

Kathy EXHIBIT 3
11/16 M. WISE 1990

PYRANOL™ COMPOSITIONS
 GENERAL ELECTRIC COMPANY
 1932 - 1976

* GE Specification - 1488, 1467, 1470, A1383B. (1497 = A1383B), A50P5..
 # ASTM D 2283 Type (), Annual Book of Standards, Vol. 10.03.
 1242, 1254, 1260 - Aroclor™ PCB mixtures - Monsanto Chemical
 T₃CB - tri- & tetra-chlorobenzenes - Hooker Chemical
 Sn₄ - tin tetraphenyl - Hooker Chemical(1944-1957),

Metal & Thermite Corp
 Union Carbide &
 CY-179, Ciba-Geigy

EDDC - epoxide dicyclo-diepoxy carboxylate - ERL 4221, Metal & Thermite Corp

PITTSFIELD, MA

<u>1932-NOV 1944</u> <u>1488*</u>	<u>NOV 1944-APR 1952</u> <u>1467</u>	<u>APR 1952-MAR 1963</u> <u>1470</u>	<u>MAR 1963-APR 1972</u> <u>A1383B (B)#</u>
60% 1260 40% T ₃ CB	60% 1260 40% T ₃ CB 0.125% Sn ₄	45% 1260 40% T ₃ CB 15% T ₄ CB 0.125% Sn ₄	45% 1260 40% T ₃ CB 15% T ₄ CB 0.125% EDDC
<u>APR 1972-NOV 1973</u> <u>A1383B2 (F)</u>	<u>NOV 1973-FEB 1974</u> <u>A50P559</u>	<u>JAN 1974-END</u> <u>A1383B3 (G)</u>	
45% 1254 40% T ₃ CB 15% T ₄ CB 0.125% EDDC	65% 1254 23% T ₃ CB 12% T ₄ CB 0.125% EDDC	60% 1254 40% T ₃ CB 0.125% EDDC	

ROME, GA

<u>1953 - 1963</u> <u>1470</u>	<u>1963 - 1965</u> <u>A1383B (B)</u>	<u>1965 - 1970</u> <u>A50P524 (C)</u>	<u>SEP 1969 - OCT 1970</u> <u>A1383B (B)</u>
45% 1260 40% T ₃ CB 15% T ₃ CB 0.125% Sn ₄	45% 1260 40% T ₃ CB 15% T ₄ CB 0.125% EDDC	80% 1242 13% T ₃ CB 7% T ₄ CB 0.125% EDDC	45% 1260 40% T ₃ CB 15% T ₄ CB 0.125% EDDC
<u>1970 - 1972</u> <u>A50P559</u>	<u>1972 - 1974</u> <u>A1383B2 (F)</u>	<u>NOV 1973-FEB 1974</u> <u>A50P559</u>	<u>MAR 1974-END</u> <u>A50P570</u>
65% 1254 23% T ₃ CB 12% T ₃ CB 0.125% EDDC	45% 1254 40% T ₃ CB 15% T ₄ CB 0.125% EDDC	65% 1254 23% T ₃ CB 12% T ₄ CB 0.125% EDDC	40% 1254 60% T ₃ CB 0.125% EDDC

HICKORY, NC & SHREVEPORT, LA

Pyranol - never used

/38008

tor 12-29-87

CEP 000654

Standard Specification for CHLORINATED AROMATIC HYDROCARBONS (ASKARELS) FOR CAPACITORS¹

This standard is issued under the fixed designation D 2233, the number immediately following the designation indicates the original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last revision.

1. Scope

This specification covers synthetic non-flammable electrical insulating liquids of the chlorinated aromatic hydrocarbon type known as askarels, which are used as an electrical insulating and cooling medium in capacitors. This specification includes liquids that were previously available and are still in use in this status.

Insulation systems incorporating these askarels and cellulosic or other organic materials, when arced, produce gaseous mixtures that are moderately flammable.

Askarels covered by this specification are of four types as follows:

1.1 *Type A*—Biphenyl that has been chlorinated to a content of 42 weight %.

1.2 *Type B*—Biphenyl that has been chlorinated to a chlorine content of 54 weight %.

1.3 *Type C*—A mixture of approximately 75 % Type D 2233 B and 25 % trichlorobenzene.

1.4 *Type D*—The same as Type A, except that the higher boiling homologs have been reduced to a maximum level of 0.4 %.

Note 1—These statements are merely descriptions of the materials currently in common use and are not intended as part of this specification, which is based on physical and chemical properties prescribed in Table 1.

Note 2—Current governmental regulations prohibit the manufacture and sale of polychlorinated biphenyls (askarels). This method is being maintained for reference of those units still in service.

Note 3—For information on PCB's in mineral oils,

D88 Test Method for Saybolt Viscosity²

D92 Test Method for Flash and Fire Points by Cleveland Open Cup²

D97 Test Method for Pour Point of Petroleum Oils²

D664 Test Method for Neutralization Number by Potentiometric Titration²

D877 Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes²

D923 Methods of Sampling Electrical Insulating Liquids²

D924 Test Method for A-C Loss Characteristics and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids²

D974 Test Method for Neutralization Number by Color-Indicator Titration²

D1169 Test Method for Specific Resistance (Resistivity) of Electrical Insulating Liquids²

D1218 Test Method for Refractive Index and Refractive Dispersion of Hydrocarbon Liquids²

D1533 Test Methods for Water in Insulating Liquids (Karl Fischer Reaction Method)²

D1810 Test Method for Specific Gravity of Askarels²

D1820 Test Method for Hydrolyzable Chlorine Compounds in Chlorinated Aromatic Hydrocarbons (Askarels)²

D1821 Test Method for Inorganic Chloride in Askarels²

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 Synthetic Liquids. Approved Jan. 31, 1986. Published March 1, 1988.

D1903 Test Method for Coefficient of Thermal Expansion of Electrical Insulating Liquids of Petroleum Origin, and Askarels²

D1936 Test Method for Thermal Stability of Chlorinated Aromatic Hydrocarbons (Askarels)²

D2129 Test Method for Color of Chlorinated Aromatic Hydrocarbons (Askarels)²

D4059 Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography²

2. Definition

2.1 *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 capacitors shall conform to the requirements prescribed in Table 1.

Note 4—Since October 1971 askarel produced in the United States for use in capacitors has conformed to Type D as shown in Table 1. Materials previously available are still in use in the field.

Note 5—These materials sometimes contain additives whose presence may interfere with the chemical tests prescribed in Table 1. Unless it is known that no additives are present, results of the chemical tests may be misleading.

5. Sampling and Test Methods

5.1 The material shall be sampled in accordance with Methods D 923 and tests shall be conducted in accordance with the methods of test listed in Table 1.

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, Pa. 19103.



TABLE 1. Detail Requirements for Askarels for Capacitors

Property	Type A	Type B	Type C	Type D ⁶	ASTM Test Method ⁶
V. max. mg KOH/g 0.1% max	0.01 50	0.01 50	0.01 150	0.01 40	D 974, D 644 D 2129
viscosity, max. poise minutivity at 100°C and 1 kHz	clear 0.05	clear 0.05	clear 0.05	clear 0.05	(visual) D 1821
die breakdown voltage, min. kV	4.7 to 4.9 35	4.15 to 4.35 35	4.1 to 4.6 35	4.80 to 4.95 35	D 924 D 877
die breakdown voltage, min. kV pour ⁴	4.7 to 4.9 35	4.15 to 4.35 35	4.1 to 4.6 35	4.80 to 4.95 35	D 924 D 877
oxidative chlorine compounds, max. ppm	0.5	1.0	1.0	0.5	D 924 D 877
pour ⁴	0.5	1.0	1.0	0.5	D 924 D 877
active index, 25°C	-14 max 1.6240 to 1.6260	7 to 12 1.6370 to 1.6390	-15 max 1.6325 to 1.6315	-14 max 1.6215 to 1.6235	D 1218
active index, 25°C	500 x 10 ⁶ 1.381 to 1.392	500 x 10 ⁶ 1.495 to 1.505	100 x 10 ⁶ 1.525 to 1.535	500 x 10 ⁶ 1.562 to 1.572	D 1169 D 1810
density at 100°C, 5V/mm, 6-8 mm Ø, cm dc gravity	25/15.5°C 0.00064	65/15.5°C 0.00066	15.5/15.5°C 0.00070	25/15.5°C 0.00068	D 1903 D 1936
coefficient of thermal expansion, ⁴ cm ³ /cm ³ /°C	0.4 12 to 92 at 37.8°C	0.5 44 to 48 at 98.9°C	0.5 70 to 82 at 37.8°C	0.4 71 to 81 at 37.8°C	D 1936 D 1533
min. stability, max. poise	35	35	35	35	D 1533
ASTM, Saybolt Universal, s					
at constant, max. poise					

⁴When testing for fire point, pseudo-flash may be observed; it differs considerably from the flash obtained on combustible materials and is not indicative of a fire hazard.

⁵These are approximate values included for information only.

⁶These are approximate values included for use in calculations after October 1971.

⁷These designations refer to the test methods referenced in Section 2.

Standard Specification for CHLORINATED AROMATIC HYDROCARBONS (ASKARELS) FOR TRANSFORMERS¹

This standard is issued under the fixed designation D 2233; 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 non-flammable 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 O 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. Applicable Documents

2.1 ASTM Standards:

- D88 Test Method for Saybolt Viscosity²
- D92 Test Method for Flash and Fire Points by Cleveland Open Cup³
- D97 Test Method for Pour Point of Petroleum Oils³
- D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)²
- D664 Test Method for Neutralization Num-

ber by Potentiometric Titration²

D877 Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes²

D923 Methods of Sampling Electrical Insulating Liquids²

D924 Test Method for A-C Loss Characteristics and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids²

D974 Test Method for Neutralization Number by Color-Indicator Titration²

D1169 Test Method for Specific Resistance (Resistivity) of Electrical Insulating Liquids²

D1218 Test Method for Refractive Index and Refractive Dispersion of Hydrocarbon Liquids²

D1533 Test Method for Water in Insulating Liquids (Karl Fischer Reaction Method)²

D1701 Test Method for Scavenger Content of Askarels²

D1810 Test Method for Specific Gravity of Askarels²

D1821 Test Method for Inorganic Chlorides in Askarels²

D1903 Test Method for Coefficient of Thermal Expansion of Electrical Insulating Liquids of Petroleum Origin, and Askarels²

D2129 Test Method for Color of Chlorinated Aromatic Hydrocarbons (Askarels)²

¹This 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 Synthetics. Current edition approved Jan. 31, 1986. Published Mar 1986. Originally published as D 2233 - 64. Last previous edition D 2233 - 82 (1983)^ε.

3. Definition

3.1 *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 The material shall be sampled in accordance with Methods D 923, and tests shall be conducted in accordance with the methods of test listed in Table 2.

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 ^a	60	45		70		45	60	
Pentachlorobiphenyl ^b				30	100		40	
Trichlorobiphenyl ^c	40		80					
Trichlorobenzene ^d		55	70			55		100
Tri-tetra blend ^e	0.18 to 0.22			0.18 to 0.22	0.18 to 0.22			
Phenoxypropene oxide ^f						0.115 to 0.135	0.115 to 0.135	0.10 to 0.25
Diepoxide type compound ^g		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 Biphenyl chlorinated to a chlorine content of 60 weight %.

^b Biphenyl chlorinated to a chlorine content of 54 weight %.

^c Biphenyl chlorinated to a chlorine content of 42 weight %.

^d A mixture of isomers of trichlorobenzene.

^e A mixture of isomers of trichlorobenzene and tetrachlorobenzene.

^f Glycidyl phenylether.

^g 3,4-Epoxy-cyclohexylmethyl 3,4-epoxycyclohexane carboxylate.

^h Non-PCB contains no chlorinated biphenyls.

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
Color, APHA, max	150	150	150	150	150	150	150	150	D 664
Condition	clear	clear	clear	clear	clear	clear	clear	clear	D 212
Chlorides, inorganic, ppm max	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	D 182
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	-42	-38	-20	-20	D 97
Refractive index, 25°C	1.6130 to 1.6154	1.6088 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 121
Resistivity at 100°C, 5 V/mil, d.c. ^d min, Ω·cm	100 × 10 ¹²	100 × 10 ¹²	100 × 10 ¹²	100 × 10 ¹²	100 × 10 ¹²	100 × 10 ¹²	100 × 10 ¹²	100 × 10 ¹²	D 116
Scavenger content, %: Phenoxypropene oxide	0.18 to 0.22			0.18 to 0.22	0.18 to 0.22				D 170
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	D 181
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 181
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	0.0007	D 190
Water content max, ppm	30	30	30	30	30	30	30	30	D 153

^a 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.

^b See Note 4.

^c These are approximate values included for information only.

^d These designations refer to the methods referenced in Section 2.

^e Non-PCB contains no chlorinated biphenyls.

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years, and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, Pa. 19103.

ASKAREL*TRADE NAMES

AROCLOR
ASBESTOL
CLOPHEN
CHLOREXTOL
CHLORINOL
CLORPHEN
DIACLOR
DK, INCLOR, FENCOLOR
DYKANOL
ELEMEX
EUCAREL
HYVOL
INERTEEN
KANECHLOR
N-3
NO-FLAMOL
PHENOCOLOR
PYDRAUL
PYROCOLOR
PYRALENE
PYRANOL
SAF-T-KUHL
SANTOTHERM
THERMINOL

MONSANTO CO.
AMERICAN CORP.
BAYER (GERMANY)
ALLIS CHALMERS
SPRAGUE
JARD
SANGAMO ELECT.
CAFFARO (ITALY)
CORNELL DUBILIER
MCGRAW EDISON

AEROVOX
WESTINGHOUSE HOUSE
MITSUBISHI (JAPAN)
NIAGARA TRANSFORMER
WAGNER ELECTRIC
PRODELEC (FRANCE)

PRODELEC (FRANCE)
GENERAL ELECTRIC
KUHLMAN ELECTRIC
MITSUBISHI (JAPAN)

*GENERIC NAME FOR PCB

A&ESD PROPRIETARY INFORMATION

RDP/GE/040184 (3)

5/29/84
9AF

SEP 000658

WATER_PCB-SD0000029157