Demonstration of Bonderite M-NT 7400 at Anniston Army Depot

by Tom Considine, Tom Braswell, and Jack Kelley
NOTICES

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*Weapons and Materials Research Directorate, ARL*
# Demonstration of Bonderite M-NT 7400 at Anniston Army Depot

## Abstract
The US Army Research Laboratory (ARL) was invited to conduct a demonstration to help transition from the recently cancelled high volatile organic compound–containing DOD-P-15328 hexavalent chrome wash primer to a TT-C-490 Type IV–approved chrome-free alternative pretreatment. A technology with a similar application process as the wash primer was selected for the production facility at the Anniston Army Depot (ANAD). This pretreatment was previously demonstrated successfully at Letterkenny Army Depot. The demonstration platform used at ANAD was an abrasive-blasted M992 A2 Field Artillery Ammunition Support Vehicle (FAASV) V hull. Nine staff painters participated in in the application of the alternative material using the high-volume low-pressure spray equipment supplied by ARL. The production painters were trained onsite in the mixing and application of the pretreatment. Many were impressed with the ease of application compared with the wash primer. In addition to the demonstration on the FAASV hull, the ANAD production engineer is considering using it on the paint lines for small parts. The demonstrated product is approved for immersion and spray application in TT-C-490.

## Subject Terms
- demonstration
- Bonderite
- pretreatment
- TT-C-490
- chrome-free

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1. Introduction

US Department of Defense (DOD)-P-15328\(^1\) wash primer contains 1.5 lb of hexavalent chromium pigment and has over 6 lb of volatile organic compounds (VOCs) per admixed gallon of coating. It has been well documented that hexavalent chromium is a risk to human health and the environment. The US Army Research Laboratory (ARL) completed a program (Toxic Metals Reduction [TMR]-12-01)\(^2\) to examine the effectiveness and feasibility of alternative hexavalent chrome-free spray applied pretreatment technologies for multiple metal substrate types to replace DOD-P-15328. The candidate materials were laboratory tested in juxtaposition to the requirements mandated in Federal Specification TT-C-490F\(^3\) and in testing that surpassed the scope of the original TT-C-490. Those pretreatments that met or exceeded the requirements of TT-C-490 were listed on the specifications qualified product database (QPD) as Type III (organic) and Type IV (inorganic) alternatives to wash primer. The QPD allows applicators the option to use these hexavalent-chrome-free alternatives without requiring drawing changes, effectively expediting the implementation of the alternative products. TT-C-490 offers even greater flexibility for implementing the products on the QPD in that it allows for Type III and IV pretreatments to be used interchangeably, replacing hexavalent-chrome-based pretreatments such as the wash primer, chromate conversion coatings, and chromated sealers. Some of these qualified products were successfully demonstrated on military assets at Letterkenny Army Depot (LEAD) and BAE Systems York.

The success of the project and the revision of TT-C-490 with an added QPD facilitated the cancellation of DOD-P-15328 wash primer specification. The specification was officially cancelled on 25 July 2018 with instruction to use Type III and Type IV pretreatments listed on the TT-C-490 QPD (see Appendix). The alternatives that meet performance requirements of TT-C-490 will be listed on the QPD for the specification. The QPD allows applicators the option to use these nonchromate alternatives without requiring drawing changes or Engineering Change Notices, effectively expediting the implementation of the alternative products.

Army Regulation (AR) 750-1\(^4\) states that all Army-based ground equipment is required to have a full Chemical Agent Resistant Coating (CARC) system. The typical CARC system consists of 1) a conversion coating or pretreatment in direct contact with the substrate, followed by 2) an epoxy primer, and then 3) a polyurethane-based topcoat. Until recently, completed assemblies, whole
platforms, and vehicles required the spray-applied wash primer DOD-P-15328 as the pretreatment.

The Anniston Army Depot (ANAD) requested that ARL conduct a demonstration of one of the alternatives listed on the QPD, Bonderite M-NT 7400. This demonstration was conducted on 2 October 2018 in cooperation with Henkel Corporation and the Process Engineering Division at ANAD.

2. Demonstration

The ARL team was asked to assist ANAD paint production in Building 433 in a demonstration to transition from the recently cancelled high-VOC-containing DOD-P-15328 hexavalent chrome wash primer to a TT-C-490 Type IV–approved chrome-free alternative pretreatment. ARL selected an alternative with a similar application process for the production facility at ANAD, Henkel Bonderite M-NT 7400. This pretreatment was successfully demonstrated at LEAD. At ANAD, the Bonderite M-NT 7400 was applied on an abrasive-blasted M992 A2 Field Artillery Ammunition Support Vehicle (FAASV) hull (Fig. 1). Nine painters applied the material using the high-volume low-pressure (HVLP) spray equipment supplied by ARL.

![Fig. 1 Freshly blasted M992 A2 FAASV hull awaiting pretreatment process](image)

The application procedure, shown in Fig. 2, does not significantly differ from the wash primer application. This in itself can contribute to greater buy-in from the applicators on staff, as there is little in the way of retraining to be performed. First, the vehicle has to be prepared for application. This typically includes degreasing and cleaning in a wash bay, followed by abrasive blasting in a blast booth. The FAASV is composed primarily of aluminum, but with several areas made of steel. The surface profile of the aluminum was not measurable using profile tape and a surface profile gauge, and was instead measured using a digital depth micrometer.
and found to be approximately 11 mil. Steel areas were not as aggressively profiled and were measured with both surface profile tape and digital depth micrometer at approximately 2 mil. Following cleaning and abrasive blasting, the vehicles are then cleaned by staff of the blast media spoils still remaining on and inside the hull. The applicators then have a 24-h window in which to apply the pretreatment. The Bonderite M-NT 7400 was supplied as a concentrate, which was mixed with deionized water to yield an 8% solution of the pretreatment.

The Bonderite M-NT 7400 was applied using a pressure pot at 3- to 5-psi fluid pressure and an HVLP spray gun using a 1-mm fluid needle and tip, following an approach similar to the wash primer application. The reason for these modifications is so that the Bonderite M-NT 7400 is sprayed as a light mist coat onto the vehicle hull. The substrate needs only to be wetted for the pretreatment to react with the base metal, so a much lower amount of product was used. This results in savings through material costs compared with the volume of material needed for the wash primer as demonstrated at LEAD. The final step applying the pretreatment was to allow the product to air-dry before applying primer. Outside of extreme weather conditions, the dry time for a vehicle hull ranges from minutes to under an hour. After drying, the primer and topcoats are applied as usual. To further simplify this process, the applicators were provided with two mixing containers of appropriate size to facilitate the exact composition each time. Compared with the procedure for properly mixing wash primer, the procedure for the Bonderite M-NT 7400 was faster and easier because there is little mixing and no induction time, which is typically 15–30 min for wash primer. Another characteristic of Bonderite M-NT 7400 versus the wash primer is that the former has no established pot life limitation. This essentially allows the Bonderite M-NT 7400 to remain in the mixing vessel until used. By contrast, the pot life of the wash primer is relatively short.

Fig. 2  Step-by-step process for pretreating demonstration vehicle with Bonderite M-NT 7400
(4–8 h, depending on the manufacturer) and this leads to quite a bit of waste in time, material, and disposal costs. An example of a wash primed hull is shown in Fig. 3.

Fig. 3 M113 Armored Personnel Carrier pretreated with the DOD-P-15328 wash primer

The spray equipment used in the demonstration was similar to the equipment used daily by the painters to apply the wash primer. Once the painters were used to the subtle differences in the application, they became very comfortable applying the Bonderite M-NT 7400. The M992 A2 FAASV hull was successfully coated using the Bonderite M-NT 7400 and verified by the floor-support quality inspectors. Comments from the painters were positive, and at least two painters said that once they were set up, they could apply the Bonderite M-NT 7400 much faster than the wash primer. The only criticism expressed was that, as with all nonchrome pretreatments, the Bonderite M-NT 7400 provided little color change when applied; however, slight darkening and iridescence (Fig. 4) of the substrate appear adequate to identify treated areas.
Because of the unlimited pot life, the admixed Bonderite M-NT 7400 can be saved for the next production cycle. The painters indicated that much of the admixed wash primer must be disposed of as hazardous waste.

At the request of ANAD, the ARL team expanded the demonstration to Building 463 to for use on the Small Parts Paint Line. As with the M992 A2 FAASV demonstration, the Bonderite M-NT 7400 was applied using a pressure pot at 3- to 5-psi fluid pressure and an HVLP spray gun using a 1-mm fluid needle and tip. The small parts process, used for steel and aluminum, can replace the need for the chrome-sealed zinc phosphate in accordance with TT-C-490 Type I and chromate conversion coatings in accordance with MIL-DTL-5541 Type I and II. Figure 5 shows the process line used in Building 463.

Fig. 4  M992 A2 FAASV hull partially treated with Bonderite M-NT 7400

Fig. 5  Schematic of the pretreatment line used in Building 463
3. Status and Conclusion

Taking a proactive approach in maintaining compliance, ANAD reached out to ARL for assistance in transitioning an approved alternative pretreatment for the cancelled DOD-P-15328 wash primer. ARL coordinated with ANAD and Henkel Corporation to arrange a full-scale demonstration at ANAD. Bonderite M-NT 7400 was selected from the TT-C-490 QPD as the most appropriate alternative.

ARL successfully demonstrated the application of a chrome-free pretreatment, Bonderite M-NT 7400, to replace DOD-P-15328. The goal of the demonstration was to expedite the transition of a TT-C-490 Type IV–approved chrome-free alternative pretreatment to replace the recently cancelled high-VOC-containing DOD-P-15328 hexavalent chrome wash primer. ANAD was provided with new dedicated spray equipment and continued support from competent Henkel technical experts.

At least nine large parts and four small parts production painters were trained onsite in the mixing and application of the pretreatment. Many of the artisans were impressed with the ease of application for the Bonderite M-NT 7400. The quality assurance representatives for the ANAD paint area were also on hand to witness and buy-into the process change in accordance with the requirements of TT-C-490.

In addition to using Bonderite M-NT 7400 as a spray applied replacement for wash primer, ANAD’s production engineer is considering using it in the paint lines for small parts. The Bonderite M-NT 7400 is approved for immersion and spray application in TT-C-490.

4. Anniston Army Depot Points of Contact

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5. References


2. Toxic Metal Reductions (TMR) 12-01. Verification and demonstration for transition of non-hexavalent chromium, low VOC alternative technologies to replace DOD-P-15328 wash primer for multi-metal applications. Washington (DC): Department of the Army (US); 2017 Sep.


Appendix. Notice of Cancellation for Department of Defense (DOD)-P-15328 Primer Wash
NOTICE OF CANCELLATION

DOD-P-15328D
NOTICE 2
25 July 2018
SUPERSEDED
DOD-P-15328D
NOTICE 1
21 March 1992

DETAILED SPECIFICATION

PRIMER (WASH), PRETREATMENT (FORMULA NO. 117 FOR METALS) (METRIC)

DOD-P-15328D, dated 21 Apr 1978, is hereby cancelled. Future acquisitions for this item may refer to:

TT-C-490F “Chemical Conversion Coatings and Pretreatments for Metallic Substrates (Base for Organic Coatings)”. Users are instructed to use the Type III (greater than 50% organic compounds by weight in the dried film) and Type IV (greater than 50% inorganic compounds by weight in the dried film) products listed under QPL-TT-C-490.

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(Copies of these documents are available online at https://assist.dla.mil)

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Army - MR Army - MR
Navy – SH (Project 8010-2018-001)

Review activities:
Army – AV
Navy – AS, SA, YD

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<tbody>
<tr>
<td>ANAD</td>
<td>Anniston Army Depot</td>
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<tr>
<td>ARL</td>
<td>US Army Research Laboratory</td>
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<tr>
<td>CARC</td>
<td>Chemical Agent Resistant Coating</td>
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<tr>
<td>DOD</td>
<td>Department of Defense</td>
</tr>
<tr>
<td>HVLP</td>
<td>high-volume low-pressure</td>
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<tr>
<td>LEAD</td>
<td>Letterkenny Army Depot</td>
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<tr>
<td>QPD</td>
<td>qualified product database</td>
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<tr>
<td>TMR</td>
<td>Toxic Metals Reduction</td>
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<tr>
<td>VOC</td>
<td>volatile organic compound</td>
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