

Approval Standard

Flammability
Classification of
Industrial Fluids

Class Number 6930
April 2009





Member of the FM Global Group

Approval Standard for Flammability Classification of Industrial Fluids

Class Number 6930

April 2009

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Foreword

Approvals are intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of Approval Standards is to present the criteria for Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for Approval shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing and/or applications shall ensure a consistently uniform and reliable product or service. Approval Standards strive to be performance-oriented and to facilitate technological development.

For examining equipment, materials and services, Approval Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and Listing depends on compliance with the Master Agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility or service/application.

FM Approvals LLC reserves the right in its sole judgement to change or revise its standards, criteria, methods, or procedures.

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1. INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states Approval requirements for the flammability rating for industrial fluids intended for use as, but not limited to, lubricants, hydraulic power transmission, turbine governor control, heat transfer, transformer insulation and cooling fluid.
- 1.1.2 Fluids intended for use as transformer fluids shall also meet the requirements of Approval Standard 6933, “Less Flammable Transformer Fluids” or Approval Standard 6934, “Non Flammable Transformer Fluids”, as appropriate.
- 1.1.3 Approval criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program.

1.2 Scope

- 1.2.1 This standard evaluates the flammability characteristics of fluids intended for use in industrial equipment by determining their chemical heat release rate from spray fires and the fluid’s critical heat flux for ignition, or by determining the critical temperature to sustain combustion. Based on these values, a Spray Flammability Parameter (SFP) or Adiabatic Stoichiometric Flame Temperature ($T_{ad, cr}$) can be calculated. The SFP or the ($T_{ad, cr}$) is then used as the basis for classifying the fluid and is useful in determining acceptable fire protection techniques and requirements applicable to a given installation in accordance with FM Global Property Loss Prevention Data Sheets.
- 1.2.2 An industrial fluid that meets the requirements of this standard shall be eligible to be flammability rated as FM Approved.
- 1.2.3 This standard is intended only to evaluate a fluid’s flammability under stated conditions. Environmental considerations, toxicity and the suitability for the end use of the product have not been evaluated.
- 1.2.4 The tests conducted as part of this examination are intended to simulate conditions that may occur while the fluid is in use. This standard is not intended to be used to determine the protection requirements when containers of the fluid are placed in storage or other conditions.

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on field loss experience, research and testing, and/or the application standards of FM Approvals and/or other national or international organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of industrial fluids for the purpose of obtaining Approval. Industrial fluids having characteristics not anticipated by this standard may be FM Approved if performance equal, or superior, to that required by this Standard is demonstrated, or if the intent of the standard is met. Alternatively, industrial fluids which meet all of the requirements identified in this standard may not be FM Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

- 1.3.3 Meeting the requirements of this standard shall result in the eligibility of the fluid to be classified as described in Section 4.4.1 of this document. Approval requirements prohibit component substitution or changes in formulation without prior written authorization by FM Approvals.

1.4 Basis for Approval

Approval shall be based upon a satisfactory evaluation of the product and the manufacturer in the following areas:

- Examination and tests on production samples shall be performed to evaluate the flammability of the product;
- An initial in-house Facilities and Procedures Audit inspection of the manufacturer's quality control program.

1.5 Basis for Continued Approval

Continued Approval is based upon:

- Production or availability of the product as currently FM Approved;
- The continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- Compliance with the terms stipulated in the Approval report;
- Satisfactory re-examination of production samples for continued conformity to requirements;
- Satisfactory Facilities and Procedures Audits (F&PA's) conducted as part of FM Approvals' product follow-up program.

1.6 Effective Date

- 1.6.1 The effective date of an Approval Standard mandates that all products or services evaluated for Approval after the effective date shall satisfy the requirements of that Standard. Products Approved under a previous edition shall comply with the new version by the effective date or else forfeit their listing. The effective date shall apply to the entire Approval Standard, or, where so indicated, only to specific paragraphs of the Standard.

- 1.6.2 The effective date of this standard is April 1, 2009 for compliance with all requirements.

1.7 System of Units

Units of measurement used in this Standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10-97, "Standard for Use of the International System of Units (SI): The Modern Metric System."

1.8 Applicable Documents

The following are standards, test methods, and practices referenced in the examinations conducted per this standard. Refer to the most current version of the method.

American National Standards Institute

(ANSI) B93.2 “Glossary of Fluid Power Systems and Products”

American Society for Testing and Materials

ANSI/ASTM D92 “Standard Test Method for Flash and Fire Points by Cleveland Open Cup”

ASTM E203 “Standard Test Method for Water Using Volumetric Karl Fischer Titration”

ASTM D240 “Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter”

ASTM D808 “Standard Test Method for Chlorine in New and Used Petroleum Products (Bomb Method)”

ASTM D1179 “Standard Test Method for Fluoride Ion in Water”

ASTM D1480 “Standard Test Method for Density and Relative Density (Specific Gravity) of Viscous Materials by Bingham Pycnometer”

ASTM D4052 “Standard Test Method for Density and Relative Density of Liquids by Digital Density Meter”

ASTM D4309 “Standard Practice for Sample Digestion using Closed Vessel Microwave Heating Technique for the Determination of Total Metals in Water”

ASTM D4327 “Standard Test Method for Anions in Water by Chemically Suppressed Ion Chromatography”

ASTM D4868 “Standard Test Method for Estimation of Net and Gross Heat of Combustion of Burner and Diesel Fuels”

ASTM D5291 “Standard Test Method for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants”

FM Approvals

FM Approval Standard 6930 “Flammability Classification of Industrial Fluids”, 2002

FM Approval Standard 6933, “Less Flammable Transformer Fluids”, 1979

FM Approval Standard 6934 “Non Flammable Transformer Fluids”, 1983

FM Global Research

FM Global Research Technical Report Project 0T0W3.RC, “Spray Flammability of Hydraulic Fluids and Development of a Test Method”

FM Global Research Technical Memorandum to R. G. Bill, Jr., January 17, 2005 “Calculation of the Sustained Combustion of Hydraulic Fluids – Modification to the Calculation Procedure (alpha 0.31 version)”

FM Global Research Technical Memorandum to R. G. Bill, Jr., July 15, 2005 “Determination of Adiabatic Stoichiometric Flame Temperature of Hydraulic Fluids Using the NASA Equilibrium Code”

National Aeronautics and Space Administration

NASA Combustion Equilibrium and Application Code (CEA).

1.9 Definitions

General terminology shall be in accordance with ANSI B93.2 “Glossary of Fluid Power Systems and Products” unless shown below. For purposes of this Standard, the following terms apply:

Adiabatic Stoichiometric Flame Temperature (T_{ad}) – the critical temperature for sustained combustion

Concentrate Adiabatic Stoichiometric Flame Temperature ($T_{ad, conc}$) – the critical temperature for sustained combustion for the fluid concentrate

Critical Adiabatic Stoichiometric Flame Temperature ($T_{ad, cr}$) – the critical temperature for sustained combustion for the finished fluid at the lowest water content as specified by the manufacturer.

Critical Heat Flux – the maximum heat flux at or below which there is no ignition

Fluid Concentrate – The term as used herein defines the part of the finished fluid submitted for examination containing all the component parts except water, or with water content of 18% or less by mass percent.

Normalized SFP – The term normalized, as used herein, is defined as SFP measured at a unit flow

Spray Flammability Parameter (SFP) – a measure of the degree of flammability of a fluid in a highly atomized condition when pressurized to the stated pressure shown in this standard.

2 GENERAL INFORMATION

2.1 Product Information

- 2.1.1 Industrial fluids are liquids that may have two or more components in their composition and consist, but are not limited to, aqueous solutions, emulsions, vegetable oils, synthetic fluids, petroleum-based mineral oils, or other types of base stocks that are processed for stability and resilience. Other fluid compositions meeting the criteria of this standard may also be considered for Approval. Industrial fluids are intended for use as, but not limited to, lubricants, hydraulic power transmission, turbine governor control, heat transfer, transformer insulation and cooling fluids. The suitability of the industrial fluid for specific use shall be determined by the manufacturer.:-