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## LABORATORY REPORT

**Date:** May 8, 2015

**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

	Tensile /PSI	% Elongation
Solvent Soak	2476	622
Control	2513	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

	Tensile /PSI	% Elongation
Solvent Soak	940	307
Control	950	295
Comparison	99%	104%
Status	Pass	Pass

## EPDM Rubber

	Tensile /PSI	% Elongation
Solvent Soak	2480	497
Control	2510	493
Comparison	98%	101%
Status	Pass	Pass

### c. Insulation Materials

The 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 RP™ Rapid Power for 1 minute  $\pm$  5 seconds and volume swell was determined by this formula. Acceptance criteria for volume swell after immersion to be less than  $\pm$ 10%:

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

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

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

Results are shown in the tables below:

### XLPE

	$Wt_i$ /g	$Wt_F$ /g	$Wt_g$ /g	% Volume Swell
Avg	1.5482	8.1342	-0.0008	-0.01
Status				Pass

### EPR

	$Wt_i$ /g	$Wt_F$ /g	$Wt_g$ /g	% Volume Swell
Avg	0.5303	7.127	0.0099	3.34
Status				Pass

## 2. Electrical

### a. Volume Resistivity 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,  $\rho$ , 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  $\rho$  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  $\pm 20\%$  at 96 hours.

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

### XLPE

	Control	RP	% of Control
Initial	29.0	28.7	99
15 min	29.0	31.6	109
30 min	30.4	31.6	104
24 hr	30.4	30.9	101
48 hr	29.7	29.4	99
96 hr	29.7	29.4	99
Average	29.7		Pass

### EPR

	Control	RP	% of Control
Initial	15.6	16.3	105
15 min	15.6	15.7	101
30 min	16.3	16.3	101
24 hr	17.5	17.0	97
48 hr	16.3	16.3	101
96 hr	16.3	16.3	101
Average	16.3		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.

#### Discussion:

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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