

# **Process Specification for Polytetrafluoroethylene (PTFE) – Impregnated or Codeposited Surface Treatment of Aluminum Alloys**

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**Engineering Directorate**

**Structural Engineering Division**

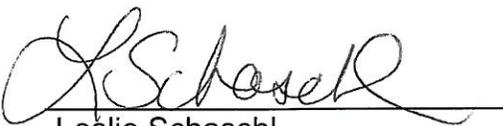
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# Process Specification for Polytetrafluoroethylene (PTFE) – Impregnated or Codeposited Surface Treatment of Aluminum Alloys

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REVISIONS		
VERSION	CHANGES	DATE
Baseline	Original version	1/22/07
Rev A	Added reference documents and periodic testing requirements	

## **1.0 SCOPE**

This process specification establishes the engineering requirements for producing a hard, PTFE-impregnated or codeposited coating on metal alloys and the properties of the coating. PTFE is commonly known as Teflon.

## **2.0 PROCESS DESCRIPTION**

This type of Teflon coating produces a hard, wear resistant coating with a low coefficient of friction that becomes an integral part of the substrate. The particles are mechanically bonded to the surface and the resulting new surface layer is resistant to chipping, flaking and peeling.

The Teflon coating is applied to a metal substrate in a multi-step process that starts with specialized cleaning treatments. The substrate's surface is then enhanced by conversion deposition, thermal spray or a blend-matrix of all three processes, depending on the type of coating to be applied. The process continues with the controlled infusion of engineered polymers or other dry-lubricating particles and/or metals. The final treatment insures the particles have thoroughly integrated into the surface.

## **3.0 APPLICATIONS**

Teflon-impregnated or codeposited Teflon surface coatings on aluminum alloys are also known by the registered trademark name of Tufram, one of General Magnaplate's coatings. This process is typically used to increase the surface hardness and resistance to abrasion and corrosion in aluminum alloys containing less than 5% copper or 8% silicon or a total of 8% of both by the formation of a dense, Teflon-impregnated aluminum oxide or codeposited Teflon-aluminum oxide layer. Alloys with higher silicon content alone can be coated satisfactorily with proper precautions in processing. Careful consideration should be given to the use of this process on highly stressed parts because of the lowered fatigue resistance and on parts with sharp corners or edges where chipping may result.

Typical components processed include: guide rails, impeller blades, valves, and molds. The thickness of the coating will range from 0.0004 – 0.003 inches, normally with 50% growth and 50% penetration per surface (minimum practical thickness is 0.0005 inch). The thickness requirements do not apply to blind holes and recesses with depth greater than twice the diameter or in open holes with depth greater than seven times the diameter unless a specific coating thickness

is specified in those areas. Typically, holes and slots are masked and then chemical conversion coated per NASA/JSC PRC 5005.

This specification shall be applicable whenever the Teflon-impregnated or Teflon-codeposited process is invoked per section 4.0, "Usage".

Unless otherwise specified on the engineering drawing, all parts shall be heat treated to the required temper, final machined, brazed, welded and formed prior to the application of the coating.

#### **4.0 USAGE**

This process specification shall be called out on the engineering drawing by using a drawing note that identifies the process specification and the type.

The two types of Teflon coatings are:

Type 1            Teflon-impregnated aluminum oxide

Type 2            Codeposited Teflon and aluminum oxide

If a specific type is not specified, type 1 shall be supplied.

An example of a drawing note would be:

**MASK ALL HOLES AND SLOTS AND APPLY TEFLON IMPREGNATED ALUMINUM OXIDE COATING PER NASA/JSC PRC 5011 TYPE 1 (GENERAL MAGNAPLATE TUFRAM H+ OR EQUIVALENT). ALODINE CONVERSION COAT (CLASS 1A) ALL HOLES AND SLOTS PER NASA/JSC PRC 5005.**

Tufram H+ maintains maximum hardness, corrosion resistance and lubricity.

#### **5.0 REFERENCES**

All documents listed are assumed to be the current revision unless a specific revision is listed.

ASTM B117

American Society for Testing and Materials  
Specification, Standard Test Method for  
Operating Salt Spray (Fog) Testing Apparatus

ASTM B244	American Society for Testing and Materials Specification, Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM B487	American Society for Testing and Materials Specification, Standard Test Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM B1193	American Society for Testing and Materials Specification, Reagent Water
ASTM D1894	Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting
ASTM D4060	American Society for Testing and Materials Specification, Standard Test Method for Measurement of Abrasion Resistance of Organic Coatings by the Taber Abraser
SAE AMS 2482	Society of Automotive Engineers, Inc., Aerospace Material Specification: Hard Coating Treatment of Aluminum Alloys Teflon- Impregnated of Codeposited
SAE AMS 4037	Society of Automotive Engineers, Inc., Aerospace Material Specification: Aluminum Alloy, Sheet and Plate

The following references were used in developing this process specification:

SOP-007.1	Preparation and Revision of Process Specifications
JSC 8500C	Engineering Drawing System Requirements

## **6.0 MATERIALS REQUIREMENTS**

This process is specific for aluminum alloys containing less than 5% copper or 8% silicon or a total of 8% of both. Alloys with higher silicon content alone can be coated satisfactorily with proper precautions in processing. Careful consideration should be given to the use of this process on highly stressed parts because of the lowered fatigue resistance and on parts with sharp corners or edges where chipping may result.

## **7.0 PROCESS REQUIREMENTS**

Prior to coating, all parts will have clean surfaces and be free from water breaks.

For parts being coated over the entire surface, the location of the contact points shall be acceptable to the customer. For those parts not coated all over, the contact point locations shall be in areas where the coating is not required.

Coatings shall be smooth, uniform in appearance and free from scratches, chips and burned areas.

## **8.0 PROCESS QUALIFICATION**

Thickness of the coating shall be determined on representative parts or specimens by microscopic method, micrometer measurement, or eddy-current method in accordance with ASTM B244 or ASTM B487 or another customer accepted method.

Corrosion resistance shall be verified from coated specimens fabricated from an alloy similar to the part, washed in ASTM D1193, Type IV, water then dried and subjected to 5% salt spray test for 336 hours in accordance with ASTM B117.

Abrasion resistance shall be verified on AMS 4037 aluminum alloy sheet or the predominant alloy being processed and tested in accordance with ASTM D4060.

The coefficient of friction shall be verified from coated test specimens from AMS 4037 aluminum alloy sheet or the predominant alloy being processed and tested in accordance with ASTM D1894 or another method acceptable to the customer.

## **9.0 PROCESS VERIFICATION**

The vendor shall supply all samples for process qualification and verification testing. When parts are to be tested, such parts shall be supplied by the purchaser. The purchaser reserves the right to sample and perform any

confirmatory testing necessary to ensure that the coating conforms to the requirements.

Thickness of the coating and coating quality in relationship to a smooth, uniform appearance, which is free from scratches, chips and burned areas shall be performed on each material lot.

Periodic testing for corrosion resistance and abrasion resistance shall be performed monthly unless specified differently by the cognizant engineering organization.

Periodic testing for coefficient of friction shall be performed semi-annually unless specified differently by the cognizant engineering organization.

Testing of cleaning and processing solutions shall be performed at a frequency selected by the vendor unless frequency of testing is specified by the purchaser or cognizant engineering organization.

#### **10.0 TRAINING AND CERTIFICATION OF PERSONNEL**

All Teflon coated parts used on flight hardware shall be coated by a qualified company or certified operators.

#### **11.0 DEFINITIONS**

Material Lot            A single batch (bar, forging, extrusion, etc.) of material that is produced by the vendor and is documented by a certificate of compliance.

#### **12.0 QUALITY RECORDS**

None.

