SSP 50309

Space Station Program
Node 3 to Habitation Module
Interface Control Document, Part 1

International Space Station Program

May 18, 1999

agenzia spaziale italiana
(Italian Space Agency)

National Aeronautics and Space Administration
International Space Station Program
Johnson Space Center
Houston, Texas

REVISION AND HISTORY PAGE

REV.	DESCRIPTION	PUB. DATE
–	Baseline Issue (Reference SSCBD 002409, EFF. 12–03–99)	02–02–00

NASA/ASI

INTERNATIONAL SPACE STATION PROGRAM

NODE 3 TO HABITATION MODULE INTERFACE CONTROL DOCUMENT

MAY 18, 1999

NASA ICWG Chairman	Ralph Grau	11/17/99
	Print Name	Date
	/s/ *Ralph Grau*	11/17/99
	Signature	
ASI ICWG Chairman	Maria Christina Falvella	10/27/99
	Print Name	Date
	/s/ *Maria Christina Valvella*	10/27/99
	Signature	
Alenia ICWG Chairman	Alessandro Bellomo	11/7/99
	Print Name	Date
	/s/ *Alessandro Bellomo*	11/7/99
	Signature	
Boeing Houston	Warren England	
	Print Name	Date
	/s/ *Warren England*	11/18/99
	Signature	
Boeing–Huntington Beach	N/A	
	Print Name	Date
	Signature	
DQA	Freddie Young	11/18/99
	Print Name	Date
	/s/ *Freddie Young*	11/18/99
	Signature	

NASA/ASI

INTERNATIONAL SPACE STATION PROGRAM

NODE 3 TO HABITATION MODULE INTERFACE CONTROL DOCUMENT

MAY 18, 1999

Alenia	/s/ *Walter Cugno* Walter Cugno	14/7/99 Date
ASI	/s/ *Maria Christina Falvella* Andrea Lorenzoni	10/27/99 Date
NASA–MSFC	/s/ *Robert Crumbley* Robert Crumbley	7/15/99 Date

INTERNATIONAL SPACE STATION PROGRAM

NODE 3 TO HABITATION MODULE INTERFACE CONTROL DOCUMENT, PART 1

MAY 18, 1999

PREFACE

The Node 3 to Habitation Module Interface Control Document (ICD) defines the physical, functional, and environmental interfaces between the Node 3 and the Habitation modules for the on–orbit interfaces.

The contents of this document are intended to be consistent with the task and products to be prepared by the International Space Station (ISS) Program Partners as defined in SSP 41000, International Space Station System Specification. This ICD shall be implemented on all new ISS Program activities and shall be included in any existing contracts through contract changes. This document is under the control of the Interface Control Working Group as described in SSP 30459.

/s/*Michael T. Suffredini* *11/19/99*

Michael T. Suffredini Date
NASA Vehicle Manager
International Space Station

INTERNATIONAL SPACE STATION PROGRAM

NODE 3 TO HABITATION MODULE
INTERFACE CONTROL DOCUMENT, PART 1

LIST OF CHANGES

MAY 18, 1999

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

SSCBD	ENTRY DATE	CHANGE	PARAGRAPH(S)

TABLE(S)

FIGURE(S)

APPENDIX(ES)

ADDENDA

TABLE OF CONTENTS

TABLES

FIGURES

APPENDIX

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This ICD defines the on–orbit physical, functional, and environmental interfaces between Node 3 and the Habitation Module (HAB).

1.2 PRECEDENCE

In case of conflict between this document and SSP 41000, Space Station System Specification, SSP 41000 takes precedence.

1.3 DELEGATION OF AUTHORITY

The responsibility for assuring the definition, control, and implementation of the interfaces identified in this document is vested with the NASA ISS Program Office and the Italian Space Agency (ASI). This document shall be formally approved and controlled in accordance with the provisions of SSP 30459, ISS Interface Plan, and jointly signed by NASA and ASI. The NASA ISS Prime Contracto and the ASI Prime Contractor are participants in the development of this ICD.

2.0 DOCUMENTS

2.1 APPLICABLE DOCUMENTS

The following documents form part of this ICD to the extent specified herein

DOCUMENT NO.	TITLE
683–16347	Fitting, Threaded Fluid (Reference paragraphs 3.2.1.1.3.4, 3.2.2.1.3.4)
683–16348	Coupling, Quick Disconnect, Fluid, Self Sealing, Internal (Reference paragraphs 3.2.1.1.3.4, 3.2.2.1.3.4)
MIL–STD–1553 Revision B, Notice 2 8 Sep 1986	Digital Time Division Command/Response Multiplex Data Bus (Reference paragraphs 3.2.1.3.3.1, 3.2.2.3.3.1)
MSFC–DWG– 20M02540 Revision D 28 Feb 1990	Assessment of Flexible Lines for Flow Induced Vibrations (Reference paragraphs)
NSTS 08123 Revision B 3 June 1994	Certification of Flex hoses and Bellows for flow induced vibration (Reference paragraphs 3.2.2.1.3.5)
SSP 30237 Revision D, DCN 004, 005 12 June 1998	Electromagnetic Emission and Susceptibility Requirements (Reference paragraph 3.2.1.4.1.2)
SSP 30240 Revision C 22 Dec 1998	Space Station Grounding Requirements (Reference paragraphs)
SSP 30242 Revision E 22 Dec 1998	Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility (Reference paragraphs 3.2.1.4.1.5, 3.2.2.4.1.5)
SSP 30243 Revision E, DCN 003 9 June 1998	Space Station Requirements for Electromagnetic Compatibility (Reference paragraphs)
SSP 30245 Revision D, DCNs 004, 005 4 June 1998	Space Station Electrical Bonding Requirements (Reference paragraphs 3.2.1.4.1.4, 3.2.2.4.1.4)

SSP 30482 Volume 1 Electrical Power Specifications and Standards Volume 1: EPS Electrical Performance Specifications
Revision C, DCN 003 (Reference paragraphs 3.2.1.4.1.2, 3.2.2.4.1.2)
7 July 1997

SSP 30482 Volume 2 Electrical Power Specifications and Standards Volume 2: Consumer Constraints
Revision A, DCNs 001, 002, 003, 004 (Reference paragraphs 3.2.1.4.1.2, 3.2.2.4.1.2)
January 1994

SSP 30573 Space Station Fluid Procurement and Use Control Specification
(Reference
Revision E paragraphs)
1 March 1998

SSP 41004 Part 1 Common Berthing Mechanism to Pressurized Elements Interface
Revision F, IRNs 41004–1465, 1594, 1481, and 1555 Control Document, Part 1
30 April 1998 (Reference paragraphs 3.2.2.1.4.1, 3.2.1.1.6)

SSP 41148 Part 1 Active Common Berthing Mechanism to Passive Common Berthing
Revision D Mechanism Interface Control Document (Reference paragraphs
30 Sep 1998 3.2.1.1.5, 3.2.2.1.5)

SSP 50002 International Space Station Video Standard (Reference paragraphs
Revision A 3.2.1.3.1.1, 3.2.1.3.1.3.1, 3.2.1.3.1.3.2, 3.2.2.3.1.1, 3.2.2.3.1.3.1,
6 May 1998 3.2.2.3.1.3.2)

SSP 50005 International Space Station Flight Crew Standard (Reference
Revision B, DCNs 001 thru 006 paragraphs 3.2.1.1.3.1, 3.2.1.4.3, 3.2.2.1.3.1, 3.2.2.4.3)
9 Aug 1995

SSP 50023 Thermal Control Plan (Reference paragraphs 3.2.1.4.2, 3.2.2.4.2)
Revision Basic
15 April 1994

SSQ 21635 Connectors and Accessories, Electrical,
Revision H, DCNs 011 thru 015 Circular, Miniature, IVA/EVA Compatible, Space
1 Aug 1997 Quality, General Specification for (Reference paragraphs)

SSQ 21653 Cable Coaxial, Twinaxial and Triaxial, Flexible and Semirigid,General Specification for
Revision C, DCNs 001, 002, 003 (Reference paragraphs 3.2.1.1.3.6.3, 3.2.2.1.3.6.3)
19 Apr 1996

SSQ 21654 Cable, Single Fiber, Multimode, Space
Revision C Quality, General Specification for(Reference paragraphs 3.2.1.1.3.6.2, , 3.2.2.1.3.6.2,)
8 Sep 1998

2.2 REFERENCE DOCUMENTS

The following documents defined in theSpace Station System Specification, are referenced in this ICD for context and user convenience:

SSP 30219 Refefence	Space Station Reference Coordinate Systems
SSP 30459 Reference	International Space Station Interface Control Plan
SSP 41162	United States On–Orbit Segment Specification (Reference paragraph 1.2)

3.0 INTERFACES

3.1 GENERAL

3.1.1 INTERFACE DESCRIPTION

The Node 3 to the HAB on–orbit configuration is shown in Figure 3.1.1–1. Dimensions and material characteristics at the Common Berthing Mechanism (CBM) interface are in accordance with SSP 41004, Common Berthing Mechanism to Pressurized Lements Interface Control Document. The Node 3 to the HAB interface functions are shown in Figure 3.1.1–2. The HAB births to the Port side of Node 3.

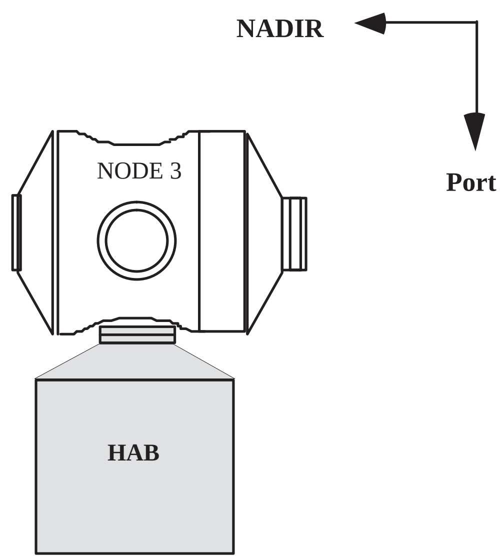


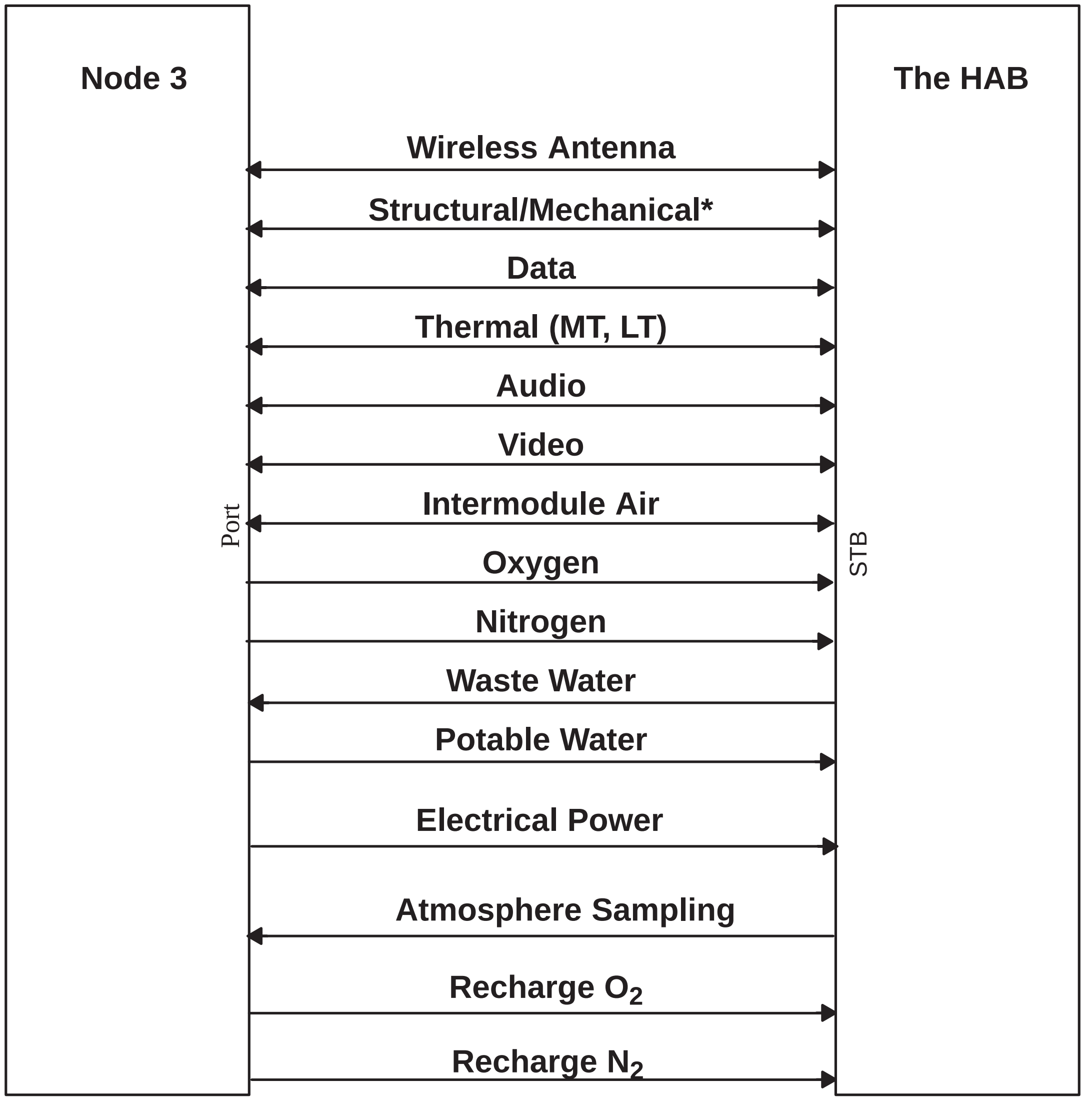
FIGURE 3.1.1–1 ON–ORBIT CONFIGURATION OF THE HAB MODULE

3.1.1.1 NODE 3 DESCRIPTION

The purpose of Node 3 is to act as a building block to connect the system elements; provide a pressurized passageway between berthed elements; and distribute/transfer commands and data, audio and video, electrical power, atmosphere, water, nitrogen, generate oxygen, and provide thermal energy to adjacent elements.

3.1.1.2 THE HAB DESCRIPTION

The HAB is the primary crew service element. Eating, recreation, crew health care and hygiene facilities as well as storage areas are included in the Hab.



*** Refer to SSP 41004 and SSP 41148 for Structural/Mechanical interface definition**

FIGURE 3.1.1–2 NODE 3 TO THE HAB FUNCTIONAL INTERFACES

3.1.1.3 INTERFACE PLANE DESCRIPTION

The Node 3 to the HAB utility plane is shown in Figure 3.1.1.3–1, Node 3 to the HAB Interface Planes. The utility interface plane is on the pressure bulkhead at the external feedthrough connector of each element. The structural and mechanical interface is at the plane between the Active CBM (ACBM) and Passive CBM (PCBM) as defined in SSP 41148, and as shown in Figure 3.1.1.3–1.

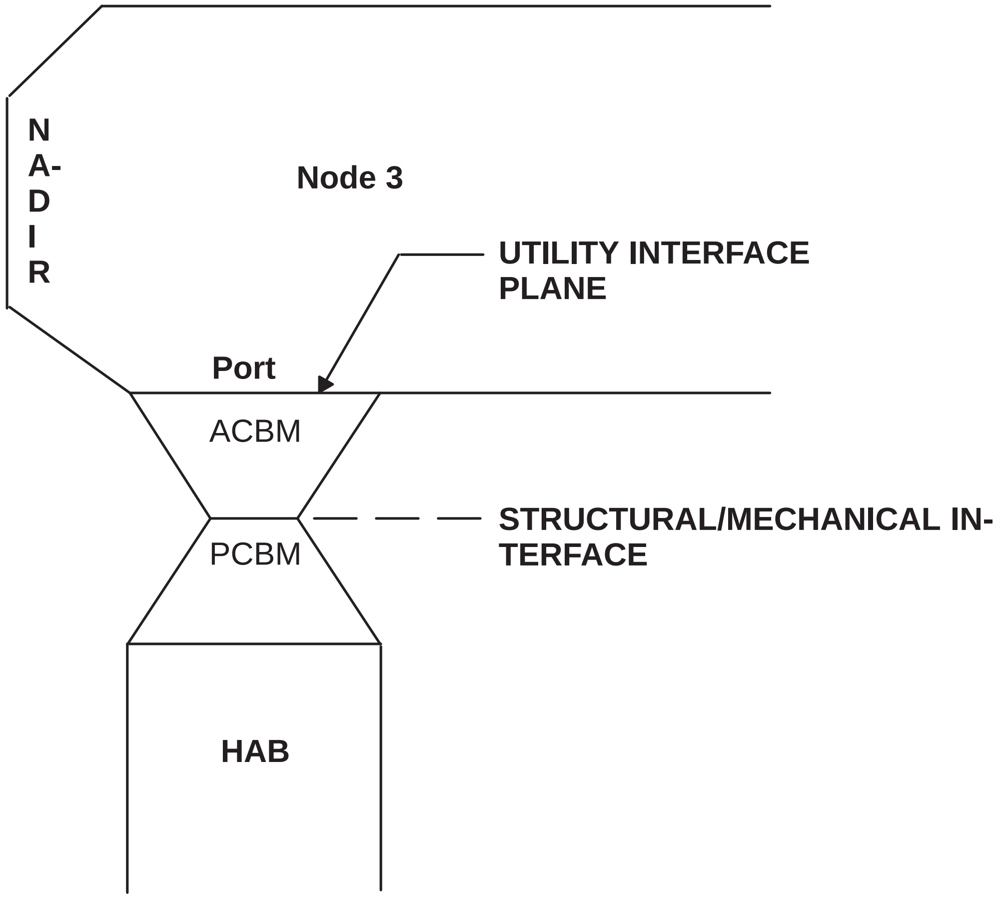


FIGURE 3.1.1.3–1 NODE 3 TO THE HAB INTERFACE PLANES

3.1.1.4 COORDINATE SYSTEMS

3.1.1.4.1 SPACE STATION COORDINATE SYSTEM

The space station coordinate system is defined in SSP 30219.

3.1.1.4.2 INTERFACING ELEMENT COORDINATE SYSTEMS

The Node 3 coordinate system is as defined in SSP 30219. The HAB coordinate system is as defined in SSP 30219.

3.1.1.5 NODE 3 INTERFACE FUNCTIONS

Node 3 will support the following functions at the interface to the HAB:

A. Structural/Mechanical Attachment

B. Receive Coolant (LT, MT,)

C. Return Coolant (LT, MT,)

D. Supply Oxygen

E. Supply Nitrogen

F. Return Intermodule Air

G. Receive Intermodule Air

H. Receive Waste Water

I. Supply Potable Water

J. Receive Atmosphere Sampling

K. Send Video

L. Receive Video

M. Send Audio

N. Receive Audio

O. Send Ultra High Frequency (UHF) Communication Data

P. Receive UHF Communication Data

Q. Send Data

R. Receive Data

S. Supply Electrical Power

T. Supply Recharge Oxygen

U. Supply Recharge Nitrogen

3.1.1.6 THE HAB INTERFACE FUNCTIONS

The HAB will support the following functions at the interface to Node 3:

A. Structural/Mechanical Attachment

B. Supply Coolant (LT, MT)

C. Receive Return Coolant (LT, MT)

D. Receive Oxygen

E. Receive Nitrogen

F. Receive Return Intermodule Air

G. Supply Intermodule Air

H. Supply Waste Water

I. Receive Potable Water

J. Supply Atmosphere Sampling

K. Receive Video

L. Send Video

M. Receive Audio

N. Send Audio

O. UHF Communication Data

P. UHF Communication Data

Q. Receive Data

R. Send Data

S. Receive Electrical Power

T. Receive Recharge Oxygen

U. Receive Recharge Nitrogen

3.1.1.7 ENGINEERING UNITS AND TOLERANCES

3.1.1.7.1 ENGINEERING UNITS

Dimensions shown in this document are in the English (inch, pound, second) system of units followed by the equivalent SI (metric) value in parentheses. Measurement may be verified in either system of units except that connector threads, tubes/ducts diameters will be verified in English standard convention of units.

3.1.1.7.2 CONVERSIONS AND TOLERANCES

For detailed descriptions of conversions and tolerances, reference ASTM E380.

3.1.1.7.2.1 TOLERANCE

Linear tolerance on English dimensions are as indicated in Table 3.1.1.7–1, Linear Tolerances. For a detailed description of conversions see ASTM E380.

TABLE 3.1.1.7.2.1–1 LINEAR TOLERANCES

ENGLISH DIMENSION	IMPLIED TOLERANCE INCHES
X.XX	±0.03
X.XXX	±0.010

3.1.2 INTERFACE RESPONSIBILITIES

3.1.2.1 RESPONSIBILITY FOR NODE 3

ASI/Alenia is responsible for the module structure interface and the module outfitting interface requirements imposed on Node 3.

3.1.2.2 RESPONSIBILITY FOR THE HAB

TBD is responsible for the structural and outfitting interface requirements imposed on the HAB.

3.2 INTERFACE REQUIREMENTS

3.2.1 NODE 3 INTERFACE REQUIREMENTS

3.2.1.1 STRUCTURAL/MECHANICAL ATTACHMENT

Node 3 shall structurally attach to the HAB via a CBM. The CBM has two halves each of which are attached to the pressure shell of each element in accordance with SSP 41004. The CBM Meteroid/Debris Cover and Node 3 external hardware stayout zones/envelopes for noninterference shall be in accordance with SSP 41004. The bulkhead of each element provides for the passage of utilities around the passage envelope and within the CBM volume. The ACBM to PCBM structural/mechanical interface shall be in accordance with SSP 41148.

3.2.1.1.1 LOADS

Node 3 shall supply structural and mechanical provisions for the mechanical attachment of Node 3 to the HAB during on–orbit assembly, in accordance with the loads defined in 3.2.1.5.5.

3.2.1.1.2 BERTHING/ATTACHMENT MECHANISM(S)

Interfaces between the ACBM and Node 3 shall be in accordance with SSP 41004.

The ACBM of Node 3 shall support the capability to attach to and form a pressurized seal with the PCBM on the HAB in accordance with SSP 41148.

3.2.1.1.3 INTERCONNECTING UTILITY HARDWARE

The Node 3 interface shall incorporate provisions for the mechanical connection of electrical power, data, video, audio, thermal coolant, water, and atmospheric gas utilities between Node 3 and the HAB during on–orbit assembly.

3.2.1.1.3.1 ACCESSIBILITY

All internal vestibule utility interface connections shall be designed to be manually mateable after the opening of one module hatch in the berthed configuration. Vestibule utility interface design shall comply with SSP 50005, International Space Station Flight Crew Standard, requirements for IVA accessibility.

Utilities, except those involving toxic or corrosive substances, shall be accessible from inside the pressurized elements after the elements are berthed.

Node 3 utility interfaces shall contain physical provisions to preclude incorrect installation of utility lines and shall not be lockwired or staked.

3.2.1.1.3.2 REDUNDANCY

Node 3 shall provide redundant utility interfaces for power distribution and element–to–element command and control. Alternate or redundant functional paths shall be separated or protected at the interface such that a credible event which causes the loss of one functional path will not result in the loss of the alternate or redundant functional path(s).

3.2.1.1.3.3 ELECTRICAL CONNECTORS

The characteristics for electrical connectors inside the vestibule shall be in accordance with SSQ 21635.

3.2.1.1.3.4 FLUID FITTINGS/COUPLINGS

Fluid fittings/couplings used at inter–element interfaces shall comply with 683–16347.

3.2.1.1.3.5 FLUID LINES AND BELLOWS

Flexible lines and bellows design shall be in accordance with 20M02540. Flexible lines and bellows shall be certified in accordance with NSTS 08123.

3.2.1.1.3.6 UTILITY CABLE SPECIFICATIONS

3.2.1.1.3.6.1 AUDIO DATA BUS CABLE SPECIFICATIONS

The audio data bus interconnect cables shall comply with the requirements of SSQ 21654.

3.2.1.1.3.6.2 VIDEO CABLE SPECIFICATIONS

Fiber optic video interconnect cables shall comply with SSQ 21654.

3.2.1.1.3.6.3 UHF COMMUNICATIONS SYSTEM CABLE SPECIFICATIONS

The UHF communication system interconnect cables shall comply with the requirements of SSQ 21653.

3.2.1.1.4 ACCESS/PASSAGE WAYS

3.2.1.1.4.1 VESTIBULE CLEARANCES

Vestibule clearances for utility jumpers and internal envelopes shall be in accordance with SSP 41004.

3.2.1.1.4.2 INGRESS/EGRESS PASSAGEWAYS

The passage envelope shall be as shown in Figure 3.2.1.1.4.2–1, Node 3 to HAB Passage Envelope.

3.2.1.1.5 ATMOSPHERIC SEALS

Atmospheric seal interface requirements shall be as defined in SSP 41004 and SSP 41148.

3.2.1.1.6 LEAKAGE MONITORING

The HAB shall incorporate provisions for monitoring and detecting seal leakage as defined in SSP 41004.

3.2.1.1.7 INTERFACE TEMPERATURE

Node 3 shall meet all requirements specified herein when the structural interface temperature is within 60° to 113°F.

3.2.1.2 FLUID INTERFACES

3.2.1.2.1 SUPPLY COOLANT

Node 3 shall supply low temperature and moderate temperature water coolant to the HAB for active heat acquisition and transport.

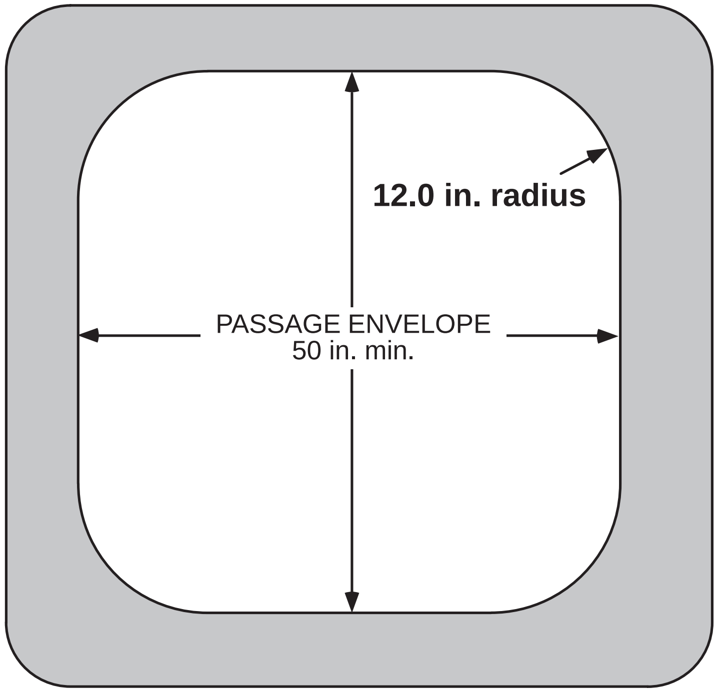


FIGURE 3.2.1.1.1.4.2–1 NODE 3 TO THE HAB PASSAGE ENVELOPE

3.2.1.2.1.1 COOLANT CHARACTERISTICS

3.2.1.2.1.1.1 COOLANT SPECIFICATION

Supply coolant shall comply with the requirements of SSP 30573.

3.2.1.2.1.1.2 COOLANT SUPPLY TEMPERATURE

Node 3 shall supply low temperature water coolant at a non selectable temperature of 38°F to 44°F. Node 3 shall supply moderate temperature water coolant at a non selectable temperature of 61°F to 65°F.

3.2.1.2.1.1.3 COOLANT SUPPLY PRESSURE

Node 3 shall supply low temperature water coolant at a pressure of 18 to 100 psia. Node 3 shall supply moderate temperature water coolant at a pressure of 18 to 100 psia.

3.2.1.2.1.1.4 COOLANT SUPPLY RATE

Node 3 shall supply low temperature water coolant at a rate of 950 $\pm$ 50 lbm per hr. Node 3 shall supply moderate temperature water coolant at a rate of 950 $\pm$ 50 lbm per hr .

3.2.1.2.1.1.5 NODE 3 DELTA PRESSURE MAXIMUM FLOWRATE

The maximum pressure drop across the Node 3 low temperature lines at the Node 3 to the HAB inlet/outlet interface shall be no greater than 8.0 psid **TBR** at a maximum flowrate of 1000 lbm per hr.

The maximum pressure drop across the Node 3 moderate temperature lines at the Node 3 to the HAB inlet/outlet interface shall be no greater than 8.5 psid **TBR** at a maximum flowrate of 1000 lbm per hr.

3.2.1.2.1.1.6 SUPPLY COOLANT LEAKAGE RATE

Node 3 shall accommodate maximum coolant leakage rate for coolant supplied at 100 psia shall not exceed **TBD** for the low temperature loop.

3.2.1.2.1.1.7 SUPPLY COOLANT LEAKAGE RATE

Node 3 shall accommodate a leakage rate for coolant supplied at 100 psia shall not exceed **TBD** for the moderate temperature loop.

3.2.1.2.1.1.8 VOLUME ALLOCATION

Node 3 shall accommodate a HAB Low Temperature (LT) Loop water volume of **TBD** Ft^3.
Node 3 shall accommodate a HAB Medium Temperature (MT) Loop water volume of **TBD** Ft^3.

3.2.1.2.2 RECEIVE RETURN COOLANT

Node 3 shall receive return LT and MT water coolant from the Hab.

3.2.1.2.2.1 COOLANT CHARACTERISTICS

3.2.1.2.2.1.1 COOLANT RECEIVE RETURN TEMPERATURE

Node 3 shall receive return LT water coolant at a non–selectable temperature of 38° to 70°F.
Node 3 shall receive return MT water coolant at a non–selectable temperature of 61° to 120°F.

3.2.1.2.2.1.2 COOLANT RECEIVE RETURN PRESSURE

Node 3 shall receive return LT water coolant at a pressure of 18 to 100 psia. Node 3 shall receive return MT water coolant at a pressure of 18 to 100 psia.

3.2.1.2.2.1.3 COOLANT RECEIVE RETURN RATE

Node 3 shall receive return LT water coolant at a rate of 950 $^{+}/-$ 50 lbm/hr **TBR**. Node 3 shall receive return MT water coolant at a rate of 950 $^{+}/-$ lbm/hr **TBR**.

3.2.1.2.2.1.4 NODE 3 HEAT TRANSFER RETURNED TO THE HAB

Node 3 shall accommodate a maximum of 6.3 kW across the moderate temperature lines. Node 3 shall accommodate a maximum of 3.4 kW across the low temperature lines.

3.2.1.2.2.2 CONTROL COOLANT

Node 3 shall provide means to turn off and isolate coolant flow across the interface.

3.2.1.2.3 SUPPLY OXYGEN

Node 3 shall supply oxygen to the HAB.

3.2.1.2.3.1 OXYGEN CHARACTERISTICS

3.2.1.2.3.1.1 SUPPLY OXYGEN TEMPERATURE

Node 3 shall supply oxygen to the HAB at a temperature range of 60°F to 113°F.

3.2.1.2.3.1.2 SUPPLY OXYGEN PRESSURE

Node 3 shall supply oxygen to the HAB at a pressure range between 90 and 120 psia. The maximum design pressure shall be 200 psia.

3.2.1.2.3.1.3 SUPPLY OXYGEN RATE

Node 3 shall supply oxygen to the HAB at a flow rate of 0 to 0.2 lb per min.

3.2.1.2.4 SUPPLY NITROGEN

Node 3 shall supply nitrogen to the HAB.

3.2.1.2.4.1 NITROGEN CHARACTERISTICS

3.2.1.2.4.1.1 SUPPLY NITROGEN TEMPERATURE

Node 3 shall supply nitrogen to the HAB at a temperature range of 60°F to 113°F.

3.2.1.2.4.1.2 SUPPLY NITROGEN PRESSURE

Node 3 shall supply nitrogen to the HAB at a pressure range between 90 and 120 psia. The maximum design pressure shall be 200 psia.

3.2.1.2.4.1.3 SUPPLY NITROGEN RATE

Node 3 shall supply nitrogen to the HAB at a flow rate of 0 to 0.2 lb per min.

3.2.1.2.5 RECEIVE INTERMODULE ATMOSPHERE

Node 3 shall receive intermodule air from the HAB.

3.2.1.2.5.1 INTERMODULE ATMOSPHERE CHARACTERISTICS

3.2.1.2.5.1.1 INTERMODULE ATMOSPHERE RECEIVE TEMPERATURE

Node 3 shall receive intermodule air from the HAB at a temperature range of 65° to 85°F.

3.2.1.2.5.1.2 INTERMODULE ATMOSPHERE RECEIVE RATE

Node 3 shall receive a minimum flow rate of 135 cfm **TBR** by providing a suction pressure of **TBD** inches of water excluding jumpers.

3.2.1.2.5.1.3 INTERMODULE ATMOSPHERE LOAD

Node 3 shall accommodate a maximum sensible heat load of ± 220 watts exchanged through the intermodule atmosphere interface with no latent heat load.

3.2.1.2.6 RETURN INTERMODULE ATMOSPHERE

Node 3 shall return intermodule air to the HAB nominally through the open hatch or off–nominally through the Intermodule Ventilation (IMV) duct.

3.2.1.2.6.1 INTERMODULE ATMOSPHERE CHARACTERISTICS

3.2.1.2.6.1.1 INTERMODULE ATMOSPHERE RETURN TEMPERATURE

Node 3 shall return intermodule air to the HAB at a temperature range of 65° to 85°F.

3.2.1.2.6.1.2 INTERMODULE ATMOSPHERE RETURN RATE

Node 3 shall return a minimum flowrate of 135 cfm **TBR** with a maximum pressure drop of **TBD** inches of water excluding jumpers when in the off nominal condition.

3.2.1.2.7 RECEIVE WASTE WATER

Node 3 shall receive waste water from the HAB.

3.2.1.2.7.1 WASTE WATER RECEIVE CHARACTERISTICS

3.2.1.2.7.1.1 WASTE WATER RECEIVE QUALITY

The waste water free gas content shall not exceed 10% peak by volume at 40°F and 20.7 psia. The particulate size shall not exceed 100 microns.

3.2.1.2.7.1.2 WASTE WATER RECEIVE TEMPERATURE

3.2.1.2.7.1.2.1 NOMINAL

Node 3 shall receive waste water from the HAB at a temperature range of 55° to 113°F at the nominal and maximum flow rates.

3.2.1.2.7.1.2.2 TRANSIENT

Node 3 shall receive waste water from the HAB at a temperature range of 40° to 113°F at the transient flow rate.

3.2.1.2.7.1.3 WASTE WATER RECEIVE PRESSURE

Node 3 shall receive waste water from the HAB at a pressure range of 0 to 8 psig at the nominal flow rate. The maximum design pressure shall be 85 psig.

3.2.1.2.7.1.4 WASTE WATER RECEIVE FLOW RATE

3.2.1.2.7.1.4.1 NOMINAL

Node 3 shall receive waste water from the HAB at a nominal flow rate range of 0 to 2.0 lb per hr. **TBR**

3.2.1.2.7.1.4.2 TRANSIENT

Node 3 shall receive waste water from the HAB at a transient flow rate of 0 to 132.0 lb per hr. **TBR**

3.2.1.2.8 SUPPLY POTABLE WATER

Node 3 shall supply Potable Water to the HAB.

3.2.1.2.8.1 SUPPLY POTABLE WATER CHARACTERISTICS

3.2.1.2.8.1.1 SUPPLY POTABLE WATER RECEIVE TEMPERATURE

Node 3 shall supply Potable Water to the HAB at a temperature range of 63° to 113°F.

3.2.1.2.8.1.2 SUPPLY POTABLE WATER SUPPLY PRESSURE

Node 3 shall supply Potable Water to the HAB at a pressure range 15 **TBR** to 30 psig. The maximum design pressure shall be 35 psig.

3.2.1.2.8.1.3 SUPPLY POTABLE WATER SUPPLY RATE

Node 3 shall supply Potable Water to the HAB at a flow rate of 0 to 500 lb per hr.

3.2.1.2.9 RECEIVE ATMOSPHERE SAMPLE AIR

Node 3 shall receive atmosphere sample air from the HAB.

3.2.1.2.9.1 ATMOSPHERE SAMPLE AIR RECEIVE FLOW RATE

Node 3 shall receive atmosphere sample air at a flow rate of 100 to 400 standard cubic centimeters per minute (sccm) from the HAB when Node 3 is drawing atmosphere sample air from the Hab.

3.2.1.2.10 SUPPLY RECHARGE OXYGEN

Node 3 shall supply recharge oxygen to the Hab.

3.2.1.2.10.1 SUPPLY RECHARGE OXYGEN CHARACTERISTICS

3.2.1.2.10.1.1 SUPPLY RECHARGE OXYGEN TEMPERATURE

Node 3 shall supply recharge oxygen to the HAB at a temperature range of 25°F to 113°F.

3.2.1.2.10.1.2 SUPPLY RECHARGE OXYGEN PRESSURE

Node 3 shall supply recharge oxygen to the HAB at a pressure up to 1050 psia at a flow rate up to 16 lbm per hr.

3.2.1.2.11 SUPPLY RECHARGE NITROGEN

Node 3 shall supply recharge Nitrogen to the Hab.

3.2.1.2.11.1 SUPPLY RECHARGE NITROGEN CHARACTERISTICS

3.2.1.2.11.1.1 SUPPLY RECHARGE NITROGEN TEMPERATURE

Node 3 shall supply recharge Nitrogen to the HAB at a temperature range of 25°F to 113°F.

3.2.1.2.11.1.2 SUPPLY RECHARGE NITROGEN PRESSURE

Node 3 shall supply recharge Nitrogen to the HAB at a pressure up to 3400 psia at a flow rate up to 3 lbm per hr.

3.2.1.3 ELECTRICAL POWER INTERFACES

3.2.1.3.1 SUPPLY POWER

3.2.1.3.1.1 NODE 3 POWER TO HAB

Node 3 shall provide 2 independent 12 kW power feeders.

3.2.1.3.1.2 POWER RATING

Each power feeder shall be rated at 12.0 kW minimum.

3.2.1.3.1.3 MAXIMUM CURRENT RATING

The secondary power interface shall consist of 2 independent feeds. Each feed shall have a maximum current rating of 100 amps.

3.2.1.3.1.4 POWER QUALITY

The power quality of each power feeder at the Node 3 to HAB interface shall comply with SSP 30482 Volume 1, and provide the performance of Interface A with the following exceptions:

3.2.1.3.1.4.1 OPERATIONAL BUS VOLTAGE

The steady state bus voltage (not including transients or ripple) shall be from 120.6 to 126 volts Direct Current (dc) for load levels up to the Interface Current Rating.

3.2.1.3.1.4.2 VOLTAGE ENVELOPE

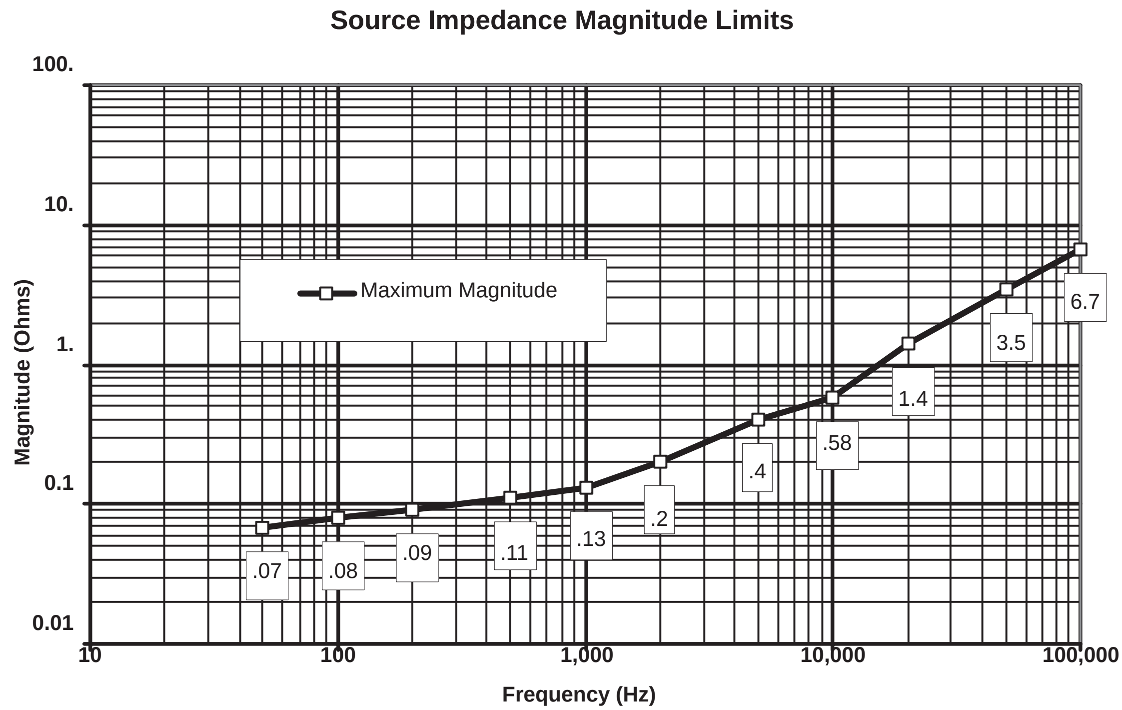
The voltage transient in response to a 3.125 kW load change shall be within the envelope shown in Figure 3.1.2.1.4–1 of SSP 30482 Volume 1.

3.2.1.3.1.4.3 ABNORMAL VOLTAGE ENVELOPE

The voltage transient in response to an abnormal condition, as described in SSP 30482 Volume 1, shall be within the envelope shown in Figure 3.1.2.2.1–1.

3.2.1.3.1.4.4 SOURCE OUTPUT IMPEDANCE

When a single DDCU is providing power, the magnitude and phase of the source impedance shall be within the acceptable region as shown in Figure 3.2.1.3.1.4.4–1. When two DDCUs, operating in parallel are providing power, the magnitude and phase of the source impedance shall be within the acceptable region shown in figure 3.2.1.3.1.4.4–2. For the magnitude, the acceptable region is at or below the maximum values shown. For phase, the acceptable region is bounded by the maximum and minimum values shown. The interface shall remain stable during normal operating conditions.



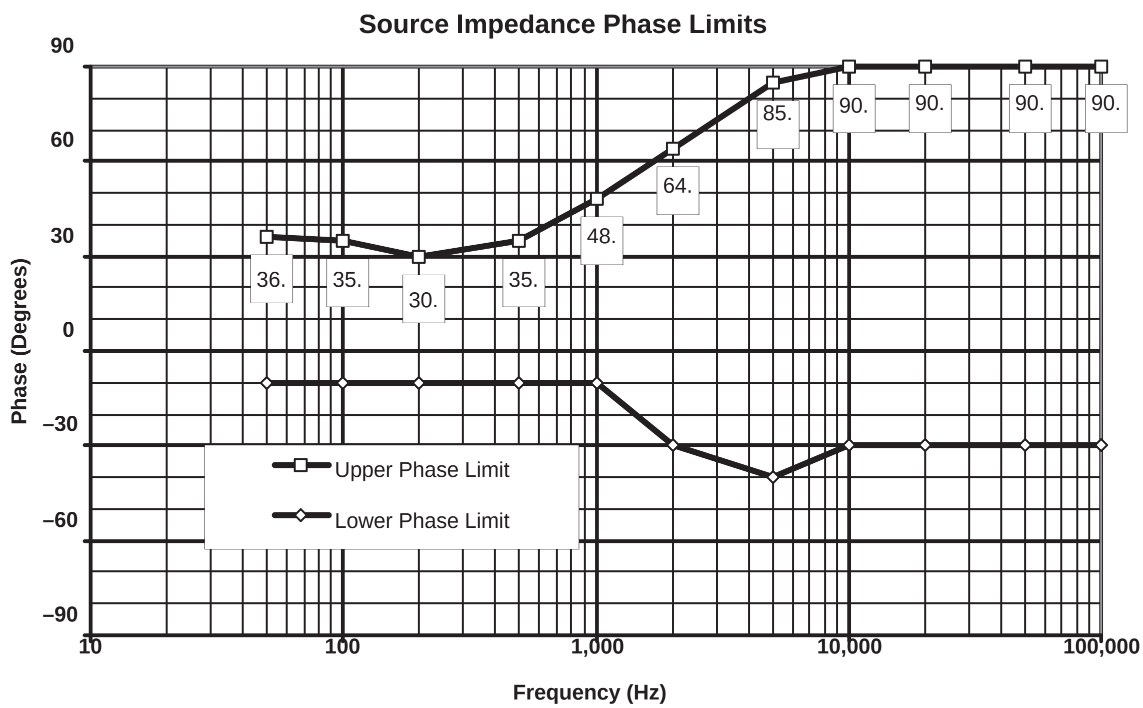


FIGURE 3.2.1.3.1.4.4–1 POWER SOURCE IMPEDANCE AT NODE 3 TO HAB INTERFACE (SINGLE DDCU)

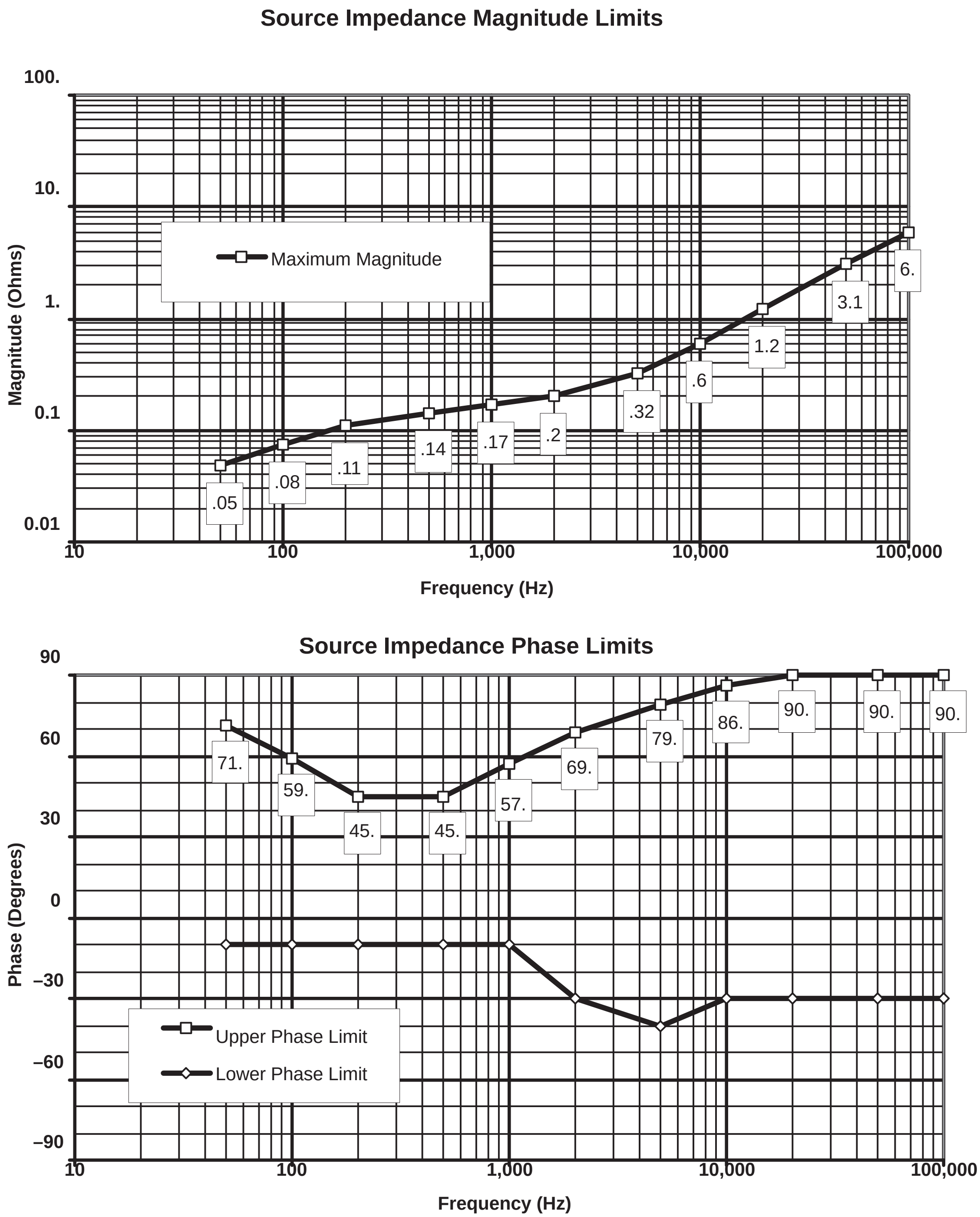


FIGURE 3.2.1.3.1.4.4–3 SOURCE OUTPUT IMPEDANCE (PARALLEL DDCU'S)

3.2.1.3.1.4.5 PHASE AND GAIN MARGINS

The load impedance shall maintain 3dB (decibals) gain and 30 degree phase margins with respect to the source impedance of figure **TBD**. The margin will be maintained if the maginitude of the load impedance in 3dB above the source impedance magnitude. In frequencies where the load impedance is not 3dB greater than the source impedance, the phase angle of the load impedance subtracted from the source impedance phase angle must not fall between 150 and 210 degrees. The impedance phase is the entire region from maximum phase to minimum phase on Figure **TBD**.

3.2.1.3.1.5 CURRENT LIMITING

Node 3 shall provide short circuit protection for all secondary power feeds crossing the interface.

3.2.1.3.1.6 WIRE AND CONNECTOR SIZING

Wiring and connector sizing at the Node 3/HAB interface shall be compatible with the current protective device.

3.2.1.3.1.7 FAULT CURRENT RETURN

The Node 3 to HAB interface shall provide a single–fault tolerant fault–current return path.

3.2.1.3.1.8 RETURN GROUNDING

Each power feeder return shall be referenced to structure at the Node 3 source.

3.2.1.3.1.9 POWER FEEDER ISOLATION

Each Node 3 to HAB power feeder shall provide power from independent sources.

3.2.1.4 ELECTRONIC INTERFACES

3.2.1.4.1 VIDEO SIGNALS

Node 3 shall transmit to and receive from the HAB the signals described in the following subparagraphs.

3.2.1.4.1.1 OPTICAL PULSE FREQUENCY MODULATION VIDEO SIGNAL CHARACTERISTICS

The optical PFM National Television Standards Committee (NTSC) video signal characteristics shall be in accordance with SSP 50002, International Space Station Video Standard, paragraphs 3.2.1.5.4 and 3.2.1.5.5.

3.2.1.4.1.1.1 OPTICAL PFM NTSC VIDEO SIGNAL TRANSMIT POWER LEVELS

The minimum average optical Pulse Frequency Modulated (PFM) NTSC video signal transmit power, measured at ambient temperature, transmitted by Node 3 shall meet Table 3.2.1.4.1.1.1–1 at each signal interface.

TABLE 3.2.1.4.1.1.1–1 OPTICAL PFM NTSC VIDEO SIGNAL TRANSMIT POWER

Source to Destination		Node 3 Output
Video Source	**Destination**	**Optical Power (dBm)**
VSU 5	HAB TBD	TBD
VSU 5	HAB TBD	TBD

3.2.1.4.1.1.2 OPTICAL PFM NTSC VIDEO SIGNAL RECEIVE POWER LEVELS

Node 3 shall meet all transmission power requirements with minimum average optical PFM NTSC video signal input power, at ambient temperature, provided by Table 3.2.1.4.1.1.2–1 at each signal interface.

TABLE 3.2.1.4.1.1.2–1 OPTICAL PFM NTSC VIDEO SIGNAL RECEIVE POWER

Source to Destination		Node 3 Input
Video Source	**Destination**	**Optical Power (dBm)**
HAB TBD	VSU 5	TBD
HAB TBD	VSU 5	TBD

3.2.1.4.1.2 OPTICAL PFM NTSC SYNC AND CONTROL SIGNAL CHARACTERISTICS

The optical PFM NTSC sync and control signal characteristics shall be in accordance with SSP 50002, paragraphs 3.2.1.5.4 and 3.2.1.5.5.

3.2.1.4.1.2.1 OPTICAL PFM NTSC SYNC AND CONTROL SIGNAL TRANSMIT POWER LEVELS

The minimum average optical PFM NTSC sync and control signal transmit power, measured at ambient temperature, transmitted by Node 3 shall meet Table 3.2.1.4.1.2.1–1 at each signal interface.

TABLE 3.2.1.4.1.2.1–1 OPTICAL PFM NTSC SYNC AND CONTROL SIGNAL TRANSMIT POWER

Source to Destination		Node 3 Output
Video Source	Destination	Optical Power (dBm)
VSU 5	HAB TBD	TBD
VSU 5	HAB TBD	TBD

3.2.1.4.2 AUDIO SIGNALS

Node 3 shall transmit the signals described in the following subparagraphs to the HAB.

3.2.1.4.2.1 OPTICAL LINEAR PULSE CODE MODULATED AUDIO SIGNAL CHARACTERISTICS

Node 3 shall transmit optical Linear Pulse Code Modulated (LPCM) audio signals to the HAB with the following signal characteristics:

(1) Bit Rate: 11.76 Mbps

(2) Optical Center Frequency: 1300 nm

(3) Light is non–coherent.

3.2.1.4.2.1.1 OPTICAL LPCM AUDIO SIGNAL POWER LEVELS

The minimum optical LPCM audio signal output power, measured at ambient temperature, of Node 3 shall meet Table 3.2.1.4.2.1.1–1 at each signal interface. Node 3 shall meet all transmission requirements with minimum optical LPCM audio signal input power, at ambient temperature, provided by Table 3.2.1.4.2.1.1–2 at each specified signal interface.

TABLE 3.2.1.4.2.1.1–1 OPTICAL LPCM AUDIO SIGNAL OUTPUT POWER

Source to Destination		Node 3 Output
Audio Source	Destination	Optical Power (dBm)
Node 3 ABC 5	HAB Audio ORU1	TBD
Node 3 ABC 5	HAB Audio ORU2	TBD
Node 3 ABC 5	HAB Audio ORU3	TBD
Node 3 ABC 5	HAB Audio ORU 4	TBD
Node 3 ABC 6	HAB Audio ORU 1	TBD
Node 3 ABC 6	HAB Audio ORU 2	TBD
Node 3 ABC 6	HAB Audio ORU 3	TBD
Node 3 ABC 6	HAB Audio ORU 4	TBD

TABLE 3.2.1.4.2.1.1–2 OPTICAL LPCM AUDIO SIGNAL INPUT POWER

Source to Destination		Node 3 Input
Audio Source	Destination	Optical Power (dBm)
HAB Audio ORU 1	Node 3 ABC 5	TBD
HAB Audio ORU 2	Node 3 ABC 5	TBD
HAB Audio ORU 3	Node 3 ABC 5	TBD
HAB Audio ORU 4	Node 3 ABC 5	TBD
HAB Audio ORU 1	Node 3 ABC 6	TBD
HAB Audio ORU 2	Node 3 ABC 6	TBD
HAB Audio ORU 3	Node 3 ABC 6	TBD
HAB Audio ORU 4	Node 3 ABC 6	TBD

3.2.1.4.2.2 UHF COMMUNICATION

3.2.1.4.2.2.1 UHF COMMUNICATION DISTRIBUTION

Node 3 shall support UHF communication to and from the HAB via a dedicated coaxial cable, NRFC–50–coax–3.

3.2.1.4.2.2.2 UHF COMMUNICATION SIGNAL CHARACTERISTICS

UHF communication shall be at a selectable center frequency of 414.2 MHz or 417.1 MHz using Pulse Code Modulated – Frequency Modulated (PCM–FM) modulation and five–slot Time Division Multiple Accessing (TDMA).

3.2.1.4.2.2.3 INTERFACE IMPEDANCE

The interface impedance measured at the Node 3 and HAB interface shall be 50 Ohms nominal.

3.2.1.4.2.2.4 INTERFACE VSWR

The Voltage Standing Wave Ratio (VSWR) measured at the Node 3 and HAB interface shall be less than 1.8:1.0 TBC over 413 MHz to 415 MHz and 416 MHz to 418 MHz.

3.2.1.4.2.2.5 UHF INTERFACE POWER LEVEL

Node 3 shall transmit Radio Frequency (RF) Power of **TBD** dBm minimum for the HAB at the Node 3/HAB interface.

3.2.1.4.3 C&DH MIL–STD–1553 INTERFACES

3.2.1.4.3.1 DATA BUS STANDARDS

The physical characteristics and data transfer protocol for the Command and Data Handling (C&DH) MIL–STD–1553B interface shall conform to MIL–STD–1553B.

3.2.1.4.3.2 INTERFACE BUSES

The following buses shall cross the Node 3 to the HAB interface: CB CT–BIA–23, CB CT–4, LB CHeCS–HAB, LB SEPS–N3–14, LB SEPS–N3–23, LB SEPS–HCZ–14, LB SEPS–HCZ–23, LB SYS–HCZ–1, and LB SYS–HCZ–2. Each bus shall provide redundant data paths across the interface. The data path interfaces for each bus shall conform to the redundancy requirements given in paragraph 3.2.1.1.3.2.

3.2.1.4.3.3 PROVIDE OUTPUT AMPLITUDE

Node 3 shall provide a minimum signal amplitude of 3.6 volts, peak–to–peak, line–to–line, at the HAB interface for messages transmitted on Node 3 pass–through MIL–STD–1553 data buses.

3.2.1.4.3.4 JUMPERS AND TERMINATIONS

Node 3 shall provide removable terminations for the CB CT–BIA–23, CB CT–4, LB CHeCS–HAB, LB SEPS–N3–14, LB SEPS–N3–23, LB SEPS–HCZ–14, LB SEPS–HCZ–23, LB SYS–HCZ–1, and LB SYS–HCZ–2 data buses at the HAB interface when the HAB is not berthed to Node 3.

3.2.1.4.3.5 MEDIUM RATE DATA LINK INTERFACE

The Node 3 shall provide three (3) Ethernet transmission lines and three (3) Ethernet receive lines to the HAB supporting the Operations Local Area Network (OPS LAN) (formerly Personal Computing System Local Area Network (PCS LAN)).

3.2.1.5 ENVIRONMENTS

3.2.1.5.1 ELECTROMAGNETIC EFFECTS

3.2.1.5.1.1 ELECTROMAGNETIC COMPATIBILITY

The Node 3 to the HAB interface shall meet the requirements of SSP 30243.

3.2.1.5.1.2 ELECTROMAGNETIC INTERFERENCE

The Node 3 to the HAB interface shall meet the requirements of SSP 30237.

3.2.1.5.1.3 GROUNDING

The Node 3 to the HAB interface shall meet the requirements of SSP 30240.

3.2.1.5.1.4 BONDING

Node 3 to the HAB structural/mechanical interface shall meet the requirements of SSP 30245. The on–orbit bonding shall meet the requirements for a Class R Bond, which includes the Class H parameters, when permanently mated. During all other operations, the bond shall meet the requirements of a Class H Bond.

3.2.1.5.1.5 CABLE AND WIRE DESIGN

The Node 3 to the HAB cable and wire interface shall meet the requirements of SSP 30242.

3.2.1.5.2 THERMAL

The Node 3 to the HAB interface shall function as described herein when exposed to the thermal radiation environment per SSP 50023. Math models and/or thermal design analysis criteria for interface design are specified in SSP 50023.

3.2.1.5.3 ACOUSTIC

Node 3 shall not induce noise levels on the HAB exceeding the NC–50 levels specified in SSP 50005, measured in octave bands from 63 to 8000 Hz except during alarm or warning conditions.

3.2.1.5.4 ACCELERATIONS

Node 3 shall be capable of on–orbit induced accelerations of 0.2 g's acting in any direction, assuming a free–free boundary condition.

3.2.1.5.5 ON–ORBIT TRANSIENT INTERFACE LOADS

Node 3 shall support the induced load environment defined in the current version of SSP 50318. The berthing contact loads at the Node 3 to the HAB interface shall be as defined in Table 3.2.1.4.5–1, and 3.2.1.4.5–2. The load components within each load case shall be applied concurrently in any combination of positive and negative values for each component.

TABLE 3.2.1.4.5–1 NODE 3 / THE HAB RESULTANT BERTHING CONTACT FORCES

Axial (lb)	RSS Shear (lb)	RSS Moment (in–lb)	Torsion (in–lb)
–9170 TBR	±1870 TBR	±160700 TBR	±111600 TBR

TABLE 3.2.1.4.5–2 NODE 3 / THE HAB CBM CONTACT POINT CONTACT LOADS

Alignment Pin Load (lb)	Shear Guide Load (lb)	Plunger Load (lb)
1205	260	515

3.2.2 THE HAB INTERFACE REQUIREMENTS

3.2.2.1 STRUCTURAL/MECHANICAL ATTACHMENT

The HAB structurally attaches to Node 3 via a CBM. The CBM has two halves each of which are attached to the pressure shell of each element in accordance with SSP 41004. The CBM Meteroid/Debris Cover and the HAB external hardware stayout zones/envelopes for noninterference shall be in accordance with SSP 41004. The bulkhead of each element provides for the passage of utilities around the passage envelope and within the CBM volume. The ACBM to PCBM structural/mechanical interface shall be in accordance with SSP 41148.

3.2.2.1.1 LOADS

The HAB shall supply structural and mechanical provisions for the mechanical attachment of the Node 3 to the HAB during on–orbit assembly, in accordance with the loads defined in 3.2.2.5.5.

3.2.2.1.2 BERTHING/ATTACHMENT MECHANISM(S)

Interfaces between the PCBM and the HAB shall be in accordance with SSP 41004.

The PCBM of the HAB shall support the capability to attach to and form a pressurized seal with the ACBM on Node 3 in accordance with SSP 41148.

3.2.2.1.3 INTERCONNECTING UTILITY HARDWARE

The HAB interface shall incorporate provisions for the mechanical connection of electrical power, data, video, audio, thermal coolant, water, and atmospheric gas utilities between the HAB and Node 3 during on–orbit assembly.

3.2.2.1.3.1 ACCESSIBILITY

All internal vestibule utility interface connections shall be designed to be manually mateable after the opening of one module hatch in the berthed configuration. Vestibule utility interface design shall comply with SSP 50005 requirements for IVA accessibility.

Utilities, except those involving toxic or corrosive substances, shall be accessible from inside the pressurized elements after the elements are berthed.

Utility interfaces shall contain physical provisions to preclude incorrect installation and shall not be lockwired or stoked.

3.2.2.1.3.2 REDUNDANCY

The HAB shall provide redundant utility interfaces for power distribution and element–to–element command and control. Alternate or redundant functional paths shall be separated or protected at the interface such that a credible event which causes the loss of one functional path will not result in the loss of the alternate or redundant functional path(s).

3.2.2.1.3.3 ELECTRICAL CONNECTORS

The characteristics for electrical connectors inside the vestibule shall be in accordance with SSQ 21635.

3.2.2.1.3.4 FLUID FITTINGS/COUPLINGS

Fluid fittings/couplings used at inter–element interfaces shall comply with 683–16347 & 683–16348.

3.2.2.1.3.5 FLUID LINES AND BELLOWS

Flexible lines and bellows design shall be in accordance with 20M02540. Flexible lines and bellows shall be certified in accordance with NSTS 08123.

3.2.2.1.3.6 UTILITY CABLE SPECIFICATIONS

3.2.2.1.3.6.1 AUDIO DATA BUS CABLE SPECIFICATIONS

The audio data bus interconnect cables shall comply with the requirements of SSQ 21654.

3.2.2.1.3.6.2 VIDEO CABLE SPECIFICATIONS

Fiber optic video interconnect cables shall comply with SSQ 21654.

3.2.2.1.3.6.3 WIRELESS COMMUNICATIONS SYSTEM CABLE SPECIFICATIONS

The wireless communication system interconnect cables shall comply with the requirements of SSQ 21653.

3.2.2.1.4 ACCESS/PASSAGE WAYS

3.2.2.1.4.1 VESTIBULE CLEARANCES

Vestibule clearances for utility jumpers and internal envelopes shall be in accordance with SSP 41004.

3.2.2.1.4.2 INGRESS/EGRESS PASSAGEWAYS

The passage envelope shall be as shown in Figure 3.2.1.3.5–1.

3.2.2.1.5 ATMOSPHERIC SEALS

Atmospheric seal requirements shall be as defined in SSP 41004 and SSP 41148.

3.2.2.1.6 LEAKAGE MONITORING

The HAB design shall incorporate provision for monitoring and detecting seal leakage as defined in SSP 41004.

3.2.2.1.7 INTERFACE TEMPERATURE

The HAB shall meet all requirements specified herein when the structural interface temperature is within 60° to 113°F.

3.2.2.2 FLUID INTERFACES

3.2.2.2.1 RETURN COOLANT

The HAB shall return LT and MT coolant to Node 3 for active heat acquisition and transport.

3.2.2.2.1.1 COOLANT CHARACTERISTICS

3.2.2.2.1.1.1 COOLANT SPECIFICATION

The return water coolant shall comply with the requirements of SSP 30573.

3.2.2.2.1.1.2 COOLANT RETURN TEMPERATURE

The HAB shall return LT water coolant at a non selectable temperature of 38° to 70°F. The HAB shall return MT water coolant at a non selectable temperature of 61° to 120°F.

3.2.2.2.1.1.3 COOLANT RETURN PRESSURE

The HAB shall return LT water coolant at 18 to 100 psia. The HAB shall return MT water coolant at 18 to 100 psia.

3.2.2.2.1.1.4 COOLANT RETURN RATE

The HAB shall return LT water coolant at a rate of 950 $\pm$ 50. The HAB shall return MT water coolant at a rate of 950 $\pm$ 50.

3.2.2.2.1.1.5 THE HAB DELTA PRESSURE MAXIMUM FLOWRATE

The HAB shall not exceed a maximum pressure drop of 8.0 psid **TBR** at a maximum flowrate of 1000 lbm per hr across the HAB LT lines at the Node 3 to the HAB inlet/outlet interface.

The HAB shall not exceed a maximum pressure drop of 8.0 psid **TBR** at a maximum flowrate of 1000 lbm per hr across the HAB MT lines at the Node 3 to the HAB inlet/outlet interface.

3.2.2.2.1.1.6 RETURN COOLANT LEAKAGE RATE

The HAB interface design maximum coolant leakage rate for coolant supplied at 100 psia shall not exceed **TBD** for the LT loop.

3.2.2.2.1.1.7 RETURN COOLANT LEAKAGE RATE

The HAB interface design maximum coolant leakage rate for coolant supplied at 100 psia shall not exceed **TBD** for the MT loop.

3.2.2.2.1.1.8 VOLUME ALLOCATION

The HAB LT Loop water volume shall be no greater than **TBD** Cubic Feet (Ft^3).

The HAB MT Loop water volume, shall be no greater than **TBD** Ft^3.

3.2.2.2.2 RETURN COOLANT

The HAB shall return LT and MT water coolant to Node 3.

3.2.2.2.2.1 COOLANT CHARACTERISTICS

3.2.2.2.2.1.1 COOLANT RECEIVE RETURN TEMPERATURE

Node 3 shall receive return LT water coolant at a non–selectable temperature of 38° to 70°F. Node 3 shall receive return MT coolant at a non–selectable temperature of 61° to 120°F.

3.2.2.2.2.1.2 COOLANT RECEIVE RETURN PRESSURE

Node 3 shall receive LT water coolant at 18 to 100 psia. Node 3 shall receive return MT coolant at 18 to 100 psia.

3.2.2.2.2.1.3 COOLANT RETURN RATE

The HAB shall return LT water coolant at a rate of 950 $\pm$ 50 lbm/hr. The HAB shall return MT coolant at a rate of 950 $\pm$ 50 lbm/hr.

3.2.2.2.2.1.4 THE HAB HEAT TRANSFER RECEIVED FROM NODE 3

The HAB shall not exceed a maximum of 6.3 kW across the MT lines. The HAB shall not transfer more than 3.4 kW of heat across the LT lines.

3.2.2.2.2.2 CONTROL COOLANT

The HAB shall provide internal means to turn off and isolate coolant flow across the interface.

3.2.2.2.2.3 THE HAB COOLANT RETURN WATER AIR INCLUSION

The HAB LT water return shall not exceed a non condensible gas inclusion of **TBD** Cubic Inches (in^3)(cc) at 21 psia and 70°F.

The HAB MT water return shall not exceed a non condensible gas inclusion of **TBD** in^3(cc) at 21 psia and 70°F.

3.2.2.2.3 RECEIVE OXYGEN

The HAB shall receive oxygen from Node 3.

3.2.2.2.3.1 OXYGEN CHARACTERISTICS

3.2.2.2.3.1.1 RECEIVE OXYGEN TEMPERATURE

The HAB shall receive oxygen from Node 3 at a temperature range of 60°F to 113°F.

3.2.2.2.3.1.2 RECEIVE OXYGEN PRESSURE

The HAB shall receive oxygen from Node 3 at a pressure range of 90 to 120 psia. The maximum design pressure shall be 200 psia.

3.2.2.2.3.1.3 RECEIVE OXYGEN RATE

The HAB shall receive oxygen from Node 3 at a flow rate of 0 to 0.2 lb per min.

3.2.2.2.4 RECEIVE NITROGEN

The HAB shall receive nitrogen from Node 3.

3.2.2.2.4.1 NITROGEN CHARACTERISTICS

3.2.2.2.4.1.1 RECEIVE NITROGEN TEMPERATURE

The HAB shall receive nitrogen from Node 3 at a temperature range of 60°F to 113°F.

3.2.2.2.4.1.2 RECEIVE NITROGEN PRESSURE

The HAB shall receive nitrogen from Node 3 at a pressure range of 90 to 120 psia. The maximum design pressure shall be 200 psia.

3.2.2.2.4.1.3 RECEIVE NITROGEN RATE

The HAB shall receive nitrogen from Node 3 at a flow rate of 0 to 0.2 lb per min.

3.2.2.2.5 SUPPLY INTERMODULE ATMOSPHERE

The HAB shall supply intermodule air to the Node 3.

3.2.2.2.5.1 INTERMODULE ATMOSPHERE CHARACTERISTICS

3.2.2.2.5.1.1 INTERMODULE ATMOSPHERE SUPPLY TEMPERATURE

The HAB shall supply intermodule air to Node 3 at a temperature of 65° to 85°F.

3.2.2.2.5.1.2 INTERMODULE ATMOSPHERE SUPPLY RATE

The HAB shall supply a minimum flowrate of 135 cfm **TBR** to Node 3 of Intermodule air with a maximum pressure drop of **TBD** inches of water in the HAB including the jumpers.

3.2.2.2.6 RECEIVE RETURN INTERMODULE ATMOSPHERE

The HAB shall receive return intermodule air from Node 3 nominally through the open hatch or off–nominally through the IMV duct.

3.2.2.2.6.1 INTERMODULE ATMOSPHERE CHARACTERISTICS

3.2.2.2.6.1.1 INTERMODULE ATMOSPHERE RECEIVE RETURN TEMPERATURE

The HAB shall receive return intermodule air from Node 3 at a temperature range of 65° to 85°F.

3.2.2.2.6.1.2 INTERMODULE ATMOSPHERE RECEIVE RETURN RATE

The HAB shall receive return intermodule air at a minimum flowrate of 135 cfm **TBR** by providing a minimum suction pressure of **TBD** inches of water at the Node 3 bulkhead.

3.2.2.2.7 SUPPLY WASTE WATER

The HAB shall supply waste water to Node 3.

3.2.2.2.7.1 WASTE WATER SUPPLY CHARACTERISTICS

3.2.2.2.7.1.1 WASTE WATER SUPPLY QUALITY

The waste water free gas content shall not exceed 10% peak by volume at 40°F and 20.7 psia. The particulate size shall not exceed 100 microns.

3.2.2.2.7.1.2 WASTE WATER SUPPLY TEMPERATURE

3.2.2.2.7.1.2.1 NOMINAL

The HAB shall supply waste water to Node 3 at a nominal temperature range of 55° to 113°F at nominal or flowrate.

3.2.2.2.7.1.2.2 TRANSIENT

The HAB shall supply waste water to Node 3 at a temperature range of 40° to 113°F at transient flow rate.

3.2.2.2.7.1.3 WASTE WATER SUPPLY PRESSURE

The HAB shall supply waste water to Node 3 at a pressure range of 0 to 8 psig at the nominal flow rate. The maximum design pressure shall be 85 psig.

3.2.2.2.7.1.4 WASTE WATER SUPPLY FLOW RATE

3.2.2.2.7.1.4.1 NOMINAL

The HAB shall supply waste water to Node 3 at a nominal flow rate of 0 to 2.0 lb per hr **TBR**.

3.2.2.2.7.1.4.2 TRANSIENT

The HAB shall supply waste water to Node 3 at a transient flow rate of 0 to 132.0 lb per hr **TBR.**

3.2.2.2.7.1.5 WASTE WATER SUPPLY DELTA PRESSURE

The HAB shall supply waste water at a maximum pressure drop of 1 psid at the transient flow rate to Node 3 including the jumper.

3.2.2.2.8 RECEIVE POTABLE WATER

The HAB shall receive potable water from Node 3.

3.2.2.2.8.1 POTABLE WATER CHARACTERISTICS

3.2.2.2.8.1.1 POTABLE WATER RECEIVE TEMPERATURE

The HAB shall receive potable water from Node 3 at a temperature range of 63° to 113°F.

3.2.2.2.8.1.2 POTABLE WATER SUPPLY PRESSURE

The HAB shall receive potable water from Node 3 at a pressure range of 15 **TBR** to 30 psig with a maximum design pressure of 35 psig..

3.2.2.2.8.1.3 POTABLE WATER RECEIVE RATE

The HAB shall receive potable water from Node 3 at a flow rate in the range of 0 to 500 lb/hr.

3.2.2.2.9 SUPPLY ATMOSPHERE SAMPLE AIR

The HAB shall supply atmosphere sample air to Node 3.

3.2.2.2.9.1 ATMOSPHERE SAMPLE AIR SUPPLY FLOW RATE

The HAB shall supply atmosphere sample air at a flow rate of 100 to 400 sccm to Node 3 when either Node 3 or the USL is drawing a sample.

3.2.2.2.9.2 ATMOSPHERE SAMPLE AIR SUPPLY PRESSURE DROP

The HAB shall supply atmosphere sample air to Node 3 at a pressure drop not to exceed 0.25 psid between the HAB bulkhead and the HAB sample probe inlet when Node 3 or the USL is drawing atmosphere sample air at a flow rate of 400 sccm and an ambient inlet pressure of 14.7 psia.

3.2.2.2.10 RECEIVE RECHARGE OXYGEN

The HAB shall receive recharge oxygen from Node 3.

3.2.2.2.10.1 RECHARGE OXYGEN CHARACTERISTICS

3.2.2.2.10.1.1 RECEIVE RECHARGE OXYGEN TEMPERATURE

The HAB shall receive recharge oxygen from Node 3 at a temperature range of 25°F to 113°F.

3.2.2.2.10.1.2 RECEIVE RECHARGE OXYGEN PRESSURE

The HAB shall receive recharge oxygen from Node 3 at a pressure up to 1050 psia at a flowrate up to 16lbm per hr.

3.2.2.2.11 RECEIVE RECHARGE NITROGEN

The HAB shall receive recharge Nitrogen from Node 3.

3.2.2.2.11.1 RECHARGE NITROGEN CHARACTERISTICS

3.2.2.2.11.1.1 RECEIVE RECHARGE NITROGEN TEMPERATURE

The HAB shall receive recharge Nitrogen from Node 3 at a temperature range of 25°F to 113°F.

3.2.2.2.11.1.2 RECEIVE RECHARGE NITROGEN PRESSURE

The HAB shall receive recharge Nitrogen from Node 3 at a pressure up to 3400 psia at a flow rate up to 3 lbm per hr.

3.2.2.3 ELECTRICAL POWER INTERFACES

3.2.2.3.1 RECEIVE POWER

The HAB shall receive secondary power from Node 3.

3.2.2.3.1.1 VOLTAGE RATING

The secondary power interface shall be a maximum of 126 volts dc.

3.2.2.3.1.2 MAXIMUM CURRENT RATING

The secondary power interface shall consist of 2 independent feeds. Each feed shall have a maximum current rating of 100 amps.

3.2.2.3.1.3 CURRENT LIMITING

Node 3 shall provide short circuit protection for all secondary power feeds crossing the interface.

3.2.2.3.1.4 WIRE AND CONNECTOR SIZING

Wiring and connector sizing at the Node 3/HAB interface shall be compatible with the current protective device.

3.2.2.3.2 LOAD CONSTRAINTS

TBD

3.2.2.4 ELECTRONIC INTERFACES

3.2.2.4.1 VIDEO SIGNALS

The HAB shall transmit and receive from Node 3 the signals as described in the following subparagraphs.

3.2.2.4.1.1 OPTICAL PFM NTSC VIDEO SIGNAL CHARACTERISTICS

The optical PFM NTSC video signal characteristics shall be in accordance with SSP 50002, paragraphs 3.2.1.5.4 and 3.2.1.5.5.

3.2.2.4.1.1.1 OPTICAL PFM NTSC VIDEO SIGNAL TRANSMIT POWER LEVELS

The minimum average optical PFM NTSC video signal transmit power, measured at ambient temperature, transmitted by the HAB shall meet the values in Table 3.2.2.4.1.1.1–1 at each signal interface.

TABLE 3.2.2.4.1.1.1–1 OPTICAL PFM NTSC VIDEO SIGNAL TRANSMIT POWER

Source to Destination		HAB Output
Video Source	Destination	Optical Power (dBm)
HAB TBD	VSU 5	TBD
HAB TBD	VSU 5	TBD

3.2.2.4.1.1.2 OPTICAL PFM NTSC VIDEO SIGNAL RECEIVE POWER LEVELS

The HAB shall meet all transmission power requirements with minimum average optical PFM NTSC video signal input power, at ambient temperature, provided by Table 3.2.2.4.1.1.2–1 at each signal interface.

TABLE 3.2.2.4.1.1.2–1 OPTICAL PFM NTSC VIDEO SIGNAL RECEIVE POWER

Source to Destination		HAB Input
Video Source	Destination	Optical Power (dBm)
VSU 5	HAB TBD	TBD
VSU 5	HAB TBD	TBD

3.2.2.4.1.2 OPTICAL PFM NTSC SYNC AND CONTROL SIGNAL CHARACTERISTICS

The optical PFM NTSC sync and control signal characteristics shall be in accordance with SSP 50002, paragraphs 3.2.1.5.4 and 3.2.1.5.5.

3.2.2.4.1.2.1 OPTICAL PFM NTSC SYNC AND CONTROL SIGNAL RECEIVE POWER LEVELS

The HAB shall meet all transmission quality requirements with minimum average optical PFM NTSC sync and control signal input power, measured at ambient temperature, provided by Table 3.2.2.4.1.2.1–1 at each signal interface.

TABLE 3.2.2.4.1.2–1 OPTICAL PFM NTSC VIDEO SIGNAL RECEIVE POWER

Source to Destination		HAB Input
Video Source	Destination	Optical Power (dBm)
VSU 5	HAB TBD	TBD
VSU 5	HAB TBD	TBD

3.2.2.4.2 AUDIO DATA BUS

The HAB shall transmit the signals described in the following subparagraphs to the Node 3.

3.2.2.4.2.1 OPTICAL LPCM AUDIO SIGNAL CHARACTERISTICS

The HAB shall transmit optical LPCM audio signals to Node 3 with the following signal characteristics:

(1) Bit Rate: 11.76 Mbps

(2) Optical Center Frequency: 1300 nm

(3) Light is non–coherent.

3.2.2.4.2.1.1 OPTICAL LPCM AUDIO SIGNAL POWER LEVELS

The minimum optical LPCM audio signal output power, measured at ambient temperature, of the HAB shall meet Table 3.2.2.4.1.1–1 at each signal interface. The HAB shall meet all transmission requirements with minimum optical LPCM audio signal input power, at ambient temperature, provided by Table 3.2.2.4.2.1.1–2 at each specified signal interface.

TABLE 3.2.2.4.2.1.1–1 OPTICAL LPCM AUDIO SIGNAL OUTPUT POWER

Source to Destination		The HAB Output
Audio Source	Destination	Optical Power (dBm)
HAB Audio ORU 1	Node 3 ABC 5	TBD
HAB Audio ORU 2	Node 3 ABC 5	TBD
HAB Audio ORU 3	Node 3 ABC 5	TBD
HAB Audio ORU 4	Node 3 ABC 5	TBD
HAB Audio ORU 1	Node 3 ABC 6	TBD
HAB Audio ORU 2	Node 3 ABC 6	TBD
HAB Audio ORU 3	Node 3 ABC 6	TBD
HAB Audio ORU 4	Node 3 ABC 6	TBD

TABLE 3.2.2.4.2.1.1–2 OPTICAL LPCM AUDIO SIGNAL INPUT POWER

Source to Destination		The HAB Input*
Audio Source	Destination	Optical Power (dBm)
Node 3 ABC 5	HAB Audio ORU1	TBD
Node 3 ABC 5	HAB Audio ORU2	TBD
Node 3 ABC 5	HAB Audio ORU3	TBD
Node 3 ABC 5	HAB Audio ORU 4	TBD
Node 3 ABC 6	HAB Audio ORU 1	TBD
Node 3 ABC 6	HAB Audio ORU 2	TBD
Node 3 ABC 6	HAB Audio ORU 3	TBD
Node 3 ABC 6	HAB Audio ORU 4	TBD

3.2.2.4.2.2 ULTRA HIGH FREQUENCY (UHF)

3.2.2.4.2.2.1 UHF COMMUNICATION DISTRIBUTION

The HAB shall support UHF communication to and from Node 3 via a dedicated coaxial cable, NRFC–50–coax–3.

3.2.2.4.2.2.2 UHF COMMUNICATION SIGNAL CHARACTERISTICS

UHF communication shall be at a selectable center frequency of 414.2 MHz or 417.1 MHz using PCM–FM modulation and five–slot TDMA.

3.2.2.4.2.2.3 INTERFACE IMPEDANCE

The interface impedance measured at the HAB and Node 3 interface shall be 50 Ohms nominal.

3.2.2.4.2.2.4 INTERFACE VSWR

The VSWR measured at the HAB and Node 3 interface shall be less than 1.35:1.0 over 413 MHz to 414 MHz and 416 MHz to 418 MHz.

3.2.2.4.2.2.5 UHF INTERFACE POWER LEVEL

The HAB shall transmit RF power of **TBD** dbm minimum for the Node 3 at the Node 3/HAB interface.

3.2.2.4.3 C&DH MIL–STD–1553 INTERFACE

3.2.2.4.3.1 DATA BUS STANDARDS

The physical characteristics and data transfer protocol for the C&DH MIL–STD–1553B interface shall conform to MIL–STD–1553B.

3.2.2.4.3.2 INTERFACE BUSES

The following buses shall cross the HAB to Node 3 interface: CB CT–BIA–23, CB CT–4, LB CHeCS–HAB, LB SEPS–N3–14, LB SEPS–N3–23, LB SEPS–HCZ–14, LB SEPS–HCZ–23, LB SYS–HCZ–1, and LB SYS–HCZ–2. Each bus shall provide dual redundant data paths across the interface. The data path interfaces for each bus shall conform to the redundancy requirements given in paragraph 3.2.2.1.3.2.

3.2.2.4.3.3 PROVIDE OUTPUT AMPLITUDE

The HAB shall provide a minimum response signal amplitude of 3.6 volts, peak–to–peak, line–to–line, at the Node 3 interface for messages transmitted on HAB MIL–STD–1553 data buses with active Terminal Interface Units connected to the bus.

The HAB shall provide a minimum signal amplitude of 3.6 volts, peak–to–peak, line–to–line, at the Node 3 interface for messages transmitted on the HAB pass–through MIL–STD–1553 data buses.

3.2.2.4.3.4 MEDIUM RATE DATA LINK INTERFACE

The HAB shall provide three Ethernet transmission lines and three Ethernet receive lines to the Node 3 supporting the OPS LAN (formerly PCS LAN).

3.2.2.5 ENVIRONMENTS

3.2.2.5.1 ELECTROMAGNETIC EFFECTS

3.2.2.5.1.1 ELECTROMAGNETIC COMPATIBILITY

The HAB to Node 3 interface shall meet the requirements of SSP 30243.

3.2.2.5.1.2 ELECTROMAGNETIC INTERFERENCE

The HAB to Node 3 interface shall meet the requirements of SSP 30237, paragraph 4.2.

3.2.2.5.1.3 GROUNDING

The HAB to Node 3 interface shall meet the requirements of SSP 30240.

3.2.2.5.1.4 BONDING

The HAB to Node 3 structural/mechanical interface shall meet the requirements of SSP 30245. The on–orbit bonding shall meet the requirements for a Class R Bond, which includes the Class H parameters, when permanently mated. During all other operations, the bond shall meet the requirements of a Class H Bond.

3.2.2.5.1.5 CABLE AND WIRE DESIGN

The HAB to Node 3 cable and wire interface shall meet the requirements of SSP 30242.

3.2.2.5.2 THERMAL

The HAB to Node 3 interface shall function as defined herein when exposed to the thermal radiation environment per SSP 50023. Math models and/or thermal design analysis criteria for the interface design are specified in SSP 50023.

3.2.2.5.3 ACOUSTIC

The HAB shall not induce acoustic noise levels on Node 3 exceeding the NC–50 levels specified in SSP 50005, measured in octave bands from 63 to 8000 Hz except during alarm or warning conditions.

3.2.2.5.4 ACCELERATIONS

The HAB shall be capable of on–orbit induced accelerations of 0.4g's acting in any direction, assuming a free–free boundary condition.

3.2.2.5.5 ON–ORBIT TRANSIENT INTERFACE LOADS

The maximum on–orbit transient quasi–static loads at the HAB to Node 3 interface shall be as defined in the current version of SSP 50318 Tables 3.2.1.4.5–1, 3.2.1.4.5–2, and 3.2.2.4.5–1. The load components within each load case shall be applied concurrently in any combination of positive and negative values for each component. The associated on–orbit transient load spectrum is defined in Table 3.2.2.4.5–2 and is referenced to the maximum design loads resulting from Table 3.2.2.4.5–1.

TABLE 3.2.2.4.5–1 NODE 3 / HAB COUPLED INTERFACE LOADS

Axial (lb)	RSS Shear (lb)	RSS Moment (in–lb)	Torsion (in–lb)
± 1,300 TBR	± 1,180 TBR	± 231,200 TBR	± 93,700 TBR

APPENDIX A ABBREVIATIONS AND ACRONYMS

A.1 ABBREVIATIONS AND ACRONYMS

ACBM	Active Common Berthing Mechanism
ASI	Italian Space Agency
ASTM	American Society of Testing and Materials
BD&SG	Boeing Defense & Space Group
CBM	Common Berthing Mechanism
C&C	Command and Control
cfm	cubic feet per minute
C&DH	Command and Data Handling
dB	Decibals
dBm	Decibal Meters
dc	Direct Current
EVA	Extravehicular Activity
Ft^3	Cubic Feet
g	Gravitational Acceleration
HAB	Habitation Module
ICD	Interface Control Document
IMV	Intermodule Ventilation
IRE	Institute of Radio Engineers
ISS	International Space Station
IVA	Intravehicular Activity
lb	pounds
lbm	pounds mass
LPCM	Optical Linear Pulse Code Modulated

LT	Low Temperature
Mbps	Megabytes per second
MDA	McDonnell–Douglas
MDM	Multiplexer/Demultiplexer
MHz	Megahertz
MIL–STD	Military Standard
min	minute
mV	Milivolts
MSFC–DWG	Marshall Space Flight Center – Drawing
MT	Medium Temperature
NASA	National Aeronautics and Space Administration
nM	Nano – Meters
NSTS	National Space Transportation System
NTSC	National Television Standard Committe
OPS LAN	Operations Local Area Network
ORU	Orbital Replacement Unit
PCBM	Passive Common Berthing Mechanism
PCM	Pulse Code Modulated – Frequency Modulated
PCS LAN	Personal Computing System Local Area Network
PFM	Pulse–Frequency Modulated
PDGF	Power and Data Grapple Fixture
PIDS	Prime Item Development Specification
psia	pounds per square inch absolute
psid	Pounds per square inch differential
psig	pounds per square inch guage
RF	Radio Frequency

RT	Remote Terminal
SI	International System of Units
SMAC	Spacecraft Maximum Allowable Concentrations
sscm	Standard Cubic Centimeter per Minute
SSP	Space Station Program
SSQ	Space Station Quality
TBD	To Be Determined
TBR	To Be Reviewed
TDMA	Time Division Multiple Accessing
TTL	Transistor Transistor Logic
USOSS	United States On–Orbit Segment Specification
UHF	Ultra High Frequency
USL	United States Laboratory
Vdc	Volt Direct Current
VSU	Video Switching Unit
VSWR	Voltage Standing Wave Ratio