Designation: D 5222 – 00

Standard Specification for High Fire-Point Mineral Electrical Insulating Oils[1]

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1. Scope

1.1 This specification describes a high fire-point mineral oil based insulating fluid, for use as a dielectric and cooling medium in new and existing power and distribution electrical apparatus, such as transformers and switchgear.

1.2 High fire-point insulating oil differs from conventional mineral insulating oil by possessing a fire-point of at least 300°C. High fire-point mineral insulating oils are also referred to as "less flammable" mineral insulating oils.This property is necessary in order to comply with certain application requirements of the National Electrical Code (Article 450-23) or other agencies. The material discussed in this specification is miscible with other petroleum based insulating oils. Mixing high fire-point liquids with lower fire point hydrocarbon insulating oils (for example, Specification D 3487 mineral oil) may result in fire points of less than 300°C.

1.3 This specification is intended to define a high fire-point electrical mineral insulating oil that is compatible with typical material of construction of existing apparatus and will satisfactorily maintain its functional characteristic in its application in this application. The material described in this specification may not be miscible with electrical insulating liquids of non-petroleum origin. The user should contact the manufacturer of the high fire-point insulating oil for guidance in this respect.

1.4 This specification applies only to new insulating material oil as received prior to any processing. Information on in-service maintenance testing is available in appropriate guides.[2] The user should contact the manufacturers of the equipment or oil if questions of recommended characteristics or maintenance procedures arise.

2. Referenced Documents

2.1 *ASTM Standards:*

D 92 Test Method for Flash and Fire Points by Cleveland Open Cup[3]

D 97 Test Method for Pour Point of Petroleum Products[3]

D 117 Guide to Sampling Test Methods and Standard Practices for Electrical Insulating Oils of Petroleum Origin[4]

D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids[3]

D 611 Test Methods for Aniline Point and Mixed Aniline Point of Petroleum Products and Hydrocarbon Solvents[3]

D 664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration[3]

D 877 Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes[4]

D 878 Test Method for Inorganic Chlorides and Sulfates in Insulating Oils[4]

D 923 Practices for Sampling Electrical Insulating Liquids[4]

D 924 Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids[4]

D 971 Test Method for Interfacial Tension of Oil Against Water by the Ring Method[4]

D 974 Test Method for Acid and Base Number by Color-Indicator Titration[3]

D 1275 Test Method for Corrosive Sulfur in Electrical Insulating Oils[4]

D 1298 Practice for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method[3]

D 1500 Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)[3]

D 1524 Test Method for Visual Examination of Used Electrical Insulating Oils of Petroleum Origin in the Field[4]

D 1533 Test Methods for Water in Insulating Liquids (Karl Fischer Method)[4]

D 2112 Test Method for Oxidation Stability of Inhibited Mineral Insulating Oil by Rotating Bomb[4]

D 2300 Test Method for Gassing of Insulating Oils Under Electrical Stress and Ionization (Modified Pirelli Method)[4]

D 2440 Test Method for Oxidation Stability of Mineral Insulating Oil[4]

D 2668 Test Method for 2,6-Ditertiary-Butyl Para-Cresol and 2,6-Ditertiary-Butyl Phenol in Electrical Insulating Oil by Infrared Absorption[4]

D 2864 Terminology Relating to Electrical Insulating Liquids and Gases[4]

D 3487 Specification for Mineral Insulating Oil Used in

[1] This specification is under the jurisdiction of ASTM Committee D-27 on Electrical Insulating Liquids and Gasesand is the direct responsibility of Subcommittee D27.01on Mineral.

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[2] Refer to American National Standard C57.121 IEEE Guide for Acceptance and Maintenance of Less Flammable Hydrocarbon Fluid in Transformers.

[3] *Annual Book of ASTM Standards,* Vol 05.01.

[4] *Annual Book of ASTM Standards,* Vol 10.03.

Electrical Apparatus[4]

D 4059 Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography[4]

D 4768 Test Method for Analysis of 2,6-Ditertiary-Butyl Para-Cresol and 2,6-Ditertiary-Butyl Phenol in Insulating Fluids by Gas Chromatography[4]

2.2 *National Fire Protection Association Standards:*

National Electrical Code, Article 450-23[5]

2.3 *Institute of Electrical and Electronics Engineers Standard:*

C57.121 Guide for Acceptance and Maintenance of Less-Flammable Hydrocarbon Fluids and its Maintenance in Transformers[6]

3. Terminology

3.1 Definitions of terms related to this specification are given in Terminology D 2864. Significance of tests related to this specification can be found in Guide D 117 and Specification D 3487.

4. Sampling and Testing

4.1 Take all oil samples in accordance with Test Methods D 923.

4.2 Perform each test in accordance with the ASTM test method specified in Table 1.

NOTE 1—Because of the different needs of various users, items relating to packaging, labeling, and inspection are considered to be subject to buyer-seller agreement.

NOTE 2—In addition to all other tests listed herein, it is sound engineering practice for the apparatus manufacturer to perform an evaluation of insulating oils in insulation systems, prototype structures, or full-scale apparatus, or any combination thereof, to ensure suitable service life.

5. Property Requirements

5.1 High fire-point mineral insulating oil, as received, shall conform to the requirements of Table 1. The significance of these properties is covered in Guide D 117.

TABLE 1 Property Requirements for High Fire-Point Mineral Insulating Oils, as Received

Property	Limit	ASTM Test Method
Physical:		
Visual examination	Bright and clear	D 1524
Color, ASTM units, max.	2.5	D 1500
Fire point, °C, min.	300	D 92
Flash point, °C, min.	275	D 92
Aniline Point, °C, max.	125	D 611
Interfacial tension at 25 °C, mN/m, min.	40	D 971
Pour point, °C, max.	−21	D 97
Relative density, 15 °C, max.	0.91	D 1298
Viscosity, kinematic, cSt, max.		D 445
0 °C (32 °F)	2500	
40 °C (104 °F)	130.0	
100 °C (212 °F)	14.0	
Electrical:		
Dielectric breakdown voltage at 60 Hz		
Disk electrodes, kV, min.	30	D 877
Gassing tendency, µl/min., max.	+30	D 2300
Dissipation factor at 60 Hz, %, max.		D 924
25 °C	0.05	
100 °C	0.30	
Chemical:		
Corrosive sulfur	non-corrosive	D 1275
Inorganic chlorides and sulfates	non-detectable	D 878
Acid number, mg KOH/g, max.	0.03	D 664 or D 974
Water content, ppm, max.	35	D 1533
Oxidation stability [A] 72 h:		D 2440
sludge, % by mass, max	0.15	
acid number, mg KOH/g, max	0.30	
Oxidation stability,[A]164 h		
sludge, % by mass, max	0.30	
acid number, mg KOH/g, max	0.60	
Oxidation stability (rotating bomb), min[A]	195	D 2112
Oxidation inhibitor content, % by mass, max.	0.40	D 2668 or D 4768
PCB content, ppm:	non-detectable	D 4059

[A]The values for oxidation tests are typical requirements expected from a type II oil (according to Specification D 3487). All the commercially available high fire-point insulating liquid contained 0.4 % of antioxidant.

6. Keywords

6.1 electrical insulating oil; fire point; flammability; insulating fluid; mineral insulating oil

[5] Available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

[6] Available from the Institute of Electrical and Electronics Engineers, Inc. 345 E. 47th St., New York, NY 10017-2394.