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Information Analysis Center

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Overview

A representative of the Y-12 National Security Complex requested information regarding common protective coatings for aircraft and aerospace parts.

Findings

HDIAC found that chromate-based compounds (hexavalent chromium, barium chromate, and strontium chromate) are most common in military specifications for pretreatment and epoxy primers for protective aircraft coatings. Additionally, HDIAC found that military specifications for aircraft topcoats most often require urethane-based compounds (polyurethane, polyester urethane, or acrylic urethane).

Table 1 lists the military specifications relevant to aircraft corrosion protective coatings.

Military Specification Number	Description
MIL-STD-7179A	Authoritative guidance on standards and specifications for all finishes, protective coatings, and sealants used on aerospace weapons systems [1]
MIL-DTL-5541F	Chemical Conversion Coatings on Aluminum and Aluminum Alloys [2]
MIL-PRF-23377	Primer Coatings: Epoxy, High-Solids [3]
MIL-PRF-85582	Primer Coatings: Epoxy, Waterborne [4]
MIL-PRF-22750F	Coating: Epoxy, High-Solids [5]
MIL-DTL-53039E	Detail Specification: Primer Coating, Epoxy, Water-Based, Lead and Chromate Free [6]
MIL-PRF-85285E	Coating: Polyurethane, Aircraft and Support Equipment [7]

Table 1: Common military specifications concerning protective coatings for aircraft applications.

Pretreatments

The pretreatment most commonly used across all service branches is MIL-DTL-5541F, Class 1A, which primarily calls for using pretreatment coatings containing hexavalent chromium, unless otherwise specified by aircraft part manufacturers [2]. MIL-DTL-5541F is standard for T3 tempered aluminum panels [2, 3]. This aluminum conversion coating applies to the entire aircraft prior to the application of the epoxy primers, enabling the adhesion of the other coats, thereby increasing corrosion resistance [2, 8].

Epoxy Primers

MIL-PRF-23377 specifies common epoxy primers suitable for application to military aircraft [3]. These primers consist of Class C1, a barium chromate based corrosion inhibitor; Class C2, a strontium chromate based corrosion inhibitor; and Class N, a non-chromate based corrosion inhibitor [4]. In some situations, environmental conditions require use of an epoxy containing lower levels of volatile organic compounds (VOCs), in which case MIL-PRF-85582 is substituted for MIL-PRF-23377 [4, 8]. Although MIL-PRF-85582 calls for the same epoxy primers as MIL-PRF-23377 (Class C1, C2, N), it specifies water-based primer coatings with a maximum VOC content of 340 grams per liter [4, 8].

Topcoats

MIL-STD-22750F [5], MIL-DTL-53039E [6], and MIL-PRF-85285E [7] all detail topcoat requirements. Typical compositions for topcoats are urethane based, such as polyurethane, polyester urethane, or acrylic urethane [5–7, 9–11].

Conclusion

HDIAC identified several standard pretreatments, epoxy primers, and topcoats indicated for use on aircraft by several military specifications. Of the three coatings types, topcoat compositions vary the most, as these must incorporate different colors and visual patterns specific to aircraft mission requirements. Pretreatment aluminum conversion coatings are typically comprised of hexavalent chromium. Epoxy primers may contain barium chromate, strontium chromate, or non-chromate for corrosion inhibiting. Topcoats for aircraft equipment are mainly urethane-based (polyurethane, polyester urethane, or acrylic urethane).

We request your feedback on this Inquiry: https://www.hdiac.org/new-inquiry-assessment-form/

References

1. Department of Defense. (2009, August). Department of Defense standard practice: Finishes, coatings, and sealants, for the protection of aerospace weapons systems (MIL-STD-7179A).
2. Naval Air Warfare Center. (2006, July). Detail specification: Chemical conversion coatings on aluminum and aluminum alloys (MIL-DTL-5541F). Lakehurst, NJ
3. Naval Air Warfare Center. (2005, April). Performance specification, Primer coatings: Epoxy, high solids (MIL-PRF-23377J). Lakehurst, NJ
4. Naval Air Warfare Center. (2002, May). Performance specification, Primer coatings: Epoxy, waterborne (MIL-PRF-85582D). Lakehurst, NJ
5. Naval Air Warfare Center. (1994, May). Military specification, Coatings: Epoxy, waterborne. (MIL-PRF-22750F). Lakehurst, NJ
6. U.S. Army Research Laboratory (2011, January) Detail specification: Coating, aliphatic polyurethane, single component, chemical agent resistant (MIL-DTL-53039E). Aberdeen Proving Ground, MD.
7. Naval Air Warfare Center. (2012, January). Performance specification, coating: Polyurethane, aircraft and support equipment (MIL-PRF-85285E). Lakehurst, NJ
8. Lafferman, F. (2018, August 6). Common protective coatings for aircraft [E-mail].
9. 3Chem Corporation. (2017). Polyurethane fuel tank coating. Retrieved from http://www.3chem.com/wp-content/uploads/2011/08/P-1042-Tech-Data-Sheet-2017-4.pdf
10. Sherwin-Williams Aerospace Coatings. (2013, October). Jet Glo Express Military MIL-PRF-85285E, Type I, Class H 840 and 843 series (YM, YMS, ZM and ZMS Colors). Retrieved from https://www.swaerospace.com/swaservice/hearsdata/HearsDocumentLookupAction/download/CM0843AR3/SWAERO/PDS/2
11. Sherwin-Williams Aerospace Coatings. (2018, June). Acry Glo Conventional Basecoat Metallic – Large Area 571 Series (HLG - Colors). Retrieved from https://www.swaerospace.com/swaservice/hearsdata/HearsDocumentLookupAction/download/H/SWAERO/PDS/2