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TRI-SERVICE CONFERENCE ON CORROSION



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Revision of Navy Paint Specifications

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Introduction

The Navy maintains a number of specifications for the organic coatings applied to aircraft and ground support equipment. These documents are periodically revised and amended to include lessons learned from qualification testing, improvements in the state-of-the-art, and new regulatory requirements. To accomplish these objectives, we will revise ten different specifications by the end of this year. They include:

- MIL-C-8514 wash primer
- TT-P-1757 alkyd primer
- MIL-P-23377 and MIL-P-85582 epoxy primers
- TT-P-2760 polyurethane primer
- MIL-L-81352 acrylic lacquer
- MIL-P-52905 temporary, acrylic lacquer
- MIL-C-22750 epoxy topcoat
- MIL-C-85285 polyurethane topcoat
- MIL-C-85322 polyurethane, rain-erosion coating

All of these specifications (including every type and class) will comply with air-pollution regulations that limit the volatile organic compounds (VOC) content. This will be accomplished using water-borne or high-solids coatings technology. The maximum VOC content will generally be set at 340 grams/liter for primers and 340-420 grams/liter for other coatings. The use of 1,1,1-trichloroethane (exempt from VOC regulations) will no longer be permitted due to its classification as an ozone-depleting substance. This solvent will be banned, along with other chlorinated

and fluorinated compounds, in the near future. In addition, the use of hexavalent chromium is being restricted since it is a suspected carcinogen. Strontium and other chromates are the accepted standard for the protection of aluminum structures. We will continue to use them as long as possible, but will also include provisions for non-chromate inhibitors. Finally, we are revising several specifications to introduce three new materials. This includes a water-reducible, wash primer; a one-component, touch-up paint; and a temporary, camouflage paint.

1,1,1-trichloroethane

1,1,1-trichloroethane is widely used as a cleaning solvent, particularly for vapor degreasing of metal parts. It is also used as a solvent in formulating and thinning various paints. This includes the following aircraft coatings:

MIL-P-23377F, Class 3 epoxy primer
TT-P-2760, Class 3 polyurethane primer
MIL-C-22750E, Type II epoxy topcoat

A number of contractors have used these products to meet VOC regulations, because they involve a simple paint reformulation with little additional cost and similar application properties. The viscosity is lower and the pot life is longer than typical high-solids coatings. There are also disadvantages. Chlorinated solvents, such as 1,1,1-trichloroethane, can react with certain metals (particularly at high temperatures or pressures). Spray equipment must have all wetted parts made of stainless steel or other resistant materials. Many high-strength aluminum, steel, and titanium alloys are susceptible to stress-corrosion cracking. Paints applied to these metals must be formulated with an inhibited grade of 1,1,1-trichloroethane (such as Dow CHLOROTHENE SM) and cannot be used on hot, engine parts or in areas where the solvent could be trapped. This includes faying surfaces and the wet installation of fasteners.

1,1,1-trichloroethane is one of several chlorinated solvents that are exempt from current air-pollution regulations, because they are not

photochemically reactive and do not contribute to smog (ozone) formation in the lower atmosphere. However, they are members of a class of chlorinated and fluorinated compounds that contribute to the destruction of the ozone layer in the upper atmosphere. All of them will be banned or severely restricted from use by the end of 1995. We will comply by eliminating the affected types and classes in all Navy specifications.

Chromate Pigments

The use of hexavalent chromium is greatly restricted, since it is a suspected carcinogen. Corrosion inhibitors such as strontium, barium, and zinc chromates are the accepted standard for the protection of aluminum structures. They are used in the following primers:

MIL-C-8514 wash primer
TT-P-1757 alkyd primer
MIL-P-23377 and MIL-P-85582 epoxy primers
TT-P-2760 polyurethane primer

We will continue to use chromates as long as possible, but will also include provisions for non-chromate inhibitors. Blends of phosphates, molybdates, borates, and other novel compounds are being formulated into corrosion-resistant primers and self-priming topcoats. These coatings, due to their low toxicity, are becoming an acceptable alternative for many applications. Unfortunately, we know little about their performance in long-term use. Many of our aircraft will be in service for 40 years or more. Exterior surfaces are generally stripped and repainted every 4-8 years. However, the interior surfaces may never be touched unless there is a known corrosion problem. These areas are subject to the intrusion of water and other corrosive media. The use of non-chromate primers in such areas could involve some risk. Paint manufacturers consider the formulations to be a proprietary trade-secret. We must rely totally on the corrosion resistance requirements in the specifications to assure performance. We will, therefore, upgrade the requirement for salt-spray exposure from 1,000 to 2,000 hours to improve our level of confidence.

In addition, we will forbid the use of lead and cadmium compounds in all of the revised specifications. Chromate compounds will also be forbidden in coatings other than primers. The primer specifications will be divided into Class 1 (chromate inhibitors) and Class 2 (non-chromate inhibitors) materials. Steps will be taken to prevent the procurement of non-chromate primers by unauthorized users. Existing stock numbers will be transferred to the appropriate class in the new specifications. Warnings will be added to the documents, stating that Class 2 primers should only be used with the approval of the engineering authority and buyers should obtain Class 1 primers unless Class 2 is specifically requested.

Water-reducible, Wash Primer

Specification MIL-C-8514 describes a wash primer, composed of a polyvinyl butyral resin reacted with a phosphoric acid catalyst. Because of their ability to bond directly to bare metals, wash primers are also referred to as pretreatment coatings. Zinc chromate is the specified corrosion inhibitor. Unfortunately, the VOC content of a typical primer is about 780 grams/liter. Variations in the chemistry have helped to reduce the VOC content. Sherwin-Williams has developed a water-reducible "prep primer", with the same corrosion inhibitor but a different acid catalyst, that performs well in all applications. At 420 grams/liter, it still exceeds the 340 grams/liter limit for aircraft primers. A water-reducible epoxy primer from Deft, with a non-chromate inhibitor, bonds to bare metal by virtue of an amine catalyst and adhesion promoters. With the exception of galvanized steel, it adheres well to all substrates. The VOC content is 250 grams/liter, well below the limit.

We intend to revise specification MIL-C-8514, without requiring a specific formulation, to achieve VOC compliance with both chromate and non-chromate corrosion inhibitors. The performance requirements will be based on the Sherwin-Williams and Deft primers.

One-component, Touch-up Paint

Courtaulds Aerospace has developed a one-component, water-borne, polyurethane topcoat that is ideal for touch-up applications. Since it is supplied in a single package, the paint is easy to mix and apply and has a minimum pot life of eight hours. Unused material can be poured back into the original container (reducing hazardous wastes). Although it is a polyurethane, the resins are prereacted to remove all free isocyanates. This greatly reduces the toxicity and may allow the coating to be used aboard ship. Its performance is almost equal to that of standard, two-component, polyurethane topcoats. The use of this material for touch-up will eliminate the "spotted" appearance obtained when epoxy topcoats are applied over the existing polyurethane coating system. The VOC content is 340 grams/liter.

Service tests have been scheduled on aircraft and ground support equipment at air stations in Oceana, Patuxent River, Miramar, and Whidbey Island. The touch-up paint will be included as a separate type in specification MIL-L-81352 (currently an acrylic lacquer). This would be a good fit, since both materials are one-component topcoats.

Temporary, Camouflage Paint

The camouflage scheme for tactical aircraft is a combination of various shades of gray. This color scheme is a compromise, based on cloudy conditions over a variety of terrain. During rapid-deployment missions or war-game exercises, it may be necessary to change aircraft colors on short notice to match the terrain in a specific area (desert, forest, etc.). This can be done with a temporary paint containing water-borne, acrylic resins similar to that used in floor polish. The paint is applied over the existing polyurethane coating system with a brush, roller, or spray equipment. It dries to a smooth, flat finish that resists common aircraft fluids with the exception of alkaline cleaners. After completion of the mission, the paint is removed using a mild stripper with no effect on the underlying coatings.

Service tests on both in-house and proprietary formulations (Seagrave Coatings) were conducted at air stations in Oceana, Beaufort, Tustin, and North

Island. The only problem involved some difficulty in removing the paint when left on for several months in a hot, sunny location. The next revision of specification MIL-P-52905 will include provisions for various colors of the temporary paint. This is an Army document for a similar material used in arctic camouflage.