Pressurized Payloads

Generic Payload Verification Plan

International Space Station Program

October 30, 2000

Revision C

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Agency of Japan

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european space agency

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INTERNATIONAL SPACE STATION PROGRAM

PRESSURIZED PAYLOADS GENERIC PAYLOAD VERIFICATION PLAN

October 30, 2000

PREFACE

This document describes all of the design interface and human factors verification activities necessary to satisfy requirements contained in SSP 57000, Pressurized Payloads Interface Requirements Document (IRD), for the International Space Station (ISS) Program. This document encompasses all Payloads (PL) to be placed on-board the ISS inside a pressurized module, excluding the Russian Aviation and Space Agency (ROSAVIACOSMOS) research module.

This document contains instructions, definitions, references, and guidelines for creating a unique Payload Verification Plan (PVP), that is specifically tailored to verify the interface compatibility of actual as-built payload hardware and software. This document is under the control of the ISS Multilateral Payloads Control Board (MPCB), and any changes or revisions must be approved by the MPCB.

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INTERNATIONAL SPACE STATION PROGRAM

PRESSURIZED PAYLOADS GENERIC PAYLOAD VERIFICATION PLAN

October 30, 2000

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INTERNATIONAL SPACE STATION PROGRAM

PRESSURIZED PAYLOADS GENERIC PAYLOAD VERIFICATION PLAN

LIST OF CHANGES

October 30, 2000

All changes to paragraphs, tables, and figures in this document are shown below:

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
003196	TBD		3.2.4, 3.2.6.2(H)
			TABLE(S)
			4.1, 4.2, 4.3
			FIGURE(S)
			N/A
			APPENDIX(ES)
			Appendix A
			Verification Definition Sheets
			ST-004, ST-008, ST-010,
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			EL-002, EL-006, EL-007, EL-012, EL-013, EL-016, EL-017, EL-020, EL-021, EL-022, EL-024, EL-025, EL-028, EL-029, EL-030,

EL-031, EL-032, EL-034, EL-035, EL-037, EL-039, EL-041, EL-042,

CD-001, CD-005, CD-007, CD-008, CD-009, CD-010, CD-011, CD-012, CD-013, CD-014, CD-015, CD-017, CD-018, CD-019, CD-020, CD-022, CD-023, CD-024, CD-025, CD-026

FD-003, FD-006, FD-009, FD-010, FD-013, FD-015, FD-018, FD-022, FD-023, FD-028, FD-035

EN-001, EN-002, EN-005, EN-006

MP-004

Appendix B

Example Submittal Forms (all)

Appendix H

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001824	27-JUL-99		1.1, 1.2, 1.3, 2.1, 3.1.1, 3.1.4
			3.2.1, 3.2.2, 3.2.4, 3.2.5
			3.2.6.1, 3.2.6.2, 3.3
			TABLE(S)
			4.1, 4.2, 4.3, 4.4
			FIGURE(S)
			APPENDIX(ES)
			Appendix A

VDS ST-001, VDS ST-002
VDS ST-003, VDS ST-008
VDS ST-009, VDS ST-010
VDS ST-011, VDS ME-001
VDS ME-003, VDS ME-010
VDS ME-012, VDS ME-014
VDS ME-015, VDS ME-017
VDS ME-018, VDS ME-020
VDS ME-021, VDS ME-022
VDS ME-024, VDS ME-031
VDS ME-037, VDS ME-038
VDS ME-039, VDS ME-040
VDS ME-041, VDS ME-043
VDS ME-045, VDS ME-046
VDS ME-050, VDS ME-051
VDS ME-054, VDS ME-055
VDS ME-056, VDS ME-057
VDS ME-058, VDS ME-059
VDS EL-001, VDS EL-002
VDS EL-003, VDS EL-004
VDS EL-006, VDS EL-007
VDS EL-009, VDS EL-010
VDS EL-015, VDS EL-017
VDS EL-018, VDS EL-020
VDS EL-023, VDS EL-028
VDS EL-029, VDS EL-030
VDS EL-031, VDS EL-034
VDS EL-035, VDS EL-036
VDS EL-037, VDS EL-038
VDS EL-039, VDS EL-040
VDS EL-041, VDS CD-001
VDS CD-002, VDS CD-003
VDS CD-004, VDS CD-005
VDS CD-006, VDS CD-007
VDS CD-008, VDS CD-009
VDS CD-010, VDS CD-011
VDS CD-012, VDS CD-013
VDS CD-015, VDS CD-017
VDS CD-020, VDS CD-022
VDS CD-023, VDS CD-024
VDS FD-001, VDS FD-003
VDS FD-004, VDS FD-006
VDS FD-010, VDS FD-011
VDS FD-012, VDS FD-014
VDS FD-019, VDS FD-020
VDS FD-021, VDS FD-022

VDS FD-025, VDS FD-033
VDS FD-034, VDS EN-003
VDS EN-004, VDS EN-005
VDS EN-007, VDS MP-001

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ADDENDA

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to define the complete set of verification activities necessary to ensure compliance with the requirements identified in the Pressurized Payload Interface Requirements Document (IRD). Specific design constraints and resource allocations are contained in Unique Payload Hardware ICDs. Unique Payload Software ICDs define command and data interfaces for payloads to be verified per SSP 57000. This document provides instructions and guidelines for creating a Unique Payload Verification Plan (PVP), which is required by the Space Station Program. This document addresses the generic safety requirements as defined in section 4 of SSP 57000. The Payload Developer must consult NSTS 1700.7 ISS Addendum to ensure compliance with payload safety requirements.

1.2 SCOPE

This document encompasses the complete set of verification requirements that address interface compatibility of pressurized payloads during all phases of operations, including launch site processing, ascent/descent, and on-orbit integration and operations using the ISS pressurized modules (Multi-Purpose Logistics Module (MPLM), Centrifuge Accommodation Module (CAM), United States (US) Lab, Attached Pressurized Module (APM), and Japanese Experiment Module (JEM)). This document does not address the verification requirements for payload hardware that will be launched/returned and/or operated in the Orbiter Middeck. All Payload Developers (PDs) that provide hardware or software that interfaces with ISS-provided equipment or flight crew will use this document to develop their Unique Payload Verification Plan. The verification of pressurized payloads located in the RSA research module, the verification of payload functional capabilities for achievement of science objectives, and/or payload safety hazard controls are not within the scope of this document.

1.3 PRECEDENCE

Inconsistencies among ISS payload verification-related documentation will be resolved by giving precedence in the following top-down order:

A. ISS Concept of Operations and Utilization (COU), Volume 1: Principles, SSP 50011-01.

B. SSP 50200-04, Station Program Implementation Plan (SPIP) Vol 4: Payload Engineering Integration

C. ISS Payload Verification Program Plan, SSP 57011

D. Pressurized Payloads Interface Requirements Document, SSP 57000.

E. Pressurized Payloads Generic Payload Verification Plan, SSP 57010.

F. Unique Payload Hardware ICD, SSP 57200 Series Documents.

G. Unique Payload Software ICD, SSP 57300 Series Documents.

H. Unique Payload Verification Plan SSP 57400 Series Documents.

I. Pressurized Payloads ICD Blank Book, SSP 57001.

J. Payload Software ICD Template, SSP 57002.

Information contained in the Applicable Documents (Section 2.1) may be repeated in this Generic PVP. In case of conflict, the applicable document (revision and date specified) will take precedence.

2.0 DOCUMENTATION

The following documents include specifications, models, standards, guidelines, handbooks, and other special publications related to verification activities described herein. The current issue of each document is to be used during the development of the Unique Payload Hardware Interface Control Document and the Unique ICD. A specific document release date and revision level will be documented in the Unique PVP when the Unique ICD is placed under Payload Control Board control. The status of documents identified below may be determined from the International Space Station Program Baseline Activity Index and Status Report.

The documents below form a part of this plan to the extent described herein. In the event of a conflict between the documents referenced and the contents of this verification plan, the applicable document revision listed in the Unique ICD will take precedence. Any changes to the revision level of the applicable documents listed in the Unique ICD must be assessed for impact through the Change Request processes.

2.1 APPLICABLE DOCUMENTS

DOCUMENT NO.	TITLE
683-10007	Fire Detection Assembly
CCSDS 701.0-B-2	Advanced Orbiting Systems, Networks, and Data Links: Architectural Specifications
D684-10056-01	International Space Station Program, Prime Contractor Software Standards and Procedures Specification
EIA/TIA RS-250	Electrical Performance for Television Relay Facilities
FED-STD-595	Colors Used in Government Procurement
ISO/IEC 8802-3	ANSI/IEEE STD 802.3
MIL-HBK-1553	Multiplex Application Handbook
MIL-STD-461	Requirements for the Control of Electromagnetic Interference Emissions and Susceptibility
MIL-STD-462	Measurement of Electromagnetic Interference Characteristics
MIL-STD-1553	Digital Time Division Command/Response Multiplex Data Bus
MIL-STD-1686	Electrostatic Discharge Control Program for Protection of

	Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices) Document
MS 33540	General Practices for Safety Wiring and Cotter Pinning
MSFC-SPEC-250	Protective Finishes for Space Vehicle Structures and Associated Flight Equipment, General Specification For Document
MSFC-STD-275	Marking of Electrical Ground Support Equipment, Front Panels, and Rack Title Plates
MSFC-STD-531	High Voltage Design Criteria
NASA-STD-5003	Fracture Control Requirements for Payloads Using the Space Shuttle
NSTS 1700.7	Safety Policy and Requirements for Payloads Using the Space Transportation System
NSTS 1700.7b (ISS Addendum)	Safety Policy and Requirements for Payloads Using the International Space Station
NSTS 21000-IDD-ISS	International Space Station Interface Definition Document
NSTS/ISS 18798,	Interpretations of NSTS/ISS Payload Safety Requirements
NTC-7	Video Facility Testing Technical Performance Objectives
SAE AS4536	Safety Cable Kit Procurement Specification and Requirements for Use
SDD 32100397-002	Fire Hole Decal
SN-C-0005	NSTS Contamination Control Requirements Manuel
SSP 30233	Space Station Requirements for Material and Processes
SSP 30237	Space Station Requirements for Electromagnetic Emission and Susceptibility Requirements
SSP 30238	Space Station Electromagnetic Techniques
SSP 30240	Space Station Grounding Requirements
SSP 30242	Space Station Cable/Wire Design and Control Requirements for

	Electromagnetic Compatibility
SSP 30243	Space Station Requirements for Electromagnetic Compatibility
SSP 30245	Space Station Electrical Bonding Requirements
SSP 30257:004	SSP IVA Restraints and Mobility Aids STD ICD
SSP 30262:013	Smoke Detector Assembly Standard ICD
SSP 30312	Electrical, Electronic, and Electromechanical (EEE) and Mechanical Parts Management and Implementation Plan for Space Station Program
SSP 30426	External Contamination Control Requirements
SSP 30482	Electrical Power Specifications and Standards
SSP 30573	Space Station Fluid Procurement and Use Specification
SSP 41002	International Standard Payload Rack to NASA/NASDA Modules Interface Control Document
SSP 41017	Rack to Mini Pressurized Logistics Module Interface Control Document (ICD) Part I and Part II
SSP 41175-2	Software Interface Control Document Part 1 Station Management and Control to ISS Book 2, General Software Interface Requirements
SSP 50005	International Space Station Flight Crew Integration Standard (NASA-STD-3000/T) Document
SSP 50008	International Space Station Interior Color Scheme
SSP 50184	High Rate Data Link Physical Media, Physical Signaling & Protocol Specification
SSP 57200-04	Station Implementation Plan Vol 4: Payload Engineering Integration
SSP 52005	Payload Flight Equipment Requirements and Guidelines for Safety Critical Structures
SSP 52050	Software Interface Control Document Part 1, International Standard Payload Rack to International Space Station

SSP 52054	ISS Payload Certification of Flight Readiness Implementation Plan Generic
SSP 57000	Pressurized Payloads Interface Requirements Document
SSP 57001	Pressurized Payloads Hardware Interface Control Document Template
SSP 57002	Payload Software Interface Control Document Template
SSP 57007	Rack Integrator Handbook
SSP 57020	Pressurized Payloads Accommodation Handbook (PAH) (in development)
SSP 57200 (Series Document)	Unique Payload Hardware ICD
SSP 57300 (Series Document)	Unique Payload Software ICD
SSQ 21635	Connectors and Accessories, Electrical, Rectangular, Rack and Panel
SSQ 21654	Cable, Single Fiber, Multitude, Space Quality, General Specification for Document
SSQ 21655	Cable, Electrical, MIL-STD-1553 Data Bus, Space Quality, General Specification for Document
TBE Drawing 220G07500	Rack Shipping Container Drawing
Tech. Memo 102179	Selection of Wires and Circuit Protection Devices for NSTS Orbiter Vehicle Payload Electrical Circuits
TSI-9701009 User Manual	User Manual for RT Validation Test Set

3.0 PAYLOAD VERIFICATION

3.1 PAYLOAD VERIFICATION PROCESS OVERVIEW

A Payload verification process is comprised of four major activities, shown in Figure 3.1-1, Verification Process. These activities are planning, implementation and reporting, certification, and certification maintenance. Each PD is required to follow this process in order to achieve payload flight certification endorsement.

3.1.1 PLANNING OVERVIEW

A generic set of Verification Definition Sheet(s) (VDSs) (see Appendix A) provides instructions, definitions, references, and guidelines for the verification activities associated with each payload design requirement contained in the IRD. The VDS describes what steps should be taken by the PD to verify that the payload hardware and software has satisfied the specific IRD requirement. The collection of VDSs associated with the IRD in this Generic Payload Verification Plan forms the basis for generating the Unique PVP, which is a plan tailored to the individual characteristics of each payload.

3.1.2 IMPLEMENTATION & REPORTING OVERVIEW

The implementation and reporting phase is the PD's execution of the Unique PVP, which consists of performing the verification as defined in the VDSs contained in the Unique PVP. This phase also covers verification statusing and tracking; data deliverables and schedules; and support of ISS safety and integration reviews.

3.1.3 CERTIFICATION OVERVIEW

The certification process includes the signing by the PD of a statement indicating that all of the requirements and verifications of ISS compatibility, functionality and safety compliance are observed. Refer to SSP52054, ISS Payloads Certification of Flight Readiness Implementation Plan Generic, for details of the Certification of Flight Readiness (CoFR) process.

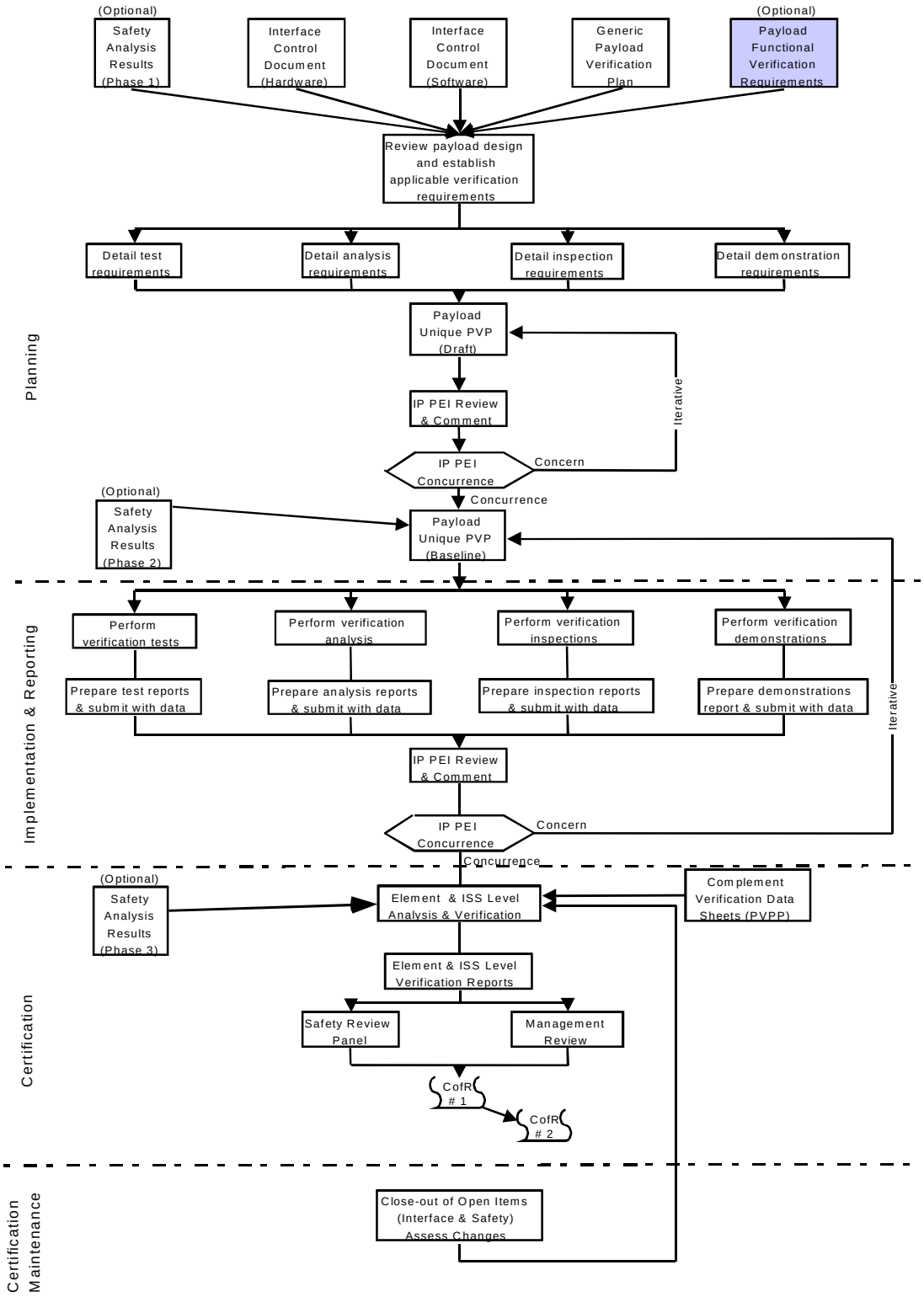
3.1.4 CERTIFICATION MAINTENANCE OVERVIEW

Certification maintenance activities occur after signing the CoFR endorsement. Any change to the payload items that are required after the initial certification endorsement must be assessed to ensure that previous verification activity and certification endorsements are not invalidated. The changes shall be coordinated with the ISS Payload Program Office for concurrence regarding any required reverification.

3.2 PAYLOAD VERIFICATION PLANNING DETAILS

The planning process involves the review of the design to determine which requirements in SSP 57000, section 4 and SSP 57010, Appendix A are applicable to each item of equipment and the identification and/or definition of the activities necessary to demonstrate that each applicable requirement has been met. The planning process can also include defining the functionality and safety verification requirements at the discretion of the PD in the Unique PVP. The following sections describe the process used to develop a Unique PVP.

Figure 3.1-1 VERIFICATION PROCESS



3.2.1 UNIQUE PVP DEVELOPMENT

The first step in the development of the Unique PVP is to establish a Unique Payload Hardware and Software Interface Control Document (ICD). The Unique PVP can be easily developed in parallel with the Unique Payload ICD (see Planning Phase of Figure 3.1-1). Payload safety and functionality (performance) requirements shall be incorporated along with the applicable VDSs from the Generic Payload Verification Plan (GPVP) into the Unique PVP. For each applicable IRD requirement, there will be at least one VDS in the Unique PVP that describes what is to be done to ensure that the payload hardware and software have met the specified requirement. Section 4 reflects the VDS-to-IRD requirement reference numbers in a matrix format. The VDSs are provided in Appendix A.

Other, existing Project verification plans may be used as the Unique PVP if the content of the Project verification plan meets the intent of this document. At a minimum, the Project verification plan must contain a cross reference from it's verification requirements to the GPVP VDSs, a definition of the verification method for each requirement, a brief description of how each requirement will be verified, and the schedule for each verification activity. The Space Station Payloads Office will review the Project verification plan and the Payloads Office Control Board will control the requirements corresponding to the GPVP VDSs.

3.2.2 MODIFICATIONS OF VDS

The specific requirements given in the VDSs, and the methods of verification, have been extracted from the Pressurized Payloads Interface Requirements Document (SSP 57000). The due dates have been extracted from information in the Payload Verification Program Plan (SSP 57011). Therefore, non-compliance with any of these items in the VDSs must be processed as an Exception, and documented in Table 3.2.2-1. After the Unique PVP is baselined, non-compliances must be handled through the waiver process as detailed in the Pressurized Payloads Interface Control Document (SSP 57001, Section 5).

If a Project verification plan is used as the Unique PVP, changes to the methods or submittal dates defined in the VDSs must also be processed as exceptions and documented in a table in the Project verification plan which meets the intent of Table 3.2.2-1.

The order of preference of verification is:

- Test
- Analysis
- Inspection
- Demonstration

Proposed changes to the verification method may be more easily approved if the proposed verification method is preferred over (i.e. more stringent than) the method named in the VDS. For example, testing may be done instead of analysis, inspection, or demonstration.

Table 3.2.2-1 VERIFICATION DEVIATION TABLE

VDS Number	VDS Title	Description of Deviation	Reason for Deviation
Example ME-003	*Payload In-flight Maintenance*	*Demonstration used in place of Analysis*	*Demonstration is easier and less costly than Analysis*
Example EL-012	*Remote Power Controllers*	*Submittal date at L-20 instead of L-22*	*Hardware will not be ready for testing at L-22*

3.2.3 CREATION OF UNIQUE VDS(S)

Decisions made during the development of the ICD may require creation of unique VDSs to accurately and completely reflect the verification required based on unique characteristics of an individual payload. A unique VDS, (related to functionality or safety) will be created when no generic VDS exists that covers a special or unique requirement defined in the ICD, or when the generic VDS is in some way inadequate to verify a special aspect of the payload. Creation of unique VDSs requires coordination and concurrence between each PD and his International Partner (IP) Payload Engineering and Integration (PEI) team.

3.2.4 HUMAN-FACTORS-RELATED VERIFICATION CLOSEOUT CONSIDERATION

An alternate process is available to PDs to closeout selected (not all) Human-Factors-related VDSs listed in Appendix C of this plan. The alternate process involves crew participation in the evaluation of PD's hardware/software. The process is to have a crewmember evaluate the PD-provided flight or flight-like hardware to assess whether operational suitability is met. Based on the evaluation, a crew consensus report will be issued for the PD hardware. The result, if approved by the Chief of each IP Crew Office, will serve as data that may be used for closure of PD verification requirements. Crew evaluations for this purpose should be planned well in advance and contingency plans developed if the crew becomes unavailable to complete this activity. **For the crewmember to perform these tasks, it is the PD's responsibility to negotiate and schedule with the Astronaut Office.**

3.2.5 CREW EVALUATION PLAN

Development Phase:

The payload developer should involve the crewmember during the development phase of the hardware to ensure that the hardware is acceptable for safe and effective operation in the Space Station. The crewmember approach will be to observe, utilize or operate, and evaluate the functionality of the individual interface features. This will be accomplished in several stages, with early crewmember exposure to interface features during their development site visits.

Execution Phase:

Where Human Factors interfaces requirements are subjective the PD-developed hardware will be made available for the crewmember to evaluate the operational suitability of these selected Human Factors

interfaces. This can be accomplished incrementally during the crewmember site review of the hardware. The process is for the Astronaut Office to be presented the procedure for evaluation, and to have the procedure approved by the Astronaut Office one month prior to the evaluation. The procedure shall define the requirements and the description (picture/drawings) of the interface to be evaluated. The crewmember/team will evaluate these interfaces and if a consensus from the Johnson Space Center (JSC) Astronaut Office or IP crew office is obtained, this evaluation will be used for closure of the verification of the requirement. Appendix C includes a checklist of Human Factors Interfaces acceptable to the Astronaut Office for evaluation sign-off.

3.2.6 THE VERIFICATION DEFINITION SHEET

The VDS form (Figure 3.2.6-1) is separated into two parts, the header and the body. Paragraph 3.2.6.1 “VDS Header” explains blocks A through D of Figure 3.2.6-1, and paragraph 3.2.6.2 “VDS Body” explains blocks E through O of Figure 3.2.6-1.

Ⓐ Number	Ⓑ Title	Ⓒ Method	Ⓓ Hazard Report(s)
AA-NNN	*Example VDS*	*A/D/I/T*	*Unique PVP only*

Ⓔ SSP 57000, Section 4 Number(s), Title(s), and Method(s):

Applicable SSP 57000 Section 4.0 requirements.

Ⓕ Requirement Summary:

The requirement that must be verified to ensure payload hardware/software interface compatibility.

Ⓖ Detailed Descriptions of Requirements:

Instructions and details suggesting how the verification method(s), as identified in the header, should be implemented (what analyses, tests, inspections, or demonstrations are required and implementation details). In addition, any related clarification deemed necessary to further explain what is required will be provided.

Ⓗ Required Verification Data:	Ⓘ Data Submittal Dates:
Data that is required to be submitted showing compliance to the verification requirement.	*Date the data is to be Submitted to ISS.*

Ⓙ Description of Reverification Requirements:	Ⓚ Reverification Method:	Ⓛ Hazard Report(s)
	A/D/I/T	*Unique PVP only*

I. Description of the requirement that must be accomplished prior to on-orbit relocation of the integrated rack.

II. Description of the requirement that must be accomplished prior to on-orbit subrack PL changeout (new, reflight, or series) of the integrated rack.

Ⓜ Required Reverification Data:	Ⓝ Data Submittal Dates:
I. Submittal data required for item I above.	*I. Date the data is to be submitted to ISS.*
II. Submittal data required for item II above.	*II. Date the data is to be submitted to ISS.*

Ⓞ Applicable Document(s):

Listing of any documents that are applicable to the identified verification requirement.

FIGURE 3.2.6-1 EXAMPLE VERIFICATION DEFINITION SHEET

3.2.6.1 VDS HEADER

The header is used for identification and tracking purposes and contains:

A. Number (Alphanumeric)

(1) (2)

AA- NNN

(1) Discipline Identifier [2 characters (alphabetical)]

ST - Structural

ME - Mechanical (include Human Factors)

EL - Electrical

CD - Command and Data Handling (Command & Data Handling and audio/video)

FD - Fluid Dynamics (Thermal Control, Vacuum, and Gases)

EN - Environmental

MP - Materials and Parts

SA - Safety (This category is for use by the PDs to address generic and unique safety requirements in their Unique PVPs.)

FN - Functionality (performance) Related (Requirements in this category are the responsibility of the PD as coordinated with Payload Integration Management)

Note: Requirements in Categories SA and FN are not within the scope of this plan but are included for completeness. They are the responsibility of the PD (with appropriate guidance from Payload Integration Management and Program safety engineers or IP equivalent for both). They shall be incorporated into the Unique PVP. Data submittals for any SA and FN VDSs are not required by ISS PEI.

(2) Numerical Sequence NNN [3 digits (numeric)]

Use all digits - 001, 002, etc. This number represents sequential numbering of VDSs driven by the discipline. Example ST- 003. This is the third VDS within the structures discipline.

B. Title

The requirement title is a category identification of the design requirement and is derived from the IRD requirement paragraph title. If the verification requirement covers more than one IRD requirement, a general statement is provided.

C. Method

There are four unique methods of verifying a design requirement: Analysis (A), Test (T), Inspection (I), and Demonstration (D). Each VDS will identify the required method of verification by indicating the method letter identifier, or a combination of identifiers, if more than one method applies.

(1) Test

Test is actual operation of equipment, normally instrumented, under simulated or flight equivalent conditions or the subjection of parts or equipment to specified environments to measure and record responses in a quantitative manner. (Flight hardware will be required for all tests unless the use of hardware, which replicates flight hardware, is specifically identified on the VDS.)

(2) Analysis

Analysis is the technical evaluation process of using techniques and tools such as mathematical models and computer simulations, historical/design/test data, and other quantitative assessments to calculate characteristics and verify specification compliance. Analysis is used to verify requirements where established techniques are adequate to yield confidence or where testing is impractical.

(3) Inspection

Inspection is a physical measurement or visual evaluation of equipment and associated documentation. Inspection is used to verify construction features, drawing compliance, workmanship, and physical condition. (Flight hardware will be required for all inspections unless the use of hardware, which replicates flight hardware, is specifically identified on the VDS.) Note: Inspection in the context does not imply a Quality-Control type of activity.

(4) Demonstration

Demonstration is the qualitative determination of compliance with requirements by observation during actual operation or simulation under pre-planned conditions and guidelines. (Flight hardware will be required for all demonstrations unless the use of hardware, which replicates flight hardware, is specifically identified on the VDS.)

D. Hazard Report(s) (This block can be used in the Unique PVP)

A Payload Hazard Report (PHR) identifies safety verification methods to ensure hazard controls will function/operate as intended. The PD is encouraged to identify the PHR(s) which include safety verification method(s) that are the same as the verification activity(ies) described on the VDS. This allows traceability between payload verification and safety verification used to control hazards. If the VDS is not related to safety then place “N/A” in the block.

3.2.6.2 VDS BODY

The body of the VDS contains the following: a summary statement of the applicable design requirement; the verification method description, and tasks to be accomplished to verify that the requirement has been satisfied. It also contains a description of the data that must be generated and delivered as proof of meeting the requirement, and any applicable documentation and notes that may aid in accomplishing the verification.

E. IRD Section 4 Number(s), Title(s), and Method(s):

This section contains a listing of the SSP 57000, Section 4 Requirements that the VDS addresses.

F. Requirement Summary:

This section contains a summary statement of the intent of the IRD requirements that the VDS addresses.

G. Detailed Descriptions of Requirements:

This section includes instructions and details suggesting how the verification method(s) identified in the header should be implemented (what analyses, tests, inspections, or demonstrations are required and implementation details). In addition, any related clarification deemed necessary to further explain what is required will be provided.

H. Required Verification Data:

The results of verification activities shall be documented. All supporting documentation will be retained and provided by the PD upon request. Data that are required to be submitted will be identified on the VDS. Data submittals specified herein do not relieve the PD from reports required to support program and design reviews. The three categories of submittal data are defined below, and the VDS will identify which category is acceptable to demonstrate compliance with the verification requirement. The Payload Developer is required to indicate on each of the following forms the Stage Effectivity (i.e., 5A.1, 6A, 7A, etc.) for each verification closure submittal..

(1) <u>Certificate of Compliance</u>

A Certificate of Compliance (COC) is a memorandum from a PD certifying that the hardware and/or software comply with the applicable VDS requirement. Multiple VDSs may be combined on a single COC. It should also state that the supporting data would be maintained by the PD and provided upon request. A COC can be used to address analysis, test, inspection, and demonstration verification methods. An example is given in Appendix B.

Note: For Command and Data Handling VDSs some of the COC submittals would follow the following process:

- At L-16 the PD would submit to the Payload Data Library (PDL), or IP equivalent, a COC that stated that the data is complete and ready for flight. This is considered a

"Private Level" PDL data submittal. Data requirements that should be part of the submittal consist of the following: 100% definition from the PD at the PDL for Payload Health & Status, Telemetry Packet Profiles, Telemetry Packet Definitions for HOSC, or IP equivalent, processing (if needed), command definitions, limits, state codes, and calibration coefficient for command and telemetry parameters. As a minimum, the PD should provide calibration coefficients based on the vendor data specification sheets from the hardware design if actual calibration coefficients are not available.

A "Private Level" submittal to PDL is the level that a PD can enter data into the PDL. This is the lowest level or the working level in PDL. Once a PD completes their data entry, then they can promote their data inside PDL to the integration level.

At the "Integration Level" period the IP PEI office has the responsibility to verify the validity of the ISPR data, for ISS compliance, which includes all Payload data for all Payloads inside that ISPR. The PEI office also has the responsibility to enter ISS controlled/provided data required to complete the Payloads data sets. If PEI discovers any problems with the data, then PEI will demote the Payload data back down to the Private Level to have it corrected by the PD. Once corrected, a new COC will be signed and the PD should promote the data back to the integration level. The final process is for PEI to promote the ISPR data set to the Configuration Management Level for baselining.

At the "Configuration Managed Level" the ISPR data set is controlled at the ISS level and all changes must go through the CR process. In addition, the ISPR data set can be sent to the dependent databases for flight configurations and simulations.

- At L-11 the PD should submit a COC that states either that there are no changes since the L-16 delivery or if there are changes, state what they are. The data requirements that may be submitted would consist of the following: Actual hardware calibration coefficients should be available, software definition changes due to test validations or simulations, and new software requirements. NOTE: The above PDL data input process for the PDs applies here as well.

- At L-8 the PD should submit a COC that states either that there are no changes since the L-11 delivery or if there are changes they are to state what they are. The data requirements that may be submitted would consist of the following: Actual hardware calibration coefficients should be available, software definition changes due to test validations or simulations, and new software requirements. NOTE: These are flight quality data definitions and no more changes are allowed after L-8. NOTE: The above PDL data input process for the PDs applies here as well.

- At L-6, on those C&DH VDSs that have "Test" as a verification method, the PD should submit a COC to certify that the testing was performed with the PRCU or equivalent after the data was verified by PSIV. NOTE: This is a general comment.

Specific VDSs have been updated to include L-6 test COC data submittal requirements.

(2) Data Certification

A Data Certification is a memorandum from a PD certifying that the requirements identified on the referenced VDS have been met and provides the required summary results. It should also state that the supporting data would be maintained by the PD and provided upon request. The Data Certification will provide the following information:

- Statement of fact concerning the completion of the applicable analysis or test.
- Completion date of the analysis or test
- Identification of the report containing the results of the analysis or test (i.e., Title and Number).
- Summary statement including the results of the analysis or test (e.g., margins of safety summary table or an isolation measurement).

An example is given in Appendix B.

(3) Detailed Data

Detailed analysis and test data per the data required section of each VDS. An example is given in Appendix B.

I. Data Submittal Dates:

This block contains the submittal dates for the required verification data. The submittal dates in this plan are in terms of Launch minus a number of months, (i.e., L-6 would be Launch minus six months).

J. Description of Reverification Requirements:

The reverification section of the VDS currently describes the two scenarios that may require additional verification activities to be performed by the PD. The activities could include a complete or partial rework of the analysis, demonstration, inspection, and test requirements that were originally needed to show compliance with the VDS. When the PD has defined any on-orbit subrack payload component or rack subsystem planned activities such as hardware modifications, component changeout, or maintenance, reverification requirements will be established and included in the Unique PVP. The details of the reverification requirement and the required submittal data are documented on each VDS in Appendix A. The two reverification conditions are listed below.

(1) On-orbit relocation of the integrated rack.

(2) On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack.

When the statement "Same as the Detailed Descriptions of Requirements identified above" is listed in this section, it means that the analysis, demonstration, inspection, or test identified in the original requirement must be redone.

K. Reverification Method:

This block contains the method(s) used for reverification.

L. Hazard Reports (This block can be used in the Unique PVP.)

Same as block D.

M. Required Reverification Data:

This section of the VDS identifies the data that must be submitted to show compliance with the reverification requirement. When the statement "Same as the Required Verification Data identified above", new COCs, Data Certs, or detailed data must be submitted to show compliance with the reverification requirement.

N. Data Submittal Dates:

This block contains the submittal dates for the required reverification data. Any data submittals with a L+ date must be submitted prior to any on-orbit operations of the payload.

O. Applicable Document(s):

This section of the VDS lists any documents that are applicable to the requirements listed on the VDS.

3.3 VERIFICATION SUBMITTAL PROCESS

The data submittals identified on the VDSs of the Unique PVP shall be submitted as they become available but no later than the agreed upon date listed in the each Unique PVP VDS. Example submittal forms are provided in Appendix B. PDs shall submit completed verification packages to the PEI Payload Verification Group. The applicable ICD Engineer will notify the PD if the PEI Team rejects the data submittal or requests additional data. The ICD Engineer will provide the PD a list of the additional data required to closeout the verification package. The PD shall submit the additional data required to the PEI Payload Verification Group per the required dates. Additionally, PDs can monitor the verification tracking process through the web page. Figure 3.1-1, Verification Process, contains the flow of the submittal process discussed above.

4.0 CROSS-REFERENCE MATRICES

This section contains Table 4-1, IRD Traceability Matrix, Table 4-2, VDS to IRD Section 4 cross-reference Matrix (the “Safety Yes/No” and “Hazard Number” columns are included is this table as aids in the construction of the Unique PVPs), Table 4-3, Control Plans Matrix, and Table 4-4, ISS Tasks To Provide Payload Rack Integrator Data Matrix.

TABLE 4-1 IRD TRACEABILITY MATRIX

IRD Par. #	IRD Requirement Title	VDS #
3.0	**PAYLOAD INTERFACE REQUIREMENTS AND GUIDANCE**	**TITLE**
3.1	**STRUCTURAL/MECHANICAL, MICROGRAVITY, AND STOWAGE INTERFACE REQUIREMENTS**	**TITLE**
3.1.1	Structural/Mechanical	NVR
3.1.1.1.A	GSE Interfaces	ME-051
3.1.1.1.B	GSE Interfaces	ME-051
3.1.1.1.C	GSE Interfaces	ME-051
3.1.1.1.D	GSE Interfaces	ST-007
3.1.1.2.A	MPLM Interfaces	ME-046
3.1.1.2.B	MPLM Interfaces	ST-003
3.1.1.2.C	MPLM Interfaces	**DELETED
3.1.1.2.D	MPLM Interfaces	**DELETED
3.1.1.2.E	MPLM Interfaces	ST-011
3.1.1.2.1	MPLM Late/Early Access Requirements	ME-058
3.1.1.2.1.1.A	MPLM Late Access Envelope (KSC)	ME-058
3.1.1.2.1.1.B	MPLM Late Access Envelope (KSC)	ME-058
3.1.1.2.1.1.C	MPLM Late Access Envelope (KSC)	ME-058
3.1.1.2.1.2.A	MPLM Early Access Envelopes (KSC and DFRC)	ME-058
3.1.1.2.1.2.B	MPLM Early Access Envelopes (KSC and DFRC)	ME-058
3.1.1.3.A	Loads Requirements	ST-001
3.1.1.3.B	Loads Requirements	ST-001
3.1.1.3.C	Loads Requirements	ME-004
3.1.1.3.D	Loads Requirements	ST-002
3.1.1.3.E	Loads Requirements	ST-001
3.1.1.3.F	Loads Requirements	ST-001
3.1.1.4.A	Rack Requirements	ME-001
3.1.1.4.B	Rack Requirements	ST-003
3.1.1.4.C	Rack Requirements	ST-004
3.1.1.4.D	Rack Requirements	Info. Only
3.1.1.4.E	Rack Requirements	ME-021
3.1.1.4.F	Rack Requirements	ME-015
3.1.1.4.G	Rack Requirements	**DELETED
3.1.1.4.H	Rack Requirements	**DELETED
3.1.1.4.I	Rack Requirements	ME-021
3.1.1.4.J	Rack Requirements	**DELETED
3.1.1.4.K	Rack Requirements	ST-003
3.1.1.4.L	Rack Requirements	ME-021
3.1.1.4.M	Rack Requirements	TBD

TABLE 4-1 IRD TRACEABILITY MATRIX

IRD Par. #	IRD Requirement Title	VDS #
3.1.1.4.1.A	Lab Window Rack Location Requirements	ST-002
3.1.1.4.1.B	Lab Window Rack Location Requirements	ME-015
3.1.1.4.1.C	Lab Window Rack Location Requirements	ME-015
3.1.1.5.A	Safety Critical Structures Requirements	ST-001 ST-002 ST-003 ST-004 ST-008 ST-009 ST-010
3.1.1.5.B	Safety Critical Structures Requirements	**DELETED
3.1.1.5.C	Safety Critical Structures Requirements	**DELETED
3.1.1.5.D	Safety Critical Structures Requirements	**DELETED
3.1.1.6	**CONNECTOR AND UMBILICAL PHYSICAL MATE**	**TITLE**
3.1.1.6.1	Connector Physical Mate	ME-056
3.1.1.6.2	Umbilical Physical Mate	ME-014
3.1.1.7.A	On-Orbit Payload Protrusions	ME-059
3.1.1.7.B	On-Orbit Payload Protrusions	ME-059
3.1.1.7.1	On-Orbit Permanent Protrusions	ME-059
3.1.1.7.2.A	On-Orbit Semi-Permanent Protrusions	ME-059
3.1.1.7.2.B	On-Orbit Semi-Permanent Protrusions	ME-059
3.1.1.7.2.C	On-Orbit Semi-Permanent Protrusions	ME-059
3.1.1.7.3.A	On-Orbit Temporary Protrusions	ME-059
3.1.1.7.3.B	On-Orbit Temporary Protrusions	ME-059
3.1.1.7.4	On-Orbit Momentary Protrusions	ME-059
3.1.1.7.5.A	On-Orbit Protrusions For Keep Alive Payloads	ME-059
3.1.1.7.5.B	On-Orbit Protrusions For Keep Alive Payloads	ME-059
3.1.2	**MICROGRAVITY**	**TITLE**
3.1.2.1.A	Quasi-Steady Requirements	EN-005
3.1.2.1.B	Quasi-Steady Requirements	EN-005
3.1.2.2.A	Vibratory Requirements	EN-005
3.1.2.2.B	Vibratory Requirements	EN-005
3.1.2.3.A	Transient Requirements	EN-005
3.1.2.3.B	Transient Requirements	EN-005
3.1.2.4	Microgravity Environment	Info. Only
3.1.2.5	ARIS Interfaces	NVR
3.1.3	Stowage	Info. Only
3.2	Electrical Interface Requirements	NVR
3.2.1	Electrical Power Characteristics	NVR
3.2.1.1	Steady-State Voltage Characteristics	NVR
3.2.1.1.1	Interface B	EL-001
3.2.1.1.2	Interface C	EL-001
3.2.1.2	Ripple Voltage Characteristics	NVR
3.2.1.2.1	Ripple Voltage and Noise	EL-002
3.2.1.2.2	Ripple Voltage Spectrum	EL-002

TABLE 4-1 IRD TRACEABILITY MATRIX

IRD Par. #	IRD Requirement Title	VDS #
3.2.1.3	Transient Voltages	NVR
3.2.1.3.1	Interface B	EL-003
3.2.1.3.2	Interface C	EL-003
3.2.1.3.3	Fault Clearing and Protection	EL-004
3.2.1.3.4.A	Non-Normal Voltage Range	EL-005
3.2.1.3.4.B	Non-Normal Voltage Range	EL-005
3.2.1.4.A	Common Mode Noise	**DELETED
3.2.1.4.B	Common Mode Noise	**DELETED
3.2.2	Electrical Power Interface	NVR
3.2.2.1.A	UIP and UOP Connectors and Pin Assignments	NVR
3.2.2.1.B	UIP and UOP Connectors and Pin Assignments	EL-007
3.2.2.1.C	UIP and UOP Connectors and Pin Assignments	EL-007
3.2.2.1.D	UIP and UOP Connectors and Pin Assignments	NVR
3.2.2.1.E	UIP and UOP Connectors and Pin Assignments	EL-007
3.2.2.1.F	UIP and UOP Connectors and Pin Assignments	EL-007
3.2.2.2.A	Power Bus Isolation	EL-008
3.2.2.2.B	Power Bus Isolation	EL-008
3.2.2.3	Compatibility With Soft Start/Stop RPC	EL-009
3.2.2.4	Surge Current	EL-010
3.2.2.5	Reverse Energy/Current	EL-011
3.2.2.6	Circuit Protection Devices	NVR
3.2.2.6.1	ISS EPS Circuit Protection Characteristics	NVR
3.2.2.6.1.1.A	Remote Power Controllers (RPCs)	EL-012
3.2.2.6.1.1.B	Remote Power Controllers (RPCs)	EL-012
3.2.2.6.1.1.C	Remote Power Controllers (RPCs)	EL-012
3.2.2.6.1.1.D	Remote Power Controllers (RPCs)	EL-012
3.2.2.6.1.1.E	Remote Power Controllers (RPCs)	EL-012
3.2.2.6.2	EPCE RPC Interface Requirements	NVR
3.2.2.6.2.1	RPC Trip Coordination	NVR
3.2.2.6.2.1.1	Payload Trip Rating	EL-012
3.2.2.6.2.1.2	Deleted	DELETED
3.2.2.7	EPCE Complex Load Impedances	NVR
3.2.2.7.1.A	Interface B	EL-014
3.2.2.7.1.B	Interface B	EL-014
3.2.2.7.2	Interface C	EL-014
3.2.2.8	Large Signal Stability	EL-023
3.2.2.9	Maximum Ripple Voltage Emissions	EL-015
3.2.2.10.A	Electrical Load-Stand Alone Stability	EL-016
3.2.2.10.B	Electrical Load-Stand Alone Stability	EL-016
3.2.2.10.C	Electrical Load-Stand Alone Stability	EL-016
3.2.2.11	Electrical Load Inductance (TBD)	TBD
3.2.3	Electrical Power Consumer Constraints	NVR
3.2.3.1.A	Wire Derating	EL-017
3.2.3.1.B	Wire Derating	EL-017
3.2.3.1.C	Wire Derating	EL-017
3.2.3.2.A	Exclusive Power Feeds	EL-018
3.2.3.2.B	Exclusive Power Feeds	EL-018

TABLE 4-1 IRD TRACEABILITY MATRIX

IRD Par. #	IRD Requirement Title	VDS #
3.2.3.3	Loss of Power	*SAFETY
3.2.4	Electromagnetic Compatibility	EL-020
3.2.4.1	Electrical Grounding	EL-021
3.2.4.2	Electrical Bonding	EL-022
3.2.4.3	Cable/Wire Design and Control Requirements	EL-021
3.2.4.4	Electromagnetic Interference	EL-020
3.2.4.5	Electrostatic Discharge	EL-024
3.2.4.6	Alternating Current (ac) Magnetic Fields	EL-020
3.2.4.7	Direct Current (dc) Magnetic Fields	EL-020
3.2.4.8	Corona	EL-042
3.2.4.9	Lightning	EL-025
3.2.4.10	EMI Susceptibility for Safety-Critical Circuits	EL-019
3.2.5	Safety Requirements	NVR
3.2.5.1	Payload Electrical Safety	NVR
3.2.5.1.1	Mating/Demating of Powered Connectors	*SAFETY
3.2.5.1.2	Safety-Critical Circuits Redundancy	*SAFETY
3.2.5.2	Rack Maintenance Switch (Rack Power Switch)	EL-028
3.2.5.3.A	Power Switches/Controls	EL-029
3.2.5.3.B	Power Switches/Controls	EL-029
3.2.5.3.C	Power Switches/Controls	EL-029
3.2.5.4.A	Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage	EL-030
3.2.5.4.B	Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage	EL-030
3.2.5.4.C	Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage	EL-030
3.2.5.4.D	Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage	EL-030
3.2.5.4.E	Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage	EL-030
3.2.5.4.F	Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage	EL-030
3.2.5.4.G	Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage	EL-030
3.2.5.5.A	Portable Equipment/Power Cords	EL-031
3.2.5.5.B	Portable Equipment/Power Cords	EL-031
3.2.5.6	Deleted	**DELETED
3.2.6	MPLM	NVR
3.2.6.1.A	MPLM Electrical Power Characteristics	EL-035
3.2.6.1.B	MPLM Electrical Power Characteristics	EL-035
3.2.6.1.C	MPLM Electrical Power Characteristics	EL-035
3.2.6.1.D	MPLM Electrical Power Characteristics	EL-035
3.2.6.1.E	MPLM Electrical Power Characteristics	EL-035
3.2.6.1.F	MPLM Electrical Power Characteristics	EL-035
3.2.6.1.G	MPLM Electrical Power Characteristics	EL-035
3.2.6.1.H	MPLM Electrical Power Characteristics	**DELETED
3.2.6.1.I	MPLM Electrical Power Characteristics	**DELETED
3.2.6.2.A	MPLM Electrical Power Interface	EL-036

TABLE 4-1 IRD TRACEABILITY MATRIX

IRD Par. #	IRD Requirement Title	VDS #
3.2.6.2.B	MPLM Electrical Power Interface	EL-036
3.2.6.2.C	MPLM Electrical Power Interface	EL-036
3.2.6.2.D	MPLM Electrical Power Interface	EL-036
3.2.6.2.E	MPLM Electrical Power Interface	EL-036
3.2.6.2.F	MPLM Electrical Power Interface	EL-036
3.2.6.2.1.A	MPLM UIP Connector and Pin Assignments	NVR
3.2.6.2.1.B	MPLM UIP Connector and Pin Assignments	EL-037
3.2.6.2.1.C	MPLM UIP Connector and Pin Assignments	EL-037
3.2.6.2.2	Compatibility with RPC Soft Start/Stop in MPLM	EL-037
3.2.6.2.3.A	MPLM Surge Current	EL-037
3.2.6.2.3.B	MPLM Surge Current	EL-037
3.2.6.2.3.C	MPLM Surge Current	EL-037
3.2.6.2.3.D	MPLM Surge Current	EL-037
3.2.6.2.4	MPLM Reverse Energy/Current	EL-037
3.2.6.2.5	MPLM Payload Trip Ratings	EL-037
3.2.6.3.A	MPLM Electrical Power Consumer Constraints	EL-038
3.2.6.3.B	MPLM Electrical Power Consumer Constraints	EL-038
3.2.6.3.C	MPLM Electrical Power Consumer Constraints	EL-038
3.2.6.3.D	MPLM Electrical Power Consumer Constraints	EL-038
3.2.6.4.A	MPLM Electromagnetic Compatibility	EL-039
3.2.6.4.B	MPLM Electromagnetic Compatibility	EL-039
3.2.6.4.C	MPLM Electromagnetic Compatibility	EL-039
3.2.6.4.D	MPLM Electromagnetic Compatibility	EL-039
3.2.6.4.E	MPLM Electromagnetic Compatibility	EL-039
3.2.6.4.F	MPLM Electromagnetic Compatibility	EL-039
3.2.6.4.G	MPLM Electromagnetic Compatibility	EL-039
3.2.6.4.H	MPLM Electromagnetic Compatibility	EL-039
3.2.6.4.I	MPLM Electromagnetic Compatibility	EL-039
3.2.6.4.J	MPLM Electromagnetic Compatibility	EL-039
3.2.6.4.1	MPLM Bonding	EL-039
3.2.6.5.A	MPLM Safety Requirements	EL-040
3.2.6.5.B	MPLM Safety Requirements	EL-040
3.2.6.5.C	MPLM Safety Requirements	EL-040
3.2.6.5.D	MPLM Safety Requirements	EL-040
3.2.6.5.E	MPLM Safety Requirements	EL-040
3.2.6.5.F	MPLM Safety Requirements	EL-040
3.3	**COMMAND AND DATA HANDLING INTERFACE REQUIREMENTS**	**TITLE**
3.3.1	General Requirements	NVR
3.3.2	Word/Byte Notations, Types, And Data Transmissions	Info. Only
3.3.2.1	Word/Byte Notations	CD-001
3.3.2.2	Data Types	CD-001
3.3.2.3.A	Data Transmissions	CD-001
3.3.2.3.B	Data Transmissions	CD-001
3.3.2.3.C	Data Transmissions	CD-001
3.3.3	Deleted	**DELETED
3.3.4	Consultative Committee For Space Data Systems	NVR

TABLE 4-1 IRD TRACEABILITY MATRIX

IRD Par. #	IRD Requirement Title	VDS #
3.3.4.1.A	CCSDS Data	CD-001
3.3.4.1.B	CCSDS Data	CD-001
3.3.4.1.C	CCSDS Data	CD-001
3.3.4.1.1	CCSDS Data Packets	CD-001
3.3.4.1.1.1	CCSDS Primary Header	CD-001
3.3.4.1.1.2.A	CCSDS Secondary Header	CD-001
3.3.4.1.2	CCSDS Data Field	CD-003
3.3.4.1.3	CCSDS Data Bitstream	CD-003
3.3.4.1.4	CCSDS Application Process Identification Field	NVR
3.3.4.2	CCSDS Time Codes	NVR
3.3.4.2.1	CCSDS Unsegmented Time	CD-004
3.3.4.2.2	CCSDS Segmented Time	NVR
3.3.5	MIL-STD-1553B Low Rate Data Link (LRDL)	CD-005
3.3.5.1	MIL-STD-1553B Protocol	NVR
3.3.5.1.1	Standard Messages	CD-005
3.3.5.1.2	Commanding	CD-005
3.3.5.1.3	Health and Status Data	CD-005
3.3.5.1.4.B	Safety Data	CD-005
3.3.5.1.4.1	Caution And Warning	NVR
3.3.5.1.4.1.1	Class 1 - Emergency	NVR
3.3.5.1.4.1.2	Class 2 - Warning	CD-021
3.3.5.1.4.1.3	Class 3 - Caution	CD-021
3.3.5.1.4.1.4	Class 4 - Advisory	CD-021
3.3.5.1.5	Service Requests	CD-006
3.3.5.1.6	Ancillary Data	NVR
3.3.5.1.7	File Transfer	CD-006
3.3.5.1.8	Low Rate Telemetry	CD-006
3.3.5.1.9	Defined Mode Codes	CD-007
3.3.5.1.10	Implemented Mode Codes	CD-007
3.3.5.1.11	Unimplemented/Undefined Mode Codes	CD-008
3.3.5.1.12	Illegal Commands	CD-008
3.3.5.2	MIL-STD-1553B Low Rate Data Link (LRDL) Interface Characteristics	NVR
3.3.5.2.1	LRDL Remote Terminal Assignment	NVR
3.3.5.2.1.1	LRDL Connector/Pin Assignments	NVR
3.3.5.2.1.2.A	MIL-STD-1553B Bus A Connector/Pin Assignment	NVR
3.3.5.2.1.2.B	MIL-STD-1553B Bus A Connector/Pin Assignment	EL-007
3.3.5.2.1.2.C	MIL-STD-1553B Bus A Connector/Pin Assignment	EL-007
3.3.5.2.1.3.A	Deleted	**DELETED
3.3.5.2.1.3.B	Deleted	**DELETED
3.3.5.2.1.3.C	Deleted	**DELETED
3.3.5.2.1.4.A	Remote Terminal Hardwired Address Coding	CD-026
3.3.5.2.1.4.B	Remote Terminal Hardwired Address Coding	CD-026
3.3.5.2.1.4.C	Remote Terminal Hardwired Address Coding	CD-026
3.3.5.2.1.4.D	Remote Terminal Hardwired Address Coding	CD-026
3.3.5.2.1.4.E	Remote Terminal Hardwired Address Coding	CD-026

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IRD Par. #	IRD Requirement Title	VDS #
3.3.5.2.2	LRDL Signal Characteristics	CD-009
3.3.5.2.3	LRDL Cabling	EL-032
3.3.5.2.4	Multi-Bus Isolation	CD-025
3.3.6	Medium Rate Data Link (MRDL)	NVR
3.3.6.1	MRDL Protocol	CD-010
3.3.6.1.1	Integrated Rack Protocols on the MRDL	CD-010
3.3.6.1.2.A	MRDL Address	CD-011
3.3.6.1.2.B	MRDL Address	CD-011
3.3.6.1.2.C	MRDL Address	CD-011
3.3.6.1.3.A	ISPR MRDL Connectivity	CD-011
3.3.6.1.3.B	ISPR MRDL Connectivity	CD-011
3.3.6.1.3.C	ISPR MRDL Connectivity	CD-011
3.3.6.1.4.A	MRDL Connector/Pin Assignments and Wire Requirements	NVR
3.3.6.1.4.B	MRDL Connector/Pin Assignments and Wire Requirements	EL-007
3.3.6.1.4.C	MRDL Connector/Pin Assignments and Wire Requirements	EL-007
3.3.6.1.4.D	MRDL Connector/Pin Assignments and Wire Requirements	EL-007
3.3.6.1.4.1	Deleted	N/A
3.3.6.1.4.2	Deleted	N/A
3.3.6.1.5	MRDL Signal Characteristics	CD-012
3.3.6.1.6	MRDL Cable Characteristics	EL-033
3.3.6.1.6.1	Insertion Loss	CD-012
3.3.6.1.6.2	Differential Characteristic Impedance	CD-012
3.3.6.1.6.3	Medium Timing Jitter	CD-012
3.3.7	High Rate Data Link (HRDL)	NVR
3.3.7.1	Payload To High Rate Frame Multiplexer (HRFM) Protocols	NVR
3.3.7.2	HRDL Interface Characteristics	NVR
3.3.7.2.1	Physical Signaling	CD-013
3.3.7.2.1.1.A	Physical Signaling Date Rates	CD-013
3.3.7.2.1.1.B	Physical Signaling Date Rates	CD-013
3.3.7.2.1.1.C	Physical Signaling Date Rates	CD-013
3.3.7.2.2	Encoding	CD-013
3.3.7.2.3	Deleted	DELETED
3.3.7.3	Integrated Rack HRDL Optical Power	NVR
3.3.7.3.1	Integrated Rack HRDL Transmitted Optical Power	CD-014
3.3.7.3.2	Integrated Rack HRDL Received Optical Power	CD-014
3.3.7.4	HRDL Fiber Optical Cable	EL-027
3.3.7.5	HRDL Fiber Optical Cable Bend Radius	ME-005
3.3.7.6.A	HRDL Connectors and Fiber	NVR
3.3.7.6.B	HRDL Connectors and Fiber	EL-007
3.3.7.6.C	HRDL Connectors and Fiber	EL-007
3.3.7.6.D	HRDL Connectors and Fiber	EL-007
3.3.8	Portable Computers	NVR

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IRD Par. #	IRD Requirement Title	VDS #
3.3.8.1.A	Payload Laptop	CD-022
3.3.8.1.B	Payload Laptop	CD-022
3.3.8.1.C	Payload Laptop	CD-022
3.3.8.1.D	Payload Laptop	CD-022
3.3.8.1.E	Payload Laptop	CD-022
3.3.8.1.F	Payload Laptop	CD-022
3.3.8.1.G	Payload Laptop	CD-022
3.3.8.1.H	Payload Laptop	CD-022
3.3.8.2.A	PCS	CD-023
3.3.8.2.B	PCS	CD-023
3.3.8.2.C	PCS	CD-023
3.3.8.2.1.A	PCS to UOP Interface	NVR
3.3.8.2.1.B	PCS to UOP Interface	NVR
3.3.8.2.2.A	760XD Laptop to Rack Interface	CD-022
3.3.8.2.2.B	760XD Laptop to Rack Interface	CD-022
3.3.8.2.2.C	760XD Laptop to Rack Interface	CD-022
3.3.8.2.2.D	760XD Laptop to Rack Interface	CD-022
3.3.8.3.A	SSC	CD-024
3.3.8.3.B	SSC	CD-024
3.3.9	UOP	NVR
3.3.10	Maintenance Switch, Smoke Detector, Smoke Indicator, And Integrated Rack Fan Interfaces	NVR
3.3.10.1.A	Rack Maintenance Switch (Rack Power Switch) Interface	CD-015
3.3.10.1.B	Rack Maintenance Switch (Rack Power Switch) Interface	CD-015
3.3.10.2	Smoke Detector Interfaces	CD-016
3.3.10.2.1	Analog Interface Characteristics	CD-016
3.3.10.2.2	Discrete Command Built-In-Test Interface Characteristics	CD-016
3.3.10.2.3	Smoke Indicator Electrical Interfaces	CD-019
3.3.10.2.4	Fan Ventilation Status Electrical Interfaces	CD-019
3.3.10.3.A	Rack Maintenance Switch (Rack Power Switch)/Fire Detection Support Interface Connector	NVR
3.3.10.3.B	Maintenance Switch/Fire Detection Support Interface Connector	EL-034
3.3.10.3.C	Maintenance Switch/Fire Detection Support Interface Connector	EL-034
3.4	Payload NTSC Video And Audio Interface Requirements	NVR
3.4.1	Payload NTSC Video Interface Requirements	NVR
3.4.1.1.A	Payload NTSC Optical Video Characteristics	CD-017
3.4.1.1.B	Payload NTSC Optical Video Characteristics	CD-017
3.4.1.1.C	Payload NTSC Optical Video Characteristics	CD-017
3.4.1.2	NTSC Fiber Optic Video	NVR
3.4.1.2.1.A	Pulse Frequency Modulation NTSC Fiber Optic Video Characteristics	CD-017
3.4.1.2.1.B	Pulse Frequency Modulation NTSC Fiber Optic Video Characteristics	CD-017
3.4.1.2.2	Integrated Rack NTSC PFM Video Transmitted Optical Power	CD-017
3.4.1.2.3	Integrated Rack NTSC PFM Video and Sync Signal	CD-017

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IRD Par. #	IRD Requirement Title	VDS #
	Received Optical Power	
3.4.1.2.4	Fiber Optic Cable Characteristics	EL-027
3.4.1.2.5	PFM NTSC Video Fiber Optic Cable Bend Radius	ME-005
3.4.1.2.6	Deleted	**DELETED
3.4.1.2.7.A	PFM NTSC Optical Connector/Pin Assignments	NVR
3.4.1.2.7.B	PFM NTSC Optical Connector/Pin Assignments	EL-007
3.4.1.2.7.C	PFM NTSC Optical Connector/Pin Assignments	EL-007
3.4.1.3	NTSC Electrical Video Interfaces	NVR
3.4.1.3.1	Cables	CD-018
3.4.1.3.2	Signal Standard	CD-018
3.4.1.3.3	Interface Circuit	CD-018
3.4.1.3.4	Cross Talk	CD-018
3.4.1.4.A	NTSC Electrical Connector/Pin Assignments	NVR
3.4.1.4.B	NTSC Electrical Connector/Pin Assignments	EL-007
3.4.1.4.C	NTSC Electrical Connector/Pin Assignments	EL-007
3.4.2	U.S. Element Audio Interface Requirements	NVR
3.5	**THERMAL CONTROL INTERFACE REQUIREMENTS**	**TITLE**
3.5.1	**INTERNAL THERMAL CONTROL SYSTEM (ITCS) INTERFACE REQUIREMENTS**	**TITLE**
3.5.1.1.A	Physical Interface	NVR
3.5.1.1.B	Physical Interface	NVR
3.5.1.2.A	ITCS Fluid Use and Charging	FD-002
3.5.1.2.B	ITCS Fluid Use and Charging	FD-002
3.5.1.3	**ITCS PRESSURE DROP**	**TITLE**
3.5.1.3.1.A	On-Orbit Interface	FD-003
3.5.1.3.1.B	On-Orbit Interface	FD-003
3.5.1.3.2	MPLM Interface	FD-003
3.5.1.4.A	Coolant Flow Rate	FD-004
3.5.1.4.B	Coolant Flow Rate	FD-004
3.5.1.5.A	Coolant Supply Temperature	NVR
3.5.1.5.B	Coolant Supply Temperature	NVR
3.5.1.6.A	Coolant Return Temperature	FD-005
3.5.1.6.B	Coolant Return Temperature	FD-005
3.5.1.6.C	Coolant Return Temperature	FD-005
3.5.1.6.D	Coolant Return Temperature	FD-005
3.5.1.7.A	Coolant Maximum Design Pressure (Moderate Temperature Loop)	ST-010
3.5.1.7.B	Coolant Maximum Design Pressure (Low Temperature Loop)	ST-010
3.5.1.7.C	Coolant Maximum Design Pressure (MPLM Temperature Loop)	ST-010
3.5.1.8	Fail Safe Design	FD-031
3.5.1.9.A	Leakage	FD-006
3.5.1.9.B	Leakage	FD-006
3.5.1.10	Quick-Disconnect Air Inclusion	FD-007
3.5.1.11	Rack Front Surface Temperature	FD-032

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IRD Par. #	IRD Requirement Title	VDS #
3.5.1.12	Cabin Air Heat Leak	FD-008
3.5.1.13	MPLM Cabin Air Cooling	FD-009
3.5.1.14.A	Simultaneous Cooling	FD-010
3.5.1.14.B	Simultaneous Cooling	FD-010
3.5.1.15	Control System Time Constant	FD-011
3.5.1.16	Payload Coolant Quantity	FD-012
3.5.1.17	Payload Gas Inclusion	FD-013
3.6	**VACUUM SYSTEM REQUIREMENTS**	**TITLE**
3.6.1	**VACUUM EXHAUST SYSTEM(VES)/WASTE GAS SYSTEM (WGS)REQUIREMENTS**	**TITLE**
3.6.1.1	VES/WGS Physical Interface	NVR
3.6.1.2.A	Input Pressure Limit	FD-015
3.6.1.2.B	Input Pressure Limit	FD-015
3.6.1.2.C	Input Pressure Limit	FD-015
3.6.1.3	Input Temperature Limit	FD-016
3.6.1.4	Input Dewpoint Limit	FD-017
3.6.1.5.A	Acceptable Exhaust Gases	FD-018
3.6.1.5.B	Acceptable Exhaust Gases	FD-018
3.6.1.5.C	Acceptable Exhaust Gases	FD-018
3.6.1.5.D	Acceptable Exhaust Gases	FD-018
3.6.1.5.1.A	Acceptable Gases - Initial List	NVR
3.6.1.5.1.B	Acceptable Gases - Initial List	NVR
3.6.1.5.1.C	Acceptable Gases - Initial List	NVR
3.6.1.5.2	External Contamination Control	FD-019
3.6.1.5.3.A	Incompatible Gases	FD-020
3.6.1.5.3.B	Incompatible Gases	FD-020
3.6.1.6	Payload Vacuum System Access Valve	FD-035
3.6.2	**VACUUM RESOURCE SYSTEM (VRS)/VACUUM VENT SYSTEM (VVS) REQUIREMENTS**	**TITLE**
3.6.2.1	VRS/VVS Physical Interface	NVR
3.6.2.2.A	Input Pressure Limit	FD-022
3.6.2.2.B	Input Pressure Limit	FD-022
3.6.2.2.C	Input Pressure Limit	FD-022
3.6.2.3	VRS/VVS Through-Put Limit	FD-023
3.6.2.4	Acceptable Gases	NVR
3.7	**PRESSURIZED GASES INTERFACE REQUIREMENTS**	**TITLE**
3.7.1	**NITROGEN INTERFACE REQUIREMENTS**	**TITLE**
3.7.1.1	Nitrogen Interface Control	FD-024
3.7.1.2	Nitrogen Interface MDP	FD-025
3.7.1.3	Nitrogen Interface Temperature	FD-026
3.7.1.4	Nitrogen Leakage	FD-027
3.7.1.5	Nitrogen Physical Interface	NVR
3.7.2	**ARGON INTERFACE REQUIREMENTS**	**TITLE**
3.7.2.1	Argon Interface Control	FD-024
3.7.2.2	Argon Interface MDP	FD-025
3.7.2.3	Argon Interface Temperature	FD-026

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IRD Par. #	IRD Requirement Title	VDS #
3.7.2.4	Argon Leakage	FD-027
3.7.2.5	Argon Physical Interface	NVR
3.7.3	**CARBON DIOXIDE INTERFACE REQUIREMENTS**	**TITLE**
3.7.3.1	Carbon Dioxide Interface Control	FD-024
3.7.3.2	Carbon Dioxide Interface MDP	FD-025
3.7.3.3	Carbon Dioxide Interface Temperature	FD-026
3.7.3.4	Carbon Dioxide Leakage	FD-027
3.7.3.5	Carbon Dioxide Physical Interface	NVR
3.7.4	**HELIUM INTERFACE REQUIREMENTS**	**TITLE**
3.7.4.1	Helium Interface Control	FD-024
3.7.4.2	Helium Interface MDP	FD-025
3.7.4.3	Helium Interface Temperature	FD-026
3.7.4.4	Helium Leakage	FD-027
3.7.4.5	Helium Physical Interface	NVR
3.7.5	Pressurized Gas Systems	FD-028
3.7.6	Manual Valves	ME-048
3.8	**PAYLOAD SUPPORT SERVICES INTERFACES REQUIREMENTS**	**TITLE**
3.8.1	Potable Water	NVR
3.8.1.1	Potable Water Interface Connection	NVR
3.8.1.2	Potable Water Interface Pressure	FD-029
3.8.1.3.A	Potable Water Use	FD-030
3.8.1.3.B	Potable Water Use	FD-030
3.8.2	Fluid System Servicer	ME-049
3.9	**ENVIRONMENT INTERFACE REQUIREMENTS**	**TITLE**
3.9.1	**ATMOSPHERE REQUIREMENTS**	**TITLE**
3.9.1.1	Pressure	*SAFETY
3.9.1.2	Temperature	*SAFETY
3.9.1.3	Humidity	EN-001
3.9.2	**INTEGRATED RACK USE OF CABIN ATMOSPHERE**	**TITLE**
3.9.2.1.A	Active Air Exchange	EN-002
3.9.2.1.B	Active Air Exchange	EN-002
3.9.2.2	Oxygen Consumption	EN-003
3.9.2.3	Chemical Releases	*SAFETY
3.9.3	**RADIATION REQUIREMENTS**	**TITLE**
3.9.3.1	Integrated Rack Contained or Generated Ionizing Radiation	*SAFETY
3.9.3.2	Ionizing Radiation Dose	NVR
3.9.3.3	Single Event Effect (SEE) Ionizing Radiation	EN-004
3.9.3.4	Lab Window Rack Location Radiation Requirements	NVR
3.9.3.4.1	Window Rack Infrared Radiation Requirements	EN-007
3.9.3.4.2	Window Rack Ultraviolet Radiation Requirements	EN-007
3.9.4	Additional Environmental Conditions	NVR
3.10	**FIRE PROTECTION INTERFACE REQUIREMENTS**	**TITLE**
3.10.1	Fire Prevention	*SAFETY

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IRD Par. #	IRD Requirement Title	VDS #
3.10.2	Payload Monitoring And Detection Requirements	NVR
3.10.2.1	**SMOKE DETECTION**	**TITLE**
3.10.2.1.1.A	Smoke Detector	ME-052
3.10.2.1.1.B	Smoke Detector	ME-052
3.10.2.1.2	Force Air Circulation Indication	ME-052
3.10.2.1.3.A	Fire Detection Indicator	ME-054
3.10.2.1.3.B	Fire Detection Indicator	ME-054
3.10.2.2	**PARAMETER MONITORING**	**TITLE**
3.10.2.2.1	Parameter Monitoring Use	ME-054
3.10.2.2.2	**PARAMETER MONITORING RESPONSE**	**TITLE**
3.10.2.2.2.1.A	Parameter Monitoring in Subrack	CD-020
3.10.2.2.2.1.B	Parameter Monitoring in Subrack	CD-020
3.10.2.2.2.2.A	Parameter Monitoring in Integrated Rack	CD-020
3.10.2.2.2.2.B	Parameter Monitoring in Integrated Rack	CD-020
3.10.3	Fire Suppression	NVR
3.10.3.1.A	Portable Fire Extinguisher	ME-055
3.10.3.1.B	Portable Fire Extinguisher	ME-055
3.10.3.2	Fire Suppression Access Port Accessibility	ME-055
3.10.3.3	Fire Suppressant Distribution	ME-055
3.10.3.4	Deleted	**DELETED
3.10.3.4.1	Deleted	N/A
3.10.3.4.2	Deleted	N/A
3.10.4.A	Labeling	ME-055
3.10.4.B	Labeling	ME-054
3.11	**MATERIALS AND PARTS INTERFACE REQUIREMENTS**	**TITLE**
3.11.1	Materials and Parts Use and Selection	*SAFETY
3.11.1.1	Commercial Parts	*SAFETY
3.11.2.A	Fluids	MP-001
3.11.2.B	Fluids	MP-001
3.11.2.C	Fluids	MP-001
3.11.3	Cleanliness	MP-002
3.11.4	Fungus Resistant Material	MP-003
3.12	**HUMAN FACTORS INTERFACE REQUIREMENTS**	**TITLE**
3.12.1.A	Strength Requirements	ST-005
3.12.1.B	Strength Requirements	ST-005
3.12.2	**BODY ENVELOPE AND REACH ACCESSIBILITY**	**TITLE**
3.12.2.1	Adequate Clearance	ME-021
3.12.2.2.A	Accessibility	ME-021
3.12.2.2.B	Accessibility	ME-021
3.12.2.3	Full Size Range Accommodation	ME-006
3.12.3	**HABITABILITY**	**TITLE**
3.12.3.1	**HOUSEKEEPING**	**TITLE**
3.12.3.1.1	Closures and Covers	ME-007

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IRD Par. #	IRD Requirement Title	VDS #
3.12.3.1.2.A	Built-In Control	ME-008
3.12.3.1.2.B	Built-In Control	ME-008
3.12.3.1.2.C	Deleted	**DELETED
3.12.3.1.3	Deleted	**DELETED
3.12.3.1.4	Deleted	**DELETED
3.12.3.1.5	One-Handed Operation	ME-009
3.12.3.1.6	Deleted	**DELETED
3.12.3.2	Touch Temperature	*SAFETY
3.12.3.2.1	Continuous/Incidental Contact - High Temperature	*SAFETY
3.12.3.2.2	Continuous/Incidental Contact - Low Temperature	*SAFETY
3.12.3.3	Acoustic Requirements	NVR
3.12.3.3.1.A	Continuous Noise Limits - Integrated Rack Whose Sub-rack Equipment Will Not Be Changed Out	EN-006
3.12.3.3.1.B	Continuous Noise Limits - Integrated Rack Whose Sub-rack Equipment Will Be Changed Out	EN-006
3.12.3.3.1.C	Continuous Noise Limits - Independently Operated Equipment	EN-006
3.12.3.3.2	Intermittent Noise Limits	EN-006
3.12.3.4.A	Lighting Design	ME-043
3.12.3.4.B	Lighting Design	ME-043
3.12.3.4.C	Lighting Design	ME-043
3.12.3.4.D	Lighting Design	ME-043
3.12.3.4.E	Lighting Design	ME-043
3.12.4	**STRUCTURAL/MECHANICAL INTERFACES**	**TITLE**
3.12.4.1	Deleted	**DELETED
3.12.4.1.1	Deleted	**DELETED
3.12.4.2	**PAYLOAD HARDWARE MOUNTING**	**TITLE**
3.12.4.2.1	Equipment Mounting	ME-011
3.12.4.2.2	Drawers and Hinged Panels	ME-012
3.12.4.2.3	Deleted	**DELETED
3.12.4.2.4	Deleted	**DELETED
3.12.4.2.5	Alignment	ME-013
3.12.4.2.5.1	Deleted	**DELETED
3.12.4.2.6	Slide-out Stops	ME-002
3.12.4.2.7	Push-Pull Forces	ST-006
3.12.4.2.8	Access	ME-042
3.12.4.2.8.1.A	Covers	ME-007
3.12.4.2.8.1.B	Covers	ME-007
3.12.4.2.8.2	Self-Supporting Covers	ME-007
3.12.4.2.8.3	Deleted	**DELETED
3.12.4.2.8.4	Unique Tools	ME-016
3.12.4.3	**CONNECTORS**	**TITLE**
3.12.4.3.1	One-Handed Operation	ME-017
3.12.4.3.2.A	Accessibility	ME-018
3.12.4.3.2.B	Accessibility	ME-018
3.12.4.3.3.A	Ease of Disconnect	ME-017
3.12.4.3.3.B	Ease of Disconnect	ME-017

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IRD Par. #	IRD Requirement Title	VDS #
3.12.4.3.4	Indication of Pressure/Flow	ME-050
3.12.4.3.5	Self Locking	ME-017
3.12.4.3.6.A	Connector Arrangement	ME-018
3.12.4.3.6.B	Connector Arrangement	ME-018
3.12.4.3.7	Arc Containment	EL-026
3.12.4.3.8	Connector Protection	ME-019
3.12.4.3.9	Connector Shape	ME-019
3.12.4.3.10	Fluid and Gas Line Connectors	FD-001
3.12.4.3.11.A	Alignment Marks or Guide Pins	ME-020
3.12.4.3.11.B	Deleted	**DELETED
3.12.4.3.12.A	Coding	ME-020
3.12.4.3.12.B	Coding	ME-020
3.12.4.3.13	Pin Identification	EL-007
3.12.4.3.14	Orientation	ME-020
3.12.4.3.15.A	Hose/Cable Restraints	ME-022
3.12.4.3.15.B	Hose/Cable Restraints	ME-022
3.12.4.3.15.C	Hose/Cable Restraints	NVR
3.12.4.3.15.D	Hose/Cable Restraints	ME-022
3.12.4.4	**FASTENERS**	**TITLE**
3.12.4.4.1	Non-Threaded Fastener Status Indication	ME-023
3.12.4.4.2	Mounting Bolt/Fastener Spacing	ME-024
3.12.4.4.3	Deleted	**DELETED
3.12.4.4.4.A	Multiple Fasteners	ME-025
3.12.4.4.4.B	Deleted	**DELETED
3.12.4.4.5	Captive Fasteners	ME-026
3.12.4.4.6.A	Quick Release Fasteners	ME-026
3.12.4.4.6.B	Quick Release Fasteners	ME-026
3.12.4.4.7	Threaded Fasteners	ME-026
3.12.4.4.8.A	Over Center Latches	ME-027
3.12.4.4.8.B	Over Center Latches	ME-027
3.12.4.4.8.C	Over Center Latches	ME-027
3.12.4.4.9	Winghead Fasteners	ME-026
3.12.4.4.10	Deleted	**DELETED
3.12.4.4.11.A	Fastener Head Type	ME-028
3.12.4.4.11.B	Fastener Head Type	ME-028
3.12.4.4.11.C	Fastener Head Type	ME-028
3.12.4.4.12	One-Handed Actuation	ME-029
3.12.4.4.13	Deleted	**DELETED
3.12.4.4.14	Access Holes	ME-024
3.12.5	**CONTROLS AND DISPLAYS**	**TITLE**
3.12.5.1	Controls Spacing Design Requirements	ME-030
3.12.5.2	**ACCIDENTAL ACTUATION**	**TITLE**
3.12.5.2.1.A	Protective Methods	ME-031
3.12.5.2.1.B	Protective Methods	ME-031
3.12.5.2.1.C	Protective Methods	ME-031
3.12.5.2.1.D	Protective Methods	ME-031
3.12.5.2.1.E	Protective Methods	ME-031

TABLE 4-1 IRD TRACEABILITY MATRIX

IRD Par. #	IRD Requirement Title	VDS #
3.12.5.2.1.F	Protective Methods	ME-031
3.12.5.2.1.G	Protective Methods	ME-031
3.12.5.2.2	Noninterference	ME-030
3.12.5.2.3	Dead-Man Controls	*SAFETY
3.12.5.2.4	Barrier Guards	ME-030
3.12.5.2.5	Recessed Switch Protection	ME-031
3.12.5.2.6	Deleted	**DELETED
3.12.5.2.7	Position Indication	ME-032
3.12.5.2.8	Hidden Controls	ME-031
3.12.5.2.9	Hand Controllers	ME-031
3.12.5.3.A	Valve Controls	ME-033
3.12.5.3.B	Valve Controls	ME-033
3.12.5.3.C	Valve Controls	ME-033
3.12.5.3.D	Valve Controls	ME-033
3.12.5.3.E	Valve Controls	ME-033
3.12.5.4	Toggle Switches	ME-034
3.12.6	Restraints and Mobility Aids	ME-035
3.12.6.1.A	Stowage Drawer Contents Restraints	ME-036
3.12.6.1.B	Stowage Drawer Contents Restraints	ME-036
3.12.6.1.C	Stowage Drawer Contents Restraints	ME-036
3.12.6.2.A	Stowage and Equipment Drawers/Trays	ME-027
3.12.6.2.B	Stowage and Equipment Drawers/Trays	ME-027
3.12.6.3	Captive Parts	ME-036
3.12.6.4	**HANDLE AND GRASP AREA DESIGN REQUIREMENTS**	**TITLE**
3.12.6.4.1	Handles and Restraints	ME-037
3.12.6.4.2	Deleted	**DELETED
3.12.6.4.3	Handle Location/Front Access	ME-037
3.12.6.4.4	Handle Dimensions	ME-037
3.12.6.4.5.A	Non-Fixed Handles Design Requirements	ME-037
3.12.6.4.5.B	Non-Fixed Handles Design Requirements	ME-037
3.12.6.4.5.C	Non-Fixed Handles Design Requirements	ME-037
3.12.7	Identification Labeling	ME-057
3.12.7.1	Introduction	**DELETED
3.12.7.2	Function Considerations	NVR
3.12.7.3	Deleted	**DELETED
3.12.7.4	Deleted	**DELETED
3.12.7.5	**LABEL DESIGN REQUIREMENTS**	**TITLE**
3.12.7.5.1	Deleted	**DELETED
3.12.7.5.2.A	Deleted	**DELETED
3.12.7.5.2.B	Deleted	**DELETED
3.12.7.5.3.A	Deleted	**DELETED
3.12.7.5.3.B	Deleted	**DELETED
3.12.7.5.3.C	Deleted	**DELETED
3.12.7.5.3.D	Deleted	**DELETED
3.12.7.5.3.E	Deleted	**DELETED
3.12.7.5.4.A	Deleted	**DELETED

TABLE 4-1 IRD TRACEABILITY MATRIX

IRD Par. #	IRD Requirement Title	VDS #
3.12.7.5.4.B	Deleted	**DELETED
3.12.7.5.4.C	Deleted	**DELETED
3.12.7.5.4.D	Deleted	**DELETED
3.12.7.5.4.E	Deleted	**DELETED
3.12.7.5.5	Deleted	**DELETED
3.12.7.5.6.A	Deleted	**DELETED
3.12.7.5.6.B	Deleted	**DELETED
3.12.7.5.6.C	Deleted	**DELETED
3.12.7.5.6.D	Deleted	**DELETED
3.12.7.5.7	Deleted	**TITLE**
3.12.7.5.7.1.A	Deleted	**DELETED
3.12.7.5.7.1.B	Deleted	**DELETED
3.12.7.5.7.1.C	Deleted	**DELETED
3.12.7.5.8	Deleted	**DELETED
3.12.7.5.9.A	Deleted	**DELETED
3.12.7.5.9.B	Deleted	**DELETED
3.12.7.5.9.C	Deleted	**DELETED
3.12.7.5.9.D	Deleted	**DELETED
3.12.7.5.10.A	Deleted	**DELETED
3.12.7.5.10.B	Deleted	**DELETED
3.12.7.5.10.C	Deleted	**DELETED
3.12.7.5.10.D	Deleted	**DELETED
3.12.7.5.11.A	Deleted	**DELETED
3.12.7.5.11.B	Deleted	**DELETED
3.12.7.5.11.C	Deleted	**DELETED
3.12.7.5.11.D	Deleted	**DELETED
3.12.7.5.11.E	Deleted	**DELETED
3.12.7.5.11.F	Deleted	**DELETED
3.12.7.5.12	Deleted	**DELETED
3.12.7.5.13.A	Deleted	**DELETED
3.12.7.5.13.B	Deleted	**DELETED
3.12.7.6.A	Deleted	**DELETED
3.12.7.6.B	Deleted	**DELETED
3.12.7.6.C	Deleted	**DELETED
3.12.8	Color	ME-047
3.12.9	Crew Safety	*SAFETY
3.12.9.1.A	Electrical Hazards	*NVR
3.12.9.1.B	Electrical Hazards	*EL-041
3.12.9.1.C	Electrical Hazards	*EL-041
3.12.9.1.D	Electrical Hazards	*EL-041
3.12.9.1.E	Electrical Hazards	*EL-041
3.12.9.1.1	Mismatched	ME-019
3.12.9.1.2	Deleted	**DELETED
3.12.9.1.3	Deleted	**DELETED
3.12.9.1.4	Overload Protection	NVR
3.12.9.1.4.1	Device Accessibility	EL-013
3.12.9.1.4.2	Extractor-Type Fuse Holder	EL-013

TABLE 4-1 IRD TRACEABILITY MATRIX

IRD Par. #	IRD Requirement Title	VDS #
3.12.9.1.4.3	Overload Protection Location	EL-013
3.12.9.1.4.4	Overload Protection Identification	EL-013
3.12.9.1.4.5	Automatic Restart Protection	EL-013
3.12.9.1.5	Deleted	**DELETED
3.12.9.1.5.1	Deleted	**DELETED
3.12.9.2	Sharp Edges and Corners Protection	*SAFETY
3.12.9.3	Holes	ME-007
3.12.9.4	Latches	ME-027
3.12.9.5	Screws and Bolts	ME-026
3.12.9.6	Securing Pins	ME-053
3.12.9.7	Levers, Cranks, Hooks, and Controls	ME-053
3.12.9.8	Burrs	ME-053
3.12.9.9.A	Locking Wires	ST-009
3.12.9.9.B	Locking Wires	ST-009
3.12.9.10.A	Audio Device Displays	ME-044
3.12.9.10.B	Deleted	**DELETED
3.12.9.10.C	Audio Device Displays	ME-044
3.12.9.10.D	Audio Device Displays	ME-044
3.12.9.11	Deleted	**DELETED
3.12.9.12	Egress	*SAFETY
3.12.10	Payload In-Flight Maintenance	ME-003
3.12.11	Deleted	**DELETED

* The IRD requirements that have “SAFETY” in the VDS number column are included for the completeness of the design requirements. It is the responsibility of each PD to address these requirements through the PSRP.

** The IRD requirements that have “DELETED” in the VDS number column is requirements that have been deleted from SSP 57000.

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Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
ST-001	Structural - Structural Strength	4.3.1.1.3.(A,B,E,F) Loads Requirement (A) 4.3.1.1.5.A Safety Critical Structures Req.	A or A&T		
ST-002	Structural - Crew-Applied Loads	4.3.1.1.3.D Loads Requirement (A) 4.3.1.1.4.1.A Lab Window Rack Location Requirements (A) 4.3.1.1.5.A Safety Critical Structures Req.	A		
ST-003	Structural - On-Orbit Depress/Repress	4.3.1.1.2.B MPLM Interfaces (A) 4.3.1.1.4.B Rack Requirement (A) 4.3.1.1.4.K Rack Requirement (A) 4.3.1.1.5.A Safety Critical Structures Req.	A		
ST-004	Structural - Natural Frequency	4.3.1.1.4.C Rack Requirement (A) 4.3.1.1.5.A Safety Critical Structures Req.	A or A&T		
ST-005	Structural - Human Factor Strength Requirement	4.3.12.1.(A-B) Strength Requirement (AorD)	A or D		
ST-006	Structural - Push-Pull Forces	4.3.12.4.2.7 Push-Pull Forces (A)	A		
ST-007	Structural - Ground Transportation Loads	4.3.1.1.1.D GSE Interfaces (A&T)	A&T		
ST-008	Structural - Fracture Control	4.3.1.1.5.A Safety Critical Structures Req.	A&I		
ST-009	Structural - Securing of Threaded Fasteners	4.3.1.1.5.A Safety Critical Structures Req. 4.3.12.9.9.A Locking Wires (A) 4.3.12.9.9.B Locking Wires (I)	A&I or T		
ST-010	Structural - Pressurized Systems	4.3.1.1.5.A Safety Critical Structures Req. 4.3.5.1.7 (A,B,&C) Coolant Maximum Design Pressure (A&T)	A&T		
ST-011	Structural - MPLM Interfaces	4.3.1.1.2.E MPLM Interfaces (A)	A		
ME-001	Mechanical - Weight and CG	4.3.1.1.4.A Rack Requirements (A&D)	A&D		
ME-002	Mechanical - Mechanical Stops	4.3.12.4.2.6 Slide-Out Stops (A or D or I)	A or D or I		
ME-003	Mechanical - Payload In-Flight Maintenance	4.3.12.10 Payload In-Flight Maintenance (A)	A		
ME-004	Mechanical - Launch/Landing Umbilical Restraint	4.3.1.1.3.C Loads Requirements (I)	I		
ME-005	Mechanical - Fiber Optical Cable Bend Radius	4.3.3.7.5 HRDL Fiber Optical Cable Bend Radius (I) 4.3.4.1.2.5 PFM NTSC Video Fiber Optic Cable Bend Radius (I)	I		
ME-006	Mechanical - Full Size Range Accommodation	4.3.12.2.3 Full Size Range Accommodation (A)	A		
ME-007	Mechanical - Closures and Covers	4.3.12.3.1.1 Closures and Covers (I) 4.3.12.4.2.8.1.(A,B) Covers (A) 4.3.12.4.2.8.2 Self-Supporting Covers (A) 4.3.12.9.3 Holes (A&I)	A&I		
ME-008	Mechanical - Built-In Controls	4.3.12.3.1.2.A Built-In Controls (I) 4.3.12.3.1.2.B Built-In Controls (A or D)	A&I or D&I		
ME-009	Mechanical - One-Handed	4.3.12.3.1.5 One-Handed Operation (D)	D		

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
	Cleaning Operations				
ME-010	VDS Deleted				
ME-011	Mechanical - Equipment Mounting	4.3.12.4.2.1 Equipment Mounting (A or D)	A or D		
ME-012	Mechanical - Drawers and Hinged Panels	4.3.12.4.2.2 Drawers and Hinged Panels (A)	A		
ME-013	Mechanical - Alignment	4.3.12.4.2.5 Alignment (A)	A		
ME-014	Mechanical - Umbilical Restraint	4.3.1.1.6.2 Umbilical Physical Mate (D)	D		
ME-015	Mechanical - USL Window Keepout Envelope	4.3.1.1.4.F Rack Requirements (A) 4.3.1.1.4.1.B Lab Window Rack Location Requirements (I) 4.3.1.1.4.1.C Lab Window Rack Location Requirements (A)	A&I		
ME-016	Mechanical - Unique Tools	4.3.12.4.2.8.4 Unique Tools (A)	A		
ME-017	Mechanical - Connector Mating/Demating	4.3.12.4.3.1 One-Handed Operation(A or D) 4.3.12.4.3.3 (A-B) Ease of Disconnect (A) 4.3.12.4.3.5 Self-Locking (A)	A or A&D		
ME-018	Mechanical - Connector Arrangement and Accessibility	4.3.12.4.3.2.(A-B) Accessibility (A or D) 4.3.12.4.3.6.(A-B) Conn. Arrangement (I)	A&I or D&I		
ME-019	Mechanical - Connector Protection and Shape	4.3.12.4.3.8 Connector Protection (A) 4.3.12.4.3.9 Connector Shape (A) 4.3.12.9.1.1 Mismatched (D or I)	A&D or A&I		
ME-020	Mechanical - Alignment, Coding, and Orientation	4.3.12.4.3.11.A Align. Marks or Guide Pins (I) 4.3.12.4.3.12.(A-B) Coding (I) 4.3.12.4.3.14 Orientation (A)	A&I		
ME-021	Mechanical - Physical Interference	4.3.1.1.4.E Rack Requirements (I) 4.3.1.1.4.I Rack Requirements (A) 4.3.1.1.4.L Rack Requirements (A) 4.3.12.2.1 Adequate Clearance (A or D) 4.3.12.2.2.(A-B) Accessibility (A or D)	A&I or A&D&I		
ME-022	Mechanical - Hose/Cable Restraints	4.3.12.4.3.15.(A,B&D)Hose/Cable Restraints (I)	I		
ME-023	Mechanical - Engagement Status Indication	4.3.12.4.4.1 Non-Threaded Fastener Status Indication (D or I)	D or I		
ME-024	Mechanical - Mounting Bolt/Fastener Spacing and Tool Clearance	4.3.12.4.4.2 Mounting Bolt/Fastener Spacing (I) 4.3.12.4.4.14 Access Holes (I)	I		
ME-025	Mechanical - Multiple Fasteners	4.3.12.4.4.4.A Multiple Fasteners (I)	I		
ME-026	Mechanical - Fasteners	4.3.12.4.4.5 Captive Fasteners (A) 4.3.12.4.4.6.(A-B) Quick Release Fasteners (I) 4.3.12.4.4.7 Threaded Fasteners (I) 4.3.12.4.4.9 Winghead Fasteners (I) 4.3.12.9.5 Screws and Bolts (A&I)	A&I		
ME-027	Mechanical - Latches	4.3.12.4.4.8.(A-C) Over Center Latches (I) 4.3.12.6.2.(A-B) Stow and Equip. Drawers/Trays (I)	I		

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
		4.3.12.9.4 Latches (I)			
ME-028	Mechanical - Fastener Head Type	4.3.12.4.4.11.(A-C) Fastener Head Type (I)	I		
ME-029	Mechanical - One-Handed Fastener Actuation	4.3.12.4.4.12 One-Handed Actuation (A or D)	A or D		
ME-030	Mechanical - Controls Spacing Design	4.3.12.5.1 Controls Spacing Design Requirements (I) 4.3.12.5.2.2 Noninterference (I) 4.3.12.5.2.4 Barrier Guards (I)	I		
ME-031	Mechanical - Accidental Actuation Protection	4.3.12.5.2.1 Protective Methods (I) 4.3.12.5.2.5 Recessed Switch Protection (I) 4.3.12.5.2.8 Hidden Controls (I) 4.3.12.5.2.9 Hand Controllers (I)	I		
ME-032	Mechanical - Position Indication	4.3.12.5.2.7 Position Indication (I)	I		
ME-033	Mechanical - Valve Controls	4.3.12.5.3.(A-E) Valve Controls (I)	I		
ME-034	Mechanical - Toggle Switch Dimensions	4.3.12.5.4 Toggle Switch (I)	I		
ME-035	Mechanical - Restraint and Mobility Aids	4.3.12.6 Restraint and Mobility Aids (A or D)	A or D		
ME-036	Mechanical - Captive Parts	4.3.12.6.1.A Stowage Drawer Contents Req. (A&I) 4.3.12.6.1.B Stowage Drawer Contents Req. (D) 4.3.12.6.1.C Stowage Drawer Contents Req. (D) 4.3.12.6.3 Captive Parts (I)	A&D&I		
ME-037	Mechanical - Handles	4.3.12.6.4.1 Handles and Restraints (D or I) 4.3.12.6.4.3 Handle Location/Front Access (I) 4.3.12.6.4.4 Handle Dimensions (D) 4.3.12.6.4.5.A Non-Fixed Handles Design Req. (A&D) 4.3.12.6.4.5.B Non-Fixed Handles Design Req. (D) 4.3.12.6.4.5.C Non-Fixed Handles Design Req. (I&D)	A&D&I		
ME-038	VDS Deleted				
ME-039	VDS Deleted				
ME-040	VDS Deleted				
ME-041	VDS Deleted				
ME-042	Mechanical - ORU Accessibility	4.3.12.4.2.8 Access (A or D)	A or D		
ME-043	Mechanical - Lighting Design	4.3.12.3.4.A Lighting Design (I or T) 4.3.12.3.4.B Lighting Design (T) 4.3.12.3.4.C Lighting Design (D) 4.3.12.3.4.D Lighting Design (D) 4.3.12.3.4.E Lighting Design (A or T)	A&D&T or A&D&I&T		
ME-044	Mechanical - Audio Device Displays	4.3.12.9.10.(A,C,D) Audio Device Displays (A&D)	A&D		
ME-045	VDS Deleted				

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
ME-046	Mechanical - Mechanical Attachment Points	4.3.1.1.2.A MPLM Interfaces (I)	I		
ME-047	Mechanical - Color	4.3.12.8 Color (I)	I		
ME-048	Mechanical - Manual Valves	4.3.7.6 Manual Valves (I)	I		
ME-049	Mechanical - Fluid System Servicer	4.3.8.2 Fluid System Servicer (D or I)	D or I		
ME-050	Mechanical - Indication of Pressure Flow	4.3.12.4.3.4 Indication of Pressure/Flow (A)	A		
ME-051	Mechanical - GSE Interfaces	4.3.1.1.1.A GSE Interfaces (I) 4.3.1.1.1.(B-C) GSE Interfaces (D)	D&I		
ME-052	Mechanical - Smoke Detection	4.3.10.2.1.1.A Smoke Detection (I) 4.3.10.2.1.1.B Smoke Detection (D&I) 4.3.10.2.1.2 Forced Air Circulation Indication (T)	D&I&T		
ME-053	Mechanical - Burrs and Protrusions	4.3.12.9.6 Securing Pins (A) 4.3.12.9.7 Levers, Cranks, Hooks, & Controls (A&I) 4.3.12.9.8 Burrs (I)	A&I		
ME-054	Mechanical - Fire Detection Indicator and Parameter Monitoring	4.3.10.2.1.3.A Fire Detection Indicator(I&T) 4.3.10.2.1.3.B Fire Detection Indicator (I) 4.3.10.2.2.1 Parameter Monitoring Use (A&I) 4.3.10.4.B Labeling (I)	A&I&T		
ME-055	Mechanical - Fire Suppression Access Hole	4.3.10.3.1.(A-B) Portable Fire Extinguisher (A&I) 4.3.10.3.2 Fire Suppression Access Port Access. (D) 4.3.10.3.3 Fire Suppressant Distribution (A or T) 4.3.10.4.A Labeling (I)	A&D&I or A&D&I &T		
ME-056	Mechanical – Connector Physical Mating	4.3.1.1.6.1 Connector Physical Mate (D)	D		
ME-057	Mechanical – Identification Labeling	4.3.12.7 Identification Labeling (I)	I		
ME-058	Mechanical – MPLM Late/Early Access Requirements	4.3.1.1.2.1 MPLM Late/Early Access Requirements (T) 4.3.1.1.2.1.1 (A-C) MPLM Late Access Envelope (KSC) (I) 4.3.1.1.2.1.2 (A&B) MPLM Early Access Envelopes (KSC and DFRC) (I)	T & I		
ME-059	Mechanical – Payload Protrusions	4.3.1.1.7 (A-B) On-Orbit Payload Protrusions (I & D) 4.3.1.1.7.1 On-Orbit Permanent Protrusions (I) 4.3.1.1.7.2 (A-C) On-Orbit Semi-Permanent Protrusions (I & D) 4.3.1.1.7.3 (A-B) On-Orbit Temporary Protrusions (I & D)	I & D		

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
		4.3.1.1.7.4 On-Orbit Momentary Protrusions (D) 4.3.1.1.7.5 On-Orbit Protrusions for Keep Alive Payloads (I)			
EL-001	Electrical - Steady-State Voltage Characteristics	4.3.2.1.1.1 Interface B (T) 4.3.2.1.1.2 Interface C (T)	T		
EL-002	Electrical - Ripple Voltage Characteristics, Noise, and Spectrum	4.3.2.1.2.1 Ripple Voltage and Noise (A) 4.3.2.1.2.2 Ripple Voltage Spectrum (A)	A		
EL-003	Electrical - Transient Voltages	4.3.2.1.3.1 Interface B (A or T) 4.3.2.1.3.2 Interface C (A or T)	A or T		
EL-004	Electrical - Fault Clearing and Protection	4.3.2.1.3.3 Fault Clearing and Protection (A)	A		
EL-005	Electrical - Non-Normal Voltage Range	4.3.2.1.3.4(A,B) Non-Normal Voltage Range(A)	A		
EL-006	VDS Deleted				
EL-007	Electrical - UIP and UOP Connectors and Pin Assignments	4.3.2.2.1.(B,C,E,F) UIP and UOP Connectors and Pin Assignments (I) 4.3.3.5.2.1.2.(B-C) MIL-STD-1553B Bus A Connector/Pin Assignments (I) 4.3.3.6.1.4.(B-D) MRDL Connector/Pin Assign. (I) 4.3.3.7.6.(B-D) HRDL Connector and Fiber (I) 4.3.4.1.2.7.(B&C) PFM NTSC Optical Connector/Pin Assignment (D&I) 4.3.4.1.4.(B&C) NTSC Electrical Connector/Pin Assignments (D&I) 4.3.12.4.3.13 Pin Identification (I)	D&I		
EL-008	Electrical - Power Bus Isolation	4.3.2.2.2.(A-B) Power Bus Isolation (A)	A		
EL-009	Electrical - Compatibility with Soft Start/Stop RPC	4.3.2.2.3 Compatibility with Soft Start/Stop RPC (T)	T		
EL-010	Electrical -Surge Current	4.3.2.2.4 Surge Current (A&T)	A&T		
EL-011	Electrical - Reverse Energy/Current	4.3.2.2.5 Reverse Energy/Current (A)	A		
EL-012	Electrical - Remote Power Controllers (RPC)	4.3.2.2.6.1.1.(A-C) Remote Power Controllers (T) 4.3.2.2.6.1.1.(D-E) Remote Power Controllers (A) 4.3.2.2.6.2.1.1 Payload Trip Ratings (A)	A &T		
EL-013	Electrical - Overload Protection	4.3.12.9.1.4.1 Device Accessibility (I) 4.3.12.9.1.4.2 Extractor-Type Fuse Holder (D) 4.3.12.9.1.4.3 Overload Protection Location (I) 4.3.12.9.1.4.4 Overload Protection	D&I		

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
		Identification (I) 4.3.12.9.1.4.5 Automatic Restart Protection (D)			
EL-014	Electrical - EPCE Load Impedance	4.3.2.2.7.1.(A,B) Interface B (T) 4.3.2.2.7.2 Interface C (T)	T		
EL-015	Electrical - Maximum Ripple Voltage Emissions	4.3.2.2.9 Maximum Ripple Voltage Emissions (A&T)	A&T		
EL-016	Electrical - Load-Stand Alone Stability	4.3.2.2.10 Electrical Load-Stand Alone Stability (A)	A		
EL-017	Electrical - Wire Derating	4.3.2.3.1(A&B) Wire Derating (A) 4.3.2.3.1.C Wire Derating (I or A)	A or I&A		
EL-018	Electrical - Exclusive Power Feeds	4.3.2.3.2 Exclusive Power Feeds (A)	A		
EL-019	Electrical - Electromagnetic Compatibility for Safety-Critical Circuits	4.3.2.4.10 EMI Susceptibility for Safety-Critical Circuits (A&T)	A&T		
EL-020	Electrical - Electromagnetic Interference/Compatibility	4.3.2.4 Electromagnetic Compatibility (A &T) 4.3.2.4.4 Electromagnetic Interference (A&T) 4.3.2.4.6 Alternating Current Magnetic Fields (A or T) 4.3.2.4.7 Direct Current Magnetic Fields (A or T)	A&T		
EL-021	Electrical - Cable/Wire Design and Grounding	4.3.2.4.1 Electrical Grounding (A&T) 4.3.2.4.3 Cable/Wire Design and Control Req. (A&T or I&T)	A&T or A&T&I		
EL-022	Electrical - Electrical Bonding	4.3.2.4.2 Electrical Bonding (A&I&T)	A&I&T		
EL-023	Electrical - Large Signal Stability	4.3.2.2.8 Large Signal Stability (A&T)	A&T		
EL-024	Electrical - Electrostatic Discharge	4.3.2.4.5 Electrostatic Discharge (A&I or I&T)	A&I or I&T		
EL-025	Electrical - Lightning	4.3.2.4.9 Lightning (A)	A		
EL-026	Electrical - ARC Containment	4.3.12.4.3.7 ARC Containment (A)	A		
EL-027	Electrical - Fiber Optic Cable Characteristics	4.3.3.7.4 HRDL Fiber Optic Cable (I) 4.3.4.1.2.4 Fiber Optic Cable Characteristics (I)	I		
EL-028	Electrical - Rack Maintenance Switch (Rack Power Switch)	4.3.2.5.2 Rack Maintenance Switch (Rack Power Switch) (D&I)	D&I		
EL-029	Electrical - Power Switches/Controls	4.3.2.5.3.(A-C) Power Switches/Controls (A)	A		
EL-030	Electrical - Ground Fault Circuit Interrupters	4.3.2.5.4.(A) Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage (A) 4.3.2.5.4.(B, ,F) Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage (A or T) (T) 4.3.2.5.4 (C) Ground Fault Circuit	A&D&T		

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
		Interrupters/Portable Equipment DC Sourcing Voltage (A or T) 4.3.2.5.4 (D) Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage (A and T) 4.3.2.5.4 (E) Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage (A or T) 4.3.2.5.4.G Ground Fault Circuit Interrupters/Portable Equipment DC Sourcing Voltage (A&D)			
EL-031	Electrical - Portable Equipment/Power Cords	4.3.2.5.5.(A-B) Portable Equipment/Power Cords (A)	A		
EL-032	Electrical - LRDL Cabling Characteristics	4.3.3.5.2.3 LRDL Cabling (I)	I		
EL-033	Electrical - MRDL Cable Characteristics	4.3.3.6.1.6 MRDL Cable Characteristics (I)	I		
EL-034	Electrical – Rack Maintenance Switch (Rack Power Switch)/Fire Detection Support Interface Connector	4.3.3.10.3.(B&C) Rack Maintenance Switch (Rack Power Switch)/Fire Detection Support Interface Connector (I)	I		
EL-035	Electrical - MPLM Electrical Power Characteristics	4.3.2.6.1.(A-G) MPLM Electrical Power Characteristics (A&T)	A&T		
EL-036	Electrical - MPLM Electrical Power Interface Performance	4.3.2.6.2(A-F) MPLM Electrical Power Interface (A&T)	A&T		
EL-037	Electrical - MPLM Electrical Power Connectivity and Protection Interface	4.3.2.6.2.1.(B-C) MPLM UIP Connector and Pin Assignments (I) 4.3.2.6.2.2 Compatibility With RPC Soft Start/Stop MPLM 4.3.2.6.2.3.(A-D) MPLM Surge Current (A&T) 4.3.2.6.2.4 MPLM Reverse Energy Current (A) 4.3.2.6.2.5 MPLM Payload Trip Ratings (A)	A& I&T		
EL-038	Electrical - MPLM Electrical Power Consumer Constraints	4.3.2.6.3.(A-D) MPLM Electrical Power Consumer Constraints (A&D&I)	A&D&I		
EL-039	Electrical - MPLM Electromagnetic Compatibility	4.3.2.6.4.(A-J) MPLM Electromagnetic Compatibility (A&I&T) 4.3.2.6.4.1 MPLM Bonding (A)	A&I&T		
EL-040	Electrical - Safety Requirements	4.3.2.6.5.(A-F) MPLM Safety Req. (A&I&T)	A&I&T		
EL-041	Electrical – Electrical Hazards	4.3.12.9.1 (B-E)Electrical Hazards (A or T)	A or T		
EL-042	Electrical – Corona	4.3.2.4.8 Corona (A or A&T)	A or T		
CD-001	C&DH - Word/Byte Notations, Data Types, and Data Transmission	4.3.3.2.1 Word/Byte Notations (I) 4.3.3.2.2 Data Types (I) 4.3.3.2.3.(A-C) Data Transmissions (A&I) 4.3.3.4.1 CCSDS Data (A or T) 4.3.3.4.1.1 CCSDS Data Packets (I&T)	A or T or I I&T		

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
		4.3.3.4.1.1.1 CCSDS Primary Header (I&T) 4.3.3.4.1.1.2 CCSDS Secondary Header (I&T)			
CD-002	VDS Deleted				
CD-003	C&DH - CCSDS User Data Field	4.3.3.4.1.2 CCSDS Data Field (T) 4.3.3.4.1.3 CCSDS Data Bitstream (T)	T		
CD-004	C&DH - CCSDS Time Codes	4.3.3.4.2.1 CCSDS Unsegmented Time (T)	T		
CD-005	C&DH - LRDL Protocol	4.3.3.5 MIL-STD-1553B LRDL (T) 4.3.3.5.1.1 Standard Messages (I&T) 4.3.3.5.1.2 Commanding (T) 4.3.3.5.1.3 Health and Status Data (T) 4.3.3.5.1.4 Safety Data (T)	T or I&T		
CD-006	C&DH - LRDL Messages and Commands	4.3.3.5.1.5 Service Requests (T) 4.3.3.5.1.7 File Transfer (T) 4.3.3.5.1.8 Low Rate Telemetry (T)	T		
CD-007	C&DH - LRDL Mode Codes	4.3.3.5.1.9 Defined Mode Codes (T) 4.3.3.5.1.10 Implemented Mode Codes (T)	T		
CD-008	C&DH - LRDL Mode Codes and Illegal Commands Error	4.3.3.5.1.11 Unimplemented/Undefined Mode Codes (T) 4.3.3.5.1.12 Illegal Commands (T)	T		
CD-009	C&DH -LRDL Signal Characteristics	4.3.3.5.2.2 LRDL Signal Characteristics (T)	T		
CD-010	C&DH - MRDL Protocol and Signal Characteristics	4.3.3.6.1 MRDL Protocols (I&T) 4.3.3.6.1.1 Integrated Rack Protocols on the MRDL (I&T)	I&T		
CD-011	C&DH - MRDL Connectivity and Addressing	4.3.3.6.1.2 (A-C) MRDL Address (I&T) 4.3.3.6.1.3 (A&B)ISPR MRDL Connectivity (I&T) 4.3.3.6.1.3.C ISPR MRDL Connectivity (T)	I&T		
CD-012	C&DH - MRDL Cable Characteristics	4.3.3.6.1.5 MRDL Signal Characteristics (I&T) 4.3.3.6.1.6.1 Insertion Loss (T) 4.3.3.6.1.6.2 Differential Characteristic Impedance (T) 4.3.3.6.1.6.3 Medium Timing Jitter (T)	I&T		
CD-013	C&DH - HRDL Signal, Symbols, and Encoding	4.3.3.7.2.1 Physical Signaling (A&T) 4.3.3.7.2.1.1 (A-B) Physical Signaling Date Rates (A&T) 4.3.3.7.2.2 Encoding (I&T)	A&I&T		
CD-014	C&DH - HRDL Send/Receive Optical Power	4.3.3.7.3.1 Integrated Rack HRDL Transmitted Optical Power (T) 4.3.3.7.3.2 Integrated Rack HRDL Received Optical Power (T)	T		
CD-015	C&DH –Rack Maintenance Switch (Rack Power Switch) Interfaces	4.3.3.10.1 Rack Maintenance Switch (Rack Power Switch) Interfaces (I&T)	I&T		
CD-016	C&DH - Smoke Detection	4.3.3.10.2 Smoke Detector Interfaces (I)	I		

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
		4.3.3.10.2.1 Analog Interface Characteristics (I) 4.3.3.10.2.2 Discrete Command Built-In-Test Interface Characteristics (I)			
CD-017	C&DH - NTSC Video Characteristics	4.3.4.1.1 Payload NTSC Optical Video Characteristics (T) 4.3.4.1.2.1 (A&B) Pulse Frequency Modulation NTSC Fiber Optic Video Characteristics (T)	T		
CD-018	C&DH - NTSC PFM Electrical Video Characteristics	4.3.4.1.2.2 Integrated Rack NTSC PFM Video Transmitted Optical Power (T) 4.3.4.1.2.3 Integrated Rack NTSC PFM Video and Sync Received Optical Power(T) 4.3.4.1.3.1 Cables (I) 4.3.4.1.3.2 Signal Standard (T) 4.3.4.1.3.3 Interface Circuit (A) 4.3.4.1.3.4 Cross Talk (T)	A&I&T		
CD-019	C&DH - Smoke Indicator and Fan Ventilation Status Electrical Interfaces	4.3.3.10.2.3 Smoke Indicator Electrical Interface (I&T) 4.3.3.10.2.4 Fan Ventilation Status Electrical Interfaces (I)	I&T		
CD-020	CD&H - Parameter Monitoring in Subrack and Integrated Rack	4.3.10.2.2.2.1.(A-B) Parameter Monitoring in Subrack (T&A) 4.3.10.2.2.2.2.(A-B) Parameter Monitoring in Integrated Rack (T)	T&A		
CD-021	CD&H - Integrated Rack Caution and Warning	4.3.3.5.1.4.1.2 Class 2 - Warning (A&T) 4.3.3.5.1.4.1.3 Class 3 - Caution (A&T) 4.3.3.5.1.4.1.4 Class 4 - Advisory (A&T)	A&T		
CD-022	CD&H – Portable Computer System – Payload Laptop	4.3.3.8.1 (A-H) Payload Laptop (I&D) 4.3.3.8.2.2 (A-D) 760XD Laptop to Rack Interface (I)	I&D		
CD-023	CD&H – Portable Computer System	4.3.3.8.2 (A) Portable Computer System (T) 4.3.3.8.2 (B) Portable Computer System (D) 4.3.3.8.2 (C) Portable Computer System (I)	T, D, & I		
CD-024	C&DH – Portable Computer System Station Support Computer	4.3.3.8.3 (A) Station Support Computer (I) 4.3.3.8.3.(B) Station Support Computer (D)	I & D		
CD-025	C&DH – Multi-Bus Isolation	4.3.3.5.2.4 Multi-Bus Isolation	T		
CD-026	C&DH – Remote Terminal	4.3.3.5.2.1.4 Remote Terminal Hardwired Address Coding	T		
FD-001	Fluid Dynamics - Physical Interface	4.3.12.4.3.10 Fluid and Gas Line Connectors (A)	A		
FD-002	Fluid Dynamics - ITCS Fluid Use and Charging	4.3.5.1.2.A ITCS Fluid Use and Charging (T) 4.3.5.1.2.B ITCS Fluid Use and Charging (A)	A&T		
FD-003	Fluid Dynamics - ITCS Pressure Drop	4.3.5.1.3.1 (A-B) On-Orbit Interface (T) 4.3.5.1.3.2 MPLM Interface (T)	T		

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
FD-004	Fluid Dynamics - Coolant Flow Rate	4.3.5.1.4 Coolant Flow Rate (A or T)	A or T		
FD-005	Fluid Dynamics - Coolant Return Temperature	4.3.5.1.6.A Coolant Return Temperature (A&T) 4.3.5.1.6.B Coolant Return Temperature (A) 4.3.5.1.6.C Coolant Return Temperature (A&T) 4.3.5.1.6.D Coolant Return Temperature (A&T)	A&T		
FD-006	Fluid Dynamics - Coolant Loop Leakage	4.3.5.1.9.(A-B) Leakage (T)	T		
FD-007	Fluid Dynamics - Quick-Disconnect Air Inclusion	4.3.5.1.10 Quick-Disconnect Air Inclusion (A or T)	A or T		
FD-008	Fluid Dynamics - Cabin Air Heat Leak	4.3.5.1.12 Cabin Air Heat Leak (A)	A		
FD-009	Fluid Dynamics - Cabin Air Cooling	4.3.5.1.13 MPLM Cabin Air Cooling (A)	A		
FD-010	Fluid Dynamics - Simultaneous Cooling	4.3.5.1.14.A Simultaneous Cooling (A) 4.3.5.1.14.B Simultaneous Cooling (I)	A&I		
FD-011	Fluid Dynamics - Control System Time Constant	4.3.5.1.15 Control System Time Constants (T)	T		
FD-012	Fluid Dynamics - Payload Coolant Quantity	4.3.5.1.16 Payload Coolant Quantity (A or T)	A or T		
FD-013	Fluid Dynamics - Payload Gas Inclusion	4.3.5.1.17 Payload Gas Inclusion (A)	A		
FD-014	VDS Deleted				
FD-015	Fluid Dynamics - VES Input Pressure Limit	4.3.6.1.2.A Input Pressure Limit (T) 4.3.6.1.2.B Input Pressure Limit (A&T) 4.3.6.1.2.C Input Pressure Limit (A)	A&T		
FD-016	Fluid Dynamics - VES Input Temperature Limit	4.3.6.1.3 Input Temperature Limit (T)	T		
FD-017	Fluid Dynamics - VES Input Dewpoint Limit	4.3.6.1.4 Input Dewpoint Limit (T)	T		
FD-018	Fluid Dynamics - VES Acceptable Exhaust Gases	4.3.6.1.5.A Acceptable Exhaust Gases (A or T) 4.3.6.1.5.B Acceptable Exhaust Gases (A)	A or A&T		
FD-019	Fluid Dynamics - External Contamination Control	4.3.6.1.5.2 External Contamination Control (A)	A		
FD-020	Fluid Dynamics - Incompatible Gases	4.3.6.1.5.3 Incompatible Gases (A&I)	A&I		
FD-021	VDS Deleted				
FD-022	Fluid Dynamics - VRS Input Pressure Limit	4.3.6.2.2 (A-C) Input Pressure Limit (A&T)	A&T		
FD-023	Fluid Dynamics – VRS/VVS Through-Put Limit	4.3.6.2.3 VRS Through-Put Limit (T)	T		
FD-024	Fluid Dynamics - Pressurized Gases Interface Control (Nitrogen, Argon, CO_2, & Helium)	4.3.7.1.1 Nitrogen Interface Control (T) 4.3.7.2.1 Argon Interface Control (T) 4.3.7.3.1 Carbon Dioxide Interface Control (T) 4.3.7.4.1 Helium Interface Control (T)	T		
FD-025	Fluid Dynamics - Pressurized Gases Interface MDP (Nitrogen,	4.3.7.1.2 Nitrogen Interface Pressure (A&T) 4.3.7.2.2 Argon Interface MDP (A&T)	A&T		

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
	Argon, CO_2, & Helium)	4.3.7.3.2 Carbon Dioxide Interface Pressure (A&T) 4.3.7.4.2 Helium Interface MDP (A&T)			
FD-026	Fluid Dynamics - Pressurized Gases Interface Temperature (Nitrogen, Argon, CO_2, & Helium)	4.3.7.1.3 Nitrogen Interface Temperature (A or T or A&T) 4.3.7.2.3 Argon Interface Temperature (A or T or A&T) 4.3.7.3.3 Carbon Dioxide Interface Temperature (A or T or A&T) 4.3.7.4.3 Helium Interface Temperature (A or T or A&T)	A or T or A&T		
FD-027	Fluid Dynamics - Pressurized Gases Leakage (Nitrogen, Argon, CO_2, & Helium)	4.3.7.1.4 Nitrogen Leakage (T) 4.3.7.2.4 Argon Leakage (T) 4.3.7.3.4 Carbon Dioxide Leakage (T) 4.3.7.4.4 Helium Leakage (T)	T		
FD-028	Fluid Dynamics - Pressurized Gas Systems	4.3.7.5 Pressurized Gas Systems (A)	A		
FD-029	Fluid Dynamics - Potable Water Interface Pressure	4.3.8.1.2 Potable Water Interface Pressure (T)	T		
FD-030	Fluid Dynamics - Potable Water Use	4.3.8.1.3.(A-B) Potable Water Use (A)	A		
FD-031	Fluid Dynamics - Fail Safe Loss of Cooling	4.3.5.1.8 Fail Safe Design (A or A&T)	A or A&T		
FD-032	Fluid Dynamics - Touch Temperature	4.3.5.1.11 Rack Front Surface Temperature (A or T)	A or T		
FD-033	VDS Deleted				
FD-034	VDS Deleted				
FD-035	Fluid Dynamics – Vacuum System Access Valve	4.3.6.1.6 Payload Vacuum System Access Valve (A&I)	A&I		
EN-001	Environmental - Atmosphere Humidity	4.3.9.1.3 Humidity (A)	A		
EN-002	Environmental - Active Air Exchange	4.3.9.2.1.A Active Air Exchange (I) 4.3.9.2.1.B Active Air Exchange (A)	A&I		
EN-003	Environmental - Oxygen Consumption	4.3.9.2.2 Oxygen Consumption (A)	A		
EN-004	Environmental - Ionizing Radiation Dose	4.3.9.3.3 Single Event Effect (SEE) Ionizing Radiation Dose (A)	A		
EN-005	Environmental - Microgravity Environment	4.3.1.2.1.(A-B) Quasi-Steady Requirements (TBD) 4.3.1.2.2.(A-B) Vibratory Requirements (TBD) 4.3.1.2.3.(A-B) Transient Requirements (TBD) 4.3.1.2.5.B ARIS Requirements (I)	TBD		
EN-006	Environmental - Acoustic Levels	4.3.12.3.3.1.(A-C) Continuous Noise Limits (A&T) 4.3.12.3.3.2 Intermittent Noise Limit (A&T)	A&T		
EN-007	Environmental –	4.3.9.3.4.1 Window Rack Infrared Radiation	T		

Table 4-2 VDS TO IRD SECTION 4 CROSS-REFERENCE MATRIX

Number	Title	IRD Section 4 Number(s), Title(s), and Method(s)	Method	*Hazard Number (original)	*Hazard Number (reflight)
	Infrared/Ultraviolet Radiation	Requirements (T) 4.3.9.3.4.2 Window Rack Ultraviolet Radiation Requirements (T)			
MP-001	Materials - Fluids	4.3.11.2.A Fluids (T) 4.3.11.2.B Fluids (T) 4.3.11.2.C Fluids (A or I)	T,A, or I		
MP-002	Materials - Cleanliness	4.3.11.3.A Cleanliness (I)	I		
MP-003	Materials - Fungus Resistant Material	4.3.11.4 Fungus Resistant Material (I)	I		
MP-004	VDS Deleted				

*NOTE: The “Safety Yes/No” and the “Hazard Number” columns are included as aids in the construction of the Unique PVPs.

Table 4-3 CONTROL PLANS MATRIX

VDS Number	Control Plan Guidelines	Reference
ST-001	Structural Verification Plan	SSP 52005, paragraph 9.2.2. SSP 57010, ST-001
ST-008	Fracture Control Plan	SSP 52005, paragraph 5.3, SSP 57010, ST-008
EN-005	Microgravity Control Plan	SSP 57010, Appendix E
EN-006	Acoustic Noise Control Plan	SSP 57010, Appendix D
EL-020	EMI/EMC Control, Test Plan and Design Analysis Report	SSP 57010. Appendix F
EL-020	EMI/EMC Test Data Format	SSP 57010, Appendix G

Table 4-3 Note: Control Plan guidelines either exist or are being developed to support the requirements in the above VDSs. The documents shown here are also referenced in the VDSs to which they relate.

Table 4-4 ISS TASKS TO PROVIDE PAYLOAD RACK INTEGRATOR DATA MATRIX

VDS Number	VDS Title	Description	Coordination	Performed and Provided By
ST-001	Structural Strength	DLA Design Load VLA Verification Load	PEI	ISS Payload Engineering and Integration
ST-011	MPLM Interfaces	Attach point forces for each rack as a result of VCL.	PEI	ISS Payload Engineering and Integration
EL-020	Electromagnetic Interference/ Compatibility	Review the PD provided EMI/EMC Control, Test Plan and Design Analysis Report.	PEI	ISS Payload Engineering and Integration
FD-018	VES Acceptable Exhaust Gases	Venting gas constituents, mass, volume, concentration, temperature & pressure	PEI	ISS Materials Working Group
FD-019	External Contamination Control	Venting gas constituents, mass, volume, concentration, temperature, pressure & particulate size	PEI	ISS Environmental Team

Table 4-4 ISS TASKS TO PROVIDE PAYLOAD RACK INTEGRATOR DATA MATRIX (continued)

VDS Number	VDS Title	Description	Coordination	Performed and Provided By
EN-005	Microgravity Environment	Review the PD provided Microgravity Control Plan.	PEI	ISS Payload Engineering and Integration
EN-006	Acoustic Levels	Review the PD-provided Acoustic Noise Control Plan	PEI	ISS Payload Engineering and Integration
MP-004	Surface Materials	Review the PD-provided surface materials	PEI	ISS Materials Working Group

Table 4-4 Note: In order for the requirements in the VDSs listed above to be met, the PD will need support from disciplines of the ISS Program. Table 4-4 identifies the ISS disciplines required to perform certain tasks in order to close the related VDS.

Number	Title	Method	Hazard Report(s)
ST-001	STRUCTURAL - STRUCTURAL STRENGTH	A or A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.1.1.3.A Loads Requirements (A)
4.3.1.1.3.B Loads Requirements (A)
4.3.1.1.3.E Loads Requirements (A)
4.3.1.1.3.F Loads Requirements (A)
4.3.1.1.5.A Safety Critical Structures Req.

Requirement Summary:

These requirements address the structural strength of integrated racks. The integrated-rack safety-critical structure (SCS) must be able to withstand the launch, ascent, acoustic noise, random vibration, and loads due to on-orbit acceleration as well as launch and landing accelerations.

Detailed Descriptions of Requirements:

All integrated-rack SCS elements (except those covered by verification items ST-003, "On-Orbit Depress/Repress", and ST-010, "Pressurized Systems") will be included in this requirement, i.e., load carrying members. Verify by stress analysis using appropriate factors of safety that all safety critical structures have positive margins of safety. Structural design and analysis criteria as specified in SSP 52005 shall be used. Strength of the integrated rack shall be verified for all mission phases (including launch and ascent, on-orbit, and landing) and shall use MPLM launch, ascent, and landing loads environments developed from the appropriate combination of acoustic noise, random vibration, acceleration, and thermal environments as specified in SSP 41017 Part 1, Tables 3.2.1.4.1.1-1 and 3.2.1.4.1.2-1, and par. 3.2.1.4.2. On-orbit loads shall be based on the 0.2G acceleration as specified in SSP 57000, paragraph 3.1.1.3.B.

Required Verification Data:	Data Submittal Dates:
1. Data Cert that provides a summary of the margins of safety for all SCS identified in accordance with SSP 52005 using design loads.	1. L-22
2. Data Cert that provides a summary of the margins of safety for all SCS identified in accordance with SSP 52005 using loads from the Design Loads Analysis (DLA) results.	2. L-12
3. Data Cert that provides a summary of the margins of safety for all SCS identified in accordance with SSP 52005 using loads validated by the Verification Loads Analysis (VLA) results.	3. L-5

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Positive margins of safety must be verified for:
   a. Added subrack PL items - Launch/ascent loads, acoustic noise, random vibration, acceleration, and landing acceleration environments.
   b. Reconfigured integrated racks - On-orbit loads.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. Same as original submittal dates

Applicable Document(s):

SSP 41017, Part 1, Tables 3.2.1.4.1.1-1 and 3.2.1.4.1.2-1, and par. 3.2.1.4.2
SSP 52005, Entire Document
SSP 57000, par. 3.1.1.2, 3.1.1.3, and 3.1.1.5
SSP 57007 Rack Integrator's Handbook

Number	Title	Method	Hazard Report(s)
ST-002	STRUCTURAL - CREW-APPLIED LOADS	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.3.D Loads Requirements (A)
4.3.1.1.4.1.A Lab Window Rack Location Requirements (A)
4.3.1.1.5.A Safety Critical Structures Req.

Requirement Summary:

These are requirements that address the ability of the integrated rack or other attachments to withstand crew-applied loads.

Detailed Descriptions of Requirements:

Verify the capability of all rack equipment that has a potential interface with the crew for operation, use, or impact (whether inadvertent or not) to withstand crew applied loads as specified in SSP 57000, paragraph 3.1.1.3.D. Verify by stress analysis, using appropriate factors of safety, that all structures identified in SSP 57000, Table 3.1.1.3-1, have positive margins of safety.

Verify by analysis that the protective cover for the Lab Window can withstand the crew-applied loads as defined in SSP 57000, paragraph 3.1.1.3.D. Also, verify by analysis that the protective cover does not contact the lab window surface. Verification shall be considered successful when the analysis show the cover can withstand the loads specified in 3.1.1.3.D, cabinets and any other exposed equipment and does not contact the lab window surface.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing a summary listing as defined in SSP 57000, Table 3.1.1.3-1 showing positive margins of safety.	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.1.1.3, 3.1.1.4.1,and 3.1.1.5

Number	Title	Method	Hazard Report(s)
ST-003	STRUCTURAL - ON-ORBIT DEPRESS/REPRESS	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.1.1.2.B MPLM Interfaces (A)
4.3.1.1.4.B Rack Requirements (A)
4.3.1.1.4.K Rack Requirements (A)
4.3.1.1.5.A Safety Critical Structures Req.

Requirement Summary:

These requirements address the ability of the integrated rack to withstand pressure buildup during on-orbit depressurization/repressurization.

Detailed Descriptions of Requirements:

An analysis shall be conducted which determines the maximum delta pressure from within to outside the integrated rack to show that the integrated rack allowable delta pressure is not exceeded. Verification shall be considered successful when the analysis shows that 3.5 kPa (0.5 psi) delta pressure is not exceeded. Verification to ensure sufficient orifice area may be either by venting analysis or by inspection of integrated rack design drawings for NASA-provided 683-50243-4 ISPRs with intact and unblocked pressure relief valves. Subrack items that intentionally contain trapped volumes are not included in this item and are to be treated as part of ST-010, “Pressurized Systems”.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC.	II. L-6

Applicable Document(s):

SSP 57000, par. 3.1.1.2, 3.1.1.4, and 3.1.1.5

S864-10101E, par 3.3.14.6.5

Number	Title	Method	Hazard Report(s)
ST-004	STRUCTURAL - NATURAL FREQUENCY	A or A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.4.C Rack Requirements (A)
4.3.1.1.5.A Safety Critical Structures Req.

Requirement Summary:

These requirements address the natural frequencies of integrated racks and kneebrace assemblies.

Detailed Descriptions of Requirements:

Each integrated rack and kneebrace assembly shall have a modal frequency, for launch and landing, in accordance with SSP 52005, section 5.7, second paragraph, based on rigidly mounting the integrated rack in the launch configuration. The minimum modal frequency shall meet the frequency requirement specified.

The natural frequencies shall be determined by analysis or by dynamic testing (modal survey or vibration test). Analysis shall be performed using the guidelines provided in accordance with SSP 52005, Appendix C.1.2.2 and a Finite Element Model (FEM) that has been developed in accordance with SSP 52005, paragraphs 6.1.1.2, 6.1.1.3, and 7.1.

Required Verification Data:	Data Submittal Dates:
1. Finite Element Model.	1. L-18
2. Verified Finite Element Model.	2. L-11

Description of Reverification Requirements:	Reverification Method: A or A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC.	II. L-11

Applicable Document(s):

SSP 52005, par. 5.7, 6.1.1.2, 6.1.1.3, 7.1, and App. C par. 1.2.2
SSP 57000, par. 3.1.1.4 and 3.1.1.5

Number	Title	Method	Hazard Report(s)
ST-005	STRUCTURAL - HUMAN FACTOR STRENGTH REQUIREMENT	A or D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.1.A Strength Requirements (A or D)
4.3.12.1.B Strength Requirements (A or D)

Requirement Summary:

These requirements ensure that the crew will be physically capable of removing, replacing, controlling, operating, and maintaining the payload hardware and equipment on-orbit.

Detailed Descriptions of Requirements:

Normal Operations
Grip Strength - Verify by analysis or demonstration that the grip strength required to remove, replace, and operate the integrated rack equipment is less than 254 N (57 lbf).

Linear Forces - Verify by analysis or demonstration that the linear forces required to remove, replace, and operate the integrated rack equipment are less than the strength values for the 5th percentile female, defined as 50% of the strength values as specified in SSP 57000, Figure 3.12.1-1 and 60% of the strength values shown in SSP 57000, Figure 3.12.1-2.

Torsional Forces - Verify by analysis or demonstration that the torsional forces required to remove, operate, and replace the integrated rack equipment are less than the strength values for the 5th percentile female, defined as 60% of the calculated 5th percentile male capability as specified in SSP 57000, Figure 3.12.1-3.

Maintenance Operations
Strength Requirements - Verify by analysis or demonstration that the strength values required for maintenance of the integrated rack and equipment is as specified in SSP 57000, Figures 3.12.1-1, 3.12.1-2, 3.12.1-3, 3.12.1-4, and 3.12.1-5.

Note: "Demonstration should be limited to the force generated by the arm not the weight of the body."

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC)	1. L-6

Description of Reverification Requirements:	Reverification Method: A or D	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC.	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.1 and Figures 3.12.1-1, 3.12.1-2, 3.12.1-3, 3.12.1-4, and 3.12.1-5

Number	Title	Method	Hazard Report(s)
ST-006	STRUCTURAL - PUSH-PULL FORCES	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.2.7 Push-Pull Forces (A)

Requirement Summary:

This requirement ensures that the crew will be physically capable of operating equipment that requires push-pull actions.

Detailed Descriptions of Requirements:

Push-Pull forces shall be verified by analysis. Verification shall be considered successful when an analysis of the payload flight hardware shows that hardware mounted into a capture-type receptacle that requires push-pull action requires a force less than 156 N (35lbf) to install and remove.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC)	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC.	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.2.7

Number	Title	Method	Hazard Report(s)
ST-007	STRUCTURAL - GROUND TRANSPORTATION LOADS	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.1.D GSE Interfaces (A&T)

Requirement Summary:

This requirement ensures that the integrated rack does not exceed 80% of the flight load during ground transportation.

Detailed Descriptions of Requirements:

Verify by analysis and test that the integrated rack ground transportation accelerations do not exceed 80% of the flight accelerations as specified in SSP 41017 Part I, paragraph 3.2.1.4.2. Verification shall be considered successful when test provides a measurement of the maximum accelerations encountered during shipment in the three orthogonal rack axes and an analysis shows that these accelerations do not exceed 80% of the flight accelerations. Integrated rack shall be designed either to withstand these accelerations, or shall be protected during handling by suitable equipment container design.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC)	1. L-5

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 41017, Part I, par. 3.2.1.4.2
SSP 57000, par. 3.1.1.1

Number	Title	Method	Hazard Report(s)
ST-008	STRUCTURAL - FRACTURE CONTROL	A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.5.A Safety-Critical Structures Req.

Requirement Summary:

Each integrated rack assembly must be capable of withstanding the design load environment throughout its design life.

Detailed Descriptions of Requirements:

Fracture control is required on all safety-critical flight structures in accordance with the requirements of NASA-STD-5003. This requires that a fracture mechanics analysis of each integrated rack assembly be performed to ensure that it is capable of surviving the design loading environment without material flaws/cracks growing to failure during the specified design life. Guidelines for fracture control/fracture mechanics analysis are available in SSP 52005, paragraphs 5.3 and 6.2.

Critical flaw sizes that result from the fracture mechanics analysis will determine any requirements for Nondestructive Evaluation (NDE) of structural parts. Fracture control planning, analysis, inspection requirement, and inspection results shall be performed per a user-developed Fracture Control Plan approved by the Payload Safety Review Panel (PSRP) as specified in SSP 52005, paragraph 9.2.2.

Required Verification Data:	Data Submittal Dates:
1. Fracture Control Plan (submitted for PSRP approval during preliminary design phase). * Per PSRP Template.	1. L-22* 2. L-12*
2. Data Cert providing a fracture control summary.	

Description of Reverification Requirements:	Reverification Method: A&I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Data Cert providing a fracture control summary.	II. L-12

Applicable Document(s):

NASA-STD-5003 Entire Document
SSP 52005, Entire Document
SSP 57000, par. 3.1.1.5

Number	Title	Method	Hazard Report(s)
ST-009	STRUCTURAL - SECURING OF THREADED FASTENERS	A&I or T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.1.1.5.A Safety-Critical Structure Req.
4.3.12.9.9.A Locking Wires (A)
4.3.12.9.9.B Locking Wires (I)

Requirement Summary:

All the threaded fasteners connecting safety-critical structures must be secured by a positive locking device; however, safety wires may not be used on fasteners that are to be removed or replaced on-orbit.

Detailed Descriptions of Requirements:

For safety-critical fasteners (excluding fracture-critical) that are not directly accessible to the crew, positive locking can be provided by cotter pins, safety wires, safety cable, locktite, locking nuts, and locking inserts, or equivalent. For fasteners that are directly accessible to the crew or that require removal/replacement, safety wiring is excluded as an acceptable method. If locking devices are not used the design must be validated by comparing the position of torque stripes or torque values before and after a vibration test at expected flight levels.

Fracture-critical fasteners and fasteners that retain a fracture critical rotary device shall be safety-wired or cotter-pinned as specified in MS 33540 or safety-cabled as specified in SAE AS4536.

Verification shall be considered successful when an inspection of threaded fasteners shows that positive locking provisions are in place in accordance with SSP 52005, paragraph 5.6. If locking devices are not used (non-fracture-critical fasteners only) the design must be validated by comparing the position of torque stripes or the torque values before and after a vibration test at expected flight levels. The vibration test duration is in accordance with SSP 52005, paragraph 7.2.2.

NOTE: Fasteners internal to the payload components, which are shown to be contained, are excluded from this requirement.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: I or T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: An inspection or test is required to verify that all threaded fasteners connecting safety critical structures are secure.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

MS 33540
SAE AS4536
SSP 52005, par. 5.6
SSP 57000, par. 3.12.9.9 and 3.1.1.5

Number	Title	Method	Hazard Report(s)
ST-010	STRUCTURAL - PRESSURIZED SYSTEMS	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.5.A Safety Critical Structures Req. 4.3.5.1.7 (A, B,&C)Coolant Maximum Design Pressure (A&T)

Requirement Summary:
The structural integrity of all pressure system components, including lines and fittings, pressure tanks, actuating cylinders, valves, filters, and switches, must be maintained.

Detailed Descriptions of Requirements:

A. Pressure Vessels -
Any component that meets the criteria of a pressure vessel (as specified in NSTS 1700.7 ISS Addendum) shall be verified by stress analysis and proof test using appropriate factors of safety (as specified in SSP 52005, paragraph 5.1.3.2) to show positive margins of safety. Components meeting the criteria of a pressure vessel are deemed fracture-critical and must also satisfy verification item ST-008, "Fracture Control".

Paragraph 6.2.3 of SSP 52005 describes the specific analysis, test, and unique requirements for qualifying/verifying a pressure vessel. Applicable combination of loads environments (as specified in SSP 52005, paragraph 4.1.6) shall be used.

B. Components Not Meeting Criteria of Pressure Vessel -
Verify by stress analysis and/or burst test using factors of safety as specified in NSTS 1700.7 ISS Addendum, paragraph 208.4c, that pressure system components not meeting the criteria of a pressure vessel have positive margins of safety. Appropriate combinations of load factors (as specified in SSP 52005, paragraph 4.1.6) shall be used. Certified vendors' burst data may be used in lieu of analysis to verify margins of safety when pressure loads are the principal failure mode (except for attachment lugs/fittings, which still must be verified by analysis to show capability of withstanding flight loads). A pressurized system is considered fracture-critical if leakage or loss of pressurization would result in a catastrophic hazard (as specified in SSP 52005, paragraph 4.1.6, 5.1.3, 5.1.3.2 and 6.2.4). In that case, the system would also be required to satisfy verification item ST-008, "Fracture Control".

Note: The verification of integrated rack hardware leakage shall be by test. . Leak checks shall be considered successful if the integrated rack passes the leak check in accordance with (IAW) SSP 52005, paragraph 5.1.3. Sub-rack items that contain intentionally trapped volumes should also be taken into account as part of the pressurized system.

Required Verification Data:	Data Submittal Dates:
1. Data identified for Phased Safety Review II in accordance with SSP52005, Table 9.2.2-1.	1. L-22
2. Data identified for Phased Safety Review III in accordance with SSP52005, Table 9.2.2-1.	2. L-12

Description of Reverification Requirements:	Reverification Method: A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. Same as the original submittal dates

Applicable Documents:
NSTS 1700.7 ISS Addendum, par. 208.4c
SSP 52005, par. 4.1.6, 5.1.3.2, 6.2.4, and Table 9.2.2-1
SSP 57000, par. 3.1.1.5 and 3.5.1.7
SSP 57001, par. 3.5.1.5

Number	Title	Method	Hazard Report(s)
ST-011	STRUCTURAL - MPLM INTERFACES	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.2.E MPLM Interfaces (A)

Requirement Summary:

This requirement ensures that integrated racks, when attached to the MPLM, do not produce forces that exceed the strength of the MPLM attach-points.

Detailed Descriptions of Requirements:

Integrated racks shall be limited to producing interface attach-point forces less than or equal to those as specified in SSP 41017 Part 1, paragraph 3.2.1.4.3 based on acceleration environments as specified in SSP 41017 Part 1, paragraph 3.2.1.4.2. An analysis shall be performed using the referenced acceleration data and calculating the interface attach-point forces via Finite Element Modeling (FEM) constrained at the interfaces with the MPLM. If the calculated interface forces exceed the MPLM allowable limits, attach point interface forces calculated from the Design Couple Loads (DCL) analysis may be used, provided that the integrated rack FEM model used in the DCL adequately represents the flight configuration.

The analysis shall be considered successful when the attach point forces do not exceed the MPLM allowable limits.

Final verification of the MPLM interface attach point forces shall be based on results from the Verification Coupled Loads (VCL) analysis conducted by the ISS Program using an approved VCL FEM. The final verification shall be considered successful when the VCL interface attach point force results do not exceed the MPLM allowable limits as specified in SSP 41017 Part 1, paragraph 3.2.1.4.3.

Required Verification Data:	Data Submittal Dates:
1. Preliminary Data Cert, based on static analysis using approved FEM (or DCL analysis results), providing the MPLM interface attach point forces and margins of safety calculations based on the allowable limits as specified in SSP 41017 Part 1, paragraph 3.2.1.4.3.	1. L-12
2. Final Data Cert, providing the MPLM interface attach point forces and margins of safety calculations based on the allowable limits as specified in SSP 41017 Part 1, paragraph 3.2.1.4.3. (Attachment force can be obtained from the result of the VCL).	2. L-5

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above for item 2.	II. L-6

Applicable Document(s):

SSP 57000, par. 3.1.1.2
SSP 41017, Part 1, paragraphs 3.2.1.4.2 and 3.2.1.4.3

Number	Title	Method	Hazard Report(s)
ME-001	MECHANICAL - WEIGHT AND CG	A&D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.4.A Rack Requirements (A&D)

Requirement Summary:

This requirement ensures that the weight and center of gravity (CG) of each integrated rack is within specified limits.

Detailed Descriptions of Requirements:

Determine the actual weight of an integrated rack by analysis based on weight measurement data, including any stowage items within the rack and any PD-provided ancillary equipment. Allowable tolerance shall be ± 2%. The actual mass of the integrated rack shall be no greater than the control mass as specified in SSP 57000, paragraph 3.1.1.4.

Determine the actual CG by analysis based on weight measurement data of the integrated rack in three orthogonal axes. Allowable tolerance shall be ±0. 5 in. in all three axes.

A Mass Properties summary including the CG and the weight of the integrated rack and all PD-provided ancillary equipment is required for both launch and landing scenarios.

Required Verification Data:	Data Submittal Dates:
1. Data Cert that provides weight and CG summary for launch and landing of the integrated rack.	1. L-7

Description of Reverification Requirements:	Reverification Method: A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: A test is required for the subrack payload prior to launch, and the mass and CG of the reconfigured rack (i.e., on-orbit, landing) shall be determined analytically.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. Same as the original submittal dates

Applicable Document(s):

SSP 57000, par. 3.1.1.4
SSP 57001, par. 3.1.1.3

Number	Title	Method	Hazard Report(s)
ME-002	MECHANICAL - MECHANICAL STOPS	A or D or I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.2.6 Slide-Out Stops (A or D or I)

Requirement Summary:

This requirement ensures that all mechanical stops are provided as required.

Detailed Descriptions of Requirements:

Verification that mechanical stops are provided shall include an analysis or inspection of the payload flight hardware drawings or a demonstration of the payload flight hardware to verify that the required mechanical limit stops are included in the design. The requirement applies to limit stops that are provided on slide or pivot-mounted sub-rack hardware that is required to be pulled out of its installed position.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or D or I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.2.6

Number	Title	Method	Hazard Report(s)
ME-003	MECHANICAL - PAYLOAD IN-FLIGHT MAINTENANCE	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.10 Payload In-Flight Maintenance (A)

Requirement Summary:

This requirement ensures that integrated racks/payloads can be maintained using Space Station-provided on-board tools.

Detailed Descriptions of Requirements:

Payloads shall be designed to be maintainable using Space Station-provided on-board tools, as specified in (SSP 57020 Pressurized Payloads Accommodations Handbook , paragraph 5.10). The verification shall be considered successful when an analysis of payload hardware and flight drawings confirm that the hardware can be maintained using Space Station-provided on-board tools.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.10
SSP 57020, Pressurized Payloads Accommodations Handbook

Number	Title	Method	Hazard Report(s)
ME-004	MECHANICAL - LAUNCH/LANDING UMBILICALS RESTRAINT	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.3.C Loads Requirements (I)

Requirement Summary:

This requirement ensures that Rack Utility Panel umbilicals are restrained during launch and landing.

Detailed Descriptions of Requirements:

Rack Utility Panel (RUP) umbilicals shall be restrained during launch and landing to prevent damage to loose connectors. An inspection of the hardware to flight approved drawings shall be performed to verify that hardware is provided to restrain rack umbilicals.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 57000, par. 3.1.1.3

Number	Title	Method	Hazard Report(s)
ME-005	MECHANICAL - FIBER OPTIC CABLE BEND RADIUS	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.7.5 HRDL Fiber Optic Cable Bend Radius (I)
4.3.4.1.2.5 PFM NTSC Video Fiber Optic Cable Bend Radius (I)

Requirement Summary:

ISS interface fiber optic cable routing, installation, and handling procedures must be adequate to prevent the fiber optic cable from being bent beyond the allowable limits.

Detailed Descriptions of Requirements:

The Rack Integrator shall develop the routing, installation and handling procedures to assure that a fiber optic cable minimum bend radius of 2 inches or greater is maintained at all times. The verification shall be considered successful when inspection of the integrated rack fiber optic cable routing, installation and handling procedures shows that the cables are not bent in a tighter radius.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.3.7.5 and 3.4.1.2.5

Number	Title	Method	Hazard Report(s)
ME-006	MECHANICAL - FULL SIZE RANGE ACCOMMODATION	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.2.3 Full Size Range Accommodation (A)

Requirement Summary:

Payload workstations must be sized to accommodate the functional reach limits of the crew who will use them.

Detailed Descriptions of Requirements:

Analyses of end item drawings that contain on-orbit crew interfaces shall be performed to verify that Payload hardware accommodates the 5th percentile Japanese female to the 95th percentile American male size measurements, estimated for the year 2000, as specified in SSP 50005, Anthropometric and Biomechanics related design data. Drawings of workstations and hardware having crew nominal operations and planned maintenance shall be analyzed to verify that they are sized to not confine the body envelope of the 95th percentile American male.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.2.3
SSP 50005, par. 3.3.3.3.1

Number	Title	Method	Hazard Report(s)
ME-007	MECHANICAL - CLOSURES AND COVERS	A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.3.1.1 Closures and Covers (I)
4.3.12.4.2.8.1.A Covers (A)
4.3.12.4.2.8.1.B Covers (A)
4.3.12.4.2.8.2 Self-Supporting Covers (A)
4.3.12.9.3 Holes (A&I)

Requirement Summary:

Closures and covers are required for areas that are not designed for routine cleaning. Access covers that are not completely removable must be self-supporting in the open position.

Detailed Descriptions of Requirements:

A. Closures or covers shall be provided for any area of the integrated rack that is not designed for routine cleaning. An inspection of the hardware to flight approved drawings shall be performed to verify compliance with the requirement (SSP 57000, paragraph 3.12.3.1.1)

B. Covers - An analysis of payload hardware and flight drawings shall be performed to verify SSP 57000, paragraph 3.12.4.2.8.1. The verification shall be considered successful when the analysis shows the requirement has been met.

C. Access covers that are not completely removable shall be self-supporting in the open position (SSP 57000, paragraph 3.12.4.2.8.2). Verification shall be considered successful when an analysis of the payload flight hardware drawings shows that all access covers that are not completely removable are self-supporting in the open position.

D. Covers shall be provided for holes that are round or slotted in the range of 10.0 to 25.0 mm (0.4 to 1.0 in.) (SSP 57000, paragraph 3.12.9.3) and that are in IVA crewmember translation paths and maintenance worksites. An analysis shall be performed using data from drawings, integration documentation, and operational procedures to identify the applicable holes. An inspection of the hardware to flight approved drawings shall be performed to ensure that either proper hole sizes have been used or that all applicable holes are covered or guarded.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A&I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.3.1.1, 3.12.4.2.8.1, 3.12.4.2.8.2, and 3.12.9.3

Number	Title	Method	Hazard Report(s)
ME-008	MECHANICAL - BUILT-IN CONTROLS	A&I or D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.3.1.2.A Built-In Controls (I)
4.3.12.3.1.2.B Built-In Controls (A or D)

Requirement Summary:

Containers of liquids or particulate matter must have built-in methods of capture control, and the capture mechanisms/elements should not disperse their trapped materials while they are being replaced or cleaned.

Detailed Descriptions of Requirements:

A. Payload containers of liquids or particulate matter shall have built-in equipment/methods for control of vaporization, material overflow, or spills. (SSP 57000, paragraph 3.12.3.1.2.A) An inspection of the hardware to flight approved drawings shall be performed to verify compliance with the requirement.

B. Capture elements, including grids, screens, or filter surfaces shall be accessible for replacement or cleaning without dispersion of the trapped materials. (SSP 57000, paragraph 3.12.3.1.2.B). The verification shall be considered successful when demonstration or analysis shows that the crew can access the flight hardware capture elements for cleaning or replacement without dispersion of trapped material.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A&I or D&I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):
SSP 57000, par. 3.12.3.1.2

Number	Title	Method	Hazard Report(s)
ME-009	MECHANICAL - ONE-HANDED CLEANING OPERATIONS	D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.3.1.5 One-Handed Operation (D)

Requirement Summary:

Payload cleaning equipment and supplies must be designed for one-handed operation or use.

Detailed Descriptions of Requirements:

Verify by demonstration that payload cleaning equipment and supplies can be operated using only one hand, which does not preclude the use of either hand.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	D	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):
SSP 57000, par. 3.12.3.1.5

Number	Title	Method	Hazard Report(s)
ME-011	MECHANICAL - EQUIPMENT MOUNTING	A or D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.2.1 Equipment Mounting (A or D)

Requirement Summary:

Equipment must be labeled or marked to protect against improper installation.

Detailed Descriptions of Requirements:

Equipment mounting used during nominal operations and planned maintenance shall be verified by analysis or demonstration. The verification shall be considered successful when the analysis or demonstration shows that the payload hardware used during nominal operations and planned maintenance is designed, labeled, or marked to protect against improper installation.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or D	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: An inspection is required to ensure that an alignment mark is on the reflight part per the drawings.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.2.1

Number	Title	Method	Hazard Report(s)
ME-012	MECHANICAL - DRAWERS AND HINGED PANELS	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.2.2 Drawers and Hinged Panels (A)

Requirement Summary:

Payload Orbital Replacement Units (ORUs) that are pulled out for routine inspection must be mounted on equipment drawers or hinged panels such that they can remain in the "open" position without being supported by hand.

Detailed Descriptions of Requirements:

Payload ORUs that are pulled out of their installed positions for routine inspection shall be mounted on equipment drawers or hinged panels. Such drawers or hinged panels shall remain in the "open" position without being supported by hand. Verification shall be considered successful when an analysis of the equipment flight drawings shows that the requirement is met.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.2.2

Number	Title	Method	Hazard Report(s)
ME-013	MECHANICAL - ALIGNMENT	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.2.5 Alignment (A)

Requirement Summary:

Guide pins or their equivalent must be provided for payload hardware that has blind-mate connectors.

Detailed Descriptions of Requirements:

Verification shall be considered successful when an analysis of the payload flight hardware drawings shows that guide pins or their equivalent are provided to assist in alignment during installation of hardware with blind mate connectors.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.2.5

Number	Title	Method	Hazard Report(s)
ME-014	MECHANICAL - UMBILICAL RESTRAINT	D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.6.2 Umbilical Physical Mate (D)

Requirement Summary:

A Rack Utility Panel and umbilicals must be provided to connect the integrated rack to the ISS standoff Utility Interface Panel.

Detailed Descriptions of Requirements:

Integrated racks shall provide a Rack Utility Panel and umbilicals that allow connection of rack utilities from the rack to the standoff Utility Interface Panel as specified in SSP 41002, Figure 3.2.2-1 and the appropriate Utility Interface Panel connector layout as specified in SSP 41002, Figures 3.3-1 through 3.3-5. Verification shall be considered successful when a demonstration shows that the umbilicals can successfully reach their intended connector and that the connectors are observed in a fully mated condition with no tension on the umbilicals.

The demonstration shall be conducted using the Payload Rack Checkout Unit (PRCU), or equivalent.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 41002, Figures 3.2.2-1 and 3.3-1 through 3.3-5
SSP 57000, par. 3.1.1.6.2

Number	Title	Method	Hazard Report(s)
ME-015	MECHANICAL - USL WINDOW KEEPOUT ENVELOPE	A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.4.F Rack Requirements (A)
4.3.1.1.4.1.B Lab Window Rack Location Requirements (I)
4.3.1.1.4.1.C Lab Window Rack Location Requirements (A)

Requirement Summary:

The geometry of the integrated rack must be compatible with the static-envelope requirements at the US Lab Nadir Window.

Detailed Descriptions of Requirements:

Integrated racks that will be installed in the US Lab Nadir Window location shall accommodate the modified ISPR static envelope as specified in SSP 57001, Figure 3.1.1.4-1. Verification shall be considered successful when an analysis of the clearance dimensions between the window hardware and the integrated rack hardware indicates a positive clearance.

Verification that the integrated rack at the lab window location provides a keep-out zone as specified in SSP 57001, Figure 3.1.1.4-1 shall be done by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawings shows that the integrated rack provides a keep-out zone as specified in SSP 57001, Figure 3.1.1.4-1.

Verification that the integrated rack at the lab window location provides a barrier between the Lab pressure wall and the integrated rack shall be by analysis. An analysis shall determine whether or not a barrier is provided by the integrated rack that would prevent airflow and debris from leaving/entering the integrated rack. Verification shall be considered successful when the analysis shows a barrier is provided that would prevent airflow and debris from enter/leaving the rack between the back of the rack and the pressure wall.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.1.1.4 and 3.1.1.4.1
SSP 57001, Figure 3.1.1.4-1

Number	Title	Method	Hazard Report(s)
ME-016	MECHANICAL - UNIQUE TOOLS	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.2.8.4 Unique Tools (A)

Requirement Summary:

Payload-provided unique tools must comply with ISS tool design requirements.

Detailed Descriptions of Requirements:

Payload-provided unique tools shall meet the requirements in accordance with SSP 50005, paragraph 11.2.3. Verification shall be considered successful when an analysis of the payload flight hardware drawings for payload-provided unique tools shows that the tool requirements are met.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 50005, par. 11.2.3
SSP 57000, par. 3.12.4.2.8.4

Number	Title	Method	Hazard Report(s)
ME-017	MECHANICAL - CONNECTOR MATING/DEMATING	A or A&D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.3.1 One-Handed Operation (A or D)
4.3.12.4.3.3 Ease of Disconnect (A)
4.3.12.4.3.5 Self Locking (A)

Requirement Summary:

These requirements ensure that fluid and electrical connectors can be operated easily by crewmembers on-orbit. Fluid connectors must be designed for one-handed operation. The crew should be able to disconnect electrical connector plugs by a single turn, and internal connector plugs must provide a self-locking safety catch.

Detailed Descriptions of Requirements:

A. Fluid Connectors
All ORU connectors, whether operated by hand or tool, shall be designed so that they can be mated/demated using one hand. Connector design shall not preclude the use of either the right or the left hand. (SSP 57000, paragraph 3.12.4.3.1) Verification shall be considered successful when analysis or demonstration shows that all ORU connectors (flight hardware or hardware that replicates the flight hardware configuration), can be mated/demated using only one hand, which does not preclude the use of either hand.

B. Electrical Connectors
i. All ORU connectors, whether operated by hand or tool, shall be designed so that they can be mated/demated using one hand. Connector design shall not preclude the use of either hand. (SSP 57000, paragraph 3.12.4.3.1) Verification shall be considered successful when analysis or demonstration shows that all ORU connectors can be mated/demated using only one hand, which does not preclude the use of either hand.

ii.a Electrical connectors which are mated/demated during nominal operations shall require no more than two turns to disconnect. Ease of disconnect shall be verified by analysis. Verification shall be considered successful when the analysis shows that electrical connectors which are mated/demated during nominal operations require no more than two turns to disconnect.

ii.b. Electrical connectors which are mated/demated during ORU replacement operations only shall require no more than six turns to disconnect. Ease of disconnect shall be verified by analysis. Verification shall be considered successful when the analysis shows that electrical connectors which are mated/demated during ORU replacement operations require no more than six turns to disconnect.

iii. Payload electrical connectors shall provide a self-locking feature. (SSP 57000, paragraph 3.12.4.3.5) Verification shall be considered successful when an analysis of payload flight hardware drawings shows payload electrical connectors are provided with a self-locking feature.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or A&D	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A II. COC	I. N/A II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.3.1, 3.12.4.3.3, and 3.12.4.3.5

Number	Title	Method	Hazard Report(s)
ME-018	MECHANICAL - CONNECTOR ARRANGEMENT AND ACCESSIBILITY	A&I or D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.4.3.2.A Accessibility (A or D)
4.3.12.4.3.2.B Accessibility (A or D)
4.3.12.4.3.6.A Connector Arrangement (I)
4.3.12.4.3.6.B Connector Arrangement (I)

Requirement Summary:
Integrated-rack connectors must be accessible, and they should be easy to disconnect, or reconnect without causing damage to them.

Detailed Descriptions of Requirements:

A. i. Nominal Operations
Accessibility shall be verified by analysis or demonstration. Verification shall be considered successful when an analysis of the payload flight hardware drawings or demonstration of the payload flight hardware shows that it is possible to mate/demate individual connectors without having to remove or mate/demate other connectors.

ii. Maintenance Operations
Accessibility shall be verified by analysis or demonstration. Verification shall be considered successful when an analysis of the payload flight hardware drawings or demonstration of the payload flight hardware shows that it is possible to mate/demate individual connectors without having to remove or mate/demate connectors on other ORUs or payloads.

B. Electrical connectors and cable installations shall permit disconnection and reconnection without damage to wiring connectors. Verification shall be considered successful when an analysis of the payload hardware drawings shows that it is possible to disconnect and reconnect electrical connectors and cable installations without damage to wiring connectors.

C. Space between connectors and adjacent obstructions shall be a minimum of 25 mm (1 inch) for Intravehicular Activity (IVA) access. Verification shall be considered successful when an inspection of the hardware to flight approved drawings shows a space between connectors and adjacent obstructions.

D. Connectors in a single row or staggered rows which are removed sequentially by the crew (IVA) shall provide a minimum of 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. Verification shall be considered successful when an inspection of hardware to flight approved drawings shows connectors in a single row or staggered rows.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A&I or D&I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.3.2 and 3.12.4.3.6

Number	Title	Method	Hazard Report(s)
ME-019	MECHANICAL - CONNECTOR PROTECTION AND SHAPE	A&D or A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.3.8 Connector Protection (A)
4.3.12.4.3.9 Connector Shape (A)
4.3.12.9.1.1 Mismatched (D or I)

Requirement Summary:

Integrated-rack connectors should be designed to prevent inadvertent reversing or mismatching of electrical connections. They should also have sufficient mechanical protection to prevent crewmember contact with exposed electrical contacts, and physical damage/contamination protection should be provided for demated connectors.

Detailed Descriptions of Requirements:

A. Fluid Connectors
   i. Physical - Protection against physical damage and contamination shall be provided for all demated connectors. (SSP 57000, paragraph 3.12.4.3.8). Verification shall be considered successful when an analysis shows that protection against physical damage and contamination is provided for all demated connectors.
   ii. Mismating - Connectors that are of different shapes or physically incompatible shall be used when lines differ in content. (SSP 57000, paragraph 3.12.4.3.9). Verification shall be considered successful when an analysis of payload flight hardware drawings shows that connectors that differ in content are of different shape or are physically incompatible.

B. Electrical Connectors
   i. Physical - Protection shall be provided for all demated connectors against physical damage and contamination. (SSP 57000, paragraph 3.12.4.3.8). Verification shall be considered successful when an analysis shows that protection is provided for all demated connectors against physical damage and contamination.
   ii. Mismating - The design of integrated rack connectors and subrack equipment connectors shall be verified by demonstration or inspection. The demonstration shall be performed on the integrated rack connectors and subrack equipment connectors. An inspection of the hardware to flight approved drawings shall be performed to verify compliance with the requirement. The verification shall be considered successful when the demonstration or inspection shows that the connectors are unique to its appropriate connection, thereby preventing mismatching.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A&D or A&I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.3.8, 3.12.4.3.9, and 3.12.9.1.1

Number	Title	Method	Hazard Report(s)
ME-020	MECHANICAL - ALIGNMENT, CODING, AND ORIENTATION	A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.4.3.11.A Alignment Marks or Guide Pins (I)
4.3.12.4.3.12.A Coding (I)
4.3.12.4.3.12.B Coding (I)
4.3.12.4.3.14 Orientation (A)

Requirement Summary:

Parts that are to be mated on-orbit must have alignment marks with both halves properly coded, and grouped plugs must be oriented so that aligning pins are in the same relative position.

Detailed Descriptions of Requirements:

A. Alignment marks, guide pins, or mating parts shall be verified by inspection. The inspection shall be performed by examining the mating hardware for alignment marks or guide pins in a visible location during mating. Verification shall be considered successful when an inspection shows that the alignment marks or guide pins are applied to mating parts and consist of a straight or curved line to a width and length sufficient to allow accurate alignment. Guide pins shall be verified by inspection of the drawings or the hardware. The verification shall be considered successful when the guide pins are shown to extend beyond the plugs electrical pins to ensure that guide is obtained before the electrical pins engage.

B. Both halves of mating connectors shall display a code or identifier, which is unique to that connection. The labels or codes on connectors shall be located so that they are visible when connected or disconnected. (SSP 57000, paragraph 3.12.4.3.12) Verification shall be considered successful when an inspection of the hardware to flight approved drawings shows that both halves of mating connectors display a code or identifier, which is unique to that connection.

C. Grouped plugs and receptacles shall be oriented so that the aligning pins or equivalent devices are in the same relative position. (SSP 57000, paragraph 3.12.4.3.14) Verification shall be considered successful when an analysis of the payload flight hardware drawings shows that grouped plugs and receptacles are oriented so that the aligning pins or equivalent devices are in the same relative position.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.3.11, 3.12.4.3.12, and 3.12.4.3.14

Number	Title	Method	Hazard Report(s)
ME-021	MECHANICAL - PHYSICAL INTERFERENCE	A&I or A&D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.1.1.4.E Rack Requirements (I)
4.3.1.1.4.I Rack Requirements (A)
4.3.1.1.4.L Rack Requirements (A)
4.3.12.2.1 Adequate Clearance (A or D)
4.3.12.2.2.A Accessibility (A or D)
4.3.12.2.2.B Accessibility (A or D)

Requirement Summary:

Integrated racks must have adequate volume and clearances such that they provide sufficient access to equipment during on-orbit rack installation, operations, and maintenance.

Detailed Descriptions of Requirements:

A. Integrated racks shall comply with the keepout zone for rack pivot mechanisms as specified in SSP 41017 Part 1, paragraph 3.2.1.1.2. The verification shall be considered successful when the inspection of the umbilical routing drawing shows that the envelope is provided, or when analysis shows that the umbilicals can be moved out of the envelope without exceeding any umbilical bend radii requirements.

B. Integrated racks shall be capable of rotating a minimum of 80 degrees about the pivot point for on-orbit installation, removal and maintenance. (SSP 57000, paragraph 3.1.1.4.I) Integrated racks requiring rotation shall use the rack and crew restraints as specified in SSP 30257:004, (for example: the 14 inch fixed-length tether and the 71 inch adjustable-length tether), to secure the rack in these rotated positions for payload operations and maintenance. The verification of the minimum rotation angle shall be considered successful when an analysis of the maximum rotation angle is calculated to be at least 80 degrees. Verification of the rack positional and crew restraints at rotating angles for payload operations and maintenance shall be considered successful when an analysis of the rack positional and crew restraints shows that ISS-provided hardware can secure the rack in the required rotation positions.

C. The integrated rack clearance shall be verified by analysis or demonstration. The analysis shall be based on an evaluation of the drawing(s) with the calculated clearance requirements to perform the relevant tasks using the necessary tools and equipment utilized in payload installation, operations, and maintenance. The demonstration shall be performed on the flight hardware or hardware that replicates the flight hardware configuration with the tools and equipment utilized in payload installation, operations, and maintenance. The verification shall be considered successful when the analysis or demonstration shows that the clearance to accommodate crew performance of tasks, including tool utilization, is sufficient to install/de-install, operate, and maintain the integrated rack equipment.

D. Payload hardware shall be geometrically arranged to provide physical and visual access for all payload installation, operations, and maintenance tasks. (SSP 57000, paragraph 3.12.2.2.A) The verification shall be considered successful when an analysis or demonstration shows that the specified accessibility to remove, replace, operate, and maintain the integrated rack equipment as well as specified IVA clearance are met.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

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Number	Title	Method	Hazard Report(s)
ME-021	MECHANICAL - PHYSICAL INTERFERENCE	A&I or A&D&I	

continued from previous page

Description of Reverification Requirements:	Reverification Method: A&I or A&D&I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 30257:004
SSP 41017, Part I, par. 3.2.1.1.2
SSP 57000, par. 3.1.1.4, 3.12.2.1, and 3.12.2.2

Number	Title	Method	Hazard Report(s)
ME-022	MECHANICAL - HOSE/CABLE RESTRAINTS	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.3.15.A Hose/Cable Restraints (I)
4.3.12.4.3.15.B Hose/Cable Restraints (I)
4.3.12.4.3.15.D Hose/Cable Restraints (I)

Requirement Summary:

These requirements ensure that hoses and cables are adequately restrained.

Detailed Descriptions of Requirements:

A. Hose/Cable restraints shall be verified by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawings shows that the loose ends of hoses and cables have a means of being restrained.

B. Hose/Cable restraints shall be verified by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawings shows that conductors, bundles, or cables are secured by a means of clamps unless they are contained in wiring ducts or cable retractors.

C. Hose/Cable restraints shall be verified by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawings shows that loose cables are restrained as specified in SSP 57000, paragraph 3.12.4.3.15.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 57000, par. 3.12.4.3.15

Number	Title	Method	Hazard Report(s)
ME-023	MECHANICAL - ENGAGEMENT STATUS INDICATION	D or I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.4.1 Non-Threaded Fastener Status Indication (D or I)

Requirement Summary:

Non-Threaded fasteners must provide an indication that they are correctly engaged.

Detailed Descriptions of Requirements:

Non-threaded fasteners status indication shall be verified by demonstration or inspection. Verification shall be considered successful when the demonstration or inspection shows that an indication of correct engagement (hooking, latch fastening, or proper positioning of interfacing parts) of non-threaded fasteners shall be provided.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: D or I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.4.1

Number	Title	Method	Hazard Report(s)
ME-024	MECHANICAL - MOUNTING BOLT/FASTENER SPACING AND TOOL CLEARANCE	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.4.2 Mounting Bolt/Fastener Spacing (I)
4.3.12.4.4.14 Access Holes (I)

Requirement Summary:

Spacing around fasteners must allow hand or tool access, and holes that fasteners pass through should not require precise alignment of the fastener.

Detailed Descriptions of Requirements:

A. Mounting bolts and fasteners shall be spaced the required distance from other surfaces as specified in SSP 57000, paragraph 3.12.4.4.2 mounting bolt/fasteners shall be verified by inspection. Verification shall be successful when an inspection of the hardware to flight approved drawings shows that mounting bolts and fasteners are spaced as specified.

B. Covers or shields through which mounting fasteners must pass shall have holes that allow passage of the fastener (and hand or necessary tool if either is required) without precise alignment. (SSP 57000, paragraph 3.12.4.4.14) Verification shall be considered successful when an inspection of the hardware to flight approved drawings shows that covers or shields through which mounting fasteners must pass for attachment to the basic chassis of the unit have holes for passage of the fastener without precise alignment.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.4.2and 3.12.4.4.14

Number	Title	Method	Hazard Report(s)
ME-025	MECHANICAL - MULTIPLE FASTENERS	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.4.4.A Multiple Fasteners (I)

Requirement Summary:

When several fasteners are used on one item, they should all be of the same type (excluding length), and the design should prohibit them from being assembled incorrectly.

Detailed Descriptions of Requirements:

Multiple fasteners shall be verified by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawings shows that when several fasteners are used on one item they are all of identical type (excluding length).

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.4.4

Number	Title	Method	Hazard Report(s)
ME-026	MECHANICAL - FASTENERS	A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.4.4.5 Captive Fasteners (A)
4.3.12.4.4.6.A Quick Release Fasteners (I)
4.3.12.4.4.6.B Quick Release Fasteners (I)
4.3.12.4.4.7 Threaded Fasteners (I)
4.3.12.4.4.9 Winghead Fasteners (I)
4.3.12.9.5 Screws and Bolts (A&I)

Requirement Summary:

These requirements ensure that fasteners in the integrated racks comply with specified operational requirements.

Detailed Descriptions of Requirements:

A. All fasteners shall be captive when disengaged. (SSP 57000, paragraph 3.12.4.4.5) Verification shall be considered successful when an analysis shows that fasteners that are planned to be installed and/or removed on-orbit are captive when disengaged.

B. Quick Release Fasteners shall:

   i. Require a maximum of one complete turn to operate (quarter-turn fasteners are preferred). (SSP 57000, paragraph 3.12.4.4.6.A) Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that fasteners require a maximum of one complete turn to operate.

   ii. Be positive-locking in the open and closed positions. (SSP 57000, paragraph 3.12.4.4.6.B) Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that fasteners are positive-locking in open and closed positions.

C. Threaded fasteners shall have only right-hand threads. (SSP 57000, paragraph 3.12.4.4.7) Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that threaded fasteners have right-handed threads per the hardware or drawings as specified in SSP 52005, section 5.6.

D. Winghead fasteners shall fold down and be retained flush with surfaces. (SSP 57000, paragraph 3.12.4.4.9) Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that winghead fasteners fold and are retained flush with surfaces.

E. Locking devices used in conjunction with pin fasteners shall be made accessible and visible. (SSP 57000, paragraph 3.12.4.4.10.B) Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that locking devices used in conjunction with pin fasteners are accessible and visible.

F. 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. (SSP 57000, paragraph 3.12.9.5) To satisfy the verification an analysis shall be performed using data from drawings, integration documentation, and operational procedures to identify screws and bolts that exceed the length specified in the requirements and the required use of guards or covers due to location in crewmember translation paths and maintenance worksites. The verification shall be considered successful when a drawing inspection of the hardware to flight approved drawing's shows that screws and bolts which exceed the specified length have been properly covered, or guarded.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

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Number	Title	Method	Hazard Report(s)
ME-026	MECHANICAL - FASTENERS	A&I	

continued from previous page

Description of Reverification Requirements:	Reverification Method: A&I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 52005, section 5.6
SSP 57000, par. 3.12.4.4.5, 3.12.4.4.6, 3.12.4.4.7, 3.12.4.4.9, and 3.12.9.5

Number	Title	Method	Hazard Report(s)
ME-027	MECHANICAL - LATCHES	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.4.4.8.A Over Center Latches (I)
4.3.12.4.4.8.B Over Center Latches (I)
4.3.12.4.4.8.C Over Center Latches (I)
4.3.12.6.2.A Stowage and Equipment Drawers/Trays (I)
4.3.12.6.2.B Stowage and Equipment Drawers/Trays (I)
4.3.12.9.4 Latches (I)

Requirement Summary:

These requirements ensure that latches and associated handles/operating mechanisms in the integrated racks comply with specified operational requirements.

Detailed Descriptions of Requirements:

A. Over center latches shall have the following design features:

i. Nonself-Latching - Over center latches shall include a provision to prevent undesired latch element realignment, interface, or re-engagement. (SSP 57000, paragraph 3.12.4.4.8.A). Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that there is a provision to protect against undesired latch element realignment, interface, or re-engagement.

ii. Latch Lock - Latch catches shall have locking features. (SSP 57000, paragraph 3.12.4.4.8.B). Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that latch catches have locking features.

iii. Latch Handles - If the latch has a handle, the latch handle and latch release shall be operable by one hand. (SSP 57000, paragraph 3.12.4.4.8.C). Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that the latch handle and latch release are operable by one hand.

B. Latches on drawers/trays shall include the following design features:

i. 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. (SSP 57000, paragraph 3.12.6.2.A). Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that all latches, handles, and operating mechanisms are designed to be latched/unlatched and opened/closed with one hand by the 95th percentile American male and accommodate the 5th percentile female.

ii. The design of latches shall be such that their status (locked/unlocked) can be determined through visual inspection. (SSP 57000, paragraph 3.12.6.2.B). Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that the status of latches can be determined through visual inspection.

C. 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 crewmembers appendage. (SSP 57000, paragraph 3.12.9.4). Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that all latches and similar devices have been properly covered, or guarded and designed to prevent entrapment of crewmember appendages.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

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Number	Title	Method	Hazard Report(s)
ME-027	MECHANICAL - LATCHES	I	

continued from previous page

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.4.8, 3.12.6.2, and 3.12.9.4

Number	Title	Method	Hazard Report(s)
ME-028	MECHANICAL - FASTENER HEAD TYPE	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.4.11.A Fastener Head Type (I)
4.3.12.4.4.11.B Fastener Head Type (I)
4.3.12.4.4.11.C Fastener Head Type (I)

Requirement Summary:

These requirements ensure that fastener head designs comply with operational requirements.

Detailed Descriptions of Requirements:

A. Hex type external or internal grip or combination-head fasteners type shall be verified by inspection. The inspection shall be of the drawings and parts list or of the flight hardware. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that the hex type external or internal grip or combination head fasteners are used for all on-orbit crew-actuated equipment.

B. Flush or oval head internal hex grip fasteners shall be used only where smooth surfaces are required. The inspection shall be of the flight hardware or the drawings and parts list. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that, when a smooth surface is required, only flush or oval head internal hex grip fastener head types are used.

C. The verification that straight-slot fasteners are not used to carry launch loads for hard mounted equipment shall be by inspection. The inspection shall be of the flight hardware or the drawings and parts list. The verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that straight-slot fasteners are not used to carry launch loads for hard mounted equipment.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.4.11

Number	Title	Method	Hazard Report(s)
ME-029	MECHANICAL - ONE-HANDED FASTENER ACTUATION	A or D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.4.12 One-Handed Actuation (A or D)

Requirement Summary:

One-handed operation (either left or right hand) should be sufficient to actuate fasteners.

Detailed Descriptions of Requirements:

One-handed actuation shall be verified by analysis or demonstration. The analysis or demonstration shall be performed on the drawings, flight hardware, or hardware, which replicates the flight hardware configuration. Verification shall be considered successful when the analysis demonstration shows that fasteners planned to be removed or installed on-orbit can be mated/demated using only one hand, which does not preclude the use of either hand.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or D	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.4.12

Number	Title	Method	Hazard Report(s)
ME-030	MECHANICAL - CONTROLS SPACING DESIGN	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.5.1 Controls Spacing Design Requirements (I)
4.3.12.5.2.2 Noninterference (I)
4.3.12.5.2.4 Barrier Guards (I)

Requirement Summary:

Controls, barrier guards, and other protection devices must comply with minimum spacing requirements.

Detailed Descriptions of Requirements:

A. All spacing between controls and adjacent obstructions shall meet the minimum requirements provided in accordance with SSP 57000, paragraph 3.12.5.1 for ungloved operation. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that the spacing between controls and adjacent obstructions is as specified.

B. Payloads shall provide protection devices that do not cover or obscure other displays or controls. (SSP 57000, paragraph 3.12.5.2.2) Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that protection devices do not cover or obscure other displays and controls.

C. Barrier guard spacing shall adhere to the requirements for toggle switches, rotary switches, and thumbwheels as specified in SSP 57000, paragraph 3.12.5.2.4 for ungloved operation. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that the barrier guard spacing is as specified.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.5.1, 3.12.5.2.2, and 3.12.5.2.4

Number	Title	Method	Hazard Report(s)
ME-031	MECHANICAL - ACCIDENTAL ACTUATION PROTECTION	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.5.2.1 (A-G) Protective Methods (I)
4.3.12.5.2.5 Recessed Switch Protection (I)
4.3.12.5.2.8 Hidden Controls (I)
4.3.12.5.2.9 Hand Controllers (I)

Requirement Summary:

These requirements protect against accidental actuation of switches or other control devices.

Detailed Descriptions of Requirements:

A. Payloads shall provide protection methods to reduce the likelihood of accidental actuation of displays and controls used for maintenance and adjustments, which could disrupt nominal operations if actuated. Suggested protective methods/requirements are in accordance with SSP 57000, paragraph 3.12.5.2.1. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows one or more of the conditions called out in SSP 57000, paragraph 3.12.5.2.1A through G are satisfied.

B. When a barrier guard is not used to prevent accidental actuation, rotary switches that control functions shall be recessed as specified in SSP 57000, paragraph 3.12.5.2.5. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that rotary switches that control critical functions, and do not have barrier guards, are addressed as specified.

C. Controls that cannot be directly viewed will be avoided. If present, hidden controls shall be guarded to prevent inadvertent actuation in accordance with SSP 57000, paragraph 3.12.5.2.8. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that hidden controls are guarded to protect against inadvertent actuation.

D. Hand Controllers shall have a separate on/off control to prevent inadvertent actuation when the controller is not in use as specified in SSP 57000, paragraph 3.12.5.2.9. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that hand controllers have a separate on/off control.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.5.2.1, 3.12.5.2.5, 3.12.5.2.8, and 3.12.5.2.9

Number	Title	Method	Hazard Report(s)
ME-032	MECHANICAL - POSITION INDICATION	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.5.2.7 Position Indication (I)

Requirement Summary:

The position of switches or other control devices should be evident without requiring removal of protective covers.

Detailed Descriptions of Requirements:

When payload switch protective covers are used, control positions shall be evident without requiring cover removal. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that the control position is evident without removal of the protective cover.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.5.2.7

Number	Title	Method	Hazard Report(s)
ME-033	MECHANICAL - VALVE CONTROLS	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.5.3.A Valve Controls (I)
4.3.12.5.3.B Valve Controls (I)
4.3.12.5.3.C Valve Controls (I)
4.3.12.5.3.D Valve Controls (I)
4.3.12.5.3.E Valve Controls (I)

Requirement Summary:

Valve controls need different types of handles, depending on the amount of torque needed to operate them. Rotary valves should be threaded such that they open in the counter-clockwise direction, and the handles should be sized for easy manipulation.

Detailed Descriptions of Requirements:

A. Low-torque valve controls shall be verified by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's of valves classified as low-torque (i.e., requiring 1N-M (10 in-lb.) or less for operation) are equipped with a central pivot type handle.

B. Intermediate-torque valve controls shall be verified by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's of valves classified as intermediate-torque (i.e., requiring between 1 and 2 N-M (10 and 20 in-lbs.) for operation) are equipped with a central pivot or lever type handle.

C. High-torque valve controls shall be verified by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's of valves classified as high-torque (i.e., requiring between 2 N-M (20 in-lbs.) or more for operation) are equipped with lever-type handles.

D. Valve handle dimensions shall meet the requirements as specified in SSP 57000, paragraph 3.12.5.3.D. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that valve handle dimensions meet the requirements.

E. Rotary valve controls shall be verified by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that rotary valve controls open the valve with a counter-clockwise motion.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.5.3

Number	Title	Method	Hazard Report(s)
ME-034	MECHANICAL - TOGGLE SWITCH DIMENSIONS	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.5.4 Toggle Switches (I)

Requirement Summary:

Toggle switches should be of a standard size.

Detailed Descriptions of Requirements:

Toggle switches shall be verified by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that toggle switch dimensions meet the requirements as specified in SSP 57000, paragraph 3.12.5.4.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.5.4

Number	Title	Method	Hazard Report(s)
ME-035	MECHANICAL - RESTRAINT AND MOBILITY AIDS	A or D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.6 Restraint and Mobility Aids (A or D)

Requirement Summary:

Integrated racks should be designed and built such that any crewmember, while using restraints and mobility aids, is able to perform integrated rack installation, operation, and maintenance.

Detailed Descriptions of Requirements:

The design of the integrated rack shall be verified by demonstration or analysis. Verification shall be considered successful when the payload rack installation, operation, and maintenance tasks can be performed using standard crew restraints, mobility aids, and interfaces as specified in SSP 30257:004. The demonstration or analysis shall show adequate clearance for attaching Rack Mobility Aids (RMA) in a position that the 95th percentile male to the 5th percentile female crew can reach, and is oriented to perform the installation, operation, and maintenance tasks.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or D	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.6

Number	Title	Method	Hazard Report(s)
ME-036	MECHANICAL - CAPTIVE PARTS	A&D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.6.1.A Stow. Drawer Contents Restraints (A&I)
4.3.12.6.1.B Stow. Drawer Contents Restraints (D)
4.3.12.6.1.C Stow. Drawer Contents Restraints (D)
4.3.12.6.3 Captive Parts (I)

Requirement Summary:

These requirements ensure that the contents of payload drawers do not escape when the drawer is opened; they do not jam the tray when one attempts to open or close it, and they can be removed from the tray without using any tools. Also, any unrestrained parts that are temporarily removed from the tray must be held captive.

Detailed Descriptions of Requirements:

A. i. The payload drawer/tray contents restraints shall be verified by inspection and analysis. The inspection and analysis shall be of the drawings of the flight hardware or hardware which replicates the flight hardware configuration. Verification shall be considered successful when the inspection and analysis shows that all items in a drawer/tray are restrained in a manner to prevent floating when the drawer is opened or closed.

ii. The payload drawer/tray contents will be verified by demonstration. The demonstration shall be performed on the payload drawer/tray contents or hardware. Verification shall be considered successful when a demonstration shows that the restrained payload drawer/tray contents (including the restraints mentioned in 4.3.12.6.1.A) do not jam the drawer during opening or closing.

iii. The restraints for the payload drawer/tray contents shall be verified by demonstration. The demonstration shall be performed on the payload drawer/tray contents and the restraint. The verification shall be considered successful when the demonstration shows that the contents of the payload drawer/tray can be removed and/or replaced without using a tool under 1 G.

B. Captive parts shall be verified by inspection. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that all parts that are removed on-orbit are held captive, or provisions for temporarily stowing the loose items are provided.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&D&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.6.1 and 3.12.6.3

Number	Title	Method	Hazard Report(s)
ME-037	MECHANICAL - HANDLES	A&D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.6.4.1 Handles and Restraints (D or I)
4.3.12.6.4.3 Handle Location/Front Access (I)
4.3.12.6.4.4 Handle Dimensions (D)
4.3.12.6.4.5.A Non-Fixed Handles Design Req. (A&D)
4.3.12.6.4.5.B Non-Fixed Handles Design Req. (D)
4.3.12.6.4.5.C Non-Fixed Handles Design Req. (I&D)

Requirement Summary:
These requirements ensure that removable or portable payload units provide handles or other suitable means for grasping them (if required) and that the handles/grasping means satisfy specified design requirements.

Detailed Descriptions of Requirements:

A. All removable or portable payload items which cannot be grasped with one hand, as per Table 3.12.6.4.2-1, shall be provided with handles or other suitable means for grasping, tethering, carrying, and restraining as specified in SSP 57000, paragraph 3.12.6.4.1. Verification of portable equipment grasp capability shall be by demonstration or inspection. The demonstration shall utilize personnel with hand dimensions within 10% of Table 3.12.6.4.2-1 to demonstrate that sufficient grasp capability is provided for the 5th percentile female and 95th percentile male. The inspection shall utilize drawings to verify that a handle or other suitable grasp area is provided for portable equipment. The demonstration or inspection shall be considered successful when it is shown that both 5th percentile and 95th percentile personnel using one hand can grasp the portable equipment.
B. Handles and grasp areas shall be placed on the accessible surface of a payload item consistent with the removal direction in accordance with SSP 57000, paragraph 3.12.6.4.3. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's confirms compliance with the requirement.
C. Intravehicular Activity (IVA) handles for movable or portable units shall be designed in accordance with the minimum applicable dimensions in accordance with SSP 57000, paragraph 3.12.6.4.4. Verification shall be considered successful when demonstration of the flight hardware confirms compliance with the requirement.
D. Hinged, foldout, or attachable (i.e., non-fixed) handles will comply with the requirements as specified in SSP 57000, paragraph 3.12.6.4.5. Verification shall be considered successful when the following items are met:
   i. An analysis of flight hardware drawings and demonstration of the flight hardware confirms that non-fixed handles have a stop position for holding the handle perpendicular to the surface on which it is mounted.
   ii. Demonstration of flight hardware shows that non-fixed handles can be put in the use position by one hand and that they can be removed or stowed with one hand.
   iii. Inspection and demonstration of flight hardware confirms that attachable/removable handles incorporate tactile and/or visual indication of locked/unlocked status.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&D&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.6.4.1, 3.12.6.4.3, 3.12.6.4.4, and 3.12.6.4.5 and Table 3.12.6.4.2-1

Number	Title	Method	Hazard Report(s)
ME-042	MECHANICAL - ORU ACCESSIBILITY	A or D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.2.8 Access (A or D)

Requirement Summary:

Inspection or replacement of an item should be possible without requiring the removal of another ORU or the removal of more than one access cover.

Detailed Descriptions of Requirements:

Access to inspect or replace a hardware item, which is planned to be accessed on a daily or weekly basis, shall be verified by analysis or demonstration. Verification shall be considered successful when an analysis of the payload flight hardware drawings or a demonstration of the payload flight hardware shows that hardware items, which are planned to be accessed on a daily or weekly basis, can be inspected and replaced without requiring the removal of an ORU or more than one access cover.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or D	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.2.8

Number	Title	Method	Hazard Report(s)
ME-043	MECHANICAL - LIGHTING DESIGN	A&D&T or A&D&I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.3.4.A Lighting Design (I or T)
4.3.12.3.4.B Lighting Design (T)
4.3.12.3.4.C Lighting Design (D)
4.3.12.3.4.D Lighting Design (D)
4.3.12.3.4.E Lighting Design (A or T)

Requirement Summary:

Lighting provided for integrated rack work areas must meet specified illumination levels, and work surfaces must meet specific light reflection conditions.

Detailed Descriptions of Requirements:

A. Verification of the specularity of the total work surface reflection shall be by testing or inspection. The testing shall be considered successful when the specularity of the total work surface reflection does not exceed 20 percent. The inspection shall be considered successful if the work space surface uses paint(s) selected in accordance with Table 4.12.3.4-I of SSP 57000.

B. The appropriate task illumination level as specified in Table 3.12.3.4-I of SSP 57000 shall be verified by test. The test shall be considered successful when illumination level as identified in Table 3.12.3.4-I of SSP 57000 measured at the appropriate task site(s) is met. The illumination level in a glovebox payload shall be determined by taking the average of a minimum of nine measurements (3-by-3 matrix) that are equally spaced encompassing the base of the work area surface.

C. Verification of a dimmable light source shall be by demonstration. The demonstration shall be considered successful when the light source is demonstrated to be continuously adjustable between 0 (off) and 100 percent (on) output.

D. Verification of the brightness ratio in a glovebox shall be by demonstration. The demonstration shall be considered successful when the minimum to maximum illumination levels, taken from the nine measurements in 4.3.12.3.4.B, does not exceed a brightness ratio of 3:1.

E. The use of the Portable Utility Light (PUL) for medium payload operational tasks shall be verified by analysis or test. The analysis be performed by providing drawings which show the PUL illuminating the task site(s) at the required level as specified in SSP 57000, table 3.12.3.4-1. This drawing will include the distance between the PUL and the task site with a clear field of view. The analysis or test shall be considered successful when it shows that the payload is designed to use the PUL for all medium payload operational tasks.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A&D&T or A&D&I&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A II. COC	I. N/A II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.3.4 and Tables 3.12.3.4-1 and 4.3.12.3.4-1

Number	Title	Method	Hazard Report(s)
ME-044	MECHANICAL - AUDIO DEVICE DISPLAYS	A&D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.9.10.A Audio Device Displays (A&D)
4.3.12.9.10.C Audio Device Displays (A&D)
4.3.12.9.10.D Audio Device Displays (A&D)

Requirement Summary:

Audible warning signal devices and circuits must include methods to allow a crewmember to determine whether they are working properly. Moreover, they should not fail in such a way that they continuously emit sounds.

Detailed Descriptions of Requirements:

A. Verification that the audio alarm device displays and circuits protect against false alarm shall be by analysis. The verification shall be considered complete when analysis shows that protective measures have been taken.

B. Verification of circuit test device displays or other means of operability testing shall be by demonstration. The requirement will be met when demonstration shows that the circuit test device correctly indicates when the audio device is working and not working.

C. Verification of the manual disable device displays shall be by an analysis that determines whether any failure modes can result in sustained activation of the audio device. If no such failure mode exists, then further verification is not required. However, if analysis shows that there are failure modes that can result in sustained activation of the audio device, then demonstration of the manual disable mode shall be required. In that case, the requirement shall be considered successful when demonstration shows that the audio device can be manually turned off.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&D	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.9.10

Number	Title	Method	Hazard Report(s)
ME-046	MECHANICAL - MECHANICAL ATTACHMENT POINTS	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.2.A MPLM Interfaces (I)

Requirement Summary:

The integrated rack attach points must be compatible with the MPLM structural attach points.

Detailed Descriptions of Requirements:

Verify by inspection of the hardware to flight approved drawing's that the structural attachment points are compatible in accordance with the table referenced in SSP 41017 Part II, figure 3.1.1-1.

Note: No verification is required when NASA ISPR is used. The ISPR is identified in the Unique Payload Hardware ICD.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: N/A	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 41017 Part II, figure 3.1.1-1
SSP 57000, par. 3.1.1.2
SSP 57200 Hardware ICD Series Document

Number	Title	Method	Hazard Report(s)
ME-047	MECHANICAL - COLOR	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.8 Color (I)

Requirement Summary:

Payload interior colors must comply with a standard color scheme.

Detailed Descriptions of Requirements:

Payloads shall select interior colors in accordance with the requirements of SSP 50008, paragraph 3.2.7. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that interior colors are as specified.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 50008, par. 3.2.7
SSP 57000, par. 3.12.8

Number	Title	Method	Hazard Report(s)
ME-048	MECHANICAL - MANUAL VALVES	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.7.6 Manual Valves (I)

Requirement Summary:

Manual control valves that are used to control pressurized gas flow must have specific clearance to allow access to them without rotating the rack.

Detailed Descriptions of Requirements:

Verification that manual valves used to control the flow of pressurized gases are accessible without rack rotation shall be by inspection. Verification shall be considered successful when inspection of the hardware to flight approved drawing's shows that the manual valve is accessible for manual operation without having to rotate the rack and that the clearance around the valves meets the requirements as specified in SSP 57000, paragraph 3.12.5.1.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above if the subrack component contains a manual valve.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.7.6 and 3.12.5.1

Number	Title	Method	Hazard Report(s)
ME-049	MECHANICAL - FLUID SYSTEM SERVICER	D or I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.8.2 Fluid System Servicer (D or I)

Requirement Summary:

Integrated rack requirements for the Fluid System Servicer (FSS) must be compatible with the Servicer capabilities and interfaces.

Detailed Descriptions of Requirements:

The rack integrator shall verify by demonstration or inspection that the integrated rack requiring use of the FSS satisfactorily interfaces and operates within the physical and functional interfaces as specified in SSP 57000, paragraph 3.8.2.

Note: The demonstration can be performed with the PRCU or equivalent.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: D or I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Subrack PL are not required to be compatible with the FSS, but must satisfy the "Detailed Descriptions of Requirements" identified above if the servicer is planned to be used.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.8.2

Number	Title	Method	Hazard Report(s)
ME-050	MECHANICAL - INDICATION OF PRESSURE FLOW	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.3.4 Indication of Pressure/Flow (A)

Requirement Summary:

Payload liquid or gas lines with quick disconnects not designed to be connected/disconnected under pressure must have pressure/flow indicators.

Detailed Descriptions of Requirements:

Indication of pressure flow shall be verified by analysis. Verification shall be considered successful when analysis of payload flight hardware drawings show that payload liquid or gas lines not equipped with quick-disconnect connectors, that are designed to be connected/disconnected under pressure, are fitted with pressure/flow indicators.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 57000, par. 3.12.4.3.4

Number	Title	Method	Hazard Report(s)
ME-051	MECHANICAL - GSE INTERFACES	D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.1.A GSE Interfaces (I)
4.3.1.1.1.B GSE Interfaces (D)
4.3.1.1.1.C GSE Interfaces (D)

Requirement Summary:

Integrated rack geometry and interface forces must be compatible with requirements for Ground Support Equipment (GSE) interface geometry, overall envelope geometry, and interface forces.

Detailed Descriptions of Requirements:

A. Integrated racks shall interface to the Kennedy Space Center (KSC) GSE in accordance with the requirements of SSP 57000, paragraph 3.1.1.1.A. Verification shall be considered successful when inspection of the hardware to flight approved drawing's shows the interface is compatible with the drawings in accordance with SSP 41017 Part I, paragraph 3.2.1.1.2 and an analysis of the rack-to-GSE interface forces for ground handling provides results that do not exceed the limits provided in accordance with SSP 41017 Part I, paragraph 3.2.1.4.3. The NASA-provided 683-50243-4 ISPR structure is assumed to meet these interfaces, provided that the integrated rack hardware does not exceed the static envelope requirement.

B. Integrated rack interfaces shall interface to Rack Shipping Containers (RSC) in accordance with Teledyne Brown Engineering (TBE) drawing 220G07500. Verify by a fit check demonstration that the rack can be successfully connected to the RSC. The NASA-provided 683-50243-4 ISPR structure is assumed to meet these interfaces, provided that the integrated rack hardware does not exceed the static envelope requirement.

C. Integrated racks shall interface to Rack Handling Adapters (RHA) in accordance with the drawings identified in SSP 57000, paragraph 3.1.1.1.C. Verify by a fit check that the rack can be successfully connected to the RHA. The NASA-provided 683-50243-4 ISPR structure is assumed to meet these interfaces, provided that the integrated rack hardware does not exceed the static envelope requirement.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	D&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above if a ground rack is used to ship/handle subrack payload.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above if ground rack is used to ship/handle subrack payload.	II. L-6

Applicable Document(s):

SSP 41017 Part I, par. 3.2.1.1.2 and 3.2.1.4.3
SSP 57000, par. 3.1.1.1
TBE drawing 220G07500

Number	Title	Method	Hazard Report(s)
ME-052	MECHANICAL - SMOKE DETECTION	D&I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.10.2.1.1.A Smoke Detector (I)
4.3.10.2.1.1.B Smoke Detector (D&I)
4.3.10.2.1.2 Forced Air Circulation Indication (T)

Requirement Summary:
Smoke detectors must meet the ISS operational requirements.

Detailed Descriptions of Requirements:

A. Smoke Detector (SD)

i. Verification that integrated racks that contain a potential fire source and have forced air shall use a smoke detector that meets the requirements as specified in 683-10007 and SSP 30262:013 shall be by inspection. Verification shall be considered successful when the inspection shows the end item spec and interface control document of the smoke detector used meets the requirements as specified in 683-10007 and SSP 30262:013 respectively. Integrated racks using the ISS-provided smoke detector shall be considered in compliance with this requirement.

ii. Verification that integrated racks requiring a smoke detector provide a smoke detector interface at the J43 connection shall be by inspection and demonstration. The inspection shall consist of reviewing schematics/drawings to verify that they show wiring to the J43 connector. The verification shall be considered successful when the inspection shows wiring from the smoke detector to the J43 connector. Demonstration shall be conducted to show that the connector mates with the ISS-equivalent connector. The verification shall be considered successful when the demonstration shows that the connector mates with the ISS-equivalent connector. Note: The PRCU supports demonstration verification of a payload's interface to the fire detection and maintenance system. The PRCU provides connector savers to emulate the Z-panel interface for fire detection and suppression maintenance.

B. Forced Air Circulation Indication

Verification that integrated racks provide information indicating whether or not airflow is being provided to the smoke detector when the smoke detector is in use shall be by test. Verification shall be considered successful when the test shows signal strength meets the interface characteristics as specified in SSP 57000, paragraph 3.3.10, when airflow of 3-30.5 m/s (10-100 ft/sec) is provided at the smoke detector.

Required Verification Data:	Data Submittal Dates:
1. Item A. i.. ISS provided SD - Certificate of Compliance (COC) PD-provided SD - Analysis report comparing performance of the PD-provided SD with the ISS-provided SD. The analysis should contain a summary statement showing that the PD-provided SD is the same or better than the ISS-provided SD. ii. COC	1. L-12
2. Item B. COC	2. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Item A - Reverification is not required. Item B - Same as the "Detailed Descriptions of Requirements" identified above for Item B.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-12

Applicable Document(s):
683-10007
SSP 30262:013
SSP 57000, par. 3.10.2.1.1 and 3.10.2.1.2

Number	Title	Method	Hazard Report(s)
ME-053	MECHANICAL - BURRS AND PROTRUSIONS	A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.9.6 Securing Pins (A)
4.3.12.9.7 Levers, Cranks, Hooks, & Controls (A&I)
4.3.12.9.8 Burrs (I)

Requirement Summary:

Burrs and catch points of the integrated rack and PD-provided ancillary equipment must be removed/protected from equipment that is accessible to the crew.

Detailed Descriptions of Requirements:

A. Securing Pins
An analysis of payload hardware and flight drawings shall be performed to verify that securing pins above handholds do not back out. The verification shall be considered successful when the analysis shows the requirement has been met.

B. Levers, Cranks, Hooks, and Controls
Verification shall be by analysis and inspection. The verification shall be considered successful when the inspection of the hardware to flight approved drawing's and analysis shows that all levers, cranks, hooks, and controls have been properly covered or guarded, and cannot pinch, snag, or cut the crewmembers or their clothing.

C. Burrs
Verification shall be by inspection. The verification shall be considered successful when the inspection of the hardware to flight approved drawing's shows that all edges have been properly deburred.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 50005, par. 6.3.1.1
SSP 57000, par. 3.12.9.6, 3.12.9.7, and 3.12.9.8

Number	Title	Method	Hazard Report(s)
ME-054	MECHANICAL - FIRE DETECTION INDICATOR AND PARAMETER MONITORING	A&I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.10.2.1.3.A Fire Detection Indicator (I&T)
4.3.10.2.1.3.B Fire Detection Indicator (I)
4.3.10.2.2.1 Parameter Monitoring Use (A&I)
4.3.10.4.B Labeling (I)

Requirement Summary:
Smoke detection indicator Light Emitting Diodes (LEDs) must operate as specified.

Detailed Descriptions of Requirements:

A. Verification that integrated racks using a smoke detector provide a red fire-detection indicator LED in an easily visible location on the front of the rack shall be by test and inspection. Test verification shall be considered successful when the test shows that the indicator LED meets or exceeds the operational characteristics of the ISS-provided LED when provided with the interface characteristics as specified in SSP 57000, paragraph 3.3.10. Integrated racks using the ISS fire-detection LED shall be considered in compliance with this requirement. The inspection shall show the LED is positioned in an obvious, easily-viewed location on the aisle side of the rack. Inspection verification shall be considered successful when the inspection shows the LED is positioned in an obvious, easily-viewed location on the aisle side of the rack.

B. If integrated racks require a fire-detection indicator, then they must also have a fire-detection-indicator interface at the J43 connection. Verification of this interface shall be by inspection. The inspection shall consist of reviewing schematics/drawings to verify that they show wiring to the J43 connector. The verification shall be considered successful when the inspection shows wiring from the fire detection indicator to the J43 connector.

C. Situations may occur where enclosed rack volumes (integrated rack or subrack volumes) do not exchange air with the rack smoke detector, but nevertheless contain a potential fire source. In those cases, analysis and inspection will be used to verify that sensors have been provided to monitor those rack volumes. An analysis of the payload volume design shall be conducted to determine whether or not the volume contains a potential fire source. If there is a potential fire source present, an inspection of the drawings or flight hardware shall be conducted to determine whether or not the volume contains the sensors to detect a fire event as approved by the PSRP during the phased safety reviews. Verification shall be considered successful when the inspection and analysis shows that there are sensors, as approved by the PSRP during the phased safety reviews, to detect a fire event in a volume that contains a potential fire source and does not exchange air with the rack smoke detector.

D. Inspection will be used to verify that the fire-detection-indicator LED is labeled “SMOKE INDICATION” on racks where this is required. Verification shall be considered successful when the inspection shows the label “SMOKE INDICATION” has been placed above the Fire Detection Indicator LED using lettering in accordance with MSFC-STD-275 with 3.96 mm (0.156 inch) letters, style Futura Demibold, and color 37038 (Lusterless Black) as specified in FED-STD-595. Integrated racks using the ISS-provided LED on the rack maintenance switch assembly with the engraved “SMOKE INDICATION” label shall be considered in compliance with this requirement.

Required Verification Data:	Data Submittal Dates:
1. Drawing and a COC for inspection showing the size and location of the Fire Detection Indicator for Item D. 2. Certificate of Compliance (COC) for Items A, B and C.	1. L-12 2. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&I&T	

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A II. COC	I. N/A II. L-6

Applicable Document(s):
SSP 57000, par. 3.3.10, 3.10.2.1.3, 3.10.2.2.1, and 3.10.4.B

Number	Title	Method	Hazard Report(s)
ME-055	MECHANICAL - FIRE SUPPRESSION ACCESS HOLE	A&D&I or A&D&I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.10.3.1.A Portable Fire Extinguisher (A&I)
4.3.10.3.1.B Portable Fire Extinguisher (A&I)
4.3.10.3.2 Fire Suppression Access Port Accessibility (D)
4.3.10.3.3 Fire Suppressant Distribution (A or T)
4.3.10.4.A Labeling (I)

Requirement Summary:

Fire suppression access holes must be provided; they must also be usable, and labeled.

Detailed Descriptions of Requirements:

A. Portable Fire Extinguisher
Verification that integrated racks and subracks provide a Portable Fire Extinguisher (PFE) access port for each rack volume containing a potential fire source shall be by inspection and analysis. Analysis of the payload volume will determine whether or not the payload volume contains a potential fire source. Verification shall be considered successful when the inspection of the hardware to flight approved drawing's shows that the access port is a hole between 12.7 mm (0.5 inch), for a panel thickness of < 3.175 mm (0.125 inch) and 25.4 mm (1.0 inch.) in diameter for a panel thickness of > 3.175 mm (0.125 inch).

B. Fire Suppression Access Port Accessibility
Verification that the design of the integrated rack permits the PFE nozzle to interface with the access port shall be by demonstration. Verification shall be considered successful when the demonstration shows that the design of the integrated rack, including protrusions, allows the PFE nozzle to interface with the access port over the face of the integrated rack, without relying on areas adjacent to the integrated rack.

C. Fire Suppressant Distribution
Verification that the internal layout of the integrated rack will allow ISS PFE fire suppressant to be distributed to the entire volume that the PFE Access Port serves, lowering the Oxygen concentration to or below 10.5% by volume at any point within the enclosure within one minute shall be by analysis or test. Rack qualification tests show that the ISS PFE will reduce rack volume Oxygen concentration to or below 10.5% by volume within one minute. An analysis shall be performed on the integrated rack to determine whether or not the internal layout of the integrated rack prevents suppressant from flowing to any volume internal to the volume that PFE Access Port serves. When verified by test, the test shall be performed to determine whether or not the ISS PFE fire suppressant, as specified in SSP 57000, Figure 3.1.1.3, is distributed to the entire volume that the PFE Access Port serves. Thereby, lowering the Oxygen concentration to or below 10.5% by volume at any point within the enclosure within one minute. Verification shall be considered successful when the analysis or test shows the internal layout of the integrated rack will allow ISS PFE fire suppressant to be distributed to the entire volume a PFE Access Port serves. Thereby, lowering the Oxygen concentration to or below 10.5% by volume at any point within the enclosure within one minute.

D. Labeling
Verification that the PFE access port is labeled with a SDD 32100397-002 “Fire Hole Decal” shall be by inspection. Verification shall be considered successful when the inspection shows that a SDD 32100397-002 “Fire Hole Decal” has been placed over the PFE access port.

continued on next page

Number	Title	Method	Hazard Report(s)
ME-055	MECHANICAL - FIRE SUPPRESSION ACCESS HOLE	A&D&I or A&D&I&T	

continued from previous page

Required Verification Data:	Data Submittal Dates:
1. Items A, B, and D - Certificate of Compliance (COC).	1. L-6
2. Item A - Drawings showing the size and location of the Fire Suppression Access Port. These drawings will be used for PEI Analysis only.	2. L-12
3. Item C - Analysis or test report showing that all open areas of the rack are invaded by the fire suppression material at the specified concentrations within one minute.	3. L-6

Description of Reverification Requirements:	Reverification Method: A&D&I or A&D&I&T	Hazard Report(s):
I. On-orbit relocation of the integrated rack: No reverification required. II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.		

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. Same as the original submittal dates.

Applicable Document(s):

FED-STD-595
MSFC-STD-275
SSP 57000, par. 3.1.1.4, 3.10.3.1, 3.10.3.2, 3.10.3.3, and 3.10.4 and Figure 3.1.1.3

Number	Title	Method	Hazard Report(s)
ME-056	MECHANICAL – CONNECTOR PHYSICAL MATING	D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.6.1 Connector Physical Mate (D)

Requirement Summary:

Connectors of integrated racks requiring power or pressurized gas must have proper interfaces, and allowances must be given to access and inspect the interface components. In addition, potable water containers must properly interface with the galley water connector.

Detailed Descriptions of Requirements:

Verification of power, Low Rate Data Link (LRDL), Medium Rate Data Link (MRDL), High Rate Data Link (HRDL), and video connectors of the integrated rack physical mating to the UIP and UOP connectors shall be by demonstration. The verification shall be considered successful when the demonstration shows that the integrated rack connectors can physically mate with the PD-provided corresponding UIP and UOP module connectors identified in the table above with the part number as specified in SSP 57000, Table 3.1.1.6.1-1.

Verification that the integrated rack nitrogen, argon, CO_2, helium interface, Vacuum Exhaust System (VES), and potable water interface connectors physically mate with the corresponding module connectors shall be by demonstration. The demonstration shall use a module connector with the part number as specified in SSP 57000, Table 3.1.1.6.1-1 to verify that the nitrogen, argon, CO_2, helium, and potable water interface connectors physically mate. The verification shall be considered successful when the demonstration shows the integrated rack connector physically mates with its corresponding module connector.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: For pressurized gas interface, it is the same as the Detailed Description of Requirements identified above. For water interfaces it is the same as the "Detailed Descriptions of Requirements" identified above if a potable water containers of new design is used. For power it is the same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):
SSP 57000, par. 3.1.1.6.1

Number	Title	Method	Hazard Report(s)
ME-057	MECHANICAL – IDENTIFICATION LABELING	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.7 Identification Labeling (I)

Requirement Summary:

This requirement ensures that labels required for payload hardware are designed and developed in accordance with the requirements specified in SSP 57000.

Detailed Descriptions of Requirements:
An inspection shall be performed on all Labels on integrated racks, all (installed in the rack or separately) sub-rack elements, loose equipment, consumables, ORUs, crew accessible connectors and cables, switches, indicators, and controls. The inspection shall be of the Flight Crew Support Division (FCSD) approval documentation provided in accordance with SSP 57000, Appendix C. The verification shall be considered successful when all of the above items have been shown to have FCSD approved labels.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) showing FCSD Approval.	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):
SSP 57000, par. 3.12.7

Number	Title	Method	Hazard Report(s)
ME-058	MECHANICAL – MPLM LATE/EARLY ACCESS REQUIREMENTS	T&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.2.1 MPLM Late/Early Access Requirements (T)
4.3.1.1.2.1.1 (A-C) MPLM Late Access Envelope (KSC) (I)
4.3.1.1.2.1.2 (A&B) MPLM Early Access Envelopes (KSC and DFRC) (I)

Requirement Summary:

This requirement provides the definition of the ISS MPLM late/early access requirements for payloads and associated ground support equipment.

Detailed Descriptions of Requirements:

A. A test shall be performed to verify that cargo (with GSE) which will be installed/removed during late/early access times does not exceed a total weight of 250 lbs. as defined in SSP 57000, paragraph 3. 1.1.2.1. Verification shall be considered successful when data shows that the items to be installed into the MPLM prior to launch and after landing does not exceed the total weight identified in SSP 57000.

B. An inspection shall be performed of the late access cargo (with GSE) to determine if the equipment meets the late access hatch envelope, hoist hook interface, and monorail hook hoist interface requirements as defined in SSP 57000, Figures 3.1.1.2.1.1-1, 3.1.1.2.1.1-2, and 3.1.1.2.1.1-3. Verification shall be considered successful when it is shown by measurement that the late access cargo (with GSE) is within the envelope and interface requirements stated above.

C. An inspection shall be performed of the early access cargo (with GSE) to determine if the equipment meets the early access ODS envelope and the DEAP monorail interface requirements as defined in SSP 57000, Figures 3.1.1.2.1.2-1 and 3.1.1.2.1.2-2, respectively. Verification shall be considered successful when it is shown by measurement that the early access cargo (with GSE) is within the envelope and interface requirements stated above.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):
SSP 57000, par. 3.1.1.2.1, 3.1.1.2.1.1, 3.1.1.2.1.2.

Number	Title	Method	Hazard Report(s)
ME-059	MECHANICAL – PAYLOAD PROTRUSIONS	I&D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.1.1.7 (A-B) On-Orbit Payload Protrusions (I & D)
4.3.1.1.7.1 On-Orbit Permanent Protrusions (I)
4.3.1.1.7.2 (A-C) On-Orbit Semi-Permanent Protrusions (I & D)
4.3.1.1.7.3 (A-B) On-Orbit Temporary Protrusions (I & D)
4.3.1.1.7.4 On-Orbit Momentary Protrusions (D)
4.3.1.1.7.5 On-Orbit Protrusions for Keep Alive Payloads (I)

Requirement Summary:

These requirements ensure that payloads with equipment that protrudes beyond the GSE plane, either permanently or temporarily, are designed appropriately to meet operational requirements of the International Space Station.

Detailed Descriptions of Requirements:

On-Orbit Payload Protrusions:

A: An inspection of the hardware or as-built drawings shall be performed to determine that on-orbit protrusions do not extend laterally across the edges of the rack or pass between racks. The verification shall be considered successful when the inspection of the hardware to flight approved drawing's shows that no on-orbit protrusion extends laterally across the edges of the rack or pass between racks.

B: A demonstration using the actual flight hardware or flight-like equivalent shall be performed to verify that the integrated rack hardware does not prevent attachment of RMA on the seat track. The verification shall be considered successful when the demonstration shows that the integrated rack hardware does not prevent attachment of RMA on the rack seat track.

On-Orbit Permanent Protrusions:

An inspection of the hardware to flight approved drawing's shall be performed to determine that there are no permanent protrusions. The verification shall be considered successful when the inspection shows that there are no permanent protrusions.

On-Orbit Semi-Permanent Protrusions:

A: An inspection of the hardware to flight approved drawing's shall be performed to determine that SIR and ISIS drawer handles remain within the envelop shown in SSP 57000, Figure 3.1.1.7.2-1. The verification shall be considered successful when the inspection shows that all SIR and ISIS drawers handles remain within the required envelope.

B: An inspection of the hardware to flight approved drawing's shall be performed to verify that semi-permanent protrusions such as knobs, switches, guards, quick-disconnect fittings, etc., on the integrated rack are within the envelop identified in SSP 57000, Figure 3.1.1.7.2-2 of 500 square inches. Verification shall be considered successful when it is shown that the 500 square inch envelope has not been exceeded.

C: A demonstration using the flight hardware shall be performed to determine that semi-permanent protrusions are removable with hand operations and/or standard IVA tools. Verification shall be considered successful when it is shown that these protrusions can be removed either with hand operations and/or with standard IVA tools.

On-Orbit Temporary Protrusions:

A: An inspection of the hardware to flight approved drawing's shall be performed on the integrated rack to determine that all on-orbit temporary protrusions remain within the envelope shown in SSP 57000, Figure 3.1.1.7.3-1. The verification shall be considered successful when the inspection shows that all on-orbit temporary protrusions remain within the envelope shown in SSP 57000, Figure 3.1.1.7.3-1.

B: A demonstration using the flight hardware shall be performed to verify that temporary protrusions can be eliminated or returned to their stowage configuration within 10 minutes using hand operations and/or standard IVA tools.

Number	Title	Method	Hazard Report(s)
ME-059	MECHANICAL – PAYLOAD PROTRUSIONS	I&D	

Verification shall be considered successful when the protrusion can be eliminated or stowed within 10 minutes using hand operations or standard IVA tools.

On-Orbit Momentary Protrusions:
A demonstration using the flight hardware shall be performed to verify that the momentary protrusions, which includes drawers/doors/covers, etc., can be eliminated within the integrated rack within 30 seconds. Verification shall be considered successful when the demonstration shows that these protrusions can be eliminated with the required time frame.

On-Orbit Protrusions for Keep Alive Payloads:

A. An inspection of the hardware to flight approved drawing's shall be performed to verify that the on-orbit protrusions (power/data cables and thermal hoses) associated with Keep-Alive experiments is limited to no more than 500 square inches with the envelope shown in SSP 57000, Figure 3.1.1.7.5-1. Verification shall be considered successful when the inspection shows that the envelope dimensions are not exceeded. NOTE: The sum of the on-orbit semi-permanent protrusions and the on-orbit keep alive payloads is limited to no more than 500 square inches.

B: An inspection of the mated low temperature fluid line connectors and associated connection hardware or as-built drawings shall be performed to verify that this hardware associated with the Habitat Holding Racks, Advanced Animal Habitat, Aquatic Habitat, Cell Culture Unit, Egg Incubator, Insect Habitat, Plant Research Unit, Incubator, and/or the Refrigerated Centrifuge is within the envelope shown in SSP 57000, Figure 3.1.1.7.5-2 of 100 square inches. Verification shall be considered successful when the inspection shows that this hardware is limited to an envelope of no more than 100 square inches.

C: An inspection of the air filters and low temperature fluid lines or as-built drawings shall be performed to verify that this hardware associated with the Habitat Holding Racks, Advanced Animal Habitat, Aquatic Habitat, Cell Culture Unit, Egg Incubator, Insect Habitat, Plant Research Unit, Incubator, and/or the Refrigerated Centrifuge is within the envelope shown in SSP 57000, Figure 3.1.1.7.5-3 of 900 square inches. Verification shall be considered successful when the inspection shows that this hardware is limited to an envelope of no more than 900 square inches.

NOTE: For ground demonstration verification: Assume the ground based protrusion removal requires half the time of an on-orbit protrusion removal and that the tools are readily available.
NOTE: Protrusions are limited to 1.3 inches for ground processing and launch/landing as described in SSP 57000, paragraph 3.1.1.1.A.

Required Verification Data:	Data Submittal Dates:
1. Preliminary Data Cert. providing drawings identifying all protrusions.	1. L-20
2. Updated Data Cert. providing drawings identifying all protrusions (if required).	2. L-12
3. Certificate of Compliance (COC) for all the demonstrations performed above.	3. L-6

Description of Reverification Requirements:	Reverification Method: I&D	Hazard Report(s):
I. On-orbit relocation of the integrated rack: No reverification required. II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.		

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Certificate of Compliance (COC)	II. L-12

Applicable Document(s):
SSP 57000, par. 3.1.1.7, 3.1.1.7.1, 3.1.1.7.2, 3.1.1.7.3, 3.1.1.7.4, 3.1.1.7.5.
SSP 57000, figures 3.1.1.7.2-1, 3.1.1.7.2-2, 3.1.1.7.3-1, 3.1.1.7.5-1, 3.1.1.7.5-2, and 3.1.1.7.5-3.

Number	Title	Method	Hazard Report(s)
EL-001	ELECTRICAL - STEADY-STATE VOLTAGE CHARACTERISTICS	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.1.1.1 Interface B (T)
4.3.2.1.1.2 Interface C (T)

Requirement Summary:

Integrated rack power must be compatible with the nominal ISS voltage range.

Detailed Descriptions of Requirements:

The selection of low and high test voltage is dependent upon the possible interface B and/or interface C on-orbit locations at which the rack must operate. To facilitate verification of on-orbit configuration changes, which may alter the voltage at various locations within the Electrical Power Consuming Equipment (EPCE), systems or component data shall be performed by test over a wider voltage range. The 116 to 126 Vdc range for Interface B and 113 to 126 Vdc range for Interface C covers the range of ISS power system fluctuations and cable voltage loss to the worst-case attached payload interface. Consequently, rack integrators must account for distribution voltage loss on the payload side of the interface only, and it is not necessary to add additional cable length or Line Impedance Simulation Network (LISN) to simulate the ISS interface. The integrated rack shall be operated under selected loading conditions that envelop the operational loading. In general it will be sufficient to show that the hardware performs in various load conditions at the low voltage limit and at the high voltage limit. The verification shall be considered successful when the test data shows that the integrated rack can perform all functional capabilities under low and high voltage conditions and that EPCE is compatible with the steady-state voltage limits as specified in SSP 57000, paragraphs 3.2.1.1.1 and 3.2.1.1.2.

Verification may be performed by the PRCU, or equivalent.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.1.1.1 and 3.2.1.1.2

Number	Title	Method	Hazard Report(s)
EL-002	ELECTRICAL - RIPPLE VOLTAGE CHARACTERISTICS, NOISE, AND SPECTRUM	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.1.2.1 Ripple Voltage and Noise (A)
4.3.2.1.2.2 Ripple Voltage Spectrum (A)

Requirement Summary:

These requirements ensure that all integrated racks or other electrical-power-consuming equipment are compatible with specific ripple voltage, ripple-voltage spectrum, and ripple-voltage noise characteristics of ISS.

Detailed Descriptions of Requirements:

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Ripple Voltage and Noise requirements shall be verified by analysis.
The verification shall be considered successful when the analysis of the CS-01 test data (see VDS EL-020 for test requirement) shows the integrated rack connected to interface B and EPCE (or integrated rack in MPLM) connected to interface C operate and are compatible with the EPS time domain ripple voltage and noise level of at least 2.5 Vrms within the frequency range of 30 Hz to 10 kHz.

Ripple Voltage Spectrum requirements shall be verified by analysis.
The verification shall be considered successful when the analysis of the CS-01 and CS-02 test data (see VDS EL-020 for test requirement) shows that the integrated rack, connected to Interface B, and EPCE (or integrated rack in MPLM) connected to Interface C operates and is compatible with the Ripple Voltage Spectrum in SSP 57000, Figure 3.2.1.2.2-1.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing plot of input voltage vs. frequency.	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

SSP 30237
SSP 30238
SSP 57000, par. 3.2.1.2.1, 3.2.1.2.2, 3.2.2.1, 3.2.2.2, 3.2.2.4, and Figure 3.2.1.2.2-1

Number	Title	Method	Hazard Report(s)
EL-003	ELECTRICAL - TRANSIENT VOLTAGES	A or T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.1.3.1 Interface B (A or T)
4.3.2.1.3.2 Interface C (A or T)

Requirement Summary:

EPCE must be compatible with voltage transients on the ISS electrical power system.

Detailed Descriptions of Requirements:

Input voltages shall be 116 Vdc and 126 Vdc with the Interface B source impedance and 113 Vdc and 126 Vdc with the Interface C source impedance as specified in SSP 30482, Volume I.

Verification of compatibility with the specified Transient Voltages shall be performed by test or analysis of EPCE operation across the transient envelope as specified in SSP 57000, Figures 3.2.1.3.1-1 and 3.2.1.3.2-1.

The verification shall be considered successful when the test or analysis shows that the EPCE is compatible with the EPS transient voltage characteristics as specified in SSP 57000, Figures 3.2.1.3.1-1 and 3.2.1.3.2-1.

Note: The selection of maximum and minimum test voltage is dependent upon the possible Interface B and/or Interface C on-orbit locations at which the EPCE must operate, as specified in SSP 57000, paragraphs 3.2.1.3.1 and 3.2.1.3.2 for each power input. It is sufficient to test at the high voltage and at the low voltage limits as specified in SSP 57000, Figure 3.2.1.3.2-1.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Test required of new components, which are not isolated from ISS power.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.1.3.1 and 3.2.1.3.2; Figures 3.2.1.3.1-1 and 3.2.1.3.2-1
SSP 30482, Vol. I

Number	Title	Method	Hazard Report(s)
EL-004	ELECTRICAL - FAULT CLEARING AND PROTECTION	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.1.3.3 Fault Clearing and Protection (A)

Requirement Summary:

The integrated rack and EPCE must be compatible with short-duration high voltage transients that can result from ISS fault clearing and protection system operation.

Detailed Descriptions of Requirements:

Inputs supporting functional capabilities of the EPCE , ISS Transient Voltages shall be as specified in SSP 57000, Figure 3.2.1.3.3-1 for both a worst-case positive and negative transient.

The verification shall be considered successful when analysis shows that the integrated rack at Interface B and EPCE at Interface C does not produce an unsafe condition. Or one that could result in damage to ISS equipment and payload hardware from the EPS transient voltages as specified in SSP 57000, Figure 3.2.1.3.3-1.

Note: The transient shown in the expanded view is a composite of three possible transient conditions; consequently, the analysis may consist of separate examination of the 12 microsecond transient, the 150 microsecond transient and the 300 microsecond transient.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.1.3.3 and Figure 3.2.1.3.3-1

Number	Title	Method	Hazard Report(s)
EL-005	ELECTRICAL - NON-NORMAL VOLTAGE RANGE	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.1.3.4.A Non-normal Voltage Range (A)
4.3.2.1.3.4.B Non-normal Voltage Range (A)

Requirement Summary:

The integrated rack and EPCE must not produce an unsafe condition or one that could result in damage to ISS equipment when non-normal voltages occur.

Detailed Descriptions of Requirements:

Verification of compatibility with Non-Normal voltage range conditions shall be performed by analysis. The analysis shall ensure that the integrated rack and EPCE will not produce an unsafe condition nor a condition that could result in damage to ISS equipment external to the integrated rack and EPCE, when non-normal voltage levels as specified in SSP 57000, paragraph 3.2.1.3.4 are present. The analysis should be performed with all converters directly downstream of Interface B or Interface C.

The verification shall be considered successful when analysis shows that the integrated rack or EPCE is safe within ISS interface conditions as specified in SSP 57000, paragraph 3.2.1.3.4.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above for new EPCE not isolated by previously qualified dc to dc converters.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.1.3.4

Number	Title	Method	Hazard Report(s)
EL-007	ELECTRICAL - UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.7.6(B-D) HRDL Connector and Fiber (I)
4.3.2.2.1.(B,C,E,F) UIP and UOP Conn. and Pin Assign. (I)
4.3.4.1.2.7.(B-C) PFM NTSC Optical Conn. Pin Assign. (D&I)
4.3.3.5.2.1.2.(B-C) MIL-STD-1553B Bus A and B Conn./Pin Assign. (I)
4.3.4.1.4.(B-C) NTSC Elec. Conn./Pin Assign. (D&I)
4.3.12.4.3.13 Pin Identification (I)
4.3.3.6.1.4.(B-D) MRDL Connector/Pin Assign. (I)

Requirement Summary:
These requirements ensure that the connectors and pin assignments of the integrated rack or other electrical-power-consuming equipment are compatible with the available interfaces.

Detailed Descriptions of Requirements:

A. Verification of power, LRDL, MRDL, HRDL, and video connectors appropriate pin assignments shall be by inspection. The inspection shall be an inspection of the payload drawings to verify that the power, LRDL, MRDL, HRDL, and video connector pinouts are as specified in the SSP 57001, Figures 3.2.1.1-1, 3.2.1.2-1, 3.3.2.2-1, 3.3.2.2-2, 3.3.3.1-1, 3.3.3.1-2, 3.3.4.1-1, 3.4.1.2-2, and 3.4.2.1-1.

B. Verification of the power, LRDL, MRDL, HRDL, HRDL fiber, and video connectors with the requirements in accordance with SSQ 21635 shall be by inspection. (The inspection shall consist of an inspection of the payload drawings to confirm that the SSQ 21635 requirements are identified on the payload connector drawings.)

C. Verification of P3 and P4 physical mating with UOP J3 and J4 connectors shall be by demonstration. The verification shall be considered successful when the demonstration shows that the P3 and P4 connectors can physically mate with the J3 and J4 connectors.

D. Verification of P3 and P4 appropriate pin assignment shall be by inspection. The inspection shall be an inspection of payload drawings to verify that the P3 and P4 pinouts match the corresponding UOP J3 and J4 pinouts. The verification shall be considered successful when the inspection shows that the P3 and P4 connector pinout is appropriate.

E. Verification of the P3 and P4 connector with the requirements as specified in SSQ 21635 shall be by inspection. The inspection shall consist of an inspection of the drawings to identify that the SSQ 21635 requirement is identified on the drawing for the P3 and P4 connectors.

F. Verification that the P46 and P47 (MRDL Connector/Pin) wire complies in accordance with the requirements of SSQ 21655 shall be by inspection. The inspection shall consist of an inspection of the drawings to confirm that the 100 ohm SSQ 21655 requirement is identified on the drawing for the P46 and P47 (MRDL Connector/Pin) wiring. Documentation of wire qualification to SSQ 21655 or equivalent will be required either by qualification data package or reference to previously qualified wire vendor and part number.

G. Pin identification shall be verified by inspection. Verification shall be considered successful when an inspection shows each pin is uniquely identified (i.e., labeled).

Note: Verification of the MIL-STD-1553B Bus A and B Connector/Pin Assignments can be accomplished by performing a test of the integrated rack using the PRCU. Test would be for the MIL-STD-1553B to correctly received and execute commands on P3 and P4 independently with various address assignments at P3 and P4.

Number	Title	Method	Hazard Report(s)
EL-007	ELECTRICAL - UIP AND UOP CONNECTORS AND PIN ASSIGNMENTS	D&I	

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	D&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.2.1, 3.3.5.2.1.2, , 3.3.6.1.4, 3.3.7.6, 3.4.1.4, 3.4.1.2.7, 3.12.4.3.13, and Table 3.1.1.6.1-1
SSQ 21635
SSQ 21655
SSP 57001, Figures 3.2.1.1-1, 3.2.1.2-1, 3.3.2.2-1, 3.3.2.2-2, 3.3.3.1-1, 3.3.3.1-2, 3.3.4.1-1, 3.4.1.2-2, and 3.4.2.1-1

Number	Title	Method	Hazard Report(s)
EL-008	ELECTRICAL - POWER BUS ISOLATION	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.2.2.A Power Bus Isolation (A)
4.3.2.2.2.B Power Bus Isolation (A)

Requirement Summary:

Power buses must be isolated from structure and from each other.

Detailed Descriptions of Requirements:

A. Verification of Power Bus Isolation between two independent ISS Power Buses as specified, shall be performed by analysis. The verification shall be considered successful when the analysis shows that the integrated rack, with a source voltage of +126 Vdc, and its internal and external EPCE, provides a minimum of 1-megaohm isolation in parallel with not more than 0.03 microfarads of mutual capacitance between the two independent power buses including both the supply and return lines.

B. Verification or Power Bus Isolation without the use of diodes shall be verified by analysis. The analysis shall show the exclusion of diodes used to isolate the two independent ISS power bus high side or return lines. The verification shall be considered successful when analysis shows there are no diodes used, to electrically tie together independent ISS power bus high side or return lines, within the integrated rack and its internal and external EPCE.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.2.2

Number	Title	Method	Hazard Report(s)
EL-009	ELECTRICAL - COMPATIBILITY WITH SOFT START/STOP RPC	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.2.3 Compatibility With Soft Start/Stop RPC (T)

Requirement Summary:

This requirement ensures that the EPCE can initialize operation and is compatible with the soft start/stop characteristics of the ISS remote power controllers.

Detailed Descriptions of Requirements:

Verification of initialization with soft start/stop performance characteristics shall be by test when the initial supply of power is provided to the equipment connected to the Remote Power Controller (RPC)(s). Input power to the payload rack and EPCE connected to either Interface B or Interface C shall be delivered through an RPC, or PRCU, capable of matching the voltage over time profiles in accordance with SSP 57000, paragraph 3.2.2.3. The EPCE connected to Interface B or C shall be operated within multiple load combinations at levels ranging from 0% to 100% of the RPC rated conductivity over the specified maximum duration. Since the concern is that the delayed application of full current imposed by RPCs may be incompatible with payload operation, it is necessary to test only for an activation matching or exceeding the longest duration as specified in SSP 57000, paragraph 3.2.2.3. If the resistance and turn-on characteristics of the payload permit, the turn-on conductance may be simulated by a programmable voltage or current source which delays the application of full current in accordance with the conductance as specified in SSP 57000, paragraph 3.2.2.3.

The verification shall be considered successful when test shows that the EPCE can initialize operation and prove compatibility with soft start/stop RPC characteristics, representative of SSP 57000, Figure 3.2.2.3-1, as specified in SSP 57000, paragraph 3.2.2.3.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.2.3 and Figure 3.2.2.3-1

Number	Title	Method	Hazard Report(s)
EL-010	ELECTRICAL - SURGE CURRENT	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.2.4 Surge Current (A&T)

Requirement Summary:

The EPCE surge currents upon activation and deactivation must not exceed the allowable limits.

Detailed Descriptions of Requirements:

Verification of compatibility with Surge Current limits shall be performed by test at high, nominal, and low input voltage values as specified. Input power to the integrated rack or EPCE should be representative of the ISS power environment. The power source used to perform the test shall be capable of providing a range of power between 0 kW to 6 kW at 116-126 Vdc for Interface-B-connected equipment, and 0 kW to 1.44 kW at 113-126 Vdc for Interface-C-connected equipment. The EPCE shall be operated under worst-case loading conditions that envelope operational loading and voltage ranges. The analysis shall be performed using test data from the above test. The analysis shall show that the EPCE surge current envelope does not exceed the limits as specified in SSP 57000, paragraph 3.2.2.4. These requirements apply to all operating modes and changes including power-up and power-down.

Required Verification Data:	Data Submittal Dates:
1. Analysis report including surge current profiles for common integrated rack configurations.	1. L-12
2. Test Report.	2. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: The effect of configurations differing from the original flight equipment is to be documented by analysis and test. The analysis shall consider common integrated rack current surge profiles to be updated based on revised component data.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. Same as the original submittal dates.

Applicable Document(s):

SSP 57000, par. 3.2.2.4

Number	Title	Method	Hazard Report(s)
EL-011	ELECTRICAL - REVERSE ENERGY/CURRENT	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.2.5 Reverse Energy/Current (A)

Requirement Summary:

The equipment must not introduce unacceptable Reverse Energy/Current into the ISS power system.

Detailed Descriptions of Requirements:

Verification of compatibility with Reverse Energy/Current limits shall be performed by analysis at 6 kW, 3 kW, or 1.44 kW values corresponding to the integrated rack or EPCE design.

Input power to the integrated rack or EPCE should be representative of the ISS power environment.

The power source used to perform the analysis shall be capable of providing a range of power between 0 kW to 6 kW at 116-126 Vdc for Interface-B-connected equipment, and 0 kW to 1.44 kW at 113-126 Vdc for Interface-C-connected equipment.

The EPCE shall be analyzed under selected loading conditions that envelope operational loading.

The verification shall be considered successful when the following conditions are met:

a. Analysis shows that the integrated rack and EPCE complies with requirements as specified in SSP 57000, Table 3.2.2.5-I for the reverse energy/current into the upstream power source.

b. Analysis shows the reverse-energy or the reverse-current requirement is met for all environmental conditions as specified in SSP 57000, when powered from a voltage source as specified in SSP 57000, paragraphs 3.2.1 and 3.2.2.4 with a source impedance of 0.1 ohm.

Required Verification Data:	Data Submittal Dates:
1. Data Cert comparing worst case reverse current and potential reverse current case conditions to SSP 57000, Table 3.2.2.5-1 allowables.	1. L-20
2. Updated Data Cert comparing worst case reverse current and potential reverse current case conditions to SSP 57000, Table 3.2.2.5-1 allowables (if required).	2. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-20

Applicable Document(s):

SSP 57000, par. 3.2.1, 3.2.2.4, 3.2.2.5 and Table 3.2.2.5-1

Number	Title	Method	Hazard Report(s)
EL-012	ELECTRICAL - REMOTE POWER CONTROLLERS (RPC)	A &T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.2.2.6.1.1.A Remote Power Controllers (T)
4.3.2.2.6.1.1.B Remote Power Controllers (T)
4.3.2.2.6.1.1.C Remote Power Controllers (T)
4.3.2.2.6.1.1.D Remote Power Controllers (A)
4.3.2.2.6.1.1.E Remote Power Controllers (A)
4.3.2.2.6.2.1.1 Payload Trip Ratings (A)

Requirement Summary:
Overcurrent protection is required at all points in the system where power is distributed to lower-level feeders or branch lines, and it must be configured such that current limiting is provided in all the distribution paths.

Detailed Descriptions of Requirements:

A. Tests shall be performed to show the integrated rack connected to an Interface B ISPR location operates and is compatible with the characteristics shown and described in SSP 57001 Figures 3.2.6-2, 3.2.6-3, 3.2.6-4 and paragraph 3.2.6. The tests shall be performed at initiation of power to the integrated rack and with multiple internal load combinations that include, but are not limited to sub-rack payloads. The verification shall be considered successful if the test results show the initial current flow, when powered “on”, to the integrated rack and current flow during the integrated rack operations with multiple internal load combinations including sub-rack payloads does not exceed the current magnitude and duration as defined and described in SSP 57001 Figures 3.2.6-2, 3.2.6-3, 3.2.6-4 and paragraph 3.2.6.

B. Tests shall be performed to show the integrated rack connected to a MPLM powered rack location operates and is compatible with the characteristics shown and described in SSP 57001 Figure 3.2.6-6and paragraph 3.2.6. The tests shall be performed at initiation of power to the integrated rack and with multiple internal load combinations that include, but are not limited to sub-rack payloads. The verification shall be considered successful if the test results show the initial current flow, when powered “on”, to the integrated rack and current flow during the integrated rack operations with multiple internal load combinations including sub-rack payloads does not exceed the current magnitude and duration as defined and described in SSP 57001 Figures 3.2.6-6and paragraph 3.2.6.

C. Tests shall be performed to show the EPCE connected to a UOP location operates and is compatible with the characteristics shown and described in SSP 57001 Figure 3.2.6-5 and paragraph 3.2.6. The tests shall be performed at initiation of power to the EPCE and with load combinations for which the EPCE is designed. The verification shall be considered successful if the test results show the initial current flow, when powered “on”, to the EPCE and current flow during the EPCE operations with load combinations does not exceed the current magnitude and duration as defined and described in SSP 57001 Figures 3.2.6-4 and paragraph 3.2.6.

D. Analysis of electrical circuit schematics shall be performed to show overcurrent protection exists at all points in the payload electrical architecture system where power is distributed to lower level (wire size not protected by upstream circuit protection device) feeder and branch lines. The analysis shall be considered successful when results show overcurrent protection exists at each point in the payload electrical architecture system where power is distributed to lower level (wire size) feeder and branch lines.

E. Analysis of electrical circuit schematics shall be performed to show current limiting overcurrent protection exists for all internal loads drawing power from an Interface B power feed(s). The analysis shall be considered successful when results show current limiting overcurrent protection exists in the distribution paths to all load devices connected to an Interface B power feed(s).

F. The integrated rack or EPCE Trip Ratings shall be verified by analysis. An analysis shall be performed for the integrated rack connected to Interface B. The analysis will compare the current rating and trip characteristics of the circuit protection device in the integrated rack to the current rating and trip characteristics of the upstream RPC. The verification shall be considered successful when the analysis shows that the circuit protection device in the integrated rack will trip before the upstream RPC.

continued on next page

Number	Title	Method	Hazard Report(s)
EL-012	ELECTRICAL - REMOTE POWER CONTROLLERS (RPC)	A &T	

continued from previous page

Required Verification Data:	Data Submittal Dates:
1. Analysis Data 2. Test Data	1. L-12 2. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Analysis required to show new or modified downstream loads are within the previously performed test envelope.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Analysis Report	II. L-12

Applicable Document(s):

SSP 57000, par. 3.2.2.6.1.1, and 3.2.2.6.2.1.1
SSP 57001, par. 3.2.6 and Figures 3.2.6-1, 3.2.6-2, 3.2.6-3, and 3.2.6-4

Number	Title	Method	Hazard Report(s)
EL-013	ELECTRICAL - OVERLOAD PROTECTION	D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.12.9.1.4.1 Device Accessibility (I)
4.3.12.9.1.4.2 Extractor-Type Fuse Holder (D)
4.3.12.9.1.4.3 Overload Protection Location (I)
4.3.12.9.1.4.4 Overload Protection Identification (I)
4.3.12.9.1.4.5 Automatic Restart Protection (D)

Requirement Summary:

The equipment must meet overload protection accessibility, location, labeling, and identification specifications.

Detailed Descriptions of Requirements:

A. Hardware inspection shall be used to verify that an overload protective device will not be accessible without opening a door or cover (except operating handles or buttons of a circuit breaker, the cap of an extractor-type fuse holder, and similar parts that project outside the enclosure). Verification shall be considered successful when inspection of the hardware to flight approved drawing's shows that a door or cover must be opened to access the overload protective device.

B. Demonstration shall be used to verify that the arrangement of the extractor-type fuse holder operates such that the fuse is extracted when the cap is removed. Verification shall be considered successful when demonstration shows that the fuse is extracted when the removable cap assembly is removed.

C. Hardware inspection shall be used to verify that overload protection (fuses and circuit breakers), intended to be manually replaced or physically reset on-orbit, are located where they can be seen and replaced or reset without removing other components. Verification shall be considered successful when hardware inspection results show that overload protection devices are directly visible and accessible without removal of other components.

D. Hardware inspection shall be used to verify that each overload protector (fuse or circuit breaker), intended to be manually replaced or physically reset on-orbit, shall be readily identified or keyed (mechanically or color coded) for its rated value. Verification shall be considered successful when inspection results shows that the rated identification for each overload protector is in place.

E. The demonstration shall first induce an “Overload Initiated Shutdown” as defined in SSP 57000 Paragraph 3.2.2.6.1.1 and then observe system response to assure that Automatic Restart does not occur unless the Protection Switch/Control is explicitly operated to enable restarting. The verification of Automatic Restart Protection shall be considered successful when it is shows that automatic restart cannot occur following an overload-initiated shutdown without explicit operation of the protection switch/control to enable restarting.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: D&I or A&D&I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.2.6.1.1, 3.12.9.1.4.1, 3.12.9.1.4.2, 3.12.9.1.4.3, 3.12.9.1.4.4, and 3.12.9.1.4.5

Number	Title	Method	Hazard Report(s)
EL-014	ELECTRICAL - EPCE LOAD IMPEDANCE	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.2.2.7.1.A Interface B (T)
4.3.2.2.7.1.B Interface B (T)
4.3.2.2.7.2 Interface C (T)

Requirement Summary:

EPCE load impedance must meet ISS amplitude and phase requirements.

Detailed Descriptions of Requirements:

EPCE load impedance shall meet the amplitude and phase requirements as specified in SSP 57000, paragraphs 3.2.2.7.1 and 3.2.2.7.2. If downstream devices can be shown to have negligible effect on load impedance magnitude and phase, or be realistically simulated by passive devices, then simulated loads may be used as downstream devices for test. Load impedance shall be tested under conditions of high, nominal, and low voltage to the integrated rack. The active converters directly downstream shall also be exercised through the complete range of their loading. Selected combinations of converters that can influence the measured load impedance at Interface B and/or C shall be tested.

The verification shall be considered successful when the test shows that all load impedances measured for high, nominal and low voltage conditions remain within specified limits.

Note: The test report shall include the following:

1. A brief description of the test setup and procedure.
2. Input impedances for each configuration tested, magnitude and phase between 100 Hz and 100 kHz, with a minimum of 20 points per decade being measured.
3. An electronic copy of data and figures via floppy disc or other ICD-agreed electronic media.

Format:

1. Graphical Data - plots of magnitude and phase versus frequency on a log scale. Identify with each plot:
   A. The combination of RPCs and switches that are powered (closed)
   B. Which electrical items are “on”, including items which have filters powered when the EPCE is “off”.
   C. The operational state or mode of each powered EPCE.
2. Tabular Data: Space or tab-delimited ASCII data, one row per frequency point, terminated in a carriage return/line feed, or in EXCEL file format.

Verification may be performed by the PRCU, or equivalent.

Required Verification Data:	Data Submittal Dates:
1. Test Report showing compliance with the Unique Payload Hardware ICD	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.2.2.7.1 and 3.2.2.7.2

Number	Title	Method	Hazard Report(s)
EL-015	ELECTRICAL - MAXIMUM RIPPLE VOLTAGE EMISSIONS	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.2.9 Maximum Ripple Voltage Emissions (A&T)

Requirement Summary:

EPCE induced Ripple Voltage emissions must not exceed allowable limits.

Detailed Descriptions of Requirements:

Maximum Ripple Voltage Emissions shall be verified by test and analysis.

Maximum ripple voltage induced on each of the power lines by the integrated rack and EPCE connected to Interface B and Interface C, respectively, shall be verified by test using the CE-07 test configuration as specified in SSP 30238 (measured with a 20 MHz bandwidth instrument). Maximum ripple voltage for the on-orbit configuration of an integrated rack shall be verified by analysis of test data from individual EPCE test results.

The verification shall be considered successful when:

1. Test shows the integrated rack and EPCE does not induce voltage levels, at or upstream of Interface B and Interface C, greater than 0.5 volts peak-to-peak from the supply to return line.
2. Analysis of test data shows the on-orbit configuration of an integrated rack does not induce voltage levels at or upstream of Interface B, greater than 0.5 volts peak-to-peak from supply to return line.

Note: Maximum ripple voltage in credible on-orbit configurations may be performed by analysis, summing the results of component assemblies, or may be performed by integrated test in a variety of operating configurations which envelope the operation range.

Required Verification Data:	Data Submittal Dates:
1. Test report (This report may be a part of the EMI test submitted for EL-020).	1. L-12
2. Analysis report	2. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Analysis report based on component testing.	II. L-12

Applicable Document(s):

SSP 30238
SSP 57000, par. 3.2.2.9

Number	Title	Method	Hazard Report(s)
EL-016	ELECTRICAL - LOAD-STAND ALONE STABILITY	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.2.10 Electrical Load-Stand Alone Stability (A)

Requirement Summary:

Load stability must be maintained under all nominal source/load conditions.

Detailed Descriptions of Requirements:

Load stability shall be verified by analysis of test data for CS-01, CS-02, and CS-06 (See VDS EL-020 for test requirements).. The verification shall be considered successful when analysis of test data from the requirements identified in the following paragraphs are met.: SSP 30237 (CS01) paragraph 3.2.2.1, (CS02) paragraph 3.2.2.2, and (CS06) paragraph 3.2.2.3.

NOTE: WAIVERS TO EMI DO NOT CONSITUTE A WAIVER TO THIS REQUIREMENT.

Required Verification Data:	Data Submittal Dates:
1. Analysis report (A brief summary of the results of EMI/EMC tests). A detailed report independent of EMI/EMC request for waiver is necessary to show that stand-alone stability exists if EMI/EMC waivers or deviations are required).	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Analysis report	II. L-12

Applicable Document(s):

SSP 30238
SSP 57000, par. 3.2.2.8 and 3.2.2.10

Number	Title	Method	Hazard Report(s)
EL-017	ELECTRICAL - WIRE DERATING	A or I & A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.2.3.1.A Wire Derating (A)
4.3.2.3.1.B Wire Derating (A)
4.3.2.3.1.C Wire Derating (I or A)

Requirement Summary:

Wires must be derated for location and temperature of operation, and downstream wires from a protective device must have the capability of carrying the full current load.

Detailed Descriptions of Requirements:

A. Derating for wire/cable between EPCE and the UOP shall be verified by analysis. Analysis of the electrical power schematics shall be performed to show that the wire between the EPCE and the UOP meets the derating requirements in SSP 30312. The verification shall be considered successful when the analysis shows the wire gauge meets the wire derating requirements in SSP 30312.

B. Wire derating for EPCE at and downstream of the primary circuit protection device(s) in the integrated rack shall be verified by analysis. Analysis of the electrical power schematics shall be performed to show that the wire gauge of the integrated rack and EPCE meets the requirements of SSP 57000, paragraph 3.2.3.1. The verification shall be considered successful when the analysis shows the integrated rack and EPCE meets the wire derating requirements as specified in NASA Technical Memo 102179 as interpreted by NSTS 18798, TA-92-038. Wire gauge meeting the requirements of SSP 30312 is accepted as meeting the requirements of NASA Technical Memo 102179 as interpreted by NSTS 18798, TA-92-038.

C. Wire size for the wire/cable from UIP to the primary circuit protection device(s) in the ISPR shall be verified by inspection or analysis. Inspection or analysis of cable drawings shall be performed to show that the wire gauge meets the requirements specified in paragraph 3.2.3.1.C. The verification shall be considered successful when the inspection or analysis shows that 4 gauge wires are used for main and auxiliary connections from UIP to the primary circuit protection device(s) in the ISPR.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I or A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

NSTS/ISS 18798, Tech-memo 102179
SSP 30312
SSP 57000, par. 3.2.3.1

Number	Title	Method	Hazard Report(s)
EL-018	ELECTRICAL - EXCLUSIVE POWER FEEDS	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.3.2 (A&B) Exclusive Power Feeds (A)

Requirement Summary:

The exclusive power feed requirements shall be verified by analysis of electrical circuit schematics.

Detailed Descriptions of Requirements:

The payload design with exclusive power feeds shall be verified by analysis of electrical design and component selection. The purpose of this requirement is to prevent the hazard of connection to multiple power sources resulting in the existence of power on/off indicators which falsely indicate the removal of hazardous voltage when one source of power is removed and the other remains active.

The analysis will show that each individual ISPR will be provided power from its dedicated ISPR location and no intra-rack cabling exists. The analysis shall be considered successful when the results show that each individual ISPR input power cabling will interface to the ISPRs dedicated Utility Interface Panel and that no cabling exists between Interface C connected EPCE with Interface B; and/or Interface B connected EPCE with Interface C. ISPR analysis will extend to internal hardware, which connects directly to ISS power.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.3.2

Number	Title	Method	Hazard Report(s)
EL-019	ELECTRICAL - ELECTROMAGNETIC COMPATIBILITY FOR SAFETY-CRITICAL CIRCUITS	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.4.10 EMI Susceptibility for Safety-Critical Circuits (A&T)

Requirement Summary:

Safety-critical circuits must be EMI-compatible.

Detailed Descriptions of Requirements:

The Electromagnetic Compatibility (EMC) of the integrated rack at Interface B and EPCE at Interface C shall be verified by test and analysis. The analysis and test shall address the requirements as specified in SSP 30243, paragraph 3.2.3, identifying safety-critical circuits and verifying the absence of critical-circuit susceptibility to EMI. This requirement is independent of the submission of safety hazard reports, and is intended to ensure that all systems-level safety hazards have been identified.

The analysis/test should include the following:

- Identification of safety-critical circuits
- Margins (threshold susceptibility limits)
- Geometry and location of safety-critical circuits
- Potential paths of susceptibility
- Potential frequencies of susceptibility
- Comparison plot of susceptibility threshold vs. SSP 30237
- Circuit input sensitivity level

Test reports for EL-020, “Electromagnetic Interface/Compatibility”, shall include tests covering this requirement.

Required Verification Data:	Data Submittal Dates:
1. Analysis report with supporting test data.	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: A revised analysis is required for each new configuration of existing hardware and for refurbished hardware if safety critical circuits exist.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

SSP 30243, par. 3.2.3
SSP 57000, par. 3.2.4.10

Number	Title	Method	Hazard Report(s)
EL-020	ELECTRICAL - ELECTROMAGNETIC INTERFERENCE/COMPATIBILITY	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.2.4.6 Alternating Current (ac) Magnetic Fields (T or A) 4.3.2.4.7 Direct Current (dc) Magnetic Fields (T or A)
4.3.2.4 Electromagnetic Compatibility (A &T) 4.3.2.4.4 Electromagnetic Interference (A&T)

Requirement Summary:
All integrated racks, including ancillary equipment, EPCE (or an integrated rack in the MPLM), must assure electromagnetic compatibility and protect against electromagnetic interference.

Detailed Descriptions of Requirements:

A. Electromagnetic Compatibility
The Electrical-EMC verification test requirements are met when results show that payload integrated rack and EPCE EMC is in compliance with the requirements of SSP 30243, paragraph 3.1and 3.6.2. Documentation requirements are shown in Appendix F. The analysis is based on end item qualification data and integrated rack and EPCE design and analysis data. The analysis requirements are met when the data shows the payload integrated rack and EPCE meets the EMC requirements of SSP 30243, paragraph 3.1.

B. Electromagnetic Interference
Electromagnetic Interference (EMI) requirements for the payload integrated rack and EPCE are considered met when all EMI test requirements of SSP 30237 are met. Test methods are specified in SSP 30238. Documentation requirements are shown in Appendix F. The test requirements for each integrated rack and EPCE are met when results show that the requirements of SSP 30237 are met. The analysis of each integrated rack and EPCE is performed using subrack payload test data. The analysis shall be based on end item qualification data and payload EPCE design and analysis data. The analysis shall be considered successful when the data shows the integrated rack and EPCE meet the EMC requirements of SSP 30237. An isolation evaluation must be included in the EMI analysis to verify the requirements of SSP 57000, paragraph 4.3.2.4.4 are met.

C. Alternating Current (ac) Magnetic Fields
Verification of the ac magnetic field emissions (30 Hz to 50 kHz), for an integrated rack connected to Interface B or EPCE (or integrated rack in MPLM) connected to Interface C, shall be by test or analysis of equipment, cables, and interconnecting wiring. The analysis should be based on the test data of the components which generate the magnetic fields.Test setup guidelines will be per SSP 30238, Figure 3.2.3.1.4-1 or 3.2.3.1.4-2, not the setup identified by MIL-STD0462D. Guidelines of SSP 30238, Figure 3.2.3.1.4-1 and 3.2.3.1.4-2, requirement of 1 meter separation does not apply to RE101. Measurements are required from 30 Hz to 50 kHz rather than 100kHz required by MIL-STD-461D. Measurements are performed at 7cm from the generating equipment. In the event emissions are out-of-specification, measurements are performed at 50 cm from the generating equipment. See Appendix F for documentation requirements. Documentation may be included under 4.3.2.4.4 above. Verification shall be considered successful when test or analysis results show the generated ac magnetic fields of the integrated rack connected to Interface B or EPCE connected to Interface C, including cables and interconnecting wiring, do not exceed the magnetic fields emission limits of 140 dB above 1 picotesla for frequency at 30 Hz, and then falling 26.5 dB per decade to 3.5 kHz and 85 dB for frequencies ranging from 3.5 kHz to 50 kHz.

D. Direct Current (dc) Magnetic Fields
For equipment containing electromagnetic or permanent magnetic devices, verification that the equipment meets dc magnetic field emissions requirement of 170 dBpT shall be by test or analysis. The measurement or analysis of dc magnetic fields will be performed at 7 cm from the enclosure of the generating equipment. Measurements or analysis at 10 cm from the generating equipment will be performed if there is a dc magnetic field greater than 170 dBpT. Additional measurements or analysis will be performed at 10 cm increments away from the generating equipment until data proves the dc magnetic fields are 6 dB below the 170 dBpT. The verification will be considered successful when test or analysis results show the generated dc magnetic fields of the integrated rack connected to Interface B and EPCE (or integrated rack in MPLM) connected to Interface C do not exceed 170 dBpT at a distance of 7 cm from the generating equipment, including electromagnetic and permanent magnetic devices. See Appendix F for documentation requirements. Documentation may be included under 4.3.2.4.4 above. Verification closure will be accomplished under this paragraph number.

Number	Title	Method	Hazard Report(s)
EL-020	ELECTRICAL - ELECTROMAGNETIC INTERFERENCE/COMPATIBILITY	A&T	

continued from previous page

Required Verification Data:	Data Submittal Dates:
1. The EMI/EMC Control, Test Plan and Design Analysis Report (first submission with plans, design data, and developmental data), as given in Appendix F. (All Items)	1. L-22
2. Test Report for Item A (Results must be provided for each configuration in the worst-case operational modes. The report should include the test configuration/layout (including cables), photographs of the test configuration, and a description of testing equipment.)	2. L-12
3. Test results in electronic format as specified in SSP 57010 Appendix G, for Item A and B.	
4. For requirement 4.3.2.4.7item D above, a tabular listing of each magnetic field measurement, distance from Equipment Under Test (EUT), and mode of EUT operation.	3. L-12 4. L-12
5. For item C above, emissions greater than 20 dB below specified limits will be recorded in the EMI test report. In cases where the noise floor and ambient are not 20 dB below specified level, only those emissions above the noise floor/ambient are required to be recorded. (This verification data is submitted as part of Item 2 above, if required.)	5. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: A revised analysis shall be performed to show compliance with the limits as specified in SSP 30237. The analysis of the integrated ISPR shall be performed using test results of the integrated ISPR, considering the effects of all EPCE being removed and all EPCE being added.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. a. Analysis report (results must be provided for each configuration in the worst-case operational modes). The report should include the test configuration/layout (including cables), and a description of EMI impacts (installed or removed) explaining how the results of the integrated ISPR analysis is derived.	II. a. L-12
b. Test results in electronic format in accordance with SSP 57010, Appendix G.	b. L-12

Applicable Document(s):
MIL-STD-462
SSP 30237 (Entire Document)
SSP 30238 (Entire Document)
SSP 30243, par. 3.1and 3.6.2
SSP 57000, par. 3.2.4, 3.2.4.4, 3.2.4.6, and 3.2.4.7

Number	Title	Method	Hazard Report(s)
EL-021	ELECTRICAL - CABLE/WIRE DESIGN AND GROUNDING	A&T or A&T&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.4.1 Electrical Grounding (A&T)
4.3.2.4.3 Cable/Wire Design and Control Requirements (A&T or I&T)

Requirement Summary:

Equipment must be electrically grounded and cable/wire design requirements must be met.

Detailed Descriptions of Requirements:

A. Electrical Grounding

The test will be considered successful when the results show that the integrated rack connected to Interface B and EPCE connected to Interface C is in compliance with the requirements in Section 3 of SSP 30240.

The analysis will be based on end item qualification data and integrated rack and EPCE design and analysis data. The analysis will be considered successful when the data shows the integrated rack connected to Interface B and EPCE connected to Interface C is electrically grounded within the requirements of Section 3 of SSP 30240.

B. Cable/Wire Design and Control Requirements (External Cables)

The test will be considered successful when the results show all requirements of SSP 30242 are met.

The analysis will be based on end item qualification data and integrated rack and EPCE design and analysis data. The analysis will be considered successful when the results show all the requirements of SSP 30242 are met.

The inspection will be based on physical/visual indications of the integrated rack connected to Interface B and EPCE connected to Interface C. The inspection will be considered successful when physical/visual indications show that external cable and wire design is in compliance with the requirements of SSP 30242.

SSP 30242 harness requirements can normally be met by inspection of drawings and hardware.

Analysis is required to classify signals and determine the necessary isolation between signals.

Test may be required to determine impedance and sensitivity characteristics of the circuit when classification cannot be determined by examination of the circuit known characteristics.

Required Verification Data:	Data Submittal Dates:
1. Analysis report showing compliance of actual grounding (based on end item qualification test data) versus grounding design philosophy (in Design Analysis Report), and the compliance with SSP 30242.	1.L-12
2. Certificate of Compliance (COC) for the test and inspection	2. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: An analysis shall be performed as required above, along with an inspection of the as-built subrack payloads.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):
SSP 30240, Sec. 3
SSP 30242
SSP 30243
SSP 57000, par. 3.2.4.1 and 3.2.4.3

Number	Title	Method	Hazard Report(s)
EL-022	ELECTRICAL – ELECTRICAL BONDING	A&I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.4.2 Electrical Bonding (A&I&T)

Requirement Summary:

Equipment must be electrically bonded.

Detailed Descriptions of Requirements:

The test will be considered successful when the results show all requirements of SSP 30245 and the requirements in Sections 213 and 220 of NSTS 1700.7B/ISS Addendum are met.

The analysis will be based on end item qualification data and integrated rack and EPCE design and analysis data. The analysis will be considered successful when the data shows the integrated rack and EPCE is electrically bonded within the requirements of SSP 30245 and Sections 213 and 220 of NSTS 1700.7B/ISS Addendum are met. The inspection will be based on physical/visual indications of the integrated rack and EPCE. The inspection will be considered successful when physical/visual indications show all requirements of SSP 30245 and Sections 213 and 220 of NSTS 1700.7B/ISS Addendum are met.

Required Verification Data:	Data Submittal Dates:
1.Test report showing compliance with SSP 30245 and NSTS 1700.7B/ISS, 213 and 220.	1. L-12
2. Analysis report showing compliance with SSP 30245, NSTS 1700.7B/ISS, 213 and 220, and the Unique Payload Hardware ICD.	2. L-12
3. Certificate of Compliance (COC) for the inspection.	3. L-6

Description of Reverification Requirements:	Reverification Method: A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack connected to Interface B and multiple EPCE connected at interface C: A revised analysis shall be performed for each configuration change where the bonding scheme is modified or when electrical drawings are modified. Measurements will be made of the bonding for new and refurbished assemblies prior to flight.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

NSTS 1700.7 ISS Addendum, Sec. 213 and 220
SSP 30245, (Entire Document)
SSP 57000, par. 3.2.4.2

Number	Title	Method	Hazard Report(s)
EL-023	ELECTRICAL - LARGE SIGNAL STABILITY	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.2.8 Large Signal Stability (A&T)

Requirement Summary:

Transient responses to large signal disturbances are to diminish within specified time limits.

Detailed Descriptions of Requirements:

The purpose of this test is to verify stability when a large voltage disturbance, sufficient to cause current limiting in upstream protective devices, or other non-linear effects is present at input to the integrated rack or EPCE. The following report data is to be provided:

1. Test configuration detail showing which EPCE was active for each test configuration.
2. Description of prototype, substitute, or missing flight EPCE items.
3. Current and voltage profiles for the input pulse and response as specified in SSP 57000, paragraph 4.3.2.2.8.

It is necessary to show stability with the worst-case combination of loads that will be used. It will be necessary to develop payload EPCE models and to verify these models by the Large Signal Stability Test if on-orbit change of loads is foreseen, to avoid the requirement of performing stability tests on-orbit. Compatibility with other payload EPCE is not ensured by the time-to-dampen criterion, just compatibility with ISS. Consequently, detailed large signal response data may be required for integration, particularly in cases where payloads share significant source impedance.

This test requires use of a LISN with inductance and resistance set according to the load rating. The integrated rack or EPCE response is monitored for damping within a specified period of time rather than a minimum damping coefficient. The transient duration criterion is used to ensure that transient response, regardless of extent of damping returns to the steady-state voltage range of ISS EPS.

Large signal stability shall be verified by test and analysis. A large signal stability test shall be conducted for the integrated rack, connected at Interface B, and EPCE connected to Interface C. An integrated analysis shall be provided by the rack integrator for representative maximum and minimum case loads to demonstrate that the impedance variations will not impact system stability. The input and transient response waveform for the integrated rack and EPCE shall be recorded from the start of impulse through the time when the transient diminishes to, and remains below, 10% of the maximum amplitude of the response.

The required test conditions may be produced using a suitable programmable power source or the setup as specified in SSP 57000, Figure 4.3.2.2.8-1. The 25 amp and 50 amp LISN, or equivalent, is to be used for integrated racks connecting to Interface B, and the 12 amp LISN, or equivalent, is to be used for EPCE connecting to Interface C as shown in SSP 57000, Figure 4.3.2.2.8-2. The pulse generator/amplifier must provide a source impedance of less than 0.2 ohms from 100 Hz to 10 kHz, to the 2-ohm load of the primary side of the pulse transformer. Pulses of 100, 125, and 150 microsecond +/- 10 microsecond duration shall be applied. The pulse amplitude must be between 10 and 15 volts. Pulse rise and fall times must not exceed 10 microseconds between 10% and 90% percent of the pulse amplitude. A typical test setup, test equipment and examples of test results are shown in the reference document, D684-10572, Large Signal Stability Demonstration Test Report.

The test and analysis will be considered successful when results show transient responses, measured at the input to integrated rack or EPCE, diminish to 10% of the maximum amplitude within 1.0 milliseconds and remains below 10% thereafter.

Continued on next page

Number	Title	Method	Hazard Report(s)
EL-023	ELECTRICAL - LARGE SIGNAL STABILITY	A&T	

Required Verification Data:	Data Submittal Dates:
1. Preliminary analysis and test data for each integrated rack and EPCE.	1. L-20
2. Final analysis and test data for each integrated rack and EPCE.	2. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Test data is required including all new and replacement EPCE which interfaces with ISS EPS. Test data of transient responses to worst-case load data are to be provided.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.2.2.8 and Figures 3.2.2.8-1

D684-10572, Large Signal Stability Demonstration Test Report

Number	Title	Method	Hazard Report(s)
EL-024	ELECTRICAL - ELECTROSTATIC DISCHARGE	T or A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.4.5 Electrostatic Discharge (T or A&I)

Requirement Summary:

Unpowered equipment must not be susceptible to electrostatic discharges of less than 15, 000 volts.

Detailed Descriptions of Requirements:

Electrostatic Discharge (ESD) (Susceptibility to ESD)

The susceptibility of the Electrostatic Discharge of the un-powered payload EPCE and its components shall be verified by test or analysis and inspection. The analysis shall be based on payload EPCE design and analysis data. The test or analysis shall be considered successful when the results show the requirement in paragraph 3.2.4.5 of this document is met. The inspection shall be based on physical/visual indication of the payload EPCE. The inspection shall be considered successful when physical/visual indications show the labeling of EPCE susceptible to ESD up to 15,000 V are in accordance with MIL-STD-1686.

Required Verification Data:	Data Submittal Dates:
1. A report on test results or an analysis showing compliance with SSP 57000, par. 3.2.4.5.	1. L-12
2.Certificate of Compliance (COC) showing that the inspection identifies labeling of integrated rack and EPCE.	2. L-12

Description of Reverification Requirements:	Reverification Method: A or A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Required Verification Data" identified above for "new" subrack changeouts. No reverification required for reflight or series subracks.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. L-12

Applicable Document(s):

MIL-STD-1686
SSP 57000, par. 3.2.4.5

Number	Title	Method	Hazard Report(s)
EL-025	ELECTRICAL - LIGHTNING	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.4.9 Lightning (A)

Requirement Summary:

Payloads located in the Payload Bay are susceptible to secondary effects of lightning and shall be designed not to propagate any failure to the Orbiter.

Detailed Descriptions of Requirements:

This requirement deals primarily with basic payload transient design levels regarding protection against secondary effects of lightning for power, data and video interface circuits. The secondary effects to payloads should not cause physical damage or interference that presents a hazard to the safety of the vehicle or its crew. The analysis shall be based on the end item qualification data for Payload EPCE design and test data. The analysis shall be considered successful when the data shows the payload EPCE is compatible with the requirements as specified in paragraph 3.2.8.1 of SSP 30243.

Orbiter lightning produced electromagnetic environment per Shuttle Orbiter/ Small Payload Accommodations (NSTS-21000-IDD-ISS, paragraph 10.7.2.2.1.2) requires that equipment in the payload bay show immunity to the secondary effects of a lightning attachment. This requirement addresses lightning produced magnetic fields in the payload bay for vehicle in flight, on the ground protected, and on the ground not protected. The following description for power connections and data/video connections is provided to show how the verification can be satisfied by using the EMI/EMC test results for CS06 and RS02.

A. Power Connections:
The EPCE power circuits connecting to ISS and/or MPLM at either Interface B or Interface C shall meet the lightning induced environment requirements by analysis using the results of EMI/EMC tests for CS06 as specified in SSP 30238, paragraph 3.2.2.3. The analysis will show that the hardware was not damaged from the applied spike amplitude, rise time, and duration as specified in SSP 30237, paragraph 3.2.2.3.2 and load stability is maintained during nominal operations. If the CS06 passed without deviation, waiver, or TIA and the hardware is fully operational, then the analysis could be a statement to this effect.

B. Data/Video Connections:
The EPCE data and video circuits connecting to ISS and/or MPLM shall meet the lightning induced environment requirements by analysis using the results of EMI/EMC tests for RS02 as specified in SSP 30238, paragraph 3.2.4.1. The analysis will show that the hardware was not damaged from the applied spike amplitude, rise time, and duration as specified in SSP 30237, paragraph 3.2.4.1.2 and nominal operations are maintained. If the RS02 passed without deviation, waiver, or TIA and the hardware is fully operational, then the analysis could be a statement to this effect.

Note: Successful completion of CS06 and RS02 testing demonstrates compliance with the lightning effects specified in the NSTS-21000-IDD-ISS for all cable harnesses up to 75 meters (250 ft.) in length.

Required Verification Data:	Data Submittal Dates:
1. Analysis showing compliance with the requirements of SSP 30243 paragraph 3.2.8.1.	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Analysis is required for each new item or series of EPCE, either as a separate report or modification to the existing report.

Number	Title	Method	Hazard Report(s)
EL-025	ELECTRICAL - LIGHTNING	A	

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Analysis showing compliance with the requirements of SSP 30243 paragraph 3.2.8.1..	II. L-12

Applicable Document(s):

NSTS-21000-IDD-ISS
SSP 30243, par. 3.2.8.1
SSP 57000, par. 3.2.4.9
SSP-30238, par. 3.2.2.3 & 3.2.4.1
SSP-30237, par. 3.2.2.3.2 & 3.2.4.1.2

Number	Title	Method	Hazard Report(s)
EL-026	ELECTRICAL - ARC CONTAINMENT	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.3.7 ARC Containment (A)

Requirement Summary:

Electrical connector plugs must confine or isolate the electrical arcs or sparks associated with mating and demating.

Detailed Descriptions of Requirements:

Arc containment shall be verified by analysis. Verification shall be considered successful when an analysis of the flight hardware drawings shows that electrical connector plugs confine/isolate the mate/demate electrical arcs or sparks.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.4.3.7

Number	Title	Method	Hazard Report(s)
EL-027	ELECTRICAL - FIBER OPTIC CABLE CHARACTERISTICS	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.7.4 HRDL Fiber Optic Cable (I)
4.3.4.1.2.4 Fiber Optic Cable Characteristics (I)

Requirement Summary:

These requirements ensure that electrical and fiber-optic cables have specified characteristics.

Detailed Descriptions of Requirements:

Verification shall be by inspection of the integrated rack HRDL cable and the fiber optic video cable.

A. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that the interface cable from the integrated rack to the HRDL is in accordance with SSQ 21654 or equivalent. Vendor-supplied data can be used to perform this verification.

B. Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that the integrated rack fiber optic video cable is in accordance with SSP 57000, paragraph 3.4.1.2.4, Fiber Optic Cable Characteristics. Vendor-supplied data can be used to perform this verification.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above if a cable is replaced, modified, or added.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.3.7.4 and 3.4.1.2.4
SSQ 21654

Number	Title	Method	Hazard Report(s)
EL-028	ELECTRICAL - RACK MAINTENANCE SWITCH (Rack Power Switch)	D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.5.2 Rack Maintenance Switch (Rack Power Switch) (D&I)

Requirement Summary:

The integrated rack must be equipped with a guarded, two-position, manually operated switch on the front of the rack that removes all power to the integrated rack which is visible and accessible.

Detailed Descriptions of Requirements:

Rack maintenance switch (Rack Power Switch) shall be verified by inspection and demonstration.

The inspection shall ensure that the Integrated rack is equipped with a Rack Maintenance Switch (Rack Power Switch) on its front face. The demonstration shall be performed to ensure that the data signals from the Rack Maintenance Switch (Rack Power Switch) indicate the designed voltage and current levels expected for both the on and off positions.

The verification shall be considered successful when 1). the inspection shows the integrated rack is equipped with a Rack Maintenance Switch on the front of the integrated rack and when 2). the demonstration shows that data signals from the Rack Maintenance Switch indicates the designed voltage and current levels expected for both the on and off positions.

Required Verification Data:	Data Submittal Dates:
1. Drawings showing the size and location of the "Rack Maintenance Switch (Rack Power Switch)" for the inspection.	1. L-12
2. Certificate of Compliance (COC) for the Demonstration.	2. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	D&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above if power circuitry is modified.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.5.2

Number	Title	Method	Hazard Report(s)
EL-029	ELECTRICAL - POWER SWITCHES/CONTROLS	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.2.5.3.A Power Switches/Controls (A)
4.3.2.5.3.B Power Switches/Controls (A)
4.3.2.5.3.C Power Switches/Controls (A)

Requirement Summary:

These requirements protect the ISS and its crew from accidents related to electrical shock. Power on/off switches/controllers must indicate when all electrical connections with the power supply are discontinued. If the power supply is not completely disconnected, then a crewmember should be able to determine this by examining the indicators. While in the power-off position, all power supply conductors (except the power return and grounding conductor) must be open (dead-faced).

Detailed Descriptions of Requirements:

A. Switches/controls requirements shall be verified by analysis. An analysis shall be performed to ensure that the switches/controls performing on/off functions for all power interfaces open (dead-face) all supply circuit conductors, except the power return and equipment grounding conductor, while in the power-off position. Verification shall be considered successful when analysis of electrical circuit schematics shows that the switches/controls performing on/off power functions, all power interfaces open (dead-face) all supply conductors except the power return and equipment grounding conductor, while in the power-off position.

B. Power-off markings and/or indications requirement shall be verified by analysis. The analysis shall ensure that power-off markings and/or indications exist when all electrical connections with the power supply circuit are disconnected. The verification shall be considered successful when analysis shows that power switches/controls power-off markings and/or indication(s) exist when all electrical connections with the power supply circuit are disconnected.

C. Standby, charging, and descriptive nomenclature requirement shall be verified by analysis. The analysis shall ensure the existence of descriptive nomenclature such as standby, charging, or whatever is necessary to indicate that the power supply circuit is not completely disconnected. The verification shall be considered successful when analysis shows descriptive nomenclature exists to indicate that the power supply circuit is not completely disconnected.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.5.3

Number	Title	Method	Hazard Report(s)
EL-030	ELECTRICAL - GROUND FAULT CIRCUIT INTERRUPTERS	A&D&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.2.5.4.A Ground Fault Circuit Interrupters (A)
4.3.2.5.4.B Ground Fault Circuit Interrupters (T)
4.3.2.5.4.C Ground Fault Circuit Interrupters (T or A)
4.3.2.5.4.D Ground Fault Circuit Interrupters (A and T)
4.3.2.5.4.E Ground Fault Circuit Interrupters (T or A)
4.3.2.5.4.F Ground Fault Circuit Interrupters (T)
4.3.2.5.4.G Ground Fault Circuit Interrupters (A&D)

Requirement Summary:

Portable electrical equipment must have Ground Fault Circuit Interrupters (GFCI). If the equipment generates or uses internal voltages greater than thirty volts, then it must be shown that the GFCI trips below a specified threshold.

Detailed Descriptions of Requirements:

Ground fault circuit interrupters/portable equipment sourcing voltage requirement shall be verified by test and analysis.

A. The analysis of electrical wiring schematics shall ensure that a GFCI is in the non-portable utility outlet and is in the power path to portable equipment receiving voltages exceeding 30 volts rms or dc nominal (32 volts rms or dc maximum) from a non-portable utility outlet. The verification shall be considered successful when the analysis shows a GFCI is in the non-portable utility outlet and is in the power path between the non-portable utility outlet power source supplying output voltage exceeding 30 volts rms or dc nominal (32 volts rms or dc maximum) and the load receiving power from the non-portable utility outlet.

B. The test shall ensure that the DC trip detection is independent of the portable equipment's safety (green) wire. The verification shall be considered successful when the test shows that the DC trip detection does not depend on the current sensing of the portable equipment's safety (green) wire.

C. The test shall ensure that the AC trip detection is dependent on the portable equipment's safety (green) wire when the safety (green) wire is present. The verification shall be considered successful when the test shows that the AC trip detection is dependent on the current sensing of the portable equipment's safety (green) wire when the safety (green) wire is present. NOTE: If an analysis including all the leads which may be connected to the utility outlet shows that AC fault currents do not exist under any failure conditions, this test is not required.

D. The analysis shall ensure the GFCI protection is included within the portable equipment and is in the credible fault path or return path defined and documented in the Hazard Analysis, for equipment generating or using internal voltages greater than 30 volts rms or dc nominal (32 volts rms or dc maximum). The test shall ensure that the GFCI trips without exceeding the currents specified in SSP 57000, Table 3.2.5.4-1. The verification shall be considered successful when, 1). The analysis shows that the GFCI protection is included within the portable equipment and is in the credible fault path to a crewmember for portable equipment with nominal voltage above 30 volts rms or dc (32 volts rms or dc maximum) and, 2). The test shows that the GFCI trips before exceeding the current level specified in SSP 57000, Table 3.2.5.4-1. The credible fault path or return path shall be documented in the Flight Safety Hazard Analysis. Note: A credible fault/return path within the portable equipment is a fault/return path to a crewmember not protected by the GFCI within the utility outlet supplying power to the portable equipment.

E. The test shall ensure that non-portable utility outlets, when supplying power to portable equipment, include GFCI that trip without exceeding the currents as specified in SSP 57000, Table 3.2.5.4-1. The verification shall be considered successful when the test shows that each GFCI, within non-portable utility outlets, trips before exceeding these current levels specified in SSP 57000, Table 3.2.5.4-1. NOTE: If an analysis including all the loads which may be connected to the utility outlet shows that AC fault currents do not exist under any failure conditions, this test for AC current is not required.

F. The test shall ensure that the GFCI removes power from the output power leads within 25 milliseconds upon encountering the fault current. The verification shall be considered successful when the test shows GFCI removes power from the output power leads within 25 milliseconds upon encountering the fault current.

G. The analysis shall ensure that the GFCI provides an on-orbit method for testing the trip current detection threshold at DC and at a frequency within the maximum human sensitivity range of 15 to 70 Hertz. The method for the GFCI on-

Number	Title	Method	Hazard Report(s)
EL-030	ELECTRICAL - GROUND FAULT CIRCUIT INTERRUPTERS	A&D&T	

orbit checkout shall be by demonstration. The verification shall be considered successful when the analysis shows that the GFCI provides an on-orbit method and procedure for testing the trip current detection threshold at DC and at a frequency within 15 to 75 Hertz. The demonstration must also show that on-orbit checkout methods will trip the GFCI circuit and that the GFCI circuit can be manually reset.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A&D&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.5.4 and table 3.2.5.4-1

Number	Title	Method	Hazard Report(s)
EL-031	ELECTRICAL - PORTABLE EQUIPMENT/POWER CORDS	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.5.5.A Portable Equipment/Power Cords (A)
4.3.2.5.5.B Portable Equipment/Power Cords (A)

Requirement Summary:

Power cords for portable electrical equipment must meet specific requirements with respect to voltage capacity, grounding, and fault currents.

Detailed Descriptions of Requirements:

A. Analysis of schematics shall ensure that non-battery powered portable equipment, that consumes or generates more than 30 volts rms, incorporates a three-wire power cord containing a supply (+) lead, a return (-) lead and a safety (green) wire. Verification shall be considered successful when the analysis shows that the portable equipment/power cords contain a supply (+) lead, a return (-) lead, and a safety (green) wire with one end connected to the portable equipment chassis (and all exposed conductive surfaces) and the other end connected to structure at the utility outlet through the GFCI interface if GFCI is used. Use of double insulation or its equivalent without the safety (green) wire, when used as an alternative, shall be documented in the Unique Payload ICD as an exception.

B. The analysis shall ensure that the fault currents, through the credible fault path or return path to the crew member, resulting from a single failure at the primary (input) side of the power converter within non-battery powered portable equipment, (i.e., portable equipment receiving power from the utility outlet provided by ISS or payload) do not exceed the total peak currents specified in SSP 57000 Table 3.2.5.4-1 for fault current frequencies of 15 Hertz and above. Verification shall be considered successful when the analysis shows that fault current resulting from a single failure doesn't exceed the total peak currents specified in the profile shown in SSP 57000 Table 3.2.5.4-1 for fault current frequencies of 15 Hertz and above. The verification is not required for portable equipment with internal voltages below 30 Volts rms or dc nominal (32 volts rms or dc maximum).

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.5.5 and table 3.2.5.4-I

Number	Title	Method	Hazard Report(s)
EL-032	ELECTRICAL - LRDL CABLING CHARACTERISTICS	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.5.2.3 LRDL Cabling (I)

Requirement Summary:

Low-Rate Data Link (LRDL) cables must meet ISS unique requirements.

Detailed Descriptions of Requirements:

Verification shall be considered successful when an inspection of the hardware to flight approved drawing's shows that the integrated rack LRDL cable is in accordance with SSQ 21655, 75 ohm requirements or equivalent. Vendor supplied data can be used to perform this verification.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.3.5.2.3
SSQ 21655

Number	Title	Method	Hazard Report(s)
EL-033	ELECTRICAL - MRDL CABLE CHARACTERISTICS	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.6.1.6 MRDL Cable Characteristics (I)

Requirement Summary:

Medium-Rate Data Link (MRDL) cables must meet ISS requirements.

Detailed Descriptions of Requirements:

Verification shall be by inspection of the integrated rack MRDL cable. Verification shall be considered successful when it is shown that the integrated rack MRDL cable meets the requirements as specified in SSQ 21655 or equivalent for 100 ohm characteristic impedance wire. Equivalent specifications must address the low attenuation, reliability, and environmental requirements as specified in SSQ 21655. Vendor documentation of wire qualification to SSQ 21655 or equivalent can be used to perform this verification.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.3.6.1.6
SSQ 21655

Number	Title	Method	Hazard Report(s)
EL-034	ELECTRICAL – RACK MAINTENANCE SWITCH(RACK POWER SWITCH)/FIRE DETECTION SUPPORT INTERFACE CONNECTOR	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.3.10.3.(B-C) Rack Maintenance Switch(Rack Power Switch)/Fire Detection Support Interface Connector (I)

Requirement Summary:

The rack maintenance switch (rack power switch)connectors(including those for the fire detection and suppression system) must mate correctly with their counterparts.

Detailed Descriptions of Requirements:

A. Verification of P43 appropriate pin assignment shall be by inspection of the hardware to flight approved drawing's. Payload drawings shall be inspected to verify that the P43 pinout matches the corresponding J43 pinout. The verification shall be considered successful when the inspection shows that the P43 connector pinout is appropriate. (4.3.3.10.3.B)

B. Verification of the P43 connector with the requirements as specified in SSQ 21635 shall be by inspection. Payload drawings shall be inspected to identify that the SSQ 21635 requirements are identified on the drawing for the P43 connector. (4.3.3.10.3.C)

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.1.1.6.1 and 3.3.10.3 and Table 3.1.1.6.1-1
SSP 57001, par. 3.3.5
SSQ 21635, (Entire Document)

Number	Title	Method	Hazard Report(s)
EL-035	ELECTRICAL - MPLM ELECTRICAL POWER CHARACTERISTICS	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.6.1(A-G) MPLM Electrical Power Characteristics (A&T)

Requirement Summary:

The integrated rack with MPLM electrical power characteristics must be compatible with the Interface Bus C.

Detailed Descriptions of Requirements:

The operation and compatibility of the integrated rack with MPLM electrical power characteristics shall be verified by the Interface C verification requirements in the following VDSs.

A. EL-001 “Steady State Voltage Characteristics” for Interface C
B. EL-002 “Ripple Voltage Characteristics, Noise, and Spectrum”
C. EL-003 “Transient Voltages” for Interface C
D. EL-004 “Fault Clearing and Protection”
E. EL-005 “Non-Normal Voltage Range”
F. EL-006 “Common Mode Noise”

The verification shall be considered successful when it is shown that all of the above requirements are met.

NOTE: This VDS is provided as information only to the PDs. Information required to closeout the VDS is provided in other VDSs, therefore, PEI will gather the required data to closeout this VDS. No PD action is required.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing plot of input voltage vs. frequency for Item B above.	1. L-12
2. Certificate of Compliance (COC) for Items A, C, D, E, and F above.	2. L-6

Description of Reverification Requirements:	Reverification Method: A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above with the exception that the preliminary Data Cert for Items B and C is not required.	II. L-12 for the Data Cert. L-6 for the COC.

Applicable Document(s):

SSP 57000, par. 3.2.6.1

Number	Title	Method	Hazard Report(s)
EL-036	ELECTRICAL - MPLM ELECTRICAL POWER INTERFACE PERFORMANCE	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.6.2.(A-F) MPLM Electrical Power Interface (A&T)

Requirement Summary:

The integrated rack must be compatible with MPLM electrical power interface when power is in use.

Detailed Descriptions of Requirements:

The integrated rack shall meet the electrical power interface verification requirements in the following VDSs:

A. EL-012, "Remote Power Controllers (RPC)", Items b and d.
B. EL-014, "EPCE Load Impedance", for Interface C.
C. EL-015, "Maximum Ripple Voltage Emissions", with the 12 amp LISN in SSP 57000 Figure 3.2.2.9.1 used in the test setup.
D. EL-016, "Load Stand Alone Stability"
E. EL-023, "Large Signal Stability"

The verification shall be considered successful when it is shown that all of the above requirements are met.

NOTE: This VDS is provided as information only to the PDs. Information required to closeout the VDS is provided in other VDSs, therefore, PEI will gather the required data to closeout this VDS. No PD action is required.

Required Verification Data:	Data Submittal Dates:
1. Preliminary Analysis and Test reports for Item A above.	1. L-20
2. Final Analysis and Test reports for Item A above.	2. L-12
3. Test report for Item B.	3. L-12
4. Analysis and Test reports for Items C, D, and E above.	4. L-12

Description of Reverification Requirements:	Reverification Method: A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above with the exception that the preliminary analysis and test reports for Item A are not required.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.2.6.2 and Figure 3.2.2.9.1

Number	Title	Method	Hazard Report(s)
EL-037	ELECTRICAL - MPLM ELECTRICAL POWER CONNECTIVITY AND PROTECTION INTERFACE	A& I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.2.6.2.1.(B&C) MPLM UIP Connector and Pin Assignments (I)
4.3.2.6.2.2 Compatibility with RPC Soft Start/Stop in MPLM (T)
4.3.2.6.2.3.(A-D) MPLM Surge Current (A&T)
4.3.2.6.2.4 MPLM Reverse Energy Current (A)
4.3.2.6.2.5 MPLM Payload Trip Rating (A)

Requirement Summary:

The integrated rack must be compatible with MPLM electrical power connectivity and protection when power is in use.

Detailed Descriptions of Requirements:

A. Pin Assignments
   i. Verification of appropriate pin assignment shall be by inspection. Inspection of payload drawings shall be used to verify that the P1 pinouts match the corresponding J1 pinouts. The verification shall be considered successful when the inspection shows that the P1 connector pinout is appropriate.
   ii. Verification of the P1 connector with the requirements of SSQ 21635 shall be by inspection. An inspection of the drawings shall be used to verify that the SSQ 21635 requirement is identified on the drawings for the P1 connectors.

B Compatibility with RPC Soft Start/Stop in MPLM
Verification of compatibility with RPC soft start/stop performance characteristics shall be performed by test when the initial supply of power is provided to the equipment connected to the RPC(s). Input power to the integrated rack shall be delivered through a PRCU or equivalent. The integrated rack connected to interface C shall be operated with multiple load combinations at levels from 0% to 100% of the rated load current. The verification shall be considered successful when test shows the integrated rack can initialize operation and is compatible with the RPC soft start/stop characteristics shown in SSP 57000, Figure 3.2.6.2.2-1 and paragraph 3.2.6.2.2.

C. Surge Current
Surge Current shall be verified by test and analysis. Input power to the integrated rack should be representative of the ISS power environment. Verification of compatibility with Surge Current limits shall be performed by test at high, nominal, and low input voltage values as specified. The power source used to perform the test shall be capable of providing a range of power between 0 kW to 1.2 kW at 113-126 Vdc. The integrated rack shall be operated under selected loading conditions that envelop operational loading. The analysis shall be performed using test data from the above test. Based on test data and the requirements specified in SSP 57000, paragraph 3.2.6.2.3,the analysis shall indicate that the integrated rack can operate and is compatible with the Interface C electrical power characteristics. The verification shall be considered successful when test and analysis, under high, nominal, and low voltage conditions, show that the surge current is less than 9.8 A for an integrated rack at the high power location, or less than 5.3 A at the low power location. Test and analysis must also show that the maximum current rate of change does not exceed the values defined in SSP 57000, Figure 3.2.2.4-3, and the duration of the surge current does not exceed 9 milliseconds.

D. Reverse Energy Current
Input power to the integrated rack should be representative of the ISS power environment.

Verification of compatibility with Reverse Energy/Current limits shall be performed by analysis at the input power level corresponding to the integrated rack design. The power source used to perform the analysis shall be capable of providing a range of power between 0 kW to 1.2 kW at 113-126 Vdc. The integrated rack shall be analyzed under selected loading conditions that envelop operational loading.

The verification shall be considered successful when analysis shows that the integrated rack complies with requirements defined in SSP 57000, Table 3.2.6.2.4-I for the reverse energy/current into the upstream power source. The analysis must also show that the reverse energy or the reverse current requirement is met for all environmental conditions specified in SSP 57000 when powered from a voltage source with characteristics specified in SSP 57000, paragraph 3.2.6.1 and with a source impedance of 0.1 ohm.

Number	Title	Method	Hazard Report(s)
EL-037	ELECTRICAL - MPLM ELECTRICAL POWER CONNECTIVITY AND PROTECTION INTERFACE	A& I&T	

E. Payload Trip Ratings

The verification shall be considered successful when the analysis shows that payload power circuit protection device in the integrated rack connected to either the high power location or the low power location in the MPLM is designed to provide trip coordination. Trip coordination is defined as the downstream circuit protection device disconnects a shorted circuit or an overloaded circuit from the upstream power interface without tripping the upstream circuit protection device. The trip coordination is achieved either by shorter trip time or lower current limitation that the upstream protection devices defined in Paragraph 3.2.2.6.1.1.B.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing a plot of worst case reverse current and potential reverse current case conditions to SSP 57000, Table 3.2.2.5-1 allowables for Item D above.	1. L-20
2. Analysis and test reports for Item C above.	2. L-12
3. Analysis report for Item E above.	3. L-12
4. Certificate of Compliance (COC) for Item A and B above.	4. L-6

Description of Reverification Requirements:	Reverification Method: A& I&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.2.6.1, 3.2.6.2.1, 3.2.6.2.2, 3.2.6.2.3, 3.2.6.2.4, and 3.2.6.2.5, Tables 3.2.2.5-1, and 3.2.6.2.4-I and Figure 3.2.2.4-3

Number	Title	Method	Hazard Report(s)
EL-038	ELECTRICAL - MPLM ELECTRICAL POWER CONSUMER CONSTRAINTS	A&D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.6.3.(A-D) MPLM Electrical Power Consumer Constraints (A&D&I)

Requirement Summary:

Wires must be derated for location and temperature of operation. When multiple power sources are connected to one piece of equipment, power on/off indicators must correctly indicate the existence of an active power source.

Detailed Descriptions of Requirements:

The integrated rack shall meet the electrical power consumer constraints in the following VDSs:

A. EL-017, "Wire Derating"

B. EL-018, "Exclusive Power Feeds"

The verification shall be considered successful when it is shown that all of the above requirements are met.

NOTE: This VDS is provided as information only to the PDs. Information required to closeout the VDS is provided in other VDSs, therefore, PEI will gather the required data to closeout this VDS. No PD action is required.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&D&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.6.3

Number	Title	Method	Hazard Report(s)
EL-039	ELECTRICAL - MPLM ELECTROMAGNETIC COMPATIBILITY	A&I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.6.4.(A-J) MPLM Electromagnetic Compatibility (A&I&T)
4.3.2.6.4.1 MPLM Bonding (A)

Requirement Summary:

All integrated rack and ancillary equipment must assure electromagnetic compatibility with the MPLM.

Detailed Descriptions of Requirements:

The electromagnetic compatibility (EMC) requirements of an integrated rack in the MPLM shall be verified by the verification requirements in the following VDSs:

A. EL-019, “Electromagnetic Compatibility for Safety Critical Circuits”
B. EL-020, “Electromagnetic Interference/Compatibility”
C. EL-021, “Cable/Wire Design and Grounding”
D. EL-022, “Bonding”*
E. EL-024, “Electrostatic Discharge”
F. EL-025, “Lightning”
G. EL-042, “Corona”

*Additionally, the bonding between an integrated rack and MPLM shall be verified by analysis. The analysis shall be based on integrated rack qualification data, and design and analysis data. The verification shall be considered successful when the data shows the bonding between the integrated rack and MPLM meets the Class R bonding requirements in accordance with SSP 30245.

NOTE: This VDS is provided as information only to the PDs. Information required to closeout the VDS is provided in other VDSs, therefore, PEI will gather the required data to closeout this VDS. No PD action is required.

Required Verification Data:	Data Submittal Dates:
1. The EMI/EMC Control, Test Plan and Design Analysis Report (first submission with plans, design data, and developmental data), as given in Appendix F, for Item B above.	1. L-22
2. Analysis and test reports for Item E above.	2. L-12
3. Analysis report including applicable test data for Item A above.	3. L-12
4. Test and Analysis Reports for Items C and D above.	4. L-12
5. Test and Analysis Report for Item F above.	5. L-6

Description of Reverification Requirements:	Reverification Method: A&I&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. Same as the “Data Submittal Dates” above.

Applicable Document(s):

SSP 30245
SSP 57000, par. 3.2.6.4

Number	Title	Method	Hazard Report(s)
EL-040	ELECTRICAL - MPLM SAFETY REQUIREMENTS	A&I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.6.5.(A-F) MPLM Safety Requirements (A&I&T)

Requirement Summary:

The MPLM safety requirements must be met.

Detailed Descriptions of Requirements:

The MPLM Safety Requirements shall be verified by the verification requirements in the following VDSs:

A. EL-028, "Rack Maintenance Switch (Rack Power Switch)"
B. EL-029, "Power Switches/Controls"
C. EL-030, "Ground Fault Circuit Interrupters"
D. EL-031, "Portable Equipment/Power Cords"

The verification shall be considered successful when it is shown that all of the above requirements are met.

NOTE: This VDS is provided as information only to the PDs. Information required to closeout the VDS is provided in other VDSs, therefore, PEI will gather the required data to closeout this VDS. No PD action is required.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A&I&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.2.6.5

Number	Title	Method	Hazard Report(s)
EL-041	ELECTRICAL – ELECTRICAL HAZARDS	A or T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.9.1 (B-E) Electrical Hazards (AorT)

Requirement Summary:

These requirements ensure that proper hazard controls are in place.

Detailed Descriptions of Requirements:

For equipment other than bio-instrumentation equipment, verification of hazard controls shall be analysis or test. The analysis or test shall: 1). Define the maximum voltage and current profiles to which a crewmember might be exposed by the worst case combination of credible failures, events, and/or environments the equipment might experience, and 2). Show that the crew is protected by the controls incorporated in the equipment. Verification shall be considered successful when it shows that the appropriate requirements from the following list are satisfied:

- The exposure condition exceeds the threshold for shock, but is below the threshold of the let-go current profile (critical hazard) as defined in SSP 57000, Table 3.2.5.4-1, and two independent controls (e.g., a safety (green) wire, bonding, insulation, leakage current levels below maximum requirements) are provided. In addition, design of the controls is such that no single failure, event, or environment can eliminate more than one control.
- The exposure condition exceeds both the threshold for shock and the threshold of the let-go current profile (catastrophic hazardous events) as defined in SSP 57000, Table 3.2.5.4-1, and three independent controls are provided. In addition, the design of the controls is such that no combination of two failures, events, or environments can eliminate more than two controls.
- If two dependent controls are provided, the physiological effect that a crewmember experiences as a result of the combinations of the highest internal voltage applied to or generated within the equipment and the frequency and wave form associated with a worst case credible failure is below the threshold of the let-go current profile as defined in SSP 57000, Table 3.2.5.4-1.
- If the analysis fails to clearly define the exposure condition that a crewmember might experience, three independent hazard controls are provided and the design of the controls is such that no combination of two failures, events, or environments can eliminate more than one control.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A II. COC	I. N/A II. L-6

Applicable Document(s):

SSP 57000, par. 3.12.9.1 and Table 3.2.5.4-1

Number	Title	Method	Hazard Report(s)
EL-042	ELECTRICAL - CORONA	A or A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.2.4.8 Corona (A or A&T)

Requirement Summary:

Equipment with voltages (steady state, transient, internal or external) greater than 190 volts or equipment containing gases mixture other than those present in the pressurized module shall be verified by analysis or analysis and test. If the equipment (with voltages greater than 190 volts) may be powered during depressurization, the verification shall be by test.

Detailed Descriptions of Requirements:

Verification that the payload has been designed to ensure no detrimental corona shall be by analysis or analysis and test. An analysis shall be done by the payload developer to verify proper corona design techniques (reference MSFC-STD-531, section 6) and to define the operational environment. Electrical/Electronic components with a sealed (reference MSFC-STD-531, par. 6.1.2, solid encapsulation of components and circuitry) chassis design or components which are powered under space vacuum conditions only are not required to do corona testing. However, corona testing is required on unsealed electrical/electronic components which 1) operate during ascent/descent or during a depressurization/repressurization event and 2) have voltage greater than 190 volts.

Guidance for meeting the corona design requirements may be found in MSFC-STD-531, High Voltage Design Criteria, and for testing of the EPCE to ensure compliance to the requirements in this document may be performed using the test methods given in SSP 41172, section 4.2.14 (reference SSCN 1450). With the EPCE powered-up and monitored (i.e. visual observation of the glow or wide-band oscilloscope used as a detector), the test chamber pressure shall then be reduced to the specified pressure level. Verification shall be considered successful when the EPCE can adequately demonstrate the absence of corona/arcing.

Required Verification Data:	Data Submittal Dates:
1. Detailed analysis of corona design techniques, voltage levels, and any gases plus operating environment.	1. L-12
2. Test Report identifying test configuration plus the test results.	2. L-12

Description of Reverification Requirements:	Reverification Method: A or A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Required Verification Data" identified above for "new" subrack changeouts. No reverification required for reflight or series subracks.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. L-12

Applicable Document(s):
SSP 41172, para. 4.2.14 (SSCN 1450)
MIL-STD-531
SSP 57000, par. 3.2.4.8

Number	Title	Method	Hazard Report(s)
CD-001	C&DH - WORD/BYTE NOTATIONS, DATA TYPES, AND DATA TRANSMISSION	A or T or I I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.3.2.1 Word/Byte Notations (I)
4.3.3.2.2 Data Types (I)
4.3.3.2.3.(A-C) Data Transmissions (I)
4.3.3.4.1 (A-C) CCSDS Data (A orT)
4.3.3.4.1.1 CCSDS Data Packets (I&T)
4.3.3.4.1.1.1 CCSDS Primary Header (I&T)
4.3.3.4.1.1.2 (A&B) CCSDS Secondary Header (I&T)

Requirement Summary:
All data (low-, medium- and high-rate) must use specific formats for data transmission.

Detailed Descriptions of Requirements:

A. Word Byte Notations - Word/byte notations produced by the integrated rack shall be inspected in accordance with SSP 52050, paragraphs 3.1 “Data Formats and Standards”, 3.3 “Medium Rate Data Link (MRDL)” ,and 3.1.1, “ Data Bit/Byte Numbering Convention of SSP 57002”, to verify conformity:
   - LRDL - Entire data block
   - MRDL - Headers and trailers
   - HRDL - Start delimiter, header, and end delimiter

   Exception: Intrarack communications between payloads are not covered by this requirement.

Note: Testing shall be considered successful when the PRCU, or equivalent, can verify headers and trailers..

B. LRDL Data Types - Data types produced by the integrated rack as shown in the Unique Payload Software ICD shall be inspected to ensure compliance with SSP 52050, paragraph 3.2 “MIL-STD-1553B Interfaces”.

C. Data Transmission - Data transmission order is verified with the completion of the inspection of the following Word/Byte notations and data types verification: LRDL conforms D684-10056-01, paragraph 3.4, “ Non-Signal Data Coding Standards”.; MRDL conforms to SSP 52050, paragraph 3.3.3.1 “Transmission Order”; and HRDL conforms to CCSDS 701.0-B-2, paragraph 1.6, “Bit Numbering Convention and Nomenclature”.

Note: The CCSDS requirements identified in the IRD section 4 requirements section above are a subset of word/byte notations, data types, and data transmission. Proper verification of word/byte notations, data types, and data transmission will encompass the CCSDS requirements.

Required Verification Data:	Data Submittal Dates:
1. COC (PDL Submittal Completed)	1. L-16
2. COC (No changes since L-16)	2. L-11
3. COC (No changes since L-11)	3. L-8
4. COC for testing	4. L-6

Description of Reverification Requirements:	Reverification Method: A or T or I I&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-16, L-11,L-8

Number	Title	Method	Hazard Report(s)
CD-001	C&DH - WORD/BYTE NOTATIONS, DATA TYPES, AND DATA TRANSMISSION	A or T or I I&T	

Applicable Document(s):
SSP 57002, par. 3.1.1
SSP 52050, par. 3.1,3.2, 3.3, and 3.3.3.1
SSP 57000, par. 3.3.2, 3.3.2.1, 3.3.2.2, 3.3.2.3, 3.3.4.1, 3.3.4.1.1, 3.3.4.1.1.1, and 3.3.4.1.1.2
D684-10056-01, par. 3.4
CCSDS 701.0-B-2, par. 1.6

Number	Title	Method	Hazard Report(s)
CD-003	C&DH - CCSDS USER DATA FIELD	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.4.1.2 CCSDS Data Field (T)
4.3.3.4.1.3 CCSDS Data Bitstream (T)

Requirement Summary:

Data from the transmitting application to the receiving application must be in the CCSDS data field.

Detailed Descriptions of Requirements:
Verification of the Pressurized Payload Software CCSDS data fields shall be by test. The inspection of the CCSDS data fields defined by the tables in the Unique Payload Software ICD shall be complete when it is determined that the requirements as specified in SSP 52050, paragraph 3. 1, have been satisfied. The content of the data file and bitstream data shall be confirmed by showing that the payload responds as expected with the data field and bitstream. The test of the CCSDS data shall be complete after the PRCU, or equivalent, correctly receives the CCSDS data.

A. CCSDS Data Field (see CD-005, "LRDL Protocol")
The test verification will be satisfied after the payload software can successfully identify and manipulate the payload's command and data stream as defined in the Unique Payload Software ICD.

B. CCSDS Data Bitstream
The test verification will be satisfied after the results show the software has successfully identified and manipulated the payload bit stream data as specified in the Unique Payload Software ICD.

Note: Verification activities performed for CD-001, "Word/Byte Notations, Data Types, and Data Transmissions", can encompass the activities listed above.

Required Verification Data:	Data Submittal Dates:
1. COC for testing	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):
CCSDS 701.0-B-2, par. 2.3.2.3
SSP 41175-2, Section 3.3.2.1.1
SSP 57000, par. 3.3.4.1, 3.3.4.1.2, and 3.3.4.1.3
SSP 57300 Software ICD Series Document

Number	Title	Method	Hazard Report(s)
CD-004	C&DH - CCSDS TIME CODES	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.4.2.1 CCSDS Unsegmented Time (T)

Requirement Summary:

The payload must have the ability to receive and process broadcast time.

Detailed Descriptions of Requirements:

Verify by test that each Payload using the MIL-STD-1553B bus has the ability to receive and process broadcast time from subaddress #29 of the P/L MDM data and insert it correctly in the payload CCSDS Secondary Header. The test shall be considered successful when the data sent is identical to the data received, and when the data is inserted properly in the payload CCSDS Secondary Header. The PRCU, or equivalent, can be used for the above test.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) for the test	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

MIL-STD-1553B
SSP 57000, par. 3.3.4.2.1

Number	Title	Method	Hazard Report(s)
CD-005	C&DH - LRDL PROTOCOL	I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.3.5 MIL-STD-1553B LRDL (T)
4.3.3.5.1.1 Standard Messages (I&T)
4.3.3.5.1.2 Commanding (T)
4.3.3.5.1.3 Health and Status Data (T)
4.3.3.5.1.4 (A&B) Safety Data (T)

Requirement Summary:

The payload must have the ability to receive commands and data over the MIL-STD-1553B data bus.

Detailed Descriptions of Requirements:

Verify by test and inspection that each payload using the MIL-STD-1553B bus has the ability to receive data messages, (commands), and transmit data messages (standard messages, health and status data, and safety data).

Inspection shall be considered successful when it is shown that the standard as shown in tables A-5, A-13, and A-14 in the Unique Payload Software ICD conform to the requirements as specified in SSP 52050, Sections 3.2.3.3.1 through 3.2.3.6.

Testing shall be considered successful when the PRCU, STEP, or equivalent, transmits commands and receives standard messages including (health, status, and safety data) from the ISPR.

Required Verification Data:	Data Submittal Dates:
1. Preliminary Certificate of Compliance (COC) for the inspection to ensure the conformance to the Unique Payload Software ICD.	1. L-16
2. Final COC for the inspection to ensure the conformance to the Unique Payload Software ICD.	2 L-11
3. COC for the test.	3. L-8

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Inspection is required, per the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. L-16/L-11/L-8

Applicable Document(s):

MIL-STD-1553B
SSP 52050, Section 3.2.3.3.1 - 3.2.3.6
SSP 57000, par. 3.3.4.2.1, 3.3.4.2.2, 3.3.5, 3.3.5.1.1, 3.3.5.1.2, 3.3.5.1.3, and 3.3.5.1.4
SSP 57002, Table A-5, A-1

Number	Title	Method	Hazard Report(s)
CD-006	C&DH - LRDL MESSAGES AND COMMANDS	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.3.5.1.5 Service Requests (T)
4.3.3.5.1.8 Low Rate Telemetry (T)
4.3.3.5.1.7 File Transfer (T)

Requirement Summary:

The payload that requires service requests, ancillary data, file transfers, and low-rate telemetry data must have the ability to request and receive these types of data.

Detailed Descriptions of Requirements:

Verify by test that each Payload requiring payload MDM services using the MIL-STD-1553B bus has the ability to request, respond to, and receive services from the Payload MDM. These services are defined in SSP 57000, Section 3.3.5.1.5 through 3.3.5.1.8.

The test shall be considered successful when the PRCU, or equivalent, receives the Payload request for services and the Payload receives and processes the response correctly.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) for the test.	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Test is required, per the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

MIL-STD-1553B
SSP 57000, par. 3.3.5.1.5, 3.3.5.1.6, 3.3.5.1.7, and 3.3.5.1.8
SSP 57300 Software ICD Series Document

Number	Title	Method	Hazard Report(s)
CD-007	C&DH - LRDL MODE CODES	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.5.1.9 Defined Mode Codes (T)
4.3.3.5.1.10 Implemented Mode Codes (T)

Requirement Summary:

Data word counts and mode codes must follow a standard format.

Detailed Descriptions of Requirements:

Verify by test that each Payload using the MIL-STD-1553B bus has the implemented data word count/mode code defined as specified in SSP 52050, Section 3.2.3.2.1.5.

The mode codes as specified in SSP 52050, section 3.2.3.2.1.5, which have "Yes" on the "required" column of the table, shall be tested with the PRCU or equivalent test equipment. The test shall be considered successful when the integrated rack's Payload Bus Remote Terminal, or equivalent, receives the mode codes error free in accordance with the RT Validation Test Plan defined in Appendix A of MIL-HDBK-1553, Notice 1.

Required Verification Data:	Data Submittal Dates:
1. COC for the test.	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Inspection is required, per the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

MIL-HDBK-1553, Appendix A

MIL-STD-1553B
SSP 52050, section 3.2.3.2.1.5
SSP 57000, par. 3.3.5.1.9 and 3.3.5.1.10

Number	Title	Method	Hazard Report(s)
CD-008	C&DH - LRDL MODE CODES AND ILLEGAL COMMANDS ERROR	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.5.1.11 Unimplemented/Undefined Mode Codes (T)
4.3.3.5.1.12 Illegal Commands (T)

Requirement Summary:

These requirements ensure that mode code errors will be detected.

Detailed Descriptions of Requirements:

Verify by test that each Payload using the MIL-STD-1553B bus has the capability of detecting Unimplemented/Undefined mode codes and/or Illegal Commands.

The test, in accordance with a RT Validation Test Plan as defined in MIL-HDBK-1553, Notice 1, Appendix A, of the integrated rack's Payload Bus Remote Terminal with the PRCU, or equivalent, will be complete after the detection of an Unimplemented/Undefined mode code and/or the reception of an illegal command results in the setting of the message error bits in the Payload status word response.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) for the test.	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: The subrack PL shall be tested using a GSE rack simulator (ISPR, EXPRESS, etc.) with the same rack configuration as the affected flight rack. The subrack PL, with either ISPR or EXPRESS, shall use a PRCU, PSIV/F, or a high fidelity GSE simulator for ground testing.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):
MIL-HDBK-1553, Appendix A
MIL-STD-1553B
SSP 57000, par. 3.3.5.1.11 and 3.3.5.1.12

Number	Title	Method	Hazard Report(s)
CD-009	C&DH - LRDL SIGNAL CHARACTERISTICS	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.5.2.2 LRDL Signal Characteristics (T)

Requirement Summary:

Integrated racks that require connectivity to the payload local bus must have specific electrical and terminal characteristics.

Detailed Descriptions of Requirements:

Integrated racks, which require connectivity to the payload local MIL-STD-1553B bus shall meet the characteristics in accordance with MIL-STD-1553B, paragraph 4.3.

The integrated rack MIL-STD-1553B terminal characteristics shall be in accordance with paragraph 4.5.2 of MIL-STD-1553B.

Verification of the MIL-STD-1553B bus A and bus B shall be by test.

Verification shall be to test the integrated rack's Payload Bus Remote Terminal with the RT Validation Test Set, for correct test of the MIL-STD-1553B signal characteristics in accordance with paragraph 4.5.2 of MIL-STD-1553B and with a MIL-STD-1553B bus analyzer as specified in MIL-HDBK-1553 Handbook, Notice 1, Appendix A, RT Validation Test Plan.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) for the test.	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: The subrack PL shall be tested using a GSE rack simulator (ISPR, EXPRESS, etc.) with the same rack configuration as the affected flight rack. The subrack PL, with either ISPR or EXPRESS, shall use a PRCU, PSIV/F, or a high fidelity GSE simulator for ground testing.

Required Reverification Data:	Data Submittal Dates:
I. Same as the "Required Verification Data" identified above.	I. L-6
II. Same as the "Required Verification Data" identified above.	II. L-12

Applicable Document(s):

MIL-HDBK-1553B
MIL-STD-1553B, par. 4.3 and 4.5.2
SSP 57000, par. 3.3.5.2.2

Number	Title	Method	Hazard Report(s)
CD-010	C&DH - MRDL PROTOCOL AND SIGNAL CHARACTERISTICS	I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.6.1 MRDL Protocol (I&T)
4.3.3.6.1.1 Integrated Rack Protocols on the MRDL (I&T)

Requirement Summary:

The Medium-Rate Data Link (MRDL) protocol must comply with a specified industry standard.

Detailed Descriptions of Requirements:

Inspection verification shall be complete after the Unique Payload Software ICD has been completed and approved.

Test verification of the integrated rack shall be performed using an Ethernet network analyzer to insure the MRDL protocol is in accordance with the ISO/IEC 8802-3 Pics Proforma for 10 Base T.

Note: PRCU can provide a port for correct routing of messages.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) (PDL Submittal Completed)	1. L-16
2. COC (No changes since L-16)	2. L-11
3. COC (No changes since L-11)	3. L-8
4. COC for the test.	4. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: The subrack PL shall be tested using a GSE rack simulator (ISPR, EXPRESS, etc.) with the same rack configuration as the affected flight rack. The subrack PL, with either ISPR or EXPRESS, shall use a PRCU, PSIV/F, or a high fidelity GSE simulator for ground testing.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-16/L-11/L-8/L-6

Applicable Document(s):

ISO/IEC 8802-3 (Entire Document)
SSP 52050, Section 3.3.3
SSP 57000, par. 3.3.6.1, and 3.3.6.1.1

Number	Title	Method	Hazard Report(s)
CD-011	C&DH - MRDL CONNECTIVITY AND ADDRESSING	A&I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.6.1.2 (A-C) MRDL Address (A&T)
4.3.3.6.1.3 (A-B) ISPR MRDL Connectivity (I&T)
4.3.3.6.1.3.C ISPR MRDL Connectivity (T)

Requirement Summary:

The Medium-Rate Data Link (MRDL) must have proper connectivity to Local Area Networks (LAN), and the addressing must allow software commands and data to be received by the intended recipient.

Detailed Descriptions of Requirements:

A. MRDL Address: Verification of the integrated rack (or sub rack and or non-rack payloads internal) MRDL LAN 1 and LAN 2 unique address shall be by analysis and test. The analysis shall verify that the unique numbers were issued by IEEE or their representative. The test shall verify that the integrated rack correctly implements the Ethernet protocol with the PRCU or equivalent. The test of the sub rack or non-rack payload shall verify that the payloads correctly implement the Ethernet protocol with the Ethernet network analyzer. The verification for integrated rack, subrack, and nonrack payloads shall be considered successful when traceability of addresses to IEEE has been shown and when the protocol meets the requirements of ISO/IEC 8802-3 Pics Proforma for 10 Base T, using an Ethernet network analyzer.

Verification of MAC address shall be set prior to the Ethernet terminal going active shall be by test. The test shall verify that the integrated rack, sub rack , or non-rack payloads correctly implements the Ethernet protocol with Ethernet network analyzer. The verification shall be considered successful when the protocol meets the requirements of ISO/IEC 8802-3 Pics Proforma for 10 Base T, using an Ethernet network analyzer. This test may be combined with the tests described in the previous paragraph of this VDS.

B. ISPR MRDL Connectivity: Verification of the integrated rack MRDL connectivity shall be by inspection. The inspection shall be considered successful when it is shown that the integrated rack drawings in the unique hardware ICD conform to SSP 57001, section 3.3.3.1. Verification of MRDL data routing shall be by test. The test shall be accomplished with the PRCU or equivalent. The test shall be considered successful when it is shown that MRDL data can be successfully routed to the proper ISS LAN with the correct MRDL address.

C. Integrated Racks with Internal MRDL – Verification shall be to test using the PRCU or equivalent to show that isolation exists between the integrated rack internal LAN and the ISS LAN.

Note: PRCU can be used to route MRDL data from the system emulators to the payload a well as routing MRDL data from the payload to the system emulators.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) (PDL Submittal Completed)	1. L-16
2. COC (No changes since L-16)	2. L-11
3. COC (No changes since L-11)	3. L-8
4. COC for the test.	4. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: The subrack PL shall be tested using a GSE rack simulator (ISPR, EXPRESS, etc.) with the same rack configuration as the affected flight rack. The subrack PL, with either ISPR or EXPRESS, shall use a PRCU, PSIV/F, or a high fidelity GSE simulator for ground testing.

Number	Title	Method	Hazard Report(s)
CD-011	C&DH - MRDL CONNECTIVITY AND ADDRESSING	A&I&T	

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. L-16/11/L-8/L-6

Applicable Document(s):

SSP 52050, par.3.3.6
SSP 57000, par. 3.3.6.1.2 and 3.3.6.1.3
SSP 57001, Tables 3.3.2.2-1 and 3.3.2.2-2
SSP 57002, Tables 3.1.2.2-1 and 3.1.2.2-2
SSP 57300 Software ICD Series Document

Number	Title	Method	Hazard Report(s)
CD-012	C&DH - MRDL CABLE CHARACTERISTICS	I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.3.6.1.5 MRDL Signal Characteristics (I&T)
4.3.3.6.1.6.1 Insertion Loss (T)
4.3.3.6.1.6.2 Differential Characteristic Impedance (T)
4.3.3.6.1.6.3 Medium Timing Jitter (T)

Requirement Summary:

The Medium-Rate Data Link (MRDL) cable characteristics (signal characteristics, insertion losses, Differential Characteristic Impedance, and Medium Timing Jitter) must meet specific industry standards.

Detailed Descriptions of Requirements:

The inspection of the ISPR MRDL signal characteristics as specified in the Unique Payload Software ICD will be complete when it is determined it conforms to section 14.2.1 of ISO/IEC 8802-3 with the exception stated in paragraph 3.3.6.1.5 of SSP 57000.

The test of the ISPR MRDL signal characteristics will be complete when it is determined it conforms to section 14.4.2.1 of ISO/IEC 8802-3, 1994, with the exception that the wire meets SSP 57000, Table 3.3.6.1.6-I.

The test of the ISPR MRDL Differential Characteristic Impedance will be complete when it is determined it conforms to section 14.4.2.2 of ISO/IEC 8802-3, 1994, with the exception that the wire meets SSP 57000, Table 3.3.6.1.6-I.

The test of the ISPR MRDL Medium Timing Jitter will be complete when it is determined it conforms to section 14.4.2.3 of ISO/IEC 8802-3, 1994, with the exception that the wire meets SSP 57000, Table 3.3.6.1.6-I.

Note: PRCU can provide a port for correct routing of messages.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) (PDL Submittal Completed)	1. L-16
2. COC (No changes since L-16)	2. L-11
3. COC (No changes since L-11)	3. L-8
4. COC for the test	4. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: The subrack PL shall be tested using a GSE rack simulator (ISPR, EXPRESS, etc.) with the same rack configuration as the affected flight rack. The subrack PL, with either ISPR or EXPRESS, shall use a PRCU, PSIV/F, or a high fidelity GSE simulator for ground testing.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC.	II. L-16/L-11/L-8/L-6

Applicable Document(s):

ISO/IEC 8802-3, par. 14.2.1, 14.4.2.1, 14.4.2.2, and 14.4.2.3
SSP 57000, par. 3.3.6, 3.3.6.1.5, 3.3.6.1.6.1, 3.3.6.1.6.2, and 3.3.6.1.6.3; Table 3.3.6.1.6-I
SSP 57300 Software ICD Series Document

Number	Title	Method	Hazard Report(s)
CD-013	C&DH - HRDL SIGNAL, SYMBOLS, AND ENCODING	A&I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.7.2.1 Physical Signaling (A&T)
4.3.3.7.2.1.1 (A&B) Physical Signaling Date Rates (A&T)
4.3.3.7.2.2 Encoding (I&T)

Requirement Summary:

These requirements ensure that the physical signaling, physical signal date rates, and data encoding meet specific standards.

Detailed Descriptions of Requirements:

A. Physical Signaling
Verification of the HRDL physical signaling shall be by test and analysis. Verification of the fiber optic transmitted waveform at the fiber optic transmitter component shall be by test. This test may be conducted at fiber optic component subassembly. Verification of the integrated rack fiber optic transmitted waveform shall be by analysis. Verification of the fiber optic receiver fiber optic sensitivity and bus error rate (BER) shall be by test of the fiber optic receiver component. Verification of the integrated rack fiber optic receiver sensitivity and BER is by analysis. BER is required per the ANSI X3.255 test.

B. Physical Signaling Date Rates
Verification of the HRDL physical signaling shall be by test and analysis. Verification of the date rate being a multiple of 0.5 Mbps shall be by test at the integrated rack.
1). Verification of the payload data rates is by test and is considered successful when the HRDL data rate is greater than or equal to 0.5 Mbps and less than or equal to the maximum negotiated data rate or 95.0 Mbps, whichever is less.
2). Verification of the payload data rates is by test and is considered successful when the HRDL data rate is in increments of 0.5 Mbps. All selectable data rates are to be recorded.

C. Encoding
Verification of the HRDL encoding shall be by inspection and test. Verification shall be by inspection of the integrated rack HRDL protocol to the unique integrated rack hardware ICD against SSP 50184 and SSP 57001. Verification shall be to test the integrated rack with the PRCU, for correct test of the HRDL protocal.

Required Verification Data:	Data Submittal Dates:
1. COC providing rates, signal coding, and control signals. 2. Certificate of Compliance (COC) for signal coding and control signal	1. L-16 2. L-8

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: The subrack PL shall be tested using a GSE rack simulator (ISPR, EXPRESS, etc.) with the same rack configuration as the affected flight rack. The subrack PL, with either ISPR or EXPRESS, shall use a PRCU, PSIV/F, or a high fidelity GSE simulator for ground testing.

Required Reverification Data:	Data Submittal Dates:
I. N/A II. Same as the “Required Verification Data” identified above.	I. N/A II. L-16/L-8

Applicable Document(s):

SSP 52050, par. 3.4.1 and 3.4.1.1
SSP 57000, par. 3.3.7.2.1, 3.3.7.2.2, and 3.3.7.2.3

Number	Title	Method	Hazard Report(s)
CD-014	C&DH - HRDL SEND/RECEIVE OPTICAL POWER	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.7.3.1 Integrated Rack HRDL Transmitted Optical Power (T)
4.3.3.7.3.2 Integrated Rack HRDL Received Optical Power (T)

Requirement Summary:

These requirements ensure that transmitted and received optical power falls within a specified range.

Detailed Descriptions of Requirements:

The integrated rack transmitted and received optical power shall be tested at the integrated rack P7 connector to the ISPR connector interface panel using the Halt symbol.

The integrated rack that transmits data on the HRDL, with or without an ARIS adapter, shall be tested to transmit a HRDL signal in accordance with SSP 50184, paragraph 3.1.1, Transmitted Optical Characteristics, at an average optical power greater than -16.75 dBm and less than -8.3 dBm.

The integrated rack that receives data on the HRDL, with or without an ARIS adapter, shall be tested to receive a HRDL signal in accordance with SSP 50184, section 3.1.2, Received Optical Characteristics, at an average optical power greater than -30.45 dBm and less than -8.5 dBm.

The PRCU, or equivalent can be used for the integrated rack data transmittal test.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: The subrack PL shall be tested using a GSE rack simulator (ISPR, EXPRESS, etc.) with the same rack configuration as the affected flight rack. The subrack PL, with either ISPR or EXPRESS, shall use a PRCU, PSIV/F, or a high fidelity GSE simulator for ground testing.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC.	II. L-6

Applicable Document(s):

SSP 50184, Sec. 3.3.1 and 3.3.2
SSP 57000, par. 3.3.7.3.1 and 3.3.7.3.2

Number	Title	Method	Hazard Report(s)
CD-015	C&DH - MAINTENANCE SWITCH INTERFACES	I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.10.1 Rack Maintenance Switch (Rack Power Switch) Interfaces (I&T)

Requirement Summary:

The rack maintenance switch (rack power switch) interface data characteristics of the integrated rack must meet certain standards.

Detailed Descriptions of Requirements:

Verification of the rack maintenance switch (rack power switch) interface shall be by inspection and test.

An inspection of the rack maintenance switch (rack power switch) interface data characteristics shall be made to verify that the rack power-off command interface characteristics meet the requirements as specified in SSP 57000, Table 3.3.10.1-1, Bi-Level Data Characteristics (Switch Contact). The integrated payload rack power cut-off shall be implemented with a manually operated two-position, lever lock switch.

Tests shall be conducted using the integrated rack with the PRCU, or equivalent, to verify the correct operation of the rack maintenance switch (rack power switch).

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: The subrack PL shall be tested using a GSE rack simulator (ISPR, EXPRESS, etc.) with the same rack configuration as the affected flight rack. The subrack PL, with either ISPR or EXPRESS, shall use a PRCU, PSIV/F, or a high fidelity GSE simulator for ground testing.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.3.10.1 and Table 3.3.10.1-1

Number	Title	Method	Hazard Report(s)
CD-016	C&DH - SMOKE DETECTION	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.10.2 Smoke Detector Interfaces (I)
4.3.3.10.2.1 Analog Interface Characteristics (I)
4.3.3.10.2.2 Discrete Command Built-in-Test Interface Characteristics (I)

Requirement Summary:

The smoke-detector signal and interfaces must meet specific requirements.

Detailed Descriptions of Requirements:

Verification of the Smoke Detector Interfaces, Analog Interface Characteristics, and Discrete Command Built-in-test (BIT) Interface Characteristics shall be by inspection.

Verification that the Smoke Detector Interfaces, Analog Interface characteristics, and the Discrete Command BIT Interface characteristics meet the requirements as specified in SSP 30262-013, Table 3-VI, shall be by inspection.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.3.10.2, 3.3.10.2.1, and 3.3.10.2.2
SSP 30262-013, Table 3-VI

Number	Title	Method	Hazard Report(s)
CD-017	C&DH - NTSC OPTICAL VIDEO CHARACTERISTICS	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.4.1.1Payload NTSC Optical Video Characteristics (T)
4.3.4.1.2.1(A&B) Pulse Frequency Modulation NTSC Fiber Optic Video Characteristics (T)
4.3.4.1.2.2 Integrated Rack NTSC PFM Video Transmitted Optical Power (T)
4.3.4.1.2.3 Integrated Rack NTSC PFM Video and Sync Signal Received Optical Power (T)

Requirement Summary:

These requirements ensure that payload NTSC optical video characteristics conform to specific criteria.

Detailed Descriptions of Requirements:

Testing shall be performed on the integrated rack with the PRCU or equivalent to verify that the Payload NTSC optical video characteristics are in accordance with SSP 57000, Table 3.4.1.1-1 NTSC Video Performance Characteristics. The interpretation shall be in accordance with EIA/TIA RS-250, End-to-End NTSC Video for Satellite Transmission System, per the paragraphs as specified in SSP 57000, Table 3.4.1.1-1 while receiving the PFM NTSC Fiber Optic Video Characteristics, SSP 57000, Table 3.4.1.2-1 NTSC Fiber Optic Video Signal Characteristics. Video signal-to-crosstalk noise shall be in accordance with paragraph 3.19 of NTC-7.

Verification tests shall be performed using an integrated rack that transmits PFM video signals over the optical video system, with or without an ARIS adapter. The test shall be used to verify that the transmitted video PFM signal has an average optical power greater than -15.5 dBm.

Verification tests shall be performed using an integrated rack that receives PFM video signals and sync over the optical video system, with or without an ARIS adapter. The test shall be used to verify that the received PFM video and sync signals have an average optical power greater than -22.2 dBm.

The PRCU, or equivalent can be used for the above tests.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-11

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC.	II. L-11

Applicable Document(s):

EIA/TIA RS-250
NTC-7 par. 3.19
SSP 57000 par. 3.4.1.1, 3.4.1.2.1, 3.4.1.2.2, 3.4.1.2.3, and Tables 3.4.1.1-1 and 3.4.1.2-1.

Number	Title	Method	Hazard Report(s)
CD-018	C&DH - NTSC PFM ELECTRICAL VIDEO CHARACTERISTICS	A&I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.4.1.3.1 Cables (I)
4.3.4.1.3.2 Signal Standard (T)
4.3.4.1.3.3 Interface Circuit (A)
4.3.4.1.3.4 Cross Talk (T)

Requirement Summary:

These requirements ensure that payload NTSC electrical video characteristics conform to specific criteria.

Detailed Descriptions of Requirements:
Cables:

Verification of the cables required for transmission of sync and control signals and video and status signals shall be by inspection of the flight drawings. Verification shall be considered successful when the inspection shows that the cable meets the requirements of SSQ 21655; NDBC-TFE-22-2SJ-75.

Signal Standard:

Verification of the integrated rack's ability to send and receive video, status, and sync signals shall be by test. The signal degradation from Out-Put video to In-Put video can be simulated by using a 60 meter long SSQ 21655: NDBC-TFE-22-25J-75 cable. A test shall be performed using the PRCU or equivalent to verify that ISPR input/output video, status and sync signals are in accordance with RS-170A at the UIP interface as defined in SSP 57000, Figure 3.4.1.3.2-1, Interface B.

Interface Circuit:

Verification of interface circuit of video system component in the ISPR for sync, video output and video input shall be by analysis. The analysis shall show that the input load impedance of the receive circuit to cable is greater than 6 K ohms measured from signal to ground while the circuit is active, and voltage in the circuit shall not exceed the tolerance limits of +/- 5.5 V. The verification shall be considered successful when the analysis shows that the video system interface circuit complies with SSP 57000, Figure 3.4.1.3.3-1.

Cross Talk:
Verification of cross talk shall be by test. The test shall use NTC-7 method and record the actual cross-talk value in dB. Verification shall be considered successful when the test value is less than the requirement identified in SSP 57000, paragraph 3.4.1.3.4.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-11

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&I&T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A II. COC.	I. N/A II. L-11

Applicable Document(s):

SSP 57000, par. 3.4.1.3.1, 3.4.1.3.2, 3.4.1.3.3, and 3.4.1.3.4 and Figures 3.4.1.3.3-1 and 3.4.1.3.2-1

Number	Title	Method	Hazard Report(s)
CD-019	C&DH - SMOKE INDICATOR AND FAN VENTILATION STATUS ELECTRICAL INTERFACES	I&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.10.2.3 Smoke Indicator Electrical Interfaces (I&T)
4.3.3.10.2.4 Fan Ventilation Status Electrical Interfaces (I)

Requirement Summary:

These requirements ensure that the smoke indicator electrical interface characteristics and the fan ventilation status electrical interfaces meet certain standards.

Detailed Descriptions of Requirements:

A. Verification of the smoke indicator electrical interface shall be by inspection and test.

Verification shall be by inspection of the discrete command BIT interface characteristics to the Unique Payload Hardware ICD and SSP 57001, Table 3.3.5. 2-1.

Verification shall be to test the integrated rack with the PRCU, or equivalent, for proper functioning of the smoke indicator using the output from UIP connector P43. No test on the luminance of the indicator is required.

B. Verification of the fan ventilation status electrical interfaces shall be by inspection

Verification shall be by inspection of the fan ventilation status electrical interface characteristics to ensure that they are in accordance with SSP 57000, paragraph 3.3.10.2.1, “Analog Interface Characteristics”.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-11

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I&T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC.	II. L-11

Applicable Document(s):

SSP 57000, par. 3.3.10.2.1, 3.3.10.2.3, and 3.3.10.2.4 and Table 3.3.10.2.3-I
SSP 57001, Table 3.3.5. 2-1
SSP 57200 Hardware ICD Series Document

Number	Title	Method	Hazard Report(s)
CD-020	C&DH - PARAMETER MONITORING IN SUBRACK AND INTEGRATED RACK	T&A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.10.2.2.2.1.(A-B) Parameter Monitoring in Subrack (T&A)
4.3.10.2.2.2.2.(A-B) Parameter Monitoring in Integrated Rack (T)

Requirement Summary:

The integrated rack and subrack using parameter monitoring for detection of "out of bounds conditions" must be able to terminate the forced air circulation and power when an "out of bounds condition" is detected. The cause of the "out of bounds condition" and affected integrated rack and sub-rack locations will be sent to the Payload (PL) Multiplexer/Demultiplexer (MDM).

Detailed Descriptions of Requirements:

A. Parameter Monitoring in Subrack

(1) Verification that the integrated rack provides manual and automatic capabilities to terminate forced air circulation (if present) and power to each sub-rack volume that is monitored with parameter monitoring shall be by test. A test shall be conducted to determine whether or not forced air circulation and electrical power can be manually and automatically terminated in the sub-rack volume when an "out of bounds" condition is indicated by the parameter monitoring sensors. Verification shall be considered successful when the test shows forced air circulation and electrical power can be terminated manually and automatically when an "out of bounds" condition is indicated by the parameter monitoring sensors.

(2) Verification that the integrated rack responds to an "out of bounds" condition within a separate, sub-rack volume that is monitored with parameter monitoring by sending data to indicate the occurrence and location of the "out of bounds" condition to the payload MDM in the format specified in SSP 57000, paragraph 3.3.5.1.4 shall be by test and analysis. For the initial configuration of the integrated rack, a test with the PRCU or equivalent shall determine whether or not the rack health and status data is formatted to indicated the occurrence and location of an "out of bounds" condition when one is indicated by parameter monitoring sensors. For sub-rack payloads that are changed out, a test of the interface to the integrated rack's controller or equivalent and an analysis to determine the interface to the Payload MDM is correct shall be conducted. Verification shall be considered successful when the test and analysis shows data is sent in the format specified in SSP 57000, paragraph 3.3.5.1.4 to indicated the occurrence and location of an "out of bounds" condition when one is indicated by the parameter monitoring sensors.

B. Parameter Monitoring in Integrated Rack

(1) Verification that integrated racks only using parameter monitoring provide manual and automatic capability to terminate forced air circulation (if present) and power to the integrated rack shall be by test. A test with the PRCU or equivalent shall be conducted to determine whether or not forced air circulation and electrical power can be manually or automatically terminated in the integrated rack when an "out of bounds" condition is indicated by the parameter monitoring sensors. Verification shall be considered successful when the test shows forced air circulation and electrical power can be terminated manually or automatically when an "out of bounds" condition is indicated by the parameter monitoring sensors.

(2) Verification that integrated racks only using parameter monitoring respond to an "out of bounds" condition by sending data to indicate the occurrence and location of the "out of bounds" condition to the payload MDM in the format specified in SSP 57000, paragraph 3.3.5.1.4 shall be by test. A test with the PRCU or equivalent shall determine whether or not the rack health and status data is formatted to indicate the occurrence and location of an "out of bounds" condition when one is indicated by parameter monitoring sensors. Verification shall be considered successful when the test shows data is sent in the format specified in SSP 57000, paragraph 3.3.5.1.4 to indicate the occurrence and location of an "out of bounds" condition when one is indicated by the parameter monitoring sensors.

Number	Title	Method	Hazard Report(s)
CD-020	C&DH - PARAMETER MONITORING IN SUBRACK AND INTEGRATED RACK	T&A	

continued from previous page

Required Verification Data:	Data Submittal Dates:
1. Test Report including the test data.	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&T	

I. On-orbit relocation of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: A test of the interface to the integrated rack's controller or equivalent and an analysis to determine the interface to the payload MDM is correct shall be conducted. Verification shall be considered successful when the test shows that data is sent in the format specified in SSP 57000, paragraph 3.3.5.1.4 to indicate the occurrence and location of an "out of bounds" condition when one is identified by the parameter monitoring sensors.

Required Reverification Data:	Data Submittal Dates:
I. Same as the "Required Verification Data" identified above.	I. L12
II. Test Report.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.3.5.1.4, 3.10.2.2.2.1, 3.10.2.2.2.2, 3.10.3.4.1, and 3.10.3.4.2

Number	Title	Method	Hazard Report(s)
CD-021	C&DH - INTEGRATED RACK CAUTION AND WARNING	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.5.1.4.1.2 Class 2 - Warning (A&T)
4.3.3.5.1.4.1.3 Class 3 - Caution (A&T)
4.3.3.5.1.4.1.4 Class 4 - Advisory (A&T)

Requirement Summary:

Integrated rack warning, caution, and advisory data shall be transmitted by the integrated payload to the Payload MDM.

Detailed Descriptions of Requirements:

A. The Integrated Rack Caution and Warning data (caution, warning, and advisory) contained in the Payload Unique Software ICD shall be compared with the data fields specified in SSP 57002, Tables A-1 and A-6 for conformance. After this conformance has been validated an analysis will be made of the warning, caution, and advisory flags located in the Payload C&W word to verify the coding of the data is as defined in SSP 52050, paragraph 3.2.3.5.1.1 for all possible conditions.

B. The test of proper transmission of all possible warning, caution, and advisory data from the integrated rack shall be performed using the PRCU, STEP, or equivalent test unit for receiving and logging the caution and warning word. The test shall be considered successful when the received and logged caution and warning word is verified to be correct for the data defined in the Unique Payload Software ICD.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing analysis and test results.	1. L-12

Description of Reverification Requirements:	Reverification Method: A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. Same as the “Required Verification Data” identified above.	I. L-12
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

SSP 52050, par. 3.2.3.5.1.1 and Table3.2.3.5-1
SSP 57000, par. 3.3.5.1.4.1.2, 3.3.5.1.4.1.3 and 3.3.5.1.4.1.4
SSP 57002, Tables A-1 and A-6

Number	Title	Method	Hazard Report(s)
CD-022	C&DH – PORTABLE COMPUTER SYSTEM – PAYLOAD LAPTOP	I&D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.3.8.1 (A) Payload Laptop (I)
4.3.3.8.1 (B) Payload Laptop (I)
4.3.3.8.1 (C) Payload Laptop (D)
4.3.3.8.1 (D) Payload Laptop (I)
4.3.3.8.1 (E) Payload Laptop (I)
4.3.3.8.1 (F) Payload Laptop (I)
4.3.3.8.1 (G) Payload Laptop (I)
4.3.3.8.1 (H) Payload Laptop (I)
4.3.3.8.2.2 (A-D) 760XD Laptop to Rack Interface (I)

Requirement Summary:

This requirements ensures that Payload Laptops provided by the Payload Developers and used to provided both rack and experiment control and display, properly interfaces with the PDs integrated rack and does not interfere with other space station operations.

Detailed Descriptions of Requirements:

A. An inspection shall be performed of the qualified vendor documentation to determine if the vendor is a qualified vendor (e.g JSC PCS Project) and that the laptop provided is an IBM 760XD (model 9546U9E) per JSC 27337. Verification shall be considered successful when it is shown that the payload laptop was procured from a qualified vendor.

B. An inspection of the payload laptop software load shall be performed to determine if the payload laptop is utilizing the Windows NT 4.0 server software load to include a computer browser, Internet Info Server 4.0, TCP/IP Printing, NetBIOS Interface, Network Monitor & Tools, RPC Configuration, Server, Transaction Server, and Workstation). Verification shall be considered successful when it is shown that the payload laptop includes the Windows NT 4.0 software load in accordance with SSP 57000, paragraph 3.3.8.1.B.

C. A demonstration of payload displays, in accordance with the requirements in SSP 50313, shall be performed to the Payload Display Review Panel (PDRP). Verification shall be considered successful when the PDRP accepts the displays and verifies that they meet the requirements identified in SSP 50313, Display and Graphical Commonality Standard.

D. An inspection shall be performed of the integrated rack flight drawings to determine if no more than one payload laptop can be connected to the integrated rack at one time. Verification shall be considered successful when it is shown that no more than one Payload Laptop can be connected to the integrated rack.

E. An inspection shall be performed of the flight drawings to determine if the payload laptop and/or 760XD laptop connectors provided by the payload laptop interface correctly to the front panel connection of the rack. The connectors will be as specified in SSP 57000C, Table 3.3.8.1-1 and as in SSP 57001, Figures 3.3.6.1-1 through 3.3.6.1-4. Verification shall be considered successful when the inspection shows that the above verification requirements have been met.

F. An inspection shall be performed of the flight drawings to determine if the data/power cables were designed in accordance with the requirements defined in Figure 3.3.8.1-1 of SSP 57000C. Verification shall be considered successful when it is determined that the cable design requirements have been met.

G. An inspection shall be performed of the flight drawings to determine if the 28V power converter is properly identified in accordance with the Figure 3.3.8.1-1 of SSP 57000C and the design drawing SED39126010-305. Verification shall be considered successful when it is determined that the power converter has been designed in accordance with the above requirements.

H. An inspection shall be performed of the flight drawings to determine if the payload laptop and/or 760XD mounting is in accordance with the connectors identified in SSP 57000C, paragraph 3.3.8.1.H and/or paragraph 3.3.8.2.2.D. Verification shall be considered successful when it is determined that the connector used to attach the Payload Laptop to the rack seat track is as specified in SSP 57000C.

Number	Title	Method	Hazard Report(s)
CD-022	C&DH – PORTABLE COMPUTER SYSTEM – PAYLOAD LAPTOP	I&D	

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance	1. L-6

Description of Reverification Requirements:	Reverification Method: I&D	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):
SSP 57000, par. 3.3.8.1 and 3.3.8.2.2
SSP 57001, Figures 3.3.6.1-1 through 3.3.6.1-4.
SSP 50313

Number	Title	Method	Hazard Report(s)
CD-023	C&DH – PORTABLE COMPUTER SYSTEM	T,D&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.8.2 (A) Portable Computer System (T)
4.3.3.8.2 (B) Portable Computer System (D)
4.3.3.8.2 (C) Portable Computer System (I)

Requirement Summary:

This requirement ensures that Payload Developers who request to use the PCS resources adhere to the software requirements.

Detailed Descriptions of Requirements:

A. A test shall be performed by the PSIV per the CEA PCS-PSIV-01 to determine if the payload provided software meets the requirements identified in SSP 52052. Verification shall be considered successful when PSIV testing shows that the requirements in SSP 52052 have been met.

B. A demonstration of payload displays for the PCS, in accordance with the requirements in SSP 50313, shall be performed to the Payload Display Review Panel (PDRP). Verification shall be considered successful when the PDRP accepts the displays and verifies that they meet the requirements identified in SSP 50313, Display and Graphical Commonality Standard.

C. An inspection shall be performed of the integrated rack flight drawings or actual flight hardware to determine that each integrated rack uses no more that one PCS. Verification shall be considered successful when it is shown that no integrated rack uses more than one PCS.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) (PDL Submittal Completed)	1. L-16
2. COC (No changes since L-16)	2. L-11
3. COC (No changes since L-11)	3. L-8
4. COC for the test.	4. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I&D	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-16/L-11/L-8/L-6

Applicable Document(s):
SSP 57000, par. 3.3.8.2
SSP 52052
SSP 50313

Number	Title	Method	Hazard Report(s)
CD-024	C&DH – PORTABLE COMPUTER SYSTEM-STATION SUPPORT COMPUTER	I&D	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.8.3 (A) Station Support Computer (I)
4.3.3.8.3 (B) Station Support Computer (D)

Requirement Summary:

This requirement ensures that Payload Developers who request to use the SSC resources adheres to the software requirements identified in SSP 52052 and has verified that their integrated rack is limited to one shared SSC.

Detailed Descriptions of Requirements:

A. An inspection shall be performed of the Payload Developers integrated rack flight drawings or actual flight hardware to determine that each integrated rack shares no more that one SSC connection. Verification shall be considered successful when it is shown that no integrated rack shares more than one SSC.

B. A demonstration of the station support computer displays, in accordance with the requirements in SSP 50313, shall be performed to the Payload Display Review Panel (PDRP). Verification shall be considered successful when the PDRP accepts the displays and verifies that they meet the requirements identified in SSP 50313, Display and Graphical Commonality Standard.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) (PDL Submittal Completed)	1. L-16
2. COC (No changes since L-16)	2. L-11
3. COC (No changes since L-11)	3. L-8

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I&D	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-16/L-11/L-8

Applicable Document(s):
SSP 57000, par. 3.3.8.3
SSP 50313

Number	Title	Method	Hazard Report(s)
CD-025	C&DH – MULTI-BUS ISOLATION	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.5.2.4 Multi-Bus Isolation (T)

Requirement Summary:

This requirement ensures that the signal isolation between the buses for payloads utilizing multiple ISS Payload MIL-STD-1553B data buses, shall be no less than 58 dB. This requirement does not apply to payload unique buses.

Detailed Descriptions of Requirements:

Verification of the isolation between the various ISS payload MIL-STD-1553B data buses shall be by test if an integrated rack's Payload Bus RT utilizes multiple ISS Payload MIL-STD-1553B data buses. The test shall consist of the measurement of the signal isolation between the multiple ISS Payload Bus Remote Terminal in a RT validation test as defined in MIL-HDBK-1553, Notice 1, Appendix A, RT Validation Test Plan. Verification shall be considered successful when the measurement of the signal isolation between the integrated rack's Payload Bus Remote Terminals multiple ISS Payload MIL-STD-1553B data buses is no less than 58 dB.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC)	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):
SSP 57000, par. 3.3.5.2.4
MIL-HDBK-1553, Appendix A
MIL-STD-1553B

Number	Title	Method	Hazard Report(s)
CD-026	C&DH – REMOTE TERMINAL	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.3.5.2.1.4 Remote Terminal Hardwired Address Coding (T)

Requirement Summary:

This requirement ensures that the integrated rack is designed to read and respond to the hardware remote terminal address coding scheme for the Standard Payload bus, for all ISPR locations defined in Table 3.3.5.2.1.4-1 of SSP 57000.

Detailed Descriptions of Requirements:

Verification of the RT hardwired address coding scheme shall be by test. The test shall be performed with the PRCU or equivalent to detemine that the integrated rack responds to all the assigned proper RT hardwired address for the ISPR locations. The test shall be considered successful if it demonstrates that the integrated rack responds only to the assigned RT hardwired address. Each assigned location shall be tested separately.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) for the test.	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):
SSP 57000, par. 3.3.5.2.1.4 and Table 3.3.5.2.1.4-1.

Number	Title	Method	Hazard Report(s)
FD-001	FLUID DYNAMICS - PHYSICAL INTERFACE	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.4.3.10 Fluid and Gas Line Connectors (A)

Requirement Summary:

Connectors of integrated racks requiring liquid or gas cooling provisions must interface properly, and allowances must be given for access and inspection of the interface components.

Detailed Descriptions of Requirements:

Fluid and gas line connectors that are mated and demated on-orbit shall be verified by analysis. Verification shall be considered successful when an analysis of payload flight hardware drawings shows that fluid and gas connectors that are mated and demated on-orbit are located and configured so that they can be fully inspected for leakage.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 57000, par. 3.12.4.3.10

Number	Title	Method	Hazard Report(s)
FD-002	FLUID DYNAMICS - ITCS FLUID USE AND CHARGING	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.2.A ITCS Fluid Use and Charging (T)
4.3.5.1.2.B ITCS Fluid Use and Charging (A)

Requirement Summary:

These requirements ensure coolant cleanliness, quality, and liquid expansion charge compatibility over the transport temperature range.

Detailed Descriptions of Requirements:

A. ITCS Fluid Use
Testing shall be used to verify that the coolant contained in the integrated rack interfacing with the ITCS coolant system satisfies the TCS coolant verification test requirements as specified in SSP 30573. The verification shall be considered successful when the test results show that the integrated rack coolant meets the TCS coolant requirements as specified in SSP 30573.

B. Integrated Rack Charging

Verification of integrated rack charging shall be by analysis stating that the amount of coolant charged into the Integrated rack allows for thermal expansion during transport. The verification shall be considered successful when the amount of coolant charged into the integrated rack allows for thermal expansion when exposed to the temperature range of 1.67° C (35° F) and 46° C (114.8° F).

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 30573
SSP 57000, par. 3.5.1.2

Number	Title	Method	Hazard Report(s)
FD-003	FLUID DYNAMICS - ITCS PRESSURE DROP	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.3.1 (A-B) On-Orbit Interface (T)
4.3.5.1.3.2 MPLM Interface (T)

Requirement Summary:

Coolant pressure differential must be compatible with ITCS interface requirements across the flight flowrate range.

Detailed Descriptions of Requirements:

1. On-Orbit Interfaces: Verification of the pressure differential measured across the ITCS supply and return interfaces for the flow rates in the range to be used in flight shall be by test with both halves of each mated QD pair included as part of the payload pressure differential. A figure with a curve of flow rate versus pressure drop will be generated for each flow configuration and mode of operation. This curve will show the pressure drop versus flow rate when flow controllers using closed loop control are fully open such that the closed loop control is inactive. The verification shall be considered successful if the test results are within the values specified in the Unique Payload Hardware ICD.

   Verification that either 1) the pressure drop across the interface is 5.8 ± 0.2 psid (40 ± 1.4 kPa) at any of the operational flow rates of the rack, or 2) the integrated rack can control the operational flow rate at a constant flow rate given that the pressure differential at the interface is 5.8 ± 0.2 psid (40 ± 1.4 kPa), shall be by test with both halves of each mated QD pair included as part of the payload pressure differential. A figure with a curve of flow rate versus pressure drop will show the range of flow rates compatible with a pressure drop of 5.8 ± 0.2 psid (40 ± 1.4 kPa). The verification shall be considered successful when the test confirms that the payload maintains proper flow rates when the interface pressure is controlled at 5.8 ± 0.2 psid (40 ± 1.4 kPa).

2. MPLM Interfaces: Verification of the pressure differential measured across the ITCS supply and return interfaces for the flow rate to be used in flight shall be by test with both halves of each mated QD pair included as part of the payload pressure differential and the equivalent of two halves of the QDs subtracted from the value. The verification shall be considered successful if the test results are within the value specified in the unique payload hardware ICD.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing pressure differentials (in psid) vs. flow rate results (in lbm per hour).	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: If a new or different subrack PL is installed as a replacement, a revised integrated rack pressure drop analysis is to be performed.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Data Cert providing pressure differentials (in psid) vs. flow rate results (in lbm per hour).	II. L-12

Applicable Document(s):

SSP 57000, par. 3.5.1.3.1 and 3.5.1.3.2
SSP 57200 Hardware ICD Series Document

Number	Title	Method	Hazard Report(s)
FD-004	FLUID DYNAMICS - COOLANT FLOW RATE	A or T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.4 (A-B) Coolant Flow Rate (A or T)

Requirement Summary:

Integrated rack coolant flow rates must be compatible with the low and/or moderate temperature loop capabilities for all flight modes.

Detailed Descriptions of Requirements:

Verification of compatibility with the design flow rate, as specified in the Unique Payload Hardware ICD, shall be by analysis or by test using the PRCU, or equivalent test equipment. The payload developer shall provide the flow rate for several flow configurations that bound the operating envelope. The verification shall be considered successful when the analysis or test results show that the integrated rack flow rate for all modes of operation are at or below the coolant flow rate limits as specified in the Unique Payload Hardware ICD.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing power data (in kW) and flow rate (in lbm per hour) for each mode of operation in tabular form. (Can be combined with Table required for FD-005, “Coolant Return Temperature”.)	1. L-12

Description of Reverification Requirements:	Reverification Method: A	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Analysis showing that the integrated rack flow rates for all modes of operation meets the requirement identified above in the “Detailed Descriptions of Requirements”.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.5.1.4
SSP 57200 Hardware ICD Series Document

Number	Title	Method	Hazard Report(s)
FD-005	FLUID DYNAMICS - COOLANT RETURN TEMPERATURE	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.5.1.6.A Coolant Return Temperature (A&T)
4.3.5.1.6.B Coolant Return Temperature (A)
4.3.5.1.6.C Coolant Return Temperature (A&T)
4.3.5.1.6.D Coolant Return Temperature (A&T)

Requirement Summary:
Integrated rack return temperature must be compatible with the low and/or moderate temperature loop limits for all flight modes.

Detailed Descriptions of Requirements:

A. Verification the initial configuration integrated rack moderate differential return temperature is above the minimum allowable shall be verified by test and analysis. The test shall utilize a PRCU, or equivalent to measure the differential temperature for the minimum, maximum, and nominal power modes of the integrated rack. Analysis shall be used to account for any on-orbit modifications of equipment, using a thermal model adjusted with the results from the integrated rack return temperature testing, to verify that the changes in equipment satisfy the minimum differential temperature. The verification shall be considered successful when the initial test and subsequent analysis show that the moderate differential return temperature is above the minimum allowable.
B. Verification that the integrated rack using moderate temperature coolant is designed to operate using 100 lbm/hr flow during modes of operation which require less than 1025 watts of power shall be verified by analysis. The verification shall be considered successful when the analysis shows that the integrated rack using moderate temperature coolant is designed to operate using 100 lbm/hr flow during operating modes which require less than 1025 watts of power.
C. Verification the initial configuration integrated rack moderate TCS return temperature does not exceed the maximum specified temperature shall be verified by test and analysis. The test shall utilize a PRCU, or equivalent to measure the outlet temperature for the maximum and nominal power modes of the integrated rack. Analysis shall be used to account for any on-orbit modifications of equipment, using a thermal model adjusted with the results from the integrated rack return temperature testing, to verify that the changes in equipment do not exceed the allowable return temperature. The verification shall be considered successful when the initial test and subsequent analysis show that the moderate temperature return limit is not exceeded.
D. Verification the initial configuration integrated rack low TCS return temperature does not exceed the maximum specified temperature shall be verified by test and analysis. The test shall utilize a PRCU, or equivalent to measure the outlet temperature for the maximum and nominal power modes of the integrated rack. Analysis shall be used to account for any on-orbit modifications of equipment, using a thermal model adjusted with the results from the integrated rack return temperature testing, to verify that the changes in equipment do not exceed the allowable return temperature. The verification shall be considered successful when the initial testing and subsequent analysis show that the low temperature return limit is not exceeded.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing return coolant temperature (in °F) and power draw (in kW) for each mode of operation in tabular form. (Can be combined with Table required for FD-004, "Coolant Flow Rate".)	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Analysis showing that the integrated rack coolant return temperatures meets the requirement stated above in the "Detailed Descriptions of Requirements".

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.5.1.6

Number	Title	Method	Hazard Report(s)
FD-006	FLUID DYNAMICS - COOLANT LOOP LEAKAGE	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.9.A Leakage (T)
4.3.5.1.9.B Leakage (T)

Requirement Summary:

Fluid leakage of integrated rack coolant loop hardware at maximum design pressure must be below a specified limit.

Detailed Descriptions of Requirements:

A. Integrated Rack. Testing shall be used to verify that each ITCS fluid loop, including all payload equipment and connections as well as the supply and return interfaces and connections at the utility interface panel does not exceed the leakage requirement. The leakage test shall be performed at MDP or above as specified in SSP 57001, paragraph 3.5.1.5.1. If helium or some other medium is used in testing, the results shall be converted to an equivalent water leakage in scc per hour. The verification shall be considered successful if the test results show the integrated rack leakage rate to be equal to or less than 14 X 10^{-3} scc/hr of liquid for each thermal loop at the MDP of 121 psia (834 kPa). NOTE: A conversion factor of 1 cc/hr of water = 233scc/hr of helium at a pressure of 121 psia shall be used when converting helium leakage to an equivalent water leakage.

B. Racks Operating Within the MPLM. Testing shall be used to verify that all payload equipment and connections as well as the supply and return interfaces and connections at the utility interface panel of the MPLM do not exceed the leakage requirement. The leakage test shall be performed at MDP or above as specified in SSP 57001, paragraph 3.5.1.5.1. The verification shall be considered successful when the test results show the integrated rack leakage rate to be equal to or less than 9 X 10^{-3} scc/hr of liquid for 72 hours when exposed ot 100% Freon-21 in the water lines at the MDP of 210 psia (1,448 kPa). NOTE: A conversion factor of 1 cc/hr of water = 386scc/hr of helium at a pressure of 210 psia shall be used when converting helium leakage to an equivalent water leakage.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing leakage test results (in scc per hour).	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Analysis calculating leakage of the integrated rack.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Analysis showing maximum leakage rate for the integrated rack (in scc per hour). (Recommend testing the subrack component and using the test data in the analysis)	II. L-12

Applicable Document(s):

SSP 57000, par. 3.5.1.9
SSP 57001, par. 3.5.1.5.1

Number	Title	Method	Hazard Report(s)
FD-007	FLUID DYNAMICS - QUICK-DISCONNECT AIR INCLUSION	A or T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.10 Quick-Disconnect Air Inclusion (A or T)

Requirement Summary:

Payload quick-disconnect (QD) air inclusion must be below a specified limit during coupling and decoupling.

Detailed Descriptions of Requirements:

Verification that air inclusion into the QD during coupling and uncoupling does not exceed 0.3 cc per couple/uncouple cycle shall be by test or analysis of QD certification data. If air is not used in testing of the QD, the results shall be converted to an equivalent volume of air. The verification shall be considered successful when the test results show that the integrated rack QD air inclusion does not exceed 0.3 cc per couple/uncouple cycle.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC)	1. L-6

Description of Reverification Requirements:	Reverification Method: N/A	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 57000, par. 3.5.1.10

Number	Title	Method	Hazard Report(s)
FD-008	FLUID DYNAMICS - CABIN AIR HEAT LEAK	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.12 Cabin Air Heat Leak (A)

Requirement Summary:

Integrated rack cabin air heat leak must not exceed specific limits.

Detailed Descriptions of Requirements:

Analysis shall be used to verify that the cabin air heat leak does not exceed the limits as specified in the Unique Payload Hardware ICD. The verification shall be considered successful if the analysis results show that the integrated rack does not exceed the cabin air heat leak limits.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing integrated rack-to-cabin heat leak analysis results. (The analysis should include all PD-provided ancillary equipment.)	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.5.1.12
SSP 57200 Hardware ICD Series Document

Number	Title	Method	Hazard Report(s)
FD-009	FLUID DYNAMICS -MPLM CABIN AIR COOLING	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.13 MPLM Cabin Air Cooling (A)

Requirement Summary:

MPLM Cabin air heat load absorbed as a result of integrated-rack operation must not exceed specific limits.

Detailed Descriptions of Requirements:

Verification that the MPLM cabin air heat load absorbed by the integrated racks in the MPLM does not exceed the limits specified in paragraph 3.5.1.13 of SSP 57000 shall be by analysis. The verification shall be considered successful when the analysis results show that the integrated racks do not exceed the cabin air heat load absorption limit.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing analysis results (in watts) that the cabin air cooling (heat absorbed) of the integrated rack is within limits.	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.5.1.13
SSP 57200 Hardware ICD Series Document

Number	Title	Method	Hazard Report(s)
FD-010	FLUID DYNAMICS - SIMULTANEOUS COOLING	A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.14.A Simultaneous Cooling (A)
4.3.5.1.14.B Simultaneous Cooling (I)

Requirement Summary:

Simultaneous cooling requirements for an integrated rack include thermal design, auto shut-off capability, flowmeter, outlet temperature sensor implementation and physical isolation between the two ITCS loops.

Detailed Descriptions of Requirements:

A. Verification of simultaneous flow requirements shall be by analysis. The verification shall be considered successful when the analysis results show that the integrated rack meets the interface requirements for simultaneous flow as specified in SSP 57001, paragraph 3.5.1.5.

B. Verification that the moderate- and low-temperature loop coolant does not mix together shall be verified by inspecting the engineering drawings. The verification shall be considered successful when the inspection shows that the integrated rack thermal systems do not mix.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: A test of the subrack payload will be required along with an analysis of the integrated rack for the new configuration.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-6

Applicable Document(s):

SSP 57000, par. 3.5.1.14
SSP 57001, par. 3.5.1.6

Number	Title	Method	Hazard Report(s)
FD-011	FLUID DYNAMICS - CONTROL SYSTEM TIME CONSTANT	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.15 Control System Time Constant (T)

Requirement Summary:

The integrated rack time constant (time interval per flow rate change) must be of a specified minimum duration.

Detailed Descriptions of Requirements:

Verification that the payload control system time constant is of the specified duration shall be by test. The verification shall be considered successful when it can be shown that it meets the time requirement specified in SSP 57000, paragraph 3.5.1.15 to reach 63.2% (i.e., 1-e-1) of the commanded change in flow rate when the flow rate change is greater than 5 lbm/hr.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Test per the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.5.1.15

Number	Title	Method	Hazard Report(s)
FD-012	FLUID DYNAMICS - PAYLOAD COOLANT QUANTITY	A or T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.16 Payload Coolant Quantity (A or T)

Requirement Summary:

The quantity of internal-loop coolant in the Integrated rack must be within allowable limits.

Detailed Descriptions of Requirements:

Verification that the maximum allowable payload coolant quantity is not exceeded shall be by test of the hardware or analysis of the payload design drawings. The verification shall be considered successful when the test or analysis results show the integrated rack coolant quantity to be within the values as specified in the Unique Payload Hardware ICD.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing integrated rack coolant quantity (in liters normalized to the 16.1°C (61°F) reference temperature as provided in the Unique Payload Hardware ICD).	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Analysis per the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.5.1.16
SSP 57200 Hardware ICD Series Document

Number	Title	Method	Hazard Report(s)
FD-013	FLUID DYNAMICS - PAYLOAD GAS INCLUSION	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.17 Payload Gas Inclusion (A)

Requirement Summary:

The volume of gas included in the internal coolant of the Integrated rack must be within allowable limits.

Detailed Descriptions of Requirements:

Verification that the maximum allowable payload gas inclusion or volume limit is not exceeded shall be by analysis of the payload design drawings (i.e., QDs). The verification shall be considered successful when the analysis shows the integrated rack gas inclusion amount to be within the amount as specified in the Unique Payload Hardware ICD.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.5.1.17
SSP 57200 Hardware ICD Series Document

Number	Title	Method	Hazard Report(s)
FD-015	FLUID DYNAMICS - VES INPUT PRESSURE LIMIT	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.6.1.2.A Input Pressure Limit (T)
4.3.6.1.2.B Input Pressure Limit (A&T)
4.3.6.1.2.C Input Pressure Limit (A)

Requirement Summary:

The integrated rack vacuum interface must be able to withstand a specified maximum pressure at the VES mechanical connection. The integrated rack shall also be two failures tolerant to protect against failure conditions that would exceed VES/WGS maximum design pressure of 40 psia.

Detailed Descriptions of Requirements:

The integrated rack and/or connected rack volumes shall be able to withstand a maximum pressure of 40 psia as specified in SSP 57000, paragraph 3.6.1.2 and SSP 57001, paragraph 3.6.1.B.

A. Integrated rack vented gas pressure shall be verified by test. The test shall utilize a PRCU, or equivalent, to measure the vented gas pressure at the interface plane. The integrated rack volumes that are connected to VES shall be pressurized to the expected experiment pressures for the test. (Since the PRCU does not provide positive pressures, the integrated rack volumes that are connected to the VES shall be pre-pressurized to the expected experiment pressure for the test.)

B. The MDP of integrated rack volumes connected to the VES/WGS shall be verified by the test and analysis guidelines as specified in SSP 52005, paragraph 5.1.3. (Note: The PRCU does not proof-test.)

C. An analysis shall determine whether or not the payload system (including the experiment chamber) connected to the ISS VES/WGS provides a two fault tolerant design to prevent venting gases at pressures greater than 276 kPa (40 psia) at the rack to station interface. Verification shall be considered successful when the analysis shows the payload system provides a two fault tolerant design to prevent venting gases to the ISS VES/WGS at pressures greater than 276 kPa (40 psia) at the rack to station interface.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 52005, par. 5.1.3
SSP 57000, par. 3.6.1.2
SSP 57001, par. 3.6.1

Number	Title	Method	Hazard Report(s)
FD-016	FLUID DYNAMICS - VES INPUT TEMPERATURE LIMIT	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.6.1.3 Input Temperature Limit (T)

Requirement Summary:

The temperature of the integrated-rack vacuum exhaust mechanical interface must be below a specified limit.

Detailed Descriptions of Requirements:

Integrated rack vent exhaust temperature shall not exceed limits as specified in SSP 57000, paragraph 3.6.1.3 and will be verified by test. The test shall utilize a PRCU, or equivalent, to measure the initial temperature at the interface plane. The integrated rack volumes that are connected to VES shall be pressurized to the expected pressures for the test. The experiment shall be subjected to the same heat generating operations that will be experienced on–orbit and vented at the same relative time during the experiment operation as would be experienced on–orbit.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: A test of the subrack payload will be required along with an analysis of the integrated rack with the new configuration.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.6.1.3

Number	Title	Method	Hazard Report(s)
FD-017	FLUID DYNAMICS - VES INPUT DEWPOINT LIMIT	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.6.1.4 Input Dewpoint Limit (T)

Requirement Summary:

The dewpoint of the integrated-rack vacuum exhaust mechanical interface must be below a specified limit.

Detailed Descriptions of Requirements:

Integrated rack vent exhaust dewpoint temperature shall not exceed the limits as specified in SSP 57000, paragraph 3.6.1.4 and will be verified by test. The test shall utilize a PRCU, or equivalent, to measure the initial dewpoint at the interface plane. The integrated rack volumes that are connected to VES shall be pressurized to the expected pressures for the test. The experiment shall be subjected to the same operations that will be experienced on–orbit and vented at the same relative time during the experiment operation as would be experienced on–orbit.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: A test of the subrack payload will be required along with an analysis of the integrated rack for the new configuration.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.6.1.4

Number	Title	Method	Hazard Report(s)
FD-018	FLUID DYNAMICS - VES ACCEPTABLE EXHAUST GASES	A or A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.6.1.5.A Acceptable Exhaust Gases (A or T)
4.3.6.1.5.B Acceptable Exhaust Gases (A)
4.3.6.1.5.C Acceptable Exhaust Gases (A)
4.3.6.1.5.D Acceptable Exhaust Gases (A)

Requirement Summary:

The integrated rack's vented constituents must be compatible with wetted materials of the module VES, and there must be no explosive gas potential.

Detailed Descriptions of Requirements:

A. Verification that exhaust gases vented into the Vacuum Exhaust System/Waste Gas System (VES/WGS) of the USL, APM, and JEM are compatible with the wetted surface materials of the respective laboratory(ies) in which the integrated rack will operate shall be by analysis or test. Gases documented in Appendix D of SSP 57000 have been analyzed for compatibility with the ISS VES/WBS wetted materials. The integrated rack provider shall submit a complete list of all proposed vent gas constituents, initial volume, concentration, temperature, and pressure to the ISS program. The list submitted shall also identify which exhaust gases will be vented together and shall include the products of any reactions determined in paragraph 3.6.1.5.B of SSP 57000. The ISS module integrator will analyze the list of vent gases not specified in Appendix D of SSP 57000 and the VES/WGS wetted surface materials to determine whether or not the proposed exhaust gases are compatible with the ISS VES/WGS wetted materials. The ISS Program will evaluate and conduct a test, if necessary, for gases that do not have compatibility documentation to determine whether or not the proposed exhaust gases are compatible with the VES/WGS wetted surface. The payload developer shall review the integrated racks proposed vent gases and determine whether or not the gases are listed as acceptable in Appendix of SSP 57000 or on the report provided by the program in the stage. Verification shall be considered successful when the proposed exhaust gases are shown to be compatible with the ISS VES/WGS wetted surface materials of the respective laboratory (ies) in which the integrated rack will operate as specified in Appendix D or in the analysis report from ISS program. The verification process performed by the ISS program is documented in SSP 57011, Figure 3.4.11-9.

NOTE: This analysis/test will consider flammability, pitting and general corrosion, and degradation and swelling of seal materials. An analysis will consist of a literature search that will review technical documentation for documented compatibility of exhaust gases with the wetted materials listed in SSP 41002, paragraph 3.3.7.2. Materials and gases will be considered compatible if the documentation shows one of the following: existing use of the material in a system containing the gas in question, test data showing compatibility or general materials information stating compatibility. For exhaust gases where no technical data showing compatibility is found, a test will be conducted. The test will review material weight loss, wetted material surface changes, soft material swelling and wetted material trace contaminate inclusion in the test gases after exposure to the materials.

B. Verification that integrated rack gases vented to the ISS VES/WGS are non-reactive with other vent gas mixture constituents shall be by analysis. An analysis shall determine what gases will be vented to the ISS VES/WGS and, assuming the worst case reactions possible, shall determine all reactions that are possible among the vent gas constituents. An analysis shall calculate the worst case temperature change associated with the possible vent gas reactions in accordance with the equation documented in paragraph 4.3.6.1.5.B of SSP 57000. Verification shall be considered successful when the analysis shows the gases vented to the ISS VES/WGS are non-reactive according to the equation specified in paragraph 4.3.6.1.5.B of SSP 57000.

C. Verification that integrated racks venting to the ISS VES/WGS provide a means of removing gases that should adhere to the VES/WGS tubing walls at a wall temperature of 4°C (40°F) and a pressure of 10^{-3} torr shall be by analysis. An analysis shall determine whether or not the gas mixture contains gases with a molecular weight greater than 75 amu or gases which have a boiling greater than 100°C (212°F) at atmospheric pressure.

Each proposed vent gas with a molecular weight greater than 75 amu or boiling point greater than 100°C (212°F) at

Number	Title	Method	Hazard Report(s)
FD-018	FLUID DYNAMICS - VES ACCEPTABLE EXHAUST GASES	A or A&T	

atmospheric pressure shall be analyzed to determine whether or not the vapor pressure is below a pressure of 10^{-3} torr at 4°C (40°F). This analysis shall be conducted gas-by-gas. If any proposed vent gases are determined to have a vapor pressure below 10^{-3} torr at 4°C (40°F), an analysis shall be conducted to determine whether or not the integrated rack provides a means to remove these gases from the vent gas mixture prior to venting to the ISS VES/WGS.

Verification shall be considered successful when the analysis shows the gases that will be exposed to the ISS VES/WGS will not adhere to the ISS VES/WGS tubing walls at a wall temperature of 4°C (40°F) at 10^{-3} torr. Gases that will be exposed to the ISS VES/WGS will not adhere to the ISS VES/WGS tubing walls when each vent gas is shown to have a vapor pressure above 10^{-3} torr at 4°C (40°F) or a boiling temperature below 4°C (40°F) at a pressure of 10^{-3} torr and/or, any gases found with a vapor pressure below 10^{-3} torr at 4°C (40°F) or a boiling temperature above 4°C (40°F) at a pressure of 10^{-3} torr are removed from the gas mixture.

D. Verification that integrated racks venting to the ISS VES/WGS remove particulates from vent gases that are larger than 100 micrometers shall be by analysis. An analysis shall determine whether or not the vent gases will contain particulate contamination larger than 100 microns. Should the analysis show that particulate contamination greater than 100 microns will be introduced into, or generate in, the vent gases, an analysis shall determine whether or not a means of removing the particles above 100 microns before venting to the ISS VES/WGS is included in the integrated rack design. Verification shall be considered successful when the analysis shows the vent gases will not contain particulate contamination greater than 100 microns.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing constituents of vented gas, volume, concentration, temperature, and pressure.	1. L-20
2. Data Cert providing updated constituents of vented gases, volume, concentration, temperature, and pressure (if required).	2. L-12
3. Data Cert showing the integrated rack gases vented to the ISS VES/WGS are non-reactive with other vent gas mixture constituents for item B.	3. L-12
4. Data Cert. for Item C, showing that integrated racks venting in the ISS VES/WGS provide a means to remove gases that should adhere to the VES/WGS tubing walls.	4. L-12
5. Data Cert. for Item D, showing that all particulates larger than 100 micrometers are removed prior to venting to the VES/WGS.	5. L-12

Description of Reverification Requirements:	Reverification Method: A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: A test of the subrack payload will be required along with an analysis of the integrated rack for the new configuration.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Certificate of Compliance (COC)	II. L-6

Applicable Document(s):

SSP 57000, par. 3.6.1.5

Number	Title	Method	Hazard Report(s)
FD-019	FLUID DYNAMICS - EXTERNAL CONTAMINATION CONTROL	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.6.1.5.2 External Contamination Control (A)

Requirement Summary:

Vented constituents must not exceed the specified external contamination limits.

Detailed Descriptions of Requirements:

Verification shall be by analysis. The integrated rack provider shall submit the list of vented gas constituents, mass, temperature, concentration, maximum particulate size, maximum flow rate (if DD controls the flow rate), and pressure to the ISS program.

The verification shall be considered successful when the External Contamination Team verifies that the vented gases do not exceed the external contamination limits as specified in SSP 30426, paragraph 3.4.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing the required list of vented gas characteristics (vented gas constituents, mass, temperature, concentration, maximum particulate size, maximum flow rate, and pressure). Note: Provide maximum mass flow rate of the exhaust venting system at the rack interface if the Payload Developer designer controls the flow rate.	1. L-20
2. Updated Data Cert (if required).	2. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: An analysis of the integrated rack for the new configuration will be performed.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. CData Certification.	II. L-6

Applicable Document(s):

SSP 30426 par. 3.4
SSP 57000 par. 3.6.1.5.2

Number	Title	Method	Hazard Report(s)
FD-020	FLUID DYNAMICS - INCOMPATIBLE GASES	A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.6.1.5.3 (A-B) Incompatible Gases (A&I)

Requirement Summary:

The methods and hardware utilized for incompatible gas containment, storage, and transport must satisfy certain criteria.

Detailed Descriptions of Requirements:

Verification shall be by inspection and analysis. The inspection shall consist of verification that gas containment volume is provided for incompatible gases to SSP 57000, paragraph 3.6.1.5.3. The analysis shall verify that the containment volume is sufficient to contain the gas and complies with the pressure vessel requirements as specified in SSP 52005, paragraph 5.1.3. The method of transportation of containment volume from on–orbit to ground shall be identified.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC). Note: This requirement can be satisfied when ST-010, “Pressurized Systems”, is completed.	1. L-6

Description of Reverification Requirements:	Reverification Method: A&I	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: A inspection of the subrack payload will be required along with an analysis of the integrated rack for the new configuration.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 52005, par. 5.1.3
SSP 57000, par. 3.6.1.5.3

Number	Title	Method	Hazard Report(s)
FD-022	FLUID DYNAMICS – VRS/VVS INPUT PRESSURE LIMIT	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.6.2.2 A Input Pressure Limit (T)
4.3.6.2.2 B Input Pressure Limit (T&A)
4.3.6.2.2 C Input Pressure Limit (A)

Requirement Summary:

The interface pressure from the integrated rack to VRS/VVS must not exceed specific limits.

Detailed Descriptions of Requirements:

A. Verify by test that the interface pressure from the integrated rack to VRS/VVS will not exceed 10^{-3} Torr at the interface plane as specified in SSP 57000, paragraph 3.6.2.2.
Note: PRCU, or equivalent, will be able to monitor VRS throughput. The integrated rack volumes that are connected to ISS VRS/VVS shall be pressurized to the expected experiment pressures for the test.

B. The Maximum Design Pressure MDP of the integrated rack volumes connected to the VRS/VVS shall be verified by the test and analysis guidelines identified in SSP 52005, paragraph 5.1.3.

C. An analysis shall determine whether or not the payload system (including the experiment chamber) connected to the ISS VRS/VVS system provides a two fault tolerant design to prevent venting gases at pressures greater than 276 kPa (40 psia) at the rack to station interface. Verification shall be considered successful when the analysis shows the payload system provides a two fault tolerant design to prevent venting gases to the ISS VRS/VVS system at pressures greater than 276 kPa (40 psia) at the rack to station interface.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: N/A	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 52005, par. 5.1.3
SSP 57000, par. 3.6.2.2

Number	Title	Method	Hazard Report(s)
FD-023	FLUID DYNAMICS - VRS THROUGH-PUT LIMIT	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.6.2.3 VRS Through-Put Limit (T)

Requirement Summary:

Throughput pressure at the VRS/VVS mechanical connection must be within specified limits.

Detailed Descriptions of Requirements:

Testing shall be used to verify that the throughput to the VRS/VVS interface shall be limited to 1.2 X 10^{-3} Torr liters/second as specified in SSP 57001, paragraph 3.6.2.B. The test shall utilize a PRCU, or equivalent, to measure the vented gas throughput at the interface plane.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 57000, par. 3.6.2.3
SSP 57001, par. 3.6.2B

Number	Title	Method	Hazard Report(s)
FD-024	FLUID DYNAMICS - PRESSURIZED GASES INTERFACE CONTROL (NITROGEN, ARGON, CO_2, & HELIUM)	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.7.1.1 Nitrogen Interface Control (T)
4.3.7.2.1 Argon Interface Control (T)
4.3.7.3.1 Carbon Dioxide Interface Control (T)
4.3.7.4.1 Helium Interface Control (T)

Requirement Summary:

The integrated rack must be capable of controlling the flow of pressurized nitrogen, argon, carbon dioxide, and/or helium gas supply systems when connected to those systems.

Detailed Descriptions of Requirements:

Verification of gaseous flow control shall be by test. The verification shall be considered successful when the test results confirm that the integrated rack can turn the flow of gas on and off and can maintain the gas flows below the pressurants maximum flow rate. The maximum allowable flow rate is applicable over the pressurants operating range. Pressurants include one or more of the following:

- nitrogen (to requirements in accordance with SSP 57000, paragraph 3.7.1.1) (The PRCU, or equivalent, can be used for nitrogen testing.)
- argon (to requirements in accordance with SSP 57000, paragraph 3.7.2.1)
- carbon dioxide (to requirements in accordance with SSP 57000, paragraph 3.7.3.1)
- helium (to requirements in accordance with SSP 57000, paragraph 3.7.4.1)

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above if the flow rate control is contained in the subrack component.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.7.1.1, 3.7.2.1, 3.7.3.1, and 3.7.4.1

Number	Title	Method	Hazard Report(s)
FD-025	FLUID DYNAMICS - PRESSURIZED GASES INTERFACE MDP (NITROGEN, ARGON, CO_2, & HELIUM)	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.7.1.2 Nitrogen Interface Pressure (A&T)
4.3.7.2.2 Argon Interface MDP (A&T)
4.3.7.3.2 Carbon Dioxide Interface Pressure (A&T)
4.3.7.4.2 Helium Interface MDP (A&T)

Requirement Summary:

The Maximum Design Pressure (MDP) of integrated rack hardware connected to pressurized nitrogen, argon, carbon dioxide, and/or helium gas supply systems must comply with pressure requirements.

Detailed Descriptions of Requirements:

The MDP of integrated rack volumes connected to the gaseous supply systems shall be verified by the test and analysis guidelines as specified in SSP 52005, paragraph 5.1.3, and verification item ST-010, “Pressurized Systems”. The MDP of any hardware interfacing with referenced pressurant systems shall be 1,379 kPa (200 psia). Pressurants include one or more of the following:
- nitrogen (to requirements in accordance with SSP 57000, paragraph 3.7.1.2)
- argon (to requirements in accordance with SSP 57000, paragraph 3.7.2.2)
- carbon dioxide (to requirements in accordance with SSP 57000, paragraph 3.7.3.2)
- helium (to requirements in accordance with SSP 57000, paragraph 3.7.4.2)

Note: Verification activities identified in this VDS may be carried out in ST-010, “Pressurized Systems”, activities and visa versa.

Required Verification Data:	Data Submittal Dates:
1. Data Cert per ST-010, “Pressurized Systems”.	1. L-20
2. Data Cert per ST-010, “Pressurized Systems”.	2. L-12

Description of Reverification Requirements:	Reverification Method: A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above if the subrack component hooks up to the nitrogen supply.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above if the new or reflight subrack component hooks up to any pressurized gas supply such as nitrogen, argon, CO_2, and helium.	II. Same as the original submittal dates

Applicable Document(s):

SSP 52005, par. 5.1.3
SSP 57000, par. 3.7.1.2, 3.7.2.2, 3.7.3.2, and 3.7.4.2

Number	Title	Method	Hazard Report(s)
FD-026	FLUID DYNAMICS - PRESSURIZED GASES INTERFACE TEMPERATURE (NITROGEN, ARGON, CO_2, & HELIUM)	A or T or A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.7.1.3 Nitrogen Interface Temp (A or T or A&T)
4.3.7.2.3 Argon Interface Temp (A or T or A&T)
4.3.7.3.3 Carbon Dioxide Interface Temp (A or T or A&T)
4.3.7.4.3 Helium Interface Temp (A or T or A&T)

Requirement Summary:

The integrated rack hardware connected to pressurized nitrogen, argon, carbon dioxide, and/or helium gas supply systems must comply with supply-temperature range requirements.

Detailed Descriptions of Requirements:

Verification that the integrated rack gas pressurant system is compatible with the gaseous supply systems interface temperature range shall be by test or analysis or both. The verification shall be considered successful when analysis of the gas system components, including component qualification data packs or test results, show that the integrated rack system is compatible with the gaseous supply systems temperature range specified. Pressurants include one or more of the following:
- nitrogen (to requirements in accordance with SSP 57000, paragraph 3.7.1.3)
- argon (to requirements in accordance with SSP 57000, paragraph 3.7.2.3)
- carbon dioxide (to requirements in accordance with SSP 57000, paragraph 3.7.3.3)
- helium (to requirements in accordance with SSP 57000, paragraph 3.7.4.3)

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or T or A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.7.1.3, 3.7.2.3, 3.7.3.3, and 3.7.4.3

Number	Title	Method	Hazard Report(s)
FD-027	FLUID DYNAMICS - PRESSURIZED GASES LEAKAGE (NITROGEN, ARGON, CO_2, & HELIUM)	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.7.1.4 Nitrogen Leakage (T)
4.3.7.2.4 Argon Leakage (T)
4.3.7.3.4 Carbon Dioxide Leakage (T)
4.3.7.4.4 Helium Leakage (T)

Requirement Summary:

When connected to the pressurized nitrogen, argon, carbon dioxide, and/or helium gas supply systems, fluid leakage at the MDP of the integrated rack hardware must be less than allowable limits.

Detailed Descriptions of Requirements:

Verification of integrated rack gaseous leakage shall be by test. The verification shall be considered successful when the test results show that the sum of all potential leakage sources from the standoff UIP panel connection to the point of pressurized nitrogen, argon, carbon dioxide, and/or helium gas flow control in the integrated rack does not exceed the allowable leakage rate at MDP. Pressurants include one or more of the following:
- nitrogen (to requirements in accordance with SSP 57000, paragraph 3.7.1.4)
- argon (to requirements in accordance with SSP 57000, paragraph 3.7.2.4)
- carbon dioxide (to requirements in accordance with SSP 57000, paragraph 3.7.3.4)
- helium (to requirements in accordance with SSP 57000, paragraph 3.7.4.4)

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing leakage test results in units of each gas used (in scc per sec.). If a representative gas is used to determine leakage (i.e. helium), conversion factors used for the subject gas are to be provided.	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.7.1.4, 3.7.2.4, 3.7.3.4, and 3.7.4.4

Number	Title	Method	Hazard Report(s)
FD-028	FLUID DYNAMICS - PRESSURIZED GAS SYSTEMS	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.7.5 Pressurized Gas Systems (A)

Requirement Summary:

The maximum leak rate of pressurized gas bottles transported in the MPLM must not exceed the specified limit.

Detailed Descriptions of Requirements:

Verification of the expanded volume and flow rate for pressurized gas systems shall be by analysis. The verification shall be considered successful when the analysis of the drawing's show that the expanded volume of the gas in the pressurized system is below the limiting volume specified in SSP 57000 paragraph 3.7.5. If the volume exceeds the limiting volume, then an analysis must be performed verifying that the flow rate after a single failure does not exceed the maximum allowable amount after release of the limiting expanded volume as defined in SSP 57000, paragraph 3.7.5.

Required Verification Data:	Data Submittal Dates:
1. Data Cert providing maximum credible leak rate (in slpm) for each bottle.	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: If a replacement bottle, of a different design, is transported in the MPLM, a new analysis must be performed.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.7.5

Number	Title	Method	Hazard Report(s)
FD-029	FLUID DYNAMICS - POTABLE WATER INTERFACE PRESSURE	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.8.1.2 Potable Water Interface Pressure (T)

Requirement Summary:

Potable water containers and interfacing hardware must not leak over the specified system pressure range.

Detailed Descriptions of Requirements:

Testing shall be used to verify that the payload–provided container or series of containers (same design), and all hoses, tubing, and connectors used with the ISS potable water interface, do not leak when exposed to the ISS potable water interface pressure. The verification shall be considered successful when the test shows that the container, and all hoses, tubing, and connectors used with the ISS potable water interface, do not visibly leak liquid water when pressurized to the maximum water pressure as specified in SSP 57000, paragraph 3.8.1.2.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.8.1.2

Number	Title	Method	Hazard Report(s)
FD-030	FLUID DYNAMICS - POTABLE WATER USE	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.8.1.3.A Potable Water Use (A)
4.3.8.1.3.B Potable Water Use (A)

Requirement Summary:

The integrated rack must not exceed its allocated water use (excluding contributions from humidity).

Detailed Descriptions of Requirements:

A. Verification that the integrated rack use of water from the ISS water system that is not returned to the cabin air as humidity does not exceed the specified amount shall be by analysis. The verification shall be successful when the analysis shows that the total use of water that is not returned to the cabin air as humidity does not exceed the limitation as specified in SSP 57000, paragraph 3.8.1.3.A.

B. Verification of the integrated rack total water use from the ISS water system shall be by analysis. The verification shall be successful when the analysis shows that the total use of water (including contributions from humidity) does not exceed the limitation as specified in SSP 57000, paragraph 3.8.1.3.B.

Required Verification Data:	Data Submittal Dates:
1. Preliminary Data Cert providing integrated rack water consumption analysis summary.	1. L-20
2. Final Data Cert providing integrated rack water consumption analysis summary.	2. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: A test of the subrack payload will be required along with an analysis of the integrated rack for the new configuration.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.8.1.3

Number	Title	Method	Hazard Report(s)
FD-031	FLUID DYNAMICS - FAIL SAFE LOSS OF COOLING	A or A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.8 Fail Safe Design (A or A&T)

Requirement Summary:

Integrated rack hardware must fail safe in the case of loss of cooling for all operational modes.

Detailed Descriptions of Requirements:

Analysis shall be used to verify that payload equipment and rack internal water loop piping utilizing ISS or payload–provided heat rejection system(s) is fail safe in the case of loss of cooling under all modes of operation and will not result in over–temperature, over–pressurization, fire, explosion, release of hazardous or toxic materials, or damage that could propagate to other systems. Testing shall be used to verify that the shutdown controls operate properly in cases where loss of cooling results in a hazard. The verification shall be considered successful when the analysis or analysis and test results show that the integrated rack satisfies the fail safe design criteria. The analysis report described above will be a part of the safety data package submitted by the PD.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.5.1.8

Number	Title	Method	Hazard Report(s)
FD-032	FLUID DYNAMICS - TOUCH TEMPERATURE	A or T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.5.1.11 Rack Front Surface Temperature (A or T)

Requirement Summary:

Payload and/or integrated rack front surface temperatures must be less than allowable limits.

Detailed Descriptions of Requirements:

Analysis or test shall be used to verify that the average rack front surface temperature and maximum temperature limits will not be exceeded during all modes of operation. The verification shall be considered successful when the analysis or test results show that the integrated rack surface average and maximum-limit temperatures are less than those as specified in SSP 57000, paragraph 3.5.1.11.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method: A or T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 57000, par. 3.5.1.11

Number	Title	Method	Hazard Report(s)
FD-035	FLUID DYNAMICS – VACUUM SYSTEM ACCESS VALVE	I&A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.6.1.6 Payload Vacuum System Access Valve (I&A)

Requirement Summary:

Integrated racks using the ISS Vacuum Exhaust System/Waste Gas System (VES/WGS) shall provide a vacuum system access valve in the integrated rack to isolate the integrated rack experiment chamber from the ISS VES/WGS when the integrated rack is not venting to the ISS VES/WGS.

Detailed Descriptions of Requirements:

Verification that the integrated rack, which uses the VES/WGS, provides a vacuum system access valve in the integrated rack system to isolate the experiment chamber from the ISS VES/WGS shall be by inspection and analysis.

An analysis of the integrated rack list of vent gases shall determine whether or not the integrated rack will vent gases other than the constituents of cabin air, noble gases or ISS pressurized gases. If the analysis shows only the constituents of cabin air, noble gases or ISS pressurized gases will be vented from the integrated rack, the integrated rack vacuum system access valve is not required.

For integrated racks found to be venting gases other than the constituents of cabin air, noble gases or ISS pressurized gases, an inspection of the integrated rack as-built drawings or flight hardware shall be performed. This inspection shall determine whether or not the integrated rack system contains a vacuum system access valve that isolates the experiment chamber from the ISS VES/WGS.

Verification shall be considered successful when the inspection and analysis shows that a vacuum system access valve, isolating the experiment chamber from the ISS VES/WGS, is provided if the integrated rack will vent gases other than the constituents of cabin air, noble gases or ISS pressurized gases. The integrated rack vacuum system access valve is not required if the integrated rack is venting only the constituents of cabin air, noble gases or ISS pressurized gases.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	N/A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: No reverification required.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. N/A	II. N/A

Applicable Document(s):

SSP 57000, par. 3.6.1.6

Number	Title	Method	Hazard Report(s)
EN-001	ENVIRONMENTAL - ATMOSPHERE HUMIDITY	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.9.1.3 Humidity (A)

Requirement Summary:

Integrated rack surfaces must preclude formation of condensation when exposed to a specified humidity and dewpoint range.

Detailed Descriptions of Requirements:

Analysis shall be used to verify that the integrated rack is designed to not cause condensation when exposed to the specified dewpoint and relative humidity except when condensation is an intended operation of the integrated rack. The verification shall be considered successful when analysis shows that no internal or external surfaces in contact with the cabin air will allow condensation when humidity and dewpoint are within the ISS atmosphere envelope defined by Figure 3.9.1.3-1 of SSP 57000. Surfaces shall be considered to be in contact with the cabin air unless a volume is hermetically sealed or environmentally conditioned to control humidity.

Required Verification Data:	Data Submittal Dates:
1. Analysis report including: - Description of condensation collection system - Illustration of all components or surfaces where condensation is most likely to occur when the cabin humidity exceeds the nominal case. - Upper humidity limit in terms of dewpoint. - All rack surface temperatures	1. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-12

Applicable Document(s):

SSP 57000, par. 3.9.1.3

Number	Title	Method	Hazard Report(s)
EN-002	ENVIRONMENTAL -ACTIVE AIR EXCHANGE	A&I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.9.2.1.A Active Air Exchange (I)
4.3.9.2.1.B Active Air Exchange (A)

Requirement Summary:

Integrated rack and aisle-mounted or operated equipment air exchange with the cabin is limited by specimen metabolic, mass conservation, and heat rejection constraints.

Detailed Descriptions of Requirements:

A. Inspection shall be used to verify that active air exchange with the cabin atmosphere by an integrated rack is limited to air exchange for specimen metabolic purposes and for mass conservation purposes. The verification shall be considered successful when inspection of the flight drawings shows that the active air exchange with the cabin atmosphere by an integrated rack is limited to air exchange for specimen metabolic purposes and for mass conservation purposes.

B. Verification that aisle-mounted payload and rack payload equipment heat loads imposed on cabin air is within the specified limits for each module shall be by analysis. The verification shall be considered successful when the analysis shows that aisle-mounted payload and payload equipment cabin air heat loads comply with the values as specified in the Unique Payload Hardware ICD.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC). (Item B data for rack payload equipment is collected in FD-008, “Cabin Air Heat Leak”)	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A&I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-6

Applicable Document(s):

SSP 57000, par. 3.9.2.1

Number	Title	Method	Hazard Report(s)
EN-003	ENVIRONMENTAL - OXYGEN CONSUMPTION	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.9.2.2 Oxygen Consumption (A)

Requirement Summary:

Integrated rack consumption of atmospheric oxygen must not exceed the daily allowable.

Detailed Descriptions of Requirements:

Verification that the integrated rack consumption of atmospheric oxygen does not exceed the specified amount shall be by analysis. The verification shall be considered successful when analysis shows that the integrated rack consumption of atmospheric oxygen shall not exceed 1.08 kg per day (2.38 lbm per day) as specified in SSP 57000, paragraph 3.9.2.2.

Required Verification Data:	Data Submittal Dates:
1. Preliminary Data Cert providing the integrated rack oxygen consumption analysis results	1. L-20
2. Final Data Cert providing the integrated rack oxygen consumption analysis results.	2. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-20/L-12

Applicable Document(s):

SSP 57000, par. 3.9.2.2

Number	Title	Method	Hazard Report(s)
EN-004	ENVIRONMENTAL - IONIZING RADIATION DOSE	A	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.9.3.3 Single Event Effect (SEE) Ionizing Radiation Dose (A)

Requirement Summary:

Equipment and subsystems must not produce an unsafe condition as a result of exposure to ionizing or Single Event Effect (SEE) radiation.

Detailed Descriptions of Requirements:

Verification that equipment and subsystems are designed to not produce an unsafe condition or one that could cause damage to equipment external to the payload as a result of exposure to SEE ionizing radiation shall be by analysis. An analysis of equipment and subsystems shall be performed using the operational lifetime and parts characterization data to assure that the design meets the requirement when exposed to SEE ionizing radiation. The verification shall be considered successful when the analysis shows that the equipment and subsystems will not produce an unsafe condition or one that could cause damage to equipment external to the payload when exposed to the specified environment.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC)	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	A	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-6

Applicable Document(s):

SSP 57000, par. 3.9.3.3

Number	Title	Method	Hazard Report(s)
EN-005	ENVIRONMENTAL - MICROGRAVITY ENVIRONMENT	TBD	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):

4.3.1.2.1.A Quasi-Steady Requirements (TBD)
4.3.1.2.1.B Quasi-Steady Requirements (TBD)
4.3.1.2.2.A Vibratory Requirements (TBD)
4.3.1.2.3.A Transient Requirements (TBD)
4.3.1.2.3.B Transient Requirements (TBD)
4.3.1.2.2.B Vibratory Requirements (TBD)

Requirement Summary:

Payloads shall not exceed maximum allowable quasi-steady, vibratory or transient microgravity disturbance limits.

Detailed Descriptions of Requirements:

A. Integrated racks shall meet the quasi-steady, vibroacoustic, and transient disturbance requirements as specified in SSP 57000, paragraph 3.1.2.

   i. Quasi-steady - TBD

   ii. Vibroacoustic - Integrated rack components shall be tested to determine vibroacoustic disturbance forces. This data shall be analyzed using transfer functions contained in accordance with the SSP 57000 Section TBD, and the methods described within to combine the component disturbance data. The verification shall be considered successful when the test data is analyzed using the prescribed method and the disturbance forces fall within the limits identified in the requirement.

   iii. Transient - TBD

B. Integrated ARIS racks shall meet the quasi-steady, vibroacoustic, and transient disturbance requirements as specified in SSP TBD ARIS IDD. (SSP 57000, paragraph 3.1.2).

   i. Quasi-steady - TBD

   ii Vibroacoustic - TBD

   iii Transient - TBD

Required Verification Data:	Data Submittal Dates:
1. Microgravity Control Plan (Guidelines given in Appendix E)	1. L-22
2. Preliminary Test Report	2. L-20 (input to Payload ICD)
3. Final Test Report	3. L-12

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required if within the limits specified by the original analysis.
II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Test Report	II. L-20/L-12

Applicable Document(s):

SSP 57000, par. 3.1.2.1, 3.1.2.2, 3.1.2.3, and 3.1.2.5.3; SSQ 21635

Number	Title	Method	Hazard Report(s)
EN-006	ENVIRONMENTAL - ACOUSTIC LEVELS	A&T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.12.3.3.1.(A-C) Continuous Noise Limits (A&T)
4.3.12.3.3.2 Intermittent Noise Limit (A&T)

Requirement Summary:
Integrated rack acoustic levels must not exceed specified values.

Detailed Descriptions of Requirements:

A. Continuous Acoustic Noise - The integrated rack (including PD-provided active ancillary equipment operated outside the rack) shall not exceed the continuous acoustic noise requirements as specified in SSP 57000, paragraph 3.12.3.3.1. Any independently operated ancillary equipment item, stowed within the rack or elsewhere, and deployed on orbit for a separate function other than that of the rack system, shall individually comply with the requirements. Continuous noise sources, which exhibit intermittent acoustical characteristics, must meet both the continuous noise specification and the intermittent noise requirements of paragraph B below.

i. Verification of continuous noise sources for integrated racks whose sub-rack payloads will not be changed shall be performed by test. Sound Pressure Level (SPL) test measurements shall be made for each integrated flight rack (or subrack ancillary equipment operated outside the rack) following the guidelines provided in Appendix D herein. Measurements shall be made on all sides of each rack. The SPL test shall use a Type 1 Sound Level Meter to measure the SPL at the loudest location 0.6 meters from the rack surfaces (or 0.6 meters from the loudest point on an independent subrack payload). SPL shall be measured in each of eight octave bands: 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz. Verification shall be considered successful when the test shows that the loudest noise on integrated rack surfaces exposed directly to the crew habitable volume does not exceed the levels as specified in SSP 57000, paragraph 3.12.3.3.1. Integrated racks unable to meet the specified levels will be required to take sound power measurements in addition to SPL measurements.

ii. Verification of continuous noise sources for integrated racks whose sub-rack payloads will change shall be performed using a test-correlated analytical model or some other methods approved and documented in the Acoustic Noise Control Plan section of the Unique PVP. The analytical process/procedure shall be documented in an Acoustics Noise Control Plan section of the Payload Unique Verification Plan. The verification shall be considered successful when the results from the test-correlated analytical model predicts the loudest location 0.6 meters from the rack surface exposed to the crew habitable volume, in each of the eight octave bands as specified in SSP 57000, Table 3.12.3.3.1-1, to be at or below the levels as specified in SSP 57000, Table 3.12.3.3.1-1 for additions, deletions or configuration changes to any subrack equipment within the integrated rack.

B. Intermittent Acoustic Noise - The integrated rack (including PD-provided active ancillary equipment operated outside the rack) shall not exceed the intermittent acoustic noise requirements as specified in SSP 57000, paragraph 3.12.3.3.2. Any independently operated ancillary equipment item, stowed within the rack or elsewhere, and deployed on orbit for a separate function other than that of the rack system, shall individually comply with the requirements. Intermittent noise characteristics shall be quantified in terms of (1) when the intermittent sound occurs, (2) duration and A-weighted SPL, and (3) a projected mission timeline(s). Intermittent noise sources, which also exhibit continuous acoustical noise characteristics, must meet both the intermittent noise requirements and the continuous noise specification of paragraph A above.

i. Verification of intermittent noise sources for integrated racks whose sub-rack payloads will not be changed shall be performed by test. Overall A-weighted SPL (dBA) test measurements shall be made for each integrated flight rack (or subrack ancillary equipment operated outside the rack). Measurements shall be made for each rack following the guidelines provided in Appendix D herein. The SPL test shall use a Type 1 Sound Level Meter to measure the overall A-weighted SPL at the loudest location 0.6 meters from the rack surfaces (or, 0.6 meters from the loudest point on an independent subrack payload). Verification shall be considered successful when the test shows the integrated rack overall A-weighted SPL (dBA) does not exceed the levels as specified in SSP 57000, paragraph 3.12.3.3.2.

continued on next page

Number	Title	Method	Hazard Report(s)
EN-006	ENVIRONMENTAL - ACOUSTIC LEVELS	A&T	

continued from previous page

ii. Verification of intermittent noise sources for integrated racks whose sub-rack payloads will change shall be performed using a test-correlated analytical model or some other method approved and documented in the Acoustic Noise Plan section of the Unique PVP. The analytical process/procedure shall be documented in the Acoustics Control Plan defined above in paragraph A. ii. The verification shall be considered successful when the results from the test-correlated analytical model predict the A-weighted noise level of the integrated rack for the Maximum Rack Noise Duration to be at or below levels as specified in SSP 57000, Table 3.12.3.3.2-1.

Required Verification Data:	Data Submittal Dates:
1. Acoustic Noise Control Plan for Items A&B (Guidelines given in Appendix D).	1. L-26
2. Preliminary Acoustic summary that includes a list of potential noise sources (continuous and intermittent) and their locations. A. Continuous Noise Source - SPL (dB) for the eight octave bands (for each unit) (Note: If the rack does not meet specified sound levels additional sound power level data must also be provided for the eight octave bands) B. Intermittent Noise Source - Overall A-weighted SPL (dBA)	2. L-20 (Input to Payload ICD)
3. Final Submittal of A&B data listed below A. Continuous Noise Source - SPL (dB) for the eight octave bands (for each unit) (Note: If the rack does not meet specified sound levels additional sound power level data must also be provided for the eight octave bands) B. Intermittent Noise Source - Overall A-weighted SPL (dBA)	3. L-12 (with further updates as required)

Description of Reverification Requirements:	Reverification Method: A&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. Same as the dates listed above.

Applicable Document(s):

SSP 57000, par. 3.12.3.3.1, 3.12.3.3.2, and Tables 3.12.3.3.1-1 and 3.12.3.3.2-1

Number	Title	Method	Hazard Report(s)
EN-007	ENVIRONMENTAL – INFRARED/ULTRAVIOLET RADIATION	T	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.9.3.4.1 Window Rack Infrared Radiation Requirements (T)
4.3.9.3.4.2 Window Rack Ultraviolet Radiation Requirements (T)

Requirement Summary:
Whenever the lab window scratch pane is removed the payload developer must provide shielding to protect the crew from both infrared and ultraviolet radiation in accordance with the specified requirements.

Detailed Descriptions of Requirements:

A. A test shall be performed to verify that the provided infrared shielding reduces transmittance to less than 10.0 percent of the wavelengths between 850 and 1000 nanometers in accordance with the requirements identified in SSP 57000, paragraph 3.9.3.4.1, Table 3.9.3.4.1-1. Verification shall be considered successful when the test shows shielding is provided that reduces the infrared transmittance to less than 10.0 percent for wavelengths between 850 and 1000 nanometers.

B. A test shall be performed to verify that the provided ultraviolet shielding reduces transmittance to less than 0.01 percent for wavelengths between 220 and 280 nanometers and less than 0.1 percent for wavelengths between 280 and 320 nanometers as shown in SSP 57000, Table 3.9.3.4.1-1. Verification shall be considered successful when the test shows shielding is provided that reduces the ultraviolet transmittance in accordance with the above criteria.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	T	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the "Required Verification Data" identified above.	II. Same as the dates listed above.

Applicable Document(s):

SSP 57000, par. 3.9.3.4.1 and 3.9.3.4.2: Table 3.9.3.4.1-1.

Number	Title	Method	Hazard Report(s)
MP-001	MATERIALS - FLUIDS	T, A, or I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.11.2.A Fluids (T)
4.3.11.2.B Fluids (T)
4.3.11.2.C Fluids (A or I)

Requirement Summary:

Integrated-rack fluids that interface with the ISS must meet the specified fluid cleanliness, composition, and systems material galvanic compatibility requirements.

Detailed Descriptions of Requirements:

A. Verification of fluid physical and chemical characteristics shall be by test. A test shall be conducted according to the verification test requirements as specified in SSP 30573, section 4.0 to determine whether or not the fluid contained in the integrated rack interfacing with the ISS satisfies the fluid physical and chemical characteristics. The verification shall be considered successful when the test results show that the integrated rack fluid physical and chemical characteristics meet the fluid chemistry requirements as specified in SSP 30573.

B. Verification of fluid system cleanliness levels shall be by test. The verification shall be considered successful when sampling tests in accordance with SSP 30573, section 4.0 show that fluids in the integrated rack comply with the cleanliness level requirements specified.

C. Verification of fluid system dissimilar metals compatibility shall be by inspection or analysis. The inspection shall compare the materials and parts list with the materials listed in MSFC-SPEC-250, Table III. Verification shall be considered successful when the inspection of the materials and parts list shows that the internal materials used in the integrated rack aqueous fluid systems are compatible according to the table specified. Analysis shall be performed on materials not listed in MSFC-SPEC-250, Table III. Verification shall be considered successful when the analysis of the materials shows that the internal materials used in the integrated rack aqueous fluid systems do not create a dissimilar metal couple greater than 0.25 Volts with the ISS aqueous fluid system.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC) for item A, B, and C explicitly.	1. L-6

Description of Reverification Requirements:	Reverification Method: A&T or I&T	Hazard Report(s):

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. Same as the “Required Verification Data” identified above.	II. L-6

Applicable Document(s):

MSFC-SPEC-250, Table III
SSP 30573, Section 4.0
SSP 57000, par. 3.11.2

Number	Title	Method	Hazard Report(s)
MP-002	MATERIALS - CLEANLINESS	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.11.3 Cleanliness (I)

Requirement Summary:

Integrated-rack and PD-provided ancillary equipment, (i.e. portable computer, camcorder, etc.), surfaces must meet certain criteria for surface cleanliness and the integrated rack exposed surfaces can be cleaned.

Detailed Descriptions of Requirements:

Verification that integrated racks conform to Visibly Clean-Sensitive (VC-S) cleanliness requirements as specified in SN-C-0005 shall be by inspection. An inspection of the cleanliness documentation required by precision cleaning shall be performed to show that each assembly part, component, subsystem, and system of the end product meets the VC-S requirement. Verification shall be considered successful when the inspection shows that each part, component, subsystem, and system of the end product meets the VC-S requirements.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the "Detailed Descriptions of Requirements" identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SN-C-0005
SSP 57000, par. 3.11.3

Number	Title	Method	Hazard Report(s)
MP-003	MATERIALS - FUNGUS RESISTANT MATERIAL	I	

SSP 57000 Section 4 Number(s), Title(s), and Method(s):
4.3.11.4 Fungus Resistant Material (I)

Requirement Summary:

Integrated-rack and PD-provided ancillary equipment that is intended to remain on orbit for more than one year must use fungus-resistant materials according to specific criteria.

Detailed Descriptions of Requirements:

Inspection shall be used to verify that integrated racks that are intended to remain on-orbit for more than one year use fungus resistant materials according to the requirements as specified in SSP 30233, paragraph 4.2.10. Inspection of design drawings and materials lists shall determine whether fungus resistant materials have been used as required. Verification shall be considered successful when the inspection shows fungus resistant materials are used as required.

Required Verification Data:	Data Submittal Dates:
1. Certificate of Compliance (COC).	1. L-6

Description of Reverification Requirements:	Reverification Method:	Hazard Report(s):
	I	

I. On-orbit relocation of the integrated rack: No reverification required.

II. On-orbit subrack PL changeout (new, reflight, or series) of the integrated rack: Same as the “Detailed Descriptions of Requirements” identified above.

Required Reverification Data:	Data Submittal Dates:
I. N/A	I. N/A
II. COC	II. L-6

Applicable Document(s):

SSP 30233, par. 4.2.10
SSP 57000, par. 3.11.4

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Hardware Certificate of Compliance (COC)

I hereby certify compliance with the verification requirements as specified in _____. I also certify that the identified as-built hardware, per the current applicable Engineering Configuration List, was manufactured in accordance with the design drawings, parts lists, applicable waivers and deviations. All supporting data is valid, applicable, and complete. This data is maintained in our files and will be made available upon request.

Note: If the verification data can be used across multiple stages (i.e., 5A.1, 6A, 7A, etc.) then identify each applicable stage in the Stage Effectivity block shown on this form.

Payload	Stage Effectivity	VDS Number	Method	Applicable Document Rev. Date	Drawings, Parts Lists, Waivers, Deviations, Procedures, Etc. (Attach correlated list as needed)

_____

Print Name/Signature/Date

Payload Developer Responsible Person

Organization

Certificate of Compliance (COC)

For Command and Data Handling (C&DH) Data Set Inputs into the Payload Data Library (PDL)

I hereby certify that the Command and Data Handling (C&DH) data sets have been entered into the Payload Data Library (PDL) and that those data sets are complete and ready for flight. Any incomplete data is as identified below in the Comments column. If there is no incomplete data, enter "None" in the Comments column.

Note: If the verification data can be used across multiple stages (i.e., 5A.1, 6A, 7A, etc.) then identify each applicable stage in the Stage Effectivity block shown on this form.

Payload	Stage Effectivity	Completion Date for PDL Inputs	VDS Number	Applicable Document Rev/Date	Comments (Identification of Incomplete Data)

_____

Print Name/Signature/Date

Payload Developer/Integrator Responsible Person

Organization

Data Certification

I hereby certify compliance with the verification requirements as specified in _____. I also certify that the identified as-built hardware, per the current applicable Engineering Configuration List, was manufactured in accordance with the design drawings, parts lists, applicable waivers and deviations. All supporting data is valid, applicable, and complete. This data is maintained in our files and will be made available upon request.

Note: If the verification data can be used across multiple stages (i.e., 5A.1, 6A, 7A, etc.) then identify each applicable stage in the Stage Effectivity block shown on this form.

Payload	Stage Effectivity	VDS Number	Method	Applicable Document Rev. Date	Completion Date	Summary (attach sheets as needed)

_____

Print Name/Signature/Date

Payload Developer Responsible Person

Organization

VERIFICATION ANALYSIS REPORT				
Payload:	Stage Effectivity:	Analyst:	Configuration analyzed:	Date:
1. Objective of the Analysis:				
2. Requirements Satisfied:				
3. Description of Analytical Technique:				
4. Analysis Input Data (Summary):				
5. Technical Results:				
6. Conclusions:				
7. Signature and Organization				

Note: If the verification data can be used across multiple stages (i.e., 5A.1, 6A, 7A, etc.) then identify each applicable stage in the Stage Effectivity block shown on this form.

VERIFICATION TEST REPORT

Payload:	Stage Effectivity:	Test Engineer:	Test Procedure Used:	Date:

1. Item Tested (Name, Serial Number, Part Number):

2. Objectives of the Test:

3. Description of Test Setup:

4. Test Results Summary:

5. Correlation of Test Sequence to Verification Requirements:

6. Explanation of all Failures and Corrective Action Taken During the Test:

7. Signature and Organization	8. Quality Assurance:

Note: If the verification data can be used across multiple stages (i.e., 5A.1, 6A, 7A, etc.) then identify each applicable stage in the Stage Effectivity block shown on this form.

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Human Factors VDS Candidate List Not Requiring Analysis For Verification

The following is a tentative list of the requirements, which are proposed for crew review as a verification option.

VDS Number	IRD Section 3 Requirement	IRD Requirement Title	Date Reviewed	Astronaut Office Acceptance Date
ME-002	3.12.4.2.6	SLIDE-OUT STOPS		
ME-007	3.12.3.1.1	CLOSURES OR COVERS		
ME-008	3.12.3.1.2.B	BUILT-IN CONTROL		
ME-009	3.12.3.1.5	ONE-HANDED OPERATION		
ME-011	3.12.4.2.1	EQUIPMENT MOUNTING		
ME-017	3.12.4.3.1	ONE-HANDED OPERATION		
ME-018	3.12.4.3.2.A	ACCESSIBILITY		
ME-018	3.12.4.3.6	CONNECTOR ARRANGEMENT		
ME-018	3.12.4.3.6.B	CONNECTOR ARRANGEMENT		
ME-020	3.12.4.3.11.A	ALIGNMENT MARKS OR GUIDE PINS		
ME-020	3.12.4.3.12.A	CODING		
ME-020	3.12.4.3.12.B	CODING		
ME-021	3.12.2.2.A	ACCESSIBILITY		
ME-021	3.12.2.2.B	ACCESSIBILITY		
ME-022	3.12.4.3.15.A	HOSE/CABLE RESTRAINTS		
ME-022	3.12.4.3.15.B	HOSE/CABLE RESTRAINTS		
ME-022	3.12.4.3.15.D	HOSE/CABLE RESTRAINTS		
ME-023	3.12.4.4.1	NON-THREADED ENGAGEMENT STATUS INDICATION		
ME-025	3.12.4.4.4.A	MULTIPLE FASTENERS		
ME-026	3.12.4.4.7	THREADED FASTENERS		
ME-026	3.12.4.4.6.A	QUICK RELEASE FASTENERS		
ME-026	3.12.4.4.6.B	QUICK RELEASE FASTENERS		
ME-026	3.12.4.4.9	WINGHEAD FASTENERS		
ME-027	3.12.4.4.8.A	OVER CENTER LATCHES		
ME-027	3.12.4.4.8.B	OVER CENTER LATCHES		
ME-027	3.12.4.4.8.C	OVER CENTER LATCHES		
ME-027	3.12.6.2.A	STOWAGE AND EQUIPMENT DRAWERS/TRAYS		
ME-027	3.12.6.2.B	STOWAGE AND EQUIPMENT DRAWERS/TRAYS		
ME-028	3.12.4.4.11.A	FASTENER HEAD TYPE		
ME-028	3.12.4.4.11.B	FASTENER HEAD TYPE		
ME-028	3.12.4.4.11.C	FASTENER HEAD TYPE		
ME-029	3.12.4.4.12	ONE-HANDED ACTUATION		
ME-030	3.12.5.2.2	NONINTERFERENCE		
ME-031	3.12.5.2.8	HIDDEN CONTROLS		
ME-031	3.12.5.2.1.A	PROTECTIVE METHODS		
ME-031	3.12.5.2.1.B	PROTECTIVE METHODS		
ME-031	3.12.5.2.1.C	PROTECTIVE METHODS		
ME-031	3.12.5.2.1.D	PROTECTIVE METHODS		
ME-031	3.12.5.2.1.E	PROTECTIVE METHODS		
ME-031	3.12.5.2.1.F	PROTECTIVE METHODS		
ME-031	3.12.5.2.1.G	PROTECTIVE METHODS		
ME-031	3.12.5.2.9	HAND CONTROLLERS		
ME-032	3.12.5.2.7	POSITION INDICATION		

Human Factors VDS Candidate List Not Requiring Analysis For Verification

VDS Number	IRD Section 3 Requirement	IRD Requirement Title	Date Reviewed	Astronaut Office Acceptance Date
ME-033	3.12.5.3.E	VALVE CONTROLS		
ME-036	3.12.6.1.A	STOWAGE DRAWER CONTENTS RESTRAINTS		
ME-036	3.12.6.1.B	STOWAGE DRAWER CONTENTS RESTRAINTS		
ME-036	3.12.6.1.C	STOWAGE DRAWER CONTENTS RESTRAINTS		
ME-036	3.12.6.3	CAPTIVE PARTS		
ME-037	3.12.6.4.1	PROVIDE HANDLES		
ME-037	3.12.6.4.3	HANDLE LOCATION/FRONT ACCESS		
ME-042	3.12.4.2.8	ACCESS		
ME-043	3.12.3.4.C	LIGHTING DESIGN		
ME-050	3.12.4.3.4	INDICATION OF PRESSURE FLOW		
ME-055	3.12.4.1.1	FIRE SUPPRESSION PORT ACCESS		
EL-007	3.12.4.3.13	PIN IDENTIFICATION		

ACOUSTIC NOISE CONTROL PLAN

for

ISS PAYLOADS

Draft

June 1998

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D.6.0 REFERENCES D-25

D.1.0 INTRODUCTION

Acoustic sound levels within habitable crew areas of the Orbiter and module have been a troublesome issue in past flights where experiments often exceeded specified noise requirements. This has led to crewmember complaints of communication difficulty, concentration problems, sleep interference, headaches, and ringing of ears. Excessive noise has also been attributed as the cause of temporary threshold hearing shifts during short missions and, in several cases, permanent hearing loss.

The Acoustic Noise Control Plan herein presents an approach that, if followed, will preclude acoustic noise problems within the ISS. Payload equipment cannot be deemed qualified for flight until it is shown that its nominal (non-failure) operating modes, location, and configuration(s) over its life onboard the ISS will not acoustically degrade the crew living environment of the element in which it resides.

Toward this objective, this document summarizes the acoustic noise criteria inside the ISS modules, suballocation of the overall criteria, requirements for verifying compliance with criteria, and methods that can be implemented in design and management of the payload equipment to control emitted noise.

Since part of the process of verifying compliance with acoustic noise criteria is the development of a Payload-Unique Noise Control Plan, this document also provides an outline and guidelines for developing this plan. The Payload-Unique Noise Control Plan will outline the procedures, sequence of events, and design developments that will be taken in order to ensure acoustic noise compliance. The intent of this guide is to assist the user to address the design towards acoustic compliance. The items submitted as sample quieting methods are not intended to limit the integrator's possible solution base. This plan requires tailoring specific to the integrator's methods of implementation and hardware characteristics.

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D.2.0 ACOUSTIC NOISE ALLOCATION

ISS acoustic noise requirements have been established for an integrated ISS module. The NC-50 noise curve criteria was selected based upon several considerations, notably the following: hearing acuity, speech intelligibility, habitability, safety, productivity, annoyance, and sleep interference. Reference 1 describes the findings that were mandated as the National Aeronautic and Space Administration's requirements for acoustics onboard the ISS.

Since total acoustic noise environment in an ISS module is the sum of all noise contributors, the NC-50 noise criteria must be suballocated to the noise-making components within the ISS module. Subsections below discuss suballocation of the module noise criteria to individual racks, to components in a rack, and to non-rack components.

D.2.1 INTEGRATED RACK ALLOCATION

The NC50 noise criteria, applicable to an ISS module, has been suballocated in Section 3.12.3.3 of the Pressurized Payloads IRD (Reference 2) to individual components in the module (e.g., integrated rack). This suballocation of the acoustic noise environment to each integrated rack shall be instituted as design requirements and shall apply to the composite noise level of the noisiest configuration of simultaneously-operating components within the rack (including any supporting adjunct active portable equipment operated outside the integrated rack but within the ISS module).

Acoustic noise limits are defined in Reference 2 for two types of noise sources: (1) Continuous Noise Source and (2) Intermittent Noise Source. To reiterate the definitions, an integrated rack that operates for more than eight hours in a 24 hour period and generates an A-weighted sound pressure level (SPL) equal to or in excess of 37 decibels (dBA) measured at 0.6 meter distance from the noisiest part of the rack is a Continuous Noise Source. An integrated rack which operates for less than eight hours in any one 24 hour period and generates an A-weighted sound pressure level (SPL) equal to or in excess of 37 dBA measured at 0.6 meter distance from the noisiest part of the rack, is an Intermittent Noise Source. Further information is given in Section 3.12.3.3 of the IRD concerning acoustic noise limits for hardware that exhibits both Continuous and Intermittent noise characteristics.

D.2.2 SUBRACK ALLOCATION

Acoustic noise limits, provided in Section 3.12.3.3 of the IRD for individual integrated racks, shall be further suballocated to subrack components by the rack integrator such that the acoustic noise of the composite rack will not exceed limits defined in the IRD.

D.2.3 NON-RACK ALLOCATION

Acoustic noise limits of non-rack components, operated independently of and outside the integrated rack, are allocated the same limits imposed for an integrated rack. (Reference Section 3.12.3.3 of the IRD) Note that any external adjunct equipment that is operated in support of the integrated rack is included with the integrated rack discussed in Section D.2.1.

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D.3.0 ACOUSTIC NOISE VERIFICATION

Acoustic noise verification of ISS Payloads is a multi-stage process, with data deliveries required at specific points along the path. Section D.3.1 discusses the four primary verification stages. Three of these stages require data inputs to the Element Integrator. Section D.3.2 delineates the verification data required and the schedule for submittal. Section D.3.3 provides additional technical details about the verification data required.

D.3.1 VERIFICATION STAGES

The first stage of the verification process begins at the start of hardware design development. Many times, acoustic noise compatibility is not addressed by hardware developers until the certification testing phase (i.e., final verification stage). This is likely to result in hardware that will not meet specified acoustic requirements. To preclude this from occurring, acoustic noise criteria should be included in the hardware design specifications. It is inherently easier to design for “low noise” rather than trying to “seal” the noise from entering the crew compartment. No formal data delivery is required for the first stage; however, plans and actions implemented in the first stage are included in the data delivery for the second stage.

The second stage of verification is the development and submittal of a Payload-Unique Acoustic Noise Control Plan for the integrated rack or ancillary equipment. The Acoustic Noise Control Plan shall provide the rack integrator’s (or adjunct equipment developer’s) plan for controlling acoustic noise emissions to ensure that final verification requirements are met. The plan shall also describe acoustic noise data that will be submitted for verification and define analytical and test methodology that will be used to obtain verification data. If an analytical process will be used in obtaining verification data, the process for test-validating the analysis procedure must be defined. Section D.5.0 herein provides guidelines for developing the Payload-Unique Acoustic Noise Control Plan.

The third stage of verification is the development of preliminary acoustic noise emission data. At this stage, the acoustic noise data should represent the best data available that can be obtained analytically via estimation or calculation, obtained from developmental testing, or obtained using measured data from similar hardware. The preliminary data should provide predictions of the noise emitted from the worst-case continuous noise source and from the worst-case intermittent noise source. Formal submittal of an Acoustic Noise Report is not required at this stage. The data shall, however, be included in the Payload-Unique ICD prior to its baseline.

The fourth stage of verification is the submittal of final data for flight certification that acoustic noise verification requirements have been met. Information submitted in the final Acoustic Analysis Report defines acoustic noise sources, summarizes the acoustic noise emission from the integrated rack (or adjunct equipment), describes tests performed to measure acoustic noise emissions, describes analytical procedures used in deriving acoustic noise emissions, and documents compatibility with acoustic requirements. Section D.3.2.3 herein provides additional details about contents and schedule for the final Acoustic Analysis Report. Section D.3.3 provides information concerning technical requirements for the final verification data.

D.3.2 VERIFICATION DATA REQUIREMENTS/SCHEDULE

Acoustic data submittals are required for three of the four verification stages discussed in Section D.3.1. Sections D.3.2.1 through D.3.2.3 discuss the data requirements and schedule for each of the three submittals.

D.3.2.1 PAYLOAD-UNIQUE ACOUSTIC NOISE CONTROL PLAN SUBMITTAL

The first report that must be submitted is a Payload-Unique Acoustic Noise Control Plan, required 26 months prior to launch. The Payload-Unique Acoustic Noise Control Plan defines the rack integrator's (or adjunct equipment supplier's) plan for ensuring/verifying that the integrated rack or adjunct equipment will meet acoustic noise requirements specified in the IRD. The plan should describe the acoustic noise system, define applicable requirements, define the methodology for suballocation of requirements, identify the technical approach to verification (e.g., testing, analysis), describe the approach to validating analytical methods (if applicable), describe testing methodology, etc.

The plan should also identify the process that will be used to control acoustic noise of subrack elements. This includes a recovery plan (see paragraph D.5.1.5 for details) that will be implemented if acoustic noise emissions exceed allocated noise requirements.

Section D.5.0 provides more specific details about the development of a Payload-Unique Acoustic Noise Control Plan.

D.3.2.2 PRELIMINARY ACOUSTIC ANALYSIS DATA

The second data item that must be submitted is the inclusion of preliminary acoustic noise data into the Payload Unique ICD. This data shall be included in the Payload-Unique ICD prior to its baselining, no later than 20 months prior to launch. Preliminary data included in the Payload-Unique ICD shall include noise emitted from the worst-case continuous noise source and from the worst-case intermittent noise source. Data for continuous-type noise sources shall be SPL data as a function of the octave-band frequencies: 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz. Linear overall and A-weighted overall levels shall also be provided. Data for intermittent-type noise sources shall be the A-weighted overall levels. SPL data for the preliminary report are usually obtained from the best source available and may be obtained from developmental testing, previous testing of similar hardware, or from analysis.

Data in the Payload-Unique ICD provides a preliminary acoustic compatibility assessment of whether the integrated rack or adjunct equipment meets the IRD noise requirements. The data also will be used by the Element Integrator to perform a preliminary acoustic noise analysis of the integrated module.

It is important that the preliminary acoustic noise data provided in the Payload-Unique ICD accurately represent best-available noise level predictions, even if these levels indicate that noise limits will be exceeded. An exceedance will alert the Element Integrator to a potential problem. Then the Element Integrator can use information from the preliminary acoustic analysis data to identify, review, and research possible noise reduction measures. The information also can be used to prevent co-location of noisy equipment; thus, reducing noise source concentration.

If the preliminary acoustic noise data suggests that acoustic noise limits specified by the IRD will be exceeded, a recovery plan shall be included in the Payload-Unique ICD. Reference to a recovery plan in the Payload-Unique Noise Control Plan could be used to satisfy this.

D.3.2.3 FINAL ACOUSTIC VERIFICATION REPORT

The third report that must be submitted, required 12 months prior to launch, is the Final Acoustic Verification Report. This report will (1) verify that the integrated rack or adjunct equipment meets specified acoustic requirements in the IRD and (2) provide data that can be used by the Element Integrator to perform a final acoustic noise analysis of the integrated module.

The Final Acoustic Verification Report should identify significant noise sources by type of noise (continuous or intermittent); provide the geometric location of noise sources; and provide Sound Pressure Level (SPL) data for each noise source, noise type and operational mode. Operational data such as time-line schedules for each significant noise source shall be provided in the report. A list shall also be provided identifying independently-operated equipment, dependent hardware, and adjunct hardware. Data shall be in sufficient detail to allow definition of the major noise contributors (e.g., data shall be provided for individual subrack elements within an integrated rack).

ISPRs using the Vacuum Exhaust System (VES) shall list their exhaust requirements in terms of volume, pressure (max and nominal), flowrate (max and duration), and time-to-exhaust-to-vacuum requirements. The vacuum event information shall also include a description of how the vacuum exhaust events are to be timelined, whether they correspond to crew activity, or are based upon self-activation or telescience activities.

The Final Acoustic Verification Report also should provide information about the process used to obtain final verification data. Acoustic noise testing is the preferred method of obtaining final verification data, but in some cases a test-verified analytical method can be used. (See Section D.3.3) Information that must be included in the Final Acoustic Verification Report is described below for each of the two methods of obtaining data. If acoustic data in the final report are obtained via testing, the report shall include the following:

1. <u>Test Set-Up/Test Room Characteristics</u> - Describe (preferably via sketches) the test set-up including the type of room used in performing the tests. If a “quiet room” is used, document the test set-up/test room characteristics. (“quiet” room is defined in Section D.3.3.1.1) This should include a description of the test configuration (including room dimensions, description of room surfaces, and test article layout), identification of test-article loudest radiating surface, identification of test-article surfaces exposed to habitable areas, equipment location, and microphone location.

2. Acoustic Noise Emission Data - Sound Pressure Level (SPL) data shall be provided for the loudest point on each side of the integrated rack or adjunct equipment. This information shall be provided for each operational mode for which acoustic data are collected (See Item 1 of Section D.3.3.1.2). Data for continuous noise sources shall be SPL data measured at the octave-band frequencies: 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz. The linear overall and A-weighted overall readings should also be provided. Data for intermittent noise sources shall be the A-weighted overall readings.

3. Background Noise Measurement Data - Background noise measurement data corresponding to the acoustic noise measurements from Item 2 above shall be provided.

If SPL data are obtained using a test-verified analytical method, the technical approach shall be documented in the report. The report shall also describe how the analytical method is test-validated. Data shall be provided for each operational mode identified. For continuous noise sources, the data shall include SPL data as a function of octave-band frequencies: 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz. The linear overall and A-weighted overall levels should also be provided. Data for intermittent noise sources shall be the A-weighted overall levels.

D.3.3 TECHNICAL REQUIREMENTS FOR VERIFICATION DATA

Measured test data from actual flight hardware is the preferred source for acoustic noise verification data. It is recognized, however, that measured test data may not be available in some cases. For example, performing acoustic noise tests for integrated racks whose complements will change on-orbit may not be practical. Thus, acoustic analysis is acceptable for these exceptions, subject to the requirements of Section D.3.3.2 below. Technical requirements for obtaining data via testing are discussed in Section D.3.3.1 below.

D.3.3.1 VERIFICATION DATA VIA ACOUSTIC NOISE TEST

The objective of acoustic noise testing is to determine the noise emission characteristics of an integrated rack (or adjunct equipment) during all on-orbit operational phases. The integrity of the test is highly dependent upon the quality of the acoustic test conducted. An improperly performed test provides little-or-no useful data that can be used to determine the integrated module acoustic noise environment. The purpose of this section is to provide technical guidelines for performing acoustic emission testing.

Sound Pressure Level (SPL) tests provide the standard data required for verification. When integrated racks (or adjunct equipment) are unable to meet specified SPL levels, Sound Power Level (PWL) test data will be required. Technical guidelines are given below for both SPL and PWL testing.

D.3.3.1.1 SOUND PRESSURE LEVEL TESTING

D.3.3.1.1.1 TEST ROOM REQUIREMENTS

Acoustic noise emission tests shall be performed either in an anechoic chamber or a qualified reverberant quiet room. A “quiet” room has background acoustic noise environment at least 3 dB lower

that the test article. A qualified reverberant room is one in which the reverberant characteristics are

known.

If a “quiet” room is selected as the test room, it should have as little background noise as possible. The background noise should preferably be at least 15 dB, below the noise limit specified for the test article (i.e., limits discussed in Section 2 herein). If this cannot be attained, the equipment to be measured should emit at least 3 dB greater noise than the background noise levels. If this condition can not be achieved, it is acceptable if the test article noise levels plus the background noise levels are below the maximum allowable values provided in the acoustical specification. Otherwise, the flight equipment noise is not measurable. For many laboratory environments, additional measures to reduce the background noise will probably be required, such as turning off air conditioning equipment and/or using sound absorbing partitions to create a better background environment. The background noise restrictions apply in all octave bands.

Room dimensions should be as large as possible and the inner surfaces of the walls, floor, and ceiling should be as acoustically-absorbent as possible. The width of the room should be at least 6 meters and in all cases at least 4 meters. Acoustically-reflective articles (e.g., bookcases, tables, filing cabinets) should be removed from the room or placed at least 3 meters from the test article.

Ground Support Equipment (GSE) that produce noise should be well separated from the flight hardware during the test (preferably located outside the test facility). If the GSE is in the test area, it should be operating during the background noise measurements.

D.3.3.1.1.2 TEST OPERATION

To obtain accurate and meaningful data, acoustic noise emission tests shall be performed with the test article configured and operating in all operational modes that will occur on on-orbit and that result in significant noise emission. Also, operating voltage should be the same as on-orbit.

The test article should be placed on a small table or stand (about one meter high) near the center (but not exactly in the center) of the test room. It should be oriented so that the test article surface is flush with the edge of the test stand and is oriented so that the test article surface is not parallel with any of the room walls.

The first test to be performed is to measure and record the background noise. This will verify that the background noise requirements of Section 3.3.1.1 are met. Background noise data shall be measured in each of eight octave bands: 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz.

After verifying adequate background levels, the following sequence of tests should be performed to measure acoustic noise emission. These tests shall be performed using a Type I Sound Level Meter (SLM) that has calibrated within the previous 12 months.

1. With the test article operating in a to-be-flown configuration, measure A-weighted overall acoustic emission around all outer surfaces (about 0.6 meter from the surface) to locate the noisiest point on each surface.

2. Record acoustic noise emission from the noisiest point on each surface at 0.6 meter from the surface. If the noise source is continuous-type, Sound Pressure Level (SPL) data shall be

recorded in each of eight octave bands: 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, and 8000 Hz. This data will be used for variant rack configuration analyses. Verification of each rack (or adjunct equipment) is based upon the noisiest location on a surface adjacent to the crew environment. This data should be measured using linear (no weighting or filtering) response. If the noise source is intermittent-type, only the A-weighted overall data is required.

3. After completion of Step 2, switch the test article off and record the background noise with the SLM ranged at the same full-scale settings used in Step 2. It is not necessary that these background noise measurements be accurate, but are performed to determine how much electronic and acoustic background exist at the settings used when making measurements of the test article.

D.3.3.1.2 SOUND POWER LEVEL TESTING

Sound Power Level testing, performed to determine the strength of the sound source, can be performed using one of several methods, including:

- Reverberation Chamber Testing
- Anechoic Chamber Testing
- Sound Intensity Testing

In general, sound power testing is more involved than sound pressure testing. For Example, sound power testing requires numerous measurements from microphones at predetermined locations on an imaginary “test surface” located away from but surrounding the sound source. Requirements for “test surface” location and number of microphones vary for each method. Therefore, each of the three methods and their associated “test surface” requirements will be discussed separately. The decision as to which method to use for performing PWL testing will depend upon: accessibility of the accepted hardware, cost, and degree of difficulty in conducting the test.

Discussion of each method includes a brief description of the method, a brief summary of requirements/guidelines, and a list of references that provide additional details for the test method.

In addition to references that apply specifically to one of the three test methods, other references of general interest include References “4” through “7”. Note that Reference “4”, Chapter 6 describes analytical aspects of Sound Power Level Measurements.

D.3.3.1.2.1 REVERBERATION CHAMBER TESTING

A reverberation chamber (generally a laboratory-grade reverberant room) is characterized as a room where all boundaries are hard and the reverberant sound field extends over nearly the entire room volume. The room shape should meet specified requirements and the total room volume required is determined by minimum third-octave center-frequency to be measured.

Testing can be performed either of two ways: (1) by the Comparison Method where the test article noise is compared to a reference source (i.e., calibrated power level noise source) or (2) by the Absolute Method where the sound-absorbing properties of the test room, measured for each frequency band, are used to determine sound power.

Definition of the "test surface" and measurement locations on the surface is a function of test room volume, wavelength of the sound, and accuracy desired.

Since the reverberation method is based on the premise that a diffuse (reverberant) sound field is present, sound directivity is not an issue. This results in an advantage for the reverberation chamber test method, namely that fewer microphone measurements are required. Thus, use of a reverberation chamber is the quickest method of obtaining sound power level data.

References "4" and "8" through "10" provide additional information about sound power testing in reverberation rooms.

D.3.3.1.2.2 ANECHOIC CHAMBER TESTING

An anechoic chamber is characterized as a room where boundaries are highly absorbent and the free-field region (i.e., region free of reverberation) extends almost to the absorbent boundary. The chamber is a semi-anechoic room if the floor is hard and other surfaces are highly absorbent. This is referred to as Hemispherical Space. The chamber is an anechoic room if all surfaces are highly absorbent.

The "test surface" is a hemisphere or sphere centered on the noise source. The number and location of measurement points needed depend on the accuracy required and the directivity characteristics of the noise.

An advantage of the anechoic chamber test method is that a more complete definition of the noise emission field can be obtained that includes both sound power and sound directivity characteristics. As an example, sound directivity data can be used to characterize noise emission from an integrated rack where the noise emitted from the sides of the rack differs from that emitted from the front of the rack.

References "4" and "11" provide additional information about sound testing in anechoic and semi-anechoic rooms.

D.3.3.1.2.3 SOUND INTENSITY TESTING

Sound intensity measurements are performed using a sound intensity probe that measures sound pressure at two points separated by a small distance. The sound intensity probe consists of two microphones separated by a spacer, where spacer thickness is determined by frequency range of the noise measurements.

The "test surface" can be a box, a hemisphere, or a shape that approximates the shape of the test article. Advantages of the sound intensity test method are that (1) background noise does not affect the total

sound power measurement and (2) knowledge of the acoustic properties of the test room is not necessary. References “4”, “12” and “13” provide additional information about sound intensity testing.

D.3.3.2 VERIFICATION DATA VIA ANALYSIS

Data produced by acoustic analysis may be used for preliminary verification and for final verification of integrated racks where it is not feasible to perform acoustic noise emission tests of an integrated rack. A rack analysis must model the rack’s acoustic configuration in detail. The output of the analysis shall predict the noise contribution to the crew environment for each surface that is exposed to the crew environment. The analysis and input data should be sufficiently detailed such that alterations of the configuration could be predicted within a defined level of tolerance. The integrated rack acoustic analysis shall list the possible error tolerance inherent in the analysis. To account for possible error tolerance, the overall design goal for the total integrated rack acoustic noise emission should be set at a value below the requirement (-3 dB for example).

When analysis is used to produce acoustic noise data for final verification, the analysis shall be performed using a test-correlated analytical model or some other test-verified methodology. Figure 4.3.12.3.3.1-1 of the IRD provides a typical flow for the process of developing a test-correlated model. An example of an “other test-verified methodology” could include an analytical process for combining measured sound power levels from multiple subrack components with rack subsystem noise to analytically predict the composite SPL noise emission for the integrated rack. One approach to accomplishing this would be to analytically compute/combine the emitted sound pressure levels from the various sound power sources, applying noise absorption and directivity factors as applicable to the integrated rack. Such an approach would require test correlation of the noise absorption characteristics of the rack and test correlation of the effects of the integrated rack on directivity of the noise from the various noise sources.

D.4.0 ACOUSTIC NOISE CONTROL

Acoustic noise systems can be described as consisting of three components - sources, transmission paths, and receivers. Since receivers consist of the crew and other payloads, control of acoustic noise must be implemented for the sources and transmission paths. Furthermore, reduction of noise levels at the source is generally the preferred method of noise control with the treatment of transmission paths considered a secondary method. Controls are best implemented via design and operational management applied at the beginning of hardware development. Due to weight and space constraints, the easiest manner of developing quiet hardware requires selecting and designing with quiet operation in mind. It is inherently easier to design "quiet" rather that cover and seal the noise away from the crew environment. Specific suggestions for accomplishing noise control via hardware design and operational control are given below. (See Reference 3 for additional details)

D.4.1 HARDWARE DESIGN TECHNIQUE FOR NOISE CONTROL

D.4.1.1 CONTROL OF ACOUSTIC NOISE SOURCES

Mechanical systems involving moving parts (e.g., motors, pumps, fans) or fluid flow systems are usual sources for acoustic noise generation. Thus, noise emission from these sources can be reduced through judicious selection of components and the proper design of fluid systems.

D.4.1.1.1 SELECTION OF LOW-NOISE-LEVEL COMPONENTS

Motors, pumps, and fans should be purchased from vendors that certify the balance "grade" and noise criterion of their equipment. These components should include proper balancing and use of precision bearings. Also, rotating equipment should be used instead of reciprocating equipment.

Equipment items that have multiple operating speeds should be selected. Furthermore they should be controllable through use of speed controllers, rpm monitoring, or thermally-activated speed control.

Ventilation fans should be selected based on the number of blades and operating speed to avoid resonance excitation in fan support structures. A larger number of blades will create higher excitation frequencies, which are easier to control. In general, centrifugal fans with airfoil blades create lower acoustic levels than other fan wheel designs. Also, fan blades constructed from plastic material have been observed to be less noisy than blades made of metal.

Alignment functions and power transmission are often controlled by the meshing of gears or use of chains. Alternate, quieter methods of motion and power transmission can be designed, using various types of belts.

D.4.1.1.2 FLUID SYSTEM DESIGN FOR LOW NOISE

In addition to the selection of low-noise-source components such as motors, pumps, and fans discussed in the previous section, acoustic noise emission from fluid systems can be reduced by designing fluid systems that have low flow velocities and by avoiding large pressure drops in fluid or gas systems.

Use multiple speed pumps to control fluid flow instead of throttling. Throttling tends to induce greater

flow noise.

Specify fans that operate in their optimum range and application. (i.e., Do not use a fan designed to move high flowrates through small avionics areas when there is an open plenum area that would allow use of a larger diameter fan turning at much lower speeds.)

Locate fans away from surface panels. This allows the use of duct muffling devices that can absorb noise without affecting flow or delta-P. Also, a fan located near the surface can cause turbulent air currents which, passing through a screen, may cause greater noise than the fan itself.

Other design options for reducing the transmission of acoustic noise from fluid systems are discussed below in Section D.4.1.3.

D.4.1.2 CONTROL OF NOISE TRANSMISSION

Two types of acoustic noise transmission occur: Structureborne and airborne. Complex situations may arise where airborne noise is propagated by structureborne vibration and reradiated into an airspace. Control of this situation involves both attenuating the structureborne transmission path and minimizing structural radiation efficiency.

D.4.1.2.1 CONTROL OF STRUCTUREBORNE NOISE TRANSMISSION

The first order of reducing structureborne acoustic noise transmission is to isolate noise-source components and any associated piping or ducting from their structural support. The second most important item is to design resonant-free support structures by modifying structural stiffness, resonances, damping, and structural coupling. Problem resonances can appear in the form of local panel vibration modes, piping or ductwork vibration modes, or primary structure vibration modes. Primary structure vibration modes are defined as resonances that involve motion of a major portion of the primary support structure. Panel and piping/ductwork vibration modes generally involve motion only in local areas.

When problem resonances cannot be avoided, damping treatments may be applied. Damping treatments include resilient mounts between equipment or piping/ductwork and primary structure or treatment applied to surfaces of structural members. Resilient mounts can be a simple sheet or block of viscoelastic material between equipment or piping/ductwork and its support structure or they can be more complex isolation mounts. Treatment to structural members, which is especially effective for local panel vibration, can range from simple thin coatings of viscoelastic materials to multilayered constrained layer treatments.

Most damping treatments perform more effectively at higher frequencies. Thus, resonance avoidance design and damping treatments work well together when support structures are designed to shift problem resonance higher in frequency.

D.4.1.2.2 CONTROL OF AIRBORNE NOISE TRANSMISSION

Airborne noise transmission from payloads aboard the ISS can be controlled by enclosing the source, modification of ducts and interior spaces, or moving the source as far as possible from habitable areas. As an example of the latter, if the front surface of a rack is exposed to a habitable area, locate the noise source at the rear of the rack. This results in longer transmission paths and therefore, more losses of energy.

A properly-designed structure to enclose an acoustic source inherently attenuates the acoustic noise transmitted outside the enclosure. Enclosures designed to attenuate acoustic noise should include attention to many details including: stiffener placement, penetrations, enclosure isolation, and interior geometry. Rib-stiffened panels should be used carefully since sound tends to radiate from structural discontinuities in a panel, such as a rib-stiffened interface. Penetrations in enclosures for cables or pipes should be kept to a minimum. Penetrating pipes or cables should be as flexible as possible to avoid creating flanking paths. The enclosure itself should be mechanically isolated from internal noise sources. Enclosure interior surfaces should ideally be at least a quarter wavelength away from noise-source-surfaces, at the lowest frequency at which attenuation is desired.

Adding absorptive liner materials within an enclosure increases acoustic absorption within the enclosure, thus, reducing acoustic energy and noise. Modification to alter the enclosure reverberation characteristics also may be used to reduce acoustic noise.

Airborne acoustic noise via reradiation of noise from structureborne vibration is controlled by minimizing radiation efficiency. This can be accomplished using the avoidance of resonance frequencies and damping treatment methods discussed in Section D.4.1.2.1

Air ducts can be significant acoustic noise transmission paths. Constructing air ducts with internal absorptive material or silencers can attenuate propagation of noise down the duct. Both upstream and downstream ductwork should be analyzed and treated as appropriate. Airborne noise also is generated at diffusers and grilles. Lowering airflow velocity reduces this effect. High relative airflow velocities should be avoided in mixing zones where airstreams enter regions of relatively still air.

D.4.1.3 ANALYSIS UNCERTAINTY

Analytical methods are available to develop estimates of the acoustic noise emitted. These include acoustic modeling and other analytical equations that calculate noise emission from a sound power level source based on absorption of sound, reverberant characteristics, and sound directivity. However, analysis tools are limited to working in the ideal world and there have been many cases where analysis has under-estimated actual levels. Therefore, for acoustic noise analysis in early stages of hardware development or when analysis is used to establish design limits, an error tolerance factor should be applied to the analysis results or acoustic noise specification (-3 dB for example). If the analysis is performed using a test-validated process, a lower error tolerance factor could be applied.

Elimination of analysis uncertainty and the establishment of a successful acoustic noise program requires an energetic measurement program. As the design process proceeds from the design phase into fabrication, measured data should be obtained and substituted for estimated or calculated data.

D.4.2 OPERATIONAL TECHNIQUES FOR NOISE CONTROL

D.4.2.1 TIMELINE MANAGEMENT

Rescheduling science operations to prevent two (or more) noisy hardware items from operating simultaneously will result in reduced noise emission. Determine preliminary/updated timeline schedules for ISPR operation with respect to noise emissions. Providing this data to the Element Integrator via will allow scheduling overall module operations to minimize acoustic noise.

D.4.2.2 OPERATING PARAMETER MANAGEMENT

Operation of equipment items which have multiple operating speeds (e.g., fans, pumps) can be used to control acoustic noise emission. Control can be applied in two ways: (1) by using worst-case operating characteristics in the noise budget allocation or (2) operate equipment at speeds that minimize noise emission. Operating voltage is usually a significant parameter in the noise emission of fans and rotating equipment. Reducing operating voltage to the minimum level required can significantly reduce noise emission. Also, pumps should not be operated near speeds corresponding to pump shaft resonant frequencies.

Setting cooling devices to less strict temperature limits can also be used to abate noise emission. Limits that are more strict than needed causes extra duty cycles of operation.

D.4.2.3 EQUIPMENT LOCATION

Provide physical separation of noisy hardware items that must operate concurrently. Since a portion of the emitted acoustic noise is a function of distance from the source, this will reduce the noise environment at a given point.

D.5.0 GUIDELINES FOR DEVELOPMENT OF A PAYLOAD-UNIQUE NOISE CONTROL PLAN

As defined in Section D.3.2.1, the rack integrator or adjunct equipment provider is required to develop and submit a Payload-Unique Acoustic Noise Control Plan. Guidelines are provided in the following subsections for development of the information required in the plan. This includes defining the technical contents of a typical plan and defining the approval process.

D.5.1 TECHNICAL CONTENT

The plan should define the approach that the rack integrator (or adjunct equipment supplier) will take to ensure/verify that the integrated rack or adjunct equipment meets specified acoustic noise requirements. In general, the plan will describe the system in terms of various noise sources, define applicable requirements, define the suballocation of requirements, describe how verification data will be obtained, describe how the data will be documented, and describe the general process for controlling noise.

D.5.1.1 SYSTEM DESCRIPTION

The acoustic system(s) that are covered by the plan should be described. The system description should define the subelements comprising the acoustic system and define who is responsible for providing acoustic data for the final verification of each subelement. Description of the acoustic system also should define the type of noise emitted for the subelement hardware (i.e., continuous, intermittent). If a potential acoustic noise problem is known that could interfere with another hardware item operation or its science goals, the interference should be described. Use of the Vacuum Exhaust System by an integrated rack represents a potential significant noise source. Thus, use of the VES should be described in terms of volume, pressure (max and nominal), flowrate (max and duration), and time to exhaust. The system description should define the hardware system configuration. (Figures should be provided if possible, particularly for integrated-rack systems).

D.5.1.2 REQUIREMENTS DEFINITIONS

A Payload-Unique Acoustic Noise Control Plan should define the applicable acoustic noise environment that will be used as limits in hardware design/development and imposed as verification requirements. These noise limits include the applicable environments from the Pressurized Payloads IRD as well as those levied on subrack payloads via the suballocation process. The plan should describe the process used to suballocate integrated rack acoustic noise limits to individual subrack payloads.

D.5.1.3 METHOD FOR OBTAINING VERIFICATION DATA

One of the most important requirements for the contents of the plan is to define how data that will be used for final verification will be obtained (i.e., acoustic noise testing, acoustic analysis). Acoustic noise testing is the preferred method of obtaining final verification data. This includes acoustic testing of an integrated rack operating in its worst-case on-orbit acoustic noise configuration. In some situations, acoustic testing of an on-orbit configuration may not be possible. (For example, when subrack payload equipment will be changed out on-orbit.) In such cases acoustic analysis may be used to analytically combine acoustic data measured for subrack equipment. The analysis process, however, shall be test-

validated.

The type of information that should be provided about the process for obtaining data varies, depending on whether test or analysis is used to obtain data.

D.5.1.3.1 DESCRIPTION OF TEST METHODS

If acoustic noise data is to be obtained by acoustic noise emission testing, the Payload-Unique Acoustic Noise Control Plan should describe the acoustic testing process. The description should include:

1. Description of test facility. Includes type of facility (e.g., anechoic, "quiet room"), dimensions of test room, and acoustic properties of test room. (If test facility information is unknown, a description of the requirements that will be levied for the test facility can be described in lieu of the test facility description.)

2. Identification of acoustic noise measuring devices. Includes a definition of acoustic noise measuring equipment that will be used for tests (or a description of requirements that will be levied).

3. Description of test article configuration. This should define all of the on-orbit configurations for the test article(s) that generate significant noise, identify which of the configurations will be tested, and provide rationale or selection process if not all are selected for test.

4. Summary of the Acoustic Noise Test Plan/Procedure. This should provide the basic approach of how testing will be performed, where measurements will be made, and a description of the data that will be measured.

D.5.1.3.2 DESCRIPTION OF ANALYSIS METHOD

If a test-validated analytical process is to be used to obtain integrated rack acoustic noise emission using measured data for subrack equipment, the Payload-Unique Acoustic Noise Control Plan shall define the analytical process that will be used. The description of the analysis method shall discuss the technical approach and describe the process of test-validation for the approach.

D.5.1.3.2.1 TECHNICAL APPROACH

A detailed description of the technical approach to the analytical process shall be provided. This should include the identification of acoustic analysis software used in modeling. For approaches not using acoustic modeling, the approach and details of the analysis methodology shall be provided.

D.5.1.3.2.2 TEST-VALIDATION OF TECHNICAL APPROACH

Section 4.3.12.3.3 of the IRD (Reference 1) requires test-correlation of any analytical process used to obtained acoustic verification data. This includes test-correlation of acoustic analysis models or other approved analysis methods.

The Payload-Unique Acoustic Noise Control Plan should either provide evidence that a test-correlated analytical process is in place or provide a description of the process that will be used to test-correlate the proposed analysis procedure.

D.5.1.4 REPORTING PROCESS

To ensure that preliminary and final acoustic noise data will meet the needs of the Element Integrator, the Payload-Unique Verification Plan should include a description and format of data that will be included in the Acoustic Noise Verification Report.

D.5.1.5 NOISE CONTROL PROCESS

The Payload-Unique Verification Plan should describe the basic process that will be used for controlling acoustic noise emission. This includes controls placed on hardware development, such as plans for incorporation of acoustic noise criteria in hardware design specifications. Also, controllable design and operational factors such as those defined in Section D.4 herein are other examples.

Another aspect of the Acoustic Noise Control Plan is the rack integrator's (or adjunct equipment provider's) recovery plan (see paragraph D.5.1.5 for details) if acoustic noise emissions exceed specified limits. The recovery plan should include the case where preliminary analysis results predict that specified limits may be exceeded and the case where final verification shows exceedance of specified limits.

The following are typical examples of steps that could be implemented and described in a recovery plan.

1. Modify Equipment to Reduce Acoustic Noise Emitted - Discuss possible equipment design modifications that could be implemented to reduce noise.

2. Limit Number of Subrack Components Operating Simultaneously

3. Change Equipment Operational Parameters - Examples include change of equipment operating speed, change in operating voltage, etc.

4. Implement Controls with Individual Equipment Developers - At the integrated rack level, one aspect of control is to determine significant contributors to the acoustic noise violation and, as a rack integrator, work individually with the equipment developer(s) to reduce acoustic noise emission.

5. Remove Conservatism using Higher-Fidelity Data - If acoustic noise data is preliminary data incorporating a factor of safety, an early energetic testing program can remove unnecessary conservatism, thus reducing the predicted noise emission.

6. Retrofit Acoustic Barriers to Experiments - Acoustic noise can be reduced by attaching an acoustic blanket or acoustic barrier to the front of the equipment or rack to absorb/block emitted acoustic energy.

7. Reconfigure Integrated Rack to Remove Noisy Equipment

D.5.2 APPROVAL PROCESS

The Payload-Unique Acoustic Noise Control Plan shall be submitted to the ISS Utilization Office, OZ3, or IP PEI team, per the schedule in Section D.3.2.1 herein. It is reviewed by the ISS Utilization Office and Acoustics Working Group to verify that the planned acoustic noise control and verification plans are adequate to meet specified noise requirements of the IRD and the data needs of the Element Integrator. Review comments/approval will be returned to the developer of the plan within two months after plan submission.

D.6.0 REFERENCES

1. BBN Job No. 157160, “Recommendations for Noise Levels in the Space Shuttle”, Bolt Beranek and Newman, Inc., February 28, 1975.

2. SSP 57000, Revision B (Include. PIRN 0062), “Pressurized Payloads Interface Requirements Document, International Space Station Program”, NASA/JSC, May 1998.

3. TSS30671, “Space Station Freedom Vibroacoustic Control Plan”, NASA/JSC, March 1992.

4. Int’l. Std. Book No. 0-9622072-0-9, “Noise and Vibration Control”, Revised Edition, Edited by Leo L. Beranek, Institute of Noise Control Engineering, 1988.

5. ANSI-S12.23, “Method for the Designation of Sound Power Emitted by Machinery and Equipment”, 1996.

6. ANSI-S12.34, “Engineering Methods for the Determination of Sound Power Levels of Noise Sources for Essentially Free-field Conditions over a Reflecting Plane”, 1993.

7. ANSI-S12.36, “Survey Methods for the Determination of Sound Power Levels of Noise Sources”, 1990.

8. ANSI-S12.31, “Precision Methods for the Determination of Sound Power Levels of Broad-band Noise Sources in Reverberation Rooms”, 1996.

9. ANSI-S12.32, “Precision Methods for the Determination of Sound Power Levels of Discrete Frequency and Narrow-band Noise Sources in Reverberation Rooms”, 1996.

10. ANSI-S12.33, “Engineering Methods for the Determination of Sound Power Levels of Noise Sources in Special Reverberation Test Room”, 1990.

11. ANSI-S12.35, “Precision Methods for the Determination of Sound Power Levels in Anechoic and Hemi-anechoic Rooms”, 1996.

12. ANSI-S12.12, “Engineering Method for the Determination of Sound Power Levels of Noise Sources using Sound Intensity”, 1992.13. ISO 9614-2, “Acoustics - Determination of Sound Power Levels of Noise Sources using Sound Intensity - Part 2: Measuring by Scanning”, 1996.

13. ISO 9614-2, “Acoustics - Determination of Sound Power Levels of Noise Sources using Sound Intensity - Part 2:Measuring by scanning”, 1996.

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TBD

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The report will include the details of the integrated rack connected to Interface B and multiple EPCE connected to Interface C electromagnetic effects control program. The control plan will be written to address, but not be limited to the following:

- An overview description of the integrated rack connected to interface B and multiple EPCE connected to interface C.
- Designate an Electromagnetic Effects (EME) responsible organization.
- Schedules and milestones pertaining to EME related design and test activities.
- Planned facilities for EME testing.
- Identification of the line-item deliverable hardware including identification of the end item specification.
- Identification of the first level suppliers of components, subsystems, and systems that comprise the deliverable hardware and the applicable end item specification for each item.
- An overview description of each line-item deliverable hardware including installed systems and subsystems.
- Description of general approach for meeting EMC requirements

Note: To accomplish the required analyses after a subrack payload changeout (new, reflight, or series), all of the original subrack test data will be required. This includes conducted and radiated emissions data, conducted and radiated susceptibility data, grounding and isolation data, and bonding data.

DESIGN ANALYSIS REPORT:

This portion of the data item will insure that station EME interfaces will be met and the integrated rack connected to Interface B and multiple EPCE connected to Interface C are built to be self-compatible. The Design Analysis Report will be written to address, but not be limited to the following:

- Identification of electrical processes, electrical bond resistance, dissimilar metal treatment methods, and other fabrication design features to insure bonding requirements of SSP 30245 will be met.
- Grounding design philosophy that insures grounding requirements of SSP 30240 will be met.
- Identification of any perceived problem areas in meeting the EME requirements.
- Identification of any transmitters and means of maintaining EMC.
- Cable design including wire categorization criteria for identifying, labeling and installing interference generating or susceptible wires, shielding techniques, and wire routing. This includes meeting SSP 30242 requirements at the interface and defining the wire routing within the integrated rack connected to Interface B and multiple EPCE connected to Interface C with the necessary test

and analysis to show that cable coupling will not be a problem within the integrated rack connected to Interface B and multiple EPCE connected to Interface C when payloads are integrated.

- Equipment, subsystem, etc. electrostatic discharge design features, and verification methods.
- Lightning protection (magnetic field protection) design features if powered in the Orbiter.
- Electrical/electronic EMI control and suppression techniques.
- Identify critical circuits and margin verification techniques.
- Plan for payload requirements that insure payload compatibility and station interface EMI requirements are met per SSP 30237 when the integrated rack connected to Interface B and multiple EPCE connected to Interface C is integrated with its payloads. This should include analysis of EMI test data as it becomes available.
- Corona design considerations.

EMC TEST PLAN/REPORT:

PURPOSE: The EMC Test Plans/As Run Procedures/Reports will be used for the measurement of the electrical, electronic, and electromechanical characteristics (compatibility, bonding, grounding) of the deliverable end item (highest level deliverable).

SCOPE: The EMC Test Plan/As Run Procedure/Report will describe the plans/procedures to be used in EMC testing of deliverable end items.

DESCRIPTION: The Plan/As Run Procedure/Report will give the details of the functional compatibility demonstration that will include, but not be limited to, the following and will include a matrix that maps these items to the test plan/procedure:

1. Title Page: The title page will contain the following information:

   a. Name and Nomenclature of systems

   b. Name of Manufacturer

2. Table of Contents

3. Introduction: The EMC Test Plan/As Run Procedure/Report will contain an introduction that covers the following:

   a. The purpose of the plan/procedure and its relationship to the overall EMC program for the flight element, system, etc.

   b. Description of the flight element or system.

4. Applicable Documents

5. Test Site: A description of the test site, covering the following:

   a. Description of test facility, shielded enclosure or anechoic chamber (size, plane waves).

   b. Description of plans used to ensure that the electromagnetic ambient environment at the test site will not affect the validity of the tests.

6. Instrumentation: Test instrumentation to be used will be described as follows:

   a. Complete description of EMC instrumentation for measuring electrical, video, and mechanical outputs of equipment and subsystems to be monitored during the testing.

   b. The characteristics of any other equipment used including matching transformers and band-reject filters, antenna factors of specified antennas, and transfer impedance's of current probes.

7. Test Set-Up: A description of the test set-up will include the actual physical layout of the hardware. In addition, the Power source characteristics (output and impedance, regulation, voltage and current) necessary to operate the unit under test will be described.

8. The plan/procedure will include the following details on critical circuits and Bridge Wire Actuated Devices (BWAD).

   a. Critical circuits

      1. Methods used to identify critical circuits

      2. Methods used to verify safety margins

   b. BWADs

      1. Methods used to simulate BWAD's

      2. Methods used to test BWAD systems

      3. Methods used to verify safety margins

9. Test Operation: The description of the testing operation will cover:

   a. Procedures for developing failure criteria and limits.

   b. Test conditions and procedures for all electronic and electrical equipment installed in or associated with the integrated rack and EPCE and the sequence for operations during tests, including switching. This should be part of the step-by-step test procedure.

   c. Implementation and application of test procedures which include modes of operation and monitoring points for each subsystem and equipment.

   d. Means of testing design adequacy for electrification (static electricity) and lightning protection.

e. Electrical power voltage limits and methods for monitoring alternating current and direct current power buses to assure voltages are within the proper limits.

f. Descriptions of arrangements for simulating operational performance in cases where actual operation is impractical.

g. Adjustments and settings of variable controls such as audio gain, video gain, sensitivity, squelch setting, etc.

h. Details concerning frequency ranges, channels, and combinations to be specifically tested such as images, frequencies, local oscillator, and transmitter fundamental and harmonically related frequencies. Subsystem susceptibility frequencies identified during laboratory testing will be included.

i. Identification of simulated signal inputs such as Doppler, radar altimeter, etc.

10. Evaluation: The plan/procedure will include the basis and methodology for evaluating test results including as a minimum, the following:

    a. Use of approved results from laboratory interference tests on subsystems and equipment.

    b. Evaluation and degradation criteria for each flight rack and equipment under test.

11. Data Sheets: The plan/procedure will include data sheets for recording data of each test. The data sheet will also include requirements' values with tolerances wherever applicable. The paragraphing of the data sheets will correspond to the paragraphing of the test procedure. Provisions for recording the data, the test performed, signature of the tester, signature of the inspector, and serial number of the equipment will be included. In addition, the data will be presented in graphical form wherever applicable.

EMI TEST PLAN/REPORT:

PURPOSE: Ensure that the equipment level design is self-compatible and has accommodated EME design requirements.

SCOPE: The test procedures establish the step-by-step methodology that will be used for the measurement and determination of the electromagnetic interference characteristics (emissions, susceptibility, bonding, grounding and Electro Static Discharge (ESD)) of each item test. Each item tested will have an individual qualification test report and plan/as run procedure. Test reports and plans/as run procedures may be combined if the items tested are by design interconnected to form a subsystem (rationale for combining test plans must be included in the test plan).
The EMI Test Plans for equipment located within the Space Station will describe the measurement methodology that will be employed to demonstrate that deliverable flight equipment, FSE, Orbital Support Equipment (OSE) and ORUs or subsystems comply with the EMI requirements defined in SSP 57000. The plan will also describe how the general test methods in SSP 30238 will be applied on the equipment or subsystem. The Test Procedures establish the step-by step methodology that will be used

for the measurement and determination of the electromagnetic interference characteristics (emissions, susceptibility, bonding, grounding and ESD) of each item tested.

DESCRIPTION: The EMI test report and plan/as run procedure will conform to the content and format requirements described below:

1. Title Page: This title page will contain the following information:

    a. Name and nomenclature of Equipment

    b. Name of Manufacturer Information concerning the number of pages will be placed on the lower half of the page. Revision page information will be included if appropriate (applicable to the submission of revision pages).

2. Table of Contents: Follows the title page.

3. List of Abbreviations and Acronyms: This list will include all abbreviations and acronyms, as well as their definition, that are used in this test procedure.

4. Applicable Documents: will be listed as follows:

    a. NASA

    b. other

Introduction/Test Plan:

The EMI Test Plan will contain an introduction that will cover the following:

1. The purpose of the plan and its relationship to the overall EMI program for the tested item. A test schedule and list of responsible engineers will be included.

2. A table listing all the tests to be performed, the applicable requirement references and test methodology.

3. Description of test sample, including operating frequency, line current.

Test Site:

A description of the test site, covering the following:

1. Description of test facility, shielded enclosure or anechoic chamber (size, plane waves).

2. Description of ground plane (size and type) and methods of grounding and bonding test samples in order to simulate actual equipment installation.

3. Evidence of spot-check measurements of the ambient electromagnetic emission profile of test facility, both radiated and conducted emissions, to determine ambient suitability.

Test Instrumentation:

1. Test equipment nomenclature, applicable characteristics, and calibration date.

2. The characteristics of matching transformers and band-reject filters.

3. Antenna factors of specified antennas and transfer impedance's of current probes.

4. Impedance of Line Impedance Stabilization Networks (LISN) and insertion losses and impedance curves of 10 microfarad capacitors.

5. Information on calibration of test equipment, as well as any general information deemed necessary for calibration of test conditions and procedure, will be included.

Test Set-Up:

A general description of test sample set-up will include the actual physical layout of the equipment under test, the position of the feed-through capacitors of line impedance stabilization networks on the ground plane and the location of bond straps, loads, and test sets. (Notes may be used to indicate height above ground plane for loads.)

Test Sample Operation:

The description of the test sample's operation will cover:

1. Modes of operation for each test.

2. Control settings on the test sample.

3. Control settings on any test sets employed or characteristics of input signals.

4. Test frequencies at which such devices as oscillators and clocks may be expected to approach requirements and limits.

5. Performance check initiated to designate the equipment as meeting minimal working standard requirements and limits.

6. Circuits, outputs, or displays to be monitored during susceptibility testing will be enumerated, as well as the criteria for monitoring performance.

7. Normal, malfunction, and degradation of performance criteria for susceptibility testing.

Measurements and Methodology:

The measurements that demonstrate compliance with the requirements will be described. As a minimum, the following will be indicated for each test:

1. Block diagram depicting test setup.

2. Test equipment used in performance of the test (including calibration data), and the methods of grounding, bonding or achieving isolation for the measurement instrumentation.

3. Procedures for (1) probing the test sample, (2) determining placement and orientation of probes and antennas, and (3) selecting measurement frequencies and detector functions.

4. Information to be recorded during the test, including frequency and units of recorded information. Sample data sheets, test logs and graphs, including test limits, will be shown. All data whether below or above specification level will be shown.

5. Modulation characteristics of the susceptibility test signals, such as amplitude, wave form, and type of modulation.

Test Procedure:

Test Conditions - The conditions will include pictorial diagrams of the equipment setup that identify each piece of equipment, its orientation, and relation to other equipment. The pictorial diagrams will clearly identify each piece of equipment to be utilized and the reference designation of connectors and interconnecting cabling.

Data Sheets:

Data sheets will be included for recording data of each test. The data sheet will include specification requirement values with tolerances wherever applicable. The paragraphing of the data sheets will correspond to the paragraphing of the test procedure. Provisions for recording the date the test was performed, signature of the tester, signature of the inspector, and serial number of the equipment must be included. In addition, the data will be presented in graphical form to enhance reader comprehension.

The EMI Test Report will conform to the format requirements described below:

1. Administrative Data: The EMI Test report will contain an administrative section covering the following:

    a. Name and nomenclature of items tested;

    b. Name of manufacturer;

    c. Authentication and Certification of performance of the tests by qualified representative of the procuring activity;

    d. Disposition of the test specimen;

    e. Description of the test sample, including function and intended use or installation;

f. List of tests performed and changes in limits or test frequencies previously authorized; and

g. Any approved deviations to the test plan procedures.

2. Test Results: Each test section will cover the applicable test procedure. The log sheets will be contained in a separate appendix. The test results section will contain the following data:

   a. Photographs or diagrams of test set up and test sample with identification

   b. Graphs of applicable limits and measured data in units as specified in the requirements.

   c. Data to show compliance with susceptibility requirements and thresholds of susceptibility or limitations of test equipment.

   d. If suppression devices are employed to meet the requirements, they must be identified, using schematics, performance data and drawings.

   e. Sample calculations, if any.

3. Recommendation and Conclusions. Recommendations and conclusions, including results of the tests in brief narrative form, a discussion of remedial actions already initiated and proposed corrective measures that will be implemented to ensure compliance of the equipment or subsystem, with the EMI requirements.

This is the information needed to populate the database for a given piece of equipment. This data is associated with the following tables: EQUIPMENT, EQUIP_TEST_DATA, and TEST_INFORMATION.

Table EQUIPMENT - contains information about the part numbers of the pieces of equipment.

Table EQUIP_TEST_DATA - contains the test data for a part number and a specific analysis type.

Table TEST_INFORMATION - contains information about the test procedure and test report for a part number.

Field Name	**Notes**
part_number	Part number of element (30 characters) this must be in the equipment information. This may be any unique identifier for an electronic device in the Space Station. The identifier may be a make and model of an off the shelf item or a drawing number for a component of an experiment or an identifier for a specific experiment. A part number may occur multiple times, but would have a different element identifier tied to x, y, z coordinate system.
equip_description	Description of the part number or piece of equipment (60 characters).
specification_id	The identifier of the specification used for analysis of this part number (30 characters).
equip_supplier	The supplier of the equipment, or other identifying information (30 characters).
analysis_type	A valid ISEAS analysis type.
x_value	The frequency (or time) test data value. Format E23.16 (maximum of 1000 points)
y_value	The amplitude test data value. Format E23.16 (maximum of 1000 points)
test_procedure	A description of how the test was performed on the equipment (30 characters). This could refer to the procedures for the specification or any special procedures used to test the equipment.
test_procedure_date	Date test was performed. Format MM/DD/YY
test_report	A description of the test that was performed (30 characters).
test_report_date	Date test was conducted. Format MM/DD/YY

test_mode	Operational test mode (40 characters). For analysis types CE01 and CE03 the tested power level in Amps should be included in the string delimited by spaces. (EXAMPLE: Tested at 5.2 amps) **Note: For CS06 Analysis designate positive and negative pulse in this field.**
mode_description	Test mode description (60 characters).
default_mode	Default test mode this should be the normal mode of operation (40 characters)
waiver_id	The unique identifier of the waiver (15 char).
waiver_status	The status of the waiver (60 char).
waiver_comment	Comments about the waiver (120 char).

Valid ISEAS analysis types for data entry into tables are listed below. Valid frequency (x) ranges and units and amplitude (y) units are also listed below for each analysis type.

Analysis Type	**X (Frequency) and Range**	**Y(Amplitude)Units**
+CE01	30 Hz to 15,000 Hz	dB µamps
-CE01	30 Hz to 15,000 Hz	dB µamps
+CE03BB	15,000 Hz to 50,000,000 Hz	dB µamps /MHz
-CE03BB	15,000 Hz to 50,000,000 Hz	dB µamps /MHz
+CE03NB	15,000 Hz to 50,000,000 Hz	dB µamps
-CE03NB	15,000 Hz to 50,000,000 Hz	dB µamps
+CE07	0.01 µsecond to 1,000,000 µseconds	volts from nominal
-CE07	0.01 µsecond to 1,000,000 µseconds	volts from nominal
+CS01	30 Hz to 50,000 Hz	volts rms
-CS01	30 Hz to 50,000 Hz	volts rms
+CS02	50,000 Hz to 50,000,000 Hz	volts rms

-CS02	50,000 Hz to 50,000,000 Hz	volts rms
+CS06	0.01 µsecond to 1,000,000 µseconds	volts from nominal
-CS06	0.01 µsecond to 1,000,000 µseconds	volts from nominal
RE01	30 Hz to 50,000 Hz	dB picoTesla
RE02BB	14,000 Hz to 1,000,000,000 Hz	dB µVolts/meter/MHz
RE02NB	14,000 Hz to 10,000,000,000 Hz	dB microVolts/meter
RS01	30 Hz to 50,000 Hz	dB picoTesla
RS02	0.01 µsecond to 1,000,000 µseconds	volts from nominal
RS03	14000 Hz to 50000000000 Hz	volts/meter

* **+ Indicates positive lead test.**

- Indicates negative lead test.

Electronic data entry capability will be provided for each database table listed below. Data for each database table will be contained in one ASCII file of fixed length records 80 characters long. A data set will consist of multiple records. Column one of each line is used as a continuation column. The first column of the first record in a data set will contain an asterisk (*). The first column of every other record in that same data set will contain a blank.

Table EQUIPMENT - contains information about the part numbers of the pieces of equipment.

Electronic file format

Field Name	Record	Columns	Notes
asterisk(*)	1	1	Column one, first record in the data set
part_number	1	2-31	Part number of the piece of equipment.
blank character	2	1	Blank character in first column
equip_description	2	2-41	Description of the part number or piece of equipment.
blank character	3	1	Blank character in first column
specification_id	3	2-31	The identifier of the specification used for analysis of this part number.
equip_supplier	3	33-62	The supplier of the equipment, or other identifying information.

Table EQUIP_TEST_DATA - contains the test data for a part number and a specific analysis type.

Electronic file format

Field Name	Record	Columns	Notes
asterisk(*)	1	1	Column one, first record in the data set
analysis_type	1	2-11	A valid ISEAS analysis type.
part_number	1	13-42	The part number of the piece of equipment
blank character	2	1	Blank in first column of record
x_value	2	2-24	The frequency (or time) test data value. Format E23.16
y_value	2	26-48	The amplitude test data value. Format E23.16
blank character	3	1	Blank in first column of record
test_mode	3	2-41	Operational test mode.

Table TEST_INFORMATION - contains information about the test procedure and test report for a part number

Electronic file format

Field Name	Record	Columns	Notes
asterisk(*)	1	1	Column one, first record in the data set
part_number	1	2-31	The part number of the piece of equipment.
analysis_type	1	33-42	Valid ISEAS analysis type.
test_procedure	1	44-73	A description of how the test was performed on the equipment.
blank character	2	1	Blank in first column of record
test_procedure_date	2	2-9	Date test was performed. Format MM/DD/YY
test_report	2	11-40	A description of the test that was performed.
test_report_date	2	42-49	Date test was conducted. Format MM/DD/YY
blank character	3	1	Blank in first column of record
test_mode	3	2-41	Operational test mode. For analysis types CE01 and CE03 the tested power level in Amps should be included in the string delimited by spaces. (EXAMPLE: Tested at 5.2 amps)
blank character	4	1	Blank in first column of record
mode_description	4	2-61	Test mode description
blank character	5	1	Blank in first column of record
default_mode	5	2-41	Default test mode

Examples of database tables:

EQUIPMENT

*TST1000

TEST OF TEST MODE LOADER PART ONE
TST_SPEC_1 SUPPLIER OF PART ONE

*TST1001

TEST OF TEST MODE LOADER PART TWO

TST_SPEC_1 SUPPLIER OF PART TWO

EQUIP_TEST_DATA

*+CE01 TST1000

30. 110.

TEST MODE 5.1 AMP

*+CE01 TST1000

250. 110.

TEST MODE 5.1 AMP

*+CE01 TST1000

675. 102.

TEST MODE 5.1 AMP

*+CE01 TST1000

1500. 92.

TEST MODE 5.1 AMP

TEST_INFORMATION

*TST1000 CE01 TEST_PROCEDURE

12/05/95 TEST_REPORT 12/05/94

OPERATIONA_MODE 1 A

OPERATION_TEST_MODE_DESCRIPTION

MODE 5.1

*TST1001 CE01 TEST_PROCEDURE

12/05/95 TEST_REPORT 12/05/94

OPERATIONAL_MODE 3 A

OPERATION_TEST_MODE_DESCRIPTION

MODE 3.1

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A	Analysis
ac	Alternating Current
APM	Attached Pressurized Module
ARIS	Active Rack Isolation System
BER	Bus Error Rate
BIT	Built-in-Test
BWAD	Bridge Wire Actuated Device
C	Centigrade
cc	Cubic Centimeter
C&DH	Command and Data Handling
C&W	Caution and Warning
CAM	Centrifuge Accommodation Module
CCSDS	Consultative Committee for Space Data Systems
CDR	Critical Design Review
Cert	Certification
CG	Center of Gravity
COC	Certificate of Compliance
COFR	Certificate of Flight Readiness
COU	Concept of Operations and Utilization
D	Demonstration
dB	Decibel
dBA	Acoustic Decibel Level
dBm	Decibels Referenced to One Milliwatt
dc	Direct Current

DCL	Design Coupled Loads
DLA	Design Loads Analysis
e.g.	For Example
EMC	Electromagnetic Compatibility
EME	Electromagnetic Effects
EMI	Electromagnetic Interference
EPCE	Electrical Power Consuming Equipment
EPS	Electrical Power System
ESD	Electrostatic Discharge
etc.	Etceteras
EUT	Experiment Under Test
EXPRESS	Expedite the Processing of Experiments to Space Station
F	Fahrenheit
FCSD	Flight Crew Support Division
FDS	Fire Detection Support
FEM	Finite Element Module
FSS	Fluid System Servicer
GFCI	Ground Fault Circuit Interrupter
GPVP	Generic Payload Verification Plan
GSE	Ground Support Equipment
hr	Hour
HRD	High Rate Demultiplexer
HRDL	High Rate Data Link
Hz	Hertz
I	Inspection

i.e.	That is
IAW	In Accordance With
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronic Engineers
in	Inches
IP	International Partner
IRD	Interface Requirements Document
ISIS	International Sub-rack Interface Standard
ISPR	International Standard Payload Rack
ISS	International Space Station
ITCS	Internal Thermal Control System
IVA	Intravehicular Activity
JEM	Japanese Experiment Module
JSC	Johnson Space Center
kg	Kilograms
kHz	Kilohertz
kPa	KiloPascal
KSC	Kennedy Space Center
kW	Kilowatt
LAN	Local Area Network
lbf	Pounds Force
lbm	Pounds Mass
LED	Light Emitting Diode
LEL	Lower Explosive Limit
LISN	Line Impedance Simulation Network

LRDL	Low Rate Data Link
max	Maximum
Mbps	Megabits per Second
MDM	Multiplexer-Demultiplexer
MDP	Maximum Design Pressure
MIL-STD	Military Standard
min	Minimum
mm	Millimeter
MPLM	Multi-Purpose Logistics Module
MRB	Microgravity Rack Barrier
MRDL	Medium Rate Date Link
MPCB	Multilateral Payloads Control Board
MSFC	Marshall Space Flight Center
N	Newton
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
NDE	Nondestructive Evaluation
NSTS	National Space Transportation System
NTSC	National Television System Committee
ORU	Orbital Replacement Units
PAH	Payload Accommodations Handbook
par	Paragraph
PCB	Payload Control Board
PD	Payload Developer

PDR	Preliminary Design Review
PEI	Payload Engineering Integration
PFE	Portable Fire Extinguisher
PFM	Pulse Frequency Modulation
PHR	Payload Hazard Report
PL	Payloads
PRCU	Payload Rack Checkout Unit
psi	Pounds per Square Inch
psia	Pounds per Square Inch Absolute
PSIV/F	Payload Software Integration and Verification Facility
PSRP	Payload Safety Review Panel
PUI	Program Unique Identifier
PUL	Portable Utility Light
PVP	Payload Verification Plan
PVPP	Payload Verification Program Policy
QD	Quick-Disconnect
Rev	Revision
RHA	Rack Handling Adapter
RIP	Rack Interface Panel
RMA	Rack Mobility Aids
RPC	Remote Power Controller
ROSAVIACOSMOS	Russian Aviation and Space Agency
RSC	Rack Shipping Container
RUP	Rack Utility Panel
SD	Smoke Detector

scc	Standard Cubic Centimeter
SCS	Safety Critical Structures
sec	Second
SEE	Single Event Effect
SIR	Standard Interface Rack
slpm	Standard Liter Per Minute
SMAC	Spacecraft Maximum Allowable Concentration
SPEC	Specification
SPIP	Station Program Implementation Plan
SPL	Sound Pressure Level
SSP	Space Station/Shuttle Program
SSQ	Space Station Qualified
STEP	Suitcase Test Equipment for Payloads
T	Test
TBD	To Be Determined
TBE	Teledyne Brown Engineering
TCS	Thermal Control System
UIP	Utility Interface Panel
UOP	Utility Outlet Panel
US	United States
USL	United States Laboratory
V	Volts
VC-S	Visibly Clean-Sensitive
Vdc	Volts Direct Current
VCL	Verification Coupled Loads

VDS	Verification Definition Sheet
VES	Vacuum Exhaust System
VES/WGS	Vacuum Exhaust System/Waste Gas System
VLA	Verification Loads Analysis
VRS	Vacuum Resource System
VRS/VVS	Vacuum Resource System/Vacuum Vent System
WG	Waste Gas
WGS	Waste Gas System

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Cross Reference Between GPVP and PVPP
Payload Verification Data For Stage Analysis

PVPP Requirements	GPVP Requirement	Verification input from GPVP Rev B (IRD Rev D)
ME-01, Mass Properties	ME-001, Weight and CG	Data Cert that provides weight and CG summary for launch and landing of the integrated rack.
ME-02, Pressurized Payload Work Volumes	ME-059, Payload Protrusions	Data Cert providing drawings identifying all protrusions
ME-03, Integrated Attached Payload Collision		**N/A**
ME-04, Payload Field of View		**N/A**
ME-05, Crew Translation Path	ME-059, Payload Protrusions	Data Cert providing drawings identifying all protrusions
ME-06, Equipment Translation Path	ME-059, Payload Protrusions	Data Cert providing drawings identifying all protrusions
ME-07, IVA Emergency Egress Path	ME-059, Payload Protrusions	Data Cert providing drawings identifying all protrusions
ME-08, EVA Emergency Path		**N/A**
ME-09, Visibility and Access to Critical Equipment and Controls	ME-054, Fire Detection Indicator	Drawing showing the size and location of the Fire Detection Indicator.
	ME-055, Fire Suppression Access Hole	• Drawings showing the size and location of the Fire Suppression Access Port. • Analysis or test report showing that all open areas of the rack are invaded by the fire suppression material at the specified concentrations within one minute.
	ME-057, Identification Labeling	COC showing FCSD approval.
	EL-028, Rack Maintenance Switch (Rack Power Switch)	Drawings showing the size and location of the “Rack Maintenance Switch.
ME-10, Attached Payload Robotics		**N/A**
EL-01, Element-level Pressurized/Attached Payloads EMI/EMC	EL-019, EMC for Safety Critical Circuits	Analysis report with supporting test data.
	EL-020, EMC	• EMI/EMC Control plan per Appendix F • EMI/EMC test report and test results in electronic format.
	EL-021, Cable/Wire Design and Grounding	Analysis report showing compliance of actual grounding versus grounding design philosophy, and the compliance with SSP 30242.
	EL-022, Electrical Bonding	• Test report showing compliance with SSP 30245 and NSTS 1700.7B/ISS • Analysis report showing compliance with SSP 30245 and NSTS 1700.7B/ISS
	EL-024, Electrostatic Discharge	• A report on test results or an analysis. • Inspection identifying labeling of integrated rack and EPCE
	EL-025, Lightning	Analysis showing compliance with the requirements of SSP 30243.
	EL-042, Corona	• Detailed analysis of corona design technique voltage level, and any gases plus operating environment. • Test report identifying test configuration plus test results.

Cross Reference Between GPVP and PVPP
Payload Verification Data For Stage Analysis

PVPP Requirements	GPVP Requirement	Verification input from GPVP Rev B (IRD Rev D)
EL-02, ISS-Level Pressurized/Attached Payloads EMI/EMC		Input data for this PVPP requirement comes from PVPP EL-01 **N/A**
EL-03, Electrical Power System Stability	EL-002, Ripple Voltage Characteristics, Noise, and Spectrum	Data Cert providing plot of input voltage vs. frequency
	EL-010, Surge Current	• Analysis report including surge current profiles for common integrated rack configurations. • Test report.
	EL-011, Reverse Energy/Current	Data Cert comparing worst case reverse current and potential reverse current case conditions.
	EL-014, EPCE Load Impedance	Test report showing compliance with the Unique Payload Hardware ICD
	EL-015, Maximum Ripple Voltage Emmissions	• Test report • Analysis report
	EL-016, Load Stand Alone Stability	Analysis report
	EL-020, Electromagnetic Interference/Compatibility	• EMI/EMC Control plan per Appendix F • EMI/EMC test report and test results in electronic format.
	EL-023, Large Signal Stability	Analysis and test data for each integrated rack and EPCE
EL-04, Channelized Power/Thermal Analysis	FD-004, Coolant Flow Rate	Data Cert providing power data (in kW) and flow rate (in lbm per hour) for each mode of operation in tabular form.
	FD-005, Coolant Return Temperature	Data Cert providing return coolant temperature and power draw for each mode of operation in tabular form.
	FD-008, Cabin Air Heat Leak	Data Cert providing integrated rack-to-cabin heat leak analysis results.
CD-01, Payload MDM Complement Configuration		Software update at L-8 based on S/W ICD
CD-02, Payload MSD Resource Utilization		Software update at L-8 based on S/W ICD
CD-03, Timeliner Configuration and Utilization		Software update at L-8 based on S/W ICD
CD-04, PCS Payload Displays and Applications Software		Software update at L-8 based on S/W ICD
CD-05, Payload 1553B Data Bus Loading		Software update at L-8 based on S/W ICD
CD-06, Payload Ethernet Bus Loading		Through PIA Addendum
FD-01, Integrated Truss Element Thermal Compatibility		**N/A**

Cross Reference Between GPVP and PVPP
Payload Verification Data For Stage Analysis

PVPP Requirements	GPVP Requirement	Verification input from GPVP Rev B (IRD Rev D)
FD-02, Fluid and Atmosphere Consumables Usage	FD-027, Pressurized Gases Leakage (Nitrogen, Argon, CO2, & Helium)	Data Cert providing leakage test results in units of each gas used.
	FD-030, Potable Water Use	Data Cert providing integrated rack water consumption analysis summary.
	EN-003, Oxygen Consumption	Data Cert providing the integrated rack oxygen consumption analysis results.
FD-03, CO2 Partial Pressure	EN-003, Oxygen Consumption	Data Cert providing the integrated rack oxygen consumption analysis results.
FD-04, VES Acceptable Exhaust Gases	FD-018, VES Acceptable Exhaust Gases	• Data Cert providing constituents of vented gas, volume, concentration, temperature, and pressure. • Data Cert showing integrated rack gases vented to the ISS VES/WGS are non-reactive with other vent gas mixture constituents. • Data Cert showing that integrated racks venting in the ISS VES/WGS provide a means to remove gases that should adhere to the VES/WGS tubing walls. • Data Cert showing that all particulates larger than 100 micrometers are removed prior to venting to the VES/WGS.
FD-05, Latent Heat Load	FD-008, Cabin Air Heat Leak	Data Cert providing integrated rack-to-cabin heat leak analysis results.
	EN-001, Atmosphere Humidity	Analysis Report
FD-06, External Contamination/Venting	FD-019, External Contamination Control	Data Cert providing the required list of vented gas characteristics.
FD-07, Pressurized Element Thermal Compatibility	FD-003, ITCS Pressure Drop	Data Cert providing pressure differentials (in psid) vs. flow rate results (in lbm per hour).
	FD-004, Coolant Flow Rate	Data Cert providing power draw and flow rate for each mode of operation in tabular form.
	FD-005, Coolant Return Temperature	Data Cert providing return coolant temperature and power draw for each mode of operation in tabular form.
	FD-006, Coolant Loop Leakage	Data Cert providing leakage test results.
	FD-008, Cabin Air Heat Leak	Data Cert providing integrated rack-to-cabin heat leak analysis results.
	FD-009, Cabin Air Cooling	Data Cert providing analysis results that the cabin air cooling of the integrated rack is within limits. **(Applicable to racks transported in the MPLM only.)**
	FD-012, Payload Coolant Quantity	Data Cert providing integrated rack coolant quantity.
EN-01, Microgravity	EN-005, Microgravity Environment	• Microgravity Control Plan • Test report
EN-02, Acoustic Emissions	EN-006, Acoustic Levels	Acoustic summary that includes a list of potential noise sources

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TBD/TBR NUMBER	NASDA COMMENT NO. ON GPVP	GPVP VDS NUMBER/TITLE	IRD SECTION/TITLE (VERIFICATION)	TBD/TBR DESCRIPTION REQUIRED UPDATE ON IRD
1	4	ME-031 Accidental Actuation Protection	4.3.12.5.2.1 ..... Protective Methods 4.3.12.5.2.5 ..... Recessed Switch Protection 4.3.12.5.2.8 ..... Hidden Controls	NASDA requested to change inspection requirement to analysis and inspection requirement.
2	7	FD-029 Potable Water Interface Pressure	4.3.8.1.2 ..... Potable Water Interface Pressure	NASDA requested to add leak rate “scc/min” requirement to the Potable Water Requirement.
3	11	ME-001 Weight and CG	4.3.1.1.4.A ..... Rack Requirements	NASDA requested to change the verification method to reflect A&T instead of A&D.
4	12	N/A	4.3.1.1.4.M..... Rack Requirements	There is no § 4.3.1.1.4.M in IRD to correspond with § 3.1.1.4.M.
5	22	EL-008 Power Bus Isolation	4.3.2.2.2.A ..... Power Bus Isolation	NASDA requested to change analysis to inspection.
6	27	CD-016 Smoke Detector	4.3.3.10.2 ..... Smoke Detector Interfaces 4.3.3.10.2.1 ..... Analog Interface Characteristics 4.3.3.10.2.2 ..... Discrete Command Built-in Test Interface Characteristics	NASDA requested to add the evaluation to compare the initial inspection data of analog signal with the final data in order to verify that the smoke detector has no failure and to add visual inspection of the canister to the interface characteristics.
7	17	FD-018 Fluid VES Acceptable Exhaust Gases	4.3.6.1.5.A ..... Acceptable Exhaust Gases	NASA desires that the ISS module integrator will analyze and verify the vent gases compatibility with ISS module VES/WGS wetted surface materials for the gas not specified in Appendix D. NASDA desires that Integrated Rack Provider will analyze and verify the vent gases compatibility with ISS module VES/WGS wetted surface materials for the gas not specified in Appendix D.

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TBD/TBR NUMBER	ESA COMMENT NO. ON GPVP	GPVP VDS NUMBER/TITLE	IRD SECTION/TITLE (VERIFICATION)	TBD/TBR DESCRIPTION REQUIRED UPDATE ON IRD
1	21	ME-004 LAUNCH/LANDING UMBILICAL RESTRAINT	4.3.1.1.3.C Loads Requirements	ESA requests an analysis based on an integrated rack configuration representative test as compared to the current NASA requirement of analysis only.
2	22	ME-001 WEIGHT AND CG	4.3.1.1.4.A Rack Requirements	ESA requests the addition of Moment of Intertia requirements to the VDS. NASA currently has no requirement for this.
3	24	ME-021 PHYSICAL INTERFACE	4.3.1.1.4.E Rack Requirements 4.3.1.1.4.I Rack Requirements 4.3.1.1.4.L Rack Requirements 4.3.12.2.1 Adequate Clearance 4.3.12.2.2.(A-B) Accessibility	ESA requests that the analysis be supported by test (as a demonstration) as compared to the current NASA requirement of analysis only.
4	25	ST-003 ON-ORBIT DEPRESS/REPRESS	4.3.1.1.2.B MPLM Interfaces 4.3.1.1.4.B Rack Requirement 4.3.1.1.4.K Rack Requirement 4.3.1.1.5.A Safety Critical Structures Req.	ESA requests the addition of a verification requirement for Section 3.1.1.4.M. This requirement is currently missing in the IRD.
5	30	FD-002 ITCS FLUID USE AND CHARGING	4.3.5.1.2.B ITCS Fluid Use and Charging	ESA requests adding an inspection requirement as compared to the current NASA requirement of analysis only.
6	31	FD-004 COOLANT FLOW RATE	4.3.5.1.4 Coolant Flow Rate	ESA requests an analysis and test be performed instead of NASA's current requirement of analysis only.
7	32	FD-004 COOLANT FLOW RATE	4.3.5.1.5.A Coolant Supply Temperature	ESA requests adding a verification requirement for Section 3.5.1.5.A instead of NASA's NVR.
8	33	FD-013 PAYLOAD GAS INCLUSION	4.3.5.1.17 Payload Gas Inclusion	ESA requests adding fluid charging procedures as part of the analysis.
9	36	EN-002 ACTIVE AIR EXCHANGE	3.9.1.2 Temperature	ESA requests that Section 3.9.1.2 be addressed in Section 4 of the IRD.

TBD/TBR NUMBER	ESA COMMENT NO. ON GPVP	GPVP VDS NUMBER/TITLE	IRD SECTION/TITLE (VERIFICATION)	TBD/TBR DESCRIPTION REQUIRED UPDATE ON IRD
10	37	EN-002 ACTIVE AIR EXCHANGE	4.3.9.2.1.A Active Air Exchange	ESA requests an analysis be performed instead of the NASA requirement of an inspection.
11	43	ME-008 BUILT-IN CONTROLS	4.3.12.3.1.2.B Built-In Controls	ESA requests a demonstration be used instead of NASA's requirement of a demonstration or analysis.
12	45	ME-012 DRAWERS AND HINGED PANELS	4.3.12.4.2.2 Drawers and Hinged Panels	ESA requests that the analysis shall be supported by test data instead of NASA's requirement of an analysis.
13	46	ME-007 CLOSURES AND COVERS	4.3.12.4.2.8.2 Self-Supporting Covers	ESA requests a test be performed on the payload flight hardware instead of NASA's requirement of an analysis of the drawings.
14	50	ME-035 RESTRAINT AND MOBILITY AIDS	4.3.12.6 Restraint and Mobility Aids	ESA requests a demonstration and analysis instead of NASA's requirement of a demonstration or analysis.
15	52	ME-019 CONNECTOR PROTECTION AND SHAPE	4.3.12.4.3.8 Connector Protection 4.3.12.4.3.9 Connector Shape 4.3.12.9.1.1 Mismatched	ESA requests that the verification be by demonstration only instead of NASA's requirement of either a demonstration or inspection.