


REVISION HISTORY (ALL SHEETS SAME STATUS)

REV	DESCRIPTION	DATE	APPROVED
H	Subsection 1.4 clarified drawing citation. Para. 2.1.4 inserted UOS exception to color requirement. Para. 5.1.4 and 6.1.3 was 100-mesh now 150-mesh filter.	2022AP28	F. Tolmie
J	ECO-0230. Para. 2.2.1 was TYPE II now TYPE I. Para. 2.2.2 was 0.035mm [.0014 inch] now 0.01mm [.0004 inch]. Para. 2.2.3 added sentence excepting FAI. Added para. 5.1.11 and 6.1.10 low gloss reqt.	2023MY02	W. Garner

Plating or Coating Type:	Applied to:	Requirements:
MIL-A-8625 Anodization	Aluminum	Pg. 3, subsection 2.1
MIL-DTL-32459 Micro-Arc Oxidation	Magnesium	Pg. 3, subsection 2.2
ASTM B733 Nickel-Phosphorous Plating	Ferrous Steel	Pg. 3, subsection 2.3
MIL-DTL-5541 Chemical Conversion	Aluminum	Pg. 3, subsection 2.4
Acrylic Urethane Paint	Aluminum Ferrous Steel Magnesium	Pg. 4, section 3
Electro-Coated Paint	Aluminum Magnesium	Pg. 4, section 4
Ceramic Coating (metals)	Aluminum Ferrous Steel Magnesium	Pg. 5, section 5
Ceramic Coating (plastics)	Nylon PA11 or PA12	Pg. 6, section 6

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PLATING AND COATING SPECIFICATION			
CAGE CODE 745H3	SHEET 1 OF 7	DWG NO. 21-3690	REV J



1. General Information

1.1 Scope. This Trillium Engineering (hereafter, the Company) process specification defines requirements and provides instruction for the application of various finishes (plating and coating) to fabrication items of various plastics and metals specified, designed, and procured by the Company from any selected source of supply.

1.2 Application. When cited on an engineering drawing as part of the finish definition, this specification, the drawing, and the related documents below shall comprise the complete set of application requirements. The application processes shall not deviate from these requirements without advance approval of the Company.

1.3 Related documents. To the extent specified in sections 2 through 6, the following standards, product datasheets (PDS) and training manual are a required part of this specification. Unless otherwise stated, the latest revision of each document shall be used.

MIL-A-8625	ANODIC COATINGS FOR ALUMINUM AND ALUMINUM ALLOYS
MIL-DTL-5541	CHEMICAL CONVERSION COATINGS ON ALUMINUM AND ALUMINUM ALLOYS
MIL-DTL-32459	COATINGS, ANODIC FOR MAGNESIUM AND MAGNESIUM ALLOYS
SAE AMS-STD-595	COLORS USED IN GOVERNMENT PROCUREMENT
ASTM B733	AUTOCATALYTIC (ELECTROLESS) NICKEL-PHOSPHORUS COATINGS
TAG 8PS-004	E-Coat Paint Standard (Technology Applications Group, Inc. CAGE 0THW1)
P-169P	Prima Acrylic Urethane Primer Surfacer PDS (PPG Industries, Inc. CAGE 02LS2)
P-162	DX 685 Flattening Agent PDS (PPG Industries, Inc. CAGE 02LS2)
P-168	Concept DCC Acrylic Urethane PDS (PPG Industries, Inc. CAGE 02LS2)
ALIGN MAO	Micro–Arc Oxidation (Align Machine Works LLC, Athens, GA) CERAKOTE® Training Manual (NIC Industries, Inc. CAGE 4C1N7)

1.4 Drawing Notes and Views. Plating or coating requirements shall be presented in one or more general notes citing this document as "...Trillium specification 21-3690." When the drawing presents requirements that differ from this specification, the drawing requirements shall take precedence. When surfaces, specific areas or features are excluded from plating or coating, these shall be defined in one or more drawing views identified as 'COATING DETAILS' providing dimensional extents when required and specific local notes such as DO NOT COAT or OVERSPRAY PROHIBITED.

1.4.1 Unless otherwise stated, interior and exterior surfaces and blind or through holes shall meet all tolerances of size, location, and shape before plating or coating is applied.

1.4.2 Unless otherwise stated, internal and external thread features shall not be plated or coated. When plating or coating of thread features is required, the threads shall meet standard thread profile tolerances after coating.

1.4.3 Unless otherwise stated, overspray, feathering and dusting of interior or adjacent surfaces is permissible when the accumulation of material is less than the thickness requirements for the coated surfaces.

2. Finish Requirements by Material Type

2.1 Aluminum Alloys, Anodic Coating. When the drawing specifies anodic coating for an aluminum alloy workpiece, the general note shall cite paragraph 2.1.1 (unsealed) or paragraph 2.1.2 (sealed). The requirements in paragraphs 2.1.3 through 2.1.5 apply equally to both citations. When the drawing does not specify SEAL or UNSEALED, paragraph 2.1.1 UNSEALED shall apply.

2.1.1 Coating shall be in accordance with MIL-A-8625, TYPE III, UNSEALED.

2.1.2 Coating shall be in accordance with MIL-A-8625, TYPE III, COBALT-FREE SEAL REQUIRED.

2.1.3 Coating thickness shall be a minimum of 0.04mm [.0016 inch] to a maximum of 0.06mm [.0024 inch].

2.1.4 Unless otherwise stated in the engineering drawing note, color shall be dark grey in accordance with SAE AMS-STD-595, Color No. 36099.

2.1.5 Quality, testing and acceptance criteria shall be in accordance with MIL-A-8625.

2.2 Magnesium Alloys, Micro-Arc Oxidation. When the drawing specifies Micro-Arc Oxidation (anodic coating) for a magnesium alloy workpiece, the following requirements shall apply.

2.2.1 Coating shall be applied in accordance with MIL-DTL-32459, TYPE I, CLASS A.

2.2.2 Coating thickness shall be a minimum of 0.005mm [.0002 inch] to a maximum of 0.01mm [.0004 inch].

2.2.3 Quality, testing and acceptance criteria shall be in accordance with MIL-DTL-32459. Unless the purchase order states otherwise, first article inspection (MIL-DTL-32459 subsection 4.4) is not required.

2.3 Ferrous Steel Alloys, Nickel Plating. When the drawing specifies electroless nickel-phosphorus plating for a ferrous steel alloy workpiece, the following requirements shall apply.

Note: These requirements shall not be applied to corrosion-resistant (CRES, or stainless) steel alloys.

2.3.1 Plating shall be in accordance with ASTM B733.

2.3.2 Plating thickness shall be a minimum of 0.025mm [.0010 inch] to a maximum of 0.03mm [.0012 inch] (moderate service condition SC3).

2.3.3 Quality, testing and acceptance criteria shall be in accordance with ASTM B733.

2.4 Aluminum Alloys, Chemical Conversion Coating. When the drawing specifies chemical conversion coating for an aluminum alloy workpiece, the general note shall cite paragraph 2.4.1 (CLASS 3 low resistivity) or paragraph 2.4.2 (CLASS 1A maximum protection). The requirement of paragraph 2.4.3 applies equally to both citations. When the drawing does not specify CLASS, paragraph 2.4.1 CLASS 3 shall apply.

2.4.1 Coating shall be in accordance with MIL-DTL-5541, TYPE II, CLASS 3, NO COLOR (CLEAR).

2.4.2 Coating shall be in accordance with MIL-DTL-5541, TYPE II, CLASS 1A, COLOR YELLOW.

2.4.3 Quality, testing and acceptance criteria shall be in accordance with MIL-DTL-5541.



3. Paint Requirements for Plastics and Aluminum, Magnesium and Ferrous Steel Alloy Workpieces.

When the drawing specifies the acrylic urethane painting of a metallic workpiece, the following requirements shall apply.

3.1 Total primer and paint coating thickness shall not exceed 0.5mm [.020 inch].

3.2 The color requirement shall be defined in the engineering drawing note using standard SAE AMS-STD-595 color number and name.

3.3 Approved Materials. The following materials are approved for use. Substitutions are prohibited.

3.3.1 PPG Industries Concept® (DCC) acrylic urethane paint. See PDS P-168.

3.3.2 PPG Industries K36 primer surfacer. See PDS P-169P.

3.3.3 PPG Industries DX 685 flattening agent. See PDS 162.

3.3.4 PPG Industries DCX61 hardener. See PDS P-169P.

3.3.5 PPG Industries DT870 reducer.

Note: Depending on ambient temperature, another PPG reducer may be used. See PDS P-168.

4. Electro-coated Paint Requirements for Aluminum and Magnesium Alloy Workpieces. When the drawing specifies the cathodic electro-coated painting of a magnesium alloy workpiece, the following requirements shall apply.

4.1 Electro-coated paint shall be applied to the workpiece in accordance with the requirements of the Technology Applications Group E-coat Paint Standard TAG 8PS-004, Type I (matte finish), Class 1.

4.2 Electro-coating thickness shall be applied within the optimal range of 0.013mm [.0005 inch] to 0.018mm [.0007 inch] up to a maximum allowance of 0.025mm [.0010 inch].

4.3 The color requirement shall be defined in the engineering drawing note using standard SAE-AMS-STD-595 color number and name.

4.4 Quality, testing and acceptance criteria shall be in accordance with TAG 8PS-004.

5. Ceramic Coating for Aluminum, Magnesium and Ferrous Steel Alloy Workpieces. When the drawing specifies ceramic coating for a metal alloy workpiece, the following requirements shall apply.

5.1 Ceramic coating shall be applied to the workpiece in accordance with the recommendations and general requirements of NIC Industries Cerakote® training manual – see phase 2 *Degrease* through phase 8 *Curing Schedule*. The following paragraphs impose specific process requirements exceptional to the manual and shall take precedence. These paragraphs combined with the training manual comprise the complete set of process requirements.

5.1.1 Magnesium Alloy Workpieces Only. All magnesium alloy workpieces shall have a Micro–Arc Oxidation (MAO) coating applied in accordance with subsection 2.2 prior to ceramic coating.

Note: MAO–coated magnesium workpieces shall not be media blasted prior to ceramic coating or upon any rework of the coating.

5.1.2 Degreasing. All workpieces shall be degreased using Simple Green® cleaning agent or acetone solvent by wiping down all surfaces or by immersion soaking. When Simple Green® is used, degreasing shall be immediately followed by thorough rinsing in warm water no greater than 60°C [140°F]. Water rinsing when using acetone is not required.

Note: Workpieces shall be exposed to the cleaning agent or solvent for no greater than 25 minutes.

5.1.3 Media Blasting, Aluminum and Steel Alloys Only. Media blasting (sandblasting) shall use a 100 to 120 grit aluminum oxide or garnet sand media at a pressure of 60 to 80 psi.

5.1.4 Coating Preparation. After the catalyst has been added and thoroughly mixed, the preparation shall be strained through a 150–mesh paint filter before use.

5.1.5 Color. Coating color shall be in accordance with Cerakote H-series No. H-213 (grey) with a satin finish requiring an 18:1 mix ratio of coating material to catalyst.

5.1.6 Coating Thickness. Using three full coats, ceramic coating shall be built up to a film thickness within the range of 0.025mm [.001 inch] minimum to 0.05mm [.002 inch] maximum.

5.1.7 Flash Off. Before placing in the cure oven, coated workpieces shall remain undisturbed for a minimum of 15 minutes to a maximum of 1 hour to permit any residual solvent to completely evaporate (flash off).

5.1.8 Rework Prior to Oven Curing. When imperfections such as runs, smudging or dry spray are detected prior to oven curing, the coating shall be removed in accordance with paragraph 5.1.2 and reapplied in accordance with paragraphs 5.1.4 through 5.1.7.

5.1.9 Oven Cure Time. Immediately following flash off, coated workpieces shall be oven cured at a temperature of 121°C [250°F] for a minimum of 2 hours.

5.1.10 Rework After Oven Curing. When imperfections are not detected until after oven curing, the coating shall be mechanically etched to remove runs and raised edges. Following etching, workpieces shall be degreased, media blasted (*except* magnesium, see **Note** at paragraph 5.1.1), recoated, and oven cured in accordance with paragraphs 5.1.2 through 5.1.7 and paragraph 5.1.9.

5.1.11 Low Gloss Surfaces Requirement. After curing, the coated surfaces shall be tested for gloss level using a gloss meter calibrated to a minimum of 100 GU (Gloss Units) at a reflective angle of 85 degrees. The average of a minimum of three observations over the coated surfaces shall be 5 GU or less.

6. Nylon PA 11 and Nylon PA 12 (polyamide plastics), Ceramic Coating. When the drawing specifies ceramic coating applied to a Nylon PA 11 or PA 12 plastic workpiece, the following requirements shall apply.

6.1 Ceramic coating shall be applied to the workpiece in accordance with the recommendations and general requirements of NIC Industries Cerakote® training manual – see phase 2 *Degrease* through phase 8 *Curing Schedule*. The following paragraphs impose specific process requirements exceptional to the manual and shall take precedence. These paragraphs combined with the training manual comprise the complete set of process requirements.

6.1.1 Degreasing. All workpieces shall be degreased using Simple Green® cleaning agent by wiping down all surfaces or by immersion soaking. Degreasing shall be immediately followed by thorough rinsing in warm water no greater than 60°C [140°F]. Acetone solvent shall not be used.

Note: Workpieces shall be exposed to the cleaning agent for no greater than 25 minutes.

6.1.2 Media Blasting. Media blasting (sandblasting) shall use a 100 to 120 grit aluminum oxide media at a pressure of 60 to 80 psi.

6.1.3 Coating Preparation. After the catalyst has been added and thoroughly mixed, the preparation shall be strained through a 150–mesh paint filter before use.

6.1.4 Color. Coating color shall be in accordance with Cerakote H-series No. H-213 (grey) with a satin finish requiring an 18:1 mix ratio of coating material to catalyst.

6.1.5 Coating Thickness. Using three full coats, ceramic coating shall be built up to a film thickness within the range of 0.025mm [.001 inch] minimum to 0.05mm [.002 inch] maximum.

6.1.6 Flash Off. Before placing in the cure oven, coated workpieces shall remain undisturbed for a minimum of 15 minutes to a maximum of 1 hour to permit any residual solvent to completely evaporate (flash off).

6.1.7 Rework Prior to Oven Curing. When imperfections such as runs, smudging or dry spray are detected prior to oven curing, the coating shall be removed in accordance with paragraph 6.1.1 and reapplied in accordance with paragraphs 6.1.3 through 6.1.6.

6.1.8 Oven Cure Time. Immediately following flash off, coated workpieces shall be oven cured at a temperature of 93°C [200°F] for a minimum of 2 hours.

6.1.9 Rework After Oven Curing. When imperfections are not detected until after oven curing, the coating shall be mechanically etched to remove runs and raised edges. Following etching, workpieces shall be degreased, media blasted, recoated, and oven cured in accordance with paragraphs 6.1.1 through 6.1.6 and paragraph 6.1.8.

6.1.10 Low Gloss Surfaces Requirement. After curing, the coated surfaces shall be tested for gloss level using a gloss meter calibrated to a minimum of 100 GU (Gloss Units) at a reflective angle of 85 degrees. The average of a minimum of three observations over the coated surfaces shall be 5 GU or less.



7. Sources of Supply

All vendors providing items to the Company plated or coated in accordance with this specification shall use the approved standards, processes and materials listed in subsection 1.3. Substitutions are prohibited, and any alternative shall not be used without prior review and approval of the Company. The suggested sources for materials or process application listed in Table 7.1 are recommendations only and do not preclude obtainment from other sources capable of meeting all the requirements of this Company standard.

Table 7.1

Suggested Source of Supply	Capability	CAGE Code
Advanced Coatings. Redmond, Oregon	Ceramic Coating. Section 5 and 6.	
Align Machine Works LLC Athens, Georgia	Anodic coating, micro–arc oxidation. Subsection 2.2.	
Decavo LLC Hood River, Oregon	Ceramic Coating. Section 5 and 6.	6M5N0
Magnum Custom Works LLC Hood River, Oregon	Ceramic Coating. Section 5 and 6.	
Technology Applications Group, Inc.	Anodic coating, micro–arc oxidation. Subsection 2.2. Cathodic electro–coated paint. Section 4. Ceramic Coating. Section 5 and 6.	0THW1