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

**MEASUREMENT
SYSTEM
IDENTIFICATION
INCH-POUND**

MSFC-SPEC-2497

REVISION F

EFFECTIVE DATE: 06-05-2015

**EM40
MSFC TECHNICAL STANDARD
REQUIREMENTS FOR HAND WIPE CLEANING**

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| Revision | B | 3/17/97 | Revision B supersedes revision A and all changes in its entirety. |
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1.0 SCOPE

This specification establishes the requirements for use of environmentally compliant hand wipe cleaners on surfaces. When a critical process, as defined by the respective Project Office utilizes any hand cleaning operations of this specification, the cleaning process will be a part of the critical process.

Contractors and subcontractors (hereinafter, “contractors”) may use other specifications if they have prior approval of National Aeronautics and Space Administration (NASA) Marshall Space Flight Center (MSFC) Materials and Processes (M&P) and meet the product requirements along with the intent of this specification.

1.1 Implementing Documentation

Implementing documentation, such as manufacturing process instructions and process plans and procedures, will contain sufficient detailed instructions and guidelines on operating parameters to ensure reliable and consistent quality processing of hardware. Any subcontractor proposed variations to materials or processes specified in this document will be submitted to NASA MSFC M&P for approval. Approval by NASA MSFC M&P is required before implementation. The contractor will supply necessary technical and supporting test data and Safety Data Sheets.

1.2 Requirements with Limited Applicability to Programs/Projects, Hardware items, or contractors

This specification includes requirements that have applicability to specific program/projects, hardware items, or contractors. When a requirement has limited applicability, the program/project or hardware item applicability is identified preceding the requirement (i.e. paragraph heading or preceding sentence) or is identified in parentheses immediately following the requirement. When requirements include references to contractor documents, those requirements are only applicable to the contractor that originated the applicable document. Access to contractor documentation is only available from the issuing contractor.

1.2.1 Space Launch System (SLS)

MSFC-SPEC-2497 is a critical process for Space Launch System (SLS) hardware per the SLS Element Offices. The qualification tests conducted during the Space Shuttle program are still applicable for use on the SLS Booster Element. These requirements are included for the Booster including the Five Segment Reusable Solid Rocket Motor (RSRMV).

2.0 APPLICABLE DOCUMENTS

| Multiprogram/Project Common-Use Document EM40 | | |
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2.1 Government Documents

The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or requests for proposals will apply.

2.1.1 NASA

| | |
|----------------|---|
| MSFC-SPEC-1918 | Ablative Compound, Thermal |
| MSFC-SPEC-2489 | Cleaner, Organic |
| MSFC-SPEC-2490 | Cleaner, Organic With D-Limonene |
| MSFC-SPEC-2491 | Cleaner, Aqueous |
| MSFC-SPEC-2945 | Cleaner, DS-104, General Specification For |
| MPCV 70156 | Cross Program Fluid Procurement and Use Control Specification |
| SE-S-0073 | National Space Transportation System Specification, Fluid Procurement and Use Control |

2.1.2 Military

| | |
|--------------|---|
| MIL-I-631 | Insulation, Electrical, Synthetic-Resin Composition, Nonrigid |
| MIL-PRF-6855 | Rubber, Synthetic, Sheets, Strips, Molded or extruded shapes, General Specification for |

2.1.3 Federal

| | |
|----------|----------------------------|
| TT-I-735 | Isopropyl Alcohol, Grade A |
|----------|----------------------------|

2.2 Non-Government Documents

The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposals will apply.

2.2.1 Standards

| | |
|------------|---|
| A-A-59474 | Insulation Tape, Electrical; High Temperature, Polytetraflouroethylene Pressure Sensitive |
| AMS-3819 | Cloths, Cleaning for Aircraft Primary and Secondary Structural Surfaces |
| ASTM D329 | Standard Specification for Acetone |
| ASTM D1193 | Standard Specification for Reagent Water |

2.2.2 Orbital-ATK Documents

NOTE: Copies of Orbital-ATK documents may not be obtained through NASA.

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STW4-9005C Methyl Chloroform (1,1,1 Trichloroethane)

3.0 REQUIREMENTS

3.1 Equipment and Materials

Materials, processes, procedures, and equipment used for storing, handling and applying the cleaners shall not introduce contamination to the substrates being cleaned.

3.1.1 Shelf Life

Shelf life requirements for materials, if applicable, shall be verified prior to use.

3.1.2 In-Process Material

If the integrity of in-process material is at any time suspect (e.g. liquid-phase separation, not free flowing, cloudy, foreign material or precipitate present), the material in question shall be either recertified or discarded.

3.1.3 Preproduction Contamination Control

Work areas shall be protected from applicable contamination sources. This definition will be established by program plans or other applicable documentation. Tools shall be visibly clean prior to start of operations. Eating, drinking, and use of tobacco products in the work area shall not be permitted. Personnel directly involved with exposed sensitive surfaces of components are required to have satisfactorily completed control training or Foreign Object Damage/Debris (FOD) training.

3.1.4 Materials

| <u>NAME</u> | <u>IDENTIFICATION</u> |
|----------------------------------|-------------------------------------|
| Cleaner, Organic | MSFC-SPEC-2489 |
| Cleaner, Organic With D-Limonene | MSFC-SPEC-2490 |
| Cleaner, Aqueous | MSFC-SPEC-2491 |
| Cleaner, DS-104, General | |
| Specification For | MSFC-SPEC-2945 |
| 1,1,1 – Trichloroethane | STW4-9005C |
| Cleaning, Low-Lint Cloths | AMS 3819, Texwipe 318 or equivalent |
| Isopropyl Alcohol (IPA) | TT-I-735 |
| Water | Grade A per SE-S-0073, MPCV 70156 |
| Acetone | ASTM D329 |

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3.2 Toxic Products and Safety

The Vendor shall furnish a Safety Data Sheet (SDS) to the procuring activity. The user of this specification shall be responsible for implement the necessary safety procedures/precautions.

3.3 Personnel Certification

All processing shall be performed by personnel that are skill certified for the processes governed by this specification. Training and certification plans will be created, defined and regulated by each program.

3.4 Cleaner Selection

Usage of environmentally compliant cleaners is based primarily on the surface being cleaned. Cleaning shall be performed per paragraph 3.5 for the contaminants listed in Table I and the surfaces listed in Table II.

3.4.1 Metal

Metal surfaces shall be cleaned using MSFC-SPEC-2489 cleaner and shall meet the applicable cleanliness criteria specified in section 4.1. If the contaminant is identifiable and cannot be removed by the Table II specified cleaner, use a cleaner specified in Table I.

3.4.2 Primed and Topcoated Surfaces

Primed and topcoated surfaces shall be cleaned using MSFC-SPEC-2489 cleaner and shall meet the applicable cleanliness criteria specified in section 4.1. If the contaminant is identifiable and cannot be removed by the Table II specified cleaner, use a cleaner specified in Table I.

Table I. Contaminants and Cleaners for Metal and Painted Surfaces

| Contaminants | Hardware | Cleaner(s) | Dry Time |
|-------------------------------|--------------|----------------|------------|
| Machinist Ink | Non-RSRMV | ASTM D329 | 15 minutes |
| | | MSFC-SPEC-2945 | 30 minutes |
| Part Marking Ink ¹ | Non-RSRMV | ASTM D329 | 15 minutes |
| | | MSFC-SPEC-2945 | 30 minutes |
| Clear Overcoat ² | All Hardware | ASTM D329 | 15 minutes |
| | Non-RSRMV | MSFC-SPEC-2945 | 30 minutes |
| Tape Residue ³ | All Hardware | MSFC-SPEC-2490 | 15 minutes |
| | Non-RSRMV | ASTM D329 | 15 minutes |
| | Non-RSRMV | MSFC-SPEC-2945 | 30 minutes |

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| Contaminants | Hardware | Cleaner(s) | Dry Time |
|---|--------------|----------------|------------|
| Grease Pencil, Paper Identification Label, DC-1200 Primer | All Hardware | MSFC-SPEC-2490 | 15 minutes |
| Residual Uncured PR-1422 ^{3,4} | All Hardware | MSFC-SPEC-2490 | 15 minutes |
| | Non-RSRMV | ASTM D329 | 15 minutes |
| | Non-RSRMV | MSFC-SPEC-2945 | 30 minutes |
| Primer/Topcoat Oversprays | Non-RSRMV | MSFC-SPEC-2489 | 15 minutes |
| | | MSFC-SPEC-2490 | 15 minutes |
| | | ASTM D329 | 15 minutes |
| | | MSFC-SPEC-2945 | 30 minutes |

¹(NON-RSRMV Only) For bare metal surfaces, ASTM D329, TT-I-735 or MSFC-SPEC-2491 may also be used to remove the contaminants. Allow 15 minutes dry time minimum, before performing additional processing.

²(NON-RSRMV Only) For bare metal surfaces, ASTM D329 or MSFC-SPEC-2945 may also be used to remove the contaminant. Allow 15 minutes dry time for ASTM D329 and 30 minutes dry time for MSFC-SPEC-2945 minimum, before performing additional processing.

³Suitable hand tools shall be used, if required.

⁴ASTM D329 and MSFC-SPEC-2945 shall not be used on Hypalon topcoats.

Table II. Surface and Corresponding Cleaner

| Material Family | Surface | Cleaner | Dry Times** |
|---------------------------------|--|----------------|-------------|
| Metal | Aluminum (AL)-Bare Aluminum-Anodized Aluminum-Alodined Inconel-Bare Alloy Steel-Bare & Cadmium Plated Stainless Steel-Bare Titanium-Bare Lead | MSFC-SPEC-2489 | 15 minutes |
| Primed and/or Topcoated Surface | Deft Primer 44GN007 Deft Topcoat 03W127A Low VOC Deft Topcoat 02Y040A – Aluminum, Stainless Steel | MSFC-SPEC-2489 | 15 minutes |

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| Material Family | Surface | Cleaner | Dry Times** |
|---------------------------------|--|---|-------------|
| | Low VOC Deft Primer 99W009 – Aluminum, Stainless Steel Topcoat-Rust-Oleum A93 3315 Primer-Rust-Oleum A93 9518 Hypalon Topcoat H-27 Acrymax Topcoat SP130XT-LV Chemlok Zinc-Rich Primer Hentzen Primer 05510WEP-X Hentzen Topcoat 4600CHA-SG | | |
| Thermal Protection System (TPS) | BTA MSFC-SPEC-1918 RT455 | MSFC-SPEC-2489 | 30 minutes |
| | Cork | TT-I-735 | 30 minutes |
| Rubber Material | EPDM | MSFC-SPEC-2489 | 15 minutes |
| | Silicone | MSFC-SPEC-2491 | 15 minutes |
| | NBR | ASTM D4126 or MIL-T-81533 | 30 minutes |
| | Aft Inhibitor Liner | Water per 3.1.4 | 30 minutes |
| Plastic | Plastic Sealant Cap | MSFC-SPEC-2489 | 15 minutes |
| Composite Materials | EA-934NA | MSFC-SPEC-2489 | 15 minutes |
| | Carbon or Glass Phenolic | MSFC-SPEC-2489 | 60 minutes |
| | Propellant | ASTM D4126, MIL-T-81533 or MSFC-SPEC-2490 | 60 minutes |
| Sealant | RTV-133 PR1422 3-6077 RTV | MSFC-SPEC-2489 | 15 minutes |
| Cable and Cable Assemblies | Cable (Teflon, Ether Base Polyurethane, Kapton, Polyolefin, MIL-R-6855, MIL-I-631, AMS-DTL-23053 | MSFC-SPEC-2489* | 15 minutes |

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| Material Family | Surface | Cleaner | Dry Times** |
|-----------------|---|----------------|-------------|
| Nylon | Mounting Base | MSFC-SPEC-2489 | 15 minutes |
| Teflon Tape | A-A-59474 | MSFC-SPEC-2489 | 15 minutes |
| Thermal Tape | Silicon Rubber | MSFC-SPEC-2491 | 15 minutes |
| Viton | O-Ring V-2 Filler <u>Packing with Retainer</u> <u>S&A Gaskets</u> | TT-I-735 | 15 minutes |
| | | None | |
| Miscellaneous | Solid Film Lube Thermal Curtains Fused Silica Glass Fused Silica Glass with MgF ₂ Coating | TT-I-735 | 15 minutes |

All cleaners may have incidental contact on all surfaces, provided the required dry times specified in paragraph 3.5 are met before additional processing with the following exceptions:

- a. If incidental contact occurs between MSFC-SPEC-2491 or water and alloy steel surfaces, reclean the affected surface per paragraph 3.5.1
- b. If incidental contact with cork surfaces occurs, a one-hour dry time, minimum, is required before additional processing can be performed. If incidental contact occurs with bare Marshall Convergent Coating (MCC-1) surfaces, a two hour dry time is required before additional processing can be performed.
- c. If incidental contact of closed cable connectors with an unapproved cleaner occurs, dry the affected surface with a low-lint cloth and reclean per paragraph 3.5.1 with the approved cleaner. Incidental contact of an open connector with an unapproved cleaner is not permitted.

* Cables may also be cleaned with TT-I-735.

**There is no required dry time between hand wipe cleaning operation and abrading operation. As a minimum, the dry time requirement is to be met between final hand wipe cleaning of substrate and application of subsequent material.

3.4.3 TPS Materials

Thermal Protection System (TPS) materials shall be cleaned using the specified cleaner in Table II. Cleaned TPS surfaces shall meet the applicable cleanliness criteria specified in Section 4.1.

3.4.3.1 BTA

Booster Trowellable Ablator shall be cleaned using MSFC-SPEC-2489 cleaner.

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3.4.3.2 RT455 (MSFC-SPEC-1918)

RT455 shall be cleaned using MSFC-SPEC-2489 cleaner.

3.4.3.3 MCC-1

Bare MCC-1 is not cleaned with liquid cleaners. If incidental contact occurs with MCC-1, a two hour dry time, minimum, is required before additional processing can be performed.

3.4.3.4 Cork

Cork shall be cleaned using TT-I-735.

3.4.4 Foam

Foam (PR-855) is not cleaned with liquid cleaners. Foam shall be cleaned by mechanically removing the contaminated foam and shall meet the applicable cleanliness criteria specified in Section 4.1.

3.4.5 Composite Materials

Composite materials shall be cleaned using MSFC-SPEC-2489, except propellant shall be cleaned using ASTM-D4126, MIL-T-81533 or MSFC-SPEC-2490, cleaner and shall meet the applicable cleanliness criteria specified in Section 4.1.

3.4.6 Sealant

Sealants shall be cleaned using MSFC-SPEC-2489 cleaner and shall meet the applicable cleanliness criteria specified in Section 4.1.

3.4.7 Cable Assemblies

Cable assemblies shall be cleaned using MSFC-SPEC-2489 (Cables may also be cleaned with TT-I-735) and shall meet the applicable cleanliness criteria specified in Section 4.1. Cable connectors are not cleaned per this specification.

3.4.8 Thermal Tape

Thermal tape shall be cleaned using MSFC-SPEC-2491 cleaner and shall meet the applicable cleanliness criteria specified in Section 4.1.

3.4.9 Nylon

Nylon shall be cleaned using MSFC-SPEC-2489 cleaner and shall meet the applicable cleanliness criteria specified in Section 4.1.

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3.4.10 Rubber

EPDM shall be cleaned using MSFC-SPEC-2489. Silicone shall be cleaned using MSFC-SPEC-2491. NBR shall be cleaned using ASTM D4126 or MIL-T-81533 and the Aft Inhibitor Liner shall be cleaned using water per 3.1.4. After cleaning, all surfaces shall meet the applicable cleanliness criteria specified in Section 4.1.

3.4.11 Plastic

Plastics shall be cleaned using MSFC-SPEC-2489 cleaner and shall meet the applicable cleanliness criteria specified in Section 4.1.

3.4.12 Teflon

Teflon shall be cleaned using MSFC-SPEC-2489 and shall meet the applicable cleanliness criteria specified in Section 4.1.

3.4.13 Viton

Viton (except S&A gaskets) shall be cleaned using TT-I-735 and shall meet the applicable cleanliness criteria specified in Section 4.1. S&A gaskets shall be cleaned with a dry, lint-free cloth only.

3.4.14 Miscellaneous

Solid film lube surfaces shall be cleaned using TT-I-735 and shall meet the applicable cleanliness criteria specified in Section 4.1. Thermal curtains (and their associated surfaces) shall be cleaned using TT-I-735 and shall meet the applicable cleanliness criteria in Section 4.1. Fused Silica Glass and Fused Silica Glass with MgF₂ coating shall be cleaned using TT-I-735 (Isopropyl Alcohol) and shall meet the applicable cleanliness criteria specified in Section 4.1.

3.5 Cleaning Procedure

Cleaners shall be in accordance with Table II or Paragraph 3.4. Materials used shall be in accordance with Paragraph 3.1.4. Cleaning methods are specified below:

3.5.1 Method I – Organic Cleaning

Organic cleaner specifications are:
MSFC-SPEC-2489
MSFC-SPEC-2490
TT-I-735

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ASTM D4126
MSFC-SPEC-2945

MIL-T-81533
ASTM D329

The cleaning process for these cleaners is as follows:

- a. Wipe surface with a clean, low-lint cloths(s) lightly dampened with the specified cleaner.
- b. Repeat step “a” until no contaminants are evident on cleaned surface.
- c. Wipe surface again with a clean, dry, low-lint cloth before the cleaner completely evaporates.
- d. Prior to sealant application, repeat dry wiping process, replacing cloth as necessary, until no cleaner is evident on the cleaned surface.
- e. As a minimum, follow the dry times in Table II after the final dry wipe before beginning subsequent processing for specified surfaces.
- f. Special contaminants may be cleaned using cleaners and dry times per Table I if cleaners in Table II did not cover the contaminant.

3.5.2 Method II – Aqueous Cleaning

Aqueous cleaning shall be performed with MSFC-SPEC-2491 cleaner as follows:

- a. Wipe surface with a clean, low-lint cloth(s) lightly dampened with the specified cleaner.
- b. Repeat step “a” until no contaminants are evident on the surface.
- c. Wipe surface with a clean, low-lint cloth dampened with water.
- d. Wipe surface with a clean, dry, low-lint cloth before the water completely evaporates from the substrate surface.
- e. Prior to sealant application, repeat dry wiping process, replacing cloth as necessary, until no water is evident on cloth.
- f. As a minimum, follow the dry times in Table II after the final dry wipe before beginning subsequent processing for specified surfaces.

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3.6 Repair/Rework

For individual RT455 and BTA repairs, each of the underlying substrates shall be treated as a part of the same system and shall be cleaned using MSFC-SPEC-2489 cleaner followed by a one hour dry time, minimum.

For individual cork repairs, each of the underlying substrates shall be treated as part of the same system and shall be cleaned using TT-I-735 followed by one hour dry time, minimum.

All repair surfaces (RT455, BTA & cork) shall meet the cleanliness criteria specified in the applicable process specification requirement.

4.0 VERIFICATION

4.1 Process Verification

Process verification shall be in accordance with the applicable subsequent process specifications or drawing requirements. If no requirements are specified, then surfaces shall be cleaned to “visibly clean” criteria.

5.0 PACKAGING

Not applicable

6.0 NOTES

6.1 Definitions

6.1.1 Incidental Contact

Incidental contact occurs when a cleaner on a dampened, low-lint cloth comes in contact with a surface for which it has not been recommended for use. Incidental contact will not result in damage or contamination of the surface. The cleaning of a surface with the wrong cleaner is not acceptable unless otherwise specified within this document.

6.1.2 Visibly Clean.

Visibly Clean surfaces will be those that demonstrate an absence of all particulate and nonparticulate visible to the normal, unaided (except corrected vision) eye. Particulate is identified as a matter of observable length, width, and thickness. Nonparticulate is film matter without definite dimension. Observation distance will be 1 to 4 feet.

6.2 Modifications or Changes

Recommendations for modifications or changes to the requirements specified herein will be submitted in writing to the Office of Primary Responsibility Designee (OPRD) of this document at MSFC for consideration.

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