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LABORATORY REPORT

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Purpose:

To evaluate Type HP™ cleaner under the guidelines proposed in IEEE 1493, "Guide for the Evaluation of Solvents Used for Cleaning Electrical Cables and Accessories."

Procedure & Results:

A. Safety

Type HP™ cleaner is available as a pre-saturated towelette. This eliminates any spill hazard and limits usage and vapor exposure. Type HP™ cleaner has a high flashpoint and does not contain any listed carcinogens.

B. Regulatory

Type HP™ cleaner is not listed on the EPA Phase I or Phase II list of banned or phased out chlorofluorocarbons. It is not considered 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

Type HP™ cleaner has a flashpoint of 63 - 67°C. Acceptance criteria is a flashpoint greater than or equal to 60.5°C (141°F).

2. Dielectric

Type HP™ cleaner produces a dielectric breakdown of ≥40 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

The evaporation rate of Type HP™ cleaner is 60.0 as (n-butyl acetate = 1.0) per ASTM D 1901. Since Type HP™ cleaner is used as a wipe (components being cleaned are not soaked or immersed in the cleaner), evaporation takes place relatively quickly.

2. % Non-Volatile Residue

Type HP™ cleaner does not leave a residue. The cleaner was tested per ASTM D 2369. Three samples of approximately 3 grams were weighed accurate to 0.1mg. The solvent was allowed to evaporate at 100°C and residue was determined. The nonvolatile residue was determined to be 0 ppm (not detectable). Acceptance criteria is a non-volatile residue less than 100 ppm.

3. Cleaning Effectiveness

Type HP™ 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. Type HP™ cleaner was found to quickly and effectively clean the component.

E. Compatibility

Whereas testing guidelines for compatibility call for immersion of cable components in the cleaning compound being evaluated, Type HP™ cleaner is used as a wipe in field use, therefore exposure of cable components to Type HP™ during actual use would be much more limited than during testing.

1. Physical

a. Plastic Materials - XLPE

XLPE jacket material was stripped from a cable and cut into a dumbbell shape (ASTM D 412 Die D). Samples were immersed in the Type HP™ cleaner 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 2 inches/minute. These values were compared to the control.

XLPE	Tensile	Elongation
Solvent Soak	2142 psi	363%
Control	2010 psi	327%
Comparison	107%	+11%

Percent weight change of XLPE Cable Jacket 15 minutes after immersion is +0.33%.

b. Rubber Materials - EPDM and Silicone Rubber

Platen samples of EPDM and Silicone Rubber were obtained and cut into dumbbell shapes (ASTM D 412 Die D). Samples were immersed in the Type HP™ cleaner for 1 minute +/- 5 seconds. Tensile and Elongation values were measured at 15 minutes after immersion. For the EPDM Rubber samples, Tensile and Elongation values were again measured at 96 hours after immersion. Initial jaw separation was 2 inches and pulling speed was set at 20 inches/minute. These values were compared to the control.

	(15 minutes after immersion)	
Silicone Rubber	**Tensile**	**Elongation**
Solvent Soak	978 psi	188%
Control	1022 psi	199%
Comparison	96%	-6%
Status	Pass (> 80%)	Pass (± 20%)

Percent weight change of Silicone Rubber 15 minutes after immersion is +3.48%.

	(96 hours after immersion)	
EPDM Rubber	**Tensile**	**Elongation**
Solvent Soak	1215 psi	301%
Control	1181 psi	290%
Comparison	103%	+4%
Status	Pass (> 90%)	Pass (± 10%)

Percent weight change of EPDM Rubber 15 minutes after immersion is +3.61%.

2. Electrical

a. Volume Resistivity of Cable Insulation Shield

Volume Resistivity was tested as described in IEEE 1210, Section 5.11. Type 0691 XLPE platens were cut in strips 190mm ± 3mm long by 10mm ± 1 mm wide. Silver paint was applied at a separation of 100 mm to create potential electrodes. The platen strip was immersed in Type HP™ cleaner for 1 minute. A control sample was also tested. Resistance measurements were converted using the following formula:

$$P(n) = \frac{RWT}{L}$$

where
P is the volume resistivity in Ω-cm
R is the measured resistance in Ω
W is the average width of the cut specimen (before immersion), in cm
T is the thickness of the specimen (before immersion) in cm
L is the distance between potential electrodes in cm
n is the time from start of aging

Volume resistivity results are as follows:

Time	Control	Immersed
Initial	40 Ω-cm	40 Ω-cm
3 Minutes	40 Ω-cm	45 Ω-cm
15 Minutes	40 Ω-cm	45 Ω-cm
1 Hour	40 Ω-cm	41 Ω-cm
24 Hours	40 Ω-cm	40 Ω-cm

The platen soaked in Type HP™ has an acceptable volume resistivity. The volume resistivity values are slightly elevated immediately, but do come to stability very quickly, between 1 and 24 hours.

Discussion:

Type HP™ cleaner has a high flashpoint, fast evaporation (when used as intended), good dielectric strength, and excellent cleaning ability. Type HP™ cleaner has a negligible effect on the physical properties of XLPE plastic and silicone rubber. It has a short-term effect on EPDM rubber, which becomes negligible within 96 hours after exposure. It also has a negligible effect on the electrical properties of XLPE semi-conducting compound.

Prepared By:

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