National Aeronautics and
Space Administration

JSC 28484

Lyndon B. Johnson Space Center
Houston, Texas 77058

SPACE SHUTTLE/SPACE STATION

PROGRAM REQUIREMENTS DOCUMENT FOR JOHNSON SPACE CENTER NON-CRITICAL GOVERNMENT FURNISHED EQUIPMENT

JANUARY 24, 2000

REVISION LOG

REV LTR	CHANGE NO	DESCRIPTION	DATE
		BASELINE ISSUE (Reference Space Shuttle/Space Station JPRCB A061322, dated 12/6/99)	01/24/00

CHANGE SHEET

FOR

JSC 28484 – Space Shuttle/Space Station
Program Requirements Document for
Johnson Space Center Non-critical
Government Furnished Equipment

BASELINE - ERRATA

This errata is authorized by SSP DOC-457.

February 24, 2000

Robert H. Heselmeyer
Secretary, Program Requirements
Control Board

---

1. Remove the following listed pages and replace with the same numbered attached pages:

Page	PRCBD No.
B-9 - B-14	SSP DOC-457

NOTE: A black bar in the margin indicates the information that was changed.

2. Partial data in Table B.1, Column 3 was omitted from the baseline. This errata corrects that oversight.

3. Remove the List of Effective Pages, dated January 24, 2000 and replace with List of Effective Pages, dated February 24, 2000.

4. Sign and date this page in the space provided below to show that the changes have been incorporated and file immediately behind the List of Effective Pages.

_____ _____
Signature of person incorporating changes Date

JSC 28484 - Space Shuttle/Space Station Program Requirements Document for Johnson Space Center Non-critical Government Furnished Equipment

LIST OF EFFECTIVE PAGES

February 24, 2000

The current status of all pages in this document is as shown below:

Page No.	Change No.	PRCBD No.	Date
i - viii	Baseline	A061322	January 24, 2000
1-1 - 1-2	Baseline	A061322	January 24, 2000
2-1 - 2-6	Baseline	A061322	January 24, 2000
3-1 - 3-18	Baseline	A061322	January 24, 2000
4-1 - 4-4	Baseline	A061322	January 24, 2000
5-1 - 5-2	Baseline	A061322	January 24, 2000
6-1 - 6-2	Baseline	A061322	January 24, 2000
A-1 - A-4	Baseline	A061322	January 24, 2000
B-1 - B-8	Baseline	A061322	January 24, 2000
B-9 - B-14	Baseline	A061322 SSP DOC-457	January 24, 2000, February 22, 2000
C-1 - C-10	Baseline	A061322	January 24, 2000

SPACE SHUTTLE/SPACE STATION

PROGRAM REQUIREMENTS DOCUMENT

FOR
JOHNSON SPACE CENTER
NON-CRITICAL GOVERNMENT
FURNISHED EQUIPMENT

Approved by:

Ronald D. Dittemore
Manager, Space Shuttle Program

Tommy W. Holloway
Manager, International Space Station Program

JSC 28484
Baseline

THIS PAGE INTENTIONALLY LEFT BLANK

PREFACE

This requirements document defines the minimum set of requirements for JSC non-critical Intravehicular Activity (IVA) Government Furnished Equipment (GFE) to be used in NASA space flight programs or projects. Implementation and acceptance of this document is through program management memorandums and control board directives. The requirements in this document establish the baseline risk that the program has accepted for use of equipment certified to these requirements. This document is applicable to new non-critical IVA GFE and is not retroactive to previously-certified equipment, or to equipment in the process of certification to another set of requirements. This document is not applicable to Extravehicular Activity (EVA) equipment.

The requirements identified in Section 3 were derived from many existing documents and lessons learned, including the Shuttle and Station Program requirements, JHB 8080.5, standards, multiple safety requirements documents, and the results of investigative teams.

The “rationale” information, in italics, following a requirement, is provided for clarification and background information. The “rationale” information is not a requirement, but is provided to help the reader understand the intent of the requirement.

The review activity for this document included a cross section of JSC employees recognized as experts while representing the programs, projects, operations, engineering, manufacturing, and assurance.

This document is under the control of the Joint Program Requirements Control Board (JPRCB). Changes to this document must be approved by the JPRCB.

THIS PAGE INTENTIONALLY LEFT BLANK

CONTENTS

CONTENTS

APPENDICES

TABLES

1.0 SCOPE

This document is applicable to new non-critical, JSC built or procured Intravehicular Activity (IVA) Government Furnished Equipment (GFE). This document defines the requirements for design and workmanship for JSC GFE. This document is not applicable to Extravehicular Activity (EVA) equipment.

Not all requirements in this document will be applicable for each equipment item. The applicability will be determined and documented in the Applicable Requirements Matrix (ARM) (reference Appendix B).

Other additional requirements will be documented in the ARM. The ARM will be approved by the provider, customer, and Safety, Reliability and Quality Assurance (SR&QA) prior to implementation of the flight project.

Prior to use and implementation of this document, a criticality assessment must be performed in accordance with NT3-GFE-012, Preparation of Risk Assessment Executive Summary Report (RAESR) and Risk Reports and approved by the Safety and Mission Assurance Review Team (SMART). The approved classification as non-critical equipment is a prerequisite to use of this document.

THIS PAGE INTENTIONALLY LEFT BLANK

2.0 APPLICABLE DOCUMENTS

The following document's latest revision form a part of this specification to the extent specified herein. In the event of a conflict between the documents referenced herein, the contents of this specification is considered a superseding requirement.

2.1 SPECIFICATIONS, STANDARDS, AND HANDBOOKS

NSTS 37330 (Current Issue)	Bonding, Electrical, and Lightning Specifications Ref. Para. 3.3.4.6; Apx. B
SL-E-0002 (Current Issue)	Space Shuttle Specification Electromagnetic Interference Characteristics, Requirements for Equipment Ref. Para. 3.3.4.1.1.1, 3.3.4.1.1.2, 3.3.4.1.2.1, 3.3.4.1.2.2; Apx. B
JSC 20793	Manned Space Vehicle Battery Safety Handbook Ref. Para. 3.3.6.3; Apx. B
JSC 23642	JSC Fastener Integrity Testing Program Ref. Para. 3.3.5.4; Apx. B
JSC 25863	Fracture Control Plan for JSC Flight Hardware Ref. Para. 3.3.5.3; Apx. B
JSC 27291	GFE Software Design, Development, Test and Evaluation Work Instruction Ref. Para. 3.3.9; Apx. B
JSC 27301A	Materials Control Plan for JSC Flight Hardware Ref. Para. 3.3.1.1; Apx. B, C

JSC 27743	EMC Test Methods for Shuttle Orbiter Equipment/ Experiments Ref. Para. 3.3.4.1.1.2
JSC 27964	Toxicological Assessment and Verification Process Ref. Para. 3.3.6.7; Apx. B
JSC 28035	JSC Government Furnished Equipment (GFE) Problem Reporting and Corrective Action (PRACA) Requirements Ref. Para. 4.2.2; Apx. B
ANSI/ASQC Q9001-1994 Q9002-1994	Quality Assurance Management Requirements Ref. Para. 4.2.1
ANSI-Z136.1	American National Standard for Safe Use of Lasers Ref. Para. 3.3.6.8; Apx. B
FAA 7400.2D	Outdoor Laser/High Intensity Light Demonstrations Ref. Para. 3.3.6.8
FED-STD-595-B	Colors Used in Government Procurement Ref. Para. 3.3.7.8; Apx. B
JHB 5322.1C	JSC Contamination Control Requirements Manual Ref. Para. 3.3.1.2; Apx. B

JHB 8080.5	JSC Design and Procedural Standards Manual Ref. Preface, Para. 3.3.4.2, 3.3.5.2.5, 3.3.5.5.3, 4.2.7; Apx. B, C
JPD 5335.1	Lyndon B. Johnson Space Center Quality Manual Ref. Para. 4.2.1
JPG 8500.4	Engineering Drawing System Manual Ref. Para. 4.2.5
MIL-STD-129	Marking for Shipment and Storage Ref. Para. 5.2; Apx. B
MIL-STD-1686C	ESD Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment Ref. Para. 3.3.6.10
NASA-STD-3000	Manned Systems Integration Standards Ref. Para. 3.3.5.4, 3.3.6.1, 3.3.6.6, 3.3.6.9, 3.3.7.3; Apx. B
NASA-STD-5001	Structural Design and Test Factors of Safety for Spaceflight Hardware Ref. Para. 3.3.5.2.3; Apx. B
NASA-STD-8739.4	Crimping, Interconnecting Cables, Harnesses and Wiring Ref. Para. 3.3.4.2; Apx. B

NASA-STD-8739.7	Electrostatic Discharge Control Ref. Para. 3.3.6.10
NT3-GFE-011	JSC Government Furnished Equipment (GFE) Flight Safety Review Process Ref. Para. 3.3.6
NT3-GFE-012	Preparation of Risk Assessment Executive Summary Report (RAESR) and Risk Reports Ref. Para. 1.0, 3.3.6
PRC-9002	Process Specification for Part Marking Ref. Para. 3.3.2; Apx. B
SSP 30237	Space Station Electromagnetic and Susceptibility Requirement Ref. Para. 3.3.4.1.1.1, 3.3.4.1.2.1; Apx. B
SSP 30695	Acceptance Data Package Requirements Specification Ref. Para. 4.2.3
SSP 50094	NASA/RSA Joint Specification Standards Document for the ISS Russian Segment Ref. Para. 3.3.4.1.1.1, 3.3.4.1.2.1, Apx. B
SSP 50254	Operations Nomenclature Ref. Para. 3.3.7.7

TM 102179

Selection of Wires and Circuit Protection Devices for STS Orbiter Vehicle Payload Electrical Circuits

Ref. Para. 3.3.4.2, Apx. B

THIS PAGE INTENTIONALLY LEFT BLANK

3.0 SYSTEM REQUIREMENTS

3.1 CHARACTERISTICS

3.1.1 Performance Characteristics

Customer performance and functional requirements, life requirements, as well as unique verification requirements will be formally documented in the ARM (see Section 1.0 and Appendix B).

3.1.2 Physical Characteristics

The physical characteristic requirements, such as, mass, weight, envelope, dimensions, etc., will be formally documented in the ARM.

3.1.3 Reliability

Equipment failure shall not induce a failure external to the failed system.

Additional reliability and workmanship testing will be formally documented in the ARM.

3.1.4 Maintainability

No planned on-orbit maintenance interfaces shall be lockwired or staked.

Equipment expected to require on-orbit servicing, replacement, or maintenance shall be designed to be accessible without the removal of other equipment.

On-orbit planned maintenance requirements will be formally documented in the ARM.

Rationale: Planned on-orbit maintenance (such as battery replacement) should be accomplished without the need for tools. Crew on-orbit time is costly and limited. Every reasonable attempt should be made to reduce planned maintenance time. The time associated with locating, obtaining, and returning tools needed for maintenance can be significant over the life of the program. When a design solution or minor modification (thumb screws, latches, etc.) can allow planned maintenance to be performed without the need for tools, and the cost is less than the program life cycle cost for on–orbit time, then the design should be implemented.

3.2 ENVIRONMENTAL CONDITIONS

As a minimum, equipment shall meet performance requirements in the following environment.

Environment	Value	Test Tolerance
Temperature	75 degrees F	± 10 degrees F
Pressure	14.7 psi	± 1 psi
Humidity	50%	± 25%

The equipment provider is responsible for evaluating the full range of environments the equipment will see during ground and flight transportation, handling, and operation, and for verifying the equipment will meet performance requirements within these environments. The program accepts the risk for no additional environmental verification requirements.

3.3 DESIGN AND CONSTRUCTION

3.3.1 Materials/Processes/Cleanliness

3.3.1.1 Materials and Processes

Materials and processes shall be in accordance with JSC 27301A, Materials Control Plan for JSC Flight Hardware.

3.3.1.2 Cleanliness

As a minimum, the equipment shall be processed to the generally clean level per JHB 5322.1C, JSC Contamination Control Requirements Manual.

3.3.2 Nameplates and Product Marking

As a minimum, equipment shall be labeled in accordance with PRC-9002, Process Specification for Part Marking.

3.3.3 Workmanship and Screening

Workmanship and screening requirements will be formally documented in the ARM.

3.3.4 Electrical Design Requirements

3.3.4.1 Electromagnetic Compatibility (EMC)

The emission requirements of this section apply as specified in the following subsections.

Any equipment, which electrically interfaces with vehicle or critical systems, shall meet the radiated and conducted specifications defined in Paragraph 3.3.4.1.1 and Paragraph 3.3.4.1.2, respectively.

The need to perform susceptibility tests is determined upon project initiation and documented in the ARM.

3.3.4.1.1 Radiated Emissions

The requirements in this section apply to any equipment that produces electric or magnetic fields.

3.3.4.1.1.1 Electric Field Emissions (RE02)

All equipment shall meet the radiated emission requirements of SL-E-0002, Space Shuttle Specification Electromagnetic Interference Characteristics, Requirements for Equipment, Section 6.11.1 and Section 6.11.2, the radiated emission requirements of SSP 50094, Section 3.4.1.1.3, and the radiated emission requirements of SSP 30237, Space Station Electromagnetic and Susceptibility Requirement, Section 3.2.3. Refer to SSP 50094, NASA/RSA Joint Specification Standards Document for the ISS Russian Segment, Section 3.4, Electromagnetic Compatibility for test set up.

3.3.4.1.1.2 AC Magnetic Field Emissions (RE04)

All equipment shall meet the radiated emission requirements of SL-E-0002, Section 6.13. Refer to JSC 27743, EMC Test Methods for Shuttle Orbiter Equipment/ Experiments, for test set up.

3.3.4.1.2 Conducted Emissions

Conducted emissions requirements are dependent upon the equipment's interfacing power source and whether the equipment is a receiver or transmitter using an antenna.

3.3.4.1.2.1 Conducted Emissions Requirements for Equipment with Power Interfaces

Equipment interfacing to the International Space Station (ISS) 120 Volts, Direct Current (VDC) shall meet the conducted emission requirements of SSP 30237, Section 3.2.1 (CE01, CE03, and CE07).

Equipment interfacing to 28 VDC shall meet the power leads conducted emission requirements of SL-E-0002, Section 6.1 (CE01), Section 6.2 (CE03), and Section 6.18 (TT01) and the conducted emission requirements of SSP 50094, Section 3.4.1.1.1 and Section 3.4.1.1.2.

Equipment interfacing to Space Shuttle 115 VAC shall meet the power leads conducted emission requirements of SL-E-0002, Section 6.1 (CE01), Section 6.2 (CE03), and Section 6.19 (TT02).

3.3.4.1.2.2 Conducted Emissions Requirements for Receivers and Transmitters

All receivers and transmitters using antennas shall meet the conducted emission requirements of SL-E-0002, Section 6.3 (CE06).

3.3.4.2 Cable and Wire Harness Design

a. Electrical wire and cable raw stock shall be procured and acceptance tested according to JHB 8080.5, JSC Design and Procedural Standards Manual (E-24).

   Rationale: Cable purchased from vendors, even to a mil-spec, often contain weaknesses in the insulation that are not detectable during normal acceptance testing. Wire that passes the E-24 testing provides a higher reliability for operational life. The failure rate at JSC has been over 10% for E-24 re-screening.

b. Power cables shall pass a Dielectric Withstanding Voltage (DWV) test as part of pre-flight testing pre-installation acceptance testing. DWV testing criteria shall be derived from NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring, or JHB 8080.5, JSC Design and Procedural Standards Manual (E-14).

   Rationale: DWV testing can identify problems in the dielectric strength of the insulation, which can not be detected visually, or during nominal operations. Operational use or abuse can lead to degradation of the insulation. Dielectric problems can lead to short circuits and ignition sources, as well as failure of the cable to perform the intended function. DWV testing is recommended for signal cables, where the testing will not degrade the equipment, but is not required.

c. Interconnecting cable and harness assemblies shall be tested for point-to-point electrical continuity. Continuity testing criteria shall be compliant to NASA-STD-8739.4.

d. Wire harness protection shall be per NASA-STD-8739.4.

e. Shields shall not be used as current carrying paths for power cables. Shields should be used only for Electromagnetic Interference (EMI) prevention.

f. Fixtures shall be wired with conductors having insulation suitable for the environmental conditions, current, voltage, and temperature to which the conductors will be subjected per NASA-STD-8739.4.

g. Cables and harnesses shall be routed so that they are protected from abrasion, cold flow, cut through, vibration, chafing, flexing, and sharp edges.

h. Cable and harness accessories (clamps, screws, etc.) shall contain no sharp edges, pinch points, or protrusions that could injure crew or damage equipment. Reference Paragraph 3.3.6.1.

i. Provisions shall be provided to prevent inadvertent disconnection of energized power connections.

Rationale: Disconnection of energized contacts results in damage to the contacts, creates an ignition source, can lead to increased resistance, heat, or a fire, and produces EMI. Connectors should be restrained from inadvertent separation, and switching should be provided to allow removal of power for nominal disconnection.

j. Electrical connectors shall be selected such that misalignment during connect and disconnect operations will not cause pin damage.

k. Cables and connectors shall be provided with stress relief to prevent the conducting wire from being the structural strength and to restrict wire flexing of the joint per NASA-STD-8739.4.

Rationale: The conducting wires, shields, terminating pins, and wire insulation are evaluated and rated for electrical strength, and not intended to provide structural strength. Strain relief is intended to limit the force imposed on the wire and pins. Multiple wire flexing beyond the bend radius of the wire will damage the insulation or break the wire. (Insulation cold flow or cold work) The teleprinter power cable on STS-28 failed mainly because of poor strain relief and multiple bending. Multiple data cables have failed in the program due to wires pulling out of pins or pins pulling out of connectors because the conducting wire provided the only structural strength for pulling on the cable.

l. Conductors and wire harnesses shall be derated to safely operate under the maximum current allowed by the supply protection devices. Derating shall be per TM 102179, Selection of Wires and Circuits Protection Devices for STS Orbiter Vehicle Payload Electrical Circuits.

Rationale: The breakers, fuses, and other protective devices incorporated into the power supply are intended to protect the power supply from damage by down stream failures. A single failure in the equipment using the power supply can result in continuous exposure of the equipment to the maximum current that the power supply can provide. Equipment that is not designed for this condition can create fires or propagate failure.

m. For cables that will be connected to an interfacing connector that is mounted to structure, the wire harness shall be undamaged and capable of operating after exposure to the following:

1. A 125 pounds-force (lbf) pull test.

2. The expected bending cycles experienced during operational use, with a scatter factor of 4.

Rationale: Cables that are connected to a hard mounted receptacle and are exposed to the cabin crew translation and work stations must be robust in design to survive the environment. The zero-G environment can result in a crew member pulling on a cable or pushing off of a bulkhead connected cable. These forces should be accounted for in the design to reduce the chance of failure associated with a normal environment.

n. Equipment with electrical connectors, plugs, and receptacles which otherwise could be incorrectly mated shall be designed or selected to prevent incorrect connection with other accessible connectors, plugs, or receptacles. Techniques used shall be the following:

1. Use of constraints built into a cable or harness that locate similar connectors so they cannot be interchanged.

2. Selection of different sizes for connectors to be located adjacent to each other.

3. Selection of alternative polarization (alternative keying) of adjacent, similar connectors only if this requirement cannot be met with Method 1 or 2.

o. Permanent identification of mating connectors shall be provided on each side of each connector pair.

3.3.4.3 Electrical, Electronic, and Electromechanical (EEE) Parts Derating

The derating criteria for all new designs shall, as a minimum, require a 50% derating of upper worst case electrical stress levels and 25% derating of upper worst case thermal stress from the part specification's maximum rating. Off-the-Shelf (OTS) equipment is exempt from this requirement.

An EEE parts list will be provided at design reviews for all new designs.

3.3.4.4 Electrical Interfaces

Electrically powered equipment shall provide short circuit protection for each input power interface.

Equipment providing branch electrical power distribution circuits shall be designed to include overload protection for each branch circuit.

Protection devices for branch circuits shall be designed such that in the event of a branch circuit overload, upstream devices will not act to remove power from the equipment or other branch circuits provided by the equipment. This requirement is not applicable to power distribution cables. Simple power distribution breakout boxes and power strips are exempt from this requirement, unless specifically listed in the ARM.

Equipment that redistributes power shall be designed so that all necessary mating and demating of connectors can be accomplished without producing electrical arcs that will damage connector pins or ignite surrounding materials or vapors.

Equipment with electrical power or data interfaces to other systems shall be designed to meet the interface requirements of the interfacing system. The applicable requirements document will be listed in the ARM.

3.3.4.5 Circuit Breakers

Circuit breakers shall be resettable. All tripped conditions shall be visually indicated.

3.3.4.6 Bonding and Grounding

Electrical equipment shall meet the bonding requirements of NSTS 37330, Bonding, Electrical, and Lightning Specifications.

3.3.5 Mechanical Design Requirements

3.3.5.1 Crew Induced Loads

Equipment exposed to crew contact shall withstand a design load of 125 lbf over a 4” X 4” square without loss of function. (This requirement is also applicable for cable’s interfacing with vehicle bulkhead connectors.)

Equipment exposed to crew contact shall withstand a design load of 175 lbf over a 4” X 4” square without creating a hazard.

EXCEPTION: Temporary on-orbit stowage of equipment with non-rigid, temporary restraints, such as, Velcro, bungee cords, or tape is excluded from this requirement, when no critical or catastrophic hazard is created by crew-induced loads.

3.3.5.2 Structural Design Requirements

3.3.5.2.1 Stiffness and Strength Requirement

All hardware shall withstand the launch, on-orbit, and landing design environments (maintaining positive margins of safety) without any failure that could leak hazardous

fluids or release any equipment that could damage the vehicle or cause injury to the crew.

3.3.5.2.2 Fatigue Life Requirement

All structurally mounted hardware shall be evaluated, by test or analysis, for structural life based on the sustained static and cyclic load conditions of the design environment. Structural life is defined as four times the hardware service life environment. Structural parts which are classified as fracture critical should implement fracture control requirements of Section 3.3.5.3 instead of fatigue life requirements.

Rationale: Typically, structural life verification will be accomplished by analysis. The available analysis methods are fatigue and durability. The most common method used is durability, which is a fracture mechanics analysis based on the maximum size material flaw that is consistent with the inspection method implemented.

3.3.5.2.3 Factors of Safety

The minimum factor of safety to be used with limit load conditions to establish design loads shall be as defined in NASA-STD-5001, Structural Design and Test Factors of Safety for Spaceflight Hardware.

3.3.5.2.4 Margins of Safety

A positive margin of safety shall be maintained for every structural part. All appropriate failure modes shall be evaluated.

3.3.5.2.5 Other Considerations

Stainless steel tubing shall meet the requirements of JHB 8080.5, JSC Design and Procedural Standards Manual (M/S-15).

3.3.5.3 Fracture Control

JSC 25863, Fracture Control Plan for JSC Flight Hardware, shall be implemented for fracture control on all hardware.

3.3.5.4 Fasteners

Procurements of fasteners shall be in accordance with JSC 23642, JSC Fastener Integrity Testing Program.

Fasteners shall be selected and designed in accordance with NASA-STD-3000, Manned Systems Integration Standards, Section 11.9.3.

Fasteners shall be of the captive type or made captive by the use of a suitable adhesive or an anaerobic locking sealant.

Devices such as self-tapping screws and bolts shall not be used.

3.3.5.5 Fluid System Requirement

3.3.5.5.1 Fluid Quantity Determination

A fluid quantity determination capability shall be provided in fluid storage and resupply systems.

3.3.5.5.2 Interface Hardware

Fluid transfer interface hardware design shall preclude mating to any unintended interface.

Fluid systems that interface with other systems shall meet the fluid standards and interface requirements of the interfacing system. Applicable interface requirements documents will be listed in the ARM.

3.3.5.5.3 Fluid System Standards

Fluid systems shall meet the requirements of the following JHB 8080.5 standards:

a. F-7

b. F-8

c. F-17

d. F-18

e. F-19

f. F-20

g. F-24

h. F-25

i. F-30

j. M/S-16

3.3.5.6 Mechanical Interfaces

Equipment interfacing mechanically with other systems shall be designed to meet the Interface Control Document (ICD) of the interfacing system. Applicable interface requirements documents will be listed in the ARM.

3.3.5.7 Interfaces to Crew Members

Cables, wiring, and/or hoses connecting to the crew member during launch and landing shall incorporate a breakaway feature that shall release at no greater than 25 lbf. These breakaway features shall function without creating a hazard or reducing the performance of the crew escape suit or crew escape equipment. The Orbiter seat belts are exempt from this requirement.

Rationale: During emergency egress, the crew must be able to perform a rapid unimpeded evacuation from the seat and vehicle. Any additional actions that the crew must perform, such as disconnecting a cable or hose, add to the minimum time needed to egress, and reduce the crews ability to egress during an emergency. Additionally, emergency rescue personnel must be able to remove or assist in the egress of crew members when there is an emergency rescue at a landing site.

3.3.6 Safety

All systems will be designed or selected to preclude or control hazards based on the following hazard reduction precedence sequence:

a. Design for Minimum Hazard. The major goal throughout the design phase will be to ensure inherent safety through the selection of appropriate design features as fail-operational/fail-safe combinations and appropriate safety factors. Hazards should be eliminated by design where possible. Damage control, containment, and isolation of potential hazards should be included in design considerations.

b. Safety Devices. Known hazards which cannot be eliminated through design selection should be reduced to an acceptable level through the use of appropriate safety devices as part of the system, subsystem, or equipment.

c. Warning Devices. Where it is not possible to preclude the existence or occurrence of a known hazard, devices should be employed for the timely detection of the condition and the generation of an adequate warning signal. Warning signals and their application should be designed to minimize the probability of wrong signals or of improper personnel reaction to the signal.

d. Special Procedures. Where it is not possible to reduce the magnitude of existing or potential hazards through design, or the use of safety and warning devices, special procedures should be developed to counter hazardous conditions for enhancement of ground and flight crew safety. Precautionary notations should be standardized.

The minimum requirements for design safety are:

a. Fault tolerance - No combination of two failures or two operator errors shall result in a catastrophic hazard. No single failure or operator error shall result in a critical hazard. (reference Paragraph 6.1 for definition of hazard severity)

b. Design for minimum risk - Hazards controlled by compliance with the technical requirements of this document, other than failure tolerance, are called Design for Minimum Risk. Examples are structures, pressure vessels, pressurized line and fittings, material compatibility, etc.

A Risk Assessment Executive Summary Report (RAESR) will be prepared, submitted, and approved in accordance with the following procedures:

a. NT3-GFE-012, Preparation of Risk Assessment Executive Summary Report (RAESR) and Risk Reports

b. NT3-GFE-011, JSC Government Furnished Equipment (GFE) Flight Safety Review Process

The following paragraphs of this section define technical requirements related to the control or elimination of hazards. Any deviation or waiver to these requirements will be documented in the RAESR. Approval of the RAESR constitutes approval of the deviation/waiver.

3.3.6.1 Mechanical and Sharp Edge Hazards

Equipment shall be designed or selected to preclude injury to personnel or damage to equipment per NASA-STD-3000, Paragraph 6.3.3. Equipment that has sharp edges needed for providing a function (such as scissors, knifes, screwdrivers, etc.) is exempt from this requirement when in use, but must be protected by suitable covers, guards, or stowage design when not in use.

Hazards resulting from structural failure or impact will be controlled by meeting the requirements of Paragraph 3.3.5.

3.3.6.2 Surface Temperature

Equipment shall be designed or selected to preclude crew exposure to surface temperatures that can cause injury. The following defines the temperature limits for normally exposed surfaces:

a. Maximum of 113° F for continuous contact (more than 30 seconds)

b. Maximum of 122° F for incidental contact (less than 30 seconds)

c. Minimum of 40° F for continuous contact (more than 30 seconds)

d. Minimum of 0° F for incidental contact (less than 30 seconds)

Equipment that has hot or cold surfaces needed for providing a function (such as, heating food, cooling specimens, etc.) does not require a waiver of this requirement if the hazard is approved by the SMART.

Rationale: Incidental contact refers to situations in which the crew member may discontinue contact with the equipment if the crew member feels discomfort. Continuous contact refers to situations in which the crew member does not have the ability or option of discontinuing contact with the equipment. Long term exposure to temperatures above 113° F or below 40° F results in damage to cell tissue. Momentary contact with temperatures up to 122° F or below 0° F does not cause tissue damage. The potential for cell damage is based on time of exposure, force of contact, heat transfer rate, initial skin temperature, and other factors that should be evaluated for the acceptability of the risk.

3.3.6.3 Batteries

Batteries shall be controlled in accordance with JSC 20793, Manned Space Vehicle Battery Safety Handbook.

3.3.6.4 Acoustic Emissions

Equipment that produces noise shall meet the requirements defined in this section. The NASA Acoustic Lead may be consulted to make an experienced determination if an equipment item is considered a significant noise source.

NOTE: The NASA Acoustic Lead in consultation with the Acoustic Working Group personnel, provide information and interpretation of acoustical requirements and test procedures.

3.3.6.4.1 Continuous Noise Limits

A significant noise source that exists for a cumulative total of 8 hours or more in any 24-hour period is considered a continuous noise source. A GFE continuous noise source shall not exceed the limits provided in Table 3.1, for all octave bands. This is equivalent to NC40.

3.3.6.4.2 Intermittent Noise Limits

A significant noise source that exists for a cumulative total of less than 8 hours in any 24-hour period is considered an intermittent noise source. A GFE intermittent noise source shall comply with the limits provided in Table 3.2.

3.3.6.5 Pressure Rate of Change

Equipment shall not induce a hazard during or after exposure to the following pressure rates of change through the pressure range of 14.7 psi to approximately 0 psi:

Depressurization - 8 psi per minute

Repressurization - 9 psi per minute

3.3.6.6 Electrical Shock

Equipment shall be designed or selected to ensure the crew is protected from electrical hazards in accordance with NASA-STD-3000, Section 6.4.3.

3.3.6.7 Toxic Liquids, Gasses, or Powders

In addition to the requirements of Paragraph 3.3.1, liquids, gasses, or powders shall be controlled in accordance with JSC 27964, Toxicological Assessment and Verification Process.

Rationale: Any system flown in a habitable module and containing liquids, gasses, or powders will be assessed for toxicological level, and appropriate levels of containment will be provided. The provider of the equipment will furnish a list of the materials and their quantities to the JSC Toxicologist as per JSC 27964. Levels of containment are directly related to the toxicology level of the material.

3.3.6.8 Lasers and Lights

Equipment containing lasers shall meet the requirements of ANSI-Z-136.1, American National Standard for Safe Use of Lasers, and Federal Aviation Administration (FAA) Order 7400.2D, Outdoor Laser/High Intensity Light Demonstrations, Chapter 34, as applicable.

3.3.6.9 Ionizing/Non-ionizing Radiation Emission Limits

Any equipment that emits ionizing radiation shall obtain concurrence for use by the Radiation Constraints Panel. Concurrence is provided by an approved JSC Form 44. Equipment shall not expose crew members to radiation levels in excess of those specified in Title 20, Code of Federal Regulations. In addition, hardware brought into the ISS shall not produce radiation levels in excess of two millirad (Si) per day, at a distance of one centimeter from any surface.

Equipment that emits non-ionizing radiation shall meet the requirements of NASA-STD-3000, Paragraph 5.7.3.

3.3.6.10 Electrostatic Discharge (ESD)

Hardware shall be handled and protected in such a manner so as not to cause ESD damage to sensitive devices. Two NASA-recommended ESD prevention programs are documented in MIL-STD-1686C, ESD Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment, and NASA-STD-8739.7, Electrostatic Discharge Control.

3.3.6.11 Corona

Electrical and electronic equipment that contains voltage potential in excess of 300 volts shall be designed to preclude hazards caused by corona.

3.3.6.12 Shatterable Materials

Material that can shatter shall not be used in the habitable compartment unless positive protection is provided to prevent fragments from entering the cabin environment. Elimination or positive protection shall consist of one of the following, as appropriate, to control the hazard:

a. Substitution of non-shatterable material wherever possible.

b. Use of containment devices.

Photographic, optoelectronic, binocular, and television lenses are exempt from this requirement when in use, but must be protected by suitable covers when not in use.

Rationale: Fragmentation of shatterable material may cause injury to the crew from physical contact or ingestion. Fragments may cause damage to the vehicle by lodging in critical equipment. Shatterable material includes items such as mirrors, lenses, filters, apparatus viewports, experiment apparatus/components, fuses, and standard commercially available light bulbs.

3.3.6.13 Emergency Safing

Cables and hoses shall not be designed to be routed through open hatches unless required by their intended use. Any cable or hose whose intended use requires it to be routed through an open hatch shall be designed to include a quick disconnect provision within the vicinity of the hatch, such that the cable or hose can be cleared from the hatch within five seconds.

3.3.6.14 Fans and Motors

A stalled or locked rotor shall not produce a hazard.

Positive protection shall be provided for fans when contact with the fan blades could result in crew injury or hazardous propelled debris.

3.3.6.15 Pressure Release

Where pressurized systems could fail in such a way that the total gas supply dumped directly into a compartment would be greater than the relief valve or venting could handle without overpressurization of the compartment, necessary flow restrictions shall be incorporated at the pressure source to restrict the mass flow to a level that can be handled by the relief valve and/or venting.

The release of the total gas supply of a pressurized system shall not result in the displacement of oxygen below the partial pressure needed to prevent asphyxiation.

3.3.6.16 Ignition Sources in Pressure Garments

Equipment located inside pressure garments, with energy storage or current carrying devices capable of energy discharge or short circuit currents sufficient to ignite materials, shall have adequate energy/current limiting.

3.3.6.17 Restriction on the Use of Parts

Silver cased wet slug Tantalum capacitors shall not be used in JSC in-house designs. Commercial-Off-the-Shelf (COTS) are exempt from this requirement.

3.3.7 Human Engineering

3.3.7.1 IVA Closures and Covers Design Requirements

IVA closures and covers design requirements will be formally documented in the ARM.

3.3.7.2 Controls and Displays Design Requirements

Controls and displays design requirements will be formally documented in the ARM.

3.3.7.3 Anthropometry

Anthropometric requirements apply when and to the extent identified in the customer agreement, or when and to the extent necessary to control a hazardous condition or event. When so identified, NASA-STD-3000, Section 3.0, shall be used as the definition to accommodate the anthropometry of the 5% Japanese female to the 95% American male.

3.3.7.4 Visual Access

Visual access design requirements will be formally documented in the ARM.

3.3.7.5 Physical Access

Physical access requirements will be formally documented in the ARM.

3.3.7.6 Removal, Replacement, and Modularity Design

Removal, replacement, and modularity requirements will be formally documented in the ARM.

3.3.7.7 Labeling

Requirements for uniquely fabricated labels are listed below: Abbreviations and nomenclature related to on-orbit operations will conform to the operational nomenclature provided in SSP 50254, Operations Nomenclature.

3.3.7.8 Color Coding

If color coding is to be used, red (#11105 or #21105 of FED-STD-595-B, Colors Used in Government Procurement) shall be reserved for emergency functions and yellow (#33538 of FED-STD-595-B) shall be reserved for caution functions.

3.3.8 Pyrotechnic Devices

Pyrotechnic devices shall not be used in non-critical equipment.

3.3.9 Software

Software shall meet the requirements of JSC 27291, GFE Software Design, Development, Test and Evaluation Work Instruction.

TABLE 3.1

CONTINUOUS NOISE LIMITS FOR GFE

Frequency Octave Band (Hz)	Maximum Sound Pressure Level (@ 60 cm, dB re 20 μPa SPL)
63	64
125	56
250	50
500	45
1000	41
2000	39
4000	38
8000	37

TABLE 3.2

INTERMITTENT NOISE LIMITS FOR GFE

Maximum Noise Duration Per 24-hour Period	A-Weighted SPL (dBA re 20 μPa)
8 Hours	≤ 49
7 Hours	≤ 50
6 Hours	≤ 51
5 Hours	≤ 52
4 Hours	≤ 54
3 Hours	≤ 57
2 Hours	≤ 60
1 Hour	≤ 65
30 Minutes	≤ 69
15 Minutes	≤ 72
5 Minutes	≤ 76
2 Minutes	≤ 78
1 Minute	≤ 79
Not Allowed	≥ 80

NOTE: The noise duration is the total time that the GFE item produces intermittent noise above the NC-40 limit during a 24-hour time period.

4.0 VERIFICATION

This section contains the requirements for verification.

The verification phase of the project includes those activities performed to demonstrate the acceptability of a product to satisfy: the requirements identified in the ARM and any additional verification identified in the RAESR.

Formal verification of performance characteristics for the full range of performance requirements are verified during qualification. Formal verification of workmanship, nominal performance, and physical requirements are verified during acceptance.

Columns 1 through 9 of the ARM, in Appendix B, will be provided for each system, and will serve as the verification matrix. The preliminary verification matrix will be approved by the provider and SR&QA prior to initiation of acceptance or qualification activity. The completed verification matrix will be provided with the Certification Data Package (CDP).

The methodology associated with verification will be consistent with Paragraph 4.1 of this document. Unless defined in this document or the customer agreement, the method of verification is at the choice of the providing organization, with concurrence from JSC SR&QA.

4.1 METHODS

Verification methods are defined as follows:

a. Inspection is a method that determines conformance to requirements by the review of drawings, data, or by visual examination of the item using standard quality control methods.

b. Analysis is a process used in lieu of, or in addition to, other methods to ensure compliance to specification requirements. The selected techniques may include, but not be limited to, engineering analysis, statistics and qualitative analysis, computer and hardware simulations, and analog modeling. Analysis may also include assessing the results of lower level qualification activity. Analysis may be used when it can be determined that:

    1. Rigorous and accurate analysis is possible.

    2. Test is not cost effective.

    3. Verification by inspection is not adequate.

c. Similarity is the process of analyzing the specification criteria for hardware configuration and application for an article to determine if it is similar or identical in design, manufacturing process, and quality control to an existing article that

has previously been qualified to equivalent or more stringent specification criteria. Special effort will be made to avoid duplication of previous tests from this or similar programs. If the previous application is considered similar, but not equal to or greater in severity, additional methods should concentrate on the areas of new or increased requirements.

d. Demonstration consists of a qualitative determination of the properties of a test article. This qualitative determination is made through observation, with or without special test equipment or instrumentation, which verifies characteristics such as human engineering features, services, access features, and transportability.

e. Test is a method in which technical means, such as the use of special equipment, instrumentation, simulation techniques, and the application of established principles and procedures, are used for the evaluation of components, subsystems, and systems to determine compliance with requirements. Test should be selected as the primary method when analytical techniques do not produce adequate results; failure modes exist which could compromise personnel safety, adversely affect flight systems or payload operation, or result in a loss of mission objectives. The analysis of data derived from tests is an integral part of the test program, and should not be confused with analysis as defined above.

4.2 RESPONSIBILITY FOR VERIFICATIONS

Unless otherwise specified in an agreement, the equipment provider is responsible for the performance of all verification activities.

4.2.1 Quality Assurance

The Quality Management System (QMS) shall be in accordance with the JPD 5335.1, Lyndon B. Johnson Space Center Quality Manual, for on-site design, development, and manufacturing. For off-site procurement activities, the QMS shall be ANSI/ASQC Q9001-1994 or ANSI/ASQC Q9002-1994, Quality Assurance Management Requirements, as tailored for that particular procurement, or through a QMS approved by NASA.

4.2.2 Problem Reporting

Problems shall be reported and resolved as documented in JSC 28035, JSC Government Furnished Equipment (GFE) Problem Reporting and Corrective Action (PRACA) Requirements.

4.2.3 Acceptance Data Package (ADP)

An ADP for each deliverable item will be prepared in accordance with SSP 30695, Acceptance Data Package Requirements Specification. An ADP is not required whenever the deliverable item contains only items or sub-components that are exempt from traceability and/or standard usage hardware (e.g., nuts, bolts, shims, pins).

4.2.4 Certification Data Package

A CDP for each configuration will be provided. The CDP contains the following items:

a. Hard and soft-copy Government Certification Approval Request (JSC Form 1296) (See http://wwwsrqa.jsc.nasa.gov/gcars for information and instructions.)

b. ARM/verification matrix

c. Risk Assessment Executive Summary Report

d. Materials certification and, as needed, the Fracture Control Report and Materials Usage Agreement

e. Engineering Analysis Reports (stress analysis, thermal analysis, etc.)

f. Acceptance Test Reports (for qualification unit)

g. Qualification Test Reports

h. Waivers and deviations

i. Discrepancy Reports and Problem Closure Reports (for qualification unit)

j. Limited life items list

k. Select engineering drawings

l. Approved Change Request (CR) to the ARM

m. Listing of project approved operational controls

4.2.5 Drawings

Drawings will be in accordance with JPG 8500.4, Engineering Drawing System Manual.

4.2.6 NASA and Government-Industry Data Exchange Program (GIDEP) Acute Launch Emergency Reliability Tip (ALERT)

The equipment provider will participate in the NASA and Government-Industry Data Exchange Program (GIDEP) Acute Launch Emergency Reliability Tip (ALERT) program and provide response to the JSC ALERT coordinator for parts identified in the ALERT.

4.2.7 Limited Life Items

The equipment provider will identify all limited life items in accordance with JHB 8080.5 (G-10).

5.0 PREPARATION FOR DELIVERY

5.1 PRESERVATION AND PACKAGING

Packing shall be used in conjunction with the appropriate protective measures and materials, handling procedures, and methods of transport to maintain the item within the appropriate cleanliness levels and to prevent damage or degradation in reliability or performance of the item when exposed to the natural and induced ground based and transportation and ground handling environment.

5.2 MARKING FOR SHIPMENT

Marking for shipment and storage of packages and exterior shipping containers shall be in accordance with MIL-STD-129, Marking for Shipment and Storage.

THIS PAGE INTENTIONALLY LEFT BLANK

6.0 NOTES

This section contains information of a general or explanatory nature.

6.1 DEFINITIONS

Hazard. The presence of a potential risk situation caused by an unsafe act or condition.

Hazard Likelihood:

a. Probable - Expected to happen in the life of the program.

b. Infrequent - Could happen in the life of the program. Controls or verifications have significant limitations or uncertainties.

c. Remote - Could happen in the life of the program, but not expected. Controls or verifications have minor limitations or uncertainties.

d. Improbable - Extremely remote possibility that it will happen in the life of the program. Strong controls and verifications in place.

Hazard Severity:

a. Catastrophic Hazard - Effect of the hazard could result in a mishap causing fatal injury to personnel and/or loss of one or more major elements of the flight program, flight vehicle, or ground facility.

b. Critical Hazard - Effect of the hazard could result in serious injury to personnel and/or damage to flight or ground equipment that would cause loss of primary mission objectives, mission abort, or a significant program delay.

c. Marginal Hazard - Effect of the hazard could result in a mishap of minor nature inflicting first-air injury to personnel and/or damage to flight or ground equipment which can be tolerated without abort or repaired without significant program delay.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A

ACRONYMS AND ABBREVIATIONS

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A

ACRONYMS AND ABBREVIATIONS

ac	alternating current
ADP	Acceptance Data Package
ALERT	Acute Launch Emergency Reliability Tip
ARM	Applicable Requirements Matrix
CDP	Certification Data Package
COTS	Commercial Off-the-Shelf
CR	Change Request
dc	direct current
DWV	Dielectric Withstanding Voltage
EEE	Electrical, Electronic, and Electromechanical
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
EVA	Extravehicular Activity
GFE	Government Furnished Equipment
GIDEP	Government-Industry Data Exchange Program
Hz	Hertz
ICD	Interface Control Document
ISS	International Space Station
IVA	Intravehicular Activity
JPRCB	Joint Program Requirements Control Board
lbf	pounds-force
OTS	Off-the-Shelf
psi	pounds per square inch

QMS	Quality Management System
RAESR	Risk Assessment Executive Summary Report
SMART	Safety and Mission Assurance Review Team
SR&QA	Safety, Reliability and Quality Assurance
VDC	Volts, Direct Current

APPENDIX B

APPLICABLE REQUIREMENTS MATRIX

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B

APPLICABLE REQUIREMENTS MATRIX

The ARM is detailed below. The first five columns are filled out and approved as the applicable requirements. Columns 6 thru 9 are completed during the design phase and the total matrix represents the verification matrix. The last column is filled in at the completion of certification and acceptance activities.

ARM for (unique system identifier or control authority CR/directive number)

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]

[1] Unique identifier for each requirement.
[2] Document number the requirement is contained within (JSC 28484, RAESR, etc.).
[3] Paragraph number of the requirement.
[4] Applicability of the requirement.
[5] Text (within reason) of the requirement, i.e., the “shall.” Add the revision letter for the applicable documents.
[6] Success criteria for the requirement (must include pass/fail criteria if not obvious from the statement).
[7] Verification method for the requirement (analysis, inspection, demonstration, or test).
[8] Indicate whether this requirement is verified during initial acceptance testing of each unit.
[9] Indicate whether this requirement is verified during any preflight or recurring acceptance testing of each unit.
[10] Indicate documents that contain the objective evidence that the requirement was satisfied.

APPLICABLE REQUIREMENTS MATRIX APPROVAL SHEET

Equipment Provider

SR&QA

Customer

TABLE B.1

APPLICABLE REQUIREMENTS MATRIX

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]
	JSC 28484	3.1.1	A	Customer performance and functional requirements, life requirements, as well as unique verification requirements will be formally documented in the ARM (see Section 1.0).					
	JSC 28484	3.1.2	A	The physical characteristic requirements, such as, mass, weight, envelope, dimensions, etc., will be formally documented in the ARM.					
	JSC 28484	3.1.3	A	Equipment failure shall not induce a failure external to the failed system.					
		3.1.3	A	Define any additional reliability and workmanship tests.					
	JSC 28484	3.1.4	A	No planned on-orbit maintenance interfaces shall be lockwired or staked.					
	JSC 28484	3.1.4	A	Equipment expected to require on-orbit servicing, replacement, or maintenance shall be designed to be accessible without the removal of other equipment.					
	JSC 28484	3.2	A	As a minimum, equipment shall meet performance requirements in the following environment.					
	JSC 28484	3.3.1.1	A	Materials and processes shall be in accordance with JSC 27301A.					
	JSC 28484	3.3.1.2	A	As a minimum, the equipment shall be processed to the generally clean level per JHB 5322.1C.					
	JSC 28484	3.3.2	A	As a minimum, equipment shall be labeled in accordance with PRC-9002.					
		3.3.3	A	Workmanship and screening requirements.					
	JSC 28484	3.3.4.1.1	A	All equipment shall meet the radiated emission requirements of SL-E-0002, Section 6.11.1, Section 6.11.2, and Section 6.13; SSP 50094, Section 3.4.1.1.3; and SSP 30237, Section 3.2.3.					

TABLE B.1

APPLICABLE REQUIREMENTS MATRIX - Continued

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]
	JSC 28484	3.3.4.1.2.1	A	Equipment interfacing to ISS 120 VDC shall meet the conducted emission requirements of SSP 30237, Section 3.2.1 (CE01, CE03, and CE07).					
	JSC 28484	3.3.4.1.2.1	A	Equipment interfacing to 28 VDC shall meet the power leads conducted emission requirements of SL-E-0002, Section 6.1 (CE01), Section 6.2 (CE03), and Section 6.18 (TT01) and the conducted emission requirements of SSP 50094, Section 3.4.1.1.1 and Section 3.4.1.1.2.					
	JSC 28484	3.3.4.1.2.1	A	Equipment interfacing to Space Shuttle 115VAC shall meet the power leads conducted emission requirements of SL-E-0002, Section 6.1 (CE01), Section 6.2 (CE03), and Section 6.19 (TT02).					
	JSC 28484	3.3.4.1.2.2	A	All receivers and transmitters using antennas shall meet the conducted emission requirements of SL-E-0002, Section 6.3 (CE06).					
	JSC 28484	3.3.4.2	A	Power cables shall pass a DWV test as part of preflight testing pre-installation acceptance testing. DWV testing criteria shall be derived from NASA-STD-8739.4 or JHB 8080.5 (E-14).					
	JSC 28484		A	Interconnecting cable and harness assemblies shall be tested for point-to-point electrical continuity. Continuity testing criteria shall be compliant to NASA-STD-8739.4.					
	JSC 28484		A	Wire harness protection shall be per NASA-STD-8739.4.					
	JSC 28484		A	Shields shall not be used as current carrying paths for power cables.					
	JSC 28484		A	Fixtures shall be wired with conductors having insulation suitable for the environmental conditions, current, voltage and temperature to which the conductors will be subjected per NASA-STD-8739.4.					

TABLE B.1

APPLICABLE REQUIREMENTS MATRIX - Continued

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]
	JSC 28484		A	Cables and harnesses shall be routed so that they are protected from abrasion, cold flow, cut through, vibration, chafing, flexing and sharp edges.					
	JSC 28484		A	Cable and harness accessories (clamps, screws, etc.) shall contain no sharp edges, pinch points, or protrusions that could injure crew or damage equipment.					
	JSC 28484		A	Provisions shall be provided to prevent inadvertent disconnection of energized power connections.					
	JSC 28484		A	Electrical connectors shall be selected such that misalignment during connect and disconnect operations will not cause pin damage.					
	JSC 28484		A	Cables and connectors shall be provided with stress relief to prevent the conducting wire from being the structural strength and to restrict wire flexing of the joint per NASA-STD-8739.4.					
	JSC 28484		A	Conductors and wire harnesses shall be derated to safely operate under the maximum current allowed by the supply protection devices. Derating shall be per TM 102179.					
	JSC 28484		A	For cables that will be connected to an interfacing connector that is mounted to structure, the wire harness shall be undamaged and capable of operating after exposure to the following: a. A 125 lbf pull test. b. The expected bending cycles experienced during operational use, with a scatter factor of 4.					
	JSC 28484		A	Equipment with electrical connectors, plugs, and receptacles which otherwise could be incorrectly mated shall be designed or selected to prevent incorrect connection with other accessible connectors, plugs, or receptacles.					

TABLE B.1

APPLICABLE REQUIREMENTS MATRIX - Continued

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]
	JSC 28484		A	Permanent identification of mating connectors shall be provided on each side of each connector pair.					
	JSC 28484	3.3.4.3	A	The derating criteria for all new designs shall, as a minimum, require a 50% derating of upper worst case electrical stress levels and 25% derating of upper worst case thermal stress from the part specification's maximum rating. OTS equipment is exempt from this requirement.					
	JSC 28484	3.3.4.4	A	Electrically powered equipment shall provide short circuit protection for each input power interface.					
	JSC 28484	3.3.4.4	A	Equipment providing branch electrical power distribution circuits shall be designed to include overload protection for each branch circuit. Protection devices for branch circuits shall be designed such that in the event of a branch circuit overload, upstream devices will not act to remove power from the equipment or other branch circuits provided by the equipment. This requirement is not applicable to power distribution cables. Simple power distribution breakout boxes and power strips are exempt from this requirement, unless specifically listed in the ARM.					
	JSC 28484	3.3.4.4	A	Equipment which redistributes power shall be designed so that all necessary mating and demating of connectors can be accomplished without producing electrical arcs that will damage connector pins or ignite surrounding materials or vapors.					
	JSC 28484	3.3.4.4	A	Equipment with electrical power or data interfaces to other systems shall be designed to meet the interface requirements of the interfacing system. The applicable requirements document will be listed in the ARM.					

TABLE B.1

APPLICABLE REQUIREMENTS MATRIX - Continued

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]
	JSC 28484	3.3.4.5	A	Circuit breakers shall be resettable. All tripped conditions shall be visually indicated.					
	JSC 28484	3.3.4.6	A	Electrical equipment shall meet the bonding requirements of NSTS 37330.					
	JSC 28484	3.3.5.1	A	Equipment exposed to crew contact shall withstand a design load of 125 lbf over a 4"X 4" square without loss of function.					
	JSC 28484	3.3.5.1	A	Equipment exposed to crew contact shall withstand a design load of 175 lbf over a 4" X 4" square without creating a hazard.					
	JSC 28484	3.3.5.2.1	A	All hardware shall withstand the launch, on–orbit, and landing design environments (maintaining positive margins of safety) without any failure that could leak hazardous fluids or release any equip-ment that could damage the vehicle or cause injury to the crew.					
	JSC 28484	3.3.5.2.2	A	All structurally mounted hardware shall be evaluated, by test or analysis, for struc-tural life based on the sustained static and cyclic load conditions of the design environment. Structural life is defined as four times the hardware service life environment. Structural parts which are classified as fracture critical should implement fracture control requirements of Section 3.3.5.3 in stead of fatigue life requirements.					
	JSC 28484	3.3.5.2.3	A	The minimum factor of safety to be used with limit load conditions to establish design loads shall be as defined in NASA-STD-5001.					
	JSC 28484	3.3.5.2.4	A	A positive margin of safety shall be maintained for every structural part. All appropriate failure modes shall be evaluated.					
	JSC 28484	3.3.5.2.5	A	Stainless steel tubing shall meet the requirements of JHB 8080 (M/S-15).					

TABLE B.1

APPLICABLE REQUIREMENTS MATRIX - Continued

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]
	JSC 28484	3.3.5.3	A	JSC 25863 shall be implemented for fracture control on all hardware.					
	JSC 28484	3.3.5.4	A	Procurements of fasteners shall be in accordance with JSC 23642.					
	JSC 28484	3.3.5.4	A	Fasteners shall be selected and designed in accordance with NASA-STD-3000, Section 11.9.3.					
	JSC 28484	3.3.5.4	A	Fasteners shall be of the captive type or made captive by the use of a suitable adhesive or an anaerobic locking sealant.					
	JSC 28484	3.3.5.4	A	Devices such as self-tapping screws and bolts shall not be used.					
	JSC 28484	3.3.5.5.1	A	A fluid quantity determination capability shall be provided in fluid storage and resupply systems.					
	JSC 28484	3.3.5.5.2	A	Fluid transfer interface hardware design shall preclude mating to any unintended interface.					
	JSC 28484	3.3.5.5.2	A	Fluid systems that interface with other systems shall meet the fluid standards and interface requirements of the inter-facing system. Applicable interface requirements documents will be listed in the ARM.					
	JSC 28484	3.3.5.5.3	A	Fluid systems shall meet the requirements of the following JHB 8080.5 standards: a. F-7 b. F-8 c. F-17 d. F-18 e. F-19 f. F-20 g. F-24 h. F-25 i. F-30 j. M/S-16					

TABLE B.1

APPLICABLE REQUIREMENTS MATRIX - Continued

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]
	JSC 28484	3.3.5.6	A	Equipment interfacing mechanically with other systems shall be designed to meet the ICD of the interfacing system. Applicable interface requirements documents will be listed in the ARM.					
	JSC 28484	3.3.5.7	A	Cables, wiring, and/or hoses connecting to the crew member during launch and landing shall incorporate a break-away feature that shall release at no greater than 25 lbf. These break-away features shall function without creating a hazard or reducing the performance of the crew escape suit or crew escape equipment.					
	JSC 28484	3.3.6.1	A	Equipment shall be designed or selected to preclude injury to personnel or damage to equipment per NASA-STD-3000, Paragraph 6.3.3.					
	JSC 28484	3.3.6.2	A	Equipment shall be designed or selected to preclude crew exposure to surface temperatures that can cause injury.					
	JSC 28484	3.3.6.3	A	Batteries shall be controlled in accordance with JSC 20793.					
	JSC 28484	3.3.6.4.1	A	A GFE continuous noise source shall not exceed the limits provided in Table 3.1, for all octave bands.					
	JSC 28484	3.3.6.4.2	A	A GFE intermittent noise source shall comply with the limits provided in Table 3.1.					
	JSC 28484	3.3.6.5	A	Equipment shall not induce a hazard during or after exposure to the following pressure rates of change through the pressure range of 14.7 psi to approximately 0 psi: Depressurization - 8 psi per minute Repressurization - 9 psi per minute					
	JSC 28484	3.3.6.6	A	Equipment shall be designed or selected to ensure the crew is protected from electrical hazards in accordance with NASA-STD-3000, Section 6.4.3.					

TABLE B.1

APPLICABLE REQUIREMENTS MATRIX - Continued

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]
	JSC 28484	3.3.6.7	A	In addition to the requirements of Paragraph 3.3.1, liquids, gasses, or powders shall be controlled in accordance with JSC 27964.					
	JSC 28484	3.3.6.8	A	Equipment containing lasers shall meet the requirements of ANSI-Z136.1 and FAA Order 7400.2D, Chapter 34, as applicable.					
	JSC 28484	3.3.6.9	A	Any equipment that emits ionizing radiation shall obtain concurrence for use by the radiation constraints panel. Concurrence is provided by an approved JSC Form 44. Equipment shall not expose crew members to radiation levels in excess of those specified in Title 20, Code of Federal Regulations. In addition, hardware brought into the ISS shall not produce radiation levels in excess of two millirad (Si) per day, at a distance of one centimeter from any surface. Equipment that emits non-ionizing radiation shall meet the requirements of NASA-STD-3000, Paragraph 5.7.3.					
	JSC 28484	3.3.6.10	A	Hardware shall be handled and protected in such a manner so as not to cause Electrostatic Discharge (ESD) damage to sensitive devices.					
	JSC 28484	3.3.6.11	A	Electrical and electronic equipment that contains voltage potential in excess of 300 volts shall be designed to preclude hazards caused by corona.					
	JSC 28484	3.3.6.12	A	Material that can shatter shall not be used in the habitable compartment unless positive protection is provided to prevent fragments from entering the cabin environment.					

TABLE B.1

APPLICABLE REQUIREMENTS MATRIX - Continued

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]
	JSC 28484	3.3.6.13	A	Cables and hoses shall not be designed to be routed through open hatches unless required by their intended use. Any cable or hose whose intended use requires it to be routed through an open hatch shall be designed to include a quick disconnect provision within the vicinity of the hatch, such that the cable or hose can be cleared from the hatch within five seconds.					
	JSC 28484	3.3.6.14	A	A stalled or locked rotor shall not produce a hazard.					
	JSC 28484	3.3.6.14	A	Positive protection shall be provided for fans when contact with the fan blades could result in crew injury or hazardous propelled debris.					
	JSC 28484	3.3.6.14	A	Where pressurized systems could fail in such a way that the total gas supply dumped directly into a compartment would be greater than the relief valve or venting could handle without overpressurization of the compartment, necessary flow restrictions shall be incorporated at the pressure source to restrict the mass flow to a level that can be handled by the relief valve and/or venting.					
	JSC 28484	3.3.6.15	A	The release of the total gas supply of a pressurized system shall not result in the displacement of oxygen below the partial pressure needed to prevent asphyxiation.					
	JSC 28484	3.3.6.16	A	Equipment located inside pressure garments, with energy storage or current carrying devices capable of energy discharge or short circuit currents sufficient to ignite materials, shall have adequate energy/current limiting.					
	JSC 28484	3.3.6.17	A	Silver cased wet slug Tantalum capacitors shall not be used in JSC in-house designs.					

TABLE B.1

APPLICABLE REQUIREMENTS MATRIX - Concluded

Reqm't No.[1]	Document[2]	Paragraph[3]	A: Applicable[4] N: Not Applicable E: Exception	Shall Statement[5]	Verification Success Criteria[6]	Verif. Method[7]	Flight Acceptance[8]	Pre-Installation Acceptance?[9]	Result[10]
	JSC 28484	3.3.7.3	A	Anthropometric requirements apply when and to the extent identified in the customer agreement, or when and to the extent necessary to control a hazardous condition or event. When so identified, NASA-STD-3000, Section 3.0, shall be used as the definition to accommodate the anthropometry of the 5% Japanese female to the 95% American male.					
	JSC 28484	3.3.7.8	A	If color coding is to be used, red (#11105 or #21105 of FED-STD-595–B) shall be reserved for emergency functions and yellow (#33538 of FED-STD-595-B) shall be reserved for caution functions.					
	JSC 28484	3.3.8	A	Pyrotechnic devices shall not be used in non-critical equipment.					
	JSC 28484	3.3.9	A	Software shall meet the requirements of JSC 27291.					
	JSC 28484	4.2.2	A	Problems shall be reported and resolved as documented in JSC 28035.					
	JSC 28484	5.1	A	Packing shall be used in conjunction with the appropriate protective measures and materials, handling procedures, and methods of transport to maintain the item within the appropriate cleanliness levels and to prevent damage or degradation in reliability or performance of the item when exposed to the natural and induced ground based and transportation and ground handling environment.					
	JSC 28484	5.2	A	Marking for shipment and storage of packages and exterior shipping containers shall be in accordance with MIL-STD-129.					
				Enter any additional unique requirments.					

APPENDIX C

JHB 8080.5 TRACEABILITY MATRIX

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE C.1

JHB 8080.5 TRACEABILITY MATRIX

Reqm't No.[1]	A: Applicable N: Not Applicable E: Exception	Title of Standard	Applicability and Traceability
G-1 *(1/A)* *(136)*	A	Equipment Accessibility for Maintenance	Covered by Paragraph 3.1.4.
G-2 *(4/B)* *(20/A)*	N	Separation of Redundant Equipment	Critical Equipment Requirement.
G-3 *(7)*	E	Systems Checkout Provisions	Not cost effective for non-critical equipment.
G-4 *(9)*	A	Protection of Spacecraft Electrical and Mechanical Systems from Debris	Covered by JSC 27301A.
G-5 *(10)*	N	Interior Design of Spacecraft for Cleanliness	Vehicle requirement. Item 4 covered by JSC 27301A.
G-6 *(12/A)*	N	Redundancy Requirements	Covered by Paragraph 3.3.6.
G-7 *(11/A)* *(58)*	E	Time Displays	Time displays on non-critical equipment are based on the display needs, not a generic time display requirement.
G-8 *(36)*	N	Redundant Paths - Verification of Operation	Critical Equipment Requirement.
G-9 *(41/A)*	A	Shatterable Material - Exclusion from Habitable Compartment	Covered by Paragraph 3.3.6.12.
G-10 *(77)*	A	Control of Limited Life Components	Covered by Paragraph 4.2.8.
G-11 *(79)*	N	Procurement Document Identification for Manned Spaceflight Vehicle Items	Not a design requirement.
G-12 *(83)*	A	Application of Previous Qualification Tests	Covered by Section 4.0.
G-13 *(84/A)*	A	Shipping and Handling Protection for Spaceflight Hardware	Covered by Section 5.0.
G-14 *(99/C)*	A	Identification and Classification of Flight and Non-flight Equipment	Covered by SLP 4.8.
G-15 *(28)* *(100)*	N	Equipment Failure-Verification of Flight Readiness	Not a design requirement.
G-16 *(102)*	N	Operating Limits on Temperature-Controlled Equipment	Not a design requirement.
G-17 *(107)*	A	Separate Stock for Spaceflight Parts and Materials	Not a design requirement.
G-18 *(115)*	A	Safety Precautions - Test and Operating Procedures	Covered by Section 3.3.6.
G-19 *(119)*	A	Special Processes - Identification of Drawings	Covered by JHB 8500.

TABLE C.1

JHB 8080.5 TRACEABILITY MATRIX - Continued

Reqm't No.[1]	A: Applicable N: Not Applicable E: Exception	Title of Standard	Applicability and Traceability
G-20 *(121)*	N	Spacecraft Equipment - Protection from System Liquids	Vehicle Requirement.
G-21 *(122)*	A	Spacecraft Equipment - Moisture Protection	Covered by Paragraph 3.2.
G-22 *(129)*	A	Parts Identification	Covered by Paragraph 4.2.1.
G-23 *(130)*	A	Pressure Garment Wiring - Ignition of Materials by Electrical Current	Covered by Section 3.3.6.
G-24 *(153)*	N	Ground Support Equipment and Airborne Support Equipment Protective Devices	GSE requirement.
G-25 *(new)*	A	Thermal Design and Analysis - Thermal Parameters	Covered by Paragraph 3.2.
G-26 *(new)*	A	Internally Generated Radiation	Covered by Section 3.3.6.
G-27 *(new)*	A	Fire Control	Flammability requirements are covered by Section 3.3.1.
G-28 *(53)*	N	Sealing - Solid Propellant Rocket Motors	SRM Requirement.
G-29 *(54)*	N	Reentry Propulsion Subsystem In-flight Test	Vehicle Requirement.
G-30 *(59)*	A	Switch Protection Devices	Covered by Section 3.3.6.
G-31 *(56) (65)*	N	Detachable Crew-Operated Tools - Restriction in Spacecraft	Tools are not used for controls.
G-32 *(75)*	N	Measurement Systems That Display Flight Information to the Crew - Indication of Failure	Critical Equipment Requirement.
G-33 *(new)*	A	Surface Temperatures	Covered by Paragraph 3.3.6.2.
G-34 *(new)*	N	Extravehicular Activity Electronic Connectors	EVA Requirement.
G-35 *(new)*	N	Enclosure Panels External to the Habitable Modules	EVA Requirement.
G-36 *(new)*	N	Thermal Blankets - Extravehicular Activity	EVA Requirement.
G-37 *(126)*	N	Verification of Adequate External Visibility	Vehicle Requirement.
G-38 *(127)*	N	Pressurization or Repressurization - Precluding Ingress of Undesirable Elements	Vehicle Requirement.
G-39 *(138)*	N	Lightning Protection Design	Vehicle Requirement.

TABLE C.1

JHB 8080.5 TRACEABILITY MATRIX - Continued

Reqm't No.[1]	A: Applicable N: Not Applicable E: Exception	Title of Standard	Applicability and Traceability
G-40 *(141/A)*	A	Radioactive Luminescent Devices	Covered by Section 3.3.6.
G-41 *(145)*	A	Acoustic Noise Criteria	Covered by Section 3.3.6.4.
G-42 *(55)*	N	Solar Wind Environment	Vehicle Requirement.
G-43 *(new)*	N	Centralized Subsystem Controls	Vehicle Requirement.
G-44 *(57/A)*	N	Attitude Control Authority	Vehicle Requirement.
G-45 *(66)*	N	Solid Propellant Rocket Motors - Ignition Capability with Unsealed Nozzle	SRM Requirement.
G-46 *(124)*	N	Separation Sensing System - Structural Deformation	Vehicle Requirement.
G-47 *(16)*	N	Gyroscopes - Verification of Rotational Speed or Drift Rate	Vehicle Requirement.
G-48 *(27)*	A	Onboard Experiments - Required Prein-stallation Checklist	Covered by Section 3.3.6.
G-49 *(44)*	N	Temperature and Pressure Monitoring Requirements of Hydrogen Peroxide Systems	Critical Equipment Requirement.
G-50 *(86)*	E	Direct Procurement of Parts	Not cost effective for non-critical equipment.
G-51 *(104)*	N	Flight Hardware - Restriction on Use for Training	Not a design requirement.
G-52 *(108/A)*	A	Reuse of Flight Hardware	Covered by Verification Plan, Certification, Acceptance, and limited life list.
E-1 *(3/A)*	A	Mating Provisions for Electrical Connectors	Covered by Paragraph 3.3.4.2, Subparagraphs n and o.
E-2 *(6/A)*	N	Protection of Severed Electrical Circuits	Vehicle Requirement.
E-3 *(13)*	E	Electrical and Electronic Devices - Protec-tion from Reverse Polarity and/or Other Improper Electrical Inputs	Not cost effective for non-critical equipment.
E-4 *(31) (80)*	E	Electrical Connectors - Moisture Protection	Not cost effective for non-critical equipment.
E-5 *(32)*	A	Electrical Connectors - Pin Assignment	Covered by Section 3.1.3 and Section 3.3.4.4.
E-6 *(37)*	A	Corona Suppression	Covered by Paragraph 3.3.6.11.

TABLE C.1

JHB 8080.5 TRACEABILITY MATRIX - Continued

Reqm't No.[1]	A: Applicable N: Not Applicable E: Exception	Title of Standard	Applicability and Traceability
E-7 *(52)*	A	Tantalum Wet Slug Capacitors - Restriction on Use	Covered by Paragraph 3.3.6.16.
E-8 *(68)*	N	Electrical and Electronic Supplies and Loads - Verification Tests	GSE Requirement.
E-9 *(69)*	A	Electrical Circuits - Deenergizing Requirement	Covered by Paragraph 3.3.4.4.
E-10 *(81)*	A	Cleaning of Electrical and Electronic Equipment	Covered by Paragraph 3.3.1.1.
E-11 *(85/A)*	A	Protective Covers or Caps for Electrical Receptacles and Plugs	Covered by JSC 27301A.
E-12 *(112)* *(128)*	N	Electrical Connectors - Disconnection for Trouble-Shooting and Bench Testing	GSE Requirement.
E-13 *(131)*	A	Bioinstrumentation Systems - Crew Electrical Shock Protection	Covered by Paragraph 3.3.6.6.
E-14 *(133/D)*	A	Electrical Wire Harnesses - Dielectric Tests	Covered by JSC 27301A.
E-15 *(134)*	A	Electrical Power Distribution Circuits - Overload Protection	Covered by Section 3.3.4.4.
E-16 *(148)*	N	Testing Protective Devices for Solid-State Circuits	Critical Equipment Requirement.
E-17 *(19)*	E	Electrical and Electronic Piece Parts - Closure Construction	Obsolete requirement.
E-18 *(48)*	N	Circuitry for Automatic Shutdown of Launch Vehicle Engine(s)	Critical Equipment Requirement.
E-19 *(146)*	E	Equipment Design - Power Transients	EMI emission requirements covered in Section 3.3.4.1 and electrical interface requirements covered in Section 3.3.4.4. EMI conducted susceptibility requirements are waived for non-critical equipment.
E-20 *(new)*	A	Control of Electrostatic Discharge for Electronic Parts and Assemblies	Covered by JSC 27301A.
E-21 *(new)*	A	Electrical Connectors	Covered by Paragraph 3.3.4.2j and JSC 27301A.
E-22 *(new)*	E	Ionizing Radiation Effects	Not cost effective for non-critical equipment.
E-23 *(5)*	E	Transistors - Selection of Types	Obsolete requirement.
E-24 *(95/E)*	A	Electrical Wire and Cable Acceptance Tests	Covered by Paragraph 3.3.4.2a.
F-1 *(17)*	A	Flow Restriction Requirements - Pressurized Sources	Covered by Paragraph 3.3.6.15.

TABLE C.1

JHB 8080.5 TRACEABILITY MATRIX - Continued

Reqm't No.[1]	A: Applicable N: Not Applicable E: Exception	Title of Standard	Applicability and Traceability
F-2 *(24)*	N	Moisture Separators in a Zero-Gravity Environment	Not a requirement, this is a design consideration.
F-3 *(30)*	N	Service Points - Positive Protection From Inter-Changeability of Fluid Service Lines	Vehicle Requirement.
F-4 *(35)*	N	Ground Service Points - Fluid Systems	Vehicle Requirement.
F-5 *(42)*	N	Fluid Lines - Separation Provisions	Vehicle Requirement.
F-6 *(new)*	N	Temperature and Pressure Monitoring Requirements for Potentially Hazardous Reactive Fluids	Vehicle Requirement.
F-7 *(47)*	A	Capping of Servicing and Test Ports	Covered by Paragraph 3.3.5.5.3.
F-8 *(49)*	A	Fluid System Components Whose Function is Dependent on Direction of Flow - Protection Against Incorrect Installation	Covered by Paragraph 3.3.5.5.3.
F-9 *(50/A)*	N	Spacecraft Venting - Induced Perturbing Forces	Vehicle Requirement. EVA Requirement.
F-10 *(64)*	N	Nozzles and Vents - Protection Prior to Launch	Vehicle Requirement.
F-11 *(67)*	N	Fluid Supplies - Verification Tests	GSE Requirement.
F-12 *(71)*	N	Protection of Pressurized Systems from Damage Due to Pressurant Depletion	Covered by Paragraph 3.1.3.
F-13 *(72)*	N	Crew Cabin Module Pressure - Venting Restriction	Vehicle Requirement.
F-14 *(73)*	E	Crew Cabin Module Ventilating Fans - Protection From Debris	Covered by Paragraph 3.3.6.14. Second sentence is case by case exception.
F-15 *(74)*	N	Separation of Hypergolic Reactants	Critical Equipment Requirement.
F-16 *(76)*	N	Fluid Line Installation	Vehicle Requirement.
F-17 *(78)*	A	Cleanliness of Flowing Fluids and Associated Systems	Covered by Paragraph 3.3.5.5.3.
F-18 *(92)*	A	Pressure Relief Valves - Standardization of Functional Testing	Covered by Paragraph 3.3.5.5.3.
F-19 *(93)*	A	Protection for Tubing, Fittings, and Fluid System Components - Flight Hardware and Associated Equipment	Covered by Paragraph 3.3.5.5.3.
F-20 *(94)* *(97)*	A	Fluid Systems - Cleanliness	Covered by Paragraph 3.3.5.5.3.

TABLE C.1

JHB 8080.5 TRACEABILITY MATRIX - Continued

Reqm't No.[1]	A: Applicable N: Not Applicable E: Exception	Title of Standard	Applicability and Traceability
F-21 *(118)*	N	Purge Gases - Temperature and Humidity Requirements	Vehicle Requirement.
F-22 *(123)*	N	Pressure Garments - Protection Against Failure Propagation	Critical Equipment Requirement.
F-23 *(147/A)*	N	Qualification Fluid	Verification Requirement.
F-24 *(38/A)*	A	Fluid Systems - Design for Flushing and Draining	Covered by Paragraph 3.3.5.5.3.
F-25 *(34)*	A	Toxicity - Fluids Contained in Systems in the Crew Compartment	Covered by Paragraph 3.3.5.5.3.
F-26 *(143)*	N	Atmospheric Pressure and Composition Control	Vehicle Requirement.
F-27 *(91)*	N	Liquid or Gas Containers - Verification of Contents	GSE Requirement.
F-28 *(new)*	N	Use of Halogen Method for Coolant System Leak Detection	Verification Requirement.
F-29 *(new)*	N	Filter Protection of Active Fluid Components	Not a requirement, this is a design consideration.
F-30 *(149)*	A	Pressure Relief for Pressure Vessels	Covered by Paragraph 3.3.5.5.3.
M/P-1 *(14/A)*	A	Material Selection, Review, and Drawing Sign-Off	Covered by JSC 27301A.
M/P-2 *(22/A)*	A	Flammability of Wiring Material	Covered by JSC 27301A.
M/P-3 *(23)*	A	Toxicity of Materials Used in Crew Compartments - Wire Insulation, Ties, Identification Marks, and Protective Covering	Covered by JSC 27301A.
M/P-4 *(63)*	A	Metals and Metal Couples - Restriction on Use	Covered by JSC 27301A.
M/P-5 *(70)*	N	Solutions Which Contain Ethylene Glycol - Requirements for Silver Chelating Agent	Covered by JSC 27301A. No Ethylene Glycol in non-critical equipment.
M/P-6 *(33)* *(89)*	A	Toxicity - Requirements for Nonmetallic Materials Proposed for Use within Crew Compartment	Covered by JSC 27301A.
M/P-7 *(101)*	A	Material Detrimental to Electrical Connectors	Covered by JSC 27301A.
M/P-8 *(111)*	A	Leak Detectors - Wetting Agents	Covered by JSC 27301A.
M/P-9 *(120/A)*	N	Breathing Systems - Requirement to Test for Mercury Contamination	Critical system requirement.

TABLE C.1

JHB 8080.5 TRACEABILITY MATRIX - Continued

Reqm't No.[1]	A: Applicable N: Not Applicable E: Exception	Title of Standard	Applicability and Traceability
M/P-10 *(152/B)*	A	Liquid Locking Compounds - Restrictions and Controls	Covered by JSC 27301A.
M/P-11 *(140)*	N	Pressure Vessel Documentation	Not a design requirement. This is a documentation requirement.
M/P-12 *(new)*	N	Multilayer Blanket Bake-Out	EVA requirement.
M/P-13 *(139)*	A	Pressure Vessel Design	Covered by JSC 27301A.
M/P-14 *(new)*	A	Silicate Ester Coolant System Design	Covered by JSC 27301A.
M/P-15 *(116)*	A	Mercury - Restriction on Use	Covered by JSC 27301A.
M/P-16 *(43)*	A	Restriction on Coatings for Areas Subject to Abrasion	Covered by JSC 27301A.
M/P-17 *(87/A)*	N	Radiographic Inspection of Brazed and Welded Tubing Joints	Verification Requirement.
M/P-18 *(98) (109/B)*	A	Etching Fluorocarbon Insulated Electrical Wire	Covered by JSC 27301A.
M/P-19 *(18)*	A	Spacecraft Material - Restriction on Use of Polyvinyl Chloride	Covered by JSC 27301A.
M/P-20 *(26)*	A	Titanium or Its Alloys - Prohibited Use with Oxygen	Covered by JSC 27301A.
M/P-21 *(51)*	A	Beryllium - Restricted Use within Crew Compartment(s)	Covered by JSC 27301A.
M/P-22 *(82)*	N	Brazed Joints - Identification Marks	Vehicle Requirement.
M/P-23 *(114/A)*	A	Pressure Vessels - Materials Compatibility and Vessel Qualification Tests	Covered by JSC 27301A.
M/P-24 *(125)*	A	Cadmium - Restriction on Use	Covered by JSC 27301A.
M/P-25 *(137)*	A	Pressure Vessels - Non-destructive Evaluation Plan	Covered by JSC 27301A.
M/P-26 *(135)*	A	Repair of Sandwich - Type Structures	Covered by JSC 27301A.
M/S-1 *(2/A)*	E	Equipment Containers - Design for Rapid Spacecraft Decompression	Covered for Safety only.
M/S-2 *(8/A)*	A	Alignment of Mechanical Systems	Covered by Paragraph 3.1.1.
M/S-3 *(25)*	A	Wire Bundles - Protective Coating	Covered by JSC 27301A.

TABLE C.1

JHB 8080.5 TRACEABILITY MATRIX - Concluded

Reqm't No.[1]	A: Applicable N: Not Applicable E: Exception	Title of Standard	Applicability and Traceability
M/S-4 *(61)*	N	Hatches - Repeated Use	Vehicle Requirement.
M/S-5 *(62)*	A	Threaded Fittings - Restrictions on Release of Particles and Foreign Material	Covered by JSC 27301A, and Paragraph 3.3.5.4.
M/S-6 *(142)*	A	Exposed Sharp Surfaces or Protrusions	Covered by Paragraph 3.3.6.1.
M/S-7 *(144)*	A	Windows and Glass Structure	Covered by Section 3.3.5.2.
M/S-8 *(151)*	N	Penetration of Inhabited Spacecraft Compartments	Vehicle Requirement.
M/S-9 *(new)*	E	Mechanisms	The first requirement is not cost effective for non-critical equipment. Items 2 and 3 are not applicable for non-critical equipment.
M/S-10 *(150)*	N	Functional Doors That Operate in Flight	Vehicle Requirement.
M/S-11 *(21/A)*	N	Meteoroid Protection Levels for Structures	Vehicle Requirement.
M/S-12 *(60)*	N	Spacecraft Recovery Hoist Loops	Vehicle Requirement.
M/S-13 *(new)*	N	Lifting and Hoisting Ground Support Equipment Identification	GSE Requirement.
M/S-14 *(110/B)*	A	Structural Analysis	Covered by Section 3.3.5.2.
M/S-15 *(29)*	A	Stainless Steel Tubing - Method of Joining	Covered by Paragraph 3.3.5.2.5.
M/S-16 *(132)*	A	Pressure Vessels - Negative Pressure Damage	Covered by Paragraph 3.3.5.5.3.
P-1 *(39/A)*	N	Explosive Devices - Arming and Disarming	No pyrotechnic devices allowed. Covered by Paragraph 3.3.8.
P-2 *(105/B)*	N	Pyrotechnic Devices - Preflight Verification Tests at Launch Sites	No pyrotechnic devices allowed. Covered by Paragraph 3.3.8.
P-3 *(88/A)*	N	Wire Splicing	No pyrotechnic devices allowed. Covered by Paragraph 3.3.8.
P-4 *(90/B)*	N	Explosive Devices - Packaging Material	No pyrotechnic devices allowed. Covered by Paragraph 3.3.8.
P-5 *(96/A)*	N	Explosive Devices - Identification Requirements	No pyrotechnic devices allowed. Covered by Paragraph 3.3.8.
P-6 *(46)*	N	Protection of Electrical Circuitry for Explosive Devices Employing Hot Bridgewire Initiators	No pyrotechnic devices allowed. Covered by Paragraph 3.3.8.
P-7 *(103/A)*	N	Explosive Devices - Color Coding Requirements	No pyrotechnic devices allowed. Covered by Paragraph 3.3.8.