TT-C-490 – Implementing alternatives through specifications

Tom Braswell, Fred Lafferman, John Kelley, Tom Considine, Chris Miller, William Lum, John A. Escarsega

ASETSDefense 2014 : Sustainable Surface Engineering for Aerospace and Defense
November 18th 2014  Fort Myer, VA.
**TT-C-490 -Implementing alternatives through specifications**

**Army Research Laboratory, 2800 Powder Mill Road, Adelphi, MD, 20783**

Approved for public release; distribution unlimited

**ASETSDefense 2014: Sustainable Surface Engineering for Aerospace and Defense, 18-20 Nov 2014, Fort Myer, VA.**

Security classification: unclassified

Limitation of abstract: Same as Report (SAR)

Number of pages: 24

Name of responsible person: unclassified

---

Standard Form 298 (Rev. 8-98)
Proscribed by ANSI Std Z39-18
1. Background and Motivation for TT-C-490

2. Strategy for Over-Arching Specifications

3. Details of the Specification

4. Closing Comments
Prior to 2013, TT-C-490 was “Chemical Conversion Coatings and Pretreatments for Ferrous Surfaces (Base for Organic Coatings)”
Existing Pretreatments for CARC Coating System TT-C-490E

Prior to 2013, TT-C-490 was “Chemical Conversion Coatings and Pretreatments for Ferrous Surfaces (Base for Organic Coatings)”

- Pretreatments specific for ferrous substrates
- Specifies either zinc phosphate conversion coating or wash primer conforming to DOD-P-15328 or MIL-C-8514
- Wash primers contain hexavalent chromium
  - Also high in VOCs and contain HAPs
  - Only pretreatment allowed for multi-metal application
- Zinc phosphate is either applied by immersion or spray in a contained area
Major Gaps in TT-C-490E Pretreatments

- Other than DOD-P-15328 & MIL-C-8514, there was no other pretreatment approved for multi-metal application
  - No approved alternatives to wash primer
- Most users do not have facilities large enough to apply zinc phosphate to structures and hulls
- Material compatibility issues (heat, acids, etc)
  - Hydrogen embrittlement risks perceived with WP and Phos
- No avenue to evaluate, approve, and adopt new technologies
- Direct-to-metal is not approved for CARC
  - Limited exemption by waiver
Motivation to update TT-C-490

- TT-C-490 became outdated and used beyond original scope
- Restrictive language limits process improvements and prevents innovation
  - Lock-step procedures dictate material selections
  - Proven technologies are available and being used in commercial industries
- John J. Young Jr., The Office of the Undersecretary of Defense, memo (April 8, 2009) mandating reduction in chrome has led to elimination of TT-C-490 Type III (DoD-P-15328) on most new contracts
  - Impending cancellation of Type III DoD-P-15328
- Technologies demonstrated for military applications (e.g.: ESTCP WP-200906) have no avenue other than waivers to use materials and processes outside specification
- Engineering drawings specific to TT-C-490 process have forced OEM’s to get PM approvals on materials not yet evaluated by ARL
Why TT-C-490?

TT-C-490E, “Chemical Conversion Coatings and Pretreatments for Ferrous Surfaces (Base for Organic Coatings)”

- Overarching document referenced in tens of thousands of military specifications and drawings
- The definitive reference for engineers to specify cleaning and pretreatment of ferrous materials
  - Often used improperly for cleaning non-ferrous metals
- Major gaps existed between the technologies permitted in TT-C-490E and what is available today
  - Prohibited use of chromated wash primer and eventual cancellation leaves technology gap for large components and multi-metal assemblies
- TT-C-490 is used by all services and OEMs for finishing metal
Revision Timeline

- **Launched update of TT-C-490E**
  - Sept 2008

- **Obtained comments and ideas from industry/gov**
  - April 2009

- **Team formed to modify draft**
  - May 2009

- **Begin formalizing update**
  - June 2009

- **Begin coordination with MIL-DTL-53072**
  - Oct 2009

- **Developed JTP for WP200906**

- **First draft and presentation**
  - March 2012

- **First coordination document released**
  - Aug 2012

- **Second coordination document released**
  - Jan 2013

- **Pre-publication clarifications**
  - March 2012

- **Second coordination document released**
  - Aug 2012

- **Pre-publication clarifications**
  - Jan 2013

- **TT-C-490F Published:** 1/31/2013
  - **Available on ASSIST:** 2/4/2013

**Timeline Events:**
- **Launched update of TT-C-490E**
  - Sept 2008

- **Obtained comments and ideas from industry/gov**
  - April 2009

- **Team formed to modify draft**
  - May 2009

- **Begin formalizing update**
  - June 2009

- **Begin coordination with MIL-DTL-53072**
  - Oct 2009

- **Developed JTP for WP200906**

- **First draft and presentation**
  - March 2012

- **First coordination document released**
  - Aug 2012

- **Second coordination document released**
  - Jan 2013

- **Pre-publication clarifications**
  - March 2012

**TT-C-490F Published:** 1/31/2013
- **Available on ASSIST:** 2/4/2013
<table>
<thead>
<tr>
<th>Team Member</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas Braswell</td>
<td>TT-C-490F Team Lead</td>
</tr>
<tr>
<td>Fred Lafferman</td>
<td>Coatings Technical Lead</td>
</tr>
<tr>
<td>Bernie Hart (retired)</td>
<td>Specification and Standards</td>
</tr>
<tr>
<td>William Lum</td>
<td>Specification Coordinator</td>
</tr>
<tr>
<td>Thomas Considine</td>
<td>Corrosion Testing Standards</td>
</tr>
<tr>
<td>Christopher Miller</td>
<td>Subject Matter Expert TT-C-490E</td>
</tr>
<tr>
<td>John Kelley</td>
<td>Corrosion Team Facilitator</td>
</tr>
</tbody>
</table>
Significant Changes in TT-C-490F

- TT-C-490F will require Objective Quality Evidence (OQE)
  - Continuous monitoring… “Tell me, show me, prove it”
  - Requires the use of certifiable process checks (ISO 9001/17025) to demonstrate competencies
  - Replaces “old” quality system which did not adequately control ongoing quality production
    - Government had insufficient resources to follow-up
    - No more “set and forget” production lines
  - Applies to both legacy and new systems
    - New systems also require qualification through QPD
- TT-C-490F bolsters the quality of legacy zinc phosphate systems while maintaining integrity of the original processes including optional on-site inspection
- Incorporation of non-ferrous substrates embraces new technologies
  - Enables the use of new approved technologies without the need for negotiating within contract
- ARL steward of QPD
What does this all mean to DOD and its contractors?

– TT-C-490F augments requirements in MIL-DTL-53072
– More flexibility in terms of pretreatment choices
  
  • *First Fed specification to encourage the use of new technologies for multiple metal substrates*

– New TT-C-490 technologies can be applied through Engineer Change Notice (ECN) without changes to main drawings (drawing changes = $$$$)
– Greener technologies
  
  • Significant step towards elimination of Cr\(^{6+}\), VOC’s and HAP’s
  • Reduced energy costs for operating pretreatment lines
  • Reduced wastes (little or no sludge removal/maintenance)
– In some cases, vastly better performance (zinc-rich)
– Applied program of quality assurance OQE
– ARL stewardship
  
  • Provides QPD for approved materials
  • Formal path for evaluating new materials and processes
  • Encourages innovation
Impact of TT-C-490F

Specifications and Standards
### Example of Potential Cost Savings

<table>
<thead>
<tr>
<th></th>
<th>Zinc Phosphate 125°F (52°C)</th>
<th>Iron Phosphate 125°F (52°C)</th>
<th>Advanced Pretreatment 70°F (21°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Cost</td>
<td>$100</td>
<td>$100</td>
<td>$100</td>
</tr>
<tr>
<td>Heating Energy</td>
<td>$100</td>
<td>$100</td>
<td>$70</td>
</tr>
<tr>
<td>Electric Energy</td>
<td>$100</td>
<td>$86</td>
<td>$71</td>
</tr>
<tr>
<td>Rinsing Water</td>
<td>$100</td>
<td>$100</td>
<td>$40</td>
</tr>
<tr>
<td>Waste Disposal</td>
<td>$100</td>
<td>$35</td>
<td>$17</td>
</tr>
<tr>
<td>Maintenance</td>
<td>$100</td>
<td>$25</td>
<td>$15</td>
</tr>
<tr>
<td></td>
<td><strong>$600</strong></td>
<td><strong>$446</strong></td>
<td><strong>$313</strong></td>
</tr>
</tbody>
</table>

*Information provided by Gary Nelson, Chemetall*
Foundation for MIL-DTL-53072

- Chemical Agent Resistant Coating (CARC) consists of four distinct steps:
  - Cleaning and Preparation of Substrate (TT-C-490)
  - Pretreatment (TT-C-490)
  - Priming
  - Top-coating
Over-Arching Specifications

MIL-DTL-53072
CARC Application Document

TT-C-490
Pretreatment for Ferrous & Non-Ferrous

Directly supports Technical Manuals and Bulletins

Which as a group directly supports Contract Details
Qualification of New Technology

• New Types that require qualification and inclusion in Qualified Products Database:
  – Type III – Organic pretreatments (chromate free)
  – Type IV – Inorganic pretreatments (silanes, zirconates, etc)
  – Type VIII – Metal-rich coatings for abrasive blasted surfaces

• Zinc phosphate, iron phosphate and current wash primers are legacy systems and do not require TT-C-490 QPD

• Statements of composition (full disclosure) and process requirements required for qualification

• QPD will be based upon Type, Class, and Cleaning Method

• Performance criteria established in specification and must be compatible with CARC primers

• QPD is transition from specification to implementation
Qualification of New Technology

1. Complete all required testing
   - Pass all requirements for TT-C-490F
     - (Type IV Inorganic Pretreatment)

2. Manufacturer submits Letter of Intent
   - Specify Type and Class
   - Provide full disclosure

3. TT-C-490F Team Review of documentation
   - Approved and placed on QPD
490F: Answers in regard to Transition Questions

• Expected questions from users:
  – What is the transition method to implement new pretreatment technologies?
    • Approval to TT-C-490F requirements
    • ARL initiates a formal QPD program
      – Legacy products not affected
  – Will it effect government drawings and contracts?
    • No effects on existing drawings and contracts
      – Can use ECNs to access new technologies
    • Enables new technologies to be used in future contracts
  – Will the new technologies cost more?
    • Generally, no
    • Enhanced performance products may increase costs
      – i.e.: zinc metal
• Overarching document referenced in tens of thousands of military specifications and drawings

• Requires continuous monitoring to provide objective quality evidence (OQE).
  - Bolsters quality of legacy systems like phosphate

• Encompasses both ferrous and non-ferrous substrates

• ARL stewardship provides formal process for evaluating and approving new materials for QPD

• *Expedites implementation of new approved technologies by providing a QPD*
  - No need for negotiating within contract
  - Implementation strategy for WP200906 and TMR-12-01
Type I - Zinc phosphate.
Type II - Aqueous iron phosphate.
Type III - Organic pretreatment.
Type IV - Inorganic pretreatment.
Type V - Medium weight zinc phosphate.
Type VI - MIL-DTL-5541, Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
Type VII - Anodic coating and electrolytic passivation.
Type VIII - Metal-rich coating for abrasive blasted surfaces.
Specifications are just one link to many elements to support implementation and use of new technologies.

Posture is to reduce the number of “types” in specification to ensure only top level performance.

Request and Mandate OEMs, Vendors and DOD do not restrict or isolate a particular technology.....reference the specification and select what works best for each end-user.
<table>
<thead>
<tr>
<th>Contributor</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Escarsega</td>
<td>US Army Research Laboratory, MMSD-CARC Commodity Manager, Signature approving Authority</td>
</tr>
<tr>
<td>William Lum</td>
<td>US Army Research Laboratory, MMSD-Coatings Team, APG, MD 21005</td>
</tr>
<tr>
<td>Fred Lafferman</td>
<td>US Army Research Laboratory, MMSD-Corrosion Team, APG, MD 21005</td>
</tr>
<tr>
<td>Chris Miller</td>
<td>US Army Research Laboratory, MMSD-Corrosion Team, APG, MD 21005</td>
</tr>
<tr>
<td>Brian Plazankis</td>
<td>US Army Research Laboratory, MMSD-Corrosion Team, APG, MD 21005</td>
</tr>
<tr>
<td>Tom Considine</td>
<td>US Army Research Laboratory, MMSD-Corrosion Team, APG, MD 21005</td>
</tr>
<tr>
<td>Tom Braswell</td>
<td>US Army Research Laboratory, MMSD-Corrosion Team, APG, MD 21005</td>
</tr>
<tr>
<td>Scott Grendal</td>
<td>US Army Research Laboratory, APG, MD 21005</td>
</tr>
<tr>
<td>Jonathan Montgomery</td>
<td>US Army Research Laboratory, APG, MD 21005</td>
</tr>
<tr>
<td>Bernard Hart (retired)</td>
<td>US Army Research Laboratory, MMSD-Coatings Team, APG, MD 21005</td>
</tr>
<tr>
<td>Jack Kelley</td>
<td>US Army Research Laboratory, MMSD-Corrosion Team, APG, MD 21005</td>
</tr>
<tr>
<td>Gary Nelson</td>
<td>Chemetall Inc</td>
</tr>
<tr>
<td>Randall Brady</td>
<td>Deft Coatings</td>
</tr>
<tr>
<td>Chuck Ray</td>
<td>Deft Coatings</td>
</tr>
<tr>
<td>Mike Berger</td>
<td>Henkel</td>
</tr>
<tr>
<td>George Newton</td>
<td>Henkel</td>
</tr>
<tr>
<td>Pat Scalera</td>
<td>Henkel</td>
</tr>
<tr>
<td>John Mort</td>
<td>Hentzen Coatings</td>
</tr>
<tr>
<td>Terry Tuttle</td>
<td>Hentzen Coatings</td>
</tr>
<tr>
<td>Wes Prince</td>
<td>Impreglon Corp.</td>
</tr>
<tr>
<td>Amy Fowler</td>
<td>Naval Air Warfare Center, Patuxant River, MD</td>
</tr>
<tr>
<td>Randy Terrill</td>
<td>NCP Coatings</td>
</tr>
<tr>
<td>Matt Flory</td>
<td>Sherwin Williams</td>
</tr>
<tr>
<td>Nabil Zaki</td>
<td>Surtec Inc</td>
</tr>
<tr>
<td>Bernie Tucker</td>
<td>Tucker Liquid Ind. Coatings</td>
</tr>
<tr>
<td>Joe Menke</td>
<td>Corrosion Engineer, RIA</td>
</tr>
<tr>
<td>Carl Handsy (retired)</td>
<td>TARDEC</td>
</tr>
<tr>
<td>Jeff Adams</td>
<td>AMZ Corporation</td>
</tr>
</tbody>
</table>
## Contacts for TT-C-490F

<table>
<thead>
<tr>
<th>Contacts</th>
<th>Telephone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas Braswell</td>
<td>410-306-0935</td>
<td><a href="mailto:Thomas.braswell2.civ@mail.mil">Thomas.braswell2.civ@mail.mil</a></td>
</tr>
<tr>
<td>Fred Lafferman</td>
<td>410-306-1520</td>
<td><a href="mailto:fred.lafferman.civ@mail.mil">fred.lafferman.civ@mail.mil</a></td>
</tr>
<tr>
<td>John Escarsega</td>
<td>410-306-0693</td>
<td><a href="mailto:john.a.escarsega.civ@mail.mil">john.a.escarsega.civ@mail.mil</a></td>
</tr>
<tr>
<td>William Lum</td>
<td>410-306-0706</td>
<td><a href="mailto:william.s.lum.civ@mail.mil">william.s.lum.civ@mail.mil</a></td>
</tr>
<tr>
<td>Thomas Considine</td>
<td>410-306-2564</td>
<td><a href="mailto:thomas.a.considine.ctr@mail.mil">thomas.a.considine.ctr@mail.mil</a></td>
</tr>
<tr>
<td>Christopher Miller</td>
<td>410-306-0849</td>
<td><a href="mailto:christopher.e.miller44.civ@mail.mil">christopher.e.miller44.civ@mail.mil</a></td>
</tr>
<tr>
<td>John Kelley</td>
<td>410-306-0837</td>
<td><a href="mailto:John.v.kelley8.civ@mail.mil">John.v.kelley8.civ@mail.mil</a></td>
</tr>
</tbody>
</table>
Questions