



National Aeronautics and  
Space Administration

**Lyndon B. Johnson Space Center  
Houston, Texas 77058**

April 2001

---

Hardware Requirements Document (HRD)  
for the  
Human Research Facility  
8PU Stowage Drawer (SD8)

REVIEW COPY

For CCB Control

LS-71088

# PROJECT DOCUMENT APPROVAL SHEET

DOCUMENT NUMBER

LS-71088

DATE

NO. OF  
PAGES

**TITLE:**

Hardware Requirements Document (HRD)  
for the  
Human Research Facility  
8PU Stowage Drawer (SD8)

APPROVED:

EA5/E. Strong  
Technical Manager

DATE

PREPARED BY

CHANGE APPROVALS

CHANGE  
NUMBER

**Report Number**

LS-71087-4

**Date**

**Hardware Requirements Document (HRD)**  
**for the**  
**Human Research Facility**  
**8PU Stowage Drawer (SD8)**

Prepared by: \_\_\_\_\_ Date \_\_\_\_\_  
 Daniel Barineau  
 Project Engineer

Approved by: \_\_\_\_\_ Date \_\_\_\_\_  
 Jerry McDonald  
 Manager, Hardware Development Section

Approved by: \_\_\_\_\_ Date \_\_\_\_\_  
 Don Kilbourn  
 Manager, Safety and Product Assurance

Approved by: \_\_\_\_\_ Date \_\_\_\_\_  
 Sharad Bhaskaran  
 Manager, Systems Integration and Development  
 Department

Prepared by:  
 Lockheed Martin Space Operations  
 Houston, Texas  
 for  
 National Aeronautics and Space Administration  
 Johnson Space Center

**REVISION/CHANGE APPROVALS**

Date	Change Number	Prepared by	Approved by:		
			Unit Manager	SR&QA Manager	Projects Manager

DOCUMENT NUMBER LS-71088	<b>DOCUMENT CHANGE/ REVISION LOG</b>	PAGE <u> 1 </u> OF <u> 1 </u>
-----------------------------	--	-------------------------------

CHANGE/ REVISION	DATE	DESCRIPTION OF CHANGE	PAGES AFFECTED
BASIC			All

Altered pages must be typed and distributed for insertion.

## *Preface*

*This Hardware Requirements Document (HRD) defines the minimum set of requirements for the 8 Panel Unit (PU) Stowage Drawer (SD8) to be placed on the International Space Station (ISS) and mounted within the Human Research Facility (HRF) Rack. This document is under the control of the HRF Configuration Control Board (CCB).*

---

HRF CCB Chair

DATE

# CONTENTS

Section		Page
1.0	<u>SCOPE</u>	1-1
2.0	<u>APPLICABLE DOCUMENTS</u>	2-1
2.1	DOCUMENTS	2-1
2.2	ORDER OF PRECEDENCE	2-2
3.0	<u>SYSTEM REQUIREMENTS</u>	3-3
3.1	ITEM DEFINITION	3-3
3.1.1	<u>Description</u>	3-3
3.2	CHARACTERISTICS	3-4
3.2.1	<u>Performance Characteristics</u>	3-4
3.2.1.1	Functional Performance Characteristics	3-4
3.2.2	<u>Physical Characteristics</u>	3-4
3.2.2.1	Mass and Center of Gravity Properties	3-4
3.2.2.2	Envelope	3-4
3.2.3	<u>Reliability, Quality, and Non-Conformance Reporting</u>	3-9
3.2.3.1	Failure Propagation	3-10
3.2.3.2	Useful Life	3-10
3.2.4	<u>Maintainability</u>	3-10
3.2.4.1	Logistics and Maintenance	3-11
3.2.5	<u>Environmental Conditions</u>	3-11
3.2.5.1	On-Orbit Environmental Conditions	3-11
3.2.5.2	Acoustic Emission Limits	3-13
3.2.5.3	Lighting Design	3-13
3.2.5.4	Instrument Surface Temperature	3-13
3.2.6	<u>Transportability</u>	3-14
3.2.6.1	Launch and Landing	3-14
3.2.7	<u>Operational Interface Requirements</u>	3-14
3.2.7.1	Mechanical Interface Requirements	3-14
3.2.7.2	Electrical Power Interface Requirements	3-15
3.2.7.3	Command and Data Handling (C&DH) Interface Requirements	3-15
3.2.7.4	Payload National Television Standards/Systems Committee (NTSC) Video Interface Requirements	3-15
3.2.7.5	Thermal Control Interface Requirements	3-15
3.2.7.6	Vacuum System Requirements	3-15
3.2.7.7	Pressurized Gas Interface Requirements	3-15
3.2.7.8	Payload Support Services Interfaces Requirements	3-16
3.2.7.9	Fire Protection Interface Requirements	3-16
3.2.7.10	Other Interface Requirements	3-16

## CONTENTS (Cont'd)

Section		Page
3.3	DESIGN AND CONSTRUCTION	3-16
3.3.1	<u>Materials, Processes, and Parts</u>	3-16
3.3.1.1	Materials and Processes	3-16
3.3.1.2	Sharp Edges and Corner Protection	3-17
3.3.1.3	Holes	3-17
3.3.1.4	Latches	3-17
3.3.1.5	Screws and Bolts	3-17
3.3.1.6	Securing Pins	3-17
3.3.1.7	Lever, Cranks, Hooks, and Controls	3-17
3.3.1.8	Burrs	3-17
3.3.1.9	Locking Wires	3-17
3.3.2	<u>Nameplates and Product Marking</u>	3-18
3.3.2.1	Equipment Identification	3-18
3.3.3	<u>Workmanship</u>	3-18
3.3.4	<u>Interchangeability</u>	3-18
3.3.5	<u>Safety Requirements</u>	3-18
3.3.5.1	Electrical Safety	3-18
3.3.6	<u>Human Engineering</u>	3-18
3.3.6.1	Closures or Covers Design Requirements	3-18
3.3.6.2	Interior Color	3-18
3.3.6.3	Full Size Range Accommodation	3-19
3.3.6.4	Operation and Control of Payload Equipment	3-19
3.3.6.5	Maintenance Operations	3-20
3.3.6.6	Adequate Clearance	3-23
3.3.6.7	Accessibility	3-23
3.3.6.8	One-Handed Operation	3-23
3.3.6.9	Continuous/Incidental Contact - High Temperature	3-24
3.3.6.10	Continuous/Incidental Contact - Low Temperature	3-24
3.3.6.11	Equipment Mounting	3-24
3.3.6.12	Drawers and Hinged Panels	3-24
3.3.6.13	Alignment	3-24
3.3.6.14	Slide-Out Stops	3-24
3.3.6.15	Push-Pull Force	3-24
3.3.6.16	Covers	3-24
3.3.6.17	Self-Supporting Covers	3-25
3.3.6.18	Accessibility	3-25
3.3.6.19	Ease of Disconnect	3-25
3.3.6.20	Indication of Pressure/Flow	3-25
3.3.6.21	Self Locking	3-25

## CONTENTS (Cont'd)

Section		Page
3.3.6.22	Connector Arrangement	3-25
3.3.6.23	Arc Containment	3-25
3.3.6.24	Connector Protection	3-25
3.3.6.25	Connector Shape	3-25
3.3.6.26	Fluid and Gas Line Connectors	3-26
3.3.6.27	Alignment Marks or Guide Pins	3-26
3.3.6.28	Coding	3-26
3.3.6.29	Pin Identification	3-26
3.3.6.30	Orientation	3-26
3.3.6.31	Hose/Cable Restraints	3-26
3.3.6.32	Non-Threaded Fasteners Status Indication	3-26
3.3.6.33	Mounting Bolt/Fastener Spacing	3-26
3.3.6.34	Multiple Fasteners	3-26
3.3.6.35	Captive Fasteners	3-26
3.3.6.36	Quick Release Fasteners	3-28
3.3.6.37	Threaded Fasteners	3-28
3.3.6.38	Over Center Latches	3-28
3.3.6.39	Winghead Fasteners	3-28
3.3.6.40	Fastener Head Type	3-28
3.3.6.41	One-Handed Actuation	3-28
3.3.6.42	DELETED	3-28
3.3.6.43	Access Holes	3-29
3.3.6.44	Controls Spacing Design Requirements	3-29
3.3.6.45	Accidental Activation	3-30
3.3.6.46	Position Indication	3-32
3.3.6.47	Hidden Controls	3-32
3.3.6.48	Hand Controllers	3-32
3.3.6.49	Valve Controls	3-32
3.3.6.50	Toggle Switches	3-32
3.3.6.51	Restraints and Mobility Aids	3-32
3.3.6.52	Electrical Hazards	3-33
3.3.6.53	Audio Devices (Displays)	3-33
3.3.6.54	Egress	3-33
3.3.7	<u>System Security</u>	3-33
3.3.8	<u>Design Requirements</u>	3-35
3.3.8.1	Structural Design Requirements	3-35
3.3.8.2	Electrical Power Consuming Equipment (EPCE) Design	3-36
3.4	ACCEPTANCE AND QUALIFICATION REQUIREMENTS	3-37
3.4.1	<u>Nominal Operation Under Thermal Environment</u>	3-37

## CONTENTS (Cont'd)

Section		Page
3.4.2	<u>Workmanship Vibration</u>	3-37
3.4.3	<u>Functional Performance</u>	3-37
3.4.4	Electrical, Electronic, and Electromechanical (EEE) Parts Control, Selection, and Burn-In	3-37
3.4.5	<u>Flammability</u>	3-37
3.4.6	<u>Offgassing</u>	3-37
3.4.7	<u>Shock</u>	3-37
3.4.8	<u>Bench Handling</u>	3-37
3.4.9	<u>Payload Mass</u>	3-38
3.4.10	<u>Electromagnetic Compatibility (EMC)</u>	3-38
3.4.11	<u>Acoustic Noise</u>	3-38
3.4.12	<u>Safety Critical Structural Verification</u>	3-38
3.4.12.1	Safety Critical Structure Dimensional Check	3-38
3.4.12.2	Safety Critical Structure Material Certification	3-38
3.4.13	<u>Pre-Delivery Acceptance</u>	3-38
3.5	HUMAN RESEARCH PROGRAM PROGRAM REQUIREMENTS	3-38
3.5.1	<u>Safety</u>	3-38
3.5.2	<u>Documentation Requirements</u>	3-38
3.5.2.1	Acceptance Data Package Requirements List	3-39
4.0	<u>VERIFICATION PROVISIONS</u>	4-1
4.1	GENERAL	4-1
4.2	FUNCTIONAL PERFORMANCE ACCEPTANCE TESTING	4-2
4.3	ACCEPTANCE AND QUALIFICATION VERIFICATION METHODS	4-2
4.3.1	<u>Thermal Cycle Tests</u>	4-2
4.3.1.1	Qualification Thermal Cycling	4-3
4.3.1.2	Acceptance Thermal Cycling	4-3
4.3.2	<u>Vibration Tests</u>	4-3
4.3.2.1	Sinusoidal Resonance Survey	4-6
4.3.2.2	Random Vibration Test	4-6
4.3.3	<u>Functional Testing</u>	4-8
4.3.4	Electrical, Electronic, and Electromechanical Parts Control, Selection, and Burn-In	4-8
4.3.5	<u>Flammability</u>	4-9
4.3.6	<u>Offgassing</u>	4-9
4.3.7	<u>Shock Test</u>	4-9
4.3.8	<u>Bench Handling</u>	4-9
4.3.9	<u>Payload Mass</u>	4-10

## CONTENTS (Cont'd)

Section		Page
4.3.10	<u>Electromagnetic Compatibility</u>	4-10
4.3.11	<u>Acoustic Noise</u>	4-10
4.3.12	<u>Pre-Delivery Acceptance</u>	4-10
4.3.13	<u>Pre-Installation Acceptance (PIA)</u>	4-10
5.0	<u>PREPARATION FOR SHIPMENT</u>	5-1
5.1	GENERAL	5-1
5.2	PACKING, HANDLING, AND TRANSPORTATION	5-1
5.3	PRESERVATION AND PACKING	5-1
5.4	MARKING FOR SHIPMENT	5-2
5.5	NASA CRITICAL SPACE ITEM LABEL	5-2
6.0	<u>NOTES</u>	6-1
6.1	DEFINITIONS	6-1
APPENDIX A	RESERVED	A-1
APPENDIX B	ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX	B-1
APPENDIX C	FUNCTIONAL PERFORMANCE VERIFICATION MATRIX	C-1
APPENDIX D	ACCEPTANCE AND QUALIFICATION TEST APPLICABILITY MATRICES	D-1
APPENDIX E	JHB 8080.5 DESIGN GUIDANCE MATRIX	E-1

## LIST OF TABLES

Table		Page
3.1-1	GROUND SUPPORT EQUIPMENT (GSE) ITEMS	3-3
3.2.2.1.1-1	HRF SIR DRAWER CENTER-OF-GRAVITY CONSTRAINTS	3-5
3.2.5.1.5-1	ISS PRESSURE RATE OF CHANGE	3-12
3.2.5.1.5-2	MPLM PRESSURE RATE OF CHANGE	3-13
3.2.7.1.2.1-1	DIMENSIONAL TOLERANCES	3-15
3.3.9.1.1-1	CREW-INDUCED LOADS	3-35
3.3.8.1.4-1	RANDOM VIBRATION CRITERIA FOR HRF RACK POST MOUNTED EQUIPMENT WEIGHING 100 POUNDS OR LESS IN THE MPLM	3-36
3.3.8.1.4-3	HRF RACK MOUNTED EQUIPMENT LOAD FACTORS (EQUIPMENT FREQUENCY 35 HZ)	3-36
4.3.2.2.1-1	QUALIFICATION RANDOM VIBRATION TEST LEVELS	4-7
4.3.2.2.2-1	QUALIFICATION ACCEPTANCE RANDOM VIBRATION TEST LEVELS	4-7
4.3.2.2.3-1	ACCEPTANCE RANDOM VIBRATION WORKMANSHIP TEST LEVELS	4-8
D-1	ACCEPTANCE AND QUALIFICATION TEST APPLICABILITY MATRIX	D-1
D-2	NON-CRITICAL HARDWARE QUALIFICATION TEST REQUIREMENTS	D-2
D-3	NON-CRITICAL HARDWARE ACCEPTANCE TEST REQUIREMENTS	D-3

## LIST OF FIGURES

Figure		Page
3.1.1-1	HRF 8 PU Stowage Drawer	3-3
3.2.2.2.2.1.2-1	SIR and ISIS Drawer Handles Protrusion Envelope	3-7
3.2.2.2.2.1.2-2	On-Orbit Semi-Permanent Protrusions Envelope	3-8
3.2.7.1	HRF 8 PU Stowage Drawer	3-14
3.3.6.4-1	Arm, Hand, and Thumb/Finger Strength (5th Percentile Male Data)	3-20
3.3.6.4-2	Leg Strength at Various Knee and Thigh Angles (5th Percentile Male Data)	3-21
3.3.6.4-3	Torque Strength	3-21
3.3.6.5-1	Maximal Static Push Forces	3-22
3.3.6.5-2	Male Grip Strength as a Function of the Separation Between Grip Elements	3-23
3.3.6.7-1	Minimum Sizes for Access Openings for Fingers	3-23
3.3.6.33-1	Minimal Clearance for Tool-Operated Fasteners	3-27
3.3.6.44-1	Control Spacing Requirements for Ungloved Operation	3-29
3.3.6.45.4-1	Rotary Switch Guard	3-31
3.3.6.51.4.3-1	Minimum IVA Handle Dimensions for IVA Applications	3-34
4.3.1.1-1	Qualification Thermal Cycling	4-4
4.3.1.2-1	Acceptance Thermal Cycling	4-5

## ACRONYMS AND ABBREVIATIONS

AC	Alternating Current
ADP	Acceptance Data Package
AVT	Acceptance Vibration Testing
C&DH	Command and Data Handling
CCB	Configuration Control Board
CCSDS	Consultative Committee for Space Data Systems
CG	Center of Gravity
CIL	Critical Items List
COTS	Commercial Off-the-Shelf
dB	Decibels
DC	Direct Current
DGCS	Display and Graphics Commonality Standards
dia	diameter
DR	Discrepancy Report
DRD	Data Requirements Document
EEE	Electrical, Electronic, and Electromechanical
EIA	Electronic Industry Association
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EPCE	Electrical Power Consuming Equipment
ESD	Electrostatic Discharge
FIAR	Failure Investigation Analysis Report
FMEA	Failure Modes and Effects Analysis
FSS	Fluid System Servicer
g	Gravity
GDS	Gas Delivery System
GFCI	Ground Fault Circuit Interrupter
GPVP	Generic Payload Verification Plan
GSE	Ground Support Equipment
HRD	Hardware Requirements Document
HRF	Human Research Facility
HRP	Human Research Program
Hz	Hertz
IMS	Inventory Management System
in	inch
ISIS	International Subrack Interface Standard

## ACRONYMS AND ABBREVIATIONS (Cont'd)

ISPR	International Standard Payload Rack
ISS	International Space Station
ITCS	Internal Thermal Control System
IVA	Intravehicular Activity
JSC	Johnson Space Center
kg	Kilogram
kPa	kilopascal
lb	pound
lbf	pounds force
LLIL	Limited Life Items List
max	Maximum
MDM	Multiplexer-Demultiplexer Module
MDP	Maximum Design Pressure
min	minimum
mm	millimeter
MPLM	Mini Pressurized Logistics Module
MSFC	Marshall Space Flight Center
MTL	Moderate Temperature Loop
MUA	Material Usage Agreement
N	Newton (metric force measurement)
N/A	Not Applicable
NASDA	Japanese Space Agency
NASA	National Aeronautics and Space Administration
NTSC	National Television Standards/Systems Committee
oct	Octave
ORU	Orbital Replacement Unit
Pa	Pascal
PDA	Pre-Delivery Acceptance
PFE	Portable Fire Extinguisher
PHTR	Packaging, Handling, and Transportation Records
PIA	Pre-Installation Acceptance
P/L	Payload
PRD	Program Requirements Document
psi	pounds per square inch
psia	pounds per square inch absolute
PU	Panel Unit

## ACRONYMS AND ABBREVIATIONS (Cont'd)

PUL	Portable Utility Light
Rad	Radiation Absorbed Dose
RIC	Rack Interface Controller
RMA	Rack Mounting Adapter
rms	Root Mean Square
QAVT	Qualification for Acceptance Vibration Testing
QD	Quick Disconnect
QVT	Qualification Vibration Test
SD	Standard Deviation
SE&I	Systems Engineering and Integration
sec	second
SIR	Standard Interface Rack
SLAMMD	Space Linear Acceleration Mass Measurement Device
SOW	Statement of Work
SPL	Sound Pressure Level
TBD	To Be Determined
TIA	Telecommunications Industry Association
TPS	Task Performance Sheet
V	Volts
VC-S	Visibly Clean - Sensitive
VDS	Verification Data Sheet
VES	Vacuum Exhaust System
VRS	Vacuum Resource System
WSTF	White Sands Test Facility
°C	Degrees Celsius
°F	Degrees Fahrenheit
$\pi$	pi

## 1.0

### SCOPE

This specification defines the Human Research Facility (HRF) program requirements for the 8 Panel Unit (PU) Stowage Drawer (SD8). The SD8 is a sub-rack payload that will be used as a stowage drawer for the HRF.

The primary governing document for the requirements levied in this document is LS-71000, "Program Requirements Document for the Human Research Facility." Other requirements are derived from the experiment unique interface definition documents for the various items of HRF equipment.

The requirements in Sections 3, 4, and 5 of this document consist of a minimum set of constraints for the SD8 hardware. This system contains no software. Hardware Criticality is defined in the table in Section 3.2 of LS-71000.

The HRF Project Office is the controlling authority for this document. The HRF Configuration Control Board (CCB) or a delegated authority must approve any deviations from the requirements of this document.

2.0

APPLICABLE DOCUMENTS

The following applicable documents of the exact issue shown herein form a part of this specification to the extent specified herein. If a revision level or date is not cited, the latest version of the document should be used.

All specifications, standards, exhibits, drawings or other documents referenced in this specification are hereby incorporated as cited in the text of this document.

2.1

DOCUMENTS

<u>Document Number</u>	<u>Revision</u>	<u>Document Title</u>
FED-STD-595	Rev. B 12/89	Colors Used in Government Procurement
JSC-SN-C-0005	Rev. C 2/89	National Space Transportation System Contamination Control Requirements
LS-60077	Basic 7/93	Standard Interface Rack Specification
LS-71000	Rev. A 4/00	Program Requirements Document for the Human Research Facility
LS-71001	Rev A08/31/95	Functional Requirements Document for the Human Research Facility
MIL-STD-1686	Rev. C 10/95	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies And Equipment (Excluding Electrically Initiated Explosive Devices)
MSFC-STD-250	Rev. A 10/77	Protective Finishes for Space Vehicle Structures and Associated Flight Equipment, General Specification for
NSTS/ISS 13830	Rev. C, Ch. 1 2/99	Safety Review and Data Submittal Requirements for Payloads Using the Space Shuttle and International Space Station
NSTS-1700.7	Rev. B, Ch. 4 3/97	Safety Policy and Requirements For Payloads Using the Space Transportation System
NSTS-1700.7B ISS ADDENDUM	12/95	Safety Policy and Requirements For Payloads Using the International Space Station
NSTS/ISS 18798	Rev. B, Ch. 3 9/97	Interpretations of NSTS/ISS Payload Safety Requirements

<u>Document Number</u>	<u>Revision</u>	<u>Document Title</u>
NSTS-21000-IDD-MDK	Rev. B 02/97	Shuttle Orbiter/MDK Cargo Element Interfaces
SP-T-0023B	Rev. B 09/75	Environmental Acceptance Testing Specification
SSP 30233	Rev. F 7/99	Space Station Requirements for Materials and Processes
SSP 30245	Rev. D, Ch. 6 6/99	Space Station Electrical Bonding Requirements
SSP 30312	Rev. F 11/95	Electrical, Electronic, and Electromechanical (EEE) and Mechanical Parts Management and Implementation Plan International Space Station Program
SSP 30573	Rev. A 10/94	Space Station Program Fluid Procurement and Use Control Specification
SSP 30695	Rev. A 10/94	Acceptance Data package Requirements Specification
SSP 41017	Rev. D 10/00	Rack to Mini Pressurized Logistics Module Interface Control Document (ICD) Part 1
SSP 50005	Rev. B, Ch. 1 9/98	International Space Station Flight Crew Integration Standard (NASA-STD-3000/T)
SSP 50007	Rev. A 10/98	Space Station Inventory Management System Label Specification
SSP 50008	Rev. B 7/98	International Space Station Interior Color Scheme
SSP 50467	11/00	ISS Cargo Stowage Technical Manual: Pressurized Volume
SSP 52005	Rev. B 3/99	Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures
SSP 57000	Rev. E 9/20/00	Pressurized Payloads Interface Requirements Document
SSP 57001	Rev. C 10/00	Pressurized Payloads Hardware Interface Control Document Template

## 2.2 ORDER OF PRECEDENCE

In the event of a conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification,

however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3.0 SYSTEM REQUIREMENTS

3.1 ITEM DEFINITION

The following items of the 8 PU Stowage Drawer will be designed and certified under this requirement document for use on International Space Station (ISS) as a part of the HRF program. The HRF Rack hardware used with this hardware is certified under separate documentation, which is maintained by the appropriate program(s).

Table 3.1-1 lists the equipment items covered by this document including the stowage kits that will be used to transport the items and contain the items on-orbit. The quantities in this table are for reference only and indicate the number of units to be built.

TABLE 3.1-1. GROUND SUPPORT EQUIPMENT (GSE) ITEMS

Item Name	Part Number	Class	Quantity	Notes

3.1.1 Description

8 PU Stowage Drawer shall be used as a stowage drawer for the mass measuring arms of Space Linear Acceleration Mass Measurement Device (SLAMMD) on the HRF Rack Two.

The SD8 is an 8 PU drawer with no power or data interfaces.

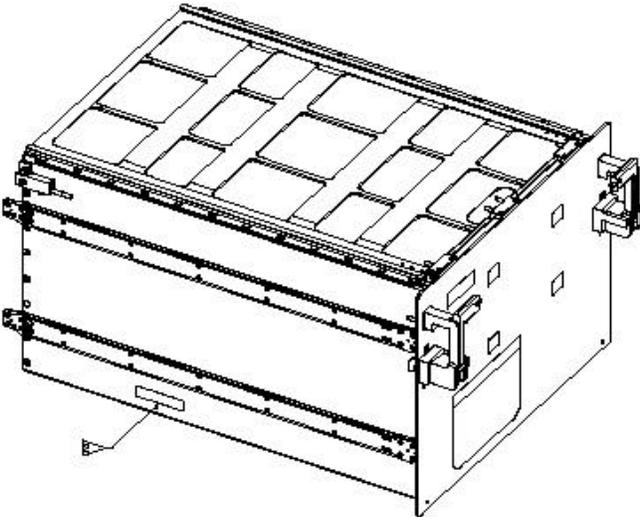


Figure 3.1.1-1. HRF 8 PU Stowage Drawer

## 3.2 CHARACTERISTICS

### 3.2.1 Performance Characteristics

This Hardware Requirements Document (HRD) uses LS-71001, “Functional Requirements Document (FRD) for the Human Research Facility,” to, in part, derive the HRD performance requirements.

#### 3.2.1.1 Functional Performance Characteristics

### 3.2.2 Physical Characteristics

#### 3.2.2.1 Mass and Center of Gravity Properties

The weight (mass) of the SD8 shall not exceed 128 lbs (58 Kg).

##### 3.2.2.1.1 HRF Rack Mounted SIR Drawer Center-of-Gravity Constraints

HRF rack mounted Standard Interface Rack (SIR) drawer instruments shall meet the center of gravity (CG) constraints specified in Table 3.2.2.1.1-1, HRF SIR Drawer Center-of-Gravity Constraints. (LS-71000, Section 6.2.1.2.4)

#### 3.2.2.2 Envelope

##### 3.2.2.2.1 Stowed Envelope

Not applicable to the SD8.

##### 3.2.2.2.2 Deployed Envelope

##### 3.2.2.2.2.1 On-Orbit Payload Protrusions

Definitions for on-orbit permanent protrusions, on-orbit semi-permanent protrusions, on-orbit temporary protrusions, on-orbit momentary protrusions, and protrusions for on-orbit keep alive payloads can be found in Section 6.1, Definitions. The requirements in Section 3.2.2.2.2.1 apply to installation and operation activities, but not to maintenance activities.

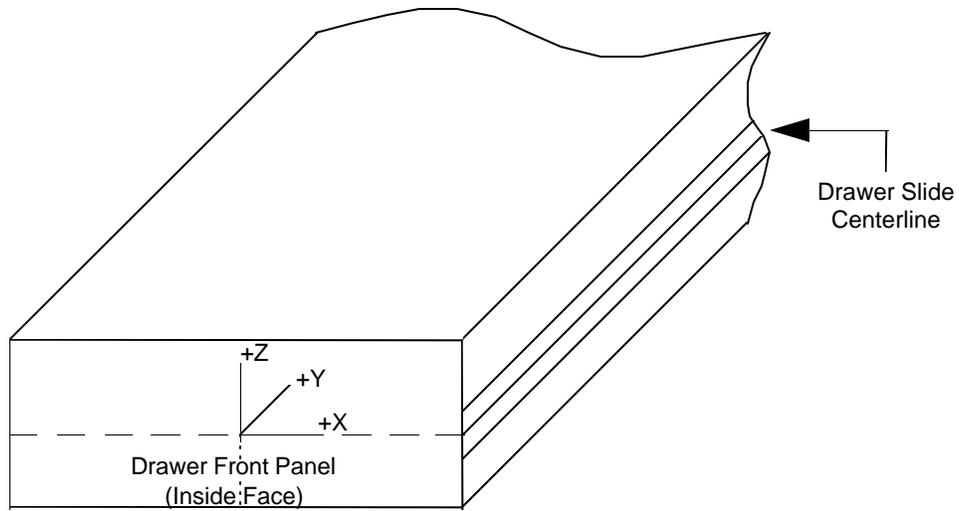
NOTE: The on-orbit protrusion requirements in this section are applicable to when the payload is on-orbit and do not apply to other phases of the transportation of the payload (e.g., launch, landing, Mini Pressurized Logistics Module (MPLM) installation).

A. On-orbit protrusions, excluding momentary protrusions, shall not extend laterally across the edges of the rack or pass between racks. (LS-71000, Section 6.2.1.1.5.A)

TABLE 3.2.2.1.1-1. HRF SIR DRAWER CENTER-OF-GRAVITY CONSTRAINTS

Drawer Configuration	X (in) Min.	X (in) Max.	Y (in) Min.	Y (in) Max.	Z (in) Min.	Z (in) Max.
Single Slide Drawer (4 PU)	-1.75	+1.75	+7.99	+12.00	-0.63	+0.87
Double Slide Drawer (8 PU)	-2.20	+2.20	+10.24	+14.00	+1.675	+3.975
Triple Slide Drawer (12 PU)	-1.50	+1.50	+9.74	+13.00	+6.37	+8.87

**NOTE:** CG envelope is measured from the drawer coordinate system as defined below. The geometric center for “Z” axis is measured from the centerline of the bottom-most rail toward the top of the drawer. Total maximum integrated mass (including drawer, contents and slides) on any one set of slides is limited to 64 lbs. Multiple-slide drawers are to evenly distribute loading between the sets of slides.



- B. The integrated rack hardware, excluding momentary protrusions, shall not prevent attachment of the Rack Mounting Adapter (RMA) on any seat track attach holes. (LS-71000, Section 6.2.1.1.5.B)

Constraints that may be associated with payload protrusions include:

- Removal of the protrusion during rack installation, translation, and crew translation
- Removal of the protrusion if RMA is installed on the rack
- Removal of the protrusion to prevent interference with microgravity operations
- Removal or powering off of the rack if the protrusion blocks Portable Fire Extinguisher (PFE) access or the fire indicator
- May limit the rack location (e.g., protrusions located in the floor and the ceiling are limited to a total of no more than 12 inches.)
- May limit operation of the payload

As is indicated by the constraints above, protrusions have a negative impact on crew operations and are to be minimized.

#### 3.2.2.2.2.1.1 On-Orbit Permanent Protrusions

The SD8 shall not allow permanent protrusions. (LS-71000, Section 6.2.1.1.5.1)

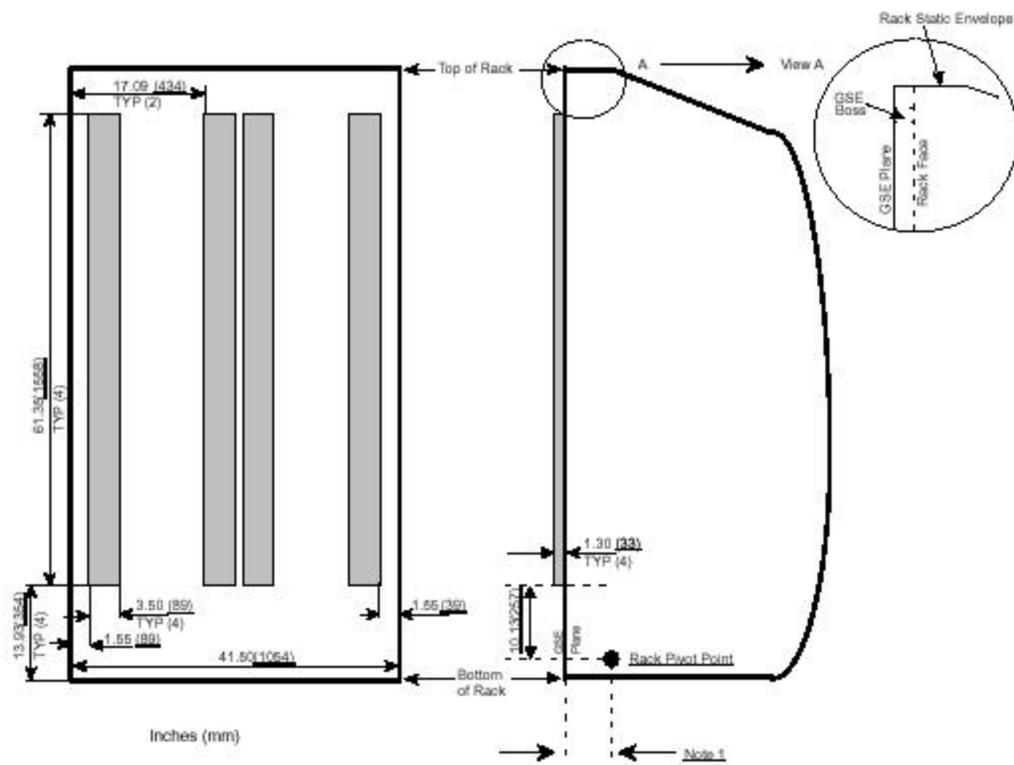
#### 3.2.2.2.2.1.2 On-Orbit Semi-Permanent Protrusions

- A. SIR and International Subrack Interface Standard (ISIS) drawer handles shall remain within the envelope shown in Figure 3.2.2.2.1.2-1. (LS-71000, Section 6.2.1.1.5.2.A)
- B. Other on-orbit semi-permanent protrusions shall be limited to no more than 500 square inches within the envelope shown in Figure 3.2.2.2.1.2-2. (LS-71000, Section 6.2.1.1.5.2.B)

NOTE: The sum of the on-orbit semi-permanent protrusions and the on-orbit protrusion for keep alive payloads is limited to no more than 500 square inches.

NOTE: The SIR and ISIS drawer handles are not included in the 500 square inch limit.

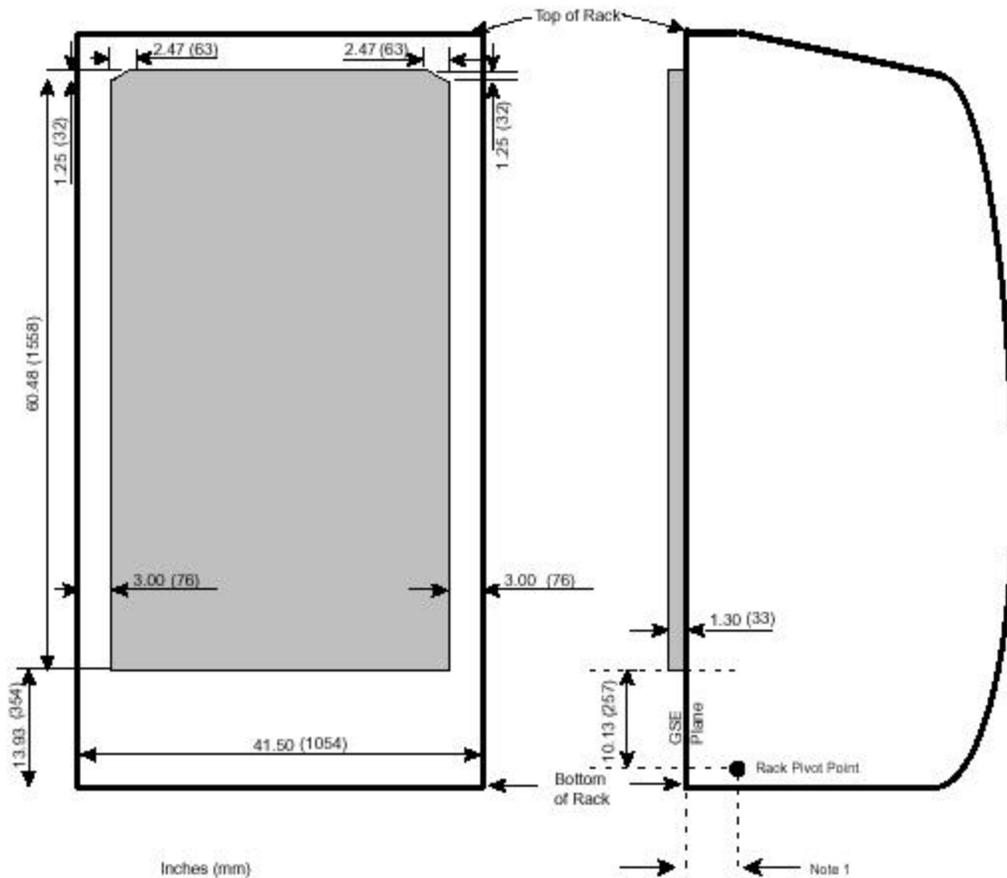
- C. All on-orbit semi-permanent protrusions shall be designed to be removable by the crew with hand operations and/or standard Intravehicular Activity (IVA) tools. (LS-71000, Section 6.2.1.1.5.2.C)



Note:

1. The dimension for a Boeing ISPR is 3.50 (89). The dimension for a NASDA ISPR is 2.47 (63).

Figure 3.2.2.2.1.2-1. SIR and ISIS Drawer Handles Protrusion Envelope



**Note:**

1. The dimension for a Boeing ISPR is 3.50 (89). The dimension for a NASDA ISPR is 2.47 (63).
2. Protrusions are limited to 1.3 (33mm) inches for ground processing and launch/landing as described in paragraph 3.1.1.1.A

**NOTE:** Protrusions are limited to 1.3 inches for ground processing and launch/landing.

Figure 3.2.2.2.1.2-2. On-Orbit Semi-Permanent Protrusions Envelope

### 3.2.2.2.2.1.3 On-Orbit Temporary Protrusions

The SD8 does not have temporary protrusions.

### 3.2.2.2.2.1.4 On-Orbit Momentary Protrusions

The SD8 does not have momentary protrusions.

### 3.2.2.2.2.2 Deployed Envelope Dimensions

## 3.2.3 Reliability, Quality, and Non-Conformance Reporting

A. Reliability and maintainability requirements for the HRF Gas Delivery System (GDS) shall be as defined in LS-71026, "Human Research Facility (HRF) Reliability Plan." (LS-71000, Section 7.1.2)

### B. Non-Conformance Reporting

- 1) For flight hardware produced under a contract or subcontract at a site other than Johnson Space Center (JSC), non-conformance reporting requirements shall be specified in the Statement of Work (SOW) Data Requirements List, and Data Requirements Documents (DRDs) shall be used to identify the submittal and data requirements. (LS-71000, Section 7.3.2.1)
- 2) For flight hardware developed at JSC, non-conformance reporting shall be in accordance with JPD 5335.1 and the applicable technical division plan. (LS-71000, Section 7.3.2.2)
- 3) Non-conformances, which meet the Level 1 Problem Reporting and Corrective Action criteria for payloads as defined in SSP 30223, shall be reported in accordance with SSP 30223. (LS-71000, Section 7.3.2.3)

### C. Non-Conformance Reporting

1. For flight hardware produced under a contract or subcontract at a site other than JSC, non-conformance reporting requirements shall be specified in the SOW Data Requirements List, and DRDs shall be used to identify the submittal and data requirements. (LS-71000, Section 7.3.2.1)
2. For flight hardware developed at JSC, non-conformance reporting shall be in accordance with JPD 5335.1 and the applicable technical division plan. (LS-71000, Section 7.3.2.2)

3. Non-conformances, which meet the Level 1 Problem Reporting and Corrective Action criteria for payloads as defined in SSP 30223, shall be reported in accordance with SSP 30223. (LS-71000, Section 7.3.2.3)
4. Software non-conformance reporting shall be in accordance with LS-71020-1, “Software Development Plan for the Human Research Facility.” (LS-71000, Section 7.3.2.4)

#### 3.2.3.1 Failure Propagation

The design of the SD8 shall preclude propagation of failures from the payload to the environment outside the payload. (NSTS 1700.7B, Section 206)

#### 3.2.3.2 Useful Life

HRF SD8 hardware shall be designed for a 10-year utilization. (LS-71000, Section 7.2.1)

##### 3.2.3.2.1 Operational Life (Cycles)

Operational life applies to any hardware that deteriorates with the accumulation of operating time and/or cycles and thus requires periodic replacement or refurbishment to maintain acceptable operating characteristics. Operational life includes the usage during flight, ground testing, and pre-launch operations. All components of the SD8 shall have an operational life limit of 10 years, except those identified as having limited life (See Section 3.2.3.2.3).

##### 3.2.3.2.2 Shelf Life

Shelf life is defined as that period of time during which the components of a system can be stored under controlled conditions and put into service without replacement of parts (beyond servicing and installation of consumables). The SD8 shall have a shelf life limit of 10 years.

##### 3.2.3.2.3 Limited Life

Limited life is defined as the life of a component, subassembly, or assembly that expires prior to the stated useful life in Section 5.5 of this HRD. Limited life items or materials, such as soft goods, shall be identified, and the number of operation cycles shall be determined. Limited life items shall be tracked on a limited life list that is maintained as a part of the hardware acceptance data pack.

#### 3.2.4 Maintainability

A. Not applicable to the SD8.

- B. All Orbital Replacement Unit (ORU) connectors, whether operated by hand or tool, shall be designed and placed so they can be mated/demated using either hand. (LS-71000, Section 6.4.4.3.1)
- C. It shall be possible to mate/demate individual connectors without having to remove or mate/demate connectors on other ORUs or payloads during maintenance operations. (LS-71000, Section 6.4.4.3.2B)
- D. Not applicable to the SD8.
- E. Access to inspect or replace a hardware item (e.g., an ORU) which is planned to be accessed on a daily or weekly basis shall not require removal of another hardware item or more than one access cover. (LS-71000, Section 6.4.4.2.6)
- F. Not applicable to the SD8.
- G. Not applicable to the SD8.
- H. ORUs shall be designed to be replaced without requiring the removal of other components or assemblies.

3.2.4.1 Logistics and Maintenance

3.2.4.1.1 Payload In-Flight Maintenance

Payloads shall be designed to be maintainable using Space Station provided on-board tools. Available tools on-orbit are defined in the "Payloads Accommodations Handbook," SSP 57020. (LS-71000, Section 6.4.10)

3.2.4.1.2 Maintenance

There are no planned maintenance activities for the 8 PU Stowage Drawer.

3.2.5 Environmental Conditions

3.2.5.1 On-Orbit Environmental Conditions

3.2.5.1.1 On-Orbit Internal Environments

3.2.5.1.1.1 Pressure

The 8 PU Stowage Drawer shall be safe when exposed to pressures of 0 to 104.8 kPa (0 to 15.2 psia). (LS-71000, Section 6.2.9.1.1)

3.2.5.1.1.2 Temperature

The 8 PU Stowage Drawer shall be safe when exposed to temperatures of 10 °C to 46 °C (50 to 115 °F). (LS-71000, Section 6.2.9.1.2)

3.2.5.1.1.3 Humidity

The 8 PU Stowage Drawer shall be designed to not cause condensation when exposed to the ISS atmosphere ranging in dewpoint from 4.4 °C to 15.6 °C (40 ° to 60 °F) and in relative humidity from 25 to 75%.

3.2.5.1.2 Use of Cabin Atmosphere

Not applicable to the SD8.

3.2.5.1.3 Ionizing Radiation Requirements Leak

Not applicable to the SD8.

3.2.5.1.4 Additional Environmental Conditions

The environmental information provided in Table 6.2.9.3-1, Environmental Conditions on ISS, and Figure 6.2.9.3-1, Operating Limits of the ISS Atmospheric Total Pressure, Nitrogen and Oxygen Partial Pressures, in Section 6.2.9.4 of the HRF Program Requirements Document (PRD) is supplied for design and analysis purposes.

3.2.5.1.5 Pressure Rate of Change

A.

TABLE 3.2.5.1.5-1. ISS PRESSURE RATE OF CHANGE

Depressurization	878 Pa/sec (7.64 psi/minute)
Repressurization	230 Pa/sec (2.0 psi/minute)

B. The 8 PU Stowage Drawer shall maintain positive margins of safety for maximum depressurization and repressurization rates for the carrier(s) in which it will be transported. (LS-71000, Section 6.2.1.1.6B)

(1) The 8 PU Stowage Drawer shall maintain positive margins of safety for maximum depressurization and repressurization rates for the MPLM documented in Table 3.2.5.1.5-2. (Derived from LS-71000, Section 6.2.1.1.6A)

TABLE 3.2.5.1.5-2. MPLM PRESSURE RATE OF CHANGE

Depressurization	890 Pa/sec (7.75 psi/minute)
Repressurization	800 Pa/sec (6.96 psi/minute)

- C. Not applicable to the SD8.
- D. The SD8 shall not have a pressure relief device on its front face. (LS-71000, Section 6.2.1.1.6D)

3.2.5.1.6 Microgravity

Microgravity requirements have not been determined by the ISS Program.

- A. Quasi-Steady Requirements  
TBD (LS-71000, Section 6.2.1.1.7A)
- B. Vibratory Requirements  
TBD (LS-71000, Section 6.2.1.1.7B)
- C. Transient Requirements  
TBD (LS-71000, Section 6.2.1.1.7C)

3.2.5.2 Acoustic Emission Limits

Not applicable to the SD8.

3.2.5.3 Lighting Design

The general illumination of the space station in the aisle will be a minimum of 108 lux (10 foot candles) of white light. This illumination will be sufficient for ordinary payload operations performed in the aisle (e.g., examining dials or panels, reading procedures, transcription, tabulation, etc.).

Payloads will meet the following requirements:

- A. Payload work surface specularity shall not exceed 20 percent. Paints listed in Table 3.2.5.3-1 meet this requirement. (LS-71000, Section 6.4.3.4A)

3.2.5.4 Instrument Surface Temperature

The SD8 shall be designed such that the average surface temperature is less than 37 °C (98.6 °F) with a maximum temperature limit not to exceed 49 °C (120 °F).

### 3.2.6 Transportability

#### 3.2.6.1 Launch and Landing

Not applicable to the SD8.

### 3.2.7 Operational Interface Requirements

As shown in Figure 3.2.7-1, the SD8 is a passive drawer, with no electrical or data interfaces to the HRF Rack.

#### 3.2.7.1 Mechanical Interface Requirements

##### 3.2.7.1.1 Connector Physical Mate

Not applicable to the SD8.

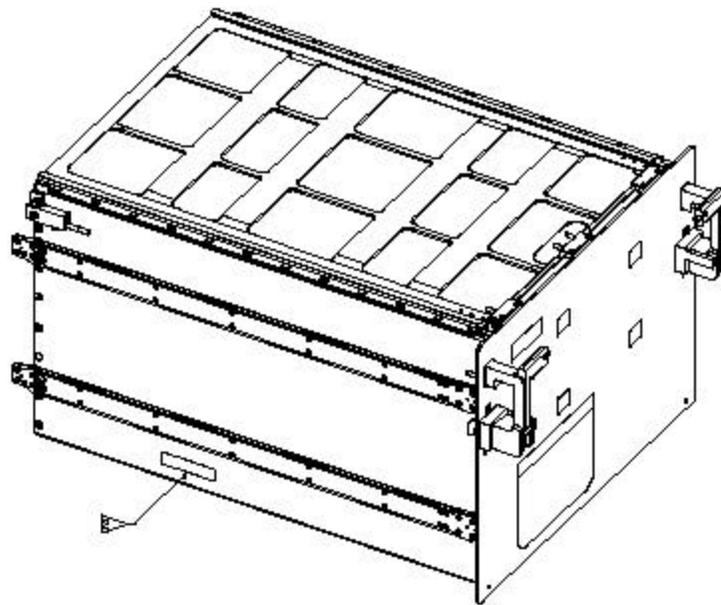


Figure 3.2.7.1. HRF 8 PU Stowage Drawer

##### 3.2.7.1.2 HRF Rack to SIR Drawer Structural Interface Requirements

###### 3.2.7.1.2.1 Dimensional Tolerances

HRF rack mounted SIR drawer dimensional tolerances shall be in accordance with Table 3.2.7.1.2.1-1. (LS-71000, Section 6.2.1.2.1)

TABLE 3.2.7.1.2.1-1. DIMENSIONAL TOLERANCES

English Dimension	Tolerance
X.XX	±0.030
X.XXX	±0.010
X°	±1°

3.2.7.1.2.2 SIR Drawer Structural/Mechanical Interfaces

The SD8 drawer shall meet the structural/mechanical interface as defined in LS-60077, “Standard Interface Rack Specification.”

3.2.7.2 Electrical Power Interface Requirements

Not applicable to the SD8.

3.2.7.3 Command and Data Handling (C&DH) Interface Requirements

Not applicable to the SD8.

3.2.7.4 Payload National Television Standards/Systems Committee (NTSC) Video Interface Requirements

Not applicable to the SD8.

3.2.7.5 Thermal Control Interface Requirements

Not applicable to the SD8.

3.2.7.6 Vacuum System Requirements

Not applicable to the SD8.

3.2.7.7 Pressurized Gas Interface Requirements

Not applicable to the SD8.

3.2.7.7.1 Nitrogen Interface Requirements

Not applicable to the SD8.

3.2.7.7.2 Pressurized Gas Systems

Not applicable to the SD8.

3.2.7.7.3 Manual Valves

Not applicable to the SD8.

3.2.7.8 Payload Support Services Interfaces Requirements

Not applicable to the SD8.

3.2.7.9 Fire Protection Interface Requirements

Not applicable to the SD8.

3.2.7.10 Other Interface Requirements

Not applicable to the SD8.

3.3 DESIGN AND CONSTRUCTION

3.3.1 Materials, Processes, and Parts

3.3.1.1 Materials and Processes

3.3.1.1.1 Materials and Parts Use and Selection

The SD8 shall use materials and parts that meet the materials requirements specified in NSTS 1700.7, ISS Addendum, Section 209. (LS-71000, Section 6.2.11.1)

3.3.1.1.2 Commercial Parts

Commercial Off-the-Shelf (COTS) parts used in the SD8 shall meet the materials requirements specified in NSTS 1700.7, ISS Addendum, Section 209. (LS-71000, Section 6.2.11.2)

3.3.1.1.3 Fluids

Not applicable to the SD8.

3.3.1.1.4 Cleanliness

The SD8 shall conform to Visibly Clean - Sensitive (VC-S) requirements as specified in SN-C-0005. (LS-71000, Section 6.2.11.4)

3.3.1.1.5 Fungus Resistant Material

HRF rack dependent instruments that are intended to remain on-orbit for more than one year shall use fungus resistant materials according to the requirements specified in SSP 30233, Paragraph 4.2.10. (LS-71000, Section 6.2.11.5)

### 3.3.1.2 Sharp Edges and Corner Protection

The SD8 design shall protect crewmembers from sharp edges and corners during all crew operations in accordance with NSTS 1700.7, ISS Addendum, Paragraph 222.1. (LS-71000, Section 6.4.9.2)

### 3.3.1.3 Holes

Holes that are round or slotted in the range of 10.0 to 25.0 mm (0.4 to 1.0 in) shall be covered. (LS-71000, Section 6.4.9.3)

### 3.3.1.4 Latches

Latches that pivot, retract, or flex so that a gap of less than 35 mm (1.4 in) exists shall be designed to prevent entrapment of a crewmember's appendage. (LS-71000, Section 6.4.9.4)

### 3.3.1.5 Screws and Bolts

Threaded ends of screws and bolts accessible by the crew and extending more than 3.0 mm (0.12 in) shall be capped to protect against sharp threads. (LS-71000, Section 6.4.9.5)

### 3.3.1.6 Securing Pins

Securing pins shall be designed to prevent their inadvertently backing out above the handhold surface. (LS-71000, Section 6.4.9.6)

### 3.3.1.7 Levers, Cranks, Hooks, and Controls

Levers, cranks, hooks, and controls shall not be located where they can pinch, snag, or cut the crewmembers or their clothing. (LS-71000, Section 6.4.9.7)

### 3.3.1.8 Burrs

Exposed surfaces shall be free of burrs. (LS-71000, Section 6.4.9.8)

### 3.3.1.9 Locking Wires

- A. Safety wires shall not be used on fasteners that must be unfastened for on-orbit removal or replacement. (LS-71000, Section 6.4.9.9A)
- B. All fracture-critical fasteners as defined in SSP 52005 (Paragraph 5.6, "Fastener Requirements," and Appendix B, "Glossary of Terms"), which must be unfastened for on-orbit removal or replacement, shall be safety cabled or cotter-pinned. (LS-71000, Section 6.4.9.9B)

### 3.3.2 Nameplates and Product Marking

#### 3.3.2.1 Equipment Identification

Integrated racks, all (installed in the rack or separately) sub-rack elements, loose equipment, stowage trays, consumables, ORUs, crew accessible connectors and cables, switches, indicators, and controls shall be labeled. Labels are markings of any form [including Inventory Management System (IMS) bar codes] such as decals and placards, which can be adhered, “silk screened,” engraved, or otherwise applied directly onto the hardware. Appendix C of SSP 57000C provides instructions for label and decal design and approval. (LS-71000, Section 6.4.7)

### 3.3.3 Workmanship

Workmanship shall be of aerospace quality and shall conform to high-grade aerospace manufacturing practices as directed by LS-71030, “Quality Assurance Plan for the Human Research Facility.” (LS-71000, Section 7.3.1)

### 3.3.4 Interchangeability

The SD8 will be built to flight released drawings. This will ensure interchangeability among each subassembly.

### 3.3.5 Safety Requirements

#### 3.3.5.1 Electrical Safety

Not applicable to the SD8.

### 3.3.6 Human Engineering

#### 3.3.6.1 Closures or Covers Design Requirements

Closures or covers shall be provided for any area of the payload that is not designed for routine cleaning. (LS-71000, Section 6.4.3.1.1)

#### 3.3.6.2 Interior Color

##### 3.3.6.2.1 Rack Mounted Equipment

A. Front panels for active and stowage drawers meant for installation in HRF racks shall be off-white, Specification #27722 as given in FED-STD-595B, “Federal Standard Colors Used in Government Procurement.” (LS-71000, Section 6.4.3.5.1)

B. The finish shall be semi-gloss. (LS-71000, Section 6.4.3.5.1)

- C. SIR drawer panel handle latches are not subject to requirements 3.3.6.2.1 A and B and shall be finished in accordance with the engineering drawings for the panel handle latches. (LS-71000, Section 6.4.3.5.1)

#### 3.3.6.2.2 Stowed/Deployable Equipment

The colors and finishes for stowed and deployable equipment, even if it is normally attached to the rack during use shall be as specified below:

- A. COTS equipment that is not repackaged by HRF engineers shall be finished as delivered by the manufacturer. (LS-71000, Section 6.4.3.5.2A)
- B. Items that are repackaged by HRF engineers shall be finished using anodic film per MIL-A-8625, Type II, Class 2, Dyed Turquoise. Reference FED-STD-595, Color Specification 15187. (LS-71000, Section 6.4.3.5.2B)

#### 3.3.6.2.3 Colors for Soft Goods

Not applicable to the SD8.

#### 3.3.6.3 Full Size Range Accommodation

All payload workstations and hardware having crew nominal operations and planned maintenance shall be sized to meet the functional reach limits for the 5th percentile Japanese female and yet shall not constrict or confine the body envelope for the 95th percentile American male as specified in SSP 50005, Section 3. (LS-71000, Section 6.4.2.3)

#### 3.3.6.4 Operation and Control of Payload Equipment

##### A. Grip Strength

To remove, replace and operate payload hardware, grip strength required shall be less than 254 N (57 lbf). (LS-71000, Section 6.4.1.1A)

##### B. Linear Forces

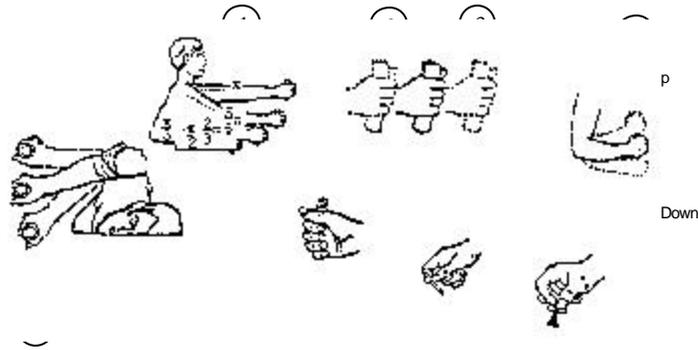
Linear forces required to operate or control payload hardware or equipment shall be less than the strength values for the 5th percentile female, defined as 50% of the strength values shown in Figure 3.3.6.4-1 and 60% of the strength values shown in Figure 3.3.6.4-2. (LS-71000, Section 6.4.1.1B)

##### C. Torque

Torque required to operate or control payload hardware or equipment shall be less than the strength values for the 5th percentile female, defined as 60% of the calculated 5th percentile male capability shown in Figure 3.3.6.4-3. (LS-71000, Section 6.4.1.1C)

### 3.3.6.5 Maintenance Operations

Forces required for maintenance of payload hardware and equipment shall be less than the 5th percentile male strength values shown in Figures 3.3.6.4-1, 3.3.6.4-2, 3.3.6.4-3, 3.3.6.5-1, and 3.3.6.5-2. (LS-71000, Section 6.4.1.2)



Arm Strength (N)													
(1)	(2)		(3)		(4)		(5)		(6)		(7)		
Degree of elbow flexion (rad)	Pull		Push		Up		Down		In		Out		
	L**	R**	L	R	L	R	L	R	L	R	L	R	
p	222	231	187	222	40	62	58	76	58	89	36	62	
5/6 p	187	249	133	187	67	80	80	89	67	89	36	67	
2/3 p	151	187	116	160	76	107	93	116	89	98	45	67	
1/2 p	142	165	98	160	76	89	93	116	71	80	45	71	
1/3 p	116	107	96	151	67	89	80	89	76	89	53	76	
Hand and thumb-finger strength (N)													
	(8)				(9)				(10)				
	Hand Grip					Thumb-finger grip (Palmer)				Thumb-finger grip (tips)			
	L		R			60				60			
Momentary hold	250		260						35				
Sustained hold	145		155						35				
*Elbow angle shown in radians													
**L = Left, R = Right													
Arm strength (lb)													
(1)	(2)		(3)		(4)		(5)		(6)		(7)		
Degree of elbow flexion (deg)	Pull		Push		Up		Down		In		Out		
	L	R*	L	R	L	R	L	R	L	R	L	R	
180	50	52	42	50	9	14	13	17	13	20	8	14	
150	42	56	30	42	15	18	18	20	15	20	8	15	
120	34	42	26	36	17	24	21	26	20	22	10	15	
90	32	37	22	36	17	20	21	26	16	18	10	16	
60	26	24	22	34	15	20	18	20	17	20	12	17	
Hand and thumb-finger strength (lb)													
	(8)				(9)				(10)				
	Hand Grip					Thumb-finger grip (Palmer)				Thumb-finger grip (tips)			
	L		R			13				13			
Momentary hold	56		59						8				
Sustained hold	33		35						8				
*Left; R = Right													

Figure 3.3.6.4-1. Arm, Hand, and Thumb/Finger Strength (5th Percentile Male Data)

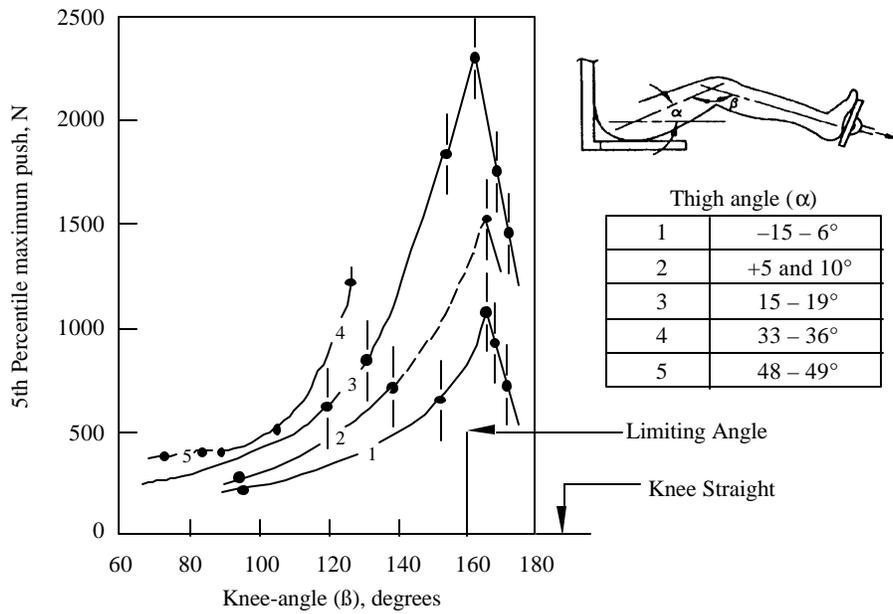


Figure 3.3.6.4-2. Leg Strength at Various Knee and Thigh Angles (5th Percentile Male Data)

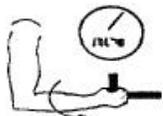
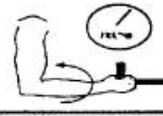
	Unpressurized suit, bare handed	
	Mean	SD
 Maximum torque: Supination, Nm (lb-in.)	13.73 (121.5)	3.41 (30.1)
 Maximum torque: Pronation, Nm (lb-in.)	17.39 (153.9)	5.08 (45.0)

Figure 3.3.6.4-3. Torque Strength

	Force-plate (1) height	Distances (2)	Force, N (lbf)			
			Means	SD		
 <p>Force Plate</p>	100 percent of shoulder height	50	Both hands	583 (131)	142 (32)	
		60		667 (150)	160 (36)	
		70		983 (221)	271 (61)	
		80		1285 (289)	400 (90)	
		90		979 (220)	302 (68)	
		100		645 (145)	254 (57)	
			50	Preferred hand	262 (59)	67 (15)
			60		298 (67)	71 (16)
			70		360 (81)	98 (22)
			80		520 (117)	142 (32)
			90		494 (111)	169 (38)
			100		427 (96)	173 (39)
			Percent of thumb-tip reach*			
			100 percent of shoulder height	50		369 (83)
60				347 (78)	125 (28)	
70				520 (117)	165 (37)	
80				707 (159)	191 (32)	
90				325 (73)	133 (30)	
Percent of span**						
	Force-plate (1) height	Distances (2)	Force, N (lbf)			
			Means	SD		
	50	100	774 (174)	214 (48)		
	50	120	778 (175)	165 (37)		
	70	120	818 (184)	138 (31)		
	Percent of shoulder height		1-g applicable data			

NOTES:

- (1) Height of the center of the force plate - 200 mm (8 in) high by 254 mm (10 in) long - upon which force is applied.
- (2) Horizontal distance between the vertical surface of the force plate and the opposing vertical surface (wall or footrest, respectively) against which the subject brace themselves.
- (3) Thumb-tip reach - distance from backrest to tip of subject's thumb as thumb and fingertips are pressed together.
- (4) Span - the maximal distance between a person's fingertips as he extends his arms and hands to each side.
- (5) 1-g data.

Figure 3.3.6.5-1. Maximal Static Push Forces

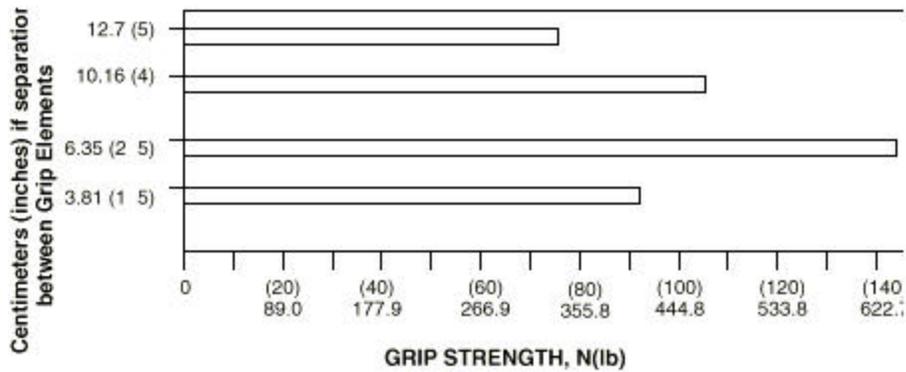


Figure 3.3.6.5-2. Male Grip Strength as a Function of the Separation Between Grip Elements

### 3.3.6.6 Adequate Clearance

The payloads shall provide clearance for the crew to perform installation, operations, and maintenance tasks, including clearance for hand access, tools and equipment used in these tasks. (LS-71000, Section 6.4.2.1)

### 3.3.6.7 Accessibility

A. Payload hardware shall be geometrically arranged to provide physical and visual access for all payload installation, operations, and maintenance tasks. Payload ORUs should be removable along a straight path until they have cleared the surrounding structure. (LS-71000, Section 6.4.2.2A)

B. IVA clearances for finger access shall be provided as given in Figure 3.3.6.7-1. (LS-71000, Section 6.4.2.2B)

Minimal finger-access to first joint		
Push button access:	Bare hand:	32 mm dia (1.26 in.)
	Thermal gloved hand:	38 mm dia (1.5 in.)
Two finger twist access:	Bare hand:	object plus 50 mm (1.97 in.)
	Thermal gloved hand:	object plus 65 mm (2.56 in.)



Figure 3.3.6.7-1. Minimum Sizes for Access Openings for Fingers

### 3.3.6.8 One-Handed Operation

Not applicable to the SD8.

- 3.3.6.9 Continuous/Incidental Contact - High Temperature  
Not applicable to the SD8.
- 3.3.6.10 Continuous/Incidental Contact - Low Temperature  
Not applicable to the SD8.
- 3.3.6.11 Equipment Mounting  
Equipment items used during nominal operations and planned maintenance shall be designed, labeled, or marked to protect against improper installation. (LS-71000, Section 6.4.4.2.1)
- 3.3.6.12 Drawers and Hinged Panels
- A. Payload ORUs that are pulled out of their installed positions for routine checkout shall be mounted on equipment drawers or on hinged panels. (LS-71000, Section 6.4.4.2.2A)
  - B. Such drawers or hinged panels shall remain in the “open” position without being supported by hand. (LS-71000, Section 6.4.4.2.2B)
- 3.3.6.13 Alignment  
Not applicable to the SD8.
- 3.3.6.14 Slide-Out Stops  
Limit stops shall be provided on slide- or pivot-mounted sub-rack hardware that is required to be pulled out of its installed positions. (LS-71000, Section 6.4.4.2.4)
- 3.3.6.15 Push-Pull Force  
Payload hardware mounted into a capture-type receptacle that requires a push-pull action shall require a force less than 156 N (35 lbf) to install or remove. (LS-71000, Section 6.4.4.2.5)
- 3.3.6.16 Covers  
Where physical access is required, one of the following practices shall be followed, with the order of preference given.
- A. Provide a sliding or hinged cap or door where debris, moisture or other foreign materials might otherwise create a problem. (LS-71000, Section 6.4.4.2.6.1A)
  - B. Provide a quick opening cover plate if a cap will not meet stress requirements. (LS-71000, Section 6.4.4.2.6.1B)

- 3.3.6.17 Self-Supporting Covers  
Not applicable to the SD8.
- 3.3.6.18 Accessibility  
It shall be possible to mate/demate individual connectors without having to remove or mate/demate other connectors during nominal operations. (LS-71000, Section 6.4.4.3.2A)
- 3.3.6.19 Ease of Disconnect  
Not applicable to the SD8. The SD8 contains no electrical connectors.
- 3.3.6.20 Indication of Pressure/Flow  
Not applicable to the SD8.
- 3.3.6.21 Self Locking  
Not applicable to the SD8. The SD8 contains no electrical connectors.
- 3.3.6.22 Connector Arrangement
- A. Space between connectors and adjacent obstructions shall be a minimum of 25 mm (1 inch) for IVA access. (LS-71000, Section 6.4.4.3.6A)
  - B. Connectors in a single row or staggered rows which are removed sequentially by the crew IVA shall provide 25 mm (1 inch) of clearance from other connectors and/or adjacent obstructions for 270 degrees of sweep around each connector beginning at the start of its removal/replacement sequence. (LS-71000, Section 6.4.4.3.6B)
- 3.3.6.23 Arc Containment  
Not applicable to the SD8.
- 3.3.6.24 Connector Protection  
Protection shall be provided for all demated connectors against physical damage and contamination. (LS-71000, Section 6.4.4.3.8)
- 3.3.6.25 Connector Shape  
Payload connectors shall use different connector shapes, sizes or keying to prevent mating connectors when lines differ in content. (LS-71000, Section 6.4.4.3.9)

- 3.3.6.26 Fluid and Gas Line Connectors  
Not applicable to the SD8
- 3.3.6.27 Alignment Marks or Guide Pins  
Not applicable to the SD8.
- 3.3.6.28 Coding
- A. Both halves of mating connectors shall display a code or identifier that is unique to that connection. (LS-71000, Section 6.4.4.3.12A)
  - B. The labels or codes on connectors shall be located so they are visible when connected or disconnected. (LS-71000, Section 6.4.4.3.12B)
- 3.3.6.29 Pin Identification  
Not applicable to the SD8.
- 3.3.6.30 Orientation  
Not applicable to the SD8.
- 3.3.6.31 Hose/Cable Restraints  
Not applicable to the SD8.
- 3.3.6.32 Non-Threaded Fasteners Status Indication  
An indication of correct engagement (hooking, latch fastening, or proper positioning of interfacing parts) of non-threaded fasteners shall be provided. (LS-71000, Section 6.4.4.4.1)
- 3.3.6.33 Mounting Bolt/Fastener Spacing  
Clearance around fasteners to permit fastener hand threading (if necessary) shall be a minimum of 0.5 inches for the entire circumference of the bolt head and a minimum of 1.5 inches over 180 degrees of the bolt head and provide the tool handle sweep as seen in Figure 3.3.6.33-1. Excepted are NSTS standard mid-deck lockers or payload-provided hardware with the static envelope dimensions (cross-section) as specified in Figures 3.4.2.1-1, 3.4.2.2-1 and 3.4.2.3-1 of NSTS-21000-IDD-MDK and other similar captive fastener arrangements. (LS-71000, Section 6.4.4.4.2)
- 3.3.6.34 Multiple Fasteners  
When several fasteners are used on one item, they shall be of identical type. (LS-71000, Section 6.4.4.4.3)
- 3.3.6.35 Captive Fasteners  
All fasteners planned to be installed and/or removed on-orbit shall be captive when disengaged. (LS-71000, Section 6.4.4.4.4)

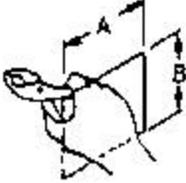
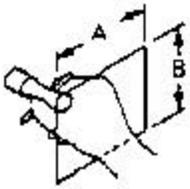
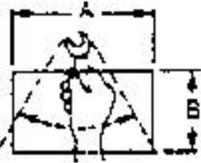
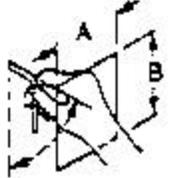
Opening dimensions		Task
	<p>A 117 mm (4.6 in) B 107 mm (4.2 in)</p>	<p>Using common screwdriver with freedom to turn hand through 180°</p>
	<p>A 133 mm (5.2 in) B 115 mm (4.5 in)</p>	<p>Using pliers and similar tools</p>
	<p>A 155 mm (6.1 in) B 135 mm (5.3 in)</p>	<p>Using T-handle wrench with freedom to turn wrench through 180°</p>
	<p>A 203 mm (8.0 in) B 135 mm (5.3 in)</p>	<p>Using open-end wrench with freedom to turn wrench through 62°</p>
	<p>A 122 mm (4.8 in) B 155 mm (6.1 in)</p>	<p>Using Allen-type wrench with freedom to turn wrench through 62°</p>

Figure 3.3.6.33-1. Minimal Clearance for Tool-Operated Fasteners

3.3.6.36 Quick Release Fasteners

- A. Quick release fasteners shall require a maximum of one complete turn to operate (quarter - turn fasteners are preferred). (LS-71000, Section 6.4.4.4.5A)
- B. Quick release fasteners shall be positive locking in open and closed positions. (LS-71000, Section 6.4.4.4.5B)

3.3.6.37 Threaded Fasteners

Only right-handed threads shall be used. (LS-71000, Section 6.4.4.4.6)

3.3.6.38 Over Center Latches

- A. Nonself-latching - Over center latches shall include a provision to prevent undesired latch element realignment, interface, or reengagement. (LS-71000, Section 6.4.4.4.7A)
- B. Latch lock - Latch catches shall have locking features. (LS-71000, Section 6.4.4.4.7B)
- C. Latch handles - If the latch has a handle, the latch handle and latch release shall be operable by one hand. (LS-71000, Section 6.4.4.4.7C)

3.3.6.39 Winghead Fasteners

Not applicable to the SD8.

3.3.6.40 Fastener Head Type

- A. Hex type external or internal grip or combination head fasteners shall be used where on-orbit crew actuation is planned, e.g., ORU replacement. (LS-71000, Section 6.4.4.4.9A)
- B. If a smooth surface is required, flush- or oval-head internal hex grip fasteners shall be used for fastening. (LS-71000, Section 6.4.4.4.9B)
- C. Slotted fasteners shall not be used to carry launch loads for hard-mounted equipment. Slotted fasteners are allowed in non-structural applications (e.g., computer data connectors, stowed commercial equipment). (LS-71000, Section 6.4.4.4.9C)

3.3.6.41 One-Handed Actuation

Fasteners planned to be removed or installed on-orbit shall be designed and placed so they can be mated/demated using either hand. (LS-71000, Section 6.4.4.4.10)

3.3.6.42 DELETED

3.3.6.43 Access Holes

Covers or shields through which mounting fasteners must pass for attachment to the basic chassis of the unit shall have holes for passage of the fastener without precise alignment (and hand or necessary tool if either is required to replace). (LS-71000, Section 6.4.4.4.12)

3.3.6.44 Controls Spacing Design Requirements

All spacing between controls and adjacent obstructions shall meet the minimum requirements as shown in Figure 3.3.6.44-1, Control Spacing Requirements for Ungloved Operation. (LS-71000, Section 6.4.5.1)

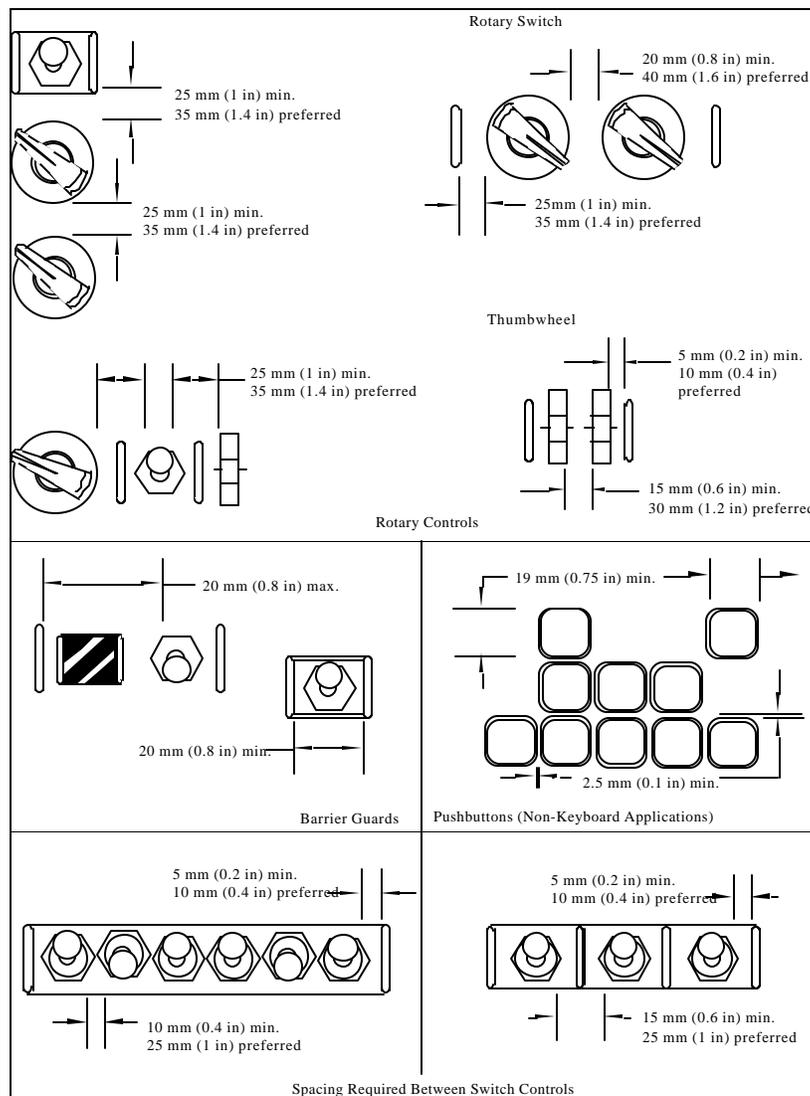


Figure 3.3.6.44-1. Control Spacing Requirements for Ungloved Operation

### 3.3.6.45 Accidental Activation

Requirements for reducing accidental actuation of controls are defined as follows:

#### 3.3.6.45.1 Protective Methods

Payloads shall provide protection against accidental control actuation using one or more of the protective methods listed in sub-paragraphs A through G below. Infrequently used controls (i.e. those used for calibration) should be separated from frequently used controls. Leverlock switches or switch covers are strongly recommended for switches related to mission success. Switch guards may not be sufficient to prevent accidental actuation. (LS-71000, Section 6.4.5.2.1)

NOTE: Displays and controls used only for maintenance and adjustments, which could disrupt normal operations if activated, should be protected during normal operations, e.g., by being located separately or guarded/covered.

- A. Locate and orient the controls so that the operator is not likely to strike or move them accidentally in the normal sequence of control movements. (LS-71000, Section 6.4.5.2.1A)
- B. Recess, shield, or otherwise surround the controls by physical barriers. The control shall be entirely contained within the envelope described by the recess or barrier. (LS-71000, Section 6.4.5.2.1B)
- C. Cover or guard the controls. Safety or lock wire shall not be used. (LS-71000, Section 6.4.5.2.1C)
- D. Cover guards when open shall not cover or obscure the protected control or adjacent controls. (LS-71000, Section 6.4.5.2.1D)
- E. Provide the controls with interlocks so that extra movement (e.g., lifting switch out of a locked detent position) or the prior operation of a related or locking control is required. (LS-71000, Section 6.4.5.2.1E)
- F. Provide the controls with resistance (i.e., viscous or coulomb friction, spring loading, or inertia) so that definite or sustained effort is required for actuation. (LS-71000, Section 6.4.5.2.1F)
- G. Provide the controls with a lock to prevent the control from passing through a position without delay when strict sequential actuation is necessary (i.e., the control moved only to the next position, then delayed). (LS-71000, Section 6.4.5.2.1G)

3.3.6.45.2 Noninterference

Payload provided protective devices shall not cover or obscure other displays or controls. (LS-71000, Section 6.4.5.2.2)

3.3.6.45.3 Dead-Man Controls

Dead-man controls are covered under NSTS 1700.7B, ISS Addendum Paragraphs 200.4a and 303.2. (LS-71000, Section 6.4.5.2.3)

3.3.6.45.4 Barrier Guards

Barrier guard spacing shall adhere to the requirements for use with the toggle switches, rotary switches, and thumbwheels as shown in Figures 3.3.6.44-1, Control Spacing Requirements for Ungloved Operation and 3.3.6.45.4-1, Rotary Switch Guard. (LS-71000, Section 6.4.5.2.4)

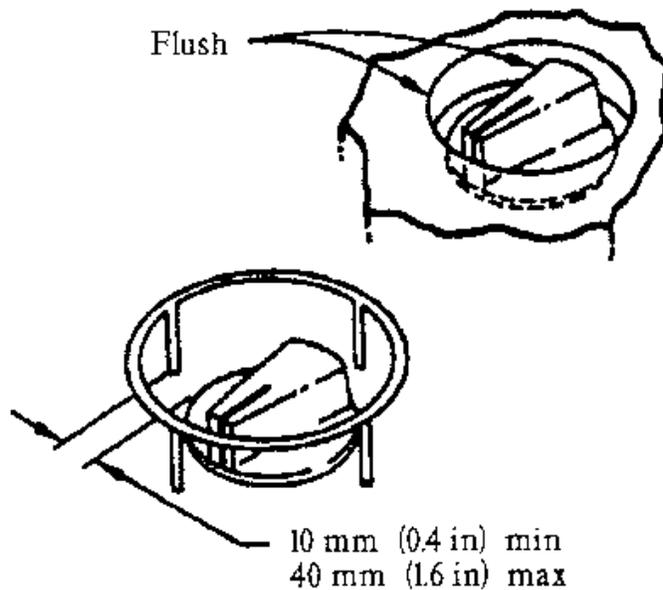


Figure 3.3.6.45.4-1. Rotary Switch Guard

3.3.6.45.5 Recessed Switch Protection

When a barrier guard is not used, rotary switches that control critical functions shall be recessed as shown in Figure 3.3.6.45.4-1, Rotary Switch Guard. (LS-71000, Section 6.4.5.2.5)

3.3.6.46 Position Indication

When payload switch protective covers are used, control position shall be evident without requiring cover removal. (LS-71000, Section 6.4.5.2.7)

3.3.6.47 Hidden Controls

Controls that cannot be directly viewed will be avoided. If present, hidden controls shall be guarded to protect against inadvertent actuation. (LS-71000, Section 6.4.5.2.8)

3.3.6.48 Hand Controllers

Hand controllers, excluding trackballs and mice, shall have a separate on/off control to prevent inadvertent actuation when the controller is not in use. (LS-71000, Section 6.4.5.2.9)

3.3.6.49 Valve Controls

Not applicable to the SD8. The SD8 contains no valves..

3.3.6.50 Toggle Switches

Not applicable to the SD8. The SD8 contains no switches.

3.3.6.51 Restraints and Mobility Aids

Payloads shall be designed such that all installation, operation, and maintenance can be performed using standard crew restraints, mobility aids, and interfaces as defined in SSP 30257:004. (LS-71000, Section 6.4.6)

3.3.6.51.1 Stowage Drawer Contents Restraints

- A. Payload drawer/tray contents shall be restrained in such a way that the items do not float when the drawer/tray is opened or closed. (LS-71000, Section 6.4.6.1A)
- B. Payload drawer/tray contents shall be restrained in a way such that the items do not jam the drawer when the drawer is opened or closed. (LS-71000, Section 6.4.6.1B)
- C. Drawer/tray contents shall be restrained in such a way that the contents can be removed/replaced without using a tool. (LS-71000, Section 6.4.6.1C)

3.3.6.51.2 Stowage and Equipment Drawers/Trays

- A. All latches, handles, and operating mechanisms shall be designed to be latched/unlatched and opened/closed with one hand by the 95th percentile American male to the 5th percentile female. (LS-71000, Section 6.4.6.2A)

B. The design of latches shall be such that their status (locked/unlocked) can be determined through visual inspection. (LS-71000, Section 6.4.6.2B)

### 3.3.6.51.3 Captive Parts

Payloads and payload equipment shall be designed in such a manner to ensure that all unrestrained parts (e.g., locking pins, knobs, handles, lens covers, access plates, or similar devices) that may be temporarily removed on orbit will be tethered or otherwise held captive. (LS-71000, Section 6.4.6.3)

### 3.3.6.51.4 Handle and Grasp Area Design Requirements

#### 3.3.6.51.4.1 Handles and Restraints

All removable or portable items that cannot be grasped with one hand, as per Table 3.3.6.51.4.1-1 [TBD, referenced table is not included in SSP 57000], shall be provided with handles or other suitable means of grasping, tethering, carrying, and restraining. (LS-71000, Section 6.4.6.4.1)

#### 3.3.6.51.4.2 Handle Location/Front Access

Handles and grasp areas shall be placed on the accessible surface of a payload item consistent with the removal direction. (LS-71000, Section 6.4.6.4.2)

#### 3.3.6.51.4.3 Handle Dimensions

IVA handles for movable or portable units shall be designed in accordance with the minimum applicable dimensions in Figure 3.3.6.51.4.3-1. (LS-71000, Section 6.4.6.4.3)

#### 3.3.6.51.4.4 Non-Fixed Handles Design Requirements

Not applicable to the SD8. The SD8 contains no non-fixed handles.

### 3.3.6.52 Electrical Hazards

Not applicable to the SD8. The SD8 contains no electrical components.

### 3.3.6.53 Audio Devices (Displays)

Not applicable to the SD8. The SD8 contains no audio devices.

### 3.3.6.54 Egress

All payload egress requirements shall be in accordance with NSTS 1700.7B, ISS Addendum, Paragraph 205. (LS-71000, Section 6.4.9.11)

## 3.3.7 System Security

Not applicable to the SD8.

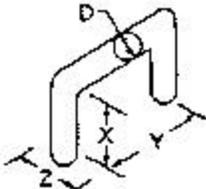
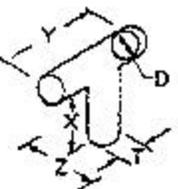
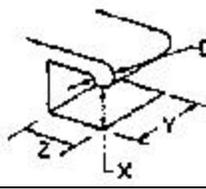
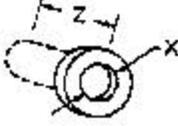
Illustration	Type of handle	Dimensions in mm (in inches)		
		(Bare hand)		
		X	Y	Z
	Two-finger bar	32 (1-1/4)	65 (2-1/2)	75 (3)
	One-hand bar	48 (1-7/8)	111 (4-3/8)	75 (3)
	Two-hand bar	48 (1-7/8)	215 (8-1/2)	75 (3)
	T-bar	38 (1-1/2)	100 (4)	75 (3)
	J-bar	50 (2)	100 (4)	75 (3)
	Two-finger recess	32 (1-1/4)	65 (2-1/2)	75 (3)
	One-hand recess	50 (2)	110 (4-1/4)	90 (3-1/2)
	Finger-tip recess	19 (3/4)	—	13 (1/2)
	On-finger recess	32 (1-1/4)	—	50 (2)
Curvature of handle  (DOES NOT PRECLUDE USE OF OVAL HANDLES)		Weight of item or edge up to 6.8 kg (up to 15 lbs) 6.8 to 9.0 kg (15 to 20 lbs) 9.0 to 18 kg (20 to 40 lbs) Over 18 kg (over 40 lbs) T-bar post	Minimum Diameter D = 6 mm (1/4 in) D = 13 mm (1/2 in) D = 19 mm (3/4 in) D = 25 mm (1 in) T = 13 mm (1/2 in)	Gripping efficiency is best if finger can curl around handle or edge to any angle of 2/3 π rad (120°) or more

Figure 3.3.6.51.4.3-1. Minimum IVA Handle Dimensions for IVA Applications

3.3.8 Design Requirements

3.3.8.1 Structural Design Requirements

3.3.8.1.1 On-orbit Loads

A. The SD8 shall provide positive margins of safety for on-orbit loads of 0.2 Gs acting in any direction. (LS-71000, Section 6.2.1.1.4A)

B. Crew Induced Load Requirements

The SD8 shall provide positive margins of safety when exposed to the crew induced loads defined in Table 3.3.9.1.1-1, Crew-Induced Loads. (LS-71000, Section 6.2.1.1.4B)

TABLE 3.3.9.1.1-1. CREW-INDUCED LOADS

Crew System or Structure	Type of Load	Load	Direction of Load
Levers, Handles, Operating Wheels, Controls	Push or Pull concentrated on most extreme edge	222.6 N (50 lbf), limit	Any direction
Small Knobs	Twist (torsion)	14.9 N-M (11 ft-lbf), limit	Either direction
Exposed Utility Lines (Gas, Fluid, and Vacuum)	Push or Pull	222.6 N (50 lbf)	Any direction
Rack front panels and any other normally exposed equipment	Load distributed over a 4 inch by 4 inch area	556.4 N (125 lbf), limit	Any direction
Legend: ft = feet, m = meter, N = Newton, lbf = pounds force			

3.3.8.1.2 Safety Critical Structures Requirements

The SD8 shall be designed in accordance with the requirements specified in SSP 52005. (LS-71000, Section 6.2.1.1.1)

3.3.8.1.3 First Modal Frequency

SIR drawer instruments shall have a first modal frequency of not less than 35 Hz for launch and landing, based on rigidly mounting the instrument at the rack to SIR drawer instrument interface. (LS-71000, Section 6.2.1.1.2)

3.3.8.1.4 Launch and Landing Loads

A. For design and qualification purposes, SIR drawer instruments shall maintain

positive margins of safety for the MPLM ascent random vibration environment as defined in Table 3.3.8.1.4-1, Random Vibration Criteria for HRF Rack Post Mounted Equipment Weighing 100 Pounds or Less in the MPLM. (LS-71000, Section 6.2.1.1.3A)

TABLE 3.3.8.1.4-1. RANDOM VIBRATION CRITERIA FOR HRF RACK POST MOUNTED EQUIPMENT WEIGHING 100 POUNDS OR LESS IN THE MPLM

Frequency	Level
20 Hz	0.005 g <sup>2</sup> /Hz
20-70 Hz	+5.0 dB/oct
70-200 Hz	0.04 g <sup>2</sup> /Hz
200-2000 Hz	-3.9 dB/oct
2000 Hz	0.002 g <sup>2</sup> /Hz
Composite	4.4 grms

NOTE: Criteria is the same for all directions (X, Y, Z)

- B. SIR drawer instruments shall maintain positive margins of safety for the launch and landing conditions in the MPLM. For early design, the acceleration environment defined in Table 3.3.8.1.4-3, HRF Rack Mounted Equipment Load Factors (Equipment Frequency 35 Hz) will be used. These load factors will be superseded by load factors obtained through ISS-performed Coupled Loads Analysis as described in SSP 52005. (LS-71000, Section 6.2.1.1.3B)

TABLE 3.3.8.1.4-3. HRF RACK MOUNTED EQUIPMENT LOAD FACTORS (EQUIPMENT FREQUENCY 35 HZ)

<b>Liftoff</b>	<b>X</b>	<b>Y</b>	<b>Z</b>
(g)	±7.7	±11.6	±9.9
<b>Landing</b>	<b>X</b>	<b>Y</b>	<b>Z</b>
(g)	±5.4	±7.7	±8.8

NOTE: Load factors apply concurrently in all possible combinations for each event and are shown in the rack coordinate system defined in SSP 41017, Part 2, Paragraph 3.1.3.

3.3.8.2 Electrical Power Consuming Equipment (EPCE) Design  
Not applicable to the SD8.

## 3.4 ACCEPTANCE AND QUALIFICATION REQUIREMENTS

### 3.4.1 Nominal Operation Under Thermal Environment

The SD8 shall be designed to operate between 18 °C and 30 °C (65-85 °F).

### 3.4.2 Workmanship Vibration

The SD8 shall operate in accordance with the work authorizing document following vibration at workmanship levels.

#### Vibration and Sine Sweep

- A. SD8 shall perform a sinusoidal resonance survey.
- B. SD8 shall operate nominally following vibration at flight vibration loads.
- C. SD8 shall operate nominally following vibration at workmanship loads.

### 3.4.3 Functional Performance

The SD8 shall operate in accordance with the work authorizing document under all planned modes of operation.

### 3.4.4 Electrical, Electronic, and Electromechanical (EEE) Parts Control, Selection, and Burn-In

Not applicable to the SD8.

### 3.4.5 Flammability

The SD8 shall meet the flammability test requirements as described in Section 4.3.5.

### 3.4.6 Offgassing

The SD8 shall meet the offgassing test requirements as described in Section 4.3.6.

### 3.4.7 Shock

The SD8 shall meet the shock test requirements as described in 4.3.7.

### 3.4.8 Bench Handling

The SD8 shall meet the requirements as described in Section 4.3.8.

3.4.9 Payload Mass

The SD8 shall meet the payload mass control requirements as described in Section 4.3.9.

3.4.10 Electromagnetic Compatibility (EMC)

Not applicable to the SD8.

3.4.11 Acoustic Noise

Not applicable to the SD8.

3.4.12 Safety Critical Structural Verification

3.4.12.1 Safety Critical Structure Dimensional Check

All SD8 elements identified as safety critical structures shall be verified to be in accordance with the final design drawing dimensional requirements. (LS-71000, Section 5.4.1.1.11.1)

3.4.12.2 Safety Critical Structure Material Certification

All structural elements that are identified as safety critical structures of each of the flight units shall have the components used in those safety critical structures certified to be fabricated from the materials and alloys identified in the final design drawings, and to be fabricated from materials approved by NASA-JSC. (LS-71000, Section 5.4.1.1.11.2)

3.4.13 Pre-Delivery Acceptance

The SD8 shall meet the pre-delivery acceptance (PDA) requirements as described in Section 4.3.12.

3.5 HUMAN RESEARCH PROGRAM PROGRAM REQUIREMENTS

3.5.1 Safety

The SD8 shall meet the applicable requirements of NSTS 1700.7, NSTS 1700.7 ISS Addendum, NSTS/ISS 18798, NSTS/ISS 13830, and KHB 1700.7.

3.5.2 Documentation Requirements

Documentation requirements for the SD8 shall be as specified in Appendix A of the PRD for HRF, LS-71000. Required items for submittal to NASA are summarized below for convenience.

3.5.2.1

Acceptance Data Package Requirements List

All flight hardware being provided under contract to NASA shall have an Acceptance Data Package (ADP) upon final delivery. The ADP will be reviewed by NASA and discussed at the PDA review. The acceptance of any equipment item will be contingent upon NASA’s approval of the ADP for that item.

#	Document	Required for Project		Comments
		Yes	No	
1	Shipping Documentation (DD250/1149)	X		
2	Quality Log	X		Historical record of top assembly
3	Index or Table of Contents	X		
4	Engineering Drawings	X		
5	Inventory of Serialized Components	X		
6	Operating, Maintenance, and Handling Procedures	X		
7	Limited Life/Time and Cycle Requirements	X		
8	“As run” Test Procedures, Data, and Reports	X		
9	Waiver requests	X		Waiver requests are coordinated through HRF Systems Engineering and Integration (SE&I)
10	Safety Data	X		
11	Structural Analyses	X		
12	Pressure Vessel Data	X		
13	Radioactive Material Data		X	No radioactive material
14	Calibration Data		X	No calibration data required

## 4.0

### VERIFICATION PROVISIONS

This section contains the required verification methods for ISS interface certification, science functional acceptance, and program qualification and acceptance. Section 4.1 addresses definitions for terms used herein.

Appendix B contains the applicability matrix for ISS Pressurized Payload Interface Requirements Document requirements. The Verification Data Sheet (VDS) addressing the appropriate method for ISS interface verification is also contained in Appendix B. If an alternate verification method is desired, the new verification method must be negotiated in the Unique Payload Verification Plan.

Section 4.2 contains the verification methods for science functional acceptance. Appendix C contains the applicability matrix for science functional requirements.

Section 4.3 contains the verification methods for program qualification and acceptance requirements. Appendix D contains the applicability matrices for acceptance and qualification requirements.

The responsibility for the performance of all verification activities is as specified in Appendices B, C, and D. All testing described in Appendices B, C, and D shall be documented via Task Performance Sheet (TPS) (JSC Form 1225) per JSC Work Instruction NT1-CWI-001. Except as otherwise specified in the contract, the provider may use their own or any other facility suitable for the performance of the verification requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the verifications set forth in this specification.

## 4.1

### GENERAL

Equipment verification methods are defined as follows:

- A. Inspection is a method that determines conformance to requirements by the review of drawings, data or by visual examination of the item using standard quality control methods, without the use of special laboratory procedures.
- B. Analysis is a process used in lieu of, or in addition to, other methods to ensure compliance to specification requirements. The selected techniques may include, but not be limited to, engineering analysis, statistics and qualitative analysis, computer and hardware simulations, and analog modeling. Analysis may also include assessing the results of lower level qualification activity. Analysis may be used when it can be determined that (1) rigorous and accurate analysis is possible, (2) test is not cost effective, and (3) verification by inspection is not adequate.

Verification by similarity is the process of analyzing the specification criteria for hardware configuration and application for an article to determine if it is similar or identical in design, manufacturing process, and quality control to an existing article that has previously been qualified to equivalent or more stringent specification criteria. Special effort will be made to avoid duplication of previous tests from this or similar programs. If the previous application is considered to be similar, but not equal to or greater in severity, additional qualification tests shall concentrate on the areas of new or increased requirements.

- C. Demonstration consists of a qualitative determination of the properties of a test article. This qualitative determination is made through observation, with or without special test equipment or instrumentation, which verifies characteristics such as human engineering features, services, access features, and transportability. Demonstration requirements are normally implemented within a test plan, operations plan, or test procedure.
- D. Test is a method in which technical means, such as the use of special equipment, instrumentation, simulation techniques, and the application of established principles and procedures, are used for the evaluation of components, subsystems, and systems to determine compliance with requirements. Test shall be selected as the primary method when analytical techniques do not produce adequate results; failure modes exist which could compromise personnel safety, adversely affect flight systems or payload operation, or result in a loss of mission objectives; or for any components directly associated with Space Station and orbiter interfaces. The analysis of data derived from tests is an integral part of the test program, and should not be confused with analysis as defined above.

## 4.2 FUNCTIONAL PERFORMANCE ACCEPTANCE TESTING

The requirements herein describe specific test requirements for functional performance acceptance.

## 4.3 ACCEPTANCE AND QUALIFICATION VERIFICATION METHODS

The requirements herein describe specific test requirements for SD8 acceptance and qualification. Qualification testing shall only be performed utilizing the SD8 qualification model.

### 4.3.1 Thermal Cycle Tests

HRF payloads undergoing thermal cycle testing shall be functionally tested at each stable temperature and during transitions. The pass-fail criteria for the functional test and the definition of the functional test will be equipment unique and shall be defined in the test plan and test procedure. Functional tests shall be conducted on end items prior to, during, and after environmental exposure. (LS-71000, Section 5.4.1.1.6)

#### 4.3.1.1 Qualification Thermal Cycling

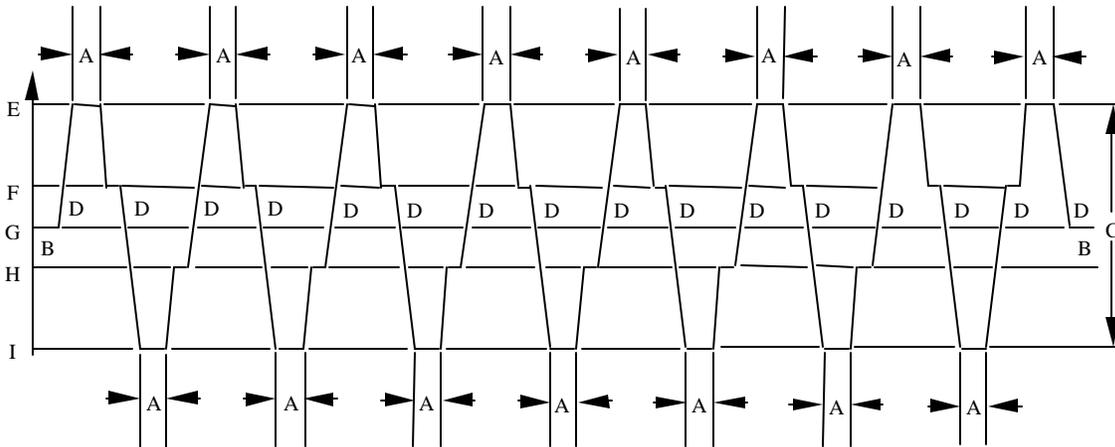
The Qualification Thermal Cycle Test shall be over a range of 110 °F (61.1 °C) centered about the normal operating temperature of 75 °F (23.9 °C) or as defined in the individual test plans. The Qualification thermal test shall consist of 7½ cycles. One cycle is defined as starting from normal operating temperature, increasing to the maximum high temperature, decreasing to the minimum low temperature and then returning to the normal operating temperature as depicted in Figure 4.3.1.1-1. The complete test is seven and one-half (7½) cycles with one-hour soaks at each extreme. The hardware will be functionally tested during transitions and at the highest and lowest temperature extremes, consistent with the defined operating temperature range. The hardware shall not be functionally tested at temperatures in excess of the defined operating temperature range. (Hardware shall be unpowered when outside the manufacturer's operating limits.) The specific profile shall be defined in the individual test plans. (LS-71000, Section 5.4.1.1.6.1)

#### 4.3.1.2 Acceptance Thermal Cycling

The acceptance thermal cycle shall be conducted over a temperature range of 100 °F (55.6 °C) centered about the hardware normal operating temperature of 75 °F (23.9 °C) or as defined in the test plan. The hardware shall be functionally tested before and after the temperature test, at each transition, and at each stable temperature. The hardware shall not be functionally tested at temperatures in excess of the defined operating temperature range. (Hardware shall be unpowered when outside the manufacturer's operating limits.) One cycle is defined as starting from normal operating temperature, increasing to the maximum high temperature, decreasing to the minimum low temperature and then returning to the normal operating temperature as depicted in Figure 4.3.1.2-1. The complete test consists of one and one-half (1½) thermal cycles with one-hour soaks at each extreme. Minimum temperature sweep shall be 100 °F around the normal operating temperature, and the hardware shall dwell at the temperature extremes for a minimum of 1 hour. (LS-71000, Section 5.4.1.1.6.2)

#### 4.3.2 Vibration Tests

Qualification for Acceptance Random Vibration Test levels are as described in Section 4.3.2.1. Acceptance Random Vibration Test levels are as described in Section 4.3.2.2.



**NOTES:**

1. A = Time to stabilize equipment temperature plus 1-hour minimum.
2. B = Functional tests to be performed as shown.
3. C = Control temperature range between high and low acceptance test conditions shall be a minimum of  $61.11^{\circ}\text{C}$  ( $110^{\circ}\text{F}$ ). Contractor is to specify tolerances on stable temperature periods.
4. D = Simplified Functional Test. Rate of temperature change during temperature transition shall not be less than  $0.55^{\circ}\text{C}$  ( $1^{\circ}\text{F}$ )/min. nor greater than  $2.22^{\circ}\text{C}$  ( $4^{\circ}\text{F}$ )/min.
5. E = Median operational temperature plus  $30.56^{\circ}\text{C}$  ( $55^{\circ}\text{F}$ ).
6. F = Maximum operational temperature.
7. G = Median operational temperature.
8. H = Minimum operational temperature.
9. I = Median operational temperature minus  $30.56^{\circ}\text{C}$  ( $55^{\circ}\text{F}$ ).

Figure 4.3.1.1-1. Qualification Thermal Cycling

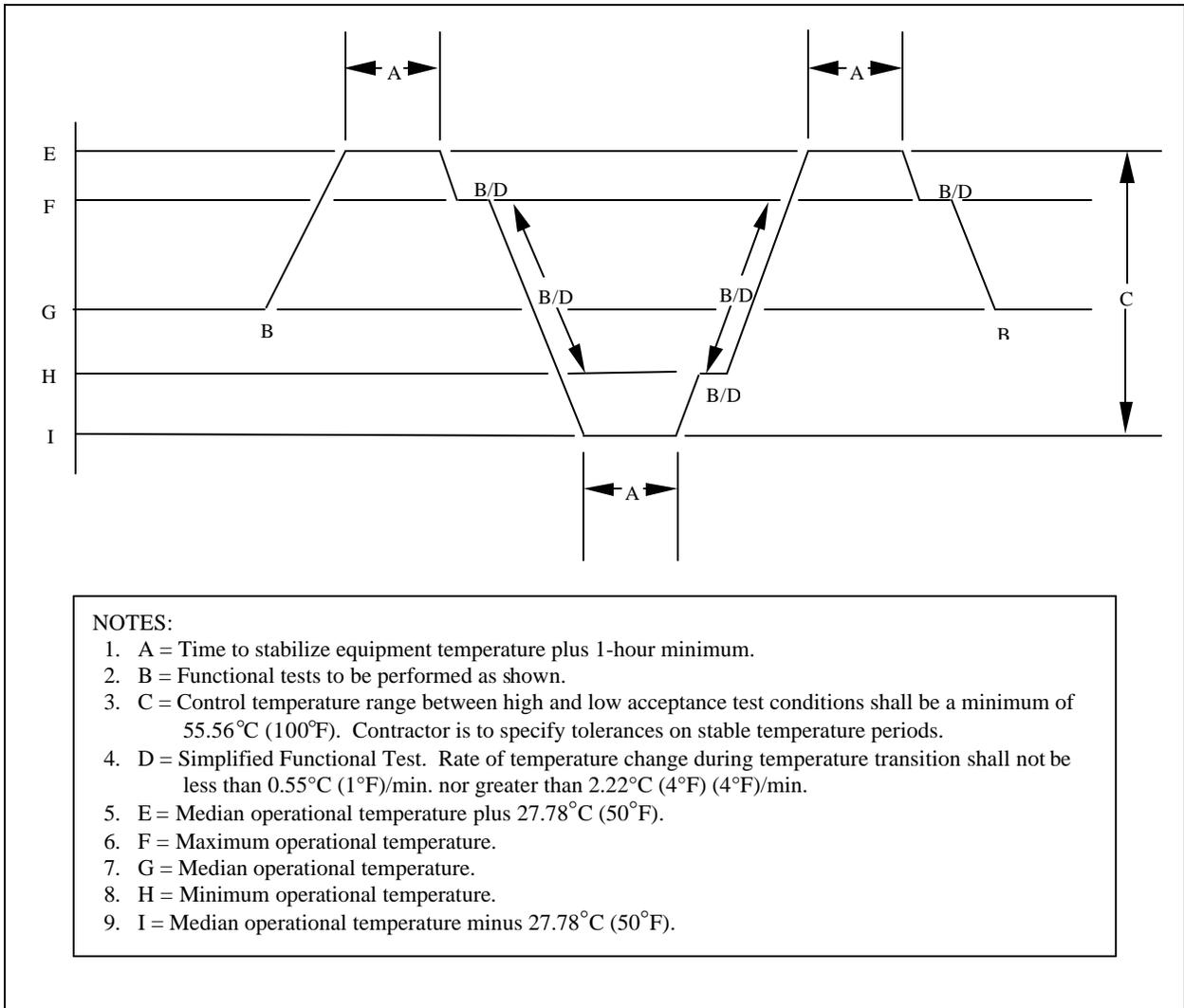


Figure 4.3.1.2-1. Acceptance Thermal Cycling

#### 4.3.2.1 Sinusoidal Resonance Survey

HRF rack mounted instruments shall be subjected to a sinusoidal resonance survey to determine the fundamental resonance frequencies of the test article. The survey shall be conducted at a sweep rate of one octave (oct) per minute in each of three orthogonal axes from 5 to 200 Hz, one sweep up and down, with an input not to exceed 0.25 g zero to peak. The equipment under test shall have an accelerometer mounted at an accessible hard point on the test item near or on the CG of the test article. The output of this response accelerometer shall be monitored and not allow the hardware to experience more than 0.5 g peak. The input acceleration level shall be monitored by an accelerometer mounted as close as possible to the test fixture/hardware interface.

#### 4.3.2.2 Random Vibration Test

Random vibration testing is required for all HRF rack mounted hardware. Random vibration testing is not required for hardware packed in vibration damping materials such as foam, or for hardware launched in soft stowage containers. Each HRF instrument subjected to vibration testing shall be functionally tested before and after vibration testing. It is also preferred that the hardware be operating and functionally tested during vibration testing. An assessment of the impact of operating the hardware during vibration testing shall be conducted and recommendations presented. The pass-fail criteria for the functional test and the definition of the functional test will be equipment unique and shall be defined in the test plan and test procedure for each element.

It is recommended that the hardware be hard mounted to the vibration test fixture in order to achieve a one-to-one transfer of the vibration levels shown in the following paragraphs. If the individual hardware flight mounting configuration is expected to result in amplification of flight vibration levels above the test levels defined in the following paragraphs, a test program should be developed that verifies the survivability of the hardware.

Requirements for qualification vibration testing are defined in SSP 52005. Requirements for acceptance vibration testing are defined in SP-T-0023.

##### 4.3.2.2.1 Qualification Random Vibration Test

Qualification Vibration Test (QVT) certifies the design for a number of launch cycles determined by the duration of the vibration test in each axis. QVT shall be conducted on dedicated qualification test hardware only. Spectral density and frequency of QVT vibration levels shall be equivalent expected flight levels. The duration of the QVT shall be four times the expected life time exposure to flight vibration, but not less than 60 sec per axis. Hardware may be certified for additional launch cycles by increasing vibration duration by 30 seconds in each axis for each additional launch cycle required. HRF requires a minimum duration of 120 seconds in each axis. The flight level vibrations for QVT are shown in Table 4.3.2.2.1-1.

**TABLE 4.3.2.2.1-1. QUALIFICATION RANDOM VIBRATION TEST LEVELS**

Frequency Range (Hz)	Minimum Power Spectral Density (g <sup>2</sup> /Hz)
20 Hz	0.005 g <sup>2</sup> /Hz
20-70 Hz	+5 dB/octave
70-350 Hz	0.004 g <sup>2</sup> /Hz
350-2000 Hz	-3.9 dB/octave
2000 Hz	0.002 g <sup>2</sup> /Hz
Composite	4.4 g RMS

4.3.2.2.2 Qualification for Acceptance Random Vibration Test

Qualification for Acceptance Vibration Testing (QAVT) determines the number of Acceptance Vibration Tests that may be run on flight units. QAVT shall be run on dedicated qualification test hardware only. The QAVT for HRF equipment shall be performed at a 7.93 g rms composite level over the frequency range and spectral density defined in Table 4.3.2.2.2-1. QAVT shall be conducted at 1.69 times the Acceptance Random Vibration Test levels. QAVT duration shall be the Acceptance Vibration Testing (AVT) duration multiplied by the number of AVTs for which the hardware is to be qualified. (LS-71000, Section 5.4.1.1.3.2)

**TABLE 4.3.2.2.2-1. QUALIFICATION ACCEPTANCE RANDOM VIBRATION TEST LEVELS**

Frequency Range (Hz)	Minimum Power Spectral Density (g <sup>2</sup> /Hz)
20	0.017
20 - 80	3 dB/Octave Slope
80 - 350	0.067
350 - 2000	-3 dB/Octave Slope
2000	0.0118
Composite	7.93 g rms

#### 4.3.2.2.3 Acceptance Random Vibration Test

AVT is used to screen defects in workmanship that cannot be detected by inspection. AVT for the GDS shall be performed at a 6.1 g rms composite level over the frequency range and minimum AVT levels defined in Table 4.3.2.2.3-1. Vibration duration shall be a minimum of 60 seconds in each of three axes. Functional/continuity tests shall be conducted on components before, during, and after the AVT. (LS-71000 Section 5.4.1.1.3.3)

TABLE 4.3.2.2.3-1. ACCEPTANCE RANDOM VIBRATION WORKMANSHIP TEST LEVELS

Frequency Range (Hz)	Minimum Power Spectral Density (g <sup>2</sup> /Hz)
20	0.01
20 - 80	+3 dB/Octave - Slope
80 - 350	0.04
350 - 2000	-3 dB/Octave - Slope
2000	0.007
Composite	6.1 g rms

#### 4.3.3 Functional Testing

Abbreviated and full functional test procedures shall be as specified in a TPS or a released procedure.

Functional tests are performed to validate the operation of the SD8 flight hardware. Functional tests make up the core of certain tests and can be performed before and after environmental testing. The functional test done prior to testing establishes the functional state (or baseline) of the hardware while the functional done after testing evaluates its ability to withstand the test levels.

An abbreviated functional will be used to test the functional state of the hardware during some environmental testing (i.e., thermal, vibration, bench handling, etc.). The intended use of an abbreviated functional is to verify nominal hardware function between test stages.

#### 4.3.4 Electrical, Electronic, and Electromechanical Parts Control, Selection, and Burn-In

Not applicable to the SD8.

#### 4.3.5 Flammability

Payload materials shall be non-flammable or self-extinguishing per the test criteria of NASA-STD-6001, Test 1, “Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion.” The material shall be evaluated in the worst-case use environment at the worst-case use configuration. When the use of a nonflammable material is not possible, a Material Usage Agreement (MUA) or equivalent shall be submitted to the cognizant NASA center for disposition. If test data does not exist for a material, the experimenter may be asked to provide samples (see NASA-STD-6001, Chapter 4) to a NASA certified test facility, Marshall Space Flight Center (MSFC) or White Sands Test Facility (WSTF) for flammability testing.

Materials used in all other habitable areas shall be tested and evaluated in the worst-case use environment of 24.1% oxygen and 15.2 psia. (LS-71000, Section 5.4.1.1.8)

#### 4.3.6 Offgassing

All flight hardware located in habitable areas shall be subjected to test and meet the toxicity offgassing acceptance requirements of NASA-STD-6001, Test 7. (LS-71000, Section 5.4.1.1.9)

#### 4.3.7 Shock Test

A shock test shall be performed on the qualification unit for all rack mounted hardware which will be subjected to ground handling shocks (not necessary if transport packaging will protect hardware from excessive shocks). A shock test shall be performed on the certification unit for all crew-worn hardware which will be subjected to potential shocks during usage by the crew. The shock test shall be a sawtooth wave form at a 20 g level for a duration of 11 milliseconds, three shocks in each direction of each of three orthogonal axes (a total of 18 shocks). The shock test shall be conducted in accordance with MIL-STD-810, Method 516.2, Procedure I. The hardware shall be functionally tested before and after each test direction of each axis, but not necessarily between shocks. To reduce set-up time, it is recommended that this test be performed between vibration test axes. (LS-71000, Section 5.4.1.1.4)

#### 4.3.8 Bench Handling

A bench-handling test shall be performed on the qualification unit for all hardware. The bench handling test shall be conducted in accordance with MIL-STD-810, Section 516.4, I3.6, Procedure 4 or 6 with the following modifications: Test conditions of 26 drops altered to two (2) drops. Surfaces, corners, edges shall be identified in the test procedure. (LS-71000, Section 5.4.1.1.5)

#### 4.3.9 Payload Mass

The SD8 shall comply with LS-71014, "Mass Properties Control Plan." (LS-71000, Section 5.4.1.1.1)

#### 4.3.10 Electromagnetic Compatibility

Not applicable to the SD8.

#### 4.3.11 Acoustic Noise

Not applicable to the SD8.

#### 4.3.12 Pre-Delivery Acceptance

The responsible manufacturing parties shall perform a PDA after the complete fabrication and assembly has been conducted for all Class I deliverable assemblies. This test shall include verification of software interface and operation. The PDA must be completed before hardware certification testing begins. It is a full functional test and inspection that validates that the hardware operates per the design requirements and that it is constructed per released engineering drawings. All PDA tests shall be approved by the hardware's JSC technical monitor and JSC/NT3, as well as the contractor quality engineering (if applicable). The following are standard steps that each PDA test shall contain:

1. Conformance to Drawing: Verify that the hardware conforms to released engineering drawings.
2. No Sharp Edges: Inspect the hardware to verify that there are no sharp edges or corners present.
3. Proper Identifying Markings: Verify that the hardware has the proper part number and serial number (if applicable) on it.
4. Weight and CG: Measurements shall be taken of the as-built configuration per Section 3.2.2.1 of this document.
5. Functional Testing: This is a full functional test and checks all interfaces.

#### 4.3.13 Pre-Installation Acceptance (PIA)

PIA testing occurs prior to installation in the HRF Rack.

1. Cleanliness: PIA tests shall include verification that surfaces are to the cleanliness level of Section 3.3.1.1.4 of this document.
2. Functional Testing: PIA functional testing checks rack interfaces prior to installation in the HRF Rack.

## 5.0 PREPARATION FOR SHIPMENT

The SD8 will be shipped in accordance with WM-3230-001 (4.2.3). All shipping rules and regulations are performed and verified by logistics personnel in B421. This requirement is not verifiable and is not the responsibility of the payload developers.

### 5.1 General

- A. The methods of preservation, packaging, and packing used for shipment, together with necessary special control during transportation, shall adequately protect the article(s) from damage or degradation in reliability or performance as a result of the natural and induced environments encountered during transportation and subsequent indoor storage. (LS-71000, Section 9.1A)
- B. To reduce program cost, prior to developing a newly designed container, every effort will be made by project participants to use container designs and/or containers available commercially or from Government inventories. If reusable containers are not available, a screening process should be initiated for container availability in the following priority: existing containers, COTS containers, and modified commercial off-the shelf containers. Shipping containers and protective devices will be designed for effective and economical manufacture, procurement, and transportability. (LS-71000, Section 9.1B)

### 5.2 Packing, Handling, and Transportation

- A. Packaging, handling, and transportation shall be in accordance with applicable requirements of NHB 6000.1C, and referenced documents therein. (LS-71000, Section 9.2A)
- B. Documented procedures and physical controls shall be established to ensure that the HRF rack and individual items of equipment will not be subjected to temperature, shock, and humidity outside the non-operational limits during shipment. (LS-71000, Section 9.2C)
- C. The SD8 shall be cleaned to the “Visibly Clean Level 1 (Sensitive)” as determined in JSC-SN-C-0005, Specification Contamination Control Requirements for the Shuttle Program. (LS-71000, Section 9.2D)

### 5.3 Preservation and Packing

Preservation and packing shall be in accordance with approved Packaging, Handling, and Transportation Records (PHTRs). (LS-71000, Section 9.3)

#### 5.4 Marking for Shipment

Interior and exterior containers shall be marked and labeled in accordance with NHB 6000.1C including precautionary markings necessary to ensure safety of personnel and facilities, and to ensure safe handling, transport, and storage. Should the individual items of equipment contain any hazardous materials, markings shall also comply with applicable requirements governing packaging and labeling of hazard materials. Packages with reuse capability shall be identified with the words “Reusable Container - Do Not Destroy - Retain for Reuse.” NASA Critical Item Labels (Form 1368 series) shall be applied in accordance with NHB 6000.1C. (LS-71000, Section 9.4)

#### 5.5 NASA Critical Space Item Label

The NASA Critical Space Item Labels Form 1368 shall be affixed to exterior and interior shipping containers in accordance with NHB 6000.1C. (LS-71000, Section 9.5A)

## 6.0 NOTES

This section contains information of a general or explanatory nature that may be helpful but is not mandatory.

## 6.1 DEFINITIONS

Qualification Test	Test conducted as part of the certification program to demonstrate that the design and performance requirements can be realized under specified conditions.
Acceptance Test	Formal tests conducted to assure that the end item meets specified requirements. Acceptance tests include performance demonstrations and environmental exposures to screen out manufacturing defects, workmanship errors, incipient failures, and other performance anomalies not readily detectable by normal inspection techniques or through ambient functional tests.
Active Air Exchange	Forced convection between two volumes. For example, forced convection between a sub-rack payload and the internal volume of an integrated rack, or forced convection between a sub-rack payload and cabin air.
Continuous Noise Source	A significant noise source that exists for a cumulative total of eight hours or more in any 24-hour period is considered to be a continuous noise source.
Intermittent Noise Source	A significant noise source that exists for a cumulative total of less than eight hours in a 24-hour period is considered to be an intermittent noise source.
On-Orbit Momentary Protrusions	Payload Obstructions that typically would protrude for a very short time or could be readily eliminated by the crew at any time. Momentary protrusions include only the following: drawer/door/cover replacement or closure.
On-Orbit Permanent Protrusion	A payload hardware item that is not ever intended to be removed.
On-Orbit Semi-Permanent Protrusion	A payload hardware item that is typically left in place, but can be removed by the crew with hand operations or standard IVA tools. Example: SIR and ISIS drawer handles, other equipment that does not interfere with crew restraints and mobility aids.
On-Orbit Temporary Protrusion	A payload item that is typically located in the aisle for experiment purposes only. These items should be returned to their stowed configuration when not being used. Example: Front panel mounted equipment.

APPENDIX A

RESERVED



APPENDIX B

ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION  
MATRIX



## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX

*{If a request for deviation or waiver from the requirement stated in this HRD is anticipated or if the type of documentation supplied or method of verification is anticipated to not be as stated in this matrix, this information should be noted in the Comment column. }*

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.2.2.2.1A	--	3.1.1.7A	On-Orbit Payload Protrusions - Lateral Extension	✓	ME-059		
3.2.2.2.2.1B	--	3.1.1.7B	On-Orbit Payload Protrusions - Attachment of RMA		ME-059		
3.2.2.2.2.1.1	--	3.1.1.7.1	On-Orbit Permanent Protrusions	✓	ME-059		
3.2.2.2.2.1.2A	--	3.1.1.7.2A	On-Orbit Semi-Permanent Protrusions - SIR and ISIS Drawer Handles	✓	ME-059		
3.2.2.2.2.1.2B	--	3.1.1.7.2B	On-Orbit Semi-Permanent Protrusions - Other	✓	ME-059		
3.2.2.2.2.1.2C	--	3.1.1.7.2C	On-Orbit Semi-Permanent Protrusions - Removable	✓	ME-059		
3.2.2.2.2.1.3A	--	3.1.1.7.3A	On-Orbit Temporary Protrusions - Envelope	N/A	ME-059		No temporary protrusions
3.2.2.2.2.1.3B	--	3.1.1.7.3B	On-Orbit Temporary Protrusions - Removal	N/A	ME-059		No temporary protrusions
3.2.2.2.2.1.4	--	3.1.1.7.4	On-Orbit Momentary Protrusions		ME-059		No momentary protrusions
3.2.4A	6.4.4.2.6.3	3.12.4.2.8.4	Maintainability - Unique Tools	N/A	ME-016		No unique tools required
3.2.4B	6.4.4.3.1	3.12.4.3.1	Maintainability - One-handed Operation	✓	ME-017		
3.2.4C	6.4.4.3.2B	3.12.4.3.2A2	Maintainability - Connector Mate/Demate	✓	ME-018		
3.2.4D	6.4.4.3.2C	3.12.4.3.2B	Maintainability - No Damage to Wiring Connectors	N/A	ME-018		No electrical connectors in design
3.2.4E	6.4.4.2.6	3.12.4.2.8	Maintainability - Access to Hardware Items	✓	ME-042		
3.2.4F	6.4.3.1.2A	3.12.3.1.2A	Maintainability - Built-in Control		ME-008		

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.4G	6.4.3.1.2B	3.12.3.1.2B	Maintainability - Access to Filters for Replacement/Cleaning	N/A	ME-008		No capture elements in design
3.2.4.1.1	6.4.10	3.12.10	Payload In-flight Maintenance	✓	ME-003		
3.2.5.1.1.1	6.2.9.1.1	3.9.1.1	Pressure	✓	Safety		
3.2.5.1.1.2	6.2.9.1.2	3.9.1.2	Temperature	✓	Safety		
3.2.5.1.1.3	6.2.9.1.3	3.9.1.3	Humidity	✓	EN-001		
3.2.5.1.2.1	6.2.9.2.1	3.9.2.1A	Active Air Exchange	N/A	EN-002		No active air exchange
3.2.5.1.2.2	6.2.9.2.2	3.9.2.2	Oxygen Consumption	N/A	EN-003		No oxygen consumption by SD8
3.2.5.1.2.3	6.2.9.2.3	3.9.2.3	Chemical Releases	N/A	Safety		No chemicals released by SD8
3.2.5.1.2.4	6.2.5.4	3.5.1.12	Cabin Air Heat Leak	N/A	FD-008		No heat source in SD8
3.2.5.1.2.5	6.2.5.5	3.5.1.13	Cabin Air Cooling	N/A	FD-009		SD8 absorbs no heat
3.2.5.1.3.1	6.2.9.3.1	3.9.3.1	Instrument Contained or Generated Ionizing Radiation	N/A	Safety		No radiation sensitive material in SD8
3.2.5.1.3.3	6.2.9.3.3	3.9.3.3	Single Event Effect (SEE) Ionizing Radiation	N/A	EN-004		No radiation sensitive material in SD8
3.2.5.1.5A	6.2.1.1.6B	3.1.1.4B	Pressure Rate of Change - On-orbit		ST-003		
3.2.5.1.5B1	6.2.1.1.6A	3.1.1.4B	Pressure Rate of Change - MPLM		ST-003		
3.2.5.1.5C	6.2.1.1.6C	3.1.1.4K	Pressure Rate of Change - PFE	N/A	ST-003		No PFE access port
3.2.5.1.5D	6.2.1.1.6D	3.1.1.4M	Pressure Relief Device	N/A	TBD		
3.2.5.1.6A	6.2.1.1.7A	3.1.2.1A	Microgravity - Quasi-steady	TBD	EN-005		
3.2.5.1.6B	6.2.1.1.7B	3.1.2.2A	Microgravity - Vibratory	TBD	EN-005		
3.2.5.1.6C	6.2.1.1.7C	3.1.2.3A	Microgravity - Transient	TBD	EN-005		
3.2.5.2.1A	6.4.3.3.1A	3.12.3.3.1A	Continuous Noise Limits - Sub-Rack Equipment Not Changed Out	N/A	EN-006		No noise producing elements of SD8
3.2.5.2.1B	6.4.3.3.1B	3.12.3.3.1B	Continuous Noise Limits - Sub-Rack Equipment Changed Out	N/A	EN-006		No noise producing elements of SD8

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.5.2.1C	6.4.3.3.1C	3.12.3.3.1C	Continuous Noise Limits - Independently Operated Equipment	N/A	EN-006		No noise producing elements of SD8
3.2.5.2.2A	6.4.3.3.2A	3.12.3.3.2	Intermittent Noise Limits - A-weighted Sound Pressure Level (SPL) Limits	N/A	EN-006		No noise producing elements of SD8
3.2.5.2.2B	6.4.3.3.2B	3.12.3.3.2	Intermittent Noise Limits - Cumulative Duration	N/A	EN-006		No noise producing elements of SD8
3.2.5.3A	6.4.3.4A	3.12.3.4A	Lighting Design - Specularity	N/A	ME-043		No lighting sources in SD8
3.2.5.3B	6.4.3.4B	3.12.3.4B	Lighting Design - Levels	N/A	ME-043		No lighting sources in SD8
3.2.5.3C	6.4.3.4C	3.12.3.4C	Lighting Design - Dimmable	N/A	ME-043		No lighting sources in SD8
3.2.5.3D	6.4.3.4D	3.12.3.4D	Lighting Design - Brightness Ratio	N/A	ME-043		No lighting sources in SD8
3.2.5.3E	6.4.3.4E	3.12.3.4E	Lighting Design - Utilize ISS PUL	N/A	ME-043		No lighting sources in SD8
3.2.5.4	6.2.5.3	3.5.1.11	Instrument Surface Temperature	✓	FD-032		
3.2.7.1.1	6.1.1.6.1	3.1.1.6.1	Connector Physical Mate	N/A	EL-007 ME-056		
3.2.7.2.7	6.2.2.8	3.2.4	Electromagnetic Compatibility (EMC)	N/A	EL-020		No electrical parts in SD8
3.2.7.2.7.1	6.2.2.8.1	3.2.4.1	Electrical Grounding	N/A	EL-021		No electrical parts in SD8
3.2.7.2.7.2	6.2.2.8.2	3.2.4.2	Electrical Bonding	N/A	EL-022		No electrical parts in SD8
3.2.7.2.7.3A	6.2.2.8.4	3.2.4.4	Electromagnetic Interference	N/A	EL-020		No electrical parts in SD8
3.2.7.2.1.2B	6.3.2.4.4	3.2.4.4	Electromagnetic Interference - Alternative Use of RS03PL	N/A	EL-020		No electrical parts in SD8
3.2.7.2.8A	6.2.2.9	3.2.4.5	Electrostatic Discharge (ESD) ≤ 4000V	N/A	EL-024		No electrical parts in SD8
3.2.7.2.8B	6.2.2.9	3.2.4.5	ESD between 4000V and 15000V - Labeling Electrical Power Consuming Equipment (EPCE)	N/A	EL-024		No electrical parts in SD8
3.2.7.2.8C	6.2.2.9	3.2.4.5	ESD Labeling	N/A	EL-024		No electrical parts in SD8
3.2.7.2.9	6.2.2.12	3.2.4.8	Corona	N/A	EL-024		No electrical parts in SD8
3.2.7.2.10	6.2.2.8.3	3.2.4.3	Cable/Wire Design and Control Requirements	N/A	EL-021		No electrical parts in SD8

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.7.2.10.1A	6.2.2.7.1A	3.2.3.1B	Wire Derating - - Instruments Connected to HRF Rack 28 V Power Outlets	N/A	EL-017		No electrical parts in SD8
3.2.7.2.10.2	6.2.2.7.2	3.2.3.2B	Exclusive Power Feeds	N/A	EL-018		No electrical parts in SD8
3.2.7.2.11	6.2.2.7.3	3.2.3.3	Loss of Power	N/A	Safety		No electrical parts in SD8
3.2.7.2.12	6.2.2.10	3.2.4.6	Alternating Current (AC) Magnetic Fields	N/A	EL-020		No electrical parts in SD8
3.2.7.2.13	6.2.2.11	3.2.4.7	Direct Current (DC) Magnetic Fields	N/A	EL-020		No electrical parts in SD8
3.2.7.3.6.1.1	6.2.3.6.1	3.3.2.1	Word/Byte Notations	N/A	CD-001		No C&DH interfaces in SD8
3.2.7.3.6.1.2	6.2.3.6.2	3.3.2.2	Data Types	N/A	CD-001		No C&DH interfaces in SD8
3.2.7.3.10.1	6.2.3.10.1	3.3.2.3B	Data Transmissions	N/A	CD-001		No C&DH interfaces in SD8
3.2.7.3.10.2A	6.2.3.10.2A	3.3.4.1A	CCSDS Data: Space to Ground	N/A	CD-001		No C&DH interfaces in SD8
3.2.7.3.10.2B	6.2.3.10.2B	3.3.4.1B	CCSDS Data: Ground to Space	N/A	CD-001		No C&DH interfaces in SD8
3.2.7.3.10.2C	6.2.3.10.2C	3.3.4.1C	CCSDS Data: Instrument to Payload (P/L) Multiplexer-Demultiplexer Module (MDM)	N/A	CD-001		No C&DH interfaces in SD8
3.2.7.3.10.2.1	6.2.3.10.2.1	3.3.4.1.1	CCSDS Data Packets	N/A	CD-001		No C&DH interfaces in SD8
3.2.7.3.10.2.1.1	6.2.3.10.2.1.1	3.3.4.1.1.1	CCSDS Primary Header	N/A	CD-001		No C&DH interfaces in SD8
3.2.7.3.10.2.1.2A	6.2.3.10.2.1.2A	3.3.4.1.1.2A	CCSDS Secondary Header - Location	N/A	CD-001		No C&DH interfaces in SD8
3.2.7.3.10.2.1.2B	6.2.3.10.2.1.2B	3.3.4.1.1.2B	CCSDS Secondary Header - format	N/A	CD-001		No C&DH interfaces in SD8
3.2.7.3.10.2.2	6.2.3.10.2.2	3.3.4.1.2	CCSDS Data Field	N/A	CD-003		No C&DH interfaces in SD8
3.2.7.5.1.2A	6.2.5.1.2A	3.5.1.2A	Internal Thermal Control System (ITCS) Fluid Use	N/A	FD-002		No thermal control interfaces in the SD8
3.2.7.5.1.2B	6.2.5.1.2B	3.5.1.2B	Rack dependent Instrument Charging	N/A	FD-002		No thermal control interfaces in the SD8
3.2.7.5.1.4	6.2.5.1.4	3.5.1.7A	Coolant Maximum Design Pressure	N/A	ST-010		No thermal control interfaces in the SD8
3.2.7.5.1.5	6.2.5.1.5	3.5.1.16	Payload Coolant Quantity	N/A	FD-012		No thermal control interfaces in the SD8
3.2.7.5.1.6	6.2.5.1.6	3.5.1.8	Fail Safe Design	N/A	FD-031		No thermal control interfaces in the SD8
3.2.7.5.1.7	6.2.5.1.7	3.5.1.9	Leakage	N/A	FD-006		No thermal control interfaces in the SD8

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.7.5.1.8	6.2.5.1.8	3.5.1.10	Quick-Disconnect Air Inclusion	N/A	FD-007		No thermal control interfaces in the SD8
3.2.7.6.2.1A	6.2.6.2.1A	3.6.1.2A	Vacuum Exhaust System (VES) Input Pressure Limit - Rack-to-Station Interface	N/A	FD-015		No Vacuum Exhaust System (VES) interface in SD8
3.2.7.6.2.1B	6.2.6.2.1B	3.6.1.2B	VES Input Pressure Limit - Maximum Design Pressure	N/A	FD-015		No VES interface in SD8
3.2.7.6.2.1C	6.2.6.2.1C	3.6.1.2C	VES Input Pressure Limit - Two Failure Tolerance	N/A	FD-015		No VES interface in SD8
3.2.7.6.2.2	6.2.6.2.2	3.6.1.3	VES Input Temperature Limit	N/A	FD-016		No VES interface in SD8
3.2.7.6.2.3	6.2.6.2.3	3.6.1.4	VES Input Dewpoint Limit	N/A	FD-017		No VES interface in SD8
3.2.7.6.2.4A	6.2.6.2.4A	3.6.1.5A	VES Acceptable Exhaust Gases - Compatibility	N/A	FD-018		No VES interface in SD8
3.2.7.6.2.4B	6.2.6.2.4B	3.6.1.5B	VES Acceptable Exhaust Gases - Non-reactivity	N/A	FD-018		No VES interface in SD8
3.2.7.6.2.4C	6.2.6.2.4C	3.6.1.5C	VES Acceptable Exhaust Gases - Gas Removal	N/A	FD-018		No VES interface in SD8
3.2.7.6.2.4D	6.2.6.2.4D	3.6.1.5D	VES Acceptable Exhaust Gases - Particulate Removal	N/A	FD-018		No VES interface in SD8
3.2.7.6.2.5	6.2.6.2.5	3.6.1.5.2	VES External Contamination Control	N/A	FD-019		No VES interface in SD8
3.2.7.6.2.6A	6.2.6.2.6A	3.6.1.5.3A	VES Incompatible Gases - Containment	N/A	FD-020		No VES interface in SD8
3.2.7.6.2.6B	6.2.6.2.6B	3.6.1.5.3B	VES Incompatible Gases - Containment Hardware	N/A	FD-020		No VES interface in SD8
3.2.7.6.3.1A	6.2.6.3.1A	3.6.2.2A	Vacuum Resource System (VRS) Input Pressure Limit - Vented VRS Gases	N/A	FD-022		No VES interface in SD8
3.2.7.6.3.1B	6.2.6.3.1B	3.6.2.2B	VRS Input Pressure Limit - Maximum Design Pressure	N/A	FD-022		No VES interface in SD8
3.2.7.6.3.1C	6.2.6.3.1C	3.6.2.2C	VRS Input Pressure Limit - Two Failure Tolerance	N/A	FD-022		No VES interface in SD8
3.2.7.6.3.2	6.2.6.3.2	3.6.2.3	VRS Through-Put Limit	N/A	FD-023		No VES interface in SD8
3.2.7.7.1.2	6.2.7.1.2	3.7.1.1	Nitrogen Interface Control	N/A	FD-024		No Nitrogen rack interface in SD8

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.2.7.7.1.3	6.2.7.1.3	3.7.1.2	Nitrogen Interface MDP	N/A	FD-025		No Nitrogen rack interface in SD8
3.2.7.7.1.4	6.2.7.1.4	3.7.1.3	Nitrogen Interface Temperature	N/A	FD-026		No Nitrogen rack interface in SD8
3.2.7.7.1.5	6.2.7.1.5	3.7.1.4	Nitrogen Leakage	N/A	FD-027		No Nitrogen rack interface in SD8
3.2.7.7.2	6.2.7.2	3.7.5	Pressurized Gas Systems	N/A	FD-028		
3.2.7.7.3	6.2.7.3	3.7.6	Manual Valves	N/A	ME-048		
3.2.7.8.1.1	6.2.8.1.1	3.8.1.1, 3.1.1.6.1	ISS Potable Water Interface Connection	N/A	ME-056		No potable water interface in SD8
3.2.7.8.1.2	6.2.8.1.2	3.8.1.2	Potable Water Interface Pressure	N/A	FD-029		No potable water interface in SD8
3.2.7.8.1.3A	6.2.8.1.3A	3.8.1.3A	Potable Water Use - Not Returned to Cabin Air as Humidity	N/A	FD-030		No potable water interface in SD8
3.2.7.8.1.3B	6.2.8.1.3B	3.8.1.3B	Potable Water Use - Total Use	N/A	FD-030		No potable water interface in SD8
3.2.7.8.2	6.2.8.2	3.8.2	Fluid System Servicer	N/A	ME-049		No Fluid System Servicer (FSS) interface in SD8
3.2.7.9.1	6.2.10.1	3.10.1	Fire Prevention	N/A	Safety		No fire sources in SD8
3.2.7.9.2.1.1		3.10.2.2.1	Parameter Monitoring Use	N/A	ME-054		No fire sources in SD8
3.2.7.9.2.1.2A		3.10.2.2.2.1A	Parameter Monitoring in Subrack	N/A	CD-020		No fire sources in SD8
3.2.7.9.2.1.2B		3.10.2.2.2.1B	Parameter Monitoring in Subrack	N/A	CD-020		No fire sources in SD8
3.2.7.9.3.1A	6.2.10.2A	3.10.3.1A	PFE - Small Access Port	N/A	ME-055		No fire sources in SD8
3.2.7.9.3.1B	6.2.10.2B	3.10.3.1B	PFE - Large Access Port	N/A	ME-055		No fire sources in SD8
3.2.7.9.3.2	6.2.10.3	3.10.3.2	Fire Suppression Access Port Accessibility	N/A	ME-055		No fire sources in SD8
3.2.7.9.3.3	6.2.10.4	3.10.3.3	Fire Suppressant Distribution	N/A	ME-055		No fire sources in SD8
3.2.7.9.4	6.2.10.5	3.10.4A	Labeling	N/A	ME-055		No fire sources in SD8
3.3.1.1.1	6.2.11.1	3.11.1	Materials and Parts use and Selection	✓	Safety		
3.3.1.1.2	6.2.11.2	3.11.1.1	Commercial Parts	✓	Safety		
3.3.1.1.3A	6.2.11.3A	3.11.2A	Fluids - General Requirements	N/A	MP-001		No rack fluid system interface with SD8
3.3.1.1.3B	6.2.11.3B	3.11.2B	Fluids - Cleanliness Levels	N/A	MP-001		No rack fluid system interface with SD8

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.1.1.3C	6.2.11.3C	3.11.2C	Fluids - Instrument Internal Materials	N/A	MP-001		No rack fluid system interface with SD8
3.3.1.1.4	6.2.11.4	3.11.3	Cleanliness	✓	MP-002		
3.3.1.1.5	6.2.11.5	3.11.4	Fungus Resistant Material	✓	MP-003		
3.3.1.2	6.4.9.2	3.12.9.2	Sharp Edges and Corner Protection	✓	Safety		
3.3.1.3	6.4.9.3	3.12.9.3	Holes	✓	ME-007		
3.3.1.4	6.4.9.4	3.12.9.4	Latches	✓	ME-027		
3.3.1.5	6.4.9.5	3.12.9.5	Screws and Bolts	✓	ME-026		
3.3.1.6	6.4.9.6	3.12.9.6	Securing Pins	✓	ME-053		
3.3.1.7	6.4.9.7	3.12.9.7	Levers, Cranks, Hooks, and Controls	✓	ME-053		
3.3.1.8	6.4.9.8	3.12.9.8	Burrs	✓	ME-053		
3.3.1.9A	6.4.9.9A	3.12.9.9A	Locking Wires	✓	ST-009		
3.3.1.9B	6.4.9.9B	3.12.9.9B	Locking Wires	✓	ST-009		
3.3.2.1	6.4.7	3.12.7	Equipment Identification	✓	ME-057		
3.3.5.1	6.2.2.14	3.2.5.1.1	Electrical Safety	N/A	Safety		No electrical parts in SD8
3.3.5.1.1	6.2.2.14.1.2	3.2.5.1.2	Safety-Critical Circuits Redundancy	N/A	Safety		No electrical parts in SD8
3.3.5.1.2	6.2.2.13	3.2.4.10	EMI Susceptibility for Safety-Critical Circuits	N/A	EL-019		No electrical parts in SD8
3.3.5.1.3A	6.2.2.14.1.1	3.2.5.1.1	Mating/Demating of Powered Connectors	N/A	Safety		No electrical parts in SD8
3.3.5.1.4A	6.2.2.15A	3.2.5.3A	Power Switches/Controls -Open Supply Circuit Conductors	N/A	EL-029		No electrical parts in SD8
3.3.5.1.4B	6.2.2.15B	3.2.5.3B	Power Switches/Controls -Power-off Markings/Indications	N/A	EL-029		No electrical parts in SD8
3.3.5.1.4C	6.2.2.15C	3.2.5.3C	Power Switches/Controls -Supply Circuit not Completely Disconnected	N/A	EL-029		No electrical parts in SD8
3.3.5.1.5A	6.2.2.16A	3.2.5.4A	Ground Fault Circuit Interrupter (GFCI)-Output Voltages > 30 V rms	N/A	EL-030		No electrical parts in SD8

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.5.1.5B	6.2.2.16B	3.2.5.4B	GFCI - DC Detection Independent of Safety Wire	N/A	EL-030		No electrical parts in SD8
3.3.5.1.5C	6.2.2.16C	3.2.5.4C	GFCI - AC Detection Dependent on Safety Wire	N/A	EL-030		No electrical parts in SD8
3.3.5.1.5D	6.2.2.16D	3.2.5.4D	GFCI - Equipment Generating Internal Voltages > 30 V rms	N/A	EL-030		No electrical parts in SD8
3.3.5.1.5E	6.2.2.16E	3.2.5.4E	GFCI - Trip Current	N/A	EL-030		No electrical parts in SD8
3.3.5.1.5F	6.2.2.16F	3.2.5.4F	GFCI - Power Removal Time	N/A	EL-030		No electrical parts in SD8
3.3.5.1.5G	6.2.2.16G	3.2.5.4G	GFCI - On-Orbit Testing	N/A	EL-030		No electrical parts in SD8
3.3.5.1.6A	6.2.2.17A	3.2.5.5A	Portable Equipment/Power Cords - Non-battery Powered Portable Equipment	N/A	EL-031		No electrical parts in SD8
3.3.5.1.6B	6.2.2.17B	3.2.5.5B	Portable Equipment/Power Cords - Fault Currents	N/A	EL-031		No electrical parts in SD8
3.3.6.1	6.4.3.1.1	3.12.3.1.1	Closures or Covers Design Requirements	✓	ME-007		
3.3.6.3	6.4.2.3	3.12.2.3	Full Size Range Accommodation	✓	ME-006		
3.3.6.4A	6.4.1.1A	3.12.1A1	Grip Strength	✓	ST-005		
3.3.6.4B	6.4.1.1B	3.12.1A2	Linear Forces	✓	ST-005		
3.3.6.4C	6.4.1.1C	3.12.1A3	Torque	✓	ST-005		
3.3.6.5	6.4.1.2	3.12.1B	Maintenance Operations	✓	ST-005		
3.3.6.6	6.4.2.1	3.12.2.1	Adequate Clearance	✓	ME-021		
3.3.6.7A	6.4.2.2A	3.12.2.2A	Accessibility - Geometric Arrangement	✓	ME-021		
3.3.6.7B	6.4.2.2B	3.12.2.2B	Accessibility - Access Openings for Fingers	✓	ME-021		
3.3.6.8	6.4.3.1.3	3.12.3.1.5	One-Handed Operation	N/A	ME-009		No cleaning supplies for SD8
3.3.6.9	6.4.3.2.1	3.12.3.2.1	Continuous/Incidental Contact - High Temperature	N/A	Safety		No sources of heat within SD8
3.3.6.10	6.4.3.2.2	3.12.3.2.2	Continuous/Incidental Contact - Low Temperature	N/A	Safety		No sources of cooling within SD8

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.6.11	6.4.4.2.1	3.12.4.2.1	Equipment Mounting	✓	ME-011		
3.3.6.12A	6.4.4.2.2A	3.12.4.2.2	Drawers and Hinged Panels - for routine checkout of P/L ORUs	✓	ME-012		
3.3.6.12B	6.4.4.2.2B	3.12.4.2.2	Drawers and Hinged Panels - remain open without manual support	✓	ME-012		
3.3.6.13	6.4.4.2.3	3.12.4.2.5	Alignment	N/A	ME-013		No blind mate connectors
3.3.6.14	6.4.4.2.4	3.12.4.2.6	Slide-Out Stops	✓	ME-002		
3.3.6.15	6.4.4.2.5	3.12.4.2.7	Push-Pull Force	✓	ST-006		
3.3.6.16A	6.4.4.2.6.1A	3.12.4.2.8.1A	Covers - sliding or hinged cap or door	✓	ME-007		No covers in design
3.3.6.16B	6.4.4.2.6.1B	3.12.4.2.8.1B	Covers - quick-opening cover plate	✓	ME-007		No covers in design
3.3.6.17	6.4.4.2.6.2	3.12.4.2.8.2	Self-Supporting Covers	✓	ME-007		No covers in design
3.3.6.18	6.4.4.3.2A	3.12.4.3.2A1	Accessibility	✓	ME-018		
3.3.6.19A	6.4.4.3.3A	3.12.4.3.3A	Ease of Disconnect - Nominal Operations	N/A	ME-017		No electrical connections in design
3.3.6.19B	6.4.4.3.3B	3.12.4.3.3B	Ease of Disconnect - ORU Replacement Operations	N/A	ME-017		No electrical connections in design
3.3.6.20	6.4.4.3.4	3.12.4.3.4	Indication of Pressure/Flow	N/A	ME-050		SD8 has quick-disconnects
3.3.6.21	6.4.4.3.5	3.12.4.3.5	Self Locking	N/A	ME-017		No electrical connections in design
3.3.6.22A	6.4.4.3.6A	3.12.4.3.6A	Connector Arrangement - Space between Connectors and Adjacent Obstructions	N/A	ME-018		
3.3.6.22B	6.4.4.3.6B	3.12.4.3.6B	Connector Arrangement - Space between Connectors in a Row	N/A	ME-018		
3.3.6.23	6.4.4.3.7	3.12.4.3.7	Arc Containment	N/A	EL-026		No electrical connections in design
3.3.6.24	6.4.4.3.8	3.12.4.3.8	Connector Protection	✓	ME-019		
3.3.6.25	6.4.4.3.9	3.12.4.3.9	Connector Shape	✓	ME-019		
3.3.6.26	6.4.4.3.10	3.12.4.3.10	Fluid and Gas Line Connectors	N/A	FD-001		
3.3.6.27	6.4.4.3.11A	3.12.4.3.11A	Alignment Marks or Guide Pins	N/A	ME-020		Quick Disconnects (QDs) need no alignment/orientation marks

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.6.28A	6.4.4.3.12A	3.12.4.3.12A	Coding - Unique to Connection	✓	ME-020		
3.3.6.28B	6.4.4.3.12B	3.12.4.3.12B	Coding - Visible	✓	ME-020		
3.3.6.29	6.4.4.3.13	3.12.4.3.13	Pin Identification	N/A	EL-007		No electrical connections in design
3.3.6.30	6.4.4.3.14	3.12.4.3.14	Orientation	N/A	ME-020		QDs need no alignment/orientation marks
3.3.6.31A	6.4.4.3.15A	3.12.4.3.15A	Hose/Cable Restraints - Loose Ends	N/A	ME-022		No hoses, cables, or loose ends with SD8
3.3.6.31B	6.4.4.3.15B	3.12.4.3.15B	Hose/Cable Restraints - Clamps	N/A	ME-022		No hoses, cables, or loose ends with SD8
3.3.6.31D	6.4.4.3.15D	3.12.4.3.15D	Hose/Cable Restraints - Loose Cables	N/A	ME-022		No hoses, cables, or loose ends with SD8
3.3.6.32	6.4.4.4.1	3.12.4.4.1	Non-Threaded Fasteners Status Indication	✓	ME-023		
3.3.6.33	6.4.4.4.2	3.12.4.4.2	Mounting Bolt/Fastener Spacing	✓	ME-024		
3.3.6.34	6.4.4.4.3	3.12.4.4.4A	Multiple Fasteners	✓	ME-025		
3.3.6.35	6.4.4.4.4	3.12.4.4.5	Captive Fasteners	✓	ME-026		
3.3.6.36A	6.4.4.4.5A	3.12.4.4.6A	Quick Release Fasteners - One turn max	✓	ME-026		
3.3.6.36B	6.4.4.4.5B	3.12.4.4.6B	Quick Release Fasteners - Positive Locking	✓	ME-026		
3.3.6.37	6.4.4.4.6	3.12.4.4.7	Threaded Fasteners	✓	ME-026		
3.3.6.38A	6.4.4.4.7A	3.12.4.4.8A	Over Center Latches - Nonself-latching	✓	ME-027		
3.3.6.38B	6.4.4.4.7B	3.12.4.4.8B	Over Center Latches - Latch Lock	✓	ME-027		
3.3.6.38C	6.4.4.4.7C	3.12.4.4.8C	Over Center Latches - Latch Handles	✓	ME-027		
3.3.6.39	6.4.4.4.8	3.12.4.4.9	Winghead Fasteners	✓	ME-026		
3.3.6.40A	6.4.4.4.9A	3.12.4.4.11A	Fastener Head Type - On-Orbit Crew Actuation	✓	ME-028		
3.3.6.40B	6.4.4.4.9B	3.12.4.4.11B	Fastener Head Type - Smooth Surface	✓	ME-028		
3.3.6.40C	6.4.4.4.9C	3.12.4.4.11C	Fastener Head Type - Slotted Fasteners	✓	ME-028		
3.3.6.41	6.4.4.4.10	3.12.4.4.12	One-Handed Actuation	✓	ME-029		
3.3.6.43	6.4.4.4.12	3.12.4.4.14	Access Holes	N/A	ME-024		
3.3.6.44	6.4.5.1	3.12.5.1	Controls Spacing Design Requirements	✓	ME-030		

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.6.45.1A	6.4.5.2.1A	3.12.5.2.1A	Protective Methods - Location/Orientation	N/A	ME-031		No activating controls in SD8
3.3.6.45.1B	6.4.5.2.1B	3.12.5.2.1B	Protective Methods - Recess/Shielding	N/A	ME-031		No activating controls in SD8
3.3.6.45.1C	6.4.5.2.1C	3.12.5.2.1C	Protective Methods - Cover/Guard, No Safety or Lock Wire	N/A	ME-031		No activating controls in SD8
3.3.6.45.1D	6.4.5.2.1D	3.12.5.2.1D	Protective Methods - Obscuration by Cover Guards	N/A	ME-031		No activating controls in SD8
3.3.6.45.1E	6.4.5.2.1E	3.12.5.2.1E	Protective Methods - Interlocks	N/A	ME-031		No activating controls in SD8
3.3.6.45.1F	6.4.5.2.1F	3.12.5.2.1F	Protective Methods - Resistance	N/A	ME-031		No activating controls in SD8
3.3.6.45.1G	6.4.5.2.1G	3.12.5.2.1G	Protective Methods - Position Locks for Sequencing	N/A	ME-031		No activating controls in SD8
3.3.6.45.2	6.4.5.2.2	3.12.5.2.2	Noninterference	N/A	ME-030		No activating controls in SD8
3.3.6.45.3	6.4.5.2.3	3.12.5.2.3	Dead-Man Controls	N/A	Safety		No activating controls in SD8
3.3.6.45.4	6.4.5.2.4	3.12.5.2.4	Barrier Guards	N/A	ME-030		No activating controls in SD8
3.3.6.45.5	6.4.5.2.5	3.12.5.2.5	Recessed Switch Protection	N/A	ME-031		No activating controls in SD8
3.3.6.46	6.4.5.2.7	3.12.5.2.7	Position Indication	N/A	ME-032		No activating controls in SD8
3.3.6.47	6.4.5.2.8	3.12.5.2.8	Hidden Controls	N/A	ME-031		No activating controls in SD8
3.3.6.48	6.4.5.2.9	3.12.5.2.9	Hand Controllers	N/A	ME-031		
3.3.6.49A	6.4.5.3A	3.12.5.3A	Valve Controls - Low-Torque Valves	N/A	ME-033		
3.3.6.49B	6.4.5.3B	3.12.5.3B	Valve Controls - Intermediate-Torque Valves	N/A	ME-033		
3.3.6.49C	6.4.5.3C	3.12.5.3C	Valve Controls - High-Torque Valves	N/A	ME-033		
3.3.6.49D	6.4.5.3D	3.12.5.3D	Valve Controls - Handle Dimensions	N/A	ME-033		
3.3.6.49E	6.4.5.3E	3.12.5.3E	Valve Controls - Rotary Valve Controls	N/A	ME-033		No rotary valves in SD8 design
3.3.6.50	6.4.5.4	3.12.5.4	Toggle Switches	N/A	ME-034		No activating controls in SD8
3.3.6.51	6.4.6	3.12.6	Restraints and Mobility Aids	✓	ME-035		
3.3.6.51.1A	6.4.6.1A	3.12.6.1A	Stowage Drawer Contents - Restraints	✓	ME-036		

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.6.51.1B	6.4.6.1B	3.12.6.1B	Stowage Drawer Contents - Restraints	✓	ME-036		
3.3.6.51.1C	6.4.6.1C	3.12.6.1C	Stowage Drawer Contents - Restraints	✓	ME-036		
3.3.6.51.2A	6.4.6.2A	3.12.6.2A	Stowage and Equipment Drawers/Trays	✓	ME-027		
3.3.6.51.2B	6.4.6.2B	3.12.6.2B	Stowage and Equipment Drawers/Trays	✓	ME-027		
3.3.6.51.3	6.4.6.3	3.12.6.3	Captive Parts	✓	ME-036		
3.3.6.51.4.1	6.4.6.4.1	3.12.6.4.1	Handles and Restraints	✓	ME-037		
3.3.6.51.4.2	6.4.6.4.2	3.12.6.4.3	Handle Location/Front Access	✓	ME-037		
3.3.6.51.4.3	6.4.6.4.3	3.12.6.4.4	Handle Dimensions	✓	ME-037		
3.3.6.51.4.4A	6.4.6.4.4A	3.12.6.4.5A	Non-Fixed Handles Design Requirements - Stop Position	✓	ME-037		
3.3.6.51.4.4B	6.4.6.4.4B	3.12.6.4.5B	Non-Fixed Handles Design Requirements - One Hand Use	✓	ME-037		
3.3.6.51.4.4C	6.4.6.4.4C	3.12.6.4.5C	Non-Fixed Handles Design Requirements - Locked/Unlocked Indication	✓	ME-037		
3.3.6.52B	6.4.9.1B	3.12.9.1B	Electrical Hazards - Exposure hazard exceeds threshold for shock	N/A	EL-041		No electrical components in SD8 design
3.3.6.52C	6.4.9.1C	3.12.9.1C	Electrical Hazards - Exposure hazard exceeds threshold for shock and threshold of let-go profile	N/A	EL-041		No electrical components in SD8 design
3.3.6.52D	6.4.9.1D	3.12.9.1D	Electrical Hazards -Two dependent controls provided	N/A	EL-041		No electrical components in SD8 design
3.3.6.52E	6.4.9.1E	3.12.9.1E	Electrical Hazards -Three independent hazard controls	N/A	EL-041		No electrical components in SD8 design
3.3.6.52.1A	6.4.9.1.1A	3.12.9.1.1	Mismatched - Reversed Connection	N/A	ME-019		No electrical components in SD8 design
3.3.6.52.1B	6.4.9.1.1B	3.12.9.1.1	Mismatched - Blind Connections	N/A	ME-019		No electrical components in SD8 design
3.3.6.52.1C	6.4.9.1.1C	3.12.9.1.1	Mismatched - Mismatching	N/A	ME-019		No electrical components in SD8 design
3.3.6.52.1D	6.4.9.1.1D	3.12.9.1.1	Mismatched -Minimizing Equipment Risk	N/A	ME-019		No electrical components in SD8 design
3.3.6.52.2.1	6.4.9.1.2.1	3.12.9.1.4.1	Device Accessibility	N/A	EL-013		No electrical components in SD8 design

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX B

### ISS PRESSURIZED PAYLOAD INTERFACE REQUIREMENTS DOCUMENT VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	SSP 57000 Section	Requirement	Applicable	GPVP VDS #	Responsibility	Comments
3.3.6.52.2.2	6.4.9.1.2.2	3.12.9.1.4.2	Extractor-Type Fuse Holder	N/A	EL-013		No electrical components in SD8 design
3.3.6.52.2.3	6.4.9.1.2.3	3.12.9.1.4.3	Overload Protection Location	N/A	EL-013		No electrical components in SD8 design
3.3.6.52.2.4	6.4.9.1.2.4	3.12.9.1.4.4	Overload Protection Identification	N/A	EL-013		No electrical components in SD8 design
3.3.6.52.2.5	6.4.9.1.2.5	3.12.9.1.4.5	Automatic Restart Protection	N/A	EL-013		No electrical components in SD8 design
3.3.6.53A	6.4.9.10A	3.12.9.10A	Audio Displays - False Alarms	N/A	ME-044		No audio components in SD8 design
3.3.6.53B	6.4.9.10C	3.12.9.10C	Audio Displays - Operability Testing	N/A	ME-044		No audio components in SD8 design
3.3.6.53.C	6.4.9.10D	3.12.9.10D	Audio Displays - Manual Disable	N/A	ME-044		No audio components in SD8 design
3.3.6.54	6.4.9.11	3.12.9.12	Egress	✓	Safety		
3.3.8.1.1A	6.2.1.1.4A	3.1.1.3B	Structural Design Requirements - Positive Safety Margins for On-orbit Loads	✓	ST-001		
3.3.8.1.1B	6.2.1.1.4B	3.1.1.3D	Structural Design Requirements - Crew Induced Load Requirements	✓	ST-002		
3.3.8.1.2	6.2.1.1.1	3.1.1.5A	Safety Critical Structures Requirements	✓	ST-001 ST-002 ST-003 ST-004 ST-008 ST-009 ST-010		
3.3.8.1.4A	6.2.1.1.3A	3.1.1.3E	Launch and Landing Loads - Random Vibration	✓	ST-001		
3.3.8.1.4B	6.2.1.1.3B	3.1.1.3F	Launch and Landing Loads - Load Factors	✓	ST-001		

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX C

### FUNCTIONAL PERFORMANCE VERIFICATION MATRIX

APPENDIX C

FUNCTIONAL PERFORMANCE VERIFICATION MATRIX

HRD Section	LS-71000 Section	Requirement	Applicable	Method	Procedure	Verification Document	Comments
3.2.1.1g	N/A	Accessing additional tanks	N/A	I			
3.2.1.1j	N/A	Volume capability	✓	I			Inspect Drawings
3.2.2.1		Mass Properties	✓	T			Weigh SD8
3.2.2.1.1	6.2.1.2.4	HRF Rack Mounted SIR Drawer Center of Gravity Constraints	✓	T			S683-34510 A, CG measurement
3.2.2.2.1		Stowed Envelope	N/A	N/A			
3.2.2.2.2		Deployed Envelope Dimensions	✓	I			Inspect Drawings
3.2.3.1		Failure Propagation	✓	IA			
3.2.5.1.5B(2)	6.3.1.2A	Pressure Rate of Change - Carrier (Orbiter)	N/A	N/A			Not transported in orbiter
3.2.6.1	6.3.1.3	Launch and Landing	N/A	N/A			Not transported to/from orbiter locker
3.2.7.1.2.1	6.2.1.2.1	Dimensional Tolerances	✓	I			S683-34510 A, Inspect drawings
3.2.7.1.2.2	6.2.1.2.2	SIR Drawer Structural/ Mechanical Interfaces	✓	I			LS-60077, Inspect drawings
3.2.7.2.1.1	6.2.2.1.1	SIR Drawer Power Connectors	N/A	N/A			No power required
3.2.7.2.1.2	6.2.2.1.2	Rack connector panel J1 Power Connector	N/A	N/A			No power required
3.2.7.2.2.1	6.2.2.2.1	Steady-State Operating Voltage	N/A	N/A			No power required
3.2.7.2.2.2	6.2.2.2.2	Transient Operating Voltage Envelope	N/A	N/A			No power required
3.2.7.2.2.3A	6.2.2.2.3A	Ripple Voltage/Noise Characteristics - Peak to Peak	N/A	N/A			No power required
3.2.7.2.2.3B	6.2.2.2.3B	Ripple Voltage/Noise Characteristics - Spectrum	N/A	N/A			No power required
3.2.7.2.3	6.2.2.3	Maximum Current Limit	N/A	N/A			No power required
3.2.7.2.4	6.2.2.4	Reverse Current	N/A	N/A			No power required

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX C

### FUNCTIONAL PERFORMANCE VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	Requirement	Applicable	Method	Procedure	Verification Document	Comments
3.2.7.2.5	6.2.2.5	Reverse Energy	N/A	N/A			No power required
3.2.7.2.6	6.2.2.6	Capacitive Loads	N/A	N/A			No power required
3.2.7.2.10.1B	6.2.2.7.1B	Wire Derating - Basis	N/A	N/A			No power required
3.2.7.3.1.1	6.2.3.1.1	SIR Drawer Data Connectors	N/A	N/A			No data interface in design
3.2.7.3.1.2	6.2.3.1.2	HRF Rack connector Panel J2 Connector	N/A	N/A			No data interface in design
3.2.7.3.2	6.2.3.2	HRF Ethernet Interfaces	N/A	N/A			No data interface in design
3.2.7.3.3	6.2.3.3	HRF TIA/EIA-422 Interfaces	N/A	N/A			No data interface in design
3.2.7.3.4	6.2.3.4	HRF Bi-Directional Discretes Interfaces	N/A	N/A			No data interface in design
3.2.7.3.5	6.2.3.5	HRF Analog Interfaces	N/A	N/A			No data interface in design
3.2.7.3.7A	6.2.3.7A	HRF Program Software Requirements - File Pathnames	N/A	N/A			No data interface in design
3.2.7.3.7B	6.2.3.7B	HRF Program Software Requirements - Environment	N/A	N/A			No data interface in design
3.2.7.3.7C	6.2.3.7C	HRF Program Software Requirements - Consistent Results	N/A	N/A			No data interface in design
3.2.7.3.7D	6.2.3.7D	HRF Program Software Requirements - DGCS	N/A	N/A			No data interface in design
3.2.7.3.7E	6.2.3.7E	HRF Program Software Requirements - Real-time data Format	N/A	N/A			No data interface in design
3.2.7.3.8	6.2.3.8	ISS C&DH services through HRF Common Software Interface	N/A	N/A			No data interface in design
3.2.7.3.9	6.2.3.9	ISS C&DH Services through the HRF RIC	N/A	N/A			No data interface in design
3.2.7.4.1.1	6.2.4.1.1	Sir Drawer Video Interface	N/A	N/A			No video interface in design
3.2.7.4.1.2	6.2.4.1.2	Rack Connector Panel Interface	N/A	N/A			No video interface in design
3.2.7.3.7A	6.2.3.7A	HRF Software Requirements - File	N/A	N/A			No software requirements for SD8

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX C

### FUNCTIONAL PERFORMANCE VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	Requirement	Applicable	Method	Procedure	Verification Document	Comments
		Pathnames					
3.2.7.3.7B	6.2.3.7B	HRF Software Requirements - Execution environment	N/A	N/A			No software requirements for SD8
3.2.7.3.7C	6.2.3.7C	HRF Software Requirements - Consistent Results	N/A	N/A			No software requirements for SD8
3.2.7.3.7D	6.2.3.7D	HRF Software Requirements - Display and Graphics Commonality Standards (DGCS)	N/A	N/A			No software requirements for SD8
3.2.7.3.7E	6.2.3.7E	HRF Software Requirements - Real-time Data Format	N/A	N/A			No software requirements for SD8
3.2.7.3.8	6.2.3.8	ISS Command and Data Handling Services Through HRF Common Software Interface	N/A	N/A			No software requirements for SD8
3.2.7.4.2	6.2.4.2	HRF Rack Video Interface Characteristics	N/A	N/A			No video interface in design
3.2.7.5.1.1	6.2.5.1.1	HRF Rack MTL Interface Connectors	N/A	N/A			No thermal interfaces in design
3.2.7.5.1.3	6.2.5.1.3	MTL Interface Maximum Heat Load	N/A	N/A			No thermal interfaces in design
3.2.7.5.2.1	6.2.5.2.1	Heat Exchanger interface Maximum Heat Load	N/A	N/A			No thermal interfaces in design
3.2.7.5.2.2A	6.2.5.2.2A	Fan Hardware	N/A	N/A			No thermal interfaces in design
3.2.7.5.2.2B	6.2.5.2.2B	Fan Location	N/A	N/A			No thermal interfaces in design
3.2.7.5.2.2C	6.2.5.2.2C	Vibration Isolation	N/A	N/A			No thermal interfaces in design
3.2.7.5.2.2D	6.2.5.2.2D	Fan Mounting	N/A	N/A			No thermal interfaces in design
3.2.7.5.2.2E	6.2.5.2.2E	Fan Operating Voltage	N/A	N/A			No thermal interfaces in design
3.2.7.5.2.2F	6.2.5.2.2F	Fan Speed Controller	N/A	N/A			No thermal interfaces in design
3.2.7.6.1	6.2.6.1	HRF Vacuum Interface Connectors	N/A	N/A			No vacuum interfaces in design
3.2.7.7.1.1	6.2.7.1.1	HRF Rack Nitrogen Interface Connectors	N/A	N/A			No vacuum interfaces in design
3.3.6.2.1A	6.4.3.5.1	Interior Color - Rack Mounted	✓	I			HRF ED-001A, Inspect drawings

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX C

### FUNCTIONAL PERFORMANCE VERIFICATION MATRIX (Cont'd)

HRD Section	LS-71000 Section	Requirement	Applicable	Method	Procedure	Verification Document	Comments
		Equipment - Front Panel Color					
3.3.6.2.1B	6.4.3.5.1	Interior Color - Rack Mounted Equipment - Front Panel Finish	N/A	N/A			
3.3.6.2.1C	6.4.3.5.1	Interior Color - Rack Mounted Equipment - Latches	✓	I			HRF ED-001A, Inspect drawings
3.3.6.2.2A	6.4.3.5.2A	Interior Color - Stowed/Deployable Equipment - COTS	✓	I			HRF ED-001A, Inspect drawings
3.3.6.2.2B	6.4.3.5.2B	Interior Color - Stowed/Deployable Equipment - Repackaged	✓	I			HRF ED-001A, Inspect drawings
3.3.6.2.3	6.4.3.5.3	Soft Goods - Color	N/A	N/A			No soft goods
3.3.8.1.3	6.2.1.1.2	First Modal Frequency	✓	A			Derived from SSP 57000, Section 3.1.1.4D, Reference Stress Analysis
3.3.8.2.1	6.2.2.14	Batteries	N/A	N/A			No batteries in design

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

## APPENDIX D

### ACCEPTANCE AND QUALIFICATION TEST APPLICABILITY MATRICES

APPENDIX D

TABLE D-1. ACCEPTANCE AND QUALIFICATION TEST APPLICABILITY MATRIX

HRD Section	HRD Verification Section	LS-71000 Section	Requirement	Applicable	Comments
3.4.1	4.3.1.1, 4.3.1.2	5.4.1.1.6.1 and 5.4.1.1.6.2	Nominal Operation Under Thermal Environment	✓	
3.4.2	4.3.2.1, 4.3.2.2	5.4.1.1.3.2-2 and 5.4.1.1.3.2-3	Workmanship Vibration	✓	
3.4.3	4.3.3		Functional Performance	✓	
3.4.4	4.3.4	5.4.1.1.10	EEE Parts Control, Selection, and Burn-in	N/A	No electrical parts
3.4.5	4.3.5	5.4.1.1.8	Flammability	✓	
3.4.6	4.3.6	5.4.1.1.9	Offgassing	✓	
3.4.7	4.3.7	5.4.1.1.5	Bench Handling	✓	
3.4.8	4.3.8	5.4.1.1.1	Payload Mass	✓	
3.4.9	4.3.9	5.4.1.2.1	EMI/EMC	N/A	No electrical parts
3.4.10	4.3.10	5.4.1.1.7	Acoustic Noise	N/A	No moving parts
3.4.11	4.3.11		Pre-Delivery Acceptance	✓	

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

TABLE D-2. NON-CRITICAL HARDWARE QUALIFICATION TEST REQUIREMENTS

Type Test \ Component	Example Electronic Equipment	Example Mechanical Equipment	Example Battery	SD8	Part Number	Part Number	Part Number	Part Number
Thermal Cycling 7.5 Cycles	✓	✓	✓	✓				
Qualification for Acceptance Vibration	✓	✓	✓	✓				
Flammability	✓	✓	✓	✓				
Offgassing	✓	✓	✓	✓				
Bench Handling	✓	✓	✓	✓				
Payload Mass Control Plan	✓	✓	✓	✓				
EMI/EMC Control Plan	✓		✓	N/A				
Acoustic Noise Control Plan	✓	✓		N/A				
EEE Parts Screening	✓	✓	✓	N/A				
EEE Parts Control	✓	✓	✓	N/A				

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

TABLE D-3. NON-CRITICAL HARDWARE ACCEPTANCE TEST REQUIREMENTS

Type Test \ Component	Example Electronic Equipment	Example Mechanical Equipment	Example Battery	SD8	Part Number	Part Number	Part Number	Part Number
Thermal Cycling 1½ Cycles	✓	✓	✓	✓				
Acceptance Vibration	✓	✓	✓	✓				
Functional	✓	✓	✓	✓				
Burn-in	✓	✓	✓	N/A				
Pre-Delivery Acceptance Functional	✓	✓	✓	✓				

✓ - Requirement is applicable

E - Exception

N/A - Requirement is not applicable

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX

SECTION III					
JHB 8080.5 DESIGN GUIDANCE SECTION					
No.	Standard #	Abbreviated Requirement	App.	HRD Section	Comments
<b>GENERAL</b>					
	G-1	Equipment Accessibility for Maintenance	✓		Inspect drawing, design, and hardware
	G-2	Separation of Redundant Equipment	✓		Ref. Hardware Item Failure Modes and Effects Analysis (FMEA)/Critical Items List (CIL)
	G-3	Systems Checkout Provisions	✓		Inspect drawing, design, and hardware
	G-4	Protection of Spacecraft Electrical and Mechanical Systems from Debris	✓		Inspect drawing and design
	G-5	Interior Design of Spacecraft for Cleanliness	N/A		N/A to SD8 design
	G-6	Redundancy Requirements	✓		Review Hardware Item design and drawings
	G-7	Time Displays	N/A		N/A to SD8 design
	G-8	Redundant Paths - Verification of Operation	✓		
	G-9	Shatterable Material - Exclusion From Habitable Compartment	✓		Inspect H/W Item drawing and design
	G-10	Control of Limited- Life Components	✓		Review Limited Life Items List (LLIL)
	G-11	Procurement Document Identification for Manned Space Flight Vehicle Items	✓		Audit procurement documents as necessary
	G-12	Application of Previous Qualification Tests	N/A		SD8 is new design
	G-13	Shipping and Handling Protection for Space Flight Hardware	✓		
	G-14	Identification and Classification of Flight and Non-flight Equipment	✓		

✓ = Applicable

N/A - Not Applicable

E = Exception

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX (Cont'd)

SECTION III					
JHB 8080.5 DESIGN GUIDANCE SECTION					
No.	Standard #	Abbreviated Requirement	App.	HRD Section	Comments
	G-15	Equipment Failure - Verification of Flight Readiness	✓		Discrepancy Report (DR) and Failure Investigation Analysis Report (FIAR) Systems in place
	G-16	Operating Limits on Temperature - Controlled Equipment	✓		
	G-17	Separate Stock for Space Flight Parts and Materials	✓		Reference assembly TPSs and ADP for evidence of traceability
	G-18	Safety Precautions - Test and Operating Procedures	✓		Audit Test Procedures
	G-19	Special Processes - Identification of Drawings	✓		Review Drawings. Applicable to Class I flight equipment only.
	G-20	Spacecraft Equipment - Protection from System Liquids	N/A		SD8 contains no liquids
	G-21	Spacecraft Equipment - Moisture Protection	N/A		
	G-22	Parts Identification	✓		Reference assembly TPSs and ADP for evidence of traceability
	G-23	Pressure Garment Wiring - Ignition of Materials by Electrical Current	N/A		N/A to SD8 design
	G-24	GSE and Airborne Support Equipment Protective Devices	✓		Review Hardware Item design and drawings
	G-25	Thermal Design and Analysis - Thermal Parameters	✓		
	G-26	Internally Generated Radiation	N/A		SD8 contains no radiation sources
	G-27	Fire Control	N/A		SD8 contains no self-igniting parts
	G-28	Sealing - Solid Propellant Rocket Motors	N/A		SD8 is not a rocket motor
	G-29	Reentry Propulsion Subsystem In-Flight Test	N/A		N/A to SD8 design

✓ = Applicable

N/A - Not Applicable

E = Exception

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX (Cont'd)

SECTION III					
JHB 8080.5 DESIGN GUIDANCE SECTION					
No.	Standard #	Abbreviated Requirement	App.	HRD Section	Comments
	G-30	Switch Protection Devices	N/A		N/A to SD8 design
	G-31	Detachable Crew-Operated Tools - Restriction in Spacecraft	N/A		SD8 has no detachable tools
	G-32	Measurement Systems That Display Flight Information to the Crew - Indication of Failure	N/A		
	G-33	Surface Temperatures	✓		
	G-34	Extravehicular Activity Electronic Connectors	N/A		N/A to SD8 design
	G-35	Enclosure Panels External to the Habitable Modules	N/A		N/A to SD8 design
	G-36	Thermal Blankets - Extravehicular Activity	N/A		N/A to SD8 design
	G-37	Verification of Adequate External Visibility	N/A		N/A to SD8 design
	G-38	Pressurization or Repressurization - Precluding Ingress of Undesirable Elements	✓		
	G-39	Lightning Protection Design	N/A		SD8 is not a spacecraft
	G-40	Radioactive Luminescent Devices	N/A		SD8 contains no radioactive material
	G-41	Acoustic Noise Criteria	N/A		SD8 has no moving parts
	G-42	Solar Wind Environment	N/A		SD8 not used externally
	G-43	Centralized Subsystem Controls	✓		Review Hardware Item design and drawings
	G-44	Attitude Control Authority	N/A		
	G-45	Solid Propellant Rocket Motors - Ignition Capability with Unsealed Nozzle	N/A		SD8 is not a rocket motor

✓ = Applicable

N/A - Not Applicable

E = Exception

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX (Cont'd)

<b>SECTION III</b>					
<b>JHB 8080.5 DESIGN GUIDANCE SECTION</b>					
<b>No.</b>	<b>Standard #</b>	<b>Abbreviated Requirement</b>	<b>App.</b>	<b>HRD Section</b>	<b>Comments</b>
	G-46	Separation Sensing System - Structural Deformation	N/A		N/A to SD8 design
	G-47	Gyroscopes - Verification of Rotational Speed or Drift Rate	N/A		SD8 contains no gyroscopes
	G-48	Onboard Experiments - Required Pre-installation Checklist	✓		Review procedures
	G-49	Temperature and Pressure Monitoring Requirements of Hydrogen Peroxide Systems	N/A		SD8 contains no hydrogen peroxide
	G-50	Direct Procurement of Parts	✓		Audit Procurement Documentation
	G-51	Flight Hardware - Restriction on Use for Training	✓		Controlled through TPSs
	G-52	Reuse of Flight Hardware	N/A		SD8 is new design
<b>ELECTRICAL</b>					
	E-1	Mating Provisions for Electrical Connectors	N/A		N/A to SD8 design
	E-2	Protection of Severed Electrical Circuits	N/A		N/A to SD8 design
	E-3	Electrical and Electronic Devices - Protection from Reverse Polarity and/or Other Improper Electrical Inputs	N/A		N/A to SD8 design
	E-4	Electrical Connectors - Moisture Protection	N/A		N/A to SD8 design
	E-5	Electrical Connectors - Pin Assignment	N/A		N/A to SD8 design
	E-6	Corona Suppression	N/A		N/A to SD8 design
	E-7	Tantalum Wet Slug Capacitors - Restriction on Use	N/A		N/A to SD8 design

✓ = Applicable

N/A - Not Applicable

E = Exception

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX (Cont'd)

<b>SECTION III</b>					
<b>JHB 8080.5 DESIGN GUIDANCE SECTION</b>					
<b>No.</b>	<b>Standard #</b>	<b>Abbreviated Requirement</b>	<b>App.</b>	<b>HRD Section</b>	<b>Comments</b>
	E-8	Electrical and Electronic Supplies and Loads - Verification Tests	N/A		N/A to SD8 design
	E-9	Electrical Circuits - De-energizing Requirements	N/A		N/A to SD8 design
	E-10	Cleaning of Electrical and Electronic Equipment	N/A		N/A to SD8 design
	E-11	Protective Covers or Caps for Electrical Receptacles and Plugs	N/A		N/A to SD8 design
	E-12	Electrical Connectors - Disconnection for Troubleshooting and Bench Testing	N/A		N/A to SD8 design
	E-13	Bioinstrumentation Systems - Crew Electrical Shock Protection	N/A		N/A to SD8 design
	E-14	Electrical Wire Harness - Dielectric Tests	N/A		N/A to SD8 design
	E-15	Electrical Power Distribution Circuits - Overload Protection	N/A		N/A to SD8 design
	E-16	Testing Protective Devices for Solid-State Circuits	N/A		N/A to SD8 design
	E-17	Electrical and Electronic Piece Parts - Closure Construction	N/A		N/A to SD8 design
	E-18	Circuitry for Automatic Shutdown of Launch Vehicle Engine(s)	N/A		N/A to SD8 design
	E-19	Equipment Design - Power Transients	N/A		N/A to SD8 design
	E-20	Control of Electrostatic Discharge for Electronic Parts and Assemblies	N/A		N/A to SD8 design
	E-21	Electrical Connectors	N/A		N/A to SD8 design
	E-22	Ionizing Radiation Effects	N/A		N/A to SD8 design
	E-23	Transistors - Selection of Types	N/A		N/A to SD8 design

✓ = Applicable

N/A - Not Applicable

E = Exception

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX (Cont'd)

<b>SECTION III</b>					
<b>JHB 8080.5 DESIGN GUIDANCE SECTION</b>					
<b>No.</b>	<b>Standard #</b>	<b>Abbreviated Requirement</b>	<b>App.</b>	<b>HRD Section</b>	<b>Comments</b>
	E-24	Electrical Wire and Cable Acceptance Tests	N/A		N/A to SD8 design
<b>FLUIDS</b>					
	F-1	Flow Restriction Requirements - Pressurized Sources	N/A		Review Hardware Item design and drawings
	F-2	Moisture Separators in a Zero-Gravity Environment	N/A		SD8 contains no water separators
	F-3	Service Points - Positive Protection From Interchangeability of Fluid Service Lines	✓		Review Hardware Item design and drawings
	F-4	Ground Service Points - Fluid Systems	N/A		SD8 located in pressurized compartment
	F-5	Fluid Lines - Separation Provisions	N/A		Applicable only to planned vehicle separation
	F-6	Temperature and Pressure Monitoring Requirements for Potentially Hazardous Reactive Fluids	N/A		SD8 contains no reactive fluids
	F-7	Capping of Servicing and Test Ports	N/A		
	F-8	Fluid System Components Whose Function is Dependent on Direction of Flow - Protection Against Incorrect Installation	N/A		SD8 has no flow direction dependent equipment
	F-9	Spacecraft Venting - Induced Perturbing Forces	✓		Review Hardware Item design and drawings
	F-10	Nozzles and Vents - Protection Prior to Launch	N/A		SD8 is located in MPLM during launch
	F-11	Fluid Supplies - Verification Tests	N/A		Review procedures
	F-12	Protection of Pressurized Systems from Damage Due to Pressurant Depletion - GSE and Airborne Support Equipment	N/A		Review procedures

✓ = Applicable

N/A - Not Applicable

E = Exception

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX (Cont'd)

SECTION III					
JHB 8080.5 DESIGN GUIDANCE SECTION					
No.	Standard #	Abbreviated Requirement	App.	HRD Section	Comments
	F-13	Crew Cabin Module Pressure - Venting Restriction	N/A		SD8 is not a module venting system
	F-14	Crew Cabin Module Ventilating Fans - Protection from Debris	N/A		SD8 contains no fans
	F-15	Separation of Hypergolic Reactants	N/A		SD8 contains no hypergolic reactants
	F-16	Fluid Line Installation	N/A		
	F-17	Cleanliness of Flowing Fluids and Associated Systems	N/A		
	F-18	Pressure Relief Valves - Standardization of Functional Testing	N/A		
	F-19	Protection for Tubing, Fittings, and Fluid System Components - Flight Hardware and Associated Equipment	N/A		
	F-20	Fluid Systems - Cleanliness	N/A		
	F-21	Purge Gases - Temperature and Humidity Requirements	N/A		SD8 contains no purge gases
	F-22	Pressure Garments - Protection Against Failure Propagation	N/A		SD8 is not a part of pressure garments
	F-23	Qualification Fluid	N/A		
	F-24	Fluid Systems - Design for Flushing and Draining	N/A		SD8 not a spacecraft fluid system
	F-25	Toxicity - Fluids Contained in Systems in the Crew Compartment	N/A		SD8 has no fluids
	F-26	Atmospheric Pressure and Composition Control	✓		Review Hardware Item design and drawings
	F-27	Liquid or Gas Containers - Verification of Contents	N/A		SD8 has no liquids or gases

✓ = Applicable

N/A - Not Applicable

E = Exception

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX (Cont'd)

<b>SECTION III</b>					
<b>JHB 8080.5 DESIGN GUIDANCE SECTION</b>					
<b>No.</b>	<b>Standard #</b>	<b>Abbreviated Requirement</b>	<b>App.</b>	<b>HRD Section</b>	<b>Comments</b>
	F-28	Use of Halogen Method for Coolant System Leak Detection	N/A		SD8 contains no coolants
	F-29	Filter Protection of Active Fluid Components	N/A		SD8 has no fluid components
	F-30	Pressure Relief for Pressure Vessels	N/A		SD8 has no pressure vessels
<b>MATERIALS AND PROCESSES</b>					
	M/P-1	Material Selection, Review, and Drawing Sign-off	✓		Review Hardware Item Material Review Cert.
	M/P-2	Flammability of Wiring Material	N/A		SD8 contains no wires
	M/P-3	Toxicity of Materials Used in Crew Compartments - Wire Insulation, Ties, Identification Marks, and Protective Coverings	N/A		SD8 contains no circuitry
	M/P-4	Metals and Metal Couples - Restriction on Use	✓		Review Hardware Item Material Review Cert.
	M/P-5	Solutions Which Contain Ethylene Glycol - Requirements for Silver Chelating Agent	N/A		SD8 contains no ethylene glycol
	M/P-6	Toxicity - Requirements for Nonmetallic Materials Proposed for Use Within Crew Compartment	✓		Review Hardware Item Material Review Cert.
	M/P-7	Material Detrimental to Electrical Connectors	N/A		SD8 contains no electrical connectors.
	M/P-8	Leak Detectors - Wetting Agents	N/A		SD8 uses no leak detectors
	M/P-9	Breathing Systems - Requirement to Test for Mercury Contamination	N/A		SD8 is not a breathing system

✓ = Applicable

N/A - Not Applicable

E = Exception

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX (Cont'd)

SECTION III					
JHB 8080.5 DESIGN GUIDANCE SECTION					
No.	Standard #	Abbreviated Requirement	App.	HRD Section	Comments
	M/P-10	Liquid Locking Compounds, Restrictions, and Controls	N/A		
	M/P-11	Pressure Vessel Documentation	N/A		
	M/P-12	Multi-Layer Blanket Bake-Out	N/A		SD8 is not a thermal blanket
	M/P-13	Pressure Vessel Design	N/A		SD8 is not a pressure vessel
	M/P-14	Silicate Ester Coolant System Design	N/A		SD8 is not a cooling system
	M/P-15	Mercury - Restriction on Use	✓		N/A by design
	M/P-16	Restriction on Coatings for Areas Subject to Abrasion	✓		N/A by design
	M/P-17	Radiographic Inspection of Brazed and Welded Tubing Joints	N/A		SD8 contains no tubing joints
	M/P-18	Etching Fluorocarbon Insulated Electrical Wire	N/A		SD8 contains no wire
	M/P-19	Spacecraft Material - Restriction on Use of Polyvinyl Chloride	✓		N/A by design
	M/P-20	Titanium or its Alloys - Prohibited Use With Oxygen	✓		N/A by design
	M/P-21	Beryllium - Restricted Use Within Crew Components	✓		N/A by design
	M/P-22	Brazed Joints - Identification Marks	N/A		SD8 has no brazed joints
	M/P-23	Pressure Vessels - Materials Compatibility and Vessel Qualifications Tests	N/A		
	M/P-24	Cadmium - Restriction on Use	✓		N/A by design
	M/P-25	Pressure Vessels - Nondestructive Evaluation Plan	N/A		
	M/P-26	Repair of Sandwich - Type Structures	N/A		SD8 has no sandwich-type structures

✓ = Applicable

N/A - Not Applicable

E = Exception

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX (Cont'd)

<b>SECTION III</b>					
<b>JHB 8080.5 DESIGN GUIDANCE SECTION</b>					
<b>No.</b>	<b>Standard #</b>	<b>Abbreviated Requirement</b>	<b>App.</b>	<b>HRD Section</b>	<b>Comments</b>
<b>MECHANICAL AND STRUCTURAL</b>					
	M/S-1	Equipment Containers - Design For Rapid Spacecraft Decompression	✓		Review drawings and design, Test if necessary
	M/S-2	Alignment of Mechanical Systems	✓		Review drawings and design
	M/S-3	Wire Bundles - Protective Coating	N/A		SD8 contains no wires
	M/S-4	Hatches - Repeated Use	N/A		SD8 contains no hatches
	M/S-5	Threaded Fittings - Restrictions on Release of Particles and Foreign Materials	N/A		Review Hardware Item Material Review Cert
	M/S-6	Exposed Sharp Surfaces or Protrusions	✓		Review drawings and design
	M/S-7	Windows and Glass Structure	N/A		SD8 has no glass
	M/S-8	Penetration of Inhabited Spacecraft Compartments	N/A		SD8 is not an inhabited compartment
	M/S-9	Mechanisms	✓		
	M/S-10	Functional Doors That Operate in Flight	N/A		SD8 is not a spacecraft
	M/S-11	Meteoroid Protection Levels for Structures	N/A		SD8 is an internal payload
	M/S-12	Spacecraft Recovery Hoist Loops	N/A		SD8 is not a recoverable spacecraft
	M/S-13	Lifting and Hoisting GSE Identification	N/A		SD8 contains no slings
	M/S-14	Structural Analysis	✓		
	M/S-15	Stainless Steel Tubing - Method of Joining	✓		
	M/S-16	Pressure Vessels - Negative Pressure Damage	N/A		
	<b>PYROTECHNIC</b>		✓		

✓ = Applicable

N/A - Not Applicable

E = Exception

APPENDIX E

JHB 8080.5 DESIGN GUIDANCE MATRIX (Cont'd)

SECTION III					
JHB 8080.5 DESIGN GUIDANCE SECTION					
No.	Standard #	Abbreviated Requirement	App.	HRD Section	Comments
	P-1	Explosive Devices - Arming and Disarming	N/A		SD8 contains no pyrotechnic devices
	P-2	Pyrotechnic Devices - Preflight Verification Tests at Launch Sites	N/A		SD8 contains no pyrotechnic devices
	P-3	Wire Splicing	N/A		SD8 contains no pyrotechnic devices
	P-4	Explosive Devices - Packaging Material	N/A		SD8 contains no pyrotechnic devices
	P-5	Explosive Devices - Identification Requirements	N/A		SD8 contains no pyrotechnic devices
	P-6	Protection of Electrical Circuitry for Explosive Devices Employing Hot Bridge Wire Initiators	N/A		SD8 contains no pyrotechnic devices
	P-7	Explosive Devices - Color Coding Requirements	N/A		SD8 contains no pyrotechnic devices

✓ = Applicable

N/A - Not Applicable

E = Exception

DISTRIBUTION LIST  
FOR  
LS-71088

NASA/JSC

EA5/E. Strong

LOCKHEED MARTIN

B08/D. Kilbourn

S03/Science Payloads Library

S18/S. Bhaskaran

S22/D. Barineau

S361/J. McDonald

S362/STI Center/Bldg. 36 (5)