



- 4119 White Bear Parkway, St. Paul, MN 55110 USA
- Phone: (651) 429-1100, Fax: (651) 429-1122
- Toll Free: (800) 4-CORTEC, E-mail: info@cortecvc.com
- cortecvc.com • corcelaboratories.com

Evaluation of Armor and Zerust Film Compared to VpCI-126 Film

To: Customer

From: Cortec Laboratories, Inc.
4119 White Bear Parkway
St. Paul, MN 55110

cc: Boris Miksic
Cliff Cracauer
Robert Kean
Jay Zhang
Mike Gabor

Project #: 18-187-1125.bis

Results reported by:

Brian Benduha
Lab Technician

Approved by:

Robert T. Kean, Ph.D.
Laboratory Director



Background: The customer uses multiple VCI films and bags, such as Armor VCI film and Zerust film, but is considering switching to Cortec film. This report will evaluate the corrosion protection of the Armor VCI film and Zerust film compared to VpCI-126 film.

Samples Received: The following film samples were received on 9-19-18 in good condition:
1. Blue Armor film, 3mils
2. Yellow Zerust film, 5.5mils

Method: FTIR Analysis, CC-006
Razor Blade Test, CC-004*
NACE Standard VIA Test, TM0208-2008, item No. 21253*
*The tests marked are not covered under Cortec Laboratories, Inc. ISO 17025 Scope of Accreditation

Materials: VIA test kit (testing jars/apparatus, steel plugs, 400grit sandpaper)
VpCI-126 film, 4mil (batch #510220)
Carbon Steel panels, SAE 1010 (for razor blade testing)
Copper panels (for razor blade testing)
Glycerol (lot #Q10A018)
Methanol, ACS grade (lot #071417B)

Procedure: For VIA testing, the procedure was followed according to NACE VIA Test, TM0208-2008 option 2 (option 2 uses machine-aided grinding and polishing for the steel plugs).

Note- the VIA tests were conducted using two strips of sample per jar (1" X 6" per strip)

The FTIR analysis and razor blade testing was followed according to standard procedure.

Results: The following results were found for the razor blade testing:

Razor Blade Test- Carbon Steel Panels

| Sample | Panel #1 | Panel #2 | Panel #3 | End Result |
|----------------|----------|----------|----------|------------|
| Armor VCI Film | Fail | Fail | Fail | Fail |
| Zerust Film | Fail | Fail | Fail | Fail |
| VpCI-126 Film* | Pass | Pass | Pass | Pass |
| Control | Fail | - | - | Fail |

Razor Blade Test- Copper Panels

| Sample | Panel #1 | Panel #2 | Panel #3 | End Result |
|----------------|----------|----------|----------|------------|
| Armor VCI Film | Fail | Fail | Fail | Fail |
| Zerust Film | Fail | Fail | Fail | Fail |
| VpCI-126 Film* | Pass | Pass | Pass | Pass |
| Control | Fail | - | - | Fail |

*Note- The results for VpCI-126 film used in this report was previously tested (from 16-083-1125)

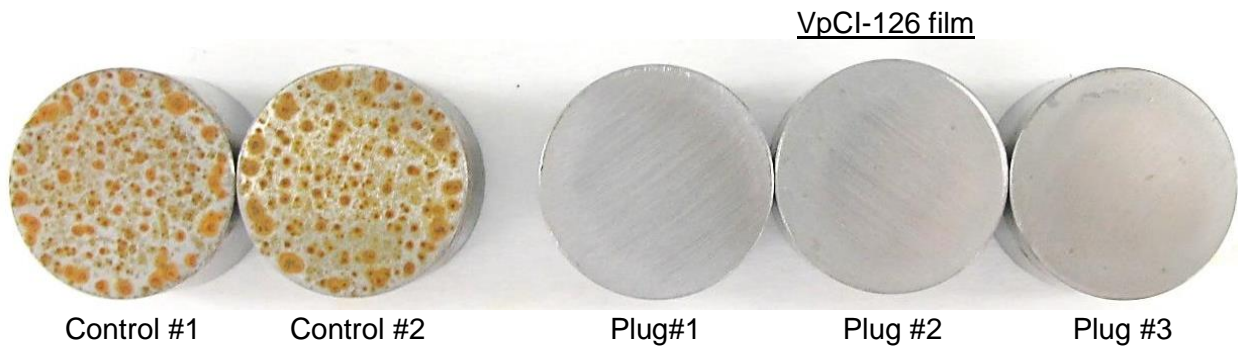
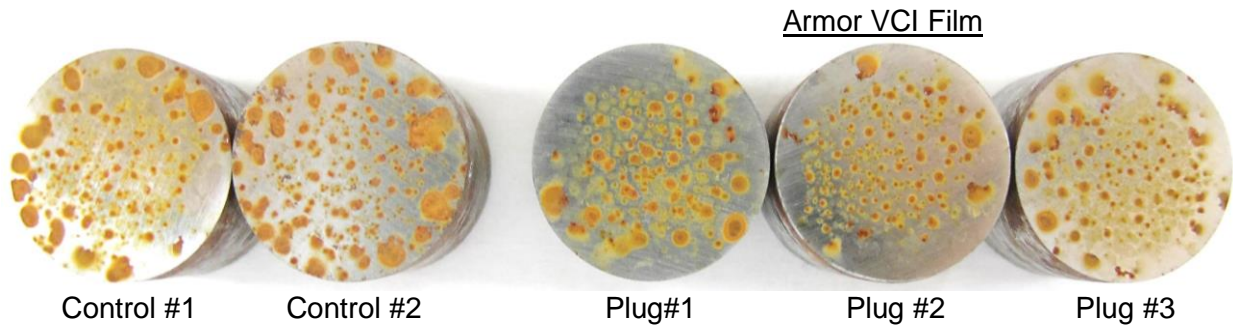
Results:

The following results were found for the razor blade testing:

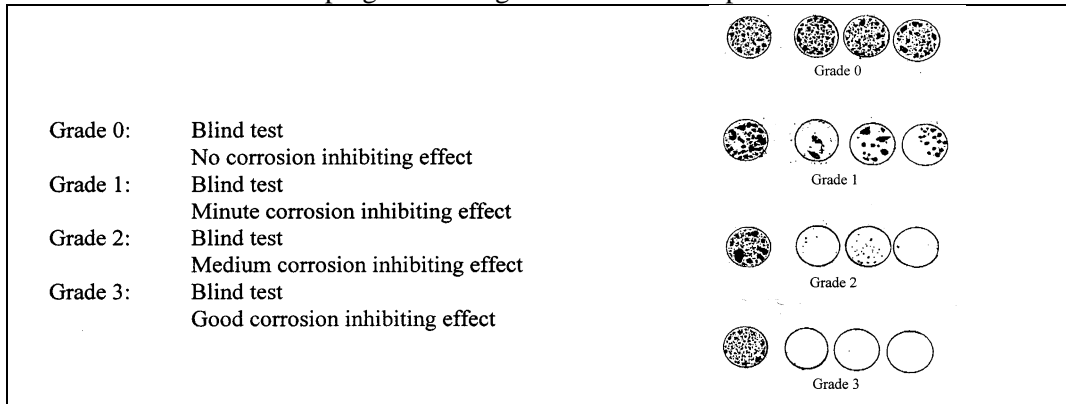
| NACE VIA Test | | | | |
|----------------------|---------|---------|---------|------------|
| Sample | Plug #1 | Plug #2 | Plug #3 | End Result |
| Armor VCI Film | Grade 1 | Grade 1 | Grade 0 | Fail |
| Zerust Film | Grade 1 | Grade 1 | Grade 1 | Fail |
| VpCI-126 Film* | Grade 3 | Grade 3 | Grade 2 | Pass |
| Control | Grade 0 | - | - | Fail |

*Note- The results for VpCI-126 film used in this report was previously tested (from 16-083-1125)

Photo from the NACE VIA test:

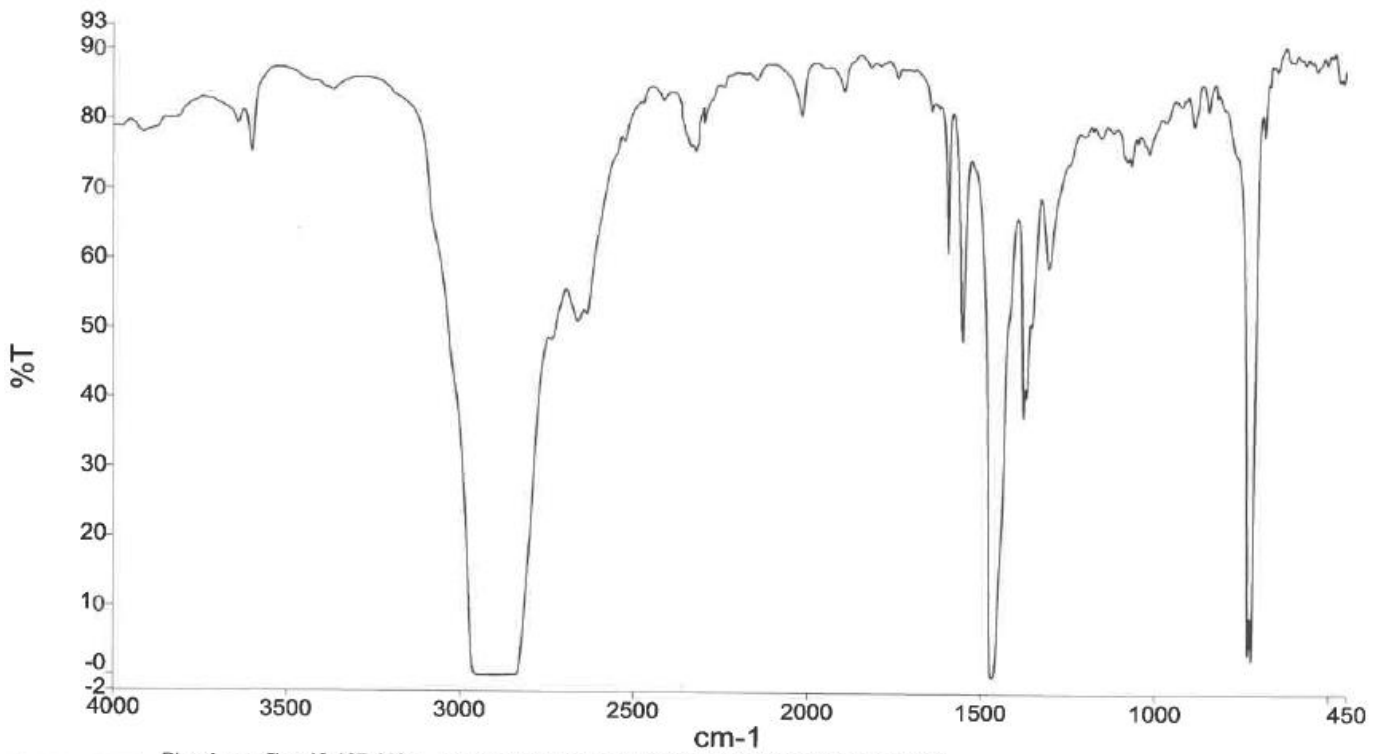


VIA Test Grades (Grade 2 or 3 are passing)
 All three plugs must be grade 2 or better to pass the test



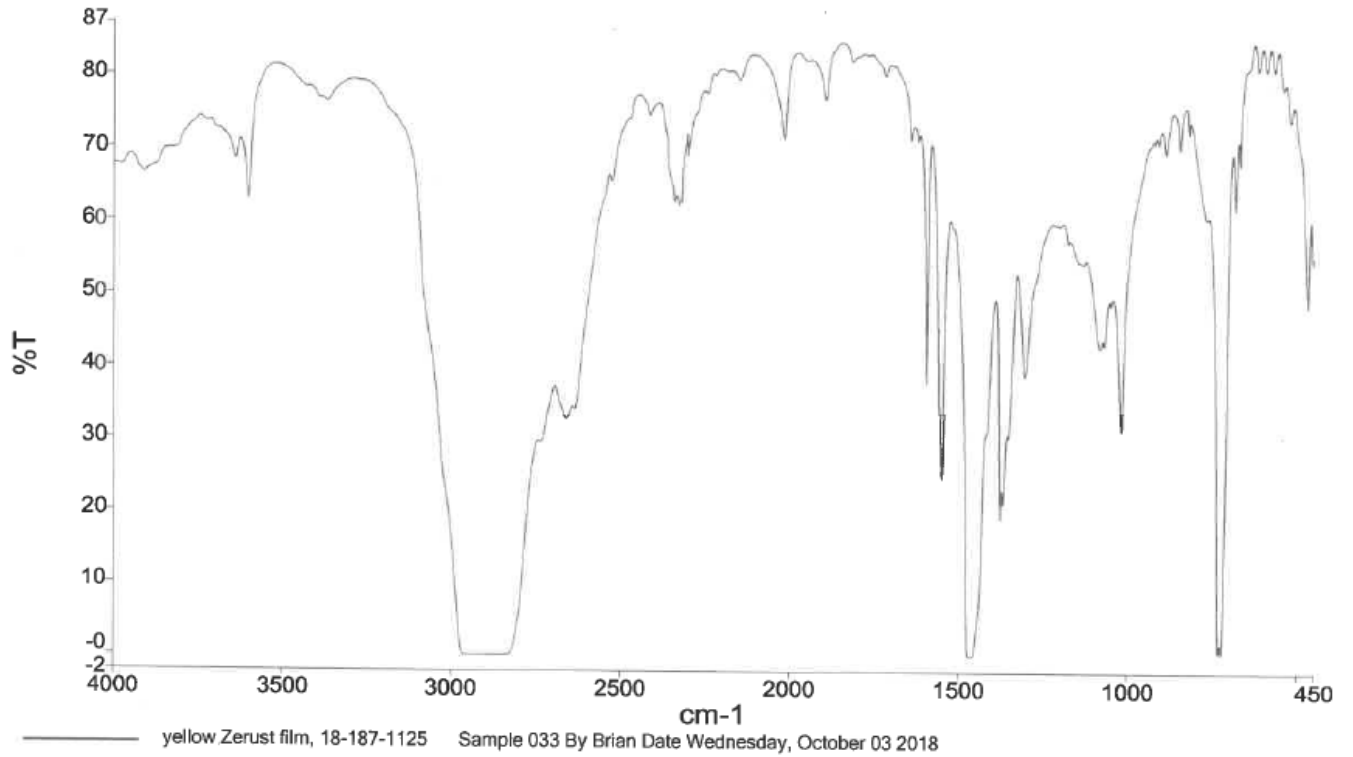
FTIR Analysis:

Armor VCI Film



FTIR Analysis:

Zerust Film



Interpretations:

The Armor and Zerust film do not provide sufficient corrosion protection to pass the VIA or razor blade tests. Cortec's VpCI-126 film provides excellent corrosion protection in both the vapor phase and contact phase.