

Interface Requirements Document International Standard Payload Rack (ISPR)

International Space Station Program

Revision G

16 February 2011

Type 1 NASA Approved



National Aeronautics and Space Administration
International Space Station Program
Johnson Space Center
Houston, Texas
Contract No. PIC-NNJ09GA18B DRD NO. PIC-SI-01



REVISION AND HISTORY PAGE

REV.	DESCRIPTION	PUB. DATE
-	Baseline Issue (Reference SSCBD 000002, EFF. 2-18-94)	02-18-94
	SCN 001 (Change as agreed per SSCD 000008, TDC-371)	05-06-94
	SCN 002 – CANCELLED	
A	Revision A per SSCD 000079R1, EFF. 1-31-95	02-28-95
	SCN 003 incorporates ECP 000069 (Reference SSCBD 000069, EFF. 10-03-94)	09-19-96
	DCN 004 incorporates ECP 000109 (Release to File)	04-28-99
	DCN 005 per SSCD 000145, EFF. 10-31-95 (Release to File)	04-28-99
	DCN 007 per SSCD 000147R1, EFF. 08-05-96 (Release to File)	04-28-99
	DCN 006 per SSCD 000180R1, EFF. 01-18-96 (Release to File)	04-28-99
	DCN 002 per SSCD 000102R3, EFF. 06-10-97 (Release to File)	04-28-99
	DCN 008 per SSCD 000226R2, EFF. 10-27-97 (Release to File)	04-28-99
	DCN 012 per SSCD 000263, EFF. 10-03-97 (Release to File)	04-28-99
	DCN 011 per SSCD 000229, EFF. 10-08-97 (Release to File)	04-28-99
	DCN 022 per SSCD 001161, EFF. 07-14-98 (Release to File)	04-28-99
B	Revision B per SSCD 001161, EFF. 07-14-98	04-28-99
	The following DCN numbers have been cancelled. These SSCNs will never be released. The reason for these cancellations is because the content of the SSCNs has been incorporated into Revision C.	
	DCN 024 per SSCD 000290 (Administrative Cancellation)	
	DCN 018 per SSCD 000470 (Administrative Cancellation)	
	DCN 019 per SSCD 000646 (Administrative Cancellation)	
	DCN 026 per SSCD 002049 (Administrative Cancellation)	
	DCN 028 per SSCD 002049 (Administrative Cancellation)	
	DCN 030 per SSCD 002049 (Administrative Cancellation)	
	DCN 031 per SSCD 002049 (Administrative Cancellation)	

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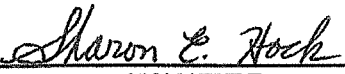
REV.	DESCRIPTION	PUB. DATE
C	<p>Revision C per SSCD 002049, EFF. 02–26–99 Revision C incorporates the following SSCNs: 000290, 000470, 000646, and 002049.</p> <p>Revision C accounts for impacts identified in the following SSCNs: 000256, 000845, 000591, 000583, 000773, 001004, 000832, 000440, 000671, 000877, 000894, 000915, 000844, 001029, 001051, 001052, 001026, 000823, 000673, 000585, 000588, 000567, 001481, 001127, and 000554.</p> <p>Revision C closes SSCN 000346 as it was withdrawn and SSCN 000264 as it was overcome by events.</p> <p>Note: DCN numbers 009, 010, 013, 021, 027, 029, and 032 have been administratively cancelled.</p> <p>The following DCN numbers have been cancelled. These SSCNs will never be released. The reason for these cancellations is because the content of the SSCNs has been incorporated into Revision D. DCN 025 per SSCD 005504 DCN 033 per SSCD 002137 DCN 036 per SSCD 001702 DCN 038 per SSCD 002581 DCN 053 per SSCD 005504</p>	06–20–01
D	<p>Revision D per SSCD 005504, EFF. 08–29–01</p> <p>Revision D incorporates the following SSCNs: 001702, 002137, 002581, and 005504.</p> <p>Revision D also closes the following SSCN as it was withdrawn: 001662 (DCN 039).</p> <p>Note: DCN 035 has been retired without use. This DCN was originally referenced in SSCM 001937, but was withdrawn.</p>	08–12–02
E	<p>Revision E per SSCD 009052, EFF. 02–14–05</p> <p>Note: DCN 056 has been retired without use. This DCN was originally referenced in SSCM 005645, but was withdrawn.</p> <p>Revision E incorporates the following DCNs: DCN 023 per SSCN 001021 DCN 054</p>	10–20–05


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REV.	DESCRIPTION	PUB. DATE
F	<p>Revision F per SSCD 010445, EFF. 07-28-08</p> <p>Revision F incorporates the following DCNs:</p> <ul style="list-style-type: none"> DCN 057 (approved as Rev. C) per SSCN 006154 DCN 058 per SSCN 007864 DCN 059 per SSCNs 003219, 005509 DCN 060 (approved as Rev. B) DCN 061 (approved as Rev. A) DCN 062 DCN 017 per SSCN 000249 DCN 020 per SSCN 000600 DCN 071 (approved as Rev. B) per SSCN 009055 DCN 074 per SSCNs 008805, 008854 DCN 076 DCN 079 DCN 080 (approved as Rev. A) per SSCN 008007 	08/08/08
G	<p>Revision G per SSCD 012739, EFF. 06-13-11</p> <p>Revision G incorporates the following DCNs:</p> <ul style="list-style-type: none"> DCN 078 per SSCNs 003282, 009171 DCN 084 (approved as Rev. A) per SSCNs 010157, 010782, 011193 DCN 087 per SSCN 010054 DCN 088 DCN 090 per SSCN 012037 <p>The following DCNs will not be used as their assigned contents have been incorporated into DCN 078: DCN 068 (SSCN 003282), DCN 077 (SSCN 009171).</p> <p>The following DCN will not be used as its assigned content has been incorporated into DCN 084 (approved as Rev. A): DCN 089 (SSCN 011193)</p>	08/04/11

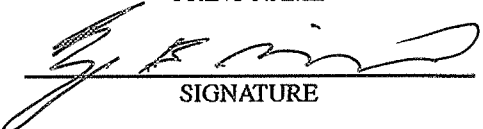
INTERNATIONAL SPACE STATION PROGRAM
INTERNATIONAL STANDARD PAYLOAD RACK (ISPR)
INTERFACE REQUIREMENTS DOCUMENT

CONCURRENCE
SSP 41152, Revision G

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PREFACE

The Space Station Interface Requirements Document (IRD) for the International Standard Payload Rack (ISPR) defines the physical and functional interface requirements between the United States National Aeronautics and Space Administration (NASA), the European Space Agency (ESA) and the Japan Aerospace Exploration Agency (JAXA) laboratory modules with respect to standard interfaces at all ISPR locations. This IRD provides all interface requirements necessary to develop The International Standard Payload Rack Interface Control Document (ICD).

The contents of this document equally applies to NASA, ESA, and JAXA and their respective contractors. The Space Station IRD International Standard Payload Rack shall be implemented on all new Space Station Program (SSP) contractual and internal activities and shall be included in any existing contracts through contract changes. This document is under the control of the Space Station Control Board (SSCB), and any changes or revisions will be jointly signed by NASA, ESA, and JAXA.

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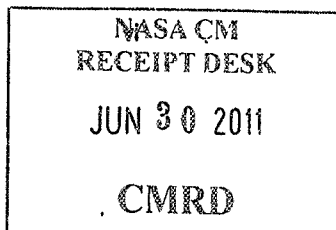
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SPACE STATION PROGRAM
INTERFACE REQUIREMENTS DOCUMENT
INTERNATIONAL STANDARD PAYLOAD RACK (ISPR)

LIST OF CHANGES

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

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
Directive 000002	18 Feb. 1994	Baseline Issue	ALL
Directive 000008	6 May 1994	SCN-001	3.3.1.4 3.3.1.5 3.3.1.5.1
Directive 000079R1	28 Sept. 1994	Revision A	1.2 2.1 3.3.1.5 3.3.2.12 3.3.3.5 (new) 3.3.3.6 (new) 3.3.4.1 3.3.4.2 3.3.4.2.1 3.3.4.3 3.3.4.4 3.3.4.4.1 3.3.4.5 3.3.5.1 3.3.5.1.1 (Deleted) 3.3.5.1.2 (Deleted) 3.3.5.2 3.3.6 3.3.6.1 3.3.6.2 (Deleted) 3.3.6.3 (Deleted) 4.0 4.1 4.2

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SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S) APPENDIX(ES)
			Appendix B Remove/Issue ISPR-3 Remove/Issue ISPR-6
Directive 001161	20 March 1998	Revision B	2.1 3.1.3.3, 3.2, 3.2.1, 3.2.2, 3.2.2.1, 3.2.3, 3.2.3.1, 3.3, 3.3.1, 3.3.1.1 3.3.2.3 3.3.2.5 3.3.3.3.1.1 3.3.3.3.2 3.3.3.3.3 3.3.4.5 3.3.4.5.1 3.3.4.6 3.3.4.6.3 3.3.4.9 3.3.4.9.1 3.3.4.9.2 3.3.4.9.3 3.3.5.1 3.3.6 3.3.6.2 3.3.6.3 4.0, 4.1, 4.2.1, 4.2.2 4.2.3 4.2.4 4.2.5 4.3

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			4.1
Directive 000470	14 Oct. 1997	Revision B	3.3.6.2, 3.3.6.3
Directive 000646	16 Jan. 1998	Revision B	3.3.4.10
Directive 002049	26 Feb. 1999	Revision C	2.1, 3.3.1.6, 3.3.1.7, T:4-1, 3.3.2.4, 3.3.6, 3.3.8
Directive 005504	31 July 2001	Revision D	
SSCN 005504	31 July 2001	DCN 053	A.2
SSCN 002581	31 July 2001	DCN 038	2.1, 3.3.7
SSCN 001702	31 July 2001	DCN 036	1.2 1.4 2.1 3.3.1.2.1 3.3.1.3 3.3.2.2 3.3.3.3 3.3.4.5.1 3.3.4.9.1 3.3.4.9.3 3.3.5.1 3.3.6 3.3.6.2 3.3.6.3 3.3.7 4.0 4.1 A.2
SSCN 002137	31 July 2001	DCN 033	3.1.3.1 3.3.1.7 T:4-1

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SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
SSCN 001269	31 July 2001	DCN 025	3.3.4.3.1 3.3.4.9.4 T:4-1
Directive 009052	29 July 2004	Revision E	
SSCN 001021	29 July 2004	DCN 023	3.3.4.9.4 T: 4-1
SSCN 009052	29 July 2004	DCN 054	3.3.7
Directive 010445	31 January 2007	Revision F	
SSCN 006154	31 January 2007	DCN 057 (approved as Rev. C)	2.1
SSCN 007864	31 January 2007	DCN 058	T:4-1
SSCN 003219, 005509	31 January 2007	DCN 059	2.1
SSCN 010445	31 January 2007	DCN 060 (approved as Rev. B)	3.3.5.1 3.3.5.4 (new) 3.3.5.4.1 (new) 3.3.5.4.2 (new)
SSCN 010445	31 January 2007	DCN 061 (approved as Rev. A)	3.3.4.6.3.1 (new) 3.3.4.7.1.1 (deleted) T:4-1
SSCN 010445	31 January 2007	DCN 062	2.1
SSCN 000249	31 January 2007	DCN 017	3.3.5.1.1 (new) 3.3.5.1.2 (new) T:3.3.5.1.1-1 (new) T:3.3.5.1.2-1 (new) T:4.1-1
SSCN 000600	31 January 2007	DCN 020	2.1 2.2

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SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)
SSCN 009055	31 January 2007	DCN 071 (approved as Rev. B)	1.1,1.2,2.1, 2.2, 3.3.1.1
SSCN 008805, 008854	31 January 2007	DCN 074	2.1
SSCN 010445	31 January 2007	DCN 076	3.3.4.10,A.2 T:3.3.5.1.1-1
SSCN 010445	31 January 2007	DCN 079	2.1, 2.2
SSCN 008007	31 January 2007	DCN 080 (approved as Rev. A)	3.3.3.3.1
Directive 012739	16 February 2011	Revision G	
SSCN 003282, 009171	16 February 2011	DCN 078	2.1
SSCN 010157, 010782, 011193	16 February 2011	DCN 084 (approved as Rev A)	2.1
SSCN 010054	16 February 2011	DCN 087	1.2, 1.4, 2.1, 2.2, 3.1.3.1, 3.3.1.2.1, 3.3.1.3, 3.3.2.2, 3.3.3.3, 3.3.4.5.1, 3.3.4.9.1, 3.3.4.9.3, 3.3.5.1, 3.3.6, 3.3.6.2, 3.3.6.3, 4.0, 4.1, A.2 T:4-1
SSCN 012739	16 February 2011	DCN 088	3.3.5.1
SSCN 012037	16 February 2011	DCN 090	2.1

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1.0 INTRODUCTION

ISPRs are defined as racks which are interchangeable between NASA, ESA, and JAXA laboratories, regardless of the provider or site of initial installation within the Space Station.

1.1 PURPOSE AND SCOPE

This IRD defines the on-orbit physical and functional interface requirements between the NASA, ESA, and JAXA laboratory modules with respect to standard interfaces to all ISPR locations. The implementation of the ISPR interface requirements is controlled in SSP 41002, International Standard Payload Rack to NASA/ESA/JAXA Modules Interface Control Document.

1.2 PRECEDENCE

The overall functional requirements on the ISPR interfaces are contained in SSP 41162, Segment Specification for the United States On-Orbit Segment (USOS), in SSP 41160, Segment Specification for the European Space Agency Attached Pressurized Module, in SSP 41165, Segment Specification for the Japanese Experiment Module, and in this IRD. These documents together form a consistent set of requirements to be implemented by NASA, ESA, and JAXA, respectively, and take precedence on all other SSP applicable documentation, with the exception of SSP 41000.

In case of conflict between these documents and the SSP 41000, Space Station System Specification, SSP 41000 takes precedence.

1.3 CHANGE AUTHORITY

Changes to this document are controlled jointly by the Partners through the SSCB.

1.4 RESPONSIBILITIES

Unless otherwise noted herein, NASA, JAXA and ESA carry the responsibility for designing and verifying respectively for the United States Laboratory (USL), the Japanese Experiment Module (JEM), and the Attached Pressurized Module (APM) to the interface requirements established in this IRD.

2.0 DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents form a part of this IRD to the extent specified herein:

DOCUMENT NUMBER	TITLE
ANSI/IEEE 802.3 1993 Edition Reference	Information Technology – Local and Metropolitan Area Networks, Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specification (3.3.4.9.3)
COL–ESA–RQ–014 Issue 2, Rev. E 10 December 2001 Reference	Columbus EMC & Power Quality Requirements (3.3.1.1, 3.3.1.6, 3.3.1.7)
EIA RS–170–A 1 November 1977 Reference	EIA Industrial Electronics Tentative Standard No. 1, Color Television Studio Picture Line Amplifier Output Drawing (3.3.5.3)
ISO 9314–1 15 April 1989 Reference	Information processing systems — Fibre Distributed Data Interface (FDDI) – Part 1: Token Ring Physical Layer Protocol (PHY) (3.3.6.1)
MIL–STD–1553B Rev. B, Notice 2 8 September 1986 References	Digital Time Division Command/Response Multiplex Data Bus (3.3.4.5, 3.3.4.6.1.1, 3.3.4.6.1.2, 3.3.4.6.2, 3.3.4.6.3)
SSP 30482, Vol. 1 Rev. C 7 July 1997 Reference	Electrical Power Specifications and Standards Volume 1: EPS Electrical Performance Specifications (3.3.1.1)
SSP 30482, Vol. 2 Rev. A January 1994 Reference	Electrical Power Specifications and Standards Volume 2: Consumer Constraints (3.3.1.1)
SSP 30573 Rev. E December 2, 2009 Reference	Space Station Program Fluid Procurement and Use Control Specification (3.3.2.14)

DOCUMENT NUMBER	TITLE
SSP 30240* Rev. D July 31, 2002 Reference	Space Station Grounding Requirements (3.3.1.6)
* Document revision applicable to JEM.	
SSP 30240** Rev. F July 30, 2005 Reference	Space Station Grounding Requirements (3.3.1.6)
** Document revision applicable to USL.	
SSP 30245* Rev. D, SSCN 6154, DCN 029 June 4, 1998 Reference	Space Station Electrical Bonding Requirements (3.3.1.7)
* Document revision applicable to JEM.	
SSP 30245** Rev. F, DCN 029 May 3, 2002 Reference	Space Station Electrical Bonding Requirements (3.3.1.7)
** Document revision applicable to USL.	
SSP 41002 Rev. N April 30, 2008 References	International Standard Payload Rack to NASA/ESA/JAXA Modules Interface Control Document (1.1, 3.3.7)
SSP 41150 Revision J 23 August 2004 References	Interface Requirements Document Space Station Manned Base (SSMB) to Columbus Attached Pressurized Module (APM) (3.3.6.2, 3.3.6.3)

2.2 REFERENCE DOCUMENTS

The following documents defined in the Space Station System Specification, are referenced in this IRD for context and user convenience:

DOCUMENT NUMBER	TITLE
SSP 41000 Reference	System Specification for the International Space Station (1.2)
SSP 41160 Reference	Segment Specification for the European Space Agency Attached Pressurized Module (1.2)
SSP 41162 Reference	Segment Specification for the United States On-Orbit (1.2)
SSP 41165 Reference	Segment Specification for the Japanese Experiment Module (1.2)
SSP 50034 References	NASA/ESA Bilateral Integration & Verification Plan (4.0, 4.1)
SSP 50035 References	NASA-NASDA Bilateral Integration and Verification Plan (4.0, 4.1)
COL-ESA-RQ-032 Reference	Columbus External Interfaces Verification Requirements (4.1)
D684-10020-1 Reference	Program Master Integration and Verification Plan (4.0)

3.0 REQUIREMENTS

3.1 PAYLOAD RACK INTERCHANGEABILITY

3.1.1 MODULE INTERFACES

The NASA, ESA and JAXA laboratory modules shall provide standard interfaces at all ISPR locations.

3.1.1.1 ISPR ENVELOPE

All laboratory modules shall accommodate payload racks with compatible physical static envelope.

3.1.2 INTERFACE TYPES

3.1.2.1 STANDARD INTERFACES

Standard interfaces for ISPRs shall be physically and functionally compatible at all ISPR locations.

3.1.2.2 STANDARD INTERFACE OPTIONS

Interfaces for the standard interface options shall be physically and functionally compatible at all ISPR locations which accommodate those standard interface options.

3.1.2.3 MODULE SPECIFIC INTERFACES

Module specific interfaces are all those other rack interfaces on top of the standard interfaces and standard interface options.

3.1.3 RACK TO INTERFACE COMPATIBILITY

3.1.3.1 STANDARD INTERFACE COMPATIBILITY

A payload rack which requires no more than the standard interfaces shall be fully functional at any ISPR location without the use of hardware adaptors or payload rack software changes, with the exception of the bonding strap fasteners in the JEM.

3.1.3.2 STANDARD INTERFACE OPTION COMPATIBILITY

A payload rack which requires any of the standard interface options shall be fully functional at all ISPR locations that accommodate those standard interface options without the use of hardware adaptors or payload rack software changes.

3.1.3.3 MODULE SPECIFIC INTERFACE COMPATIBILITY

A payload rack which requires any of the module specific interfaces shall be fully functional only at the ISPR locations that accommodate those module specific interfaces.

3.2 ISPR INTERFACES

3.2.1 MECHANICAL INTERFACES

The mechanical interfaces between the ISPR and each of the laboratory modules for on-orbit installation, removal and maintenance shall be compatible.

3.2.2 UTILITY INTERFACE PANEL

A utility interface panel shall be provided in the standoff area for each ISPR location in the laboratory modules to accommodate utility connections for standard interfaces, standard interface options and module specific interfaces defined in section 3.3.

3.2.2.1 UTILITY INTERFACE PANEL LAYOUT

Connectors in a single row or staggered rows which are removed sequentially by the crew intravehicular activity shall provide 25 mm (1.0 in) 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.

3.2.3 STRUCTURAL INTERFACES

3.2.3.1 ON-ORBIT LIMIT LOADS

The on-orbit limit loads at the module to ISPR interface shall be compatible for the various modules.

3.3 SYSTEM INTERFACES

3.3.1 POWER INTERFACES

3.3.1.1 POWER CHARACTERISTICS

The power characteristics at the utility interface panel shall be in accordance with SSP 30482, Electrical Power Specifications and Standards (NASA/JAXA) or COL-ESA-RQ-014 (ESA), Columbus Electromagnetic Compatibility and Power Quality Requirements.

3.3.1.2 ISPR MAIN POWER

3.3.1.2.1 3 kW

Main power of at least 3 kW shall be provided on one feeder to ISPR locations by the USL, the APM, and the JEM as a standard interface.

3.3.1.2.2 6 kW

Main power of 6 kW shall be provided on one feeder to ISPR locations as a standard interface option.

3.3.1.2.3 12 kW

At 12 kW ISPR locations in the USL the essential/auxiliary power feeder shall provide at least 6 kW of main power.

3.3.1.3 ISPR ESSENTIAL/AUXILIARY POWER

The USL, the APM, and the JEM shall provide at least 1.2 kW of essential/auxiliary power on a separate feeder to all ISPR locations as a standard interface.

3.3.1.4 MAIN POWER CONNECTOR RATING

Interface power connectors at ISPR locations shall be identical for all main power feeders with connectors capable of supporting 6 kW.

3.3.1.5 ESSENTIAL/AUXILIARY POWER CONNECTOR RATING

Interface power connectors at ISPR locations shall be identical for the essential/auxiliary power feeders with connectors capable of supporting 6 kW.

3.3.1.5.1 12 kW ISPR LOCATIONS

In the USL, when the essential/auxiliary feeder is used to provide power to a 12 kW ISPR, its connector shall be capable of supporting 6 kW.

3.3.1.6 GROUNDING REQUIREMENTS

The ISPR grounding interface shall meet the requirements of SSP 30240, Space Station Grounding Requirements (NASA/JAXA) or COL-ESA-RQ-014, Columbus EMC & Power Quality Requirements (ESA).

3.3.1.7 BONDING REQUIREMENTS

The ISPR bonding interface shall meet the requirement of SSP 30245, Space Station Electrical Bonding Requirements (NASA/JAXA) for a class R bond or COL-ESA-RQ-014, Columbus EMC & Power Quality Requirements (ESA).

3.3.2 THERMAL INTERFACES

3.3.2.1 MODERATE TEMPERATURE

Moderate Temperature (MT) single-phase water coolant shall be supplied at the ISPR interface for active heat acquisition and transport as a standard interface.

3.3.2.2 LOW TEMPERATURE

In the USL and JEM, Low Temperature (LT) single-phase water coolant shall be supplied at the ISPR interface for active heat acquisition and transport as a module specific interface.

3.3.2.3 MT SUPPLY TEMPERATURE

The supply temperature shall be in the range of 61 to 73.4 deg Fahrenheit (16 to 23 deg Celsius) for the MT water coolant.

3.3.2.4 LT SUPPLY TEMPERATURE

The supply temperature shall be in the range of 34 to 50 deg Fahrenheit (1 to 10 deg Celsius) for the LT water coolant.

3.3.2.5 MT RETURN TEMPERATURE

The maximum return temperature of the MT water coolant shall be 120 deg Fahrenheit (49 deg Celsius).

3.3.2.6 LT RETURN TEMPERATURE

The maximum return temperature of the LT water coolant shall be 70 deg Fahrenheit (21 deg Celsius).

3.3.2.7 MT SUPPLY PRESSURE

The maximum design pressure of the MT interface shall be less than or equal to 121 psi (834 kPa).

3.3.2.8 LT SUPPLY PRESSURE

The maximum design pressure of the LT interface shall be less than or equal to 121 psi (834 kPa).

3.3.2.9 MT INTERFACE DELTA PRESSURE

The module shall accommodate ISPRs with a pressure differential between the inlet and outlet of the MT interface of 5.8 psi (40 kPa) at the ISPR required flow rate.

3.3.2.10 LT INTERFACE DELTA PRESSURE

The module shall accommodate ISPRs with a pressure differential between the inlet and outlet of the LT interface of 5.8 psi (40 kPa) at the ISPR required flow rate.

3.3.2.11 MT/LT INTERFACE FLOW RATE

The module shall provide at the MT/LT interface the required flow rate for collection of the heat loads defined in section 3.3.1.2, based on the maximum temperature ranges defined in 3.3.2.3, 3.3.2.4, 3.3.2.5 and 3.3.2.6.

3.3.2.12 ISPR HEAT TRANSPORT FLUID LEAKAGE RATE

The module shall accommodate a ISPR heat transport fluid leakage rate of 9×10^{-3} scc of H₂O/hr for each of the MT and LT interfaces.

3.3.2.13 DELIVERY OF ISPR

ISPRs shall be delivered on-orbit charged with water as specified in 3.3.2.14.

3.3.2.14 WATER COOLANT CHARACTERISTICS

The water coolant characteristics of the MT and LT water coolant shall be as specified in SSP 30573, Fluid Procurement and Use Control Specification.

3.3.2.15 INTERFACE COMMAND AND CONTROL

System instrumentation and controls for both LT and MT water cooling at ISPR locations shall be located on the module side of the interface to accommodate control of the internal water cooling system by the module.

3.3.3 ENVIRONMENTAL CONTROL & LIFE SUPPORT INTERFACES

3.3.3.1 FIRE DETECTION

Fire detection instrumentation shall be accommodated internal to ISPRs.

3.3.3.2 FIRE SUPPRESSION

The ISPR shall accommodate the application of a fire suppressant via a portable fire extinguisher.

3.3.3.2.1 FIRE SUPPRESSANT AGENT

The fire suppressant agent shall be CO₂.

3.3.3.3 GASEOUS NITROGEN INTERFACE

A single gaseous nitrogen line shall be provided as a standard interface.

3.3.3.3.1 GASEOUS NITROGEN PRESSURE

Gaseous nitrogen shall be supplied at a pressure range of 75 to 135 psi (517 to 931 kPa). The nominal pressure range while the nitrogen system is in use/flowing shall be 75 to 120 psia (517 to 827 kPa) and while not in use/flowing is 110 to 135 psia (758 to 931 kPa).

3.3.3.3.1.1 GASEOUS NITROGEN MAXIMUM DESIGN PRESSURE

The maximum design pressure shall be 200 psi (1379 kPa).

3.3.3.3.2 GASEOUS NITROGEN FLOW RATE

Gaseous nitrogen shall be supplied at a flow rate up to 12 lb/hr (5.5 kg/hr).

3.3.3.3.3 GASEOUS NITROGEN TEMPERATURE

Gaseous nitrogen shall be supplied at a temperature range of 60 to 113 deg Fahrenheit (15.6 to 45 deg Celsius).

3.3.3.3.4 GASEOUS NITROGEN INTERFACE CONTROL

Instrumentation and controls of the gaseous nitrogen interface shall be located within the ISPR to accommodate control of the interface by the payload.

3.3.3.4 DISTRIBUTED AVIONICS AIR COOLING

Distributed avionics air cooling equipment shall be located within the ISPR.

3.3.3.5 ISPR HEAT LEAK

The modules shall accommodate ISPR heat leaks into the cabin.

3.3.3.6 ISPR BIOLOGICAL LOADS

The modules shall accommodate ISPR biological loads (CO₂, O₂ and latent heat) into the cabin.

3.3.4 COMMAND AND DATA HANDLING INTERFACES

3.3.4.1 FIRE DETECTION

The modules shall provide connectivity to the ISPR located fire detection equipment, including monitoring of air circulation equipment for fire detection, via a discrete/analog interface.

3.3.4.2 PAYLOAD POWER CONTROL

Payload power control within the ISPR shall be provided by the payload.

3.3.4.2.1 MODULE SUPPORT

The modules shall support payload power control via the interface described in section 3.3.4.5, Standard Payload Bus Interface, or in section 3.3.4.6, Specific Payload Bus Interface.

3.3.4.3 PAYLOAD EMERGENCY, WARNING, CAUTION AND SAFING

Payload Emergency, Warning, Caution and Safing (EWACS) commands and data shall be communicated between the payload and the module via the interface described in section 3.3.4.5, Standard Payload Bus Interface, or in section 3.3.4.6, Specific Payload Bus Interface.

3.3.4.3.1 APM SPECIFIC PAYLOAD BUS INTERFACE

A dedicated hardwired interface shall be provided in the APM at all ISPR locations as a module specific interface for payload EWACS.

3.3.4.4 DISTRIBUTED AVIONICS AIR COOLING CONTROL

Control of the distributed avionics air cooling equipment located in the ISPR shall be provided by the payload.

3.3.4.4.1 MODULE SUPPORT

The modules shall support ISPR distributed avionics air cooling control via the interface described in section 3.3.4.5, Standard Payload Bus Interface, or in section 3.3.4.6, Specific Payload Bus Interface.

3.3.4.5 STANDARD PAYLOAD BUS INTERFACE

One connection to a payload bus using MIL–STD–1553B shall be provided at all ISPR locations as a standard interface to support payload command and control.

3.3.4.5.1 STANDARD PAYLOAD BUS INTERFACE IN THE JEM AND APM

In the JEM and APM the standard payload bus interface shall be accommodated as an extension of the USL standard payload bus.

3.3.4.5.2 DELETED

3.3.4.5.2.1 DELETED

3.3.4.5.2.2 DELETED

3.3.4.6 SPECIFIC PAYLOAD BUS INTERFACE

3.3.4.6.1 USL MODULE SPECIFIC PAYLOAD BUS INTERFACE

3.3.4.6.1.1 USL MODULE SPECIFIC PAYLOAD BUS INTERFACE WITH JEM

In the USL, one connection to a payload bus using MIL–STD–1553B shall be provided at all ISPR locations as an extension of the JEM module specific payload bus to support payload command and control of Japanese experiments located in the USL from the JEM.

3.3.4.6.1.2 USL MODULE SPECIFIC PAYLOAD BUS INTERFACE WITH APM

In the USL, one connection to a payload bus using MIL–STD–1553B shall be provided at all ISPR locations as an extension of the APM module specific payload bus to support payload command and control of European experiments located in the USL from the APM.

Note: The APM module specific payload bus deadfaces at the Node 2/APM interface as a future capability scar.

3.3.4.6.2 JEM MODULE SPECIFIC PAYLOAD BUS INTERFACE

In the JEM, an additional connection to a JEM payload bus using MIL-STD-1553B shall be provided at ISPR locations as a module specific interface.

3.3.4.6.3 APM MODULE SPECIFIC PAYLOAD BUS INTERFACE

In the APM, an additional connection to an APM payload bus using MIL-STD-1553B shall be provided at ISPR locations as a module specific interface.

3.3.4.6.3.1 TIME DISTRIBUTION FOR THE APM MODULE SPECIFIC PAYLOAD BUS

Time shall be distributed to the ISPRs with a maximum error at the ISPR interface of 20 msec with respect to time provided to the APM by the SSMB Command and Control Buses at the SSMB/APM interface plane.

3.3.4.7 TIME DISTRIBUTION

Time shall be distributed to the ISPRs via the standard payload bus interface described in 3.3.4.5.

3.3.4.7.1 TIME DISTRIBUTION ACCURACY

The maximum error at the ISPR interface with respect to time at the Space Station Global Positioning System receiver shall be 5 msec.

3.3.4.7.1.1 DELETED

3.3.4.8 MAINTENANCE POWER SWITCH CONTROL

The modules shall provide connectivity to the ISPR located maintenance power switch to remove power to the ISPR.

3.3.4.9 MODULE SPECIFIC ETHERNET INTERFACES

3.3.4.9.1 TELEMETRY ETHERNET LOCAL AREA NETWORK INTERFACES IN THE USL

In the USL, one connection to the Telemetry Ethernet Local Area Network (LAN) shall be provided at all ISPR locations as a module specific interface.

3.3.4.9.2 PAYLOAD TO PAYLOAD ETHERNET LOCAL AREA NETWORK INTERFACE IN THE USL

In the USL, one connection to the Payload to Payload Ethernet LAN shall be provided at all ISPR locations as a module specific interface.

3.3.4.9.3 USL MODULE SPECIFIC ETHERNET ELECTRICAL CHARACTERISTICS

Electrical characteristics for the Ethernet LANs shall conform to the standards as specified in ANSI/IEEE 802.3, 1993 edition CSMA/CD LAN spec., Type 10 Base T with the exception of the medium being twisted shielded pair instead of twisted pair.

3.3.4.9.4 ETHERNET LOCAL AREA NETWORK INTERFACES IN THE APM

The APM shall provide a non-redundant Ethernet LAN interface at all ISPR locations as a module specific interface for the purpose of transmitting US payload via the NASA supplied PEHG in the SSMB.

3.3.4.10 KU_BAND RECEIVER INTERFACE IN USL

In the USL, one connection shall be provided for future Ku_band ground-to-surface link interface at the LAB1P1 location. The interface shall consist of a connector with a terminator. The coaxial cable shall penetrate the utility interface panel through a protected hole.

3.3.5 VIDEO INTERFACE

3.3.5.1 OPTICAL VIDEO INTERFACE

A single connector with three fiber optic lines shall be provided as a standard interface option in the US Lab and APM to allow for a Pulse Frequency Modulation (PFM) compatible video signal reception*, video transmission and synchronization.

Note: For APM video interface for post flight 1E implementation of the APM enhanced video system, refer to paragraph 3.3.5.4.

*Note: The following ISPR locations do not allow PFM compatible video signal reception: LAB1P2, LAB1P4, LAB1S3, LAB1O1, LAB1O2, LAB1O3, LAB1O4, and LAB1O5.

3.3.5.1.1 MODULE OPTICAL PFM NTSC VIDEO POWER LEVELS

The Module shall transmit optical PFM NTSC video and sync and control signals to the ISPR at the minimum optical power levels shown in Table 3.3.5.1.1-1 (Module Side-Output), Video Interface Module Optical Power Levels.

The Module shall provide a minimum receiving capability in accordance with Table 3.3.5.1.2-1 (Module Side-Input), Video Interface ISPR Optical Power Levels.

TABLE 3.3.5.1.1-1 VIDEO INTERFACE MODULE OPTICAL POWER LEVELS

Signal Name	INTERFACE (1)	
Signal Name	ISPR Side Optical Power Levels (Input)	Module Side Optical Power Levels (Output)
Module VIDEO	- 21.0 ⁽³⁾	- 20.0 ⁽²⁾
Module SYNC	- 21.0 ⁽³⁾	- 20.0 ⁽²⁾

Note: 1) Optical Power Levels are dBm average 50 percent duty cycle, measured at ambient temperature

Note: 2) USL LAB1P1 location is -22.2 dBm

Note: 3) USL LAB1P1 location is -23.9 dBm

3.3.5.1.2 ISPR OPTICAL PFM NTSC VIDEO POWER LEVELS

The ISPR shall transmit optical PFM NTSC video signals to the Module at the minimum optical power levels shown in Table 3.3.5.1.2-1 (ISPR Side-Output), Video Interface ISPR Optical Power Levels.

The ISPR shall provide a minimum receiving capability in accordance with Table 3.3.5.1.1-1 (ISPR Side-Input), Video Interface Module Optical Power Levels.

TABLE 3.3.5.1.2-1 VIDEO INTERFACE ISPR OPTICAL POWER LEVELS

Signal Name	INTERFACE (1)	
Signal Name	ISPR Side Optical Power Levels (Output)	Module Side Optical Power Levels (Input)
ISPR VIDEO	- 15.5	- 16.5

Note: 1) Optical Power Levels are dBm average 50 percent duty cycle, measured at ambient temperature

3.3.5.2 ELECTRICAL VIDEO INTERFACE

A single connector with three electrical interfaces shall be provided as a module specific interface in the JEM for video signal reception, video transmission and synchronization.

3.3.5.3 VIDEO STANDARD

The ISPR video standard shall be in accordance to the NTSC video standard, EIA-RS-170A, EIA Industrial Electronics Tentative Standard No. 1 – Color TV Studio Picture Line Amplifier Output Drawing. In addition, any other European Video Standard with compatible PFM spectrum format may be used in the APM.

3.3.5.4 APM VIDEO INTERFACE

Note: The interface described in paragraphs below will become available with APM video Mark II post flight 1E.

3.3.5.4.1 ELECTRICAL VIDEO INTERFACE

A single connector for electrical digital video signal shall be provided as a module specific interface in Columbus for video signal reception, video transmission and synchronization.

3.3.5.4.2 OPTICAL VIDEO INTERFACE

An optical video interface with functionality as described in paragraph 3.3.5.1 shall be provided alternatively to the electrical video interface by means of an optical/electrical video signal converter connected to the electrical video system interface of the module and interfacing to the ISPR.

3.3.6 HIGH RATE DATA

A single connector with two fiber optic lines shall be provided at all ISPR locations as a standard interface for high rate data, with a capability of 100 Mbps each. An additional fiber optic line shall be provided in the same connector at each ISPR location as a module specific interface in the JEM.

3.3.6.1 HIGH RATE DATA PHYSICAL LAYER PROTOCOL

The high rate data physical layer protocol shall be as described in ISO 9314-1, Fiber Distributed Data Interface Physical Layer Protocol.

3.3.6.2 HIGH RATE DATA LINK INPUT CHARACTERISTICS

The USL and JEM module shall provide the capability to receive a high rate data signal from the ISPR at a minimum signal strength of -16.75 dBm average power, and a maximum signal strength of -8.3 dBm average power. The APM module optical loss shall be in accordance with SSP 41150.

The ISPR shall provide the capability to receive a high rate data signal from the module at a minimum signal strength of -30.45 dBm average power, and a maximum signal strength of -8.5 dBm average power.

3.3.6.3 HIGH RATE DATA LINK OUTPUT CHARACTERISTICS

The USL and JEM module shall provide the capability to transmit a high rate data signal to the ISPR at a minimum signal strength of -30.45 dBm average power, and a maximum signal strength of -8.5 dBm average power. The APM module optical loss shall be in accordance with SSP 41150.

The ISPR shall provide the capability to transmit a high rate data signal to the module at a minimum signal strength of -16.75 dBm average power, and a maximum signal strength of -8.3 dBm average power.

3.3.7 WASTE GAS INTERFACE

For the USL and APM, a single waste gas vent line interface for the disposal of gaseous payload waste compatible with the waste gas system wetted materials defined in sections 3.3.7.2.1 and 3.3.7.2.2 of SSP 41002, capable of reaching a pressure at the interface of 1×10^{-3} torr (1.3×10^{-3} mbar) in less than 2 hours for a single payload of 100 liters bell jar volume, or less than 3.5 hours for 250 liters, starting at an initial pressure of 1 bar, filled with dry air at a temperature of 70 deg Fahrenheit (21 deg Celsius), assuming zero leakage and out/off gassing and infinite conductivity between the bell jar and the rack interface, shall be provided as a standard interface.

For the JEM, a single waste gas vent line interface for the disposal of non-toxic and non-reactive gaseous payload waste, capable of reaching a pressure at the interface of 1×10^{-3} torr (1.3×10^{-3} mbar) in less than 2 hours for a single payload of 100 liters bell jar volume, or less than 3.5 hours for 250 liters, starting at an initial pressure of 1 bar, filled with dry air at a temperature of 70 deg Fahrenheit (21 deg Celsius), assuming zero leakage and out/off gassing and infinite conductivity between the bell jar and the rack interface, shall be provided as a standard interface.

3.3.7.1 DELETED

3.3.7.2 WASTE GAS PRESSURE

The maximum design pressure at the waste gas interface shall be 40 psi (276 kPa).

3.3.7.3 WASTE GAS TEMPERATURE

The waste gas interface temperature shall be in the range of 60 to 113 deg Fahrenheit (16 to 45 deg Celsius).

3.3.7.4 WASTE GAS INTERFACE CONTROL

System instrumentation and controls for waste gas venting at ISPR locations shall be located on the module side of the interface to accommodate control of the waste gas system by the module.

3.3.8 VACUUM INTERFACES

In the United States On-orbit Segment (USOS) and the JEM, a single vacuum line capable of maintaining a single payload bell jar at 1.0×10^{-3} torr (0.13 Pa) or less assuming the total gas load, including leakage and out/off gassing, does not exceed 0.1 Pa liters/sec., shall be provided as a standard interface option.

In the APM, a single vacuum line capable of maintaining a single payload bell jar at 1.68×10^{-3} torr (0.228 Pa) or less assuming the total gas load, including leakage and out/off gassing, does not exceed 0.1 Pa liters/sec., shall be provided as a standard interface option.

3.3.8.1 VACUUM INTERFACE CONTROL

System instrumentation and controls for the vacuum line shall be located on the module side of the interface to accommodate control of the vacuum system by the module.

3.3.9 ARGON GAS INTERFACES

A single gaseous argon line shall be provided as a JEM module specific interface.

3.3.9.1 GASEOUS ARGON PRESSURE

Gaseous argon shall be supplied at a pressure of up to 114 psi (786 kPa).

3.3.9.2 GASEOUS ARGON FLOW RATE

Gaseous argon shall be supplied at a flow rate of up to 10 NI/min.

3.3.9.3 GASEOUS ARGON TEMPERATURE

Gaseous argon shall be supplied at a temperature range of 55 to 113 deg Fahrenheit (13 to 45 deg Celsius).

3.3.9.4 ARGON GAS INTERFACE CONTROL

Instrumentation and controls of the argon interface shall be located within the ISPR to accommodate control of the interface by the payload.

3.3.10 HELIUM GAS INTERFACES

A single gaseous helium line shall be provided as a JEM module specific interface.

3.3.10.1 GASEOUS HELIUM PRESSURE

Gaseous helium shall be supplied at a pressure of up to 114 psi (786 kPa).

3.3.10.2 GASEOUS HELIUM FLOW RATE

Gaseous helium shall be supplied at a flow rate of up to 10 NI/min.

3.3.10.3 GASEOUS HELIUM TEMPERATURE

Gaseous helium shall be supplied at a temperature range of 55 to 113 deg Fahrenheit (13 to 45 deg Celsius).

3.3.10.4 HELIUM GAS INTERFACE CONTROL

Instrumentation and controls of the helium interface shall be located within the ISPR to accommodate control of the interface by the payload.

3.3.11 CARBON DIOXIDE GAS INTERFACES

A single gaseous CO₂ line shall be provided as a JEM module specific interface.

3.3.11.1 GASEOUS CARBON DIOXIDE PRESSURE

Gaseous CO₂ shall be supplied at a pressure of up to 114 psi (786 kPa).

3.3.11.2 GASEOUS CARBON DIOXIDE FLOW RATE

Gaseous CO₂ shall be supplied at a flow rate of up to 5 NI/min.

3.3.11.3 GASEOUS CARBON DIOXIDE TEMPERATURE

Gaseous CO₂ shall be supplied at a temperature range of 55 to 113 deg Fahrenheit (13 to 45 deg Celsius).

3.3.11.4 CARBON DIOXIDE GAS INTERFACE CONTROL

Instrumentation and controls of the CO₂ interface shall be located within the ISPR to accommodate control of the interface by the payload.

4.0 INTERFACE VERIFICATION

Each interface requirement defined in Section 3 of this IRD shall be verified on ground prior to the launch of the APM/JEM/USL/ISPR, unless otherwise specified, at the appropriate system/element level.

Section 4.1 defines individual and shared ESA, JAXA, ISPR agent and NASA responsibilities for the performance of the ISPR IRD Verification Program, and the general methods and procedures to be complied with during the ISS verification process. It also assigns verification responsibilities, as appropriate, to each IRD Partner for the applicable portion of the Interface design.

Section 4.2 defines the verification methods, and general criteria for applying them, to define the ISPR IRD Joint Verification Program.

Section 4.3 contains the Joint interface verification requirements. Each Section 4.3 verification paragraph corresponds to a Section 3 requirement paragraph in this IRD. Each verification requirement paragraph includes a description of the Joint verification method, the verification conditions and the verification success criteria.

The ISS interface verification process is described in the Program Master Integration and Verification Plan, D684-10020-1. Verification details, including facilities, support equipment and personnel required to perform International Partner interface verification activities are defined in the NASA-NASDA Bilateral Integration and Verification Plan, SSP 50035 for JEM, and the NASA-ESA Bilateral Integration and Verification Plan, SSP 50034, for JAXA and ESA respectively.

4.1 RESPONSIBILITIES

Each Partner is responsible to allocate the interface verification requirements defined in this IRD to the relevant Space Station/JEM/APM design specifications, without this being interpreted as a requirement to perform the verification more than once. Further, it is the responsibility of each Partner to establish and control the traceability between each of the Interface Requirements defined in this IRD and the corresponding design implementation data, as documented in the relevant ICD.

The Agency responsible for the design of the hardware or software which represents a mating side of the interface to be verified, is responsible for the verification that their own system/element is in compliance with the interface requirements established in the IRD, and that the “as built” status is in compliance with the associated ICD. This stand-alone verification activity may require support from the other Partner in the form of hardware, software and documentation. Stand-alone verification activities are not controlled by this IRD. Table 4-1, International Standard Payload Rack Interface Verification Matrix, lists the NASA/ESA/JAXA/ISPR agent individual verification responsibility for their own side of the interface as part of their independent (stand-alone) verification activities. The ESA stand-alone verification requirements are provided in COL-ESA-RQ-032, Columbus External Interfaces Verification Requirements. Stand-alone verification requirements for NASA and JAXA are provided in their respective Individual Verification Visibility Reports.

In the event stand-alone verification of each of the two mating parts of an interface is not sufficient and that active participation from the other Partner is necessary to fully verify the compliance with the IRD requirements, the Agencies involved are then jointly responsible for the successful completion of the interface verification. Active participation includes provision of hardware/software from one partner to the other for verification/integration and one or more of the following: installation and/or training in the operation of the provided hardware/software, development of verification objectives, verification planning, verification implementation and documentation, requirement compliance determination and documentation. Table 4-1 identifies the interface requirements and verification methods where this joint effort is requested. The lead and support responsibilities of each partner for the joint verification will be bilaterally agreed and specified in SSP 50035 for JEM, and SSP 50034 for APM. Only joint verification requirements are controlled by this IRD.

It is the responsibility of each Partner to transfer the applicability of the requirements contained in this IRD to the relevant ISPR sponsoring Agent and to guarantee their proper verification.

The close-out documentation produced by each Partner and ISPR agent to demonstrate the achieved verification of the IRD will be made available to the other Partner for consultation at one agreed location. Each of these documents shall precisely identify the IRD requirements that are verified and the corresponding close-out results.

4.2 INTERFACE VERIFICATION METHODS

The methods of verification are: Analysis/Similarity, Review of Design, Inspection, Demonstration and Test, or combination thereof, as defined below.

These methods refer to verification techniques which, at NASA, JAXA and ESA, are sometimes grouped in different categories. Typically, interfaces verified at ESA by Review of Design, would be verified at NASA by Inspection; similarly, some interfaces verified at NASA by Demonstration would be verified at ESA by Testing. In any case, while occasionally the verification method may differ in denomination, the actual verification process is identical, whatever is the assigned category.

The specific verification methods to be used to verify the interface description of Chapter 3 of this IRD are specified in the enclosed Table 4-1 for the joint verification activities of interface requirements. Chapter 3 paragraphs which are not applicable to verification either because not relevant to one of the Partner or because containing a descriptive “non-verifiable” information, are indicated in the table as Not Applicable (NA).

4.2.1 ANALYSIS/SIMILARITY

Analysis is verification by technical or mathematical models or simulation, algorithms, charts, graphs, or circuit diagrams, and representative data.

Analysis utilizes proven analytical techniques and tools such as engineering analysis, mathematical modeling, earlier obtained test data, simulations, analytical assessments, etc.

Analysis is used when flight or actual operation conditions can not be simulated adequately on ground. Analysis is also used in support to tests, where the wide spectrum of conditions prohibits testing of all conceivable configurations. Analytical methods selected for qualification shall be supported by appropriate rationale, recorded in the relevant verification documents.

Similarity is the verification method to be applied where it can be shown that the article is similar or identical in design, manufacturing process and quality standards to another article that has been previously qualified to equivalent or more stringent criteria.

4.2.2 REVIEW OF DESIGN

Review of Design is the verification method used by ESA or JAXA to verify specific design implementation requirements by use of approved lower level documentation.

Review of Design consists in utilizing approved design reports, technical descriptions, and/or engineering drawings to unambiguously demonstrate that the interface is designed as documented in the ICD.

Review of Design items are verified at an early program phase, and formalized at Preliminary Design Review or latest, for the still open aspects, at Critical Design Review.

4.2.3 INSPECTION

Inspection is verification by visual examination of the item, or reviewing descriptive documentation, and comparing the appropriate characteristics with predetermined standards to determine conformance to requirements without the use of special laboratory equipment or procedures.

Inspection verifies the compliance of the flight article with the design requirements of physical characteristics as construction features, visible workmanship, physical condition and finish, interface dimensions, etc. by use of standard visual and/or other non-destructive means.

Inspection on NASA's side also includes the examination of documentation and/or software, already covered by ESA under Review of Design.

4.2.4 DEMONSTRATION

Demonstration is verification by operation, adjustment or reconfiguration of items performing their designed functions under specific scenarios. The items may be instrumented and quantitative limits or performance monitored, but only check sheets rather than actual performance data are required to be recorded.

Demonstration is a qualitative method of verification that evaluates the properties of the verification item by observation.

Demonstration is used with or without special test equipment or instrumentation, to verify required characteristics such as operational performance, human engineering features, service and access features, transportability and displayed data. Interface demonstration should preferably be performed on flight hardware, but high fidelity simulators, mock-ups and models may be used, as defined in the specific element verification plans.

Demonstration verification on ESA's side is covered as part of the Test activities.

4.2.5 TEST

Test is verification through systematic exercising of the item under all appropriate conditions. Performance is quantitatively measured either during or after the controlled application of either real or simulated functional or environmental stimuli. The analysis of data derived from a test is an integral part of the test and may involve automated data reduction to produce the necessary results.

Verification by test is the method to determine the interface properties and performance by mechanical, electrical, environmental and functional measurement during or after the controlled application of functional and/or environmental stimuli.

Measurements may require the use of laboratory equipment, recorded data, procedures, test support items, or services. Interface verification can be performed on flight hardware, on high fidelity simulators/mock-ups, and on dedicated engineering or qualification models, as defined in the specific element verification plans.

4.3 JOINT INTERFACE VERIFICATION REQUIREMENTS

There are no Joint Verification activities identified for the Section 3 requirements of this IRD.

TABLE 4-1 INTERNATIONAL STANDARD PAYLOAD RACK INTERFACE VERIFICATION MATRIX (PAGE 1 OF 7)

VERIFICATION METHOD A – Analysis/Similarity D – Demonstration T – Test X – Applicable Individually NA – Not Applicable						
Section 3 Paragraphs	TITLE	VERIFICATION METHOD				JOINT METHOD
		NASA	ESA	JAXA	ISPR	
3.0	REQUIREMENTS	TITLE				
3.1	PAYLOAD RACK INTERCHANGEABILITY	TITLE				
3.1.1	MODULE INTERFACES	X	X	X	NA	NA
3.1.1.1	ISPR ENVELOPE	X	X	X	NA	NA
3.1.2	INTERFACE TYPES	TITLE				
3.1.2.1	STANDARD INTERFACES	X	X	X	NA	NA
3.1.2.2	STANDARD INTERFACE OPTIONS	X	X	X	NA	NA
3.1.2.3	MODULE SPECIFIC INTERFACES	X	X	X	NA	NA
3.1.3	RACK TO INTERFACE COMPATIBILITY	TITLE				
3.1.3.1	STANDARD INTERFACE COMPATIBILITY	X	X	X	X	NA
3.1.3.2	STANDARD INTERFACE OPTION COMPATIBILITY	X	X	X	X	NA
3.1.3.3	MODULE SPECIFIC INTERFACE COMPATIBILITY	X	X	X	X	NA
3.2	ISPR INTERFACES	TITLE				
3.2.1	MECHANICAL INTERFACES	X	X	X	X	NA
3.2.2	UTILITY INTERFACE PANEL	X	X	X	NA	NA
3.2.2.1	UTILITY INTERFACE PANEL LAYOUT	X	X	X	NA	NA
3.2.3	STRUCTURAL INTERFACES	TITLE				
3.2.3.1	ON-ORBIT LIMIT LOADS	X	X	X	X	NA
3.3	SYSTEM INTERFACES	TITLE				
REMARKS						

TABLE 4-1 INTERNATIONAL STANDARD PAYLOAD RACK INTERFACE VERIFICATION MATRIX (PAGE 2 OF 7)

VERIFICATION METHOD A – Analysis/Similarity D – Demonstration T – Test X – Applicable Individually NA – Not Applicable						
Section 3 Paragraphs	TITLE	VERIFICATION METHOD				JOINT METHOD
		NASA	ESA	JAXA	ISPR	
3.3.1	POWER INTERFACES	TITLE				
3.3.1.1	POWER CHARACTERISTICS	X	X	X	NA	NA
3.3.1.2	ISPR MAIN POWER	TITLE				
3.3.1.2.1	3KW	X	X	X	NA	NA
3.3.1.2.2	6KW	X	X	X	NA	NA
3.3.1.2.3	12KW	X	NA	NA	NA	NA
3.3.1.3	ISPR ESSENTIAL/AUXILIARY POWER	X	X	X	NA	NA
3.3.1.4	MAIN POWER CONNECTOR RATING	X	X	X	NA	NA
3.3.1.5	ESSENTIAL/AUXILIARY POWER CONNECTOR RATING	X	X	X	NA	NA
3.3.1.5.1	12KW ISPR LOCATIONS	X	NA	NA	NA	NA
3.3.1.6	GROUNDING REQUIREMENTS	X	X	X	X	NA
3.3.1.7	BONDING REQUIREMENTS	X ¹⁾	X ¹⁾	X ¹⁾²⁾	X	NA
3.3.2	THERMAL INTERFACES	TITLE				
3.3.2.1	MODERATE TEMPERATURE	X	X	X	NA	NA
3.3.2.2	LOW TEMPERATURE	X	NA	X	NA	NA
3.3.2.3	MT SUPPLY TEMPERATURE	X	X	X	NA	NA
3.3.2.4	LT SUPPLY TEMPERATURE	X	NA	X	NA	NA
3.3.2.5	MT RETURN TEMPERATURE	X	X	X	X	NA
3.3.2.6	LT RETURN TEMPERATURE	X	NA	X	X	NA
3.3.2.7	MT SUPPLY PRESSURE	X	X	X	NA	NA
REMARKS						
1) Qualification of Boeing provided non-standard Camlock fasteners will be done by Boeing covering Boeing & JAXA rack structures. ESA & JAXA qualification responsibility is limited to inspection of critical dimensions and surface finishes.						
2) Qualification of Boeing Requirement for standard Camlock fasteners.						

TABLE 4-1 INTERNATIONAL STANDARD PAYLOAD RACK INTERFACE VERIFICATION MATRIX (PAGE 3 OF 7)

VERIFICATION METHOD A – Analysis/Similarity D – Demonstration T – Test X – Applicable Individually NA – Not Applicable						
Section 3 Paragraphs	TITLE	VERIFICATION METHOD				JOINT METHOD
		NASA	ESA	JAXA	ISPR	
3.3.2.8	LT SUPPLY PRESSURE	X	NA	X	NA	NA
3.3.2.9	MT INTERFACE DELTA PRESSURE	X	X	X	NA	NA
3.3.2.10	LT INTERFACE DELTA PRESSURE	X	NA	X	NA	NA
3.3.2.11	MT/LT INTERFACE FLOW RATE	X	X	X	NA	NA
3.3.2.12	ISPR HEAT TRANSPORT FLUID LEAKAGE RATE	X	X	X	NA	NA
3.3.2.13	DELIVERY OF ISPR	NA	NA	NA	X	NA
3.3.2.14	WATER COOLANT CHARACTERISTICS	X	X	X	NA	NA
3.3.2.15	INTERFACE COMMAND AND CONTROL	X	X	X	NA	NA
3.3.3	ENVIRONMENTAL CONTROL & LIFE SUPPORT INTERFACES	TITLE				
3.3.3.1	FIRE DETECTION	NA	NA	NA	X	NA
3.3.3.2	FIRE SUPPRESSION	NA	NA	NA	X	NA
3.3.3.2.1	FIRE SUPPRESSION AGENT	X	X	X	NA	NA
3.3.3.3	GASEOUS NITROGEN INTERFACE	X	X	X	NA	NA
3.3.3.3.1	GASEOUS NITROGEN PRESSURE	X	X	X	NA	NA
3.3.3.3.1.1	GASEOUS NITROGEN MAXIMUM DESIGN PRESSURE	X	X	X	NA	NA
3.3.3.3.2	GASEOUS NITROGEN FLOW RATE	X	X	X	NA	NA
3.3.3.3.3	GASEOUS NITROGEN TEMPERATURE	X	X	X	NA	NA
3.3.3.3.4	GASEOUS NITROGEN INTERFACE CONTROL	NA	NA	NA	X	NA
3.3.3.4	DISTRIBUTED AVIONICS AIR COOLING	NA	NA	NA	X	NA
REMARKS						

TABLE 4-1 INTERNATIONAL STANDARD PAYLOAD RACK INTERFACE VERIFICATION MATRIX (PAGE 4 OF 7)

VERIFICATION METHOD A – Analysis/Similarity D – Demonstration T – Test X – Applicable Individually NA – Not Applicable						
Section 3 Paragraphs	TITLE	VERIFICATION METHOD				JOINT METHOD
		NASA	ESA	JAXA	ISPR	
3.3.3.5	ISPR HEAT LEAK	X	X	X	NA	NA
3.3.3.6	ISPR BIOLOGICAL LOADS	X	X	X	NA	NA
3.3.4	COMMAND AND DATA HANDLING INTERFACES	TITLE				
3.3.4.1	FIRE DETECTION	X	X	X	NA	NA
3.3.4.2	PAYLOAD POWER CONTROL	NA	NA	NA	X	NA
3.3.4.2.1	MODULE SUPPORT	X	X	X	NA	NA
3.3.4.3	PAYLOAD EMERGENCY, WARNING, CAUTION AND SAFING	X	X	X	X	NA
3.3.4.3.1	APM SPECIFIC PAYLOAD INTERFACE	NA	X	NA	NA	NA
3.3.4.4	DISTRIBUTED AVIONICS AIR COOLING CONTROL	NA	NA	NA	X	NA
3.3.4.4.1	MODULE SUPPORT	X	X	X	NA	NA
3.3.4.5	STANDARD PAYLOAD BUS INTERFACE	X	X	X	NA	NA
3.3.4.5.1	STANDARD PAYLOAD BUS INTERFACE IN THE JEM AND APM	NA	X	X	NA	NA
3.3.4.5.2	DELETED	TITLE				
3.3.4.5.2.1	DELETED					
3.3.4.5.2.2	DELETED					
3.3.4.6	SPECIFIC PAYLOAD BUS INTERFACE	TITLE				
3.3.4.6.1	USL MODULE SPECIFIC PAYLOAD BUS INTERFACE	TITLE				
3.3.4.6.1.1	USL MODULE SPECIFIC PAYLOAD BUS INTERFACE WITH JEM	X	NA	NA	NA	NA
3.3.4.6.1.2	USL MODULE SPECIFIC PAYLOAD BUS INTERFACE WITH APM	X	NA	NA	NA	NA
REMARKS						

TABLE 4-1 INTERNATIONAL STANDARD PAYLOAD RACK INTERFACE VERIFICATION MATRIX (PAGE 5 OF 7)

VERIFICATION METHOD A – Analysis/Similarity D – Demonstration T – Test X – Applicable Individually NA – Not Applicable						
Section 3 Paragraphs	TITLE	VERIFICATION METHOD				JOINT METHOD
		NASA	ESA	JAXA	ISPR	
3.3.4.6.2	JEM MODULE SPECIFIC PAYLOAD BUS INTERFACE	NA	NA	X	NA	NA
3.3.4.6.3	APM MODULE SPECIFIC PAYLOAD BUS INTERFACE	NA	X	NA	NA	NA
3.3.4.6.3.1	TIME DISTRIBUTION FOR THE APM MODULE SPECIFIC PAYLOAD BUS	NA	X	NA	NA	NA
3.3.4.7	TIME DISTRIBUTION	X	X	NA	NA	NA
3.3.4.7.1	TIME DISTRIBUTION ACCURACY	X	NA	NA	NA	NA
3.3.4.8	MAINTENANCE POWER SWITCH CONTROL	X	X	X	X	NA
3.3.4.9	MODULE SPECIFIC ETHERNET INTERFACES	TITLE				
3.3.4.9.1	TELEMETRY ETHERNET LOCAL AREA NETWORK INTERFACES IN THE USL	X	NA	NA	NA	NA
3.3.4.9.2	PAYLOAD TO PAYLOAD ETHERNET LOCAL AREA NETWORK INTERFACE IN THE USL	X	NA	NA	NA	NA
3.3.4.9.3	USL MODULE SPECIFIC ETHERNET ELECTRICAL CHARACTERISTICS	X	NA	NA	NA	NA
3.3.4.9.4	ETHERNET LOCAL AREA NETWORK INTERFACE IN THE APM	NA	X	NA	NA	NA
3.3.4.10	KU BAND RECEIVER INTERFACES IN THE USL	X	NA	NA	NA	NA
3.3.5	VIDEO INTERFACE	TITLE				
3.3.5.1	OPTICAL VIDEO INTERFACE	X	X	NA	NA	NA
3.3.5.1.1	MODULE OPTICAL PFM NTSC VIDEO POWER LEVELS	X	X	NA	NA	NA
3.3.5.1.2	ISPR OPTICAL PFM NTSC VIDEO POWER LEVELS	NA	NA	NA	X	NA
REMARKS						

TABLE 4-1 INTERNATIONAL STANDARD PAYLOAD RACK INTERFACE VERIFICATION MATRIX (PAGE 6 OF 7)

VERIFICATION METHOD A – Analysis/Similarity D – Demonstration T – Test X – Applicable Individually NA – Not Applicable						
Section 3 Paragraphs	TITLE	VERIFICATION METHOD				JOINT METHOD
		NASA	ESA	JAXA	ISPR	
3.3.5.2	ELECTRICAL VIDEO INTERFACE	NA	NA	X	NA	NA
3.3.5.3	VIDEO STANDARD	X	X	X	X	NA
3.3.6	HIGH RATE DATA	X	X ¹	X ¹	NA	NA
3.3.6.1	HIGH RATE DATA PHYSICAL LAYER PROTOCOL	X	X	X	NA	NA
3.3.6.2	HRDL INPUT CHARACTERISTICS	X	X	X	X	NA
3.3.6.3	HRDL OUTPUT CHARACTERISTICS	X	X	X	X	NA
3.3.7	WASTE GAS INTERFACE	X	X	X	NA	NA
3.3.7.1	DELETED					
3.3.7.2	WASTE GAS PRESSURE	X	X	X	X	NA
3.3.7.3	WASTE GAS TEMPERATURE	X	X	X	X	NA
3.3.7.4	WASTE GAS INTERFACE CONTROL	X	X	X	NA	NA
3.3.8	VACUUM INTERFACE	X	X	X	NA	NA
3.3.8.1	VACUUM INTERFACE CONTROL	X	X	X	NA	NA
3.3.9	ARGON GAS INTERFACES	NA	NA	X	NA	NA
3.3.9.1	GASEOUS ARGON PRESSURE	NA	NA	X	NA	NA
3.3.9.2	GASEOUS ARGON FLOW RATE	NA	NA	X	NA	NA
3.3.9.3	GASEOUS ARGON TEMPERATURE	NA	NA	X	NA	NA
3.3.9.4	ARGON GAS INTERFACE CONTROL	NA	NA	NA	X	NA
3.3.10	HELIUM GAS INTERFACES	NA	NA	X	NA	NA
3.3.10.1	GASEOUS HELIUM PRESSURE	NA	NA	X	NA	NA
3.3.10.2	GASEOUS HELIUM FLOW RATE	NA	NA	X	NA	NA
3.3.10.3	GASEOUS HELIUM TEMPERATURE	NA	NA	X	NA	NA
3.3.10.4	HELIUM GAS INTERFACE CONTROL	NA	NA	NA	X	NA
REMARKS						
1) Not responsible for the verification of the 100 Mbps data rate requirement but only for supplying the cable.						

TABLE 4-1 INTERNATIONAL STANDARD PAYLOAD RACK INTERFACE VERIFICATION MATRIX (PAGE 7 OF 7)

VERIFICATION METHOD A – Analysis/Similarity D – Demonstration T – Test X – Applicable Individually NA – Not Applicable						
Section 3 Paragraphs	TITLE	VERIFICATION METHOD				JOINT METHOD
		NASA	ESA	JAXA	ISPR	
3.3.11	CARBON DIOXIDE GAS INTERFACE	NA	NA	X	NA	NA
3.3.11.1	GASEOUS CARBON DIOXIDE PRESSURE	NA	NA	X	NA	NA
3.3.11.2	GASEOUS CARBON DIOXIDE FLOW RATE	NA	NA	X	NA	NA
3.3.11.3	GASEOUS CARBON DIOXIDE TEMPERATURE	NA	NA	X	NA	NA
3.3.11.4	CARBON DIOXIDE GAS INTERFACE CONTROL	NA	NA	NA	X	NA
REMARKS						

APPENDIX A ABBREVIATIONS AND ACRONYMS

A.1 CONTROL AUTHORITY

Appendix A is not subject to SSCB change control. Responsibility for control of configuration management abbreviations and acronyms changes is delegated to Configuration Management.

This appendix will be reviewed as required and changes will be issued as replacement pages or by complete revision of the appendix as appropriate. All requested changes will be directed to Configuration Management.

A.2 ABBREVIATIONS AND ACRONYMS

APM	Attached Pressurized Module
CO ₂	Carbon dioxide
CSMA/CD	Carrier Sense/Served Multiple Access with Collision Detection
dBm	Decibels per milliwatts
DCN	Document Change Notice
deg	Degree
ECP	Engineering Change Proposal
EPS	Electrical Power System
ESA	European Space Agency
EWACS	Emergency, Warning, Caution and Safing
H ₂ O	Water
hr	hour
ICD	Interface Control Document
IRD	Interface Requirements Document
ICWG	Interface Control Working Group
in	inches
ISPR	International Standard Payload Rack
JAXA	Japan Aerospace Exploration Agency
JEM	Japanese Experiment Module
kg	Kilogram
kPa	Kilopascals
kW	Kilowatt
LAN	Local Area Network

LAB1P1	Laboratory Module # 1 Port Bay # 1
LAB1O	Laboratory Module #1 Overhead
LAB1S	Laboratory Module #1 Starboard
lb	pound
LT	Low Temperature
mbar	millibar
Mbps	Megabytes per second
mm	Millimeter
msec	Millisecond
MT	Moderate Temperature
NA	Not Applicable
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan
NI/min	Nominal liter per minute
NTSC	National Television Standard Committee
O ₂	oxygen
Pa	Pascal
PEHG	Payload Ethernet Hub Gateway
PFM	Pulse Frequency Modulation
psi	Pounds Per Square Inch
scc	Standard Cubic Centimeter
SCN	Specification Change Notice
sec	second
SSCB	Space Station Control Board
SSCBD	Space Station Control Board Directive
SSCD	Space Station Change Directive
SSCN	Space Station Change Notice
SSMB	Space Station Manned Base
SSP	Space Station Program
USL	United States Laboratory
USOS	United States On-orbit Segment

APPENDIX B ISSUE SHEETS