APPENDIX III

ASTM METHOD D -- FOR INVESTIGATING THE COMPATIBILITY OF TRANSFORMER INSULATION AND CONSTRUCTION MATERIALS IN ASKARELS

1. Scope

1.1 This method uses the change of electrical and/or chemical characteristics of transformer askarel resulting from controlled exposure to insulation and construction materials, to evaluate their immediate major contamination effect on the askarel fluid. Delayed or long time contamination effects may not be detected.

1.2 This method also utilizes various physical tests on the insulation and construction materials after controlled exposure to the askarel to determine the compatibility of these materials with transformer askarel.

2. Summary of Method

2.1 Properly proportioned specimens of the insulation or structural materials are immersed in refined askarel for 168 hours at 100±1C. in a forced draft oven. Changes in electrical and chemical properties of the transformer askarel are compared against a control sample of the askarel treated in the same manner, in absence of the test specimens.

2.2 Color change or intensification beyond that of the control indicates that the askarel has extracted color materials from the insulation or structural components.

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2.3 Physical properties of the materials of insulation and construction are determined before and after exposure to the askarel fluid.

3. Significance

3.1 The changes in the electrical and chemical properties are due to contamination from the test specimens. The magnitude of change is basis for judging the compatibility of the materials for use with askarel fluid.

3.2 Color change or intensification indicates solubility of some components from the test specimen, which may adversely affect the fluid.

3.3 The magnitude of change in physical properties of the specimens after exposure in askarel fluid are basis for judging the short term compatibility of these insulation and structural components for use in askarel.

3.4 Conformance with the requirements of this method does not recommend a material for application, unless all other required performance criteria are met.

4. Interferences

4.1 If the askarel fluid has not been refined to a proper level, required for standardization, then the results may be obscured. Contaminated or improperly handled test specimens, improperly cleaned sample containers, handling devices, and electrical testing apparatus, can also obscure results.

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4.2 Solvents should not be used to clean the specimens unless it is part of the normal manufacturing handling process.

5. Apparatus

5.1 Sample Handling Apparatus

5.1.1 A forced draft oven, adjustable to 100±1C.

5.1.2 Clean glass quart or 800 ml. containers fitted with glass or aluminum foil covers, without gaskets.

5.1.3 Clean metal tongs, thermometers.

5.2 Electrical Apparatus

		Method
Dissipation Factor Bridge	-	ASTM D-150
Resistivity Bridge	-	ASTM D-1169
Cell	-	ASTM D-924
Dielectric Break Down Voltage	-	ASTM D-877

5.3 Chemical Apparatus

Neutralization Apparatus	-	ASTM D-664
Karl Fischer Apparatus	-	ASTM D-1533

5.4 Physical Testing Apparatus

Tensile Strength	-	Appropriate ASTM Method
Hardness	-	Appropriate ASTM Method
Dimensional Change	-	Micrometer or Caliper
Weight Change	-	Analytical Balance
Color	-	ASTM D-2129

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6. Procedure

6.1 Refinement of the Askarel Fluid

The transformer askarel should be refined by adsorptive treatment to the following specifications:

a)	Color ASTM D-2129	150	maximum
b)	Appearance	clear	
c)	Neutralization Number ASTM D-664	0.014 mg KOH/g.	maximum
d)	Moisture, ASTM D-1533	30 ppm.	maximum
e)	Dielectric breakdown voltage, ASTM D-877	35 KV	minimum
f)	Dissipation Factor, ASTM D-924 60 Hertz 100°C.	~~7.5%~~ 5.0	maximum
g)	Specific volume resistivity 100°C.; VDC, ASTM D-1169	~~5~~00 x 10^9 ohm-cm	minimum

6.2 Preparation and Size of the Test Specimens

The specimens are prepared for testing in the same way that they would be treated in the manufacturing process, except that they should be transported with tongs. [Suggested drying time for specimens is 105°C. overnight] The test specimens shall represent the "as used" condition in the manufacturing process. For solid materials the ratio of the surface area of the materials to the askarel fluid will vary and should be estimated to be greater than the ratio employed in the transformer.

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Some suggested ratios are:

a) If the specimen can be measured, no less than 4 square inches (25.8 sq. cm.) are used with each 400 ml. of askarel.

b) If the specimen is insoluble in askarel and the surface area cannot be measured, the specimen is used in the amount of one percent by the weight of the askarel.

c) If the material is soluble in the askarel, the specimen is used in the amount of 0.5 percent by the weight of the askarel.

d) Varnishes, wire enamels and materials used as dip coatings are cured on approved paper or aluminum foil and are tested at a ratio of 7 grams or approximately 100 square inches (645 sq. cm.) of surface area per 400 ml. of askarel fluid.

e) Core steel and core steel coatings are tested at a ratio of 450 square inches (2903 sq. cm.) for each 375 ml. of askarel, for transformer applications. A realistic core steel ratio for regulators is 900 square inches (5804 sq. cm.) of surface area per each 350 ml. of askarel.

f) Gasket materials are tested at a ratio of 0.5 square inch per gallon (3.23 sq. cm. per 3.8 liters) or 0.053 square inches per 400 ml (0.34 sq. cm. per 400 ml) of askarel.

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6.3 Test Details

6.3.1 Depending on the volume requirement of the dielectric cell add 400 ml. to 600 ml. of the refined askarel fluid into a clean glass jar or beaker. Add the test specimen and leave an air space for expansion.

6.3.2 Cover the beaker or glass jar with a watch glass or jar top made of glass. Prepare a similar glass container filled with an equivalent volume of the same source askarel fluid, as a control.

6.3.3 Place the jars into a forced air circulation oven adjusted to 100±1C. and heat for 168 hours. Then remove the jars from the oven. Remove the specimens. Make the dissipation factor and resistivity tests. Then pour the askarel back into the containers. Cover them and cool to room temperature.

6.3.4 Observe the jars containing the cooled fluid for cloudiness, discoloration, settling out of fillers, etc. as compared against the cooled control askarel fluid.

6.3.5 Determine dielectric breakdown voltage ASTM D-877.

6.3.6 Wash the specimens with a clean suitable solvent and dry. Then determine the physical properties indicated in 5.4 and compare against the unexposed materials.

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7. Interpretation of the Tests Made on the Askarel Fluid

7.1 The test results obtained on the askarel containing the samples must be compared with those of the control askarel to determine the effect of the samples on the askarel.

7.2 A significant change in any of the characteristics would indicate lack of compatibility and should be further studied.

7.3 The properties of the control askarel after heating for 168 hours in absence of a test specimen should be:

Characteristics	Values
Color ASTM D-2129	150, maximum
Moisture ASTM D-1533	30 ppm, maximum
Neutralization Number ASTM D-664	.014 mg KOH/g. max.
Dielectric Breakdown Voltage ASTM D-877	35 KV, Minimum
Dissipation Factor ASTM D-924 (60 Hertz, 100°C.)	7.5%, maximum
Specific volume resistivity 100°C. 500 VDC, ASTM D-1169	~~75~~ 100 x 10^9 ohm-cm min.

7.4 The properties of the askarel heated for 168 hours in the presence of a test specimen should be:

Characteristics	Values
Color ASTM D-2129	200 maximum
Moisture ASTM D-1533	35 ppm, maximum
Dielectric Strength, ASTM D-877	28 KV, minimum
Dissipation Factor ASTM D-924, (60 Hertz, 100°C.)	20%, maximum

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Characteristics	Values
Neutralization Number, ASTM D-664	.03 mg KOH/g. max.
Specific volume resistivity 100°C., 500 VDC, ASTM D-1169	50 x 10^9 ohm-cm min.

8. Interpretation of the Tests Made on Solid Insulating Materials

8.1 Obvious changes in the physical properties or dimensions of the insulation or structural materials must be considered on the basis of the specific needs of the application.

8.2 Wire enamel, tests are made to assure the physical integrity of the enamel following exposure to the askarel. Commonly used evaluation tests are bendability, scrape abrasion and dielectric breakdown.

8.3 Gasket materials are evaluated by determining the degree of swelling or embrittlement, using dimensional changes and durometer hardness.

8.4 Organic coatings and adhesive materials shall maintain their integrity after exposure to the askarel.

8.5 Laminated materials shall not delaminate after exposure to the askarel.

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