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U.S. Army Research, Development and Engineering Command

TT-C-490 –Implementing alternatives through specifications

ARL

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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Outline

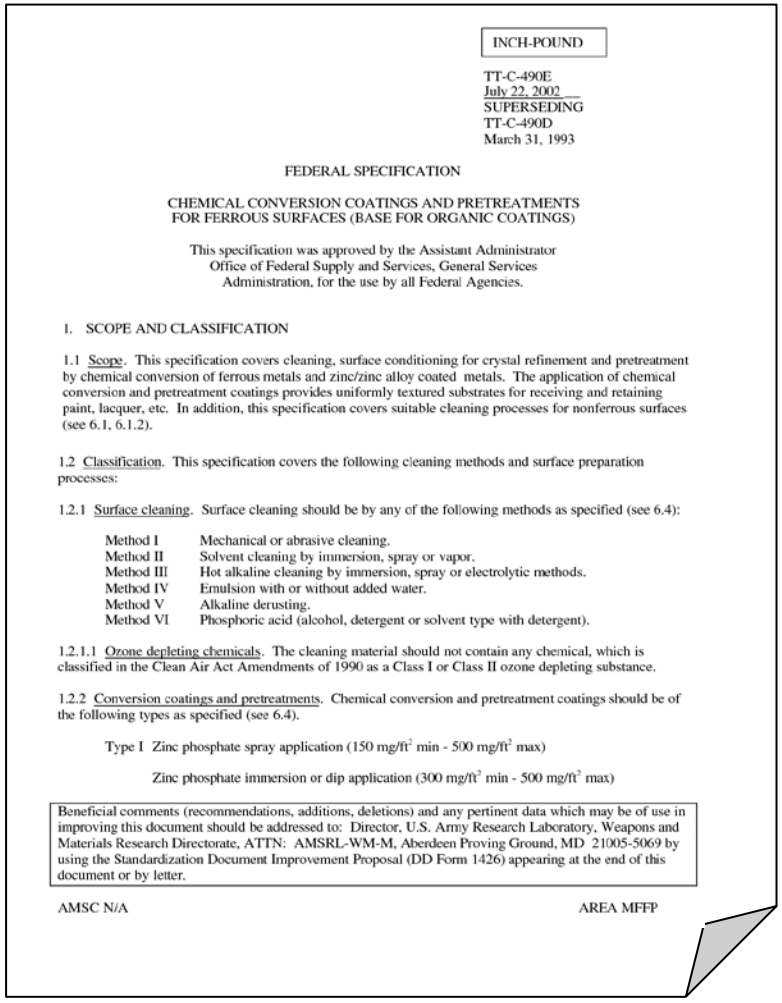
- 1. Background and Motivation for TT-C-490
- 2. Strategy for Over-Arching Specifications
- 3. Details of the Specification
- 4. Closing Comments

What is TT-C-490?

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)"



INCH-POUND

TT-C-490E
July 22, 2002
SUPERSEDING
TT-C-490D
March 31, 1993

FEDERAL SPECIFICATION

CHEMICAL CONVERSION COATINGS AND PRETREATMENTS FOR FERROUS SURFACES (BASE FOR ORGANIC COATINGS)

This specification was approved by the Assistant Administrator Office of Federal Supply and Services, General Services Administration, for the use by all Federal Agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers cleaning, surface conditioning for crystal refinement and pretreatment by chemical conversion of ferrous metals and zinc/zinc alloy coated metals. The application of chemical conversion and pretreatment coatings provides uniformly textured substrates for receiving and retaining paint, lacquer, etc. In addition, this specification covers suitable cleaning processes for nonferrous surfaces (see 6.1, 6.1.2).

1.2 Classification. This specification covers the following cleaning methods and surface preparation processes:

1.2.1 Surface cleaning. Surface cleaning should be by any of the following methods as specified (see 6.4):

Method I	Mechanical or abrasive cleaning.
Method II	Solvent cleaning by immersion, spray or vapor.
Method III	Hot alkaline cleaning by immersion, spray or electrolytic methods.
Method IV	Emulsion with or without added water.
Method V	Alkaline derusting.
Method VI	Phosphoric acid (alcohol, detergent or solvent type with detergent).

1.2.1.1 Ozone depleting chemicals. The cleaning material should not contain any chemical, which is classified in the Clean Air Act Amendments of 1990 as a Class I or Class II ozone depleting substance.

1.2.2 Conversion coatings and pretreatments. Chemical conversion and pretreatment coatings should be of the following types as specified (see 6.4).

Type I Zinc phosphate spray application (150 mg/ft^2 min - 500 mg/ft^2 max)

Zinc phosphate immersion or dip application (300 mg/ft^2 min - 500 mg/ft^2 max)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, U.S. Army Research Laboratory, Weapons and Materials Research Directorate, ATTN: AMSRL-WM-M, Aberdeen Proving Ground, MD 21005-5069 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A AREA MFFP

- 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

Courtesy of U.S. DoD

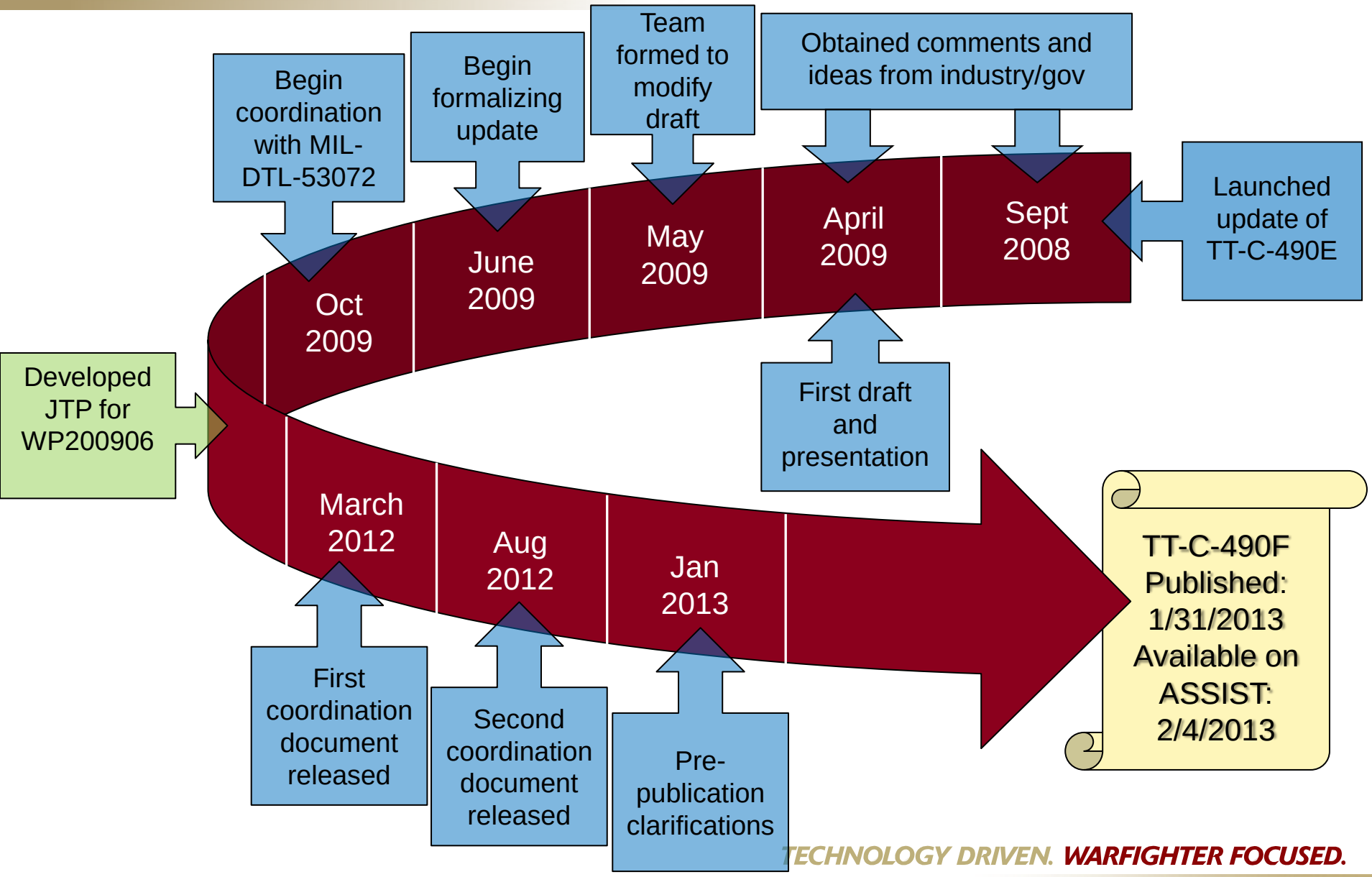
Why TT-C- 490?

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

Courtesy of U.S. DoD

Revision Timeline



ARL TT-C-490F Team

Team Member	Contribution
Thomas Braswell	TT-C-490F Team Lead
Fred Lafferman	Coatings Technical Lead
Bernie Hart (retired)	Specification and Standards
William Lum	Specification Coordinator
Thomas Considine	Corrosion Testing Standards
Christopher Miller	Subject Matter Expert TT-C-490E
John Kelley	Corrosion Team Facilitator

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**

Courtesy of U.S. DoD

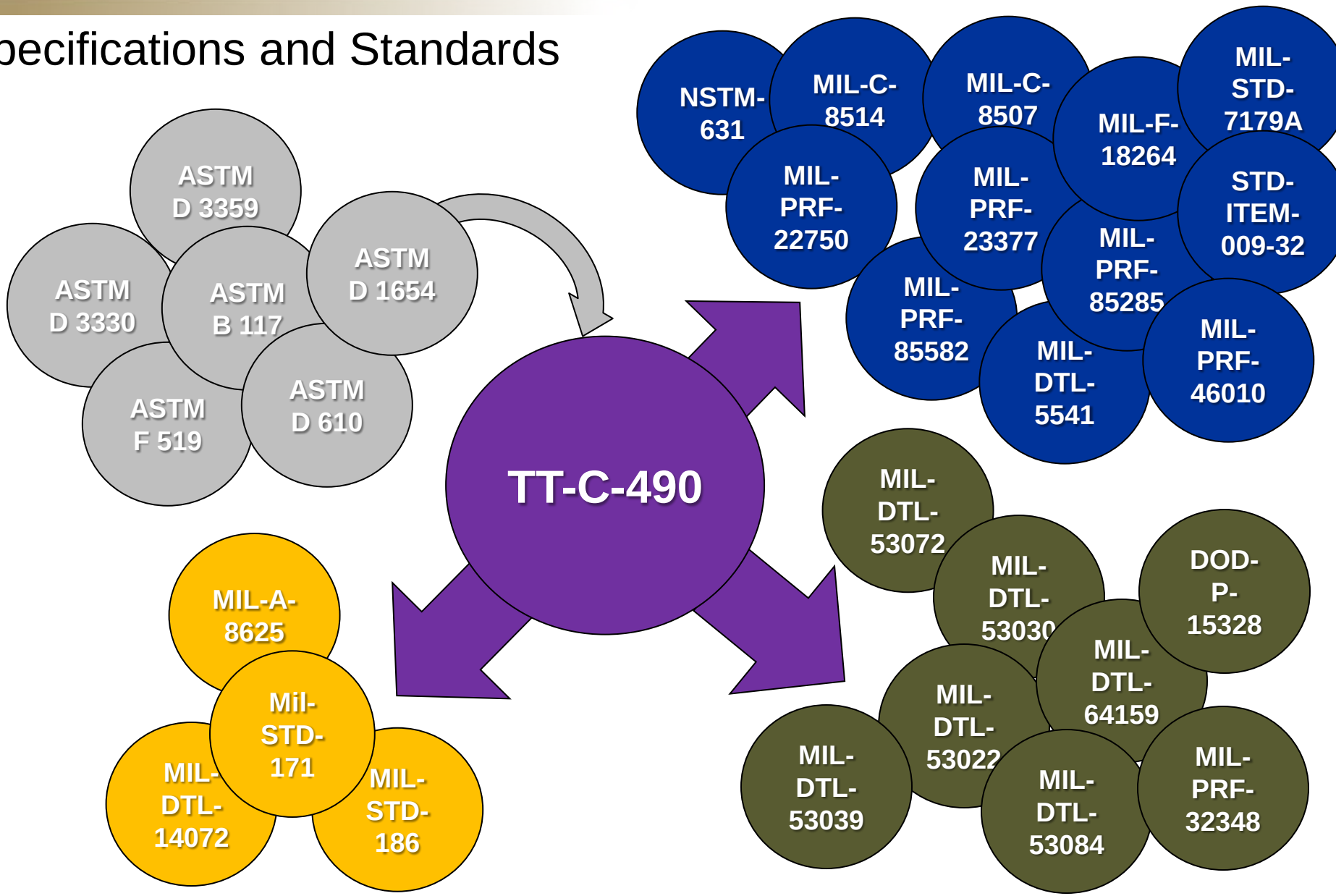
Impact of TT-C-490F

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



Impact of TT-C-490F

Example of Potential Cost Savings

	Zinc Phosphate 125°F (52°C)	Iron Phosphate 125°F (52°C)	Advanced Pretreatment 70°F (21°C)
Chemical Cost	$100	$100	$100
Heating Energy	$100	$100	$70
Electric Energy	$100	$86	$71
Rinsing Water	$100	$100	$40
Waste Disposal	$100	$35	$17
Maintenance	$100	$25	$15
	$600	**$446**	**$313**

Zinc Phosphate Line

Cleaner Technologies


Alternative Line

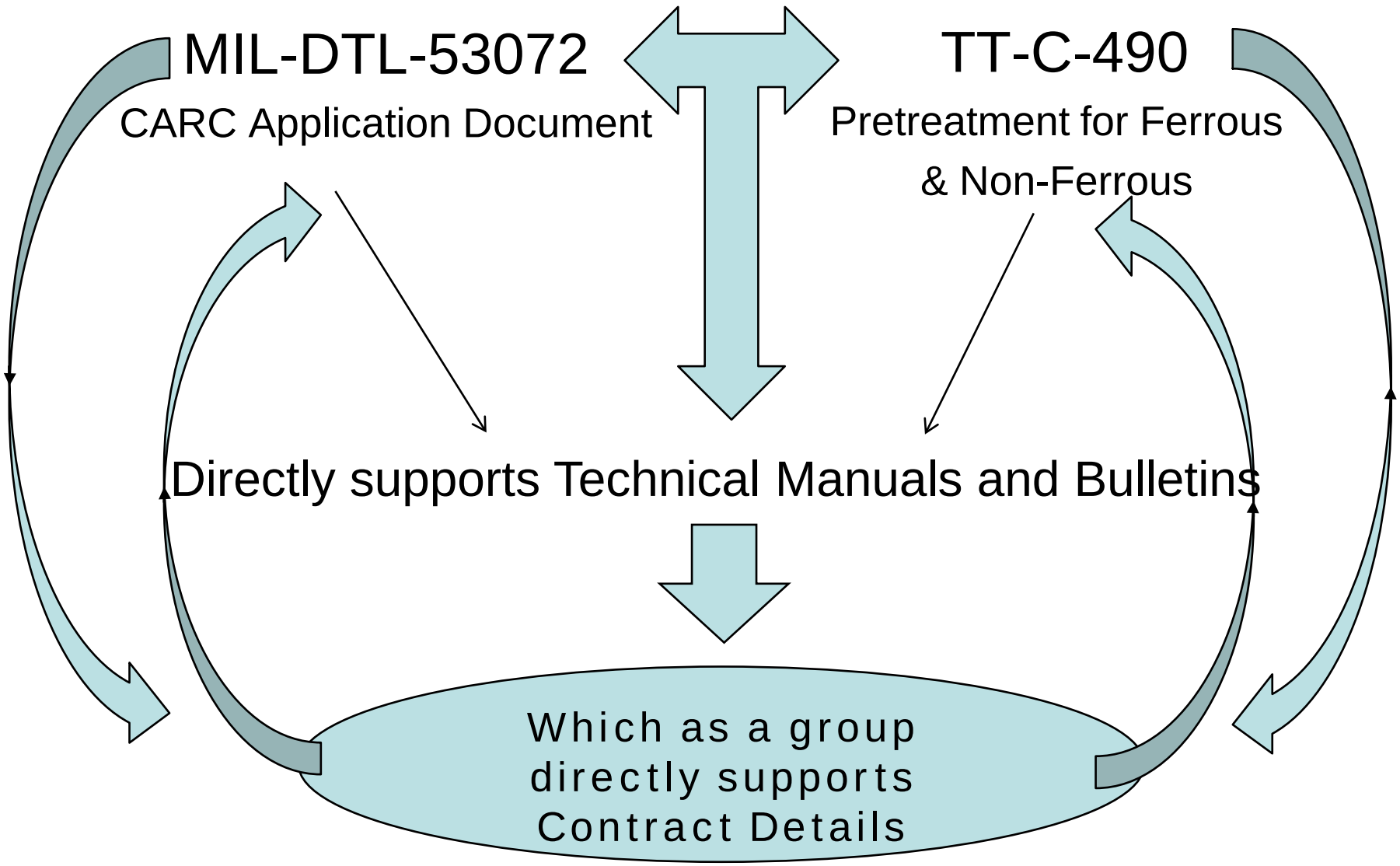
Information provided by Gary Nelson, Chemetall

Impact of TT-C-490F

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



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

Summary of TT-C-490F

- 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*

Current Types in 490F

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

Closing Comments

❖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.

Stakeholders/Contributors

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Questions

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