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George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

EM01

MSFC TECHNICAL STANDARD

POTASSIUM SILICATE COATINGS, APPLICATION OF

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Baseline	-	10/28/2020	Initial baseline release.

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1.0 SCOPE

1.1 General

This specification covers the detail requirements for the painting application of ceramic coatings used for thermal control or astronaut visual cue/part markings on space flight hardware. In general, these are two-part ceramic coatings with potassium silicate or hybrid potassium/sodium silicate binder, including Z-93P, Z-93SC55, Z-93C55, YB-71P, YB-71C, MH21:IP, MH11ZP, and MH55ICP made by Alion Sciences and AZ-93, AZW/ LA-II, AZ-2000-IECW, AZ-2100-IECW, ML-210-IB, RM-550-IB, AZ-1000-ECB, AMJ-400-IG, AMJ-600-IR, AMJ-700-IBU, AMJ-710-IBU, TMS-800-IY, and TMS-810-ICY made by AZ Technology. These coatings have flight history, either on hardware or as part of the Materials on International Space Station Experiment (MISSE). Other vendors of potassium silicate and hybrid silicate binder coatings may be considered. This document gives no recommendation, endorsement, or preference, either expressed or implied, concerning materials and vendors to be used.

This supersedes MSFC specification 10M01838, “Paint, Z-93 Temperature Control, Application of, Specification for”. Refer to MSFC-PROC-1384 for silicone binder coatings and MSFC-PROC-547 for polyurethane binder coatings.

1.2 Classification

The process covered by this specification consists of the following classes. If a class is not specified, the method of thickness verification is optional and either Class I or Class II is acceptable.

a. Class I – This class is designated for spacecraft hardware with simple configuration where strict control of the coating thickness is not difficult.
b. Class II – This class is designated for spacecraft hardware with complex configuration where strict control of the coating thickness is not practicable.
c. Class III – This class is designated for spacecraft hardware being coated for the purpose of meeting esthetic requirements. Control samples for thermal emittance and solar absorptance are not required.

This standard applies the following: All mandatory actions (i.e., requirements) are denoted by statements containing the term, “shall.” The terms: “may” or “can” denote discretionary privilege or permission; “should” denotes a good practice and is recommended, but not required; “will” denotes an expected outcome; and “are/is” denotes descriptive material.

2.0 APPLICABLE DOCUMENTS

2.1 General

The following documents of the latest issue form part of this specification to the extent specified herein.

2.1.1 Government Documents

2.1.1.1 NASA

MSFC-PROC-547 Polyurethane Coating, Application Of

MSFC-PROC-1384 Thermal Control Coating, Application Of

(Cancelled 01/27/2000)

MSFC-RQMT-2918 Requirements for Electrostatic Discharge Control

2.1.1.2 Federal

A-A-59503 Nitrogen, Research Grade or better

2.1.1.3 Military

MIL-DTL-17667 Paper, Wrapping, Chemically Neutral (Non-Corrosive)

2.1.1.4 Other Documents

ASTM D1193	Standard Specification for Reagent Water
ASTM D1400	Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Non-Ferrous Metal Base
ASTM D3359	Standard Test Methods for Measuring Adhesion by Tape Test
ASTM D7091	Standard Practice for Non-Destructive Measurements of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals
ASTM E376	Standard Practice for Measuring Coating Thickness by Magnetic Field or Eddy Current (Electromagnetic) Test Methods
ASTM E408	Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
ASTM E903	Standard Test Method for Solar Absorptance. Reflectance, and Transmittance of Materials Using Integrating Spheres
ASTM F22	Standard Test Method for Hydrophobic Surface Films by the Water-Break Test

IEST-STD-CC1246 Product Cleanliness Levels - Applications, Requirements, and Determination

NOTE*:* Alternate test methods or deviations from the subject specifications shall be submitted to NASA for evaluation and approval.

3.0 REQUIREMENTS

3.1 Application and Property Requirements

3.1.1 Thermal Control Paint Application Requirements

More than 85% of total coated surface area should meet thickness requirements (note English units, not metric) given in either Table I or Table II, without bare spots. Coating applied for astronaut visual cue/part marking is considered Class III.

Table I. Thickness Requirements for Alion Science Coatings

Coating	Thickness (mils)
Z93P	5.0 ± 1.0
Z93C55	5.0 ± 1.0
Z93SC55	5.0 ± 1.0
YB-71P	8 ± 1.5
YB-71C	8 ± 1.5
MH21:IP	2 to 5
MH11ZP	2 to 5
MH55ICP	3 to 6

Table II. Thickness Requirements for AZ Technology Coatings

Coating	Thickness (mils)
AZ93	5.0 ± 1.5
AZW/LAII	7 to 13
AZ-2000-IECW	4.0 ± 1.0
AZ-2100-IECW	5.0 ± 1.0
ML-210-IB	1 to 3.5
RM-550-IB	1.5 to 4.0
AZ-1000-ECB	2.5 ± 1.5

For complex surfaces, a thinner coating is advised due to the cracking that may occur due to thickness build up on internal radii and tops of grid structures. In this case, Z93P and Z93C55

should be limited to 5.0 mils maximum thickness. AZ-2000-IECW should be limited to 3.5 mils maximum thickness on complex surfaces, including a primer coating of MLP-300-AZ.

For all potassium silicate binder coatings, pot life is 24 hrs. once mixed. (See coating specific process specifications for coating specific parameters) Potassium silicate coating thinner shall be deionized water of minimum 18 megaohm-cm or ASTM D1193 reagent type I.

3.1.2 Optical Property Requirements

Unless otherwise specified, the coatings shall meet the optical property criteria in Table III under normal laboratory conditions. The solar absorptance (α_s) for air mass zero shall be calculated and verified from total-hemispherical reflectance measurements per ASTM E903 in the wavelength range of 0.25 to 2.5 microns, at normal ambient pressure and temperature. Measurements in the wavelength range of 0.25 to 2.8 microns are also acceptable. The infrared emittance shall be determined according to ASTM-E408.

This document does not specify a method for measuring coating conductivity. Coating conductivity is defined by the terms used in MSFC-RQMT-2918 where a conductive coating has surface resistivity less than 1×10^5 ohms/square or a volume resistivity less than 1×10^4 ohm-cm and a static-dissipative coating has surface resistivity of at least 1×10^5 ohms/square or 1×10^4 ohm-cm volume resistivity but less than 1×10^{12} ohms/square surface resistivity or 1×10^{11} ohm-cm volume resistivity.

Table III. Optical Property Requirements at Room Temperature

Coating	Solar Absorptance (α_s)	Infrared Emittance (ε_{IR})
White non-conductive	≤ 0.17	0.91 ± 0.02
White static-dissipative	≤ 0.18	0.90 ± 0.02
White conductive	≤ 0.30	0.88 ± 0.02
Black	≥ 0.95	≥ 0.87

3.1.3 Adhesion Requirements

The coating adhesion, after curing for a minimum of 7 days with ramp down humidity cure per section 3.4.5, shall be tested by the following method on witness samples painted with the hardware. Two parallel lines shall be scribed one inch apart with a new Exacto or scalpel blade, no closer to the edge of the sample than one inch. This scribing shall be through the coating to the substrate. If the cut does not reveal the substrate, then two new cuts shall be made in a different area; do not attempt to deepen a previous cut. A strip of 3M 250 tape a minimum of 3.5 inches in length shall be placed perpendicular to the scribed lines. Allow enough tape for one inch overhang of each scribe line plus enough to grip. Tape equivalent to 3M 250 in peel strength may be substituted. Use a weighted roller, eraser, or finger to ensure a good bond

between tape and coating. Remove the tape in a single smooth motion, and inspect the sample. Any apparent peeling or debond more than 1/16-inch wide shall be considered a failure.

Adhesion may also be tested according to ASTM-D3359, test method A. A rating of 3A or lower (section 7.7 of ASTM-D3359) shall be considered a failure.

3.2 Process Control Requirements

3.2.1 Process Control Documentation

A suitable document shall be used to provide instructions to the operator, to record compliance to the requirements specified herein, and to achieve traceability. The form or document shall be completely filled in, including hardware serial numbers and spacecraft models. Special handling, control, or precautions shall be noted on the document.

3.2.2 Paint Identification and Control

The lot number of the paint used shall be recorded to maintain traceability. Witness samples shall be prepared, during the processing of parts, in accordance with 3.2.2.1 and identified with the processed parts.

3.2.2.1 Witness Samples

Witness samples for paint adhesion, solar absorptance, and infrared emittance tests for each application of the same lot of paint shall be prepared from the same type material (alloy and temper) as the hardware (where applicable). Witness samples shall consist of three samples measuring a minimum of 3 x 3 inches on smaller hardware and 3 x 6 inches on larger hardware and a minimum thickness of 0.040 inch. Samples for resistivity/conductivity measurements may also be required, with measurements to be determined by the project. Surface preparation, priming, coating, and curing of the witness samples shall be done in the same manner and at the same time as the hardware.

3.2.3 Thickness Measurements

Thickness measurements for Class I and Class II process shall be as follows:

a. Class I. Class I thickness measurements shall be made directly on the workpart, after the paint has been applied and cured, using an approved thickness gage and the measuring procedure specified in 4.2.3.
b. Class II. Class II thickness measurements for control of the paint spraying process, independent of the configuration of parts, shall be made on the 3 x 6 inch or 3 x 3 inch witness samples.

3.2.4 Storage and Shelf Life

The shelf life of the thermal control paint shall not be exceeded. The pot life shall be considered to begin with time of mixing of binder and pigment components or when adding deionized water. Unmixed pigment may be stored indefinitely provided the container is kept closed when not

being used and kept under normal lab conditions. See manufacturers specifications for individual shelf life of product.

3.2.5 Hardware Release

Once a part has been submitted for processing, it shall not be released until it has completed the curing process specified in 3.4.5.

3.3 Cleanliness Requirements

The thermal control paint shall be applied in a paint-room facility, specifically designated to serve as a thermal control paint application facility, to assure that the applied coating meets the requirements specified herein. Surface preparation, precleaning, inspection, storage, and operations subordinate to paint application shall be performed in an environment adequately contamination controlled to assure compliance with the requirements specified herein. The thermal control paint shall not be applied prior to any mechanical operations such as machining, drilling, forming, or welding. Adhesive bonding on surfaces to be painted shall have been completed prior to paint application.

3.3.1 Protection of Parts

During and after an operation specified herein, parts shall be handled in a manner that will minimize biogenic substance, dust, or other foreign matter from contaminating the surface being processed. For the purpose of this specification, fingerprints, perspiration, dandruff, hair, and saliva shall be considered biogenic contamination. Protection may include clean drape material, hardcovers, shipping containers, etc. In all cases, flight hardware shall be protected from temperature extremes, high humidity, contamination, and physical damage. Temperature and humidity parameters are defined in 3.3.2.1 and 3.3.2.2. Parts shall meet visibly clean standard per IEST-STD-CC1246 unless otherwise specified in the associated design specification/ drawing.

3.3.2 Paint Facility Cleanliness and Environmental Requirements

3.3.2.1 Temperature

Recommended temperature range is 60 °F to 95 °F (15 to 35 ºC) during the processing of parts (precise temperature control is non-critical).

3.3.2.2 Humidity

a) The relative humidity during surface preparation is **not critical**; normal building facility levels are acceptable.
b) The relative humidity during spraying **is critical** and shall be maintained at a range of 50% - 80% during spraying of silicate paints.
c) The relative humidity during the cure process **is critical** and shall be maintained per section 3.4.5.

3.3.2.3 Intake Air Filters

All intake air to the paint facility shall be drawn through filters having a minimum efficiency for 30% on the NBS atmospheric dust test. Filter elements shall be changed with sufficient frequency to assure efficient dust removal.

3.3.2.4 Air Flow

a) Air flow within the spraying area shall be restricted to a minimum level that shall not cause undue water evaporation from the coating.
b) Immediately upon completion of the spraying operation, the parts shall be removed to an area wherein humidity can be controlled at the level specified in 3.3.2.2 and air flow can be held near to zero (0 - 10 ft^3/min.).

3.3.2.5 Personnel Protection

All precautions for personnel protection shall be observed to prevent the inhalation of fumes or dust generated by vapor degreasing, surface treatment, and spray painting. This may include respirators, gloves, and protective clothing such as "bunny suits".

3.4 Process Requirements

The standard process for the application of thermal control paint shall consist of masking of areas to be free of paint, surface preparation by chemical or mechanical methods, cleaning, primer and paint application, paint cure, and special handling of parts.

3.4.1 Masking

Surfaces that are to be free of paint shall be masked with pressure sensitive tape or, in the case of a large area to be masked, a combination of approved plastic film and pressure sensitive tape. Parts that are subject to damage by tape removal such as thin gage materials, thin plating, or surfaces subject to possible contamination by tape adhesive, e.g. dry film lubricants or optical components, shall be so noted on a traveler. Contact with thermal control surfaces shall be kept to an absolute minimum. Approved gloves shall be worn at all times. At all times, parts shall be handled in a manner that will prevent bio-organic substances (e.g., fingerprints, perspiration, dandruff, hair, and saliva), dust, or other foreign matter from contaminating the surfaces being processed. Extreme care shall be taken to avoid contamination of the coating. Parts and assemblies containing holes or fasteners shall be suitably masked during surface preparation and painting.

3.4.1.1 Masking Materials

Paper backed pressure sensitive adhesive tape shall be used. Tapes that have met strict contamination control requirements include 3M Scotch Tapes #1170 and #232 and Orcotape OT-7. In general, tapes with acrylic adhesive are acceptable, tape with silicone adhesive shall not be used. A cellophane or Mylar® pressure sensitive adhesive tape of 0.5 mil nominal thickness may be used in special areas where a heavy buildup along the tape edge is undesirable. Drilled holes may be plugged with approved material to maintain hole tolerance. Foil tapes may be used to prevent overspray onto adjacent hardware. Masking films compatible with cutting plotters may also be used provided they are not a contamination source.

If applying MLP-300-AZ primer (see 3.4.2.3), select a masking material compatible with the solvents used in the primer application. This masking material should also be compatible with the primer cure of 212 ºF (100 °C) for 48 hours. Otherwise, select the longer air cure or demask prior to primer curing to prevent significant contamination from adhering pressure sensitive adhesive.

3.4.1.2 Masking Procedure

Masking tape shall be applied in a manner that will seal all surfaces to be left unpainted or protected from paint overspray. Pulling or stretching of the tape around contours shall be avoided. Pressure shall be applied to seal progressively away from one end of the tape strip. A Teflon Tool may be needed/used to burnish tape edges to assure proper sealing of tape edges.

3.4.2 Surface Preparation

Surfaces to be painted shall be cleaned and prepared in accordance with the procedures specified in the following paragraphs and per applicable drawings. Metal surfaces shall be prepared for coating by either mechanical abrasion per section 3.4.2.1 and, when applicable, by application of a primer coating. Note: Conversion coatings such as alodine must be fully removed from any surface that is to be coated. Failure to remove the conversion coating will result in contamination of the coating.

Composite substrates may require thermal bakeout or thermal vacuum bakeout to remove volatile compounds prior to coating application. Failure to remove these volatiles from the substrate prior to coating application may result in discoloration and possible delamination of the coating. Bakeout should be performed at 18 ºF (10 ºC) above the expected maximum spacecraft temperature for 24 hours.

3.4.2.1 Mechanical Surface Preparation

Polished or machined aluminum or stainless steel may, if allowed, be abraded with 180-240 grit aluminum oxide paper or cloth, or Scotchbrite type abrasive pads to a water-break-free condition per ASTM F22. A dry grit blast with 100 to 150 grit aluminum oxide may be allowed. Following abrasion, the surface shall be solvent cleaned according to 3.4.2.2.

3.4.2.2 Solvent Cleaning

The surface to be painted shall be solvent cleaned with xylene or other approved solvent using clean lint-free cloth and liberal amounts of solvent. A final wipe down/cleaning using isopropyl alcohol and/or electrical grade ethyl alcohol is to be performed. Cleaning cloths and gloves used during this procedure shall be compatible with the applied solvents. The lint-free material shall be changed frequently to remove contamination and avoid smearing of contaminant residue. Solvents required by this instruction must be used in well ventilated areas. Personnel performing the cleaning shall wear non-contaminating protective gloves and other protective gear as required. The painting operation shall immediately follow final solvent cleaning and natural drying of the solvent.

An alternative to the solvent cleaning is cleaning with a 10% solution of Alconox or approved equivalent detergent followed by a rinse with distilled water.

The surface shall be water-break free and thoroughly dry prior to coating application.

3.4.2.3 Primer Application

After surface preparation and cleaning, surfaces may be primed as applicable. Priming is recommended for most substrates other than bare aluminum such as titanium, composites, stainless steel, nickel, etc. For the AZ Technology coatings, the primer is MLP-300-AZ with Part B catalyst. MLP-300-AZ is not required for bare aluminum substrates, however, it is advised to use the primer with AZ-2000-IECW on complex surfaces to promote the proper levels of adhesion. MLP-300-AZ is to be applied to a coating thickness of 0.75 mil (0.00075 in) +/- 0.25 mil (0.00025 in). The ratio for mixing is 100 +/- 0.01 by weight MLP-300-AZ base resin to 6.50 +/- 0.01 by weight Part B catalyst. Optional solvents for thinning are xylene 80 +/- 0.01 by weight and isopropyl alcohol 20 +/- 0.01 by weight for a total of 206.50 +/- 0.04 by weight.

MLP does not require the high relative humidity during application that the silicate coatings do.

The primer may be cured using one of the two following recommended methods.
Method A

- Air cure the primer coating at elevated room temperature (100 +/-10 ºF) (38 +/- 5 ºC) for a minimum period of 168 hours (7 days). Cure temperature, if possible, should be above 100 ºF (38 ºC).

- Maintain low relative humidity (< 30% RH) during cure.

Method B

- Air dry the coating at room temperature for a minimum of 1 hour.

- Place coated hardware in a 212 ºF (100 °C) oven for a minimum of 48 hours.

3.4.2.4 Special Considerations

Components that might be adversely affected by common solvents should be noted and shall not be exposed to these solvents. Where safety regulations prohibit the use of specified flammable solvents, non-flammable solvents may be used.

3.4.2.5 Post Cleaning Requirements

All operations subsequent to cleaning shall be performed by personnel wearing clean, dry, powder-free cotton, dacron, nylon, nitrile, naglene, or latex gloves, except as noted. Handling of parts and assemblies shall be kept to a minimum. Gloves shall be changed with sufficient frequency to assure cleanliness. Cleaned parts may be covered in a protective wrapping of clean, neutral film materials such as Capran® 980, Tedlar®, or plain polyethylene. Parts shall be painted as soon as possible after final cleaning and drying or after being removed from the clean-protective wrapping.

3.4.3 Paint Application

3.4.3.1 Equipment

The following equipment (or approved equal) shall be used for the application:

a) Either an HVLP (High Volume Low Pressure) system and spray gun equipped with pressure cup or pure dry nitrogen with appropriate spray gun and 5 micron filter for small parts.
b) Viscometer, Brookfield Viscometer.
c) Electronic thickness tester.
d) Powder-free nitrile gloves or equivalent.
e) Wet thickness gage.
f) Alpha wipes.

3.4.3.2 Mixing and Preparation

The pigment and binder or part A and part B are mixed in the same ratio as received per kit. Refer to the specific manufacturer coating specifications for milling instructions. In general, the grinding jar should be 30% filled with assorted balls (1/2" - 1"). Add mixed coating. Coating plus balls shall not exceed 60-75% of jar volume. Balls should not be visible above coating surface. The jar then can be rolled on a jar-rolling machine to achieve uniform consistency and spraying viscosity. Do not overgrind, as this adversely affects the optical properties of the white coatings.

3.4.3.3 Pressure and Gas

The following pressurized gases are suitable for paint spraying:

1. Nitrogen meeting A-A-59503, Type I, Class I, Grade A
2. High purity air or nitrogen.

The pressure at the nozzle of the spray gun shall be sufficient to apply a smooth coating (approximately 35 to 45 pounds per square inch (psi)). A 5 micron filter shall be inserted into the pressurizing gas line to remove particulate matter.

3.4.3.4 Rub Priming

Rub prime prior to spray application to achieve proper adhesion of the spray topcoat and reduce risk of adhesion failure.

a) Pour a small amount of prepared coating material on to an alpha wipe or equivalent wiper. If the material is pasty, lightly dampen with approved 18 MΩ water.

b) Rub the coating into the surface using a circular motion while exerting a moderate amount of force without causing deformation of the component.

c) Continue until the component acquires a uniform light grayish-white haze in appearance over the entire surface.

d) The rub prime coat shall be cured per manufacturer's specifications (typically between 1 and 16 hours) at an approximate relative humidity of 40 to 80% and a temperature between 60 °F to 95 °F (15 to 35 ºC). Cure shall not exceed a duration of 72 hours before the topcoat is deposited onto the component.

3.4.3.5 Spray Painting Procedure

Thermal control paint shall be applied over clean, dry substrate. The paint shall be applied in the required viscosity range with the appropriate spray gun or air brush. The line pressure and spray gun controls shall be adjusted to provide a uniform coating. Pressure required to obtain a uniform coating shall be determined by the operator. The coating shall be sprayed, preferably in a vertical plane, in a uniform thickness for each coat. The paint shall be applied as an initial, thin "tack" or "fog" coat followed by wet, heavy cross coats, allowing for water flash-off between coats. Periodic swirling of the paint container during spraying should be done to prevent pigment settling. The paint shall be applied to provide the total nominal thickness specified in section 3.1.1.

3.4.4 Thickness Verification and Demasking

After the application of paint and prior to demasking, the paint thickness shall be measured to verify that the thickness requirement of section 3.1.1 has been met. Demasking shall be performed carefully to avoid pulling or stressing of the paint. In the event masking tape adhesive remains on the untreated surface, the surface shall be carefully cleaned, avoiding contact or contamination of the painted surface with solvents. To remove adhesive residue from the tape on a bare, unpainted surface, wipe the surface carefully with a cotton swab saturated with isopropyl alcohol or electrical grade ethyl alcohol or other approved solvent and allow to dry. To remove adhesive residue from the tape on cured, painted surfaces, wipe the surface carefully with a cotton swab saturated with alcohol or other cleaner specified in the associated design specification/drawing. Cleanup of residue should wait until cure is complete lest the solvents weaken the uncured coating.

3.4.5 Curing

The absolute minimum cure for these coatings is at room temperature for 5 to 6 hours at greater than 50% relative humidity, followed by a minimum of 7 days at ambient conditions in a designated clean area. Adequate care shall be taken to avoid contamination of the coating throughout the process. Do not put coated flight hardware in a vacuum prior to the completion of the 7 day cure, or adhesion problems will occur.

The recommended 7 day curing schedule for the AZ Technology coatings is as follows, for optimum adhesion and coating performance:

a) Temperature: 60 ºF to 95 ºF (15 to 35 ºC) (precise temperature is not critical).

b) Initial humidity at the end of or immediately after coating application shall be in the range 60% to 80%.

c) Day 1 and Day 2. Humidity should remain between 60% and 80%. Fluctuations are allowable, but one should avoid step downs (e.g., staying steady around 80% for a number of hours and then suddenly stepping down to 60% and staying steady at 60%).

d) Day 3 through Day 6. Average humidity should be slowly lowered. Step downs shall not exceed 10% over any 24 hour period. At the end of day 6, humidity should be between 25% and 40%.

e) Day 7. Humidity should remain between 25% and 40% and step downs should be avoided. Note: For AZW/LA-II it is recommended that the cure be extended for 3 extra days with conditions held the same as for Day 7.

f) After curing is completed, hardware shall be covered with an approved clean room bagging material such as Tedlar or Capran 980 for storage in a clean environment with humidity between 25% and 40% until ready for bagging and shipping.

Upon completion of the curing cycle, parts shall be handled only by operators wearing latex, nylon, or dacron gloves and protective clothing to prevent contamination and fingerprints.

3.4.6 Reapplication

Damaged or gouged surfaces shall be recoated by means of a camel's hair or other suitable brush and shall be allowed to dry for 30 minutes between successive coats. Refer to manufacturer's specifications for repair.

4.0 QUALITY ASSURANCE REQUIREMENTS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may use their own facilities or any commercial laboratory acceptable to the procurer. The procurer reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to the prescribed requirements.

4.2 Inspection

Spacecraft flight hardware and parts processed in accordance to this specification shall be inspected before and after painting to ensure requirements are enforced.

4.2.1 Prepainting Inspection

Surfaces to be coated shall be inspected by water break test per ASTM F22 prior to painting for conformance to surface preparation requirements of 3.4.2 and for contamination by oil, grease, dirt, biogenic and other contaminants.

4.2.2 Coating Inspection

Coated surfaces shall be visually inspected for uniformity and freedom from discoloration and other gross contamination, cracks, peeling, and blisters.

Micro-cracks of a length of less than 1/4 inch in length are not cause for rejection of a coated part. Cracks tend to form in inorganic coatings as the water evaporates.

The paint shall be adherent, uniform in color, and generally uniform. Minor roughness associated with coating repairs, unavoidable paint runs, or small inclusions in the paint shall not be cause for rejection of the coating. No primer material should be visible except at masked or sharp edges where the topcoat has experienced pullback.

4.2.3 Coating Thickness Inspection

The paint thickness shall be measured on the part or on the reference sample, as appropriate per 3.2.3, and recorded on the control request form. Use of ASTM D1400, ASTM D7091 or ASTM E376 measurement techniques is acceptable. Excessive coating thickness at coating repairs shall be acceptable. Paint thickness at runs and sags which do not exceed two times the nominal paint thickness shall be acceptable. If paint thickness is measured by other than direct reading on the part, the inspection record shall clearly indicate the method used. Paint thickness requirements are given in section 3.1.1.

4.2.4 Witness Samples

The witness samples prepared in accordance with 3.2.2.1 will be tested for paint adhesion, solar absorptance, and infrared emittance. Adhesion requirements are given in 3.1.3. Solar absorptance and infrared emittance requirements are given in 3.1.2. In rare circumstances, solar absorptance and infrared emittance may be measured directly on the hardware. Paint adhesion testing with scribing shall not be performed on hardware.

5.0 PACKAGING

Parts that have completed processing (see 3.4.5 for curing) shall be wrapped in appropriate clean room film, then wrapped in paper and sealed with tape. Film packaging material and protective wrapping shall consist of clean, neutral, unplasticized film. Film materials suitable for wrapping or covering painted surfaces are: Capran 980 or other clear, heat-stabilized Nylon 6 film, such as NBF-980, Tedlar, Teflon FEP, Mylar, or plain clear (not pink) polyethylene. Capran 980 should not be used where electrostatic discharge is a concern. Neutral paper conforming to MIL-P-17667B or Capran 512H film shall be used for external wrapping. Appropriate packaging or masking tape shall be used for closure.

6.0 NOTES

6.1 Vendors

The coatings and primers described herein may be purchased from the following vendors:

Alion Science & Technology, 10 West 35th Street, Chicago, IL 60616
AZ Technology, Inc., 180 West Park Loop NW, Huntsville, AL 35806

APPENDIX A. DEFINITIONS/ACRONYMS

α	solar absorptance
ε	infrared emittance
C	Celsius
cm	centimeter
F	Fahrenheit
FEP	fluorinated ethylene propylene
HVLP	High Volume Low Pressure
in.	inch
lb.	pound
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
psi	pounds per square inch
TBD	to be determined