SPECIFICATIONS
FOR
PROCUREMENT OF A LIQUID ROCKET PROPELLANT RUN TANK
V-514-RP - (160 Gallon, 9,000 psig)

11DGK-GM03

AUGUST 2002

ISSUED: CEF AUG 2 1 2002

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHN C. STENNIS SPACE CENTER
SSC, MISSISSIPPI 39529

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SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

The work to be performed under this project consists of providing the design, fabrication, inspection, testing and delivery to Stennis Space Center, Stennis, Mississippi, at the E1 Complex, of a 160 gallon total capacity liquid rocket propellant run tank. The run tank shall be National Board Registered and ASME code stamped meeting ASME Code Section VIII, Div. 2. The vessel shall be suitable for the stationary, exposed, above ground storage of liquid rocket propellant (RP).

1.2 REFERENCES

The publications listed below form a part of these specifications to the extent referenced. The publications are referred to in the text by the basic designation only. Refer to Section 01420, "Sources for Reference Publications", for information on obtaining publications.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1998) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.9	Factory Made Wrought Steel Butt Welding Fittings
ASME B31.3	Process Piping

ASME BOILER AND PRESSURE VESSEL CODE

Section II	Material Specifications
Section V	Non-Destructive Examination
Section VIII	Rules for Construction of Pressure Vessels - Division I and Division II
Section IX	Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators

AMERICAN SOCIETY FOR NON-DESTRUCTIVE TESTING (ASNT)

ASNT-TC-1A	Recommended Practice for Non-Destructive Testing Personnel Qualification and Certification

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 182	Forged or Rolled Alloy Steel Pipe Flange, Forged Fittings and Valves and Parts for High Temperature Service
ASTM A 193	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 240	Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
ASTM A 312	Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 336/A 336M	Standard Specification for Alloy Steel Forgings for Pressure and High Temperature Parts
ASTM A 403	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

SSC STANDARDS AND SPECIFICATIONS (SSC)

SSTD-8070-0089	Surface Cleanliness Requirements for SSC Fluid Systems (supersedes SSC STD 79-001)
SSC STD 79-002	Sampling Requirements and Maximum Allowable Impurities for SSC Fluids and Fluid Systems
SSC DWG 54000-GP11	Packaging and Preservation of Clean Components

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittal Procedures:"

SD-01 Preconstruction Submittals

Design Calculations

Certified Mill Test Reports

Fabrication Time Schedules

The Contractor shall submit six copies of each of the following items six weeks after award of contract:

Requests to use existing ASME Code cases
Quality Control Manual
Welding Procedure Qualifications to ASME Section IX
NDT Procedures and Inspection Procedures
Hydrostatic Leak Check Procedures
Cleaning and Certification Procedures

Certification of NDE Personnel per ASNT-TC-1A
Welder Qualifications to ASME Section IX

For each non-metallic material used in vessel construction, the Contractor shall provide material designation, grade and governing material specification for buyer approval.

SD-02 Shop Drawings

Shop Fabrication Drawings shall be submitted in accordance with the paragraph entitled, "Shop Drawings" in this section.

SD-03 Product Data

The Contractor shall submit catalog cuts, brochures, circulars, specifications and product data for:

Hubs
Clamps
Seal Rings

SD-05 Design Data

The Contractor shall submit 6 copies of the Loading, Transportation and Lift Plan six weeks prior to vessel shipment.

SD-07 Certificates

Certificates of Compliance from the manufacturer shall be submitted showing conformance with the referenced standards contained in this section.

Qualification of Vessel Manufacturer

SD-11 Closeout Submittals

Closeout Submittals shall be submitted in accordance with paragraph entitled, "Closeout Submittals" of this section.

1.4 GENERAL REQUIREMENTS

The run tank shall be designed, fabricated, tested, cleaned and delivered cleaned in accordance with the detailed requirements of this specification. The requirements specified herein are minimum requirements. The Contractor shall take whatever additional measures are necessary in his design, fabrication, inspection and testing to produce a run tank which will satisfactorily pass the tests specified herein without damage. Where specific requirements are set forth, and where such specific requirements depart from requirements or alternatives contained in any documents referenced herein, specific requirements contained herein shall govern and take precedence. The general arrangement of the run tank and associated piping is shown in schematic form on Figure 1 of this specification.

1.5 QUALIFICATION OF VESSEL MANUFACTURER

The Contractor shall furnish with his bid, certification attesting to a minimum of 5 years experience by the manufacturer in design and manufacture of a run tank(s) of similar design. Qualification name, phone number and customer address of reference is required. The experience listing shall

include a list of run tanks fabricated, size, location of use, service, and date of manufacture.

1.6 DRAWINGS AND REPORTS

The drawings contained in this specification show the general required dimensions of the run tank as well as the requirements for capacity and performance. Nothing shown on the drawings or contained in the design data shall relieve the Contractor from his responsibility to furnish a run tank meeting the requirements of this specification.

1.7 QUALITY ASSURANCE

The Contract Administrator and Government reserve the right to inspect all work at any time during and upon completion of fabrication and to witness any or all tests. The Contractor shall cooperate fully to enable the SSC Project Engineer or Government designated representative to be present at the performance of any or all tests and any other activity as specifically requested. The Contractor shall furnish all equipment and materials for all tests except where specially stated otherwise. The Contractor shall notify the SSC Project Engineer fourteen (14) days prior to the anticipated performance of each test to be witnessed. Within twelve (12) days after the initial notification the Contractor shall confirm the test date or reschedule the test date.

Mandatory hold points for government inspections shall be as follows:

1. Government review of welding procedures and qualification records and welder certifications before any welding is executed.
2. Vessel and piping X-ray interpretation
3. Hydrostatic testing
4. Vessel cleaning
5. Packaging of vessel for shipment

1.8 WELDING PROCEDURE AND WELDING OPERATOR QUALIFICATIONS

1.8.1 General

Welding procedure and welders qualifications shall be performed in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

Contractor shall submit 6 copies of welding procedure qualifications to ASME Section IX 6 weeks after contract award.

1.8.2 Welding Procedure

Welding procedures shall be qualified per Section IX, ASME Boiler and Pressure Vessel Code and shall be submitted to the Contracting Officer's Technical Representative (COTR) for approval prior to any welding.

1.8.3 Qualifications of Welders

The determination of the qualification of welders, and the requirements for welding shall be in accordance with the applicable portions of the above referenced code and shall be submitted for approval prior to any welding.

Contractor shall submit 6 copies of welder qualifications to ASME Section IX 6 weeks after contract award.

1.8.4 Welding Materials

Welding materials shall be suitable for the type of welding to be performed. Welding materials shall be stored to prevent contamination and deterioration by moisture. A drying oven or heater shall be used in accordance with recommendations and instructions of the manufacturer.

1.9 GUARANTEE

All equipment to be furnished under this specification shall be guaranteed against defective materials, design, and workmanship for a minimum period of one year from date of acceptance, either for beneficial use or final acceptance, whichever is earliest, but not before the equipment or system involved has passed all specified tests. Upon receipt of notice of failure of any part of the guaranteed equipment during the guaranty period, new replacement parts shall be furnished and installed promptly by the Contractor at no additional cost. The Contractor shall acknowledge his responsibility under these guaranty provisions by letter, stating that the equipment and materials referred herein are guaranteed and the inclusive dates of the guaranty period. Additionally, Contractor shall supply certificates of compliance showing conformance with all referenced standards contained in this section.

1.10 DESIGN CALCULATIONS

The Contractor shall furnish Design Calculations covering all parts of the run tank. Design calculations are due 6 weeks after award of the contract. The shop drawings are due 8 weeks after award of contract. To expedite delivery, preliminary calculations for long delivery items may be submitted 2 weeks after award of contract. Design calculations shall be stamped by a professional Engineer and shall include:

ASME Code Calculations
Piping for Liquid Rocket Propellant Service
Estimated vessel weight
Fatigue Analysis

Contractor shall submit any requests to use existing ASME code cases in accordance with Section 1.3 "Submittals".

1.11 SCHEDULES

Six copies of Fabrication time schedules shall be submitted three weeks after award of contract.

1.12 CLOSEOUT SUBMITTALS

Four copies of the following shall be submitted at the time the vessel is ready for shipment:

Heat Treatment Charts and Records
Spare Parts Recommendation List

Six copies of the following shall be submitted at the time the vessel is ready for shipment:

Certified Mill Test Reports/Certificates of Compliance
Facsimile of Nameplate Stamping
Manufacturer's Data Report

Hydrostatic Test Report including test set-up configuration and log of time versus pressure
All Reports for Non-Destructive Examinations
All Radiographic Analysis Reports
One Complete Set of Radiographic Film
Weld Map
Weld Material Test Reports
Vendor certified certificates of conformance for all non-metallic materials used in vessel construction
Cleanliness Records and Certification
As-Built Vessel Drawing

PART 2 PRODUCTS

2.1 MATERIALS

Metals shall be free from defects impairing strength, durability, and appearance, and of the best commercial quality for the purpose specified. All materials shall have structural and mechanical properties to safely sustain and withstand strains and stresses to which they are normally subjected.

Certified Mill Test Reports (CMTR's) shall be furnished for all metallic materials, including weld filler metals. Six copies of each CMTR are due prior to start of fabrication. The following shall be shown in the CMTR:

Contract Number
Pipe Specification (where applicable)
Material Specification (Base Material)
Material Specification of Weld Filler Metal
Certified Charpy Impact Test results as required by ASME Boiler and Pressure Vessel Code Requirements
Heat Treatment procedures, charts and records as required by ASME Boiler and Pressure Vessel Code

2.2 DESIGN AND FABRICATION

2.2.1 Vessel Construction

The vessel shall be designed, constructed and code stamped in accordance with the ASME, Section VIII, Division 2 code requirements.

2.2.2 Design Capacity (160 Gallons-Water Volume)

The run tank shall be used for liquid rocket propellant (RP) and shall be designed for a net capacity of 145 gallons plus 10 percent ullage of 15 gallons, excluding nozzles.

2.2.2.1 RP-1 Physical Properties

Molecular Weight	175
Boiling Point	350 - 525 degrees F
Freezing Point	-40 degrees F
Density Liquid	6.7 - 6.9 pounds per gallon at 68 degrees F
Specific Gravity - Vapor (relative to STP air)	42.0 - 45.5 API
Vapor Pressure	0.2 - 0.8 psia at 50 degrees F 0.35 - 1.2 psia at 100 degrees F

Flash Point, Closed Cup (P-M(1))		110 degrees F
Flammability Range	Lean	110 degrees F
	Rich	175 - 185 degrees F
Heat of Combustion		18,433 Btu per pound

2.2.3 Working Pressure

The working pressure shall be the ullage pressure plus the static head of the liquid.

2.2.4 Design Pressure

The design pressure shall include the following pressures:
Design pressure = ullage + static head

Ullage Pressure	9,000 psig
Static Head	(to be determined using water)

2.2.5 Design Temperature

The design temperature shall be 130 degrees F to -20 degrees F for the vessel.

2.2.6 Pressurization Cycle Time

2 seconds pressurization (0 to 9,000 psig).
2 seconds de-pressurization (9,000 to 0 psig)

2.2.7 Corrosion Allowance

The vessel shall have a corrosion allowance of zero.

2.2.8 Design Life

Vessel shall be designed for a service life of 30 years.

2.2.9 Fatigue Analysis

A fatigue analysis shall be performed and certified by a registered professional engineer for compliance with the following conditions:

250 pressure cycles per year	0 psig to 9,000 psig ullage pressure
1 proof test per year	0 psig to 11,250 psig

2.2.10 Support System

a. The allowable design stress in the vessel support members shall be according to the code. For threaded members, the minimum thread engagement in accordance with thread fit tolerances shall be used.

b. Reaction forces imposed by the weight of the vessel plus the static weight of water contained by the vessel.

c. Transportation loadings and installation loadings.

d. Seismic loadings, per ASCE 7-98, zone 1.

2.2.11 Wind Forces

The external support system shall be designed to withstand a 150 mph force wind (ref.: Southern Building Code).

2.2.12 Lifting Lugs

Stainless steel lifting lugs shall be provided at the top of the vessel. Any set of lifting lugs, either at the top or at the bottom, shall be designed to lift the dry weight of the entire vessel including contractor installed appurtenances plus an additional 1000 pound load.

2.2.13 Materials of Construction

All materials of construction shall conform to ASME Section II. All material examination requirements of section AM shall be satisfied.

For each non-metallic material used in vessel construction, the Contractor shall provide material designation, grade and governing material specification for buyer approval.

2.2.13.1 Vessel Plate

All plate shall be ASTM A 240 type 304L, 316L or 304/304L stainless steel and shall conform to the requirements of part UHA as applicable per ASME Boiler and Pressure Vessel Code, Section VIII, Division 2.

2.2.13.2 Vessel Forgings

All forgings shall be ASTM A 182 or ASTM A 336/A 336M type F304L, F316L or F304/304L stainless steel and shall conform to the requirements of part UHA as applicable per ASME Boiler and Pressure Vessel Code, Section II and Section VIII, Division 2.

2.2.13.3 External Support Material

External supports shall be constructed of structural grade stainless steel and conform to the "foot print" shown on Figure 1 of this specification.

2.2.13.4 Structural Bolting

Structural Bolting shall conform to ASTM A 193, Grade B8 stainless steel. Stainless steel nuts shall conform to ASTM A 194, Grade 8.

2.2.14 Welding

All pressure retaining vessel and piping welds shall be examined by 100% radiographic examination. Those welds that cannot be examined by radiography shall be ultrasonically examined and liquid-penetrant examined at the root and cover pass. The accessible inner surface on all welds shall be ground smooth to facilitate cleaning and radiography. Backing rings and bars, if used, shall be removed prior to finishing the joint.

Nondestructive examinations shall meet the requirements of ASME Boiler and Pressure Vessel Code, Section V.

Personnel performing NDE inspection shall be qualified per ASNT-TC-1A, Level II. Contractor shall submit 6 copies of certification of NDE personnel per ASNT-TC-1A.

Contractor shall submit 6 copies of NDT procedures and inspection procedures 6 weeks after contract award.

2.3 PIPING AND NOZZLES

2.3.1 Service Media Piping

Piping and fittings shall be suitable for RP-1 service and for the pressures and temperatures involved. Piping and nozzles shall be of the size and orientation as shown on Figure 1.

2.3.1.1 Nozzles and Piping

Nozzles and piping shall be fabricated of stainless steel ASTM A 312 Type 304L, 316L, or 304/304L for pipe and ASTM A 182 Grade F304L, F316L, or F304/304L for nozzles. Service media piping shall be fabricated in accordance with ASME B31.3. Pipe sizes and fittings shall be as shown on Figure 1.

2.3.1.2 Butt-Weld Fittings

Butt-weld fittings shall conform to ASME B16.9 and ASTM A 403, Type 304L, 316L or 304/304L stainless steel.

2.3.1.3 Hubs - Facility Interface Connections

Except as otherwise noted, hubs on vessel piping shall be Reflange R-Con clamp joint type stainless steel connections and shall conform to ASME B16.5.

Stainless steel test hubs and seal rings are required and will remain with the vessel until final destination. Manufacturer shall provide spare parts lists for seals, nuts and bolts, etc.

2.3.1.4 Seal Rings

Seal rings for hubs shall be 17-4 PH material with PTFE coating.

2.3.1.5 Mechanical Bolting (Stainless Steel)

Mechanical bolting shall conform to ASTM A 193, Grade B8 for bolts and ASTM A 194, Grade 8 for nuts.

2.3.1.6 Hub and Nozzle Protection

Extreme care shall be exercised during all phases of fabrication, handling, shipping, and cleaning to insure maximum protection of all hubs, nozzles, and all other appurtenances. Warped hubs and sealing surfaces exhibiting any evidence of imperfections based on the requirements of this specification will not be accepted.

2.3.2 Vessel Penetrations

2.3.2.1 Pressurant Gas Inlet Nozzle

One 6-inch nominal integrally reinforced nozzle with a straight pipe segment and Reflange R-Con hub shall be connected to the vessel at the highest point of the vessel. One 3-inch nominal nozzle with a straight pipe segment and Reflange R-Con hub shall pass through a blind hub attached to the 6-inch nozzle. The 3-inch nozzle shall be connected to a gas

diffuser running above the 95 percent full liquid level. The diffuser shall be removable by removing the blind hub on the 6-inch nozzle.

2.3.2.2 Diffuser

Transfer of the liquid rocket propellant from the vessel will be accomplished by pressurizing the vessel with an external gaseous nitrogen supply. The gaseous nitrogen, at approximately 70 degrees F, will enter the vessel through the pressurant gas inlet nozzle. The connection shall terminate with a Contractor furnished diffuser. The diffuser shall be designed with multiple holes where each hole has a diameter of 1/4 inch or less. The total flow area of holes shall be no less than 5 square inches. The axial center line of each hole shall be horizontal or directed such that pressurant inlet gas jets are directed upward. The diffuser shall be located so that it lies entirely above the 95 percent full liquid level. The diffuser shall be designed to minimize turbulence at the gas-liquid interface. The diffuser shall not obstruct the instrumentation and spare ports.

2.3.2.3 Bottom Outlet Nozzle

One 6-inch nominal integrally reinforced nozzle with a straight pipe segment and Reflange R-Con hub shall be located at the lowest point of the vessel and shall be capable of completely draining the vessel. The nozzle axial centerline shall be orientated vertically.

2.3.2.4 Vortex Breaker

A capped-cross type vortex breaker shall be provided and shall be centered above the bottom outlet line connection. The cap shall be a designed to be supported by vertical cross plates. The minimum vertical distance between the bottom of the circular plate and the inside of the head shall be 6 inches.

2.3.2.5 Bottom Fill Nozzle

One 2-inch nominal integrally reinforced nozzle with a straight pipe segment and Reflange R-Con hub shall be located at the bottom of the vessel. The nozzle shall be located at or below the 5 percent full liquid level and shall be oriented vertically.

2.3.2.6 Top Vent Nozzle

One 3-inch nominal integrally reinforced nozzle with a straight pipe segment and Reflange R-Con hub shall be located at the top of the vessel. The nozzle shall be located at or above the 95 percent full liquid level and shall be oriented vertically.

2.3.2.7 Instrumentation Ports

Two 2-inch nominal intergrally reinforced nozzles, one on the bottom of the vessel and one on the top of the vessel for vessel instrumentation and sample capability, with Reflange R-Con hubs shall be provided. The nozzle on top of the vessel shall be located at or above the 95 percent full liquid level and shall be oriented vertically. The nozzle on the bottom of the vessel shall be located at or below the 5 percent full liquid level and shall be oriented vertically.

2.4 CLEANING

Before shipment, the Contractor shall clean the vessel for liquid rocket propellant service to a level conforming with SSTD-8070-0089, Level 2X. The Contractor shall submit to the Contracting Officer for approval a cleaning procedure and sampling methods which will ensure and verify the cleanliness.

Contractor shall submit 6 copies of cleaning and certification procedures 6 weeks after contract award.

Any items shipped loose shall be packaged per SSC DWG 54000-GP11.

2.5 PRESSURE TESTS

2.5.1 General

The vessel shall be hydrostatically tested in accordance with the requirements of Section VIII, Division 2, of the ASME Code for Unfired Pressure Vessels. After cleaning and assembly, the contractor shall leak test the vessel pneumatically per AT-355 of ASME Section VIII Div. 2. The Contractor shall employ suitable leak detection procedures, which have been specifically approved by the SSC Project Engineer and shall repair all leaks encountered. All equipment required for leak testing shall be furnished by the Contractor. Welding shall not be permitted on the vessel and/or piping after completion and acceptance of the tests.

Contractor shall submit 6 copies of hydrostatic leak check procedures 6 weeks after contract award.

2.6 RADIOGRAPHIC EXAMINATION

2.6.1 General

Welding inspection shall be as required per Section 01010 Paragraph 2.2.14.

Should a conflict result on the film interpretation that cannot be settled between the Contracting Officer or his Designee and the Contractor, final interpretation shall be the responsibility of the NASA/SSC Level III NDT Specialist. The NASA/SSC Level III Specialist interpretation shall be final and binding to all parties involved.

2.6.2 Radiographic Techniques

Radiographic techniques and interpretation thereof shall be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII Division 1, Paragraph UW-51. One set of radiographic negatives shall be submitted with the report to the Contracting Officer's Technical Representative (COTR) on completion of the vessel. Unacceptable welds shall be repaired and re-radiographed in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section VIII Division 2.

2.7 PAINTING (Not Applicable)

2.8 MARKING AND IDENTIFICATION

2.8.1 Code Label

The vessel shall be ASME coded and stamped. The vessel shall bear the standard label certifying conformance to the requirements of Section VIII,

Division 2 of the ASME Boiler and Pressure Vessel Code, affixed in an approved location on the vessel. The label material shall be corrosion resistant. It shall specify test performance data.

2.8.2 Identification Label

An identification label, of corrosion resistant material, shall be affixed to the completed unit in an approved location, with the following information stamped on it:

(a) The Government Specification number and contract number.

(b) The Contractor's name, address, equipment serial number, and month and year built.

(c) Allowable pressures and temperature for the vessel.

(d) Intended Use: 160 gallon liquid rocket propellant (kerosene) run tank.

(e) Information complying with the requirements of the ASME Code Section VIII, Division 2, Paragraph UG 119.

2.8.3 Nozzle Identification Label

An identification label, of corrosion resistance material, shall be affixed to each vessel nozzle indicating nozzle function.

2.8.4 Nozzle Identification Schematic

An identification label, of corrosion resistance material, shall be affixed to the vessel in an approved location indicating vessel nozzle function in schematic format.

2.9 Shop Drawings

Shop Fabrication Drawings shall be submitted for each shop assembly showing all details of construction. Six copies of each drawing are due eight weeks after award of the contract. Drawings shall be submitted in Autocadd version 14 or later version, Parametric Technology Corporation Pro/Engineer version 18 or later, or alternate buyer approved software. Shop drawings shall show the location and details of:

all dimensions and details of construction
connections
nozzle locations/attachments/reinforcement
piping arrangements
external supports
anchor bolt locations
appurtenances
foundation loading
support design requirements
approximate weight, dry, when filled with RP-1, when filled with water
thickness of all materials
Bill of Materials (Identification of all materials of construction)
date of manufacture
design and maximum allowable operating conditions (e.g. pressure, temp.)
design code

corrosion allowance
efficiency of joints
nondestructive examination type and requirements
type of tests (e.g. hydrostatic, pneumatic)
service (RP)
capacity of pressure vessel in cubic feet, in gallons
liquid levels (90% and 30% volume levels)

2.10 Product Data

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents for all components including:

Hubs
Clamps
Seal Rings

2.11 QUALITY CONTROL

Contractor shall submit 6 copies of quality control manual 6 weeks after contract award.

PART 3 EXECUTION

3.1 TRANSPORTATION

After the cleaning, inspecting and sealing of the vessel has been completed, the vessels' clean level shall be maintained for delivery to the E1 Facility at SSC using a positive blanket pressure of 10-20 psig "clean" nitrogen in accordance with SSC STD 79-002. A calibrated pressure gauge shall be installed onto the vessel such that internal pressure can be continuously monitored during shipment, storage, and installation of the vessel. The gauge shall be calibrated to have an accuracy of $\pm$0.5% full scale. The vendor shall assure the proper securing and bracing required to safely transport the vessel to its final destination. Packing shall meet Consolidated Freight classification rules or the regulations of other common carriers as applicable to the mode of transportation. The manufacturer shall deliver the vessel complete and ready for safe installation on site at the E1 facility at Stennis Space Center.

3.1.1 Loading, Transportation and Lift Plan

The vendor is responsible for the safe loading, securing and transportation of the vessel from his point of fabrication to Stennis Space Center, E1 Test Facility. The safe transportation of the vessel shall comply with all Federal, state and local codes and regulations. Total weight of the loaded transporter shall be provided to the Contracting Officer prior to transportation in order to assure safe transportation of the vessel once it arrives at Stennis Space Center to its final destination.

The vendor shall provide a lift plan that includes the net weight of the load and gross weight of load "under the hook". A list of all required lifting slings, spreader bars and attachment devices required shall be provided for use to off-load the vessel. Each attachment/lift point on the vessel shall be properly identified to allow proper rigging for off-loading the vessel at SSC and assure the proper configuration requirements are followed to lift and place the vessel from the transporter to the final

vertical position. The vendor shall include a drawing providing the center of gravity of the load and all other pertinent information that could affect the safe off-loading of the vessel.

3.1.2 Unloading Phase

The Vessel shall be delivered to the E1 Complex at SSC. Unloading of the vessel will be performed by others based upon the Lifting Plan, information and documentation provided by the vendor as specified in 3.1.1. Any additional information concerning the load weight, center of gravity, configuration changes or any other information that may affect the safe off-loading and placement in the vertical position must be provided prior to the off-loading of the vessel.

The Vessel manufacturer shall provide any special lifting structure (i.e. spreader bars) as part of the vessel delivery.

-- End of Section --

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

A standard transmittal form provided by the Government, SSC Form 581, shall be used to transmit each submittal.

Submittal Description (SD): Drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific portions of the work required by the contract.

The following items, SD-01 through SD-11, are descriptions of data to be submitted for the project. The requirements to actually furnish the applicable items will be called out in each specification.

SD-01 Preconstruction Submittals

Submittals which are required prior to a notice to proceed on a new contract. Submittals required prior to the start of the next major phase of the construction on a multi-phase contract. Schedules or tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work, submitted prior to contract notice to proceed or next major phase of construction.

SD-02 Shop Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work.

SD-03 Product Data

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents.

SD-05 Design Data

Design calculations, mix design analyses, or other data, written in nature, and pertaining to a part of the work.

SD-07 Certificates

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other Lower Tier

Contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality.

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

SD-11 Closeout Submittals

Special requirements necessary to properly close out a construction contract. For example, as-built drawings, manufacturer's help and product lines necessary to maintain and install equipment. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.3 PREPARATION

1.3.1 Marking

Permanent marking shall be provided on each submittal to identify it by contract number; transmittal date; Contractor's, Subcontractor's, and supplier's name, address(es) and telephone number(s); submittal name; specification or drawing reference; and similar information to distinguish it from other submittals. Submittal identification shall include space to receive the review action by the Contracting Officer.

1.3.2 Drawing Format

Drawing submittals shall be prepared on bond (20 lb. bond minimum) paper, not less than 8-1/2 by 11 inches nor larger than 30 by 42 inches in size, except for full size patterns or templates. Drawings shall be prepared to accurate size, with scale indicated, unless other form is required. Drawing reproducibles shall be suitable for microfilming and reproduction and shall be of a quality to produce clear, distinct lines and letters. Drawings shall have dark lines on a white background.

Copies of each drawing shall have the following information clearly marked thereon:

a. Job name, which shall be the general title of the contract drawings.

b. Date of the drawings and revisions.

c. Name of Contractor.

d. Name of Subcontractor.

e. Name of the item, material, or equipment detailed thereon.

f. Number of the submittal (e.g., first submittal, etc.) in a uniform location adjacent to the title block.

g. Government contract number shall appear in the margin, immediately below the title block.

Drawings shall be numbered in logical sequence. Contractor may use his own number system. Each drawing shall bear the number of the submittal in a uniform location adjacent to the title block. Government contract number shall appear in the margin, immediately below the title block, for each drawing.

A blank space, no smaller than 4 X 4 inches shall be reserved on the right hand side of each sheet for the Government disposition stamp.

1.3.3 Data Format

Required data submittals for each specific material, product, unit of work, or system shall be collected into a single submittal and marked for choices, options, and portions applicable to the submittal. Marking of each copy of product data submitted shall be identical. Partial submittals will not be accepted for expedition of construction effort.

1.4 SUBMISSION REQUIREMENTS

1.4.1 Schedules

Within 21 days of notice to proceed, the Contractor shall provide, for approval by the Contracting Officer, the following schedule of submittals:

a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Schedule shall indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.

b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).

c. Submittals called for by the contract documents will be listed on one of the above schedules. If a submittal is called for but does not pertain to the contract work, the Contractor shall include it in the applicable schedule and annotate it "N/A" with a brief explanation. Approval of the schedules by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the schedules or marked "N/A".

d. Copies of both schedules shall be re-submitted monthly annotated by the Contractor with actual submission and approval dates. When all items on a schedule have been fully approved, no further re-submittal of the schedule is required.

1.4.2 Drawings Submittals

Six blackline prints of each drawing shall be submitted. One print, marked with review notations by the Contracting Officer, will be returned to the Contractor.

1.4.3 Data Submittals

Five complete sets of indexed and bound product data shall be submitted. One set, marked with review notations by the Contracting Officer, will be returned to the Contractor.

1.5 GOVERNMENT'S REVIEW

1.5.1 Review Notations

Contracting Officer will review submittals and provide pertinent notation within 14 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "Approved as Submitted." authorize the Contractor to proceed with the work covered.

b. Submittals marked "Approved, Except as Noted, Resubmission Not Required." authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections. Notes shall be incorporated prior to submission of the final submittal.

c. Submittals marked "Approved, Except as Noted, Resubmission Required." require the Contractor to make the necessary corrections and revisions and to re-submit them for approval in the same routine as before, prior to proceeding with any of the work depicted by the submittal.

d. Submittals marked "Will Be Returned By Separate Correspondence" require the Contractor to follow the instructions given in the separate correspondence. If re-submission is required, the Contractor shall re-submit them for approval in the same routine as before prior to proceeding with any of the work depicted by the submittal.

e. Submittals marked "Disapproved" indicate noncompliance with the contract requirements and shall be re-submitted with appropriate changes. No item of work requiring a submittal shall be accomplished until the submittals are approved or approved as noted.

f. Submittals marked "Receipt Acknowledged" confirm receipt only.

g. Submittals marked "Other (Specify)" require the Contractor to follow the instructions given in the separate correspondence. If re-submission is required, the Contractor shall re-submit them for approval in the same routine as before, prior to proceeding with any of the work depicted by the submittal.

Contractor shall make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes in Contract Documentation" shall be given to the Contracting Officer. Approval of the submittals by the Contracting Officer shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Contractor shall be responsible for the dimensions and design of connection details and

construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to approved submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change shall be accomplished until the changed submittals are approved.

1.6 PROGRESS SCHEDULE

1.6.1 Bar Chart

Contractor shall:

a. Submit the progress chart, for approval by the Contracting Officer, within 21 days of Notice to Proceed, in one reproducible and 4 copies.

b. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" or comparable format acceptable to the Contracting Officer.

c. Include no less than the following information on the progress chart:

(1) Break out by major headings for primary work activity.

(2) A line item break out under each major heading sufficient to track the progress of the work.

(3) A line item showing contract finalization task which includes punch list, clean-up and demolition, and final construction drawings.

(4) A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period. Labor bar will also show the number of men (man-load) expected to be working on any given date within the contract performance period.

(5) The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.

(6) Separate line items for mobilization and drawing submittal and approval. (These items are to show no associated costs.)

d. Update the progress schedule in one reproduction and 4 copies every 30 days throughout the contract performance period.

1.7 STATUS REPORT ON MATERIALS ORDERS

Within 21 days after notice to proceed, the Contractor shall submit, for approval by the Contracting Officer, an initial status report on materials orders. This report will be updated and re-submitted every 28 days as the status on material orders changes.

Report shall list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will

be required for each material order listed:

a. Material name, supplier, and invoice number.

b. Bar chart line item or CPM activity number affected by the order.

c. Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.

d. Current delivery date agreed on by supplier.

e. When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.

f. When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.1 REFERENCES

Reference publications are cited in other sections of the specifications along with identification of their sponsoring organizations. The addresses of the sponsoring organizations are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

1711 Arlingate Lane
P.O. Box 28518
Columbus, OH 43228-0518
Ph: 800-222-2768
Fax: 614-274-6899

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
Internet: www.astm.org

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

Three Park Avenue
New York, NY 10016-5990
Ph: 212-591-7722
Fax: 212-591-7674
Internet: www.asme.org

SSC STANDARDS AND SPECIFICATIONS (SSC)

Central Engineering Files
Building 2104
Stennis Space Center, MS 39529
Ph: 228-688-3043
Fax: 228-688-3503

-- End of Section --

APPENDIX A1

SSTD-8070-0089

SURFACE CLEANLINESS REQUIREMENTS FOR
SSC FLUID SYSTEMS

SSTD-8070-0089-FLUIDS
Revision Basic
July 2002

John C. Stennis Space Center
Surface Cleanliness Requirements
For SSC Fluid Systems

Original signed by

Shamim Rahman
NASA Propulsion Test
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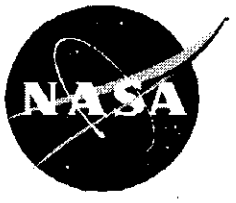
Issued CEF 07/10/02
Central Engineering Files



National Aeronautics and
Space Administration

John C. Stennis Space Center
Stennis Space Center, MS 39529-6000

Document History Log

Status/ Change/ 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 *normal*-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.

Table of Contents

TABLES

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 STD 99-008.

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 D1193	Standard Specification for Reagent Water
ASTM D4080	Standard Specification for Trichloroethylene, Technical and Vapor Degreasing Grade
ASTM D4376	Standard Specification for Vapor-Degreasing Grade Perchloroethylene (vapor degreasing use only)

ASTM D5501	Standard Test Method for Determination of Ethanol Content of Denatured Fuel Ethanol by Gas Chromotography
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
SPG 1400.1	Document Preparation, Numbering and Management Guidelines
SPG 4130.2	Hazardous Materials, Hazardous Waste and Solid Waste Handbook
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
SSC STD 99-008	Preparation, Review, Approval and Release of SSC Standards
SSLP-1440-0001	SSC Records Management Program and Control of Quality Records
TT-I-735	Federal Specification: Isopropyl Alcohol

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 buttweld 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.

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.

TABLE 1. CLEANLINESS LEVELS/REQUIREMENTS

CLEANLINESS LEVEL	PARTICULATE		NVR/HYDROCARBON mg/0.1m² (mg/ft²)□ ✔		DEWPOINT/MOISTURE CONTENT	
	SIZE (MICRONS)	NUMBER (PARTICLES) no./0.1m² (no./ft²) ⧫	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 ✔	0 ✔	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□	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	●				
3■	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	●				

NOTES:

⧫ 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.

✔ 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

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 SSC SPG 4130.2 *Hazardous Materials, Hazardous Waste, and Solid Waste Handbook* 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.

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.

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.

Note: *normal*-Propyl Bromide is not compatible with some non-metallic and metallic materials. Material compatibility must be verified before use.

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 ASTM D1193, Type II and 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.

5.4.2 DI Water Process for Particulate Analysis

When used for particulate verification, DI water shall conform to ASTM D1193, Type II and shall meet NVR and/or particulate requirements of the cleaned item. In addition, the DI water shall contain an additive (e.g., 25ppm of Zonyl surfactant) to wet the significant surfaces. The DI water and additive (reagent) must be approved by NASA PTD. If the reagent is used on a component or system that requires NVR verification, the reagent residue must be compatible with ambient liquid oxygen impact testing in accordance with NASA Standard 6001, Test 13A.

5.4.3 DI Water/Rinsing Agent

When used for rinsing operations, DI water shall conform to ASTM D1193, Type II and shall meet the NVR and/or particulate requirements of the cleaned item.

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.

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 I 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.

6.5 DRYNESS (DEW POINT) ANALYSIS

Dewpoint/moisture certification is required for all systems, components (other than excepted components, section 8.0) and IM&TE with a dewpoint requirement specified on Table 1.

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, heated gas at 135 degrees C shall be locked within the vessel for a minimum of 8 hours.

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.

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.

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.

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.

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 identified in this standard shall be maintained in accordance with SSLP-1440-0001. For Quality Records refer to the SSC Master Records Index. All forms are assumed to be the latest edition unless otherwise specified and may be obtained from the SSC Electronic Forms repository or from the NASA SSC Forms Management Officer.

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.

Dew Point - 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.

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 dew point.

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).

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.

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
TOC	Total Organic Carbon
UV	Ultraviolet

APPENDIX A2

SSC STD. 79-002

SAMPLING REQUIREMENTS AND MAXIMUM ALLOWABLE IMPURITIES FOR SSC FLUIDS AND FLUID SYSTEMS

CONCURRENCE SHEET

SAMPLING REQUIREMENTS AND MAXIMUM ALLOWABLE IMPURITIES FOR SSC FLUIDS AND FLUID SYSTEMS

Richard J. Gilbrech	04/27/00	Samuel Dale McCarty	04/27/00
NASA PROPULSION TEST DIRECTORATE	DATE	NASA CENTER OPERATIONS DIRECTORATE	DATE
John L. Gasery, Jr.	04/27/00	Issued CEF	04/28/00
NASA S&MA	DATE	CENTRAL ENGINEERING FILES	DATE

CHANGE RECORD

REVISION	DATE	PAGE	DESCRIPTION
H	26 Apr 00	All	Complete rewrite including title change. Implements change for waiver NA49 (dated 4/10/92) re: LOX moisture analyses.

CONTENTS

TABLES

1.0 INTRODUCTION

1.1 PURPOSE

This SSC standard (STD) establishes the maximum allowable impurities and sampling criteria for the fluids (gases, liquids) used as propellants and pressurants to clean, test, dry, or preserve test systems, subsystems, assemblies, components, and support equipment at Stennis Space Center (SSC).

1.2 SCOPE

This STD applies to site-wide facility systems (including offsite procurements) associated with the following services.

- High Pressure (Missile Grade) Air (HPA)
- Helium (He)
- Hydrogen, Gas (GH_2) and Liquid (LH_2)
- Nitrogen, Gas (GN_2) and Liquid (LN_2)
- Oxygen, Gas (GOX) and Liquid (LOX)

1.3 RESPONSIBILITIES

1.3.1 SSC Activities

This standard shall be implemented by NASA and Contractor personnel responsible for engineering design, manufacture, fabrication, analysis, inspection, or test operations. NASA and the Contractor shall ensure compliance with the requirements of this standard through surveillance, auditing, and process verification. The SSC Propulsion Test Directorate (PTD) Test Engineering Division and the Center Operations and Support Directorate Facilities Engineering Division (FED) are responsible for the content of this SSC STD. Revision or cancellation of this STD shall be reviewed and approved as specified in SLP-05 and SSC STD 99-008.

1.3.2 Quality Control

NASA and/or Contractor QA are responsible for verifying the certification of systems. The scheduling and the frequency of sampling shall be as indicated in Section 5.0.

2.0 REFERENCED DOCUMENTS

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

FED-STD 209	Airborne Particulate Cleanliness Classes in Clean Rooms and Clean Zones
MIL-PRF-25508	Performance Specification, Propellant, Oxygen (Grade A)
MIL-PRF-27201	Performance Specification, Propellant, Hydrogen
MIL-PRF-27401	Performance Specification, Propellant Pressurizing Agent, Nitrogen (Grade B)
MIL-PRF-27407	Performance Specification, Propellant Pressurizing Agent, Helium (Grade A)
SLP-05	Document and Data Control
SLP-16	Control of Quality Records
SPG 8715.1	NASA/SSC Safety and Health Procedures and Guidelines
SSC STD 79-001	Surface Cleanliness Requirements for SSC Facility Fluid Systems
SSC STD 99-008	Guide for the Preparation, Approval and Release of SSC Standards

3.0 GENERAL REQUIREMENTS

3.1 SAFETY

All procedures in this standard shall be performed in accordance with applicable requirements in SPG 8715.1.

3.2 CONTROLLED ENVIRONMENTS

Areas where particulate samples are analyzed shall conform to requirements for controlled environment areas per FED-STD-209.

3.3 PROCEDURES

The performing unit shall work to approved procedures for performing all sampling and analyses. The NASA Monitor/Project Engineer and the NASA Quality Assurance Representative responsible for system integrity shall approve these procedures prior to work.

3.4 PERSONNEL INSTRUCTION

Personnel involved in obtaining and analyzing test samples shall be trained and/or certified and shall wear proper personal protective equipment (PPE). Precautions must be taken to prevent introduction of contaminants into test samples.

3.5 SAMPLING

Samples shall be taken at the gas user interface point downstream of filters, regulators, valves, and any other equipment normally installed in a line. If maintenance is performed without contamination control (79-001), or when contamination is suspected, then additional samples shall be taken at the next downstream user interface point. Unless otherwise specified, gas sample volume shall be a minimum of 0.850 standard cubic meter.

3.6 CERTIFICATION RECORDS

Logs or databases shall be used to document all sampling at each use point in order to monitor trends and/or failures. The data from these logs or databases will be maintained by the performing organization and may be used to determine if the sampling frequency as required by Section 5.1.2 needs to be modified.

3.7 REPORTS

All data gathered as a result of this standard shall be documented by the performing organization as designated by NASA QA, and shall include pertinent information recorded in logs or databases per section 3.6.

3.8 ANALYSIS EQUIPMENT

The equipment used to perform the analyses specified herein shall be approved for contamination testing by the performing organization as designated by NASA QA.

CAUTION

Prior to use, hand tools, materials, and equipment that may come into contact with significant surfaces or the service media shall be certified cleaned to the required system or component clean level in accordance with SSC STD 79-001.

4.0 MAXIMUM ALLOWABLE IMPURITIES

Requirements for maximum allowable impurities in the SSC Facility Transfer Systems at the receiving and user interface points are specified in Table 1. (Note that service fluid purity levels differ from system and component clean levels specified by SSC STD 79-001.)

NOTE

The impurities in all fluid samples shall be analyzed in the gaseous state.

TABLE 1. PROPELLANTS AND PRESSURANTS MAXIMUM ALLOWABLE IMPURITIES

PROPELLANT/PRESSURANT	REQUIREMENTS*	
PARAMETER	RECEIVING	USER INTERFACE POINTS
HELIUM, GAS (He)	Ref MIL-PRF-27407 (Grade A)	
Purity	99.995% He (min.)	99.994% He (min.)
Total Impurities	50	N/A
Specific Impurities	N/A	60
H_2	1	N/A
N_2 and Argon (receiving only)	14	36
O_2 and Argon (UIP only)	3	10
H_2O	9 (-61.1°C Dew Point)	9 (-61.1°C Dew Point)
Hydrocarbon**	5	5
Neon	23	N/A
CO	1	N/A
CO_2	1	N/A
Particulate (gas)	N/A	30µ-100µ: 25; >100µ: 0
Particulate (liquid)	N/A	N/A

TABLE 1. (Continued)

PROPELLANT/PRESSURANT	REQUIREMENTS*	
PARAMETER	RECEIVING	USER INTERFACE POINTS
HYDROGEN, GAS OR LIQUID (H_2) Ref MIL-PRF-27201		
Purity	99.995% H_2 (min.)	99.993% H_2 (min.)
Total Impurities	50	N/A
Specific Impurities	N/A	70
Selected Impurities:		
Parahydrogen	95.0% (liquid H_2 only)	N/A
N_2, H_2O, Hydrocarbon**	9 (-61.1°C Dew Point)	20 (9 for H_2O) (-61.1°C Dew Point)
O_2 and Argon	1	5
He	39	45
CO_2 plus CO	1	N/A
Particulate (gas)	N/A	N/A
Particulate (liquid)	N/A	N/A
NITROGEN, GAS OR LIQUID (N_2) Ref MIL-PRF-27401 (Grade B)		
Purity	99.99% N_2 (min.)	99.989% N_2 (min.)
Total Impurities	100	N/A
Specific Impurities	N/A	111
Selected Impurities: O_2	50	100
Hydrocarbon**	5	5
H_2O	6*** (-64.0°C Dew Point)	6.0***(-64.0°C Dew Point)
Particulate (gas)	N/A	30µ-100µ: 25; >100µ: 0
Particulate (liquid)	1 mg/liter	N/A
OXYGEN, GAS (GOX) OR LIQUID (LOX) Ref MIL-PRF-25508 (Grade A)		
Purity	99.6% O_2 (min.)	99.6% O_2 (min.)
Total Impurities	4000	N/A
H_2O	3 (-69.0°C Dew Point)	20 (-55.2°C Dew Point)
Hydrocarbon**	50	50
(C_2H_2) Acetylene	0.25 ppm by weight	N/A
Particulate (gas)	N/A	30µ-100µ: 25; >100µ: 0
Particulate (liquid)	1 mg/liter	N/A
HIGH PRESSURE AIR (HPA)		
Purity	N/A	18% O_2 (min.)
H_2O	N/A	24 (-53.9°C Dew Point)
Hydrocarbon**	N/A	15
Particulate (gas)	N/A	30µ-100µ: 25; >100µ: 0
Particulate (liquid)	N/A	N/A

*Unless otherwise specified, requirement levels are total ppm by volume.
**Total hydrocarbons expressed as Methane (CH_4).
***The maximum H_2O content is 6 ppm verified from the delivery manifest. This is less than the 11.5 ppm allowed in MIL-PRF-27401; however, historical data documents receipt of product within the lower limit.

5.0 FLUID SUPPLY SYSTEM CLEANLINESS REQUIREMENTS

NOTE

Taking gas and/or liquid samples certifies systems, but the impurities in all fluid samples are analyzed in a gaseous state.

5.1 CERTIFICATION OF FLUID SYSTEMS

Certification of a fluid system shall require testing of the sample fluid as described in sections 5.1.1, 5.1.2 and 5.1.3.

5.1.1 Initial Certification

For certification of a new system, except cylinder supplied gas as defined in 5.1.3, the following requirements must be satisfied.

a. Two consecutive samples at each user interface point in the system, taken 8 to 72 hours apart, shall comply with the user interface point requirements in Table 1.

b. Two additional samples taken consecutively at 5-to-10-day intervals from each user interface point shall comply with the hydrocarbon, moisture and particulate user interface point requirements in Table 1.

5.1.2 Periodic Certification

After initial certification of a fluid system, periodic certifications are required as follows.

NOTE

When contamination is suspected, tests shall be performed to verify the impurity levels of the fluid. If these tests indicate that contamination levels exceed the requirements of 5.1.2-a or -b, then necessary corrective action shall be taken to clean and purge the system. If three consecutive samples fail, the system shall be certified as specified in 5.1.1.

a. A supply fluid sample taken at the storage vessel, at 6-month intervals, shall comply with the user interface point requirements in Table 1.

b. A sample taken at each user interface point at 3-month intervals shall comply with the hydrocarbon, moisture and particulate user interface point requirements in Table 1.

5.1.3 Cylinder Supplied Gas Certification

A gas system may consist of a cylinder, or a bank of cylinders, equipped with one or more user interface points.

a. Initial certification shall require a sample obtained from the user interface point downstream from the cylinder gas system. This sample must meet the contamination level user interface point requirements specified in Table 1. The certification sample shall be taken with all bottle valves in the open position.

b. Periodic certification is not required; however, following cylinder replacement or maintenance the provisions of Section 5.2 shall apply.

5.1.4 Intermittent Certification of Usage Points

User interface points shall be initially certified in accordance with 5.1.1, and periodically certified in accordance with 5.1.2. If an initially certified user interface point has not subsequently been periodically certified, then (a) a sample shall comply with the user interface requirements in Table 1; and (b) a second sample, taken 8 to 72 hours later, shall comply with the hydrocarbon, particulate and moisture user interface point requirements in Table 1.

5.1.5 Testing, Drying and Preservation

Gases used in the testing, drying and preservation of components, assemblies and support/test equipment shall meet the hydrocarbon, moisture and particulate user interface point requirements specified in Table 1. When used for testing, drying and preservation, gas user interface points that are used daily shall be tested weekly; if used intermittently, they shall be verified at the time of use.

5.2 RECERTIFICATION OF SYSTEMS

5.2.1 Required

A fluid system requires recertification when any part has been disassembled, recleaned, or modified. Recertification requires the following.

a. If a positive pressure flow is not maintained, then a sample shall be obtained from the next downstream user interface point and tested to verify that all parameters comply with the user interface point requirements in Table 1. If this test fails, then necessary corrective action shall be taken to clean and purge the system. If three consecutive samples fail, the system shall be certified as specified in 5.1.1.

b. If a positive flow is maintained, the media shall be tested to verify that hydrocarbon, moisture and particulate meet the user interface point requirements in Table 1. If this test fails, then necessary corrective action shall be taken to clean and purge the system. If three consecutive samples fail, the system shall be certified as specified in 5.1.1.

5.2.2 Not Required

Recertification of a system is not required if all of the following are verified.

a. A positive purge is maintained on the system when the system is disassembled.

b. The system is disassembled for removal of a component or instrument for recertification or recalibration.

c. The instrument or component is installed in an open loop configuration.

6.0 RECORDS AND FORMS

Records and forms identified in this standard shall be maintained in accordance with SLP-16. For Quality Records refer to the SSC Master Records Index. All forms are assumed to be the latest edition unless otherwise specified and may be obtained from the SSC Electronic Forms repository or from the NASA SSC Forms Management Officer.

APPENDIX A

ACRONYMS AND ABBREVIATIONS

C_2H_2	Acetylene
CO	Carbon Monoxide
CO_2	Carbon Dioxide
FED	Federal
H_2	Hydrogen
H_2O	Water
He	Helium
LH	Liquid Hydrogen
LN	Liquid Nitrogen
LOX	Liquid Oxygen
IPA	Isopropyl Alcohol
MIL	Military
N_2	Nitrogen
NASA	National Aeronautics and Space Administration
NVR	Nonvolatile Residue
O_2	Oxygen
PRF	Performance (spec)
PPE	Personal Protective Equipment
ppm	Parts per million (p/m)
QA	Quality Assurance
SLP	System Level Procedure
Spec	Specification
SPG	SSC Procedures and Guidelines
SSC	Stennis Space Center
STD	Standard
UIP	User Interface Point

APPENDIX B

DEFINITIONS

Certification - The attesting (in writing) that requirements are verified as having been met.

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

Fluid - Any gas or liquid used to clean, test, dry, or preserve test systems, subsystems, assemblies, components, and support equipment.

Hydrocarbon - Any compound containing carbon and hydrogen bonds.

Interface Point - A specific location where systems intersect.

Micron - Dimension of length equal to 0.001 millimeter (0.0000394 inch).

Moisture - The residual liquid/gas resulting from cleaned components or systems, measured in parts-per-million (PPM).

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. The predominant constituents of NVR are hydrocarbons.

Particulate - Fibers or units of matter with observable length, width, and thickness, usually measured in microns.

Significant Surfaces - Those surfaces of components, piece-parts, assemblies, subsystems, systems, and ground support equipment that come in contact with test solvents.

Standard Cubic Meter - Volume of one cubic meter of gas at one atmosphere of pressure (i.e., 760 mm of mercury) at 70°F (21.1°C).

APPENDIX B (continued)

DEFINITIONS

Testing - The process of acquiring and analyzing samples to determine the impurities and purity levels.

User Interface Point - Any specific service port where commodities are extracted from the system. In some cases, the user interface point may be the specific port where commodities are injected into the system.

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

APPENDIX A3

SSC DWG 54000-GP11

PACKAGING AND PRESERVATION OF CLEAN COMPONENTS

54000-GP11

SYM	ZONE	DESCRIPTION	DATE	APPROVED

REVISIONS

	SIGNATURE	DATE
DRAWN		
CHECKED		
ENGINEER		
PROJ		
SUBMITTED		
NASA SAFETY		
APPROVED		
USED ON		

ISSUED UNDER

CADD CONTROLLED DRAWING
LAUD P/N
SCD\54000\GP11RD\SHT1

National Aeronautics and Space Administration

John C. Stennis Space Center
SSC, MS 39529-6000

PACKAGING & PRESERVATION OF CLEANED COMPONENTS

SIZE	DWG NO	REV.
B	54000-GP11	0

AUTHORITY

SHEET

1.0 SCOPE

THIS SPECIFICATION COVERS THE REQUIREMENTS FOR PACKAGING AND PRESERVATION OF COMPONENTS, PIECE PARTS AND SOFTGOODS THAT HAVE BEEN CLEANED TO A SPECIFIED CLEAN LEVEL.

2.0 DEFINITIONS

2.1 ACLAR - TRANSPARENT, COLORLESS, CONTAMINATE-FREE POLYCHLOROTRIFLUOROETHYLENE (ACLAR 22A) FILM WITH A NOMINAL .0015 TO .0030 INCH THICKNESS.

2.2 COMPONENT - AN ARTICLE WHICH IS NORMALLY A COMBINATION OF PARTS, SUB-ASSEMBLIES, OR ASSEMBLIES AND IS A SELF-CONTAINED ELEMENT WITHIN A COMPLETE OPERATING UNIT.

2.3 FEP TEFLON - TRANSPARENT, VIRGIN FLUORINATED ETHYLENE PROPYLENE FILM WITH NO COLORING OR ADDITIVES OF ANY DESCRIPTION, AND A NOMINAL 2 MIL (.002") THICKNESS.

2.4 ITEM - THE WORD ITEM(S) IS USED HEREIN, FOR BREVITY, TO INDICATE COMPONENTS, PARTS, EQUIPMENT OR ANY COMBINATION OF THESE TERMS.

2.5 MARKING - THE APPLICATION OR USE OF MARKS, SYMBOLS, AND ADDRESSES FOR PURPOSES OF GUIDING OR DIRECTING THE SAFE HANDLING AND SHIPPING OF PACKAGED ITEMS.

2.6 NYLON, ANTI-STATIC - TRANSPARENT POLYAMIDE (NYLON 6 OR EQUAL) FILM WITH A NOMINAL 2 MIL (.002") THICKNESS, CONTAINING AN ORGANIC, ANTI-STATIC AGENT THROUGHOUT THE FILM.

2.7 PACKAGING - APPLICATION OR USE OF ADEQUATE PROTECTIVE MEASURES TO PREVENT DAMAGE FROM PHYSICAL HAZARDS OR CONDITIONS INCLUDING, AS APPLICABLE, WRAPPING FOR PROTECTION FROM PHYSICAL DANGER, CUSHIONING, INTERIOR CONTAINERS, AND COMPLETE IDENTIFICATION MARKING, UP TO BUT NOT INCLUDING THE EXTERIOR SHIPPING CONTAINER EXCEPT WHEN A UNIT CONTAINER IS ALSO THE SHIPPING CONTAINER.

2.7.1 PRIMARY (OR INTIMATE) PACKAGING - MATERIAL USED TO COVER AND PROTECT PRECISION CLEANED ITEMS.

2.7.2 SECONDARY (OR ENVIRONMENTAL) PACKAGING - MATERIAL USED TO PROVIDE PROTECTION TO THE PRIMARY PACKAGING AND AS AN ADDITIONAL BARRIER TO PROTECT THE PRECISION CLEANED ITEM.

2.8 PACKING - THE FINAL PLACEMENT OF ITEMS OR PACKAGES IN EXTERIOR SHIPPING CONTAINERS OR OTHER MEDIA INCLUDING THE NECESSARY BLOCKING, BRACING OR CUSHIONING, WEATHERPROOFING, AND EXTERIOR STRAPPING.

2.9 PART - THE LEAST SUBDIVISION OF A COMPONENT: A PIECE THAT FUNCTIONS IN INTERACTION WITH OTHER ELEMENTS OF A COMPONENT, BUT IS ITSELF NOT ORDINARILY SUBJECT TO DISASSEMBLY.

2.10 POLYETHYLENE, ANTI-STATIC - PINK, PLASTIC FILM WITH A NOMINAL 6 MIL (.006") THICKNESS, CONTAINING AN ORGANIC, ANTI-STATIC AGENT THROUGHOUT THE FILM.

2.11 PRECISION CLEAN - FOR THE PURPOSES OF THIS PROCEDURE, A HIGH DEGREE OF CLEANLINESS WHICH HAS BEEN VERIFIED TO MEET THE REQUIREMENTS OF A SPECIFIED CLEAN LEVEL (e.g., SSC STANDARD 79-001 LEVEL 1XX, KSC-123 LEVEL VC-UV).

2.12 PRESERVATION - APPLICATION OR USE OF ADEQUATE PROTECTIVE MEASURES TO PREVENT DETERIORATION FROM ENVIRONMENTAL HAZARDS OR CONDITIONS INCLUDING, AS APPLICABLE, THE USE OF APPROPRIATE CLEANING AND DRYING METHODS, PRESERVATIVES, AND WRAPPING FOR PROTECTION FROM CHEMICAL DANGER.

2.13 SHIPPING AND HANDLING - THE ACT OF TRANSPORTING AND HANDLING PACKAGED AND PACKED ITEMS FROM ONE PLACE TO ANOTHER.

2.14 SIGNIFICANT SURFACES - ANY SURFACE OF AN ITEM THAT CONTACTS THE SERVICE MEDIA AND/OR IS SUBJECT TO CLEAN LEVEL VERIFICATION. SIGNIFICANT SURFACES ARE SUBJECT TO THE PACKAGING AND PRESERVATION REQUIREMENTS OF THIS SPECIFICATION.

2.15 TAPE - A WATERPROOF, PRESSURE-SENSITIVE, ADHESIVE STRIP WITH BACKING MATERIAL MADE OF PLASTIC FILM WHICH MAY BE EITHER COLORED OR TRANSPARENT AND IS USED FOR PACKAGING AND SEALING. (TAPE WITH WOVEN FABRIC CLOTH BACKING MATERIAL MAY BE USED TO SECURE LEVEL 3 COMPONENT PACKAGING, AND SECONDARY PACKAGING ONLY.)

3.0 PACKAGING AND PRESERVATION

NOTE

SELECTION OF THE PRIMARY PACKAGING FILM IS BASED ON THE INTENDED SERVICE MEDIA OF THE ITEM. REFERENCE TABLE 1 FOR MATERIAL GUIDE WHEN SELECTING/VERIFYING PACKAGING MATERIAL.

TABLE 1
REQUIRED PACKAGING FOR SPECIFIC MEDIA/CLEANLINESS LEVEL

MEDIA/CLEANLINESS LEVEL	PACKAGING REQUIREMENT
ALL PRECISION CLEANED ITEMS FOR LO/GO SERVICE MEDIA.	• PRIMARY SEAL (OR BAG) OF ACLAR/FEP TEFLON FILM • SECONDARY SEAL (OR BAG) OF POLYETHYLENE FILM
ALL PRECISION CLEANED ITEMS FOR WHICH NO SERVICE MEDIA IS SPECIFIED.	
ALL PRECISION CLEANED ITEMS FOR SERVICE MEDIA OTHER THAN LO/GO [EXCEPT LEVEL 3 COMPONENTS (VISUALLY CLEAN)].	• PRIMARY SEAL (OR BAG) OF NYLON FILM • SECONDARY SEAL (OR BAG) OF POLYETHYLENE FILM
LEVEL 3 (VISUALLY CLEAN) ITEMS.	• PRIMARY SEAL (OR BAG) OF POLYETHYLENE FILM • SECONDARY SEAL NOT REQUIRED

3.1 GENERAL NOTES

3.1.1 THE OXYGEN COMPATIBLE PRIMARY SEALING MATERIAL SPECIFIED IN THIS PROCEDURE IS ACLAR OR FEP TEFLON FILM, AND IS TO BE USED ON ALL LO/GO ITEMS. ACLAR OR FEP TEFLON MAY ALSO BE USED AS THE PRIMARY SEALING MATERIAL FOR ALL OTHER APPLICATIONS, HOWEVER DUE TO COST CONSIDERATIONS AND THE TENDENCY FOR THE FILM TO SLOUGH, THEY SHOULD ONLY BE USED WHEN ABSOLUTELY NECESSARY.

3.1.2 ACLAR OR FEP TEFLON FILM SHALL BE USED AS THE PRIMARY SEALING MATERIAL ON PRECISION CLEANED ITEMS FOR WHICH NO SERVICE MEDIA IS SPECIFIED.

3.1.3 ANTI-STATIC NYLON SHALL BE THE PREFERRED PRIMARY PACKAGING MATERIAL ON ALL OTHER (NON-LO/GO) PRECISION CLEANED ITEMS, WITH THE EXCEPTION OF LEVEL 3 (VISUALLY CLEAN) ITEMS.

3.1.4 METAL CAPS, PLUGS, HUBS, ETC. (STAINLESS STEEL FOR STAINLESS COMPONENTS AND CARBON STEEL FOR CARBON COMPONENTS), MAY BE USED IN LIEU OF ACLAR/FEP TEFLON OR NYLON FILMS TO PROTECT SIGNIFICANT SURFACES OF PRECISION CLEANED ITEMS. WHEN USING METAL CLOSURES AS PRIMARY PACKAGING, NO SECONDARY PACKAGING MATERIAL IS REQUIRED.

3.1.5 ALL PRIMARY PACKAGING MATERIALS WILL BE CERTIFIED AS CLEAN AS, OR CLEANER THAN, THE ITEM IT IS TO PROTECT.

3.1.6 THE SECONDARY (OR ENVIRONMENTAL) PACKAGING SPECIFIED IN THIS PROCEDURE IS ANTI-STATIC POLYETHYLENE. THIS SECONDARY MATERIAL PROVIDES PHYSICAL PROTECTION ONLY. ALTHOUGH IT DOES NOT REQUIRE THE CLEANLINESS CERTIFICATION OF THE PRIMARY PACKAGING MATERIAL, THE POLYETHYLENE MATERIAL SHALL BE VISUALLY CLEAN.

3.1.7 DUE TO THE HIGH WATER VAPOR TRANSMISSION RATE (W.V.T.R.) OF NYLON FILMS, NYLON IS TO BE USED AS A PRIMARY COVER ONLY, AND THIS IS PERMITTED ONLY WHEN IT IS USED IN CONJUNCTION WITH A SECONDARY COVER OF POLYETHYLENE PACKAGING MATERIAL.

3.1.8 ADEQUATE OVER-PACKAGING OF ITEMS SHALL BE PROVIDED AS REQUIRED, IN ADDITION TO THE PACKAGING HEREINAFTER SPECIFIED, TO PROTECT THE ITEMS DURING HANDLING, SHIPPING AND STORAGE.

3.1.9 PACKAGING OF SOFT GOODS SHALL NOT CONSTRAIN THE PART OR IN ANY WAY IMPEDE THE PART'S ORIGINAL CONFIGURATION. THE PACKAGING SHALL BE SUFFICIENTLY OVERSIZED TO ALLOW FOR FREE MOVEMENT WITHIN THE PRIMARY SEALING MATERIAL.

3.1.10 AN ITEM FOR WHICH NYLON IS USED AS THE PRIMARY COVER SHALL HAVE ITS CLEANING CERTIFICATION CARD STAMPED "NOT PACKAGED FOR OXYGEN SERVICE".

3.2 FILTER ELEMENTS

3.2.1 DUE TO THE FRAGILE CONSTRUCTION AND HIGH COST OF STAINLESS STEEL FILTER ELEMENTS, SPECIAL CARE MUST BE APPLIED IN PACKAGING AND TRANSPORT. THE FOLLOWING NOTICES MUST BE APPLIED BETWEEN THE PRIMARY AND SECONDARY PACKAGING: "THIS END UP", "FRAGILE", "HANDLE WITH CARE".

3.2.2 FILTER ELEMENTS RECEIVED IN WOODEN CONTAINERS SHALL BE DOUBLE BAGGED PER STEP 3.2.1 AND RETURNED IN THE SAME WOODEN CONTAINERS. SMALL FILTER ELEMENTS SHALL BE DOUBLE BAGGED PER STEP 3.2.1 AND PLACED IN PASTEBOARD BOXES OR OTHER SUITABLE RIGID CONTAINERS, WITH ADEQUATE PADDING TO PREVENT FILTER DAMAGE. THE EXTERIOR OF THE CONTAINER SHALL BE LABELED "THIS END UP", "FRAGILE", "HANDLE WITH CARE".

3.2.3 THE CLEANING CERTIFICATION CARD SHALL BE SEALED IN A POLYETHYLENE BAG, AND ATTACHED TO THE OUTSIDE CONTAINER.

3.3 LO/GO COMPONENTS, PIECE PARTS, AND SOFTGOODS

3.3.1 COMPONENTS

3.3.1.1 COMPONENTS SHALL HAVE ALL PORTS AND OTHER SIGNIFICANT SURFACES PROTECTED BY COVERING WITH ONE LAYER OF CLEAN ACLAR OR FEP TEFLON FILM. SECURE AND REINFORCE THE ACLAR OR FEP TEFLON FILM WITH TAPE.

3.3.1.2A FOR SMALL COMPONENTS WHOSE SIZE WILL PERMIT PLACING THE ENTIRE COMPONENT IN A POLYETHYLENE BAG, COVER THE ACLAR, OR FEP TEFLON FILM BY PLACING THE ENTIRE COMPONENT IN A POLYETHYLENE BAG. THE CLEANING CERTIFICATION CARD SHALL BE PLACED IN THE POLYETHYLENE BAG WITH THE COMPONENT PRIOR TO SEALING.

3.3.1.2B FOR COMPONENTS WHOSE SIZE WILL NOT PERMIT PLACING THE ENTIRE COMPONENT IN A POLYETHYLENE BAG, COVER THE ACLAR, OR FEP TEFLON FILM WITH ONE LAYER OF POLYETHYLENE AND SECURE WITH TAPE. THE CLEANING CERTIFICATION CARD SHALL BE SEALED IN A POLYETHYLENE ENVELOPE AND ATTACHED TO THE COMPONENT.

3.3.1.3 OPENINGS (1-1/2" AND LARGER) SHALL HAVE AN ADDED COVER OF METAL OR HARDBOARD OVER THE SECONDARY PACKAGING TO PREVENT DAMAGE. SECURE HARD COVER WITH TAPE.

3.3.2 SMALL PARTS AND SOFTGOODS

NOTE
SMALL PARTS AND SOFTGOODS FOR WHICH NO SERVICE MEDIA IS SPECIFIED SHALL BE PACKAGED PER STEP 3.3.2.1.

3.3.2.1 SMALL PARTS AND SOFTGOODS SHALL BE SEALED IN ONE ACLAR OR FEP TEFLON BAG AND PLACED INTO ONE POLYETHYLENE BAG. THE CLEANING CERTIFICATION CARD SHALL BE PLACED BETWEEN THE PRIMARY AND SECONDARY BAG PRIOR TO SEALING. PURGING OR EVACUATION OF OVER-PACKAGING SHALL NOT BE REQUIRED

3.3.3 VESSEL OR TANK PORTS

3.3.3.1 VESSEL OR TANK PORTS SHALL BE SEALED BY APPLYING ONE LAYER OF CLEAN ACLAR OR FEP TEFLON FILM OVER THE PORTS AND SECURING WITH TAPE. THE ACLAR OR FEP TEFLON SHALL BE TAPED ON THE OUTSIDE AREA OF THE PORT, ABOVE (OR BEHIND) THE THREADED AREA. COVER THE ACLAR OR FEP TEFLON WITH POLYETHYLENE, AND SECURE WITH TAPE.

3.3.3.2 SEAL THE CLEANING CERTIFICATION CARD INSIDE A POLYETHYLENE ENVELOPE AND ATTACH IT TO THE VESSEL OR TANK.

3.4 ALL PRECISION CLEANED COMPONENTS, PIECE PART AND SOFTGOODS, EXCEPT LEVEL 3 AND LO/GO ITEMS

3.4.1 COMPONENTS

3.4.1.1 COMPONENTS SHALL HAVE ALL PORTS AND OTHER SIGNIFICANT SURFACES PROTECTED BY COVERING WITH ONE LAYER OF CLEAN NYLON FILM. SECURE AND REINFORCE THE NYLON FILM WITH TAPE.

3.4.1.2A FOR SMALL COMPONENTS WHOSE SIZE WILL PERMIT PLACING THE ENTIRE COMPONENT IN A POLYETHYLENE BAG, COVER THE NYLON FILM BY PLACING THE ENTIRE COMPONENT IN A POLYETHYLENE BAG. THE CLEANING CERTIFICATION CARD SHALL BE STAMPED "NOT PACKAGED FOR OXYGEN SERVICE" AND PLACED IN THE POLYETHYLENE BAG WITH THE COMPONENT PRIOR TO SEALING.

3.4.1.2B FOR COMPONENTS WHOSE SIZE WILL NOT PERMIT PLACING THE ENTIRE COMPONENT IN A POLYETHYLENE BAG, COVER THE NYLON FILM WITH ONE LAYER OF POLYETHYLENE AND SECURE WITH TAPE. THE CLEANING CERTIFICATION CARD SHALL BE STAMPED "NOT PACKAGED FOR OXYGEN SERVICE", SEALED IN A POLYETHYLENE ENVELOPE AND ATTACHED TO THE COMPONENT.

3.4.1.3 OPENINGS (1-1/2" OR LARGER) SHALL HAVE AN ADDED COVER OF METAL OR HARDBOARD OVER THE SECONDARY PACKAGING TO PREVENT DAMAGE. SECURE HARD COVER WITH TAPE.

3.4.2 SMALL PARTS AND SOFTGOODS

NOTE
SMALL PARTS AND SOFTGOODS FOR WHICH NO SERVICE MEDIA IS SPECIFIED SHALL BE PACKAGED PER STEP 3.3.2.1

3.4.2.1 SMALL PARTS AND SOFTGOODS SHALL BE SEALED IN ONE NYLON BAG AND PLACED INTO ONE POLYETHYLENE BAG. THE CLEANING CERTIFICATION CARD SHALL BE STAMPED "NOT PACKAGED FOR OXYGEN SERVICE" AND PLACED BETWEEN THE PRIMARY AND SECONDARY BAG PRIOR TO SEALING. PURGING OR EVACUATION OF OVER-PACKAGING SHALL NOT BE REQUIRED.

3.4.3 VESSEL OR TANK PORTS

3.4.3.1 VESSEL OR TANK PORTS SHALL BE SEALED BY APPLYING ONE LAYER OF CLEAN NYLON FILM OVER THE PORTS AND SECURING WITH TAPE. THE NYLON SHALL BE TAPED ON THE OUTSIDE AREA OF THE PORT, ABOVE (OR BEHIND) THE THREADED AREA. COVER THE NYLON WITH POLYETHYLENE, AND SECURE WITH TAPE.

3.4.3.2 STAMP THE CLEANING CERTIFICATION CARD "NOT PACKAGED FOR OXYGEN SERVICE", SEAL IT INSIDE A POLYETHYLENE ENVELOPE AND ATTACH IT TO THE VESSEL OR TANK.

3.5 LEVEL 3 (VISUALLY CLEAN) COMPONENTS, PIECE PARTS AND SOFTGOODS

3.5.1 FOR ITEMS WHOSE SIZE WILL NOT PERMIT PLACING THE ENTIRE ITEM IN A POLYETHYLENE BAG, COVER ALL PORTS AND OTHER SIGNIFICANT SURFACES WITH ONE LAYER OF POLYETHYLENE FILM AND SECURE WITH TAPE. THE CLEANING CERTIFICATION CARD SHALL BE SEALED IN A POLYETHYLENE ENVELOPE AND ATTACHED TO THE ITEM.

3.5.2 FOR ITEMS WHOSE SIZE WILL PERMIT PLACING THE ENTIRE ITEM IN A POLYETHYLENE BAG, PLACE THE ENTIRE LEVEL 3 ITEM IN A POLYETHYLENE BAG. THE CLEANING CERTIFICATION CARD SHALL BE SEALED INSIDE THE POLYETHYLENE BAG WITH THE COMPONENT.

3.6 SPARE CARBON STEEL COMPONENTS

3.6.1 CLEANED SMALL CARBON STEEL COMPONENTS (LESS THAN 1-1/2") THAT ARE TO BE WAREHOUSED FOR INDEFINITE PERIODS OF TIME SHALL HAVE, IN ADDITION TO THE PROPER PACKAGING, A SUITABLE BAGGED DESICCANT AND A HUMIDITY CARD INDICATOR (STOCK NO. 6685-00-752-8240G OR EQUIVALENT) PLACED INSIDE THE OUTER POLYETHYLENE FILM COVER OR BAG PRIOR TO SEALING.

3.6.2 CLEANED CARBON STEEL COMPONENTS (1-1/2" OR LARGER) REQUIRE AN INERT GAS BLANKET FOR INDEFINITE WAREHOUSE STORAGE. USE THE FOLLOWING METHOD FOR PACKAGING.

3.6.2.1 INSTALL A CERTIFIED CLEAN HUB AND SEAL RING, OR FLANGE WITH GASKET (AS REQUIRED) WITH A SCHRAEDER VALVE ON ONE PORT OF THE COMPONENT.

3.6.2.2 INSTALL A CERTIFIED CLEAN HUB AND SEAL RING, OR FLANGE AND GASKET (AS REQUIRED) TAPPED FOR A 0-60 (MAXIMUM) PSIG PRESSURE GAUGE ON THE OPPOSITE PORT OF THE COMPONENT.

3.6.2.3 PURGE THROUGH THE SCHRAEDER VALVE WITH GN APPROXIMATELY THREE MINUTES TO EVACUATE ALL AIR. REDUCE GN PURGE TO THE MINIMUM PRESSURE REQUIRED TO MAINTAIN POSITIVE PRESSURE ON THE COMPONENT.

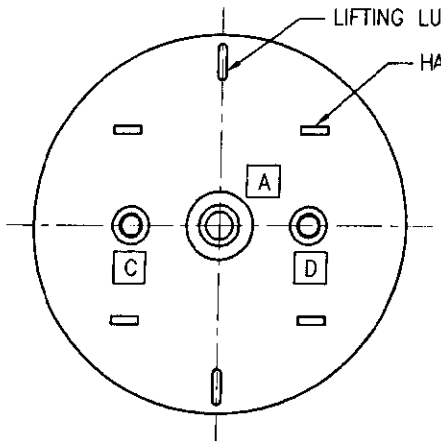
3.6.2.4 WHILE STILL MAINTAINING POSITIVE PURGE PRESSURE, INSTALL THE PRESSURE GAUGE. INCREASE GN PRESSURE IN COMPONENT TO 20 ±5 PSIG. RECORD STABILIZED PRESSURE READING IN "REMARKS" SECTION OF THE CLEANING CERTIFICATION CARD.

3.6.2.5 VERIFY NO PRESSURE LOSS AFTER A MINIMUM 12 HOUR WAITING PERIOD TO INSURE PRESERVATION OF THE COMPONENT.

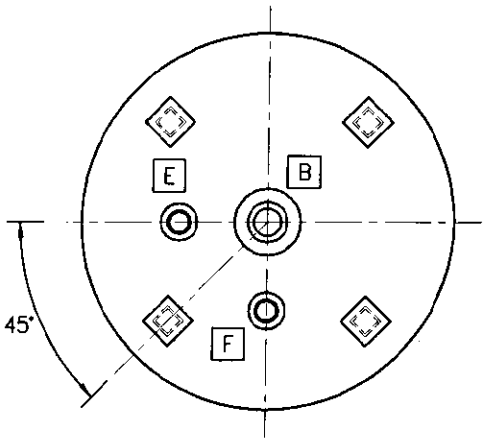
3.6.2.6 THE CLEANING CERTIFICATION CARD SHALL BE SEALED IN A POLYETHYLENE ENVELOPE AND ATTACHED TO THE COMPONENT

FIGURE 1

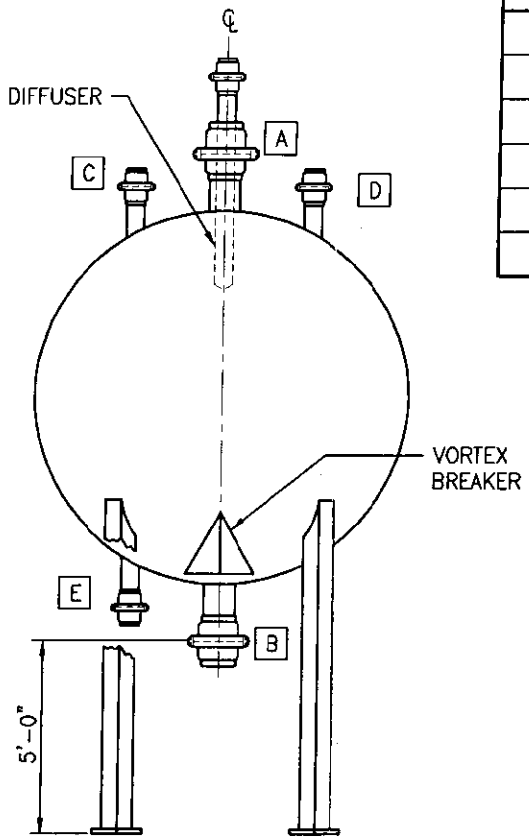
LIQUID ROCKET PROPELLANT VESSEL
NOZZLE ORIENTATION AND SUPPORTS



TOP



BOTTOM



SIDE

NOZZLE SCHEDULE

DESIG	FUNCTION	SIZE	END CONNECTION
A	PRESSURIZATION	3"/6"	R-CON HUB OR APPROVED EQUAL
B	OUTLET	6"	R-CON HUB OR APPROVED EQUAL
C	VENT	3"	R-CON HUB OR APPROVED EQUAL
D	INSTRUMENTATION	2"	R-CON HUB OR APPROVED EQUAL
E	INLET	2"	R-CON HUB OR APPROVED EQUAL
F	INSTRUMENTATION	2"	R-CON HUB OR APPROVED EQUAL

DESIGN CONDITIONS

MAWP = 9,000 PSIG

TEMP = -20°F TO +130°F

NOTES:

1. ANTI-VORTEX DEVICE REQUIRED ON OUTLET.
2. DIFFUSER REQUIRED AT PRESSURIZATION INLET.

RP-1 160 GAL. VESSEL

N.T.S.

SYM	ZONE	DESCRIPTION	DATE	APPROVED

REVISIONS

SIGNATURE	DATE
DRAWN	
CHECKED	
ENGINEER	
ISSUED	
SUBMITTED	
NASA SAFETY	
APPROVED	
USED ON	

CADD CONTROLLED DRAWING
CADD P/N:
EM\H3281\P2300\SPEC-11DGK-GM03

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

JOHN C. STENNIS SPACE CENTER
SSC, MS 39529-6000

FIGURE 1
VESSEL NOZZLE
ORIENTATION AND SUPPORTS

SIZE	DWG. NO.	REV.
B	SPEC. 11DGK-GM03	0

AUTHORITY SWR-H3281P2300 SHEET