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Cortec and Commercial Product Comparison Charts

To: Whom it may concern
From: Cortec Corporation Laboratories
CC: Eric Uutala
Ed Bertges
Ken Motsinger
Date: February 12, 2013

Background: It was requested that Cortec tests and compare different rust remover, converter, and preventative products with those currently in the commercial market.

Results: Three spreadsheets have been prepared for comparison of each line of products in the attached documents (Appendix B, C, and D). The products are compared by test results from previous Cortec testing and information provided on the company's MSDS. Additionally, a document with an explanation of the comparison charts is provided in Appendix A.

A handwritten signature in black ink that reads "Caleb Pheneger".

Caleb Pheneger
Technical Service Engineer
Cortec Corporation



Appendix A: Explanation of product comparison charts

The following are descriptions and definitions for categories used to compare different lines of products:

| | |
|---------------------|---|
| Product (Type): | Name of product, may be slightly abbreviated. Type of product specifies either the class of rust remover, or the packaging the product comes in. |
| Transportation: | Information on any restrictions or classifications for shipping based on the listing in section 14 the MSDS. |
| VOC: | Volatile Organic Compounds listed as a percent of total contents. This was referenced from company MSDS and not measured. |
| Food Certification: | NSF, USDA, or FDA certification that a product can be used for applications with indirect or incidental contact with food. Only VpCI-422 and VpCI-423 has this listing. |
| USDA Bio-preferred: | Classified by USDA as a primarily bio-based material; listed as a percentage of total contents. No converters have this listing. |
| Toxicology/Ecology: | Any toxicological or ecological reports on MSDS or located/ available online. |
| pH: | Acidity of rust remover on pH scale; from MSDS, not measured. |
| DFT: | Dry Film Thickness is the thickness of a coating after it dries. For our testing each product was applied as directed and the DFT was measured in mils, which is equal to 0.001 inches. This is only a useful measurement for converters. |
| Flash Point | The lowest temperature a product can vaporize and form a combustible mixture with air. All rust removers were mostly water based and not flammable, so this section was not included. |
| PPE: | Personal Protective Equipment suggested for handling the product (Please see Appendix E for additional information regarding PPE codes). A rating of B should be used as a minimum for almost all chemicals. Please note that some products require good ventilation or a vapor respirator if the concentration levels get too high. See MSDS for complete information on proper PPE. |
| HMIS: | Hazardous Material Identification System, please see Appendix E for additional information. |

| | |
|-------------------------------|--|
| Rust Removal (mins): | Amount of time required for complete removal of moderate severity rust. Each panel was rusted for the following time for consistent moderate rust: 1010 carbon steel: 24 hours in ASTM B-117 Cast iron: 24 hours in ASTM D-1748 Copper: 120 hours in ASTM B-117 |
| ASTM B-117 Salt Spray: | Standardized test for the resistance of a coating to corrosion failure. This test includes elevated temperature and presence of salt water fog. It is an industry standard for coatings. |
| ASTM D-1748 Humidity Testing: | Standardized test for corrosion failure of rust preventatives. Temperature of 120 °F and approximately 99% relative humidity results in failure of bare metal in hours. Failure is defined by three spots of visual corrosion on a test panel. This test is a standard for rust preventatives. |

Appendix B: Rust Remover Comparison Chart

| Product (Type) | Transportation | VOC | Food Certification | USDA BioPreferred | Toxicology/Ecology | pH | PPE | HMIS | | | Rust Removal (mins) | | |
|--|---------------------------|------|-------------------------------|-------------------|--|---------|-----|------|---|---|---------------------|------|--------|
| | | | | | | | | H | F | R | Steel | Iron | Copper |
| VpCI-429 (pH neutral) | Not Regulated | 0% | No | No | Fresh and salt water fish toxicity reports available | 6.5-7.0 | B | 0 | 1 | 0 | 60 | 120 | 120 |
| Evapo-Rust (pH neutral) | Not Regulated | 0% | No | No | Biodegradable, Non-toxic (test at 5g/kg orally in rats) | 5.7-6.3 | A | 0 | 0 | 0 | 60 | 90 | Failed |
| Metal Rescue (pH neutral) | Not Regulated | 0% | No | No | Rat LD50: Oral > 2.85 mg/kg, Dermal > 5 mg/kg | 6.0-7.5 | B | 0 | 0 | 0 | 85 | >180 | 120 |
| VpCI-422 (Citric Acid) | Not Regulated | 0% | USDA & NSF (indirect contact) | 92% | Biodegradable, marine toxicity data available, CEFAS certified | 1.7-2.5 | B | 1 | 0 | 0 | 20 | 30 | 30 |
| VpCI-423 (gel) (Citric Acid) | Not Regulated | 0% | USDA (indirect contact) | 91% | Fresh and salt water fish toxicity reports available | 2.1-2.5 | B | 1 | 0 | 0 | 20 | 30 | 40 |
| VpCI-426 (Phosphoric Acid) | UN1805, Class 8 Group III | 8.9% | No | No | Fresh and salt water fish toxicity reports available | 1.5-2.5 | B | 2 | 1 | 0 | 10 | 15 | 20 |
| VpCI-426 Gel (Phosphoric Acid) | UN1805, Class 8 Group III | 8.9% | No | No | Fresh and salt water fish toxicity reports available | 1.5-2.5 | B | 2 | 1 | 0 | 10 | 20 | 20 |
| Loctite Naval Jelly (Phosphoric Acid) | UN1805, Class 8 Group III | 2.4% | No | No | Contains known carcinogen (sulfuric acid) | 1.5-2.5 | B | 1 | 0 | 0 | 20 | 155 | 120 |
| Permatex Dissolver (Phosphoric Acid) | UN3264, Class 8 Group III | 2.4% | No | No | None Located | 1.5-2.5 | B | 3 | 0 | 0 | 20 | 90 | Failed |

Appendix C: Rust Converter Comparison Chart

| Product (Type) | Transportation | VOC | Flash Point | Toxicology/Ecology | PPE | HMIS | | | DFT | Salt Spray (240 hours) |
|--|---|------------|-------------|---|-----|------|---|---|----------|------------------------|
| | | | | | | H | F | R | | |
| Corrverter (Liquid product) | Not Regulated | 3.0% | NA | No Testing Conducted | B | 1 | 1 | 0 | 3 mils | <1% field failure |
| Rust-Oleum Rust Reformer (Liquid product) | ORM-D for Air and International | Not Listed | 89 (°C) | Component information: Tannic Acid Rat LD50 = 5 g/kg | B | 2 | 2 | 1 | 1.5 mils | 80% field failure |
| Permatex Rust Treatment (Aerosol product) | Ground: Class 2.1 UN 1950 Air: Class 9 ID 8000 | 50.4% | Not listed | Components not classified as carcinogens | B | 2 | 4 | 0 | 1 mil | 100% field failure |
| Extend Rust Neutralizer (Aerosol product) | Class 2.1 UN 1950 | 33.1% | < -6.7 (°C) | Components not classified as carcinogens | B | 2 | 4 | 2 | 1 mil | 90% field failure |
























Appendix D: Rust Preventative Comparison Chart

| Product (Type) | Transporation | USDA Biopreferred | VOC | Flash Point | Toxicology/Ecology | PPE | HMIS | | | ASTM D-1748 Humidity Testing |
|---|--|-------------------|----------------|-------------|--|-----|------|---|---|------------------------------|
| | | | | | | | H | F | R | |
| EcoAir BioCorr (Air Powered Spray Can) | Not Regulated | 64% | < 1.0% | 149 °C | No Testing Conducted | B | 1 | 1 | 0 | > 500 Hours |
| EcoAir VpCI-377 (Air Powered Spray Can) | Not Regulated | No | ~15% in EcoAir | 101 °C | Fresh and salt water fish toxicity data available. | B | 1 | 2 | 0 | > 500 Hours |
| Dry Coat RP (Trigger Spray Bottle) | Not Regulated | No | 0.0% | > 93 °C | Mobility: Air <5%, Water 30-50%, Soil 30-50% | B | 2 | 1 | 0 | 24 Hours |
| Evapo-Rust Rust-Block (Trigger Spray Bottle) | Not Regulated | No | Not Listed | Not Listed | None Located | A | 1 | 0 | 0 | 24 Hours |
| VpCI-325 (Trigger Spray Bottle, Oil) | Not Regulated | No | Not Listed | > 94 °C | No Testing Conducted | B | 1 | 2 | 1 | > 500 Hours |
| Ecoline 3690 (Bulk Liquid Product, Oil) | Not Regulated | 76% | 0.0% | 250 °C | Fresh and salt water fish toxicity data available. | B | 1 | 1 | 0 | > 500 Hours |
| Ecoline 3220 (Bulk Liquid Product, Oil) | Not Regulated | 99% | 0.0% | 100 °C | Fresh and salt water fish toxicity data available. | B | 1 | 1 | 0 | > 500 Hours |
| Rust-Oleum Rust Inhibitor (Aerosol Can, Oil) | US Ground: ORM-D Other: Class 2.1 UN 1950 | No | Not Listed | < -100 °C | Isoparaffinic Hydrocarbon >25 ml/kg (Rat, Oral) | B | 3 | 4 | 0 | 144 Hours |

APPENDIX E: HMIS Hazardous Materials Identification System

HMIS Label Example

| | | |
|--|----------|----------|
| HMIS [®] Chemical Name | | |
| HEALTH | * | 2 |
| FLAMMABILITY | | 1 |
| PHYSICAL HAZARD | | 0 |
| PERSONAL PROTECTION | | A |
| Emergency Overview: Summarize the nature and appearance of the chemical and the important health hazards. | | |
| <small>HMIS[®] - 2001 NIOSH - Printed by JPA - Rev 01 - 1-800-527-6566</small> | | |

| PERSONAL PROTECTION INDEX | | | | | | |
|--|---|---|---|---|--|--|
| A  | G  | | | | | |
| B  | H  | | | | | |
| C  | I  | | | | | |
| D  | J  | | | | | |
| E  | K  | | | | | |
| F  | X Consult your supervisor or S.O.P. for "SPECIAL" handling directions | | | | | |
| A  Safety Glasses | n  Splash Goggles | o  Face Shield & Eye Protection | p  Gloves | q  Boots | r  Synthetic Apron | s  Full Suit |
| t  Dust Respirator | u  Vapor Respirator | w  Dust & Vapor Respirator | y  Full Face Respirator | z  Airline Hood or Mask | Additional Information | |

HMIS HEALTH HAZARD RATING CHART

| | |
|--------------------------|---|
| * CHRONIC HAZARD | Chronic (long-term) health effects may result repeated overexposure. |
| 0=MINIMAL HAZARD | No significant risk to health. |
| 1=SLIGHT HAZARD | Irritation or minor reversible injury possible. |
| 2=MODERATE HAZARD | Temporary or minor injury may occur. |
| 3=SERIOUS HAZARD | Major injury likely unless prompt action is taken and medical treatment is given. |
| 4=SEVERE HAZARD | Life-threatening, major or permanent damage may result from single or repeated overexposures. |

HMIS Hazardous Materials Identification System

| HMIS FLAMMABILITY HAZARD RATING CHART | |
|---------------------------------------|--|
| 0=MINIMAL HAZARD | Materials that will not burn. |
| 1=SLIGHT HAZARD | Materials that must be preheated before ignition will occur. Includes liquids, solids and semi solids having a flash point above 200° F. (Class IIIB) |
| 2=MODERATE HAZARD | Materials which must be moderately heated or exposed to high ambient temperatures before ignition will occur. Includes liquids having a flash point at or above 100° F but below 200° F. (Classes II & IIIA) |
| 3=SERIOUS HAZARD | Materials capable of ignition under almost all normal temperature conditions. Includes flammable liquids with flash points below 73° F and boiling points above 100° F, as well as liquids with flash points between 73° F and 100° F. (Classes IB & IC) |
| 4=SEVERE HAZARD | Flammable gases, or very volatile flammable liquids with flash points below 73° F, and boiling points below 100° F. Materials may ignite spontaneously with air. (Class IA) |

| HMIS PHYSICAL HAZARD RATING CHART | |
|-----------------------------------|--|
| 0=MINIMAL HAZARD | Materials that are normally stable, under fire conditions and will not react to water, polymerize, decompose, condense or self react. |
| 1=SLIGHT HAZARD | Materials that are normally stable but can become unstable at high temperature and pressures. Materials may react non-violently with water or undergo hazardous polymerization in the absence of inhibitors. |
| 2=MODERATE HAZARD | Materials that are unstable and may undergo violent chemical change at normal temperature and pressure with low risk for explosion. Materials may react violently with water or form peroxides upon exposure to air. |
| 3=SERIOUS HAZARD | Materials that may form explosive mixtures with water are capable of detonation or explosive reaction in the presence of a strong initiating source or undergo chemical change at normal temperature and pressure with moderate risk of explosion. |
| 4=SEVERE HAZARD | Materials that are readily, capable of water reaction, detonation or explosive decomposition at normal temperatures and pressures. |