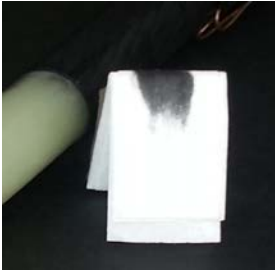

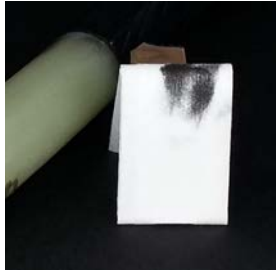
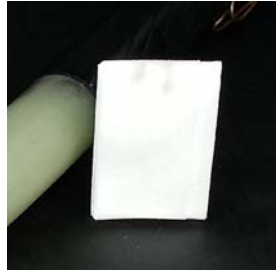


**Laboratory Report  
Polywater Cleaners RP™ (Rapid Power),  
Type TR™ and Type HP™**

28 April 2015

Polywater Electrical Cleaners are optimized for splice preparation and electrical component cleaning. Test methods are based on IEEE 1493, "Guide for the Evaluation of Solvents Used for Cleaning Electrical Cables and Accessories" as well as end use requirements.

	Type RP™ Rapid Power	Type TR™	Type HP™	Alcohol
<b>Cleaning Effectiveness</b>				
<p><b>Cleaning Test (IEEE 1493)</b> Based on ASTM Test Method D4265, a cloth saturated with cleaning solvent is wiped across a sample of cable insulation shield material. Cleaning effectiveness is judged by visual comparison of the transfer of black insulation shield onto the surface of the white cloth.</p>				
<p><b>Solubility, Various Contaminants</b> Contaminant is spread over a 38 by 13 mm polyethylene rectangle. Serrated spatula is held at a perpendicular angle to the coated sample and scraped lengthwise to create 0.6 mm ribbons of the contaminant. Sample is immersed into a 60 ml jar of cleaner and agitated. Time to completely clean the surface is noted.</p>				
<b>Silicone Grease<sup>1</sup></b>	1.0 minutes	1.0 minutes	3.5 minutes	>5.0 minutes
<b>Dielectric Oil</b>	0.5 minutes	0.5 minutes	0.5 minutes	0.5 minutes
<b>Hydrocarbon Grease, MolyLube<sup>2</sup></b>	0.5 minutes	0.5 minutes	1.0 minutes	4.0 minutes
<b>Aluminum Oxide Grease<sup>3</sup></b>	1.0 minutes	1.0 minutes	2.5 minutes	>5.0 minutes

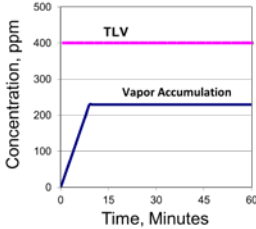
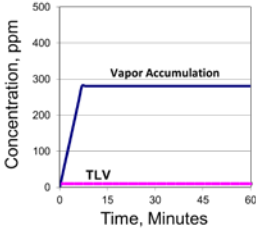
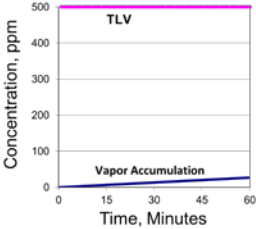
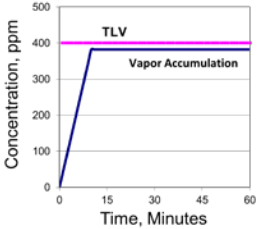






<sup>1</sup>Dow Corning #4 Electrical Insulating Compound

<sup>2</sup>Generic Molybdenum Disulfide Based Lubricant

<sup>3</sup>GB Ox-Gard™ Compound

	Type RP™ Rapid Power	Type TR™	Type HP™	Alcohol
<b>Physical Properties</b>				
<b>Dielectric Strength</b> <i>Testing based on ASTM D877, 100 mil gap.  Dielectric strength should be ≥ 10kV.</i>	56 kV	16 kV	41 kV	Varies <i>Water content lowers dielectric strength and increases conductivity</i>
<b>Residue</b> <i>Testing based on ASTM D2369  Three samples of approximately 20 grams are weighed accurate to 0.1 mg. Solvent is allowed to evaporate at 70°C and residue determined  Non-volatile residue should be less than 100 ppm.</i>	< 100 ppm	< 100 ppm	< 100 ppm	Varies*
<b>Flash Point</b> <i>Tested by Pensky-Martens Closed Cup using ASTM D93  Cleaning solvents with flash points &gt;60°C offer the highest safety margin for the craftsman, and are the least regulated for use and transport.</i>	- 7°C flammable	Not determined flammable	> 60°C combustible	12°C flammable
<b>Evaporation Rate (IEEE 1493)</b> <i>Five to ten grams cleaner is weighed into a small weighing tin and allowed to evaporate at ambient condition. Comparative evaporation rate over time is calculated.  A faster evaporating solvent will stay in contact with the cleaning surface for less time, and quickly convert to solvent vapor in the work area, increasing inhalation hazard.</i>	Fast 765 mg/min	Very Fast 1650 mg/min	Moderate- Slow 30 mg/min	Fast 765 mg/min

	Type RP™ Rapid Power	Type TR™	Type HP™	Alcohol
<b>Compatibility (IEEE 1493)</b>				
<p><b>Physical – Tensile and Elongation</b>  Material is cut into a dogbone shape, immersed in the cleaning fluid for 1 minute. Tensile and elongation is measured within 15 minutes and compared to control. Jaw separation speed is 2 inches per minute.  Tensile strength should be within 80% of control after 30 minutes and 90% of control after 96 hours. Elongation should be ± 20% of control after 30 minutes and ± 10% of control after 96 hours.</p>	<p>XLPE – Passes  &gt; 90% tensile control,  ± 10% elongation control  after 15 mins</p> <p>EPDM, Silicone Rubber – Passes  &gt; 90% tensile control,  ± 10% elongation control  after 15 mins</p>	<p>XLPE – Passes  &gt; 90% tensile control,  ± 10% elongation control  after 15 mins</p> <p>EPDM, Silicone Rubber – Passes  &gt; 90% tensile control,  ± 20% elongation control  after 15 mins</p>	<p>XLPE – Passes  &gt; 90% tensile control,  ± 20% elongation control  after 15 mins</p> <p>EPDM, Silicone Rubber – Passes  &gt; 90% tensile control,  ± 10% elongation control  after 15 mins</p>	Not Tested
<p><b>Electrical – Volume Resistivity</b>  Semi-conductive platens are cut into strips 190 mm by 10 mm and silver paint was applied at a separation of 100 mm to create potential electrodes. The strip was immersed in the cleaning fluid for 1 minute. Resistance measurements are converted to a volume resistivity.  Cleaning fluid should not change the electrical properties of the cable. Volume resistivity should be within 20% of control 96 hours after exposure.</p>	<p>XLPE &amp; EPR Semi-Con – Passes  Reaches stability; same volume resistivity as control after 24 hrs</p>	<p>XLPE Semi-Con – Passes  Reaches stability; same volume resistivity as control after 24 hrs</p>	<p>XLPE Semi-Con – Passes  Reaches stability; same volume resistivity as control after 24 hrs</p>	Not Tested
<p><b>Polycarbonate Stress Crack Testing</b>  Injection-molded plaques of polycarbonate are cut into bars, 2½ inch by ½ inch. Samples are bent in a three-point fixture. Percent strain is calculated based on the bar thickness and the radius of curvature.  “Strain limit” is the greatest percent strain where no stress cracking occurs. A strain limit greater than 0.5% indicates strain resistance.</p>	<p>Resistant,  Strain Limit &gt; 0.5%</p>	<p>Stress Cracks  Polycarbonate</p>	<p>Resistant,  Strain Limit &gt; 0.5%</p>	Not Tested

	Type RP™ Rapid Power	Type TR™	Type HP™	Alcohol
<b>Safety, Environment and End Use</b>				
<b>Toxicity</b> <i>Product shall be non-toxic. Inhalation exposure should be limited based on OSHA Threshold Limit Values (TLV).</i>	400 ppm	10 ppm	500 ppm	400 ppm
<b>PEL Enclosed Space Exposure</b> <i>Vapor accumulation in a small vault, 6 X 6 X 8 feet, no ventilation and safety factor, K set at 10. Differences based on evaporation rate, solvent charge and molecular weight. Note: It is very difficult to keep Type TR vapor level below TLV without ventilation.</i>				
<b>GHS &amp; Labeling</b> <i>New OSHA regulations require updated labeling for chemical goods. Pictograms and hazard phrases are now required on all labels.</i>	 H225 Extremely Flammable, H315 Causes skin irritation, H336 Causes drowsiness  (bulk only) (H304 Fatal if swallowed)	 H225 Extremely Flammable, H315 Causes skin irritation, H319 Causes serious eye irritation, H360 May damage fertility or unborn child, H371 May cause damage to organs, H336 Causes drowsiness	 H227 Combustible, H317 Causes allergic skin reaction  (bulk only) (H304 Fatal if swallowed)	 H225 Extremely Flammable, H319 Causes serious eye irritation, H336 Causes drowsiness
<b>Volatile Organic Content (VOC)</b> <i>VOC release requirements vary by geographical location. Some areas have strict limits on VOC release.</i>	720 g/L	1330 g/L	790 g/L	790 g/L

	<b>Type RP™ Rapid Power</b>	<b>Type TR™</b>	<b>Type HP™</b>	<b>Alcohol</b>
<b>Shipping and Storage</b>				
	Flammable: Pouches ship Not Regulated under special provision. Bulk packages ship hazardous	Flammable: Pouches ship Not Regulated under special provision. Bulk packages ship hazardous	Combustible: Not Regulated for shipping.	Flammable: Pouches ship Not Regulated under special provision. Bulk packages ship hazardous
<b>Package Availability</b>				
	Pouches Bulk Possible, Aerosol like FD-9	Pouches Aerosol	Pouches, Tins Bulk Aerosol	Offered as Type FO, Pouches & Bulk

## Conclusion

All Polywater Electrical cleaners show good compatibility with electrical materials- limited effect on the physical and electrical properties. They are good cleaners and have good dielectric strength (especially Type RP and Type HP). The greatest performance differences are in the evaporation and flashpoint. Type TR has toxicity concerns.