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## Evaluation of Yellow NTI Film

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**Project #:** 14-229-1125

**Results reported by:**

Senior Lab Technician

**Approved by:**

Margarita Kharshan  
Vice President of R&D



**Background:** It was requested that the corrosion inhibiting properties of the submitted NTI film be compared to VpCI-126.

**Samples Received:** Yellow NTI film received was received 10/08/14, in good condition; it was labeled 14-229-1125, 4 mil film

**Method:**

- 1) VIA Test, CC-027
- 2) Razor Blade Test, CC-004\*
- 3) FTIR, CC-006
- 4) Mechanical Properties (Performed at Cambridge):
  1. Breaking Factor, ASTM D882-02\*
  2. Tensile Strength at Break, Yield Strength, and Elongation at Break, ASTM D882-02\*
  3. Puncture Resistance, MIL-STD-3010, TM 2065\*
  4. Tear Strength, Modified ASTM D1922-06a\*

\*Cortec Laboratory is not accredited for the test marked



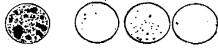

**Materials:**

- 1) VpCI-126, lot 33659
- 2) Plain polyethylene film (4mil)
- 3) VIA test kit
- 4) Razor blade test kit
- 5) DI water
- 6) Nitrite/Nitrate test strips
- 7) Paragon 1000 FTIR

**Procedure:** The tests were conducted according to standard procedures for each test.

1. The tear test performed at CAFD used 5 samples instead of the normal 10, because of the limited sample size.
2. VIA and razor blade test results for VpCI-126 lot 33569 were taken from previous QC testing.
3. VIA tests were graded according to the following scale.

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

		
		Grade 0
Grade 0:	Blind test No corrosion inhibiting effect	
Grade 1:	Blind test Minute corrosion inhibiting effect	Grade 1
Grade 2:	Blind test Medium corrosion inhibiting effect	
Grade 2:	Blind test Good corrosion inhibiting effect	Grade 2
Grade 3:	Blind test Good corrosion inhibiting effect	
		Grade 3

**Results:****Razor Blade Test- Carbon Steel Panels**

Film Sample	Panel #1	Panel #2	Panel #3	Pass / Fail
Yellow NTI Film	Pass	Pass	Pass	Pass
VpCI-126	Pass	Pass	Pass	Pass
Control	Fail			N/A

**Razor Blade Test- Copper Panels**

Film Sample	Panel #1	Panel #2	Panel #3	Pass / Fail
Yellow NTI Film	Fail	Fail	Fail	Fail
VpCI-126	Pass	Pass	Pass	Pass
Control	Fail			N/A

**VIA Test**

Film Sample	Plug #1	Plug #2	Plug #3	Pass / Fail
Yellow NTI Film	Grade 1	Grade 0	Grade 0	Fail
VpCI-126	Grade 3	Grade 3	Grade 3	Pass
Control	Grade 0			N/A

**Mechanical Properties**

Property		Test Method	Units	Yellow NTI Film	VpCI 126
Breaking Factor	MD	ASTM D882-02	lbs/in	14.55	17.14
	TD			13.81	18.17
Tensile Strength at Break	MD	ASTM D882-02	psi	4260.00	4285.00
	TD			4087.00	4543.00
Elongation at Break	MD	ASTM D882-02	%	748.28	776.77
	TD			723.07	865.52
Yield Strength	MD	ASTM D882-02	psi	1594.22	1508.27
	TD			1603.41	1638.62
Puncture Resistance	Outside	MIL-STD-3010, TM 2065	lbf	5.43	4.95
Puncture Resistance	Inside	MIL-STD-3010, TM 2065	lbf	5.42	5.38
Tear Strength	MD	ASTM D1922-06A	gram force	382.40	1152.00
	TD			1040.00	1670.40
Seal Strength	left	ASTM F88-99	lbs/in	7.13	9.69
	center			N/A	N/A
	right			6.77	10.25

**Interpretations:**

1. Based on the corrosion test results, the Yellow NTI film did not provide sufficient corrosion protection.
2. The results determined that VpCI-126 provides good vapor phase and contact phase corrosion inhibition.
3. The mechanical property testing determined the following:
  - a. Breaking factor was lower for NTI film compared to VpCI-126
  - b. Tensile strength at break (transverse direction) is slightly higher for VpCI-126.
  - c. The elongation at break is lower for the yellow NTI film compared to VpCI-126.
  - d. VpCI-126 and the Yellow NTI film have similar results for puncture resistance and yield strength.
  - e. The tear strength and the seal strength of the NTI film is significantly less than the VpCI-126 sample.
4. The FTIR results determined that the NTI film may contain a desiccant (as shown at the 1018 cm<sup>-1</sup> peak).
5. The yellow NTI film was found to contain nitrite.

