot via mail after Mr. Herzog updated several trade names that had recently changed.

The third general review was circulated 5 September 2001 and closed 5 October 2001, with the tally totaling 11 approvals, zero disapprovals and two not voting. At the 8 January 2002 Technical Board meeting, the Technical Auditor reported that the document development process has been followed. Technical Board members agreed to approve the NFPA/T2.13 recommendation to circulate NFPA/T2.13.13-2002 for final ballot.

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## **Introduction**

Viscosity is one of the most important criteria in the selection of a hydraulic fluid. A hydraulic fluid whose viscosity is too low will cause low volumetric efficiency, fluid overheating and increased pump wear. A hydraulic fluid whose viscosity is too high will cause poor mechanical efficiency, difficulty in starting and wear due to insufficient fluid flow. Selecting a fluid with the proper viscosity requires an understanding of the low and high temperature requirements of different types of hydraulic components. The effects of mechanical shear on fluid viscosity must also be taken into consideration.

This document aids users of hydraulic fluids in selecting a fluid with the proper viscosity by providing a compilation of minimum and maximum viscosity requirements specified by a number of manufacturers of hydraulic pumps and motors. Once the user determines the fluid operating temperature range, the user will be able to use the method described in this document to select a hydraulic fluid with the proper viscosity. Selecting a hydraulic fluid with the proper viscosity will improve the efficiency and life of hydraulic equipment.



# Recommended practice – Hydraulic fluid power – Fluids – Viscosity selection criteria for hydraulic motors and pumps

## 1 Scope

This document covers viscosity selection criteria for hydraulic fluids used with hydraulic motors and pumps in industrial and mobile systems.

## 2 Normative references (1), (2), (3)

The following normative documents contain provisions which, through reference in this text, constitute provisions of this NFPA document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this NFPA document are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referenced applies. NFPA maintains registers of currently valid NFPA Standards. Standards development organization contact information and links can be found on the NFPA website ([www.nfpa.com](http://www.nfpa.com)).

ASTM D 341 (*latest edition*), *Standard Viscosity – Temperature Charts for Liquid Petroleum*.

ASTM D 2983 (*latest edition*), *Standard Test Method for Low-Temperature Viscosity of Automotive Fluid Lubricants Measured by Brookfield Viscometer*.

ASTM D 5621 (*latest edition*), *Standard Test Method for Sonic Shear Stability of Hydraulic Fluid*.

ASTM D 6080 (*latest edition*), *Standard Practice for defining the Viscosity Characteristics of Hydraulic Fluids*.

ISO 3448 (*latest edition*), *Industrial liquid lubricants – ISO viscosity classification*.

ISO 5598 (*latest edition*), *Fluid power systems and components – Vocabulary*.

## 3 Definitions

For the purposes of this recommended practice, the terms and definitions given in ISO 5598 and the following apply:

**3.1 viscosity:** A fluid's resistance to flow.

**3.2 dynamic viscosity:** Viscosity measured under force-induced flow. Scientifically, dynamic or absolute viscosity is the ratio of the shearing stress to the shear rate of the fluid. The cgs unit for dynamic viscosity is cm<sup>2</sup>/s, which is commonly known as a centipoise [mPa·s (cP)].

**3.3 kinematic viscosity:** Viscosity measured under gravity-induced flow. Scientifically, kinematic viscosity is the ratio of the absolute viscosity to the mass density of the fluid. The kinematic viscosity is commonly expressed as mm<sup>2</sup>/s in metric units, corresponding to the commonly used centistoke (cSt) unit.

**3.4 Newtonian fluid:** Fluid whose viscosity is constant over all values of shear stress and/or shear rate, for example, a petroleum base oil.