

SSTD-8070-0089-FLUIDS
Revision B
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John C. Stennis Space Center Surface Cleanliness Requirements For SSC Fluid Systems

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	<i>Number</i>	<i>Rev.</i>
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Document History Log

Revision Change	Date	Originator Phone	Description
Basic	07/03/02	M. Yentzen x87252	Initial release – supersedes SSC STD 79-001 Rev. K, with the following changes: New document number and format per SPG 1400.1; Change Center Ops signature title per NASA reorg.; 1.3.1 delete ref to SLP-05; 2.0 change refs per text mods, add SCD 54000-GM11; 5.1.1 Add Material and Process Control Team option; 5.2 change “can” to “may” throughout; 5.2.2 delete prohibition of HCFC-225g (AK-225g) on titanium alloys; 5.2.9 add new for <i>normal</i> -Propyl Bromide; 6.3 add note excluding level 2 and level 4; 10.0 change SLP-16 ref to new SSLP number; Appendix B: delete terms not used in the standard.
A	8/25/03	Doug Dike Ext 8-2803	2.0 deleted ASTM D1193 per text change in 5.4.1, 5.4.2 and 5.4.3; 5.4.1, 5.4.2 and 5.4.3 revised DI water requirements, including delete of reference to ASTM D1193, add of volume/area ratio limits and (in 5.4.2, particulate) qualifiers for complex configurations and surfactants; Table 1 new note ⌘ in “systems” block and footer listing for field dewpoint verification – subsequent notes renumbered; 6.5 revised for field dewpoint verification of assembled dump/vent systems open to the atmosphere. Note: mod to 6.5 and Table 1 incorporates changes per Variance NA63.
B	7/13/04	Dale Sewell Ext 8-2642	Added sentence to 5.2.9 that stipulates not to use <i>normal</i> -Propyl Bromide for NVR and/or particulate analysis of any type of Reflange Seal Rings. 6.5 was revised for weld prepared piping.

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1.0 INTRODUCTION

1.1 PURPOSE

This standard (STD) establishes the surface cleanliness requirements for fluid systems, components, and inspection, measuring and test equipment (IM&TE) at Stennis Space Center (SSC).

1.2 APPLICABILITY

This STD applies to site-wide facility components and systems that require cleanliness certification.

1.3 RESPONSIBILITIES

1.3.1 SSC Activities

NASA and Contractor personnel responsible for engineering design, manufacture/fabrication, analysis, inspection or test operations shall implement this STD. NASA and the Contractor shall ensure compliance with requirements of this STD through surveillance, auditing and process verification. Design specifications and drawings shall identify cleanliness levels by the alphameric or numeric designations defined in this STD. Revision or cancellation of this STD shall be reviewed and approved in accordance with SSC standard SSTD-8070-0005-CONFIG.

1.3.2 Quality Control

NASA and/or Contractor QA shall verify that the surface cleanliness requirements for SSC fluid systems are satisfied.

2.0 REFERENCED DOCUMENTS

The referenced documents form an integral part of this standard and their latest issues shall apply unless otherwise specified.

A-A-59150	Federal Specification: Cleaning Compound, Solvent, Hydrofluoroether (HFE)
AMS 3649	SAE Industry Standard: Film, PCTFE Unplasticized
ASTM D4080	Standard Specification for Trichloroethylene, Technical and Vapor Degreasing Grade
ASTM D4376	Standard Specification for Vapor-Degreasing Grade Perchloroethylene (vapor degreasing use only)

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ASTM D5501	Standard Test Method for Determination of Ethanol Content of Denatured Fuel Ethanol by Gas Chromatography
ASTM D6368	normal-Propyl Bromide (Ensolv®)
JSC SE-S-0073	Space Shuttle Specification Fluid Procurement and Use Control
MIL-C-81302	Cleaning Compound Trichlorotrifluoroethane (Freon)
MIL-T-81533	Trichloroethane 1,1,1, (Methyl Chloroform) Inhibited, Vapor Degreasing
NASA STD 6001	Flammability, Odor, Offgassing and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion
O-E-760	Federal Specification: Ethyl Alcohol (Ethanol); Denatured Alcohol; Proprietary/Industrial Solvents
SCWI-8500-0004-ENV	Hazardous Materials, Hazardous Waste and Solid Waste Procedures & Guidelines
SPG 1400.1	Document Preparation, Numbering and Management Guidelines
SPG 8715.1	SSC Safety and Health Procedures and Guidelines
SSC SCD 54000-GM10	Procurement of Solvent, Cleaning and Verification, Vertrel MCA 1,1,1,2,3,4,4,5,5,5 – Decafluoropentane (62 wt%) and Trans-1,2 – Dichloroethylene (38 wt%)
SSC SCD 54000-GM11	Procurement of Solvent, Cleaning, 1,3-Dichloro-1,1,2,2,3, - Pentafluoropropane, HCFC-225G
SSC SCD 54000-GP11	Packaging & Preservation of Cleaned Components
SSC STD 79-002	Sampling Requirements and Maximum Allowable Impurities for SSC Fluids and Fluid Systems
SSLP-1440-0001	SSC Records Management Program and Control of Quality Records
SSTD-8070-0005-CONFIG	Preparation, Review, Approval and Release of SSC Standards
TT-I-735	Federal Specification: Isopropyl Alcohol

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3.0 GENERAL REQUIREMENTS

3.1 SAFETY

All procedures in this STD shall be performed in accordance with the applicable requirements of SPG 8715.1.

3.2 SYSTEM DESIGN

3.2.1 Breaks and Check Valves

When fluid systems are designed or modified, cleanliness breaks shall be established to enable connecting of systems that have different cleanliness levels.

- a. Use dual check valves for the following cleanliness breaks: 1, 1X, 1XX or 1XXX (upstream) and 2, 2X, 2XX or 3 (downstream). Add filter if downstream particulate requirements are more stringent than upstream requirements.
- b. Use single check valve for the following cleanliness breaks: 1, 1X, 1XX or 1XXX (upstream) and 2A (downstream).
- c. Use filter for the following cleanliness breaks: any combination of 1, 1X, 1XX or 1XXX (upstream or downstream).
- d. Use filter for the following cleanliness breaks: any combination of 2, 2X, 2XX or 3 (upstream or downstream).

3.2.2 Component Removal

Designs for systems and system components should enable the removal of all valves and components from the system. In cases where it is not practical to use removable components (e.g., V-J valves with butt-weld end connections), component design shall enable removal of all internal piece parts of the component while it is connected to its respective system.

3.2.3 Component Disassembly

Complete disassembly is required prior to cleaning or verifying all components except for IM&TE and for components being field cleaned or verified by an approved procedure. Therefore, use of components that cannot be completely disassembled shall be avoided.

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3.2.4 Bottles and Vessels

Designs of bottles and vessels shall incorporate adequate provisions for cleaning. These provisions shall include, but are not limited to, manway or "jet-mole" access (to inspect and flush/spray all significant surfaces wetted by service media) and low-point drains (to collect flush samples).

3.3 CLEANING

Cleaning is comprised of two categories: gross and precision. Gross cleaning may be accomplished by using one or more of the following processes or materials: mechanical cleaning, halogenated degreasers, alkaline or acid cleaners, detergents and tap or deionized (DI) water flushes. Precision cleaning is performed after gross cleaning and may be accomplished by employing methods such as solvent flushing.

Certification of a cleaned system, component and/or packaging material is required prior to packaging or securing the component or system.

3.4 ACIDITY AND ALKALINITY

Surfaces of components that have been cleaned and are rinsed with deionized water shall register a pH between 5.5 and 8.0 while the component is wet from the last rinse or after wetting the surface with deionized water.

3.5 DRYING AND TESTING GAS

Gas for drying and testing of items cleaned per this standard shall conform to SSC STD 79-002. When the cleanliness level particulate requirements are more stringent than those specified by SSC STD 79-002, the gas shall be pre-filtered through an appropriately sized filter prior to use or entry into a system or component to be dried or tested.

4.0 SPECIFIC REQUIREMENTS BY CLEAN LEVEL

The cleanliness level requirements imposed by this standard are specified in Table 1. Each cleanliness level in Table 1 requires visual inspection according to Section 6.2.

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TABLE 1. CLEANLINESS LEVELS/REQUIREMENTS

CLEANLINESS LEVEL	PARTICULATE		NVR/HYDROCARBON mg/0.1m ² (mg/ft ²) <input type="checkbox"/> <input checked="" type="checkbox"/>		DEWPOINT/MOISTURE CONTENT	
	SIZE (MICRONS)	NUMBER (PARTICLES) no./0.1m ² (no./ft ²) †	TANKS/ VESSELS	LINES/ COMPONENTS	COMPONENTS	SYSTEMS Ⓒ
1	>2500	0	5	1	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	700<X<2500	1				
	175<X<700	5				
1X	>800	0	5	1	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	175<X<800	5				
1XX	>400	0	5	1	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	175<X<400	5				
1XXX	>100	0	5	1	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	50<X<100	1				
	25<X<50	11				
	15<X<25	75				
	<15	280				
2	N/A	N/A	N/A	N/A	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
2A	N/A	N/A	0 <input type="checkbox"/>	0 <input type="checkbox"/>	N/A	N/A
2X	>400	0	N/A	N/A	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	175<X<400	5				
2XX	>100	0 <input checked="" type="checkbox"/>	N/A	N/A	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	50<X<100	5				
	25<X<50	68				
	0<X<25	<input checked="" type="checkbox"/>				
3 <input checked="" type="checkbox"/>	N/A	N/A	N/A	N/A	N/A	N/A
4 (HYDRAULIC CLEAN)	>100	10	N/A	N/A	-54°C(-65°F) /24ppm	-40°C(-40°F) /128ppm
	50<X<100	60				
	25<X<50	530				
	10<X<25	2150				
	0<X<10	<input checked="" type="checkbox"/>				

† Test sample volumes for particulate and NVR analyses are specified in section 6.1.

For the purposes of this standard, NVR may be determined by using any analytical method that accurately measures the hydrocarbon content of a particular solvent, e.g., gravimetric, TOC and FTIR.

Ⓒ The requirement for field dewpoint verification of an existing assembled dump/vent line shall be determined by the end user. Field dewpoint verification is required on all newly installed dump/vent lines. Prior to or following installation, all newly installed components shall be properly processed and verified dry in accordance with the system cleanliness level requirement for both existing and newly installed dump/vent lines.

Hydrocarbon residue as detected by fluorescence of the type and UV spectrum specified in the definition of "Black Light" from Appendix B shall be cause for rejection.

One nonmetallic particle above the maximum is permitted.

Particles in the specified range are not counted; however, a concentration of such particles sufficient to obscure membrane grid lines (silting) shall be cause for rejection.

Commercial clean is equivalent to cleanliness level 3.

5.0 CLEANING FLUIDS, VERIFICATION FLUIDS AND RINSING AGENTS

5.1 GENERAL

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Cleaning fluids, verification fluids and rinsing agents that can be used are specified in sections 5.2, 5.3 and 5.4.

The requirements of SCWI-8500-0004-ENV *Hazardous Materials, Hazardous Waste, and Solid Waste Procedures and Guidelines* shall be met when using verification fluids, cleaning fluids and rinsing agents at SSC.

Traceability of cleaning fluids, verification fluids and rinsing agents must be maintained throughout the cleaning and verification process. Traceability documentation shall include, at a minimum, fluid cleanliness certifications and product composition reports.

5.1.1 Compatibility of Cleaning Fluids, Verification Fluids and Rinsing Agents

Cleaning fluids, verification fluids and rinsing agents must be compatible with the item being cleaned, verified or rinsed and shall not cause immediate or latent degradation (e.g., leaching of plasticizers, swelling of softgoods or hardware corrosion).

The performing organization must verify that the cleaning fluids, verification fluids and rinsing agents selected for use are compatible with the item being processed. The SSC Material and Process Control Team may be used as a resource to ensure compatibility of cleaning fluids, verification fluids and rinsing agents prior to their use on new materials.

The performing organization must also ensure that cleaning, verification and rinsing processes employing multiple fluids do not degrade hardware (e.g., some mixtures of halogenated solvents and water are corrosive to some metals). Parts and components shall be dried or rinsed between operations as required to prevent the formation of corrosive mixtures.

5.1.2 Control Samples

Verification fluids and rinsing agents shall be sampled prior to use on hardware with cleanliness levels requiring an NVR or particulate analysis. Verification fluids and rinsing agents shall meet the cleanliness requirements of the item being verified or rinsed. The control sample for all fluids used to sample or rinse tanks and vessels shall have no more than 25 mg NVR per 500 ml of fluid. The control sample for all other hardware shall have no more than 1 mg NVR per 200 ml of fluid.

The control sample NVR may be subtracted from the test sample NVR to determine compliance with this standard; however, the control sample particulate results may not be subtracted from the test sample particle count.

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When the control sample of a fluid does not meet the appropriate NVR requirement, the fluid cannot be used. The fluid must be distilled and resampled to verify that the NVR requirement is met. When the control sample of a fluid does not meet the appropriate particulate requirement, the fluid cannot be used. The fluid must be filtered with a clean, wire mesh filter and resampled to verify that the particulate requirement is met.

5.2 HALOGENATED SOLVENTS

When used for testing, halogenated solvents shall comply with the latest revision of the applicable procurement specifications referenced in subsections 5.2.1 through 5.2.8. In addition, the solvent shall meet the cleanliness requirements of the cleaned item or system. When the required NVR level of the solvent is less than the procurement specification, the solvent shall be distilled or cleaned to obtain the required NVR level.

Following use of any halogenated solvent (except for CFC-113, HFE-7100® and HCFC-225g) on items or systems with NVR requirements, verification is required to ensure that the solvent has been thoroughly removed from the item or system. Verification of solvent removal from significant surfaces shall be done in accordance with a NASA approved procedure. This verification must be supported with data that demonstrate removal of the solvent for the affected item or system. After removal of the solvent, the item or system must be purged with gas to dry it. Finally a gas sample shall be taken and analyzed to verify that the total gaseous hydrocarbon content is less than 5 ppm expressed as Methane.

5.2.1 Trichlorotrifluoroethane (CFC-113), MIL-C-81302, Type 1

CFC-113 may be used to perform NVR and/or particulate analysis, but it shall **not** be used on titanium alloys or for flushing hydraulic components or systems.

5.2.2 HCFC-225g (AK-225g), SSC DWG 54000-GM11

HCFC-225g may be used to perform NVR and/or particulate analysis, but it shall **not** be used for flushing hydraulic components or systems.

5.2.3 1,1,1 Trichloroethane (Methyl Chloroform), MIL-T-81533

1,1,1 Trichloroethane may be used to perform NVR and/or particulate analysis, but it shall **not** be used on titanium alloys or for flushing hydraulic components or systems.

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5.2.4 Tetrachloroethylene (Perchloroethylene), ASTM D4376 (for vapor degreasing only) or ACS Spectrometric Grade (for cleaning and verification)

Tetrachloroethylene may be used to perform NVR and/or particulate analysis, but it shall not be used for titanium alloys, softgoods or hydraulic components/systems. When used for cleanliness verification, tetrachloroethylene shall not be used on items that contain enclosed or entrapped areas.

5.2.5 Trichloroethylene, MIL-T-27602 or ASTM D4080

Trichloroethylene may be used to perform NVR and/or particulate analysis, but it shall **not** be used on titanium alloys or for flushing hydraulic components or systems.

5.2.6 Methoxynonafluorobutane (Hydrofluoroether-7100)(HFE-7100®), A-A-59150 or JSC SE-S-0073

HFE-7100® may be used to perform particulate analysis or as a rinsing agent to remove Vertrel MCA® from items with an NVR requirement. HFE-7100® shall **not** be used as a test fluid for NVR analysis or for flushing hydraulic components or systems.

5.2.7 Decafluoropentane 62% & Trans-1,2-Dichloroethylene 38% (Vertrel MCA®), JSC SE-S-0073 or SSC DWG 54000-GM10

Vertrel MCA® may be used to perform NVR and/or particulate analysis, but it shall **not** be used for softgoods that have an NVR requirement, titanium alloys or hydraulic components or systems. Items or systems with NVR requirements shall be pre-dried in accordance with section 6.5; flushed with HFE-7100®; and verified to ensure solvent removal in accordance with section 5.2.

5.2.8 Decafluoropentane (HFC-4310 mee or Vertrel XF®), SSC DWG 54000-GM10

Vertrel XF® may be used to perform particulate analysis, but it shall **not** be used as a test fluid for NVR analysis or for flushing hydraulic components or systems.

5.2.9 *normal*-Propyl Bromide (Ensolv®), ASTM D6368

normal-Propyl Bromide may be used for NVR and/or particulate analysis for tanks and vessels. It shall **not** be used for NVR and/or particulate analysis for components. It may be used for NVR and/or particulate analysis for piping **only** if the solvent meets the NVR level of the systems being verified.

It shall not be used for NVR and/or particulate analysis of any type Reflange Seal Rings.

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5.3 ALCOHOL SOLVENTS

All alcohol solvents used for testing shall comply with the latest procurement specifications listed in paragraphs 5.3.1 and 5.3.2. In addition, the alcohol control solvent shall meet the cleanliness requirements of the item being cleaned. Alcohol solvents shall **not** be used for cleaning, verifying or rinsing oxidizer systems (hardware and softgoods) or on any system that feeds into an oxidizer system.

5.3.1 Isopropyl Alcohol, TT-I-735, Grade A or ACS Reagent Grade

Isopropyl alcohol (isopropanol) may be used to perform particulate analysis; but it shall **not** be used as a test fluid for NVR analysis.

5.3.2 Ethyl Alcohol, 0-E-760

Ethyl alcohol (ethanol) may be used to perform particulate analysis, but it shall **not** be used as a test fluid for NVR analysis or for items that contain Teflon®.

5.4 DI BASED FLUIDS

NOTE

Dry film lubricated surfaces shall not undergo any DI water process for NVR and/or particulate verification.

5.4.1 DI Water Process for NVR Verification

When used for NVR verification, DI water shall conform to a resistivity of greater than 1 meg-ohm-cm or a conductivity of less than 1 micro-siemen-cm. DI water shall meet NVR and/or particulate requirements of the cleaned item. In addition, DI water shall require use of mechanical energy (e.g. high velocity impingement, sonication and heat); therefore, it should not be used on items of complex configuration. Verification and analysis methods must conform to a procedure that is approved by NASA PTD and supported with test data that demonstrate the efficacy of the process for the affected item or assembly.

To reliably detect an NVR level of 1 mg/0.1m², the DI water volume to hardware surface area ratio used for ultrasonic extraction and Total Organic Carbon (TOC) analyses shall not exceed 3 liters/0.1m².

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5.4.2 DI Water Process for Particulate Analysis

When used for particulate verification, DI water shall conform to a resistivity of greater than 1 meg-ohm-cm or a conductivity of less than 1 micro-siemen-cm. The DI water shall meet the particulate requirements of the cleaned item. In addition, DI water shall require use of mechanical energy (e.g. high velocity impingement, sonication and heat); therefore, it should not be used on items of complex configuration. Use of a surfactant in the DI water final clean level test/verification flush solvent is acceptable but shall be limited to clean levels that do not require NVR analysis. Particulate analysis methods, including types and concentrations of surfactants used, solvent temperature controls, and application of mechanical energy, must conform to a procedure that is approved by NASA SSC PTD. Furthermore, the particulate analysis methods shall be supported with test data demonstrating the effectiveness of the process in removal of residual particle contaminants from all significant surfaces of the affected item or assembly.

5.4.3 DI Water/Rinsing Agent

When used for rinsing operations, the DI water shall conform to the resistivity of greater than 50,000 ohms-cm or a conductivity of less than 20 micro-siemen-cm.

6.0 CERTIFICATION TESTS

6.1 TEST SAMPLES

Test samples can be obtained by flushing or spraying significant surfaces with a solvent. For internal significant surface areas of 0.5 square meter or less (approximately 5 square feet), a 200-milliliter (minimum) sample shall represent approximately 0.1 square meter (approximately 1 square foot) of significant surface area. For internal significant surface areas greater than 0.5 square meter, a 100-milliliter (minimum) sample shall represent approximately 0.1 square meter of significant surface.

6.2 VISUAL INSPECTION

All significant surfaces that contact service fluids require visual inspection unless the surface is "inaccessible" as defined in Appendix B. The presence of gross contamination is not allowed. If visual evidence of contamination is found in a component or system, the foreign material shall be analyzed to determine its identity, source and compatibility with the service fluid.

NOTE

Scale-free discoloration due to welding, etching, heat treating, and passivation of lines, components or surfaces is permitted.

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6.2.1 Flash Rust

Visible, scale-free surface oxidation (flash rust) is allowed on significant surfaces; however, it shall not exceed five percent of the internal significant surface area of systems or components. Furthermore, flash rust is not acceptable if it prevents the system or component from meeting cleanliness requirements.

6.2.2 Inspection Aids

Inspection aids such as lights, borescopes, mirrors and ultraviolet (UV) lamps (black lights) must meet the cleanliness requirements of the system or component that they inspect.

6.3 PARTICULATE ANALYSIS

NOTE

If silt is discovered during particulate analysis, investigate the system or component, determine the cause and correct the problem. Silting is unacceptable.

A test sample, as described in section 6.1, shall be analyzed for particle population and size. When a test sample meets Level 1 NVR requirements but fails particulate requirements, a gas purge of 3 meters per second or more can be used for particulate analysis in lieu of an additional fluid flush. This analysis must conform to a procedure that is approved by NASA PTD.

NOTE

This is not applicable to Level 2 or Level 4 verification processes.

6.4 NONVOLATILE RESIDUE (NVR) ANALYSIS

A test sample, as described in section 6.1, shall be used for NVR analysis. If the test sample NVR level is less than the control sample NVR level, the NVR analysis shall be considered invalid and the verification process shall be repeated.

If the spray or flush method of obtaining a test sample is not practical, a swab or wipe sampling technique may be used (with customer approval) for NVR analysis. This sampling method is performed by wiping a representative area of up to one square foot with a certified clean, solvent-soaked, lint-free swab or wipe. After wiping the area to be verified, each swab or wipe shall be flushed with approximately 200 ml of solvent and analyzed for NVR. Larger surfaces may require several random wipe tests to ensure that a representative portion of the surface area is sampled.

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6.5 DRYNESS (DEWPOINT) ANALYSIS

Dewpoint Analysis certification is mandatory for all systems, components and IM&TE with a dewpoint requirement specified in Table 1, with the exception of:

- excepted components per stipulations in section 8.0;
- pipe, fittings, and pipe spools/sections with at least one weld-prepared end; and
- assembled dump/vent systems that are open to the atmosphere and are field verified for cleanliness level.

Whether or not this certification is required, proper processing and dryness verification in accordance with this standard is required for all IM&TE, components, fittings, pipe, tubing, and pipe sections/spools used in dump/vent systems and for all pipe sections/spools with at least one weld joint preparations.

- a. Components and IM&TE assembled in a clean room do not require dewpoint testing if their disassembled parts are oven dried for 30 minutes at 66 degrees C (150 degrees F).
- b. IM&TE with open configuration shall be purged with nitrogen for a minimum of 30 minutes. IM&TE with entrapped areas or closed configurations shall be vacuum dried at or below 20 in. of Hg for a minimum of 30 minutes. This will serve as certification that the item is dried.
- c. If dryness certification cannot be obtained by the methods outlined in section 6.5(a) or (b), a dewpoint test shall be performed. Prior to performing a dewpoint test on the effluent gas from a system or component, heated gas at 135 degrees C shall be used to purge the system or component for a minimum of 30 minutes, or the gas shall be locked within the system or component for a minimum of 30 minutes. Prior to performing a dewpoint test on the effluent gas from a vessel, gas shall be heated to 135 degrees C to purge the vessel. The gas shall be locked within the vessel for a minimum of 8 hours prior to performing a sample. The gas is not required to maintain the 135 degrees C minimum requirement while locked up within the vessel.

NOTE

To certify dryness for cleanliness level 2 components (not 2A, 2X, 2XX), a system dewpoint analysis may be performed in lieu of performing individual dewpoint analyses on each component in the system.

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7.0 FIELD PROCEDURES

CAUTION

Components containing softgoods incompatible with the test fluid in use shall be replaced with a temporary spool piece and/or a flange to prevent softgood degradation that could result from field cleaning/ verification operations.

7.1 FIELD CLEANING

Field cleaning is permissible for systems or components that are required to be cleaned to level 3 or level 2 (not 2A, 2X or 2XX). For all other systems or components, the provisions of section 7.2 must be satisfied before field cleaning is allowed.

7.2 CLEANING/VERIFICATION

- a. Field cleaning/verification shall be performed only when all of the following apply, unless otherwise approved by the NASA Propulsion Test Directorate.
 1. The item is part of a fixed installation and cannot be moved to a remote and controlled cleaning facility.
 2. Cleaned replacements are not available.
 3. System components having moving parts, close tolerance fluid passages, or zero flow velocity zones are replaced by pipe spool pieces or have all internal piece parts removed.
 4. All pressure gages and other instrumentation are removed.
- b. The flushing process for field cleaning/verification shall be performed by system flow-through at 1.2 meters per second or more, pressurized spraying, or by other methods approved by the NASA Propulsion Test Directorate.
- c. Sampling methods shall comply with section 6.0.

7.3 FIELD CERTIFICATION

The certification of system or component cleanliness levels may be performed in the field; however, verification processes that precede certification, such as sample analysis, are best performed in a laboratory. Verification by flushing shall be performed in a clean room or other controlled environment unless it is performed in accordance with section 7.2.

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7.4 CONTAMINATION CONTROL

Provide shelters, enclosures or a positive purge of sufficient quantity to prevent contamination of systems opened in the field. These preventive measures shall comply with NASA approved procedures.

7.4.1 Post-Verification Operations

Assembly, installation and removal of precision cleaned components shall be done with utmost care to prevent contamination. Certified clean gloves and tooling shall be used when handling cleaned significant surfaces.

7.4.2 Post-Verification Cleaning

Field hardware that meet cleanliness requirements do not need to be re-verified when contamination associated with field activities is completely accessible and can be removed by handwiping or purging.

NOTE

The certified clean, lint-free cloth used for handwiping shall be dry or moistened with a verification fluid that meets the requirements of this standard. Handwiping shall be performed in such a manner that the fluid does not flow into or become entrapped in the hardware.

7.4.3 Post-Verification Inspection

Surfaces of all cleaned components that will contact the service fluid shall be visually inspected for the presence of gross contaminants.

8.0 CERTIFICATION OF EXCEPTED COMPONENTS/SYSTEMS & SOFT GOODS

NOTE

When excepted components contain softgoods that must be removed prior to the certification process, the softgoods must be removed and precision cleaned as individual piece parts.

Components that cannot be certified using normal procedures or facilities (because of their size, construction, incompatibility with flushing solvent, or method of assembly) may be certified as excepted components. All excepted components, other than softgoods processed as excepted components due to solvent incompatibility, require approval by the NASA Propulsion Test Directorate Configuration Control Board.

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Excepted components shall be certified by the tests described in section 6.0. When acceptable results are obtained, these components will be identified by notation "EXC." on the certification tag, which shall also indicate the required cleanliness level and certification test results. The "EXC." notation will identify that the component has been certified in accordance with this standard.

9.0 PROTECTION OF CLEANED SURFACES

All protective materials shall be compatible with the system or component surface in contact with the protective material. Protective materials shall also be designed to withstand the specified environment for the storage period and mode of delivery including impact protection of significant surfaces.

9.1 PACKAGING

- a. Packaging requirements are specified in SSC drawing 54000-GP11. Before cleaning, prepare detailed instructions showing materials, methods and quality requirements for the packaging to ensure that cleanliness levels are maintained during periods of shipping and/or storage. These instructions shall be approved as specified by contract.
- b. Cleaned and certified components shall be packaged within a controlled environment equal to or cleaner than the environment in which they were cleaned and certified. Outer protective wrap (e.g., dimple wrap) may be applied outside the controlled area. This procedure shall be approved by the Quality Assurance Representative and in accordance with the requirements of section 9.2.

9.2 PACKAGING FILMS

NOTE

Stainless steel threaded plugs, blind hubs and flanges can be used for the primary packaging inner barrier that isolates clean surfaces from ambient environments. Prior to use, these plugs, hubs and flanges (and their respective seals) shall be cleaned to the same cleanliness level as the cleaned item.

- a. Packaging films used for packaging precision clean items must conform to the requirements of section 9.1. The cleanliness level of the inner wrap shall be at least equivalent to that of the exposed clean surfaces of the item packaged. The outer wrap shall be visibly clean.
- b. Selection of a specific film shall be dictated by compatibility with the specified service medium.

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- c. Items that come in contact with liquid oxygen (LOX) and gaseous oxygen (GOX) fluids or systems shall be protected with an inner bag or layer of film such as fluorohalocarbon film (e.g., Aclar 22A and 33C) conforming to AMS 3649.
- d. Removal of packaging film prior to installation of hardware into a system shall be performed such that all material is completely removed (i.e., no shreds, strips or pieces of material shall remain after packaging is removed).

10.0 RECORDS AND FORMS

Records and forms required by this standard shall be maintained as specified in SSLP-1440-0001. For Quality Records, refer to the SSC Master Records Index. Forms shall be the latest edition unless otherwise specified and may be obtained from the SSC Electronic Forms repository or the NASA SSC Forms Management Officer.

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APPENDIX A DEFINITIONS

Black Light - a high intensity, long-wave, low-energy, ultraviolet (UV) light (UV spectrum 3200-3800 angstroms).

Blanket Purge – the use of pressurized gas in an enclosed environment for protecting components, piping or vessels from contamination.

Certification – a written record demonstrating that requirements have been verified and achieved.

Cleaning - the removal of incompatible materials from the significant surfaces of components and systems within the scope of this standard.

Clean Room – a room in which precautions are employed to reduce contaminants in the air, producing a controlled environment for verification, assembly and packing of cleaned items.

Commercial Clean - without gross contamination.

Component - an item that is normally a combination of parts, subassemblies or assemblies and that is self-contained within a fluid system.

Contaminant - any material that could chemically react or mechanically interfere with a cleaned component, system or end item.

Control Sample - a specific volume of flushing solvent that is analyzed to determine a baseline contamination level before a test sample is attained.

Dewpoint - the temperature at which a gas becomes saturated with water vapor and condensation begins (usually atmospheric pressure).

Drying - reducing moisture/dewpoint levels by vacuum, purge, flush or oven-heated methods.

Excepted Component/System/Soft Good - an item or system that cannot be cleaned and certified using normal procedures or facilities because of their size, construction or method of assembly.

Field Certification - the process of certifying components in the field.

Field Cleaning - cleaning performed outside a shop or clean room environment.

Field Verification - process of obtaining samples in the field for subsequent laboratory analysis to certify cleanliness levels.

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Fluid – a gas or liquid used in an SSC system or used to clean, test, dry or preserve test systems, subsystems, assemblies, components, IM&TE and support equipment.

Flushing Solvent - the solvent used to obtain the control sample and the test sample.

Gross Cleaning - the removal of gross contaminants.

Gross Contaminants - visible contaminants, such as moisture, corrosion, loose slag, oil, grease, scale, rust, soil, sludge and grit.

Hydrocarbon - any compound containing carbon and hydrogen bonds.

Inaccessible - unable to be viewed due to physical configuration.

Inspection – the verification method performed by visual observation under ambient or black light.

Inspection, Measuring and Test Equipment (IM&TE) - items used to perform measurements where distinct values are required for system performance or to demonstrate conformance to specified requirements.

Item - anything smaller than or contained within a system (e.g., assembly, component, IM&TE, piece part).

Method - a technique or process used to test, inspect or collect samples.

Micron – dimension of length equal to 0.001 millimeter (0.0000394 inch).

Moisture - the residual water (liquid/gas) in components or systems, measured in parts per million (ppm) or dewpoint.

Nonvolatile Residue (NVR) - the residue remaining after filtration and controlled evaporation of the final flushing solvent. NVR is specified in milligrams (mg) per square meter or square foot of significant surface. Since the predominant constituents of NVR are hydrocarbons, NVR and total hydrocarbon content are considered equivalent; therefore, analytical methods that determine total hydrocarbon (e.g., gravimetrics, FTIR and TOC) may be used to determine NVR.

Particle – a unit of matter with observable length, width, and thickness; usually measured in microns.

Particulate - multiple particles.

pH - a unit of measure on a scale of 0 to 14 that describes the acidity or alkalinity of a solution, (with 7 indicating neutrality, values below 7 indicating acidity level, and values above 7 indicating alkalinity level).

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Precision Clean - a high level of cleanliness (i.e., cannot be verified with unaided eye) positively confirmed by a test for particle size/count and documented.

Sample - a selected portion or quantity of fluid collected to determine the cleanliness level of a system or component.

Significant Surfaces – those surfaces of components, piece parts, assemblies, subsystems, systems and ground support equipment that come in contact with test fluids or service fluids.

Silting - a background of particles below the size ranges counted and in such a quantity as to interfere with sample analysis.

Test - the process used to determine the cleanliness level of a system, component or packing material.

Test Sample - a specific volume of flushing solvent used for particulate and/or NVR analysis.

Ultraviolet (UV) Lamp – a lamp that produces “black light”.

Verification - the process whereby one or more of the following methods is used for the purpose of certification: performing visual inspections, obtaining samples, analyzing/testing samples and reviewing inspection/test data.

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APPENDIX B

ACRONYMS AND ABBREVIATIONS

AMS	Aerospace Materials Specification
ASTM	American Society for Testing and Material
CFC-113	Trichlorotrifluoroethane (Freon)
DI	Deionized
FTIR	Fournier Transform Infrared
GOX	Gaseous Oxygen
IM&TE	Inspection Measuring and Test Equipment
JSC	Johnson Space Center
LOX	Liquid Oxygen
MIL	Military
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NVR	Nonvolatile Residue
PCTFE	Polychlorotrifluoroethylene
PTD	Propulsion Test Directorate
SAE	Society of Automotive Engineers
SCD	Specification Control Drawing
SPG	SSC Procedures and Guidelines
SSC	Stennis Space Center
SSLP	Stennis System Level Procedure
STD	Standard
SSTD	Stennis Standard
TOC	Total Organic Carbon
UV	Ultraviolet