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***Comparing Defender Paper and Film with  
VpCI-126 and VpCI-146***

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**Project #:** 15-119-1125

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Laboratory Director



**Background:** A sample of Defender paper and a blue film sample has been submitted for corrosion testing compared to VpCI-126 film and VpCI-146 paper.

**Sample Received:** The following samples were received on 6-1-15 in good condition:  
-Paper with Defender labeling on it  
-Blue film, 4mils (does not have any labeling on it.)

**Method:** VIA Test, CC-027  
Razor Blade Test, CC-004\*  
Nitrite/Nitrate Test\*  
Mechanical Properties Testing\*  
FTIR analysis, CC-006  
*\*Cortec Laboratory is not accredited for the test marked*

**Materials:** VIA test kit  
Razor blade test kit  
Nitrite/Nitrate Test Strips  
Paragon 1000 FTIR  
VpCI-126 film, 4mil (batch #36225)  
VpCI-146 paper (batch #217270)  
Plain polyethylene film, 2mils (control)

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

**Results:**

**Razor Blade Test- Carbon Steel Panels**

Sample	Panel #1	Panel #2	Panel #3	End Result
Defender Paper	Pass	Pass	Pass	Pass
Blue Film	Pass	Fail	Fail	Fail
VpCI-126 Film	Pass	Pass	Pass	Pass
VpCI-146 Paper	Pass	Pass	Pass	Pass
Control	Fail	-	-	Fail

**Razor Blade Test- Copper Panels**

Sample	Panel #1	Panel #2	Panel #3	End Result
Defender Paper	Pass	Pass	Pass	Pass
Blue Film	Pass	Fail	Fail	Fail
VpCI-126 Film	Pass	Pass	Pass	Pass
VpCI-146 Paper	Pass	Pass	Pass	Pass
Control	Fail	-	-	Fail

**Nitrite/Nitrate Test Strip Results**

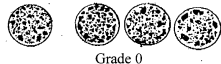
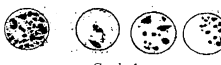
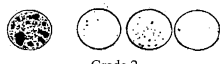
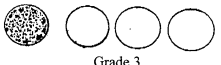
Sample	Results
Defender Paper	Does not contain any nitrite or nitrate
Blue Film	Does not contain any nitrite or nitrate

**Results:**

**VIA Test**

Sample	Plug #1	Plug #2	Plug #3	End Result
Defender Paper	Grade 3	Grade 3	Grade 3	Pass
Blue Film	Grade 0	Grade 0	Grade 0	Fail
VpCI-126 Film	Grade 3	Grade 3	Grade 2	Pass
VpCI-146 Paper	Grade 3	Grade 3	Grade 2	Pass
Control	Grade 0	-	-	Fail

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

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

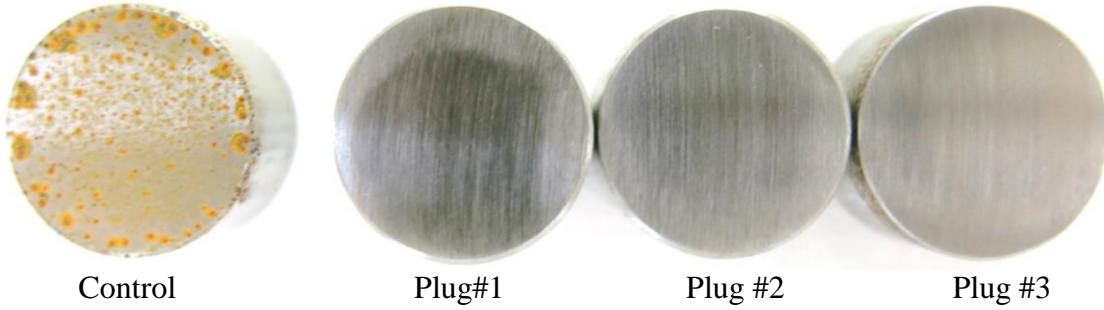
**Mechanical Properties**

Submitted Blue film compared to VpCI-126 film

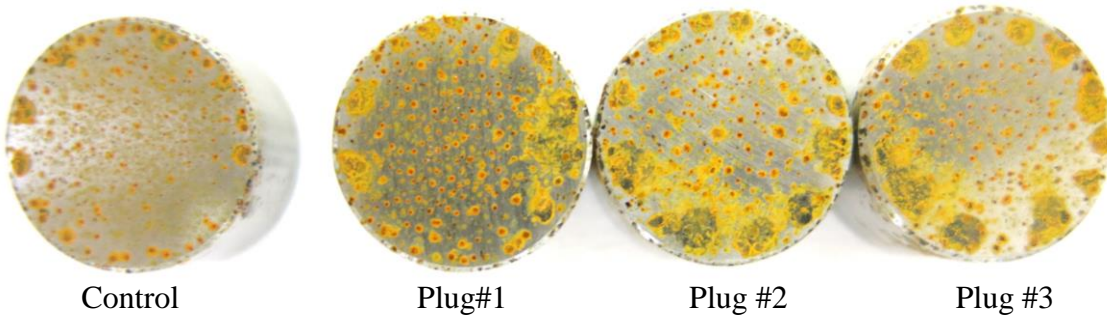
Property		Test Method	Units	Blue film	126 VPCI Film
Caliper		ASTM D6988	mil	4.00	4.00
Breaking Factor	MD	ASTM D882-02	lbs/in	14.38	15.08
	TD			13.63	15.58
Tensile Strength at Break	MD	ASTM D882-02	psi	3668.00	3810.00
	TD			3532.00	3932.00
Elongation at Break	MD	ASTM D882-02	%	725.62	682.03
	TD			782.50	757.60
Yield Strength	MD	ASTM D882-02	psi	2130.35	1569.49
	TD			2230.86	1472.50
Puncture Resistance	Outside	MIL-STD-3010, TM 2065	lbf	7.53	7.23
Puncture Resistance	Inside	MIL-STD-3010, TM 2065	lbf	8.06	6.88
Tear Strength	MD	ASTM D1922-06A	gram force	838.40	851.20
	TD			1484.80	1977.60
Coefficient of Friction		ASTM D1894	static	0.15	0.38
			kinetic	0.30	0.45

**Photos from the VIA Test:**

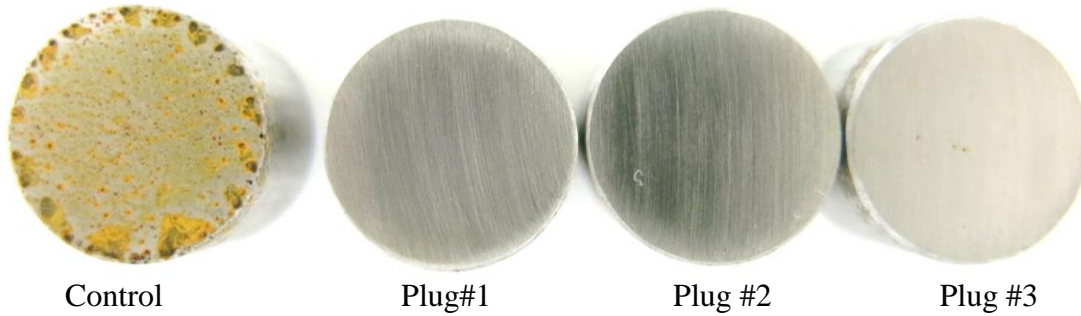
Defender Paper



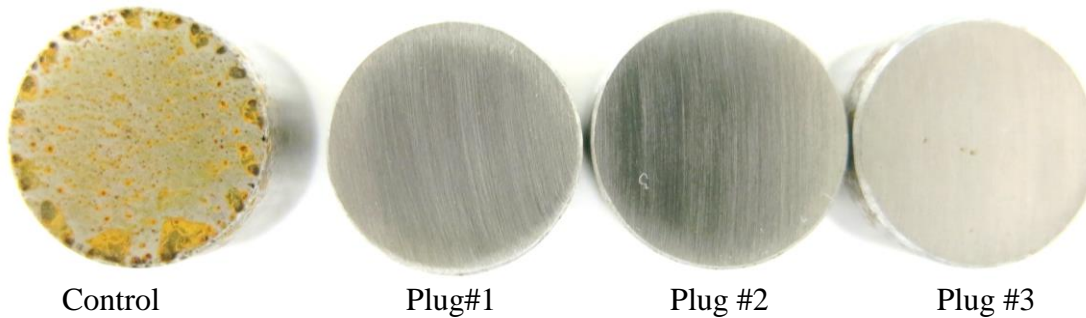
Blue Film



VpCI-126 film



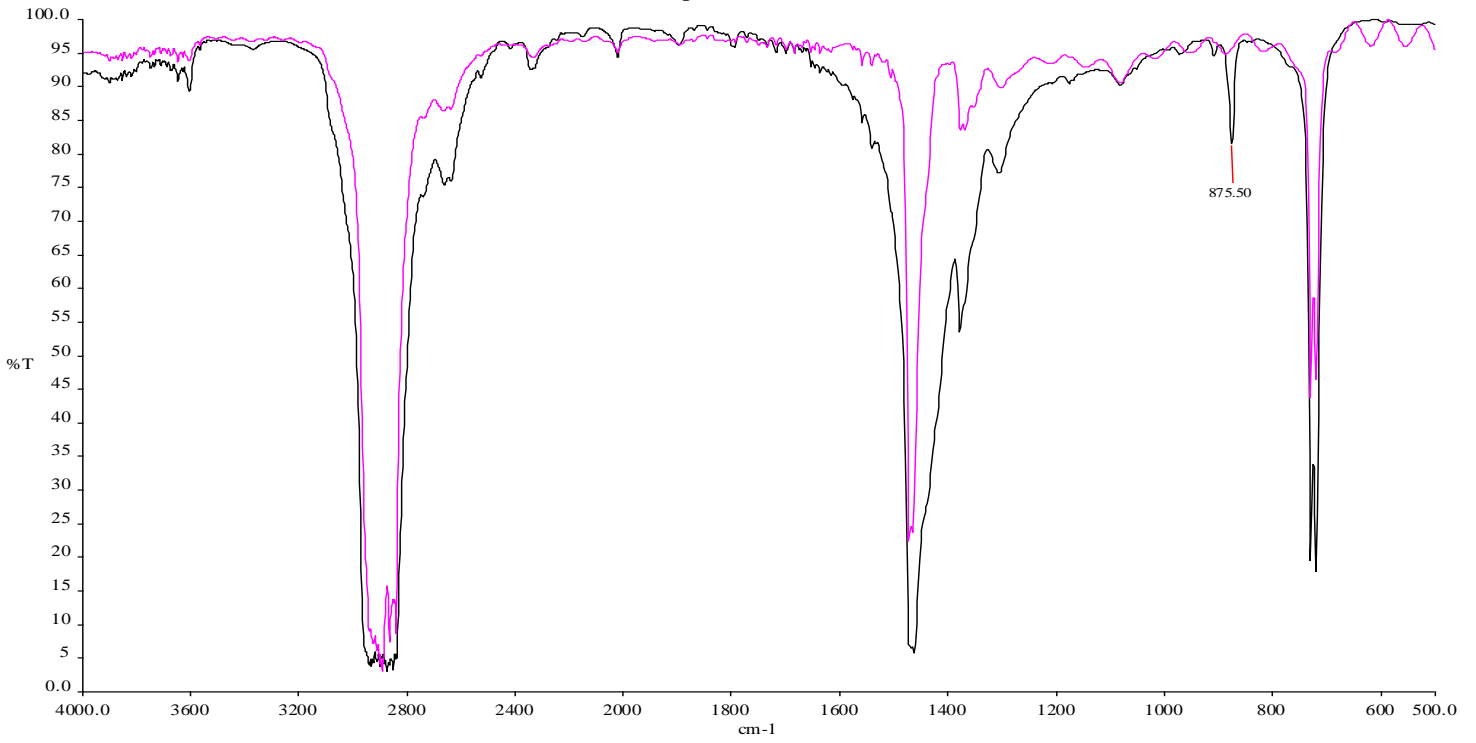
VpCI-146 paper



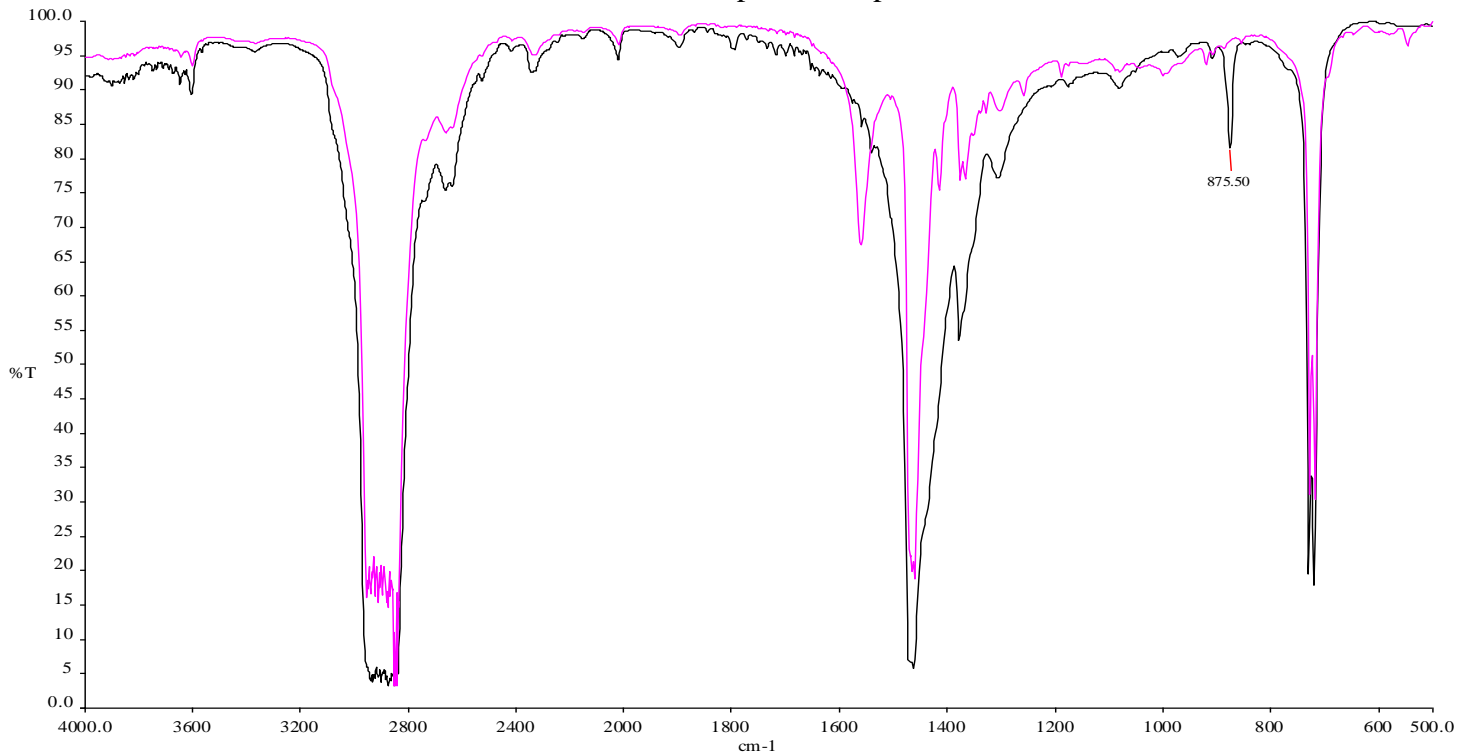


# FTIR Analysis

Submitted blue film compared to plain polyethylene film  
(blue film has the peak of benzene at 875.50)



## Submitted blue film compared to VpCI-126 film



## **Interpretations:**

Film Testing: The submitted blue film does not offer any vapor phase corrosion protection. This film also does not provide sufficient contact corrosion protection to pass the razor blade test. In comparison to Cortec's film, VpCI-126 offers excellent contact and vapor phase corrosion protection. For mechanical properties, a chart has been included to compare the difference of the two films.

Paper Testing: The Defender paper tests similar to VpCI-146 paper. Both provide good contact and vapor phase corrosion protection.