

AD-A256 253



AD

2

TECHNICAL r e p o r t

USA-BRDEC-TR // 2534

DTIC
ELECTE
OCT 14 1992
S C D

Surface Preparation of Stainless Steel Prior to Painting

by

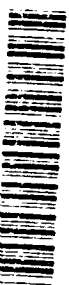
Dario A. Emeric and Christopher E. Miller

Report Date

September 1992

Distribution unlimited; approved for public release.

92-26980



United States Army
Belvoir Research, Development and Engineering Center
Fort Belvoir, Virginia 22060-5606

92 13 10 020

**Destroy this report when it is no longer needed.
Do not return it to the originator.**

**The citation in this report of trade names of
commercially available products does not constitute
official endorsement or approval of the use of such
products.**

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Service, Direction of Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE September 1992	3. REPORT TYPE AND DATES COVERED Final January to September 1992	
4. TITLE AND SUBTITLE Surface Preparation of Stainless Steel Prior to Painting (U)			5. FUNDING NUMBERS	
6. AUTHOR(S) Dario A. Emeric and Christopher E. Miller				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Belvoir Research, Development & Engineering Center Product Assurance & Engineering Directorate Advanced Technology Division, STRBE-TVO Fort Belvoir, VA 22060-5606			8. PERFORMING ORGANIZATION REPORT NUMBER 2534	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES POC: Dario A. Emeric, (703) 704-1985				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Distribution unlimited; approved for public release.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Military specification MIL-T-704, <i>Treatment and painting of materiel</i> , requires the passivation of corrosion-resisting steel surfaces before painting. It also states surfaces to be painted shall be treated with wash primer conforming to DOD-P-15328, <i>Primer (wash) pretreatment (Formula No. 117 for metals), metric</i> , or MIL-C-8514, <i>Coating compound, metal pretreatment, resin-acid</i> . Federal, state and city environmental and/or health regulations may prohibit the use of hexavalent chromium—one of the components of the passivating formulation used for the treatment of corrosion-resisting steels. Many companies are not passivating the corrosion-resisting steels before the application of the wash primer. Based on the above, we started a laboratory investigation to determine if the elimination of the passivating procedure will have an adverse effect on the camouflage paint system. From the information obtained, it is recommended that consideration be given to the elimination of the passivation requirement for stainless steel. It is also recommended that more extensive work be conducted to verify these findings.				
14. SUBJECT TERMS corrosion stainless steel wash primer epoxy primer passivating sandblasting			15. NUMBER OF PAGES 18	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited	

Report Number 2534

Surface Preparation of Stainless Steel Prior to Painting

by
Dario A. Emeric and Christopher E. Miller



US Army Belvoir RD&E Center
Fort Belvoir, Virginia 22060-5606

September 1992

Approved For	
NTIS	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Avail and/or	
Dist	Special
A-1	

Distribution unlimited; approved for public release.

Table of Contents

	Page
Section I	Test Standards and Equipment1
	ASTM Standards1
	FTMS Standards1
	Equipment Used1
Section II	Test Procedures and Observations.....2
	Preparation.....2
	Wet Adhesion Test.....3
	Salt Spray Resistance Test.....4
	Gravelometer Test/Salt Spray Test5
	Outdoor Exposure Test6
Section III	Test Conclusions and Recommendations8
	Conclusions8
	Recommendations8

Preface

Military specification MIL-T-704, *Treatment and painting of materiel*, requires the passivation of corrosion-resisting steel surfaces before painting. It also states surfaces to be painted shall be treated with wash primer conforming to DOD-P-15328, *Primer (wash) pretreatment (Formula No. 117 for metals), metric*, or MIL-C-8514, *Coating compound, metal pretreatment, resin-acid*.

Federal, state and city environmental and/or health regulations may prohibit the use of hexavalent chromium—one of the components of the passivating formulation used for the treatment of corrosion-resisting steels. Many companies are not passivating the corrosion-resisting steels before the application of the wash primer.

Based on the above, we started a laboratory investigation to determine if the elimination of the passivating procedure will have an adverse effect on the camouflage paint system. From the information obtained, we should be able to recommend whether or not to delete the passivating paragraph or procedure from MIL-T-704 and other applicable documents.

Section I

Test Standards and Equipment

This section presents test standards and equipment used for the evaluation of painting stainless steel with and without passivation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS

B117	Standard method of salt spray (fog) testing
D610	Standard method of evaluating degree of rusting of painted steel surfaces
D714	Standard method of evaluating degree of blistering of paints
D1654	Standard method for evaluation of painted or coated specimens subjected to corrosive environments
D3170	Standard test method for chip resistance of coatings
D3359	Standard method for measuring adhesion by tape test

FEDERAL TEST METHOD STANDARD (FTMS)

141, Method	
6301.2	Adhesion (wet) tape test

EQUIPMENT USED

Binks Spray Gun, Model 2001, Binks Manufacturing Company
Coatings Scribe, Model 13-378, Fisher Scientific
Cold Temperature Chamber (cold box), Model #TM-35, B-M-A Inc.
Gravelometer, Model #QGR, Q-Panel Company
Harshaw Salt Fog Cabinet, Model #22, Harshaw Chemical Company
High strength, pressure-sensitive tape
Roller, 2 kg, 4 1/2 in long, rubber-coated

Section II

Test Procedures and Observations

All stainless steel samples were cleaned with a 0.1% solution of Triton X-100 and vapor degreased to assure a water-break free surface. Nine of the cleaned, degreased samples were sandblasted to obtain a 2 to 4 mil profile. Samples A through D were wash primed (DOD-P-15328) to a thickness of 0.3 mil and primed (MIL-P-53022) to a thickness of 1.0 mil.

PREPARATION

The sample preparation listed below was followed using three panels per test procedure:

1. Clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).
2. Clean, sandblast, clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).
3. Clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).
4. Clean, sandblast, clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).
5. Clean, sandblast, clean, and prime (MIL-P-53022).
6. Clean and prime (MIL-P-53022).

WET ADHESION TEST

Wet adhesion testing was performed according to Federal Test Method Standard (FTMS) 141, Method 6301.2, *Adhesion (wet) tape test*. Panels were immersed in deionized water for 24 hours. Once removed, a diamond grid pattern consisting of four intersecting lines was scribed through the paint film in two areas on each panel. Adhesive tape was then applied using a 2-kilometer roller. Once in place for 90 seconds, it was removed using a smooth, uniform motion. (NOTE: No further testing was done of samples that failed the wet adhesion test.)

After the panels were immersed in distilled water for 24 hours according to FTMS 141, Method 6301.2, they were evaluated according to ASTM D3359, *Standard method for measuring adhesion by tape test*. Results are shown below in Table 1. All the samples passed the wet adhesion test.

Table 1. Wet Adhesion Results

Panel No.	ASTM D3359 Rating	Panel No.	ASTM D3359 Rating
1A	5A	1D	5A
2A	5A	2D	5A
3A	5A	3D	5A
1B	5A	1E	5A
2B	5A	2E	5A
3B	5A	3E	5A
1C	5A	1F	0A
2C	5A	2F	0A
3C	5A	3F	0A

Key:

A - Clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).

B - Clean, sandblast, clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).

C - Clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).

D - Clean, sandblast, clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).

E - Clean, sandblast, clean, and prime (MIL-P-53022).

F - Clean and prime (MIL-P-53022).

SALT SPRAY RESISTANCE TEST

Salt spray testing was performed in accordance with ASTM B117, *Standard method of salt spray (fog) testing*. The bottoms of the panels were scribed with a diamond grid pattern consisting of four intersecting lines. Next, the panels were placed in the Harshaw salt fog cabinet for 2,000 hours. After exposure, the unscribed region of the panels was evaluated according to ASTM D610, *Standard method of evaluating degree of rusting of painted steel surfaces*, while the scribed regions were evaluated according to ASTM D1654, *Standard method for evaluation of painted or coated specimens subjected to corrosive environments*. Table 2 presents results.

Table 2. Salt Spray Results (2,000 hours)

(Note: These samples went through the Wet Adhesion Test before the Salt Spray Exposure Test.)

Panel No.	ASTM D610 Rating	ASTM D1654 Rating	Panel No.	ASTM D610 Rating	ASTM D1654 Rating
1A	10	10	1C	10	10
2A	10	10	2C	10	10
3A	10	10	3C	10	10
1B	10	10	1D	10	10
2B	10	10	2D	10	10
3B	10	10	3D	10	10
			6E	10	10

Key:

A - Clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).

B - Clean, sandblast, clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).

C - Clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).

D - Clean, sandblast, clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).

E - Clean, sandblast, clean, and prime (MIL-P-53022).

F - Clean and prime (MIL-P-53022).

GRAVELOMETER TEST/SALT SPRAY TEST

Impact by the gravelometer was performed according to ASTM D3170, *Standard test method for chip resistance of coatings*. After the panels were painted and cured, they were placed in the cold temperature chamber and cooled to -30°F for 2 hours before testing. The temperature was 10°F colder than the test temperature of -20°F. As specified in ASTM D3170, the 10-second warm-up period accounted for the time it took to remove a panel from the cold box and begin the gravelometer test. The upper half of the panels was impinged with 1 pint of gravel (between 3/8 and 5/8 inch in size) projected at a pressure of 70 ±3 pounds per square inch (psi). The impinged samples were placed in the salt spray cabinet for 336 hours. Tables 3 and 4 present results.

Table 3. Gravelometer Results

(Note: Two readings (upper and lower half) were made on the panel. From the corrosion viewpoint, 9B is superior to 6A.)

Panel No.	ASTM D3170 Rating	Panel No.	ASTM D3170 Rating
4A	6A & 8B	4C	6A & 9B
5A	6A & 9B	5C	6A & 9B
4B	6A & 8B	4D	6A & 9B
5B	6A & 9B	5D	6A & 9B
		6E	6A & 9B

Key:

A - Clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).

B - Clean, sandblast, clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).

C - Clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).

D - Clean, sandblast, clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).

E - Clean, sandblast, clean, and prime (MIL-P-53022).

F - Clean and prime (MIL-P-53022).

Table 4. Salt Spray Results (336 Hours)

(Note: These samples went through the Gravelometer Test before the Salt Spray Exposure Test.)

Panel No.	ASTM D610 Rating	ASTM D1654 Rating	Panel No.	ASTM D610 Rating	ASTM D1654 Rating
4A	10	10	4C	10	10
5A	10	10	5C	10	10
4B	10	10	4D	10	10
4B	10	10	4D	10	10
			6E	10	10

Key:

A - Clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).

B - Clean, sandblast, clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).

C - Clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).

D - Clean, sandblast, clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).

E - Clean, sandblast, clean, and prime (MIL-P-53022).

F - Clean and prime (MIL-P-53022).

OUTDOOR EXPOSURE TEST

The outdoor exposure took place behind our laboratory at Fort Belvoir, VA. Prior to exposure, the panels were top-coated (MIL-C-53039), and they were allowed to cure for 7 days. They were scribed using a diamond grid pattern consisting of four intersecting lines through the paint film on the bottom half of each panel. The scribed panels were placed on a rack at a 30° angle from the horizontal, facing south, for six months. Results are given in Table 5.

Table 5. Outdoor Test Results

(Note: These samples were sprayed weekly with a 5% salt spray solution.)

Panel No.	ASTM D610 Rating	ASTM D1654 Rating	Panel No.	ASTM D610 Rating	ASTM D1654 Rating
6A	10	10	6C	10	10
7A	10	10	7C	10	10
8A	10	10	8C	10	10
6B	10	10	6D	10	10
7B	10	10	7D	10	10
8B	10	10	2D	10	10
			6E	10	10

Key:

A - Clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).

B - Clean, sandblast, clean, wash prime (DOD-P-15328), and prime (MIL-P-53022).

C - Clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).

D - Clean, sandblast, clean, passivate (QQ-P-35), wash prime (DOD-P-15328), and prime (MIL-P-53022).

E - Clean, sandblast, clean, and prime (MIL-P-53022).

F - Clean and prime (MIL-P-53022).

Section III

Test Conclusions and Recommendations

CONCLUSIONS

This work evaluated the effect of passivation and/or sandblasting before painting stainless steel as required by MIL-T-704. According to the test results, if a conversion coating (wash primer) is used, there may not be a need for sandblasting or for passivation of the surface to have adhesion of the coating to the substrate.

RECOMMENDATIONS

Based on these preliminary test results and environmental requirements, it is recommended that consideration be given to the elimination of the passivation requirement for stainless steel. It is also recommended that more extensive work be conducted to verify these findings.

Distribution for Report #2534

DEPARTMENT OF DEFENSE

1 Director, Technical Information
Defense Advanced Research
Projects Agency
1400 Wilson Blvd
Arlington, VA 22209

Director
Defense Nuclear Agency
1 ATTN: TITL
Washington, DC 20305

Defense Technical Information Center
Cameron Station
2 ATTN: DTIC-FDAC
Alexandria, VA 22304-6145

DEPARTMENT OF THE ARMY

Commander
Chemical Research R&D Center
1 ATTN: SMCCR-SPS (Tech Library)
Aberdeen Proving Ground, MD 21005

Commander
US Army Aberdeen Proving Ground
1 ATTN: STEAP-MT-U (GE Branch)
Aberdeen Proving Ground, MD 21005

Director
US Army Materiel Systems Analysis
Agency
1 ATTN: AMXSY-MP
Aberdeen Proving Ground, MD 21005-5071

Commander and Director
USAE Waterways Experiment Station
1 ATTN: Chief, Library Branch
1 ATTN: CEWES-IM-MI-R
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Commander
US Army Armament Research & Development
Command
1 ATTN: SMCAR-TSS
Dover, NJ 07801-5001

Commander
US Army Tank Automotive Command
1 ATTN: AMSTA-TSL
Warren, MI 48090-5000

Commander
Rock Island Arsenal
1 ATTN: SARRI-LPL
Rock Island, IL 61299-7300

Commander
US Army AMCCOM
1 ATTN: Joseph Menke
1032 N. Thornwood
Davenport, IA 52804

1 Commander
HQ, 39th Engineer Bn (Combat)
Fort Devens, MA 01433

US Army Airborne, Communications, and
Electronics
1 ATTN: STEBF-ABTD
Fort Bragg, NC 28307

US Army Armor and Engineer Board
1 ATTN: ATZK-AE-PD-E
Fort Knox, KY 40121

US Army FESA
1 ATTN: FESA-TS
Fort Belvoir, VA 22060

Director
Tobyhanna Army Depot
1 ATTN: STSTO-TPP
Tobyhanna, PA 18466-5097

HQ, USAEUR & Seventh Army
Deputy Chief of Staff, Engineer
1 ATTN: AEAEN-MT-P
APO New York 09403

Director
US Army TRADOC
Systems Analysis Activity
1 ATTN: ATAA-SL (Tech Library)
White Sands Missile Range, NM 88002

Commander
US Army Engineer School & Center
Canadian Liaison Office
1 ATTN: ATSE-DAC-LC (Major S. Allan)
Fort Leonard Wood, MO 65473

Commander
Corpus Christi Army Depot
1 ATTN: AMSAV-MRAA (A. Gonzales)
Corpus Christi, TX 78419

1 Commander
US Army Aviation Systems Command
ATTN: AMSAV-EFM (P. Haselbauer)
4300 Goodfellow Blvd
St. Louis, MO 63120-1798

1 Commander
US Army Corps of Engineers
Construction Engineering Research Lab
ATTN: USA-SERL-EM (A. Beitelman)
P. O. Box 9005
Champaign, IL 61826

1 Commander
Riverbank Army Ammunition Plant
ATTN: J. Gansel
Riverbank, CA 95367-0670

1 Commander
Rock Island Arsenal
ATTN: SMCRI-SEM (A. M. Dupont Jr.)
1 ATTN: SMCAR-IL (Technical Library)
Rock Island, IL 61299-0670

1 Commander
US Army Armament, Munitions & Chemical
Command
ATTN: AMSCMC-PCG-M (J. Kaddatz)
1 ATTN: SMCAR-ESM-H (J. Menke)
Rock Island, IL 61299-6000

1 Director
US Army Material Technology Lab
ATTN: SLCMT-EMM (M. Ley)
1 ATTN: SLCMT-MEE (K. Bamberg)
Watertown, MA 02172-0001

1 Commander
US Army Tank-Automotive Command
ATTN: AMSTA-THF (C. Hansey)
Warren, MI 48397-5000

1 Commander
US Army Armament, Munitions & Chemical
Command
Armament RDE Center
Benet Weapons Laboratory
ATTN: SMCAR-CCB-TL
Watervliet, NY 12189-5000

2 Headquarters
US Army Materiel Command
ATTN: AMCDE-XE (C. Didlandomenico)
2 ATTN: AMCDE-XE (J. Hurd)
5001 Eisenhower Avenue
Alexandria, VA 22333-0001

1 Commander
US Army Production Base Modernization
Activity
ATTN: AMSMC-PBC (R. Scola)
3 ATTN: AMSMC-PBC-A (M. Wrazen)
1 ATTN: AMSMC-PBC-A (G. Kostek)
Picatinny Arsenal, NJ 07806-5000

1 Commander
Scranton Army Ammunition Plant
ATTN: SMCSC-CA (A. Pisano)
136 Cedar Avenue
Scranton, PA 18505

1 Commandant
US Army Engineer School
ATTN: Library
Ft. Leonard Wood, MO 65473

BELVOIR RD&E CENTER

Circulate

1 Commander, SATBE-Z
Technical Director, SATBE-ZT
Assoc Tech Dir (E&A), SATBE-ZTE
Assoc Tech Dir (R&D), SATBE-ZTR
Opns Sergeant, SATBE-ZM
1 Advanced Systems Concepts Dir, SATBE-H
Product Assurance & Engr Dir, SATBE-T
Combat Engineering Dir, SATBE-J
Logistics Equipment Dir, SATBE-F
1 SATBE-TV
20 SATBE-TVO
2 Tech Report Office, ASQNK-BRS-G
1 Security Ofc, SATBE-WS
2 Tech Library, SATBE-BT
1 Public Affairs Office, SATBE-I
1 Ofc of Chief Counsel, SATBE-L

DEPARTMENT OF THE NAVY

Director
Office of Naval Research
1 Physics Program (421)
1 Earth Physics Program (464)
Arlington, VA 22217

Commander
US Naval Facilities Engineering Command
1 ATTN: Code 032-B
1 ATTN: Code 062
200 Stovall Street
Alexandria, VA 22332

1 US Naval Oceanographic Office
Navy Library/NSTL Station
Bay St. Louis, MO 39522

1 Naval Construction Battalion Center
Civil Engineering Lab
ATTN: Code L08A (Library)
Port Hueneme, CA 93043

1 US Naval Training Equipment Center
ATTN: Tech Library
Orlando, FL 32813

1 US Naval Sea Systems Command
ATTN: PMS377J1 (P. Schneider)
Washington, DC 20362-5101

1 US Naval Air Development Center
ATTN: Code 6062 (V. S. Agarwala)
Warminster, PA 18974

3 David W. Taylor Naval Research Center
ATTN: Code 2813 (A. G. S. Morton)
Annapolis, MD 21402

DEPARTMENT OF THE AIR FORCE

1 Commander
HQ USAF/RDPT
Washington, DC 20330

1 Chief, Utilities Branch
HQ USAF/PREEU
Washington, DC 20330

1 HQ, USAF Engineering & Services Center
ATTN: FL7050 (Tech Library)
Tyndall AFB, FL 32403

1 USAF Warner-Robins Air Logistics Center
ATTN: WR-ALC/MMEM
Warner-Robins AFB, GA 31098

1 Fuels and Lubrications Division
Chief, Lubrications Branch
ATTN: AFWAL/POSL
Wright-Patterson AFB, OH 45433

OTHERS

1 Oakite Products, Inc.
ATTN: R. Ascenzo
50 Valley Road
Berkely Heights, NJ 07922

1 Parker-Amchem
ATTN: P. King
32100 Stephenson Highway
Madison Heights, MI 48071

1 Ocean City Research Corp.
ATTN: G. Gehring
Tennessee Avenue & Beach Thorofare
Ocean City, NJ 08226

1 ARINC Research Corp.
ATTN: G. Evana
Two Crystal Park, Suite 101
Arlington, VA 22202

1 NI Industries
Riverbank Army Ammunition Plant
ATTN: S. Luquire
5300 Claus Road
P.O. Box 856
Riverbank, CA 95367-0856

5 Chamberlain Manufacturing Corp.
Scranton Division
ATTN: C. MacCrindle
136 Cedar Avenue
Scranton, PA 18505