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LABORATORY REPORT

DATE

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PURPOSE

To evaluate RP™ Rapid Power under the guidelines proposed in IEEE 1493, “Guide for the Evaluation of Solvents Used for Cleaning Electrical Cables and Accessories.”

PROCEDURE & RESULTS

A. SAFETY

RP™ Rapid Power is available as a pre-saturated towelette. This eliminates any spill hazard and limits usage and vapor exposure. RP™ Rapid Power has a TLV estimated 400 ppm TWA and does not contain any listed carcinogens. RP™ Rapid Power is flammable but the towelette package limits the fuel available in case of fire.

B. REGULATORY

RP™ Rapid Power is not characterized as hazardous waste under RCRA. It is not regulated under CERCLA/SARA Sec. 302 as a hazardous substance RQ or extremely hazardous substance TPQ, nor is it regulated under SARA Sec. 313.

C. PHYSICAL PROPERTIES

1. FLASH POINT

RP™ Rapid Power has a flash point of -7° C. RP™ Rapid Power does not release acrid or toxic smoke when it burns.

2. DIELECTRIC

RP™ Rapid Power produces a dielectric breakdown of 56 kV when tested by ASTM D 877, 100 mil plate gap. Acceptance criteria is a dielectric breakdown greater than or equal to 10 kV.

D. PERFORMANCE

1. EVAPORATION RATE

RP™ Rapid Power is very fast evaporating at 8000 mg/hour per ASTM D 1901.

2. %NON-VOLATILE RESIDUE

RP™ Rapid Power does not leave a residue. The solvent was tested per ASTM D 2369. Three samples of approximately 10 grams were weighed accurate to 0.1mg. The solvent was allowed to evaporate at room temperature, and then at 50°C and residue was determined. The nonvolatile residue was determined to be 0 ppm (not detectable). Acceptance criteria for a non-volatile residue are less than 100 ppm.

3. CLEANING EFFECTIVENESS

RP™ Rapid Power cleaner was evaluated in the laboratory for cleaning effectiveness by wiping a semi-conducting cable component with a piece of towel saturated with the cleaner. RP™ Rapid Power cleaner was found to quickly and effectively clean the component.

E. COMPATIBILITY

RP™ Rapid Power is fast evaporating, thus exposure to various cable components is limited. It should be noted that while the testing guidelines call for immersion testing, the packaging only allows the solvent to be wiped over a surface in field use. For the purposes of testing, bulk solvent was used for immersion.

1. PHYSICAL

a. Plastic Materials – LLDPE

LLDPE jacket material was stripped from a cable and cut into a dumbbell shape (ASTM D 412 Die D). Samples were immersed in the RP™ Rapid Power for 1 minute +/- 5 seconds. Tensile and Elongation values were measured at 15 minutes after immersion. Initial jaw separation was 2 inches and pulling speed was set at 500 mm/min. These values were compared to the control. Acceptance criteria is retaining 80% of the original tensile or elongation after the soak.

LLDPE RESULT:

DESCRIPTION	TENSILE	ELONGATION
Type RP Solvent Soak	2476 lb/in^2	622%
Control Material Property	2513 lb/in^2	613%
Comparison	98%	101%
Status	**PASS**	**PASS**

b. Rubber Materials – EPDM and Silicone Rubber

Platen samples of the EPDM and Silicone Rubber were obtained and cut into dumbbell shapes (ASTM D 412 Die D). Samples were immersed in the RP™ Rapid Power for 1 minute +/- 5 seconds. Tensile and Elongation values were measured at 15 minutes after immersion. Initial jaw separation was 2 inches and pulling speed was set at 500 mm/min. Acceptance criteria is retaining 80% of the original tensile or elongation after the soak.

SILICONE RUBBER RESULT:

DESCRIPTION	TENSILE	ELONGATION
Type RP Solvent Soak	940 lb/in^2	307%
Control Material Property	950 lb/in^2	295%
Comparison	99%	104%
Status	**PASS**	**PASS**

EPDM RUBBER RESULT:

DESCRIPTION	TENSILE	ELONGATION
Type RP Solvent Soak	2480 lb/in^2	497%
Control Material Property	2510 lb/in^2	493%
Comparison	98%	101%
Status	**PASS**	**PASS**

c. INSULATION MATERIALS

Insulation materials from Okonite and Kerite cables (provided by Memphis Light, Gas, and Water) underwent a solvent soak test as described in IEEE 1493, Section 8.2.1. During this test samples of the insulation materials were soaked in Type RP for 1 minute ± 5 seconds and volume swell was determined by this formula:

$$\% \text{ Volume Swell} = (SG_s * Wt_g) / (Wt_i * SG_l) * 100$$

$$Wt_g = Wt_F - Wt_{tare} - Wt_i$$

Where:
Wt_i = Initial specimen weight
Wt_g = Net weight gain of specimen
Wt_F = Final weight of swollen specimen and bottle
Wt_{tare} = Tare weight of bottle and lid
SG_s = Density (or specific gravity) of the specimen
SG_l = Density (or specific gravity) of the liquid

Acceptance criteria for volume swell after immersion to be less than ±10%.
Average results of three trials are shown in the tables below

XLPE INSULATION SHIELD:

%VOLUME SWELL	STATUS
-0.01	PASS

EPR INSULATION SHIELD:

%VOLUME SWELL	STATUS
3.34	PASS

2. ELECTRICAL

a. VOLUME RESISTIBITY OF CABLE INSULATION SHIELD

Volume resistivity was tested as a slightly modified version as described in IEEE 1493, Section 8.3.2. The Okonite and Kerite cables provided by Memphis Light, Gas, and Water were stripped to the insulation shield. Silver paint was applied at a separation of about 20 cm to create potential electrodes. The cables were wrapped in RP™ Rapid Power soaked paper towels for 1 minute ± 5 seconds. A control sample was also tested. Resistance measurements were converted using the following formula:

$$R = V/I$$

Where V is the voltage across the electrodes, and I is the current between the electrodes.
The volume resistivity, ρ, is calculated from:

$$\rho = (\pi/4) \cdot R\,(D^2 - d^2)/L$$

Where D = the diameter over the insulation shield in cm, d = the diameter over the insulation in cm and L = the length between the electrodes in cm. The resulting value for ρ is in ohm cm.

Acceptance criteria for this test is for the samples to not change from the average value measured for the control specimens by more than ± 20% at 96 hours.

Volume resistivity results are as follows, values are in Ohm-cm unless given as a percent:

XLPE INSULATION VOLUME RESISTIVITY

EXPOSURE TIME	CONTROL	TYPE RP	% CONTROL
Initial	29.0	28.7	99

15 minutes	29.0	31.6	109
30 minutes	30.4	31.6	104
24 hours	30.4	30.9	101
48 hours	29.7	29.4	99
96 hours	29.7	29.4	99
		STATUS:	**PASS**

EPR INSULATION VOLUME RESISTIVITY

EXPOSURE TIME	CONTROL	TYPE RP	% CONTROL
Initial	15.6	16.3	105
15 minutes	15.6	15.7	101
30 minutes	16.3	16.3	101
24 hours	17.5	17.0	97
48 hours	16.3	16.3	101
96 hours	16.3	16.3	101
		STATUS:	**PASS**

The cables soaked in RP™ Rapid Power had an acceptable volume resistivity. The volume resistivity values are slightly elevated immediately, but do come to stability very quickly, between 1 and 24 hours, quicker in the Kerite cable.

CONCLUSION

RP™ Rapid Power is a powerful electrical cleaner. It is fast evaporating, has a good dielectric strength, and excellent solvency. Because of the fast evaporation rate, solvent contact with electrical components is limited. RP™ Rapid Power has a negligible effect on the physical properties of XLPE plastic and electrical properties of cable insulation materials.

Prepared By:

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