

## MISSILE COMMAND SPECIFICATION

### PAINTING PROCESS AND INSPECTION REQUIREMENTS FOR MISSILE AND GROUND SUPPORT EQUIPMENT

#### 1. SCOPE

1.1 This specification establishes the requirements for painting the interior and exterior of PATRIOT Missile and ground support equipment with chemical agent resistant coatings (CARC).

1.2 Classification. The top coat finishes shall be of the following types, conditions and grades (see 3.1 and 6.4).

<u>Type</u>	<u>Color</u>	<u>Color Number</u>	<u>Spec</u>
I	383 Green	34094	MIL-C-46168, Type II, IV or MIL-C-53039
II	White	27875	MIL-PRF-22750
III	Green	24410	MIL-PRF-22750
IV	Black	27038	MIL-PRF-22750
V	Gray	26152	MIL-PRF-22750
VI	Gray	26492	MIL-PRF-22750
VII	Gray	26231	MIL-PRF-22750
VIII	Black	37030	MIL-C-46168, Type II, IV or MIL-C-53039
IX	383 Brown	30051	MIL-C-46168, Type II, IV or MIL-C-53039
X	Tan	30372	MIS-37280 or MIS-46150
XI	Sand	33531	MIS-37280 or MIS-46150
XII	Tan	33446	MIL-C-46168 Type II, IV, or MIL-C-53039

Condition A - Smooth surface finish

Condition B - Medium surface finish

Grades 1,1a,1b - For aluminum surfaces or plated surfaces  
with supplementary chromate treatment

Grades 2,2a - For ferrous surfaces

Grades 3,3a - For plated surfaces without supplementary chromate treatment,  
stainless steel, and copper alloys

Grades 4,4a - For anodized surfaces

## 2. APPLICABLE DOCUMENT

2.1 The following documents, of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

### SPECIFICATIONS

#### Federal

TT-C-490                      Cleaning And Pretreatment of Ferrous Surfaces for Organic Coatings

#### Military

MIL-C-5541                    Chemical Films for Aluminum and Aluminum Alloys

DOD-P-15328                Primer (Wash), Pretreatment (Formula No. 117 for Metals)

MIL-PRF-22750              Coating, Epoxy - Polyamide

MIL-PRF-23377              Primer Coatings: Epoxy - Polyamide, Chemical and Solvent Resistant

MIL-C-46168                Coating, Aliphatic Polyurethane, Chemical Agent Resistant

MIL-P-53022                Primer, Epoxy Coating, Corrosion Inhibiting, Lead and Chromate Free

MIL-P-53030                Primer Coating, Epoxy, Water Reducible, Lead and Chromate Free

A-A-59166                    Coating Compound, Nonslip (for Walkways)

2.1 continued

MIL-C-53039	Coating Aliphatic Polyurethane, Single Component, Chemical Agent Resistant
MIL-T-81772	Thinner, Aircraft Coating
<u>Army</u>	
MIS-37271	Ink, Marking, Epoxy Base
MIS-37280	Coating, Aliphatic, Polyurethane Chemical Agent Resistant. Color Tan, Sand
MIS-41253	Primer, Coating, Red Epoxy
MIS-46150	Coating, Aliphatic, Polyurethane, Single Component Chemical Agent Resistant

STANDARDS

Federal

FED-STD-141	Paint, Varnish, Lacquer and Related Materials, Methods of Inspection, Sampling and Testing
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Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
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(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials

ASTM-D-3330M	Peel Adhesion of Pressure-Sensitive Tape at 180 Degree (deg) Angle (Metric)
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(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

2.2 continued

Technical Bulletin Medical (TB Med)

Technical Guide                      Guidelines for Controlling Health Hazards in Painting  
No. 144                                      Operations, U.S. Army Environmental Hygiene Agency,  
    Aberdeen Proving Ground, MD

3. GENERAL REQUIREMENTS

3.1 Finish requirements. The following pretreatments, primers and top coats shall be applied in accordance with (IAW) the applicable grade and condition.

3.1.1 Grades.

Grade 1.                      Apply chromate, MIL-C-5541, Class 1A or 3.  
    Apply epoxy primer, spec MIL-PRF-23377 or MIL-P-53022, plus top coat  
    MIL-C-46168, MIL-C-53039, MIL-PRF-22750, MIS-37280 or MIS-46150  
    (IAW specified type, see 1.2).

NOTE:                      When removal of chromate film is permitted by the procuring agency, apply  
    pretreatment primer, spec DOD-P-15328, plus epoxy primer, spec  
    MIL-PRF-23377 or MIL-P-53022, plus top coat MIL-C-46168,  
    MIL-C-53039, MIL-PRF-22750, MIS-37280, or MIS-46150 (IAW specified  
    type, see 1.2).

Grade 1a.                      Discontinued: Use Grade 1.

Grade 1b.                      Discontinued: Use Grade 1.

Grade 2.                      Apply zinc or iron phosphate, TT-C-490, Method I, Type I or II, or as an  
    alternate use Wash Primer, DOD-P-15328 IAW TT-C-490, Method I,  
    Type III. Apply epoxy primer, MIL-P-53022, plus top coat MIL-C-46168,  
    MIL-C-53039, MIL-PRF-22750, MIS-37280, or MIS-46150 (IAW specified  
    type, see 1.2).

NOTE:                      Zinc or iron phosphate are the preferred finishes. Wash primer is an  
    acceptable alternate when circumstances such as size, shape and availability  
    of phosphate facilities apply. Method I of TT-C-490 shall consist of grit  
    blasting to a minimum condition of SP-10 in accordance with SSPC-VISI-89,  
    "Visual Standard for Abrasive Blast Cleaned Steel". In special cases, with  
    engineering approval, an SP-6 finish is acceptable.

Grade 2a.                      Discontinued: Use Grade 2.

NOTE:                      (For grades 1 or 2) - If the chromate or phosphate pretreatment has been  
    applied on a sub-assembly, it shall not be reapplied to the higher assembly  
    even though it is specified in the appropriate grade.

3.1.1 continued

Grade 3. Apply pretreatment primer spec DOD-P-15328 plus epoxy primer spec MIL-P-53022 plus top coat MIL-C-46168, MIL-C-53039, MIL-PRF-22750, MIS-37280 or MIS-46150 (IAW specified type, see 1.2).

NOTE: Plated surfaces which do not receive a supplementary chromate treatment shall be mechanically abraded or grit blasted prior to application of wash primer per DOD-P-15328.

Grade 3a. Discontinued: Use Grade 3.

Grade 4. Apply epoxy primer, spec MIL-PRF-23377 or MIL-P-53022 plus top coat MIL-C-46168, MIL-C-53039, MIL-PRF-22750, MIS-37280 or MIS-46150 (IAW specified type, see 1.2).

Grade 4a. Discontinued: Use Grade 4.

3.1.2 Condition.

Condition A. Shall be applicable to painting control panels or other surfaces as

Condition B. Shall be applicable to general painting of equipment.

3.2 Materials. All materials used shall conform to the requirements of the applicable specifications and shall be procured only from those sources approved by the procuring activity. Materials may be subject at any time to such tests of the pertinent specifications as the procuring activity shall prescribe to determine compliance with the applicable specification. Each lot of MIL-C-46168, MIL-C-53039, MIS-37280 and MIS-46150 shall be validated for color and spectral reflectance characteristics (see 3.8.1).

3.3 General painting requirements Painting shall be done in clean, dry, well-ventilated spaces. It is preferred that the air temperature be between 16 and 32 deg centigrade (C) [60 and 90 deg Fahrenheit (F)] and the relative humidity not over 65 percent. Painting should not be done when the temperature is below 10 deg C (50 deg F) or when the humidity is above 85 percent. Materials shall be thoroughly mixed and there shall be no settling or separation of ingredients during painting.

3.4 Health and environmental considerations. The primers, top coats and thinners used in the CARC system allow and in some cases require the use of solvents and other components that may present a health or environmental hazard. These materials can be used safely provided satisfactory protective clothing and ventilation is provided. General guidelines for the safe use of these materials are included in Medical Technical Guide No. 144; however, it is recommended that a bio-environmental engineer should be consulted to assure that all operations are adequately controlled.

3.5 Previously painted surfaces. Prior to the application of CARC to equipment previously painted, the surfaces shall be thoroughly scuff sanded and cleaned if the existing paint finish is in poor condition. If the paint finish appears to be in good condition, i.e., those units whose painted surface is not physically damaged, only cleaning is required. Steam cleaning may be used prior to CARC painting. If solvent is used, it shall be oil free. All loose paint shall be removed. When it is necessary to remove the old paint, it may be done with solvent-type paint remover, or by abrasive blasting, or other mechanical means. Care shall be used to remove residual paint remover from crevices and pockets. Abrasive blasting shall be used only where contamination from the process will not harm the surface being cleaned or any adjacent parts. Regardless of the method, no harmful residue shall be left on the surface. Where bare metal is showing, the appropriate primer shall be applied.

3.6 Surface cleanliness. Before any painting, all surfaces shall be free from soils and corrosion, and all other contaminants that might interfere with the intimate application of the finish. For example, grease, oil, solder flux, welding flux, weld spatter, sand, rust and scale. Cleaning shall be done immediately before the finishing operation, or suitable precautions shall be taken to ensure that the surface remain clean until they are to be finished.

3.7 Painting schedule. The first coat of the paint system shall be applied as promptly as possible (preferably within 24 hours) after the surface has been prepared for painting. This requirement shall apply particularly to metal parts that have received a surface treatment. Each coat of paint shall be dry to the touch before the application of a succeeding coat and shall be suitably protected during handling and storage between coats. Wash primer, DOD-P-15328 and epoxy coatings MIL-P-53022 and MIL-PRF-23377 shall be allowed to dry for one hour minimum before top coating.

NOTE: Cure schedule shall be consistent with the paint manufacturer's recommended practice. High solids formulations generally require additional cure time in comparison to conventional paint formulations.

3.7.1 Primer drying. MIL-PRF-23377, MIL-P-53022 and MIL-P-53030 primer which has air dried for more than 24 hours or which has been baked shall be lightly sanded and a mist coat of the primer applied prior to top coating.

3.7.2 Film thickness. The thickness of the dry paint film shall be as specified in Table I. It is essential that MIL-C-46168, MIL-C-53039, MIS-37280 and MIS-46150 be applied at a minimum dry film thickness of 1.8 mils to achieve color uniformity and optimum camouflage characteristics. Because of the higher degree of transparency of this paint in both the visual and infrared regions of the spectrum, an application of 0.8-1.2 mils dry, which is the normal application for enamels, would allow both the visual and infrared light to partially penetrate the surface and reflect the substrate or base coating. This would cause both nonuniformity in visual color and poor camouflage properties.

3.8 Appearance. The paint systems shall have uniform and satisfactory hiding power, color, gloss and smoothness as specified in Table II.

3.8.1 Due to the extreme flatness of the CARC paint, Spec MIL-C-46168, MIL-C-53039, MIS-37280 and MIS-46150 the color will vary to a degree, depending upon the texture and type of substrate, plus the orientation of the film and the direction by which the light hits the film.

Acceptance of an end item shall not be based specifically on color with the exception of types X and XI, it shall be based on whether the paint was approved by the USA Mobility Equipment Research and Development Command, ATTN: DRXFB-VO, Fort Belvoir, VA 22060, and whether application techniques are correct. As specified above, the paint must be applied at least 1.8 mils dry film thickness. A dust coat should be applied first before the subsequent coating(s) is applied. Allow a 15 minute minimum dry time for solvent flash-off before the second application.

3.8.2 Since this paint is extremely flat, it will tend to mar and scratch when handled. As long as the marring and scratching does not break through to the primer or undercoat, it should not be cause for rejection.

NOTE: This marring and scratching will not affect the camouflage properties when observed by photographic means.

3.8.3 Body filler IAW Specifications TT-F-322 or A-A-3133 may be applied sparingly to conceal minor surface imperfections on items specifying Condition A finish.

TABLE I - FILM THICKNESS

Specification	Total Thickness of Dry Film (Mils)
Pretreatment Coating:	
DOD-P-15328	0.4 - 0.6
Primer:	
MIL-PRF-23377	1.0 - 2.4
MIS-41253	1.0 - 2.4
MIL-P-53022	1.0 - 2.4
MIL-P-53030	1.0 - 2.4
Top Coat:	
MIL-C-46168	1.8 - 2.4
MIL-C-53039	1.8 - 2.4
MIL-PRF-22750	1.5 - 2.4
MIS-37280	1.8 - 2.4
MIS-46150	1.8 - 2.4

TABLE II - APPEARANCE, PAINTED SURFACES  
UNACCEPTABLE (X) SURFACE CONDITIONS  
(SEE 6.2)

Surface Condition	Cond. A	Cond. B
	Front Panels or others as indicated on drawing	All other surfaces
Surface Smoothness	Smooth	Medium
Seediness or Roughness	X	X
Bumps	X	
Specks	X	
Orange Peel	X	X
Scratches and Gouges	X	X
Scuff Marks (see note 1)	X	
Sags and Runs	X	X
Pin Holes	X	X
Discoloration	X	X
Seams and Gaps	X	X
Indentations	X	X
Cavities	X	X
Blisters	X	X
Notes:		
1. Not applicable to CARC, MIL-C-46168, MIL-C-53039, MIS-37280 or MIS-46150. This paint is flat and will tend to mar and scratch to a slight degree when handled (see 3.8.2). Control panels painted with CARC, when required, should be handled with care.		
Surface Smoothness - The comparative degrees of surface smoothness shall be defined as follows:		
Smooth (Condition A) - Smooth to touch in all directions when using fingertips.		
Medium (Condition B) - visually smooth without touching.		

3.9 Unassembled parts. When circumstances make it desirable, primers and intermediate coats may be applied to unassembled parts of an assembly, the final coat being applied after assembly. Prior to application of final coat, all damage to previously applied paint shall be repaired and all soils deposited on the surface during the assembly shall be removed with a cleaner which will not damage the primer or leave an oil deposit. The previously painted surface shall be lightly scuffed sanded prior to application of the final coating (see 3.7.1).

3.10 Paint adhesion (tape test). When tested for paint adhesion by the wet or dry tape method, the parts shall show no removal of paint between the layers of the coating or removal of the entire coating from the base material or underlying phosphate, chromate, organic pretreatment or primer by any of the following conditions:

- a. Any area exceeding 1/8 inch average diameter.
- b. More than one area exceeding 1/16 inch average diameter.
- c. More than five areas less than 1/16 inch diameter.

3.11 Paint adhesion (knife test). When tested for paint adhesion by the knife method, the paint shall adhere tightly to the metal and primed surface. It shall furrow off with the knife and shall not flake, chip or powder. The knife cut shall show bevelled edges.

3.12 Rework of end items. End items (radar set, ECS/ICC, launcher station, missile round) with a condition B finish may require rework of the paint system due to damage that occurs during the normal assembly phase. If the damaged area does not exceed 10 percent of surface area, it may be reworked by lightly abrading the damaged and surrounding areas; being careful not to further damage the primer or chemical coatings and reapplying the coatings specified by the applicable grade of Section 3.1.1. The requirements of Section 3.7, 3.8, 3.10 and 3.11 shall be not applicable to the reworked areas. The reworked area of an interior finish may also be overcoated with a clear coat conforming to MIL-PRF-22750 in order to restore uniform gloss requirements.

3.13 Thinning solvents. The solvents used for thinning shall conform to the coating and primer specification requirements.

3.14 Marking. Parts and assemblies shall be marked using the same media as the paint top coat or epoxy ink IAW MIS-37271. In order to maintain optimum camouflage characteristics externally visible surfaces will be marked IAW Table III except for CAUTION/ WARNING data that requires marking with colors other than green and black. The product documentation shall specify the detail marking requirements.

TABLE III - EXTERIOR MARKING COLORS

Paint Top Coat MIL-C-46168, MIL-C-53039, MIS-37280 or MIS-46150	Marking Media MIL-C-46168 or MIL-C-53039
BLACK, 37030 383 GREEN, 34094 383 BROWN, 30051 SAND, 33531 TAN, 30372 TAN, 33446	383 GREEN, 34091 BLACE, 37030 BLACK, 37030 BLACK, 37030 BLACK, 37030 BLACK, 37030

3.15 Walkway coating. CARC compatible polyurethane walkway coating IAW A-A-59166, Type II is specified for those surfaces that are walked upon and maximum non-slip properties for personnel safety is a major factor. The thickness of the coating shall not be specified. For maximum corrosion protection, the walkway coating should be applied after the coatings specified in 3.1 are applied. Exterior surfaces that are finished with CARC IAW MIL-C-46168, MIL-C-53039, MIS-37280 or MIS-46150 shall have a minimum of 1.8 mils of the specified top coat applied over the walkway coating. The product documentation shall specify the detail requirements.

#### 4. QUALITY ASSURANCE

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the procuring activity. The procuring activity reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification or tests. The testing and inspection of the paint finish shall be classified as follows:

4.2.1 First article inspection. First article inspection are those tests which are performed on the finish for conformance to all the requirements of this specification, and shall be performed on the first item submitted for inspection. First article inspection on subsequent parts of similar configuration and materials is not required. If necessary to make any change in materials and processes which could affect quality, manufacturer shall submit for reapproval a statement of the revised procedure.

4.2.2 Acceptance tests. Acceptance tests are those tests which are performed on individual lots of finished products submitted on contracts or order. Unless otherwise specified, a lot shall consist of all products processed IAW this specification at one time or contained in one shipment. These tests shall consist of the following:

4.2.2.1 Sample acceptance tests IAW MIL-STD-105, AQL 4.0 using single plan for normal inspection level I.

- a. Thickness IAW 4.3.1
- b. Appearance IAW 4.3.2
- c. Adhesion, dry tape IAW 4.3.3.1

4.2.3 Knife test. The procuring activity reserves the right to perform the knife adhesion test of 3.11 in addition to or in lieu of the adhesion test of 3.10.

4.2.4 Process control tests.

4.2.4.1 The wet tape tests of 4.3.3.2 shall be performed a minimum of once per week for those weeks when painting facilities are being used. In order to comply with this requirement, a minimum of one sample part from all parts (of the same or different part numbers) painted with the same process shall be tested. Failure of the tested part to meet the requirements of 3.10 shall require an investigation to determine cause and corrective action.

4.3 Test methods.

4.3.1 Film thickness. Constant diligence shall be exercised to maintain careful control of the thickness of paint finish during the production process to insure continual adherence to the established minimum thickness limits as specified in 3.7.2.

Inspection of thickness shall be limited to those flat areas of a part where a paint spray gun may be capable of depositing a uniform paint film. Because of part configuration, it may be necessary to exceed the maximum thickness in order to obtain the minimum thickness in recesses or other difficult to paint surfaces. In these instances, the parts shall not be rejected for excess thickness if the requirements of Table II are met. If necessary, quality control shall designate surfaces for thickness inspection.

4.3.1.1 Metal panels representative of the production parts in material and surface preparation, prepared with films too thick, too thin and correct, may serve as visual color guides for thickness of wash primer.

4.3.1.2 Process control panels may also be used for thickness control. Immediately prior to painting production parts, a panel shall be painted which is representative of the production parts in material and surface preparation. If the dry film thickness of this panel is adequate, indicating that the operator has the material, equipment and technique under control, the lot of parts painted at the same time will be acceptable providing all other appropriate requirements of this specification are met.

4.3.2 Appearance. All parts shall be visually examined without magnification to determine compliance with 3.8 (see 6.2).

4.3.3 Paint adhesion.

4.3.3.1 Dry tape adhesion. The test shall be performed on the painted item after a minimum of 24 hours drying unless otherwise specified. Pressure-sensitive adhesive tape (1.0 inch width) having a peel strength of 55 to 70 ounce (oz)/inch (in) width when tested IAW ASTM-D-3330M, Test Method A (see 6.3) shall be used. Press a 2-inch length of a somewhat longer piece firmly onto a flat or cylindrical surface of the item, rubbing out all air bubbles under the tape. Allow approximately 10 seconds for the test area to return to room temperature. Grasp a free end of the tape and at a rapid speed, strip it from the item by pulling the tape back upon itself at 180 deg (in such a manner that the tape is folded back to back during the procedure). Observe for bared spots. Disregard flecks of paint on tape where the underlying metal, pretreatment or primer is not visibly exposed. An average of five (5) dry tape tests per twenty-five (25) square feet of surface area shall be made. Upon completion of testing, the parts shall meet the requirements of 3.10.

4.3.3.2 Wet tape adhesion. The test shall be performed on the painted item after a minimum of 72 hours drying unless otherwise specified. A piece of cloth shall be taped on the area under inspection. The test area shall be kept soaked for a minimum of 24 hours with tap or distilled water and shall be a minimum diameter of three inches. After 24 hours, remove the wet cloth and blot up the surface water. Immediately thereafter, perform tape test as in 4.3.3.1. An average of one wet tape test per twenty-five (25) square feet of surface area shall be tested when required. Upon completion of testing, the parts shall meet the requirements of 3.10.

4.3.3.3 Knife adhesion. A representative, though inconspicuous portion of the painted surface of the part shall be tested IAW method 6304 or FED Test Method STD-141. Acceptable units subject to this test may be delivered on contract after all visible damage to the painted surface is repaired.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing. Not applicable.

6. NOTES

6.1 Intended use. The specification is intended for use in specifying the appropriate paint finish and determining the minimum paint thickness and quality requirements for the PATRIOT program.

6.2 Definitions.

6.2.1 Bump. A protrusion caused by a drop of hardened paint. Weld spattering.

6.2.2 Cavity. Depressions caused by improperly seated hardware such as rivets, inserts.

6.2.3 Discoloration. A difference in tone or shade when compared to the specified color chip.

6.2.4 Indentation. A surface dent other than the spherical depression caused by spot welding.

6.2.5 Orange peel. A wrinkled or wavy surface caused by disturbing partially dry paint. Using paint of improper consistency.

6.2.6 Runs or sags. A flow of paint caused by improper mixing. Application of too much paint.

6.2.7 Scratches and gouges. Marks on the surface or visible through the surface, caused by scraping, and exposing bare metal or primer.

6.2.8 Scuff marks. A difference in the tone or shade of the paint caused by abrasion.

6.2.9 Seams and gaps. Any break in the continuity of the painted surface created by countersunk hardware, butt joint.

6.2.10 Seediness or roughness. Hard paint spattering (over spray) on a finished surface.

6.2.11 Specks. Dirt, dust beneath the painted surface producing a surface roughness, or settled out seeds in old paint used for topcoat.

6.2.12 Pin Holes. Small pits or depressions usually caused by incomplete filling, a porous surface, or breakage of air bubbles when paint topcoat was being sprayed.

6.2.13 Blisters. Hollow projections in any layer of a paint film.

6.3 The following companies are known to produce tape meeting the requirements of paragraph 4.3.3.1:

3M Co.  
CAGE Code 26066  
St. Paul, Minn.  
#250 Tape

6.4 The following company is known to produce walkway coating meeting the requirements of A-A-59166, Type II.

Akron Paint and Varnish, Inc.  
1390 Firestone Parkway  
Akron, OH 44301-1624  
CAGE Code: 70228

6.5 Supersession data. The following lists the superseded grades and the corresponding superseding grade.

<u>Superseded Grade</u>	<u>Superseding Grade</u>
Grade 1a	Grade 1
Grade 1b	Grade 1
Grade 2a	Grade 2
Grade 3a	Grade 3
Grade 4a	Grade 4

6.6 Last page identification. The last page of this specification is identified by an asterisk (\*) immediately to the right of the last page number.

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CUSTODIAN:

Army (MI)

PREPARING ACTIVITY:

U.S. Army Missile Command  
Redstone Arsenal, Alabama  
Rev J released IAW MI-M7480,  
pages 1 thru 15, 18 March 2002