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# Evaluating Zerust Films Manufactured in Japan

Background: Customer submitted samples of Zerust films that have been manufactured

in Japan. They would like these films to be evaluated for their corrosion

inhibiting performance.

**Purpose:** To evaluate the VCI performance of submitted films.

**Materials:** Zerust HOF Film for non-ferrous metals (pink)

Zerust ESD (clear)

Zerust ROF for multi-metal (coral) Zerust MYF for ferrous metals (yellow)

Zerust Stat-3S ESD (blue)

Razorblade Test Kit

VIA Test Kit

EM Quant Nitrate/Nitrite Test Strips

Perkin Elmer Paragon 1000 FTIR Spectrometer

**Method:** Razorblade Test

VIA Test

Nitrite/Nitrate Test FTIR Spectrometry Surface Resistivity Static Decay Rate

**Procedure:** All tests were carried out according to standard procedures.

**Results:** 

#### **Carbon Steel Razorblade Test Results**

| Sample         | Panel 1 | Panel 2 | Panel 3 | Control |
|----------------|---------|---------|---------|---------|
| Zerust HOF     | Fail    | Fail    | Fail    | Fail    |
| Zerust ESD     | Fail    | Fail    | Fail    | Fail    |
| Zerust ROF     | Fail    | Fail    | Fail    | Fail    |
| Zerust MYF     | Pass    | Pass    | Pass    | Fail    |
| Zerust Stat-3S | Fail    | Fail    | Fail    | Fail    |



**Copper Razorblade Test Results** 

| copper reactive rest results |         |         |         |         |
|------------------------------|---------|---------|---------|---------|
| Sample                       | Panel 1 | Panel 2 | Panel 3 | Control |
| Zerust HOF                   | Fail    | Fail    | Fail    | Fail    |
| Zerust ESD                   | Fail    | Fail    | Fail    | Fail    |
| Zerust ROF                   | Fail    | Fail    | Fail    | Fail    |
| Zerust MYF                   | Fail    | Fail    | Fail    | Fail    |
| Zerust Stat-3S               | Fail    | Fail    | Fail    | Fail    |

### **VIA Test Results**

| Sample         | Plug 1  | Plug 2  | Plug 3  | Control |
|----------------|---------|---------|---------|---------|
| Zerust HOF     | Grade 2 | Grade 1 | Grade 1 | Grade 0 |
| Zerust ESD     | Grade 0 | Grade 1 | Grade 1 | Grade 0 |
| Zerust ROF     | Grade 3 | Grade 2 | Grade 2 | Grade 0 |
| Zerust MYF     | Grade 2 | Grade 1 | Grade 2 | Grade 0 |
| Zerust Stat-3S | Grade 1 | Grade 0 | Grade 0 | Grade 0 |

## **Nitrite/Nitrate Test Results**

| Sample         | $NO_2^-/NO_3^-$ |
|----------------|-----------------|
| Zerust HOF     | -/-             |
| Zerust ESD     | -/-             |
| Zerust ROF     | +/+             |
| Zerust MYF     | +/+             |
| Zerust Stat-3S | -/-             |

## **ESD Test Results**

| Test                                       | Zerust ESD           | Zerust Stat-3S       | Accepted Value           |
|--|----------------------|----------------------|--------------------------|
| Surface Resistivity Inside Surface (Ω/sq)  | $3.1 \times 10^{12}$ | 8.1x10 <sup>12</sup> | $1.0x10^5 - 1.0x10^{12}$ |
| Surface Resistivity Outside Surface (Ω/sq) | $5.9x10^{12}$        | 7.8x10 <sup>12</sup> | $1.0x10^5 - 1.0x10^{12}$ |
| Static Decay Rate<br>Inside Surface (s)    | 0.02                 | 0.04                 | < 2.0                    |
| Static Decay Rate Outside Surface (s)      | 0.03                 | 0.05                 | < 2.0                    |

#### **Conclusion:**

- (1) Of the submitted films, only the Zerust MYF (yellow) film demonstrated contact phase corrosion protection for ferrous metals only.
- (2) Of the submitted films, only Zerust ROF (coral) provided vaporphase corrosion inhibition as demonstrated in the VIA test results.
- (3) Zerust MYF and Zerust ROF are nitrite based films which was verified by the nitrite/nitrate test.
- (4) The submitted ESD films, blue Stat-3S and clear Zerust ESD, failed the surface resistivity test with values outside the accepted range; however, both of these films did meet the requirements for static decay rate.
- (5) The FTIR spectrum collected are attached.

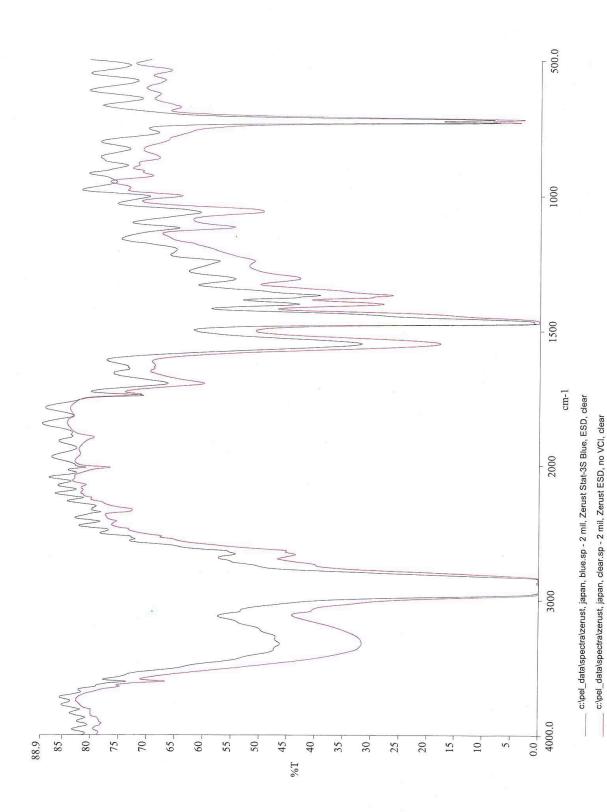
**Project #:** 09-230-1125(bis)

From: Kristy Gillette

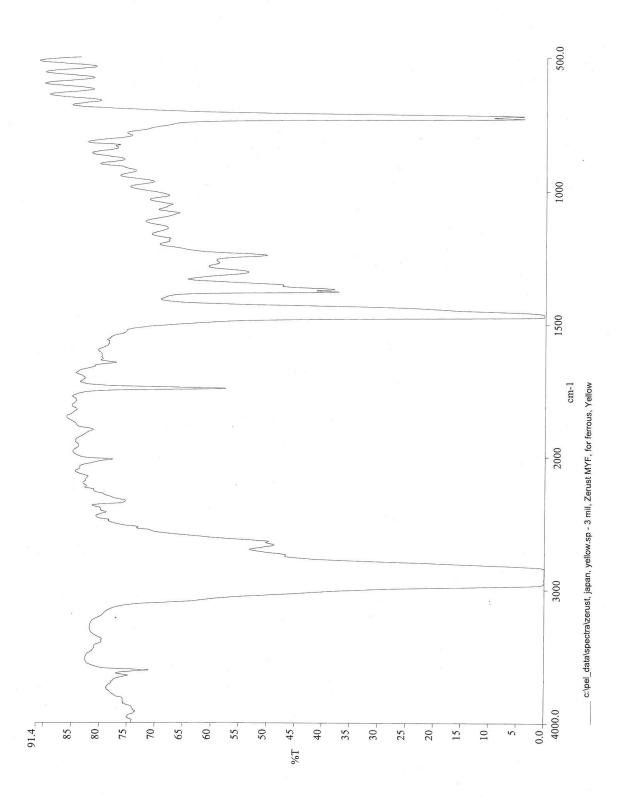
**Date:** November 3, 2009

cc: Boris Miksic

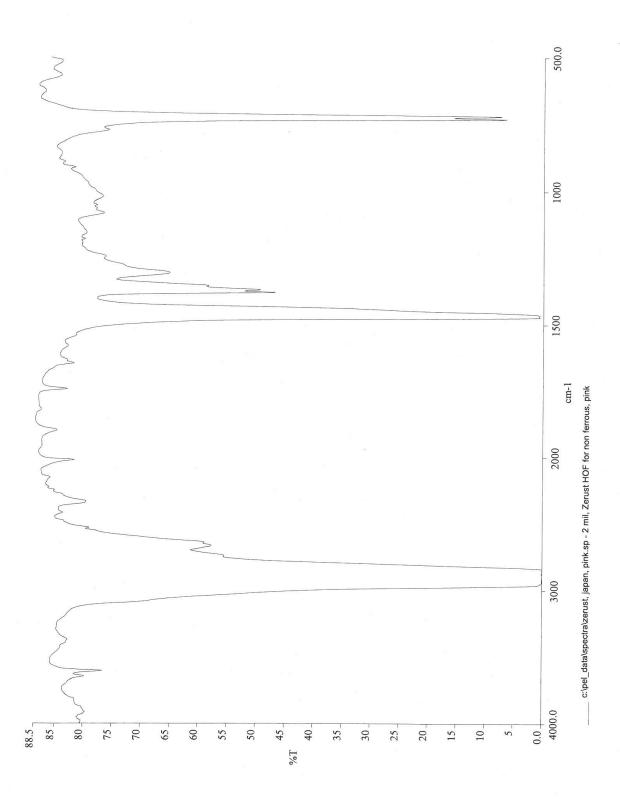
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