Hexavalent Chromium (Cr^{+6}) Reduction at U.S. Air Force Plant 44 in Tucson, Arizona

Paul Fecsik,
Raytheon Missile Systems, Tucson, Arizona
and
Jim Arthur & Leanne Debias
Concurrent Technologies Corporation, Johnstown, Pennsylvania

As part of the U.S. Air Force Plant (AFP) 44 Pollution Prevention (P2) Program at Raytheon Missile Systems in Tucson, Arizona, a project was commissioned to reduce the use of hexavalent chromium (Cr^{+6}) in missile manufacturing and depot level repair operations. The main sources of Cr^{+6} were from the conversion coating of aluminum alloys per MIL-DTL-5541. The secondary source was from Cr^{+6} containing paint primers per MIL-PRF-85582 (waterborne) and MIL-PRF-23377 (high solids) that are utilized in solvent based painting of components per MIL-PRF-85285. This paper summarizes the Cr^{+6} alternatives that were identified and how they performed in qualification testing.

Introduction

Air Force Plant (AFP) 44 is a government-owned and contractor-operated (GOCO) facility and forms a portion of the Tucson operations of Raytheon Missile Systems where a wide variety of missile and space defense systems are manufactured.

AFP 44 has a highly successful Pollution Prevention (P2) Program, whose charter is to reduce the use of hazardous materials on site. As part of this program a project was initiated to identify and qualify alternative materials or processes that would eliminate the use of hexavalent chromium (Cr^{+6}) in missile manufacturing and depot level processes. This effort aligns with the gradual shift to Cr^{+6} alternatives that are underway at a number of facilities within the Department of Defense (DoD). Additionally, the European Union has taken an even more aggressive stand via their restriction of the use of certain hazardous substances (RoHS) initiative. Military equipment has been exempted from RoHS, but due to the increasing availability of suitable alternatives for Cr^{+6}-containing materials, it cannot be assumed that this exemption will last beyond 2009.

One additional driver to eliminate Cr^{+6} at AFP 44 surfaced after the project was underway via OSHA Rule 1910.1026. This rule, which went into effect on November 27, 2006, lowered the Permissible Exposure Limit (PEL) for Cr^{+6} from 52 µg/m^3 to 5 µg/m^3. In addition, the action level was set at 2.5 µg/m^3 with medical surveillance and industrial health (IH) monitoring triggered at the action level. Still other requirements are triggered at the PEL. It was immediately realized that spraying of Cr^{+6}-based paint primers and sanding operations where Cr^{+6} primer coatings were made airborne placed the manufacturing and depot level repair areas well above the PEL.

Alternatives report

As a starting point for this Cr^{+6} elimination effort, Raytheon commissioned a survey of the Cr^{+6} alternatives that were commercially available and currently being utilized (or at least approved for use) within the DoD.

Concurrent Technologies Corporation (CTC) was selected by Raytheon to perform this survey. CTC issued a Chromium Alternatives Report on February 28, 2006, identifying the Cr^{+6}-free alternative products that were currently used or approved for use in the DoD for conversion coating and paint primer applications. This report detailed the product background, application procedures and current applications for each identified alternative. The report is available on request from Raytheon or CTC.

Qualification test plan

The next step was to write a qualification test plan for the alternative products that were identified. The EFI Group was put on contract for this task and delivered to Raytheon a Statement of Work (SOW), entitled "Chromium Qualification Test Plan," on June 19, 2006. This document identified the various tests that were required as well as the products that would be tested. The test plan is also available on request from Raytheon or CTC.

A variety of non-Cr^{+6} conversion coating products were identified by CTC in the Alternatives Report and included, among others, the U.S. Navy (NAVAIR) developed and commercially licensed and available TCP (Trivalent Chromium Cr^{+3} Pretreatment). Four TCPs were selected for testing and are designated as TCP1 through TCP4 in this paper. Although these products still contained chromium, their trivalent formulations met all of the environmental and industrial health-related goals associated with eliminating Cr^{+6} at AFP 44. Additionally, two completely non-chromium products, designated NCCC1 and NCCC2, were evaluated. A number of other promising products were identified but not evaluated as they were not being utilized beyond a pilot production phase within the DoD. Just one chromate conversion coating, designated CCC, was selected as the baseline comparison coating for aluminum. This product is a widely utilized chromate conversion coating chemistry per MIL-DTL-5541, Type I, Class 1A and is on the QPL-81706. It is widely utilized within Raytheon and its suppliers. It is also exclusively utilized for in-house touch up work.

The Qualification Test Plan identified screening tests that were to be performed on pretreated-only panels to eliminate any products that could not meet minimum performance requirements prior to advancing to a more elaborate and higher cost test matrix involving solvent-based (wet) paint processes applied per MIL-PRF-85285 and powder paint processes applied per an in-house controlled specification. The screening tests used for evaluation were 168-hr salt spray corrosion resistance, tape adhesion and appearance tests. The screening test matrix is shown in Table 1.

Table 1—Screening test matrix

Test	Test Method	Requirement
Appearance	MIL-DTL-5541, Section 3.5	Uniform, continuous, free from powdery or loose coating, voids, flaws, etc.
Corrosion Resistance	MIL-DTL-5541, Section 3.6 and Section 4.5.1 (ASTM B117)	5% salt spray for 168 hr; no more than five isolated spots or pits, none larger than 0.031 in. in diameter. No more than 15 pits, none larger than 0.031 in. in diameter on the combined surface area of all five specimens (150 in^2.).
Tape Adhesion	ASTM D 3359, Method A	No coating separation from base metal substrate.

During the writing of the test plan in early 2006, none of the selected alternatives to chromate conversion coatings were certified for use with the MIL-DTL-5541 specification. Additionally, the non-chromium paint primers were not certified for use with MIL-PRF-85582 (waterborne) or MIL-PRF-QPL-23377 (solvent borne). As a result, it was necessary to qualify the chromium-based and non-chromium-based paint primer candidates with both the baseline chromate conversion coating (CCC) as well as with the alternatives to chromate conversion coatings to assure maximum compatibility.

The waterborne paint primer selected for baseline testing was in daily use at AFP 44 and is listed on QPL-85582, which is the Qualified Products List (QPL) for MIL-PRF-85582, Type I, Class C1 (barium chromate) primers. The waterborne, non-chromated primer candidate selected for testing was expected soon to be on the QPL-85582 for use as a MIL-PRF-85582, Type I, Class "N" (non-chromate) primer.

The high solids (solvent) primer selected for baseline testing was in daily use at AFP 44 and listed on the QPL-23377 for MIL-PRF-23377, Type I, Class "C" (strontium chromate) primers. The non-chromated candidate primer selected for testing was expected to soon be on the QPL-23377 for use as a MIL-PRF-23377, Type I, Class "N" (non-chromate) primer.

Finally, it was decided to paint with a topcoat that was already being utilized in daily production at AFP 44. The topcoat selected was qualified to MIL-PRF-85285C, Type I, Color White per FED-STD-595, Color #17925. Table 2 summarizes the coatings applied.

Table 3 lists the primer and topcoat test matrix, which includes wet tape adhesion, 2000-hr corrosion resistance, water resistance and filiform corrosion.

Finally, testing was required to qualify the alternative conversion coatings for use with powder coatings. The powder coat selected was per an in-house specification but commercially available, Color Gray per FED-STD-595, Color #36375.

Table 4 summarizes the tests performed, which includes wet tape adhesion, dry tape adhesion, humidity, accelerated weathering, heat resistance, thermal shock resistance and 2000-hr sulfur dioxide (SO_2) corrosion resistance.

Table 2—Wet spray coating systems for evaluation

Name	Description
MIL-PRF-23377H, Type I, Class C	Cr^{+6}-containing solvent-borne primer
MIL-PRF-23377H, Type I, Class N	Non-chromated solvent-borne primer
MIL-PRF-85582, Type I, Class C1	Cr^{+6}-containing waterborne primer
MIL-PRF-85582, Type I, Class N	Non-chromated waterborne primer
MIL-PRF-85285C, Type I	FED-STD-595 white topcoat

This test plan was used to prepare a competitive solicitation for testing services. CTC was again put on contract to apply the baseline and alternative coatings, to perform the lab testing and to evaluate the test results. All of this work was conducted at the CTC facility in Johnstown, Pennsylvania.

Results and discussion

Table 5 shows the results for the screening testing of the baseline chromate conversion coating (CCC) and the alternatives to chromate conversion coatings. Note that this testing was performed on unpainted panels only. As expected, the baseline CCC was exceptional. Only the TCP1 product met the corrosion resistance requirements associated with MIL-DTL-5541, but, because three of the TCP products had been added to the Qualified Products List (QPL-81706) for MIL-DTL-5541 by the time this testing was completed, it was decided that all TCP products should continue to full testing. The qualifying agency, the U.S. Navy (NAVAIR), suggested that the excessive pitting on our panels may have been due to the fact that the TCP chemistries, unlike the hexavalent chromium-based conversion coatings, were more sensitive to the cleaning and deoxidizing steps as well as the actual operating parameters of the TCP solution.

Both of the non-chromate conversion coatings (NCCC1, NCCC2) failed salt spray and were eliminated from further testing. This does not imply that these two coatings would not be effective as pretreatments on aluminum prior to painting but the project requirements were only to consider non Cr^{+6} systems that could pass both on their own and with subsequent chromated and non-chromated paint primers or with direct powder coat.

Table 6 shows the results of the wet (solvent) spray paint testing. The baseline CCC and the TCPs did very well with the chromated and non-chromated paint primers. Table 7 shows the results of the powder paint testing. Again, the baseline CCC and the TCPs did very well.

As of this writing, all four of the TCPs tested have been added, via certification letters, to the QPL for MIL-DTL-5541 (QPL-81706) and designated as Type II (compositions containing no Cr^{+6}) chemical conversion materials.

Table 3—Primer and topcoat test matrix

Test	Test Method	Requirement
Wet Tape Adhesion	MIL-DTL-5541, Section 4.3.3.1.1 and MIL-PRF-85582, Section 3.6.4 IAW Section 4.5.42 (FED Test STD 141 Method 6301)	No loss of adhesion.
Water Resistance	MIL-PRF-85582, Section 3.7.1 IAW Section 4.5.7; Four-day water immersion test	No wrinkling, blistering or any coating deficiency.
Corrosion Resistance	MIL-PRF-85582, Section 3.7.2.1 IAW Section 4.5.8.1; 5% salt spray for 2000 hr; test with scribe marks	No blistering, lifting of either coating, or substrate pitting.
Filiform Corrosion	MIL-PRF-85582, Section 3.7.2.2 IAW Section 4.5.8.2; Exposure to 12 N HCl followed by 1000 hr in humidity cabinet	No filiform corrosion extending beyond 0.25 in. from scribe; majority of filaments shall be less than 0.125 in.

Table 4—Powder coat test matrix

Test	Test Method	Requirement
Wet tape adhesion	FED-STD-141A, Method 6301.3	No loss of adhesion.
Dry tape adhesion	ASTM D3359, Method A	No coating removal, cracking or flaking.
Humidity	FTMS No. 141A, Method 6201	400 hr humidity@ 100±5°F, no loss of adhesion, blistering, film softening, discoloration.
Accelerated weathering	ASTM-D-5894	Pass 2000 hr.
Heat resistance	FED-STD-141, Method 6051	Pass 24 hr@300±10°F, no blistering or loss of adhesion.
Thermal shock resistance	SCD 6500168, 4.4.2.7; 24±1 hr@300±10°F and immersion in ice water @34±2°F.	No loss of adhesion.
Corrosion resistance	SCD 6500168, 4.4.2.10; 5% salt spray per ASTM B117 except sulfur dioxide (SO_2) shall be injected at a flow rate of 1.0±0.2 $cm^3/min/ft^3$, 6° angle from vertical.	Corrosion within 3mm from scribe shall not be considered a failure.

Regarding the paint primers, the water-borne, non-chromated primer performed very well and was added to QPL-85582 for MIL-PRF-85582, Type I, Class "N" (Non-Chromate) on December 19, 2006. The high solids, non-chromated primer, while also passing all of the tests, was not initially added to the QPL for MIL-PRF-23377 due to an induction (mixing) time issue. In short, if the two-part mixture was not permitted to cure for the required 30 to 45 min, adhesion to the topcoat could be adversely affected. This induction time would not be a concern at AFP 44 but kept the primer from receiving full certification. The induction issues were finally resolved and so the high solids (solvent), non-chromated paint primer was finally added to QPL-23377 for MIL-PRF-23377 and designated a Class "N" (Non-Chromate) on April 13, 2007.

Table 5—Screening test results (pre-treatment only)

Sample name	Appearance	Adhesion	Corrosion resistance – 168 hr
CCC, 2024-T3 Al	Shiny, gold around edges and iridescent in center	Pass, 5A	10 rating, no corrosion
CCC, 6061-T6 Al	Shiny, yellow-brown coating; uneven coating - heavier along the edges	Pass, 5A	9 rating, 1-5 pits
NCCC1	Shiny, slightly iridescent coating	Pass, 5A	3 rating, 21-30% of area contains pitting and/or white corrosion product (WCP)
NCCC2	Scuffed aluminum appearance	Pass, 5A	0 rating, pitting, WCP and black corrosion product (BCP) - removed after 24 hr.
TCP1	Shiny, matte, yellow-brown coating; some scratches; uneven coating, heavier near bottom of panels	Pass, 5A	9 rating, 0-6 pits, 0-1% WCP
TCP2	Shiny, slightly iridescent, even coating; a few scratches	Pass, 5A	8 rating, 12-30 pits, 2-3% WCP
TCP3	Shiny, matte, iridescent coating	Pass, 5A	9 rating, 8-27 pits, 0-1% WCP
TCP4	Shiny, iridescent coating	Pass, 5A	8 rating, 42-100 pits, 2-3% WCP

Table 6—Wet spray paint evaluation results

Pretreatment	Coating System	Test Methods – Wet Spray Coatings			
		Wet tape adhesion	Water resistance – 4 day	Corrosion resistance – 2000 hr	Filiform corrosion – 1000 hr
Baseline CCC	MIL-PRF-23377H, Type I, Class C Primer Only	Pass – Rating of 5A	Color change – coating is more green in color	N.A.	N.A.
	MIL-PRF-23377H, Type I, Class N Primer Only	Pass – Rating of 5A	Color change – 2 panels were olive green with mint green spots; 1 panel was olive; 2 panels were mint green	N.A.	N.A.
	MIL-PRF-85582, Type I, Class C1 Primer Only	Pass – Rating of 5A	Color change – darker	N.A.	N.A.
	MIL-PRF-85582, Type I, Class N Primer Only	Pass – Rating of 5A	Color change – dulling	N.A.	N.A.
	MIL-PRF-23377H, Type I, Class C Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 10, Scribed area Rating = 8, Unscribed area (blisters)	4 panels – no filaments; 1 panel w/ 4 filaments, from 1/16″ to 1/32″
	MIL-PRF-23377H, Type I, Class N Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 10, Scribed area Rating = 10, Unscribed area	Average of 110 filaments, from 1/32″ to 1/8″ in length
	MIL-PRF-85582, Type I, Class C1 Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 10, Scribed area Rating = 10, Unscribed area	TNTC filaments, from 1/32″ to 1/8″ in length
	MIL-PRF-85582, Type I, Class N Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 9, Scribed area (WCP) Rating = 10, Unscribed area	Average of 80 filaments, from 1/32″ to 1/8″ in length

Table 6 (Continued)—Wet spray paint evaluation results

Pretreatment	Coating System	Test Methods – Wet Spray Coatings			
		Wet tape adhesion	Water resistance – 4 day	Corrosion resistance – 2000 hr	Filiform corrosion – 1000 hr
TCP1	MIL-PRF-23377H, Type I, Class C Primer Only	Rating of 5 – 4 panels Rating of 4 – 1 panel	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-23377H, Type I, Class N Primer Only	Pass – Rating of 5A	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-85582, Type I, Class C1 Primer Only	Pass – Rating of 5A	Color change – darker	N.A.	N.A.
	MIL-PRF-85582, Type I, Class N Primer Only	Pass – Rating of 5A	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-23377H, Type I, Class C Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 10, Scribed area Rating = 10, Unscribed area	Average of 36 filaments, from1/32″ to 5/16″ in length
	MIL-PRF-23377H, Type I, Class N Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 9, Scribed area (WCP) Rating = 10, Unscribed area	Average of 99 filaments, from 1/32″ to 3/32″ in length
	MIL-PRF-85582, Type I, Class C1 Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 10, Scribed area Rating = 10, Unscribed area	TNTC filaments, from 1/32″ to ¼″
	MIL-PRF-85582, Type I, Class N Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 8, Scribed area (WCP) Rating = 10, Unscribed area	Average of 110 filaments, from 1/32″ to 5/32″ in length
TCP2	MIL-PRF-23377H, Type I, Class C Primer Only	Pass – Rating of 5A	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-23377H, Type I, Class N Primer Only	Pass – Rating of 5A	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-85582, Type I, Class C1 Primer Only	Pass – Rating of 5A	Color change – darker	N.A.	N.A.
	MIL-PRF-85582, Type I, Class N Primer Only	Pass – Rating of 5A	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-23377H, Type I, Class C Primer + MIL-PRF-85285C, Type I Topcoat	Rating of 5 – 1 panel Rating of 4 – 3 panels Rating of 3 – 1 panel	No change	Rating = 10, Scribed area Rating = 10, Unscribed area	Average of 25 filaments, from 1/32″ to 3/16″ in length
	MIL-PRF-23377H, Type I, Class N Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 9, Scribed area (WCP) Rating = 10, Unscribed area	Average of 119 filaments, from 1/32″ to 1/8″ in length
	MIL-PRF-85582, Type I, Class C1 Primer + MIL-PRF-85285C, Type I Topcoat	Rating of 5 – 4 panels Rating of 4 – 1 panel	No change	Rating = 10, Scribed area Rating = 10, Unscribed area	TNTC filaments, from 1/32″ to 5/32″ in length
	MIL-PRF-85582, Type I, Class N Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 8, Scribed area (WCP) Rating = 10, Unscribed area	Average of 132 filaments, from 1/32″ to 1/8″ in length

Table 6 (Continued)—Wet spray paint evaluation results

Pretreatment	Coating System	Test Methods – Wet Spray Coatings			
		Wet tape adhesion	Water resistance – 4 day	Corrosion resistance – 2000 hr	Filiform corrosion – 1000 hr
TCP3	MIL-PRF-23377H, Type I, Class C Primer Only	Pass – Rating of 5A	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-23377H, Type I, Class N Primer Only	Pass – Rating of 5A	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-85582, Type I, Class C1 Primer Only	Pass – Rating of 5A	Color change – darker	N.A.	N.A.
	MIL-PRF-85582, Type I, Class N Primer Only	Pass – Rating of 5A	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-23377H, Type I, Class C Primer + MIL-PRF-85285C, Type I Topcoat	Rating of 5 – 2 panels Rating of 4 – 3 panels	No change	Rating = 10, Scribed area Rating = 10, Unscribed area	Average of 10 filaments, from 1/32″ to 1/8″ in length
	MIL-PRF-23377H, Type I, Class N Primer + MIL-PRF-85285C, Type I Topcoat	Rating of 5 – 3 panels Rating of 4 – 2 panels	No change	Rating = 9, Scribed area (WCP) Rating = 10, Unscribed area	Average of 95 filaments, from 1/32″ to 1/8″ in length
	MIL-PRF-85582, Type I, Class C1 Primer + MIL-PRF-85285C, Type I Topcoat	Rating of 5 – 3 panels Rating of 4 – 1 panel Rating of 3 – 1 panel	No change	Rating = 10, Scribed area Rating = 10, Unscribed area	TNTC filaments, from 1/32″ to 5/32″ in length
	MIL-PRF-85582, Type I, Class N Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 8, Scribed area (WCP) Rating = 10, Unscribed area	Average of 64 filaments, from 1/32″ to 1/8″ in length
TCP4	MIL-PRF-23377H, Type I, Class C Primer Only	Pass – Rating of 5A	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-23377H, Type I, Class N Primer Only	Pass – Rating of 5A	4 panels had slight dulling; 1 panel was olive with small mint green spots	N.A.	N.A.
	MIL-PRF-85582, Type I, Class C1 Primer Only	Pass – Rating of 5A	No change	N.A.	N.A.
	MIL-PRF-85582, Type I, Class N Primer Only	Pass – Rating of 5A	Slight color change – dulling	N.A.	N.A.
	MIL-PRF-23377H, Type I, Class C Primer + MIL-PRF-85285C, Type I Topcoat	Rating of 5 – 3 panels Rating of 4 – 2 panels	No change	Rating = 10, Scribed area Rating = 10, Unscribed area	Average of 11 filaments, from 1/32″ to 1/16″ in length
	MIL-PRF-23377H, Type I, Class N Primer + MIL-PRF-85285C, Type I Topcoat	Pass – Rating of 5A	No change	Rating = 8, Scribed area (WCP) Rating = 10, Unscribed area	Average of 102 filaments, from 1/32″ to 1/8″ in length
	MIL-PRF-85582, Type I, Class C1 Primer + MIL-PRF-85285C, Type I Topcoat	Rating of 5 – 1 panel Rating of 4 – 4 panels	No change	Rating = 10, Scribed area Rating = 10, Unscribed area	TNTC filaments, from 1/32″ to ¼″ in length
	MIL-PRF-85582, Type I, Class N Primer + MIL-PRF-85285C, Type I Topcoat	Rating of 5 – 4 panels Rating of 4 – 1 panel	No change	Rating = 8, Scribed area (WCP) Rating = 10, Unscribed area	Average of 90 filaments, from 1/32″ to 3/32″ in length

BCP = Black Corrosion Product WCP = White Corrosion Product

Table 7—Powder coating evaluation results

Pretreatment	Test Methods for Powder Coated Panels						
	Wet tape adhesion	Dry tape adhesion	Humidity	Accelerated weathering	Heat resistance	Thermal shock	SO_2 corrosion
Baseline CCC	Pass – Rating of 5A	Pass – Rating of 5A	10 Rating; no change	Yellowing with slight chalking; no coating failures	No change	No change	0 - 1.0 mm avg. creepage from scribe (8 - 9 rating); no corrosion
TCP1	Pass – Rating of 5A	Pass – Rating of 5A	10 Rating; no change	Yellowing with slight chalking; no coating failures	No change	No change	1.0 - 2.0 mm avg. creepage from scribe (7 rating); no corrosion
TCP2	Pass – Rating of 5A	Pass – Rating of 5A	10 Rating; no change	Yellowing with slight chalking; no coating failures	No change	No change	0.5 - 1.0 mm avg. creepage from scribe (8 rating); no corrosion
TCP3	Pass – Rating of 5A	Pass – Rating of 5A	10 Rating; no change	Yellowing with slight chalking; no coating failures	No change	Four panels: No change; One panel: Loss of adhesion along scribe	1.0 - 2.0 mm avg. creepage from scribe (7 rating); no corrosion
TCP4	Pass – Rating of 5A	Pass – Rating of 5A	10 Rating; no change	Yellowing with slight chalking; no coating failures	No change	No change	0.5 - 2.0 mm avg. creepage from scribe (7 - 8 rating); no corrosion

Summary

It is now possible to have a Cr^{+6} free conversion coat and paint system (solvent based or powder) for aluminum-based missile components that meet the requirements of MIL-DTL-5541, MIL-PRF-85582, MIL-PRF-23377 and MIL-PRF-85285.

All four of the TCP (trivalent chromium Cr^{+3} pretreatment) products tested by CTC have been added, via certification letter, to QPL-81706 for use with MIL-DTL-5541 and designated as Type II (compositions containing no Cr^{+6}) chemical conversion materials.

QPL-85582 now includes our product tested for use with MIL-PRF-85582 as a waterborne, non-chromated paint primer and designated as Class "N" (non-chromate).

QPL-23377 also includes our product tested for use with MIL-PRF-23377 as a high-solids (solvent), non-chromated paint primer and designated Class "N" (non-chromate).

For electronic copies of any of the reports or for additional information, contact Paul Fecsik at PWFecsik@raytheon.com, Jim Arthur at arthurj@ctc.com or Leanne Debias at debiasl@ctc.com. P&SF

About the Authors

Paul Fecsik has been a Materials and Process Engineer with Raytheon Missile Systems for over 26 years in a variety of assignments in production floor support, supervision and project engineering. For the past 12 years, Paul has acted as the US Air Force Plant 44 Pollution Prevention Program Manager for Raytheon. He has extensive hands-on expertise in electroplating and surface finishing (CEF) as well as in painting, vacuum vapor degreasing and laser based paint decoating. Paul is a retired USAF reserve pilot with many hours in the B-52 bomber and C-141 transport.

Jim Arthur is a Senior Process Engineer in the Air Force Engineering Programs group at Concurrent Technologies Corporation (CTC). He has over 10 years of experience in the execution and management of environmental and manufacturing projects and has been responsible for the specification, evaluation, design, installation, demonstration and transfer of innovative process technologies in support of these types of programs. He has worked extensively in the coatings and coatings removal areas.

Leanne Debias is a Process Engineer at Concurrent Technologies Corporation in Johnstown, PA.