Chrome-Free BMS 10-72 Primer

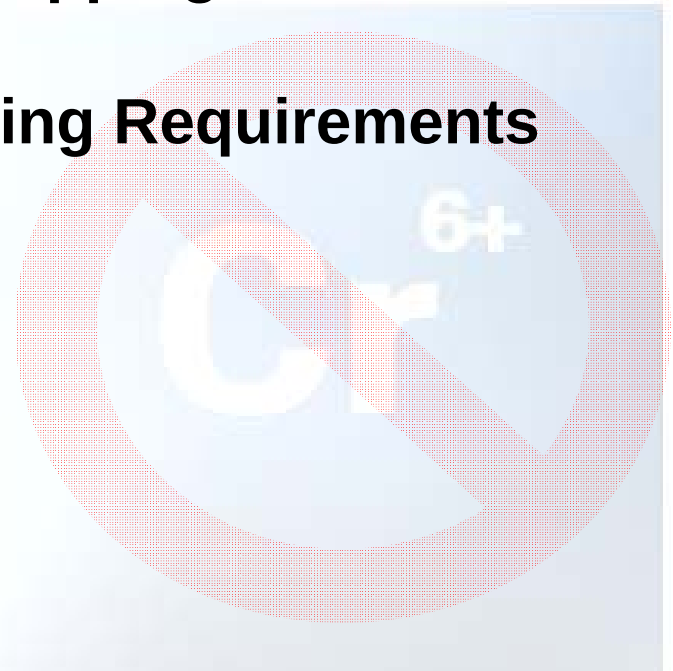
-- Exterior Decorative Paint --

Information contained herein pertains solely to Boeing Commercial products and processes

April 7, 2009

Drivers for Non-Chromated Primer

- **Customer Airline Requests**
- **Reduced Environmental Impact of Paint Process**
- **Reduced Environmental Impact of Stripping Process**
- **Simplified Safety and Health Monitoring Requirements**



Safety and Environmental Improvement with Nonchrome Primer

- **Worker Health and Safety hazards when applying chromated paint, grinding and sanding on chrome treated parts or removing chromated paint from the airplane or parts**
  - Chrome requires caution by workers in maintenance and repair operations
    - Additional protective equipment (respirators/ gloves/ protective clothing)
    - Additional facility considerations:
      Increased ventilation/ filtration/ segregated chemical storage
    - Special training to address safety considerations
    - Additional documentation and recordkeeping
    - Medical surveillance required in some countries
    - Carcinogenicity hazards
- **Disposal concerns with chrome contaminated waste**
  - Special handling for paint waste and cleanup
  - Designated offsite disposal areas
  - Long term liability associated with disposal in some countries
- **Disposal and recycle concerns with parts containing chrome**

Switching to non chromated paints reduces worker safety concerns and environmental impacts

Note: Applicable requirements may vary in some countries

Exterior Decorative Paint Systems

- **Nonchrome primer:**

  CA7502 made by PPG/PRC-DeSoto

- **Available Topcoats:**

  BMS10-72 Type VIII (Desothane HS)

  BMS10-72 Type IX (Eclipse)

Qualification Process

- **Screen test candidates**
- **Perform qualification tests – Engineering and Manufacturing**
- **Perform large scale application validation**
- **Production trials: validate the primer application in paint hangar environment on production airplanes**
- **List material as a qualified product in BMS10-72**
- **In-Service Evaluations: validate in-service performance of the primer in various in-service environments**
- **Offer the product in the Catalog**

Key Qualification Tests for PPG CA7502

- Adhesion
  - Dry/wet scribe adhesion
  - Impact adhesion
  - Rain erosion (including fasteners)
- Fluid resistance (fuel, hydraulic fluid, oil)
- Corrosion resistance
  - 3000-hour neutral salt spray corrosion resistance (2024 clad)
  - 30-day (720 hour) filiform corrosion resistance (2024 clad)
  - 3000-hour neutral salt spray corrosion resistance (2024 bare)
  - 5000-hour neutral salt spray corrosion resistance (2024 clad)
  - 2000-hour filiform corrosion resistance (2024 clad)
  - 30-day (720 hour) filiform corrosion resistance (7075 clad)
- Removability
- Sprayability

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Key Qualification Tests for PPG CA7502

Test	Detailed Test Description	Test Results	Example
Adhesion	Dry/Wet	Pass	
	Impact	Pass	
	Rain Erosion	Pass	
	Fastener Rain Erosion*	Pass	
Fluid Resistance	Hydraulic Fluid	Pass	
	Fuel and oil	Pass	
Corrosion Resistance	3000 hours neutral SS on 2024 clad	Pass	
	720 hours filiform on 2024 clad	Pass	
	3000 hours neutral SS on 2024 bare*	Equivalent	
	5000 hours neutral SS on 2024 clad*	Equivalent	
	2000 hours filiform on 2024 clad*	Equivalent	
	720 hours filiform on 7075 clad*	Not equivalent	
Removability (acid stripper)		Pass	
Sprayability		Pass	

* **Testing performed in addition to current specification tests**

Summary of Key Test Results

- **Adhesion**
  No adhesion failures even on fasteners
- **Fluid resistance** (fuel, hydraulic fluid, oil)
  Similar to currently qualified system
- **Corrosion resistance**
  - Acceptable corrosion performance on 2024 clad
  - Acceptable corrosion performance on 2024 bare
  - Corrosion performance on 7075 clad is not equivalent to chromated control
- **Removability**
  - Acid activated benzyl alcohol strippers required.
  - Boeing will incorporate acid stripper into maintenance manuals.
- **Large scale application**
  Easy application, good appearance

How will this affect airlines?

Similarities

- Washing frequency and process not affected
- Can be chemically stripped
- Similar surface preparation process
- Similar equipment and application process
- Compatible with Desothane HS and Eclipse topcoats
- Compatible with other Boeing exterior primers
- Compatible with common touch-up practices/materials

•Differences

- Non-chrome primer is gray in color (not yellow or green)
- Acid benzyl alcohol based strippers needed for depainting
- Chromated primers may still be needed on non-clad aluminum parts.

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- **To summarize, CA7502 non-chromated paint system showed good laboratory test results.**
  - **For 7075 clad aluminum, used on non-pressurized fuselage areas, testing indicates that for some in-service environments, the CA7502 primer may not provide the same level of corrosion protection as today's chromated primers.**
    - Nominal use of 7075 clad aluminum on 737 exterior.
  - **Boeing will continue to use chromated primer on all non-clad aluminum surfaces of the airplane. (e.g., window plugs, 747/767 fin).**

BACK-UP SLIDES

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Adhesion Test

Rain Erosion Resistance Test Results

Chromated Control

CA7502

The rain erosion test is a rigorous adhesion test. The non-chrome primer performs equivalent to chromated control primer.

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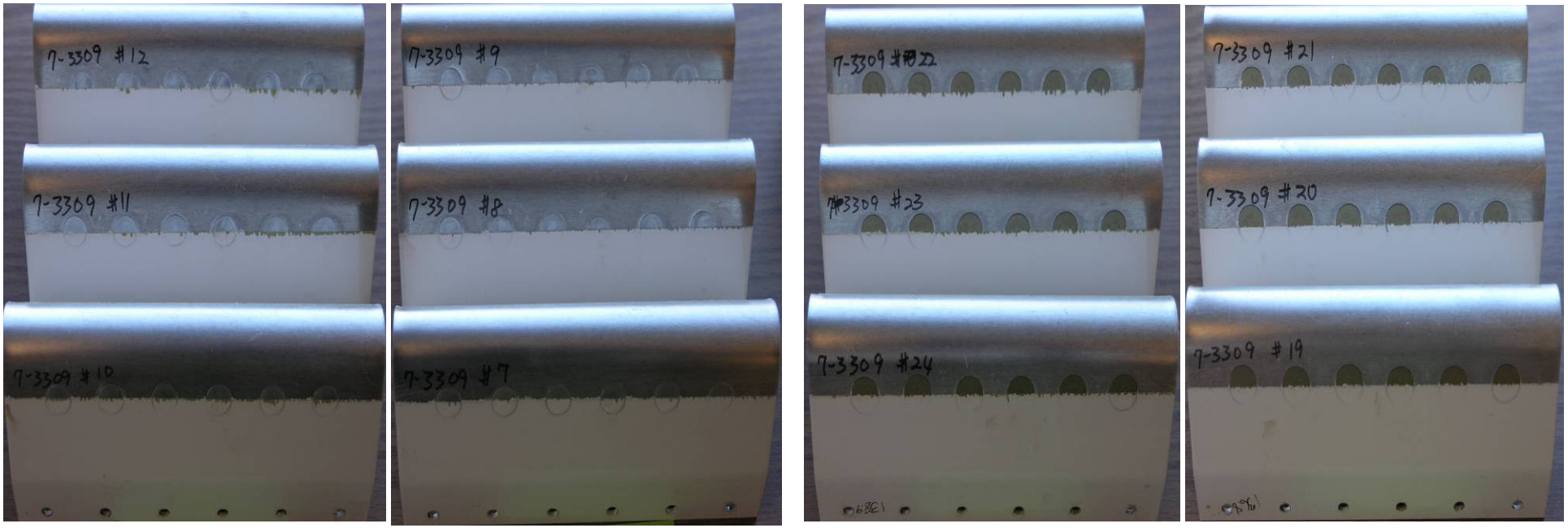
Adhesion test

Fastener Rain Erosion Resistance Test Results



BACR15GF8D6

Chromated Control **CA7502**

BACB30NZ8K4

Chromated Control **CA7502**

Fasteners were installed in rain erosion foils and then coated with a thick film build to evaluate adhesion in an erosion environment. Paint peeling was minimal after the exposure to high speed rain impact.

Hydraulic Fluid Resistance

	Pencil Hardness rating	
	Before exposure	After 30 days exposure
Chromated control paint system	2H,2H,2H	HB,HB,HB PASS
CA7502 paint system	2H,2H,2H	HB,HB,F PASS

The non-chrome primer meets the BMS requirement for resistance to hydraulic fluid.

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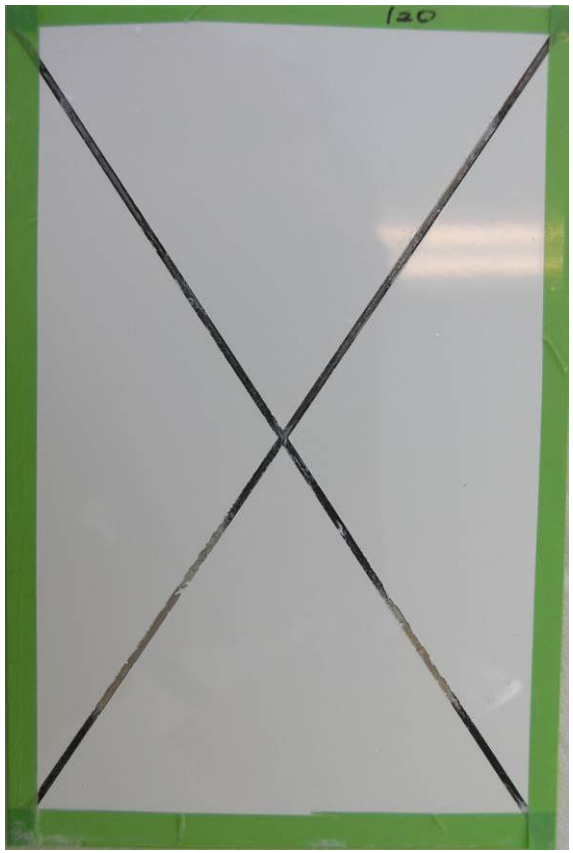
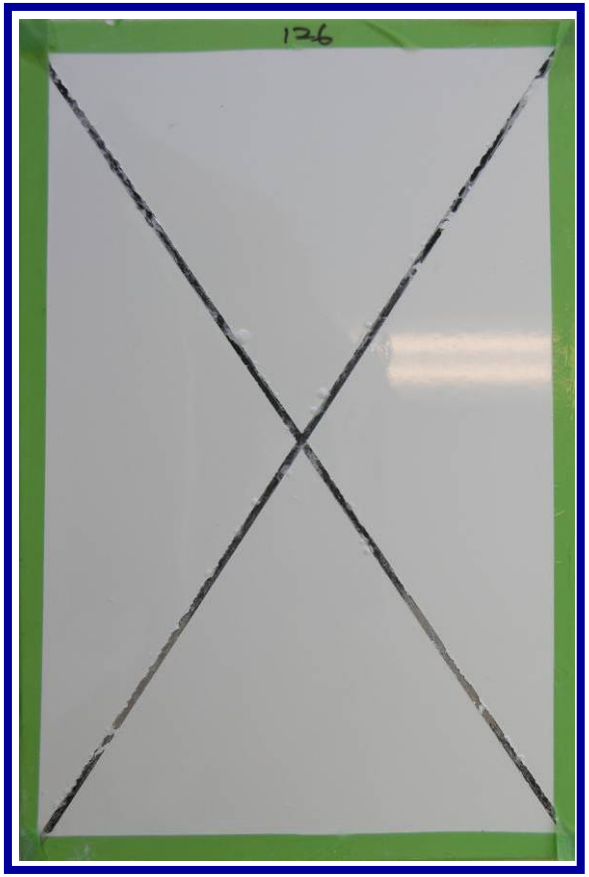
Corrosion Resistance

3000 Hour Salt Spray Corrosion Resistance Test Results – 2024-T3 Clad



Baseline chromate



CA7502

Negative control

After 3000 hour salt fog (harsh exposure), the non-chrome primer shows some blistering but is well within specification requirements.

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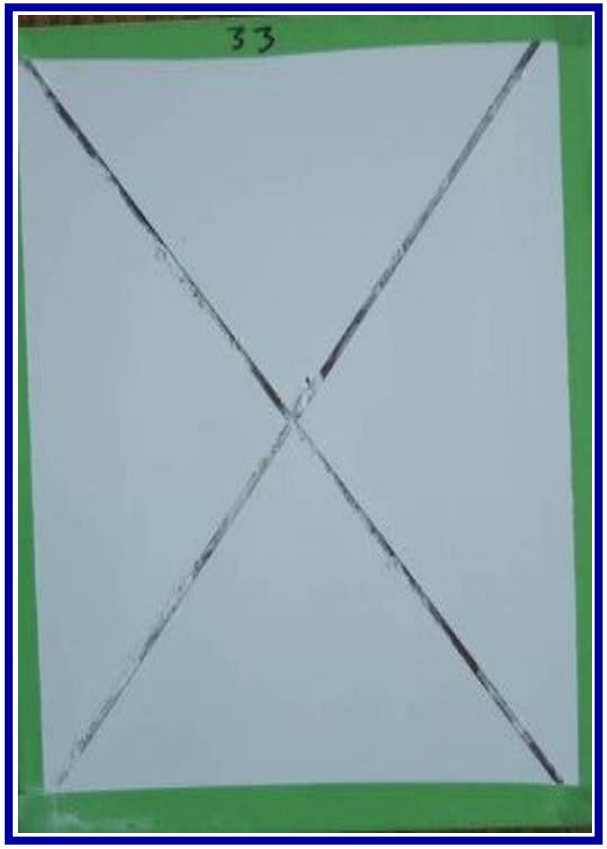
Corrosion Resistance

3000 Hour Salt Spray Corrosion Resistance Test Results – 2024-T3 Bar

Baseline chromate



CA7502

Negative control

After 3000 hours in salt fog with bare 2024 aluminum, the non-chrome primer performs similar to the chromated primer control.

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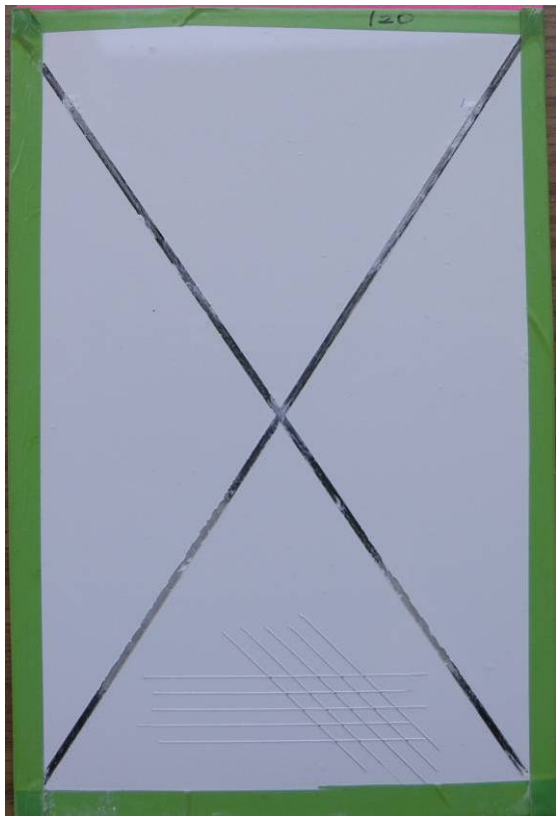
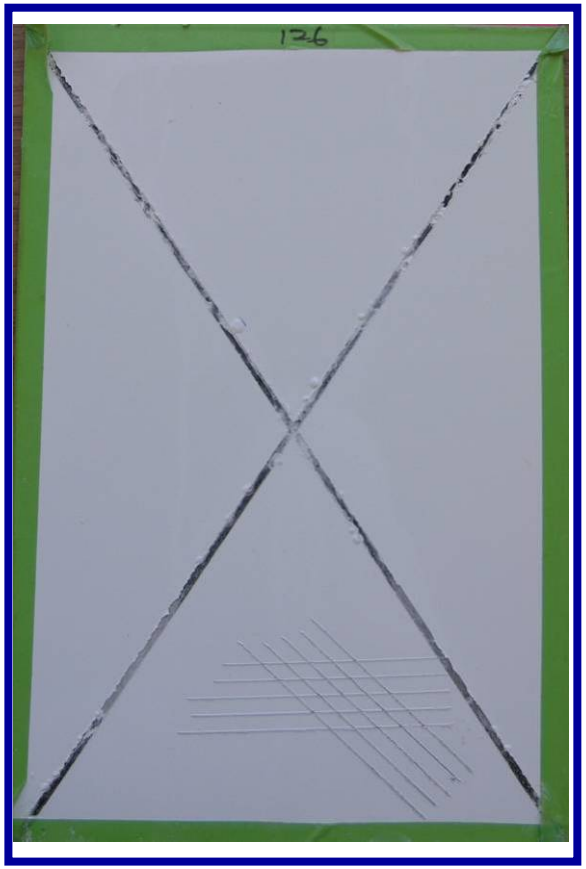
Corrosion Resistance

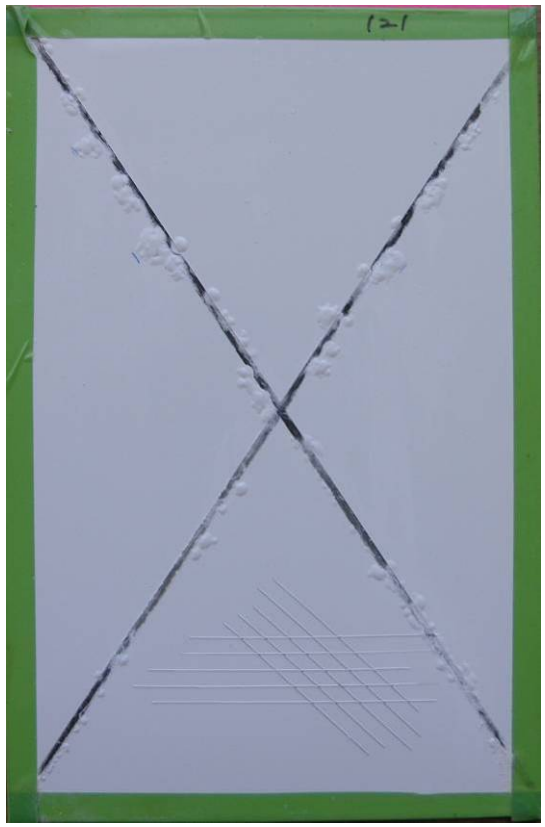
5000 Hour Salt Spray Corrosion Resistance Test Results – 2024-T3 Clad



Baseline chromate



CA7502



Negative control

After 2000 additional hours in salt fog exposure, the non-chrome primer still meets the BMS specification requirements.

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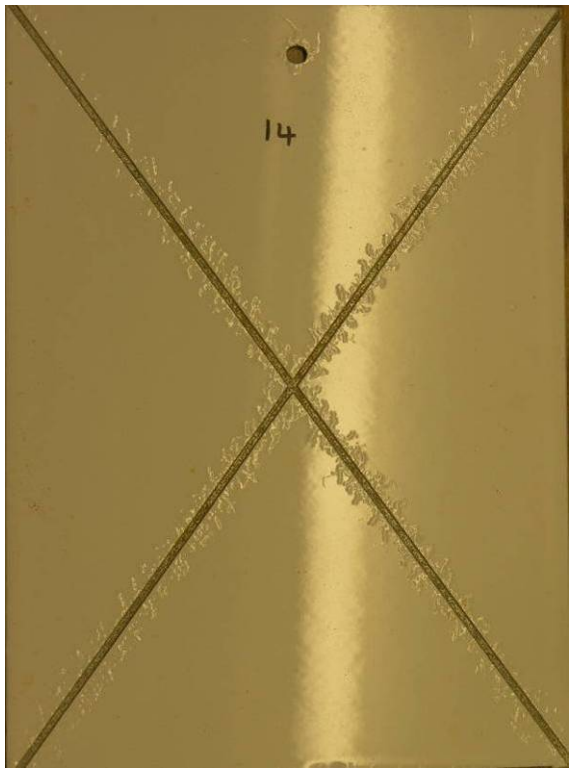
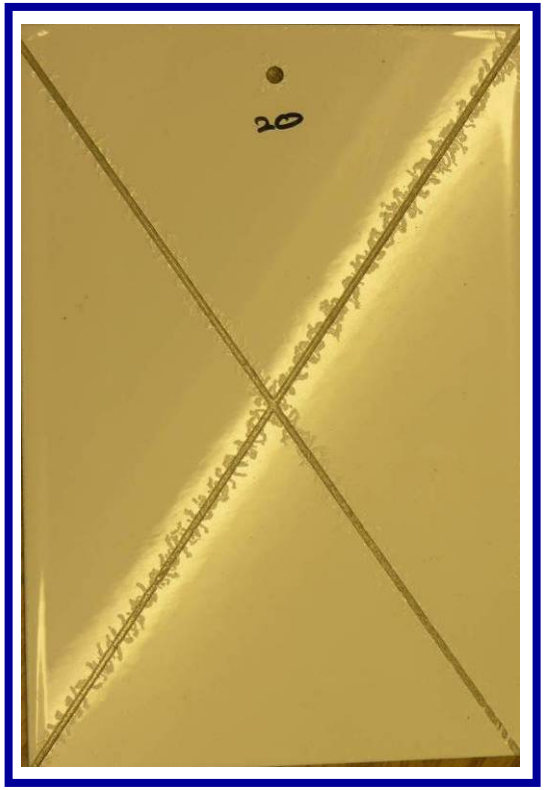
Corrosion Resistance

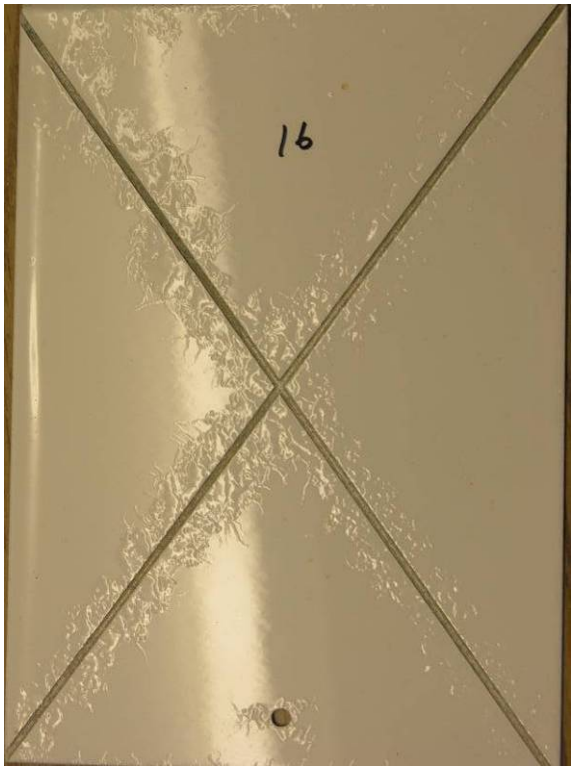
2000 Hour Filiform Corrosion Resistance Test Results – 2024-T3 Clad



Baseline chromate



CA7502



Negative control

With extended exposure in filiform to 2000 hours on 2024-T3 clad, the non-chrome primer performs better than the chromated primer control

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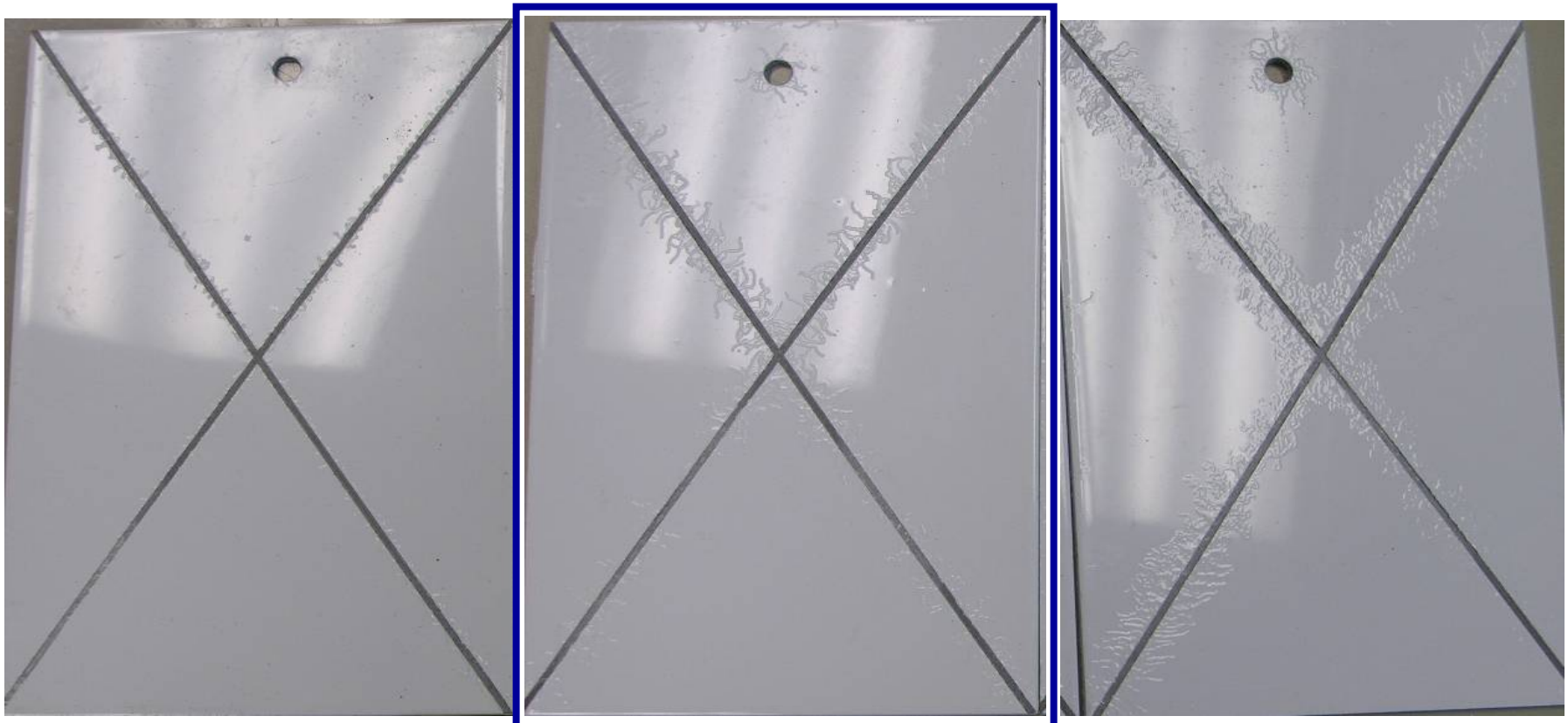
Corrosion Resistance

30 Day (720 Hour) Filiform Corrosion Resistance Test Results – 7075-T6 Clad



Baseline chromate | CA7502 | Negative control

Laboratory accelerated corrosion tests on 7075 clad aluminum shows the new non-chromate primer is not equivalent to current chromated primers. However, several airlines that have used non-chromated primers for repaint operations have not seen an in-service corrosion problem on this alloy – which is used in unpressurized fuselage sections of some models (747, 757, 767, 777).

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Removability

Paint removal rate of xenon (500KJ) aged paint systems			
paint system	**Peroxide 1**	**Peroxide 2**	**acid**
10P20-44M Eclipse	tc - 9 hrs p - >13 hrs	tc - 9 hrs p - 11 hrs	tc&p - 7 hrs
CA7502 Desothane HS	Failed to strip	Failed to strip	tc&p - 7 hrs
CA7700 Desothane HS	tc&p - 9 hrs	tc- 7 hrs p - >13 hrs	tc&p - 9 hrs

Acid activated benzyl alcohol strippers are required to remove the non-chromated primer. Several of these strippers have been used successfully in repaint facilities and Boeing currently lists two approved acid strippers in an internal stripping document. Boeing will incorporate these two acid strippers into the maintenance manuals.

Large Scale-up Tests

North Boeing Field

Everett

Smooth appearance, no application issues