Designation: D 2283 – 86 (Reapproved 1997)

Standard Specification for Chlorinated Aromatic Hydrocarbons (Askarels) for Transformers[1]

This standard is issued under the fixed designation D 2283; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers synthetic nonflammable electrical insulating liquids of the chlorinated aromatic hydrocarbon-type known as askarels, which are used as an insulating and cooling medium in liquid-filled transformers. This specification includes liquids that were previously available and are still in use in apparatus.

1.2 Askarels covered by this specification are of various types, having components in weight percent in accordance with Table 1.

NOTE 1—The components and the respective percentages given are descriptive of the materials currently in common use and are not intended as part of this specification, which is based on physical and chemical properties.

NOTE 2—Types A through G are PCB-type askarels previously available and still in use in the field. Recently Type H, a non-PCB askarel, was introduced as a retrofit and replacement.

NOTE 3—Current governmental regulations prohibit the manufacture and sale of polychlorinated biphenyls (PCBs). This method serves as a reference for all askarels, PCB and non-PCB.

2. Referenced Documents

2.1 *ASTM Standards:*

D 88 Test Method for Saybolt Viscosity[2]

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 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)[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 923 Test Method 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 974 Test Method for Acid and Base Number by Color-Indicator Titration[3]

D 1169 Test Method for Specific Resistance (Resistivity) of Electrical Insulating Liquids[4]

D 1218 Test Method for Refractive Index and Refractive Dispersion of Hydrocarbon Liquids[3]

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

D 1701 Test Methods for Scavenger Content of Askarels[4]

D 1810 Test Method for Specific Gravity of Askarels[4]

D 1821 Test Method for Inorganic Chlorides in Askarels[4]

D 1903 Test Method for Coefficient of Thermal Expansion of Electrical Insulating Liquids of Petroleum Origin, and Askarels[4]

D 2129 Test Method for Color of Water White Electrical Insulating Liquids[4]

3. Terminology

3.1 *Definition:*

3.1.1 *askarel*—a generic term for a group of synthetic, fire-resistant, chlorinated aromatic hydrocarbons used as electrical insulating liquids. They have a property under arcing conditions such that any gases produced will consist predominantly of noncombustible hydrogen chloride with lesser amounts of combustible gases.

4. Detail Requirements

4.1 Askarels for use in transformers shall conform to the requirements prescribed in Table 2.

NOTE 4—If more convenient, a measurement of dissipation factor may be made by Test Method D 924 in place of the resistivity measurement. Theoretical considerations indicate and experiment confirms that a strong statistical correlation exists between the dissipation factor and resistivity; however, other factors modify in practice the precise relationship predicted by theory. A dissipation factor at 60 Hz and 100°C that is not in excess of 15 % shall be considered satisfactory.

5. Sampling and Test Methods

5.1 Sample the material in accordance with Test Method D 923, and tests shall be conducted in accordance with the test methods listed in Table 2.

---

[1] This specification is under the jurisdiction of ASTM Committee D-27 on Electrical Insulating Liquids and Gases and is the direct responsibility of Subcommittee D27.02 on Gases and Synthetic Liquids.

Current edition approved Jan. 31, 1986. Published March 1986. Originally published as D 2283 – 64 T. Last previous edition D 2283 – 82 (1985)ε [1].

[2] *Annual Book of ASTM Standards*, Vol 04.04.

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

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

TABLE 1 Askarels Components in Weight Percent

Components	Type A	Type B	Type C	Type D	Type E	Type F	Type G	Type H [A]
Hexachlorobiphenyl [B]	60	45						
Pentachlorobiphenyl [C]				70		45	60	
Trichlorobiphenyl [D]			80		100			
Trichlorobenzene [E]	40			30			40	
Tri-tetra blend [F]		55	20			55		100
Phenoxypropene oxide [G]	0.18 to 0.22			0.18 to 0.22	0.18 to 0.22			
Diepoxide-type compound [H]		0.115 to 0.135	0.115 to 0.135			0.115 to 0.135	0.115 to 0.135	0.10 to 0.25

[A] Non-PCB contains no chlorinated biphenyls.
[B] Biphenyl chlorinated to a chlorine content of 60 weight %.
[C] Biphenyl chlorinated to a chlorine content of 54 weight %.
[D] Biphenyl chlorinated to a chlorine content of 42 weight %.
[E] A mixture of isomers of trichlorobenzene.
[F] A mixture of isomers of trichlorobenzene and tetrachlorobenzene.
[G] Glycidyl-phenyl ether.
[H] 3,4-Epoxycyclohexylmethyl-3,4-epoxycyclohexane carboxylate.

TABLE 2 Detail Requirements for Askarels for Transformers

Property	Type A	Type B	Type C	Type D	Type E	Type F	Type G	Type H [A]	ASTM Test Method [B]
Acidity, mg KOH/g, max	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	D 974, D664
Color, APHA, max	150	150	150	150	150	150	150	150	D 2129
Condition	clear	clear	clear	clear	clear	clear	clear	clear	visual
Chlorides, inorganic, ppm, max	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	D 1821
Relative permittivity at 100°C and 1 kHz	3.7 to 4.0	3.8 to 4.3	4.4 to 4.9	4.3 to 4.6	4.7 to 4.9	4.5 to 4.9	4.3 to 4.6	4.5 to 4.7	D 924
Dielectric breakdown voltage min, kV	35	35	35	35	35	35	35	35	D 877
Fire point [C]	none to boiling	none to boiling	none to boiling	none to boiling	none to boiling	none to boiling	none to boiling	none to boiling	D 92
Pour point, max, °C	−32	−44	−30	−30	−14	−42	−38	−20	D 97
Refractive index, 25°C	1.6130 to 1.6154	1.6068 to 1.6088	1.6146 to 1.6166	1.6163 to 1.6193	1.6240 to 1.6260	1.6060 to 1.6070	1.6110 to 1.6120	1.5760 to 1.5780	D 1218
Resistivity at 100°C, 5 V/mil, d-c [D] min, Ω·cm	100×10^9	100×10^9	100×10^9	100×10^9	100×10^9	100×10^9	100×10^9	100×10^9	D 1169
Scavenger content, %:									
Phenoxypropene oxide	0.18 to 0.22			0.18 to 0.22	0.18 to 0.22				D 1701
Diepoxide-type compound		0.115 to 0.135	0.115 to 0.135			0.115 to 0.135	0.115 to 0.135	0.10 to 0.25	
Specific gravity, 15.5/15.5°C	1.560 to 1.568	1.560 to 1.571	1.412 to 1.425	1.518 to 1.528	1.381 to 1.392	1.515 to 1.525	1.502 to 1.517	1.381 to 1.392	D 1810
Viscosity, Saybolt Universal, s at 37.8°C (100°F)	52 to 56	41 to 45	50 to 55	56 to 61	82 to 92	39 to 43	44 to 48	31 to 41	D 88
Coefficient of thermal expansion, [E] cm^3/cm^3°C	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.007	D 1903
Water content max, ppm	30	30	30	30	30	30	30	30	D 1533

[A] Non-PCB contains no chlorinated biphenyls.
[B] These designations refer to the methods referenced in Section 2.
[C] When testing for fire point, a pseudo-flash may be observed; it differs noticeably from the flash obtained from combustible materials and is not indicative of a fire hazard.
[D] See Note 4.
[E] These are approximate values included for information only.

6. Keywords

6.1 askarels; chlorinated aromatic hydrocarbons; transformers