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DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

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CARC SPOT PAINTING

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HEADQUARTERS, DEPARTMENT OF THE ARMY

1 January 1991

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## SECTION I. INTRODUCTION

**1-1. Purpose.** This bulletin explains the Chemical Agent Resistant Coating (CARC) process and provides the field methods of spot painting using CARC.

**1-2. Scope.** This bulletin contains information on CARC for operator and unit-level maintenance personnel. It covers the reasons CARC is used, application procedures, safety precautions and provides NSNs for the primers and paints.

**1-3. Suggested Improvements.** You can help improve this bulletin. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 to: Commander, US Army Materiel Command, ATTN: AMCSMMMD, 5001 Eisenhower Avenue, Alexandria, VA 22333-0001.

**1-4. General.** More and more equipment is being painted with CARC. It has big advantages over the older alkyd paint.

a. It lasts up to four times longer than alkyd paint if applied properly. Similar polyurethane paints are used on your car, commercial machinery and bridges anywhere a tough, durable finish is needed. The CARC topcoat also provides visual camouflage.

b. It provides a surface that resists the penetration of chemical agents. They just bead up on the surface like water on a newly waxed car. That makes for quick, complete decontamination and shorter times at MOPP-4.

c. The main word to remember is RESISTB 43-0242 TANT. CARC resists chemical agents. It does NOT soak up chemical agents the way

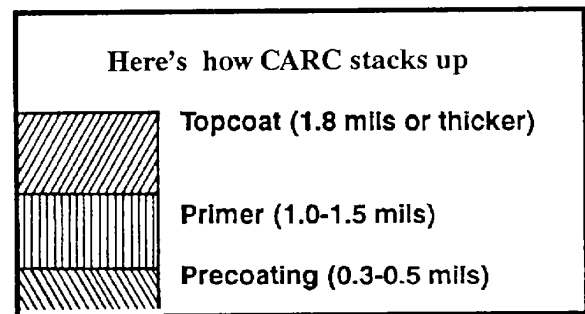
alkyd paint does. It also resists removal by decontaminating solutions.

d. It is as easy to apply as alkyd paint. Both require similar surface preparation.

e. It is as safe to use as any other paint when you take the appropriate safety measures. CARC's topcoat is similar to paint private industry has used for years.

## SECTION II. THE CARC SYSTEM

**2-1. The System.** The CARC system is a combination of pretreatments, primers and topcoats. After surface preparation and pretreatment, exteriors of vehicles are painted with an epoxy primer, then with an aliphatic polyurethane topcoat. The interior of hull-type vehicles gets an epoxy enamel over the epoxy primer.



**2-2. Identification.** Most equipment painted in the new three-color camouflage pattern wears CARC. Equipment painted with CARC should have "CARC" stenciled near the data plate.

**2-3. CARC Test.** If you don't see it stenciled, wet a cloth with acetone and rub hard on the painted surface for 10 seconds. Wet a clean corner of the cloth with acetone and rub

another 10 seconds in the same spot. If no paint comes off the second time, it's CARC. (The first wipe may remove overspray and make you think it's not CARC.)

**2-4. Spot Painting.** Use only CARC when you have to spot paint equipment painted with CARC. Likewise, only use CARC for adding unit identification markings (bumper markings). Using alkyd paint for this gives you areas where chemical agents will be retained. Since the alkyd paint previously used is not available anymore, use CARC here, too.

**2-5. Where Not Used.** CARC is NOT used on fabric, metals that have anodized or parkerized finishes (like weapons), hoses or other flexible surfaces. It is not used on exhaust pipes, turbochargers, cooling fins or other surfaces that conduct heat or get above 400 E. If you're not sure whether to use CARC on a particular surface, check with your Logistics Assistance Representative at the local USAMC Logistics Assistance Office.

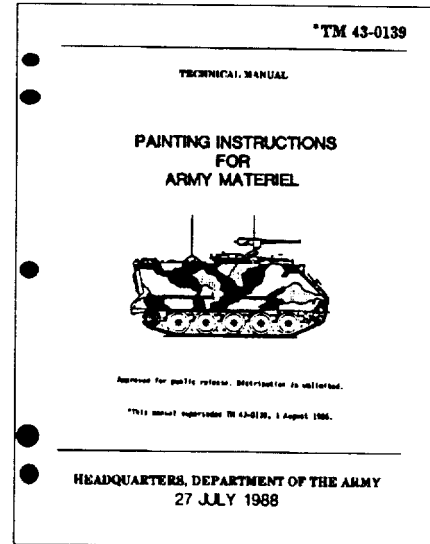
**2-6. CARC on Wood.** CARC won't last as well on wood. Wood expands and contracts with weather changes. CARC does not. It is not flexible enough to move with the wood, so it cracks and can peel off. Follow the word in Para 3-5e of TM 43-0139 to protect wood.

**2-7. Unit-level Painting.** The word on using CARC is in Para 4-42 of AR 750-1 in Maintenance Management UPDATE. Unit-level painting is limited to touch-up or spot painting using a brush or roller-no complete repainting. That goes for all paints, not just CARC.

**2-8. Touch-up Painting.** Touch-up painting is done to prevent corrosion, not for purely cosmetic reasons. If the paint is marred, but not deep enough to see bare metal, you do not need to paint.

**2-9. Complete Repainting.** Complete repainting-using any kind of paint-is only done at Direct Support, General Support and depot level maintenance facilities with

painting booths meeting OSHA standards. That's where camouflage pattern painting is done, too, because the paint must be applied very carefully to match specific patterns for each piece of equipment. Camouflage painting is covered by Chapter 4 of TM 43-0139.



**2-10. Three-color Camouflage.** Speaking of camouflage, the Army is going to a three-color camouflage pattern. Again, you don't repaint a vehicle that's painted in the four-color pattern just because it's different. Desertcamouflaged equipment painted with CARC should be painted using Tan 686. Sand was the original choice, but tan was found to be a better camouflage color. Both colors are available, so match your vehicle's color when spot painting.

**2-11. Matching Patterns.** When you're touching up a camouflaged surface, try to repaint using the original camouflage pattern. The pattern was designed to best camouflage the equipment.

### SECTION III. BEFORE YOU PAINT

**3-1. Before You Paint.** There's more to using CARC (or any other paint) than grabbing a brush, a can of paint and getting to work. Poor preparation results in a poor paint job that may soon have to be redone.

**3-2. Pubs You Need.** To begin with, grab a copy of TM 43-0139, Painting Instructions for Army Materiel, and look it over. It explains each of the primers and topcoats available and how to mix and use them. You need a copy of TB Med 514, too. It covers health precautions needed when using any paints.

Until the TB Med is printed, US Army Environmental Hygiene Activity Technical Guide 144, Guidelines for Controlling Health Hazards in Painting Operations, covers this area. Get a copy from:

**Commander US Army Environmental Hygiene Agency ATTN: IISIB-CI-O Aberdeen Proving Ground, MD 21010-5422**

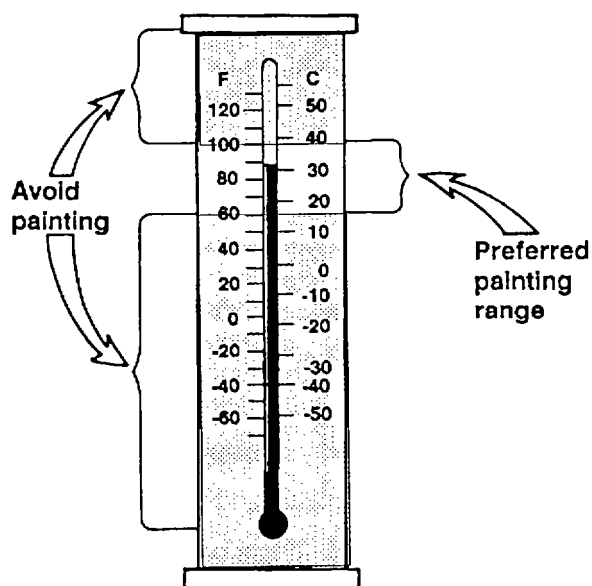
**3-3. Material Safety Data Sheets.** These must be available for each paint, solvent or other hazardous materials used in the shop. They list any special precautions or procedures needed, as well as first-aid measures. You'll find additional information in the DoD Hazardous Materials Information System Hazardous Item Listing, DOD 6050.5-L. Disposal information is in DOD 6050.5-L-1. Pay attention to warnings on paint can labels.

**3-4. Health Concerns.** Check with your local Preventive Medicine office, too. They can advise you on hazards involved in painting operations and precautions to take.

**3-5. Weather for Painting.** The weather conditions when you paint are important. Painting when the temperature is too hot or cold can be a waste of time. The paint won't dry properly, and may peel off in a matter of days or weeks.

You'll get the best results when you: a. Paint when the temperature is between 60 °F and 100 °F. The ideal temperature is 75-80 °F and a humidity of 45-50 percent.

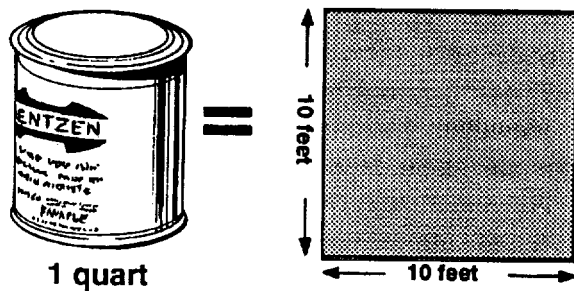
However, you can paint when the humidity is more or less than the ideal. If the temperature is over 100 °F, add a few ounces of thinner to each quart (but not more than 8 ounces per quart) so the paint doesn't dry quite so fast. Or wait for cooler evening hours to paint.



b. Paint in the shade or on overcast days, never in direct sunlight.

**3-6. Drying Concerns.** CARC dries as solvents evaporate. Then it cures, a chemical reaction. Other paints, like lacquers, only dry as the solvent evaporates. CARC will cure at temperatures below 60 °F, but it takes much longer. At temperatures over 100 °F, you may need to add thinner to slow the drying time so you can get a smooth coat.

**3-7. Coverage.** Mix up only as much paint or precoat as you need. A quart of



polyurethane topcoat, epoxy primer or epoxy enamel will cover about 100 square feet. If you're painting more or less than that, you can use the two-component topcoat. Stir each component thoroughly, then measure out what you need. Be sure that you mix the two parts of the epoxy primer or two-component topcoat in the proper proportion. For most products, that's four parts of

Component A to one part of Component B. Using more or less of Component B won't make the paint dry quicker or produce a better coating. In fact, if you use the wrong proportions, you may end up with paint that peels right off.

**3-8. One-part CARC.** You can use the one-part polyurethane topcoat for spot painting. There's no mixing of components-but you still have to stir it well. If you don't use the entire can, you may be able to save what's left overnight. Just close the can tightly. When you open the can the next day, remove any skin that may have formed on the surface of the paint. Stir the remainder well, and use it.

**3-9. Epoxy Curing.** Once you mix the epoxy primer or two component topcoat, they start hardening-curing-and nothing can stop it. You have about 15 hours for the epoxy or 8 hours for the topcoat to use them after mixing.

**3-10. Time Line.** Here's a time line showing how long each step takes to cure, how long you've got until the next step must be started and the maximum time allowable between steps.

4 hours or less	30 min to	30 min to 7 days	7-14 days
24 hours	(within 24 hours	4-6 hours	
if possible)	30 min		

Prepare surface; Wipe with feather edge.	thinner.	Apply primer	Apply topcoat	Dry to touch	Dry through	Cured
Wash with detergent and water.	Coat with coating compound.					

## SECTION IV. SAFETY PRECAUTIONS

**4-1. Safety Needed.** Just like most things you do during the course of any day in the motor pool, there are certain safety procedures that you have to follow when painting. For most touchup painting, you need to take a few commonsense precautions.

**4-2. Solvents.** To begin with, the solvents used in CARC and other paints are flammable.

Never paint around open flames or where there are sparks, like from someone welding.

**4-3. Respiratory Protection.** Avoid breathing solvents. When you paint, you need plenty of ventilation. If possible, paint outside, but out of the direct sun. If you must paint inside a building, paint in a bay with doors open on each end. Your local industrial hygienist can measure the airflow to see if you have adequate ventilation. Use a respirator to remove solvents in the air unless your local industrial hygienist or Preventive Medicine office has said that use of a respirator is not necessary. You will need a dust respirator when you sand or grind off the old paint. Individuals using respirators must be trained and have the respirators fitted.

**4-4. Gloves.** Wear gloves that will keep the paint and thinner off of your hands. Solvents in the paint and thinner can be absorbed through your skin, and make your hands dry and cracked. Some solvents can make you sick, too. Besides, CARC that's dried on your skin doesn't come off easily. Usually it has to wear off. Cloth gloves are OK unless the solvents contain cellosolve acetate. Then you need silicon rubber gloves.

**4-5. Face Protection.** Use a face shield or goggles so paint will not splatter in your face, TB 43-0242 especially when mixing paint. You need a shield or goggles if you

use a power sander or grinder to prepare the surface. Either will protect your eyes from flying paint chips.

**4-6. Hearing Protection.** Normally you will not need hearing protection when you paint. You will need ear plugs or the like if you use a power sander or grinder to remove old paint and rust.

## Section V. TOUCHUP STEP-BY-STEP

**5-1. Steps to Follow.** There are a number of steps to follow when you apply CARC. If you skip a step or take a shortcut, you'll end up with a coating that peels easily or one that bubbles up and falls off.

**5-2. Surface Preparation.** Surface preparation is important. If you skip it, or skimp on it, the paint won't stick to the surface. You can apply CARC over old CARC or alkyd paint as long as the old surface is clean and sound—that is, tightly bonded to the surface. Clean off all rust, corrosion, oil, grease, moisture, dirt, and loose or blistered paint. CARC will blister up if applied over lacquer—even if it's covered by alkyd paint.

**5-3. Painting.** Prepare ferrous metal (steel and iron) or aluminum surfaces like so:

- a. Wash with liquid detergent, NSN 793000-282-9699, and water; rinse with fresh water and let the area dry.
- b. Remove all loose paint and rust by sanding or with an orbital grinder. When you sand any old paint, use a respirator designed to filter out dust, because the old paint may contain lead or chromates. Use a HEPA vacuum, like NSN 7910-01-0685662, to clean up.

## Featheredging

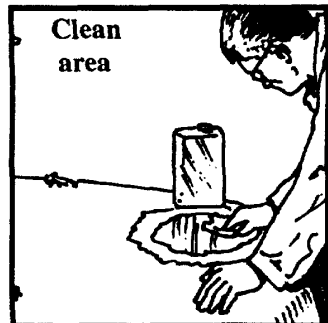


A special sanding operation--featheredging--is required when damage or corrosion reaches to the metal. Sand down to bare metal at the damage point. Make sure all corrosion and loose paint is removed. Then sand the surrounding paint, tapering up to the topcoat surface.



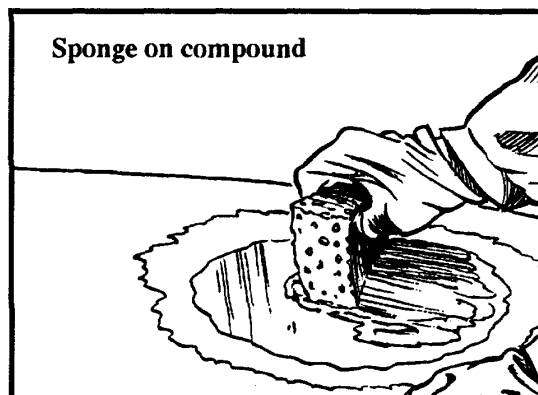
Featheredging calls for "feathering" the amount of paint applied. You apply the paint lightly at outer edges and heavier as you move to the middle. This rebuilds the paint layers to the original level and thickness.

c. Feather the edges of good paint by sanding or with steel wool.



d. As soon as possible-but no longer than four hours later-clean the area to be painted with thinner, NSN 8010-001818079.

the compound off the surrounding paint because it can keep the primer from bonding to old paint.



e. If the old paint is sound and you didn't have to sand to bare metal, you don't need the pretreatment and primer, so you can skip to Step g. Otherwise, immediately coat all bare metal surfaces with coating compound, NSN 8030-00-850-7076. This protects the surface and helps the primer bond to the surface. Keep

f. After the coating is dry-at least 30 minutes but no more than 24 hours-paint it with primer, NSN 8010-01-193-0516. Stir each component separately until uniform.



Mix the two parts well, then let stand 30 minutes before you use the primer. Don't mix more than you can use that day, because you can't save any mixed primer. It will harden in the pot within 15 hours, and there's no way to prevent hardening.

g. After application, the primer will dry hard in 30 to 90 minutes and you can add the CARC topcoat. Use either the two component or single part CARC listed in Appendix B. Stir it thoroughly before use.

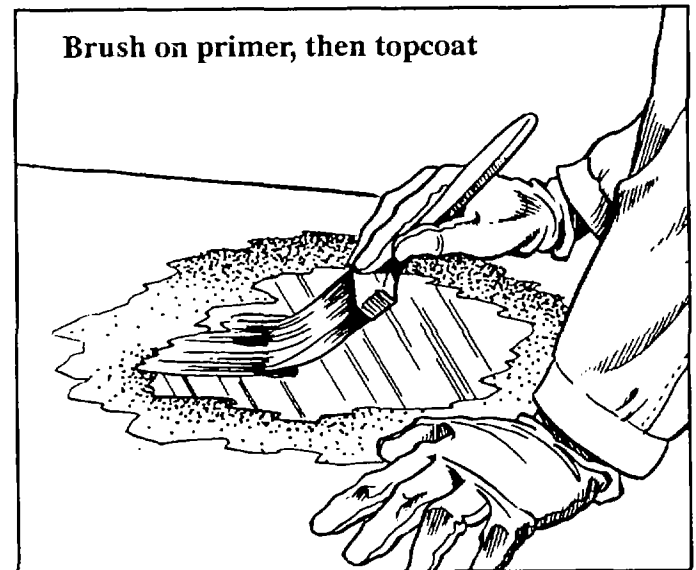
h. The topcoat will be dry to the touch in 30 minutes. It will be thoroughly dry in 4 to 6 hours. It'll be cured enough to withstand impact-like walking on it in 6 to 8 hours. Complete curing takes 7 to 14 days.

**5-4. Unused Paint** Treat any leftover paint as hazardous waste. The same goes for the topcoat component B if it goes bad in the can.

Good component B should be clear to pale yellow. If it's thickened or crystalline in consistency, seal it and get rid of it. Your unit's SOP should address how to handle hazardous waste. You can also find disposal information in the Material Safety Data Sheets or at the local Environmental Office. Or write to:

**Commander US Army Environmental  
Hygiene Agency Waste Disposal  
Engineering Division Aberdeen Proving  
Ground, MD 21010-5422**

or call them at DSN 584-3651, Commercial (301) 671-3651.



## SECTION VI. PAINT FAILURES

**6-1. Reasons for Failure.** There are a number of reasons that CAR--or any other paint fails soon after application. Some reasons are:

- a. The surface was improperly prepared. There was loose or blistered paint, sanding dust, grease or oil, diesel fuel, fingerprints on the surface, or lacquer used previously was not removed.
- b. No pretreatment or primer was used.  
  
The topcoat was applied directly to the bare metal.
- c. The primer did not have time to dry (flash off the solvent) before the next coat was applied.
- d. The surface was too hot or cold. The paint didn't have a chance to cure properly.

**6-2. What to Do.** With most paint failures, the only sure cure is to strip it down to bare metal and start over. You'll end up spending a lot more time doing it over than it would have taken to do it right the first time.

## SECTION VII. WELDING CARC-PAINTED SURFACES

**7-1. Welding is Out.** Never weld or use a cutting torch on CARC-painted material. Welding or cutting painted surfaces releases toxic gases, vapors and metal fumes.

**7-2. Remove Paint.** Before applying any heat, sand or grind off the paint down to bare metal on an area four inches on either side of where you plan to apply heat. If the other side of the metal is painted, remove the paint from it, too.

## SECTION VIII. PAINT REMOVAL

**8-1. Stripper.** There are times you need to remove CARC from a surface that can't be scratched or scored, such as cannon mounts or aircraft surfaces. You can't use sandblasting or sanding. Instead, use epoxy and polyurethane paint remover.

**8-2. Stripper NSNs.** Get the stripper with these NSNs:

Qty	NSN 8010-001
Pt	142-9273
1 Gal	181-7568
5 Gal	926-1488 5
5 Gal	926-1489

**8-3. Safety.** Read the warning label on the stripper and take all the precautions called for. The Material Safety Data Sheet will have additional information. Your Preventive Medicine folks can help, too.

**8-4. Waste Disposal.** Be sure to check with your local environmental office for guidance on disposing of the used stripper.

## SECTION IX, RESPIRATOR CARE

**9-1. Respirator Authorized.** Under some conditions you may need to wear a respirator. The most common respirator used is NSN 4240-00022-2524. It's part of the No. 1 Supplemental and No. 2 Common shop sets. It's also authorized by Chapter 18 of CTA 50-909. Your gas mask is no substitute. It won't protect you from paint fumes.

**9-2. Training, Fitting and Testing.** Your Preventive Medicine folks will fit you for a mask and be sure you have the correct type.

They will also teach you how to use it and to check for leaks before each use.

**9-3. Cartridges not Available.** You can't get the cartridges or prefilters separately. When you've used up those that come with the kit, order a new respirator.

**9-4. Before Use.** Never alter or modify your respirator. Be sure you follow the manufacturer's instructions for use and wear.

Look for tears or other damage that would prevent a positive seal. When you first put the mask on, do the positive pressure and negative pressure tests called for in Para 2-7b(4) of TB Med 502. If you can't get a good seal, don't paint.

**9-5. Respirator Use.** Use your respirator only in well-ventilated areas where plenty of oxygen is available. Otherwise, you may pass out.

Leave the area immediately if breathing becomes difficult, if you get dizzy or if you taste or smell paint.

**9-6. Cartridge Changes.** Replace the prefilter and the cartridge in your mask at the first sign of paint odor while you're wearing it. Unscrew the cartridge to replace it. Be sure the rubber

gasket is evenly seated in the filter holder when you put in the new cartridge.

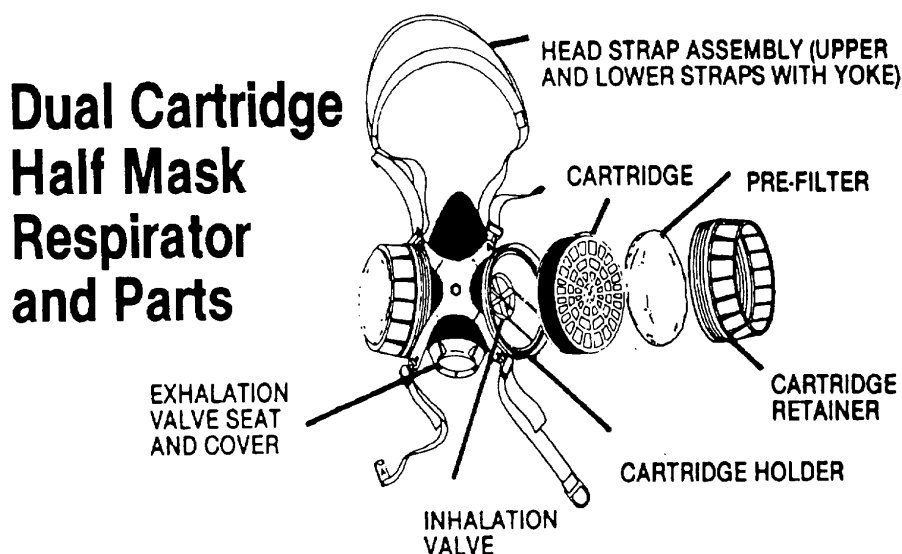
**9-7. Prefilter Replacement.** Replace the prefilter when breathing becomes difficult.

Remove the prefilter retaining ring from the front of the cartridge. Put the replacement prefilter in the retainer and replace the entire assembly on the cartridge front.

**9-8. Cleaning.** Clean your respirator after each day's use like so:

- a. Remove the filters, headbands and valves from the rubber facepiece.
- b. Immerse all parts-except the cartridges and prefilters-in a warm (140-160 °F) solution of a germ killer like calcium hypochlorite, NSN 6860-00-2706225. That's the capsules used in your water purification kit.
- c. Scrub the rubber parts of the mask gently, using a soft brush.
- d. Rinse thoroughly in clean water and let dry.
- e. When dry, reassemble the respirator and store it in a closed plastic bag. Label the plastic bag with your name and the date it was cleaned.
- f. Before using the mask, be sure to check it for leaks

**9-9. Storage.** Before storing your respirator, make sure it's clean and dry. Store it in a cool, dry area free of airborne contamination. You can store your respirator in a plastic bag. Do not put it in your locker or tool box unless it is in a container or carton. Be sure to check the respirator again before using it.



## APPENDIX A PUBLICATION LIBRARY

Here's a list of publications and specifications needed for painting operations at various maintenance levels.

Number	Title	Needed at:
TM 43-0139	Painting Instructions for Army Materiel	All levels
TM 55-1500-	Painting and Marking of Army Aircraft	All levels
	345-23	
TG 144	Guidelines for Controlling Health Hazards in Painting Operations	All levels
	Order this from: Commander US Army Environmental Hygiene Agency ATTN: HSHB-AI-A Aberdeen Proving Ground, MD 21010-5422 <i>(This will be replaced by <b>TB MED 514</b> when that is printed.)</i>	
TB MED 502	Occupational and Environmental Health Respiratory Protection Program	All levels
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment	All levels
TB 43-0144	Painting of Vessels	All levels
TB 43-0147	Color, Marking and Camouflage Patterns used on Military Equipment	All levels
TB 43-0209	Color and Marking of Military Vehicles, Construction Equipment and Materials Handling Equipment	All levels
TB 746-95-1	Color, Marking and Camouflage Pattern Painting for Armament Command Equipment	All levels
TB 750-10	Painting, Replating and Preserving Instructions for Communications Security Equipment	All levels
MIL-C-53072	Chemical Agent Resistant Coating (CARC) System Application Procedures and Quality Control Inspection	GS/Depot
MIL-T-704	Treatment and Painting of Materiel	GS/Depot
MIL-STD-171	Finishing of Wood and Metal Surfaces	GS/Depot
MIL-STD-186	Protective Finishing for Army Missile Weapon Systems	GS/Depot
MIL-STD-193	Paint Procedures and Marking for Vehicles, Construction Equipment and Material Handling Equipment	GS/Depot
MIL-STD-194	System for Painting and Finishing Fire-Control Material	GS/Depot
MIL-STD-642	Identification Marking of Combat and Tactical Transport Vehicles	GS/Depot
MIL-STD-1473	Standard General Requirements for Color and Marking of Army Materiel	GS/Depot

**TB 43-0242**

MIL-C-46168	Coating, Aliphatic Polyurethane, Chemical Agent Resistant	GS/Depot
MIL-C-53039	Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant	GS/Depot

If you need the specifications for a specific paint or solvent, check Appendix A of TM 43-0139.

You can also get a video showing how to spot paint using CARC. Check with your Training and Audiovisual Support Center for TVT 3-40, *Chemical Agent Resistant Coating (CARC)--The Real Story*.

## APPENDIX B PAINT NSNs

Here are the NSNs for commonly-used quantities of CARC primers and topcoats.

If you need the NSN for other colors, check Appendix B of TM 43-0139.

### Primer (wash) pretreatment

DOD-P-15328	Size	NSN 8030-00-
	1 1/4 Qt kit	850-7076
	1 1/4 Gal kit	281-2726
	5 Gal kit	165-8577

### Primers

Epoxy-Polyamide, MIL-P-23377

(contains chromates for use on nonferrous surfaces)

Color	Size	NSN 8010-
Deep yellow	1 Pint kit	00-229-4813
Deep yellow	1 Qt kit	00-142-9279
Deep yellow	2 Qt kit	00-935-7080
Dark green	2 Gal kit	00-082-2450
Deep yellow	2 Gal kit	01-048-6539
Deep yellow	10 Gal kit	00-082-2477

Epoxy coating, MIL-P-53022

(Corrosion inhibiting.

Lead- and chromate-free. For ferrous and nonferrous surfaces)

Color	Size	NSN 8010-01-
White	1/4 Qt kit	193-0516
White	1 1/4 Gal kit	193-0517
White	5 Gal kit	187-9820

Epoxy, Water reducible, MIL-P-53030

(Lead- and chromate-free. For ferrous and nonferrous surfaces)

Color	Size	NSN 8010-01-
Reddish-brown	1 1/4 Qt kit	193-0519
Reddish-brown	1 1/4-Galkit	193-0520
Reddish-brown	1 Gal kit	193-0521

Epoxy, VOC compliant, MIL-P-85582

(Lead-free, contains chromates, water-reducible)

Color	Size	NSN 8010-01-
Light green	1 Qt kit	218-0856
Light green	1 Gal kit	218-7354

**CARC Single Component Topcoat, Mil-C-53039**  
(Lead and Chromate-free; low VOC)

Color	NSN 8010-01-		
	1 Qt can	1 Gal can	5 Gal can
Green 383	229-7546	229-9561	229-7547
Brown 383	229-7543	229-7544	229-7545
Black	229-7540	229-7541	229-7542
Sand	234-2934	234-2935	234-2936
Tan 686	276-3638	276-3639	276-3640
Aircraft Green	246-0717	246-0718	246-0719

**CARC Two-Component Topcoat, MIL-C-46168, Type II,**  
(Lead and Chromate-free)

Color	NSN 8010-01		
	1 1/4 Qt kit	1 1/4 Gal kit	5 Gal kit
Green 383	160-6741	162-5578	160-6742
Brown 383	160-6744	160-6745	160-6746
Black	141-2419	131-6254	131-6261
Sand	141-2416	130-3347	131-6259
Tan 686	260-0910	260-0909	260-0908
Aircraft Green	141-2420	131-6255	131-6262
Interior Aircraft Gray	170-7583	146-2649	170-0132

(Used on Special Electronic Mission Aircraft)

**CARC Two-Component Topcoat, Mil-C-46168, Type IV**  
(Lead and Chromate free;  
High solids, low VOC)

Color	NSN 8010-01-		
	1 1/4 Qt kit	1 1/4 Gal kit	5 Gal kit
Green 383	260-7481	260-0911	260-0912
Brown 383	260-7482	260-0916	260-0917
Black	260-0913	260-0914	260-0915
Sand	260-0921	260-0922	260-7483

**Thinner, MIL-T-81772,**  
Type (Used with )  
I (Polyurethane)  
II (Epoxy)

	NSN 8010-		
	1 Gal can	5 Gal can	55 Gal drum
I (Polyurethane)	00-181-8080	00-181-8079	00-280-1751
II (Epoxy)	01-200-2637	01-212-1704	01-168-0684

By Order of the Secretary of the Army:

CARL E. VUONO  
*General, United States Army*  
*Chief of Staff*

Official:

Thomas F Sikora  
*Brigadier General, United States Army*  
*The Adjutant General*

Distribution:

To be distributed in accordance with DA Form 12-34E, block 4219, Requirements for TB 430242.





## The Metric System and Equivalents

### Linear Measure

1 centimeter = 10 millimeters = .39 inch  
 1 decimeter = 10 centimeters = 3.94 inches  
 1 meter = 10 decimeters = 39.37 inches  
 1 dekameter = 10 meters = 32.8 feet  
 1 hectometer = 10 dekameters = 328.08 feet  
 1 kilometer = 10 hectometers = 3,280.8 feet

### Weights

1 centigram = 10 milligrams = .15 grain  
 1 decigram = 10 centigrams = 1.54 grains  
 1 gram = 10 decigrams = .035 ounce  
 1 decagram = 10 grams = .35 ounce  
 1 hectogram = 10 decagrams = 3.52 ounces  
 1 kilogram = 10 hectograms = 2.2 pounds  
 1 quintal = 100 kilograms = 220.46 pounds  
 1 metric ton = 10 quintals = 1.1 short tons

### Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce  
 1 deciliter = 10 centiliters = 3.38 fl. ounces  
 1 liter = 10 deciliters = 33.81 fl. ounces  
 1 dekaliter = 10 liters = 2.64 gallons  
 1 hectoliter = 10 dekaliters = 26.42 gallons  
 1 kiloliter = 10 hectoliters = 264.18 gallons

### Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch  
 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches  
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet  
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet  
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres  
 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

### Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch  
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches  
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

## Approximate Conversion Factors

<i>To change</i>	<i>To</i>	<i>Multiply by</i>	<i>To change</i>	<i>To</i>	<i>Multiply by</i>
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

## Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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**PIN: 045988-000**