JSC-STD-8080
October 2011

JSC Design and Procedural Standards

Engineering Directorate

October 2011

(This document supersedes JPR 8080.5 JSC Design and Procedural Standards, dated February, 2005.)

Verify that this is the correct version before use.

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

Revision	Date	Description of Change	Originator
Basic	2011_0901	Initial Release of Document as a JSC Standard, Reference JTS CB CR# 3001	Danny Punch
DCN 1	2012_06	G-10 - Title change for clarification, G-22 Title and content change, Reference JTS CB CR# 3002	Dale Huls

PREFACE

This document is a compilation of technical policies for human spacecraft as released through the Lyndon B. Johnson Space Center (JSC) Design and Procedural Standards activity.

The Design and Procedural Standards are located in Section 2 of this manual and are identified according to the applicable discipline or category, with letter codes as follows:

Letter Codes for Standards

G	General
E	Electrical
F	Fluids
M/P	Materials and Processes
M/S	Mechanical and Structural
P	Pyrotechnics

Comments and questions regarding this document should be directed to the JSC Technical Standards Control Board (JTS) Executive Secretary or the JTS Chair, mail code EA4, Houston, Texas 77058.

/s/ Danny Punch for

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Director, Engineering

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*THIS IS A COMPLETE LISTING, BY CATEGORY AND NUMBER, OF THE STANDARDS CONTAINED IN THIS MANUAL.

SECTION 1

INTRODUCTION

1.0 INTRODUCTION

1.1 PURPOSE

This document provides design and procedural requirements appropriate for inclusion in specifications for any human spaceflight program, project, spacecraft, system, or end item. The term “spacecraft” as used in the standards includes launch vehicles, orbital vehicles, non-terrestrial surface vehicles, and modules. The standards are developed and maintained as directed by Johnson Space Center (JSC) Policy Directive JPD 8080.2, JSC Design and Procedural Standards for Human Space Flight Equipment.

1.2 SCOPE

The Design and Procedural Standards contained in this manual represent human spacecraft design and operational knowledge applicable to a wide range of spaceflight activities. These standards are imposed on JSC human spaceflight equipment through JPD 8080.2. Designers shall comply with all design standards applicable to their design effort.

1.3 BACKGROUND

The Design and Procedural Standards activity was established to develop technical and procedural policies for human spaceflight programs. Originally published in 1964, the Standards manual has been revised periodically. Because of agency document management changes over the years, the letters in front of 8080.5 have changed many times over the years without affecting the standards contained within the document.

1.4 JSC TECHNICAL STANDARDS CHANGE BOARD

The JSC Technical Standards (JTS) Change Board was established by JPD 8080.2 and charters by EPC 2104.00, Charter of the JSC Technical Standards Control Board, EA-07-028 to perform and administer the technical standards activity at the Johnson Space Center.

The JTS membership represents the various technical and operations disciplines involved in past and present human spaceflight activities at JSC. Each standard is assigned to the most knowledgeable and appropriate organization and the organization assigns a Lead Engineer for ownership.

1.5 DEVELOPMENT OF STANDARDS

Any JSC employee may propose a new JSC standard or a revision to an existing standard. Proposed new standards and revisions to existing standards will be submitted to the JTS. A Lead Engineer and Lead Organization will be identified for each new standard.

Standards will be submitted on the appropriate JTS change form. The change form identifies a revision, a proposed cancellation, or the inclusion of a new standard.

Supporting or background information should be enclosed with the change.

1.6 CANCELLED STANDARDS

Standards may be cancelled following the same process for new and revised standards. Cancelled standards are not deleted from this document so that the standard can be returned to active status. All cancelled standards are removed from the main body of this document and placed in Appendix B. The rationale for canceling the standard is documented on the standard itself, as well as in the JTS configuration management records.

1.7 WAIVERS

Standards may be waived by obtaining approval of the NASA Technical Authority and the Program/Customer Control Board (CCB) that controls the requirements specification for the project or program. The waiver process is defined in other agency documentation. Waivers are not required for standards that are determined to be "not applicable." This applicability is coordinated with the Safety and Mission Assurance Directorate.

1.8 JSC DESIGN AND PROCEDURAL STANDARDS NUMBERING

JSC Design and Procedural Standards are categorized into logical groupings and numbered consecutively, within their respective categories, as they are released, revised, or cancelled. The standards are listed in this manual in numerical order within their respective categories (see paragraph 1.11 below as well as the sections comprising Section 2). Standards appear in only one category and are not repeated, even if appropriate for another category. As an example, some electrical standards are found in the general section. The user should be familiar with all standards.

1.9 ISSUE DATES AND REVISION HISTORY

For updated standards, the information block at the top of each standard reads: “Effective as of”. For cancelled standards, the information block reads: “Cancelled”.

To trace the revision history of each standard, please refer to Appendix A where original effective dates and revision dates are located for each standard.

1.10 LISTING IN KEY WORD INDEX

Key words selected to aid in searching for relevant standards are presented in alphabetical order as a Key Word Index (see Section 3) with a listing of the standards applicable to each word. For each standard, the Statement of Standard provides the requirements. The fact that a standard may not be listed under a specific word or category does not relieve JSC organizational elements of the responsibility for applying the requirement.

1.11 LIST OF STANDARDS

JSC Design and Procedural Standards are listed below in numerical order within their respective categories. The categories are General (G), Electrical (E), Fluids (F), Materials and Processes (M/P), Mechanical and Structural (M/S), and Pyrotechnics (P). Active standards are located in the Section 2. Cancelled standards are located in Appendix B Cancelled Standards.

SECTION 2

DESIGN AND PROCEDURAL STANDARDS

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2.1. General

Equipment Accessibility for Maintenance	Document No. JSC-STD-8080.5	Standard No. G-1	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Systems, subsystems, equipment, and components shall be designed with features that contribute to the ease and rapidity of maintenance.

Equipment expected to require servicing, replacement, or maintenance shall be designed to be accessible without removal of other equipment, wire bundles, and fluid lines. This should include accessibility during ground operations (horizontal and vertical) as well as on orbit.

Electrical connections and cable installations shall be designed with sufficient flexibility, length, and protection to permit disconnection and reconnection without damage to wiring or connectors.

Panel-mounted displays and controls that are inside the habitable areas shall be capable of being totally maintained from the habitable area. Each display and control installation shall be designed to permit removal and replacement without disturbing the validity and integrity of other components or subsystems.

REMARKS

The version updated in October 2004 modifies the text to align better with longer-term maintenance activities encountered on longer duration space missions such as the International Space Station or exploration missions

Separation of Redundant Systems	Document No. JSC-STD-8080.5	Standard No. G-2	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Redundant systems, redundant subsystems, and redundant major elements of subsystems (such as assemblies, panels, power supplies, tanks, controls, and associated interconnecting wiring and fluid lines) shall be separated or protected to ensure that an unexpected event which damages one is not likely to prevent the other from performing the functions.

Electrical wiring of redundant systems, redundant subsystems, or redundant major elements of subsystems shall not be routed in the same wire bundle or through the same connector with wiring of the other redundant system, subsystem, or subsystem element.

This standard is not applicable to redundant components or piece parts mounted in common housings within redundant systems, subsystems, or subsystem elements.

This standard does not apply to redundant explosive charges that are located adjacent to each other in order to sever structural members at a given point or along a given line. However, the electrical wiring of redundant systems and routing shall apply.

REMARKS

For purposes of this standard, "redundancy" is defined as the ability to perform a function by more than one means.

This recommended separation for electrical wiring also applies to fluid lines.

Electrical and Fluid Systems Checkout Provisions	Document No. JSC-STD-8080.5	Standard No. G-3	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Electrical and fluid systems and subsystems shall be designed to permit checkout tests and shall include provisions (e.g., test points) that permit these checkout tests to be conducted without disconnecting any tubing, mated flight couplings, or any other mated flight connectors.

Test points shall allow checkout of the system without loss of integrity (e.g., loss of pressure, leakage, loss of continuity, etc.).

REMARKS

Protection From Debris - Electrical & Mechanical Systems	Document No. JSC-STD-8080.5	Standard No. G-4	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Electrical and mechanical systems shall be shielded in such a way that encounters with debris or foreign material do not cause a malfunction. Acceptable methods include, but are not limited to, the following:

1. Design and fabricate electrical circuitry to prevent the establishment of unwanted current paths from such debris.
2. Provide critical electrical items with debris-proof covers, suitable containers, housings, potting, or conformal coatings.
3. Provide critical mechanical systems with debris-proof covers, shrouds, or containers that protect the entire system prior to use, or that prevent debris from entering into critical areas of the mechanism where the debris could cause binding, jamming, or seizing.
4. Incorporate filters, strainers, traps, screens, or other devices in moving-fluid components of electrical or mechanical systems to trap debris in a manner that will eliminate it as a threat to critical mechanical or electrical components. In systems where flow reversal may occur, install such devices on both sides of critical components. Make sure all such devices are able to be cleaned in-flight and/or are able to be replaced as part of the maintenance program.

REMARKS

Refer to G-5 for prevention of debris.

Crew cabin module ventilation fans are low pressure-drop devices with small clearances between blades and duct to maximize efficiency and minimize power consumption. Under microgravity conditions ventilation systems are particularly prone to blockage due to particulates. International Space Station ventilation systems suffered up to 80% reduction in flow due to the entrainment of clusters of particulate or fibrous debris in the ventilation systems. This debris penetrated through a protective screen with .02-inch diameter hole size, but then combined to block internal flow paths with .125-inch diameter. Because simple screens have been shown to be ineffective in long duration protection of ventilation systems in microgravity, depth filters should be used to protect ventilation systems from particulate fouling for long-duration missions. A similar phenomenon can occur in liquid media systems where particulates chemically combine downstream of the filter to produce larger than screen-size debris clumps. These systems should be assessed for the use of depth filters or more effective chemical filters.

Prevention Of Debris - Electrical & Mechanical Systems	Document No. JSC-STD-8080.5	Standard No. G-5	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

A Foreign Object Debris (FOD) prevention program shall be established for all ground operations of mechanical and electrical systems of flight hardware including the design, development, manufacturing, assembly, repair, processing, testing, maintenance, operation, and check out of the equipment to ensure the highest practical level of cleanliness.

The FOD prevention program shall conform to NAS 412 "Foreign Object Damage/ Foreign Object Debris (FOD) Prevention".

REMARKS

Refer to G-4 for protection from FOD.

NAS 412 is available through NASA Technical Standards Program at Marshall Space Flight Center.

Refer to JSC 49774 "Standard Manned Spacecraft Requirements for Materials and Processes", paragraph 4.2.9 for selection of materials to prevent growth of biological contaminants.

G-6 – G-7 have been cancelled.

See Appendix B for standard text and rationale for cancellation.

Design for Redundancy Verification	Document No. JSC-STD-8080.5	Standard No. G-8	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Spacecraft systems, subsystems, and equipment shall be designed to permit verification of redundant functions or operational modes any time the system, subsystem, or equipment requires testing prior to launch or during the mission.

REMARKS

This standard is not to be interpreted to require verification of redundancy every time the system, subsystem, or equipment is tested but merely to require that the systems/subsystems/equipment be designed in a manner to allow redundancy verification if it is deemed necessary. Verification of redundancy may occur at any time from acceptance testing through launch processing, mission operations, and post flight.

Shatterable Material - Exclusion	Document No. JSC-STD-8080.5	Standard No. G-9	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Shatterable materials shall not be used in the habitable compartment unless positive protection is provided to prevent fragments from entering the cabin environment.

Photographic, optoelectronic, and television lenses are exempt from this standard when in use, but they shall be protected by suitable covers when not in use.

This standard is also applicable to nonflight hardware or ground support equipment (GSE), including wiring and tubing that is carried on or used in the habitable compartment subsequent to start of equipment installation, at the contractor's facility or in a Government facility.

REMARKS

DCN1

Time/Cycle Critical Part Control	Document No. JSC-STD-8080.5	Standard No. G-10	Page 1 of 1
	Previous Revision 2011_101	Current as of 2012_06	

STATEMENT OF STANDARD

Spacecraft components which are time-critical and/or cycle-critical or which have limited storage life shall be subject to the following controls:

1. Each time-critical or limited-life assembly, subassembly, component, and spare shall be clearly and indelibly marked with a serial number.
2. Appropriate documentation shall accompany all time-critical and limited-life items and shall include the date of manufacture of the item and of its most time-critical component. Realistic life limits shall be assigned and documented for each item and shall be suitably altered as new data and new evidence are obtained.
3. Status records shall be maintained on all such items after installation in the spacecraft. Operating-time logs shall be maintained for all items having limited operating lives. Components shall have sufficient life remaining to adequately support mission requirements.
4. Special storage requirements shall be carefully defined and strictly observed.

A time-age-life cycle database shall be maintained for verification (and notification) of time-age-life component status.

REMARKS

This requirement may be satisfied by the inventory management subsystem of the onboard data management system.

Procurement Document Identification For Human Spaceflight Items	Document No. JSC-STD-8080.5	Standard No. G-11	Page 1 of 2
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Purchase requests (PRs), requests for proposal (RFPs), purchase orders (POs), credit card purchases, contracts, and subcontracts for items procured for use in human spaceflight shall be submitted with the statement shown below.

The information shall be printed, stamped, or added in boldface type.

> FOR USE IN HUMAN SPACEFLIGHT, MATERIALS, MANUFACTURING, AND WORKMANSHIP OF HIGHEST QUALITY STANDARDS ARE ESSENTIAL TO ASTRONAUT SAFETY.
>
> IF YOU ARE ABLE TO SUPPLY THE DESIRED ITEMS WITH A QUALITY WHICH IS HIGHER THAN THAT OF THE ITEMS SPECIFIED OR PROPOSED, YOU ARE REQUESTED TO BRING THIS FACT TO THE IMMEDIATE ATTENTION OF THE PURCHASER.

Procedures shall assure that new PRs, RFPs, POs, contracts, and subcontracts issued by prime contractors and their subcontractors down to the lowest tier include this information. Present contracts and subcontracts involving such hardware shall be amended at the earliest possible date to require the prime contractor or subcontractor to establish such procedures in all actions covering new procurement.

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REMARKS

For referral, here is the content of NASA FAR Supplement clause 1852.246-73, Human Space Flight Item.

1852.246-73 Human Space Flight Item.

As prescribed in 1846.370(b), insert the following clause:

HUMAN SPACE FLIGHT ITEM

(MARCH 1997)

The Contractor shall include the following statement in all subcontracts and purchase orders placed by it in support of this contract, without exception as to amount or subcontract level:

"FOR USE IN HUMAN SPACE FLIGHT; MATERIALS, MANUFACTURING, AND WORKMANSHIP OF HIGHEST QUALITY STANDARDS ARE ESSENTIAL TO ASTRONAUT SAFETY.

IF YOU ARE ABLE TO SUPPLY THE DESIRED ITEM WITH A HIGHER QUALITY THAN THAT OF THE ITEMS SPECIFIED OR PROPOSED, YOU ARE REQUESTED TO BRING THIS FACT TO THE IMMEDIATE ATTENTION OF THE PURCHASER."

Application Of Previous Qualification Test Data	Document No. JSC-STD-8080.5	Standard No. G-12	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

When certifying an item for a new application, use of qualification test data obtained during a previous certification shall meet the following conditions prior to use:

1. There is no change in design and specifications from the original item certified including operating limits, weight, dimensions, materials, performance and tolerance, reliability, and quality.

2. The configuration (part number and dash number) previously tested is identical to the configuration proposed for the new application.

3. Manufacturing/Fabrication methods and process have not changed and are certified

4. Previous environmental test conditions are greater than or equal to the environmental extremities and exposure durations required for the new application.

5. Previous functional/performance test results are greater than or equal to the accuracy, input-output, sensitivity, and other performance/operational characteristics required for the new application.

6. The previous test configuration is documented and is considered an adequate methodology/technology to provide test results for the new application.

7. Previous test equipment tolerances and data resolution are documented.

8. Inspection methods, inspection points, and acceptance test procedures are greater than or equal to the rigor of previous methodologies.

9. Previous operating environments, exposure duration, cycling, and usage are greater than or equal to the operations concept required for the new application.

10. Previous failures have been evaluated for impact to the validity of test and analysis data

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Application Of Previous Qualification Test Data	Document No. JSC-STD-8080.5	Standard No. G-12	Page 2 of 2
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REMARKS

Flight Certification of any item involves evaluation of verification data to determine if customer requirements have been met. When some of that data is already available from a prior flight certification program, and the appropriate technical evaluation determines that the data can be used to support a new certification program, it is cost effective to use existing data instead of performing additional testing. Previous failures and waivers must be reconsidered or resubmitted for approval by the authorizing organization. Environmental testing typically refers to vibration, thermal, thermal vacuum, radiation, loads, and electromagnetics.

G-13 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Classification of Flight and Non-Flight Equipment	Document No. JSC-STD-8080.5	Standard No. G-14	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

The status of flight equipment and nonflight equipment (equipment which is not suitable for use in flight but which could be accidentally substituted for flight articles) shall be identified and classified as follows:

CLASS I Equipment acceptable for flight use. Identification shall be in accordance with drawings and specifications.

CLASS II Equipment acceptable for use in ground tests or training in a hazardous environment. The nameplate or a label adjacent to the nameplate shall be conspicuously marked "CLASS II, CONTROLLED EQUIPMENT" with flight compatible material.

CLASS III Equipment acceptable for nonhazardous training or display purposes. This equipment shall be conspicuously identified by red (or orange) stripes alternating with a contrasting base color or painted solid red. Red paint no. 28913 as specified by Federal standard 595A is the preferred color. An alternative to the paint method of identification is a red (or orange) striped nameplate or label marked "CLASS III, NOT FOR FLIGHT" applied to the equipment. The identification shall be visible when the equipment is installed.

In addition, equipment not readily identifiable as nonflight equipment, as well as nonflight equipment hidden from view in a major module, shall have a red (or orange) serialized streamer attached to, or in the immediate vicinity of the installation. The streamer shall be of a size and material compatible with the environment under which it will be used. Streamers are to be traceable to the major module which identifies and controls the item. A record of nonflight equipment and, if appropriate, associated streamer serial numbers shall accompany each major module upon formal transfer (i.e., DD250/1149) from one organization to another.

Appropriate instructions shall be printed on each streamer. Streamers shall be numbered and accounted for prior to launch.

The color coding requirements of this standard do not apply to explosive devices.

REMARKS

Nonflight equipment or hardware must be identified to preclude possible use during a flight mission.

Hazardous environment is defined as a chamber environment (such as vacuum, high temperature, low temperature, and oxygen-rich atmosphere) or any other environmental condition that could subject the user of the equipment to a hazard of any kind.

Resolution of Flight Equipment Failures/Anomalies Prior to Launch	Document No. JSC-STD-8080.5	Standard No. G-15	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Where flight or flight-like equipment has failed or otherwise exhibited anomalous performance or intermittent operation, launch-to-orbit of identical or like equipment, either as part of the flight vehicle or as a replacement, shall not be permitted unless one of the following occurs:

1. It is verified that the basic deficiency which caused the failure or anomalous performance is not present in the flight equipment or its replacement.
2. The basic deficiency has been counteracted by changes in operational procedures to a degree that eliminates it as an unacceptable risk to the success of the mission or the safety of the crew.
3. The basic deficiency does not present an unacceptable risk to the success of the mission and safety of the crew.

Do not use equipment that exhibits or has exhibited intermittent malfunctions, failures, or anomalies for flight until the malfunction, failure, or anomaly has been corrected or resolved to the satisfaction of the Flight Readiness Review Board.

REMARKS

This standard supports the current philosophy that all failures or anomalous performance must be resolved before launch.

Where the cause of an inconsistency remains unresolved, equipment is unreliable.

Operational Limits On Temperature-Controlled Equipment	Document No. JSC-STD-8080.5	Standard No. G-16	Page 1 of 2
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

For spacecraft equipment where the operating temperature is normally controlled by heating or cooling equipment and the temperature is monitored in ground test and flight, the test program and/or appropriate analyses shall define the following:

1. The maximum and minimum temperatures expected in normal operations

2. The maximum and minimum temperatures (including duration and temperature rate of change, as appropriate) at which equipment may be expected to:

   a. Fail to meet specified performance until temperature is restored to normal range.

   b. Be permanently rendered inoperative.

For critical components, automatic safing with manual override only shall be used.

Information used to satisfy requirements 1 and 2 above shall be provided in operational constraints documentation.

REMARKS

Knowing the maximum and minimum operating limits of spacecraft equipment is essential for flight and mission management. This information needs to be readily available for real time decision-making.

Item #1:
This information is needed for equipment characterization and could be used for recognizing a thermal malfunction within the spacecraft equipment.

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Operational Limits On Temperature-Controlled Equipment	Document No. JSC-STD-8080.5	Standard No. G-16	Page 2 of 2
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REMARKS CONTINUED

Item #2
This information provides guidance to NASA in an unlikely, off-nominal mission scenario that normal operating temperatures may need to be exceeded due to malfunction(s) either external or internal to the equipment. In such a scenario it may become necessary to operate equipment beyond the qualification limits and mission manager's need to know how far the equipment can be pushed and reasonably expect that the equipment can be turned off and subsequently reactivated to support the safe return of the crew. The ultimate purpose of this information is to enable flight and mission management to make the best decisions possible in an off-nominal situation to maximize the probability of safely returning the crew.

Relevant information used to form the guidelines may include data or analysis from other program or manufacturer development (from DoD to COTS), data from operational programs due to unplanned thermal conditions, similar hardware data (document similarities and contrasts, e.g. non-screened parts data), sub-part data, bench testing that was not previously documented in reports, inadvertent test conditions, etc.

The desired outcome is a set of useful temperature and duration guidelines for the deliverable units at the lowest cost. Therefore, deriving the guidelines from the best available information is preferred and supplemental high-cost testing must be approved by the Program. Engineering judgment should also be applied and documented as appropriate in meeting this requirement.

Separate Stock For Spaceflight Parts And Materials	Document No. JSC-STD-8080.5	Standard No. G-17	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Assemblies, parts, and materials procured or designated specifically for use in space shall be:

- positively identified
- stored in controlled access areas
- physically separated from nonflight parts and materials to avoid mixing.

REMARKS

This standard is to prevent nonstandard, nonspaceflight, nonsegregated stock from being unintentionally used in space or in the fabrication of spaceflight equipment.

For purposes of this standard, the term "controlled access area" is defined as: stock areas or areas of rooms which are separated from nonflight stock areas or rooms by fences, walls, or other physical separations and which have access control to ensure the following:

1. Access by authorized personnel only

2. Proper parts and materials storage, maintenance, and withdrawal

3. Compliance with applicable quality assurance directives

Safety Precautions - Test And Operating Procedures	Document No. JSC-STD-8080.5	Standard No. G-18	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Procedures developed for testing and operating spaceflight equipment or ground support equipment shall clearly indicate any step which, if not correctly followed, would result in injury to personnel, damage to a system or equipment, or an environmental impact.

The cover sheet of the procedure shall indicate if the test or operation is hazardous.

REMARKS

A warning statement, preceded by the word WARNING in upper use letters, is commonly used to emphasize any instructions which, if not correctly followed, would result in injury to personnel, damage to a system or equipment, or an environmental impact. The statement usually indicates the reason for the warning.

Special Processes - Identification of Drawings	Document No. JSC-STD-8080.5	Standard No. G-19	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Manufacturing, assembly, or installation drawings for spacecraft, space flight equipment, experiments, and ground support equipment shall identify all special processes required to manufacture, assemble, and install the equipment.

Process specifications shall be referenced, or the processes shall be specified in detail on the respective drawings.

All referenced specifications not normally available shall be submitted upon request.

REMARKS

The requirements of this standard are in addition to other requirements of the drawing system used. The preferred method of documenting the special processes is to release separate process specifications and to make reference to the specifications on the drawings.

Examples of special processes are cleaning, potting, etching, wire splicing, soldering, welding, brazing, and bonding.

Spacecraft Equipment - Protection From Liquids During Ground Operations	Document No. JSC-STD-8080.5	Standard No. G-20	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Equipment sensitive to moisture and located where it is subject to liquid leaks during ground operations shall be identified in the design documentation. This documentation shall also include:

- The rationale for positioning the equipment in that location.
- A plan for implementing protection of this equipment.

REMARKS

Major damage to spacecraft and serious delay of programs can result from small, easily correctable leaks that would be of minor significance except for the effect of the leakage on exposed equipment. Experience has shown that fluid system leaks are particularly prevalent during initial ground testing of new spacecraft.

Sources of moisture and liquid leaks may include systems fluids, water condensation, fluid from GSE or facilities, and natural phenomena.

Protection from damage by leakage may include one or more of these methods:

1. Designing the equipment to be insensitive to the liquid leakage
2. Designing the plumbing or equipment containing the liquid to locate couplings, vents, service points, and other items where leakage from them could not reach the sensitive equipment
3. Providing ground support equipment or devices to protect the sensitive equipment from leakage during ground operation
4. Providing proper insulation to prevent condensate from forming and subsequently falling on the equipment

Spacecraft Equipment - Moisture Protection	Document No. JSC-STD-8080.5	Standard No. G-21	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Spacecraft equipment within a pressurized compartment shall be designed so that performance of the equipment will not be degraded by humidity or moisture droplets in the spacecraft atmosphere or by condensation of moisture from the spacecraft atmosphere.

REMARKS

DCN1

Product Identification and Traceability	Document No. JSC-STD-8080.5	Standard No. G-22	Page 1 of 2
	Previous Revision 2011_10	Current as of 2012_06	

STATEMENT OF STANDARD

1. Product shall be identified by suitable means throughout its lifecycle in accordance with customer and/or regulatory requirements.
2. Where traceability is a customer and/or regulatory requirement, the organization controls and records for the unique identification of the product shall be documented in accordance with JPR 1440.3.
3. For all JSC GFE for which JSC is the design authority, serial and/or lot numbers shall be provided by the Engineering Document Control Center (EDCC) per JPR 8500.3H. EDCC-controlled serial and lot numbers may be assigned to engineering drawings with non-JSC numbers only if the design authority and the configuration management of the design has been transferred to JSC.
4. Records shall be maintained to preclude duplication of serial or lot numbers. Reference JPR 8500.4 for policies defining allowable values for serial and lot number assignment for JSC GFE.
5. Requirements on GFE products for a serial and/or lot number shall be established per NASA-STD-0005.
6. The engineering drawing shall document the method of marking and desired location for part identification on GFE parts, if applicable, per JPR 8500.4.
7. The organization initiating the manufacturing or purchase request shall obtain serial and/or lot numbers from the EDCC and specify specific serial and/or lot numbers on manufacturing or purchase requests, but not on drawings.
8. For critical and complex GFE hardware, the following additional requirements shall be met:
   a) The design authority/hardware owner maintains the identification of the configuration of the product in order to identify any differences between the actual configuration and the agreed configuration.
   b) According to the level of traceability required, the design authority/ hardware owner provides for:

      (1) Identification to be maintained throughout the product life;

      (2) All of the products manufactured from the same batch of raw material or from the same manufacturing batch to be traced, as well as the destination (delivery and scrap) of all products of the same batch;

      (3) An assembly, the identity of its components, and those of the next higher assembly to be traced;

      (4) For a given product, a sequential record of its production (manufacture, assembly, inspection) to be retrievable.

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G-22 Parts Identification	Document No. JSC-STD-8080.5	Standard No. G-22	Page 2 of 2
	Previous Revision 2011_10	Current as of 2012_06	

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9. Parts used in flight hardware shall be identified by physical part marking or container marking per requirements defined on the applicable drawing.

10. Hardware drawings shall include identification processes necessary to control parts until installed in an assembly.

REMARKS

These requirements are intended to meet system engineering configuration management practices, the JSC quality system requirements (including ISO and AS9100), and FAR requirements.

Pressure Garment Wiring - Ignition Of Materials By Electrical Current	Document No. JSC-STD-8080.5	Standard No. G-23	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Electrical current entering a crew member's pressure garment shall be limited to a level that will not ignite or damage materials that would contact damaged wiring within the garment under the worst combination of short-circuit current and environment.

Energy storage or conversion devices capable of producing short-circuit current of a magnitude and discharge rate sufficient to ignite materials shall not be located inside pressure garments, unless:

1. adequate current limiting is provided, or
2. there is no contact between potentially damaged wires and the material in question

REMARKS

In this standard, "no contact" is defined as no electrically conductive path.

The fire hazard associated with inclusion of communications and bioinstrumentation wiring in the oxygen-rich environment of pressure garments necessitates the analysis and selection of suitable materials to minimize the potential flammability hazard. It is necessary to confirm the compatibility of the materials and electrical currents under failure conditions in the planned oxygen environment.

Current limiting may be required to assure values below the threshold level for ignition of materials caused by arcing or heating from high-resistance heat sources. An alternative to current limiting is strategic materials placement to ensure that flammable materials, that are demonstrated to ignite at the use conditions, are prevented from contacting potentially damaged electrical wiring or componentry.

Selection of materials with suitable flammability characteristics is constrained by other requirements, such as flexibility, bulk, weight, and comfort of the crew.

Protecting Flight Equipment From Support Equipment	Document No. JSC-STD-8080.5	Standard No. G-24	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Ground support equipment (GSE), airborne support equipment (ASE), facility equipment, or test equipment used in ground or flight operations shall be equipped with protective devices to preserve safe operation margins of the flight equipment.

REMARKS

GSE or ASE, as a result of misuse or malfunction, has the potential for causing irreparable damage to spacecraft flight systems if the GSE or ASE does not incorporate design features for protecting against such eventualities.

All GSE and ASE designs should be evaluated from the standpoints of inadvertent operator error and hardware (component) malfunction to ensure that protective features are adequate to safeguard spacecraft subsystems. Consideration should be given to the need for not only static overload protection (such as pressure relief, electrical fuses, etc.) but also protection from such elements as dynamic or transient conditions (e.g., electronic filters, accumulators) or contaminants (e.g., contaminant filters).

Thermal Design And Analysis	Document No. JSC-STD-8080.5	Standard No. G-25	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Hardware shall be designed to function in the full range of the thermal environment to which it will be exposed.

Thermal analyses shall be performed for nominal and worst-case conditions for all temperature-sensitive components and structures.

Worst hot and cold cases shall be analyzed using realistic combinations of thermal parameters which produce the worst-case conditions.

REMARKS

Example: A solar constant with 3 percent seasonal variation will be used. Other heat flux impacts, solar absorptances, emittances, conductances, etc. will be varied to include measurement uncertainties, variations in application of coatings, and degradation. Boundary temperatures and heater voltages will be varied over the ranges expected.

Thermal analysis includes both transient and steady state.

This standard incorporates SSP 30213 no. G-25.

<table>
<tr><td rowspan="2">Internally-Generated Radiation</td><td>Document No.
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</table>

STATEMENT OF STANDARD

Laser sources sufficiently powerful to be a hazard shall be positioned to preclude the possibility of looking directly at the source.

Sources emitting electromagnetic wavelengths between x-ray and visible light, sufficiently strong to pose a hazard, shall be positioned to preclude crew exposure or touch.

Hazard distance shall be marked.

REMARKS

Fire Control	Document No. JSC-STD-8080.5	Standard No. G-27	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

The primary means of fire control shall be the selection of materials that are nonflammable or nonpropagating in their use configuration. Materials flammability control is addressed in Standard M/P-1.

The capability for fire detection and suppression shall be provided.

The material used to extinguish fires shall be nontoxic to humans and shall be capable of being easily cleaned up after it is used.

REMARKS

Fire, particularly in a space vehicle, can be catastrophic. Special precautions are necessary, more so than on earth, because countermeasures must be self-contained within the space vehicle.

In microgravity conditions, fires that are not actively fed with oxygen will self-extinguish. One fire control strategy is to eliminate ventilation, remove electrical power, evacuate personnel, and allow the fire to self-extinguish.

Fire-resistant storage should be provided for hardware that is controlled for flammability by stowage when not in use.

Sealing - Solid Propellant Rocket Motors	Document No. JSC-STD-8080.5	Standard No. G-28	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

On completion of final inspection following manufacture, each solid propellant rocket motor shall be sealed and pressurized to prevent damage due to entry of moisture or foreign material.

The pressurant shall be dry N_2 gas.

The pressure applied shall be sufficient to ensure against entry of contaminants under any anticipated storage conditions.

The seal shall be designed to withstand internal pressure corresponding to the maximum anticipated storage temperature with an adequate safety factor or shall include a relief device.

The seal shall be installed such that it can be expelled during normal rocket ignition without damage to the nozzle. If no other provisions can be made to inspect the grain, access shall be provided through the seal.

REMARKS

The seal may contain provisions for relief of pressure, pressurizing, and pressure gauge installation as necessary.

Reentry Propulsion Subsystem In-Flight Test	Document No. JSC-STD-8080.5	Standard No. G-29	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Crewed spacecraft which use a separate propulsion subsystem for reentry attitude control shall include means for testing this subsystem before jettisoning the last of any other attitude control systems which could be used to position the spacecraft in a reentry attitude.

REMARKS

Control circuitry and attitude cues should be developed to enable the crew to test the reentry propulsion subsystem of the reentry module before abandoning an operating attitude control subsystem.

This standard is not applicable for spacecraft without a separate propulsion subsystem for reentry attitude control. For such cases, refer to the following document and sections:

NPR 8705.2 Human-Rating Requirements and Guidelines for Space Flight Systems w/Change 2 (6/25/04) [Effective Date: June 19, 2003, Expiration Date: June 19, 2008]:

1. Preface, Applicability, p.2.
2. Section 2.5.3 Failure Tolerance and Reliability:
    a. Subsections 2.5.3.1
    b. Subsection 2.5.4.4

This standard does not preclude the need for redundant reentry attitude control systems.

G-30 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Detachable Crew-Operated Actuating Tools	Document No. JSC-STD-8080.5	Standard No. G-31	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Where possible, actuating devices shall be made an integral part of the equipment to be operated.

Detachable actuating tools, such as handles, pins, and ratchets, shall not be permitted in applications where tool nonavailability could compromise crew safety or primary mission objectives.

Where tools are allowed for system controls, provisions shall be made whereby the position of the control is readily apparent to the responsible crew member without the tool in place.

REMARKS

Detachable tools are generally undesirable for all applications in the crew compartment under zero-gravity conditions, but such devices may be used if a significant advantage in operation, weight reduction, or volume reduction is assured and if their application does not conflict with the constraints outlined above.

Standards G-32 – G-36 have been cancelled.

See Appendix B for standard text and rationale for cancellation.

Verification Of External Visibility	Document No. JSC-STD-8080.5	Standard No. G-37	Page 1 of 2
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Visibility verification for crewed spacecraft shall include tests, simulations, or analyses to verify visibility during all anticipated phases and environmental conditions of the planned mission and contingencies.

Simulations shall include mockups or high-fidelity computer simulation to ensure the view (picture) seen by the crew during each phase of the simulated mission will be comparable to that which will be seen in flight.

REMARKS

Whenever possible, visibility verification tests should incorporate actual flight hardware.

The external visibility may be provided using windows, external cameras, or alternative capability.

During previous crewed spaceflight missions, visibility problems have occurred. Deposits have covered windows. Visibility has been restricted by parts of the spacecraft during certain mission phases. Light gathering properties of some optical instruments have not been satisfactory. Reflections and parallax have caused difficulty. Moisture has condensed between inner and outer panes of windows. Fingerprints and smear marks have compromised optical surfaces.

Factors affecting satisfactory visibility include but are not limited to:

1. Visibility and field-of-view requirements during each phase of the intended mission and for all anticipated contingencies.

2. Protection or preventive measures to avoid unsatisfactory degradation of visibility due to buildup of solid or liquid deposits on all window surfaces, viewing ports, or other optical devices.

Conitued on next page

Verification Of External Visibility	Document No. JSC-STD-8080.5	Standard No. G-37	Page 2 of 2
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REMARKS – CONTINUED

3. Scene displays that will be required for simulators and training to ensure satisfactory crew training.

4. Internal and external lighting conditions during the mission.

5. Parallax.

6. Possible angular reflections, particularly from rays of the sun.

7. Optical surface coatings and treatments used to control optical properties and the sensitivity of the treated surfaces to human contact and environmental exposure.

8. Thermal and vacuum conditions to which the viewing device will be subjected.

9. Obstruction of critical view by parts of the spacecraft itself.

NASA-STD-3000, Volume 1 "Man-systems Integration Standards", contains a discussion of design considerations on the following subjects: vision (i.e., space travel effects on), window integration (i.e., placement and location), and windows.

High fidelity computer simulation capabilities may enable alternative methods for verifying visibility rather than using mockups. The computer simulations are flexible for trying out multiple window/camera configurations, whereas mockups are less flexible.

Pressurization Or Repressurization - Preventing Ingress Of Undesirable Elements	Document No. JSC-STD-8080.5	Standard No. G-38	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

In the design of pressurization, repressurization, and ventilation systems for habitable areas, provisions shall be made to prevent ingress of undesirable elements.

This standard applies to spacecraft which have habitable areas pressurized at less than atmospheric pressure during normal mission and which must enter the earth's atmosphere or other atmospheres with pressures different from the spacecraft's normal operational pressure for habitable areas.

REMARKS

During atmospheric entry and landing, undesirable elements such as vented propellants, heat shield fumes, and water may be ingested into habitable areas unless design or procedural precautions are taken.

This standard in not intended to apply to airlock ingress and egress pressurization and depressurization procedures.

Lightning Protection Design	Document No. JSC-STD-8080.5	Standard No. G-39	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Lightning protection shall be designed into spacecraft which will operate in Earth's atmosphere such that, in the event of a lightning strike, flight hardware will not be damaged or affected to the extent that mission success, crew, or ground personnel safety is compromised.

Verification of adequate protection shall be accomplished using both test and analysis based on technical detail contained in:

- SAE ARP 5412 (Rev baseline, 11/01/99) ARP5412 : Aircraft Lightning Environment and Related Test Waveforms
- SAE ARP 5413 (Rev baseline, 11/01/99) ARP5413 : Certification of Aircraft Electrical/Electronic Systems for the Indirect Effects of Lightning
- SAE ARP 5414 (Rev baseline, 12/01/99) ARP5414 : Aircraft Lightning Zoning
- SAE ARP 5415 (Rev A, 05/01/02) ARP5415 : Users Manual for Certification of Aircraft Electrical/Electronic Systems for the Indirect Effects of Lighting
- SAE ARP 5577 (Rev baseline, 09/01/02) ARP5577 : Aircraft Lightning Direct Effects Certification

REMARKS

This standard has not been evaluated for its applicability to other atmospheres.

Radioactive Luminescent Devices	Document No. JSC-STD-8080.5	Standard No. G-40	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

When radioactive material is to be used, such as radioactive luminescent devices, the following requirements shall be met:

1. Each proposed use of radioactive material shall be approved by the JSC Radiation Safety Committee.

2. A minimum amount of radioactive material shall be used consistent with the requirements.

3. Radioactive materials shall be completely sealed or encapsulated in substances having low damage potential from the inherent radiation.

4. Installation within or on the vehicle shall be such that it is unlikely that the seal of the radioactive material will be damaged because of ground or space environment, accidents, or mishandling. Installation in the habitable volume of a manned vehicle and/or in a location for potential contact with any crew member during extravehicular activity (EVA), intravehicular activity (IVA), ingress, or egress shall be protected against damage to eliminate the possibility of particle ingestion, inhalation, and/or skin contact by the crew.

5. The component bearing the radioactive substance shall be designed for replacement with no damage to the seal of the radioactive substance.

REMARKS

6. Each item containing radioactive material shall be permanently marked in a manner approved by the JSC Radiation Safety Committee.

A byproduct material license issued by the U.S. Nuclear Regulatory Commission authorizes JSC to use radioactive components on spacecraft. This license, issued pursuant to Title 10, Code of Federal Regulations, requires that each use of radioactive material be reviewed and approved by the JSC Radiation Safety Committee for compliance with NASA and JSC health and safety issuances, the Code of Federal Regulations, and other applicable statutes.

The type and degree of protection referred to in paragraph 4 will be dependent upon the amount of luminescent material and the design and location of the device

Standards G-41 – G-43 have been cancelled.

See Appendix B for standard text and rationale for cancellation.

Attitude Control Authority	Document No. JSC-STD-8080.5	Standard No. G-44	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Spacecraft automatic attitude control circuitry shall be designed so that the crew can assume manual attitude control at all times.

REMARKS

This revision increases the scope of the standard to require capability for manual takeover of the automatic attitude control circuitry during all phases of the mission.

Solid Propellant Rocket Motors	Document No. JSC-STD-8080.5	Standard No. G-45	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Solid propellant rocket motors shall be designed with the capability to ignite without a seal, or with a nozzle seal failure, up to the highest altitude and maximum elapsed time at which ignition is required.

REMARKS

Nozzle covers (seals) are required to protect the grain from the environments but the motor should be capable of being lit when necessary even in the event of a seal failure.

REFERENCES:

JSC Design and Procedural Standard G-28, Sealing - Solid Propellant Rocket Motors.

Separation Sensing System – Structural Deformation	Document No. JSC-STD-8080.5	Standard No. G-46	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Separation sensing systems designed to detect separation of stages or modules of space vehicles shall not inadvertently actuate separation sensors due to structural deformations or vibrations less severe than those associated with the structural failure of the vehicle.

Separation sensing systems that are designed to initiate subsequent steps in a sequence of events shall be designed so that the failure or actuation of a single sensor will not initiate the sequence of events.

Separation sensing systems shall be designed not to initiate a sequence of events unrelated to space vehicle separation.

REMARKS

Separation sensors have erroneously given signals of spacecraft module separation because of structural deformation. On an uncrewed flight, high aerodynamic and vibrational loads caused structural deformation that resulted in an inadvertent firing of the launch escape tower.

Structural deformation must be considered during the installation design to locate separation sensors where relative motion of the structural elements is not excessive and where inspection of the sensor can be accomplished. The sensors should be selected to require actuation travel substantially greater than the maximum deformation anticipated between the structural elements at the point of installation.

Gyroscopes - Verification Of Operational Status	Document No. JSC-STD-8080.5	Standard No. G-47	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Guidance, Navigation and Control subsystems utilizing gyroscopes shall provide continuous outputs during operation to verify that gyroscopes are operating within specified limits.

Gyroscopes shall be capable of providing operational readiness status prior to use.

Failures shall be detected within a timeframe that allows for corrective action prior to negative consequences resulting from the failure.

REMARKS

Optimum spacecraft operation and safety are dependent upon properly functioning gyroscopes. Failure detection and redundancy is desirable to mitigate the effects of gyroscope failures or off nominal operation.

Onboard Experiments – Required Preinstallation Checklist	Document No. JSC-STD-8080.5	Standard No. G-48	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Furnish analytical proof or conduct tests to demonstrate that proposed onboard experiments shall not impair the safety or effectiveness of the astronaut or jeopardize the functioning of spacecraft equipment under worst case conditions.

Examples include:

Releasing solids, liquids, or gases.

Producing temperature extremes or releasing thermal or ionizing radiation.

Emitting electromagnetic radiation.

Degrading external and internal visibility.

Degrading internal auditory environment.

Impeding crew ingress and egress.

Jeopardizing the integrity of the spacesuit.

Interfering with the operation of EVA or IVA controls.

Jeopardizing the integrity of the spacecraft power system by transients or short circuits.

Producing damage as a result of cabin decompression or recompression at maximum possible rate.

Producing damage through loss of structural integrity during any spacecraft operation including land or water landings at maximum design conditions.

Producing damage as a result of stored energy release.

REMARKS

Instances have occurred where materials that were prohibited from use in the spacecraft environment were planned for experimental use.

G-49 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Direct Procurement of Parts	Document No. JSC-STD-8080.5	Standard No. G-50	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

The initiator of purchase requests and other applicable procurement documents for parts used in a spacecraft, space flight equipment, experiments, and ground support equipment shall specify on the procurement document that procurement must be made directly from the manufacturer or from distributors who can furnish certification of the following conditions:

1. The item was actually produced or assembled by the designated manufacturer.
2. The item conforms to the manufacturer's current standards of performance and quality for items of the specified designation.
3. The distributor can furnish any traceability records or documentation required by the PR for materials control, process control, and limited life tracking. Traceability requires a configuration control system that includes drawing version control, fabrication records, and hardware serialization or lot tracking.

REMARKS

There have been cases of procurement of obsolete, out of tolerance, and improperly stored parts when lot control and serialization were not specified.

Flight Hardware - Restriction On Use For Training	Document No. JSC-STD-8080.5	Standard No. G-51	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Hardware and equipment that is scheduled as primary or spare equipment for flight shall not be used for training, unless all of the following conditions are met:

1. Training use is strictly limited to the prime and backup flight crews or a designated delegate.

2. Adequate crew familiarity with the characteristics of the actual flight equipment cannot be obtained from fabrication and use of flight-like training hardware or training models.

3. A record of all training use is documented per controlled hardware documentation requirements.

4. The equipment will subsequently be subjected to inspection and preinstallation acceptance tests prior to flight.

5. After such training use, the life remaining on all limited-life items will be adequate for completion of the mission.

REMARKS

October 2004 text modified to address crew availability during long-duration missions such as the International Space Station or exploration missions and hardware obtained specifically for training purposes.

Reuse of Flight Equipment	Document No. JSC-STD-8080.5	Standard No. G-52	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

Flight equipment that has been previously used in flight may be reused in crewed flight if the following minimum conditions have been met:

1. Appropriate refurbishment, inspection, and testing have been accomplished between flights.

2. Any elements not replaced will be within all shelf-life limits, operational time or cycle life limits, and environmental (e.g., vibration) life limits at the end of the mission.

3. No evidence exists that the unit has been stressed beyond specification limits during previous use.

REMARKS

Reverification	Document No. JSC-STD-8080.5	Standard No. G-53	Page 1 of 2
	Previous Revision 01/14/1991	Current as of 08 March 2005	

STATEMENT OF STANDARD

After successful completion of some or all of the verification program, changes may occur that dictate the need for reverification assessment. Such changes may include changes in design configuration, material, manufacturing or procurement sources, operating environments, etc. Baseline characterization data such as chemical and physical properties of materials including fluids as well as impurity composition and levels shall be collected during initial qualification such that any follow-on changes may be assessed relative to possible or anticipated impacts to equipment performance. When such changes as those identified below occur, a reverification assessment shall be performed to determine the need to repeat previously completed verification activities.

Qualification Reverification: If changes occur in any of the following, an assessment to determine the need to repeat any or all of previously completed qualification activities shall be performed and documented:

1. Design configuration or manufacturing process changes (e.g., bonding, soldering, welding, installation torques of fasteners, etc.)
2. Changes in fluids or lubricants; either in their specifications; procurement source, processing; transportation, or storage, or handling conditions.
3. Changes in materials or parts; either in their specifications; procurement source; manufacturer; or processing.
4. Changes to equipment, part, fluid, or lubricant manufacturer or manufacturing facility.
5. Inspection, test, mission change, or other data indicates that a more severe environment or operating condition exists than that to which the equipment was originally qualified.
6. Changes to flight software coding or capability.

When repeat of some or all of previously completed qualification activities is conducted due to such changes, a reverification report shall be written to formally document the reason for the reverification, justification for the degree of reverification performed, and the results of the reverification activity.

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</table>

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Acceptance reverification: If changes occur in any of the following, an assessment to determine the need to repeat any or all of previously completed acceptance activities shall be performed and documented:

1. Any change consistent with the above changes identified for qualification reverification.
2. A previously mated and verified interface has been demated.
3. Any modification, repair, replacement, or rework occurs on the equipment.
4. The equipment is subject to drift or degradation during transportation, storage, or handling.

REMARKS

This standard replaces information previously covered for qualification fluids in F-23 (1991).

<table>
<tr><td rowspan="2">Automatic Shutdown Of Launch Vehicle Engine(S)</td><td>Document No.
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</table>

STATEMENT OF STANDARD

Automatic shutdown of launch vehicle engine(s) procedures/design shall maximize crew survival probability as part of the overall system.

The integrated system design shall incorporate:

- Shutdown commands initiated by engine controller(s).
- Shutdown commands initiated by the crew.
- Shutdown commands initiated by ground personnel.
- Crew escape capability from the vehicle on the pad.
- Launch abort/escape system capability while on the pad.
- Launch abort/escape system capability while in flight.
- Specific plans for non-catastrophic, imminently-catastrophic, and other engine failure mode categories.
- Early engine-out capability of the launch vehicle.
- Handling of multiple engine shutdown requests.
- Avoidance of catastrophic impact with ground or tower for loss of an engine(s).

REMARKS

Prior to structural separation from the pad (or free-standing liftoff), it is never too late to shut the engine(s) down and abort the mission. Once structural separation has occurred, the vehicle is essentially in flight, and a pad abort is generally considered unavailable.

Unless it can be demonstrated that shutting an engine down prior to T-0 umbilical separation, but after structural separation, will cause a trajectory transient that will result in the loss of vehicle, the engine should be allowed to shut down. If an engine is violating a redline shutdown limit, there are risks associated with running that engine. If it wants to shut down to avoid a catastrophic failure we should allow it to do so.

An example failure that drives an integrated system design solution is if an engine exhibits an imminently-catastrophic failure mode just after liftoff, but shutting down the engine will result in earth or tower impact. In such an instance vehicle destruction cannot be avoided. However, the option (shutdown or not) that provides the crew more time for launch escape than the alternative option is the preferred choice.

2.2 ELECTRICAL

Mating Provisions for Electrical Connectors	Document No.	Standard No.	Page
	JSC-STD-8080.5	E-1	1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

1. Electrical connectors, plugs, and receptacles which otherwise could be incorrectly mated shall be designed to prevent incorrect connection with other accessible connectors, plugs, or receptacles.

The selection of the technique used shall be at the highest level of precedence in the following order:

a. Use of constraints built into a cable or harness that locate similar connectors so they cannot be interchanged.
b. Selection of different sizes or types of connectors to be located adjacent to each other.
c. Selection of alternative polarization (alternative keying) of adjacent, similar connectors only if this requirement cannot be met with either method a or b above.

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

3. Ground connectors shall comply when they mate with flight connectors.

REMARKS

NASA-STD-3000 addresses mating provisions and use of constraints built into a cable or harness that locate similar connectors so they cannot be interchanged (paragraph 11.10.3.5, "Connector Identification / Alignment Design Requirements").

Protection Of Severed Electrical Circuits	Document No. JSC-STD-8080.5	Standard No. E-2	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Electrical circuits which are to be severed in the normal course of mission events (e.g., vehicle separation) shall be protected against short circuiting or compromising other circuits during the remaining phases of the mission by deadfacing to remove all voltages.

REMARKS

For purposes of this standard, the term severed is defined as permanently separated by cutting conductors using guillotine devices. This standard does not address connector mate/demate using spring- or pyro-assisted mechanisms. Even small voltages could short and inadvertently power or ground the logic or control wiring resulting in adverse effects.

Spring-loaded separators may be used to physically separate bare ends of the individual wires in the cable after severing.

Electrical And Electronic Devices Protection From Reverse Polarity And/Or Other Improper Electrical Inputs	Document No. JSC-STD-8080.5	Standard No. E-3	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Electrical and electronic devices shall incorporate protection against improper electrical inputs during qualification, acceptance, and checkout tests if such inputs could damage the devices.

If it is impractical to incorporate adequate protection as a part of the device, protection shall be provided externally by the test equipment.

REMARKS

Damage of an incipient nature may remain undetected and later cause equipment failure in flight.

Examples of protective devices covered by this standard are diodes, capacitors, resistors, chokes, filters, etc., or combinations of devices included to protect electronic elements from such occurrences as unwanted transients, current reversals, short circuits, signal couplings, or wide deviations from desired operating conditions.

For verification and testing of protective devices, refer to standard E-16.

Electrical Connectors - Moisture Protection	Document No. JSC-STD-8080.5	Standard No. E-4	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Electrical connectors and wiring junctions to connectors shall be protected from moisture by methods which are demonstrated by test or analysis to provide adequate protection to prevent open and short circuits or a harmful unintended conductive current path. Shrink boots are not acceptable as moisture barriers.

Both external to and within the crew compartment, electronic and electrical equipment which is not hermetically sealed or otherwise positively protected against moisture shall not be cooled below the dew point of the surrounding atmosphere.

This requirement shall include test conditions (except for environmental qualification test articles) and all operating conditions, including flight, wherein condensation of moisture can occur either during equipment operation before equipment is brought up to operating temperature or after equipment is shut down.

REMARKS

The required composition and quality of the seal are dependent upon the environments to which the seal will be subjected. Examples include but are not limited to:

1. Rain, condensation, and other fluid environments on the launch pad
2. Condensation of cabin moisture during flight
3. Electrolytic corrosion
4. Manufacturing and storage environment

Electrical Connectors - Pin Assignment	Document No. JSC-STD-8080.5	Standard No. E-5	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Electrical circuits shall not be routed through adjacent pins of an electrical connector if a short circuit between them would constitute a single failure that would:

- • cause injury to the crew or
- • cause loss or degradation of a critical system.

REMARKS

In this standard, "adjacent" includes pins within reach of a bent pin.

Corona Suppression	Document No. JSC-STD-8080.5	Standard No. E-6	Page 1 of 2
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Electrical and electronic systems and components susceptible to corona as dictated by the Paschen Curve shall be designed such that detrimental corona discharge will not occur under any operating conditions.

Where adverse corona effects are avoided by pressurizing or evacuating a component, the seals shall be capable of maintaining the required internal pressure throughout the intended mission. Pressure maintenance may be considered in lieu of seal demonstration.

Where corona effects are avoided by conformal coating and/or encapsulate, methods shall be provided to verify that conformal coating / encapsulate is free from trapped gases, voids, or fractures.

Where adverse corona effects are avoided in unsealed components by restricting operation to space vacuum conditions the ability of the equipment to reach the required vacuum in the planned time shall be demonstrated by test or analysis.

Components protected by potting, conformal coating, or by corona prevention design shall be tested to demonstrate no detrimental effects from corona or partial discharge. Tests shall be conducted under service conditions of worst-case voltage, over the full operational range of pressure and environment. Testing shall be done on energized sub-assemblies, lowest replaceable units, as well as cable runs, bus bars, and enclosures.

Corona testing shall be part of the component selection and component qualification process.

Test(s) or analysis shall be performed to demonstrate that the systems and components will remain protected for the intended length of the mission.

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REMARKS

"Corona" is defined as an electrical discharge caused by ionization of gas in the vicinity of a conductor.

Ionization can occur on the surface of an insulated or uninsulated conductor as well as in voids and cracks within insulation.

Corona may be generally avoided or eliminated by lowering potential differences, increasing the gap or length of the current path between points of difference potential, increasing or decreasing the ambient gas pressure, or lowering the voltage stresses in gas spaces by selecting insulations with low dielectric constants.

Outgassing or inadequate venting can cause internal pressures to remain unsafe for some time after ambient pressures have reached safe values.

The possibility for corona near exposed conductors at voltage will be increased if local pressures are enhanced by nearby thruster operations, dumps, etc., particularly when extensive (e.g., reboost).

Corona prevention design techniques, such as the avoidance of sharp points and bends or the use of corona balls, should be employed.

Information on the Paschen Curve can be found in MSFC-STD-531.

Problem Electrical Components - Restrictions On Use	Document No. JSC-STD-8080.5	Standard No. E-7	Page 1 of 4
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STATEMENT OF STANDARD

In the construction of spaceflight hardware, the following parts shall not be used in the applications specified. These part types and applications have known failure mechanisms which make them a reliability risk:

1. Silver cased wet slug Tantalum capacitors (CLR65).
2. Any non hermetically-sealed part that contains a fluid, such as an Aluminum electrolytic capacitor, used in a vacuum environment.
3. Solid Tantalum capacitors used in a low impedance application of less than 1 Ohm/Volt unless each part has been surge current tested to the test procedure defined in MIL-PRF-39003/10B.
4. Sealed parts with internal voltages greater than 200 Volts that are used in a vacuum environment and have a maximum leak rate which will allow the internal cavity pressure to reach 50 Torr over the part's mission life.
5. Parts with internal or external plating of greater than 97% Tin, unless a Program-approved mitigation plan is implemented.
6. Use of cartridge style fuses (example is FM08 & FM09) in a vacuum environment with greater than 50 Volts DC applied.
7. Switches, relays, bimetallic thermostats and other mechanical contact devices:
   a. Used in a voltage application for which they were not specifically qualified and proven.

   b. With higher rated contacts used in a low voltage or current application unless specifically recommended by the device manufacturer.

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REMARKS

Remarks section below corresponds to each numbered part of this standard.

1. Silver-cased Tantalum capacitors are susceptible to internal dendrite growth between the Silver case and the tantalum anode when the capacitor is subjected to any negative voltage. This potential problem is eliminated by using a hermetic Tantalum cased (MIL-PRF-39006) capacitor instead.

2. Environmentally sealed parts that contain a gas, fluid, or gel should not be used in a vacuum environment. In the case of a non-hermetic wet capacitor the parts will begin to outgas and eventually begin overheating leading to accelerated outgassing and eventual failure.

3. Solid Tantalum capacitors have self-healing capability when they short if their circuit application provides 1 Ohm/Volt series impedance.

4. All hermetic devices have a definitive leak rate. Given enough exposure time in a vacuum environment a small cavity device will leak down below the critical pressure level of 50 Torr. If a part has 190 Volts or greater applied internally then a destructive corona event is very probable. (See MSFC-STD-531 for more detail)

5. High purity Tin plating propagates the growth of conductive Tin (Sn) whiskers that can lead to shorting and generation of conductive foreign object debris. (See JSC 49894, paragraph 2.12). Legislation passed by a number of countries in the world restricts the use of Lead (Pb) in electronic manufacturing processes. To comply with these laws electronic component manufacturers are removing Lead from the plating of their components. Although space, military, and certain industrial applications have been granted exceptions to compliance with these directives, the small market presence of these industries does not allow for much influence on component manufacturers. As a result, the vast majority of components will soon be available with only pure Tin plating. Soldering processes used with Tin/Lead solder do not fully mitigate the Tin plating issue because the entire termination is not covered during those soldering processes. The very small termination spacing on many current components further increases risk. Conformal coating reduces the risk of Tin whiskers migrating to other areas, but these whiskers can grow under or through it - possibly to adjacent terminations on the components. Replating terminations with Tin/Lead solder is a viable option if done by a qualified vendor who controls the thermal shock to the component.

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REMARKS

Additional caveats associated with Lead-free manufacturing processes:

a. Lead-free solder compounds generally require higher reflow process temperature profiles than standard Tin/Lead solder. This adds additional stress to components, which may be damaged by these reflow temperatures.

b. Alternative solders are also more brittle than Tin/Lead alloys. This may adversely affect product shock, vibration, or temperature cycle endurance.

(1) In a vacuum environment, a cartridge style fuse will leak because of its poor hermetic seal. If the internal fuse pressure falls between 50 Torr and 10^{-3} Torr during the same period that a circuit overload requires the fuse to open, testing has shown that 50 Volts or greater across the fuse element can initiate a plasma arc between the poles of the fuse. The arc may propagate, consuming the fuse and attached conductors, until the arc's working distance is exceeded or the upstream circuit protection is enabled. (See JSC 49894, paragraph 2.5)

(2) Explanation: (See JSC 49894, paragraph 2.3)

(a) High voltage DC switches require a special design to assure reliability that includes a very fast snap-action contact movement and an arc suppression mechanism to immediately quench the contact-to-contact current flow. (An example of misapplication occurs when a 250 volt AC switch is used in a 120 Volt DC application.)

(b) Switch manufacturers often give maximum contact ratings but are silent on minimum ratings. It is often mistakenly thought that if a switch is rated for 5 amps it will work for a low current application (the bigger is better; mentally). Manufacturers use special contact materials for various current and voltage configurations. Gold plated contacts are typically used in low current (dry) and/or voltage applications

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6. In a vacuum environment a cartridge style fuse will leak because of its poor hermetic seal. If the internal fuse pressure falls between 50 torr and 10-3 torr during the same period that a circuit overload requires the fuse to open, testing has shown that 50 volts or greater across the fuse element can initiate a plasma arc between the poles of the fuse. The arc may propagate, consuming the fuse and attached conductors, until the arc's distance is exceeded or the upstream circuit protection is enabled.

7. Explanation for mechanical contact devices:

a. High voltage DC switches require a special design to assure reliability that includes a very fast snap-action contact movement and an arc suppression mechanism to immediately quench the contact-to-contact current flow. Qualification can be by the manufacturer or NASA. (An example of an inappropriate selection: 250 volt AC switch used in a 120 volt DC application)

1.

b. Switch manufacturers often give maximum contact ratings but are silent on minimum ratings. It is often mistakenly thought that if a switch is rated for 5 amps it will work for a low current application (the bigger is better mentality). Manufacturers use special contact materials for various current and voltage configurations. Gold plated contacts are typically used in low current and/or voltage applications.

Electrical / Electronic Supplies And Loads – Verification Tests	Document No. JSC-STD-8080.5	Standard No. E--8	Page 1 of 1
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STATEMENT OF STANDARD

Ground support equipment, facilities, and other equipment to be connected to a spacecraft system for operation, testing, checkout, or maintenance shall be designed so that routine verification tests can be conducted before each connection is made to ensure that each electrical and electronic input to the spacecraft is compatible with the spacecraft system.

Verifications test procedures shall be provided with the equipment.

REMARKS

Instances have occurred where spacecraft has sustained damage by inputs from equipment that was not checked and verified to be within acceptable limits before it was connected to spacecraft systems.

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STATEMENT OF STANDARD

Spacecraft electrical systems 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.

Unless connectors are specifically designed and approved for mating or demating in the existing environment under the loads being carried, they shall not be mated or demated until voltages have been removed from the powered side(s) of the connector.

If the circuit breakers and switches normally provided in the power distribution system of the spacecraft do not provide a satisfactory means of complying with the intent of this standard in all planned flight and ground test operations, additional circuit interruption capability shall be provided as required.

REMARKS

Consideration in the design must be given to address the proper controls/inhibits in design features to avoid critical (two inhibits) and catastrophic (three inhibits) hazards (i.e., crew mate/demate of connectors for shock, molten metal & explosive environment hazards). Reference: Space Shuttle Program Memorandum, MA2-99-170 - Crew mating/demating of powered connectors.

Cleaning Of Electrical And Electronic Equipment	Document No. JSC-STD-8080.5	Standard No. E-10	Page 1 of 1
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STATEMENT OF STANDARD

No method of cleaning electrical or electronic equipment shall be used unless it has been established that the method will not cause damage to, reduce the reliability of, or degrade the performance of any component or assembly being cleaned.

REMARKS

Typical cleaning processes include, but are not limited to, ultrasonic, chemical, electrochemical, aqueous-, and solvent-based cleaning systems.

Protective Covers Or Caps For Electrical Receptacles And Plug	Document No. JSC-STD-8080.5	Standard No. E-11	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Electrical plugs and receptacles of flight equipment and ground equipment that connects with flight equipment shall be protected at all times.

Protective covers or caps shall be placed over electrical plugs and receptacles whenever they are not connected to the mating part. The protective covers or caps shall have the following characteristics:

1. Provide protection from moisture for the plugs and receptacles
2. Provide protection against damage to sealing surfaces, threads, and pins
3. Be made of conductive or dissipative materials that provide electrostatic discharge protection of components
4. Be resistant to abrasion, chipping, or flaking
5. Be positively marked by bright colors or streamers if they are to be removed prior to launch
6. Be maintained at a level of cleanliness equivalent to the plugs or receptacles on which they are used
7. Be made of material that is compatible with the connector material
8. Be provided with restraining devices or suitable storage areas if required for on-orbit activities. Pressure-sensitive tape shall not be used to satisfy this requirement.

REMARKS

Receptacles and plugs require restraining protection from mechanical damage, dust, dirt, and foreign objects. Incorrect practice has been to allow the disconnected parts to go unprotected.

Electrical Connectors - Disconnection For Trouble-Shooting And Bench Testing	Document No. JSC-STD-8080.5	Standard No. E-12	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Test equipment shall not be connected to spacecraft or spaceflight equipment circuits by insertion of meter probes directly into electrical connector sockets, by holding meter probes against connector pins, or by attachment of alligator clips to connector pins.

The appropriate mating connectors shall be used to minimize wear on spaceflight equipment connectors.

Connector savers and jumper cables with mating connectors may be installed and remain on the spaceflight equipment for bench tests up to the time of installation in the spacecraft.

Approved breakout boxes may also be used.

REMARKS

Shorting springs or shorting clips shall not be used in electrical or electronic connectors.

Insertion of meter probes in connector sockets and connection of alligator clips to connector pins can cause damage to these components.

Shorting springs or shorting clips are jumper wires that can be snapped or sprung into place to short connector pins to other connector pins. When installed, they do not form a reliable low impedance bond. Since spring tension or compression is all that holds them in place, mating and demating of connectors can result in breakage of the spring or clip, intermittent contact points, and resistance buildup in the circuit due to contaminants.

Test equipment with nonconducting probes (e.g., hall probes or proximity probes) may be used.

Bioinstrumentation Systems - Crew Electrical Shock Protection Standard	Document No. JSC-STD-8080.5	Standard No. E-13	Page 1 of 1
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STATEMENT OF STANDARD

To limit electrical current that could flow through an instrumented crew member as a result of contact with available voltage sources to a safe level, bioinstrumentation systems shall be designed with sufficient resistance in series with each body electrode or conductive surface.

Examples of voltage sources include, but are not limited to, sources in crew bays, power cords, batteries, and extravehicular activity umbilicals.

REMARKS

This standard is in accordance with the international standard set forth by the IEC 60601, Second Edition.

Serious electrical shock currents can accidentally flow through a crew member instrumented with electrodes that are connected through a low impedance to power ground / power return. If contact is made with a voltage source having the same ground as the bioinstrumentation system, electrical shock may occur. The shock currents include those caused by unequal ground potentials in multiple-instrument systems.

Safety considerations must therefore be given a high priority in the design of bioinstrumentation systems. Adequate protection from electrical shock hazards to the instrumented person involves consideration of the total environment. Bioinstrumentation may be reliable and safe when used alone but may electrocute the person when used in combination with other instruments or equipment that is defective or marginal. The serious electrical shock hazard can be eliminated by adequately isolating the bioinstrumentation system from ground.

The maximum safe shock current levels for direct current (dc) and alternating current (ac) currents up to 1000 Hz are defined as 1.0 uA applied internally and 100 uA applied externally to the body.

Bioinstrumentation may be isolated from other power sources by the use of a photo-optical system or other suitable isolation method.

<table>
<tr><td rowspan="2">Electrical Wire Harnesses - Acceptance Testing</td><td>Document No. JSC-STD-8080.5</td><td>Standard No. E-14</td><td>Page 1 of 1</td></tr>
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STATEMENT OF STANDARD

As a minimum, testing shall be performed on flight electrical wire harnesses prior to flight as defined in NASA-STD-8739.4, "Crimping, Interconnecting Cables Harness, and Wiring", paragraph 18.2 Testing:

1. Following fabrication and prior to installation
2. Post installation but prior to connection or reconnection to spacecraft components or devices
3. Prior to each flight for nonpermanently installed cables

Prior to performing dielectric withstanding testing, the dielectric strength of all connectors, wire, components, or devices attached to the harness shall be verified to be greater than the applied test voltage. The test voltage level shall be adjusted to prevent damage to the lowest rated item in the cable.

The individual leakage current readings shall be read and recorded for each test performed. Measurement shall have resolution to the nano (10-9) range. The data shall be maintained and available for comparison as long as the subject cable is in service.

Initial and periodic testing for shorting and dielectric failures shall be performed on ground support cables that interface with flight hardware using the test criteria described above.

Any trend in dielectric strength degradation / fluctuation greater than one order of magnitude shall be evaluated to determine the cause and worst case effect.

REMARKS

Knowledge of an "out of family" reading that could indicate an impending dielectric problem can often be found in the documentation of all test measurements. Retention of the test data enables long-term trending that can provide insight into a potential insulation breakdown.

The use of subminiature connectors has lead to dielectric breakdown failures during dielectric withstanding testing because the dielectric strength of the smaller connectors is often less than the required dielectric withstanding test voltages.

Values derived from dielectric withstanding voltage testing may be used to calculate the insulation resistance threshold. See JSC 49774 for further details.

<table>
<tr><td rowspan="2">Electrical Power Distribution – Overload Protection & Fault Propagation</td><td>Document No.
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STATEMENT OF STANDARD

Maximum operating temperatures for electrical power distribution circuit elements shall be established. Overload protection devices shall be designed, selected, and calibrated to protect all elements of the circuit. The protection provided shall include consideration of wire material properties/ratings and wire bundle derating factors that are necessary due to area environmental conditions.

Any circuit protection device shall be sized to support the maximum sustained load and to protect the smallest gauge wire to which it supplies power.

Protection device trip characteristics for branch circuits shall be designed so that combination of current and time required to isolate/remove an overloaded branch circuit will not be sufficient to cause upstream protection devices to act and remove power from other branches of the power system inadvertently.

Where circuit changes (such as the addition of splices or wiring) are made or where the environmental conditions surrounding the electrical system are changed in a manner that could adversely affect the power distribution system elements, the overload protection requirements shall be reevaluated to determine the adequacy of the protection provided.

Failure in an individual phase of a multiphase alternating current circuit shall not cause an unbalanced overload in the other phases of that circuit. Adequate protection shall be provided in each phase of the circuit supplying an item of equipment to prevent failure in other phases of that circuit or other branches upstream of the faulty equipment.

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REMARKS

The requirements of this standard are directed toward the protection of circuit elements which, if overloaded, could be damaged or could cause damage to other elements through the generation of high temperature, flame, smoke, or noxious gases. For purposes of this standard, power distribution system elements are circuit elements such as wiring, wiring accessories, connectors, terminals, wire splices, and branch power distribution circuits.

Circuit protection devices have varied trip characteristic curves and the maximum values/times should be used in assessing downstream wire size/insulation (i.e., maximum blow/trip values in fuses range from 135% to 235% in some cases). Smart short current levels should be considered in selecting the wire gauge. Insulation temperatures should not exceed their maximum rating during a max short event.

Testing Protective Devices For Electrical And Electronic Circuits	Document No. JSC-STD-8080.5	Standard No. E-16	Page 1 of 1
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STATEMENT OF STANDARD

Protective devices for electrical and electronic circuits shall be verified as functional after the environmental acceptance test of the circuit assembly and after any event, such as maintenance or handling mishaps, that could physically damage the circuit.

REMARKS

This test requirement is an important consideration during electronic circuit design where the verification should be performed without disassembly. Verification of the protective device should be accomplished by selecting test methods that do not require incorporation of special testing circuits.

Examples of protective devices covered by this standard are diodes, capacitors, resistors, chokes, filters, etc., or combinations of devices included to protect electronic elements from such occurrences as unwanted transients, current reversals, short circuits, signal couplings, or wide deviations from desired operating conditions.

For design requirements for protective circuits, refer to standard E-3.

Electrical And Electronic Piece Parts – Hermetic Construction	Document No. JSC-STD-8080.5	Standard No. E-17	Page 1 of 1
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STATEMENT OF STANDARD

Hermetic packaging shall be used for parts exposed to any pressure environment (high or low/vacuum) if such exposure would adversely affect the function of those parts or mission reliability.

Hermetic packaging shall be used for parts exposed to pressure changes during any phase of space flight if such changes would adversely affect the function of those parts or mission reliability.

REMARKS

Some examples are piece parts that can be affected by injections of debris and moisture during vehicle descent. Another example of the need for hermetic parts is the quenching effect (arc suppression) of the nominal atmospheric air mixture for contacts in relays and switches.

Long-term storage of electronic parts is usually most successful if the part has a hermetic case or, as a minimum, is stored in a vapor proof container.

Environmentally (non-hermetic) sealed parts such as an aluminum electrolytic capacitor can begin to leak around its seals when subjected to a vacuum, leading to the loss of electrolyte. This loss accelerates over heating that increases internal pressure which increases the outgassing of electrolyte. It is a vicious cycle which eventually will lead to part failure.

If procedures for powering down those parts or other procedures will provide the necessary protection from damage such as corona, the parts need not be hermetically sealed.

E-18 has been reclassified as G-54.

See General Section for standard text.

Equipment Design – Power Transients	Document No. JSC-STD-8080.5	Standard No. E-19	Page 1 of 1
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STATEMENT OF STANDARD

Electrical and electronic equipment and circuits shall be designed and tested to ensure a compatible power bus transient environment.

Design factors shall include the following:

1. Specifying the bus transient environment
2. Limiting the transient generation characteristics of equipment to specified levels in both amplitude and time duration
3. Ensuring that the equipment is not susceptible to transients of the specified amplitude and time duration with a specified margin of safety and functionality.

System tests shall be performed using flight configuration hardware or electrically equivalent to flight equipment to demonstrate that power bus transients are within specified amplitude and time duration constraints during the worst cases of loading, switching, and power source impedance. Flight electrically equivalent equipment shall have identical steady-state and transient electrical response and characteristics as the actual flight hardware.

Ground equipment connected to a spacecraft power bus shall also comply with the requirements of this standard.

REMARKS

A bus environment is the baseline voltage and frequency of the bus plus the aggregate electrical feedback of equipment powered from the bus or coupled with it electrically.

Electrostatic Discharge Protection Of Electronic Equipment	Document No. JSC-STD-8080.5	Standard No. E-20	Page 1 of 1
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STATEMENT OF STANDARD

Electronic equipment including subassemblies and assemblies shall be designed to provide ESD protection from damage or fault for Electrostatic Discharge Sensitive (ESDS) parts used in the design. The minimum requirement for subassemblies and assemblies is 2,000 volts, and the minimum requirement for equipment is 4,000 volts. These requirements specifically relate to the direct contact during non-operating conditions to input, output, and interface connections to subassembly/assembly. These requirements shall be satisfied either by test or analysis.

Any hardware in its normal flight configuration, operating or non-operating, shall be immune to upset or damage to a human body model discharge of 16,000 volts from direct contact to operator accessible points and exposed surface areas of the equipment. This requirement shall be satisfied by test or analysis.

This standard does not apply to electrically-initiated explosive devices.

REMARKS

A subassembly or assembly is a configuration that cannot be normally operated independently of other, companion subassemblies or assemblies (e.g. a circuit card).

Equipment is a configuration of subassemblies or assemblies (e.g., an avionics box).

Either the body/finger or hand/metal Human Body Model (HBM) test methods may be utilized at the subassembly or assembly levels. The hand/metal HBM test method shall be utilized at the equipment level. Guidance for the selection of test methods at the subassembly and assembly levels can be located in IEEE STD C62.38, IEEE Guide on ESD: ESD Withstand Capability Evaluation Methods (for Electronic Equipment Subassemblies)". "Acceptable test methods may be located in IEEE C62.38, ANSI C63.16, "American National Standard Guide for Electrostatic Discharge Test Methodologies and Criteria for Electronic Equipment" or IEC 61000-4-2, "Electromagnetic Compatibility (EMC) Testing and Measurement Techniques-Electrostatic Discharge Immunity Test".

Two documents recommended for use when establishing an ESD control program are:

- MIL-STD-1686, Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment and
- ANSI/ESD S20.20, ESD Association Standard For the Development of an ESD control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment.

E-21 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Ionizing Radiation Effects On Electronics	Document No. JSC-STD-8080.5	Standard No. E-22	Page 1 of 3
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STATEMENT OF STANDARD

Spacecraft electronics shall meet performance and operability requirements while in the natural ionizing radiation environment of the mission. Proof of the ability to meet the performance and operability requirements shall be established by mean time between failure (MTBF) estimations at the box or system level. These MTBF estimations shall be based on actual test data. Proper test data acquired from other tests, including vendor data that shows radiation tolerance, may be used where appropriate. All radiation effects, such as Total Ionizing Dose (TID) and Single Event Effects (SEE) including upsets, latch ups and burn outs, shall be considered.

Radiation testing may be done at the part, board, or box level. The minimum radiation testing level required to establish performance and reliable operation capability shall be by exposure of the test article to either:

1. 200 MeV (+/- 10 MeV) protons to a fluence of 1e10 protons/cm2 or
2. Heavy ions producing Linear Energy Transfer (LETs) of from 1 MeV/ (mg/cm2) to 14 MeV/ (mg/cm2) in appropriate steps of LET to a fluence of 1e6 ions/cm2.

Testing past the minimum shall be with heavy ions to extend the maximum test LET beyond 14 MeV/ (mg/cm2).

Because the minimum test is not as complete as advanced testing with heavy ions past 14 MeV/ (mg/cm2), an MTBF of 10 years shall be assigned for errors such as destructive latchups NOT seen in the minimum test. The compatibility of the 10-year MTBF with the mission needs shall be proven for all systems using the “minimum testing” criteria. Additional testing with heavy ions to achieve LETs greater than 14 MeV/(mg/cm2) may be required if a 10 year MTBF is not sufficient for the mission or the application is such a critical nature that additional assurance is deemed necessary.

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STATEMENT OF STANDARD [CONT.]

If similarity is to be used to establish the radiation susceptibility of a microelectronic part by comparison to a "similar" microelectronic part that has known radiation susceptibility characteristics, all of the following criteria shall be satisfied:

1. Both microelectronic parts must be the product of the same Qualified Parts List, Qualified Manufacturers List, and/or ISO 9000 manufacturer.
2. Both parts must have been manufactured on the same line.
3. The processing of both parts must have been identical, especially the critical parameters of rate of oxide growth, temperature of the oxide growing process and final oxide thickness.
4. The two parts must be similar in function and identical in technology including the same mask design, identical feature size, deposition, and doping.
5. The same foundry must have produced both wafers.

REMARKS

Modern microelectronic components are continuously being improved with faster operating speeds, smaller feature sizes, increased density, and reduced power requirements. These improvements, while providing superior performance in ordinary terrestrial environments, tend to increase the component’s susceptibility to the effects of ionizing radiation. There are also limited offerings of parts designed specifically for use in the space environment and the performance of these parts tends to lag technology capability by some 5 to 10 years. The overall result is that the vast population of modern microelectronic components is comprised of “commercial off the shelf” (COTS) parts designed for use on Earth. The use of these COTS parts in the radiation environment of space involves risks, both from tolerance to total ionizing dose (TID) and from susceptibility to single event effects (SEE). These risks must be quantified as part of a system design.

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Rationale for testing: Essentially all microelectronics flown today has a probability of failing in some fashion due to ionizing radiation. For the case of total ionizing dose (TID), this failure is characterized by a system that degrades over time or totally ceases to function. Exposing the hardware to a TID that represents the expected mission exposure multiplied by a safety factor will demonstrate via test that the hardware functions after such an exposure. This total dose exposure can be accomplished during the testing for SEE with high-energy protons.

Rationale for the assigned 10 year MTBF: The minimum radiation test with protons or with heavy ions to 14 MeV/ (mg/cm2) does not cover the on orbit deposited energy spectrum completely. The portion of the spectrum not covered is that of the higher LETs. Fortunately this high-LET region has considerably less population (particles per unit area per unit time), which lowers the chance for errors to be generated. However, this portion of the spectrum still offers the opportunity for failure modes to occur that won’t be seen in the basic test. NASA/JSC modeling work indicates that a 10-year MTBF must be used to account for this somewhat truncated energy deposition (LET) region in the minimum test regimen.

Rationale for similarity restrictions: The “market life” of an electronic part today ranges from 6 months to three years and then a replacement part, generally with better performance, is offered in the market place. Even during the lifetime of a part, process changes can be made that might have catastrophic effects on the performance in the radiation environment. Even consecutive lot numbers or date codes will not guarantee similar radiation performance.

E-23 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

<table>
<tr><td rowspan="2">Electrical Wire and Cable Acceptance Tests</td><td>Document No.
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STATEMENT OF STANDARD

Spacecraft electrical wire and cable, including wiring used within containerized electrical/electronic assemblies ("black boxes") shall be procured and acceptance tested to the appropriate flight hardware wire and cable specifications listed below:

- Cable specification ANSI/NEMA WC 27500, Standard for Aerospace and Industrial Electrical Cable.
- Cable specification MIL-C-17, Cables, Radio Frequency, Flexible and Semi-rigid.
- Wire specification MIL-W-22759, Wire, Electrical, Fluoropolymer Insulated Copper or Copper Alloy.
- Wire and cable defined in SSP 30423, EEE Parts Selection for the Space Station Program.

Other wire procurement specifications may be authorized by the procuring agency. Spacecraft wire and cable shall also comply with applicable program materials and process requirements.
If the wiring used in any spacecraft application is unknown, as it may be in the case of off-the-shelf equipment, pig-tailed components, heater strips, etc. and if the application is non-critical, the assembly is required only to meet applicable program materials and process requirements.

Two methods for certifying wire are:

1. As required by the procurement specification, Government Source Inspection shall certify that the test specified below has been performed by the wire manufacturer on the length of wire procured. In addition to meeting the requirements of the appropriate procurement specification, each shipment shall be accompanied by the manufacturer’s test report.
2. Wire certification can also be performed by a NASA-approved test facility.

In either case, testing shall consist of the tests below.

Testing for insulation flaws of cable’s basic wires shall be done prior to cable assembly.

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STATEMENT OF STANDARD [CONT]

100-Percent Testing

1. Insulated single conductor wires and cable basic wires
   a. Impulse dielectric test (no greater than 80% of military specification)
2. Cable
   a. Dielectric withstand of component wires
   b. Jacket flaws for shielded cables

Sample Testing

As a minimum, a sample or samples of each lot of wire/cable shall be subjected to the following applicable quality conformance inspections. (Applicability is determined by the specifications cited above).

1) Insulated single-conductor wires and cable basic wires
   a. Conductor resistance
   b. Wrap test
   c. Shrinkage (heat resistance)
   d. Cold bend followed by wet dielectric
   e. Visual and mechanical examination (finished wire o.d., identification of product, conductor diameter, strand diameter, conductor stranding, wire base metal, and the plating material)
   f. Polyimide cure test (applicable to modified aromatic polyimide coatings only)
   g. Crosslink proof testing for crosslinked insulation materials

2) Cable
   a. Shield coverage
   b. Identification of product
   c. Jacket wall thickness
   d. Cold bend
   e. Thermal shock
   f. Stress-Crack Resistance testing (MIL-C-17 Cable only)

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STATEMENT OF STANDARD [CONT]

Any failure during sample testing shall be cause for immediate rejection of the entire lot.

Certification Processes

Certification of a NASA-approved test facility is done by an audit team with representatives from the S&MA and Engineering Directorates, or their representatives.

The team shall assure the test lab is qualified to perform the test methods referenced in this standard.

At the using installation, before placing wire/cable into bonded storage, representatives from the Engineering team and/or receiving inspection function shall verify that the test report indicating conformance with all applicable procurement specification requirements accompanies each lot shipped.

Storage shelf life: Silver plated wire and cable that has exceeded a shelf life of 10 years from its manufacturing date shall be downgraded to non-flight status and not be used on flight hardware.

This standard does not apply to non-flight wire and cable.

REMARKS

The primary reason for downgrading silver plated wire after 10 years of age is to control increased solderability problems with silver and the potential for Red Plague for wire stored in a high moisture environment.

Additional requirements for processing and dispositioning wire/cable lots are defined in JSC 49879 JSC Wire & Cable Integrity Compliance Program.

Protecting Electrical Wires, Cables, Bundles, and Harnesses	Document No. JPG 8080.5	Standard No. E-25	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Electrical wire(s), cables, bundles, and wire harnesses shall be:

- designed and installed to withstand anticipated stresses induced by ground handling and flight operations,
- adequately protected to prevent insulation damage from such causes as chafing, abrasion and cold flow when passing through or touching any structure or panel;
- verified during qualification to withstand the anticipated environments.

REMARKS

Cold flow of Teflon®, and other “soft” polymer wire insulation materials, is the physical movement of the insulator under a compressive/directional load, and is often considered a latent reliability concern for electronic assemblies using wiring harnesses and cables. Cold flow only becomes a reliability issue affecting performance, if the insulation displacement becomes significant enough to thin the insulation jacket below the minimum isolation/electrical separation limit.

Panel and chassis hole edges should be properly chamfered and protected by a resilient-material grommet or non-conductive tape, e.g., Kapton®

Multiple broken wires have been detected in wire bundles at connectors. These breaks were caused by a stiff, hard coating on the bundles which did not allow sufficient flexing of the enclosed wires creating stress concentrations. Example causes include untapered tape or heatshrink tubing.

Problems have been caused by normal handling, thermal cycling, operating deformations, inadequate stress relief, vibration, and inadequate service loops.

This standard supersedes JPG 8080.5 Standard M/S-3.

2.3. Fluids

<table>
<tr><td rowspan="2">Restriction Requirements - Pressurized Components</td><td>Document No.

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<tr><td>Previous Revision
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STATEMENT OF STANDARD

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

For pressurized oxygen systems, flow restrictions shall be designed in accordance with ASTM Manual 36, *Safe Use of Oxygen and Oxygen Systems Guidelines for Oxygen System Design, Materials Selection, Operation, Storage, and Transportation* to prevent flow-induced ignition hazards.

REMARKS

Pressurized components could fail in such a way that the total gas supply would be dumped directly into the compartment. If the pressure relief valve of the compartment were unable to handle the resulting pressure increase, compartment structural failure could result.

Relief valves in compartments are normally designed to maintain a preestablished pressure within the compartment during launch and reentry or in the event of a pressure regulator failure. They are not designed to maintain pressure in the event of a break or rupture of a pressure line or vessel.

High velocity oxygen flow can pose ignition hazards in improperly designed flow restrictors.

<table>
<tr><td rowspan="2">Water Separators In A Zero-Gravity Environment</td><td>Document No.
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</table>

STATEMENT OF STANDARD

In the design of water separators for use in gas streams under zero-gravity conditions, if the design includes a condensing heat exchanger and a downstream liquid/gas separator:

1. The liquid collection components and plumbing upstream of the separator shall be designed to preclude the collection of large quantities of liquid that could accumulate and be carried to the separator as a slug. If this cannot be assured then the design shall accommodate liquid entering the separator as a slug.
2. The hardware shall accommodate the expected proportions of liquid and gas that the separator will have to process (see #5 in Remarks).
3. Atmospheric debris shall be prevented from entering the separator to prevent clogging of small openings or channels.
4. Cabin trace contaminants shall not reduce the functionality of the heat exchanger coating below the required separator performance.

REMARKS

Design considerations include:

1. The behavior of water droplets changes once the influence of gravity is removed. Droplets tend to cling to surfaces more in zero-gravity.

2. In zero-gravity the extent to which the droplet beads up on a hydrophobic surface is more pronounced than in one-gravity. If the surface is hydrophobic, the droplet can bead up and be stripped away by the air stream. If the surface is hydrophilic, the droplet will spread out into a thin layer. Over time, metabolically-produced trace contaminants tend to coat surfaces, altering the hydrophobic or hydrophilic properties of surfaces or membranes. Separator designs that rely on the hydrophillic or hydrophobic nature of surfaces or membranes may lose that property with time. This may cause blockage or liquid carryover.

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3. Liquid carryover from the separator can result from degradation of hydrophilic coatings, the separator not being designed for the liquid/gas proportions that it has to accommodate, a slug that is larger than the separator is designed to handle, or from a blockage of flow channels from debris.

4. Design verification of a liquid/gas separator can only be satisfactorily completed in a zero-gravity environment that has a long enough duration to experience the range of liquid/gas processing phases that will be expected on-orbit. Experience has shown that testing in a zero-gravity aircraft, which produces, at most, 20 seconds of micro-gravity is not always sufficient to identify problems with slugging or carryover. Results may even be misleading, since a period of increased gravity follows each 20 second micro-gravity interval. Testing for an extended period of zero-gravity is essential to verify the design of a liquid/gas separator.

5. Separators that have to process mostly liquid in a gas stream will have a different design than those that have to process mostly gas in a liquid stream.

Service Points - Positive Protection From Interchange-Ability Of Fluid Service Lines	Document No. JSC-STD-8080.5	Standard No. F-3	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Service points for spacecraft fluid systems shall be designed with positive protection by location, connector size, or type to prevent connection to incorrect fluid service lines.

REMARKS

Ground Service Points - Fluid Systems	Document No. JSC-STD-8080.5	Standard No. F-4	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Ground service points for fluid systems including those for filling, draining, purging, or bleeding shall be accessible from the exterior of the spacecraft or element.

Gas purge or bleed fittings shall exhaust outside the spacecraft or element.

Portable fluid systems and systems that are located entirely within the pressurized compartment(s) of the spacecraft are excluded from the above requirements.

REMARKS

Here, accessible means that the service points can be behind a door or access panel

A dry hose may be attached to the interior of the spacecraft for servicing by GSE.

Servicing of fluid systems from inside compartment(s) may result in the following:

1. Exposure of equipment to fluid spillage

2. Damage of service points due to inaccessibility

3. Unnecessary traffic in the compartment

<table>
<tr><td rowspan="2">Fluid Lines - Separation Provision</td><td>Document No.
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</table>

STATEMENT OF STANDARD

For separation of space-vehicle modules where one is being discarded, fluid lines that are required to be disconnected or severed on separation shall be designed such that any breakage resulting from failure of the disconnecting device to function will occur on the discarded side of the disconnect. The check valve or shutoff valve, used on the retained side of the disconnect for preventing unacceptable loss of fluid after disconnection, shall be a type that will function (i.e., that will close) in spite of such a failure.

For separation of space-vehicle modules where both need to function after separation but are not intended for subsequent reconnection, fluid lines that are required to be disconnected on separation shall be designed to preclude unacceptable loss of fluid after disconnection.

For separation of space-vehicle modules where both need to function after separation and are intended for subsequent reconnection, fluid lines that are required to be disconnected on separation shall be designed to preclude unacceptable loss of fluid after disconnection and shall include provisions to enable successful reconnection.

REMARKS

Temperature And Pressure Monitoring Requirements For Potentially Hazardous Reactive Fluids	Document No. JSC-STD-8080.5	Standard No. F-6	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

All spacecraft systems and ground support servicing equipment requiring storage of reactive fluids (e.g., hydrogen peroxide, oxidizers, and monopropellants) shall be designed to include devices for monitoring temperature and pressure.

REMARKS

This approach permits accurate determination of the rates of decomposition of the fluids contained in their respective systems.

These monitoring devices will provide time for corrective action in the event that abnormal decomposition of fluids is initiated.

Transfer lines and pumps should be considered as part of the overall monitoring effort but not necessarily individually instrumented.

This standard combines G-49 and F-6 into single standard.

Capping Of Fluid Servicing And Test Ports not Required to Function in Flight	Document No. JSC-STD-8080.5	Standard No. F-7	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Fluid servicing and test ports, not required to function in flight, shall be designed so that they can be capped immediately after servicing or test in order to preclude leakage in flight.

The method and material used for capping shall be compatible with the applicable spacecraft subsystem and the expected environment.

REMARKS

Capping of these ports is necessary to prevent leakage of the applicable subsystem.

Fluid Systems Components Whose Function Is Dependent On Direction Of Flow - Protection Against Incorrect Installation	Document No. JSC-STD-8080.5	Standard No. F-8	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

The following positive measures shall be taken to prevent incorrect installation of fluid system components whose function is dependent on direction of flow:

1. The direction of fluid flow shall be indicated with permanent markings on the exterior of the component and on the parts and lines to be mated with the component.

2. A flow check shall be performed after each installation or change.

3. Where flow checks cannot be made, provisions shall be incorporated in the fluid line components' design, end fittings, or connections to preclude incorrect installation.

REMARKS

In a complex plumbing installation, it is difficult for fabrication or assembly personnel to know the direction of flow.

Spacecraft Venting-Induced Perturbing Forces	Document No. JSC-STD-8080.5	Standard No. F-9	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Sources of venting that could occur during the mission shall be identified and an analysis made to ensure that the total vent condition is designed to be compatible with vehicle and/or mission control capabilities. Impingement of vent plumes on spacecraft shall be analyzed.

Nonpropulsive vent concepts, opposed venting, operational procedures, or similar methods shall be used to eliminate the undesirable effects of perturbing forces resulting from such vents.

REMARKS

Typical sources of planned or expected overboard venting include water boilers, cabin relief valves, fuel cell purges, waste disposals, dryers, waste compartments, and air locks.

Such venting is a major cause of error in spacecraft precision control and navigation. In addition, venting may be a major source of exterior contamination of precision optical and electromagnetic instruments on spacecraft.

<table>
<tr><td rowspan="2">Nozzles And Vents -
Protection Prior To Launch</td><td>Document No.
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STATEMENT OF STANDARD

All nozzles and vents used in crewed spacecraft systems, such as those of the reaction control system and environmental control system, shall be protected from entrance of rain, debris, or other contaminants prior to launch. (This standard applies throughout assembly, testing, shipment, and checkout of the spacecraft and its systems).

Protective covers for nozzles or vents located within a payload bay shall be designed to be readily removable during the countdown before launch or before final closure of payload bay doors.

Covers shall be designed so that removal can be accomplished without risk of dumping accumulated debris into the nozzle or vent, damaging nozzle radiation coatings or generating debris that poses a risk to the vehicle.

Covers shall be designed so that failure to remove the cover will not cause failure of the system or any other subsystem.

REMARKS

Protection is advisable at all times and is particularly required whenever any nozzle axis is pointing substantially above the horizontal axis.

Fluid Supplies - Verification Test Provisions	Document No. JSC-STD-8080.5	Standard No. F-11	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Ground support equipment, facilities, fluid containers, and other equipment to be connected to a spacecraft system for operation, testing, checkout, or maintenance shall be designed so that routine verification tests can be conducted before each connection is made to ensure that each fluid input to the spacecraft will be compatible with the spacecraft system.

Procedures shall be provided to accomplish the verification tests with the equipment.

REMARKS

Instances have occurred where a spacecraft has sustained damage by inputs from equipment which was not checked to be within acceptable limits before it was connected to spacecraft systems.

Protection of Pressurized Systems from Damage Due to Pressurant Depletion - Support Equipment	Document No. JSC-STD-8080.5	Standard No. F-12	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Where maintenance of fluid pressure is critical to prevent major damage to a space vehicle component such as a propellant tank or fuel cell, the ground support equipment (GSE), airborne support equipment (ASE) or flight support equipment (FSE) shall be designed to provide sufficient pressure to the space vehicle component in the event of a failure of the pressurant source.

The GSE, ASE or FSE shall be designed such that recovery from failures of the pressurant source can be accomplished without damage to the space vehicle component.

The GSE, ASE or FSE shall be designed to monitor pressure (or pressure differential) both from the source and to the system.

REMARKS

Depletion of the GSE, ASE or FSE pressure source or line pressure drops resulting from fluid flow have resulted in serious equipment damage in operations where the requirements of this standard were not met.

Good practice is to use separate fluid pressure sources for purge or flushing.

Habitable Module Pressure - Venting Restriction	Document No. JSC-STD-8080.5	Standard No. F-13	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

To prevent over-pressurization, all habitable pressurized elements shall have pressure relief venting systems.

Each pressurized element shall have its own vent system so that venting systems are not shared.

The venting system shall be capable of isolating the flow path from the ambient environment of the pressurized element to space vacuum, and the venting system shall be configurable to or already have online a secondary vent system in the event the primary vent fails.

REMARKS

Contamination control, fire control, and other emergency response procedures require that all pressurized elements of a spacecraft can be isolated from the other pressurized elements, and that each pressurized element can be independently vented.

Experience with Shuttle and ISS have demonstrated that vents can ice up in permanently open or closed positions. Vents can also become corroded by contact with vented products.

Vents should not be shared. Vents can fail and must be capable of isolation from the ambient environment by actions internal to the element and alternate vents should be configurable or concurrently available.

F-14 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

<table>
<tr><td rowspan="2">Separation Of Hypergolic Reactants</td><td>Document No.
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STATEMENT OF STANDARD

Oxidizer and fuel (both liquids and vapors) shall be positively separated using all-metal containment with mixing only allowed in the controlled combustion area.

REMARKS

Common pressurant gas supply for fuel and oxidizer should not be used.

Fluid Line Routing And Installation	Document No. JSC-STD-8080.5	Standard No. F-16	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Flight and GSE fluid line routing and installation shall meet the following requirements:

- Detailed drawings and procedures shall be provided for routing and installation of all fluid lines, including pressure-sensor lines.
- If temperature conditions are not within acceptable limits for the fluid involved, measures shall be taken to provide passive or active thermal control as appropriate.
- A design analysis shall be provided for each line installation to show that the temperature extremes to which it will be subjected (including storage, handling, transportation, and operations) are within acceptable limits for the fluid involved.
- Fluid lines installed external to spacecraft shall be Extravehicular Activity (EVA) compatible, if intended for future EVA maintenance or repair.
- Strain relief shall accommodate design loads, deflections, and thermal expansion.
- Fluid lines shall be restrained at intervals in accordance with the governing standard for the application.
- Fluid lines carrying oxygen shall not be configured with sharp bends that could pose a blunt flow impingement ignition hazard, in accordance with ASTM Manual 36.

REMARKS

EVA compatibility information is provided in JSC 26626A EVA Generic Design Requirements Document.

Cleanliness Of Flowing Fluids And Associated Systems	Document No. JSC-STD-8080.5	Standard No. F-17	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Spacecraft systems that will contain gases or liquids to be used or expended during the mission shall be maintained in the state of cleanliness required by the specification for the particular substance involved after factory assembly and up to and including final servicing prior to flight.

This requirement shall also apply to the gas- and liquid-handling systems of all servicing, maintenance, handling, testing, and checkout equipment.

Such systems fluids, as well as test fluids that enter spacecraft systems, shall be filtered or controlled such that the degree of cleanliness required by the specification for the particular substance is maintained.

Spacecraft systems that will contain such gases or liquids shall be designed so that required draining, flushing, drying, cold trapping, etc. can be accomplished with the spacecraft in its checkout or working attitude. The length of time to accomplish this task shall be presented for approval during design reviews.

Calibration fluids shall be furnished with analysis reports which are signed by the preparer and the source inspection agency

REMARKS

Pressure Relief Valves - Standardization Of Functional Testing	Document No. JSC-STD-8080.5	Standard No. F-18	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

To provide consistency in initial and subsequent testing of pressure relief valves, the manufacturer shall specify values for: crack and reseat pressure, mass-flow rates, pressures corresponding to full flow, and allowable leakage.

These values shall be specified for operation with the flight fluid and any other fluid recommended for test purposes.

Retest time intervals shall be specified for valves that are subject to deterioration with time.

REMARKS

Specific flow-rate values have been found necessary for verification of these valve characteristics with the precision required in preflight checkout.

Cleanliness Protection For Fluid Systems	Document No. JSC-STD-8080.5	Standard No. F-19	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Handling of flight and flight interface GSE fluid systems shall meet the following requirements:

1. Design drawings and/or process specifications shall designate the method of complying with this standard.
2. In each step of the manufacturing process and buildup, all ends of tubing, fittings, and components used in fluid systems shall be protected against damage and entry of contaminants. Equivalent protection shall be provided for tubing, fittings, and/or components when the subsystem is open to effect repair or replacement.
3. Protective caps shall meet the cleanliness requirement of the manufacturing specification. Protective cap material and design shall be compatible with the fluid.
4. All assemblies shall be cleaned and dried before packaging. For oxygen components, cleaning and packaging materials shall not pose residue or particle contamination hazards, in accordance with ASTM Manual 36.
5. Refill procedures shall provide the same protection against damage or contamination as the initial manufacturing procedures establish.
6. Protection devices for components to be installed external to spacecraft shall be Extravehicular Activity (EVA) compatible.
7. Tubing assemblies, fittings, or components that are stored or shipped shall be protected and sealed in a clean, transparent, moisture-proof bag with sufficient protective strength and thickness for the intended handling.

REMARKS

Open plumbing and components must be protected to avoid entrance of foreign material and to protect the sealing surfaces.

Additional protection and procedures may be required by the regulatory authority for the fluid in question.

EVA compatibility information is provided in JSC 26626A EVA Generic Design Requirements Document.

Methods of protection to maintain cleanliness of the hardware include but are not limited to: bagging, handling in a clean room or flow bench, and clean gas purge during assembly.

<table>
<tr><td rowspan="2">Fluid Systems - Cleanliness</td><td>Document No.
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STATEMENT OF STANDARD

After manufacturing and after any subsequent exposure to the probable entry of contaminants, fluid systems and servicing equipment shall be cleaned by flushing to remove all contaminants which could be detrimental to the system.

The flushing fluid shall be compatible with the system materials and the working fluid to be used in the system. Cleanliness levels of the flushing fluid and the system maximum allowable contamination shall be specified. During flushing, the fluid entering the system shall be filtered to the same level of cleanliness or better than that of the working fluid to be used in the system.

Whenever it is necessary to verify the cleanliness level of a spacecraft fluid system or its servicing equipment, samples of the fluid leaving the system from draining, purging or flushing operations shall be analyzed to determine that particulate and/or chemical contamination are within specified limits.

The fluid sample shall be taken at the end of the draining, purging or flushing operation.

REMARKS

Purge Gases - Dew Point Requirement	Document No. JSC-STD-8080.5	Standard No. F-21	Page 1 of 1
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STATEMENT OF STANDARD

Gases used for purging propellant vapors or other vapors from space-vehicle compartments shall have a dew point low enough to preclude moisture condensation from the purge gas on the coldest surfaces that the purging gas will contact.

REMARKS

This standard does not apply to cryogenic system surfaces when in a supercold condition and does not preclude consideration of other problems, such as static electricity or equipment temperature requirements, that may be involved with selection of proper dew point.

Purge gases may become saturated with the vapor being purged. When the gases later come in contact with colder surfaces in the compartment, the absorbed vapor may be deposited on these surfaces.

Transfer of the liquid from the point where it is being absorbed to other locations in the compartment may be dangerous.

Pressure Garments - Protection Against Failure Propagation	Document No. JSC-STD-8080.5	Standard No. F-22	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Systems which supply pressure to crew pressure garments shall be designed so that a major failure of one crew member's garment or garment pressure supply will not cause loss of life to other crew members.

REMARKS

Systems supplying gas to pressure suits should be so designed that an abrupt decompression of the suit of one crew member (such as might result from a rip in the fabric or a broken or unlatched faceplate) will not result immediately in a similar rapid loss of pressure in the suits of the other members or in a sudden total depletion of the gas supply.

The time available before the loss of pressure occurs in the other suits or before a critical depletion of the gas supply occurs should be sufficient to allow:

1. time for reasonable attempts to aid the decompressed crew member (e.g., by closing an unlatched faceplate) and

2. time to shut off flow to the open suit in the event the damage is beyond repair and the crew member cannot be saved.

F-23 has been reclassified as General Standard G-53.

See G-53 for revised standard text.

Fluid Systems - Design For Flushing and Draining	Document No. JSC-STD-8080.5	Standard No. F-24	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Spacecraft fluid systems and related servicing equipment shall be designed to permit complete flushing and draining during ground and on-orbit servicing operations.

The following conditions shall be satisfied, as a minimum:

1. The systems shall be free from dead-ended piping or passages through which flushing fluid cannot be made to flow.

2. Drain and bleed ports shall be provided for attitudes anticipated during ground servicing of the systems.

REMARKS

This standard is to clarify that the design requirements pertain to on-orbit as well as ground servicing operations.

Toxicity - Fluids Contained In Systems In The Crew Compartment	Document No. JSC-STD-8080.5	Standard No. F-25	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Fluids capable of producing toxic fumes shall not be used in systems within the crew compartment if a nontoxic substitute with equivalent performance exists.

Where no satisfactory substitute for the fluid exists, tests shall be performed to ensure that the total leakage is less than the concentration which would result in a level of toxicity that would impair crew health and safety.

REMARKS

Atmospheric Pressure And Composition Control	Document No. JSC-STD-8080.5	Standard No. F-26	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Spacecraft and habitable modules shall be designed and operated so that atmospheric pressure and composition control systems maintain a habitable environment under all nominal and contingency operational scenarios.

Provisions shall be made to monitor and control oxygen, nitrogen, carbon monoxide, carbon dioxide, partial and total atmospheric pressure, and credible atmospheric contaminants.

Crew compartments shall be designed with forced ventilation to prevent stagnant air pockets from forming in crew-habitable areas of the compartment.

REMARKS

Nominal and contingency operational scenarios include, but are not limited to: nominal operations, planned or inadvertent fluid system venting into the crew compartment, planned or inadvertent crew compartment venting to space, fluid system leakage into a crew compartment, and crew compartment leakage to space.

Credible contaminants may be organic, inorganic, or biological. Refer to MP-9 for additional information.

In the absence of natural convective air circulation in a microgravity environment, stagnant pockets may accumulate in areas without forced ventilation. Pockets of crew-generated carbon dioxide pose a toxicity hazard to the crew.

Planned or inadvertent venting of inert gas into a crew compartment may reduce oxygen concentration to a level that could pose a confined space hazard.

Planned or inadvertent venting of oxygen into a crew compartment may increase oxygen concentration to a level that poses a fire hazard. Refer to ASTM Manual 36 for guidance on proper selection of crew cabin materials for oxygen- enriched environments.

Liquid or Gas Containers - Verification of Contents	Document No. JSC-STD-8080.5	Standard No. F-27	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

The contents of each individual liquid or gas container to be used in flushing, testing, checkout, and operation of spacecraft and/or life support systems shall be shown by laboratory analysis to conform to specified requirements prior to introduction into the system.

REMARKS

Instances have occurred where incorrect labeling of containers has caused application of incorrect fluids to subsystems.

In other cases, the contents of the container have failed to meet the specified standards of purity. Inspection of shipments by sampling some of the containers has proven unsatisfactory for determining impurities in the entire shipment.

The term "prior to introduction" in the statement is interpreted to mean at the time of introduction of the fluid into the spacecraft system (recommendation is within one month) and prior to exposure of the spacecraft system to possible contamination by that fluid.

F-28 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Filter Protection Of Sensitive Fluid Components	Document No. JSC-STD-8080.5	Standard No. F-29	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Fluid system components subject to malfunction from particulate contamination in zero-gravity or reverse flow situations shall be protected by filters from particulates which might enter from either flow direction.

Filters shall be designed either to accommodate the worst expected conditions of service for their entire expected service life or to be cleaned and/or replaced as a standard maintenance item.

REMARKS

Components subject to malfunction from particulate contamination should be protected on their inlet and outlet by filters.

This applies to both mechanically active (e.g., regulators, solenoid valves, and check valves) and mechanically passive (e.g., porous plate sublimators and membrane separators) components.

Filter Protection Of Sensitive Fluid Components	Document No. JSC-STD-8080.5	Standard No. F-29	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

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<table>
<tr><td rowspan="2">Pressure Relief For Pressure Vessels/Systems</td><td>Document No. JSC-STD-8080.5</td><td>Standard No. F-30</td><td>Page 1 of 2</td></tr>
<tr><td>Previous Revision 04/01/1991</td><td colspan="2">Current as of 08 March 2005:</td></tr>
</table>

STATEMENT OF STANDARD

Pressure relief capability shall be provided for pressure vessels/systems where the contents, system design, environment or operation may cause an increase in internal pressure above the maximum design pressure (as defined below).

For pressure vessels/systems where pressure can fluctuate only because of external ambient temperature, a mechanical relief device shall not be required provided the fluctuations cannot cause the maximum design pressure to be exceeded.

All flight pressure vessels/systems shall be protected during servicing, either on the ground or in flight, by relief valves in the servicing equipment. The relief valves shall be sized for sufficient mass flow to protect the pressure vessel/system in the event of servicing pressure regulator failure. Such a failure shall not cause the pressure vessel/system to exceed the maximum design pressure.

Where mechanical relief devices are required, they shall be sized for sufficient mass flow to protect the pressure vessel/system from exceeding the maximum design pressure.

The effects of thrust or torque imparted to the pressure vessel or associated equipment by actuation of the relief device shall be considered. The effects of thrust or torque imparted to the spacecraft by actuation of the relief device shall also be considered.

Pressure rise in the compartment where the relief device vent is located shall be assessed at relief device maximum flow conditions.

Continued next page

Pressure Relief For Pressure Vessels/Systems	Document No. JSC-STD-8080.5	Standard No. F-30	Page 2 f 2
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

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REMARKS

Maximum design pressure is the highest pressure defined by maximum relief pressure and flow capability, maximum failed regulator pressure, maximum temperature or any combination of the above that may occur with one failure. Transient pressures shall be considered.

The pressure vessel/system includes all pressurized hardware (e.g. tankage, lines, fittings, and components).

Portions of fluid systems that can trap fluids (become locked-up) shall be specifically evaluated for the need of relief capabilities.

2.3. Fluids

Restriction Requirements - Pressurized Components	Document No. JSC-STD-8080.5	Standard No. F-1	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

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

For pressurized oxygen systems, flow restrictions shall be designed in accordance with ASTM Manual 36, *Safe Use of Oxygen and Oxygen Systems Guidelines for Oxygen System Design, Materials Selection, Operation, Storage, and Transportation* to prevent flow-induced ignition hazards.

REMARKS

Pressurized components could fail in such a way that the total gas supply would be dumped directly into the compartment. If the pressure relief valve of the compartment were unable to handle the resulting pressure increase, compartment structural failure could result.

Relief valves in compartments are normally designed to maintain a preestablished pressure within the compartment during launch and reentry or in the event of a pressure regulator failure. They are not designed to maintain pressure in the event of a break or rupture of a pressure line or vessel.

High velocity oxygen flow can pose ignition hazards in improperly designed flow restrictors.

Water Separators In A Zero-Gravity Environment	Document No. JSC-STD-8080.5	Standard No. F-2	Page 1 of 2
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

In the design of water separators for use in gas streams under zero-gravity conditions, if the design includes a condensing heat exchanger and a downstream liquid/gas separator:

1. The liquid collection components and plumbing upstream of the separator shall be designed to preclude the collection of large quantities of liquid that could accumulate and be carried to the separator as a slug. If this cannot be assured then the design shall accommodate liquid entering the separator as a slug.
2. The hardware shall accommodate the expected proportions of liquid and gas that the separator will have to process (see #5 in Remarks).
3. Atmospheric debris shall be prevented from entering the separator to prevent clogging of small openings or channels.
4. Cabin trace contaminants shall not reduce the functionality of the heat exchanger coating below the required separator performance.

REMARKS

Design considerations include:

1. The behavior of water droplets changes once the influence of gravity is removed. Droplets tend to cling to surfaces more in zero-gravity.

2. In zero-gravity the extent to which the droplet beads up on a hydrophobic surface is more pronounced than in one-gravity. If the surface is hydrophobic, the droplet can bead up and be stripped away by the air stream. If the surface is hydrophilic, the droplet will spread out into a thin layer. Over time, metabolically-produced trace contaminants tend to coat surfaces, altering the hydrophobic or hydrophilic properties of surfaces or membranes. Separator designs that rely on the hydrophillic or hydrophobic nature of surfaces or membranes may lose that property with time. This may cause blockage or liquid carryover.

Continued next page.

Water Separators In A Zero-Gravity Environment	Document No. JSC-STD-8080.5	Standard No. F-2	Page 2of 2
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3. Liquid carryover from the separator can result from degradation of hydrophilic coatings, the separator not being designed for the liquid/gas proportions that it has to accommodate, a slug that is larger than the separator is designed to handle, or from a blockage of flow channels from debris.

4. Design verification of a liquid/gas separator can only be satisfactorily completed in a zero-gravity environment that has a long enough duration to experience the range of liquid/gas processing phases that will be expected on-orbit. Experience has shown that testing in a zero-gravity aircraft, which produces, at most, 20 seconds of micro-gravity is not always sufficient to identify problems with slugging or carryover. Results may even be misleading, since a period of increased gravity follows each 20 second micro-gravity interval. Testing for an extended period of zero-gravity is essential to verify the design of a liquid/gas separator.

5. Separators that have to process mostly liquid in a gas stream will have a different design than those that have to process mostly gas in a liquid stream.

Service Points - Positive Protection From Interchange-Ability Of Fluid Service Lines	Document No. JSC-STD-8080.5	Standard No. F-3	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Service points for spacecraft fluid systems shall be designed with positive protection by location, connector size, or type to prevent connection to incorrect fluid service lines.

REMARKS

Ground Service Points - Fluid Systems	Document No. JSC-STD-8080.5	Standard No. F-4	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Ground service points for fluid systems including those for filling, draining, purging, or bleeding shall be accessible from the exterior of the spacecraft or element.

Gas purge or bleed fittings shall exhaust outside the spacecraft or element.

Portable fluid systems and systems that are located entirely within the pressurized compartment(s) of the spacecraft are excluded from the above requirements.

REMARKS

Here, accessible means that the service points can be behind a door or access panel

A dry hose may be attached to the interior of the spacecraft for servicing by GSE.

Servicing of fluid systems from inside compartment(s) may result in the following:

1. Exposure of equipment to fluid spillage

2. Damage of service points due to inaccessibility

3. Unnecessary traffic in the compartment

Fluid Lines - Separation Provision	Document No. JSC-STD-8080.5	Standard No. F-5	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

For separation of space-vehicle modules where one is being discarded, fluid lines that are required to be disconnected or severed on separation shall be designed such that any breakage resulting from failure of the disconnecting device to function will occur on the discarded side of the disconnect. The check valve or shutoff valve, used on the retained side of the disconnect for preventing unacceptable loss of fluid after disconnection, shall be a type that will function (i.e., that will close) in spite of such a failure.

For separation of space-vehicle modules where both need to function after separation but are not intended for subsequent reconnection, fluid lines that are required to be disconnected on separation shall be designed to preclude unacceptable loss of fluid after disconnection.

For separation of space-vehicle modules where both need to function after separation and are intended for subsequent reconnection, fluid lines that are required to be disconnected on separation shall be designed to preclude unacceptable loss of fluid after disconnection and shall include provisions to enable successful reconnection.

REMARKS

Temperature And Pressure Monitoring Requirements For Potentially Hazardous Reactive Fluids	Document No. JSC-STD-8080.5	Standard No. F-6	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

All spacecraft systems and ground support servicing equipment requiring storage of reactive fluids (e.g., hydrogen peroxide, oxidizers, and monopropellants) shall be designed to include devices for monitoring temperature and pressure.

REMARKS

This approach permits accurate determination of the rates of decomposition of the fluids contained in their respective systems.

These monitoring devices will provide time for corrective action in the event that abnormal decomposition of fluids is initiated.

Transfer lines and pumps should be considered as part of the overall monitoring effort but not necessarily individually instrumented.

This standard combines G-49 and F-6 into single standard.

Capping Of Fluid Servicing And Test Ports not Required to Function in Flight	Document No. JSC-STD-8080.5	Standard No. F-7	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Fluid servicing and test ports, not required to function in flight, shall be designed so that they can be capped immediately after servicing or test in order to preclude leakage in flight.

The method and material used for capping shall be compatible with the applicable spacecraft subsystem and the expected environment.

REMARKS

Capping of these ports is necessary to prevent leakage of the applicable subsystem.

Fluid Systems Components Whose Function Is Dependent On Direction Of Flow - Protection Against Incorrect Installation	Document No. JSC-STD-8080.5	Standard No. F-8	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

The following positive measures shall be taken to prevent incorrect installation of fluid system components whose function is dependent on direction of flow:

1. The direction of fluid flow shall be indicated with permanent markings on the exterior of the component and on the parts and lines to be mated with the component.

2. A flow check shall be performed after each installation or change.

3. Where flow checks cannot be made, provisions shall be incorporated in the fluid line components' design, end fittings, or connections to preclude incorrect installation.

REMARKS

In a complex plumbing installation, it is difficult for fabrication or assembly personnel to know the direction of flow.

Spacecraft Venting-Induced Perturbing Forces	Document No. JSC-STD-8080.5	Standard No. F-9	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Sources of venting that could occur during the mission shall be identified and an analysis made to ensure that the total vent condition is designed to be compatible with vehicle and/or mission control capabilities. Impingement of vent plumes on spacecraft shall be analyzed.

Nonpropulsive vent concepts, opposed venting, operational procedures, or similar methods shall be used to eliminate the undesirable effects of perturbing forces resulting from such vents.

REMARKS

Typical sources of planned or expected overboard venting include water boilers, cabin relief valves, fuel cell purges, waste disposals, dryers, waste compartments, and air locks.

Such venting is a major cause of error in spacecraft precision control and navigation. In addition, venting may be a major source of exterior contamination of precision optical and electromagnetic instruments on spacecraft.

<table>
<tr><td rowspan="2">Nozzles And Vents -
Protection Prior To Launch</td><td>Document No.
JSC-STD-
8080.5</td><td>Standard No.
F-10</td><td>Page
1 of 1</td></tr>
<tr><td>Previous
Revision
04/01/1991</td><td colspan="2">Current as of 08 March 2005:</td></tr>
</table>

STATEMENT OF STANDARD

All nozzles and vents used in crewed spacecraft systems, such as those of the reaction control system and environmental control system, shall be protected from entrance of rain, debris, or other contaminants prior to launch. (This standard applies throughout assembly, testing, shipment, and checkout of the spacecraft and its systems).

Protective covers for nozzles or vents located within a payload bay shall be designed to be readily removable during the countdown before launch or before final closure of payload bay doors.

Covers shall be designed so that removal can be accomplished without risk of dumping accumulated debris into the nozzle or vent, damaging nozzle radiation coatings or generating debris that poses a risk to the vehicle.

Covers shall be designed so that failure to remove the cover will not cause failure of the system or any other subsystem.

REMARKS

Protection is advisable at all times and is particularly required whenever any nozzle axis is pointing substantially above the horizontal axis.

Fluid Supplies - Verification Test Provisions	Document No. JSC-STD-8080.5	Standard No. F-11	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Ground support equipment, facilities, fluid containers, and other equipment to be connected to a spacecraft system for operation, testing, checkout, or maintenance shall be designed so that routine verification tests can be conducted before each connection is made to ensure that each fluid input to the spacecraft will be compatible with the spacecraft system.

Procedures shall be provided to accomplish the verification tests with the equipment.

REMARKS

Instances have occurred where a spacecraft has sustained damage by inputs from equipment which was not checked to be within acceptable limits before it was connected to spacecraft systems.

Protection of Pressurized Systems from Damage Due to Pressurant Depletion - Support Equipment	Document No. JSC-STD-8080.5	Standard No. F-12	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Where maintenance of fluid pressure is critical to prevent major damage to a space vehicle component such as a propellant tank or fuel cell, the ground support equipment (GSE), airborne support equipment (ASE) or flight support equipment (FSE) shall be designed to provide sufficient pressure to the space vehicle component in the event of a failure of the pressurant source.

The GSE, ASE or FSE shall be designed such that recovery from failures of the pressurant source can be accomplished without damage to the space vehicle component.

The GSE, ASE or FSE shall be designed to monitor pressure (or pressure differential) both from the source and to the system.

REMARKS

Depletion of the GSE, ASE or FSE pressure source or line pressure drops resulting from fluid flow have resulted in serious equipment damage in operations where the requirements of this standard were not met.

Good practice is to use separate fluid pressure sources for purge or flushing.

Habitable Module Pressure - Venting Restriction	Document No. JSC-STD-8080.5	Standard No. F-13	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

To prevent over-pressurization, all habitable pressurized elements shall have pressure relief venting systems.

Each pressurized element shall have its own vent system so that venting systems are not shared.

The venting system shall be capable of isolating the flow path from the ambient environment of the pressurized element to space vacuum, and the venting system shall be configurable to or already have online a secondary vent system in the event the primary vent fails.

REMARKS

Contamination control, fire control, and other emergency response procedures require that all pressurized elements of a spacecraft can be isolated from the other pressurized elements, and that each pressurized element can be independently vented.

Experience with Shuttle and ISS have demonstrated that vents can ice up in permanently open or closed positions. Vents can also become corroded by contact with vented products.

Vents should not be shared. Vents can fail and must be capable of isolation from the ambient environment by actions internal to the element and alternate vents should be configurable or concurrently available.

F-14 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Separation Of Hypergolic Reactants	Document No. JSC-STD-8080.5	Standard No. F-15	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Oxidizer and fuel (both liquids and vapors) shall be positively separated using all-metal containment with mixing only allowed in the controlled combustion area.

REMARKS

Common pressurant gas supply for fuel and oxidizer should not be used.

Fluid Line Routing And Installation	Document No. JSC-STD-8080.5	Standard No. F-16	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Flight and GSE fluid line routing and installation shall meet the following requirements:

- Detailed drawings and procedures shall be provided for routing and installation of all fluid lines, including pressure-sensor lines.
- If temperature conditions are not within acceptable limits for the fluid involved, measures shall be taken to provide passive or active thermal control as appropriate.
- A design analysis shall be provided for each line installation to show that the temperature extremes to which it will be subjected (including storage, handling, transportation, and operations) are within acceptable limits for the fluid involved.
- Fluid lines installed external to spacecraft shall be Extravehicular Activity (EVA) compatible, if intended for future EVA maintenance or repair.
- Strain relief shall accommodate design loads, deflections, and thermal expansion.
- Fluid lines shall be restrained at intervals in accordance with the governing standard for the application.
- Fluid lines carrying oxygen shall not be configured with sharp bends that could pose a blunt flow impingement ignition hazard, in accordance with ASTM Manual 36.

REMARKS

EVA compatibility information is provided in JSC 26626A EVA Generic Design Requirements Document.

Cleanliness Of Flowing Fluids And Associated Systems	Document No. JSC-STD-8080.5	Standard No. F-17	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Spacecraft systems that will contain gases or liquids to be used or expended during the mission shall be maintained in the state of cleanliness required by the specification for the particular substance involved after factory assembly and up to and including final servicing prior to flight.

This requirement shall also apply to the gas- and liquid-handling systems of all servicing, maintenance, handling, testing, and checkout equipment.

Such systems fluids, as well as test fluids that enter spacecraft systems, shall be filtered or controlled such that the degree of cleanliness required by the specification for the particular substance is maintained.

Spacecraft systems that will contain such gases or liquids shall be designed so that required draining, flushing, drying, cold trapping, etc. can be accomplished with the spacecraft in its checkout or working attitude. The length of time to accomplish this task shall be presented for approval during design reviews.

Calibration fluids shall be furnished with analysis reports which are signed by the preparer and the source inspection agency

REMARKS

Pressure Relief Valves - Standardization Of Functional Testing	Document No. JSC-STD-8080.5	Standard No. F-18	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

To provide consistency in initial and subsequent testing of pressure relief valves, the manufacturer shall specify values for: crack and reseat pressure, mass-flow rates, pressures corresponding to full flow, and allowable leakage.

These values shall be specified for operation with the flight fluid and any other fluid recommended for test purposes.

Retest time intervals shall be specified for valves that are subject to deterioration with time.

REMARKS

Specific flow-rate values have been found necessary for verification of these valve characteristics with the precision required in preflight checkout.

Cleanliness Protection For Fluid Systems	Document No. JSC-STD-8080.5	Standard No. F-19	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Handling of flight and flight interface GSE fluid systems shall meet the following requirements:

1. Design drawings and/or process specifications shall designate the method of complying with this standard.
2. In each step of the manufacturing process and buildup, all ends of tubing, fittings, and components used in fluid systems shall be protected against damage and entry of contaminants. Equivalent protection shall be provided for tubing, fittings, and/or components when the subsystem is open to effect repair or replacement.
3. Protective caps shall meet the cleanliness requirement of the manufacturing specification. Protective cap material and design shall be compatible with the fluid.
4. All assemblies shall be cleaned and dried before packaging. For oxygen components, cleaning and packaging materials shall not pose residue or particle contamination hazards, in accordance with ASTM Manual 36.
5. Refill procedures shall provide the same protection against damage or contamination as the initial manufacturing procedures establish.
6. Protection devices for components to be installed external to spacecraft shall be Extravehicular Activity (EVA) compatible.
7. Tubing assemblies, fittings, or components that are stored or shipped shall be protected and sealed in a clean, transparent, moisture-proof bag with sufficient protective strength and thickness for the intended handling.

REMARKS

Open plumbing and components must be protected to avoid entrance of foreign material and to protect the sealing surfaces.

Additional protection and procedures may be required by the regulatory authority for the fluid in question.

EVA compatibility information is provided in JSC 26626A EVA Generic Design Requirements Document.

Methods of protection to maintain cleanliness of the hardware include but are not limited to: bagging, handling in a clean room or flow bench, and clean gas purge during assembly.

Fluid Systems - Cleanliness	Document No. JSC-STD-8080.5	Standard No. F-20	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

After manufacturing and after any subsequent exposure to the probable entry of contaminants, fluid systems and servicing equipment shall be cleaned by flushing to remove all contaminants which could be detrimental to the system.

The flushing fluid shall be compatible with the system materials and the working fluid to be used in the system. Cleanliness levels of the flushing fluid and the system maximum allowable contamination shall be specified. During flushing, the fluid entering the system shall be filtered to the same level of cleanliness or better than that of the working fluid to be used in the system.

Whenever it is necessary to verify the cleanliness level of a spacecraft fluid system or its servicing equipment, samples of the fluid leaving the system from draining, purging or flushing operations shall be analyzed to determine that particulate and/or chemical contamination are within specified limits.

The fluid sample shall be taken at the end of the draining, purging or flushing operation.

REMARKS

Purge Gases - Dew Point Requirement	Document No. JSC-STD-8080.5	Standard No. F-21	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Gases used for purging propellant vapors or other vapors from space-vehicle compartments shall have a dew point low enough to preclude moisture condensation from the purge gas on the coldest surfaces that the purging gas will contact.

REMARKS

This standard does not apply to cryogenic system surfaces when in a supercold condition and does not preclude consideration of other problems, such as static electricity or equipment temperature requirements, that may be involved with selection of proper dew point.

Purge gases may become saturated with the vapor being purged. When the gases later come in contact with colder surfaces in the compartment, the absorbed vapor may be deposited on these surfaces.

Transfer of the liquid from the point where it is being absorbed to other locations in the compartment may be dangerous.

<table>
<tr><td rowspan="2">Pressure Garments -
Protection Against Failure Propagation</td><td>Document No.
JSC-STD-8080.5</td><td>Standard No.
F-22</td><td>Page
1 of 1</td></tr>
<tr><td>Previous Revision
04/01/1991</td><td colspan="2">Current as of 08 March 2005:</td></tr>
</table>

STATEMENT OF STANDARD

Systems which supply pressure to crew pressure garments shall be designed so that a major failure of one crew member's garment or garment pressure supply will not cause loss of life to other crew members.

REMARKS

Systems supplying gas to pressure suits should be so designed that an abrupt decompression of the suit of one crew member (such as might result from a rip in the fabric or a broken or unlatched faceplate) will not result immediately in a similar rapid loss of pressure in the suits of the other members or in a sudden total depletion of the gas supply.

The time available before the loss of pressure occurs in the other suits or before a critical depletion of the gas supply occurs should be sufficient to allow:

1. time for reasonable attempts to aid the decompressed crew member (e.g., by closing an unlatched faceplate) and

2. time to shut off flow to the open suit in the event the damage is beyond repair and the crew member cannot be saved.

F-23 has been reclassified as General Standard G-53.

See G-53 for revised standard text.

Fluid Systems - Design For Flushing and Draining	Document No. JSC-STD-8080.5	Standard No. F-24	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Spacecraft fluid systems and related servicing equipment shall be designed to permit complete flushing and draining during ground and on-orbit servicing operations.

The following conditions shall be satisfied, as a minimum:

1. The systems shall be free from dead-ended piping or passages through which flushing fluid cannot be made to flow.

2. Drain and bleed ports shall be provided for attitudes anticipated during ground servicing of the systems.

REMARKS

This standard is to clarify that the design requirements pertain to on-orbit as well as ground servicing operations.

Toxicity - Fluids Contained In Systems In The Crew Compartment	Document No. JSC-STD-8080.5	Standard No. F-25	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Fluids capable of producing toxic fumes shall not be used in systems within the crew compartment if a nontoxic substitute with equivalent performance exists.

Where no satisfactory substitute for the fluid exists, tests shall be performed to ensure that the total leakage is less than the concentration which would result in a level of toxicity that would impair crew health and safety.

REMARKS

<table>
<tr><td rowspan="2">Atmospheric Pressure And Composition Control</td><td>Document No.
JSC-STD-8080.5</td><td>Standard No.
F-26</td><td>Page
1 of 1</td></tr>
<tr><td>Previous Revision
04/01/1991</td><td colspan="2">Current as of 08 March 2005:</td></tr>
</table>

STATEMENT OF STANDARD

Spacecraft and habitable modules shall be designed and operated so that atmospheric pressure and composition control systems maintain a habitable environment under all nominal and contingency operational scenarios.

Provisions shall be made to monitor and control oxygen, nitrogen, carbon monoxide, carbon dioxide, partial and total atmospheric pressure, and credible atmospheric contaminants.

Crew compartments shall be designed with forced ventilation to prevent stagnant air pockets from forming in crew-habitable areas of the compartment.

REMARKS

Nominal and contingency operational scenarios include, but are not limited to: nominal operations, planned or inadvertent fluid system venting into the crew compartment, planned or inadvertent crew compartment venting to space, fluid system leakage into a crew compartment, and crew compartment leakage to space.

Credible contaminants may be organic, inorganic, or biological. Refer to MP-9 for additional information.

In the absence of natural convective air circulation in a microgravity environment, stagnant pockets may accumulate in areas without forced ventilation. Pockets of crew-generated carbon dioxide pose a toxicity hazard to the crew.

Planned or inadvertent venting of inert gas into a crew compartment may reduce oxygen concentration to a level that could pose a confined space hazard.

Planned or inadvertent venting of oxygen into a crew compartment may increase oxygen concentration to a level that poses a fire hazard. Refer to ASTM Manual 36 for guidance on proper selection of crew cabin materials for oxygen- enriched environments.

Liquid or Gas Containers - Verification of Contents	Document No. JSC-STD-8080.5	Standard No. F-27	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

The contents of each individual liquid or gas container to be used in flushing, testing, checkout, and operation of spacecraft and/or life support systems shall be shown by laboratory analysis to conform to specified requirements prior to introduction into the system.

REMARKS

Instances have occurred where incorrect labeling of containers has caused application of incorrect fluids to subsystems.

In other cases, the contents of the container have failed to meet the specified standards of purity. Inspection of shipments by sampling some of the containers has proven unsatisfactory for determining impurities in the entire shipment.

The term “prior to introduction” in the statement is interpreted to mean at the time of introduction of the fluid into the spacecraft system (recommendation is within one month) and prior to exposure of the spacecraft system to possible contamination by that fluid.

F-28 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Filter Protection Of Sensitive Fluid Components	Document No. JSC-STD-8080.5	Standard No. F-29	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Fluid system components subject to malfunction from particulate contamination in zero-gravity or reverse flow situations shall be protected by filters from particulates which might enter from either flow direction.

Filters shall be designed either to accommodate the worst expected conditions of service for their entire expected service life or to be cleaned and/or replaced as a standard maintenance item.

REMARKS

Components subject to malfunction from particulate contamination should be protected on their inlet and outlet by filters.

This applies to both mechanically active (e.g., regulators, solenoid valves, and check valves) and mechanically passive (e.g., porous plate sublimators and membrane separators) components.

Filter Protection Of Sensitive Fluid Components	Document No. JSC-STD-8080.5	Standard No. F-29	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Fluid system components subject to malfunction from particulate contamination in zero-gravity or reverse flow situations shall be protected by filters from particulates which might enter from either flow direction.

REMARKS

Components that are subject to malfunction from particulate contamination should be protected on their inlet and outlet by filters.

This applies to both mechanically active (e.g., regulators, solenoid valves, and check valves) and mechanically passive (e.g., porous plate sublimators and membrane separators) components.

Pressure Relief For Pressure Vessels/Systems	Document No. JSC-STD-8080.5	Standard No. F-30	Page 1 of 2
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Pressure relief capability shall be provided for pressure vessels/systems where the contents, system design, environment or operation may cause an increase in internal pressure above the maximum design pressure (as defined below).

For pressure vessels/systems where pressure can fluctuate only because of external ambient temperature, a mechanical relief device shall not be required provided the fluctuations cannot cause the maximum design pressure to be exceeded.

All flight pressure vessels/systems shall be protected during servicing, either on the ground or in flight, by relief valves in the servicing equipment. The relief valves shall be sized for sufficient mass flow to protect the pressure vessel/system in the event of servicing pressure regulator failure. Such a failure shall not cause the pressure vessel/system to exceed the maximum design pressure.

Where mechanical relief devices are required, they shall be sized for sufficient mass flow to protect the pressure vessel/system from exceeding the maximum design pressure.

The effects of thrust or torque imparted to the pressure vessel or associated equipment by actuation of the relief device shall be considered. The effects of thrust or torque imparted to the spacecraft by actuation of the relief device shall also be considered.

Pressure rise in the compartment where the relief device vent is located shall be assessed at relief device maximum flow conditions.

Continued next page

Pressure Relief For Pressure Vessels/Systems	Document No. JSC-STD-8080.5	Standard No. F-30	Page 2 f 2
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REMARKS

Maximum design pressure is the highest pressure defined by maximum relief pressure and flow capability, maximum failed regulator pressure, maximum temperature or any combination of the above that may occur with one failure. Transient pressures shall be considered.

The pressure vessel/system includes all pressurized hardware (e.g. tankage, lines, fittings, and components).

Portions of fluid systems that can trap fluids (become locked-up) shall be specifically evaluated for the need of relief capabilities.

2.4. Materials and Processes

Materials And Processes Control	Document No. JSC-STD-8080.5	Standard No. MP-1	Page 1 of 1
	Previous Revision 08 March 2005	Current as of 19 October 2009:	

STATEMENT OF STANDARD

Materials used in the fabrication and processing of flight hardware shall comply with NASA-STD-6016, Standard Materials and Processes requirements for Spacecraft.

Applicability to GSE is specified in NASA-STD-6016.

REMARKS

JSC 27301, Materials and Processes Selection, Control, and Implementation Plan for JSC Flight Hardware is used to implement the requirements of NASA-STD-6016 for JSC in-house flight hardware.

Selection of materials is based on the worst-case operational requirements for the particular application and the design engineering properties of the candidate materials.

The operational requirements include, but are not limited to, operational temperature limits, loads, contamination, life expectancy, moisture or other fluid media exposure, and vehicle-related induced and natural space environments.

Properties to be considered in material selection include, but are not limited to, mechanical properties, fracture toughness, flammability and offgassing characteristics, corrosion, stress corrosion, thermal and mechanical fatigue properties, vacuum outgassing, fluids compatibility, microbial resistance, moisture resistance, fretting, galling, susceptibility to electrostatic discharge (ESD).

Conditions that contribute to deterioration of hardware in service receive special consideration.

This standard supersedes JSC-STD-8080.5 (rev. date 3/8/2005) standard MP-1 and incorporates the following standards that were identified separately in JSCM 8080 (rev. date 4/1/91): MP-2, MP-3, MP-4, MP-5, MP-6, MP-7, MP-8, MP-10, MP-12, MP-14, MP-15, MP-16, MP-17, MP-18, MP-19, MP-20, MP-21, MP-23, MP-24, MP-25 (materials/fluids compatibility), and MP-26.

MP Standards 2 - 8 have been cancelled.

See Appendix B for standard text and rationale for cancellation.

Mercury Limitations In Breathable Atmospheres	Document No. JSC-STD-8080.5	Standard No. MP-9	Page 1 of 1
	Previous Revision 04/01/1991	Current as of date signed below:	

STATEMENT OF STANDARD

Direct inhalation breathing systems shall not contain any sources of mercury. Examples include but are not limited to: spacesuits, launch entry suits, underwater breathing systems, environmental chambers, and auxiliary life support systems.

Closed habitable atmospheres shall not contain sources of mercury that could lead to unsafe levels of contamination as determined by the JSC Toxicologist for spaceflight equipment and the Industrial Hygienist for ground support equipment.

REMARKS

If mercury sources are identified, the mercury should either be removed, or a waiver from JSC environmental health should be obtained. If a waiver is obtained and a source of mercury remains in the system, a test of the air will be conducted using calibrated analytical instruments capable of detecting concentrations of mercury less than 0.005 mg/m3. The minimum temperature of a system while undergoing testing will be 20 degrees C (68 degrees F).

JSC 20584, Spacecraft Maximum Allowable Concentrations (SMAC) for Airborne Contaminants defines the limit for continuous exposure to mercury.

JPG 1700.1, The JSC Safety and Health Handbook, Chapter 9.1, Section 19 cites 40 CFR 61, EPA National Emission Standards for Hazardous Air Pollutants (NESHAP), and lists mercury as a restricted substance at JSC.

MP 10 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Pressure Vessel Documentation	Document No. JSC-STD-8080.5	Standard No. MP-11	Page 1 of 2
	Previous Revision 04/01/1991	Current as of date signed below:	

STATEMENT OF STANDARD

Manufacturing, processing, and pressurization histories shall be maintained for each spaceflight pressure vessel. The minimum data required are:

1. Material certification and composition
2. Actual fabrication and processing sequence
3. Fluid exposure and temperature during fabrication and testing
4. Actual chronological tests and checkout history including all proof, leak, and cycling data along with the magnitude of pressure, type of pressurant, and number of pressure cycles to which the tank was subjected
5. Discrepancy history
6. Inspection Plan
7. Damage Control Plan for Composite Overwrapped Pressure Vessels (COPVs)
8. Fracture Control Summary
9. Certification Report

REMARKS – [CONT. NEXT PAGE]

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Pressure Vessel Documentation	Document No. JSC-STD-8080.5	Standard No. MP-11	Page 2 of 2
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REMARKS

Histories may include manufacturing, processing, and pressurization information on pressure vessels, including those used for qualification and other tests. The data should be comprehensive and enable an assessment of the similarity of production units to those subjected to qualification and other nonproduction testing.

Because of the high sensitivity of pressure vessels to structural degradation, which can occur during manufacturing, shipping, handling, and testing, conditions can develop which have not been demonstrated to be acceptable by the qualification test. Documentation should be available to assess the overall condition of each pressure vessel.

In addition to the above minimum requirements, it is desirable to maintain any pertinent backup data that would facilitate an investigation in the event of an unanticipated failure or problem related to the pressure vessel material or related components.

For the purposes of this standard, a pressure vessel is as defined in ANSI/AIAA S-080, “Space Systems-Metallic Pressure Vessels, Pressurized Structures, and Pressure Components”, and ANSI/AIAA S-081, “Space Systems-Composite Overwrapped Pressure Vessels (COPVs)” (see Standard MP-13

).

MP Standard 12 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Pressure Vessel / Special Pressurized Equipment Design And Certification	Document No. JSC-STD-8080.5	Standard No. MP-13	Page 1 of 1
	Previous Revision 04/01/1991	Current as of date signed below:	

STATEMENT OF STANDARD

The design, manufacture, test, inspection, qualification, and use of space systems pressure vessels and special pressurized equipment shall meet the requirements of:

1. American National Standards ANSI/AIAA S-080-1998, *Space Systems-Metallic Pressure Vessels, Pressurized Structures, and Pressure Components*
2. ANSI/AIAA S-081-2000, *Space Systems-Composite Overwrapped Pressure Vessels (COPVs)*

NASA-contracted ground support equipment (GSE) pressure vessels shall meet Center requirements (such as JSC-STD-1710.13, *Design, Inspection, and Certification of Pressure Vessels and Pressurized Systems*) or the pertinent requirements of *The American Society of Mechanical Engineers (ASME) Boiler and Pressure Code for Unfired Pressure Vessels,* Section VIII.

In addition, GSE pressure vessels shall have demonstrated resistance to environmentally-induced flaw propagation sufficient to preclude degradation of the tank under expected use conditions.

REMARKS

Examples of special pressurized equipment include, but are not limited to: dewars, heat pipes, and certain batteries.

This standard supersedes JSCM 8080 (4/1/1991) standards MP-13, MP-23, and MP-25.

MP Standards 14 - 26 have been cancelled.

See Appendix B for standard text and rationale for cancellation.

2.5. Mechanics and Structural

Equipment Containers – Design For Rapid Spacecraft Decompression	Document No. JSC-STD-8080.5	Standard No. MS-1	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2010	

STATEMENT OF STANDARD

Equipment containers or enclosures for use within pressurized compartments of spacecraft shall be designed to withstand rapid decompression of the spacecraft without yielding, fracturing, or sustaining damage.

REMARKS

Rapid decompression is defined as that decompression rate associated with the sudden opening of the largest inlet or outlet which vents to the space environment.

<table>
<tr><td rowspan="2">Alignment, Adjustment, and Rigging of Mechanical Systems</td><td>Document No.
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</table>

STATEMENT OF STANDARD

Mechanical systems requiring accurate alignment, adjustment, or rigging of the system or system components shall incorporate provisions allowing for such alignment, adjustment or rigging to be made without the removal of the system, any of its components, or any neighboring hardware.

Where the actual alignment, adjustment, or rigging equipment is not incorporated into the flight hardware, provisions for mounting and using the necessary alignment, adjustment or rigging equipment shall be incorporated into the flight system.

Where in-flight alignment, adjustment, or rigging is required, such capability shall be incorporated into the flight hardware. If in-flight alignment, adjustment, or rigging requires tooling, the tools shall be standard tools.

REMARKS

MS-3 has been reclassified as Electrical Standard E-25.

See Section 2.2 Electrical for standard text

Crew Hatches	Document No. JSC-STD-8080.5	Standard No. MS-4	Page 1 of 2
	Previous Revision 04/01/1991	Current as of 08 March 2010	

STATEMENT OF STANDARD

Crew hatches shall meet the following requirements.

1. OPERATION
   a. Hatches and associated hardware (hinges, latches, actuators, attenuators, seals, etc.) shall be designed for repeated operation.
   b. Hatches shall be designed to be operable on the ground with the vehicle in any ground processing orientation.
   c. Hatches shall be capable of one-handed operation under zero-g conditions.
   d. Hatches shall be capable of being manually closed and opened from both sides.
      i. Internal hatches shall have in-place provisions for latch-unlatch and opening operations from either side of the hatch.
      ii. External hatches shall have in-place provisions for latch-unlatch and opening operations from the interior of the hatch, and shall have provisions for latch-unlatch and opening operations from the exterior of the hatch.
   e. Hatch latch actuation shall require two (2) separate and distinct operations to unlatch.
   f. The hatch latch mechanism shall have an indicating system to display hatch latch locked and safe.
   g. Internal hatches shall have a means of pressure equalization and display of pressure delta across the hatch on each side of each hatch.
   h. Opening assist devices shall be provided to break the seals of the hatch to allow the differential pressure across the hatch to reduce to an acceptable level before releasing the hatch to the fully open position.

2. MAINTENANCE
   a. Hatches and associated hardware (hinges, latches, actuators, attenuators, seals, etc.) shall be designed to allow for inspection.
   b. Hatches shall have provisions for ease of removal.
   c. All associated hatch hardware (hinges, latches, actuators, attenuators, seals, etc.) shall be designed to be repairable, replaceable, or both on the ground. If operated during flight, all associated hardware shall be designed to be repairable, replaceable, or both during flight.

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Crew Hatches	Document No. JSC-STD-8080.5	Standard No. MS-4	Page 2 of 2
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3. SEAL INTEGRITY
   a. The capability shall be provided to leak check between redundant pressure seals without pressurizing/depressurizing the adjacent pressure volumes.

b. The capability for verification of hatch seal integrity shall be provided on both sides of the hatch.

4. THERMAL AND STRUCTURAL LOADS
   a. Hatches and associated mechanisms shall not be designed to carry primary structural loads.
   b. The design of the structure surrounding hatches used in escape operations shall consider provisions to minimize the probability of jamming which would prevent crew egress following emergency landing or ditching.
   c. Hatches and associated mechanisms shall allow for differential movement between structural frame and the hatch as well as maintain compartment sealing under these conditions.
5. VISIBILITY
   a. Hatches shall incorporate a window designed in accordance with NASA STD 3000.

REMARKS

Refer to MS-8 for hatch requirements related to ground and emergency operations; G-9 Exclusion of Shatterable Material and MS-7 Window and Glass Structure for requirements with respect to the use of glass

Threaded Fasteners	Document No. JSC-STD-8080.5	Standard No. MS-5	Page 1 of 2
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STATEMENT OF STANDARD

1. All fasteners shall meet the following generic requirements.
   a. Thread form of all fasteners shall be UN, UNJ, UNR, or ACME.
      i. Fasteners with the external thread form UNJ shall only be used in conjunction with internal thread form UNJ.
   b. Use of liquid locking compounds such as Vibratite and Loctite shall meet the requirements of JSC 49774 (Rev. A), *Standard Manned Spacecraft Requirements for Materials and Processes*.
   c. Use of silver-plated fasteners shall meet the requirements of JSC 49774.
   d. Wet installation of fasteners shall meet the requirements of JSC 49774.
   e. Installation of titanium fasteners and associated parts shall meet the requirements of JSC 49774.
   f. Each fastener system shall incorporate at least one verifiable locking feature.
      i. Loosening of fasteners with only one verifiable locking feature shall be addressed in the “Failure Modes and Effect Analysis” (FMEA) or other hazard analysis document.
   g. Fasteners shall be designed or selected to minimize the generation of particulate debris or foreign material. Self-tapping screws and bolts shall not be used.

2. All fasteners defined as “Safety Critical Fasteners” (see Remarks) shall meet requirement 1 above and the following additional requirements:
   a. Each fastener system shall incorporate at least two separate verifiable locking features.
      i. At least one locking feature shall be positive torque locking and vibration rated.
      ii. Joint preload may be counted as one of the locking features provided the preload level is adequate to produce the intended locking effect.
   b. Joints subject to rotation shall use at least one non-friction locking feature such as cotter pins or lockwire.
   c. Preload torques and running torques, along with their acceptable ranges, shall be specified on the installation drawings.
   d. Installation procedures shall include performing and recording functional verification of the locking feature for each individual fastener such as measurement of running torque or visual inspection of locking feature integrity.
   e. Installation procedures shall include functional verification of preload such as measurement of preload torque.

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Threaded Fasteners	Document No. JSC-STD-8080.5	Standard No. MS-5	Page 2 of 2
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3. All fasteners defined as “Safety Critical Fasteners” (see Remarks) that are installed, removed, or adjusted during the mission shall meet requirements 1 and 2 above and the following additional requirements:
   a. At least one side of the fastener interface shall be lubricated.
      i. If both internal and external threads of the fastener interface are dry-film lubricated and the interface has a significant life requirement, the interface shall be life-tested.
      ii. Fastener male and female interfaces shall be gauged or fit-checked (in and out) at room temperature after application of lubrication to verify no interference between the fastener interfaces.
      iii. Fasteners with dry-film lubrication shall undergo burnishing or wear-in.
   b. Provisions shall be made to reduce the possibility of cross-threading for EVA fasteners installed during the mission. See Remarks for suggested methods

REMARKS

Fasteners intended for an IVA operation must be designed in accordance with NASA-STD-3000.

Safety Critical Fastener – A fastener whose failure could potentially result in a Critical Hazard or a Catastrophic Hazard.

Critical Hazard – Hazard that can result in a non-disabling personnel injury, damage to flight hardware, ground facilities, or mission-critical equipment, or loss of mission.

Catastrophic Hazard – Hazard that can result in a disabling or fatal personnel injury or loss of flight hardware, ground facilities, or mission-critical equipment.

Self Locking (Running, Prevailing) Torque – Torque required to overcome kinetic friction of the mating threads plus the torque required to overcome the kinetic friction of the locking feature when 100 percent of the locking feature is engaged and the fastener is unseated. This torque can be measured in a loosening or tightening direction.

Positive Torque Locking – Device or feature that positively locks the fastener, or a self locking feature that retains full running torque after relief of preload.

Suggested methods to prevent cross threading of EVA fasteners include separate or integral alignment features, choice of thread form, ensuring proper visibility during installation, and eliminating shear loads on the fastener during installation. These methods are also suggested for safety critical IVA fasteners installed during the mission.

MS-6 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Windows And Glass Structure	Document No. JSC-STD-8080.5	Standard No. MS-7	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2010	

STATEMENT OF STANDARD

The design of all spacecraft windows and other glass structures shall include evaluation of flaw growth under the design stress and environment. A fracture mechanics analysis shall be performed for each configuration of glass structure. A proof acceptance test consistent with the type of loading shall be conducted to screen flaws in each glass structural flight item based on the results of the fracture mechanics analysis. All proof testing shall be performed in a suitable environment to limit flaw growth during the proof testing.

Until a satisfactory fracture mechanics analysis can be provided for tempered glass structures, a fracture mechanics analysis may be performed on an annealed glass structure of the same material composition, and the tempered glass proof test rationale can be based on this analysis. The design environment for the tempered glass shall be used for the annealed glass analysis.

REMARKS

Windows and other glass structures (optics, instrument covers, etc.) include any piece of glass and other glass-like materials, such as germanium and sapphire, which must carry stress and which, if broken, will endanger the crew or the mission success.

Television, photographic, and other electro-optical device lenses, which do not carry stress, are specifically exempted from this standard. See standard G-9 for guidance on controlling hazards associated with these items.

Spacecraft windows and glass structures in instruments and optical equipment must be designed with adequate structural rigor. Window design requirements and structural characteristics of glass must be clearly understood for application in environments associated with spacecraft. Fracture mechanics analysis is the best method for understanding and evaluating the structural characteristics of glass and for providing the structural rationale specifying proof test requirements.

Penetration Of Inhabited Spacecraft Compartments	Document No. JSC-STD-8080.5	Standard No. MS-8	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2010	

STATEMENT OF STANDARD

Inhabited spacecraft compartments shall be so designed that all penetrations shall take advantage of normal pressure-induced forces to aid in maintaining vessel structure and cabin pressure integrity.

The primary flight crew ingress/egress hatch used during ground operations shall be designed to be outward opening from the pressurized spacecraft compartment. For designs where it is impractical to have an outward opening hatch, provisions shall be made to rapidly equalize the pressure across the hatch.

Reliable, redundant safety devices shall be provided to prevent inadvertent opening or rapid depressurization on orbit.

REMARKS

Penetrations include ingress/egress and manufacturing access hatches.

The purpose of the outward opening feature specified is to enable rapid egress of the crew from the spacecraft.

Positive Indication Of Status For Mechanisms	Document No. JSC-STD-8080.5	Standard No. MS-9	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2010	

STATEMENT OF STANDARD

All movable mechanical systems shall provide positive indication that the mechanism has achieved its desired position.

REMARKS

Examples of desired position include ready-to-latch, latched, locked, stowed, deployed, etc.--any state in which a failure to achieve this state results in a failure of the mechanism to perform its function.

MS-10 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

<table>
<tr><td rowspan="2">Meteoroid And Orbital Debris Protection Levels For Structures</td><td>Document No.
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</table>

Protection levels against impacts from micrometeoroids and orbital debris (MMOD) for spacecraft structures shall be determined by hypervelocity impact tests and analysis.

The risks for loss of crew, loss of vehicle, and loss of mission from MMOD shall be established. Such risks shall be equal to or better than MMOD risks for previous spacecraft programs.

STATEMENT OF STANDARD

The MMOD risk assessments shall be updated as the MMOD environment definitions change.

Actual damage from MMOD impacts shall be identified and compared to predictions in order to track and trend MMOD effects on the spacecraft.

REMARKS

Empirical equations have been derived from hypervelocity impact testing on a variety of single-sheet or double-sheet structures. When the structural configuration differs significantly from the test specimen configurations from which the equations were derived, the equations cannot be considered accurate. For example, if multilayer insulation is added, the equations are likely to be invalid; or if a honeycomb core joins the MMOD bumper to the main structural shell, the protection level may be significantly altered.

Hypervelocity impact tests are considered to be the most accurate method of determining the protection levels of spacecraft structures. Current impact test capabilities are limited in velocity such that tests cover only a portion of the MMOD threat. The mass of test particles should be determined by test at the ballistic limit (or failure limit) of the structure in question as a function of impact velocity, angle and particle density, and extended by analytical means to cover all MMOD impact conditions. The resulting ballistic limit equations are used in probability analysis to assess MMOD risks for the spacecraft.

Remarks continued next page

Meteoroid And Orbital Debris Protection Levels For Structures	Document No. JSC-STD-8080.5	Standard No. MS-11	Page 2 of 2
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REMARKS [CONT.]

Suggested references:

1. NASA SP-8042, Meteoroid Damage Assessment, 1970;
2. NASA TP-2003-210788, Meteoroid/Debris Shielding, 2003
3. NASA SP-8013, Meteoroid Environment Model, 1969

The Program will establish requirements for MMOD protection that provides for crew safety, vehicle survivability and mission success. Different levels of allowable MMOD risk have historically been specified for loss-of-crew (LOC), loss-of-vehicle (LOV), early mission termination/loss-of-mission (LOM), and functional failure for equipment and systems that can degrade mission success. Future crewed spacecraft should be designed to meet or exceed levels of MMOD protection provided by previous spacecraft, in particular the Apollo Program, the International Space Station (ISS), and the Space Shuttle.

Risks from MMOD impact can be mitigated by a combination of design and operational options including but not limited to: advanced low-weight shielding, leak stop or self-sealing materials in the shielding, leak detection/damage detection sensors and repair procedures, collision avoidance maneuvers from trackable orbital debris, and flying low-MMOD risk attitudes.

The orbital debris environment and to a certain extent meteoroid environment definition models are subject to change. Spacecraft MMOD risk assessments must be updated with the latest MMOD environment definitions that have been officially released and accepted by NASA.

Actual MMOD impact damage to the spacecraft should be monitored during the life of the program for: trending MMOD damage, comparing predictions, and identifying any potential near-misses for potential corrective action to reduce MMOD risk.

MMOD damage can be monitored through photo evaluation on-orbit or by examination of returned surfaces on ground.

Spacecraft Recovery Hoist Loops	Document No. JSC-STD-8080.5	Standard No. MS-12	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2010	

STATEMENT OF STANDARD

Spacecraft recovery hoist loops shall be provided on all recoverable spacecraft.

Design of the spacecraft recovery hoist loop(s) shall be based on the following minimum requirements:

1. Before retrieval, a minimum open area equivalent to that of a 10-inch diameter circle shall be deployed. When the spacecraft is in its normal flotation or upright attitude, the loop shall be visible and accessible to retrieval personnel. The loop shall be located with respect to the spacecraft center of gravity such that the spacecraft may be readily carried and/or placed aboard the recovery vessel, vehicle, aircraft, etc. in a stable position.

2. The load envelope for the hoist loop and backup structure shall be derived from an analysis which considers the dynamic load resulting from relative motion of the spacecraft and the recovery vessel, vehicle, or aircraft. Factors to be considered in this analysis shall be defined for each particular case. In general, the minimum factors to be included in the analysis shall be:
   a) Spacecraft weight, including the effect of trapped water, unspent fluids, and cargo
   b) The relative motion of the spacecraft and the recovery vessel, vehicle, or aircraft resulting from worse case conditions in the recovery area
   c) Retrieval winch in-haul speed
   d) Stiffness characteristics of the retrieval line

3. The recovery hoist loop shall be adequate to withstand the environment experienced when the spacecraft is carried externally by a recovery vessel, vehicle, or aircraft. The environment to be considered shall be defined for each particular case.

REMARKS

Hoisting weights and accelerations vary considerably from one spacecraft type to another.

Spacecraft	Spacecraft dry weight	Spacecraft hoisting weight
Mercury	1,088.6 kg (2,400 lb)	4,535.9 kg (10,000 lb) (including water trapped in landing attenuation bag)
Gemini	1,769 kg (3,900 lb)	2,268 kg (5,000 lb)

MS-13 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

Structural Analysis	Document No. JSC-STD-8080.5	Standard No. MS-14	Page 1 of 1
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STATEMENT OF STANDARD

Structural analysis shall be performed on all spacecraft structures, including pressure vessels, to show that all elements of the design such as the strength, stiffness, structural stability, and life meet all specified criteria for the anticipated loads and environments.

The analyses shall include stress analyses, fatigue or fracture analyses, loads and environmental data, and the appropriate references for the purpose of certifying the flightworthiness of structures.

The analyses shall be compiled and documented as part of certification of the flightworthiness of the structure.

The analyses shall comply with NASA-STD-5001 "STRUCTURAL DESIGN AND TEST FACTORS OF SAFETY FOR SPACEFLIGHT HARDWARE".

REMARKS

Fluid Systems - Method Of Joining Metallics	Document No. JSC-STD-8080.5	Standard No. MS-15	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2010	

STATEMENT OF STANDARD

Metallic vessels, tubing, and fittings used in fluid systems (pressurized / non-pressurized) shall be joined by brazing or welding except where:

1) mechanical disconnects are required for replacement or servicing,
2) components would be adversely affected by brazing or welding, or
3) brazing or welding cannot be performed or verified.

REMARKS

Welding and brazing are considered more reliable methods for joining metallic vessels, tubing, and fittings in order to prevent leaks.

Fluid systems in this context refer to both liquid and gas.

Pressure Vessels – Negative Pressure Damage	Document No. JSC-STD-8080.5	Standard No. MS-16	Page 1 of 2
	Previous Revision 04/01/1991	Current as of 08 March 2010	

STATEMENT OF STANDARD

Pressure vessels shall be evaluated for susceptibility to damage by negative pressures that could occur during fabrication, testing, installation, transportation, storage, servicing, operation, and maintenance.

Those vessels identified as susceptible to damage shall be appropriately tagged and protected against negative pressure during the life cycle of the tank, particularly during manufacturing and testing, by detailed formal procedures or protective devices.

Where such protection is not required in flight, the protection shall be provided as part of the ground equipment.

REMARKS

For the purposes of this standard, "negative pressure" exists when the external pressure exceeds the internal pressure of the vessel.

Thin-walled pressure vessels and tanks designed for use in space vehicles are often vulnerable to very costly damage by relatively small negative pressure differentials. This problem is particularly prevalent during initial manufacture and ground testing on new programs. The intent of this standard is to have all vessels reviewed early in the program to identify those vessels susceptible to this type damage so protective measures can be taken in all phases of the vessel life cycle. The preventive measure selected for specific vessels will vary with programs and considerations of safety, initial cost of vessel, cost of protection, and time required for and cost of replacement or repair of the vessel.

Remarks continued on next page.

Pressure Vessels – Negative Pressure Damage	Document No. JSC-STD-8080.5	Standard No. MS-16	Page 2 of 2
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REMARKS [CONT.]

Typical sources of negative pressure damage to pressure vessels include the following:

1. Premature closure of manually operated vent during draining.

2. Rupture of a service line, allowing vessel to drain without venting. Check valves in the vent line or insufficient venting through a vent not designed for this contingency has contributed to this problem.

3. Use of a vacuum hose to remove cutting chips from a service line connected to a vessel that was not vented.

4. Failure of vents to compensate for rate of descent of aircraft during air transportation.

5. Undetected leakage of internal pressure during altitude chamber testing when the chamber is repressurized

2.6. Pyrotechnics

Pyrotechnic Devices- Arming And Disarming	Document No. JSC-STD-8080.5	Standard No. P-1	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

In the design and operation of spacecraft systems, provisions shall be made for arming pyrotechnic devices as near to the time of expected use as is feasible without compromising reliability or safety.

Provisions shall be made to promptly disarm pyrotechnic devices when no longer needed.

"Arm" and "fire" shall be separate functions that are separately controlled and displayed.

Manual arm and fire switches shall be physically separate and guarded.

REMARKS

"As near to the time of expected use as is feasible" would mean that it is preferable to arm the device within seconds of use as opposed to hours or days. This would prevent leaving a pyrotechnic device armed for an extended period of time and thus prevent premature firing of the device.

Premature firing of a pyrotechnic device could jeopardize the crew and/or mission.

Pyrotechnic Devices Preflight Verification Tests	Document No. JSC-STD-8080.5	Standard No. P-2	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

For newly (less than 5 years of service) designed pyrotechnic systems and devices, within 365 days (1 year) of each scheduled spacecraft launch, one device from each lot of pyrotechnic devices installed on that (scheduled) spacecraft shall be fired in a performance test, performed at ambient temperature.

The test equipment, instrumentation, and procedures shall be adequate to permit an accurate comparison of data with the appropriate lot acceptance test data.

The criteria for device performance shall be the same as for lot acceptance of the device.

For existing (more than 5 years of service) pyrotechnic designs, with a successful performance history, a Pre-Flight Verification Test shall not be required. Existing test screening including environment and destructive test firings during Lot Acceptance Testing and age-life extension shall be used instead of the Pre-Flight Verification Testing.

REMARKS

The object of these tests is to reduce the probability of installing hardware that has become degraded.

These tests are in addition to all other tests, destructive or nondestructive, such as qualification, certification, lot acceptance, receiving, and preinstallation.

This test shall be performed as late as possible prior to the flight use of the subject lot.

Pre-Flight Verification Tests (PVTs) are not required for a pyrotechnic device used within 1 year of its manufacturing date (i.e., the Lot Acceptance Test data suffices for 1 year.)

P-3 – P-4 have been cancelled.

See Appendix B for standard text and rationale for cancellation.

Pyrotechnic Devices- Identification Requirements	Document No. JSC-STD-8080.5	Standard No. P-5	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

Pyrotechnic devices shall be labeled on exterior surface with the following minimum information:

1. NASA part, lot and serial numbers
2. Contractor and Government Entity (CAGE) code
3. Date of Manufacture

Pyrotechnic devices shall be identified and stored with the following information:

1. Part name
2. CAGE Code
3. Manufacturer
4. Part, lot, and serial number
5. Date of manufacture

REMARKS

This standard furnishes a checklist of identification requirements for pyrotechnic devices. This information is necessary for the handling, storing, installation, and traceability for explosive devices.

Documentation requirements which were identified in the earlier version(s) of this Standard are specifically addressed in NSTS 08060, Space Shuttle Pyrotechnic Specification, paragraph 5.4.2, Lot Acceptance Data Package.

Protection Of Electrical Circuitry For The NASA Standard Initiator	Document No. JSC-STD-8080.5	Standard No. P-6	Page 1 of 1
	Previous Revision 04/01/1991	Current as of 08 March 2005:	

STATEMENT OF STANDARD

The firing circuits for the NASA Standard Initiator (NSI) shall include:

1. A means of limiting current surges resulting from multiple instantaneous firings

2. Protection for the power supplies for the NSI to prevent power loss or voltage drops that might result from postfiring short circuits in the devices.

The protective means shall in no way degrade operation or reliability of the electroexplosive device (EED).

REMARKS

Electrical Circuit Requirements for Shuttle pyros are delineated in NSTS 08060, Space Shuttle Pyrotechnic Specification, paragraph 8.0. Specific firing circuit characteristics appear in paragraph 8.2 and include references to balanced, shielded, twisted-pairs of leads. Voltage breakdown from the balanced two-wire line to vehicle structure or direct current return should be greater than 1500 VAC RMS at a frequency of 60 Hz.

Fusistors may be provided when necessary to prevent high current surges during EED firing and to limit current and interrupt flow in the event of a post firing short in the EED.

Pyrotechnics for Shuttle also meet the requirements of NSTS 07636, Lightning Protection. Also reference NSTS 08060 Space Shuttle Pyrotechnic Specification paragraph 8.3.1.1 for lightning protection.

P-7 has been cancelled.

See Appendix B for standard text and rationale for cancellation.

SECTION 3

KEY WORD INDEX

3.0 KEY WORD INDEX

How To Use This Key Word Index:

Words that indicate the scope of the JPR Design and Procedural Standards are presented in alphabetical order in the following list of key words. Next to the key words, the applicable standards are referenced. They are listed both by title and alphanumeric category code. Key word listings for cancelled standards have been removed.

The actual standards are located in Section 2, arranged numerically within their respective categories

KEY WORD	STD. NO.	STANDARD TITLE
ACCEPTANCE	E 08	Electrical and Electronic Supplies and Loads - Verification Tests
	F 11	Fluid Supplies - Verification Tests
	M/S 07	Windows and Glass Structure
	E 24	Electrical Wire and Cable Acceptance Tests
ACCESSIBILITY	G 01	Equipment Accessibility for Maintenance
	F 04	Ground Service Points - Fluid Systems
	M/S 02	Alignment of Mechanical Systems
ADJUSTMENT	M/S 02	Alignment of Mechanical Systems
ALIGNMENT	M/S 02	Alignment of Mechanical Systems
ANALYSIS	G 16	Operating Limits on Temperature-Controlled Equipment
	G 37	Verification of Adequate External Visibility
	G 48	Onboard Experiments - Required Preinstallation Checklist
	F 09	Spacecraft VentinG Induced Perturbing Forces
	F 16	Fluid Line Installation
	F 20	Fluid Systems - Cleanliness
	F 23	Qualification Fluid
	F 27	Liquid or Gas Containers - Verification of Contents
	M/P 26	Repair of Sandwich-Type Structures
	M/S 07	Windows and Glass Structure
	M/S 12	Spacecraft Recovery Hoist Loops
	M/S 14	Structural Analysis
ANOMALY	G 15	Equipment Failure - Verification of Flight Readiness
ARM	P 01	Explosive Devices - Arming and Disarming
ATTITUDE	G 29	Reentry Propulsion Subsystem In-Flight Test
	G 44	Attitude Control Authority
	F 09	Spacecraft Venting Induced Perturbing Forces
AUTOMATIC CONTROL	G 44	Attitude Control Authority
AUTOMATIC SHUTDOWN	E 18	Circuitry for Automatic Shutdown of Launch Vehicle Engine(s)
BIOINSTRUMENT ATION	E 13	Bioinstrumentation Systems - Crew Electrical Shock Protection
BRAZE	M/S 15	Stainless Steel Tubing - Method of Joining
BREATHING ATMOSPHERE	F 26	Atmospheric Pressure and Composition Control
CABLE	E 24	Electrical Wire and Cable Acceptance Tests
CAPACITOR	E 07	Tantalum Wet Slug Capacitors - Restriction on Use
CAPPING	F 07	Capping of Servicing and Test Ports
CARBON DIOXIDE	F 26	Atmospheric Pressure and Composition Control
CHECKLIST	G 48	Onboard Experiments - Required Preinstallation Checklist

CIRCUIT	G 02	Separation of Redundant Equipment
CIRCUIT BREAKER	E 09	Electrical Circuits - Deenergizing Requirement
	E 15	Electrical Power Distribution Circuits - Overload Protection
CLASSIFICATION	G 14	Identification and Classification of Flight and Nonflight Equipment
CLEANLINESS	G 04	Protection of Spacecraft Electrical and Mechanical Systems From Debris
CLEANLINESS	G 05	Interior Design of Spacecraft for Cleanliness
	G 20	Spacecraft Equipment - Protection From System Liquids
	E 10	Cleaning of Electrical and Electronic Equipment
	E 11	Protective Covers or Caps for Electrical Receptacles and Plugs
	F 10	Nozzles and Vents - Protection Prior to Launch
	F 14	Crew Cabin Module Ventilating Fans - Protection From Debris
	F 17	Cleanliness of Flowing Fluids and Associated Systems
	F 20	Fluid Systems - Cleanliness
	F 24	Fluid Systems- Design for Flushing and Draining
	F 27	Liquid or Gas Containers - Verification of Contents
	M/S 05	Threaded Fittings - Restrictions on Release of Particles and Foreign Material
CLOSURE	E 17	Electrical and Electronic Piece Parts - Closure Construction
COATING	M/S 03	Wire Bundles - Protective Coating
COLOR CODE	P 07	Explosive Devices - Color Coding Requirements
COMPARTMENT	M/S 08	Penetration of Inhabited Spacecraft Compartments
COMPONENT	G 10	Control of Limited-Life Components
	F 08	Fluid System Components Whose Function Is Dependent on Direction of Flow - Protection Against Incorrect Installation
	F 19	Protection for Tubing, Fittings, and Fluid System Components - Flight Hardware and Associated Equipment
CONNECTOR	G 02	Separation of Redundant Equipment
	E 01	Mating Provisions for Electrical Connectors
	E 04	Electrical Connectors - Moisture Protection
	E 05	Electrical Connectors - Pin Assignment
	E 09	Electrical Circuits - Deenergizing Requirement
	E 12	Electrical Connectors - Disconnection for Troubleshooting and Bench Testing
	E 14	Electrical Wire Harnesses - Dielectric Tests
	F 03	Service Points - Positive Protection From Interchangeability of Fluid Service Lines
	M/P 01	Material Selection, Review, and Drawing Sign-Off

CONNECTOR	P 07	Explosive Devices - Color Coding Requirements
CONSTRUCTION	E 17	Electrical and Electronic Piece Parts - Closure Construction
CONTAINER	F 27	Liquid or Gas Containers - Verification of Contents
	M/S 01	Equipment Containers - Design for Rapid Spacecraft Decompression
CONTENT	F 27	Liquid or Gas Containers - Verification of Contents
CONTROL	G 01	Equipment Accessibility for Maintenance
	G 10	Control of Limited-Life Components
	G 22	Parts Identification
	G 31	Detachable Crew-Operated Tools - Restriction in Spacecraft
CORONA	E 06	Corona Suppression
CORROSION	M/P 01	Material Selection, Review, and Drawing Sign-Off
COVER	E 11	Protective Covers or Caps for Electrical Receptacles and Plugs
	F 10	Nozzles and Vents - Protection Prior to Launch
COVERGUARD	G 30	Switch Protection Devices
CREW STATION	G 30	Switch Protection Devices
	G 31	Detachable Crew-Operated Tools - Restriction in Spacecraft
CREW STATION	G 32	Measurement Systems That Display Flight Information to the Crew - Indication of Failure
CURRENT LIMITING	P 06	Protection of Electrical Circuitry for Explosive Devices Employing Hot Bridgewire Initiators
CUT	E 02	Protection of Severed Electrical Circuits
DATA	G 12	Application of Previous Qualification Tests
	M/P 11	Pressure Vessel Documentation
DEBRIS	G 04	Protection of Spacecraft Electrical and Mechanical Systems From Debris
	G 05	Interior Design of Spacecraft for Cleanliness
	F 14	Crew Cabin Module Ventilating Fans - Protection From Debris
DECOMPRESSIO N	F 22	Pressure Garments - Protection Against Failure Propagation
	M/S 01	Equipment Containers - Design for Rapid Spacecraft Decompression
DEENERGIZE	E 09	Electrical Circuits - Deenergizing Requirement
DEFORMATION	G 46	Separation Sensing System - Structural Deformation
DERATE	E 15	Electrical Power Distribution Circuits - Overload Protection
DESIGN	G 01	Equipment Accessibility for Maintenance
	G 02	Separation of Redundant Equipment
	G 03	Systems Checkout Provisions
	G 04	Protection of Spacecraft Electrical and Mechanical Systems From Debris

DESIGN	G 05	Interior Design of Spacecraft for Cleanliness
	G 08	Redundant Paths - Verification of Operation
	G 19	Special Processes - Identification of Drawings
	G 20	Spacecraft Equipment - Protection From System Liquids
	G 21	Spacecraft Equipment - Moisture Protection
	G 38	Pressurization or Repressurization - Precluding Ingress of Undesirable Elements
	G 39	Lightning Protection Design
	G 40	Radioactive Luminescent Devices
	G 48	Onboard Experiments - Required Preinstallation Checklist
	E 05	Electrical Connectors - Pin Assignment
	E 09	Electrical Circuits - Deenergizing Requirement
	E 19	Equipment Design - Power Transients
	E 22	Ionizing Radiation Effects
	F 01	Flow Restriction Requirements - Pressurized Sources
	F 03	Service Points - Positive Protection From Interchangeability of Fluid Service Lines
	F 04	Ground Service Points - Fluid Systems
	F 05	Fluid Lines - Separation Provisions
	F 12	Protection of Pressurized Systems From Damage Due to Pressurant Depletion - Ground Support Equipment and Airborne Support Equipment
	F 13	Crew Cabin Module Pressure - Venting Restriction
	F 15	Separation of Hypergolic Reactants
	F 16	Fluid Line Installation
	F 17	Cleanliness of Flowing Fluids and Associated Systems
	F 24	Fluid Systems - Design for Flushing and Draining
DESIGN	M/P 13	Pressure Vessel Design
	M/S 01	Equipment Containers - Design for Rapid Spacecraft Decompression
	M/S 02	Alignment of Mechanical Systems
	M/S 07	Windows and Glass Structure
	M/S 11	Meteoroid Protection Levels for Structures
	M/S 12	Spacecraft Recovery Hoist Loops
	P 01	Explosive Devices - Arming and Disarming
DETECTION	F 26	Atmospheric Pressure and Composition Control
DIELECTRIC	E 14	Electrical Wire Harnesses - Dielectric Tests
DISARM	P 01	Explosive Devices - Arming and Disarming
DISCONNECT	E 02	Protection of Severed Electrical Circuits
DISPLAY	G 01	Equipment Accessibility for Maintenance
DISPLAY	G 31	Detachable Crew-Operated Tools - Restriction in Spacecraft
	G 32	Measurement Systems That Display Flight Information to the Crew - Indication of Failure
DOCUMENTATION	G 10	Control of Limited-Life Components

DOCUMENTATION	G 11	Procurement Document Identification for Manned Spaceflight Vehicle Items
	G 12	Application of Previous Qualification Tests
	G 22	Parts Identification
	G 50	Direct Procurement of Parts
	M/P 11	Pressure Vessel Documentation
	M/P 26	Repair of Sandwich-Type Structures
	P 03	Wire Splicing
DRAIN	F 17	Cleanliness of Flowing Fluids and Associated Systems
	F 20	Fluid Systems - Cleanliness
	F 24	Fluid Systems - Design for Flushing and Draining
DRAWING	G 19	Special Processes - Identification of Drawings
ELECTRICAL	G 01	Equipment Accessibility for Maintenance
	G 02	Separation of Redundant Equipment
	G 03	Systems Checkout Provisions
	G 04	Protection of Spacecraft Electrical and Mechanical Systems From Debris
	G 23	Pressure Garment Wiring - Ignition of Materials by Electrical Current
	G 30	Switch Protection Devices
	G 44	Attitude Control Authority
	E 01	Mating Provisions for Electrical Connectors
	E 02	Protection of Severed Electrical Circuits
	E 03	Electrical and Electronic Devices - Protection From Reverse Polarity and/or Other Improper Electrical Inputs
	E 04	Electrical Connectors - Moisture Protection
	E 05	Electrical Connectors - Pin Assignment
	E 06	Corona Suppression
	E 07	Tantalum Wet Slug Capacitors - Restriction on Use
	E 08	Electrical and Electronic Supplies and Loads - Verification Tests
	E 09	Electrical Circuits- Deenergizing Requirement
	E 10	Cleaning of Electrical and Electronic Equipment
ELECTRICAL	E 11	Protective Covers or Caps for Electrical Receptacles and Plugs
	E 12	Electrical Connectors - Disconnection for Troubleshooting and Bench Testing
	E 13	Bioinstrumentation Systems - Crew Electrical Shock Protection
	E 14	Electrical Wire Harnesses - Dielectric Tests
	E 15	Electrical Power Distribution Circuits - Overload Protection
	E 16	Testing Protective Devices for Solid-State Circuits
	E 17	Electrical and Electronic Piece Parts - Closure Construction

ELECTRICAL	E 18	Circuitry for Automatic Shutdown of Launch Vehicle Engine(s)
	E 19	Equipment Design - Power Transients
	E 20	Control of Electrostatic Discharge for Electronic Parts and Assemblies
	E 22	Ionizing Radiation Effects
	E 24	Electrical Wire and Cable Acceptance Tests
	M/S 01	Equipment Containers Design for Rapid Spacecraft Decompression
	M/S 03	Wire Bundles Protective Coating
	P 03	Wire Splicing
	P 04	Explosive Devices Packaging Material
	P 06	Protection of Electrical Circuitry for Explosive Devices Employing Hot Bridgewire Initiators
ELECTRICAL SHOCK	E 13	Bioinstrumentation Systems Crew Electrical Shock Protection
ELECTROSTATIC DISCHARGE	E 20	Control of Electrostatic Discharge for Electronic Parts and Assemblies
ENGINE	E 18	Circuitry for Automatic Shutdown of Launch Vehicle Engine(s)
ENVIRONMENT	G 28	Sealing Solid Propellant Rocket Motors
	G 45	Solid Propellant Rocket Motors Ignition Capability With Unsealed Nozzle
	E 04	Electrical Connectors Moisture Protection
	E 06	Corona Suppression
	F 01	Flow Restriction Requirements Pressurized Sources
	F 16	Fluid Line Installation
	M/P 01	Material Selection, Review, and Drawing Sign Off
	M/S 01	Equipment Containers Design for Rapid Spacecraft Decompression
	M/S 11	Meteoroid Protection Levels for Structures
EQUIPMENT	G 02	Separation of Redundant Equipment
	G 15	Equipment Failure Verification of Flight Readiness
EXPERIMENT	G 48	Onboard Experiments Required Preinstallation Checklist
EXPLOSIVE DEVICE	P 01	Explosive Devices Arming and Disarming
	P 02	Pyrotechnic Devices Preflight Verification Tests at Launch Sites
	P 04	Explosive Devices Packaging Material
EXPLOSIVE DEVICE	P 05	Explosive Devices Identification Requirements
	P 06	Protection of Electrical Circuitry for Explosive Devices Employing Hot Bridgewire Initiators
	P 07	Explosive Devices Color Coding Requirements
FAILURE	G 15	Equipment I Failure Verification of Flight Readiness

FAILURE	G 32	Measurement Systems That Display Flight Information to the Crew Indication of Failure
	G 46	Separation Sensing System Structural Deformation
	E 05	Electrical Connectors Pin Assignment
	F 05	Fluid Lines Separation Provisions
	F 22	Pressure Garments Protection Against Failure Propagation
FASTENER	M/S 05	Threaded Fittings Restrictions on Release of Particles and Foreign Material
FIRE	G 27	Fire Control
FITTING	M/S 05	Threaded Fittings Restrictions on Release of Particles and Foreign Material
FITTING	M/S 15	Stainless Steel Tubing Method of Joining
FLAMMABILITY	G 23	Pressure Garment Wiring Ignition of Materials by Electrical Current
FLIGHT READINESS	G 15	Equipment Failure Verification of Flight Readiness
FLOW DIRECTION	F 08	Fluid System Components Whose Function Is Dependent on Direction of Flow Protection Against Incorrect Installation
FLOW RESTRICTION	F 01	Flow Restriction RequirementsPressurized Sources
FLUID	G 01	Equipment Accessibility for Maintenance
	G 03	Systems Checkout Provisions
	G 04	Protection of Spacecraft Electrical and Mechanical Systems From Debris
	G 20	Spacecraft Equipment Protection From System Liquids
	G 38	Pressurization or Repressurization Precluding Ingress of Undesirable Elements
	F 01	Flow Restriction Requirements Pressurized Sources
	F 02	Moisture Separators in a Zero Gravity Environment
	F 03	Service Points Positive Protection From Interchangeability of Fluid Service Lines
	F 04	Ground Service Points Fluid Systems
	F 05	Fluid Lines Separation Provisions
	F 06	Temperature and Pressure Monitoring Requirements for Potentially Hazardous Reactive Fluids
	F 07	Capping of Servicing and Test Ports
	F 08	Fluid System Components Whose Function Is Dependent on Direction of Flow - Protection Against Incorrect Installation
	F 09	Spacecraft VentinG Induced Perturbing Forces
	F 10	Nozzles and Vents - Protection Prior to Launch
	F 11	Fluid Supplies - Verification Tests

FLUID	F 12	Protection of Pressurized Systems From Damage Due to Pressurant Depletion - Ground Support Equipment and Airborne Support Equipment
	F 13	Crew Cabin Module Pressure - Venting Restriction
	F 14	Crew Cabin Module Ventilating Fans - Protection From Debris
	F 15	Separation of Hypergolic Reactants
	F 16	Fluid Line Installation
	F 17	Cleanliness of Flowing Fluids and Associated Systems
	F 18	Pressure Relief Valves - Standardization of Functional Testing
	F 19	Protection for Tubing, Fittings, and Fluid System Components - Flight Hardware and Associated Equipment
	F 20	Fluid Systems - Cleanliness
	F 21	Purge Gases-Temperature and Humidity Requirements
	F 22	Pressure Garments - Protection Against Failure Propagation
	F 23	Qualification Fluid
	F 24	Fluid Systems - Design for Flushing and Draining
	F 25	Toxicity- Fluids Contained in Systems in the Crew Compartment
	F 26	Atmospheric Pressure and Composition Control
	F 27	Liquid or Gas Containers - Verification of Contents
	F 29	Filter Protection of Active Fluid Components
	F 30	Pressure Relief for Pressure Vessels
	M/P 01	Material Selection, Review, and Drawing Sign-Off
	M/P 09	Breathing Systems - Requirement To Test for Mercury Contamination
	M/S 15	Stainless Steel Tubing - Method of Joining
	M/S 16	Pressure Vessels - Negative Pressure Damage
FLUID LINE	F 05	Fluid Lines - Separation Provisions
FLUSH	F 17	Cleanliness of Flowing Fluids and Associated Systems
	F 20	Fluid Systems - Cleanliness
	F 24	Fluid Systems - Design for Flushing and Draining
FORCE	F 09	Spacecraft VentinG Induced Perturbing Forces
GLASS	M/S 07	Windows and Glass Structure Hydrogen Peroxide Systems
GROUND	E 03	Electrical and Electronic Devices -Protection From Reverse Polarity and/or Other Improper Electric Inputs
GROUND EQUIPMENT	G 14	identification and Classification of Flight and Nonflight Equipment
	G 18	Safety Precautions -Test and Operating Procedures
	G 19	Special Processes - Identification of Drawings
	G 20	Spacecraft Equipment -Protection From System Liquids
	G 50	Direct Procurement of Parts

GROUND EQUIPMENT	E 08	Electrical and Electronic Supplies and Loads - Verification Tests
	E 11	Protective Covers or Caps for Electrical Receptacles and Plugs
	E 12	Electrical Connectors -Disconnection for Troubleshooting and Bench Testing
	E 19	Equipment Design - Power Transients
	F 11	Fluid Supplies - Verification Tests
	F 12	Protection of Pressurized Systems From Damage Due to Pressurant Depletion Ground Support Equipment and Airborne Support Equipment
	F 17	Cleanliness of Flowing Fluids and Associated Systems
	F 20	Fluid Systems - Cleanliness
	F 24	Fluid Systems - Design for Flushing and Draining
	M/P 09	Breathing Systems - Requirement To Test for Mercury Contamination
	M/P 13	Pressure Vessel Design
HABITABLE AREA	G 01	Equipment Accessibility for Maintenance
	G 05	Interior Design of Spacecraft for Cleanliness
	G 09	Shatterable Material - Exclusion From Habitable Compartment
	G 21	Spacecraft Equipment - Moisture Protection
	G 30	Switch Protection Devices
	G 31	Detachable Crew-Operated Tools Restriction in Spacecraft
HABITABLE AREA	G 32	Measurement Systems That Display Flight Information to the Crew - Indication of Failure
	G 38	Pressurization or Repressurization Precluding Ingress of Undesirable Elements
	F 04	Ground Service Points - Fluid Systems
	F 13	Crew Cabin Module Pressure - Venting Restriction
	F 25	Toxicity - Fluids Contained in Systems in the Crew Compartment
	F 26	Atmospheric Pressure and Composition Control
	M/P 09	Breathing Systems Requirement To Test for Mercury Contamination
HARDWARE USE	G 51	Flight Hardware Restriction on Use for Training
	G 52	Reuse of Flight Hardware
HATCH	M/S 04	Hatches Repeated Use
HOIST LOOP	M/S 12	Spacecraft Recovery Hoist Loops
HUMIDITY	F 21	Purge Gases Temperature and Humidity Requirements
HYPERGOLIC REACTANT	F 15	Separation of Hypergolic Reactants
IDENTIFICATION	G 11	Procurement Document Identification for Manned Spaceflight Vehicle Items

LOCATION	F 04	Ground Service Points - Fluid Systems
LUMINESCENT DEVICE	G 40	Radioactive Luminescent Devices
MAINTAINABILITY	G 01	Equipment Accessibility for Maintenance
MAINTENANCE	G 01	Equipment Accessibility for Maintenance
	G 40	Radioactive Luminescent Devices
	F 19	Protection for Tubing, Fittings, and Fluid System Components Flight Hardware and Associated Equipment
MALFUNCTION	G 15	Equipment Failure Verification of Flight Readiness
MANUAL CONTROL	G 44	Attitude Control Authority
MANUFACTURE	G 17	Separate Stock for Spaceflight Parts and Materials
	G 19	Special Processes Identification of Drawings
	E 14	Electrical Wire Harnesses Dielectric Tests
	F 19	Protection for Tubing, Fittings, and Fluid System Components Flight Hardware and Associated Equipment
	M/S 15	Stainless Steel Tubing Method of Joining
MARK	G 22	Parts Identification
MATE AND DEMATE	E 09	Electrical Circuits Deenergizing Requirement
MATERIAL	G 09	Shatterable Material Exclusion From Habitable Compartment
	G 17	Separate Stock for Spaceflight Parts and Materials
	G 18	Safety Precautions Test and Operating Procedures
	G 23	Pressure Garment Wiring Ignition of Materials by Electrical Current
	F 15	Separation of Hypergolic Reactants
	F 20	Fluid Systems Cleanliness
	F 25	Toxicity Fluids Contained in Systems in the Crew Compartment
	M/P 01	Material Selection, Review, and Drawing Sign Off
	M/P 26	Repair of Sandwich Type Structures
	P 04	Explosive Devices Packaging Material
MEASUREMENT	F 26	Atmospheric Pressure and Composition Control
MEASUREMENT SYSTEM	G 32	Measurement Systems That Display Flight Information to the Crew Indication of Failure
MECHANICAL	G 01	Equipment Accessibility for Maintenance
	G 04	Protection of Spacecraft Electrical and Mechanical Systems From Debris
	E 01	Mating Provisions for Electrical Connectors
	M/S 01	Equipment Containers Design for Rapid Spacecraft Decompression
	M/S 02	Alignment of Mechanical Systems
MECHANICAL	M/S 04	Hatches Repeated Use

MECHANICAL	M/S 05	Threaded Fittings Restrictions on Release of Particles and Foreign Material
	M/S 12	Spacecraft Recovery Hoist Loops
MECHANISMS	M/S 09	Mechanisms
MERCURY	G 18	Safety Precautions Test and Operating Procedures
	M/P 09	Breathing Systems Requirement To Test for Mercury Contamination
METALLIC	G 18	Safety Precautions Test and Operating Procedures
METEOROID	M/S 11	Meteoroid Protection Levels for Structures
MOISTURE	G 21	Spacecraft Equipment Moisture Protection
	E 04	Electrical Connectors Moisture Protection
	F 01	Flow Restriction Requirements Pressurized Sources
	F 02	Moisture Separators in a Zero Gravity Environment
	F 21	Purge Gases Temperature and Humidity Requirements
MONITOR	F 06	Temperature and Pressure Monitoring Requirements for Potentially Hazardous Reactive Fluids
NEGATIVE PRESSURE	M/S 16	Pressure Vessels Negative Pressure Damage
NONFLIGHT HARDWARE	G 14	Identification and Classification of Flight and Nonflight Equipment
NOZZLE	F 10	Nozzles and Vents Protection Prior to Launch
OPERATING LIMIT	G 16	Operating Limits on Temperature Controlled Equipment
OPERATION	G 08	Redundant Paths Verification of Operation
	G 15	Equipment Failure Verification of Flight Readiness
	G 29	Reentry Propulsion Subsystem InFlight Test
	G 45	Solid Propellant Rocket MotorsIgnition Capability With Unsealed Nozzle
	E 04	Electrical Connectors Moisture Protection
	F 09	Spacecraft Venting Induced Perturbing Forces
	P 01	Explosive Devices Arming and Disarming
OVERLOAD	E 15	Electrical Power Distribution Circuits Overload Protection
OXYGEN	G 23	Pressure Garment Wiring Ignition of Materials by Electrical Current
	M/P 09	Breathing Systems Requirement To Test for Mercury Contamination
PACKAGING	P 04	Explosive Devices Packaging Material
PAINT	P 07	Explosive Devices Color Coding Requirements
PANEL	G 01	Equipment Accessibility for Maintenance
PART	G 17	Separate Stock for Spaceflight Parts and Materials
	G 22	Parts Identification
	G 50	Direct Procurement of Parts
PATH	G 08	Redundant Paths Verification of Operation
PHOTOGRAPHIC EQUIPMENT	G 09	Shatterable Material Exclusion From Habitable Compartment
PIECE PART	E 17	Electrical and Electronic Piece PartsClosure Construction
PLAN	M/P 30	Pressure Vessels Nondestructive Evaluation Plan

POLARITY	E 03	Electrical and Electronic DevicesProtection From Reverse Polarity and/or Other Improper Electrical Inputs
POSITION	G 30	Switch Protection Devices G 31 Detachable Crew Operated Tools Restriction in Spacecraft
POWER	E 19	Equipment Design Power Transients
POWER DISTRIBUTION	E 15	Electrical Power Distribution Circuits Overload Protection
PRESSURE	F 01	Flow Restriction Requirements Pressurized Sources
PRESSURE GARMENT	G 23	Pressure Garment Wiring Ignition of Materials by Electrical Current
	E 13	Bioinstrumentation Systems Crew Electrical Shock Protection
	F 22	Pressure Garments Protection Against Failure Propagation
PRESSURE VESSEL	F 30	Pressure Relief for Pressure Vessels
	M/P 11	Pressure Vessel Documentation
	M/P 13	Pressure Vessel Design
	M/S 16	Pressure Vessels Negative Pressure Damage
PRESSURIZATION	G 38	Pressurization or Repressurization Precluding Ingress of Undesirable Elements
PROCEDURE	G 38	Pressurization or Repressurization Precluding Ingress of Undesirable Elements
	E 08	Electrical and Electronic Supplies and Loads Verification Tests
	F 11	Fluid Supplies Verification Tests
	M/S 16	Pressure Vessels Negative Pressure Damage
PROCESS	G 19	Special Processes Identification of Drawings
	M/P 26	Repair of Sandwich Type Structures
PROCUREMENT	G 11	Procurement Document Identification for Manned Spaceflight Vehicle Items
	G 50	Direct Procurement of Parts
PROGRAM	G 01	Equipment Accessibility for Maintenance
	G 02	Separation of Redundant Equipment
PROGRAM	G 08	Redundant Paths Verification of Operation
	G 12	Application of Previous Qualification Tests
	G 14	Identification and Classification of Flight and Nonflight Equipment
	G 15	Equipment Failure Verification of Flight Readiness
	G 20	Spacecraft Equipment Protection From System Liquids
	G 21	Spacecraft Equipment Moisture Protection
	G 50	Direct Procurement of Parts
	G 51	Flight Hardware Restriction on Use for Training
	G 52	Reuse of Flight Hardware
	M/P 26	Repair of Sandwich Type Structures
	M/S 16	Pressure Vessels Negative Pressure Damage

PROPULSION	G 28	Sealing Solid Propellant Rocket Motors
	G 29	Reentry Propulsion Subsystem Inflight Test
	G 45	Solid Propellant Rocket Motors Ignition Capability With Unsealed Nozzle
PROTECTI0N	G 02	Separation of Redundant Equipment
	G 04	Protection of Spacecraft Electrical and Mechanical Systems From Debris
	G 05	Interior Design of Spacecraft for Cleanliness
	G 09	Shatterable Material Exclusion From Habitable Compartment
	G 18	Safety Precautions Test and Operating Procedures
	G 20	Spacecraft Equipment Protection From System Liquids
	G 21	Spacecraft Equipment Moisture Protection
	G 28	Sealing Solid Propellant Rocket Motors
	G 30	Switch Protection Devices
	G 39	Lightning Protection Design
	E 01	Mating Provisions for Electrical Connectors
	E 02	Protection of Severed Electrical Circuits
	E 03	Electrical and Electronic Devices Protection From Reverse Polarity and/or Other Improper Electrical Inputs
	E 04	Electrical Connectors Moisture Protection
	E 09	Electrical Circuits Deenergizing Requirement
	E 11	Protective Covers or Caps for Electrical Receptacles and Plugs
	E 12	Electrical Connectors Disconnection for Troubleshooting and Bench Testing
	E 13	Bioinstrumentation Systems Crew Electrical Shock Protection
	E 15	Electrical Power Distribution Circuits Overload Protection
	E 18	Circuitry for Automatic Shutdown of Launch Vehicle Engine(s)
	F 03	Service Points Positive Protection From Interchangeability of Fluid Service Lines
	F 07	Capping of Servicing and Test Ports
	F 10	Nozzles and Vents Protection Prior to Launch
	F 12	Protection of Pressurized Systems From Damage Due to Pressurant Depletion Ground Support Equipment and Airborne Support Equipment
	F 13	Crew Cabin Module Pressure Venting Restriction
	F 19	Protection for Tubing, Fittings, and Fluid System Components Flight Hardware and Associated Equipment
	F 22	Pressure Garments Protection Against Failure Propagation
	M/S 03	Wire Bundles-Protective Coating
	M/S 16	Pressure Vessels Negative Pressure Damage

PROTECTI0N	P 06	Protection of Electrical Circuitry for Explosive Devices Employing Hot Bridgewire Initiators
PURGE	F 17	Cleanliness of Flowing Fluids and Associated Systems
	F 20	Fluid Systems Cleanliness
PURGE GAS	F 21	Purge Gases Temperature and Humidity Requirements
PYROTECHNIC	P 01	Explosive Devices Arming and Disarming
	P 02	Pyrotechnic Devices Preflight Verification Tests at Launch Sites
	P 03	Wire Splicing
	P 04	Explosive Devices Packaging Material
	P 05	Explosive Devices Identification Requirements
	P 06	Protection of Electrical Circuitry for Explosive Devices Employing Hot Bridgewire Initiators
	P 07	Explosive Devices Color Coding Requirements
QUALIFICATION	G 12	Application of Previous Qualification Tests
	E 07	Tantalum Wet Slug Capacitors Restriction on Use
	E 08	Electrical and Electronic Supplies and Loads Verification Tests
	F 11	Fluid Supplies Verification Tests
	F 23	Qualification Fluid
RADIATION	E 02	Ionizing Radiation Effects
RADIOACTIVE	G 40	Separation Sensing System Structural Deformation
RECORD	M/P 11	Pressure Vessel Documentation
RECOVERY	M/S 12	Spacecraft Recovery Hoist Loops
REDUNDANT	G 02	Separation of Redundant Equipment
	G 08	Redundant Paths Verification of Operation
	G 44	Attitude Control Authority
	F 15	Separation of Hypergolic Reactants
REENTRY	G 29	Reentry Propulsion Subsystem InFlight Test
RELIEF VALVE	F 01	Flow Restriction Requirements Pressurized Sources
	F 18	Pressure Relief Valves Standardization of Functional Testing
REUSE	G 52	Reuse of Flight Hardware
ROCKET MOTOR	G 28	Sealing Solid Propellant Rocket Motors
	G 45	Solid Propellant Rocket MotorsIgnition Capability With Unsealed Nozzle
SAFETY	F 22	Pressure Garments Protection Against Failure Propagation
SAFETY FACTOR	M/P 13	Pressure Vessel Design
SEAL	G 28	Sealing Solid Propellant Rocket Motors
	G 40	Radioactive Luminescent Devices
	G 45	Solid Propellant Rocket Motors Ignition Capability With Unsealed Nozzle
	E 04	Electrical Connectors Moisture Protection
	E 06	Corona Suppression
SENSOR	G 46	Separation Sensing System Structural Deformation

STRESS CORROSION	M/P 01	Material Selection, Review, and Drawing Sign-Off
STRUCTURE	G 18	Safety Precautions - Test and Operating Procedures
	G 46	Separation Sensing System - Structural Deformation
	M/P 26	Repair of Sandwich-Type Structures
	M/S 01	Equipment Containers - Design for Rapid Spacecraft Decompression
	M/S 04	Hatches - Repeated Use
	M/S 12	Spacecraft Recovery Hoist Loops
	M/S 14	Structural Analysis
SUPPLY	E 08	Electrical and Electronic Supplies and Loads - Verification Tests
SUPPLY	F 11	Fluid Supplies -Verification Tests
	F 12	Protection of Pressurized Systems From Damage Due to Pressurant Depletion Ground Support Equipment and Airborne Support Equipment
	F 22	Pressure Garments - Protection Against Failure Propagation
SUPPORT EQUIPMENT	G 24	Ground Support Equipment and Airborne Support Equipment Protective Devices
SUPPRESSION	E 06	Corona Suppression
SWITCH	G 30	Switch Protection Devices
	G 40	Radioactive Luminescent Devices
SYSTEM	G 02	Separation of Redundant Equipment
TANTALUM	E 07	Tantalum Wet Slug CapacitorsRestriction on Use
TEMPERATURE	G 16	Operating Limits on TemperatureControlled Equipment
	F 21	Purge Gases Temperature and Humidity Requirements
TEST	G 03	Systems Checkout Provisions
	G 08	Redundant Paths Verification of Operation
	G 12	Application of Previous Qualification Tests
	G 16	Operating Limits on TemperatureControlled Equipment
	G 29	Reentry Propulsion Subsystem InFlight Test
	G 37	Verification of Adequate External Visibility
	G 39	Lightning Protection Design
	G 48	Onboard Experiments Required Preinstallation Checklist
	G 52	Reuse of Flight Hardware
	E 03	Electrical and Electronic Devices Protection From Reverse Polarity and/or Other Improper Electrical Inputs
	E 04	Electrical Connectors Moisture Protection
	E 06	Corona Suppression
TEST	E 07	Tantalum Wet Slug Capacitors Restriction on Use
	E 08	Electrical and Electronic Supplies and Loads Verification Tests
	E 12	Electrical Connectors Disconnection for Troubleshooting and Bench Testing
	E 14	Electrical Wire Harnesses Dielectric Tests

	E 16	Testing Protective Devices for SolidState Circuits
	E 19	Equipment Design Power Transients
	E 24	Electrical Wire and Cable Acceptance Tests
	F 08	Fluid System Components Whose Function Is Dependent on Direction of Flow Protection Against Incorrect Installation
	F 11	Fluid Supplies Verification Tests
TEST	F 18	Pressure Relief Valves Standardization of Functional Testing
	F 23	Qualification Fluid
	M/P 01	Material Selection, Review, and Drawing Sign Off
	M/P 09	Breathing Systems Requirement To Test for Mercury Contamination
	M/P 13	Pressure Vessel Design
	M/P 26	Repair of Sandwich Type Structures
	M/S 03	Wire Bundles Protective Coating
	M/S 04	Hatches Repeated Use
	M/S 07	Windows and Glass Structure
	P 02	Pyrotechnic Devices Preflight Verification Tests at Launch Sites
TEST POINT	G 03	Systems Checkout Provisions
	F 07	Capping of Servicing and Test Ports
THERMAL	G 25	Thermal Design and Analysis Thermal Parameters
THREAD	M/S 05	Threaded Fittings Restrictions on Release of Particles and Foreign Material
TIME SENSITIVE	G 10	Control of Limited Life Components
TIMING	E 07	Tantalum Wet Slug Capacitors Restriction on Use
TOOL	G 31	Detachable Crew Operated ToolsRestriction in Spacecraft
TOXICITY	G 18	Safety Precautions Test and Operating Procedures
	G 38	Pressurization or Repressurization Precluding Ingress of Undesirable Elements
	F 25	Toxicity Fluids Contained in Systems in the Crew Compartment
	M/P 09	Breathing Systems Requirement To Test for Mercury Contamination
TRACEABILITY	E 07	Tantalum Wet Slug Capacitors Restriction on Use
TRAINING	G 51	Flight Hardware Restriction on Use for Training
TRANSIENT	E 19	Equipment Design Power Transients
TRANSISTOR	M/P 13	Transistors Selection of Types
TUBING	F 19	Protection for Tubing, Fittings, and Fluid System Components Flight Hardware and Associated Equipment
	M/S 15	Stainless Steel Tubing Method of Joining
ULTRASONIC CLEANING	E 10	Cleaning of Electrical and Electronic Equipment

VALVE	F 05	Fluid Lines Separation Provisions
	F 18	Pressure Relief Valves Standardization of Functional Testing
VENT	G 38	Pressurization or Repressurization Precluding Ingress of Undesirable Elements
	F 01	Flow Restriction Requirements Pressurized Sources
VENT	F 09	Spacecraft Venting Induced Perturbing Forces
	F 10	Nozzles and Vents Protection Prior to Launch
	F 13	Crew Cabin Module PressureVenting Restriction
VERIFICATION	G 08	Redundant Paths Verification of Operation
	G 37	Verification of Adequate External Visibility
	G 39	Lightning Protection Design
VERIFICATION	E 16	Testing Protective Devices for SolidState Circuits
	F 20	Fluid Systems Cleanliness
	F 27	Liquid or Gas Containers Verification of Contents
	P 02	Pyrotechnic Devices Preflight Verification Tests at Launch Sites
VISIBILITY	G 37	Verification of Adequate External Visibility
WEIGHT	M/S 12	Spacecraft Recovery Hoist Loops
WELD	E 17	Electrical and Electronic Piece PartsClosure Construction
	F 15	Separation of Hypergolic Reactants
	M/S 14	Structural Analysis
	M/S 15	Stainless Steel Tubing Method of Joining
WINDOW	M/S 07	Windows and Glass Structure
	G 02	Separation of Redundant Equipment
	G 23	Pressure Garment Wiring Ignition of Materials by Electrical Current
	E 02	Protection of Severed Electrical Circuits
	E 14	Electrical Wire Harnesses Dielectric Tests
	E 15	Electrical Power Distribution Circuits Overload Protection
	E 24	Electrical Wire and Cable Acceptance Tests
	M/S 03	Wire Bundles Protective Coating
	P 03	Wire Splicing
WIRE HARNESS	E 14	Electrical Wire Harnesses Dielectric Tests
ZERO GRAVITY	F 01	Flow Restriction Requirements Pressurized Sources

SECTION 4

RELEASE HISTORY OF STANDARDS

4.0 RELEASE HISTORY OF STANDARDS

4.1 DOCUMENT NUMBERING SYSTEM CHANGES

The JSC Standards (JSC-STD) document numbering system was established in 2010. Prior to that, standards were contained in many different document numbering schemes and document management systems. The previous numbering scheme for 8080.5 was JPR. Prior to that, the document was JPG 8080.5.

4.2 GENERAL BACKGROUND

Center policies released through the Manned Spacecraft Criteria and Standards program were initially called Design Standard (DS)) Bulletins, Procedural Standard (PS) Bulletins, and Engineering Criteria (EC) Bulletins. The Engineering Criteria Bulletins were changed to Design Standard Bulletins in 1965. All bulletins were reissued March 6, 1970, as MSC Design and Procedural Standards. Subsequent to Change 5, dated October 16, 1972, the Center name was changed to the Lyndon B. Johnson Space Center (JSC); therefore, the standards are now being issued as JSC Design and Procedural Standards.

4.3 BULLETIN NUMBERING

The bulletin numbering system consisted of bulletin numbers and code numbers. A series of alphanumeric bulletin numbers was assigned to each bulletin type: Design Standard Bulletins were numbered DS 1, DS2, etc.; Procedural Standard Bulletins were PS 1, PS2, etc.; and Engineering Criteria Bulletins were EC 1, EC 2, etc. These bulletins were compiled into a single manual entitled Manned Spacecraft Criteria and Standards (JSCM 8080). The manual was initially divided into 28 sections by subject. The code number on each bulletin indicated the section and subsection of the manual in which it was located.

4.4 ENGINEERING CRITERIA BULLETINS

Seven Engineering Criteria Bulletins (EC 1 through EC 7) were released between November 1963 and July 1965. These bulletins were subsequently redesignated Design Standard Bulletins and were renumbered DS 21 through DS 27. No changes were made to the requirements when these seven bulletins were renumbered, and the same dates were maintained.

4.5 DESIGN STANDARDS AND PROCEDURAL STANDARDS BULLETINS

There were 75 Design Standard Bulletins and 45 Procedural Standard Bulletins released between November 1963 and July 1969. A number of these bulletins were also revised during this period. In March 1970 all bulletins were redesignated MSC Design and Procedural Standards, renumbered, and dated March 6, 1970. The code numbers were deleted from the standards.

4.6 CROSS REFERENCE – OLD: NEW STANDARD NUMBERS

The following list cross references old standard numbers (per Manned Spacecraft Criteria and Standards, JSCM 8080, Change 11, December 22, 1989) to the new standard numbers (per JSC Design and Procedural Standards Manual, JSCM 8080, April 1, 1991).

APPENDIX A

CUMULATIVE REVISION HISTORY OF DESIGN AND PROCEDURAL STANDARDS

A. CUMULATIVE REVISION HISTORY OF DESIGN AND PROCEDURAL STANDARDS

In an effort to streamline the information provided by the JSC-STD-8080.5 document, the cumulative history of initial effective date and revision dates for each standard have been removed from the standard heading. Up to and including the last official version of these standards signed on 1 April 1991, revision information has been captured in this appendix which will serve as a living history record of the standards.

Active standards will henceforth only carry the most current effective date.

STD.NO.	Effective Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date
G-1	3/30/64 (DS-1)	3/6/70 (No. 1)	6/7/71 (No. 1-A)	4/1/91 (G-10)				
G-2	9/23/64 (DS-4)	3/6/70 (No. 4)	7/8/70 (No. 4A)	11/2/71 (G-4B)	4/1/91 (G-2)			
G-3	9/23/64 (DS-7)	3/6/70 (No. 7)	4/1/91 (G-3)					
G-4	9/23/64 (DS-9)	3/6/70 (No. 9)	4/1/91 (G-4)					
G-5	9/23/64 (DS-10)	3/6/70 (No. 10)	4/1/91 (G-5)					
G-6	7/6/65 (DS-12)	3/6/70 (No. 12)	5/19/75 (G-12A)	4/1/91 (G-6)				
G-7	7/6/65 (DS-11)	3/6/70 (No. 11)	6/7/71 (G-11A)	4/1/91 (G-7)				
G-8	2/21/66 (DS-11)	3/6/70 (No. 36)	4/1/91 (G-8)					
G-9	2/21/66 (DS-41)	3/6/70 (No. 41)	12/16/75 (NO. 41A)	4/1/91 (G-9)				
G-9	2/21/66 (DS-41)	3/6/70 (No. 41)	12/16/75 (NO. 41A)	4/1/91 (G-9)				
G-10	3/30/64 (PS-2)	3/6/70 (No. 77)	4/1/91 (G-10)					
G-11	3/30/64 (PS-4)	9/23/64 (PS-4A)	7/6/65 (PS-4B)	3/6/70 (NO. 79)	4/1/91 (G-11)			
G-12	7/6/65 (PS-8)	3/6/70 (No. 83)	4/1/91 (G-12)					
G-13	7/6/65 (PS-9)	3/6/70 (No. 84)	5/19/79 (G-84A)					
G-14	2/21/66 (PS-24)	3/6/70 (No. 99)	2/1/71 (G-99A)	4/21/72 (NO. 99B)	12/1/77 (NO. 99C)	4/1/91 (G-14)		
G-15	2/21/66 (PS-25)	3/6/70 (No. 100)	4/1/91 (G-15)					
G-16	6/30/66 (PS-27)	3/6/70 (No. 102)	4/1/91 (G-16)					
G-17	6/30/66 (PS-32)	3/6/70 (No. 107)	4/1/91 (G-17)					
G-18	8/22/67 (PS-27)	3/6/70 (No. 102)	4/1/91 (G-16)					
G-19	8/22/67 (PS-44)	3/6/70 (No. 119)	4/1/91 (G-19)					
G-20	3/6/70 (NO.-121)	4/1/91 (G-20)						
G-21	3/6/70 (NO.-122)	4/1/91 (G-21)						
G-22	7/8/70 (NO.-129)	4/1/91 (G-22)						
G-23	7/8/70 (NO.-130)	4/1/91 (G-23)						
G-24	12/1/77 (NO.-153)	4/1/91 (G-24)						
G-25	4/1/91 (G-25)							
G-26	4/1/91 (G-26)							
G-27	4/1/91 (G-27)							
G-28	5/15/67 (DS-53)	3/6/70 (NO. 53)	4/1/91 (G-28)					

STD.NO.	Effective Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date
G-29	5/15/67 (DS-54)	3/6/70 (NO. 54)	4/1/91 (G-29)					
G-30	5/15/67 (DS-59)	3/6/70 (NO. 59)	4/1/91 (G-30)					
G-31	1/6/69 (DS-81)	3/6/70 (NO. 75)	4/1/91 (G-32)					
G-32	1/6/69 (DS-81)	3/6/70 (NO. 75)	4/1/91 (G-32)					
G-33	4/1/91 (G-32)							
G-34	4/1/91 (G-34)							
G-35	4/1/91 (G-35)							
G-36	4/1/91 (G-36)							
G-37	3/6/70 (NO. 126)	4/1/91 (G-37)						
G-38	3/6/70 (NO. 127)	4/1/91 (G-38)						
G-39	2/8/72 (NO. 138)	4/1/91 (G-39)						
G-40	4/2/72 (NO. 141)	5/19/75 (NO. 141A))	4/1/91 (G-40)					
G-41	10/16/72 (NO. 145)	5/19/75 (NO. 141A))						
G-42	5/15/67 (DS-55)	3/6/70 (NO. 55)	4/1/91 (G-42)					
G-44	5/15/67 (DS-57)	3/6/70 (NO. 57)	7/6/70 (NO. 57A)	4/1/91 (G-44)				
G-45	11/3/67 (DS-69)	3/6/70 (NO. 66)	4/1/91 (G-45)					
G-46	3/6/70 (DS-124)	4/1/91 (G-46)						
G-47	3/6/70 (NO. 16)	4/1/91 (G-47)						
G-48	7/6/65 (EC-7)	7/6/65 (DS-27)	3/6/70 (NO. 27)	4/1/91 (G-48)				
G-49	11/3/66 (DS-44)	3/6/70 (NO. 44)	4/1/91 (G-49)					
G-50	7/6/65 (PS-11)	3/6/70 (NO. 86)	4/1/91 (G-50)					
G-51	6/30/66 (PS-29)	3/6/70 (NO. 104)	4/1/91 (G-51)					
G-52	6/30/66 (PS-33)	1/4/69 (PS-33A)	3/6/70 (NO. 108)	2/8/72 (NO. 108A)	4/1/91 (G-52)			
G-53								
G-54								
E-1	9/23/64 (DS-3)	3/6/70 (No. 3)	6/7/71 (No. 3A)	4/1/91 (E-1)				
E-2	9/23/64 (DS-6)	3/6/70 (No. 6)	6/7/71 (No. 6A)	4/1/91 (E-2)				
E-3	7/6/65 (DS-13)	3/6/70 (No. 13)	4/1/91 (E-2)					
E-4	11/12/65 (DS-31)	3/6/70 (No. 31)	4/1/91 (E-4)					
E-5	11/12/65 (DS-32)	3/6/70 (No. 32)	4/1/91 (E-5)					

STD.NO.	Effective Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date
E-6	2/21/66 (DS-37)	3/6/70 (No. 37)	4/1/91 (E-6)					
E-7	1/24/67 (DS-52)	1/6/69 (DS-52A)	3/6/70 (NO.52)					
E-8	1/23/68 (DS-72)	3/6/70 (N0. 68)	4/1/91 (E-8)					
E-9	6/27/68 (DS-75)	3/6/70 (N0. 69)	4/1/91 (E-9)					
E-10	9/24/64 (PS-6)	3/6/70 (N0. 81)	4/1/91 (E-10)					
E-11	7/6/65 (PS-10)	1/23/68 (PS-10A)	3/6/70 (N0. 85)	2/1/71 (NO. 85A)	4/1/91 (E-11)			
E-12	5/15/67 (PS-37)	3/6/70 (N0. 112)	4/1/91 (E-12)					
E-13	7/8/70 (NO.-131)	4/1/91 (E-13)						
E-14	7/27/70 (NO-133)	12/1/77 (NO-13A3)	5/1/78 (NO. 133B)	2/1/80 (NO. 133C)	8/1/80 (NO. 133D)(	4/1/91 (E-14)		
E-15	7/27/70 (NO.-134)	4/1/91 (E-15)						
E-16	10/16/72 (NO.-148)	4/1/91 (E-16)						
E-17	9/1/65 (DS-19)	3/6/70 (NO.-19)	4/1/91 (E-17)					
E-18	11/3/66 (DS-48)	3/6/70 (NO.-48)	4/1/91 (E-18)					
E-19	10/16/72 (DS-146)	4/1/91 (E-19)						
E-20	4/1/91 (E-20)							
E-21	4/1/91 (E-21)							
E-22	4/1/91 (E-22)							
E-23	9/23/64 (DS-5)	3/6/70 (NO. 5)	4/1/91 (E-23)					
E-24	11/12/65 (DS-20)	3/6/79 (95)	7/8/79 (95A)	2/1/80 (95B)	7/24/80 (95C)	8/7/81 (95D)	3/2/82 (95E)	(4/1/91 (E-24)
E-25	7/6/65 (EC 5)	7/6/65 (DS-25)	3/6/70 (No.25)	4/1/91 (M/S -3)	6/17/91 (M/S-3)			
F-1	7/6/65 (DS-17)	3/6/70 (No. 17)	4/1/91 (F-1)					
F-2	9/23/64 (EC-4)	9/23/64 (DS-24)	3/6/70 (No. 24)	4/1/91 (F-2)				
F-3	11/12/65 (DS-30)	3/6/70 (No. 30)	4/1/91 (F-3)					
F-4	2/21/66 (DS-35)	3/6/70 (No. 35)	4/1/91 (F-4)					
F-5	6/30/66 (DS-42)	3/6/70 (No. 42)	4/1/91 (F-5)					
F-6	4/1/91 (F-6)							
F-7	11/3/66 (DS-47)	3/6/70 (No. 47)	4/1/91 (F-7)					
F-8	11/3/66 (DS-49)	3/6/70 (No. 49)	4/1/91 (F-8)					
F-9	11/3/66 (DS-50)	3/6/70 (No. 50)	7/6/70 (No. 50A)	4/1/91 (F-9)				
F-10	11/3/67 (DS-66)	3/6/70 (No. 64)	4/1/91 (F-10)					

STD.NO.	Effective Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date
F-11	1/23/68 (DS-71)	3/6/70 (No. 67)	4/1/91 (F-11)					
F-12	6/27/68 (DS-77)	3/6/70 (No. 71)	4/1/91 (F-12)					
F-13	1/6/69 (DS-78)	3/6/70 (No. 72)	4/1/91 (F-13)					
F-14	1/6/69 (DS-79)	3/6/70 (No. 73)	4/1/91 (F-14)					
F-15	1/6/69 (DS-80)	3/6/70 (No. 74)	4/1/91 (F-15)					
F-16	3/30/64 (PS-1)	3/6/70 (No. 76)	4/1/91 (F-16)					
F-17	3/30/64 (PS-3)	3/6/70 (No. 78)	4/1/91 (F-17)					
F-18	9/1/65 (PS-17)	3/6/70 (No. 92)	4/1/91 (F-18)					
F-19	9/1/65 (PS-18)	3/6/70 (No. 93)	4/1/91 (F-19)					
F-20	11/12/65 (PS-19)	3/6/70 (No. 94)	4/1/91 (F-20)					
F-21	6/27/68 (PS-43)	3/6/70 (No. 118)	4/1/91 (F-21)					
F-22	3/6/70 (No. 123)	4/1/91 (F-22)						
F-23	10/16/72 (NO. 147)	12/1/71 (No.147A)	4/1/91 (F-23)					
F-24	2/21/66 (DS-38)	3/6/70 (No 38)	2/8/72 (No 38A)	4/1/91 (F-24)				
F-25	11/12/65 (DS-34)	3/6/70 (No 34)	4/1/91 (F-25)					
F-26	4/21/72 (NO. 143)	4/1/91 (F-26)						
F-27	9/1/65 (PS. 16)	3/6/70 (NO. 31)	4/1/91 (F-27)					
F-28	4/1/91 (F-28)							
F-29	4/1/91 (F-29)							
M/P-1	7/6/65 (DS-14)	3/6/70 (No. 14)	5/19/75 (No. 14A)	4/1/91 (M/P-1)				
M/P-3	3/30/64 (EC-3)	3/30/64 (DS-23)	11/12/65 (DS-23A)	3/6/70 (No. 23)	4/1/91 (M/P-3)			
M/P-4	11/3/67 (DS-63)	3/6/70 (No. 63)	4/1/91 (M/P-4)					
M/P-5	6/27/68 (DS-76)	3/6/70 (No. 70)	4/1/91 (M/P-5)					
M/P-6	9/1/65 (PS-14)	3/6/70 (No. 89)	4/1/91 (M/P-6)					
M/P-7	2/21/66 (PS-26)	3/6/70 (No. 101)	4/1/91 (M/P-7)					
M/P-8	5/15/67 (PS-36)	3/6/70 (No. 111)	4/1/91 (M/P-8)					
M/P-9	1/6/69 (PS-46)	3/6/70 (No. 120)	6/3/80 (No. 120A)	4/1/91 (M/P-9)				
M/P-10	12/16/75 (NO. 152)	12/1/77 (NO. 152A)	3/2/82 (NO. 152B)	4/1/91 (M/P-10)				
M/P-11	2/8/72 (No. 140)	4/1/91 (M/P-11)						
M/P-12	4/1/91 (M/P-12)							

STD.NO.	Effective Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date
M/P-13	2/8/72 (No. 139)	4/1/91 (M/P-13)						
M/P-14	4/1/91 (M/P-14)							
M/P-15	11/3/67 (PS-41)	3/6/70 (No. 116)	4/1/91 (M/P-15)					
M/P-16	6/30/66 (DS-43)	3/6/70 (No. 43)	4/1/91 (M/P-16)					
M/P-17	7/6/65 (PS-12)	3/6/70 (No. 87)	2/1/71 (NO.-87A)	4/1/91 (M/P-17)				
M/P-18	9/20/66 (PS-34)	3/6/70 (No. 109)	4/26/84 (No. 109A)	4/28/88 (NO. 109B)	4/1/91 (M/P-18)			
M/P-19	9/1/65 (DS-18)	3/6/70 (No. 18)	4/1/91 (M/P-19)					
M/P-20	7/6/65 (EC-6)	7/6/65 (DS-26)	3/6/70 (No. 26)	4/1/91 (M/P-20)				
M/P-21	1/24/67 (DS-51)	3/6/70 (No. 51)	4/1/91 (M/P-21)					
M/P-22	7/6/65 (PS-7)	3/6/70 (No. 82)	4/1/91 (M/P-22)					
M/P-23	11/3/67 (PS-39)	3/6/70 (No. 114)	5/19/75 (No. 114A)	4/1/91 (M/P-23)				
M/P-24	3/6/70 (No. 125)	4/1/91 (M/P-24)						
M/P-25	11/2/71 (No. 137)	4/1/91 (M/P-25)						
M/P-26	2/1/71 (No. 135)	4/1/91 (M/P-26)						
M/S-1	3/30/64 (DS-2)	7/6/65 (DS-2A)	3/6/72 (No. 2)	11/2/71 (NO. 2A)	4/1/91 (M/S-1)			
M/S-2	9/23/64 (DS-8)	3/6/70 (N0. 8)	6/7/71 (NO. 8A)	4/1/91 (M/S-2)				
M/S-4	8/22/67 (DS-61)	3/6/70 (No. 61)	4/1/91 (M/S-4)					
M/S-5	11/23/67 (DS-62)	3/6/70 (No. 62)	4/1/91 (M/S-5)					
M/S-6	4/21/72 (No. 142)	4/1/91 (M/S-6)						
M/S-7	10/16/72 (No. 144)	4/1/91 (M/S-7)						
M/S-8	12/16/75 (No. 151)	4/1/91 (M/S-8)						
M/S-9	4/1/91 (M/S-9)							
M/S-10	12/16/75 (No. 150)	4/1/91 (M/S-10)						
M/S-11	11/8/63 (EC-1)	7/6/65 (EC-1A)	7/6/65 (DS-21)	1/24/67 (No. 21A)	3/6/70 (NO. 21)	7/6/70 (NO. 21A)	4/1/91 (M/S-11)	
M/S-12	8/22/67 (DS-60)	3/4/70 (NO. 60)	4/1/91 (M/S-12)					
M/S-13	4/1/91 (M/S-13)							
M/S-14	1/24/67 (PS-35)	3/6/70 (No. 110)	6/7/71 (NO-110A)	5/19/75 (NO. 110B)	4/1/91 (M/S-14)			
M/S-15	9/1/65 (DS-29)	3/6/70 (No. 29)	4/1/91 (M/S-15)					
M/S-16	7/8/70 (No. 132)	4/1/91 (M/S-16)						
P-1	2/21/66 (DS-39)	3/6/70 (NO. 39)	7/6/70 (NO. 39A)	4/1/91 (P-1)				

STD.NO.	Effective Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date	Revision Date
P-3	6/30/66 (PS-30)	3/6/70 (NO. 105)	10/16/72 (NO.105A)	12/22/89 (NO.105A)	4/1/91 (P-3)			
P-3	9/1/65 (PS-13)	3/6/70 (NO. 88)	12/16/75 (NO. 88A))	4/1/91 (P-3)				
P-4	9/1/65 (PS-15)	3/6/70 (NO. 90)	7/27/70 (NO.90A)	12/1/77 (NO. 90B)	4/1/91 (P-4)			
P-5	11/12/65 (PS-21)	3/6/70 (NO. 96)	5/19/75 (NO.96A)	4/1/91 (P-5)				
P-6	11/3/63 (DS-46)	3/6/70 (NO. 46)	4/1/91 (P-6					
P-7	6/30/66 (PS-28))	1/4/69 (PS-28A)	3/6/70 (No.103)	12/22/89 (No.103A)	4/1/91 (P-7)			

APPENDIX B

CANCELLED DESIGN AND PROCEDURAL STANDARDS

Appendix

Redundancy Requirements	Document No. JPR 8080.5	Standard No. G-6	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

The redundancy requirements for critical flight vehicle subsystems (except structure, thermal protective system, and pressure vessels) shall be established on an individual subsystem basis but shall not be less than fail-safe. Flight hardware and payloads will be designed, as a minimum, to sustain a failure of a single item of hardware in any subsystem without loss of life or vehicle.

The crew may be considered as an active operating system available to provide backup or redundancy to an appropriate critical subsystem except during periods of acceleration or other forces that would restrict physical movement.

Where the above criteria are not met, a list shall be provided of critical nonredundant items, the failure of which could cause loss of the crew or require abort of mission. The list shall also contain critical redundant items, the status of which cannot be readily determined or the function of which can be lost by a single cause.

The list shall include justification for the use of each critical item.

REMARKS

Mission costs, complexity, and crew survival require this design approach.

Definitions are as follows:

A "critical subsystem" is a major functional arrangement of parts, components, or assemblies that perform a function which if lost could cause loss of life or vehicle or could cause an abort.

"Fail-safe" is defined as able to sustain failure while retaining the capability to successfully terminate the mission.
This standard supersedes JSCM 8080 standard 12A.

RATIONALE FOR CANCELLATION

These requirements are superseded by NPR 8705.2 Human-Rating Requirements and Guidelines for Space Flight Systems. The Critical Items List is a part of risk management already covered by NPR 7120….

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Time Displays	Document No. JPR 8080.5	Standard No. G-7	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Time units for displays in spacecraft and mission-related ground support equipment shall indicate time or time intervals in seconds (or decimal fractions of seconds), minutes, hours, and days.

Crew station time measurement indicators shall be of the digital-readout type, except in cases where the presentation is used primarily for rate determination or where frequent resetting is required.

REMARKS

This requirement standardizes time units for spacecraft and mission-related ground support equipment to avoid use or confusion with other fractions of time.

The provisions of this standard are not intended to apply to timers used solely for recording accumulated time on equipment.

This requirement is not to be construed to mean that every timer must have days, hours, minutes, and seconds as a readout capability. If mission requirements can adequately be met by timers showing only hours, or only minutes, etc., then use of such units meets the requirements of this standard.

Presentations on digital time measurement indicators give readouts which are less likely to be misread and which require less readout time than do analog indicators.

This standard supersedes JSCM 8080 standards 11A and 58.

RATIONALE FOR CANCELLATION

The content of this 8080 standard is already covered in higher-tier NASA STD 3000, paragraph 9.4.2.3.3.5 "Clock and Timer Design Requirements."

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Shipping and Handling Protection for Spaceflight Hardware	Document No. JPR 8080.5	Standard No. G-13	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Suitably package or support spaceflight hardware to provide protection of the hardware from damage during handling and shipping.

Contractor or National Aeronautics and Space Administration (NASA) personnel will determine when shock-indicating devices are required. The use of such devices must be approved by the appropriate program office or project office before installation.

Suitably package hardware considered especially sensitive to handling or shipping damage to ensure that the hardware will arrive undamaged. The packaging shall also provide a visible indication when the hardware is subjected to potentially damaging stresses. This will facilitate the inspection for damage.

Design the mechanical means for closing and securing spacecraft ground support equipment (GSE) containers such that the spacecraft hardware flight attachments are not penetrated; i.e., GSE threaded fasteners are not to be run through flight hardware mounting holes.

REMARKS

This standard supersedes JSCM 8080 standard 84A and incorporates SSP 30213 no.G-13.t

RATIONALE FOR CANCELLATION

The NPR 6000.1 (Requirements for Packaging, Handling, and Transportation for Aeronautical and Space Systems, Equipment, and Associated Components) is the higher-level document that is used for shipping and handling all hardware. The NPR precludes the need for Standard G-13.
NPR 6000.1 references:

Paragraph P.1. Purpose: “The NPR establishes packaging, handling, and transportation practices adequate to maintain the reliability of NASA items and to achieve their damage-free delivery to the place and time of ultimate use. The purpose of this NPR is to promote a standard, streamlined approach for transportation shipment activities and to provide guidance for meeting packaging, handling, and transportation requirements pursuant to institutional, program, and project goals and missions throughout NASA.”

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Shipping and Handling Protection for Spaceflight Hardware	Document No. JPR 8080.5	Standard No. G-13	Page 2 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

RATIONALE FOR CANCELLATION [CONT]

Paragraph P.2. Applicability, "The NPR is applicable to NASA and NASA Centers, including Component Facilities. Its use is recommended for all contractors, shipping on behalf of NASA, to satisfy contractual program and project obligations."

Chapter 3. Supplier Handling and Transportation Requirements, Paragraph 3.5, Monitoring Devices for Class III Shipments: "When use of a monitoring device is indicated or has been recommended, and its use authorized, such devices shall be of a type and nature that will detect and provide a permanent notation that the packaged contents have been subjected to adverse conditions such as temperature, shock, or moisture that could impair their ability to perform their principal function in a satisfactory manner. Monitoring devices shall be installed in a manner that will permit their observation and inspection with a minimum of assembly or disassembly of the container. The location of devices, including shock-measuring instruments, shall be marked prominently on the exterior container. Shock measuring instruments shall be used in accordance with applicable standards."

Appendix A., Paragraph 11, Special Design Packaging, "Packaging that is used for items possessing characteristics requiring specially designed cushioning, blocking and bracing, or specially designed containers to provide necessary protection. The approval of a packaging engineer or specialist may be required. Special design packaging applies to items that present the following:

11.1. Special handling, packaging or transportation problems because of restrictive shock or vibration characteristics.
11.2. A requirement for special environmental control.
11.3. A requirement for maintenance within special or critical pressure or temperature limits.
11.4. A requirement for specialized container design, special handling devices, fixtures, or monitoring devices."

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Switch Protection Devices	Document No. JPR 8080.5	Standard No. G-30	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Switches requiring protection against inadvertent actuation shall have the device designed so that the position of the switch can be determined without moving the protection device.

Emergency switches for ordnance (safe, arm, and the like) should be color coded or otherwise identified.

REMARKS

This standard supersedes JSCM 8080 standard 59 and incorporates SSP 30213 no. G-30.

RATIONALE FOR CANCELLATION

The content of this 8080 standard is already covered in NASA STD 3000, paragraphs 9.3.3.2 "Accidental Acuation Design Requirements, and " 9.5.3.1.13 "Caution and Warning Labels Design Requirements." In addition, the TO DO action item database for updates to NASA STD 3000 also includes a formal action to address the following specific content portion from 8080 standard G-30: "Color code or otherwise identify emergency switched for ordnance (safe, are, and the like)." This formal action item was assigned by the Habitability and Environmental Factors Office (HEFO CCB) on Sept. 2, 2004, and closed on Sept. 15, 2004.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Surface Temperatures	Document No. JPR 8080.5	Standard No. G-33	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Surface temperatures within habitable volumes shall be designed to be less than 45 C (113 F) and greater than 4 C(41.2 F).

REMARKS

This is to prevent exposure of the astronaut to hazardous temperatures without the benefit of protective clothing.
Refrigerated interior surfaces of refrigerators located within habitable volumes are exempt from this standard.

This standard incorporates SSP 30213 no. G-33..

RATIONALE FOR CANCELLATION

The content of this 8080 standard is already covered in NASA STD 3000, paragraphs 6.5.3 "Touch Temperature Design Requirements."

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Extravehicular Activity Electronic Connectors	Document No. JPR 8080.5	Standard No. G-34	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

The following constraints shall be considered in the selection of the types of electrical connectors and their location for use in electronic boxes designed for on-orbit servicing by extravehicular activity (EVA):

1. Space shall be sufficient to allow access by a gloved astronaut for mate and demate operations.
2 The selected connector shall be of the scoop-proof type; i.e., shells extend far enough beyond the pins to prevent pin contact with the mating connector shell during the mating operation.
3. Back shells shall be designed to provide a grip point for the suited astronaut to grasp to disengage the connector.

REMARKS

These considerations will improve the capability of the gloved astronaut to effect the mating and demating of electrical connectors on boxes designed for changeout in orbit. This standard incorporates SSP 30213 no. G-34.

RATIONALE FOR CANCELLATION

There is no need to list individual Standards for EVA as all EVA requirements are now housed in one place. Reference document JSC 28918, EVA Design Requirements and Considerations, as documentation for all EVA requirements.

This standard only lists a portion of EVA requirements. Therefore if Standard G-34 remains as a standard, the possibility exists that hardware may be designed that is not fully EVA-compatible.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Enclosure Panels External to the Habitable Modules	Document No. JPR 8080.5	Standard No. G-35	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

All enclosure panels requiring extravehicular activity (EVA) access shall be hinged assemblies. All fasteners on these panels shall be captive types. No lock-wire is to be used when an EVA interface is involved.

REMARKS

The captive feature improves EVA and ground handling. Locking type inserts eliminate the lock-wiring requirement.
This standard incorporates SSP 30213 no. G-35.

RATIONALE FOR CANCELLATION

We no longer require all enclosure panels to be hinged. If Standard G-35 remains as it is currently written, the possibility exists that hardware may be designed that is not EVA compatible.

Reference document JSC 28918, EVA Design Requirements and Considerations, as documentation for all EVA requirements.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Thermal Blankets- Extravehicular Activity	Document No. JPR 8080.5	Standard No. G-36	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Where extravehicular activity (EVA) access is required to a specific area for servicing or repair, thermal blankets shall be designed for removal and replacement by a gloved astronaut. Where nonconductive fasteners (i.e., Velcro) are used, grounding shall be accomplished through the use of conductive strips.

REMARKS

The purpose of this requirement is to allow a gloved astronaut to gain access to the required worksite and thermally secure the area after servicing is complete.

This standard incorporates SSP 30213 no. G-36.

RATIONALE FOR CANCELLATION

We no longer need to list individual Standards for EVA as all EVA requirements are now housed in one place. Reference document JSC 28918, EVA Design Requirements and Considerations, as documentation for all EVA requirements. This standard only lists a portion of EVA requirements. If Standard G-36 remains as a standard, the possibility exists that hardware may be designed that is not fully EVA compatible.

Approval Signature: ______/s/ Frank Benz__________________ Date:____08 March 2005__________
Director, Engineering

Acoustic Noise Criteria	Document No. JPR 8080.5	Standard No. G-41	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Acoustic noise sound pressure levels specified by this standard establish the maximum acceptable flight crew environmental limits which would result from operation of the total spacecraft system and from the expected environment during all phases of a mission. The sound pressure levels specified cannot be directly applied as the acceptable levels which can be produced by a separate piece of equipment or subsystem because of the accumulative and interacting effects when sound sources are integrated as a complete spacecraft system. The sound pressure levels, in decibels, shall be referenced to 0.0002 microbars (0.00002 N/m2) and shall be measured at, or translated to, the external auditory meatus of the operating personnel; these sound pressure levels shall not be achieved through the use of ear coverings unless all simultaneous requirements for communications and auditory monitoring of equipment functions can also be met.
Figures 1 and 2 define the maximum allowable sound pressure levels during launch or short duration mission phases. Figure 3 defines the sound pressure levels, frequencies, exposure times, and required quiet periods after intermittent noise. Exposures shall not exceed the allowable levels, periods, or repetition rates. No single octave band or tone sound pressure level may exceed the allowable contour.
The maximum allowable continuous sound pressure levels produced by normal operating equipment or systems within work and sleep areas shall be defined by figure 4 and described as follows:

1. Broadband octave band sound pressure levels shall not exceed the noise criteria (NC) 50 contour of figure 4 during work periods and the NC 40 contour during sleep periods.
2. The maximum sound pressure level of any narrow band component shall be at least 10dB less than the sound pressure level of the octave band which contains the component.

REMARKS

See next page

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Acoustic Noise Criteria	Document No. JPR 8080.5	Standard No. G-41	Page 2 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

REMARKS

A narrow band component is a simple or complex tone or line spectra having intense and steady-state frequency components (relative to wide band noise components) in a very narrow band, 1 percent of octave band or 5 Hz, whichever is less, and is heard as a musical sound, either harmonic or discordant.

This standard supersedes JSCM 8080 standard 145.

RATIONALE FOR CANCELLATION

This standard is cancelled because revised acoustic requirements will be documented in Vol. 8 of NASA-STD-3000 for Crew Exploration Vehicle, Spiral 1, scheduled to be baselined in December, 2004. Both ISS and Shuttle programs have existing acoustic requirements.

In addition, acoustic requirements will also be considered for further revision as part of the longer-term Strategic Update to NASA-STD-3000.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

<table>
<tr><td rowspan="2">Solar Wind Environment</td><td>Document No.
JPR 8080.5</td><td>Standard No.
G-42</td><td>Page
1 of 1</td></tr>
<tr><td>Previous
Revision
04/01/1991</td><td colspan="2">Cancelled as of date signed below:</td></tr>
</table>

STATEMENT OF STANDARD

Spacecraft and components that are planned for operation outside the magnetosphere, or more than 100,000 miles from earth, shall be designed so that components which are exposed to the external environment shall not be functionally impaired by a flux of 1019 protons/m2 of 3 ± 2000 EV delivered each day, not to exceed 3 x 10l9 protons/m2 in 1 week, or 2 x 1020 protons/m2 in 1 year.

REMARKS

The flux levels specified are based on the occurrence of one magnetic storm in a day, three in a week, or twenty in a year.
This standard establishes the JSC parameters for solar wind environment for future spacecraft design.

This standard supersedes JSCM 8080 standard 55.

REFERENCES

1. General Geophysical Research, Vol. 71, nos. 5 and 13. (Based on data obtained from IMP satellite.)
2. Jet Propulsion Laboratory (JPL) technical report no. 32-514. (Based on data obtained from Mariner 2 satellite.)

RATIONALE FOR CANCELLATION

As this document does not include crew interface requirements, SF has no requirement for this standard. SF has coordinated with ES on vehicle radiation requirements and has obtained concensus that this standard is not necessary for vehicle requirements either. E-22, Ionizing Radiation Effects, adequately covers effects of radiation on the vehicle at this level.

Reference to MP-1 for materials degradation issues.

Delete standard as it is adequately covered under standard E-22 for vehicle systems.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Centralized Subsystem Controls	Document No. JPR 8080.5	Standard No. G-43	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

All controls, meters, or other monitoring devices (switches, circuit breakers, etc.) for a particular system or subsystem shall be centrally located on one panel or adjacent panels. However, redundancy criteria will apply.

REMARKS

The crew must be able to easily determine the configuration and status of a particular system or subsystem.

The intent here is to avoid, for instance, placing a set of switches associated with the module pressure control system on a panel at one end of the module and another set of switches (or circuit breakers, meters, etc.) associated with the same system on a panel at the other end of the module.

This standard incorporates SSP 30213 no. G-43.

RATIONALE FOR CANCELLATION

The content of this 8080 standard is already covered in NASA STD 3000, paragraphs 9.2.3.2.3 " Control/Display Grouping Design Requirements" and 9.2.3.2.4 "Preferred Control/Display Location Design Requirements."

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Temperature And Pressure Monitoring Requirements Of Hydrogen Peroxide Systems	Document No. JPR 8080.5	Standard No. G-49	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Design all spacecraft systems and ground support servicing equipment requiring storage of hydrogen peroxide (H_2O_2) to include devices for monitoring temperature and pressure to permit accurate determination of the rates of active-oxygen loss of the hydrogen peroxide contained in their respective systems.

REMARKS

These monitoring devices will provide time for corrective action in the event that abnormal decomposition of H_2O_2 is initiated.

This standard supersedes JSCM 808Q standard 44.

RATIONALE FOR CANCELLATION

This standard was written specifically to address issues related to hydrogen peroxide systems. Standard F-6 was subsequently incorporated into the 8080 document and is written as a more general standard applicable to "potentially hazardous reactive fluids". Thus, the specific standard related to hydrogen peroxide has been cancelled and hydrogen peroxide has been specifically referenced in the updated version of the F-6 standard.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Circuitry For Automatic Shutdown Of Launch Vehicle Engine(S)	Document No. JPR 8080.5	Standard No. E--18	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Design of circuitry for automatic shutdown of launch vehicle engine(s) shall include protection against possible engine shutdown coincidental with, or immediately after, launch vehicle release.

REMARKS

The term "immediately after" in the statement refers to the time from launch vehicle release to the time when ground support equipment umbilicals are released.

This standard supersedes JSCM 8080 standard 48.

RATIONALE FOR CANCELLATION

As revised, Standard E-18 was extensively overhauled and contained information more appropriate to its designation as a General standard. Refer to Standard G-54 for the revised text. The reclassification of E-18 to Section G was based on review by DPSWG and its subsequent recommendation

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Electrical Connectors	Document No. JPR 8080.5	Standard No. E-21	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

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

REMARKS

Past space programs have shown that significant time loss and costs have been sustained because of pin damage during manual assembly and disassembly. Connector designs exist which prevent this problem.

This standard incorporates SSP 30213 no. E-21

RATIONALE FOR CANCELLATION

This standard does not provide any additional information over what is given in standard E-1. E-1 provides the connector mating requirements.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Transistors – Selection of Types	Document No. JPR 8080.5	Standard No. E-23	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

The use of point-contract, grown junction, or alloy junction transistors shall be avoided in electronic circuits in both spacecraft and ground support equipment.

REMARKS

This standard supersedes JSCM 8080 standard 5.

RATIONALE FOR CANCELLATION

This standard is deleted because it references old technology and processes that are no longer used in industry. These technologies were the first designs of transistors back in the 1950's. Even though there was production into the 1970's, they no longer are produced.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

<table>
<tr><td rowspan="2">Crew Cabin Module Ventilating Fans - Protection From Debris</td><td>Document No.
JPR 8080.5</td><td>Standard No.
F-14</td><td>Page
1 of 1</td></tr>
<tr><td>Previous Revision
04/01/1991</td><td colspan="2">Cancelled as of date signed below:</td></tr>
</table>

STATEMENT OF STANDARD

Crew cabin module ventilation fans shall be protected by screens or other devices to prevent entrance of debris that could damage or jam the fan blades during zero-gravity conditions. Such screens or other devices shall be serviceable and/or replaceable.

REMARKS

Crew cabin module ventilating fans are generally small, low-power devices designed with low clearances between blades and duct to maximize efficiency and minimize power consumption. Under zero-gravity conditions, debris in the cabin can float freely with air currents and enter the fan. Protection is required to prevent entry of floating debris of a size that could wedge itself into the low clearances and stall the fan. However, a protective screen should not be made so fine that it restricts the flow of air through the fan to a significant degree or becomes clogged with particles of debris too small to endanger the fan.

This standard supersedes JSCM 8080 standard 73 and incorporates SSP 30213 no. F-14.

RATIONALE FOR CANCELLATION

These requirements are now covered in 8080 standard G-4. Additional remarks have been added to G-4 to provide lessons learned information and design guidelines about filters for longer duration missions.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Qualification Fluid	Document No. JPG 8080.5	Standard No. F-23	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Test and analyze fluids used in the successful equipment qualification, as required, to establish baseline reference data on the physical and chemical properties of the fluid and allowable impurities that could affect the performance of the equipment and compatibility of materials. Evaluate the effect on system and component qualification, and define any additional qualification required before any of the following changes are allowed.

1. Changes in fluid specification
2. Changes in procurement source
3. Changes in fluid processes, process conditions, or handling procedures
4. Changes in raw materials, suppliers, or manufacturers
5. Shifts in fluid properties noted in new lots or batches whenever these properties are not specifically allowed by the procurement specification.

REMARKS

Hardware changes normally include consideration of any additional qualification needed to ensure successful system function. The effect on equipment caused by changes in fluid properties must be given equal consideration whether they are introduced by changes in specification, source of fluid procurement, fluid manufacturing processes, raw materials, or by other means.

This standard supersedes JSCM 8080 standard 147A and incorporates SSP 30213 no. F-23.

RATIONALE FOR CANCELLATION

This standard has been rewritten as a generic standard for reverification and is no longer limited to fluid systems. The information captured in this standard has been moved to the more appropriate General standards section where the new standard, G-53, will serve as repository for the information.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Use Of Halogen Method For Coolant System Leak Detection	Document No. JPR 8080.5	Standard No. F-28	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Do not use gaseous nitrogen as a substitute medium for leak testing components for use with liquid low surface tension silicate ester coolants.

REMARKS

Gaseous nitrogen has been used for component level leak testing and verification on the interface unit (IU) thermal conditioning subsystem (TCS) components since their inception at George C Marshall Space Flight Center. With the use of a 60/40.1 mixture of methanol/water/sodium benzoate as a coolant, this technique was acceptable. However, after the low surface tension silicate ester coolant was incorporated in the IU TCS, visible leakage was evident even after acceptable component and system level leakage tests with gaseous nitrogen media. After evaluation of several leakage test techniques, the halogen method was the most reliable for this system.

An investigation revealed that use of halogen gases with physical constants data similar to Freon 22TM and utilizing an electronic halogen leak detector with a detection range of 1 x 10-g standard cc or greater is an acceptable method for even the smallest visible leaks found with silicate ester coolants.

This standard incorporates SSP 30213 no F-31.

RATIONALE FOR CANCELLATION

The standard addressed a system that is outdated and no longer used.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

<table>
<tr><td rowspan="2">Flammability of Wiring Material</td><td>Document No.
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<tr><td>Previous
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04/01/1991</td><td colspan="2">Cancelled as of date signed below:</td></tr>
</table>

STATEMENT OF STANDARD

This standard applies to electrical wiring within habitable compartments of spacecraft. Electrical wire insulation, wiring accessories, and materials in contact with electrical circuitry shall not be capable of sustaining combustion in the most severe oxidizing environment to be encountered during operations:

1. After removal of the source of ignition
2. Following melting of the electrical conductor by high currents, such as those resulting from short circuits or equipment malfunction

Materials in contact with a conductor subjected to these high currents shall not be capable of igniting the insulation, wiring accessories, or other materials on other conductors.

This requirement does not apply to material isolated by a container capable of retaining within the container any combustion resulting from high currents.

REMARKS

Materials are considered nonflammable or self-extinguishing if they meet the applicable flammability requirements of NHB 8060.1.

This standard supersedes JSCM 8080 standard 22A and incorporates SSP 30213 no. M/P-2.

RATIONALE FOR CANCELLATION

See next page.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Flammability of Wiring Material	Document No. JPR 8080.5	Standard No. MP-2	Page 2 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

RATIONALE FOR CANCELLATION

Requirement is covered by revised JSC 49774 paragraphs 4.1.1 and 4.1.6, which require all materials to be nonflammable or self-extinguishing, including wiring materials.

Paragraph 4.1.1 states:

> 4.1.1 FLAMMABILITY CONTROL
> Flammability control shall be based on using materials that are nonflammable or self-extinguishing when tested by NASA-STD-6001, Test 1; testing shall not be required for ceramics and metal oxides. Test 2 (Heat and Visible Smoke Release Rates) of NASA-STD-6001 is not required. If flammable materials must be used, flammability control shall be based on adequate separation of flammable materials in configuration to preclude fire propagation paths. Guidelines for hardware flammability assessment can be found in JSC 29353, Flammability Configuration Analysis for Spacecraft Applications.
>
> Material flammability ratings and test data are given in the MAPTIS database. The thickness specified for flammability includes the minimum thickness in which the material was tested. Thinner materials may not have the same rating, and may need to be tested. Similarly, the oxygen concentration specified is that in which the material was tested. MAPTIS flammability test data at other oxygen concentrations may be used only if the test data were obtained at a higher oxygen concentration than the maximum use oxygen concentration.

Paragraph 4.1.6 states:

> 4.1.6 ELECTRICAL WIRE INSULATION MATERIALS
> Electrical wire insulation materials shall be evaluated for flammability in accordance with NASA-STD-6001 Test 4.
>
> Arc tracking shall be evaluated in accordance with NASA-STD-6001 Test 18 or a generally accepted voluntary consensus standard aerospace wiring arc tracking test. Testing is not required for polytetrafluoroethylene (PTFE), PTFE laminate, ethylene tetrafluoroethlyene (ETFE), or silicone-insulated wires since the resistance of these materials to arc tracking has already been established.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Toxicity Of Materials Used In Crew Compartments - Wire Insulation, Ties, Identification Marks, And Protective Covering	Document No. JPR 8080.5	Standard No. MP-3	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

No materials that, when exposed to a short circuit, will generate toxic fumes in a concentration sufficient to impair crew safety shall be used for wire insulation, ties, identification marks, and protective covering on wiring.

REMARKS

This standard supersedes JSCM 8080 standard 23 and incorporates SSP 30213 no. M/P-3.

RATIONALE FOR CANCELLATION

This standard cannot be implemented. It is impossible to quantify the amount of toxic fumes generated by a short-circuit condition and limitation of materials to those which are least prone to generate toxic combustion/pyrolysis products limits the materials to those which are most flammable. From a flammability standpoint, Teflon-based materials are the best; from a toxic combustion/pyrolysis standpoint they are the worst.

Agency policy is to select the least flammable materials, regardless of combustion product toxicity, as the best means of controlling the amount of toxic fumes generated by a short-circuit condition. Revised M/P-1 calls out JSC 49774. Paragraphs 4.1.1 and 4.1.6 of the revised JSC 49774 require all materials to meet NASA-STD-6001 which contains Agency flammability requirements for all materials.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Metals and Metal Couples - Restriction on Use	Document No. JPR 8080.5	Standard No. MP-4	Page 1 of 3
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

The risk of galvanic corrosion in manned spacecraft shall be minimized by consideration of relative electrical potential [i.e., electromotive force (EMF)] in the selection and application of metals.
Metals that differ in potential by more than 0.25 V, as determined from table 1, shall not be used in direct contact when exposed to a common electrolyte, such as the atmosphere.
Metal couples prohibited by or not included in table I shall not be used until they have been demonstrated to be satisfactory in the proposed application.
No aluminum or aluminum alloys shall be used in liquid water conduits or in gas conduits where water condensation can routinely occur. Oxygenated/liquid water systems shall use 300 series stainless steel. In such cases, users of the system should be alerted to the fact that iron ions will leach into the liquid and form ferric oxide (rust).

REMARKS

This standard supersedes JSCM 8080 standard 63 and incorporates SSP 30213 no. M/P-4.

RATIONALE FOR CANCELLATION

Requirement is covered by revised JSC 49774 paragraph 4.6.3, which states:

> 4.6.3 CORROSION PREVENTION AND CONTROL
> All parts, assemblies, and equipment, including spares, shall be finished to provide protection from corrosion in accordance with the requirements of MSFC-SPEC-250, Protective Finishes for Space Vehicle Structures and Associated Flight Equipment, General Specification For. Corrosion evaluation shall show the possible effects of fluid release resulting from the failure or permeation of barriers. Corrosion control of galvanic couples shall be in accordance with MIL-STD-889, Dissimilar Metals. Galvanic couples for alloy combinations not listed in MIL-STD-889 shall not exceed 0.25 volts. Specific corrosion prevention and control techniques shall be defined in the Materials and Processes Selection, Control, and Implementation Plan. For hardware in the mild corrosive environment of standard habitable spacecraft volumes, the following changes may be made:

Continued next page.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Metals and Metal Couples - Restriction on Use	Document No. JPR 8080.5	Standard No. MP-4	Page 2 of 3
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RATIONALE FOR CANCELLATION [CONT.]

- The requirements of MIL-STD-889 may be relaxed with corrosion resistant aluminum alloys.
- Exposed aluminum surfaces may have anodic coatings instead of organic coatings specified in MSFC-SPEC-250.
- Conversion coatings may be used as the sole corrosion protection for 5000 and 6000 series corrosion resistant aluminum alloys. They are not acceptable as the sole corrosion protection for 2000 and 7000 series aluminum alloys.

Continued next page.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Metals and Metal Couples - Restriction on Use	Document No. JPR 8080.5	Standard No. MP-4	Page 3 of 3
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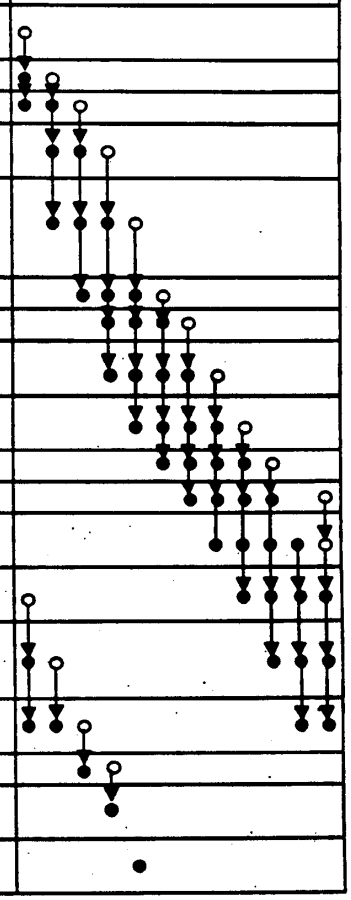
TABLE I.- METAL COUPLES

Group No.	Metallurgical category	EMF (V)	Permissible couples*
1	Gold, solid and plated; gold-platinum alloys; wrought platinum	+0.15	
2	Rhodium, graphite	+0.05	
3	Silver, solid or plated; high silver alloys	0	
4	Nickel, solid or plated; monel metal, high nickel-copper alloys; titanium	-0.15	
5	Copper, solid or plated; low brasses or bronzes; silver solder; German silver; high copper-nickel alloys; nickel-chromium alloys; Austenitic stainless steels (301, 302, 304, 309, 316, 321, 347)	-0.20	
6	Commercial yellow brasses and bronzes	-0.25	
7	High brasses and bronzes; Naval brass; Muntz metal	-0.30	
8	18% chromium type corrosion-resistant steels (440, 430, 431, 446, 17-7PH, 17-4PH)	-0.35	
9	Chromium, plated; tin, plated; 12% chromium type corrosion-resistant steels (410, 416, 420)	-0.45	
10	Tin-plate; tarnaplate; tin-lead solders	-0.50	
11	Lead, solid or plated; high lead alloys	-0.55	
12	Aluminum, wrought alloys of the Duralumin type (2014, 2024, 2017)	-0.60	
13	Iron, wrought, gray, or malleable, plain carbon and low alloy steels, armco iron	-0.70	
14	Aluminum, wrought alloys other than Duralumin type; (6061, 7075, 5052, 5056, 1100, 3003) aluminum, cast alloys of the silicon type (355, 356)	-0.75	
15	Aluminum, cast alloys other than silicon type; cadmium, plated and chromated	-0.80	
16	Hot-dip-zinc plate; galvanized steel	-1.05	
17	Zinc, wrought; zinc-base die-casting alloys; zinc, plated	-1.10	
18	Magnesium and magnesium-base alloys, cast or wrought†	-1.60	



*Members of groups connected by lines are considered to form permissible couples. These permissible couples should not be construed to be totally devoid of galvanic action, but rather to represent an acceptably low galvanic effect.

○The symbol ○ indicates the most cathodic member of the series, ● an anodic member, and the arrows the anodic direction.

† Aluminum alloys 5052, 5056, 5356, 6061, and 6063 are considered to form permissible couples with magnesium alloys.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Solutions Which Contain Ethylene Glycol – Requirements For Silver Chelating Agent	Document No. JPR 8080.5	Standard No. MP-5	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Benzotriazole (BZT), a silver chelating agent, shall be added to solutions containing ethylene glycol which are used aboard spacecraft whose electrical or electronic circuits contain silver or silver-coated copper. The concentration of BZT shall be 4500 to 5000 ppm (0.45 to 0.50 percent) by weight.

REMARKS

Bare or defectively insulated silver or silver-coated copper components such as wire, pins, sockets, or connectors impressed with a direct current potential can spontaneously ignite and burn when exposed to ethylene glycol solutions that do not contain a silver chelating agent. The addition of BZT completely eliminates this flammability hazard. This standard supersedes JSCM 8080 standard 70 and incorporates SSP 30213 no. M/P-5.

RATIONALE FOR CANCELLATION

A new paragraph has been added to JSC 49774 addressing the issue:

> 4.3.9 ETHYLENE GLYCOL
> When solutions containing ethylene glycol are used aboard spacecraft which have electrical or electronic circuits containing silver or silver-coated copper, a silver chelating agent such as benzotriazole (BZT) shall be added to the solution to prevent spontaneous ignition from the reaction of silver with ethylene glycol. [End]

Note also that Mir had ethylene glycol coolant (which leaked in large quantities) and electrical circuits containing silver-plated copper but no fires occurred. Ethylene glycol coolant is effectively prohibited (unless in a containment that is failure tolerant against leakage) because of toxicological and Environmental Control and Life Support System issues with the coolant unrelated to silver and fires.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Toxicity - Requirements For Nonmetallic Materials Proposed For Use Within Crew Compartment	Document No. JPR 8080.5	Standard No. MP-6	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Nonmetallic materials used within crew compartments shall not provide a toxic atmosphere. Identification and test requirements are specified below.

1. Identification Requirements. All nonmetallic materials proposed for use within the crew compartments of the spacecraft shall be identified as follows:
   a. Material trade name
   b. Application in spacecraft
   c. Part number
   d. Vendor
   e. Commercial designation (technical)
   f. Materials specification - primary
   g. Materials specification - secondary
   h. Weight of material in spacecraft cabin
   i. Surface area exposed in spacecraft cabin
   j. Material test status
   k. Alternative materials considered with reasons for rejection

2. Test Requirements. The contractor shall justify use of the proposed material by documentary evidence supported by testing performed by other laboratories or by the contractor itself. Test data shall consist of the following:
   a. Testing agency
   b. Test procedures
   c. Test environment
   d. Weight loss during test
   e. Major offgassing products - identification and quantification
   f. Test report and data
   g. Source of all data

Toxicity and/or offgassing testing of off-the-shelf equipment may be performed in lieu of the above requirements when materials documentation is not available.

REMARKS

Odor tests do not provide detailed information pertaining to toxicity.
This standard supersedes JSCM 8080 standards 33 and 89 and incorporates SSP 30213 no. M/P-6.

Continued next page.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Toxicity - Requirements For Nonmetallic Materials Proposed For Use Within Crew Compartment	Document No. JPR 8080.5	Standard No. MP-6	Page 2 of 2
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RATIONALE FOR CANCELLATION

Requirement is superseded by JSC 49774 paragraph 4.1.2, which states:

4.1.2 TOXIC OFFGASSING
All materials used in habitable flight compartments shall meet the offgassing requirements of NASA-STD-6001 using one of the following methodologies:

(a) Offgassing is tested as an assembled article

Summation of Toxic Hazard Index (T) values (total concentration in milligrams per cubic meter/Spacecraft Maximum Allowable Concentration) of all offgassed constituent products shall not exceed 0.5.

(b) Hardware components evaluated on a materials basis

Individual materials used to make up a component shall be evaluated based on the actual or estimated mass of the material used in the hardware component. The total T value for all materials used to make up the component shall be less than 0.5.

(c) More than one hardware component or assembly

If a single hardware component is tested or evaluated for toxicity, but more than one will be flown, the T value obtained for one unit times the number of flight units shall be less than 0.5.

(d) Bulk materials and other materials not inside a container

All materials shall be evaluated individually using the ratings in the MAPTIS database. The maximum quantity and associated rating is specified for each material code.

The analytical technique used to identify and quantify offgassed products in the NASA-STD-6001 standard test shall be capable of detecting formaldehyde concentrations of 0.05 parts per million. Offgassing testing is not required for metallic materials or for ceramics and metal oxides. SMAC values shall be obtained from JSC 20584, Spacecraft Maximum Allowable Concentrations for Airborne Contaminants. For compounds for which no SMAC values are found in JSC 20584, the values in MAPTIS shall be used.

The JSC 49774 approach has been the accepted methodology for offgassing control implementation by all NASA Centers and International Partners since it was introduced in 1989.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

<table>
<tr><td rowspan="2">Material Detrimental to Electrical Connectors</td><td>Document No.
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</table>

STATEMENT OF STANDARD

Materials containing or coated with substances known to be detrimental to metals used in electrical connectors shall not be used adjacent to exposed electrical contact surfaces. The use of materials containing or coated with sulfides or free sulfur is prohibited.

REMARKS

Difficulties of this type have been encountered where protective caps containing gaskets coated with sulfur have been used on electrical connectors.
Contact surfaces of electrical connectors electroplated with gold have developed semiconducting or insulating films in the presence of sulfur-bearing atmosphere. Investigations have shown that the base metals of the contacts (such as copper, zinc, and silver) beneath the gold plating combine chemically with atmospheric sulfur to produce a sulfide which diffuses through the gold to form films on the contact surfaces. Presence of the film can cause breakdown of an electrical connection formed by the contact surfaces.
This standard supersedes JSCM 8080 standard 101 and incorporates SSP 30213 no. M/P-7.

RATIONALE FOR CANCELLATION

This standard selects just one out of hundreds of materials compatibility issues that must be addressed by a comprehensive M&P program.

Revised M/P-1 calls out JSC 49774. JSC 49774 contains no specific requirement on this subject but contains generic requirements to ensure that all materials must be compatible with each other and have acceptable life. Such requirements are used to address many issues in the electrical world such as red plague, purple plague, tin whisker growth, and compatibility of sulfur with electrical connectors.

Approval Signature: ______/s/ Frank Benz__________________ Date:____08 March 2005__________
Director, Engineering

Leak Detectors - Wetting Agents	Document No. JPR 8080.5	Standard No. MP-8	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Any wetting agent to be used on the outside surface of pressurized spacecraft systems to detect leaks shall be verified to be compatible with the materials on which it is to be used or materials on which it might be spilled. After the leak tests are completed, the wetting agent shall be neutralized or removed by a washing and drying procedure compatible with the materials.

Only wetting agents classified as nonionic shall be used.

WARNING: If leak tests are accomplished in the crew bay, the solution must not be toxic or flammable and shall not be capable of leaving a residue which is toxic, flammable, or hygroscopic

REMARKS

Detergents such as household liquid soap are sometimes used for bubble tests in lieu of standard leak detectors. The highly alkaline nature of most detergents, however, promotes corrosion and may dissolve amphoteric metals such as cadmium and zinc. Therefore, such detergents shall not be used.
This standard supersedes JSCM 8080 standard 111 and incorporates SSP 30213 no. M/P-8.

RATIONALE FOR CANCELLATION

Requirement is covered by revised JSC 49774 paragraph 4.1.3, which states:

> 4.1.3 FLUID COMPATIBILITY
> Materials exposed to hazardous fluids1 shall be evaluated or tested for compatibility. ……
>
> 1 For the purpose of this standard, the definition of hazardous fluids includes gaseous oxygen, liquid oxygen, fuels, oxidizers, and other fluids that could cause corrosion, chemically or physically degrade materials in the system, or cause an exothermic reaction.

Continued next page.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Leak Detectors - Wetting Agents	Document No. JPR 8080.5	Standard No. MP-8	Page 2 of 2
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RATIONALE FOR CANCELLATION [CONT.]

In addition, revised JSC 49774 paragraph 3.0 states:

> 3.0 GENERAL REQUIREMENTS
>
> Materials used in the fabrication and processing of flight hardware shall be selected by considering the worst-case operational requirements for the particular application and the design engineering properties of the candidate materials. The operational requirements shall include, but not be limited to, operational temperature limits, loads, contamination, life expectancy, moisture or other fluid media exposure, and vehicle related induced and natural space environments. Properties that shall be considered in material selection include, but are not limited to, mechanical properties, fracture toughness, flammability and offgassing characteristics, corrosion, stress corrosion, thermal and mechanical fatigue properties, vacuum outgassing, fluids compatibility, microbial resistance, moisture resistance, fretting, galling, and susceptibility to electrostatic discharge (ESD) and contamination. Conditions that could contribute to deterioration of hardware in service shall receive special consideration. Non-flight materials used in processing and testing of flight hardware shall not cause degradation of the flight hardware.

The last sentence of this paragraph ensures that all aspects of compatibility between non-flight materials used in processing/checkout of flight hardware and flight hardware are properly addressed – including, but not limited to, the compatibility of leak detection fluids with flight materials.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Liquid Locking Compounds - Restrictions And Controls	Document No. JPR 8080.5	Standard No. MP-10	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Documentation and controls shall be established for all liquid locking compounds. Single-component liquid locking compounds that cure (solidify) when confined between closely fitting metal and/or primed surfaces but remain liquid when in direct contact with oxygen shall be used only when the following restrictions and controls are implemented:

1. Shelf-life limitations shall be observed.
2. Excess liquid or cured material that extends beyond the planes of the joined metal surfaces shall be removed to avoid contamination and migration.
3. Joining surfaces shall be prepared and primed in accordance with the manufacturer's recommendations.
4. Locking compounds shall be cured according to the manufacturer's recommendations prior to operations or applied loads that will stress the material.
5. In fluid systems, locking compounds shall not be used without prior NASA approval. The justification for requesting NASA approval shall include satisfactory compatibility of the liquid and/or solid with the fluid media and its environment and acceptable compliance with a failure modes and effects analysis.

REMARKS

This type locking, categorized as "anaerobic," has presented contamination problems in the past when that portion of the compound not confined between surfaces remained liquid and migrated to other areas of equipment. Anaerobic locking compound curing is inhibited by the presence of any concentration of oxygen.
This standard supersedes JSCM 8080 standard 152B and incorporates SSP 30213 no. MP-10.

RATIONALE FOR CANCELLATION

Continued next page.

Approval Signature: ______/s/ Frank Benz__________________ Date:____08 March 2005__________
Director, Engineering

Liquid Locking Compounds - Restrictions And Controls	Document No. JPR 8080.5	Standard No. MP-10	Page 2 of 2
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RATIONALE FOR CANCELLATION

This standard fails to identify the key requirements associated with the use of liquid locking compounds (that they not be used in structural applications) and limits itself to generalities on the subject of having controlled, documented processes.

Section 4.6.4.1 of JSC 49774 contains specific requirements on the use of liquid locking compounds as follows:

> 4.6.4.1 Fastener Locking Requirements -- Each bolt, screw, nut, pin, or other fastener used in a safety critical application shall incorporate two separate verifiable locking features. Preload may be used as one of the features combined with a conventional aerospace secondary locking feature that is positive locking and vibration rated. Joints that are subject to rotation in operation shall use at least one non-friction locking device. Use of a liquid locking compound as a secondary locking feature on safety-critical fasteners shall require an approved MUA [2] . Liquid locking compounds used as a secondary locking feature in non-safety-critical applications shall require a qualified process specified on the engineering drawing. Installation procedures shall require functional verification of locking features, such as measurement of running (self-locking) torque or visual inspection of lock wire integrity. Preload torques and running torques shall be specified on the drawings.
>
> [2] For the purposes of this requirement, Safety Critical fasteners are defined as :
> a) All primary or secondary structural fasteners used in the exterior and interior of flight modules.
> b) All non-structural fasteners used exterior to flight modules, which may pose a FOD risk to vehicle operations and which have not been vibration tested during qualification or acceptance of the hardware.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Multilayer Blanket Bake-Out	Document No. JPR 8080.5	Standard No. MP-12	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

1. All multilayer thermal blankets or thermal blanket materials shall be baked out prior to exposure to sensitive surfaces during vacuum or prior to flight. In general, the blankets should be baked out at 80☐C (176°F) in a vacuum for 48 hr or until a quartz crystal microbalance held at -20°C (-4°F) shows less than 10 counts per hr. Blankets not in use shall be stored in clean, sealed containers.

2. It is recommended that the materials be baked out prior to blanket construction or that blankets be slightly oversized.

REMARKS

The procedures in number 1, above, will prevent multilayer thermal blankets from contaminating sensitive surfaces.

In regard to number 2, above, typical multilayer blanket materials (Mylar☐ and Kapton☐) shrink slightly during bake out.

This standard incorporates SSP 30213 no. M/P-12.

RATIONALE FOR CANCELLATION

If MLI blankets are fabricated using materials that meet JSC 49774 outgassing requirements, there is no need to vacuum-bake the blankets before use. The one benefit of vacuum baking is that it takes care of shrinkage, but this is a minor problem and not mentioned in the standard. Some contractors like to bake their blankets but most do not.

Section 4.3.6 of the revised JSC 49774 contains specific requirements on vacuum outgassing of materials and for vacuum baking components that contain materials that fail the requirement or are unknown. Requirements are based on the standard ASTM E595 test and acceptance criteria used by every space agency in the world (even RSA).

Note: specific programs may have special, more stringent requirements (HST and ISS).

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Silicate Ester Coolant System Design	Document No. JPR 8080.5	Standard No. MP-14	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Design of a system using a silicate ester coolant shall observe the following ground rules:

1. Nitrile elastomer seals shall not be used without making allowance for shrinkage.
2. Silicone-based elastomers that will be in contact with or exposed to silicate ester coolants shall not be used because they will deteriorate.
3. Ethylene propylene elastomers may be used; however, this elastomer will swell upon exposure to silicate ester fluids.
4. Dow Corning DC-55☐ or similar lubricants shall not be used in seals, etc., exposed to silicate ester coolants such as Oronite Flo-Cool 100☐. Test and failure analyses have shown this lubricant to become a brittle, hard, and flaky material that can be detrimental to a sealing cavity, especially under dynamic conditions. Seals may be received from the manufacturer prelubricated with this type of lubricant.

REMARKS

The effects described above were realized as a result of switching to Oronite fluid in the instrument unit coolant system, which was originally designed for use of water-methanol fluid.

This standard incorporates SSP 30213 no. M/P-14.

RATIONALE FOR CANCELLATION

This standard addresses specific materials compatibility issues associated with a single coolant that has never been used by NASA in manned spacecraft. All materials compatibility issues must be addressed for any fluid used in manned spacecraft. Revised M/P-1 calls out JSC 49774. Sections 3.0 and 4.1.3 of JSC 49774 require fluids compatibility to be addressed for any material in contact with any fluid.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Mercury - Restriction On Use	Document No. JPR 8080.5	Standard No. MP-15	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

The use of equipment containing mercury in liquid or vapor form (such as manometers, lights, thermometers, etc.) shall be avoided where the mercury could come in contact with the spacecraft or spaceflight equipment at any time during manufacturing, assembly, testing, checkout, or flight. Where the use of equipment containing mercury cannot be avoided, the following information shall be documented in a waiver for approval by the Program Manager:

1. A list of equipment containing mercury to be used during manufacturing, assembly, testing, and checkout, along with justification for each use
2. The amount of mercury contained in the equipment
3. The protection provided to prevent the release of mercury
4. A plan for decontamination in the event the mercury is released. The plan must note the following:

a. An environment containing mercury vapor in concentration of 0.005 mg/m3 (or greater) is not acceptable for continuous occupancy. Equipment used to detect mercury in the crew compartment must be able to measure concentrations below this level.

b. Mercury must not be removed from metal surfaces with any abrasive cleaning method. The removal of oxide films on the metal will cause immediate mercury penetration.

REMARKS

Mercury is a particularly hazardous liquid because of its toxicity and tendency to penetrate joints and amalgamate structure materials. Corona discharge can occur at low potentials in the presence of mercury vapor.
Metal contaminated while under high stress will receive greater penetration of mercury and degradation of ability to withstand stress than will metals under relatively low stress.
This standard supersedes JSCM 8080 standard 116 and incorporates SSP 30213 no. M/P-15.

RATIONALE FOR CANCELLATION [SEE NEXT PAGE]

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Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

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RATIONALE FOR CANCELLATION

Requirement is covered by revised JSC 49774 paragraph 4.2.7, which states:

> 4.2.7 MERCURY
> Equipment containing mercury shall not be used where the mercury could come in contact with the spacecraft or spaceflight equipment during manufacturing, assembly, test, checkout, and flight. Flight hardware (including fluorescent lamps) containing mercury shall have three levels of containment to prevent mercury leakage. The bulbs of non-flight lamps containing mercury, such as those used in hardware ground processing and fluorescent penetrant inspection of flight parts, shall be protected by a non-shatterable, leak-proof outer container.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

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STATEMENT OF STANDARD

Surfaces in the habitable compartments which are expected to be exposed to extensive or continuous abrasion and rubbing contact by the spacecraft crew shall not be painted or coated with materials which are subject to flaking.

REMARKS

Arm rests and floors on spacecraft have been painted. This paint has been rubbed, chipped, and flaked off in flight, presenting a floating hazard under zero-gravity conditions.
Removable protection plates used on door facings prior to flight must also comply with this standard.
Where necessary, surfaces may be protected by compatible processes, such as anodizing.
This standard supersedes JSCM 8080 standard 43 and incorporates SSP 30213 no. M/P-16.

RATIONALE FOR CANCELLATION

The problems identified in the remarks have been observed in the past but are almost entirely due to improper manufacturing processes (poor surface preparation/excessive cure and contamination of the primer surface before topcoat application) which are not mentioned in the standard. Anodize is durable and popular with M&P, but human factors requirements often drive coating even when anodize is feasible

Continued next page.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Restriction on Coatings for Areas Subject to Abrasion	Document No. JPR 8080.5	Standard No. MP-16	Page 2 of 2
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RATIONALE FOR CANCELLATION

Section 3.0 of JSC 49774 contains generic requirements to ensure materials are selected for adequate life in the use environment. Where surfaces in habitable compartments are to be coated, the durability of the coating is a key factor in coating material trade studies. With proper materials selection and proper processes for conducting the coating, long life (such as 30 years) with minimal wear is feasible. JSC 49774 has been revised to strengthen requirements on process controls; paragraph 3.1.3 of the revised document reads:

3.1.3 PROCESS CONTROLS

The materials and processes selection, control, and implementation plan shall identify all process specifications used to implement specific requirements in this standard. All materials processes used in manufacturing shall be documented in process specifications and all applicable process specifications shall be identified on the engineering drawing. Each processing step in the process specification shall be identified in a level of detail that ensures the process is repeatable. Qualification testing shall be conducted to demonstrate the repeatability of all processes where the quality of the product cannot be verified by subsequent monitoring or measurement. Process specifications shall be made available to support design review activities. Deviations from process specifications identified in the Materials & Processes Selection, Control, and Implementation Plan shall require approved MUAs per section 3.3 of this standard.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Radiographic Inspection of Brazed and Welded Tubing Joints	Document No. JPR 8080.5	Standard No. MP-17	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Radiographic inspection shall be used on brazed and welded tubing joints per military standard MIL-STD-453 or equivalent to verify that the brazing or welding process is under proper control.
Radiographic inspection is not required on silver soldered joints of less than (12.7 mm) 0.5 in. diam. in payload systems where (1) no catastrophic hazard exists, (2) tubing installation makes radiographic inspection difficult, and/or (3) electronic devices in proximity of joint(s) could be degraded by radiographic inspection.
The use of radiographic inspection does not preclude the need for other established inspection procedures, such as visual examination, proof tests, and leak tests.
Acceptance criteria for brazed joints shall be in accordance with military specification MIL-B-7883 and weld joints in accordance with George C. Marshall Space Flight Center specification MSFC-SPEC-504 or MSFC-SPEC-560, unless otherwise specified in the procurement documents.

REMARKS

The explosive and catastrophic hazards to manned spacecraft carrying high pressure gas and liquid propellants make it mandatory that brazed and welded tubing joints be of uniform high quality. Radiographic inspection has proven to be an effective technique for determining the acceptable condition of joints produced by any given brazing or welding procedure.
Silver soldering is considered a brazing operation, but it is not identical to silver brazing.
This standard supersedes JSCM 8080 standard 87A and incorporates SSP 30213 no. M/P-17.

RATIONALE FOR CANCELLATION

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Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

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RATIONALE FOR CANCELLATION

Requirement is superseded by the revised JSC 49774 paragraphs 4.4.4, 4.4.5, and 4.4.6.

> Paragraph 4.4.4 states that "The processing and quality assurance requirements for manual, automatic, and semiautomatic fusion welding for space flight applications and special test equipment used for testing flight hardware within NASA shall meet the requirements of NASA-STD-5006, General Fusion Welding Requirements for Aerospace Materials Used in Flight Hardware."
>
> Paragraph 4.4.5 states that "Brazing shall be conducted in accordance with AWS C-3.3, Design, Manufacture, and Inspection of Critical Brazed Components, Recommended Practices for."
>
> Paragraph 4.4.6 states that "Soldering shall not be used for structural applications."

The standards called out by 4.4.4 and 4.4.5 call out appropriate inspection requirements.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Etching Fluorocarbon Insulated Electrical Wire	Document No. JPR 8080.5	Standard No. MP-18	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Electrical wire or cable insulated or coated with polytetrafluoroethylene (TFE) or fluorinated ethylene propylene (FEP) shall be etched prior to potting to ensure mechanical bond strength and environmental seal. Potting shall be accomplished within 1 year of etching, provided the etched wires have been protected from ultraviolet light and contamination.

When etching of wire insulation is required to provide satisfactory bonding to potting materials, the open end of the wire shall not be exposed to the etchant. The preferred process is to form the wire into a U shape, immersing only the bent portion in the etchant with the open ends above the etchant level. The unetched end of the wire shall not be cut off prior to neutralization of the etchant.

REMARKS

The failure of unetched TFE or FEP wire to bond to electrical connector potting materials allows moisture to penetrate within the connector, resulting in dielectric breakdown between pins.

Care should be taken to keep etched wires clean and packaged in sealed black bags and stored in cabinets so as to avoid ultraviolet light. The potential bond strength of TFE or FEP deteriorates if more than 3 weeks elapses between etching and potting without proper protection afforded to these surfaces.

Exposure of open ends of insulated wire to etchant may result in wicking of etchant between the conductor and/or shield braid and insulation. Subsequent exposure to low pressures may result in outgassing of the etchant. Wicking of the etchant may also cause corrosion of conductor and solder joints.

This standard supersedes JSCM 8080 standards 98 and 109B and incorporates SSP 30213 no. M/P-18.

RATIONALE FOR CANCELLATION [SEE NEXT PAGE]

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Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Etching Fluorocarbon Insulated Electrical Wire	Document No. JPR 8080.5	Standard No. MP-18	Page 2 of 2
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RATIONALE FOR CANCELLATION

Requirement is covered by revised JSC 49774 paragraph 4.3.10, which states:

> 4.3.10 ETCHING FLUOROCARBONS
> The etching of fluorocarbons shall meet the requirements of SAE-AMS 2491, Surface Treatment of Polytetrafluoroethylene, Preparation for Bonding. Etched surfaces must be processed within 24 hours or packaged per SAE-AMS 2491. Etched surfaces packaged per AMS 2491 shall be processed within 1 year. Electrical wire or cable insulated or coated with fluorocarbons shall be etched prior to potting to ensure mechanical bond strength and environmental seal. When etching of wire insulation is required to provide satisfactory bonding to potting materials, the open end of the wire shall not be exposed to the etchant.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Spacecraft Material – Restriction on Use of Polyvinyl Chloride	Document No. JPR 8080.5	Standard No. MP-19	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Polyvinyl chloride (PVC) shall not be used on manned spacecraft except under either of the following conditions:

1. PVC's surface temperatures will not exceed 48.8°C (120°F) and/or pressures will not be less than 2.1 x 104 Pa (3 psia) under normal or emergency conditions.
2. Adequate data is presented on outgassing, toxicity, physical changes, etc., for approval by the cognizant program office.

REMARKS

Outgassed products are hazardous and corrosive. Products include hydrogen chloride, phosgene, CO, CO2 chlorine monoxide, and acidic carbonaceous coke. Plasticiser loss causes embrittlement. PVC has a low ignition point and will not comply with the requirements of JSCM standard M/P-2, Flammability of Wiring Materials.

Results of the Manned Spacecraft Center test program have indicated that the three PVC formulations tested should not be used in applications which may be exposed to greater than 48.8°C (120°F) or less than 2.1 x 104 Pa (3 psia).

Products containing PVC are often called by trade names that do not indicate the presence of PVC.

All types of PVC tested to date are fungus nutrient.

This standard supersedes JSCM 8080 standard 18.

RATIONALE FOR CANCELLATION [SEE NEXT PAGE]

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Spacecraft Material – Restriction on Use of Polyvinyl Chloride	Document No. JPR 8080.5	Standard No. MP-19	Page 2 of 2
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RATIONALE FOR CANCELLATION

Requirement is superseded by JSC 49774 paragraphs 4.1 and 4.3.2.

JSC 49774 paragraph 4.3.2 states that "Use of polyvinylchloride on flight hardware shall be limited to applications in pressurized areas where temperatures do not exceed 120 degrees Fahrenheit (49 degrees C). Polyvinylchloride shall not be used in vacuum. "

In addition, paragraph 4.1 imposes NASA-STD-6001 requirements for flammability and toxic offgassing on all nonmetallic materials.

These requirements address all issues with use of PVC.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Titanium Or Its Alloys – Prohibited Use With Oxygen	Document No. JPR 8080.5	Standard No. MP-20	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Titanium or its alloys shall not be used where exposed to liquid oxygen.

Titanium or its alloys shall not be used where exposed to gaseous oxygen at any pressure or with air at oxygen partial pressures above 34.5 kPa (5 lb psia).

REMARKS

1. Jackson, J.D.; Miller, P.D.; and Boyd, W. K.: Reactivity of Titanium With Gaseous N2O4 Under Conditions of Tensile Rupture. Defense Metals Information Center (DMIC) Memorandum 173, Battelle Memorial Institute, Columbus, Ohio, August 1, 1963.
2. Riehl, W. A.; Key, C. F.; and Gayle, J. B.: Reactivity of Titanium With Oxygen. Technical Report NASA TR-180, George C. Marshall Space Flight Center, Alabama.
3. Molley, J. J.: Tank Explosion. Letter, Industrial Hygiene and Safety, Rocketdyne, North American Aviation, April 27, 1964.
4. Gabel, H.; and Benz, F. J.: Combustion Phenomena of Commercially Pure Titanium and Ti-6AI-4V in Oxygen. In Flammability and Sensitivity of Materials in Oxygen-Enriched Atmospheres, Vol. S, American Society for Testing Materials STP 1111, 1991.

RATIONALE FOR CANCELLATION

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Approval Signature: ______/s/ Frank Benz__________________ Date:____08 March 2005___________
Director, Engineering

Titanium Or Its Alloys – Prohibited Use With Oxygen	Document No. JPR 8080.5	Standard No. MP-20	Page 2 of 2
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RATIONALE FOR CANCELLATION [Cont.]

Requirement is superseded by JSC 49774 paragraph 4.2.3.5, which states:

> 4.2.3.5 Titanium Flammability -- Titanium alloys shall not be used with Liquid Oxygen (LOX) or Gaseous Oxygen (GOX) at any pressure or with air at oxygen partial pressures above 5 psia (34.5 kPa). Titanium alloys shall not be machined inside spacecraft modules during ground processing or in flight, because machining operations can ignite titanium turnings and cause fire.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Beryllium - Restricted Use Within Crew Compartment(s)	Document No. JPR 8080.5	Standard No. MP-21	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Unalloyed beryllium shall not be used within the crew compartment(s) of spacecraft unless suitably protected to prevent erosion, or formation of salts or oxides. Environmental tests, under expected conditions, shall be conducted to verify that the coating used provides satisfactory protection for the beryllium surface.

Beryllium and alloys or oxides of beryllium shall not be ground, filed, drilled, sawed, or in any other way machined within the spacecraft crew compartment at any stage of manufacturing, assembly, testing, modification, or operation.

REMARKS

Beryllium is an extremely toxic material whose threshold limit is 0.002 mg/m3. Mists, dusts, or fumes containing beryllium or its compounds can cause a delayed type of pneumonitis that may manifest itself after an extended period of time.

Alloys containing 4 percent or less of beryllium are an exception to this standard.

This standard supersedes JSCM 8080 standard 51.

RATIONALE FOR CANCELLATION

Requirement is covered by revised JSC 49774 paragraph 4.2.5, which states:

> 4.2.5 BERYLLIUM
> Beryllium shall not be used for primary structural applications. Beryllium is allowed as an alloying constituent up to a maximum of 4 percent by weight. Beryllium alloys containing more than 4 percent beryllium by weight shall not be used for any application within spacecraft crew compartments unless suitably protected to prevent erosion or formation of salts or oxides. Beryllium alloys and beryllium oxide of beryllium shall not be machined inside spacecraft crew compartments at any stage of manufacturing, assembly, testing, modification, or operation.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Brazed Joints – Identification Marks	Document No. JPR 8080.5	Standard No. MP-22	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Brazed joints in spacecraft fuel and oxidizer lines shall be permanently marked adjacent to the joint to identify the qualified brazer who makes the joint and the inspector who approves the joint. The mark to be used shall be applied by an approved method which has been shown to be incapable of degrading brazing or tubing material.

REMARKS

Improve manufacturing discipline, traceability, and inspection capability.

This standard supersedes JSCM 8080 standard 82.

RATIONALE FOR CANCELLATION

The process of brazing fuel and oxidizer lines is no longer performed. Tracking of welded joints is performed via inspection records

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Pressure Vessels – Materials Compatibility And Vessel Qualification Tests	Document No. JPR 8080.5	Standard No. MP-23	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

1. The compatibility of pressure vessel materials with processing, inspecting, testing, and flight fluids will be verified by data obtained under conditions simulating the intended fluid-use environment. When coupons are used to verify properties, test material will be representative of the production pressure vessel material and will have been subjected to processes that are representative of the processes for production pressure vessels. Fluids to be used in pressure testing of pressure vessels and flight fluids must be evaluated with the pressure vessel material considering the existence of flaws that can be accepted by inspecting processes The effect of material condition (parent versus weld metal or heat-affected one) must be considered in the compatibility determinations. The scope of the program shall be sufficient to show compatibility of the fluid and material for the anticipated temperature range, pressure range, pressure cycle history of the vessel, and fluid composition range.

2. Qualification tests of pressure vessels will be conducted on representative pressure vessels that have been fabricated by proposed production processes and exposed to the same processing, inspecting, and test sequences (fluids, times, and pressures) as would be expected on flight hardware.

3. The qualification program will include tests on pressure vessels containing the flight fluids at the maximum pressure allowed by the relief devices or maximum pressure expected for vessels without relief devices. In addition, the conditions of the tests will include exposure to the most deleterious operating temperature expected in use.

4. The vessels, while containing the flight fluid, shall be subjected to the above pressure and temperature conditions for twice the expected pressurized life or for 1 year, whichever is less. The flight duration shall include the time from initial pressuri zation, with the flight fluid, and the anticipated launch pad hold times under pressure.

5. For testing of pressure vessels with decaying pressure, flight duration can be taken as the time from initial pressurization with the flight fluid including the anticipated launch pad hold times under pressure to the time at which the internal pressure of the vessel reaches one-half the maximum pressure allowed by the relief device or one-half maximum operating pressure, whichever pressure is less.

REMARKS [SEE NEXT PAGE]

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Director, Engineering

Pressure Vessels – Materials Compatibility And Vessel Qualification Tests	Document No. JPR 8080.5	Standard No. MP-23	Page 2 of 2
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REMARKS [CONT.]

For the purposes of this standard, a "pressure vessel" is defined as a container for the storage of compressed fluid that would release more than 19,320 J (14,250 ft-lb) of energy [0.004 kg (0.01 lb) equivalent of TNT] based on the adiabatic expansion of a perfect gas to ambient conditions.
This standard supersedes JSCM 8080 standard 114A.

RATIONALE FOR CANCELLATION

Requirement is superseded by revised M/P-13, which calls out ANSI/AIAA S-080, “Space Systems-Metallic Pressure Vessels, Pressurized Structures, and Pressure Components”, and ANSI/AIAA S-081, “Space Systems-Composite Overwrapped Pressure Vessels (COPVs)". Each part of the standard listed above is addressed below:

1. Compatibility of pressure vessel materials – is covered by M/P-13
2. Qualification tests of pressure vessels - is covered by M/P-13
3. Qualification Program is obsolete and replaced by M/P-13
4. Life testing regime is obsolete and replaced by M/P-13
5. Not a requirement

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Cadmium - Restriction On Use	Document No. JPR 8080.5	Standard No. MP-24	Page 1 of 2
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Use of cadmium and cadmium plating should be avoided under the following conditions:

1. Where cadmium in contact with breathing gas could reach temperatures that would generate toxic fumes
2. In equipment containers where electrical and electronic equipment could be degraded to an unacceptable level by vaporization and deposition of cadmium on the equipment surfaces
3. In applications where the combination of temperature and proximity of the cadmium or cadmium plating could adversely affect critical surfaces by cadmium deposition. Critical surfaces include but are not limited to optical surfaces. electromagnetic radiating surfaces and surfaces that have specified requirements for solar radiation absorptivity or total hemispheric emissivity
4. In applications where temperature of the cadmium or cadmium plating could exceed 232.2°C (450°F)

REMARKS

Cadmium is prone to vaporize rapidly at combinations of temperature and pressure encountered in spaceflight applications. The fumes are toxic and may cause problems if redeposited on certain equipment surfaces.
A sharp decrease in the tensile strength of cadmium-plated high-strength steel parts can occur when the parts are subjected to elevated temperatures while under stress. Embrittlement occurs as a result of diffusion of cadmium into the alloy, a process that progresses rapidly at temperatures above 232.2°C (450°F). Under such conditions, failures have occurred at loads corresponding to stresses well below the tensile strength of the steel. Cadmium-plated tools should not be used on titanium or high-strength steel parts that are to be operated under stress at temperatures above 232.2°C (450°F) since small deposits of cadmium may be left on the part.

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Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Cadmium - Restriction On Use	Document No. JPR 8080.5	Standard No. MP-24	Page 2 of 2
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REMARKS

Breathable atmospheres could become severely toxic with cadmium fumes if a cadmium or cadmium-plated part were overheated. Overheating could result from an electrical short circuit a fire or from dissipated electrical power in a component installed with a cadmium-plated fastener. The toxic effect is cumulative and continued breathing of a very low concentration of cadmium fumes may result in prolonged disability or possibly death. The presence of low concentrations of cadmium fumes may not be detected until toxic effects are felt. Venting the crew compartment to outside atmosphere or space would provide only a temporary reduction in cadmium concentration unless the supply of cadmium were depleted or the source of heat eliminated. The use of an organic-based paint as a barrier overcoating of cadmium surfaces is not a reliable method of control because of the porosity of the available overcoatings and the possibility of overcoating damage during normal operations. Complete elimination of cadmium from areas exposed directly to breathable atmospheres appears to be the most practical method of avoiding the toxicity hazards involved in cadmium use.
This standard supersedes JSCM 8080 standard 125.

RATIONALE FOR CANCELLATION

Requirement is superseded by JSC 49774 paragraph 4.2.6, which specifically addresses all "to be avoided" conditions in the old standard:

> 4.2.6 CADMIUM
> Cadmium shall not be used in crew environments. Cadmium shall not be used in vacuum environments where the temperature/pressure environment could cause contamination of optical surfaces or electrical devices

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Pressure Vessels- Nondestructive Evaluation Plan	Document No. JPR 8080.5	Standard No. MP-25	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Develop nondestructive evaluation (NDE) plans during the design phase to delineate the methods and techniques used to evaluate the surface and subsurface conditions of the pressure vessel during the following phases:

1. Manufacturing phase
2. Buildup and assembly phases
3. Phase subsequent to proof testing
4. Operational life phase

REMARKS

Describe NDE methods and techniques in the design control specification and on other applicable specifications, drawings, and procedures.

Methods of inspecting welds are of particular importance. Before installation and subsequent to design proof testing, examine welds by the specified NDE methods.

For the purposes of this standard, a "pressure vessel" is defined as a container for compressed fluid that would release more than 19,320 J(14,250 ft-lb)[0.004 kg (0.01 lb) equivalent of TNT] based on the adiabatic expansion of a perfect gas to ambient conditions.

This standard supersedes JSCM 8080 standard 137.

RATIONALE FOR CANCELLATION

Requirement is superseded by revised M/P-13, which calls out:

1. ANSI/AIAA S-080, “Space Systems-Metallic Pressure Vessels, Pressurized Structures, and Pressure Components”
2. ANSI/AIAA S-081, “Space Systems-Composite Overwrapped Pressure Vessels (COPVs)"

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

Exposed Sharp Surfaces Or Protrusions	Document No. JPR 8080.5	Standard No. MS-6	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Exposed sharp surfaces or protrusions which could injure crew members or damage equipment shall be eliminated or guarded so as to avoid accidental contact.

REMARKS

Sharp surfaces or protrusions are those surfaces, edges, crevices, points, burrs, wire ends, screw heads, corners, brackets, rivets, braided cable, swaged cable, cable strands, clamps, pins, latches, lap joints, bolt ends, lock nuts, etc., that if contacted could injure crew members or damage equipment by entrapment, cutting, sawing, abrading, snagging, tearing, or puncturing.

This standard supersedes JSCM 8080 standard 142 and incorporates SSP 30213 no. M/S-6.

RATIONALE FOR CANCELLATION

The content of this 8080 standard is already covered in NASA STD 3000, paragraph 6.3.3 "Mechanical Hazards Design Requirements."

Approval Signature: ______/s/ Frank Benz__________________ Date:____08 March 2005__________
Director, Engineering

<table>
<tr><td rowspan="2">Functional Doors That Operate In Flight</td><td>Document No.
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STATEMENT OF STANDARD

Doors in the structure of the spacecraft or heat shield that open and close during flight must be designed such that a single-point failure will not cause the loss of crew or vehicle. The following design requirements shall be met:

I. Doors shall be used only if no other practicable method exists to perform the desired function.

2. Doors shall be as small as practicable and shall be designed to cover only the devices they protect; specifically, they will not be enlarged for use as maintenance access doors. Designs requiring active vents will include relief features to prevent catastrophic failures should the door fail to operate. Vehicle aerodynamics and structural integrity will not be catastrophically degraded by a failed door.

3. Spacecraft systems requiring thermal protection doors shall be designed so that if a door fails, the spacecraft can make a safe ascent and reentry.

4. For door operation that is not time critical with respect to survival of crew and/or vehicle, an alternate manual means shall be provided if items 2 and 3 are not practicable.

REMARKS

This standard supersedes JSCM 8080 standard 150.

RATIONALE FOR CANCELLATION

Standard addresses technical content that is obsolete. Standard was also unverifiable.

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

<table>
<tr><td rowspan="2">Lifting And Hoisting Ground Support Equipment Identification Standard</td><td>Document No.
JPR 8080.5</td><td>Standard No.
MS-13</td><td>Page
1 of 1</td></tr>
<tr><td>Previous Revision
04/01/1991</td><td colspan="2">Cancelled as of date signed below:</td></tr>
</table>

STATEMENT OF STANDARD

All slings are to be designed with a safety actor of 5 to 1 to the ultimate and initially tested and periodically retested to 200 percent of the maximum load capacity.

All lifting and hoisting load-bearing sling components that can be disassembled, such as individual slings, cables, shackles, pins, bolts, and similar parts, shall be tethered, serialized, tagged, or marked for positive identification and traceability to ensure proper assembly of verified hardware after proof load testing..

REMARKS

Proof loading and periodic recertification of slings and load-bearing assemblies cannot be properly verified in real time if all components of the assemblies are not traceable back to the load-testing configuration.

This standard incorporates SSP 30213 no. M/S-13

RATIONALE FOR CANCELLATION

Current standard is not comprehensive and could lead to oversights. Standard is not comprehensive and is superseded by a higher level document.

Standard is completely covered by NASA STD-8719.9, "Standard for Lifting Devices & Equipment".

Approval Signature: ______/s/ Frank Benz_________________ Date:____08 March 2005__________
Director, Engineering

<table>
<tr><td rowspan="2">Pyrotechnic Circuits- Prohibited Wire Splicing</td><td>Document No.
JPR 8080.5</td><td>Standard No.
P-3</td><td>Page
1 of 1</td></tr>
<tr><td>Previous Revision
04/01/1991</td><td colspan="2">Cancelled as of date signed below:</td></tr>
</table>

STATEMENT OF STANDARD

Wiring splicing is prohibited on both flight firing circuits and ground test firing circuits.

REMARKS

A failure due to a broken wire can cause catastrophic damage including loss of vehicle and crew

For ground test, a broken or intermittent wire can cause loss of data or cause an inadvertent firing.

RATIONALE FOR CANCELLATION

The specifications for splicing, whether for pyrotechnic or other circuits, are captured within the content of NASA-STD-8739.4.

To avoid conflicting splicing requirements, the JPR 8080 P-3 standard is cancelled.

Standard content is contained in NASA-STD-8739.4.

Approval Signature: ______ __________________ Date:____ __________
Director, Engineering

Pyrotechnic Devices- Packaging Material	Document No. JPR 8080.5	Standard No. P-4	Page 1 of 1
	Previous Revision 04/01/1991	Cancelled as of date signed below:	

STATEMENT OF STANDARD

Packaging of pyrotechnic devices shall be in accordance with the packaging and handling requirements of NSTS 08060 (Rev. J, March 2003), *Space Shuttle System Pyrotechnic Specification*.

Raw explosive mixes that are not loaded into an electro-explosive component shall be contained in conductive packaging and be in compliance with MIL-STD-2073.

REMARKS

The following paragraphs from NSTS 08060 Space Shuttle System Pyrotechnic Specification apply specifically to this standard:

- 3.2.2.1, JSC Safety
- 3.8.3, Transportation Environments
- 6.0, Preservation, Packaging and Delivery

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RATIONALE FOR CANCELLATION

Pyrotechnic packaging requirements are covered in Federal Regulations.

Packaging and shipping requirements are now covered by Federal regulations.

Pyrotechnic device packaging and shipping requirements are covered by Department of Transportation Requirements listed in the Code of Federal Regulations Title 49 Parts 100 through 199.

Approval Signature: ______ __________________ Date:____ __________

Director, Engineering

<table>
<tr><td rowspan="2">Pyrotechnic Devices Color Coding Requirements</td><td>Document No.
JPR 8080.5</td><td>Standard No.
P-7</td><td>Page
1 of 1</td></tr>
<tr><td>Previous Revision
04/01/1991</td><td colspan="2">Cancelled as of date signed below:</td></tr>
</table>

STATEMENT OF STANDARD

Pyrotechnic devices shall be color coded as follows:

1. Expended (fired) units – red paint.
2. Loaded or Charged units- Natural color of the body material (i.e., stainless steel or aluminum).
3. Charged units (or off nominal loaded units) not intended for flight - blue paint. Exceptions to painting units blue that are not intended for flight include those units in storage at JSC/ Energy Systems Test Area (ESTA) / Building 352 for testing such as Age Life Verification or Destructive Lot Acceptance Test (DLAT) setup verification firings where paint may be detrimental to environmental conditioning such as thermal cycling.
4. Color coding shall be conspicuous and not obliterate identification markings such as part, lot, or serial numbers.

REMARKS

Inert pyrotechnic devices are identified as a "pyro device" according to NSTS 08060, Space Shuttle Pyrotechnic Specification, paragraph 11.0 Definitions.

Off nominal loaded devices are defined as those units whose charge load is different from the charge load of flight operational units.

Inert (unloaded by design) flown pyrotechnic devices which accept loaded devices for functioning such as frangible nuts or thrusters that are flown are painted as required by flight environments which dictate the thermal protection and/or anti-reflectivity posture.

Because of the various sizes and configurations of explosive devices, the location and extent of color coding cannot be defined in this standard.

RATIONALE FOR CANCELLATION

Color coding requirements are now defined in Program level requirements documents.
Color coding requirements are now defined in headquarters level requirements documents.
Color coding requirements are defined in JSC 62809 Revision C.

Approval Signature: ______ ________________ Date:____ __________
Director, Engineering

APPENDIX C

CHANGE RECORD FOR JPR 8050.5

HISTORIC CHANGE RECORD FOR JPR 8080.5

Revision.	Date	Description	Originator
Baseline	4/1/1991	Incorporates Changes 1-11 to JSCM 8080. Document signed by Center Director Aaron Cohen	Directives Office
No revision annotated	8/17/1992	JSC Manuals (JSCM) are now numbered in the same manner as JSC Management Directives, i.e., a sequential number is added to the subject-classification number scheme.	Directives Office
Title Change – No revision annotated	5/25/1994	The title to JSC Manuals is changed to JSC Handbooks (JSCH) to accommodate their accessibility on the NASA On-Line Directives Information System (NODIS).	Directives Office
Title Change – No revision annotated	12/12/1995	The title to JSC Handbooks is changed to JSC Procedures and Guidelines (JPG) due to changes in format/reporting requirements and addition of metrics.	Directives Office
Replace Obsolete Standard E-24 (Change 1)	2/14/1996	Delete previous Standard E-24 and Replace with new Standard E-24 (2 pages)	Directives Office
Document availability	8/21/2000	Upload document to the NODIS for on-line viewing.	Directives Office
Revision A	2/27/2005	The title to JSC Procedures and Guidelines (JPG) is changed to JSC Procedural Requirements (JPR). Complete document revision in accordance with NASA Headquarters Rules Review. Document changed from guidelines to requirements.	EA2/ Steve Schenfeld
Rev A Change 1	5/1/09	P3 is cancelled; requirements are contained in another document. P4 is cancelled; requirements are contained in another document. P5 is cancelled; requirements are contained in another document. E7 is being modified to change the tin composition to mitigate “tin whiskers”.	E. Kluksdahl, 36484

Historic Change Record for JPR 8080.5 Standards Rev.A

Std. No.	Action	Description of Change	Originated by	Update Effective
E-7	Revise	Modified to change the tin composition to mitigate “tin whiskers”.	E.Kluksdahl	1 May 2009
P-3	Cancel	Requirements are contained in another document.	E.Kluksdahl	1 May 2009
P-4	Cancel	Requirements are contained in another document.	E.Kluksdahl	1 May 2009
P-7	Cancel	Requirements are contained in another document.	E.Kluksdahl	1 May 2009
MP-1	Revise	Modified to replace reference to JSC 49774 with NASA-STD-6016. Change approved by JTRS.	S. Schenfeld	19 Oct 2009