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Evaluating Cortec VpCI-126 Blue Film With Requirements Listed on Performance Specification MIL-PRF-22019D

Background: Cortec Corporation is seeking to have Cortec VpCI-126 listed on qualified product list MIL-PRF-22019D. The process of getting listed, involves Cortec Corporation performing the requirement tests as listed in performance specification MIL-PRF-22019D. Upon attaining results in compliance with what is listed in performance specification MIL-PRF-22019D, Cortec Corporation will submit product to Naval Air Systems Command. Naval Air Systems Command will then repeat testing to confirm results attained by Cortec Corporation.

Purpose: Evaluate Cortec VpCI-126 Blue film with test methods and requirements, from Performance Specification MIL-PRF-22019D table I.

Method: Seam Strength Test (MIL-PRF-22019D, Section 4.6.2)
Seam Strength Test after aging at 160 deg F for 12 days (MIL-PRF-22019D, Section 4.6.2.3)
Seam and material water resistance (MIL-PRF-22019D, Section 4.6.3)
Puncture Resistance (FED-STD-101 Test Method No. 2065)
Compatibility with Copper (MIL-PRF-22019D, Section 4.6.4)
Vapor inhibitor ability Test (FED-STD-101 Test Method No. 4031, procedure B)
Vapor inhibitor ability Test after exhaustion (FED-STD-101 Test Method No. 4031, procedure B)
Contact Corrosivity (FED-STD-101 Test Method No. 3005)
Low Temperature Flexibility (MIL-PRF-22019D, Section 4.6.6)
Blocking Resistance (FED-STD-101 Test Method No. 3003, procedure A)
Tearing Strength (ASTM D689)
Transparency as received (FED-STD-101 Test Method No. 4034)
Transparency after aging 12 days at 150 deg F (FED-STD-101 Test Method No. 4034)
Oil Resistance (FED-STD-101 Test Method No. 3015)
Long Term Protection (MIL-PRF-22019D, Section 4.6.5)
Water Resistance of Markings (FED-STD-101 Test Method No. 3027, change 2)
One Year Storage Stability: Seam Strength as received (MIL-PRF-22019D, Section 4.6.5, 4.6.2)
One Year Storage Stability: Seam Strength after aging at 160 deg F for 12 days (MIL-PRF-22019D, Section 4.6.5, 4.6.2.3)
One Year Storage Stability: Vapor inhibitor ability Test (MIL-PRF-22019D, Section 4.6.5, FED-STD-101 Test Method No. 4031, procedure B)
One Year Storage Stability: Transparency as received (MIL-PRF-22019D, Section 4.6.5, FED-STD-101 Test Method No. 4034)
One Year Storage Stability: Transparency after aging 12 days at 150 deg F (MIL-PRF-22019D, Section 4.6.5, FED-STD-101 Test Method No. 4034)

Materials: Cortec VpCI-126 Blue film (8 mil)
See standard operating procedures for the above-mentioned methods, for a description of materials involved.

Procedure: The above tests were performed according to standard procedures for each.



Results:

Seam Strength Test as received

Procedure was done according to MIL-PRF-22019, section 4.6.2.

Note: No impulse seals were done, only heat seals.

Drawing of film sample attached. Seal width is 0.70”, Temperature of seal is 530 deg F, Seal time is 3 seconds.

Seam strength “as received” Test results

Material	Sealed face condition after five minutes	Requirement
Cortec VpCI-126 Blue film with heat sealing	No delamination	50 % (max)
Cortec VpCI-126 Blue film with heat sealing	No delamination	50 % (max)
Cortec VpCI-126 Blue film with heat sealing	No delamination	50 % (max)

Seam Strength Test after aging at 160 deg F for 12 days

Procedure was done according to MIL-PRF-22019D, section 4.6.2.3.

Note: No impulse seals were done, only heat seals.

Drawing of film sample attached. Seal width is 0.70”, Temperature of seal is 530 deg F, Seal time is 3 seconds.

Seam Strength after aging at 160 deg F for 12 days Test results

Material	Sealed face condition after five minutes	Requirement
Cortec VpCI-126 Blue film with heat sealing	No delamination	50% (max)
Cortec VpCI-126 Blue film with heat sealing	No delamination	50% (max)
Cortec VpCI-126 Blue film with heat sealing	No delamination	50% (max)

Seam and Material water resistance

Preparation of reagent was done according to 4.6.3.1

Notes from testing attached.

Seam and Material water resistance test results

Material	% of staining on white absorbent paper	Requirement
Cortec VpCI-126 Blue film	0%	Seams and barrier shall have no leakage
Cortec VpCI-126 Blue film	0%	Seams and barrier shall have no leakage
Cortec VpCI-126 Blue film	0%	Seams and barrier shall have no leakage
Cortec VpCI-126 Blue film	0%	Seams and barrier shall have no leakage
Cortec VpCI-126 Blue film	0%	Seams and barrier shall have no leakage
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Cortec VpCI-126 Blue film	0%	Seams and barrier shall have no leakage
Cortec VpCI-126 Blue film	0%	Seams and barrier shall have no leakage
Cortec VpCI-126 Blue film	0%	Seams and barrier shall have no leakage

Puncture Resistance

Procedure was done according to FED-STD-101 Test Method No. 2065.

See attached report for Puncture Resistance test results

Compatibility with Copper

Procedure was done according to 4.6.4.2

Compatibility with Copper test results

Material	Corrosion amount on copper panels (%)	Requirement
Cortec VpCI-126 Blue film wrapped around Copper panel	0	No pitting, etching or discoloration of vapor exposed copper surface, discount attacks within 1/16 inch of specimen
Cortec VpCI-126 Blue film wrapped around Copper panel	0	No pitting, etching or discoloration of vapor exposed copper surface, discount attacks within 1/16 inch of specimen
Cortec VpCI-126 Blue film wrapped around Copper panel	0	No pitting, etching or discoloration of vapor exposed copper surface, discount attacks within 1/16 inch of specimen

Vapor inhibitor ability

Procedure was done according to Fed-STD-101 Test Method No. 4031 procedure B

Vapor inhibitor ability test results

Material	Corrosion observed (%)	Requirement
Cortec VpCI-126 Blue film	0	No corrosion, etching, or pitting of the steel panel's polished surface
Cortec VpCI-126 Blue film	0	No corrosion, etching, or pitting of the steel panel's polished surface
Cortec VpCI-126 Blue film	0	No corrosion, etching, or pitting of the steel panel's polished surface
Control	~ 40	No corrosion, etching, or pitting of the steel panel's polished surface

Vapor inhibitor ability (after exhaustion)

Procedure was done according to Fed-STD-101 Test Method No. 4031 procedure B

Vapor inhibitor ability (after exhaustion) test results

Material	Corrosion observed (%)	Requirement
Cortec VpCI-126 Blue film	0	No corrosion, etching, or pitting of the steel panel's polished surface
Cortec VpCI-126 Blue film	0	No corrosion, etching, or pitting of the steel panel's polished surface
Cortec VpCI-126 Blue film	0	No corrosion, etching, or pitting of the steel panel's polished surface
Control	~ 70	No corrosion, etching, or pitting of the steel panel's polished surface

Contact Corrosivity

Procedure was done according to Fed-STD-101 Test Method No. 3005
Panel type (Carbon Steel)

Contact Corrosivity test results

Material	Corrosion observed (%)	Requirement
Cortec VpCI-126 Blue film	0	No corrosion, etching or pitting
Cortec VpCI-126 Blue film	0	No corrosion, etching or pitting
Cortec VpCI-126 Blue film	0	No corrosion, etching or pitting

Low Temperature flexibility

Procedure was done according to 4.6.6.1.

Low Temperature flexibility test results

Material	Qualitative results	Requirement
Cortec VpCI-126 Blue film	No delamination, cracks, tears observed	No delamination, cracks or tears
Cortec VpCI-126 Blue film	No delamination, cracks, tears observed	No delamination, cracks or tears
Cortec VpCI-126 Blue film	No delamination, cracks, tears observed	No delamination, cracks or tears
Cortec VpCI-126 Blue film	No delamination, cracks, tears observed	No delamination, cracks or tears
Cortec VpCI-126 Blue film	No delamination, cracks, tears observed	No delamination, cracks or tears

Blocking Resistance

Procedure was done according to FED-STD-101 Test Method No. 3003 procedure A

Blocking Resistance test results

Material	Qualitative results	Requirement
Cortec VpCI-126 Blue film	No blocking, delamination or rupture	No blocking, delamination, or rupture
Cortec VpCI-126 Blue film	No blocking, delamination or rupture	No blocking, delamination, or rupture
Cortec VpCI-126 Blue film	No blocking, delamination or rupture	No blocking, delamination, or rupture
Cortec VpCI-126 Blue film	No blocking, delamination or rupture	No blocking, delamination, or rupture
Cortec VpCI-126 Blue film	No blocking, delamination or rupture	No blocking, delamination, or rupture
Cortec VpCI-126 Blue film	No blocking, delamination or rupture	No blocking, delamination, or rupture
Cortec VpCI-126 Blue film	No blocking, delamination or rupture	No blocking, delamination, or rupture
Cortec VpCI-126 Blue film	No blocking, delamination or rupture	No blocking, delamination, or rupture

Tearing Strength

Procedure ASTM D 1922-93 was used instead of required ASTM D 689. Both procedures are very similar, with ASTM D 689 being much more time consuming.

Tearing Strength (ASTM D 1922-93) test results

Material	Test result (gf)	Requirement (gf)
Cortec VpCI-126 Blue film	3392/3136	20
Cortec VpCI-126 Blue film	2432/2880	20
Cortec VpCI-126 Blue film	2240/3200	20
Cortec VpCI-126 Blue film	2816/3136	20
Cortec VpCI-126 Blue film	1728/3456	20
Cortec VpCI-126 Blue film	2624/2816	20

Transparency (as received)

Procedure was done according to FED-STD-101 Test Method No. 4034. Note: Current labeling on Cortec VpCI-126 Blue film was used and not the exact block style, lower case alphabet, and impression depth.

Test results for Transparency Test

Material	Qualitative results	Requirement
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible

Transparency (after aging 12 days at 150 deg F)

Procedure was done according to FED-STD-101 Test Method No. 4034. Note: Current labeling on Cortec VpCI-126 Blue film was used and not the exact block style, lower case alphabet, and impression depth.

Test results for Transparency (after aging 12 days at 150 deg F)

Material	Qualitative results	Requirement
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible

Oil Resistance (Delamination)

Procedure was done according to FED-STD-101 Test Method No. 3015 (di-2-ethylhexyl sebacate synthetic oil was only oil used)

Test results for Oil Resistance (Delamination)

Material	Leakage (%)	Requirement
Cortec VpCI-126 Blue film	<1.0	No leakage, swelling, delamination, or embrittlement
Cortec VpCI-126 Blue film	<1.5	No leakage, swelling, delamination, or embrittlement
Cortec VpCI-126 Blue film	<0.95	No leakage, swelling, delamination, or embrittlement
Cortec VpCI-126 Blue film	<1.0	No leakage, swelling, delamination, or embrittlement
Cortec VpCI-126 Blue film	<1.0	No leakage, swelling, delamination, or embrittlement

4.6.5 Long Term Protection

Procedure done according to 4.6.5.1

Long term protection test results

Material	Qualitative results	Requirement
Cortec VpCI-126 Blue film	No corrosion of steel panels. Lettering is clear and legible	No corrosion of steel panels. Shall comply with transparency requirement
Cortec VpCI-126 Blue film	No corrosion of steel panels. Lettering is clear and legible	No corrosion of steel panels. Shall comply with transparency requirement
Cortec VpCI-126 Blue film	No corrosion of steel panels. Lettering is clear and legible	No corrosion of steel panels. Shall comply with transparency requirement

Water resistance of Markings

Procedure was done according to FED-STD-101 Test Method No. 3027

Water resistance of markings test results

Material	Qualitative results	Requirement
Cortec VpCI-126 Blue film	Observed markings are clear and legible	Markings shall be clear and legible
Cortec VpCI-126 Blue film	Observed markings are clear and legible	Markings shall be clear and legible
Cortec VpCI-126 Blue film	Observed markings are clear and legible	Markings shall be clear and legible

4.6.7 Storage Stability

Cortec VpCI-126 Blue film was wrapped in one layer of MIL-PRF-131 class 1 barrier material and stored for exactly one year. Upon removal, the following tests were conducted using the Cortec VpCI-126 Blue film. Seam Strength Test (as received); Seam Strength (sealed after aging at 160 deg F for 12 days and tested at room temperature); Vapor Inhibitor Ability Test; Transparency Test (as received); Transparency Test (after aging at 150 deg F for 12 days and tested at room temperature).

Seam strength "as received" Test results

Material	Sealed face condition after five minutes	Requirement
Cortec VpCI-126 Blue film with heat sealing	No delamination	50 % (max)
Cortec VpCI-126 Blue film with heat sealing	No delamination	50 % (max)
Cortec VpCI-126 Blue film with heat sealing	No delamination	50 % (max)

Seam Strength Test results after aging at 160 deg F for 12 days

Material	Sealed face condition after five minutes	Requirement
Cortec VpCI-126 Blue film with heat sealing	No delamination	50% (max)
Cortec VpCI-126 Blue film with heat sealing	No delamination	50% (max)
Cortec VpCI-126 Blue film with heat sealing	No delamination	50% (max)

Vapor inhibitor ability test results

Material	Corrosion observed (%)	Requirement
Cortec VpCI-126 Blue film	0	No corrosion, etching, or pitting of the steel panel's polished surface
Cortec VpCI-126 Blue film	0	No corrosion, etching, or pitting of the steel panel's polished surface
Cortec VpCI-126 Blue film	0	No corrosion, etching, or pitting of the steel panel's polished surface
Control	~ 40	No corrosion, etching, or pitting of the steel panel's polished surface

Test results for Transparency Test

Material	Qualitative results	Requirement
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible

Test results for Transparency (after aging 12 days at 150 deg F)

Material	Qualitative results	Requirement
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible
Cortec VpCI-126 Blue film	Lettering is clear and legible	Lettering shall be clear and legible

Conclusion: Testing conducted by Cortec Corporation, concludes that Cortec VpCI-126 Blue film satisfies all requirements of performance specification MIL-PRF-22019D.

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