# Axiom

## Introduction

### Scope

This specification establishes the performance and design requirements for the Axiom module and elements. External requirements and interfaces are decomposed in sub-tier documents.

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| [AX-275](http://192.168.10.14:8080/browse/AX-275) | **This specification establishes the performance, interface and design requirements for the Axiom module and elements.** |  |

### Purpose

The Axiom Module is a commercially owned and operated space station module that conducts basic research in areas including microgravity, earth science, life and natural science, engineering research, technology testing and advancement, space manufacturing and exploration system maturation while supporting a crew. The Axiom Station module is the first pressurized element which will initially be berthed at the ISS.

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| [AX-286](http://192.168.10.14:8080/browse/AX-286) | **Purpose** |  |

The Axiom Module is a commercially owned and operated space station module that conducts basic research in microgravity, Earth science, life and natural science, engineering research, technology development, space manufacturing and exploration system maturation while supporting a multinational crew. The Axiom module is the first in series of elements that will link up to form a commercial space station in low Earth orbit.

### Applicability

These requirements are applicable for the Design Reference Missions described in section 3.1.2.1

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| [AX-644](http://192.168.10.14:8080/browse/AX-644) | **Engineering Unit Convention** |  |

Unless otherwise specified, all dimensions in this document are defined in SI metric equivalent with the English system of inch pound (IP) units shown in parenthesis. For the purpose of interface verification either system of units can be used.

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| [AX-645](http://192.168.10.14:8080/browse/AX-645) | **Tolerances will be called out directly for all requirements** |  |

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| [AX-646](http://192.168.10.14:8080/browse/AX-646) | **Mission Authority** |  |

MCC-H will have Mission Authority to make final decisions regarding safety of flight and crew. Axiom Space will have final decision over mission success.

## Applicable Documents

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| [AX-647](http://192.168.10.14:8080/browse/AX-647) | **List of applicable, reference and industry standard documents.** |  |

To be Provided: List of Documents grouped by applicability

## System Requirements

### System Definition

#### System Description

##### Context Diagram

##### Element Description

#### Mission

##### DRMs

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| [AX-172](http://192.168.10.14:8080/browse/AX-172) | **ISS Mission - Launch through Berthing** |  |

The Axiom module will launch from the Eastern range using a Falcon Heavy launch vehicle. The upper stage will insert the Axiom module into an ISS phasing orbit and separate from the Axiom module. The Axiom Module will complete the orbit phasing and raising maneuvers and rendezvous with the ISS. The Module will provide station keeping within the berthing box while the SSRMS grapples the module. The module will be berth at Node 2 forward port. The ISS crew will provide a initial configuration of power, thermal, IMV, data through the CBM vestibule and open the hatch. If the module can not be grappled or berthed it will depart the AE and station keep.

Rationale: The Axiom module will launch from the eastern range using a Falcon Heavy launch vehicle. The upper stage will insert the Axiom module into an ISS phasing orbit and separate from the Axiom module. The Axiom Service Module will complete the orbit phasing and raising maneuvers and rendezvous with the ISS. The SM will provide station keeping within the berthing box while the SSRMS grapples the module. The module will be berth at Node 2 forward port.

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| [AX-173](http://192.168.10.14:8080/browse/AX-173) | **ISS Mission - Activation through Un-Crewed Operation** |  |

The ISS crew completes vestibule configuration including ITCS and ISS audio. ISS crew performs EVA to configure external power feeds and PMA relocation. The ground will command the flight systems to in stages to support an initial operational capability. Critical systems will be commissioned over time to gain confidence in readiness to support crew. The ground will command science, manufacturing and research payloads as required.

Rationale: The Axiom module will support uncrewed operations onorbit supporting science and research payloads and can provide ECLSS capability to ISS while Axiom crew are not onboard.

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| [AX-176](http://192.168.10.14:8080/browse/AX-176) | **ISS Mission - Contingency Departure** |  |

In the event that Axiom needs to leave station with or without ISS crew onboard an automated sequence of hatch closure and quick disconnects would release so that the module can be release from the CBM port. Post release the axiom module would depart the AE and begin a safe solar inertial attitude.

\_Rationale: The Axiom Module will have the capability to depart from ISS with minimial to no crew involvement in the case of contingency. The Axiom module will separate to a safe distance from ISS and hold attitude. This contingency condition may not support full utilization of the module. The module performs "stay alive" fucntions for TBD months. The module supports docking with a crewed vehicle and TBD day crewed visits while in freeflyer mode. \_

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| [AX-18](http://192.168.10.14:8080/browse/AX-18) | **ISS Mission - Crewed Sortie** |  |

The Axiom module will support crewed operations on orbit with up to 7 multi-national crew members for up to 60 days. The Axiom procured Commercial Crewed Vehicle would remain attached to the station to act as a lifeboat and then return the passengers at the end of their stay. The maximum stay is dictated by the traffic model for the two docking ports.

Rationale: Crewed vehicle will deliver 7 passengers with minimal cargo. The Commercial Crewed Vehicle would remain attached to the station to act as a lifeboat and then return the passengers at the end of their stay. The maximum stay is dictated by the traffic model for the two docking ports. Since there are only two docking ports and NASA plans to have both ports occupied during an increment handover between crews, the maximum docked time would be limited to NASA crew rotations or cargo vehicles that dock instead of berth.

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| [AX-503](http://192.168.10.14:8080/browse/AX-503) | **ISS Mission- reboost and momentum management** |  |

The Axiom module has a propulsion capability that can be used for momentum management and re-boost. The ISS would command the Axiom Module for re-boost firings. Firings are limited in duration to propellant on hand. A contingency attitude hold or CMG desat could also be accommodated.

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| [AX-504](http://192.168.10.14:8080/browse/AX-504) | **ISS Mission - Axiom Module Resupply** |  |

The Axiom module requires resupply to support Consumables, Logistics and Payloads. Additionally, returned science, payloads, manufactured items and disposal of trash is required. Axiom procures up/down mass on commercial cargo vehicles to supply the continued operation of the module and its mission.

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| [AX-177](http://192.168.10.14:8080/browse/AX-177) | **Axiom module Departure at ISS EOL** |  |

At the retirement of ISS the Axiom module will enable transition of pressurized environment hardware and elements by agreement from NASA to the Axiom module.

Rationale: These may include research and manufacturing hardware. the Permanent Multipurpose Module (PMM), the Cupola, the SSRMS w/ robotics workstation, the Glovebox, express rack freezers, life support spares, tools, crew equipment, etc. Upon separation from ISS, the Axiom module will perform maneuvers to rendezvous with a new Axiom Station. The Axiom module will dock to the new station and receive additional power and thermal rejection.

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| [AX-178](http://192.168.10.14:8080/browse/AX-178) | **Axiom module transfers to Axiom Station** |  |

After ISS separation Axiom module will join the Axiom Station to continue its primary mission. The AM will perform a cooperative rendezvous and docking with Axiom Station. The AM will require a crew launch to complete outfitting and activation. Power and thermal connections will be provided by Axiom Station through the docking interface. The Axiom Module will provide life support revitalization to the Axiom Station to support the crew.

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| [AX-505](http://192.168.10.14:8080/browse/AX-505) | **Axiom module Free Flyer Crew Docking** |  |

To support the Axiom module in the event of an extended free flyer duration post contingency separation or EOL. The module will support short duration crew visits to resupply and maintain the module prior to Axiom Station being on-orbit.

#### System Capabilities

Highest level capabilities to drive interface requirements, subsystem requirements, system definition, etc..

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| [AX-19](http://192.168.10.14:8080/browse/AX-19) | **The Axiom module systems shall support tended and untended operations/payload activities.** |  |

To the extent possible payload operations should be automated and not require crew supervision. Commanding from ground is available as needed in the "untended" timeframes.

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| [AX-20](http://192.168.10.14:8080/browse/AX-20) | **The Axiom module shall facilitate earth imaging and sensing payloads** |  |

The intent is to accommodate imaging systems inside, outside and via an earth viewing airlock. These cameras need to have data connectivity for control and imagery access.

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| [AX-21](http://192.168.10.14:8080/browse/AX-21) | **The Axiom module shall host pressurized research payloads and technology testing** |  |

The ability to conduct research and host payloads is a key part of the demand and revenue for a commercial space station.

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| [AX-22](http://192.168.10.14:8080/browse/AX-22) | **The Axiom module shall support in-space manufacturing** |  |

The ability to manufacture unique materials and assemble items in space is an important use case for the commercialization of space. Demand from government and commercial users is forecast to be a growth area

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| [AX-23](http://192.168.10.14:8080/browse/AX-23) | **The Axiom module shall provide for advertising/branding opportunities** |  |

In order to close the business case additional revenue streams are necessary including naming rights, sponsorship and endorsement

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| [AX-179](http://192.168.10.14:8080/browse/AX-179) | **The Axiom module shall be structurally designed for 30 years on orbit** |  |

The requirement is meant to address structural integrety. Items that are designed for minimum risk or frature critical will need to show margins on safe life. Components that have other life limited factors will need to have R&R capability. Sparing will be either on oribit or launch on need.

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| [AX-180](http://192.168.10.14:8080/browse/AX-180) | **The Axiom module shall host unpressurized research payloads** |  |

The ability to conduct research and technology development is a key part of the demand and revenue for a commercial station.

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| [AX-506](http://192.168.10.14:8080/browse/AX-506) | **The Axiom module and operations shall adhere to TBD unit convention** |  |

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| [AX-507](http://192.168.10.14:8080/browse/AX-507) | **The Axiom critical operations shall be conducted in English** |  |

To enable effective and safe communications, all operations that can impact crew and vehicle safety will be conducted in English

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| [AX-508](http://192.168.10.14:8080/browse/AX-508) | **The Axiom module shall support exploration systems maturation testing** |  |

A key benefit the Axiom module can provide is a platform for Exploration systems developmet and testing

#### Interface Requirements

##### Internal Requirements

##### External Interfaces

All interface specifications for systems external to the Axiom Module

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| [AX-25](http://192.168.10.14:8080/browse/AX-25) | **The Axiom module shall be compatible with ISS physical interface requirements** |  |

In order to operate successfully and safely with the ISS the Axiom module must be designed and built to meet the applicable ISS physical interface requirements. The applicabillity will be limited by the Axiom mission success criteria

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| [AX-26](http://192.168.10.14:8080/browse/AX-26) | **The Axiom integrated stack shall be capable of launch on a Falcon Heavy with long payload fairing** |  |

The Axiom module is accommodated in mass and volume by the Falcon Heavy launch vehicle with the extended payload fairing <Reference Falcon Heavy Users Manual when available>

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| [AX-27](http://192.168.10.14:8080/browse/AX-27) | **The Axiom module shall have capability to deliver the Axiom module from launch vehicle to the predefined berthing box** |  |

a bus capability is required to provide deltaV and perform translation maneuvers to get Axiom from the point of launch vehicle separation to the pre-defined ISS berthing box location

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| [AX-28](http://192.168.10.14:8080/browse/AX-28) | **The Axiom module shall be robotically captured and installed on ISS** |  |

In order to berth the vehicle to the ISS the SSRMS must bring the Axiom Module from the berthing box to it's berthing location.

<reference NSTS-21000-IDD-ISS>

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| [AX-29](http://192.168.10.14:8080/browse/AX-29) | **The Axiom module shall be berthed to Node 2 forward CBM.** |  |

Forward port of Node 2 is the prefered location from a docking, ISS CG, and available interfaces perspective

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| [AX-30](http://192.168.10.14:8080/browse/AX-30) | **The Axiom module shall be capable of receiving power from the ISS.** |  |

This defines the channelization capability, it does not guarantee a power usage from ISS. The amount of power from ISS will be allocated through real time operational considerations. There will be flight rules written for power levels to support crewed and uncrewed operations

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| [AX-31](http://192.168.10.14:8080/browse/AX-31) | **The Axiom module shall be capable of rejecting heat to the ISS Thermal Control System.** |  |

This defines the capacity, it does not guarantee a thermal rejection usage from ISS. The amount of thermal rejection from ISS will be allocated through real time operational considerations. There will be flight rules written for thermal rejection to support crewed and uncrewed operations

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| [AX-32](http://192.168.10.14:8080/browse/AX-32) | **The Axiom module's pressure and Nitrogen partial presure shall be controlled by ISS** |  |

The ISS provides pressure control for all modules in the system

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| [AX-33](http://192.168.10.14:8080/browse/AX-33) | **The Axiom module shall have access to the ISS potable water bus** |  |

In addition to water reclamation from the Axiom ECLSS system the Axiom crew will require potable water from the ISS to have sufficient quantity for consumption and hygiene

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| [AX-34](http://192.168.10.14:8080/browse/AX-34) | **The Axiom module shall have access to the ISS wastewater bus** |  |

wastewater will be returned to ISS for processing. quantity can be estimated based on 7 crew continuous

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| [AX-35](http://192.168.10.14:8080/browse/AX-35) | **The Axiom module shall receive Nitrogen purge gas from the ISS through the Node 2 CBM feed through** |  |

The Axiom module will need access to inert gas for payload servicing

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| [AX-36](http://192.168.10.14:8080/browse/AX-36) | **The Axiom module shall send and receive messages through the ISS 1553b bus** |  |

The Axiom module will send health and status and caution and warning information to the ISS. Similarly the Axiom module will receive caution and warning and data from ISS. This is the primary means to address crit1 functionality. Additional, payload relevant data will be shared between ISS and Axiom via 1553 bus

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| [AX-38](http://192.168.10.14:8080/browse/AX-38) | **The Axiom module shall support the docking operations through the axial port** |  |

Both Axiom and ISS crew members will arrive via a visiting vehicle docking to the port located on the forward port of the Axiom module

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| [AX-39](http://192.168.10.14:8080/browse/AX-39) | **The Axiom module shall have EVA translation paths and worksite accomodations for assembly, reconfiguration and contingenies.** |  |

The Axiom module will requires externally mated connectors by an EVA crew member at the node 2 interface and the PMA2 interface. EVA crew will require translation and worksite accommodations to mate the connectors. Also EVA compatible tools and connectors will have to be specified.

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| [AX-181](http://192.168.10.14:8080/browse/AX-181) | **The Axiom module shall accomodate robotic reconfiguration and support** |  |

It is assumed that the SSRMS will not be able to reach the forward berthing port and will need to walk onto Axiom to get a better reach. Most likely this would have to be installed via an EVA since the payload envelope is violated.

To install and maintain elements attached to CBMs and perform configuration work, a robotic worksite will be necessary

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| [AX-182](http://192.168.10.14:8080/browse/AX-182) | **The Axiom module shall provide stand alone power** |  |

This defines the power generation of the the Axiom module while free flying in a solar inertial attitude. It also defines the power storrage requirement for orbital average usage.

To cover launch to integration, possible periods where ISS can not provide sufficient power to Axiom module and contingency separation conditions analysis needed

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| [AX-183](http://192.168.10.14:8080/browse/AX-183) | **The Axiom module shall provide stand alone heat rejection when freeflying** |  |

In addition to using ISS capabilities for TCS, the Axiom module will need to be able to provide it's own heat rejection to support independent operations

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| [AX-184](http://192.168.10.14:8080/browse/AX-184) | **The Axiom module shall provide stand alone pressure and Nitrogren partial pressure when freeflying** |  |

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| [AX-185](http://192.168.10.14:8080/browse/AX-185) | **The Axiom module shall support transfer of NASA and Axiom crew through the Axiom module to the docking port** |  |

Both Axiom and ISS crew members will arrive via a visiting vehicle docking to the docking port located on the forward port of the Axiom module

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| [AX-509](http://192.168.10.14:8080/browse/AX-509) | **The Axiom module shall have the capability to depart, maintain control and provide stable life functionality in contingency scenarios** |  |

In the event that the Axiom module must leave the ISS due to a contingency event it must be able to maintain control and provide for "stay alive" functionality

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| [AX-510](http://192.168.10.14:8080/browse/AX-510) | **The Axiom module shall be robotically unberthed for departure from ISS** |  |

Departure of the Axiom module from ISS it may be robotically enabled

#### System Diagrams

### Characteristics

#### Performance Characteristics

#### Physical Characteristics

All Requirements applying to (solely) to the Axiom Module

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| [AX-40](http://192.168.10.14:8080/browse/AX-40) | **The Axiom module shall store and prepare food and beverage for the crew** |  |

The Axiom module is intended to serve as crew quarters for the Axiom crew and should provide systems and fixtures to support day-to-day life aboard the module.

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| [AX-56](http://192.168.10.14:8080/browse/AX-56) | **The Axiom module shall provide external electronic advertising signage that is visible from the nadir approach** |  |

The vision of Axiom is to create a "city in space" and advertisement is a viable method to fund future development. Common approach trajectories from nadir will be evaluated to best design signage that is visitble from nadir side.

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| [AX-55](http://192.168.10.14:8080/browse/AX-55) | **The Axiom module shall provide an airlock for unpressurized earth sensing** |  |

Provide the ability to mount instruments to collect Earth sensing data.

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| [AX-54](http://192.168.10.14:8080/browse/AX-54) | **The Axiom module shall provide for pressurized and unpressurized earth observation locations** |  |

Provide the ability to mount instruments to collect Earth observation data. This will require power and data accomodations for sensors.

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| [AX-41](http://192.168.10.14:8080/browse/AX-41) | **The Axiom module shall provide a waste collection system that provides odor containment, leak containment, soundproofing and privacy** |  |

The Axiom module is intended to serve as crew quarters for the Axiom crew and should provide systems and fixtures to support day-to-day life aboard the module.

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| [AX-42](http://192.168.10.14:8080/browse/AX-42) | **The Axiom module shall provide a hygiene system for; bathing, shaving, teeth brushing, water/moisture containment, vacuum for hair clippings** |  |

The Axiom module is intended to serve as crew quarters for the Axiom crew and should provide systems and fixtures to support day-to-day life aboard the module.

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| [AX-43](http://192.168.10.14:8080/browse/AX-43) | **The Axiom module shall provide individual crew quarters for full crew complement** |  |

The Axiom module is intended to serve as crew quarters for the Axiom crew and should provide systems and fixtures to support day-to-day life aboard the module and includes soundproofing, radiation shielding, sleeping bag and anchors to secure bag, light, Axiom ethernet connectivity, desk/workspace, C&W annunciation.

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| [AX-45](http://192.168.10.14:8080/browse/AX-45) | **The Axiom module shall have one passive CBMs and will have 3 radial ACBMs and one axial ACBM, with TBD services to support configuration and expandability** |  |

The Axiom module will be initially mated to the ISS requiring a passive CBM. The module will support a PMA for docking vehicles as well as active CBMs for berthing vehicles. The Axiom should also have the capability to support additional modules, air locks, etc. for future missions.

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| [AX-46](http://192.168.10.14:8080/browse/AX-46) | **The Axiom module shall provide a maximum (TBD) cubic meters of storage for spares and consumables** |  |

Not all consumables will be consumed upon arrival, thus they must be stowed. Spare parts should be available should there be the need to replace or repair an instrument or system.

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| [AX-47](http://192.168.10.14:8080/browse/AX-47) | **The Axiom module shall provide windows within each crew quarter for viewing** |  |

Provides method for imaging Earth, approaching vehicles, or deep space. Provides crew and/or tourists a personal view. Note that optical quality windows are not needed for crew viewing

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| [AX-48](http://192.168.10.14:8080/browse/AX-48) | **The Axiom module shall provide displays and controls for crew situational awareness and commanding of Axiom systems** |  |

Human interface with Axiom systems is necessary for nominal operations and anomaly resolution. The displays and controls also provide access to Axiom systems as well as caution and warning indications

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| [AX-49](http://192.168.10.14:8080/browse/AX-49) | **The Axiom module shall provide data, video and audio distribution, storage and retireval** |  |

Not all data must be sent to ground via Axiom to ground telemetry. This data should be stored rather than broadcast.

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| [AX-50](http://192.168.10.14:8080/browse/AX-50) | **The Axiom module shall provide a dedicated, secure two-way communication path to the ground** |  |

The module must be able to receive commands, send data and support crew communication

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| [AX-51](http://192.168.10.14:8080/browse/AX-51) | **The axiom module shall process commands and data from the ground.** |  |

Axiom subsystems must be able to accept commands from the ground to operate the module and hosted payloads

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| [AX-52](http://192.168.10.14:8080/browse/AX-52) | **The Axiom module shall provide caution and warning annunciations to crew** |  |

via audible tones, colored light indication and C&W messages to be displayed on Axiom displays. For all indications sent and received to/from ISS and Axiom identical queues shall be used. C&W application shall have highest priority of system applications <reference 50005 sec 9.4.4 & PP 9.4.5.1.1>

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| [AX-186](http://192.168.10.14:8080/browse/AX-186) | **The Axiom module shall provide exercise equipment to support crew health maintenance** |  |

The Axiom crew will require exercise to maintain strength. Requirements during ISS mated operations are lower as the crew will have short duration stays

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| [AX-187](http://192.168.10.14:8080/browse/AX-187) | **The Axiom module shall segregate data and commands between data buses based on priority and criticality** |  |

Separarate buses are designated to ensure that high priority/criticality data send/receive can not be impacted by lower priority data exchange

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| [AX-188](http://192.168.10.14:8080/browse/AX-188) | **The Axiom module shall send command acknowledgement and data to the ground** |  |

Axiom subsystems must be able to send data to ground

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| [AX-191](http://192.168.10.14:8080/browse/AX-191) | **The Axiom module shall provide for manual and automatic generation of caution and warning messages** |  |

this includes crew initiated and sensor generated detection of hazardous conditions including fire

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| [AX-511](http://192.168.10.14:8080/browse/AX-511) | **The Axiom module shall have a dedicated, high rate downlink to the ground** |  |

Needed to support high rate downlink capability for payload research data, video

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| [AX-512](http://192.168.10.14:8080/browse/AX-512) | **THe Axiom module shall utilize the ISS communication path to the ground to recieve commands and to send data and video** |  |

For most/nominal Axiom communication data shall be sent to the ground via the ISS communication path

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| [AX-513](http://192.168.10.14:8080/browse/AX-513) | **The Axiom module shall provide automated capability to track consumables and inventory** |  |

Knowledge of current supply quantities and storage locations needed to efficiently plan and access materials onboard

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| [AX-841](http://192.168.10.14:8080/browse/AX-841) | **The Axiom module shall be plug and play for electronic and software configuration** |  |

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| [AX-673](http://192.168.10.14:8080/browse/AX-673) | **The Axiom shall accommodate (TBD number) PDGFs.** |  |

In order to facilitate berthing of vehicles and modules to the Axiom Station, the SSRMS will need to walk onto the module.

#### Operability

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| [AX-193](http://192.168.10.14:8080/browse/AX-193) | **The Axiom module shall be fail operational/ fail safe for all systems** |  |

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| [AX-194](http://192.168.10.14:8080/browse/AX-194) | **The Axiom module shall be designed for on orbit maintenance and replacement of systems that are life limited.** |  |

Design considerations for self sealing connectors and production breaks should be included

##### Availability

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| [AX-195](http://192.168.10.14:8080/browse/AX-195) | **Axiom systems shall support maintenance intervals greater than TBD** |  |

##### Reliability

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| [AX-196](http://192.168.10.14:8080/browse/AX-196) | **All Axiom systems must have a TBD mean time between failures** |  |

#### Environments

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| [AX-652](http://192.168.10.14:8080/browse/AX-652) | **RADIATIVE HEAT TRANSFER** |  |

For COTS vehicle thermal analysis, the shadowing and radiant energy interaction from all ISS components and Axiom Shall be derived in  
accordance with the ISS thermal model baselines as described in JSC 66617, ISS Passive  
Thermal Control System (PTCS) Analysis Guide.

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| [AX-663](http://192.168.10.14:8080/browse/AX-663) | **ATOMIC OXYGEN AND SOLAR UV/VUV** |  |

The Axiom module shall meet all functional, performance, safety, and reliability requirements during and  
after exposure to a ram atomic oxygen flux of 5E+21 ao/cm2/year and the solar  
ultraviolet/vacuum ultraviolet (UV/VUV) environment defined per SSP 30425 Section 7, as  
encountered during the ISS Axiom mission for the on-orbit operational lifetime of the exposed  
hardware. The requirement is applicable to all on-orbit phases of the Axiom ISS mission  
timeline.

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| [AX-657](http://192.168.10.14:8080/browse/AX-657) | **IONOSPHERIC PLASMA ENVIRONMENT** |  |

Axiom shall meet its functional and performance requirements for safety-critical functions during and after exposure to the natural plasma environment defined in SSP 30425, Space Station Program Natural Environment Definition for Design, section 5.

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| [AX-658](http://192.168.10.14:8080/browse/AX-658) | **ISS INDUCED PLASMA ENVIRONMENT** |  |

Axiom shall meet its functional and performance requirements before, during, and after exposure to the maximum expected ISS floating potential environment of +20 to ��� 80 V.

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| [AX-650](http://192.168.10.14:8080/browse/AX-650) | **THERMAL INTERFACE FOR DOCKING** |  |

A. For docking operations, the temperature of the IDA docking mechanism, at the IDA structural interface, will be within the prescribed temperatures defined in Figure 3.2.2.6.2.1.1-1, IDA/COTS Vehicle Hard and Soft Capture Interface Allowable Thermal Differentials at Docking.  
B. Post docking, the temperature of the IDA at the COTS vehicle structural interface and vestibule surfaces will be in transient and may be below ISS dew point or exceed internal volume touch temperatures. Pressurization is not restricted by the transient temperature profile, but hatch opening will occur no earlier than 1.5 hours after docking. Surfaces will be within a minimum of +60 deg F (+15.6 deg C) and a maximum of +113 deg F (+45 deg C) within 10 hours post docking to preclude the presence of any condensation (see paragraph 3.3.10.4.1.4) and provide safe internal volume touch temperatures.  
C. The temperature of the IDA at the COTS vehicle structural interface and vestibule surfaces will be maintained within a minimum of +60 deg F (+15.6 deg C) and a maximum of +113 deg F (+45 deg C) for the remainder of the docked phase, except for up to 10 hours post docking. [see 50808 figure]

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| [AX-654](http://192.168.10.14:8080/browse/AX-654) | **THERMAL ENVIRONMENT** |  |

A. While attached to the ISS, the Axiom module shall meet the performance requirements specified herein when exposed to the thermal solar constants; albedo; Earth Outgoing Long���Wave Radiation (OLR) defined in Table 3.3.9.1-1, Hot and Cold Natural Thermal Environments, Figure 3.3.9.1-1, Design Cold Thermal Environment Profile, and Figure 3.3.9.1-2, Design Hot Thermal Environment Profile, a space sink temperature of 3 K; and thermal interactions with all other on���orbit segments, accounting for thermal environment sensitivity effects from articulating surfaces (e.g. ISS Solar Alpha Array Joints, Beta Gimbal Assemblies, and Thermal Radiator Rotary Joints) during both tracking and fixed-pointing modes of operation.  
B. While attached to the ISS, the Axiom module shall survive during and meet full performance following exposure to the extreme hot and cold thermal environments defined in Table 3.3.9.1-2, Extreme Hot and Cold Natural Thermal Environment, Figure 3.3.9.1-3, Extreme Cold Thermal Environment Profile, and Figure 3.3.9.1-4, Extreme Hot Thermal Environment Profile, a space sink temperature of 3 K; and thermal interactions with all other on���orbit segments, accounting for thermal environment sensitivity effects from articulating surfaces (e.g. ISS Solar Alpha Array Joints, Beta Gimbal Assemblies, and Thermal Radiator Rotary Joints) during both tracking and fixed-pointing modes of operation. [see 50808 tables and figures]

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| [AX-664](http://192.168.10.14:8080/browse/AX-664) | **TOTAL IONIZING DOSE ENVIRONMENT HARDWARE** |  |

The Axiom module shall meet all functional, performance, safety, and reliability requirements during and  
after a combined exposure to the following total ionizing dose environments: a. a one-time  
exposure to the I96 worst week October 1989 solar particle event at 500 km and 51.6 degrees  
inclination, b. exposure to the trapped total ionizing dose environment described in SSP 30512,  
section 3.1 for the on-orbit operational lifetime of the exposed hardware. The requirement is  
applicable to all safety critical functions during all on-orbit phases of the Axiom ISS mission  
timeline.

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| [AX-662](http://192.168.10.14:8080/browse/AX-662) | **EXTREME SEE ENVIRONMENT** |  |

The Axiom module shall meet all functional, performance, safety, and reliability requirements for safety-critical functions during and after exposure to the extreme SEE environment described in SSP 30512, paragraph 3.2.2. The requirement is applicable to all safety critical functions during all on-orbit phases of the Axiom ISS mission timeline. An alternative extreme SEE environment definition may be used if it can be shown to meet the intent of the extreme SEE environment defined in SSP 30512.

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| [AX-661](http://192.168.10.14:8080/browse/AX-661) | **NOMINAL SEE ENVIRONMENT** |  |

The Axiom module shall meet all functional, performance, safety, and reliability requirements for safety-critical functions during and after exposure to the nominal Single Event Effects (SEE) environment described in SSP 30512, Space Station Ionizing Radiation Design Environment, paragraph 3.2.1. The requirement is applicable to all safety critical functions during all on-orbit phases of the Axiom ISS mission timeline. An alternative nominal SEE environment definition may be used if it can be shown to meet the intent of the nominal SEE environment defined in SSP 30512.

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| [AX-651](http://192.168.10.14:8080/browse/AX-651) | **PASSIVE INTERFACE TEMPERATURE** |  |

The temperature of the Axiom ACBM, at the PMA PCBM structural interface shall be within a minimum of +60 deg F (+15.6 deg C) and a maximum of +113 deg F (+45 deg C).

### Design and Construction Requirements

#### Materials and Processing

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| [AX-566](http://192.168.10.14:8080/browse/AX-566) | **The Axiom module shall meet the intent of Materials and Processes requirements in accordance with SSP 30233, Space Station Requirements for Materials and Processes** |  |

Required for hardware attached to the International Space station

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| [AX-793](http://192.168.10.14:8080/browse/AX-793) | **Axiom module deviations from Materials and Processes requirements for electrical components shall be documented and approved using the Materials Usage Agreement (MUA) system in NASA-STD-6016** |  |

The Axiom module shall meet ISS Materials and Processes requirements for all applications that affect the integrated safety of the ISS when Axiom is berthed to ISS. Additional materials and processes requirements for electrical components are in the following sections. Deviations from Materials and Processes requirements for electrical components shall be documented and approved using the Materials Usage Agreement (MUA) system in NASA-STD-6016, Standard Materials and Processes Requirements for Spacecraft. [see 50808 Appendix E for tailoring to the COTS program]

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| [AX-655](http://192.168.10.14:8080/browse/AX-655) | **The Axiom module shall be designed to operate in the on-orbit quiescent and non-quiescent contamination environments as defined in accordance with SSP 30426 sections 3.4, 3.5, and 3.6.** |  |

Space Station External Contamination Control Requirements

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| [AX-669](http://192.168.10.14:8080/browse/AX-669) | **The Axiom RCS thruster thermal plume impingement heat fluxes and heat flux integrals on ISS hardware shall not exceed the heat flux and integral heat flux values in SSP50808 Table 3.3.10.1-1** |  |

During approach/separation, the Axiom RCS thruster thermal plume impingement heat fluxes and heat flux integrals on ISS hardware shall not exceed the heat flux and integral heat flux values in Table 3.3.10.1-1, Plume Impingement. [see 50808 table]

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| [AX-671](http://192.168.10.14:8080/browse/AX-671) | **The Axiom module shall not vent or dump liquid water or liquid waste during proximity operations or while mated.** |  |

The Axiom module shall not vent or dump liquid water or liquid waste during proximity operations or while mated. Venting of water vapor for thermal control or humidity control purposes is permitted if the water vapor contains no dissolved substances that may cause violations of the SSP 30426 Space Station External Contamination Control Requirements.

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| [AX-670](http://192.168.10.14:8080/browse/AX-670) | **Spare** |  |

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| [AX-660](http://192.168.10.14:8080/browse/AX-660) | **Materials outgassing/deposition from the Axiom module while attached shall not produce a contaminant deposit in excess of 2.5E-8 grams/cm2 (2.5 Angstroms) per mission on ISS sensitive surfaces.** |  |

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| [AX-831](http://192.168.10.14:8080/browse/AX-831) | **Contaminant deposits produced by the Axiom module during approach shall not exceed 2.E-8 grams/cm2 (2 Angstroms) on ISS sensitive surfaces.** |  |

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| [AX-832](http://192.168.10.14:8080/browse/AX-832) | **The Axiom module shall not vent or release chemically reactive substances that can degrade or damage ISS surfaces.** |  |

#### Electromagnetic Radiation

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| [AX-656](http://192.168.10.14:8080/browse/AX-656) | **Axiom shall meet nominal performance requirements for safety-critical functions when exposed to the on-orbit electric field environment as specified in SSP50808 Figure 3.3.9.3-1** |  |

On-Orbit Electric Field Environment. [see 50808 figure]

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| [AX-294](http://192.168.10.14:8080/browse/AX-294) | **The Power System shall comply with SSP 30237 Electromagnetic Emission and Susceptibility Requirements and SSP 30343 (need title).** |  |

Minimize electrical nose generated by the Power System to meet the ISS requirements.

#### Workmanship

#### Design Requirements

##### Structural

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| [AX-563](http://192.168.10.14:8080/browse/AX-563) | **The Axiom module structural design shall meet the intent of SSP 30559, Structural Design and Verification Requirements with the exception of TBD paragraphs.** |  |

Required for hardware attached to the International Space station.

The following sections in SSP 30559 are not applicable to COTS vehicle design per SSP 50808: 3.1.3.1, 3.1.4.1, 3.1.6, 3.1.7, 3.1.8, 3.1.9.1, 3.2.1, 3.2.4.2, 3.3.2.1, 3.3.2.1.1, 3.3.3, 3.5.1.3, 3.5.7.4, 3.6.1, 4.1.2.1.1, and 4.1.3.1. However some of these sections may apply and should be negotiated (with the NASA technical authority?)

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| [AX-564](http://192.168.10.14:8080/browse/AX-564) | **Design of Axiom module glass and ceramic structures shall meet the intent of SSP 30560, Glass, Window, and Ceramic Structural Design and Verification Requirements, ISS Program.** |  |

Required for hardware attached to the International Space station.

Alternatively, and subject to the NASA Technical Authority concurrence, we may use NASA-STD-5018, which is more recent and much more detailed. The following sections (at a minimum) in NASA-STD-5018 would not be applicable to the Axiom module design: 4.6.3, 5.6.3, 4.10.2 and 5.10.2.

##### Fracture

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| [AX-565](http://192.168.10.14:8080/browse/AX-565) | **The Axiom module shall meet the intent of fracture control requirements in accordance with SSP 30558, Fracture Control Requirements for Space Station.** |  |

Required for hardware attached to the International Space station.

SSP 50558 will need to be tailored extensively for Axiom with, at a minimum, Shuttle requirements such as 4.2.1.3 removed and replaced with a more applicable standard.

##### Power

##### EVA

#### Safety

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| [AX-672](http://192.168.10.14:8080/browse/AX-672) | **The Axiom module shall meet the intent of the safety requirements in SSP 50808 Section 3.3.11** |  |

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| [AX-561](http://192.168.10.14:8080/browse/AX-561) | **The Axiom module's PNP shall exceed (0.99998) ^ (Area\* Time) with the environment defined in SSP 30425.** |  |

The Axiom module must have the necessary shielding to protect from MMOD per SSP 30425 and compliant with PNP per SSP 50808.

The Axiom module shall have a Probability of No Penetration (PNP) >= (0.99998) ^ (Area\* Time) when exposed to the Micro-Meteoroid/Orbital Debris (MM/OD) environment as defined TP-2014-217370, NASA Orbital Debris Engineering Model (ORDEM) Users Guide, and NASA Meteoroid Engineering Model (MEM) Release 2.0 Users Guide date January 2014, using the environment parameters listed in Table 3.3.9.5-1, Parameters for MicroMeteoroid and Orbital Debris Environments Definition.  
Note:  
Area = Surface Area of the Axiom module containing MM/OD critical hardware (including pressurized volumes, pressurized tanks, control moment gyros or other stored energy devices whose failure can propagate to other critical items in the Axiom module or ISS) in square meters.  
Time = Total time that Axiom module is mated to ISS in years. [see 50808 table]

#### Human Factors

#### Security

### Computer Resources

### Logistics

### Training

### Functional Requirements

#### Avionics

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| [AX-197](http://192.168.10.14:8080/browse/AX-197) | **The Axiom module shall interface with the GNC MDM LB ORB-N2-1 (A/B) and LB ORB-N2-2 (A/B) 1553 busses** |  |

The Axiom module will need to interface with the ISS 1553 GNC MDM's for C&W. The ISS provides redundant bus interfaces for each 1553 bus at the bulkhead.

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| [AX-142](http://192.168.10.14:8080/browse/AX-142) | **The Axiom module shall annunciate ISS Caution and Warning events aural notifications as defined by SSP 50005, section 9.4.4 and paragraph 9.4.5.1.1.** |  |

The Axiom module will be required to annunciate Caution and Warning notifications to alert the crew of Fire, Depress, or Tox. The annunciation could be a set of tones or verbal annunciation. The safety critical system will utilize the ORB1 and ORB 2 1553 bus to receive the C&W data.

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| [AX-141](http://192.168.10.14:8080/browse/AX-141) | **The Axiom module shall display ISS Caution and Warning event visual notification as defined by SSP 50005, section 9.4.4 and paragraph 9.4.5.1.1.** |  |

The Axiom module will be required to display Caution and Warning notifications to alert the crew of Fire, Depress, or Tox. The safety critical system will utilize the ORB1 and ORB2 1553 bus to receive the C&W data.

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| [AX-143](http://192.168.10.14:8080/browse/AX-143) | **The Axiom module shall provide unobstructed redundant interface panels to trigger an ISS Caution and Warning Event** |  |

The Axiom module will be required to provide redundant interfaces for the crew to trigger a Caution and Warning event to alert the ISS crew of Fire, Depress, or Tox. The safety critical avionics system will utilize the ORB1 and ORB2 1553 bus to send/receive C&W data. The displays must be unobstructed and easily accessible.

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| [AX-159](http://192.168.10.14:8080/browse/AX-159) | **The Axiom module avionics shall use an ethernet bus for data communication throughout the module** |  |

The Axiom module will communicate using ethernet in order to allow for a modular and scalable architecture, with the exception of ISS C&W interfaces.

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| [AX-156](http://192.168.10.14:8080/browse/AX-156) | **The Axiom module shall provide ISS ethernet pass-through to all CBM and docking locations** |  |

The Axiom module will be required to provide pass-through ethernet connectivity to all visiting vehicles located at the CBM and docking ports.

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| [AX-145](http://192.168.10.14:8080/browse/AX-145) | **The Axiom module shall detect depressurization within the Axiom module** |  |

The Axiom Module will need to provide local module status over the ISS 1553 network including depressurization status.

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| [AX-144](http://192.168.10.14:8080/browse/AX-144) | **The Axiom module shall detect fires within the Axiom module** |  |

The Axiom Module will need to provide local module status over the ISS 1553 network including fire detector status.

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| [AX-152](http://192.168.10.14:8080/browse/AX-152) | **The Axiom module avionics shall provide control for safety critical functions.** |  |

The Axiom module safety critical avionics system will need to have control over safety critical functions such as cabin fans, intermodule ventilation valves, etc. This control is likely a separate path for safing.

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| [AX-150](http://192.168.10.14:8080/browse/AX-150) | **TBR: The Axiom module shall send audio to ISS utilizing the ISS audio system** |  |

The Axiom module will need to allow crew to communicate with existing ISS modules using the ISS audio system. The crew will need to send audio from the intercom mic.

TBR: Need to resolve if this is a requirement. VV will have own means of Comm for egress. Several modules do not have audio interface panels.

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| [AX-149](http://192.168.10.14:8080/browse/AX-149) | **TBR: The Axiom module shall receive ISS audio utilizing the ISS audio system** |  |

The Axiom module will need to allow crew to communicate with existing ISS modules using the ISS audio system. The crew will need to receive audio at the intercom speaker.

TBR: Need to resolve if this is a requirement. VV will have own means of Comm for egress. Several modules do not have audio interface panels.

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| [AX-199](http://192.168.10.14:8080/browse/AX-199) | **The Axiom module shall provide a pass-through interface to the LB ORB-N2-1 (A/B) and LB ORB-N2-2 (A/B) 1553 busses at all Axiom module port feed-through locations.** |  |

The Axiom module will be required to provide pass-through 1553 connectivity to all visiting vehicles located at all ports. Node 2 provides redundant (A/B) interfaces with LB ORB-N2-1 and LB ORB-N2-2.

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| [AX-200](http://192.168.10.14:8080/browse/AX-200) | **The Axiom module shall provide LB SYS-N2-1 (A/B) and LB SYS-N2-2 (A/B) 1553 busses to each ACBM for ACBM control** |  |

The Axiom module will be required to provide INT MDM 1553 bus connections to all ACBMs to provide command and data handling during ACBM ops. The INT bus would require adding addition port at Node 2 Forward.

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| [AX-198](http://192.168.10.14:8080/browse/AX-198) | **The Axiom module shall provide a pass-through interface to the redundant PDGF 1553 LBs for PDGF control** |  |

The Axiom module will be required to provide a redundant 1553 interface to the PDGF for robotics ops which is controlled via the PDGF LBs.

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| [AX-567](http://192.168.10.14:8080/browse/AX-567) | **The Axiom module shall provide a pass-through interface for PDGF video to each PDGF location to support robotic ops** |  |

The Axiom module will be need to provide pass-through connections for all required PDGF interface including power, data, and video.

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| [AX-571](http://192.168.10.14:8080/browse/AX-571) | **The Axiom module avionics shall provide INT MDM LB SYS-N2-1 (A/B) and LB SYS-N2-2 (A/B) 1553 bus interfaces to the Flight Command & Control computers.** |  |

The Axiom avionics system will need to provide physical interfaces to the ISS INT MDM busses to provide future ACBM and NDS control from within the Axiom module.

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| [AX-572](http://192.168.10.14:8080/browse/AX-572) | **The Axiom module avionics shall provide LB PDGF A (A/B) and LB PDGF B (A/B) 1553 bus interfaces to the Flight Command & Control computers.** |  |

The Axiom avionics system will need to provide physical interfaces to the ISS LB PDGF busses to provide future robotics control from within the Axiom module.

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| [AX-839](http://192.168.10.14:8080/browse/AX-839) | **The Axiom avionics shall provide ethernet and 1553 interfaces for existing ISS payloads** |  |

The Axiom module avionics will need to provide interfaces for existing ISS payload interfaces for commands and telemetry. These interfaces will consists of ethernet and 1553 including a bus controller for the 1553 bus. We plan to interface the 1553 with the ethernet bus to communicate with the Axiom payload system.

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| [AX-201](http://192.168.10.14:8080/browse/AX-201) | **The Axiom module 1553 bus couplers and terminators shall be in accordance with SSQ 21676, Coupler, Data Bus, MIL-STD-1553B Notice 2, Space Quality, General Specification** |  |

The Axiom module 1553 couplers must comply with ISS standards.

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| [AX-202](http://192.168.10.14:8080/browse/AX-202) | **The Axiom module 1553 connections shall be by coupling transformers with a maximum of two stubs per coupler** |  |

The Axiom module 1555 connections must comply with ISS requirements.

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| [AX-203](http://192.168.10.14:8080/browse/AX-203) | **The Axiom module 1553 Terminal Interface Unit impedance shall be 1000 ohms as specified in MIL-STD-1553B Notice 2, paragraph 4.5.2.1.2.3.** |  |

The Axiom module 1553 impedance must comply with MIL-STD-1553B Notice 2.

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| [AX-205](http://192.168.10.14:8080/browse/AX-205) | **The Axiom module safety critical avionics shall provide two open 1553 stubs to allow for additional connections** |  |

The Axiom module shall provide additional 1553 stubs to allow connections for devices such as the PCS.

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| [AX-206](http://192.168.10.14:8080/browse/AX-206) | **The Axiom module shall provide an electrical interface with the Centerline Berthing Camera System (CBCS) at each ACBM hatch** |  |

The Axiom module is required to provide an interface to the Centerline Berthing Camera System at each ACBM hatch to facilitate robotics operations.

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| [AX-207](http://192.168.10.14:8080/browse/AX-207) | **The Axiom module electrical and electronic connections within the vestibule shall be in accordance with SSQ 21635, General Specifications for Connectors and Accessories, Electrical, Circular, Miniature, IVA/EVA/Robot Compatible, Space Quality.** |  |

The Axiom module vestibule connectors shall defined in 50808 calls for adherence to SSQ 21635.

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| [AX-208](http://192.168.10.14:8080/browse/AX-208) | **The Axiom safety critical avionics shall operate between -55 and 105 degrees celsius** |  |

The Axiom module safety critical avionics will need to operate nominal within the desired temperature range to ensure reliability.

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| [AX-209](http://192.168.10.14:8080/browse/AX-209) | **The Axiom safety critical avionics shall operate without interruption from SEU/SEL due to ionizing radiation per SSP 30512 rev C.** |  |

The Axiom safety critical avionics will need to operate reliably without interruption at the specified radiation level.

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| [AX-210](http://192.168.10.14:8080/browse/AX-210) | **The Axiom safety critical avionics shall withstand vibration loads as described in the Axiom Loads Databook.** |  |

The Axiom safety critical avionics will need to withstand launch vibration loads defined in the Axiom Loads Databook to ensure availability at power up.

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| [AX-155](http://192.168.10.14:8080/browse/AX-155) | **The Axiom module shall interface with the ISS Joint Station Lan (JSL) defined in SSP 50892, Ethernet Requirements for Interoperability with the Joint Station LAN (JSL)** |  |

The Axiom module avionics system will depend on network connectivity with the ISS for sending/receiving command and telemetry to/from the ground via the ISS, and video communication.

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| [AX-212](http://192.168.10.14:8080/browse/AX-212) | **The Axiom module local area network passive devices shall switch to active in the event of a failure within TBD milliseconds.** |  |

The Axiom module network will need to provide adequate redundancy to fail over to a passive system in the event of a failure without crew intervention.

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| [AX-213](http://192.168.10.14:8080/browse/AX-213) | **The Axiom module shall provide internal wireless network access throughout the Axiom module.** |  |

The Axiom module will provide adequate wireless access point coverage throughout the module to ensure connectivity with tablets, payloads, laptops, etc.

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| [AX-214](http://192.168.10.14:8080/browse/AX-214) | **The Axiom module shall provide wireless network access to external components** |  |

The Axiom module will need external wireless access to support external users.

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| [AX-211](http://192.168.10.14:8080/browse/AX-211) | **The Axiom module shall provide Network Attached Storage devices for large data collection** |  |

The Axiom module will provide multiple Networked Attached Storage devices to allow for data storage on-board the module.

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| [AX-215](http://192.168.10.14:8080/browse/AX-215) | **The Axiom module shall provide IP based video cameras** |  |

The Axiom module will need to provide IP based video cameras for use within the module. The IP cameras will have a route to the ISS JSL for on-board viewing and downlink.

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| [AX-216](http://192.168.10.14:8080/browse/AX-216) | **The Axiom module shall provide IP based audio communication** |  |

The Axiom module will provide IP based audio for intermodule communication and communication with the ground. The IP audio devices will have a route to the ISS JSL for on-board listening and downlink.

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| [AX-217](http://192.168.10.14:8080/browse/AX-217) | **The Axiom module shall provide an independent downlink communication path with the ground for commands & data** |  |

The Axiom module will need to provide a downlink data stream, independent from the ISS comm system to accommodate commands and data independently from ISS. This link will be critical for contingency DRM's.

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| [AX-218](http://192.168.10.14:8080/browse/AX-218) | **The Axiom module shall provide communication with ground systems utilizing the ISS communication paths** |  |

The Axiom module will provide the ability to receive and send commands, data, voice/audio, and video to the ground to allow crew to communicate with ops center and family. This data may interface with the Axiom ethernet bus or 1553 interface to ISS.

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| [AX-219](http://192.168.10.14:8080/browse/AX-219) | **The Axiom module shall provide an ethernet interface to the payload system** |  |

The axiom module will provide adequate ethernet network connections for payloads throughout the module.

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| [AX-220](http://192.168.10.14:8080/browse/AX-220) | **The Axiom module shall provide a command interface to the payload system** |  |

The Axiom module will provide displays for crew members and ground to command the payload system.

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| [AX-221](http://192.168.10.14:8080/browse/AX-221) | **The Axiom module shall provide a telemetry interface to the payload system** |  |

The Axiom module will provide displays for crew members to view payload system telemetry.

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| [AX-222](http://192.168.10.14:8080/browse/AX-222) | **The Axiom module shall provide fixed panel displays for module command and control** |  |

The Axiom module will provide at least two fixed panel displays to allow the onboard crew to view module health and status and provide commanding capability.

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| [AX-223](http://192.168.10.14:8080/browse/AX-223) | **The Axiom module shall provide generic multi-use server computing capability** |  |

The Axiom module will provide server capability to run various virtual machines within the module. The virtual machines will include cloud services, electronic procedures, media, etc.

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| [AX-224](http://192.168.10.14:8080/browse/AX-224) | **The Axiom module shall provide bluetooth wireless receivers throughout the module** |  |

The Axiom module will provide bluetooth wireless receivers which can be used for audio, sensor communication, inventory, etc.

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| [AX-225](http://192.168.10.14:8080/browse/AX-225) | **The Axiom module shall provide a mobile tablet per crew member** |  |

The Axiom module will provide each crew member a mobile tablet which can be used for displays and controls, e-procedures, email, etc.

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| [AX-226](http://192.168.10.14:8080/browse/AX-226) | **The Axiom module shall provide a laptop computer per crew member** |  |

The Axiom module will provide each crew member a laptop computer which can be used for displays and controls, e-procedures, email, etc.

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| [AX-272](http://192.168.10.14:8080/browse/AX-272) | **The Axiom module shall provide ethernet access to each crew quarters location within the Axiom module.** |  |

The Axiom module will need to provide individual ethernet access for each crew member in their crew quarters.

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| [AX-227](http://192.168.10.14:8080/browse/AX-227) | **The Axiom avionics shall operate between TBD and TBD degrees celsius** |  |

The Axiom module avionics will need to operate nominal within the temperature range specified.

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| [AX-228](http://192.168.10.14:8080/browse/AX-228) | **The Axiom avionics shall operate without interruption from SEU/SEL due to ionizing radiation per TBD Axiom Spec.** |  |

The Axiom safety critical avionics will need to operate reliably without interruption at the specified radiation level.

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| [AX-229](http://192.168.10.14:8080/browse/AX-229) | **The Axiom module avionics shall withstand vibration loads as described in the Axiom Loads Databook.** |  |

The Axiom avionics will need to withstand launch vibration loads defined in the Axiom Loads Databook to ensure availability at power up.

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| [AX-273](http://192.168.10.14:8080/browse/AX-273) | **The Axiom module Flight Command & Control computers shall provide a simplex connection to the ethernet bus** |  |

The Axiom module will provide ISS 1553 C&W along with safety critical end effector status over the ethernet bus to allow the Displays & Controls computers to display this data and provide alerts. This will be accomplished using a simplex connection to ensure data will not harm the Flight Command & Control computers.

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| [AX-500](http://192.168.10.14:8080/browse/AX-500) | **The Axiom module avionics shall provide electronics required to monitor and control ECLSS** |  |

The Axiom module avionics will need to provide electronics required to monitor temp, pressure, humidity, ppO2, and ppCO2.

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| [AX-501](http://192.168.10.14:8080/browse/AX-501) | **The Axiom module avionics shall provide electronics required to monitor and control Power** |  |

The Axiom module avionics shall provide electronics or I/O required to monitor the power subsystem. Power monitoring can include reading voltage and currents within the module.

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| [AX-568](http://192.168.10.14:8080/browse/AX-568) | **The Axiom module avionics shall provide electronics required to monitor and control Guidance, Navigation, and Control** |  |

The Axiom avionics will be responsible for providing interface for all GNC sensors to the Flight Command & Control computer.

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| [AX-569](http://192.168.10.14:8080/browse/AX-569) | **The Axiom module avionics shall provide electronics required to monitor and control Propulsion** |  |

The Axiom avionics system will need to provide all interface for propulsion thruster control along with propulsion sensors to the Flight Command & Control computer.

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| [AX-643](http://192.168.10.14:8080/browse/AX-643) | **INTERFACE POWER** |  |

The ISS RF power level of the UHF signal transmitted into the Axiom shall be not less than  
���27.5 dBm, when the Space Station Radio operates in the low power mode and not less than  
���14.5 dBm when the SSSR operates in the high power mode.

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| [AX-642](http://192.168.10.14:8080/browse/AX-642) | **INTERFACE VSWR** |  |

The VSWR measured at the Node 2 and Axiom interface shall be less than 1.5 :1 over 413 MHz to  
418 MHz.

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| [AX-641](http://192.168.10.14:8080/browse/AX-641) | **INTERFACE IMPEDANCE** |  |

The interface impedance measured at the Node 2 and Axiom interface shall be nominal 50 ohms.

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| [AX-640](http://192.168.10.14:8080/browse/AX-640) | **COMMUNICATION SIGNAL CHARACTERISTICS** |  |

Node 2 shall support UHF communication with a selectable center frequency of 414.2 MHz and  
417.1 MHz using PCM���FM modulation and five slot Time Division Multiple Accessing  
(TDMA).

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| [AX-639](http://192.168.10.14:8080/browse/AX-639) | **ULTRA HIGH FREQUENCY DISTRIBUTION CABLE** |  |

Node 2 shall support Ultra High Frequency (UHF) communication to and from the Axiom via a  
coax line, NRFC���50���coax���3.

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| [AX-638](http://192.168.10.14:8080/browse/AX-638) | **COMMUNICATION CABLE SPECIFICATIONS** |  |

The UHF interconnect cables shall comply with the requirements of SSQ 21653; Cables, Coaxial Twinaxing and Triaxial, Flexible, Space Quality, General Specification for, or ESA/Space Components Coordination Group (SCC) Generic Specification No. 3902, Cables, Coaxial, Radio Frequency, Flexible.

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| [AX-637](http://192.168.10.14:8080/browse/AX-637) | **INTRAVEHICULAR ANTENNA ASSEMBLY** |  |

The ISS to Axiom interface shall provide one 50 ohm coax connection to link the Axiom with  
the Space Station audio antenna for the UHF communication subsystem. This interface shall  
allow the exchange of audio and telemetry data between EVA suited crew members and the  
ISS, during emergency IVA activities inside the Axiom.

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| [AX-636](http://192.168.10.14:8080/browse/AX-636) | **OPTICAL LPCM AUDIO SIGNAL POWER LEVELS** |  |

The ISS shall meet all transmission requirements with the minimum optical LPCM audio signal input power specified in Table 3.1.5.9.1.4.1���1 at each signal interface. [see 41150 table]

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| [AX-635](http://192.168.10.14:8080/browse/AX-635) | **ISS RECEIVE OPTICAL LPCM AUDIO SIGNAL CHARACTERISTICS** |  |

The ISS shall receive optical LPCM audio signals with the following signal characteristics:  
(1) Bit Rate: 11.76 Mbps  
(2) Optical Center Frequency: 1300 nm  
(3) Light is non���coherent

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| [AX-634](http://192.168.10.14:8080/browse/AX-634) | **OPTICAL LPCM AUDIO SIGNAL POWER LEVELS** |  |

The ISS shall transmit LPCM audio signals to the Axiom at the minimum optical ISS output power levels specified in Table 3.1.5.9.1.3.1���1 at each signal interface. [see 41150 table]

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| [AX-633](http://192.168.10.14:8080/browse/AX-633) | **ISS TRANSMIT OPTICAL LINEAR PULSE CODE MODULATED (LPCM) AUDIO SIGNAL CHARACTERISTICS** |  |

The ISS shall transmit optical LPCM audio signals to the Axiom with the following signal characteristics:  
(1) Bit Rate: 11.76 Mbps  
(2) Optical Center Frequency: 1300 nm  
(3) Light is non���coherent

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| [AX-632](http://192.168.10.14:8080/browse/AX-632) | **HARDWIRED AUDIO SIGNAL ATTENUATION IN AXIOM** |  |

The drop in the audio signal strength between the ISS to Axiom interface and the Axiom system  
to ATUs connectors shall not be higher than 5.3 dB. This power drop shall be met using the  
connectors specified in Table XII���A, Fiber Optic Termini Optical Losses, of SSQ 21635.

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| [AX-631](http://192.168.10.14:8080/browse/AX-631) | **HARDWIRED AUDIO INTERFACE MEDIUM** |  |

The hardwired audio interface medium shall conform to SSQ 21654 (General Specification for Cable, Single Fiber, Multimode, Space Quality).

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| [AX-630](http://192.168.10.14:8080/browse/AX-630) | **HARDWIRED AUDIO DATA BUS** |  |

The ISS to Axiom interface shall support audio data exchange via redundant fiber optic buses for communication of voice between the ISS and the Axiom, and alarm tones from the ISS to the two Space Station common Audio Terminal Units (ATUs) located in the Axiom.

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| [AX-629](http://192.168.10.14:8080/browse/AX-629) | **CAUTION AND WARNING** |  |

A. During attached operations, the Axiom module shall report each confirmed failure and confirmed out of tolerance condition that would result in a Class 1, 2 or 3 alarm as an alarm event to the ISS.  
B. While mated to the ISS, the Axiom module shall notify the ISS of these alarm events:  
1. The Axiom module shall set Class 1 and 2 C&W bits.  
a. The Axiom module shall report Class 1 and 2 C&W events detected and confirmed within the Axiom module to the ISS within 3 seconds.  
b. This time shall be measured from the confirmation of the detected events until availability at an ISS interface.  
2. The Axiom module shall set Class 3 and 4 C&W bits.  
a. The Axiom module shall report Class 3 and 4 C&W events detected and confirmed within the Axiom module to the ISS within 10 seconds.  
b. This time shall be measured from the confirmation of the detected events until availability at an ISS interface.  
C. The Axiom C&W system shall be designed per SSP 50005, section 9.4.4 and paragraph 9.4.5.1.1.  
D. The Axiom module shall provide a mechanism to clear the C&W bits it sets as defined within the vehicle specific software ICD listed in Appendix D that governs the C&W data bits.  
E. During attached operations, the ISS will provide ISS C&W status to the Axiom module as defined in the vehicle specific software ICD listed in Appendix D.  
F. During attached operations, the Axiom module shall silence C&W tones only within the Axiom module.  
G. During attached operations, the Axiom module shall silence its tones, after annunciation, based on ISS C&W tone status as defined in the vehicle specific software ICD listed in Appendix D.  
H. During attached operations, ISS will set and clear its C&W status for a Axiom module event based on Axiom module originated C&W status as defined in the vehicle specific software ICD listed in Appendix D.  
I. During attached operations, the Axiom module shall set and clear its C&W status for an ISS event based on ISS originated C&W status as defined in the vehicle specific software ICD listed in Appendix D.  
Notes: The ISS will, based on this notification, issue the appropriate alarm (Class 1, 2, 3, or 4; Emergency, Warning, Caution, or Advisory).

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| [AX-628](http://192.168.10.14:8080/browse/AX-628) | **ISS DATA FORMAT** |  |

Axiom shall format all command, telemetry, and related signal to the ISS MIL-STD-1553B  
Notice 2 interface according to SSP 50714, International Space Station Program Data Integration  
Standards.

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| [AX-627](http://192.168.10.14:8080/browse/AX-627) | **TERMINAL INTERFACE UNIT ��� MIL-STD-1553 EEE/SSQ PARTS** |  |

Axiom Terminal Interface Unit MIL-STD-1553B, Notice 2 terminal interface and transceiver microcircuit and isolation transformer components used on all MIL-STD-1553B, Notice 2 data buses that cross ISS/Axiom interface shall be selected from the approved parts lists in:  
A. SSP 30423, Space Station Approved Electrical, Electronic, and Electromechanical (EEE) Parts List,  
B. MIL-PRF-38534, Hybrid Microcircuits, General Specification for, as specified in SSP 30423, Table 4.1-15,  
C. MIL-PRF-38535, Integrated Circuits (Microcircuits) Manufacturing, General Specification for, as specified in SSP 30423, Table 4.1-14,  
D. NASA approved Axiom parts plan/list, or have an  
E. Approved Nonstandard Part Approval Request (NSPARS).

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| [AX-626](http://192.168.10.14:8080/browse/AX-626) | **BUS TERMINATION** |  |

Axiom module data bus terminators on the ISS cross-element MIL-STD-1553B, Notice 2 bus  
shall be in accordance with SSQ 21676.

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| [AX-625](http://192.168.10.14:8080/browse/AX-625) | **INPUT IMPEDANCE** |  |

The minimum input impedance of Axiom TIUs shall be 1000 ohms as specified in MIL-STD-  
1553B Notice 2, paragraph 4.5.2.1.2.3.

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| [AX-624](http://192.168.10.14:8080/browse/AX-624) | **TERMINAL INTERFACE UNITS MULTIPLE BUS ISOLATION** |  |

Axiom TIU interfaces shall provide isolation greater than or equal to 58 dB between multiple  
independent buses in a single connector.

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| [AX-623](http://192.168.10.14:8080/browse/AX-623) | **TERMINAL INTERFACE UNITS** |  |

The Axiom TIUs shall be in accordance with MIL-STD-1553B, Notice 2, with protocols as  
specified in the vehicle specific software ICD listed in Appendix D.

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| [AX-622](http://192.168.10.14:8080/browse/AX-622) | **RECEIVE TIME** |  |

The Axiom module shall cyclically receive time reference source data, in accordance with the  
vehicle specific software ICD listed in Appendix D, and compensate for transmission delays.

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| [AX-621](http://192.168.10.14:8080/browse/AX-621) | **AXIOM REMOTE TERMINAL ADDRESSES** |  |

The MIL-STD-1553B Notice 2 data bus addresses for Axiom Terminal Interface Units (TIUs) shall be in accordance with the Software Interface Control Document listed in Table 3.2.1.5.1.5-1. [see 50808 table]

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| [AX-620](http://192.168.10.14:8080/browse/AX-620) | **BUS COUPLING** |  |

A. Axiom connections to MIL-STD-1553B Notice 2 buses shall be by coupling transformers with a maximum of two stubs per coupler.  
B. Bus stubs in the Axiom module connected to the MIL-STD-1553B Notice 2 bus and not terminated in active devices shall be capped.  
C. Axiom module data bus couplers on the MIL-STD-1553B Notice 2 bus shall be in accordance with SSQ 21676, Coupler, Data Bus, MIL-STD-1553B Notice 2, Space Quality, General Specification.

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| [AX-619](http://192.168.10.14:8080/browse/AX-619) | **BUS STUB LENGTH** |  |

The Axiom buses shall have a maximum stub length of 6.1 m (20 ft), as measured from the coupling transformer to the isolation transformer, for stubs contained within Axiom as defined in Figure 3.3.6.1.5-1, Bus Coupling, measurement A. [see 50808 figure]

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| [AX-618](http://192.168.10.14:8080/browse/AX-618) | **AXIOM NOT���TO���EXCEED BUS LENGTH** |  |

Axiom-ISS buses that cross Axiom module interfaces (the portion of the bus listed in Table 3.2.1.5.1.5-1 within the Axiom module) shall not exceed 140 ft. [see 50808 table]

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| [AX-617](http://192.168.10.14:8080/browse/AX-617) | **PROVIDE MIL-STD-1553 DATA BUS** |  |

A. The Axiom module shall provide the dual redundant MIL-STD-1553B, Notice 2 data busses to interface with the ISS Command and Data Handling system in accordance with MIL-STD-1553B, Notice 2.  
B. Axiom module MIL-STD-1553B connectors at the interface shall be as defined in the vehicle specific hardware ICD listed in Appendix D.

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| [AX-616](http://192.168.10.14:8080/browse/AX-616) | **ELECTROSTATIC DISCHARGE CONTROL** |  |

ESD sensitive parts, assemblies, and equipment shall be controlled in accordance with the  
requirements of ANSI ESD S20.20, Development of an Electrostatic Discharge Control  
Program: Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding  
Electrically Initiated Explosive Devices).

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| [AX-615](http://192.168.10.14:8080/browse/AX-615) | **ELECTRICAL WIRE WRAPPED CONNECTIONS** |  |

Wire wrapping shall not be used.

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| [AX-614](http://192.168.10.14:8080/browse/AX-614) | **ELECTRICAL CRIMPING** |  |

Crimping of electrical terminations shall meet the intent of the requirements of NASA-STD-  
8739.4. However, terminal lugs, splices, and two-piece shield termination rings shall meet the  
tensile strength and electrical requirements of SAE-AS-7928, Terminals, Lug: Splices,  
Conductor: Crimp Style, Copper, General Specification for.

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| [AX-613](http://192.168.10.14:8080/browse/AX-613) | **ELECTRICAL SOLDERING** |  |

Fabrication controls and processes used in soldering of electrical connections shall meet the intent of the requirements of NASA-STD-8739.3, Soldered Electrical Connections or IPC-J-STD-001ES. Surface mount devices shall be soldered according to the requirements of NASA-STD-8739.2, Workmanship Standard for Surface Mount Technology, or IPC-J-STD-001ES.

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| [AX-612](http://192.168.10.14:8080/browse/AX-612) | **OTHER PROCESSES** |  |

Other processes used for printed wiring assemblies shall meet the intent of the requirements in IPC-J-STD-001ES, Space Applications Electronic Hardware Addendum to IPC-J-STD-001D, Requirements for Soldered Electrical and Electronic Assemblies, and NASA-STD-8739.1. Component mounting shall meet the intent of IPC-CM-770E, Component Mounting Guidelines For Printed Boards.

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| [AX-611](http://192.168.10.14:8080/browse/AX-611) | **STAKING/CONFORMAL COATING** |  |

Fabrication controls and processes used in staking and conformal coating of printed wiring boards and electronic assemblies shall meet the intent of the requirements of NASA-STD-8739.1, Workmanship Standard for Staking and Conformal Coating of Printed Wiring Boards and Assemblies.

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| [AX-610](http://192.168.10.14:8080/browse/AX-610) | **PRINTED WIRING ASSEMBLIES** |  |

Electrical circuitry shall be designed and fabricated to prevent the production of unwanted  
current paths by debris or foreign materials floating in the spacecraft microgravity environment.

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| [AX-609](http://192.168.10.14:8080/browse/AX-609) | **PRINTED WIRING BOARDS** |  |

Printed wiring boards shall meet the intent of IPC-2221, Generic Standard on Printed Board  
Design and IPC-2222, Sectional Design Standard for Rigid Organic Printed Boards. Fabrication  
controls and processes used in rigid printed wiring boards shall meet the intent of requirements  
of IPC-6011, Generic Performance Specification for Printed Boards, and IPC-6012C, Quality  
and Performance Specification for Rigid Printed Boards. Printed wiring boards shall be  
manufactured per performance specification Class 3, as defined in IPC-2221 paragraph 1.6.2.

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| [AX-608](http://192.168.10.14:8080/browse/AX-608) | **FIBER OPTICS** |  |

A. Fabrication controls and processes for joining of fiber optic cable assemblies shall meet the intent of NASA-STD-8739.5, Fiber Optic Terminations, Cable Assemblies, and Installation.  
B. Maximum allowable loss per termination shall be as follows:  
(1) Splice (fusion/mechanical): <= 0.3 dB  
(2) Connectorized Interconnect (mated pair): <= 0.75 dB  
(3) Connectorized Repeatability (re-mated pair): <= 0.2 dB

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| [AX-607](http://192.168.10.14:8080/browse/AX-607) | **WIRE/CABLE ASSEMBLIES** |  |

Electrical connectors, cables, wiring harnesses, and solder sleeves that comprise the Axiom/ISS electrical interface shall meet the intent of the requirements of NASA-STD-8739.4, Crimping, Interconnecting Cables, Harnesses, and Wiring.

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| [AX-606](http://192.168.10.14:8080/browse/AX-606) | **USE OF SILVER** |  |

A. Electrically deposited silver shall not be used as a plating on printed wiring boards and terminal boards because of potential dendrite growth.  
B. Silver plating shall not be used on bus bars and mechanical electrical contacts such as connector pins and sockets because it can tarnish and degrade electrical conductivity.

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| [AX-605](http://192.168.10.14:8080/browse/AX-605) | **CORONA** |  |

Axiom subsystems and equipment shall meet the requirements for corona as specified in SSP  
30243, paragraph 3.2.13.

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| [AX-604](http://192.168.10.14:8080/browse/AX-604) | **ELECTROSTATIC DISCHARGE** |  |

Axiom subsystems and equipment that interface with the ISS shall meet the electrostatic  
discharge (ESD) requirements of SSP 30243, paragraph 3.2.9 and 3.2.10.

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| [AX-603](http://192.168.10.14:8080/browse/AX-603) | **AXIOM MODULE INDUCED CONDUCTED RADIATIONS** |  |

During mated operations, the Axiom module induced conducted emissions and susceptibility  
environment shall not exceed the ISS limits as specified in SSP 30237, Space Station  
Electromagnetic Emission and Susceptibility Requirements, section 3.2.1 and 3.2.2.

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| [AX-602](http://192.168.10.14:8080/browse/AX-602) | **AXIOM MODULE RADIATED SUSCEPTIBILITY** |  |

During approach, proximity, mating, and mated operations, the Axiom module shall meet all its functional and performance requirements when exposed to the RF levels of Table 3.2.2.6.1.3.1-1, Axiom Module Limits for Radiated Susceptibility. [see 50808 table]

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| [AX-601](http://192.168.10.14:8080/browse/AX-601) | **COTS VEHICLE INTENTIONAL AND UNINTENTIONAL RADIATED EMISSIONS AND SUSCEPTIBILITY** |  |

During proximity, mating, and mated operations, the Axiom module intentional and unintentional radiated emissions shall not exceed the ISS limits in Table 3.2.2.6.1.3-1, Axiom module Unintentional Radiated Emissions Limits, Table 3.2.2.6.1.3-2, ISS Vehicle Exposure Limits Due to Axiom Module Intentional Radiated Emissions, Table 3.2.2.6.1.3-3, ISS MSS Exposure Limits Due to Axiom Module Intentional Radiated Emissions, and Table 3.2.2.6.1.3-4, ISS Antenna Protection Limits for Axiom Module Radiated Emissions. [see 50808 tables]

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| [AX-600](http://192.168.10.14:8080/browse/AX-600) | **BONDING** |  |

A. When hard mated or berthed, the Axiom module to ISS interface shall meet the requirements of SSP 30245, for a Class H bond, section 3.2.1.1 in order to provide a fault current path across the interface.  
B. When hard mated or berthed, the Axiom module to ISS interface shall meet the requirements of SSP 30245, for a Class R bond, section 3.2.1.2 in order to provide a fault current path across the interface.  
Note: A single bond design may satisfy more than one bonding class requirement.

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| [AX-599](http://192.168.10.14:8080/browse/AX-599) | **ELECTROMAGNETIC COMPATABILITY** |  |

The Axiom module to ISS electrical interface shall meet the requirements of SSP 30243, sections  
3.2.1 and 3.2.4.

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| [AX-598](http://192.168.10.14:8080/browse/AX-598) | **ETHERNET** |  |

A. The Axiom module shall provide 10/100 Base-TX Ethernet data as specified in SSP 50892.  
B. The Axiom module Ethernet connectors at the interface shall be as defined in the vehicle specific hardware ICD listed in Appendix D.

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| [AX-597](http://192.168.10.14:8080/browse/AX-597) | **SOFTWARE FUNCTIONAL INTERFACES** |  |

The Axiom module to ISS software interface shall be as defined in the vehicle specific software  
ICD listed in Appendix D.

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| [AX-596](http://192.168.10.14:8080/browse/AX-596) | **SPACE STATION LOCAL BUS** |  |

When connected to the ISS interface, the Axiom module shall utilize the LB as defined in Table 3.2.1.5.1.5���1. [see 50808 table]

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| [AX-595](http://192.168.10.14:8080/browse/AX-595) | **SHIELDING** |  |

ISS to Axiom interface wire and cable shield termination shall be in accordance with SSP 30242, Space Station Cable/Wire Design and Control Requirements for Electromagnetic Compatibility, paragraph 3.2.2.1.3 Shield Grounding Requirements.

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| [AX-594](http://192.168.10.14:8080/browse/AX-594) | **GROUNDING** |  |

All electrical interfaces between the ISS and the Axiom module shall comply with the grounding requirements in SSP 30240.

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| [AX-593](http://192.168.10.14:8080/browse/AX-593) | **DATA BUS CABLE SPECIFICATIONS** |  |

Cable used in Axiom for all MIL-STD-1553B Notice 2 data buses that cross ISS/Axiom interface shall be in accordance with SSQ 21655.

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| [AX-592](http://192.168.10.14:8080/browse/AX-592) | **ELECTRICAL/ELECTRONICS CONNECTORS** |  |

The Axiom module mateable electrical and electronics connectors to the ISS shall  
meet the specification requirements of SSQ 21635.

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| [AX-591](http://192.168.10.14:8080/browse/AX-591) | **REDUNDANCY - DATA** |  |

A. The Axiom module shall supply redundant and separate MIL-STD-1553B Notice 2 buses and interface connections to NOde 2.  
C. The Axiom module utilizing the ISS Ethernet shall supply two Ethernet links and interface connections to Node 2.

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| [AX-590](http://192.168.10.14:8080/browse/AX-590) | **AUDIO INTERFACES** |  |

The Axiom module shall not inhibit the duplex audio connection between  
multiple crewed COTS vehicles (while docked to IDA), ISS crew and ISS Mission Control  
Center (MCC).

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| --- | --- | --- |
| [AX-589](http://192.168.10.14:8080/browse/AX-589) | **BONDING** |  |

The Axiom to PMA structural / mechanical interface shall meet the requirements of SSP 30245, Space Station Electrical Bonding Requirements, section 3.2.1.2 for a Class R bond.

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| [AX-588](http://192.168.10.14:8080/browse/AX-588) | **ELECTROMAGENTIC COMPATABILITY** |  |

The Axiom to PMA interface shall meet the requirements of SSP 30243, Space Station Requirements for Electromagnetic Compatibility, paragraph 3.2.3.

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| [AX-587](http://192.168.10.14:8080/browse/AX-587) | **ETHERNET INTERFACES** |  |

A. The Axiom module shall provide 10/100 Base-TX Ethernet data through the IDA and the berthed interface as specified in SSP 50892, Ethernet Requirements for Interoperability with the Joint Station LAN (JSL).  
B. The Axiom module shall provide two 10/100 Base-TX Ethernet data interfaces.

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| [AX-586](http://192.168.10.14:8080/browse/AX-586) | **COTS CREW MONITORING SYSTEM** |  |

The Axiom module shall not interfere with the COTS Crew Monitoring System between ISS and the COTS visiting vehicle.

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| [AX-585](http://192.168.10.14:8080/browse/AX-585) | **PROVIDE OUTPUT AMPLITUDE** |  |

The ISS will provide a minimum response signal amplitude of 3.6 V, peak���to���peak, line���to���line, at the ISS/COTS vehicle interface for messages transmitted on the MIL-STD-1553B Notice 2 data busses with active Terminal Interface Units (TIUs) connected to the busses.

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| [AX-584](http://192.168.10.14:8080/browse/AX-584) | **SOFTWARE FUNCTIONAL INTERFACES** |  |

The Axiom to PMA software interface shall be as defined in the vehicle specific software ICD listed in Appendix D.

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| [AX-583](http://192.168.10.14:8080/browse/AX-583) | **TERMINAL OPERATIONS** |  |

The Axiom will provide the MIL-STD-1553B Notice 2 bus controller for the local bus while the COTS vehicle is attached to the Axiom module,

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| [AX-582](http://192.168.10.14:8080/browse/AX-582) | **SPACE STATION LOCAL BUS** |  |

At the Axiom to COTS vehicle interface, the Axiom LBs will consist of the MIL-STD-1553B Notice 2 buses shown in Table 3.2.1.5.1.5���1, ISS to COTS Vehicle Module Local Bus Location. [see 50808 table]

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| [AX-581](http://192.168.10.14:8080/browse/AX-581) | **TIME DISTRIBUTION** |  |

Time will be provided by the USOS at the Local Bus (LB) to COTS MIL-STD-1553B Notice 2 buses interface with an accuracy of + 2.5 milliseconds with respect to the ISS time reference.

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| [AX-580](http://192.168.10.14:8080/browse/AX-580) | **COVERAGE DURING INTEGRATED OPERATIONS** |  |

The Axiom module will relay COTS vehicle proximity operations, rendezvous and docked data to the  
ground. The relay coverage shall be as defined in the vehicle specific ICD listed in  
Appendix D.

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| [AX-579](http://192.168.10.14:8080/browse/AX-579) | **DATA BUS STANDARDS** |  |

The Axiom electrical characteristics and data transfer protocol for the Axiom to PMA data interface shall conform to MIL-STD-1553B Notice 2.

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| [AX-578](http://192.168.10.14:8080/browse/AX-578) | **SHIELDING** |  |

A. All Axiom shields shall be terminated to structure or chassis at the interface. At the interface the preferred method is to gather shields and ground to conductive bulkhead or structure through the connector backshell.  
B. The electromagnetic compatibility design of Axiom digital data bus interface connections shall rely on compliance with the design requirements of MIL-STD-1553B Notice 2. The data bus outer braid shall be carried through the interface using connector backshell or twinax connector techniques. The shield shall not be carried through the interface by connector pins.

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| [AX-577](http://192.168.10.14:8080/browse/AX-577) | **DATA BUS CABLE SPECIFICATIONS** |  |

Data cables from Axiom to the ISS or Visiting vehicles shall meet the intent of MIL-STD-1553B Notice 2 Data Bus, Space Quality, General  
Specification for.

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| [AX-576](http://192.168.10.14:8080/browse/AX-576) | **ELECTRICAL/ELECTRONICS CONNECTORS FOR DOCKED VEHICLES** |  |

The ISS interface characteristics for electrical and electronics connectors at the docked interface plane shall be in accordance with SSQ 22680, Connectors, Rectangular, (ORU), Space Quality, General Specification For.

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| [AX-575](http://192.168.10.14:8080/browse/AX-575) | **ELECTRICAL/ELECTRONICS CONNECTORS FOR BERTHED ELEMENTS** |  |

The Axiom interface characteristics for electrical and electronics connectors inside the vestibule shall be in accordance with SSQ 21635, General Specifications for Connectors and Accessories, Electrical, Circular, Miniature, IVA/EVA/Robot Compatible, Space Quality.

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| [AX-574](http://192.168.10.14:8080/browse/AX-574) | **REDUNDANCY** |  |

The Axiom shall provide two Ethernet links to PMA berthed elements and docked vehicles as specified in Paragraph 3.2.1.5.3.  
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).

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| [AX-573](http://192.168.10.14:8080/browse/AX-573) | **REDUNDANCY** |  |

The Axiom module shall supply redundant utility interfaces for the Axiom to PMA berthed elements and docked vehicles MIL-STD- 1553B Notice 2, Digital Time Division Command/Response Multiplex Databus, buses. The 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)

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| [AX-726](http://192.168.10.14:8080/browse/AX-726) | **RADIO INTERFERENCE** |  |

A. Axiom RF links (ISS ��� Visiting Vehicle and Visiting Vehicle to Ground or Visiting Vehicle through Relay Satellite to Ground) shall not increase the noise plus interference power in ISS communications receivers or interference levels to ISS transmissions by more than 0.5 dB.  
B. The Axiom vehicle radio links shall produce an Out-of-Band power spectral density not to exceed levels specified below:  
1. 2290-2300 MHz for links operating in the 2200-2290 MHz band: Interference Spectral Flux Density of -257.0 dBW/Hz-m2,  
2. 8400-8450 MHz for links operating in the 8450-8500 MHz band: Interference Spectral Flux Density of -255.1 dBW/Hz-m2,  
3. 31.8-32.3 GHz for links operating in the 32.3-33 GHz band: Interference Spectral Flux Density of -249.3 dBW/Hz-m2  
C. The Axiom vehicle radio frequency system, employing SN return Links at a center frequency of 2287.5 MHz, shall produce a radiated power of <= 25.1 dBW.

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| [AX-725](http://192.168.10.14:8080/browse/AX-725) | **SPECTRUM REGULATORY CONSTRAINTS** |  |

A. Axiom vehicle shall comply with the Power Flux Density (PFD) Limits shown in Table 3.3.7.1.2.6-1, Power Flux Density Limits.  
B. Axiom vehicle shall comply within the spectral emissions mask shown in Figure 3.3.7.1.2.6-1, Axiom C2V2 Spectral Emission Mask. [see 50808 table and figure]

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| [AX-723](http://192.168.10.14:8080/browse/AX-723) | **RF COMMUNICATION INTERFACE** |  |

The Axiom vehicle shall communicate with the ISS in accordance with the vehicle specific hardware ICD listed in Appendix D and SSP 50934, ISS to C2V2 RF ICD.  
Note: The Axiom vehicle is responsible for interfacing to the ISS COTS C2V2 system per Figure 3.3.7.1.2.4-1, C2V2 System Diagram. [see 50808 figure]

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| [AX-733](http://192.168.10.14:8080/browse/AX-733) | **COMMAND LINK SECURITY** |  |

A. The Axiom shall secure hardware and software implementation of the decryption and encryption system for support of all Axiom communication links. Axiom shall implement FIPS PUB 197, Advanced Encryption Standard (AES), or available NSA/ National Institute of Standards and Technology (NIST) approved/certified 3DES crypto module, for all encryption of all vehicle data exchanges.  
B. Axiom shall provide command link security in accordance with SSP 50934.  
C. Axiom shall perform cryptographic operations using devices that meet FIPS Pub 140-2, Security Requirements for Cryptographic Modules, Level 2 certification.  
D. Axiom shall provide for the management of cryptographic keys in accordance with NIST SP 800-57, Recommendation for Key Management-Part 1 and 2, and with the NASA COMSEC Office of Record �R) located at the NASA Kennedy Space Center.  
E. Axiom vehicle shall provide an interface that meets the DS-101 and DS-102 electrical and physical interface requirements to support transferring of NASA provided cryptographic keys.

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| [AX-724](http://192.168.10.14:8080/browse/AX-724) | **END-TO-END DATA QUALITY** |  |

A. The ISS-Axiom communication link shall provide an end to end data quality of 1E-5 Bit Error Rate (BER) prior to the forward error correction decoder over the communications coverage defined in paragraph 3.3.7.1.1 with a link margin of 3dB.  
B. The ISS-Axiom communication link shall provide an end to end Packet Loss Rate (PLR) in accordance with Table 3.3.7.1.2.5-1, ISS Axiom Packet Loss Rates, over the communications coverage defined in paragraph 3.3.7.1.1 with a link margin of 3dB. [see 50808 table]

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| [AX-720](http://192.168.10.14:8080/browse/AX-720) | **COMMUNICATION COVERAGE** |  |

Axiom communication coverage with the ISS is as follows:  
A. During approach the Axiom vehicle system shall provide bi-directional communication with the ISS from AI until attached.  
C. During approach the Axiom vehicle system shall provide bi-directional communication with the ISS Common Communications for Visiting Vehicle (C2V2) system while the Axiom vehicle is within 10 Km of the ISS. (Max 10 Km from the ISS).

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| [AX-732](http://192.168.10.14:8080/browse/AX-732) | **ISS TO AXIOM VEHICLE COMMANDING** |  |

The Axiom system shall provide the ability for the ISS crew to originate commands to the Axiom vehicle.

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| [AX-727](http://192.168.10.14:8080/browse/AX-727) | **LOSS OF COMMUNICATION** |  |

A. The Axiom vehicle shall automatically perform a breakout maneuver when the communication link between the Axiom vehicle and the ISS is unavailable for more than 50 seconds while the Axiom vehicle is inside the KOS, unless the Axiom vehicle has been put into a free drift mode for SSRMS capture operations.  
B. The Axiom vehicle shall automatically perform a breakout maneuver when the communication link between the Axiom vehicle and the ISS is unavailable for more than 2 minutes when it is outside the KOS but inside the AE.

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| [AX-729](http://192.168.10.14:8080/browse/AX-729) | **GROUND ISSUED COMMANDS** |  |

A. The Axiom vehicle shall have the capability to accept and execute at least the following commands from the vehicle control center:

* Breakout
* Hold
* Retreat
* Authority to Proceed (Go)  
  B. The Axiom vehicle shall provide feedback to the vehicle control center that it has accepted safety critical commands sent by the vehicle control center.  
  C. The Axiom vehicle shall provide vehicle navigated state information and information to indicate any change of status of ground authorized go/no-go decision states to the vehicle control center.

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| [AX-722](http://192.168.10.14:8080/browse/AX-722) | **INTERRUPTIONS IN CASE OF REDUNDANCY SWITCHING** |  |

Redundancy switching on the ISS to Axiom communication link shall not lead to link  
interruptions of more than 50 seconds from failure detection to re-establishment of the link.

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| [AX-721](http://192.168.10.14:8080/browse/AX-721) | **GUARANTEED COVERAGE WITHOUT PERTURBATIONS** |  |

For all nominal and planned contingency trajectories/attitude profiles (with the exception of  
breakout) the Axiom vehicle shall provide 100 percent continuous space-to-space communication  
capability within the ranges described in paragraph 3.3.7.1.1 and within the conditions defined in  
paragraph 3.3.3.2.18. This requirement is for communication capability, not antenna pattern or  
data quality; reference 3.3.7.1.2.5.

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| [AX-878](http://192.168.10.14:8080/browse/AX-878) | **The Axiom vehicle shall provide external lighting and strobe indicators so that the ISS crew can visually identify the Axiom vehicle before the vehicle is authorized to enter the KOS.** |  |

(i.e. running lights)

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| [AX-879](http://192.168.10.14:8080/browse/AX-879) | **The Axiom vehicle shall allow the acquisition lights to be commanded on and off from the ISS while ISS to Axiom RF communications is available.** |  |

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| [AX-269](http://192.168.10.14:8080/browse/AX-269) | **All electrical connections in the Axiom vestibule volumes (both to Node 2 and to any visiting vehicle) shall be environmentally sealed to prohibit moisture from entering the connections.** |  |

#### Power

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| [AX-274](http://192.168.10.14:8080/browse/AX-274) | **The Axiom module shall receive power from the ISS MBSU-1A and MBSU-3B (TBR)** |  |

Baseline assumption

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| [AX-276](http://192.168.10.14:8080/browse/AX-276) | **All Axiom power subsystems shall comply with the electrical bonding requirements of SSP 30245 for interconnections between ISS and the Axiom Module** |  |

Electrical Bonding Specification. The electrical bond interface of the Power System shall be a Class R bond through the Power System attachment mechanism and connector shells in  
parallel with the dedicated Class H bond pin of the power input connector. Either bond is sufficient to carry the maximum fault current and is in accordance with  
the requirements of SSP 30245 when the Power System is installed as defined.

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| [AX-277](http://192.168.10.14:8080/browse/AX-277) | **The Axiom module external connectors shall be EVA compatible.** |  |

ISS Power cable must be installed via EVA

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| [AX-278](http://192.168.10.14:8080/browse/AX-278) | **The Axiom module shall receive input voltage from the ISS within a range of 115.0 to 173.0 Vdc, per the Power Quality Specification SSP52051** |  |

This is the power voltage levels coming from ISS - we must work within these constraints to interface with ISS provided power. We expect this to cover the electrical voltage req. for the follow on Axiom Station.

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| [AX-280](http://192.168.10.14:8080/browse/AX-280) | **The Axiom module power converter shall limit the Max. current drawn from ISS MBSU 62 amps (TBR)** |  |

Required by MBSU

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| [AX-281](http://192.168.10.14:8080/browse/AX-281) | **The Axiom Module Power Converter shall have output over current protection.** |  |

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| [AX-282](http://192.168.10.14:8080/browse/AX-282) | **The Axiom module input power from ISS shall be electrically isolated from the Axiom structure by greater than 1 megohm at 240vdc** |  |

Per DDCU spec ssp 30263

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| [AX-283](http://192.168.10.14:8080/browse/AX-283) | **The Axiom module power converter secondary output shall be electrically isolated from the chassis by greater than 1 megohm at 152 Vdc.** |  |

Per DDCU spec ssp 30263

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| [AX-284](http://192.168.10.14:8080/browse/AX-284) | **The Axiom Module Power system shall be compatible with all loads defined in the Axiom Loads Data Book (TBD,TBR).** |  |

All Crit 1 hardware must operate   
properly after manufacture, testing,  
integration, transportation, launch and assembly

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| [AX-285](http://192.168.10.14:8080/browse/AX-285) | **Resolve: All Axiom Power Related interconnections between ISS and the Axiom Module will meet the ISS interface characteristics for electrical and electronics connectors at the docked interface plane will be in accordance with SSQ 22680** |  |

ISS to Axiom IRD is specified

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| [AX-287](http://192.168.10.14:8080/browse/AX-287) | **The Axiom Module shall supply redundant 120VDC regulated distribution buses.** |  |

The Axiom Module available energy must be managed to provide a reserve in case of contingency to evacuate crew and maintain ECLSS systems.

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| [AX-288](http://192.168.10.14:8080/browse/AX-288) | **The Axiom Module Shall provide over current protection and isolation at the Point of Load (POL).** |  |

Payloads 1U power specification

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| [AX-289](http://192.168.10.14:8080/browse/AX-289) | **The Axiom Module Shall provide selectable Voltage at the Point of Load (POL) as necessary.** |  |

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| [AX-290](http://192.168.10.14:8080/browse/AX-290) | **The Axiom module power system shall be able to start up from the worst case minimum temperature** |  |

The "effective equivalent" sink temperature  
is defined as the time averaged value of the spatially averaged effective environment  
temperature.   
The instrumentation accuracy requirements however do not apply below baseplate temperature of -11 deg F.

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| [AX-291](http://192.168.10.14:8080/browse/AX-291) | **The Axiom Module power system shall be able to cold start into a safe mode from the application of external power.** |  |

in a completely pwered down condition the system need to be able to boot strap the flight computers. This will also define the low temperature condition that the system must recover from.

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| [AX-292](http://192.168.10.14:8080/browse/AX-292) | **The Axiom Module Power Converters shall be conduction cooled.** |  |

The power covnerters can displate 100 watts or more, and start up under a wider range of pressures. The heat conduction can be into structure or cold plate. Fans too noisy, no convection.

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| [AX-293](http://192.168.10.14:8080/browse/AX-293) | **Resolve: The Axiom Module power system shall comply with SSP 52051 section 4.3.2 and it's subsections, User Electric Power Specifications and Standards Volume 1, when interfacing directly with the ISS Power systems.** |  |

The Axiom module will meet Axiom Power Specifications for Axiom internal power, but will comply with applicable ISS Power Specification and Standards when interfacing ISS Power systems.

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| [AX-295](http://192.168.10.14:8080/browse/AX-295) | **Delete: The Axiom module shall comply to SSP 30243 Electromagnetic Compatibility.** |  |

The Axiom module should be at least as safe as other ISS modules

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| [AX-296](http://192.168.10.14:8080/browse/AX-296) | **Delete: Circuits implementing critical functions such that incorrect operations due to EMI could result in loss of life or loss of Axiom/ISS shall be demonstrated to have an EMI safety margin of 6 dB by test or 20 dB by analysis.** |  |

May need to be moved to higher system level requirements

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| [AX-297](http://192.168.10.14:8080/browse/AX-297) | **All Axiom module electrical and electronic equipment shall operate with voltage surges and ripples.** |  |

The Axiom module should be at least as safe as other ISS modules

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| [AX-298](http://192.168.10.14:8080/browse/AX-298) | **The Axiom module shall receive power from two ISS Node 2 RPCM (Remote Power Control Module) type II** |  |

Specify the 3 Kw RPCM output as a Power System power source. THIS IS DEPENDENT UPON AXIOM MATING TO NODE 2 OF ISS

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| [AX-299](http://192.168.10.14:8080/browse/AX-299) | **The Axiom module power system shall accept RPCM electrical power in accordance with SSP 52051, paragraph 3.1.3.1..1** |  |

Compatibility with ISS RPCM

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| [AX-300](http://192.168.10.14:8080/browse/AX-300) | **Delete: The Axiom module Power System shall meet system stability requirements as defined in SSP 52051, Paragraph 3.1.3.1.5, at the point(s) of attachment to ISS Power Systems.** |  |

The electric power system is required to maintain small and large signal stability with loads that meet the requirements of paragraph 3.2.2.3.

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| [AX-301](http://192.168.10.14:8080/browse/AX-301) | **The Axiom power system shall not exceed (TBD) current Amperage threshold for the load side of the Node2 RPCM.** |  |

Protect the RPCM from over current condition, to limit current to below the trip points of the upstream over-current protection.  
See SSP 52051 Table 3.1.1.5-1

|  |  |  |
| --- | --- | --- |
| [AX-302](http://192.168.10.14:8080/browse/AX-302) | **The Axiom Power System shall provide inrush current protection as specified in SSP 52051, 3.1.1.5 and 3.1.1.6, for all interconnections with ISS Power Systems.** |  |

Inrush currents of internal EMI filters, or other components, located upstream of over-current  
protective devices, must be limited, by design, to avoid tripping the upstream switches with  
trip characteristics as specified in 3.1.1.5, or 3.1.1.6 as applicable. This requirement must be met for the minimum soft-start rise times of the source-side switches. For non-current  
limiting source-side switches, the inrush currents shall not exceed the trip level thresholds for more than half of the minimum related trip time. For current limiting source-side switches, the inrush currents shall not be at the limiting threshold for more than half of the minimum related trip time.

|  |  |  |
| --- | --- | --- |
| [AX-303](http://192.168.10.14:8080/browse/AX-303) | **The Axiom Power System input high side and return lines shall be isolated from chassis/case ground inaccordance with (TBD) Axiom Power Quality Document.** |  |

The Axiom Power System Power Quality Document will leverage SSP 52051 common mode noise environment is defined in paragraph 3.1.3.1.6. Also see paragraphs 3.3.1.1.f, 3.3.1.3.f, 3.3.2.1.f, and 3.3.2.3.f for the applicable common mode compatibility requirement.

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| --- | --- | --- |
| [AX-304](http://192.168.10.14:8080/browse/AX-304) | **Delete: The Axiom common mode compatibility shall comply with Axiom (TBD) Power Quality Document Paragraphs (TBD).** |  |

This requirement was added as a separate requirement from line [AX-303](http://192.168.10.14:8080/browse/AX-303).  
This requirement will leverage SSP 52051 paragraph 3.1.3.1.6 for COMMON MODE NOISE VOLTAGES AND CURRENTS

|  |  |  |
| --- | --- | --- |
| [AX-305](http://192.168.10.14:8080/browse/AX-305) | **The impedance presented by the Axiom Power System shall be above the load impedance magnitude limit or within the phase limits defined by the figure 3.2.3.5-6, SSP52051, for all interconnections with ISS RPCM Power Systems** |  |

Constrains input impedance of Power System for operation with RPCM.

|  |  |  |
| --- | --- | --- |
| [AX-306](http://192.168.10.14:8080/browse/AX-306) | **The Axiom Power System shall provide performance as specified in Axiom TBD Power Quality Document** |  |

Insure nominal performance across input/output operating range

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| --- | --- | --- |
| [AX-307](http://192.168.10.14:8080/browse/AX-307) | **Delete: The Axiom Power System shall meet the requirements Axiom TBD Power Quality Document under off-nominal power conditions.** |  |

Insure the RPCM is not adversely affected by Power System during non-normal operating conditions

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| --- | --- | --- |
| [AX-308](http://192.168.10.14:8080/browse/AX-308) | **The Axiom Power System shall be able to store (TBD) Amp Hours (Ah)** |  |

It is expected that the Axiom module will be in a power negative condition from our power producing elements. Storing energy alleviates this condition

|  |  |  |
| --- | --- | --- |
| [AX-309](http://192.168.10.14:8080/browse/AX-309) | **The Axiom module power solar PV arrays shall be channelized for (TBD) kW of power** |  |

ISS power may be severely limited at times, the ability to generate a few Kw of electrical power is highly desirable. This power, in combination with the battery storage, can save the liquid coolant from freezing and keep the electronics alive when ISS has no reserve power for Axiom.

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| --- | --- | --- |
| [AX-310](http://192.168.10.14:8080/browse/AX-310) | **The Axiom module shall have internal and external power support/pass-through for (TBD- number) Power Data Grapple Fixture(s) PDGF.** |  |

The Space Station Remote Manipulator System (SSRMS) will be utilized in the assembly and attachment of ancillary module components on orbit.

|  |  |  |
| --- | --- | --- |
| [AX-311](http://192.168.10.14:8080/browse/AX-311) | **The Axiom PDGF external interface shall comply with SSQ 21635, General Specifications for Connectors and Accessories, Electrical, Circular, Miniature, IVA/EVA/Robot Compatible, Space Quality** |  |

Also REF SSP 30423 REV current  
Space Station Approved Electrical,Electronic, and Electromechanical Parts List

|  |  |  |
| --- | --- | --- |
| [AX-312](http://192.168.10.14:8080/browse/AX-312) | **Delete: The Axiom PDGF power circuits shall meet ISS PDGF Power and Power Quality Requirements according to (TBD) document(s)** |  |

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| --- | --- | --- |
| [AX-313](http://192.168.10.14:8080/browse/AX-313) | **The Axiom PDGF (aPDGF) shall provide an interface voltage of the range 107.5 Vdc to 126 Vdc at rated current and power demand to operate the Space Station Remote Manipulator System (SSRMS) for Axiom free flight.** |  |

This Voltage requirement meet the needs of the Space Station Remote Manipulator System (SSRMS). This voltage is required

|  |  |  |
| --- | --- | --- |
| [AX-314](http://192.168.10.14:8080/browse/AX-314) | **The Axiom PDGF (aPDGF) shall provide an operating current of 0 to 16.7 Amperes at the rated voltage and power needed to properly operate the Space Station Remote Manipulator System SSRMS)** |  |

This Current requirement meet the needs of the Space Station Remote Manipulator System (SSRMS)

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| --- | --- | --- |
| [AX-315](http://192.168.10.14:8080/browse/AX-315) | **Delete: The Axiom PDGF (aPDGF) shall provide overcurrent protection that is equivalent with SSP 30263:002, Type II Remote Power Control Module (RPCM) Standard ICD - TBR** |  |

The SSP 30263 document needs to be obtained

|  |  |  |
| --- | --- | --- |
| [AX-318](http://192.168.10.14:8080/browse/AX-318) | **The Axiom Module shall be capable of accommodating legacy ISS payloads and supply standard ISS payload voltages and power.** |  |

The Axiom module should easily accommodate legacy ISS Pressurized payloads.

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| --- | --- | --- |
| [AX-319](http://192.168.10.14:8080/browse/AX-319) | **Delete: The Axiom Module shall be capable of delivering power to legacy ISS payloads that meet or exceed the Electrical Power Consuming Equipment (EPCE) specifications listed in Axiom TBD Power Quality Document.** |  |

To accommodate legacy ISS payloads the Axiom module will meet or exceed current ISS power quality and level standards.

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| --- | --- | --- |
| [AX-320](http://192.168.10.14:8080/browse/AX-320) | **Delete: The Axiom Module shall be capable of supplying power to ISS legacy payloads that mimic either interface B or interface C specifications per Axiom TBD Power Quality Document** |  |

ISS has both Interface B and Interface C specifications, the Axiom module should meet both specifications to accommodate ISS legacy pressurized payloads.

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| --- | --- | --- |
| [AX-321](http://192.168.10.14:8080/browse/AX-321) | **Delete: Axiom mating and electrical power connections with a Common Berthing Module shall meet all relevant sections of Common Berthing Mechanism to Pressurized Elements Interface Control Document, SSP 41004.** |  |

The Axiom module will utilize standard Common Berthing Modules as a means of interconnection between ISS and/or other commercial modules.

|  |  |  |
| --- | --- | --- |
| [AX-322](http://192.168.10.14:8080/browse/AX-322) | **Axiom electrical power interfaces with an Active Common Berthing Mechanism (ACBM) shall be electrically rated at a minimum of 16.8 Amperes for each of two redundant power strings.** |  |

The Axiom module will utilize standard Common Berthing Modules as a means of interconnection between ISS and/or other commercial modules.

|  |  |  |
| --- | --- | --- |
| [AX-323](http://192.168.10.14:8080/browse/AX-323) | **Resolve: Axiom electrical power interfaces with an Active Common Berthing Mechanism (ACBM) shall deliver a maximum of 5 Amperes for each of two redundant power strings.** |  |

The Axiom module will utilize standard Common Berthing Modules as a means of interconnection between ISS and/or other commercial modules.

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| --- | --- | --- |
| [AX-324](http://192.168.10.14:8080/browse/AX-324) | **Delete: Axiom module shall insure Power quality delivered to the Common Berthing Unit will be in accodance with Interface C of SSP 30482, Vol. II, titled "Electrical Power Specifications and Standards" - with the exception that the steady state voltage** |  |

The Axiom module will utilize standard Common Berthing Modules as a means of interconnection between ISS and/or other commercial modules.

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| --- | --- | --- |
| [AX-325](http://192.168.10.14:8080/browse/AX-325) | **Delete: Electrical cabling within the Axiom module shall comply with Axiom TBD Electrical Cabling and ESD Document** |  |

All Axiom system cabling will meet Axiom program requirements

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| --- | --- | --- |
| [AX-326](http://192.168.10.14:8080/browse/AX-326) | **Delete: All ISS specific pass-through cabling will comply with ISS Power cabling standards** |  |

For all cabling that interfaces with end items that ISS program elements will utilize, ISS requirements will be maintained

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| --- | --- | --- |
| [AX-327](http://192.168.10.14:8080/browse/AX-327) | **Switches/controls performing ON/OFF power functions for all power interfaces shall open(dead-face) all supply circuit conductors except the power return and the equipment grounding conductor while in the power-off position.** |  |

Baseline  
These standards will be defined in the Axiom Power System Document (TBD)

|  |  |  |
| --- | --- | --- |
| [AX-328](http://192.168.10.14:8080/browse/AX-328) | **Power OFF markings and/or indications shall be used only if all parts, with the exception of overcurrent devices and associated EMI filters, are disconnected from the supply circuit.** |  |

Baseline  
These standards will be defined in the Axiom Power System Document (TBD)

|  |  |  |
| --- | --- | --- |
| [AX-329](http://192.168.10.14:8080/browse/AX-329) | **Standby, charging, or other descriptive nomenclature shall be used to indicate that the supply circuit is not completely disconnected for this power condition.** |  |

Baseline  
These standards will be defined in the Axiom Power System Document (TBD)

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| --- | --- | --- |
| [AX-330](http://192.168.10.14:8080/browse/AX-330) | **EPCE end items shall provide 1 Meg-Ohm DC isolation between power lines and chassis.** |  |

Baseline  
These standards will be defined in the Axiom Power System Document (TBD)

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| --- | --- | --- |
| [AX-331](http://192.168.10.14:8080/browse/AX-331) | **The Axiom module EPCE end items shall power on as expected when the input voltage rate of rise is 120 volts per second or less.** |  |

Baseline  
These standards will be defined in the Axiom Power System Document (TBD)

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| --- | --- | --- |
| [AX-279](http://192.168.10.14:8080/browse/AX-279) | **The Axiom Module Power Converter shall be able to terminate output power** |  |

Prevents damage to power supply

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| --- | --- | --- |
| [AX-782](http://192.168.10.14:8080/browse/AX-782) | **delete-POWER QUALITY** |  |

A. The Axiom module interface shall comply with the electrical design requirements specified in SSP 52051, User Electric Power Specifications and Standards Volume 1: 120 Volt DC Loads, for Interface B.  
B. The Axiom module shall provide normal performance while the steady state voltage is within the range defined in Table 3.2.2.4.1.1-1, Power Quality Requirements. [see 50808 figure]  
Note: The steady state voltage range will be based on the operating current only and is not required in order to consider the peak inrush current.

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| [AX-781](http://192.168.10.14:8080/browse/AX-781) | **delete: CONNECTOR DEADFACING** |  |

The capability shall exist to deadface the ISS-Node to Axiom interface in accordance with the safe limits shown in Figure 3.1.5.1.1.6-1, when the connectors are mated and demated. [see 41150 figure]

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| --- | --- | --- |
| [AX-780](http://192.168.10.14:8080/browse/AX-780) | **delete-OUTPUT PROTECTION** |  |

Each power feeder output shall provide overcurrent protection.

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| --- | --- | --- |
| [AX-779](http://192.168.10.14:8080/browse/AX-779) | **delete-ABNORMAL VOLTAGE ENVELOPE** |  |

The voltage transient in response to an abnormal condition, as described in COL-ESA-RQ-014,  
shall be within the envelope shown in Figure 3.1.5.1.1.4.3-1. During power interruption the bus  
voltage shall be within (0 - 126 V).

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| --- | --- | --- |
| [AX-778](http://192.168.10.14:8080/browse/AX-778) | **delete: The voltage transient shall be within the envelope shown in SSP41150 Figure 3.2.4.1.2.2-1** |  |

The voltage transient shall be within the envelope shown in Figure 3.2.4.1.2.2-1. [see 41150 figure]

|  |  |  |
| --- | --- | --- |
| [AX-777](http://192.168.10.14:8080/browse/AX-777) | **Delete: OPERATIONAL BUS VOLTAGE** |  |

The steady state bus voltage (not including transients and ripple) shall be from 108.5 to 126 Vdc.

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| --- | --- | --- |
| [AX-776](http://192.168.10.14:8080/browse/AX-776) | **delete:POWER QUALITY** |  |

The power quality at each SSRMS LEE PDGF power feeder shall comply with SSP 30482 (applicable to the ISS) or COL-ESA-RQ-014 (that meet or exceeds SSP 30482, applicable to the Axiom), and provide a performance of Interface C.

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| --- | --- | --- |
| [AX-775](http://192.168.10.14:8080/browse/AX-775) | **Delete: POWER RATING** |  |

Each power feeder shall be rated at 1.8 kW minimum.  
This is a hardware interface requirement and may be covered by listed Axiom Requirements.  
Typically connectors are not rated by power but by voltage and current.   
This needs more definition for the description.

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| --- | --- | --- |
| [AX-774](http://192.168.10.14:8080/browse/AX-774) | **delete-POWER INTERFACES** |  |

The ISS shall provide up to 1.8 kW electrical power to the Axiom through a PDGF with a one  
failure tolerant power feeder via the SSRMS Latch End Effector (LEE).

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| --- | --- | --- |
| [AX-773](http://192.168.10.14:8080/browse/AX-773) | **delete/resolve:COMPLIANCE WITH MA2-99-170** |  |

All power cables interfacing with ISS shall meet the intent of MA2-99-170.  
Verify this document does not extend or supersede ISS 30245, 52051

Axiom to ISS connections meet only at the connectors so ISS requirements should go to the interface only?

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| --- | --- | --- |
| [AX-772](http://192.168.10.14:8080/browse/AX-772) | **Delete: POWER CONSUMPTION for visiting vehicles** |  |

A. The Axiom module interface with visiting vehicles berthed or docked shall consume no more than 500 W of continuous power from either ISS power output circuit independently or a combination of both circuits.   
B. The Axiom module interface with visiting vehicles berthed or docked shall consume no more than 1 kW of peak power from either ISS power output circuit independently or a combination of both circuits, for two continuous hours, once per week.

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| --- | --- | --- |
| [AX-771](http://192.168.10.14:8080/browse/AX-771) | **Delete: DESIGN POWER INPUT CIRCUIT** |  |

The Axiom module shall be capable of receiving 3.0 kW of continuous power from either  
ISS power output circuit.

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| --- | --- | --- |
| [AX-770](http://192.168.10.14:8080/browse/AX-770) | **Delete: ELECTRICAL POWER INTERFACES** |  |

ISS to Axiom module electrical power interfaces shall be as shown in Figure 3.2.1.4.1. For power interfaces while attached to SSRMS, see section 3.3.8.2. [see 50808 table]

|  |  |  |
| --- | --- | --- |
| [AX-769](http://192.168.10.14:8080/browse/AX-769) | **The Axiom module Interface utility power cable, 120 Vdc, shall be selected from approved wire listed in SSP 30423, Space Station Approved Electrical, Electronic, and Electromechanical (EEE) Parts list, paragraph 2.1.17 and Table 4.1-18.** |  |

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| [AX-768](http://192.168.10.14:8080/browse/AX-768) | **spare** |  |

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| [AX-767](http://192.168.10.14:8080/browse/AX-767) | **Delete: FAULT PROTECTION** |  |

The Axiom module will provide fault protection characteristics for Axiom module input power as shown in Figure 3.2.1.4.1.5-1. [see 50808 Figure]

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| --- | --- | --- |
| [AX-766](http://192.168.10.14:8080/browse/AX-766) | **The Axiom module will be capable of supplying two redundant power feeds, as defined in 3.2.1.4.1.3, to the COTS vehicle through the Axiom module power output circuits.** |  |

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| --- | --- | --- |
| [AX-765](http://192.168.10.14:8080/browse/AX-765) | **POWER AVAILABILITY for COTS Vehicles** |  |

A. The Axiom module will be capable of allocating 500 W of continuous power to the COTS vehicle through each power output circuit [1].  
B. The Axiom module will be capable of allocating 1 kW of peak power for a maximum of two hours no more than once per week to the COTS vehicle through each power output circuit [1].  
C. The Axiom module will be capable of supplying 3kW of power per feed, but COTS vehicle allocations are limited to the levels defined above.  
NOTE: [1] Axiom module power necessary for COTS Active Payloads will be provided in addition to, not in lieu of, all other power allocations specified.

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| [AX-764](http://192.168.10.14:8080/browse/AX-764) | **POWER CONTROL FROM AXIOM MODULE** |  |

The Axiom module shall control the power supplied to the interface with the visting vehicle.

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| --- | --- | --- |
| [AX-763](http://192.168.10.14:8080/browse/AX-763) | **FEEDS FOR DOCKED COTS VEHICLE** |  |

The power source characteristics for the individual power output circuits for COTS vehicles docked to the Axiom PMA shall be as described by SSP 30482 Volume 1, with the following exceptions:  
1. The minimum steady state voltage will be 115Vdc.  
2. The minimum normal transient voltage will be per SSP 50808 Rev F Figure 3.2.1.4.1.1.2-3, Modified Transient Voltage Envelope.  
3. The source impedance will be defined per SSP 50808 Rev F Figure 3.2.1.4.1.1.2-1, Modified Source Impedance Magnitude Limit, and Figure 3.2.1.4.1.1.2-2, Modified Source Impedance Phase Limits.

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| --- | --- | --- |
| [AX-762](http://192.168.10.14:8080/browse/AX-762) | **Delete: FEEDS FOR BERTHED ELEMENT** |  |

The power source characteristics for the individual power output circuits for the Axiom berthing ports shall be as described by (TBD document).

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| --- | --- | --- |
| [AX-761](http://192.168.10.14:8080/browse/AX-761) | **The ISS to COTS vehicle berthed elements and docked vehicle electrical power interfaces shall be as shown in SSP 50808 Rev F Figure 3.2.1.4-1, ISS to COTS Vehicle Power Interfaces.** |  |

The ISS to COTS vehicle berthed elements and docked vehicle electrical power interfaces shall be as shown in SSP 50808 Rev F Figure 3.2.1.4-1, ISS to COTS Vehicle Power Interfaces.

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| --- | --- | --- |
| [AX-760](http://192.168.10.14:8080/browse/AX-760) | **Delete: GROUNDING** |  |

A. The grounding requirements for the Axiom to PMA berthed element and docked vehicle interfaces shall be in accordance with SSP 30240, Space Station Grounding Requirements.  
B. When PMA a berthed element or docked vehicle is supplied with power from ISS/Axiom, the ISS/Axiom will provide an input power return to structure ground.

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| --- | --- | --- |
| [AX-759](http://192.168.10.14:8080/browse/AX-759) | **Utility power cables from Axiom to the ISS or visiting vehicles shall meet the intent of SSQ 21652, Wire, Electric, Silicon-Insulated,Nickel-Coated Copper, Space Quality, General Specification for.** |  |

Utility power cables from Axiom to the ISS or visiting vehicles shall meet the intent of SSQ 21652, Wire, Electric, Silicon-Insulated,Nickel-Coated Copper, Space Quality, General Specification for.

|  |  |  |
| --- | --- | --- |
| [AX-758](http://192.168.10.14:8080/browse/AX-758) | **Delete REDUNDANCY** |  |

The Axiom module shall provide redundant power utilities to PMA berthed elements and docked vehicles as specified in Section 3.2.1.4.4 of SSP 50808.  
The 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).

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| --- | --- | --- |
| [AX-659](http://192.168.10.14:8080/browse/AX-659) | **AXIOM INDUCED CURRENT TO ISS** |  |

The Axiom module, while mated to ISS, shall not induce more than 1 mA current to ISS.

#### Software

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| --- | --- | --- |
| [AX-88](http://192.168.10.14:8080/browse/AX-88) | **DELETE: The Axiom module shall support individual customer, ground initiated, imaging requests** |  |

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| --- | --- | --- |
| [AX-89](http://192.168.10.14:8080/browse/AX-89) | **DELETE: The Axiom module shall deliver imagery to individual ground customers** |  |

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| [AX-90](http://192.168.10.14:8080/browse/AX-90) | **DELETE: The Axiom module shall support sensitive imagery requests and delivery via ISS MCC** |  |

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| [AX-91](http://192.168.10.14:8080/browse/AX-91) | **DELETE: The Axiom module shall use Ethernet for data comm through the module** |  |

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| --- | --- | --- |
| [AX-92](http://192.168.10.14:8080/browse/AX-92) | **DELETE: The Axiom module shall interface with the ISS 1553 network to provide commanding and health and status information to the module** |  |

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| --- | --- | --- |
| [AX-93](http://192.168.10.14:8080/browse/AX-93) | **DELETE: The Axiom module network shall interface with the ISS LAN (aba - note: not sure if this is necessary but bookmarking it for now)** |  |

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| --- | --- | --- |
| [AX-128](http://192.168.10.14:8080/browse/AX-128) | **DELETE: The Axiom module shall have a downlink data stream, independent from the ISS comm system to accommodate downlink data needs for the instruments hosted in the small airlock** |  |

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| --- | --- | --- |
| [AX-129](http://192.168.10.14:8080/browse/AX-129) | **DELETE: The Axiom stack shall provide telemetry to provide location, attitude, rates and health and status information to ISS MCC during RPOC and berthing operations** |  |

|  |  |  |
| --- | --- | --- |
| [AX-147](http://192.168.10.14:8080/browse/AX-147) | **The Axiom module shall provide crit 1 health and status data to the ISS** |  |

The Axiom module will gather local system status and provide this data over the ISS 1553 bus. This will allow the ISS to trigger Caution and Warning messages based on the received Axiom health and status.

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| --- | --- | --- |
| [AX-157](http://192.168.10.14:8080/browse/AX-157) | **The Axiom module shall receive commands from ground** |  |

The Axiom module will receive commands from MCC and Ground Stations. These commands can include imagery requests, power, etc.

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| [AX-734](http://192.168.10.14:8080/browse/AX-734) | **The Axiom shall implement time authentication as part of its communications security design.** |  |

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| [AX-728](http://192.168.10.14:8080/browse/AX-728) | **Spare** |  |

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| [AX-867](http://192.168.10.14:8080/browse/AX-867) | **The Axiom vehicle shall have the capability to accept and act upon commands from the ISS during Free Flight Integrated Operations within the ISS to Axiom RF communication range.** |  |

The commands are identified in SSP 41175-39.

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| --- | --- | --- |
| [AX-868](http://192.168.10.14:8080/browse/AX-868) | **The Axiom vehicle shall have the capability to accept and execute a Breakout command from the ISS while in Free Flight Integrated Operations within the ISS to Axiom RF communications range.** |  |

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| [AX-869](http://192.168.10.14:8080/browse/AX-869) | **The Axiom vehicle shall have the capability to accept and execute a Hold command from the ISS.** |  |

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| [AX-870](http://192.168.10.14:8080/browse/AX-870) | **The Axiom vehicle shall have the capability to accept and execute a Retreat command from the ISS.** |  |

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| [AX-871](http://192.168.10.14:8080/browse/AX-871) | **The Axiom vehicle shall provide feedback to the ISS that it has accepted or rejected safety critical commands from the ISS. The feedback responses are identified in SSP 41175-39.** |  |

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| --- | --- | --- |
| [AX-880](http://192.168.10.14:8080/browse/AX-880) | **The Axiom vehicle shall provide the ISS crew the capability to send a command from the ISS to the Axiom module RF communication system to turn on and off the Axiom vehicle acquisition lights.** |  |

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| [AX-953](http://192.168.10.14:8080/browse/AX-953) | **The Axiom software shall provide a management capability for conveying health and status information for each Axiom pressurized or attached payload.** |  |

The Axiom software needs to provide the crew with a unified quick-look as to the state of all payload health and status.

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| [AX-952](http://192.168.10.14:8080/browse/AX-952) | **The Axiom module software shall utilize both timing sources from the ISS and on-board GPS.** |  |

Onboard GPS is primary source of timing information, but timing information from the ISS 1553 bus should be used both as a backup and when communicating time-related information with the ISS.

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| [AX-951](http://192.168.10.14:8080/browse/AX-951) | **The Axiom module software shall provide a capability for performing antenna pointing.** |  |

In order to maintain direct, line-of-sight communication, Axiom will need a means of calculating and executing proper antenna pointing from a navigation solution.

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| [AX-950](http://192.168.10.14:8080/browse/AX-950) | **The Axiom module software shall make timing and navigational data available for downstream usage.** |  |

Navigational (i.e. time, state and attitude) data is required by downstream payloads and core Axiom software in order to accomplish mission objectives such as imagery and crew awareness.

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| [AX-949](http://192.168.10.14:8080/browse/AX-949) | **The Axiom module software shall receive ISS commands for thruster firings.** |  |

The Axiom module needs to provide a means of direct control of thrusters from ISS for reboost purposes. ISS GN&C data will be leveraged for executing a reboost without dependency upon Axiom's own onboard nav solution.

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| [AX-948](http://192.168.10.14:8080/browse/AX-948) | **The Axiom module software shall provide a means of routing audio from a client to the Axiom internal sound system.** |  |

The Axiom module will be equipped with an onboard sound system. Routing audio from a client device to this sound system allows for the crew to share in ground communications and media viewing without the need for individual personal headsets.

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| [AX-947](http://192.168.10.14:8080/browse/AX-947) | **The Axiom software system shall provide a means of controlling lighting elements located within the Axiom module by crew or ground personnel.** |  |

The Axiom module's lighting elements will be IP-enabled (i.e. IoT) and therefore controllable via software over the Ethernet bus. Software control allows for a more elegant and versatile control solution than physical switching. Control should be scoped to the abilities of the lighting element (e.g. luminosity, temperature and color).

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| [AX-946](http://192.168.10.14:8080/browse/AX-946) | **The Axiom module software shall provide a means of configuring an external "bill board" display.** |  |

The Axiom module will be equipped with a nadir-facing display panel which can be utilized for sponsorship displays. The software system needs to provide a secure solution for loading images onto said display.

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| [AX-945](http://192.168.10.14:8080/browse/AX-945) | **The Axiom module software shall provide a means of configuring which cameras can be controlled by local or remote entities.** |  |

In order to support outreach, remote control of cameras onboard Axiom is envisioned. Configuration of cameras which can be controlled needs to be dynamic so as to not interfere with mission objectives and/or crew privacy.

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| [AX-944](http://192.168.10.14:8080/browse/AX-944) | **The Axiom module software shall provide a means of controlling and viewing internal and external cameras attached to the Axiom module by either crew or ground personnel.** |  |

The Axiom module will be outfitted with IP-enabled (i.e. IoT) internal and external cameras which will need to be viewed and controlled by onboard and ground-based control personnel for situational awareness and mission success.

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| [AX-943](http://192.168.10.14:8080/browse/AX-943) | **The Axiom module software shall be capable of interfacing with fixed-panel, touchscreen displays for crew interface.** |  |

The Axiom module will be outfitted with at least two flat-panel touch screen displays for general crew interaction- allowing module control, providing health and status information, providing a central location for group communications with the ground, and media viewing opportunities for crew morale.

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| [AX-942](http://192.168.10.14:8080/browse/AX-942) | **The Axiom module software shall be capable of supporting a minimum of 21 Ethernet connected client computing devices.** |  |

The Axiom module software design needs to be able to support up to three devices per each seven crew members (one tablet, one laptop, and one internet-connected device).

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| [AX-941](http://192.168.10.14:8080/browse/AX-941) | **The Axiom module software shall allow for the reporting and control of power in the Axiom module.** |  |

In order to efficiently manage power within the Axiom module, software should manage power timelines and available sources in order to intelligently route power to clients. Reporting power status at Point-of-Load (POL) within the Axiom module empowers crew awareness and potentially troubleshooting.

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| [AX-940](http://192.168.10.14:8080/browse/AX-940) | **The Axiom module software shall provide a display of upcoming loss and acquisition of signal (LOS/AOS) events.** |  |

Providing insight into communications availability and interruptions allows for more efficient crew activity planning and agreeable crew experience.

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| [AX-939](http://192.168.10.14:8080/browse/AX-939) | **The Axiom module software shall provide a display of the ground track of the Axiom module.** |  |

Ground track view provides crew situational awareness as to the Axiom navigation system in relation to the surface of the Earth.

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| [AX-938](http://192.168.10.14:8080/browse/AX-938) | **The Axiom module software shall allow for the reporting and control of ECLSS in the Axiom module.** |  |

In order to maintain a habitable and comfortable climate in the module, the software system will need to negotiate the control of ECLSS effectors based upon ECLSS sensor readings in the module.

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| [AX-937](http://192.168.10.14:8080/browse/AX-937) | **The Axiom module software shall allow for the creation of fixed and configurable displays.** |  |

Fixed displays allow for pre-loading and configuration managing more critical displays that are required for operations of the Axiom module and mission success. Configurable displays allow for extensible tailoring to better support crew personalization and efficient monitoring of less critical mission objectives.

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| [AX-936](http://192.168.10.14:8080/browse/AX-936) | **The Axiom module software shall all for display of any telemetered data items in the Axiom module.** |  |

For extensibility and the support of creating custom displays, access to any data items in the Axiom module should be made available for display.

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| [AX-935](http://192.168.10.14:8080/browse/AX-935) | **The Axiom module software shall provide a capability for tracking inventory of items onboard the module.** |  |

Tracking of inventory including quantity and location of items as they are ingressed and consumed is required for appropriate management of the Axiom module.

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| [AX-934](http://192.168.10.14:8080/browse/AX-934) | **The Axiom module software shall provide a capability for media playback including movies and music.** |  |

For crew experience purposes, Axiom crew will need access to client software that will allow for playback of movies and music from onboard storage.

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| [AX-933](http://192.168.10.14:8080/browse/AX-933) | **The Axiom module software shall provide a capability for accessing e-mail while onboard Axiom.** |  |

For crew experience purposes, Axiom crew will need access to an e-mail client.

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| [AX-932](http://192.168.10.14:8080/browse/AX-932) | **The Axiom module software shall provide a capability for web browsing by crew onboard Axiom.** |  |

For crew experience purposes, Axiom crew will need access to a web browsing client.

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| [AX-931](http://192.168.10.14:8080/browse/AX-931) | **The Axiom module software shall provide a capability for voice conferencing and access to the terrestrial phone system for communication between crew onboard Axiom and entities on the ground.** |  |

For crew experience purposes, Axiom crew will need access to voice conferencing and making calls to nodes connected to the terrestrial phone system. This allows for live voice communication between the Axiom crew and ground-based control personnel or crew friends and family.

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| [AX-930](http://192.168.10.14:8080/browse/AX-930) | **The Axiom module software shall provide a capability for video conferencing between crew onboard Axiom and entities on the ground.** |  |

For crew experience purposes, Axiom crew will need access to video conferencing capability allowing for live video communication between the Axiom crew and ground-based control personnel or crew friends and family.

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| [AX-929](http://192.168.10.14:8080/browse/AX-929) | **The Axiom module software shall provide a display of current time in a configurable time zone.** |  |

Displaying time prominently within the module assists in the crew experience of adaption to the day/night cycle.

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| [AX-928](http://192.168.10.14:8080/browse/AX-928) | **The Axiom module software shall provide displays of Axiom cameras or other video sources upon fixed panel displays located within the Axiom module.** |  |

Providing views of cameras located on the exterior of Axiom allows for an opportunity to create virtual windows upon the flat panel display. Furthermore, views of other video streams can help to further enhance psychological support for the crew while they are onboard Axiom.

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| [AX-927](http://192.168.10.14:8080/browse/AX-927) | **The Axiom module software shall provide for configuration of user preferences.** |  |

Axiom is envisioned for usage by crew members of diverse cultures and language backgrounds. In order to facilitate common look-and-feel across applications, capturing languages and locales allows for software applications to optionally adhere to these languages and locales for a more tailored crew experience.

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| [AX-926](http://192.168.10.14:8080/browse/AX-926) | **The Axiom module software shall isolate the storage of data which was acquired over the internet from the rest of the Axiom software system.** |  |

In order to protect against vulnerabilities, the storage system for internet acquired data should be isolated from the rest of the Axiom software system.

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| [AX-925](http://192.168.10.14:8080/browse/AX-925) | **The Axiom module software shall provide a means of allowing crew members to store and retrieve data that has been acquired over the internet.** |  |

Axiom crew should have a means of downloading and storing media (e.g. books, games, movies, music) that they have acquired over the internet and storing it on-board the Axiom module.

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| [AX-924](http://192.168.10.14:8080/browse/AX-924) | **The Axiom module software shall provide a means of allowing crew member and ground personnel to store and retrieve data.** |  |

For media and otherwise large files, crew members and ground personnel will need a means of storing this data for later retrieval. The storage needs to be onboard Axiom to satisfy always availability and limit bandwidth.

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| [AX-923](http://192.168.10.14:8080/browse/AX-923) | **The Axiom module software shall provide a means of allowing for ground personnel to update the onboard activity timelines and stored procedures.** |  |

Ground personnel need to have a pathway for updating timelines and stored procedures for crew members.

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| [AX-922](http://192.168.10.14:8080/browse/AX-922) | **The Axiom module software shall provide crew members with access to activity timelines and procedures.** |  |

In order to maximize efficiency while on Axiom, crew members will have need access to software applications that allow for preplanned activities to be conveyed and coordinated with crew. Access to procedures allows for consolidated access of instructional materials pertaining to operation of Axiom's systems.

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| [AX-921](http://192.168.10.14:8080/browse/AX-921) | **The Axiom module software shall provide a mechanism for the crew to initiate a fire, depressurization or toxicity event within the Axiom module.** |  |

The Axiom module will need to allow for the crew to trip an indicator that they have detected a fire, depressurization or toxicity event in the module. This interaction will be purely manual, there are no automated toxicity sensors.

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| [AX-920](http://192.168.10.14:8080/browse/AX-920) | **The Axiom module software shall appropriately safe the module when a toxicity safing command is received.** |  |

The Axiom module should take appropriate action after receiving a safing command which indicates that a toxicity event has occurred within the Axiom module. Safing commands can be received from either the ISS or from internal health and status data depending upon mission mode.

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| [AX-919](http://192.168.10.14:8080/browse/AX-919) | **The Axiom module software shall appropriately safe the module when a depressurization safing command is received.** |  |

The Axiom module should take appropriate action after receiving a safing command which indicates that a depressurization event has occurred within the Axiom module. Safing commands can be received from either the ISS or from internal health and status data depending upon mission mode.

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| [AX-918](http://192.168.10.14:8080/browse/AX-918) | **The Axiom module software shall appropriately safe the module when a fire safing command is received.** |  |

The Axiom module should take appropriate action after receiving a safing command which indicates that a fire is present in the Axiom module. Safing commands can be received from either the ISS or from internal health and status data depending upon mission mode.

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| [AX-917](http://192.168.10.14:8080/browse/AX-917) | **The Axiom module software shall annunciate ISS Caution and Warning event aural notifications.** |  |

The Axiom module will be required to annunciate Caution and Warning notifications to alert the crew of Fire, Depress, or Tox. The annunciation could be a set of tones or verbal annunciation.

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| [AX-916](http://192.168.10.14:8080/browse/AX-916) | **The Axiom module software shall display ISS Caution and Warning event visual notifications.** |  |

The Axiom module will be required to display Caution and Warning notifications to alert the crew of Fire, Depress, or Tox.

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| [AX-915](http://192.168.10.14:8080/browse/AX-915) | **The Axiom module software shall forward (TBD) GN&C data from the ISS GNC MDM to the Axiom Ethernet.** |  |

During ISS attached operations, GN&C data is required by the Axiom module for applications antenna pointing, imaging, crew situational awareness and other payload applications. While Axiom will have a dedicated GN&C system, access to ISS GN&C data provides a means of supplementing that data in the event that it is unavailable from the dedicated Axiom system.

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| [AX-914](http://192.168.10.14:8080/browse/AX-914) | **The Axiom module software shall broadcast health and status information to the ISS GNC MDM at TBR rate.** |  |

The Axiom module will be required to recurringly emit the health and status including the state of all Caution and Warning sensors (fire, toxicity and pressurization) and the propulsion system to the ISS over the 1553 bus. This will allow the ISS to trigger Caution and Warning messages based on the received Axiom health and status and monitor the state of the propulsion system on the Axiom module.

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| [AX-913](http://192.168.10.14:8080/browse/AX-913) | **The Axiom module software shall transition to internal initiation of safing actions upon detachment from ISS.** |  |

Contingency scenarios that could initate detachment of the Axiom module necessitate that the transition of safing commanding from ISS to Axiom.

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| [AX-912](http://192.168.10.14:8080/browse/AX-912) | **The Axiom module software shall initiate safing from internal caution and warning data when the module is not attached to the ISS.** |  |

When attached to the ISS, safing actions inside the Axiom module are initiated by commanding from the ISS. When not attached to the ISS, the Axiom module needs to be able to initate safing based upon interrogation of internal Caution and Warning data without intervention via an external command.

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| [AX-911](http://192.168.10.14:8080/browse/AX-911) | **The Axiom module software shall receive safing commands from the ISS.** |  |

Whenever an emergency situation is encountered, the Axiom module will be required to enter into a fail-safe state whenever so commanded from the 1553 interface with the ISS via the GNC MDM.

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| [AX-910](http://192.168.10.14:8080/browse/AX-910) | **The Axiom module software shall provide a manual silencing feature for active audio annunciations within the Axiom module.** |  |

The capability to manually silence any alarm is to be provided to the crew. Requirements are to prescribe a method of manual silencing that is intuitive, achievable from different locations within the cabin and during different flight phases, and consistent with any other manual silencing mechanisms.

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| [AX-909](http://192.168.10.14:8080/browse/AX-909) | **The Axiom module software shall be capable of utilizing an independent link for internet access.** |  |

For high-bandwidth applications (e.g. video), Axiom will be equipped with an independent high-rate link. The Axiom Software needs to manage usage of this link by on-board applications.

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| [AX-908](http://192.168.10.14:8080/browse/AX-908) | **Command and telemetry streams to/from the Axiom module shall be secure.** |  |

Security of data exchanged between the Axiom module and the ground is vital in order to ensure privacy and protect against cyber threats toward Axiom.

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| [AX-907](http://192.168.10.14:8080/browse/AX-907) | **The Axiom module software shall be capable of broadcasting telemetry over the Axiom ground return link.** |  |

The Axiom module will possess it's own return link that can be utilized subject to availability.

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| [AX-906](http://192.168.10.14:8080/browse/AX-906) | **The Axiom module software shall be capable of broadcasting telemetry to the ISS Joint Station LAN (JSL).** |  |

The Axiom module should be capable of broadcasting telemetry from the ISS so as to leverage the existing ISS S-Band or Ku-Band return link.

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| [AX-905](http://192.168.10.14:8080/browse/AX-905) | **The Axiom module software hall be capable of ingesting commands received from the Axiom ground forward link.** |  |

The Axiom module will possess it's own forward link that can be utilized subject to availability.

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| [AX-904](http://192.168.10.14:8080/browse/AX-904) | **The Axiom module software shall be capable of ingesting commands received from the ISS Joint Station LAN (JSL).** |  |

The Axiom module should be capable of ingesting commands from the ISS so as to leverage the existing ISS S-Band or Ku-Band forward links.

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| [AX-903](http://192.168.10.14:8080/browse/AX-903) | **The Axiom module software shall provide two-way communication with ground-based entities.** |  |

The Axiom software system needs to provide a path for two-way video and voice communication between ground-based control personnel or crew friends and family.

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| [AX-902](http://192.168.10.14:8080/browse/AX-902) | **The Axiom API shall provide a capability for publishing data to the telemetry stream.** |  |

Providing an API call for publishing telemetry will allow for payload and/or mission software developers a mechanism for pushing data to the ground. Brokering telemetry publishing through the application server's API allows for commoditizing and rate limiting such calls.

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| [AX-901](http://192.168.10.14:8080/browse/AX-901) | **The Axiom API shall provide a capability for control of attached payloads over Ethernet.** |  |

All payloads in the Axiom module will be attached via Ethernet. Creation of an API will enable payload developers to conform their payload software to allow for control by the Axiom application server. Payload Apps that are written will then be able to command their payloads via interaction that is brokered by the Axiom application server. The API for Axiom effectors (e.g. ECLSS and Power) should be separate from the payload API so as to allow for a versatile authorization scheme.

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| [AX-900](http://192.168.10.14:8080/browse/AX-900) | **The Axiom API shall provide a capability for control of a downstream effector attached via Ethernet.** |  |

The Axiom module will employ Ethernet throughout as a physical and data link layer medium. In order to enhance modularity, the Axiom API should allow for a generic API mechanism for control of any effectors attached to the Ethernet bus (i.e. Internet-of-Things (IoT)). The API for Axiom effectors (e.g. ECLSS and Power) should be separate from the payload API so as to allow for a versatile authorization scheme.

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| [AX-899](http://192.168.10.14:8080/browse/AX-899) | **The Axiom API shall provide a capability for performing persistence (i.e. storage/retrieval) of data.** |  |

Storage and retrieval of data is a core capability of the Axiom SW system. An API should enable access to store and retrieve data without downstream clients from the nuances of the underlying storage medium. This API is intended for usage with sensors and payloads alike.

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| [AX-898](http://192.168.10.14:8080/browse/AX-898) | **The Axiom API shall include a means of performing authentication and authorization of client software applications and human users to prevent against undesired activity with the API.** |  |

Authentication confirms the identity of an approved client software application and/or user. Authorization thereby should restrict access to the Axiom API on a per client application and user basis. This allows for fine-tuned control of which applications and users can interact with the system so as to protect against unsolicited access and configuration management of applications and versioning. This also enables a throttled rate-limiting on API access on a per client application and user basis.

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| [AX-897](http://192.168.10.14:8080/browse/AX-897) | **The Axiom module software shall provide an Application Programming Interface (API) to the application server.** |  |

An evolvable API into the application server allows for agile evolution of server capabilities and a mechanism for Axiom SW developers (both apps and Command and Control SW), payload SW developers, and mission SW developers to create software apps within the Axiom ecosystem.

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| [AX-896](http://192.168.10.14:8080/browse/AX-896) | **The Axiom module software shall provide for a fail ops/fail safe response to faults.** |  |

The redundancy and robustness solution of the software system should provide for an initial fault to be handled such that the system fails into (i.e. remains in) an operational state. A subsequent fault should be handled by failing into a safe state.

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| [AX-895](http://192.168.10.14:8080/browse/AX-895) | **The Axiom module software shall perform data integrity checking upon stored and transmitted data.** |  |

Stored and trasmitted data should be interacted with in such as fashion as to detect and protect against data corruption caused by hardware faults or radiation events.

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| [AX-894](http://192.168.10.14:8080/browse/AX-894) | **Any client application which requires internet access shall be segregated from the command and control Ethernet bus.** |  |

In order to protect against vulnerabilities introduced by internet access exposure, any software clients which utilize internet access should be software isolated from the higher critical command and control elements of the Axiom module.

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| [AX-893](http://192.168.10.14:8080/browse/AX-893) | **All software-based elements of the Axiom module shall allow for updates from ground and on-board crew.** |  |

Any software implementation on the Axiom module needs a mechanism for pushing patch updates and fixes.

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| [AX-892](http://192.168.10.14:8080/browse/AX-892) | **The Axiom module software shall allow for operations by ground-based personnel.** |  |

During non-crew tended operations, control of all Axiom software elements is required.

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| [AX-891](http://192.168.10.14:8080/browse/AX-891) | **The Axiom module software shall provide a capability for pushing notifications to crew.** |  |

A means of relaying high-priority messages to the crew is required.

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| [AX-890](http://192.168.10.14:8080/browse/AX-890) | **The Axiom module software shall perform and provide monitoring statistics to crew and ground personnel.** |  |

In order to assess health and scaling needs of hardware and VM distributions- comprehensive system health should be captured and relayed to both the crew and ground flight control teams. Appropriate metrics include network loading, CPU loading, memory footprint and local disk utilization. Application servers should additionally include thread pool, connection pool and request/response traffic metrics.

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| [AX-889](http://192.168.10.14:8080/browse/AX-889) | **The Axiom module software shall provide a logging infrastructure.** |  |

For troubleshooting and tuning purposes, the Axiom software system should capture logging forensics for downstream analysis.

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| [AX-888](http://192.168.10.14:8080/browse/AX-888) | **The Axiom application servers shall provide a means of caching asynchronous server requests.** |  |

In order to accommodate high concurrency of requests into the server, a caching layer will improve efficiency by decreasing hits to the backend persistence solution when similar asynchronous requests are made upon the Axiom application server.

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| [AX-887](http://192.168.10.14:8080/browse/AX-887) | **The Axiom application servers shall allow usage of rate limiting on API hits for specific clients.** |  |

Providing a means of limiting API hits against the Axiom SW system as well as telemetry bandwidth allows for commoditizing storage and communications for payload and/or optional mission items. Core Axiom SW elements should never be rate limited.

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| [AX-886](http://192.168.10.14:8080/browse/AX-886) | **The Axiom module software shall employ usage of application servers for asynchronous client requests.** |  |

Levying an application server will ensure that the Axiom SW architecture is scalable and able to support numerous and diverse clients (e.g. different mediums- tablet, laptop as well as different platforms).

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| [AX-885](http://192.168.10.14:8080/browse/AX-885) | **The Axiom module software shall employ TCP and/or UDP at the transport layer for communication between network nodes.** |  |

The Axiom module will be outfitted with wired and Wi-Fi Ethernet as a standard communication bus throughout the module in order to allow for a modular and scalable architecture. The software should follow suit by leveraging TCP and UDP at the transport layer.

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| [AX-884](http://192.168.10.14:8080/browse/AX-884) | **Axiom module displays shall display units of measure with their corresponding values.** |  |

Measurement units are to be identifiable with the correct magnitude and scale. An effort should be made wherever possible to conform to existing ISS and/or SI standards. This ensures correct decision making when comparing or using these units in some other way.

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| [AX-883](http://192.168.10.14:8080/browse/AX-883) | **Confirmation shall be required before completing critical, hazardous, or catastrophic commands in the Axiom module.** |  |

When crewed, critical commands are to be prevented from being accidentally issued, which can be accomplished by requesting confirmation from the crew, thus reducing the chance of errors.

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| [AX-882](http://192.168.10.14:8080/browse/AX-882) | **The Axiom module software shall alert the crew if selected systems are outside of safe limits.** |  |

A set-point is the target value that an automatic control system aims to reach. Two set-points, e.g., high and low set-points, define a range of values within which a system operates. The crew or ground personnel may be able to select set-points in an automatic control system. In the event that a set-point is changed to one that is outside the safe limit, the system will alert the crew that a change has been made that puts the set-point at an unsafe setting. The alert acts as a check to ensure that the crew intentionally made the change and reminds them that there is a hazard associated with a set-point in this range.

#### Structures

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| [AX-562](http://192.168.10.14:8080/browse/AX-562) | **Per SSP 50005 paragraph 5.7.2.2.1, the Axiom module structural design shall prevent the dose equivalent to the crew member blood forming organs from exceeding 40.0 rem per year.** |  |

Module will need to be in accordance with minimum Radiation protection requirements for human habitats

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| [AX-560](http://192.168.10.14:8080/browse/AX-560) | **The Axiom module crew interfaces shall meet the intent of SSP 50005, International Space Station Flight Crew Integration Standard.** |  |

Required for hardware attached to the International Space station

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| [AX-556](http://192.168.10.14:8080/browse/AX-556) | **The Axiom module shall provide internal structural interfaces per Architecture Layout Interface Engineering document TBD.** |  |

Internal interfaces are required to interface with payloads, modular rack assemblies, crew quarters, utility raceways and passthroughs that are configured and described by its associated Interface control document

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| [AX-555](http://192.168.10.14:8080/browse/AX-555) | **In the launch configuration the Axiom module shall interface with the launch vehicle per LV ICD TBD.** |  |

The launch vehicle "Payload Assembly" consists of a full complement Axiom module attached to a full complement Orbital ATK Service Module

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| [AX-554](http://192.168.10.14:8080/browse/AX-554) | **The Axiom module shall permit IVA access the pressure wall.** |  |

This is to repair damage/ leaks/ holes. Certain kinds of patches just need a reach tool to get you there, but to clean the area for a patch or to install a sensor the crew may need full access.

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| [AX-553](http://192.168.10.14:8080/browse/AX-553) | **Axiom module secondary support structures shall permit reconfiguration of payload and vehicle systems** |  |

Desired feature to make the tool set common for all R&R to the greatest extent possible.

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| [AX-551](http://192.168.10.14:8080/browse/AX-551) | **The Axiom module crew quarters viewing windows shall each have an individually operated port cover.** |  |

Windows will provide crew with suitable views of earth. The port covers will protect the exterior surfaces of the windows and protect the window structure from MMOD impacts.

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| [AX-804](http://192.168.10.14:8080/browse/AX-804) | **POSITIONING CUES** |  |

B. The Axiom module passive CBM berthed to the ISS active CBM via the SSRMS shall accommodate the NASA-provided Centerline Berthing Camera System target, part number SEG 33112764-301.  
C. The Axiom module shall have no protrusions or obstruction into the volumes necessary to accommodate the hardware and viewing zone for the Centerline Berthing Camera System Berthing Target mounted on the Axiom hatch of the passive CBM. The volume necessary to accommodate the hardware and viewing zone for the Centerline Berthing Camera System Berthing Target is defined as a stay out envelope described in Figure 3.3.8.2.2-1, Static Envelope for Centerline Berthing Camera System Passive CBM.  
D. The Axiom module shall provide a hatch mounting interface for the Centerline Berthing Camera System target, p/n SEG 33112764-301 that is dimensionally consistent with the existing ISS CBM hatch mounting configuration as defined in the vehicle specific hardware ICD listed in Appendix D.  
E. Clocking orientation of the Centerline Berthing Camera System target, p/n SEG 33112764-301, with respect to the Axiom CBM mating interface plane shall be in accordance with the vehicle specific hardware ICD listed in Appendix D.  
F. The Axiom module hatch shall provide a reflective surface compatible with the Centerline Berthing Camera System. The reflective surface shall be consistent with the existing ISS CBM hatch windows regarding dimensions, optical reflectivity and optical dispersion per the vehicle specific hardware ICD listed in Appendix D.  
G. The Axiom module shall locate the common hatches relative to the CBM in following manner:  
1) The Hatch Wobble angle is 0.000 deg with respect to the CBM, within a tolerance of less than or equal to 1.00 deg.  
2) The Hatch Center point (the intersection of the hatch Y and Z axes) shall be coincident with the CBM center with a lateral (radial) offset of 0.000 inches within a tolerance of less than 0.70 inches.  
3) The Centerline Berthing Camera System target mounting interface plane (on the surface of the hatch) shall be 14.50 +/- 0.50 inches from the CBM to CBM mating interface plane in the negative X direction of the Hatch Coordinate Frame.  
4) The hatch reflective surface shall be 15.15 +/- 0.50 inches from the CBM to CBM mating interface plane in the negative X direction of the Hatch Coordinate Frame.  
5) Hatch Roll angle shall be 0.000 deg with respect to the CBM, within a tolerance of less than or equal to 0.75 deg.  
Notes:  
1) Tolerances include effects resulting from launch loads, the on-orbit thermal and pressure environment and installation measurement errors.  
2) The Hatch Coordinate Frame is defined as follows: The X-axis of the hatch is defined as the direction perpendicular to the plane defined by the hatch opening. The positive X direction points from the interior of the vehicle to the PCBM. The intersection of the Y and Z axes is defined as the center of the hatch, with Y-Z plane flush with the exterior surface of the center of the hatch. The Z-Axis is perpendicular to the X-axis and pointing in the same direction as the Z-axis of the CBM and passes between the two nearest Hatch Window Frame bolt holes on a standard Boeing hatch.  
3) The Hatch Wobble angle is defined as the angle between Hatch and PCBM X-axes. Lateral is defined as the Root-Sum-Square (RSS) combination of the Y-Z hatch coordinates expressed in the CBM Coordinate System. Roll is defined as the rotation of the Hatch Coordinate Frame about the PCBM X-axis. [see 50808 figures]

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| [AX-827](http://192.168.10.14:8080/browse/AX-827) | **The Axiom external areas requiring planned maintenance shall have reserved access envelopes in accordance with SSP 50005, section 14.4.3.** |  |

There are currently no planned EVA needs for Axiom Module. It is understood that failures or other situations outside of our control may necessitate EVA, so Axiom will identify potential courses of action during DAC1. Other EVA requirements may need to be pulled in as needed.

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| [AX-818](http://192.168.10.14:8080/browse/AX-818) | **ACCESSIBILITY** |  |

A. The external Axiom utility interface design for COTS vehicles shall comply with SSP 50005, section 6.3.3.6, 11.2.3.6 and 12.3.1 requirements for accessibility.  
B. All internal Axiom vestibule utility interface connections shall be manually mateable after opening one module hatch in the berthed configuration. Vestibule utility interface design shall comply with SSP 50005, section 11.10.3 for Intravehicular Activity (IVA) requirements.  
C. Axiom utilities shall be accessible from inside the pressurized elements after the elements are berthed and thermal protection is removed.  
D. The IDA will contain an Intermodule Ventilation (IMV) duct connection as an internal  
utility and all other utility connectors are external.  
E. The IDA IMV duct will comply with SSP 50005, paragraph 12.3.1.2 F and H.

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| [AX-817](http://192.168.10.14:8080/browse/AX-817) | **The Axiom module interface design shall incorporate provisions for the mechanical connection of data, power, cooling utilities, and atmospheric gas utilities between the Axiom and the berthing and docking interfaces.** |  |

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| [AX-798](http://192.168.10.14:8080/browse/AX-798) | **The Axiom module, while attached to the ISS, shall limit quasisteady (<0.01 Hz) acceleration magnitude from individual disturbance sources to less than or equal to 0.02 micro-g, excluding accelerations from payloads, aerodynamic and gravitational forces.** |  |

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| [AX-796](http://192.168.10.14:8080/browse/AX-796) | **The Axiom module internal pressure volume shall be able to withstand the ISS maximum depress/repress rate of 0.015 psi/s (0.103 kPa/s).** |  |

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| [AX-795](http://192.168.10.14:8080/browse/AX-795) | **Any mechanism-induced shock spectrum induced by the Axiom grapple fixtures shall not damage the SSRMS.** |  |

This requirement is derived from SSP50808. Draft adaptation text is provided below and should be refined into a specific shock spectrum that can be listed in a tabular format for loads analysis.

The shock response spectrum at the LEE to GF interface (grapple fixture abutment plate) caused by a mechanism (e.g., GF release mechanism) from the Axiom vehicle shall not exceed the shock severity limit defined in Table 3.3.3.2.13-1, Mechanical Condition of a Mechanism and Figure 3.3.3.2.13-1, LEE Shock Response Spectrum (SRS) Limits at the LEE to GF Interface. [see 50808 tables]

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| [AX-881](http://192.168.10.14:8080/browse/AX-881) | **The Axiom vehicle shall have the cues necessary for the ISS crew to visually determine that the Axiom vehicle is within its planned orientation (within +/- 45 degrees) prior to entering the KOS.** |  |

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| [AX-792](http://192.168.10.14:8080/browse/AX-792) | **The docked Axiom module mass properties shall be as defined in Table 3.7.5-Z** |  |

Maximum mass: 55,000 lbm  
C.G: TBD  
Fundamental mode / frequency: below 1.5Hz

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| [AX-791](http://192.168.10.14:8080/browse/AX-791) | **Axiom module plume loads shall not negatively impact the structure of the ISS.** |  |

Derived from SSP 50808.

Draft text adapted from SSP 50808 is provided below. These tables will need to be adapted to make them relevant to the Axiom design.  
A. Axiom vehicle�۪s plume pressures acting on the ISS shall not exceed the limits outlined in Table 3.2.2.6.4.5.2-1, ISS Plume Impingement Loads. [see 50808 table]  
B. The Axiom vehicle normal peak plume pressure impulses during proximity operations shall not impart on any ISS solar array wing more than 0.02 pounds per square foot second (psf-sec) within any 5 second window and 0.028 psf-sec within any 18 second window.  
Note: These limit pressures are only to be used for analyzing local components attached or mounted to the main structure and not for determining overall primary structure capability. [free-flyer only]

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| [AX-789](http://192.168.10.14:8080/browse/AX-789) | **Delete** |  |

Covered by [AX-786](http://192.168.10.14:8080/browse/AX-786)

The Axiom module shall withstand the thermally induced structural loads due to the  
maximum on orbit temperature difference across the ACBM to PCBM interface as defined in  
Table 3.2.1.6.4.3.2-1. The on-orbit transient thermal loads shall be applied according to the load  
spectra defined in Table 3.2.1.6.4.3.2-2. [see 50808 tables]

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| [AX-835](http://192.168.10.14:8080/browse/AX-835) | **Delete - WINDOWS** |  |

Windows shall meet the intent of NASA-STD-5018. The following sections in NASA-STD-5018 are not applicable to the Axiom module design: 4.6.3, 5.6.3, 4.10.2 and 5.10.2. [Need review to make sure we are not eliminating something that applies to us]

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| [AX-833](http://192.168.10.14:8080/browse/AX-833) | **Delete: ACCESSIBILITY** |  |

A. All internal vestibule utility interface connections shall be mateable after opening the ISS module hatch in the berthed configuration.  
B. The Axiom vestibule utility interface design shall comply with SSP 50005, section 11.10.3 and paragraph 12.3.1.2.  
C. Utilities shall be accessible from inside the pressurized elements after the elements are berthed.  
D. The docked Axiom module vestibule utility interface design shall comply with SSP 50005,  
paragraph 12.3.1.2 F and H.

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| [AX-788](http://192.168.10.14:8080/browse/AX-788) | **Delete** |  |

Covered by [AX-786](http://192.168.10.14:8080/browse/AX-786)

During CBM berthing the Axiom module shall withstand the induced load at the  
maximum temperature differential, created by the combination of ACBM to PCBM transient  
thermal loads and the steady state thermal load as specified in Table 3.2.1.6.4.3.1-1, applied at  
the ACBM to PCBM interface plane. [see 50808 table]

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| [AX-787](http://192.168.10.14:8080/browse/AX-787) | **Delete** |  |

Covered by [AX-786](http://192.168.10.14:8080/browse/AX-786)

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| [AX-842](http://192.168.10.14:8080/browse/AX-842) | **Detete** |  |

Axiom module shall be designed to utilize the min. set of common tools for maintanance, repair and reconfiguration

Rationale for deletion: Axiom will not use the same tool set as ISS. Axiom will not rely on ISS tools for repair.

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| [AX-649](http://192.168.10.14:8080/browse/AX-649) | **Spare** |  |

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| [AX-648](http://192.168.10.14:8080/browse/AX-648) | **spare** |  |

##### Loads

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| [AX-559](http://192.168.10.14:8080/browse/AX-559) | **The Axiom module shall meet the applicable loads defined in the Axiom Loads Data Book, document number TBD.** |  |

Loads Data Book includes all loads. (handling, shipping, integration, launch, service module, berthing / docking, on orbit loads

###### IRD Loads

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| [AX-786](http://192.168.10.14:8080/browse/AX-786) | **The Axiom/ISS structural interface shall provide positive margins under all design pressure load conditions, as listed in Table 3.7.5-X.** |  |

Table 3.7.5-X will be derived from Tables 3.2.2.6.4.2-1 and 3.2.2.6.4.2-2 provided in SSP 50808.

Sample adapted text from SSP 50808.  
A. The Axiom/ISS interface shall withstand the maximum pressure loads from the pressure load cases defined in Table 3.2.2.6.4.2-1, On-Orbit Pressure Loads and as shown in Figure 3.2.2.6.4.2-1, Pressure Loads Cases Diagram.  
B. Axiom module structure and systems shall withstand the nominal and contingency on-orbit pressurization cycles specified in Table 3.2.2.6.4.2-2, On-orbit Pressure Spectra. [see 50808 tables and figures]

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| [AX-799](http://192.168.10.14:8080/browse/AX-799) | **The Axiom module, while attached to ISS, shall limit vibratory accelerations input to ISS structure (excluding accelerations introduced by payloads) to the levels shown in SSP 50808 Figure 3.3.5.1.2-1.** |  |

SSP 50808 reference text

A. The Axiom module, while attached to the ISS, shall limit vibratory accelerations (excluding accelerations introduced by payloads) to the levels shown in Figure 3.3.5.1.2-1, The Axiom Vibro-Acoustic Microgravity Acceleration Limits, when using the transfer functions and methodology as specified in SSP 50036, Microgravity Control Plan, section 5.4.  
B. The Axiom module, while attached to the ISS, shall limit transient accelerations from individual transient disturbance sources (but not including disturbances caused by payloads) to less than or equal to 1000 micro-g per axis and when integrated over any 10 second interval, to less than or equal to 10 micro-g seconds per axis when using the transfer functions or system models and methodology as specified in SSP 50036, paragraphs 5.4.2 and 5.4.3.  
C. The Axiom module, while attached to the ISS, shall provide such a vibratory acceleration environment, concurrently with the quasi-steady acceleration environment specified in the limit quasi-steady accelerations function. [see 50808 figure]

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| [AX-801](http://192.168.10.14:8080/browse/AX-801) | **The Axiom module, while attached to the ISS, shall have angular momentum inducing an estimated CMG momentum magnitude less than 10,000 ft-lb-sec (13,558 N-m-sec) during any continuous 110 minute period.** |  |

The following text is derived from SSP 50808. It may be used to refine the requirement or the verification approach.

When the ISS is in the microgravity mode, any disturbance (non-transitory or transitory) induced by an individual disturbance source in the Axiom module (including vent impingement on the ISS structure but not including disturbances caused by payloads) shall have an angular momentum impulse which produces an estimated CMG momentum magnitude less than 10,000 ft-lb-sec (13,558 N-m-sec) during any continuous 110 minute period when evaluated in accordance with the conditions defined in Table 3.3.5.2.2-1, CMG Momentum Usage Calculation. [see 50808 table]

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| [AX-800](http://192.168.10.14:8080/browse/AX-800) | **The Axiom module, while attached to ISS, shall limit non-transitory disturbances (>10 seconds) by an individual source in / on the Axiom module to impulses less than the values shown in Table 3.3.5.2.1-1, during any continuous nine minute period.** |  |

50808 reference text

When the ISS is in the microgravity mode, any non-transitory disturbance (disturbance duration > 10 seconds) induced by an individual disturbance source in the Axiom module (including vent impingement on the ISS structure) shall have an angular momentum impulse of less than the per axis values shown in Table 3.3.5.2.1-1, Maximum Angular Momentum Impulse, during any continuous nine minute period. [see 50808 table]

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| [AX-824](http://192.168.10.14:8080/browse/AX-824) | **The Axiom module IDA docking port shall withstand the docking soft capture loads defined in in JSC 65795, Section 4.2.1.5.1.** |  |

Hard capture loads defined in 4.2.1.5.2 may need to be considered in a separate requirement.

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| [AX-790](http://192.168.10.14:8080/browse/AX-790) | **Axiom module secondary structures shall withstand plume impingement loads of 1.0 lbf in the normal and 0.1 lbf in the shear direction.** |  |

This requirement is derived from SSP 50808.

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| [AX-794](http://192.168.10.14:8080/browse/AX-794) | **The Axiom module shall function nominally after exposure to SSRMS missed capture impulse loads listed in Table 3.7.5-X (TBD).** |  |

This requirement is for the Axiom vehicle to support recovery after receiving an impulse from the SSRMS during the capture phase when capture does not occur. The actual table contents will be derived from the text contained in SSP 50808, as listed below.

A. The Axiom vehicle shall be able to safely withstand a 108 Ns impulse applied to the GF shaft at a point 25.4 cm (10 inches) above the abutment plate. The impulse shall include contact with the grapple shaft at a 0 degree and 15 degree angle in both the GF +/- y and z axis in the +x direction, see Figure 3.3.3.2.12.1.1-1, Impulse Applied to Grapple Shaft.  
Note: The event should be counted as a failure with regards to analyses to satisfy two fault tolerance safety criteria.  
B. With no failures to the SSRMS or ISS Crew error, the Axiom vehicle shall be able to safely withstand a 74.3 Ns impulse from the SSRMS under missed capture conditions. The impulse shall include contact with the abutment plate at a 0 degree and 15 degree angle in the direction away from the ISS, and be focused at the base of the grapple shaft, see Figure 3.3.3.2.12.1.1-2, Impulse Applied to Abutment Plate.  
Note: The event should NOT be counted as a failure with regards to analyses to satisfy two fault tolerance safety criteria. [see 50808 figures]

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| [AX-785](http://192.168.10.14:8080/browse/AX-785) | **The Axiom module shall withstand the berthing loads to ISS and the ISS mated load spectra for a duration of 4 years.** |  |

This requirement is derived from SSP50808. Is should be interpreted for the specific DRMs and configurations expected for the Axiom mission.

The text below is adapted from SSP 50808 and is meant to serve as guidance for revising the actual Axiom requirement,

A. The Axiom module shall withstand the peak transient loads defined in Table 3.2.2.6.4.1-1, On-orbit Transient Interface Loads (Berthed at Node 2), during Axiom/ISS berthing and mated operations.  
B. The Axiom module shall withstand the mated load spectra as defined in Table 3.2.2.6.4.1-2, On-orbit Transient Interface Load Spectra (Berthed at Node 2), while exposed to mated Axiom/ISS on-orbit events associated with the limit loads in Table 3.2.2.6.4.1-1.  
Note: The loads will be applied concurrently in all possible combinations. Bending moment and shear can act in any direction in the Y-Z Plane, as defined in Figure 3.2.2.6.4.1-1, Load Application Diagram. [see 50808 tables and figures]

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| [AX-802](http://192.168.10.14:8080/browse/AX-802) | **The Axiom module shall withstand EVA and IVA induced loads as defined in JSC 28918 and SSP 50808 respectively.** |  |

Reference text from SSP 50808

A. The Axiom module shall withstand the induced EVA loads as defined in JSC 28918, Table 4-7.  
B. The Axiom module vehicles shall withstand the IVA induced loads in Table 3.3.8.1.2-1, IVA Induced Loads. [see 50808 table]

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| [AX-809](http://192.168.10.14:8080/browse/AX-809) | **The Axiom module PDGF supporting structure shall withstand impact loads defined in paragraph A3.2.2.3.1 of SSP 42004, Part 1, MSS to User (Generic) ICD.** |  |

The PDGF supporting structure shall withstand the impact loads as per paragraph A3.2.2.3.1 of  
SSP 42004, Part 1, MSS to User (Generic) ICD.

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| [AX-819](http://192.168.10.14:8080/browse/AX-819) | **The Axiom side of the Axiom to PMA interface will support the peak on-orbit transient loads as defined in SSP 50290, Prime Item Development Specification for Node 2, paragraph 3.3.12.1.9.3 (TBD).** |  |

The Axiom side of the Axiom to PMA interface will support the peak on-orbit transient loads as defined in SSP 50290, Prime Item Development Specification for Node 2, paragraph 3.3.12.1.9.3.

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| [AX-784](http://192.168.10.14:8080/browse/AX-784) | **The Axiom module shall meet all of its structural requirements for the ISS attached configuration while accounting for degradations due to thermal, radiation, and other environmental effects.** |  |

Temperature, radiation, and atomic oxygen can all serve to reduce structural integrity. Material properties and structural margins should include knockdowns to accommodate for these effects.

The text below is adapted from SSP 50808 and is to be used as guidance as the Axiom requirement is refined.

The Axiom vehicle shall meet all of its functional and performance requirements in the ISS attached configuration while exposed to the combined effects of the ISS induced radiative environment, the on-orbit thermal environment (defined in paragraph 3.3.9.1), and the ISS attitude envelope (defined in paragraph 3.3.9.10), and using the ISS thermal model baselines as described in JSC 66617.

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| [AX-820](http://192.168.10.14:8080/browse/AX-820) | **During CBM berthing the Axiom module shall withstand the induced load at the maximum temperature differential, as specified in Table 3.2.1.6.4.3.1-1, applied at the ACBM to PCBM interface plane.** |  |

reference wording from 50808

3.2.2.6.4.3.1 ON-ORBIT THERMALLY INDUCED STRUCTURAL LOADS FOR BERTHING  
During CBM berthing the berthed COTS vehicle shall withstand the induced load at the  
maximum temperature differential, created by the combination of ACBM to PCBM transient  
thermal loads and the steady state thermal load as specified in Table 3.2.1.6.4.3.1-1, applied at the ACBM to PCBM interface plane.

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| [AX-821](http://192.168.10.14:8080/browse/AX-821) | **ON-ORBIT THERMALLY INDUCED LOADS SPECTRA** |  |

The Axiom shall withstand the thermally induced structural loads due to the maximum on���orbit temperature difference across the ACBM to PCBM interface or the loads specified in Table 3.2.1.6.4.3.2���1, On���orbit Transient Thermal Loads, when cycled fully reversible according to the loads spectra of Table 3.2.1.6.4.3.2-2, On���orbit Thermally Induced Loads Spectrum, about the mean berthing loads of Table 3.2.1.6.4.3.2���3, On���orbit Thermally Induced Mean Berthing Loads. [see 50808 tables]

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| [AX-822](http://192.168.10.14:8080/browse/AX-822) | **ON-ORBIT THERMALLY INDUCED STRUCTURAL LOADS FORDOCKING** |  |

The ISS will support the induced loads associated with a maximum COTS to IDA temperature differential at the time of the COTS docking, combined with the induced loads associated with the maximum COTS to IDA transient (steady state) temperature differential or the loads specified in Table 3.2.1.6.4.3.3-1, Peak On-orbit Thermal Loads Induced by ISS at COTS-to- IDA Interface. [see 50808 table]

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| [AX-823](http://192.168.10.14:8080/browse/AX-823) | **ON-ORBIT THERMALLY INDUCED STRUCTURAL LOAD SPECTRAFOR DOCKING** |  |

The ISS will withstand the thermally induced structural loads, during Rendezvous, Proximity Operations, Docking, and Undocking (RPODU) and mated operations, due to the maximum onorbit temperature difference across the COTS to IDA interface as specified in JSC 65795, section 4, when cycled fully reversible according to the loads spectra as specified in Table 3.2.1.6.4.3.4- 1, On-Orbit Thermally Induced Loads Spectra Induced by ISS at COTS-to-ISS Interface During RPODU and Mated Operations. [see 50808 table]

##### Berthing (ACBM, PCBM)

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| [AX-558](http://192.168.10.14:8080/browse/AX-558) | **The Axiom module shall meet the intent of the Common Berthing Mechanism to Pressurized Elements ICD per SSP 41004.** |  |

The Common Berthing Mechanism will be used on the Axiom Module as interface to International space station, visiting vehicles, airlocks and other.

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| [AX-837](http://192.168.10.14:8080/browse/AX-837) | **The Axiom module shall neither protrude into, nor obstruct, the passage envelope shown in SSP 50808 Rev F Figure 3.2.1.2.6.1.1-1, after berthing and outfitting of the passageway.** |  |

CBM and Vestibule minimum clearances must be as noted in order to maintain ISPR capability, and to support transfer of berthed visiting vehicle hardware.

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| [AX-836](http://192.168.10.14:8080/browse/AX-836) | **Delete - VESTIBULE CLEARANCES** |  |

The Axiom vestibule passageway envelope shall be as shown in SSP 50808 Rev F Figure 3.2.1.2.6.1.1���1, CBM Passageway Envelope.

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| [AX-834](http://192.168.10.14:8080/browse/AX-834) | **The ISS IMV duct shall be the only permitted protrusion into the passage envelope between the Axiom Module and Node 2.** |  |

This is specified in SSP 50808 section 3.3.11.1.3.3.1. Regardless of whether or not the Axiom module needs this ventilation accommodation SSP 50808 section 3.2.2.3.3 RECEIVE INTERMODULE ATMOSPHERE paragraph A. states 'The berthed COTS vehicle shall receive intermodule atmosphere from the ISS via a duct.'

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| [AX-830](http://192.168.10.14:8080/browse/AX-830) | **The Axiom Module shall have one Passive CBM meeting the requirements of SSP 41004, Part 1, CBM to Pressurized Element ICD section 3B.0, and Part 2, CBM to Pressurized Element ICD (Generic).** |  |

The location of the PCBM will be indicated in the Architecture and Location Interface Engineering Document TBD.

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| [AX-829](http://192.168.10.14:8080/browse/AX-829) | **The to-be-berthed Axiom module appendages outside the Berthing Stay-Out Zone, as defined in 3.2.2.1.3, shall have a static and dynamic clearance of at least 609.6 mm (2 feet) from ISS elements during berthing and mated operations.** |  |

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| [AX-826](http://192.168.10.14:8080/browse/AX-826) | **Envelopes reserved for utility jumpers from Axiom into Node 2 shall be in accordance with SSP 41004, Part 1, paragraphs 3B.2.1.3.3.1 and 3B.2.2.3.3.1.** |  |

Review and update the envelope diagrams as required.

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| [AX-816](http://192.168.10.14:8080/browse/AX-816) | **BERTHING/ATTACHMENT MECHANISM** |  |

A. Axiom shall accomodated berthed COTS vehicles and elements via a CBM. ACBM to PCBM structure/mechanical interface will meet the requirements defined in SSP 41148.  
B. The Axiom module shall supply alignment, capture, and rigidization mechanisms for the mechanical attachment of the Axiom to PMA berthed element during on���orbit berthing.  
C. Interfaces between the CBM and the Axiom shall be in accordance with SSP 41004, section 3A.  
D. The Axiom side of the interface shall have the active components of the CBM.  
E. The ACBM of the Axiom module will support the capability to attach to and form a pressurized seal with the PCBM of PMA a berthed element in accordance with SSP 41148, paragraphs 3.2.1.3, 3.2.1.4, and 3.2.1.5.

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| [AX-828](http://192.168.10.14:8080/browse/AX-828) | **The berthed Axiom Module shall not interfere with the berthing stay–out zone Figures 3.2.2.1.3–1, –2 and –3. The definition of the berthing stay–out zone encompasses the envelope required for the CBM Meteoroid/Debris Covers.** |  |

See 50808 figures TBS.

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| [AX-813](http://192.168.10.14:8080/browse/AX-813) | **ACCESS ENVELOPE FOR BERTHING** |  |

A. Axiom module Envelopes reserved for utility jumpers shall be in accordance with SSP 41004, Common Berthing Mechanism to Pressurized Elements Interface Control Document, Part 1, paragraphs 3A.2.1.3.3.1 and 3A.2.2.3.3.1.  
B. The USOS Axiom module external areas requiring maintenance will have reserved access envelopes in accordance with SSP 50005, International Space Station Flight Crew Integration Standard, section 14.4.3 and paragraph 9.2.5.2.2.

##### Grapple Fixture (PDGF, FRGF)

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| [AX-805](http://192.168.10.14:8080/browse/AX-805) | **FRGF INTERFACE REQUIREMENTS** |  |

A. Equipment requiring SSRMS support shall provide a clearance envelope around the FRGF as specified in SSP 42004, paragraph I3.2.2.1.  
B. The user to FRGF mechanical interface and mounting requirements shall be as defined in SSP 42004, paragraph I3.2.2.2.  
C. The FRGF to user interface shall meet all performance requirements after being subjected to the MBS POA, SSRMS Load Limits, and SSRMS/SPDM Load Limits as defined in SSP 42004, section N3.2.2.3.  
E. Equipment requiring SSRMS support using a FRGF shall provide a stiffness at the interface that maintains a fundamental structural frequency as specified in SSP 42004 paragraph I3.2.2.3.5.  
F. Equipment requiring SSRMS support using an FRGF shall thermally interface with the GF using the nonconductive washers and bushings as shown in Figure 3.3.8.2.4.1-1, Shuttle GF Interface Parameters.  
G. Equipment requiring SSRMS support shall maintain grapple fixture temperatures within the ranges shown in Table 3.3.8.2.4.1-1, Flight Releasable Grapple Fixture Temperatures, in the column labeled ���Operating�۝.  
H. The user to FRGF electrical bonding shall be as defined in SSP 42004 paragraph I3.2.2.5.1.

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| [AX-808](http://192.168.10.14:8080/browse/AX-808) | **STIFFNESS AT THE PDGF TO MODULE I/F** |  |

The Axiom shall provide a stiffness at the PDGF to module interface as per paragraph A3.2.2.3.2  
of SSP 42004, Part 1, MSS to User (Generic) ICD.

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| [AX-807](http://192.168.10.14:8080/browse/AX-807) | **LIMIT LOADS AT THE PDGF TO MODULE I/F** |  |

The PDGF and the Axiom shall withstand the limit loads acting at their interface plane as  
specified in paragraph A3.2.2.3 of SSP 42004, Part 1, MSS to User (Generic) ICD.

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| [AX-810](http://192.168.10.14:8080/browse/AX-810) | **The maximum thermal conductance at the PDGF to Axiom interface shall be as per paragraph A3.2.2.8.1 of SSP 42004, Part 1** |  |

The maximum thermal conductance at the PDGF to Axiom interface shall be as per paragraph  
A3.2.2.8.1 of SSP 42004, Part 1, MSS to User (Generic) ICD.

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| [AX-806](http://192.168.10.14:8080/browse/AX-806) | **SSRMS APPROACH CLEARANCE ENVELOPE** |  |

The SSRMS latching end effector approach envelopes for the PDGF shall be as shown in Figure A3.2.2.1���1 of SSP 42004, Part 1, MSS to User (Generic) ICD.

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| [AX-814](http://192.168.10.14:8080/browse/AX-814) | **ACCESS ENVELOPE FOR DOCKING** |  |

The Axiom module external areas requiring maintenance shall have reserved access envelopes in accordance with SSP 50005, International Space Station Flight Crew Integration Standard, section 14.4.3 and paragraph 9.2.5.2.2.

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| [AX-803](http://192.168.10.14:8080/browse/AX-803) | **ISS ROBOTICS REQUIREMENTS** |  |

A. The equipment requiring SSRMS support shall interface with the SSRMS LEE using a PDGF, or a Flight Releasable Grapple Fixture (FRGF) that is compatible with the SSRMS LEE as specified in SSP 42004, Mobile Servicing System (MSS) to User (Generic) Interface Control Document, Part 1, Table 1.4.1.2���1. The GF to SSRMS LEE is an internal interface to the robotic subsystem.  
B. The Axiom module shall be within the robotic payload properties of Table 3.3.8.2���1, Robotic Payload Properties.  
C. The Axiom module requiring SSRMS manipulation within 1 ft of fixed structure may be subjected to contact with the fixed structure. The Axiom module hardware within 1 ft of fixed structure shall be designed to meet performance requirements after being subjected to contact energy defined as a function of the SSRMS-manipulated mass according to the relationship:  
Contact energy (joules) = 0.4 + mass (Kg) / 4250.   
G. Axiom module hardware located within 1 ft of equipment that is being robotically manipulated by the SSRMS may be subjected to contact by the manipulated equipment. The Axiom hardware located within 1 ft of equipment that is being robotically manipulated by the SSRMS shall be designed to meet performance requirements after being subjected to contact energy defined as a function of the SSRMS-manipulated mass according to the relationship:  
Contact energy (joules) = 0.4 + mass (Kg) / 4250. If the manipulated hardware is held by the SSRMS-based SPDM during SSRMS manipulation, the energy calculation shall include the mass of the fully-loaded SPDM (2310 Kg) in addition to the manipulated hardware mass.  
J. The Axiom module shall define the location of the GF in the vehicle specific hardware ICD listed in Appendix D.  
K. In response to an MSS safing event or loss of communication with Command and Control, an element-provided berthing mechanism shall preclude MSS load limit exceedances.  
M. All Axiom vehicle hardware (VV structure, VV Flight Support Equipment (FSE)) within 1 foot of robotically manipulated hardware along the straight line extraction/insertion path shall be restrained to prevent obstruction of robotic motion. [see 50808 tables]

##### Docking (IDA,NDS)

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| [AX-838](http://192.168.10.14:8080/browse/AX-838) | **The Axiom docking passageway minimum clearance shall be as specified in JSC-65795 Rev J figure 4.1.1-1.** |  |

Per JSC-65795 section 7.1.4.17.1 IMV Duct - Use of an IMV duct is optional. The IDA IMV duct will provide air flow up to the IDA/VV plane. If a VV chooses to connect a duct to the IDA IMV duct, the connection shall be made via a NASA provided coupling.   
Rationale: ISS program office is not requiring the VV to provide a duct if they can meet their airflow requirements without one.  
Hence, one, 5-inch diameter flexible air duct protrusion into the passage envelope may be allowed.

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| [AX-825](http://192.168.10.14:8080/browse/AX-825) | **UNDOCKING SEPARATION CONDITIONS** |  |

The Axiom module shall withstand the undocking separation conditions defined in Section 3.2.2.6.4.8 (SSP 50808)

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| [AX-815](http://192.168.10.14:8080/browse/AX-815) | **DOCKING ACCOMODATION** |  |

The Axiom shall implement the IDA passive docking mechanism interface in accordance  
with JSC 65795 Sections 4.2.1.2, 4.2.1.3, and 4.2.1.4.

C. The following figures represent the IDA: Figure 3.2.1.2.1-1, IDA on PMA2/Node.2  
Forward (Front View), Figure 3.2.1.2.1-2, IDA on PMA2/Node 2 Forward (Side View).

D. The following figures represent the IDA: Figure 3.2.1.2.1-3, IDA on PMA3/Node 2  
Zenith, Figure 3.2.1.2.1-4, IDA on PMA3/Node 2 Zenith (Side View).

##### Configuration

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| [AX-557](http://192.168.10.14:8080/browse/AX-557) | **The Axiom module shall provide external structural interfaces per Architecture Layout Interface Engineering document TBD.** |  |

External interfaces are required for interfacing with launch vehicle, service module, international space station, visiting vehicles, robotic arm, airlock that are configured as described by its associated interface control document.

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| [AX-812](http://192.168.10.14:8080/browse/AX-812) | **Axiom Module Coordinate Systems** |  |

The Axiom Module Coordinate system shall be as defined in Figure 3.1.2.3.

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| [AX-811](http://192.168.10.14:8080/browse/AX-811) | **Axiom Module Mass Properties** |  |

The axiom module mass properties shall be as defined in table 3.1.2.2

#### Environmental Control, Life Support and Active Thermal

##### Vent loop

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| [AX-60](http://192.168.10.14:8080/browse/AX-60) | **The ECLSS shall maintain the absolute pressure inside the Axiom module between 724 mmHg (14.0 psia) and 770 mmHg (14.9 psia) [96.5 kPa to 102.7 kPa) during nominal free-flight operations.** |  |

The ISS operates at the listed pressures. The Axiom module must withstand the internal pressure and arrive at ISS near this pressure. Specifying the pressure affects the overall thermal design because convective cooling requires knowledge of total pressure.

Note that Axiom will not control the pressure while attached to ISS.

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| [AX-94](http://192.168.10.14:8080/browse/AX-94) | **The ECLSS shall maintain ppO2 to within the range of 146 mmHg (2.82 psia) and 173 mmHg (3.35 psia) [19.5 kPa < ppO2 < 23.1 kPa] during normal operations.** |  |

The ISS has a similar requirement and the cabin air from Axiom will mix with ISS. The Axiom ECLSS system must provide oxygen primarily for crew metabolic consumption. The Axiom module cannot rely on ISS for oxygen replacement.

Note that there is no requirement to maintain ppO2 during free-flight, ascent, rendezvous, and emergency situations.

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| [AX-95](http://192.168.10.14:8080/browse/AX-95) | **The ECLSS shall limit CO2 levels to a maximum partial pressure of 2 mmHg (0.27 kPa) averaged over 24 hours.** |  |

The ISS does not have sufficient capability to remove CO2 generated by the Axiom crew in addition to the 6 crew already aboard the ISS. Astronaut crews on the ISS report negative physical side effects when CO2 levels nears 3 mmHg, and request that long-term exposure levels to CO2 be set to 2 mmHg. It is also a desire in the Axiom mission statement to advance CO2 removal technologies, so the Axiom project will put significant effort into this development effort.

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| [AX-96](http://192.168.10.14:8080/browse/AX-96) | **The ECLSS shall maintain the Relative Humidity (RH) environment in the module shall between 25% and 70%, averaged over each 24-hour period during all mission operations.** |  |

Average humidity is to be maintained below this upper limit (70 percent) for crew comfort and to limit formation of condensation. The specific range matches ISS requirements.

ISS also specifies a lower limit to the average humidity (25 percent) to ensure that the environment is not too dry for the nominal functioning of mucous membranes and to prevent static electricity buildup within the cabin, which could pose an increased electrical hazard to people. However, the lower humidity is generally only a concern with certain CO2 removal technologies that also remove moisture from the air.

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| [AX-97](http://192.168.10.14:8080/browse/AX-97) | **The ECLSS shall provide filtration to remove 99.97% of airborne particles >0.3 micrometers in diameter.** |  |

This level of filtration is expected to satisfy the inhibition for microbial and fungal contamination as well as dust particles.

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| [AX-98](http://192.168.10.14:8080/browse/AX-98) | **The ECLSS shall limit atmospheric trace contaminant concentrations below the limits listed in Table 3.7.6-1.** |  |

This requirement will provide a subset of chemical limits listed in JSC 20584, (SMAC).   
Exposure limits for expected atmospheric constituents in space flight are to be defined to protect crewmembers from illness and injury. The spacecraft maximum allowable concentrations (SMACs) provide guidance for short-term (1 and 24 hours), medium-term (7 and 30 days), and long-term (180 days) exposure of these constituents. The SMACs take into account several unique factors of human space flight missions, including the stress on human physiology, the uniform good health of astronauts, and the absence of pregnant or very young individuals.

It is expected that for short durations this may simply be provided by charcoal filters, likely with chemical washes for specific contaminants like ammonia. A small system to control carbon monoxide may also be required. It is also possible that the TCCS in ISS may be more than adequate to handle the additional trace contaminant load as engineering analysis of the TCCS filters has shown that eh existing ISS system has significant excess capacity.

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| [AX-99](http://192.168.10.14:8080/browse/AX-99) | **The ECLSS shall monitor the cabin atmospheric conditions for pressure, temperature, humidity, ppO2, and ppCO2 and alert the crew when these parameters exceed the limits listed in Table 3.7.6-2.** |  |

Data will be reported to avionics and out-of-limit conditions will be flagged and reported to the crew and ground.

The limits for absolute pressure, temperature, ppO2, and ppCO2 will be the values listed in Requirements [AX-60](http://192.168.10.14:8080/browse/AX-60), [AX-94](http://192.168.10.14:8080/browse/AX-94), [AX-95](http://192.168.10.14:8080/browse/AX-95), [AX-96](http://192.168.10.14:8080/browse/AX-96), and [AX-103](http://192.168.10.14:8080/browse/AX-103).

Derived from NASA-STD-3001 V2 6022.

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| [AX-230](http://192.168.10.14:8080/browse/AX-230) | **The ECLSS shall accommodate the increased O2 consumption and additional output of heat, CO2, perspiration droplets, odor, and particulates generated by the crew in an exercise area.** |  |

The ppO2 in the exercise area(s) is to be maintained at normal levels; otherwise, the required physiological capabilities of crewmembers may be impaired. This requirement also addresses any particulate that may be generated by the exercise activity, e.g., skin, hair, or lint from clothing or other materials.

This requirement is a child of [AX-377](http://192.168.10.14:8080/browse/AX-377) and [AX-400](http://192.168.10.14:8080/browse/AX-400).

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| [AX-231](http://192.168.10.14:8080/browse/AX-231) | **The Axiom module atmosphere shall contain nitrogen as the physiologically inert diluent gas to prevent lung collapse.** |  |

A diluent gas, in addition to O2, is required in nominal, long-duration, breathable atmospheres to prevent lung collapse, in addition to reducing the ignition/flammability threshold. The choice of diluent gas is dependent on many factors, including physiological activity and contribution to decompression sickness (DCS).

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| [AX-232](http://192.168.10.14:8080/browse/AX-232) | **The rate of change of Axiom module total internal pressure shall be limited to between -30 psi/min (-207 kPa/min) and +13.5 psi/min (+93.1 kPa/min) when crew are present.** |  |

The rate of change of pressure is to be limited to prevent injury to crewmember's ears and lungs during depressurization and repressurization. The positive rate of change limit is designed to prevent barotraumas in space flight conditions, where microgravity may have affected head and sinus congestion, and is therefore much more conservative than the 45 psi/min (2,327 mmHg/min) (100 ft/min) descent rate limit allowed by the U.S. Navy dive manual. The negative rate of change limit is consistent with the U.S. Navy dive manual 29 psi/min (1,520 mmHg/min) (66 ft/min) ascent rate allowance.

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| [AX-233](http://192.168.10.14:8080/browse/AX-233) | **The ECLSS system shall be able to pressurize the Axiom module to 16.0 psia (110.3 kPa).** |  |

This higher pressure serves as the module MDP and may be used during launch in order to provide additional stiffness to the module.

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| [AX-130](http://192.168.10.14:8080/browse/AX-130) | **The ECLSS shall provide oxygen at a rate of 1.87 lbm (0.85 kg) /person/day for up to 60 days.** |  |

Based on average metabolic oxygen uptake.

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| [AX-103](http://192.168.10.14:8080/browse/AX-103) | **The ECLSS shall maintain the atmospheric temperature between 19 and 27 deg C (66.2 to 80.6 deg F) during nominal crewed operations.** |  |

This temperature range is defined as the range of environmental conditions in which humans can achieve thermal comfort and not have their performance of routine activities affected by thermal stress.The specific values match ISS requirements.

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| [AX-251](http://192.168.10.14:8080/browse/AX-251) | **The ECLSS shall provide a means to repressurize the Axiom module to a habitable atmosphere in the event of a module decompression.** |  |

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| [AX-252](http://192.168.10.14:8080/browse/AX-252) | **The ECLSS shall allow the crew or ground to control the humidity, temperature, and ppO2 inside the Axiom module while attached to the ISS.** |  |

The ability to control atmospheric conditions is important for crew comfort, e.g., temperature and humidity, and for mission tasks, e.g., ppO2, to ensure efficient and effective performance.

Cabin pressure inside of the Axiom module will be controlled by the ISS pressurization system while attached to the ISS.

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| [AX-105](http://192.168.10.14:8080/browse/AX-105) | **The ECLSS shall provide sufficient circulation to prohibit pockets of stagnant air.** |  |

The intent is to ensure that there are no localized pockets of CO2 or humidity that may violate the other cabin atmosphere requirements. Flow velocities, cabin air recirculation rates, etc. will all be determined based on the specific design of the module and adjusting the ventilation system to meet this overall intent.

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| [AX-270](http://192.168.10.14:8080/browse/AX-270) | **The ECLSS shall have the capability to vent cabin atmosphere into space.** |  |

The Axiom module must be able to control over pressurization events if they occur during ascent, rendezvous, or free-flight.

Note: This capability is removed during operations attached to the ISS.

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| [AX-701](http://192.168.10.14:8080/browse/AX-701) | **The ECLSS shall prevent condensation on Axiom interior surfaces except for the vestibule surfaces.** |  |

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| [AX-700](http://192.168.10.14:8080/browse/AX-700) | **The ECLSS shall accommodate the ability to purge the Axiom with breathing air prior to launch.** |  |

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| [AX-699](http://192.168.10.14:8080/browse/AX-699) | **The ECLSS shall provide indication of internal module pressure and temperature to the ISS crew and ground prior to opening the Axiom module hatch to Node 2.** |  |

Verification of the temperature and pressure is necessary to ensure the two atmospheres are adequately matched to allow safe hatch opening.

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| [AX-271](http://192.168.10.14:8080/browse/AX-271) | **The Axiom module shall not relieve pressure while attached to the ISS with hatches open.** |  |

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| [AX-694](http://192.168.10.14:8080/browse/AX-694) | **The ECLSS shall maintain a pressure loss less than 0.10 psid between the Axiom bulkhead and the sample probe inlet at a flow rate of 400 scc/min.** |  |

This is to ensure adequate flow of the atmospheric sample back to the ISS MCA.

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| [AX-688](http://192.168.10.14:8080/browse/AX-688) | **The Axiom module shall be compatible with a maximum oxygen concentration of 24.1% by volume when hatches are open between the ISS and Axiom.** |  |

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| [AX-683](http://192.168.10.14:8080/browse/AX-683) | **The Axiom module shall not rely on conduction of heat across the mated joint to ISS or visiting vehicle to maintain intramodule temperatures.** |  |

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| [AX-797](http://192.168.10.14:8080/browse/AX-797) | **The Axiom module total pressurized volume leakage rate shall not exceed 0.022 lbs/day (0.01 kg/day) of ISS atmospheric gases at 14.7 psid (760 mmHg) on-orbit mated to ISS.** |  |

Note: These numbers do not include leakage rates for the Active CBM to Passive CBM interface.

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| [AX-113](http://192.168.10.14:8080/browse/AX-113) | **The ECLSS shall maintain the atmospheric temperature between 5 and 45 deg C (41 to 113 deg F) when uncrewed and not attached to the ISS.** |  |

This wider temperature range is acceptable without crew on board and will be necessary during launch, and berthing operations, until the module is attached to the ISS LTL and MTL. Equipment inside Axiom must be designed to accommodate this wider temperature range. 41 deg F was chosen to avoid any chance of freezing water.

##### Water Loop

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| [AX-114](http://192.168.10.14:8080/browse/AX-114) | **The ITCS pumps shall be on-orbit replaceable units.** |  |

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| [AX-115](http://192.168.10.14:8080/browse/AX-115) | **The ITCS valves shall be on-orbit replaceable units or single fault tolerant.** |  |

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| [AX-116](http://192.168.10.14:8080/browse/AX-116) | **The ECLSS shall provide potable water that meets the minimum safe standards for the National Primary Drinking Water Regulations (NPDWR).** |  |

Work will need to be performed to compare these standards to the current NASA potable water standards.

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| [AX-119](http://192.168.10.14:8080/browse/AX-119) | **The ECLSS shall provide an average of 0.88 lbm (0.4 kg) of water per person per day for hygiene use.** |  |

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| [AX-247](http://192.168.10.14:8080/browse/AX-247) | **The ECLSS shall provide temporary storage for 100kg of wastewater and/or condensate.** |  |

Temporary stowage of waste water may be necessary to balance the WRS ability to process it.

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| [AX-249](http://192.168.10.14:8080/browse/AX-249) | **The ECLSS potable water bus shall have the capability to be sampled for quality.** |  |

The quantity of water required for water sampling is to be defined and requested as above and beyond the nominal potable water quantity requirements, which is done to ensure water quality.

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| [AX-120](http://192.168.10.14:8080/browse/AX-120) | **The ECLSS shall provide 8.5 lbm (3.86 kg) of potable water per crewmember per day.** |  |

This water is used for drinking, reconstituting food, hygiene, urine flush.

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| --- | --- | --- |
| [AX-121](http://192.168.10.14:8080/browse/AX-121) | **The ECLSS shall provide an average of 9 lbm (4.1 kg) per day of potable water for payload use.** |  |

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| --- | --- | --- |
| [AX-248](http://192.168.10.14:8080/browse/AX-248) | **The ECLSS shall provide sufficient tankage to store 500 kg of potable water.** |  |

Potable water, either supplied by ISS or reclaimed by Axiom systems, must be stored to allow increases or decreases in the amount collected vs. the amount consumed, and provide a contingency buffer if the WRS needs maintenance..

|  |  |  |
| --- | --- | --- |
| [AX-696](http://192.168.10.14:8080/browse/AX-696) | **The Axiom module shall control the use of water soluble volatile organic compounds to minimize their impact on the ISS ECLSS.** |  |

Use of methanol, ethanol, isopropyl alcohol, n-propyl alcohol, n-butyl alcohol, acetone, ethylene  
glycol, and propylene glycol in any quantity inside the pressurized elements presents a challenge for ECLSS systems. Consideration should be give to the requirements specified in SSP 30233, Space Station Requirements for Materials and  
Processes, section 4.2.12.

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| --- | --- | --- |
| [AX-697](http://192.168.10.14:8080/browse/AX-697) | **The ECLSS shall provide a means to reduce differential pressure across any hatch to less than 0.04 psi (2 mmHg) [0.27 kPa] in less than 10 minutes.** |  |

Differential pressure must be minimized to precludes damage to hatch mechanisms and/or injury to the crewmember during hatch actuation.

This requirement assumes both volumes are pressurized to their nominal crewed operating pressures.

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| --- | --- | --- |
| [AX-674](http://192.168.10.14:8080/browse/AX-674) | **The ECLSS shall provide fluid fittings compatible with the fitting listed in Table 3.2.1.2.5.4–1 of SSP 50808.** |  |

|  |  |  |
| --- | --- | --- |
| [AX-675](http://192.168.10.14:8080/browse/AX-675) | **The ECLSS fluid fittings shall be designed to preclude mating to the wrong fitting.** |  |

##### Fire Protection

|  |  |  |
| --- | --- | --- |
| [AX-107](http://192.168.10.14:8080/browse/AX-107) | **The ECLSS shall continuously monitor toxic atmospheric components that would result from pre-combustion and combustion events before, during, and after the event and alert the crew in sufficient time for them to take appropriate action.** |  |

Derived from NASA-STD-3001 V2 6024. Monitoring and alerting are required to identify when toxic components are detected and to alert the crew so they can take appropriate actions to maintain health and safety. Because of the extreme danger of combustion in a spacecraft, alerting is to occur quickly enough, e.g., within 5 seconds, to allow the crew to address the hazard, e.g., locating and using a fire extinguisher.

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| --- | --- | --- |
| [AX-262](http://192.168.10.14:8080/browse/AX-262) | **The Axiom fire protection system health and status data shall be provided to the crew and other mission systems.** |  |

Design requirements are to ensure that the crew has the capability of determining the health and status of the fire protection system. The crew is to be aware as soon as possible when the fire protection system has failed or is unreliable.

|  |  |  |
| --- | --- | --- |
| [AX-261](http://192.168.10.14:8080/browse/AX-261) | **The ECLSS shall provide a fire protection system comprised of detecting, warning, and extinguishing devices for all Axiom volumes without creating a hazardous environment.** |  |

Fire protection is to be based on the anticipated nature of the fire and the likely location of the crew in the event of a fire. Automated systems are to be used where crews are not capable of extinguishing anticipated fires (large fires or fires where crew could be absent). Other systems may be effectively protected with portable extinguishers. Hand-operated extinguishers are to be clearly labeled and easily accessed by the crew. All extinguishing systems are not to create any additional hazardous conditions for the crew.

|  |  |  |
| --- | --- | --- |
| [AX-264](http://192.168.10.14:8080/browse/AX-264) | **The Axiom fire protection system shall be capable of being manually activated and deactivated.** |  |

Automated systems may fail and not respond correctly to a fire or may continue extinguishing after a fire is under control. Design requirements are to ensure that the crew is provided with a fire protection system that allows for manual activation and deactivation.

|  |  |  |
| --- | --- | --- |
| [AX-265](http://192.168.10.14:8080/browse/AX-265) | **The Axiom fire protection system shall include manually operated portable fire extinguishers.** |  |

Small fires might be detected and controlled early (before detection by an automated system). Design requirements are to ensure that the crew is provided with a portable fire-fighting capability, even if a fixed firefighting system is provided.

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| --- | --- | --- |
| [AX-266](http://192.168.10.14:8080/browse/AX-266) | **Axiom emergency equipment shall be accessible and useable to complete emergency response in the time required.** |  |

Design requirements are to consider all emergency scenarios requiring access to emergency equipment. The location and proximity of emergency equipment, with respect to the crew, impacts the accessibility of emergency equipment. Requirements need to be defined in terms of time constraints to perform emergency actions. Furthermore, each emergency may have a unique time requirement and, therefore, a different constraint on access.

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| --- | --- | --- |
| [AX-268](http://192.168.10.14:8080/browse/AX-268) | **The Axiom module shall provide stowage and access to 4 ISS PBAs.** |  |

The ISS PBA is assumed to be the primary emergency portable breathing apparatus inside of the Axiom module.

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| --- | --- | --- |
| [AX-267](http://192.168.10.14:8080/browse/AX-267) | **The Axiom module shall provide close-out panels to isolate and separate equipment from the habitable volume.** |  |

This applies more to general design guidance than to ECLSS, however, it has implications for the fire protection aspect of ECLSS.

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| --- | --- | --- |
| [AX-263](http://192.168.10.14:8080/browse/AX-263) | **The Axiom crew shall be alerted to failures of the fire protection system.** |  |

Design requirements are to ensure that the crew is notified in the event the fire protection system fails. The crew is to be aware as soon as possible when the fire protection system cannot be relied upon.

##### RE-USE or Discard

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| --- | --- | --- |
| [AX-122](http://192.168.10.14:8080/browse/AX-122) | **RE-USE** |  |

|  |  |  |
| --- | --- | --- |
| [AX-234](http://192.168.10.14:8080/browse/AX-234) | **RE-USE** |  |

|  |  |  |
| --- | --- | --- |
| [AX-235](http://192.168.10.14:8080/browse/AX-235) | **RE-USE** |  |

|  |  |  |
| --- | --- | --- |
| [AX-236](http://192.168.10.14:8080/browse/AX-236) | **RE-USE** |  |

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| --- | --- | --- |
| [AX-250](http://192.168.10.14:8080/browse/AX-250) | **RE-USE** |  |

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| --- | --- | --- |
| [AX-253](http://192.168.10.14:8080/browse/AX-253) | **RE-USE** |  |

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| --- | --- | --- |
| [AX-255](http://192.168.10.14:8080/browse/AX-255) | **RE-USE** |  |

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| --- | --- | --- |
| [AX-254](http://192.168.10.14:8080/browse/AX-254) | **RE-USE** |  |

|  |  |  |
| --- | --- | --- |
| [AX-257](http://192.168.10.14:8080/browse/AX-257) | **RE-USE** |  |

|  |  |  |
| --- | --- | --- |
| [AX-256](http://192.168.10.14:8080/browse/AX-256) | **RE-USE** |  |

|  |  |  |
| --- | --- | --- |
| [AX-125](http://192.168.10.14:8080/browse/AX-125) | **RE-USE** |  |

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| --- | --- | --- |
| [AX-693](http://192.168.10.14:8080/browse/AX-693) | **RE-USE** |  |

|  |  |  |
| --- | --- | --- |
| [AX-691](http://192.168.10.14:8080/browse/AX-691) | **RE-USE** |  |

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| --- | --- | --- |
| [AX-695](http://192.168.10.14:8080/browse/AX-695) | **RE-USE** |  |

##### Interface to Node 2

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| --- | --- | --- |
| [AX-687](http://192.168.10.14:8080/browse/AX-687) | **The ECLSS shall receive intermodule air from the ISS with characteristics as defined in Table 3.2.2.3.3.1.1-1 of SSP 50808.** |  |

Delivery temperature to Axiom: 65-80 deg F  
Delivery dew point to Axiom: 40-60 deg F  
Flow rate delivered to Axiom: 115-165 SCFM  
Axiom module IMV Circuit dP Allowance: 0.41 inH2O @ 150 scfm

|  |  |  |
| --- | --- | --- |
| [AX-686](http://192.168.10.14:8080/browse/AX-686) | **The Axiom module shall receive intermodule atmosphere from the ISS via a duct per figure 3.7.6-X** |  |

Update the IVM duct Figure from SSP 50808.

|  |  |  |
| --- | --- | --- |
| [AX-689](http://192.168.10.14:8080/browse/AX-689) | **The Axiom module shall return intermodule air to the ISS via the hatch during open ISS hatch operations.** |  |

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| --- | --- | --- |
| [AX-690](http://192.168.10.14:8080/browse/AX-690) | **The ECLSS shall retun the intermodule air to ISS at a heat load not to exceed 550W without crew present.** |  |

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| --- | --- | --- |
| [AX-692](http://192.168.10.14:8080/browse/AX-692) | **The ECLSS shall provide a separate internal line to enable the ISS to perform atmosphere sampling/monitoring of the Axiom module.** |  |

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| --- | --- | --- |
| [AX-698](http://192.168.10.14:8080/browse/AX-698) | **The ECLSS shall be capable of de-pressurizing the vestibule volumes to less than 0.04 psi (2 mmHg) [0.27 kPa] in no more than 30 minutes prior to de-mating.** |  |

These volumes must be depressurized prior to releasing the structural connection between modules.

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| --- | --- | --- |
| [AX-123](http://192.168.10.14:8080/browse/AX-123) | **The ECLSS shall inhibit active pressure control while the ISS is controlling the cabin atmosphere.** |  |

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| --- | --- | --- |
| [AX-109](http://192.168.10.14:8080/browse/AX-109) | **The Axiom ITCS shall reject up to 4kW (TBR) of heat via the ISS Node 2 LTL.** |  |

The initial mission of the Axiom module is to enhance ISS utilization. As part of this mission, it will need to rely on ISS for power and heat rejection. 4kW is estimated to be the maximum available from the Node 2 LTL. This heat rejection will be primarily be needed for the condensing heat exchanger in the Axiom module, removing sensible and latent heat from the atmosphere. Some LTL water may be needed for refrigerator heat rejection.

|  |  |  |
| --- | --- | --- |
| [AX-110](http://192.168.10.14:8080/browse/AX-110) | **The Axiom ITCS shall reject up to 10kW (TBR) of heat via the ISS Node 2 MTL.** |  |

The initial mission of the Axiom module is to enhance ISS utilization. It will need to rely on ISS for power and heat rejection. 10kW is estimated to be the maximum available from the Node 2 MTL. This heat rejection will be needed to cool payloads and ECLSS equipment via cold plates.

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| --- | --- | --- |
| [AX-703](http://192.168.10.14:8080/browse/AX-703) | **The ECLSS system shall be compatible with ISS ECLSS systems.** |  |

Where practicable, the Axiom module shall limit the introduction of chemicals (liquids and/or gases) in the ISS habitable volume to quantities and concentration thresholds as defined in Appendix G, of SSP 50808 (Chemical Compounds of Concern to ISS ECLSS Hardware and Processes). The introduction of these chemicals by materials offgassing and from cargo delivered by the Axiom module is excluded from this requirement.

|  |  |  |
| --- | --- | --- |
| [AX-783](http://192.168.10.14:8080/browse/AX-783) | **The passive interface temperatures between the Axiom and Node 2 shall meet the requirements of Table 3.7.5-W** |  |

These temperatures are derived from SSP 50808.

Table 3.7.5-W:  
Allowable CBM Temperature Range during Berthing:   
No condensation allowed on interior vestibule surfaces  
Allowable CBM Temperature Range during Berthing: +60 to +113 deg F

A. For Axiom/ISS attachment operations the temperature of the Axiom module PCBM, at the ACBM structural interface shall be within the prescribed temperatures defined in Figure 3.2.2.6.2.2.1-1, Allowable CBM Temperature Range, during berthing. [see 50808 figure]  
B. The Axiom module shall ensure that the PCBM and vestibule surfaces are above +40 deg F (+4.4 deg C) prior to mated volume pressurization. If the surfaces are less than +60 deg F (+15.6 deg C) during vestibule pressurization, the Axiom module shall ensure that the PCBM and vestibule surfaces reach +60 deg F (+15.6 deg C) within 72 hours to preclude the presence of any condensation (see paragraph 3.3.10.4.1.4).  
C. The temperature of the Axiom module PCBM, at the ACBM structural interface shall be maintained within a minimum of +60 deg F (+15.6 deg C) and a maximum of +113 deg F (+45 deg C) for the remainder of the mated phase.

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| [AX-702](http://192.168.10.14:8080/browse/AX-702) | **All equipment and surfaces within the Axiom vestibule volumes (both Node 2 and visiting vehicles) shall be compatible with the presence of condensation for up to 72 hours for each berthing event and up to 7 days cumulative.** |  |

##### Interface to Visiting Vehicles

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| --- | --- | --- |
| [AX-682](http://192.168.10.14:8080/browse/AX-682) | **The ECLSS shall receive IVM air from a berthed element or docked visiting vehicle at a heat load not to exceed 550 W without crew present in the visiting vehicle.** |  |

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| --- | --- | --- |
| [AX-677](http://192.168.10.14:8080/browse/AX-677) | **The ECLSS shall provide IVM to berthed or docked visiting vehicles with the properties listed in Table 3.7.6-Y.** |  |

Delivery temperature to Axiom: 65-80 deg F  
Delivery dew point to Axiom: 40-60 deg F  
Flow rate delivered to Axiom: 115-165 SCFM  
Axiom module IMV Circuit dP Allowance: 0.41 inH2O @ 150 scfm

|  |  |  |
| --- | --- | --- |
| [AX-680](http://192.168.10.14:8080/browse/AX-680) | **The ECLSS shall provide internal means to turn off and isolate IVM atmosphere supply on the Axiom side of the interface.** |  |

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| [AX-679](http://192.168.10.14:8080/browse/AX-679) | **The ECLSS shall supply IVM atmosphere to visiting vehicles with a maximum oxygen concentration of 24.1% by volume under nominal operating conditions.** |  |

|  |  |  |
| --- | --- | --- |
| [AX-681](http://192.168.10.14:8080/browse/AX-681) | **The ECLSS shall receive return IVM air from the berthed or docked visiting vehicle via the hatch (during open hatch operation).** |  |

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| --- | --- | --- |
| [AX-678](http://192.168.10.14:8080/browse/AX-678) | **The ECLSS shall deliver IVM atmosphere to the visiting vehicle via a duct per figure 3.7.6-X** |  |

#### Guidance Navigation Control and Propulsion

##### Trajectory

###### ISS Approach and Departure

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| [AX-706](http://192.168.10.14:8080/browse/AX-706) | **The Axiom vehicle shall approach and depart from the ISS following a pre-coordinated trajectory plan during Integrated Operations** |  |

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| --- | --- | --- |
| [AX-711](http://192.168.10.14:8080/browse/AX-711) | **The Axiom vehicle shall only penetrate the KOS in the approach corridor as defined in the vehicle specific hardware ICD** |  |

The Axiom vehicle shall only penetrate the KOS in the approach corridor as defined in  
the vehicle specific hardware ICD listed in Appendix D.

|  |  |  |
| --- | --- | --- |
| [AX-712](http://192.168.10.14:8080/browse/AX-712) | **The Axiom vehicle shall stay within the approach corridor defined in the vehicle specific hardware ICD** |  |

The Axiom vehicle shall stay within the approach corridor defined in the vehicle specific  
hardware ICD listed in Appendix D during a nominal approach.

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| --- | --- | --- |
| [AX-709](http://192.168.10.14:8080/browse/AX-709) | **The Axiom module nominal approach and re-rendezvous shall include at least one point outside of the AE during Integrated Operations at which the vehicle will not continue the nominal approach unless it has received authorization from mission control.** |  |

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| --- | --- | --- |
| [AX-739](http://192.168.10.14:8080/browse/AX-739) | **The Axiom module nominal approach shall include at least one point inside of the AE and outside of the KOS at which the vehicle will not continue the nominal approach unless it has received authorization from mission control.** |  |

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| --- | --- | --- |
| [AX-854](http://192.168.10.14:8080/browse/AX-854) | **The Axiom vehicle shall be capable of performing nominal rendezvous and proximity operations without any ISS translational maneuvers.** |  |

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| [AX-741](http://192.168.10.14:8080/browse/AX-741) | **During an approach inside the KOS, the Axiom vehicle shall be able to perform a retreat to a hold-point on command from the vehicle control center or from the ISS crew.** |  |

During an approach inside the KOS, the Axiom vehicle shall be able to perform a retreat to a hold-point on command from the vehicle control center or from the ISS crew.

###### Breakout Maneuvers

|  |  |  |
| --- | --- | --- |
| [AX-740](http://192.168.10.14:8080/browse/AX-740) | **The Axiom vehicle, when under automated trajectory control, shall perform an automatic breakout if it is inside the KOS and outside the approach corridor.** |  |

The Axiom vehicle, when under automated trajectory control, shall perform an automatic  
breakout if it is inside the KOS and outside the approach corridor defined in the Axiom ICD Applicable to approach, hold, or retreat (unless in this state due to free drift for SSRMS capture).

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| --- | --- | --- |
| [AX-846](http://192.168.10.14:8080/browse/AX-846) | **A breakout maneuver initiated prior to AI shall place the vehicle on a trajectory that will not intercept the ISS AE in fewer than 24 hours.** |  |

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| --- | --- | --- |
| [AX-847](http://192.168.10.14:8080/browse/AX-847) | **The Axiom vehicle shall be able to perform a breakout maneuver independent of the ISS or ground through commands issued automatically by its onboard systems.** |  |

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| --- | --- | --- |
| [AX-848](http://192.168.10.14:8080/browse/AX-848) | **The Axiom vehicle shall be capable of performing a breakout maneuver during all Free Flight Integrated Operations except when blocked by the SSRMS.** |  |

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| --- | --- | --- |
| [AX-849](http://192.168.10.14:8080/browse/AX-849) | **The Axiom vehicle, when automated, shall automatically initiate a breakout maneuver if an irrecoverable failure leaves the vehicle in a non-fail safe state to a catastrophic hazard.** |  |

(i.e. not able to reconfigure/recover to a failsafe state)

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| --- | --- | --- |
| [AX-850](http://192.168.10.14:8080/browse/AX-850) | **An Axiom vehicle breakout maneuver that is initiated prior to vehicle control center approval to enter the KOS shall prevent the vehicle from entering the KOS** |  |

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| --- | --- | --- |
| [AX-851](http://192.168.10.14:8080/browse/AX-851) | **The first step of an Axiom vehicle breakout maneuver that is initiated inside the KOS or has entered the KOS after a receipt of a breakout command shall be the establishment of a positive opening rate.** |  |

|  |  |  |
| --- | --- | --- |
| [AX-852](http://192.168.10.14:8080/browse/AX-852) | **The Axiom vehicle that has initiated a breakout maneuver while inside the KOS and has established a positive opening rate shall maintain the positive opening rate while the vehicle is inside the AE.** |  |

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| --- | --- | --- |
| [AX-853](http://192.168.10.14:8080/browse/AX-853) | **After exiting the ISS AE following a breakout maneuver the Axiom vehicle shall not intercept the ISS AE in fewer than 24 hours from the breakout maneuver initiation.** |  |

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| --- | --- | --- |
| [AX-857](http://192.168.10.14:8080/browse/AX-857) | **The Axiom vehicle shall execute a break-out maneuver if a break-out command is received by the Axiom vehicle from the ISS while the Axiom vehicle is in free drift for SSRMS capture.** |  |

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| --- | --- | --- |
| [AX-858](http://192.168.10.14:8080/browse/AX-858) | **The Axiom vehicle shall execute a break-out maneuver if a break-out command is received by the Axiom vehicle from the vehicle control center while the Axiom vehicle is in free drift for SSRMS capture.** |  |

###### Safe Trajectory

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| --- | --- | --- |
| [AX-859](http://192.168.10.14:8080/browse/AX-859) | **Prior to AI and during re-rendezvous, the Axiom vehicle shall target trajectories such that the targeted maneuvers and related free drift trajectories stay outside of the AE for a minimum of 24 hours.** |  |

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| --- | --- | --- |
| [AX-855](http://192.168.10.14:8080/browse/AX-855) | **The Axiom vehicle shall be capable of performing contingency operations without relying on any ISS translational maneuvers for at least 24 hours.** |  |

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| --- | --- | --- |
| [AX-860](http://192.168.10.14:8080/browse/AX-860) | **During approach, all maneuvers prior to receiving authorization to enter the KOS shall target trajectories such that the targeted maneuver and related free drift trajectory stays outside of the KOS for four orbits.** |  |

|  |  |  |
| --- | --- | --- |
| [AX-863](http://192.168.10.14:8080/browse/AX-863) | **The Axiom vehicle shall maintain nominal approach and planned contingency trajectories, including expected dispersions, to keep the Axiom vehicle outside the AE** |  |

(99.73 percent of the trajectories with 90 percent confidence level)  
Prior to Approach Initiation (AI) and during re-rendezvous,

|  |  |  |
| --- | --- | --- |
| [AX-864](http://192.168.10.14:8080/browse/AX-864) | **The Axiom vehicle shall maintain its trajectory such that the AI maneuvers not specifically designed to enter the KOS keep the Axiom vehicle trajectory, including expected dispersions , outside the KOS.** |  |

(99.73 percent of the trajectories with 90 percent confidence level)

###### Monitoring Trajectory

|  |  |  |
| --- | --- | --- |
| [AX-861](http://192.168.10.14:8080/browse/AX-861) | **The Axiom vehicle shall provide the capability for the Axiom vehicle control center to take the realtime vehicle navigated state and verify the vehicle is on a safe trajectory, as defined in sections SSP50808 3.3.3.2.4 and 3.3.3.2.5.** |  |

Note: Dispersions noted in sections 3.3.3.2.4 and 3.3.3.2.5 do not have to be accounted for in these capabilities.

|  |  |  |
| --- | --- | --- |
| [AX-862](http://192.168.10.14:8080/browse/AX-862) | **The Axiom vehicle shall provide the capability for the Axiom vehicle control center to take the realtime vehicle navigated state and verify the next planned maneuver will result in a safe trajectory, as defined in SSP50808 sec. 3.3.3.2.4 and 3.3.3.2.5.** |  |

Note: Dispersions noted in sections 3.3.3.2.4 and 3.3.3.2.5 do not have to be accounted for in these capabilities.

##### ISS Attitude Envelope

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| --- | --- | --- |
| [AX-665](http://192.168.10.14:8080/browse/AX-665) | **While attached to the ISS, the Axiom module shall meet all functional and performance requirements during nominal operations in the ISS flight attitude envelope specified in SSP50808 Table 3.3.9.10.1-1, Flight Attitudes During Nominal Operations** |  |

ISS flight attitude envelope specified in Table 3.3.9.10.1-1, Flight Attitudes During Nominal Operations. [see 50808 table]

|  |  |  |
| --- | --- | --- |
| [AX-666](http://192.168.10.14:8080/browse/AX-666) | **While attached to the ISS, the Axiom module shall show functional and performance capability during contingency operations in the ISS flight attitude envelope specified in SSP 50808 able 3.3.9.10.2-1, Flight Attitudes During Contingency Operations** |  |

While attached to the ISS, the Axiom module shall show functional and performance capability during contingency operations in the ISS flight attitude envelope specified in Table 3.3.9.10.2-1, Flight Attitudes During Contingency Operations. [see 50808 table]

|  |  |  |
| --- | --- | --- |
| [AX-667](http://192.168.10.14:8080/browse/AX-667) | **While attached to the ISS, the Axiom module shall meet all functional and performance requirements for a duration of 3 hours in the temporary ISS flight attitude envelope specified in SSP 50808 Table 3.3.9.10.3-1** |  |

ISS flight attitude envelope specified in Table 3.3.9.10.3-1, Temporary Flight Attitudes During Nominal Operations. [see 50808 table]

|  |  |  |
| --- | --- | --- |
| [AX-668](http://192.168.10.14:8080/browse/AX-668) | **The Axiom module shall be able to support a one orbit maneuver including up to a 20 minute static solar vector to and from the approved attitudes and attitude ranges in SSP 50808 Tables 3.3.9.10.1-1 3.3.9.10.2-1, and 3.3.9.10.3-1.** |  |

The Axiom module shall be able to support a one orbit maneuver including up to a 20 minute  
static solar vector to and from the approved attitudes and attitude ranges in Tables 3.3.9.10.1-1  
3.3.9.10.2-1, and 3.3.9.10.3-1. [see 50808 tables]

|  |  |  |
| --- | --- | --- |
| [AX-717](http://192.168.10.14:8080/browse/AX-717) | **The Axiom vehicle shall be able to perform Free Flight Integrated Operations with the ISS orbit, ISS attitude, ISS attitude characteristics, and the solar beta environment as defined below** |  |

The Axiom vehicle shall be able to perform Free Flight Integrated Operations with the ISS orbit, ISS attitude, ISS attitude characteristics, and the solar beta environment as defined below:  
The ISS orbit, ISS attitude, ISS attitude characteristics and the Solar beta will be within the following ranges during Free Flight Integrated Operations:  
A. The ISS will be within the following orbit conditions during Free Flight Integrated Operations:  
Inclination: 51.62 to 51.68 deg  
Altitude: 333 km (180 nmi) to 460 km (248 nmi)  
Orbital Average Eccentricity: <= 0.003  
B. The Solar beta during Free Flight Integrated Operations will be anywhere between -75 deg and +75 deg.  
C. For Axiom capture operations, the ISS commanded attitude will be within the ranges specified in Tables 3.3.3.2.18-1, ISS Attitude Control System Performance During Axiom +XVV Capture Operations.  
D. The ISS-provided inertial and Local Vertical/Local Horizontal (LVLH) attitude estimate is accurate at any point on the non-articulated structure to 3.0 degrees per axis (3 sigma). This estimate is statistically independent of the control methods used and the dynamic angular motion about the commanded attitude as specified in Tables 3.3.3.2.18-1, 3.3.3.2.18-1.1, 3.3.3.2.18-2, and 3.3.3.2.18-2.1.  
E. The commanded attitude for Control Moment Gyro (CMG) Momentum Manager control method in support of Axiom capture operations will be a pre-determined attitude within the range specified in Table 3.3.3.2.18-1, depending on the ISS configuration. The commanded attitude for CMG attitude hold control with thrusters inhibited will be a mutually agreed-upon attitude as determined for the time of capture and as constrained by Table 3.3.3.2.18-1. The mutually agreed upon attitude will be contained within the attitude ranges specified in the Axiom hardware ICD in Appendix D.  
F. The ISS attitude and attitude rate characteristics during Free Flight Integrated Operations will be within those provided in Tables 3.3.3.2.18-1, 3.3.3.2.18-1.1, 3.3.3.2.18-2, and 3.3.3.2.18-2.1. The ISS attitude and attitude rate performance values in the Tables specify the ISS GN&C performance at any point on the non-articulated portion of the onorbit Space Station. [see 50808 tables]

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| [AX-865](http://192.168.10.14:8080/browse/AX-865) | **All Axiom vehicle equipment shall be capable of operating with the ISS solar arrays in any orientation or operational mode chosen by the ISS.** |  |

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| [AX-866](http://192.168.10.14:8080/browse/AX-866) | **All Axiom vehicle equipment shall be capable of operating with the ISS Thermal Rotary Radiator Joint (TRRJ) in any orientation or operational mode chosen by the ISS.** |  |

Note: not applicable to ISS/Axiom thruster interactions, which are defined in paragraphs 3.2.2.6.4.5.1 & 3.2.2.6.4.5.2

##### Propulsion

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| [AX-845](http://192.168.10.14:8080/browse/AX-845) | **The Axiom module propulsion system shall provide 6-degrees of freedom coordinated attitude and translation control within the AE.** |  |

Need to provide translation capability during free flight and rendezvous

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| [AX-844](http://192.168.10.14:8080/browse/AX-844) | **The Axiom module propulsion system shall provide 6-degree of freedom attitude control.** |  |

This is required to provide pointing and stationkeeping during free flight

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| [AX-704](http://192.168.10.14:8080/browse/AX-704) | **The Axiom module propulsion system shall have enough translational impulse, post LV seperation, to redezvous with the ISS** |  |

This include phasing maneuvers, rendezvous, prox ops, and re rendezvous attempts.

Historically ISS rendezvous delta-v ranges from about 52 mps to 112 mps with a majority being around 70 to 95 and an average of 83 mps. There is also typically about 2 to 3 mps for planar burns. These delta-v's account for the majority of the rendezvous but do not include ascent up the Rbar which is comprised of "continuous" small burns.

From 50808: A. The ISS will be within the following orbit conditions during Free Flight Integrated Operations:  
Inclination: 51.62 to 51.68 deg  
Altitude: 333 km (180 nmi) to 460 km (248 nmi)  
Orbital Average Eccentricity: <= 0.003

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| [AX-856](http://192.168.10.14:8080/browse/AX-856) | **The Axiom module propulsion system shall have enough attitude control propellant to meet the attitude timeline for nominal and off nominal ISS rendezvous** |  |

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| [AX-731](http://192.168.10.14:8080/browse/AX-731) | **The Axiom module propulsion thrusters shall have the control authority to achieve the attitude timeline** |  |

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| [AX-708](http://192.168.10.14:8080/browse/AX-708) | **The Axiom module propulsion attitude control thruster minimum impulse bit shall maintain the attitude deadband frequency for coasting, maneuvering, berthing and docking operations as defined in Table TBD** |  |

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| [AX-710](http://192.168.10.14:8080/browse/AX-710) | **The Axiom module propulsion system shall provide control authority to desaturate ISS CMGs** |  |

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| [AX-707](http://192.168.10.14:8080/browse/AX-707) | **The Axiom module propulsion system shall be able to impart 0.5 m/s of translational impulse to the integrated ISS stack.** |  |

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| [AX-718](http://192.168.10.14:8080/browse/AX-718) | **spare** |  |

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| [AX-715](http://192.168.10.14:8080/browse/AX-715) | **Spare** |  |

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| [AX-737](http://192.168.10.14:8080/browse/AX-737) | **spare** |  |

##### Navigation

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| [AX-653](http://192.168.10.14:8080/browse/AX-653) | **The axiom module shall provide GN&C aids in compliance with SSP 50808 to enable COTS vehicles to dock to Axiom.** |  |

The axiom module shall provide GN&C aids in compliance with SSP 50808 to enable COTS vehicles to dock to Axiom.

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| [AX-713](http://192.168.10.14:8080/browse/AX-713) | **The Axiom vehicle shall provide a secondary independent and dissimilar means of determining its state (range and range rate) relative to the ISS for approach within the AE.** |  |

The Axiom vehicle shall provide a secondary independent and dissimilar means of  
determining its state (range and range rate) relative to the ISS for approach within the  
AE.

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| [AX-735](http://192.168.10.14:8080/browse/AX-735) | **The time in the time-tagged command shall agree with the Axiom time within one minute.** |  |

The time in the time-tagged command shall agree with the Axiom time within one minute.

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| [AX-705](http://192.168.10.14:8080/browse/AX-705) | **The Axiom vehicle shall limit lighting exclusion periods due to relative navigation sensors to less than 5 percent of the ISS orbital period during the final 1 km of a nominal approach.** |  |

The Axiom vehicle shall limit lighting exclusion periods due to relative navigation  
sensors to less than 5 percent of the ISS orbital period during the final 1 km of a nominal  
approach.

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| [AX-736](http://192.168.10.14:8080/browse/AX-736) | **When the Axiom vehicle modes to free-drift, the Axiom vehicle shall continue to measure angular rotation rate and maintain attitude state knowledge.** |  |

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| [AX-874](http://192.168.10.14:8080/browse/AX-874) | **The Axiom module shall be able to update position, velocity, time, inertial attitude and attitude rate data** |  |

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| [AX-875](http://192.168.10.14:8080/browse/AX-875) | **The Axiom module shall be able to initialize navigation data without assistance, aiding or prior knowledge of the state** |  |

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| [AX-876](http://192.168.10.14:8080/browse/AX-876) | **The Axiom module shall use relative navigation sensors to aid rendezvous** |  |

##### ISS Capture

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| [AX-714](http://192.168.10.14:8080/browse/AX-714) | **The Axiom vehicle shall have the capability of maintaining dynamic conditions to support SSRMS capture for a minimum of five minutes.** |  |

The constraints to develop dynamic conditions to support SSRMS capture are the vehicle specific hardware ICD

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| [AX-742](http://192.168.10.14:8080/browse/AX-742) | **In the case of a failed robotic capture involving a commanded separation of the GF from the Axiom vehicle body, the Axiom vehicle shall be capable of maneuvering away from the ISS.** |  |

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| [AX-738](http://192.168.10.14:8080/browse/AX-738) | **The Axiom vehicle shall send an indication to the ISS that the vehicle is ready to receive the free drift command to begin capture.** |  |

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| [AX-730](http://192.168.10.14:8080/browse/AX-730) | **The Axiom vehicle shall inhibit the automated initiation of a break-out maneuver after being placed in free drift for SSRMS capture.** |  |

AUTOMATIC ABORT INHIBIT IN CLOSE PROXIMITY FREE-DRIFT

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| [AX-716](http://192.168.10.14:8080/browse/AX-716) | **The start of ISS crew mission involvement through completion of mating (connection of power lines) shall not exceed 10 hours for a nominal mission timeline.** |  |

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| [AX-872](http://192.168.10.14:8080/browse/AX-872) | **the Axiom vehicle shall maintain dynamic conditions at the capture box such that, following execution of a free drift command, the Axiom vehicle relative kinetic energy shall be within the limits specified in SSP50808 Table 3.3.3.2.12.1-1** |  |

To support SSRMS loads constraints, (Axiom vehicle Center of Gravity (CG) to ISS CG)

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| [AX-873](http://192.168.10.14:8080/browse/AX-873) | **After transitioning to free drift, the Axiom vehicle Grapple Fixture shall remain within the velocity and angular rate as defined in SSP50808 Table 3.3.3.2.12.1-2** |  |

while it is within the SSRMS reach limits specified in the vehicle specific ICD listed in Appendix D. This is to support SSRMS dynamic and crew performance capabilities for SSRMS capture and minimize the incidents of exceeding loads on the SSRMS. [see 50808 table]

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| [AX-719](http://192.168.10.14:8080/browse/AX-719) | **The berthing Axiom vehicle shall remain at least 6 feet (1829 mm) away from any ISS elements, other than the SSRMS, during free flight operations.** |  |

#### Crew Systems

##### Radiation

This section provides limits on radiation exposure.

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| [AX-332](http://192.168.10.14:8080/browse/AX-332) | **The Axiom program shall set system design requirements to prevent potential crewmembers from exceeding Permissible Exposure Limits (PEL) defined in Axiom (TBD)** |  |

The radiation design requirement is imposed to limit the risk of exposure-induced death (REID) and to prevent clinically significant health effects, including performance degradation, sickness, or death in flight. The mission scenario and prior crew exposure are to be considered for mission planning and allocation of system design limits across architectural elements, including EVA. The program is to consider the cumulative REID over several missions for individual astronauts in setting the design requirements. This allows experienced crewmembers to potentially support multiple missions; however, the minimum functionality of protection to the most restrictive career limit does not a priori allow unrestricted crew selection related to a crewmember's having prior radiation exposures. That is, previous exposures are to be taken into account during crew selection to ensure that career PELs are not violated. For reference, examples of various mission and crew selection scenarios are discussed in the Human Integration Design Handbook (NASA/SP-2010-3407).

###### Children

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| [AX-333](http://192.168.10.14:8080/browse/AX-333) | **The Axiom program will design systems using the ALARA principle to limit crew radiation exposure.** |  |

The ALARA principle is a legal requirement intended to ensure astronaut safety. An important function of ALARA is to ensure that astronauts do not approach radiation limits and that such limits are not considered tolerance values. ALARA is an iterative process of integrating radiation protection into the design process, ensuring optimization of the design to afford the most protection possible, within other constraints of the vehicle systems. The protection from radiation exposure is ALARA when the expenditure of further resources would be unwarranted by the reduction in exposure that would be achieved.

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| [AX-334](http://192.168.10.14:8080/browse/AX-334) | **The Axiom program shall use the ISS radiation environments for verifying the radiation design requirements.** |  |

The relevant space radiation environment is to be used in establishing system design requirements, vehicle design and development of all program architectural elements, and verification of requirements. System design requirements derived from the uncertainty in the calculation of cancer career risk limits are to specify the relevant radiation environment used in determining the requirement, since the 95-percent confidence interval depends upon the incident radiation field (solar particle event (SPE), galactic cosmic ray (GCR)) and amount of shielding provided. Relevant space radiation parameters include solar maximum and minimum conditions, energy spectra, or precise model inputs, assumptions, and model options.

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| [AX-335](http://192.168.10.14:8080/browse/AX-335) | **The Axiom system shall alert all crewmembers when radiation levels exceed acceptable levels.** |  |

The data from charged particle monitoring are the fundamental environmental information required for radiation transport calculations and crew exposure evaluation. Given an accurately measured energy spectra incident on the vehicle during an SPE, detailed crew exposure can be evaluated. This limits the uncertainly of a single absorbed dose measurement in determining crew exposure from an SPE. The crew, at all times, is to be alerted to excessive fluence of particles. Should communications from the ground be interrupted or lost, the crew requires onboard warnings when the radiation environment crosses dangerous thresholds so that appropriate countermeasure actions can be taken. Varying user-defined thresholds may be set according to the radiation environmental conditions that may be encountered, depending on mission phase. The intent is for the vehicle data management system to provide the alerting functionality.

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| [AX-336](http://192.168.10.14:8080/browse/AX-336) | **The Axiom program provide methods for monitoring personal dose and dose equivalent exposure, ambient monitoring of particle fluence as a function of direction, energy, and elemental charge and monitoring of ambient dose and ambient dose equivalent.** |  |

These measurements are the primary means for controlling crew exposure during missions to ensure that short-term and career space PELs are not exceeded. Tissue-equivalent micro-dosimeters have been used extensively for crew exposure monitoring in space for this purpose. There is a large set of data and calculations in the published literature that can be directly applied to crew exposure and risk determination, using tissue-equivalent micro-dosimeters. Passive area monitors provide a time-integrated measure of the spatial distribution of exposure rates. The exposure rates change with stowage reconfigurations. Knowledge of the spatial distribution of exposure rate is necessary to identify areas that have a relatively high exposure rate, i.e., avoidance areas, and to reconstruct a crew member's exposure in the event of lost or unusable personal dosimeter data. The data are used to track the crew exposure throughout the mission, as well as to provide positive indication of proper health and status of the absorbed dose instrument. Passive dosimeters collect data even during situations when power is lost to other instruments. Radiation data are vital for quantifying in-flight risks to the crew and for allowing mission operations to advise the crew on appropriate action in response to an SPE. For periods of time when the crew is not in communication with mission operations, the crew is to be able to ascertain the radiation conditions within the vehicle and take appropriate actions as required. The changes in the radiation environment that could cause additional crew exposure can occur in time periods as small as 1 to 5 minutes.

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| [AX-337](http://192.168.10.14:8080/browse/AX-337) | **The Axiom module shall protect the crew from exposure to harmful levels of RF radiation defined in Axiom (TBD).** |  |

Design guidance on appropriate limits can be found in table 8 and figure 9 of NASA-STD-3001 Vol 2. These limits were modified from IEEE C95.1, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio-Frequency Electromagnetic Fields, 3 kHz to 300 GHz - Description, to remove an excessive factor of safety in the power density limit for general populations, including children. Design requirements are to cover exposure RF radiation for the duration of a mission. Limits are intended to establish exposure conditions for RF and microwave radiation to which it is believed that nearly all workers can be repeatedly exposed without injury.

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| [AX-338](http://192.168.10.14:8080/browse/AX-338) | **The Axiom module shall protect the crew from exposure to lasers consistent with ANSI Z136.1** |  |

Design requirements are to cover exposure to both continuous and repetitively pulsed lasers to protect against skin and ocular injury. Design guidance can be found in the Laser Institute of America's publication ANSI Z136.1 American National Standard for Safe Use of Lasers, and ACGIH (American Conference of Governmental Industrial Hygienists), Threshold Limit Values (TLVs®) and Biological Exposure Indices (BEIs®) Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices. This requirement applies to lasers used both internal and external to the spacecraft.

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| [AX-339](http://192.168.10.14:8080/browse/AX-339) | **The Axiom module shall limit crewmembers exposure to the electromagnetic spectrum from the ultraviolet (180 nm) to the far infrared (3,000 nm) per Axiom (TBD).** |  |

Design guidance for limits is to adopt he methods given by American Conference of Governmental Industrial Hygienists (ACGIH) with limits relaxed by a factor of 5 except for ultraviolet limits. The factor of 5 removes the excessive safety margin imposed by the ACGIH on general populations. This methodology allows for the quantification of the relationship between source strength and acceptable exposure times for each of four potential injury pathways: retinal thermal injury caused by exposure to visible light, retinal photochemical injury caused by chronic exposure to blue-light, thermal injury to the ocular lens and cornea caused by infrared exposure, and exposure of the unprotected skin or eye to ultraviolet radiation. These limits do not apply to laser exposure. (See section 6.8.2.2, Laser Exposure Limits, in this NASA-STD-3001 Vol 2) The numerical values used by the ACGIH are amended by the insertion of a factor of 0.2 in the source term of each calculation, with the exception of the calculation for ultraviolet exposure, which is not amended. This removes the excessive margin of safety imposed by the ACGIH on general populations.  
The ACGIH document referenced is Threshold Limit Values (TLVs®) and Biological Exposure Indices (BEIs®) Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents &Biological Exposure Indices

##### Habitability

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| [AX-757](http://192.168.10.14:8080/browse/AX-757) | **Delete: CREW ACCESS** |  |

Axiom module hardware requiring ISS crew hand or tool access for removal, installation, or setup shall be designed in accordance with SSP 50005, paragraphs 11.2.3.6 and 11.10.3.6.  
Note: On-orbit tools available to the ISS crew are listed in SSP 41000, (Table XLIX Standard IVA Tool List and Table L IVA Diagnostic Equipment List) and JSC 28918, Extravehicular Activity (EVA) Design Requirements and Considerations, Table 1-1.

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| [AX-756](http://192.168.10.14:8080/browse/AX-756) | **Delete: SUPPORT INTERNAL CREW RESTRAINT AND MOBILITY** |  |

The Axiom module shall incorporate internal restraints and mobility aids (e.g. foot restraints, handholds, and handrails) to facilitate the crew�۪s mobility and stability in accordance with SSP 50005 sections 11.7 and 11.8.

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| [AX-755](http://192.168.10.14:8080/browse/AX-755) | **Delete: LOCATION CODING** |  |

The Axiom module shall use a location coding system to provide a unique identifier  
for defined locations within the vehicle in accordance with SSP 30575, Space Station Interior  
and Exterior Operational Location Coding System, paragraph 3.1.1.

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| [AX-754](http://192.168.10.14:8080/browse/AX-754) | **Delete: LABELING AND CODING** |  |

If required for operation, the Axiom module shall install NASA-supplied labels in locations specified by NASA in accordance with SSP 50005, section 9.5.3.1.

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| [AX-753](http://192.168.10.14:8080/browse/AX-753) | **Delete: STRENGTH REQUIREMENTS** |  |

The Axiom module internal and external controls, equipment, and hardware which will have a crew interface (including those required for crew translation and egress) shall be designed to accommodate the strength limitations of the 5th percentile female in accordance with SSP 50005, paragraph 4.9.3.A.

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| [AX-752](http://192.168.10.14:8080/browse/AX-752) | **Delete: IMV SOUND PRESSURE LEVEL LIMITS** |  |

The Axiom inter-module ventilation audible noise SPL delivered to ISS shall not exceed the values given in Table 3.3.2.2.5.8-1, Octave Band Sound Pressure Limits, measured 60 cm from each duct exit or inlet, during attached operations. [see 50808 table]

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| [AX-751](http://192.168.10.14:8080/browse/AX-751) | **Delete: LOUDSPEAKER ALARM AUDIBILITY** |  |

During attached operations, the Axiom module shall provide non-speech auditory annunciations that will clearly be audible. The masked threshold will be distinctly exceeded. [1] If relevant, the probability of hearing loss in the recipient population may be assessed and taken into account. If hearing protectors are worn, their levels of attenuation will be known and introduced into the assessment.  
To ensure alarm audibility, the SPL at the operating position of the intended receiver of the alarm signal shall meet at least one of the following criteria:  
1. Using measurements of A-weighted sound levels [ISO 7731:2003(E), method a) in 5.2.2.1], the difference between the two A-weighted sound pressure levels of the signal and the ambient noise shall be greater than 15 dBA (LS,A - LN,A > 15 dBA). This criteria shall be satisfied if the alarm signal is intended to arouse sleeping occupants,  
2. Using measurements of octave-band sound-pressure levels [according to ISO 7731:2003(E), method b) in 5.2.3.1], the sound-pressure level of the signal in one or more octave-bands shall exceed the effective masked threshold by at least 10 dB in the frequency range from 250 Hz - 4000 Hz (LSi,oct - LTi,oct > 10 dB). The method given in ISO 7731:2003(E) Annex B to calculate the effective masked threshold shall be used to verify this requirement,  
3. Using measurements of 1/3 octave-band sound-pressure levels [according to ISO 7731:2003(E), method c) in 5.2.3.2], the sound-pressure level of the signal in one or more 1/3 octave-bands shall exceed the effective masked threshold by 13 dB in the frequency range from 250 Hz - 4000 Hz (LSi,1/3oct - LTi,1/3oct > 13 dB).  
Note [1]: effective masked threshold - level of auditory danger signal just audible over the ambient noise, taking account of the acoustic parameters of both the ambient noise in the signal reception area and the listening deficiencies (hearing protection, hearing loss and other masking effects). The method for calculating the masked threshold is given in ISO 7731:2003(E) Annex B.

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| [AX-750](http://192.168.10.14:8080/browse/AX-750) | **Delete: REVERBERATION TIME** |  |

The Axiom module shall provide a reverberation time in the crew habitable volume of less than 0.6 seconds within the 500 Hz, 1 kHz, and 2 kHz octave bands during attached operations.

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| [AX-749](http://192.168.10.14:8080/browse/AX-749) | **Delete: HAZARDOUS NOISE LIMIT** |  |

During attached operations, -the Axiom module shall limit the maximum A-weighted overall SPL at the crewmember�۪s head location caused by any noise source, including voice communications to less than 85 dBA, and shall limit the maximum alarm signal A-weighted overall SPL to 95 dBA or less at the operating position of the intended receiver, during attached operations.

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| [AX-748](http://192.168.10.14:8080/browse/AX-748) | **Delete: IMPULSE NOISE** |  |

The Axiom Module shall limit impulse noise, measured at the crewmember�۪s head location to less  
than 140 dB peak SPL, during attached operations.

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| [AX-747](http://192.168.10.14:8080/browse/AX-747) | **Delete: SOUND PRESSURE LEVEL LIMITS - INTERMITTENT NOISE** |  |

The Axiom module shall limit intermittent A-weighted overall SPL emissions, measured 0.6 m from the loudest point on the hardware, to the levels and durations in Table 3.3.2.2.5.3-1, Intermittent Noise A-Weighted Overall Sound Pressure Level and Corresponding Operational Duration Limits (Measured at 0.6 m) or less, for the time noise exceeds the limits in Table 3.3.2.2.5.2-1, over any 24-hour period, during attached operations. [see 50808 table]

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| [AX-746](http://192.168.10.14:8080/browse/AX-746) | **Delete: SOUND PRESSURE LEVEL LIMITS - CONTINUOUS NOISE** |  |

The Axiom module shall limit the Sound Pressure Limits (SPLs), created by the sum of all simultaneously operating equipment, including active payloads and Government Furnished Equipment (GFE), averaged over any 20 second measurement period, throughout the crew habitable volume, to the values given by the Noise Criterion (NC)-52 curve shown in Table 3.3.2.2.5.2-1, Octave Band Sound Pressure Level Limits, or less, within each of the specified octave bands, during attached operations. [see 50808 table]

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| [AX-745](http://192.168.10.14:8080/browse/AX-745) | **Delete: ACOUSTICS** |  |

All equipment that produces significant noise (i.e. > 37 dBA @ 60 cm distance) should be mounted and located to reduce noise at crewmember stations. Use of an Acoustic Noise Control Plan to maintain noise allocations and define noise controls and installation effects has been shown to be an effective tool in managing noise levels.  
Note: All sound pressure levels (SPLs) in decibels are referenced to 20 micropascals unless otherwise stated.

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| [AX-744](http://192.168.10.14:8080/browse/AX-744) | **Delete: ANTHROPOMETRIC REQUIREMENTS** |  |

The Axiom module shall accommodate human body dimensions from a 95th percentile American male to a 5th percentile Japanese female in the design of all ISS IVA flight crew interfaces as stated in SSP 50005, paragraph 3.3.1.3.

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| [AX-743](http://192.168.10.14:8080/browse/AX-743) | **Delete: CLEANLINESS** |  |

A. Interior surfaces of Axiom module habitable volume shall conform to Visibly Clean-Sensitive cleanliness requirements as specified in SN-C-0005, Space Shuttle Contamination Control Requirements, paragraph 2.4, unless a specific hardware item requires a more stringent cleanliness level.  
B. Exterior surfaces of Axiom flight articles which are exposed to vacuum shall conform to Visibly Clean-Sensitive cleanliness requirements as specified in SN-C-0005. Exterior surface cleanliness, as specified herein, is applicable only when Axiom flight articles are in the vehicle assembly building and not while at the launch pad.  
C. The sealing surface of the Axiom module PCBM shall remain free of debris from seal installation to berthing to ISS.

###### Food and Nutrition

This section provides requirements for food quality, quantity, preparation, consumption and clean-up.

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| [AX-343](http://192.168.10.14:8080/browse/AX-343) | **The Axiom module shall provide the capability for preparation, consumption, and stowage of food.** |  |

A viable and stable food system that the crew is willing and able to consume is critical for maintaining the health of the crew. Preparation addresses the heating of the food, if necessary, and the use of whatever equipment is required. Consumption relies on utensils or implements such as forks or spoons, a method to open packaging, or a method to rehydrate. Stowage is needed for the food, as well as all the implements for preparation and consumption.

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| [AX-349](http://192.168.10.14:8080/browse/AX-349) | **Potable water dispensed by the Axiom module for hot beverages and food hydration shall be at a temperature between 68.3 deg. C (155 deg. F) and 79.4 deg. C (175 deg. F).** |  |

Many rehydrated beverages are familiar to crewmembers as warm items and are therefore more palatable served warm. Water at 79.4 deg. C (175 deg. F) allows for the temperature of rehydrated beverages to remain above 68.3 deg. C (155 deg. F), which prevents microbial growth. The higher water temperature also allows for faster rehydration of beverages.

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| [AX-350](http://192.168.10.14:8080/browse/AX-350) | **The Axiom module shall provide potable water for cold beverages at a temperature between 7.4 C (45 deg. F) and 15.6 C (60 deg. F).** |  |

Over the course of long-duration missions, crews can tire of repetitive beverages and foods. Providing cold water is an important way of keeping the crew interested in their meals and providing a familiar contact to normal Earth living. Chilled water is provided during Space Shuttle flights (nominally between 7.2 and 11.7 deg. C (45 to 53 deg. F)). In addition, a chiller is available to ISS crews to cool beverages and food items. Cold water makes certain beverages and food items (such as shrimp cocktail, berry medley, strawberries, and breakfast cereals) more acceptable.

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| [AX-340](http://192.168.10.14:8080/browse/AX-340) | **Delete: The Axiom module food system shall provide the capability to maintain food safety and nutrition during all phases of the mission.** |  |

A nutritious, viable, and stable food system that the crew is willing and able to consume is critical for maintaining the health of the crew. The viability of the food system requires not only that food be available for consumption but also that the food has the appropriate nutrient mix to maintain crew health over time. The food is to retain its safety, nutrition, and acceptability for any space flight concept of operations, be it of short or long duration.

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| [AX-341](http://192.168.10.14:8080/browse/AX-341) | **Delete:The Axiom module food system shall provide each crewmember with a minimum number of calories per day to avoid loss of body mass and adverse health effects.** |  |

A viable and stable food system that the crew is willing and able to consume is critical for maintaining the health of the crew. The food provided is to be of sufficient quality, quantity, and nutrient content to meet the energy demands of various activities, while accommodating each crew member's individual needs and desires. Guidelines for nutrition requirements are documented in the reference document Nutrition Requirements, Standards, and Operating Bands for Exploration Missions.

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| [AX-342](http://192.168.10.14:8080/browse/AX-342) | **Delete: For crewmembers performing EVA operations, the Axiom module food system shall provide additional calories above the nominal daily rate to avoid loss of body mass and adverse health effects.** |  |

Additional energy and nutrients are necessary during EVA operations, as crewmember energy expenditure is greater during those activities. Consumption of an additional 837 kJ (200 kcal), similar in nutrient content to the rest of the diet, per hour of EVA would allow a crewmember to maintain lean body weight during the course of the mission. This is the metabolic energy replacement requirement for moderate to heavy EVA tasks.

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| [AX-344](http://192.168.10.14:8080/browse/AX-344) | **The Axiom module food system shall allow the crew to unstow supplies, prepare meals, and clean up for all crewmembers** |  |

Meal preparation and cleanup activity planning takes into account previous space flight lessons learned, the water delivery and food heating systems, stowage configuration, and desire of the crew to dine together. This is to help ensure that mission goals, objectives, and timelines are not negatively impacted.

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| [AX-345](http://192.168.10.14:8080/browse/AX-345) | **The Axiom module food storage, preparation, and consumption areas shall be designed and located to protect against cross-contamination between food and the environment.** |  |

Contamination can occur from a number of sources, including proximity to cross-contamination and the growth of microorganisms. Food is to be processed properly and stored to control or eliminate microbiological concerns. Furthermore, it is critical for crew physical and psychological health that any interference between body waste management, personal hygiene, exercise, and food preparation and consumption activities is prevented. Space flight lessons learned indicate this has been an issue during Apollo and ISS missions.

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| [AX-346](http://192.168.10.14:8080/browse/AX-346) | **The Axiom module shall provide the capability to heat food and beverages** |  |

Heating is necessary for the subjective quality of food. Heating food and liquid enhances the palatability of some items, which is important for psychological health, as well as for ensuring that crewmembers eat the food provided. Maintaining the temperature of rehydrated food helps prevent microbial growth. The vehicle is to provide the ability to heat dehydrated and non-rehydrated foods.

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| [AX-347](http://192.168.10.14:8080/browse/AX-347) | **The Axiom module shall provide readily accessible trash collection and control of food system waste.** |  |

Food trash is to be considered in the overall plan for all types of trash. It is important to manage any food waste to control odors and microorganism growth. Proximity to the food preparation and consumption location facilitates ease of use and efficiency.

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| [AX-348](http://192.168.10.14:8080/browse/AX-348) | **The Axiom module shall provide methods for cleaning and sanitizing food facilities, equipment, and work areas.** |  |

The ability to clean and disinfect the food system areas helps to minimize microbial contamination of the food system. Contamination of the food system by physical debris can jeopardize the safety and health of the crew.

###### Personal Hygiene

This section includes requirements for personal hygiene facilities, supplies, and disposal.

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| [AX-351](http://192.168.10.14:8080/browse/AX-351) | **The Axiom module shall provide the capability for oral hygiene, personal grooming, and body cleansing.** |  |

Oral hygiene and personal grooming activities are to be accommodated by the system through provision of adequate and comfortable bathing and body waste management facilities as these enhance self-image, improve morale, and increase productivity of the crewmember.

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| [AX-352](http://192.168.10.14:8080/browse/AX-352) | **The Axiom module shall provide for privacy during body cleansing.** |  |

Certain hygiene functions are to have a degree of privacy, especially in a vehicle in which other crewmembers may be performing other functions simultaneously. Privacy provides for the psychological well-being of the crew and is to be provided for whole-body and partial-body cleaning and donning and doffing of clothing.

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| [AX-353](http://192.168.10.14:8080/browse/AX-353) | **The Axiom module shall provide personal hygiene items for each crewmember.** |  |

Each crewmember is to have personal hygiene provisions, e.g., tooth brush, tooth paste, deodorant for body cleansing, oral hygiene, and personal grooming throughout each space mission. Personal hygiene equipment and supplies are to accommodate the physiological differences in male and female crewmembers in the microgravity environment.

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| [AX-354](http://192.168.10.14:8080/browse/AX-354) | **The Axiom module shall provide a sanitization method for personal hygiene facilities and equipment.** |  |

To remain hygienic, personal hygiene equipment is to be easily cleaned, sanitized, and maintained. Cleaning and sanitizing helps control odor and microbial growth. As part of the overall maintenance of the hygiene facilities, crewmembers are to have readily accessible trash collection for disposable personal hygiene supplies to minimize crew exposure to the used items.

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| [AX-357](http://192.168.10.14:8080/browse/AX-357) | **Potable water dispensed by the Axiom module for personal hygiene shall be in the range between 29.4 deg C (85 deg F) and 46.1 deg C (107 deg F).** |  |

This temperature range supports comfortable body cleansing.

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| [AX-358](http://192.168.10.14:8080/browse/AX-358) | **Potable water dispensed by the Axiom module in the hygiene compartment for medical events shall be in the range between 18 deg C (64.4 deg F) and 28 deg C (82.4 deg F).** |  |

The temperature range is required to prevent thermal injury to the tissues during irrigation.

###### Body Waste Management

This section includes requirements for body waste facilities including location, maintenance, and capacity.

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| [AX-359](http://192.168.10.14:8080/browse/AX-359) | **The Axiom module shall provide the capability for collection, containment, and disposal of body waste.** |  |

A body waste management system facilitates the clean, efficient, and reliable collection and management of human waste (urine, feces, vomitus, and menses) and associated equipment and supplies.

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| [AX-360](http://192.168.10.14:8080/browse/AX-360) | **The Axiom module body waste management system shall be isolated from the food preparation and consumption areas for aesthetic and hygienic purposes.** |  |

Contamination can occur from a number of sources, including proximity to cross-contamination and the growth of microorganisms. It is critical for crew physical and psychological health that any interference between body waste management functions and food preparation and consumption be prevented. Space flight lessons learned indicate this has been an issue during Apollo and ISS missions.

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| [AX-361](http://192.168.10.14:8080/browse/AX-361) | **The Axiom module shall provide privacy during use of the body waste management system.** |  |

Certain hygiene functions are to have a degree of privacy, especially in a vehicle in which other crewmembers may be performing other functions simultaneously. Privacy provides for the psychological well-being of the crew and is to be provided for use of the waste management system.

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| [AX-362](http://192.168.10.14:8080/browse/AX-362) | **The Axiom module shall provide body waste management supplies that are accessible to and within reach of crewmembers using the waste management system.** |  |

Personal hygiene and body waste management supplies, such as tissues and towels, may need to be accessed rapidly.

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| [AX-363](http://192.168.10.14:8080/browse/AX-363) | **The Axiom module body waste management system shall allow a crewmember to urinate and defecate simultaneously.** |  |

Accidental discharge of one or both waste components into the habitable volume is not wanted, and it may be difficult for a human to relax the gastrointestinal control sphincter without relaxing the urinary voluntary control sphincter and vice versa.

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| [AX-364](http://192.168.10.14:8080/browse/AX-364) | **The Axiom module shall prevent the release of body waste from the waste management system.** |  |

A release of waste into the closed environment of a spacecraft can contaminate the human and risk the initiation or spread of disease but also can contaminate surfaces, materials, and consumables.

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| [AX-365](http://192.168.10.14:8080/browse/AX-365) | **The Axiom module shall provide odor control for the waste management system.** |  |

Uncontrolled waste-associated odors can have an adverse effect on crew performance and can exacerbate pre-existing symptoms of space motion sickness.

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| [AX-366](http://192.168.10.14:8080/browse/AX-366) | **The Axiom module body waste management trash collection shall be accessible to and within reach of crewmembers using the waste management system.** |  |

Waste management items that cannot be collected and contained with human waste are to be disposed of immediately after use. Waste management trash collection items are to be within reach of the crewmember so that it is not necessary to egress the waste management restraint system or to access closed compartments.

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| [AX-367](http://192.168.10.14:8080/browse/AX-367) | **The Axiom module body waste management system shall provide a means and sufficient volume for crewmembers to perform private bodily self-inspection and cleaning after urination and defecation.** |  |

In microgravity, body waste can float; therefore, after waste management, it is important for crewmembers to verify that they are clean.

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| [AX-368](http://192.168.10.14:8080/browse/AX-368) | **The Axiom module body waste management facilities and equipment shall be capable of being cleaned, sanitized, and maintained.** |  |

To remain hygienic, body waste management equipment is to be easily cleaned, sanitized, and maintained. Cleaning and sanitizing helps control odor and microbial growth. As part of the overall maintenance of the hygiene facilities, crewmembers are to have readily accessible trash collection for disposable personal hygiene supplies to minimize crew exposure to the used items.

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| [AX-369](http://192.168.10.14:8080/browse/AX-369) | **The Axiom module body waste management system shall be capable of collecting and containing an average of 150 g (0.3 lb) (by mass) and 150 ml (5 oz) (by volume) of fecal matter per crewmember per defecation at an average two defecations per day.** |  |

Fecal waste collection is to be performed in a manner that minimizes possible escape of fecal contents into the habitable vehicle during microgravity operations because of the high content of possibly pathogenic bacteria contained in the stool. In addition, there is the potential of injury to crewmembers and hardware that could result from such dissemination. The collection capacity accounts for the average healthy adult stool output/day. The number of defecations per day is individually variable ranging from two times per week to five times per day, with the assumed average of two times per day.

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| [AX-370](http://192.168.10.14:8080/browse/AX-370) | **The Axiom module body waste management system shall be capable of collecting and containing 500 g (1.1 lb) (by mass) and 500 ml (16.9 oz) (by volume) of fecal matter per crewmember in a single defecation.** |  |

Fecal waste collection is to be performed in a manner that minimizes possible escape of fecal contents into the habitable vehicle during microgravity operations because of the high content of possibly pathogenic bacteria contained in the stool and because of the potential of injury to crewmembers and hardware that could result from such dissemination. The collection capacity accounts for the average healthy adult maximum output during a single event.

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| [AX-371](http://192.168.10.14:8080/browse/AX-371) | **The Axiom module body waste management system shall be capable of collecting and containing eight diarrheal events (average volume of 500 ml (16.9 oz)) per crewmember per day for up to 2 days.** |  |

The fecal discharge related to gastrointestinal illness (diarrhea) occurs at an increased frequency but is also variable and unpredictable. The total collection volume is to accommodate diarrhea caused by likely pathogens such as rotavirus and enterotoxigenic E. coli.

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| [AX-372](http://192.168.10.14:8080/browse/AX-372) | **The Axiom module body waste management system shall be capable of collecting and containing 1.5 L (0.4 gal) of diarrhea in a single event.** |  |

Fecal waste collection is be performed in a manner that minimizes possible escape of fecal contents into the habitable vehicle during microgravity operations because of the high content of possibly pathogenic bacteria contained in the stool and because of the potential of injury to crewmembers and hardware that could result from such dissemination. The fecal discharge related to gastrointestinal illness (diarrhea) occurs at an increased frequency and volume but is also variable and unpredictable. The volume for a single discharge is to accommodate diarrhea caused by likely pathogens such as rotavirus and enterotoxigenic E coli. The volume 1.5 L (0.4 gal) is based on evaluation of individuals afflicted with pathogenic diarrhea, as found in medical literature, based on most likely maximal discharge in afflicted individuals. The volume 1.5 L (0.4 gal) is a maximum output, and the average output will be 0.5 L (0.13 gal).

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| [AX-373](http://192.168.10.14:8080/browse/AX-373) | **The Axiom module body waste management system shall be capable of collecting 1 L (33.8 oz) of urine per event with up to six urination events per crewmember per day.** |  |

Rarely, a single void might be as much as 1 L (33.8 oz), so the equipment is to be able to accommodate this maximum. The rate of urinary delivery into the system from the body will vary by gender (greater for females because of lower urethral resistance) but averages 10 to 35 ml/s (0.34 to 1.2 oz/s). Maximum flow rate with abdominal straining in a female may be as high as 50 ml/s (1.9 oz/s) for a few seconds.

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| [AX-374](http://192.168.10.14:8080/browse/AX-374) | **The Axiom module body waste management system shall be capable of collecting and containing a maximum total urine output volume of Vu = 3 + 2t liters per crewmember, where t is the mission length in days.** |  |

Urine production on the first day after launch, i.e., flight day 0, is 3 L (0.8 gal) per crewmember. Urine output may be slightly greater or lower in various phases of the mission associated with gravity transitions and fluid intake levels. The urinary collection system is to be capable of collecting all of the crewmember's output in succession, with an average void varying from 100 to 500 ml (3.4 to 16.9 oz). Rarely, a single void might be as much as 1 L (33.8 oz), so the equipment is to be able to accommodate this maximum. The rate of urinary delivery into the system from the body will vary by gender (greater for females because of lower urethral resistance) but averages 10 to 35 ml/s (0.34 to 1.2 oz/s). Maximum flow rate with abdominal straining in a female may be as high as 50 ml/s (1.9 oz/s) for a few seconds. The voided urine is to be isolated to prevent inadvertent discharge in the cabin that could result in injury to a crewmember's skin or mucous membranes or damage to equipment.

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| [AX-375](http://192.168.10.14:8080/browse/AX-375) | **The Axiom module body waste management system shall be capable of collecting a maximum flow rate as high as 50 ml/s (1.9 oz/s).** |  |

Urine output may be slightly greater or lower in various phases of the mission associated with gravity transitions and fluid intake levels. The urinary collection system is to be capable of collecting all of the crewmember's output in succession, with an average void varying from 100 to 500 ml (3.4 to 16.9 oz). Rarely, a single void might be as much as 1 L (33.8 oz), so the equipment is to be able to accommodate this maximum. The rate of urinary delivery into the system from the body will vary by gender (greater for females because of lower urethral resistance) but averages 10 to 35 ml/s (0.34 to 1.2 oz/s). Maximum flow rate with abdominal straining in a female may be as high as 50 ml/s (1.9 oz/s) for a few seconds. The voided urine is to be isolated to prevent inadvertent discharge in the cabin that could result in injury to a crewmember's skin or mucous membranes or damage to equipment.

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| [AX-376](http://192.168.10.14:8080/browse/AX-376) | **The Axiom module body waste management system shall be capable of collecting and containing vomitus for up to eight events of an average of 500 ml (16.9 oz) in a single event.** |  |

Vomiting and its associated odor, mainly produced by the compound putrescence, may trigger a bystander nausea and vomiting reaction in adjacent crewmembers located in close proximity in an enclosed space. Space Adaptation Syndrome (SAS) occurs in up to 70 percent of first time fliers (30 percent of whom may experience vomiting) during the first 48 to 72 hours of microgravity. In addition, a possible water landing may cause crewmembers to succumb to sea sickness. The average number of vomiting episodes per crewmember will vary from 1 to 6 per day, over a 2- to 3-day period. Regurgitation of the entire stomach contents results on average in 0.2 to 0.5 L (6.8 to 16.9 oz) of vomitus per event. Stowage and disposal is to be adequate for a worst-case number of involved crew, severity and duration of symptoms, as well as volume of gastrointestinal contents regurgitated.

###### Physiological Countermeasures

This section includes requirements for countermeasures to address the physiological effects of spaceflight.

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| [AX-377](http://192.168.10.14:8080/browse/AX-377) | **The Axiom module shall provide countermeasures to meet crew bone, muscle, sensory-motor, and cardiovascular fitness.** |  |

Exercise is used to maintain crew cardiovascular fitness (to aid in ambulation during gravity transitions and to minimize fatigue), to maintain muscle mass and strength/endurance, for recovery from strenuous tasks and confined postures, and to rehabilitate minor muscle injuries. Exercise is to commence as early as possible during the mission and continue throughout all mission phases.

###### Medical

This section includes requirements for an onboard medical facilities and its capabilities.

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| [AX-378](http://192.168.10.14:8080/browse/AX-378) | **The Axiom module shall provide a medical system capable of treating space motion sickness, basic life support, first aid, anaphylaxis response, clinical diagnostics and ambulatory care.** |  |

Appropriate medical care is required to reduce the risk that missions are impacted by crew medical issues and that long-term astronaut health risks are managed within acceptable limits. The medical system may leverage communication with ground physicians for diagnostics and ambulatory care.

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| [AX-355](http://192.168.10.14:8080/browse/AX-355) | **The Axiom module shall provide immediately available potable water for eye irrigation for particulate events, e.g., dust, foreign objects, chemical burns, and other eye irritations.** |  |

Eye irrigation is required for space flight, based on experience and data from Shuttle, International Space Station (ISS), and Apollo programs.

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| [AX-356](http://192.168.10.14:8080/browse/AX-356) | **The Axiom module shall provide immediately available potable water for medical contingency use, e.g., chemical exposure/burn.** |  |

Water for medical contingency use is required for many situations, including eye and wound irrigation during space flight, based on experience and data from Shuttle, ISS, and Apollo programs. Some medical situations require large quantities of water, for example, lithium hydroxide (LiOH) or other toxic substances in the eye or skin wound. However, these events are off-nominal and occur at lower frequency than particulate events during the mission and may be considered contingencies. The quantity of water to be provided depends on the number of crew and expected contingency events and should ensure that medical treatment can be provided.

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| [AX-379](http://192.168.10.14:8080/browse/AX-379) | **The Axiom module shall provide the capability to restrain a patient and appropriately position a medical care provider and equipment during treatment.** |  |

Patient restraints are to be capable of preventing the motion of arms and legs, allow stabilization of the head, neck, and spine, and provide attachment to the spacecraft. Care provider restraints are to allow the care provider to remain close to the patient to administer treatment but should be easily removable or allow movement to access nearby equipment. Equipment restraints are to be able to safely restrain large items such as medical kits, as well as individual items.

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| [AX-380](http://192.168.10.14:8080/browse/AX-380) | **The Axiom module shall provide capability to contain and safely dispose of biological hazards (blood and other bodily fluids).** |  |

If not properly contained, contents could damage equipment, injure crewmembers, and transmit disease. Biological waste, including suited feces/urine collection devices, vomit, and feminine hygiene products, can also cause injury and transmit disease.

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| [AX-381](http://192.168.10.14:8080/browse/AX-381) | **The Axiom module shall provide capability to safely dispose of sharp items (syringe needles).** |  |

The disposal of medical equipment is to be taken into consideration as part of the overall trash management plan. Medical equipment, depending on the type, e.g., sharp items, are to have special disposal methods to ensure that there is no injury to the crew, damage to equipment, or transmission of disease.

###### Stowage

This section includes requirements for personal and common stowage areas including accessibility requirements.

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| [AX-382](http://192.168.10.14:8080/browse/AX-382) | **The Axiom module shall provide for the stowage of hardware and supplies, to include location, restraint, and protection for these items.** |  |

Some stowed items are removed from stowage, used, and then returned to the provided provisions/location. Other items are temporarily removed from stowage, relocated to another use location, and much later stowed.

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| [AX-383](http://192.168.10.14:8080/browse/AX-383) | **The Axiom module shall provide stowage locations for personal items, food, supplies, consumables, spares and tools.** |  |

Having stowage locations for personal items and clothing provides for the well-being of the crew. When considered with inventory management, labeling, and operational nomenclature, the stowing of and access to these personal items is to be able to be done efficiently.

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| [AX-384](http://192.168.10.14:8080/browse/AX-384) | **The Axiom module shall provide the capability to restrain relocatable items during microgravity, transient accelerations, and vibrations.** |  |

Stowed items are to be restrained so that they are not free to move during vehicle motion, under the influence of internal air movement, or after inadvertent contact. These restraints assist in keeping the crew safe from items moving about and also assist in ensuring that stowed items remain where required during operations and crew tasks.

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| [AX-385](http://192.168.10.14:8080/browse/AX-385) | **Axiom module stowage containers and restraints shall be operable without the use of tools.** |  |

To maximize the use of crew time, the stowage system is to permit crew access and reconfiguration without the use of tools.

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| [AX-386](http://192.168.10.14:8080/browse/AX-386) | **The Axiom module stowage identification system shall be compatible with the inventory management system.** |  |

Space Shuttle and ISS experience has shown that stowage management and identification - the knowledge of the quantity, location, and type of each supply - is crucial for mission planning and maintaining crew productivity. Quantity and location are not the only aspects of stowage identification. Stowage, labeling, inventory tracking, and operational nomenclature are also to be considered when developing an integrated system.

###### Trash Management

This section provides requirements for the trash management system, including volume, location, odor control, and contamination control.

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| [AX-387](http://192.168.10.14:8080/browse/AX-387) | **The Axiom module shall provide a trash management system to accommodate (stow, neutralize, and dispose) all expected wet and dry trash, including sharp items, harmful chemicals, and biological and radioactive waste.** |  |

If not properly contained, trash contents could damage equipment, injure crewmembers, and transmit disease. Different types of trash require specific types of wrapping and containment. The trash management plan identifies the types of trash to be generated during mission operations; such identification then guides the disposition of the trash. Flight crews as well as ground personnel are expected to manage trash.

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| [AX-388](http://192.168.10.14:8080/browse/AX-388) | **Axiom module trash stowage volumes shall be allocated.** |  |

The trash plan defines the types and quantities of trash expected during mission operations. Trash buildup occurs, especially on missions where there is no expendable vehicle to carry away the trash. Dedicated trash stowage volumes and locations are needed and are to be coupled with appropriate packaging and containment.

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| [AX-389](http://192.168.10.14:8080/browse/AX-389) | **The Axiom module trash management system shall provide odor control of trash.** |  |

Uncontrolled odors can have an adverse effect on crew performance and can exacerbate pre-existing symptoms of SAS.

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| [AX-390](http://192.168.10.14:8080/browse/AX-390) | **The Axiom module trash management system shall prevent the release of trash into the habitable environment.** |  |

Many components of trash act as nutrient sources for microorganisms that can quickly increase their concentrations. These microorganisms can include medically significant organisms, which could negatively impact crew health and performance.

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| [AX-391](http://192.168.10.14:8080/browse/AX-391) | **Hazardous waste in the Axiom module shall be labeled on the outermost containment barrier to identify the hazard type and level contained.** |  |

It is important for safe handling purposes that the waste container label be marked accurately and completely. When multiple types of hazardous waste are accumulated in a single hazardous waste container, the outermost container label is to indicate the highest level of toxicity contained. A reference for evaluating toxic hazards can be found in JSC 26895.

###### Sleep

This section provides requirements for volume, privacy, and personal comfort in the crew sleeping accommodations.

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| [AX-393](http://192.168.10.14:8080/browse/AX-393) | **The Axiom module shall provide individual crew quarters that allow privacy.** |  |

For design guidance on privacy, see NASA Standard 3001 in Appendix C, Definitions.

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| [AX-392](http://192.168.10.14:8080/browse/AX-392) | **The Axiom module shall provide volume, sleep surface area, and personal sleep items, e.g., clothing, bedding, ear plugs, for each crewmember.** |  |

The sleep accommodation requirements depend primarily on the gravity environment and the mission duration. Unlike terrestrial and partial-gravity environments, in microgravity there is no need to consider orientation and body support (cushioning). However, in microgravity environments, restraints are provided to secure blankets and maintain positioning. For design guidance, see section 8.5, Restraints and Mobility Aids and section 7.9.2, Private Quarters in NASA-STD-3001 Vol 2.

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| [AX-394](http://192.168.10.14:8080/browse/AX-394) | **The Axiom module individual private quarters shall provide the crew control of lighting, noise, ventilation, and temperature.** |  |

Sleeping and working areas may overlap, and the crew is to be able to adjust the environment according to function. For design guidance, see section 7.9.2, Private Quarters, in NASA Standard 3001 Vol 2.

###### Clothing

This section includes requirements for crew clothing comfort, ease-of-use, and length of use.

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| [AX-396](http://192.168.10.14:8080/browse/AX-396) | **Review: The Axiom module shall provide clothing for each individual crewmember's exclusive use.** |  |

Requirements for exclusive clothing use are to include considerations for individual stowage areas, clothing identification sizing, and individual preference accommodation.

###### Children

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| [AX-395](http://192.168.10.14:8080/browse/AX-395) | **Review: The Axiom module shall provide clean, durable clothing in quantities sufficient to meet crew needs.** |  |

Requirements are to be based on acceptable definitions of "clean" and "durable." Requirements are then to include the number of days that an individual item of clothing can be worn before laundering or disposal and, for laundered clothing, the lifetime of the clothing item.

###### Housekeeping

This section provides requirements for ease and effectiveness of cleaning tasks, and safety of cleaning materials.

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| [AX-398](http://192.168.10.14:8080/browse/AX-398) | **The Axiom module shall be designed with surface materials that can be easily cleaned and sanitized using planned cleaning methods.** |  |

Program requirements are to be established so that surface materials, such as highly textured materials, are assessed for this feature.  
For reference, ISS cleanliness standards are as follows:  
A. Interior surfaces of the habitable volume shall conform to Visibly Clean-Sensitive cleanliness requirements as specified in SN-C-0005, Space Shuttle Contamination Control Requirements, paragraph 2.4, unless a specific hardware item requires a more stringent cleanliness level.  
B. Exterior surfaces of flight articles which are exposed to vacuum shall conform to Visibly Clean-Sensitive cleanliness requirements as specified in SN-C-0005. Exterior surface cleanliness, as specified herein, is applicable only when Axiom flight articles are in the vehicle assembly building and not while at the launch pad.  
C. The sealing surface of the PCBM shall remain free of debris from seal installation to berthing to ISS.

###### Children

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| [AX-397](http://192.168.10.14:8080/browse/AX-397) | **The Axiom module shall provide sufficient access to areas that need to be cleaned.** |  |

The full size range of personnel with appropriate cleaning tools and equipment is to be able to access all areas for routine cleaning. Fixed equipment should not to have to be unsecured and moved for routine cleaning. Inaccessible areas are to be closed off to prevent the accumulation of trash and dirt.

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| [AX-399](http://192.168.10.14:8080/browse/AX-399) | **The Axiom module shall provide cleaning materials that are effective, safe for human use, and compatible with system water reclamation, air revitalization, and waste management systems.** |  |

Program requirements are to be established so that cleaning materials are assessed for these features. Effective cleaning materials leave a cleaned surface ready for use without the need for additional cleaning. For example, an effective window cleaning material leaves the window with no accumulation, streaking, or any other artifact that could interfere with the use of the window (photography or piloting tasks). On the other hand, cleaning material used on a dining table could be considered effective even with the presence of streaks or accumulation, as long as the surface is safe on which to prepare, serve, and consume food.

###### Recreation

This section provides a requirement for recreation capabilities.

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| [AX-400](http://192.168.10.14:8080/browse/AX-400) | **The Axiom module shall provide recreational capabilities for the crew to maintain behavioral and psychological health.** |  |

Appropriate recreational facilities depend on the nature and duration of the mission. Program development requirements are to provide time and resources for psychological assessment of crew needs. The system design is to include recreational facilities, materials, and operational accommodations identified in these assessments.

###### Acoustics

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| [AX-258](http://192.168.10.14:8080/browse/AX-258) | **The Axiom module shall limit crew acoustic exposure consistent with Occupational Noise Exposure OSHA-1910.95** |  |

Hearing protection normally operates by decreasing the level of sound at the ear (passive protection). Normal, long-term operations are to be conducted without the impairment to hearing from hearing protection. This would interfere with the ability to communicate and hear audio signals. In some situations, however, noise levels may be uncontrollably high for relatively short periods. Facilities for communications and audio signals can be adapted so that they are possible in those situations. environment to preclude interference with communications and noise-related hearing loss and to support human performance.

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  For reference, ISS recommends that all equipment that produces significant noise (i.e. > 37 dBA @ 60 cm distance) should be mounted and located to reduce noise at crewmember stations.  
  For hazardous noise, ISS limits the maximum A-weighted overall Sound Pressure Level (SPL) at the crewmember's head location caused by any noise source, including voice communications to less than 85 dBA, and limits the maximum alarm signal A-weighted overall SPL to 95 dBA or less at the operating position of the intended receiver.   
  For impulse noise, ISS limits noise, measured at the crewmember's head location to less than 140 dB peak SPL, during attached operations.  
  For intermittent noise, ISS limits A-weighted overall SPL emissions, measured 0.6 m from the loudest point on the hardware, to the levels and durations in SSP 50808 Table 3.3.2.2.5.3-1, Intermittent Noise A-Weighted Overall Sound Pressure Level and Corresponding Operational Duration Limits (Measured at 0.6 m) or less, for the time noise exceeds the limits in Table 3.3.2.2.5.2-1, over any 24-hour period, during attached operations.   
  For continuous noise, ISS limits the Sound Pressure Limits (SPLs), created by the sum of all simultaneously operating equipment, averaged over any 20 second measurement period, throughout the crew habitable volume, to the values given by the Noise Criterion (NC)-52 curve shown in SSP 50808 Table 3.3.2.2.5.2-1, Octave Band Sound Pressure Level Limits, or less, within each of the specified octave bands, during attached operations.   
  For reference on how ISS applies limits to inter-module ventilation audible noise, see SSP 50808 Table 3.3.2.2.5.8-1, Octave Band Sound Pressure Limits, where sound is measured 60 cm from each duct exit or inlet.  
  For reference on reducing echoes, ISS limits reverberation time in the crew habitable volume to less than 0.6 seconds within the 500 Hz, 1 kHz, and 2 kHz octave bands during attached operations.

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| [AX-106](http://192.168.10.14:8080/browse/AX-106) | **Delete: The Axiom module shall limit the A-weighted sound level (excluding impulse noise and alarm signals) to 85 dBA, regardless of time duration.** |  |

A noise level of 85-dBA overall SPL is a hazardous noise limit at which action to reduce the noise level is to be taken so that interference with voice communications and alarms, as well as increased risk for hearing loss, does not occur. This is to help ensure that the habitable environment is safe. This is not intended for nominal hardware emissions but to limit the sound level of sources such as communications systems and levels that occur during maintenance activities. The noise attenuation effectiveness of hearing protection or communications headsets may not be used to satisfy this requirement.

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| [AX-237](http://192.168.10.14:8080/browse/AX-237) | **Delete: The Axiom module shall limit the Sound Pressure Levels (SPLs) of continuous noise (not including impulse noise) to allow good voice communication.** |  |

Limiting noise levels within the crew-habitable volume to allow adequate voice communications and habitability during mission operations. A design guide on suitable noise limits is the Noise Criterion (NC)-50 curve in figure 8 and table 4 of NASA-STD-3001 Vol 2. The noise limit at 16 kHz does not appear in figure 8 but is given in table 4 of the same standard. SPLs for continuous noise do not apply to alarms, communications, or noise experienced during maintenance activities. The noise attenuation effectiveness of hearing protection or communications headsets may not be used to satisfy this requirement.

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| [AX-238](http://192.168.10.14:8080/browse/AX-238) | **Delete: Axiom crew quarters and sleep areas shall limit the sound pressure levels of continuous noise.** |  |

For a crewmember to relax the auditory system, a quiet environment is to be provided during crew sleep. Design guidance on noise levels can be obtained from the NC-40 curve (figure 8 and table 4 in NASA-STD-3001 Vol 2).

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| [AX-239](http://192.168.10.14:8080/browse/AX-239) | **Delete: The Axiom module shall limit intermittent noise generated by hardware items that operate for short time periods.** |  |

This requirement limits crew exposure to intermittent noise levels of hardware items that are inherently noisy but that operate for short time periods. Intermittent sources can result in unacceptable noise levels, add to the overall crew noise exposure, impede communications, and cause disruption in crew rest/sleep. Design guidance for the limiting applied by this requirement can be found in Table 5 of NASA-STD-3001 Vol 2. Noise levels used in the table are the maximum noise emissions (not including impulse noise), measured 0.6 m from the loudest hardware surface. The noise attenuation effectiveness of hearing protection or communications headsets may not be used to satisfy this requirement.

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| [AX-240](http://192.168.10.14:8080/browse/AX-240) | **Delete: The Axiom module shall limit the maximum alarm signal A-weighted sound level to less than 95 dBA at the operating position of the intended receiver.** |  |

This allows alarm sound levels to exceed the 85-dBA hazard limit because of the need for alarm audibility. Also, alarms can be silenced at the crew's discretion.

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| [AX-241](http://192.168.10.14:8080/browse/AX-241) | **Delete: With the exception of communications and alarms, the Axiom module shall limit impulse noise levels at the crew member's head location to 10 dB above background noise levels during crew sleep periods.** |  |

Impulse noise is to be limited to less than 10 dB above the background noise to avoid waking crewmembers who are sleeping. Communications and alarms are not subject to this requirement.

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| [AX-243](http://192.168.10.14:8080/browse/AX-243) | **Delete: The Axiom module shall limit infrasonic noise (including frequencies from 1 to 20 Hz but not including impulse noise).** |  |

Limiting levels of infrasonic noise can provide health and well-being effects. American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Level Values (TLVs), Infrasound and Low-Frequency Sound, 2001 recommends a 150-dB limit for infrasonic noise levels in the frequency range from 1 to 20 Hz. The noise attenuation effectiveness of hearing protection or communications headsets should not be used to satisfy this requirement.

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| [AX-244](http://192.168.10.14:8080/browse/AX-244) | **Delete: The Axiom module shall limit levels of ultrasonic noise.** |  |

Ultrasonic noise may have little effect on general health unless the body has direct contact with the radiating ultrasonic source. These limits are designed to prevent possible hearing loss caused by exposure to ultrasonic noise plus the sub-harmonics of the set frequencies, rather than the ultrasonic sound itself. Design guidance on limits can be obtained in table 6, Ultrasonic Noise Limits Given in One-Third Octave Band SPLs in NASA-STD-3001 Vol 2.

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| [AX-245](http://192.168.10.14:8080/browse/AX-245) | **Delete: The Axiom module shall provide a means to monitor and quantify broadband and frequency-dependent SPLs as needed for crew health and safety.** |  |

Acoustic monitoring is needed to ensure that sound levels during the mission are below established limits for crew health and performance. For example, the crew may use sound level meters and acoustic dosimeters to monitor their environment.

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| [AX-242](http://192.168.10.14:8080/browse/AX-242) | **CANDIDATE FOR REMOVAL - The Axiom module shall limit the maximum SPL of narrow-band noise components and tones to at least 10 dB less than the broadband SPL of the octave band that contains the component or tone.** |  |

Narrow-band noise component and tone levels should be limited to 10 dB below the broadband level to prevent irritating and distracting noise conditions, which could affect crew performance.

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| [AX-246](http://192.168.10.14:8080/browse/AX-246) | **CANDIDATE FOR REMOVAL - The Axiom module shall provide a means to monitor and quantify noise exposure levels for each crewmember as needed for crew health and safety.** |  |

To protect the crew from excessive noise exposure, the noise exposure experienced by the crew is to be understood. Understanding of noise exposure is critical to the protection of crew hearing and helps determine the degree of remedial actions, including moving to a different environment, hardware shutdown, or proper implementation of countermeasures. Periodically on ISS, the crew uses sound level meters and acoustic dosimeters to monitor their environment.

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| [AX-259](http://192.168.10.14:8080/browse/AX-259) | **CANDIDATE FOR REMOVAL - The Axiom module shall provide the crew with appropriate personal hearing protection to the crew for contingency or personal preference.** |  |

Crews are to have readily accessible hearing protection for unanticipated high noise levels. Hearing protection is also to be available to block noise according to individual preferences, such as for concentration or for sleep.

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| [AX-260](http://192.168.10.14:8080/browse/AX-260) | **CANDIDATE FOR REMOVAL - The Axiom module shall be designed so that hearing protection does not inhibit voice communication, monitoring of systems, and detection of alerts.** |  |

Some conditions might temporarily expose the crew to high noise levels. Facilities for communications and audio signals can be adapted so that they are possible in those situations. Requirements are to specify those periods allowing the use of hearing protection, and then designs are to accommodate effective crew functioning during that time.

##### Architecture

###### Configuration

This section includes requirements on how the various functional volumes in the spacecraft should be arranged and oriented as well as requirements for location identification.

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| [AX-401](http://192.168.10.14:8080/browse/AX-401) | **Axiom module displays and controls within a crew station shall have the same orientation in plane of the crewmember's head.** |  |

Maintaining a consistent orientation of interfaces and their elements minimizes crewmember rotational realignments needed to perform tasks that have directionally dependent components, such as reading labels and displays. Inconsistent and varied display and control orientations may contribute to operational delays and errors. Given the complexity of some operations, e.g., piloting, a single orientation for all controls, displays, and labels may not be possible, but every effort is to be made in design to minimize crewmember repositioning required to efficiently perform a task. This requirement is meant to ensure that all equipment at an interface is aligned with the crewmember's head, even if the head is turned, so that an operating crewmember only needs adjust body orientation slightly in pitch and yaw at a workstation but does not need to adjust body orientation in roll.

###### Translation Paths

This section provides requirements to accommodate safe and efficient movement of crew within the vehicle.

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| [AX-402](http://192.168.10.14:8080/browse/AX-402) | **The Axiom module shall provide intravehicular activity (IVA) translation paths to allow for the movement of crew and equipment for nominal operational, contingency, and emergency conditions.** |  |

Translation paths are needed to support the safe and efficient movement of the crew and equipment throughout the vehicle. The pathway design is to take into account the type and level of activity that occur at each of the workstations, the required movement of crew and equipment between them, the location of workstations, the number of crew, and the types of equipment being translated. As an example, lessons learned from the ISS indicate that translation paths around the ISS eating area have disrupted crew rest and relaxation required during meals.  
For reference, ISS accommodates human body dimensions from a 95th percentile American male to a 5th percentile Japanese female in the design of all ISS IVA flight crew interfaces as stated in SSP 50005, paragraph 3.3.1.3.

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| [AX-404](http://192.168.10.14:8080/browse/AX-404) | **The Axiom module shall provide translation paths for ingress and egress** |  |

Suited crewmembers are to be able transfer between two docked vehicles in flight easily and quickly.

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| [AX-405](http://192.168.10.14:8080/browse/AX-405) | **Emergency paths in the Axiom module shall be marked and be visible under nominal operational, contingency, and emergency conditions.** |  |

The possibility exists for a spacecraft or subsystem failure or damage that could require evacuation, thus impacting the design for traffic flow. Crewmembers are to be provided with escape routes for egress and isolation in the event of the need for an emergency egress from their immediate location. Entry and exit pathways are to be protected; the pathways are to be free from obstruction and without dead-end corridors and marked to establish the safe and efficient movement of the crew and equipment.

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| [AX-403](http://192.168.10.14:8080/browse/AX-403) | **Delete: The Axiom module (and any space suits) shall be configured such that the crew can ingress or egress (including hatch operation, if applicable) within the time required to preserve crew health and safety in the event of an emergency.** |  |

System developers need to define emergency escape routes early in the design process to ensure they are functional. The routes need to be free of obstructions (snags, protrusions, stowed items, etc.), clearly marked, illuminated for emergency operations, and require a minimal number of operations for passage (such as awkward turns or hatch operations). When sizing the route, designers need to consider the dimensions of the users, including suits and special protective equipment, and the number of concurrent users, including possible rescue personnel.

###### Hatches and Doorways

This section provides requirements for size and shape of hatches and doorways as well as operability requirements.

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| [AX-406](http://192.168.10.14:8080/browse/AX-406) | **Axiom module hatch shall be designed to be opened and closed form either side by a crewmember without the use of tools** |  |

Hatch operation includes unlatching/opening or latching/closing the hatch. Lost or damaged tools prevent the hatches from being opened or closed, which may result in loss of crew (LOC) or loss of mission (LOM).

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| [AX-407](http://192.168.10.14:8080/browse/AX-407) | **Axiom module hatchs shall require two distinct and sequential operations to unlatch.** |  |

Inadvertent hatch opening and subsequent cabin depressurization would be catastrophic. Requiring two separate, distinct operations helps to ensure that the hatch will not be unlatched through accidental contact.

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| [AX-413](http://192.168.10.14:8080/browse/AX-413) | **Axiom module hatches (when open) shall allow for unrestricted flow of traffic.** |  |

Open hatches and doors are not to protrude into translation space and inhibit the safe and effective movement of both the crewmembers and any equipment they need to move from one location to another. In addition, open hatch covers and doors are to allow for a clear emergency translation pathway.

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| [AX-408](http://192.168.10.14:8080/browse/AX-408) | **Axiom module interior hatches shall be nominally operable by a single crewmember in no more than 60 seconds, including opening, closing, latching, and unlatching.** |  |

Hatch operation includes unlatching/opening or latching/closing the hatch. Excessively long operating times can delay crews on both sides of a hatch, which would prevent ingress or egress. The hatch operating requirement of 60 seconds is based on engineering judgment related to easily operable hatch design without complicating hatch design. This does not preclude a program from implementing more strict design requirements. The requirement applies to both flight vehicles and hatches in the ground safe haven following emergency pad egress.

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| [AX-409](http://192.168.10.14:8080/browse/AX-409) | **Delete: The Axiom module hatch shall be operable by the weakest of the selected crewmember population.** |  |

All crewmembers are to be able to operate hatches and their covers and doors. Designing operating forces to the strength of the weakest crewmember ensures the crew can perform activities related to safety and to loss-of-mission.

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| [AX-410](http://192.168.10.14:8080/browse/AX-410) | **Delete: Axiom module hatches and doorways shall be sized and shaped to accommodate unrestricted passage of a suited crewmember.** |  |

A suited crewmember represents a situation where the crew's size is enlarged in many dimensions by virtue of the suit. Should a situation arise where the crew needs to move through hatches and doorways while suited, especially in an emergency situation, the hatches and doorways are to be large enough for the crew to pass safely and efficiently.

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| [AX-411](http://192.168.10.14:8080/browse/AX-411) | **The Axiom module hatch shall have manual pressure equalization capability on both sides** |  |

Air pressure is to be equalized on either side of a hatch to safely open the hatch. In some vehicle failure scenarios, non-manual methods for pressure equalization may fail. Manual pressure equalization enables hatch opening regardless of vehicle status. This may include suited and unsuited crewmembers.

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| [AX-412](http://192.168.10.14:8080/browse/AX-412) | **The Axiom module shall provide a window for direct visual observation of the environment on the opposite side of the hatch.** |  |

Direct visual observation of the environment on the opposite side of a hatch allows the crew to determine the conditions or obstructions, such as the presence of fire or debris, on the other side of the hatch for safety purposes. Windows do not have the failure modes associated with cameras and display systems that may not be operable during emergencies when most needed.

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| [AX-414](http://192.168.10.14:8080/browse/AX-414) | **The Axiom module pressure hatch covers shall indicate closure and latching status on both sides of the hatch.** |  |

Indication of hatch closure and latch status on both sides of the hatch allows both ground personnel (launch pad) and crewmembers to verify that each hatch is closed and latched. By providing both closure and latch position status, proper security of the hatch can be verified. Hatch closure implies that the hatch is in proper position to be latched.

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| [AX-415](http://192.168.10.14:8080/browse/AX-415) | **Delete: Axiom module pressure hatch shall indicate, on both sides of the hatch, pressure differential across the hatch.** |  |

Indication of pressure difference on both sides of the hatch allows both ground personnel and crewmembers to see the changes in pressure across the hatch and to know when the pressure difference is low enough to safely open the hatch. Use of numerical values, color, or other cues can be used to indicate when it is safe to operate a hatch.

###### Restraints and Mobility Aids

This section includes requirements for location and strength of restraints and mobility aids

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| [AX-416](http://192.168.10.14:8080/browse/AX-416) | **The Axiom module shall provide crew restraints to assist in the maintaining of body position and location in reduced gravity conditions or during accelerations.** |  |

Maintaining a static position and orientation at a workstation is necessary to ensure that controls can be activated without motion being imparted to the crewmember. Without gravity to hold an individual onto a standing or sitting surface, the body floats or moves in the opposite direction of an applied force. The cognitive and physical work required to maintain body position during a task can interfere with the task performance. Activities that use both hands are not to require handholds to maintain position at a workstation but may require restraints such as foot loops, straps, or harnesses. For reference on ISS crew restraints, see SSP 50005 section 11.7.

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| [AX-425](http://192.168.10.14:8080/browse/AX-425) | **Where appropriate, the Axiom module shall provide mobility aids for the crew to conduct IVA operations.** |  |

Mobility aids, such as hand holds and foot restraints, allow crewmembers to efficiently move from one location to another in microgravity, as well as reduce the likelihood of inadvertent collision into hardware that may cause damage to the vehicle or injury to the crew. Early experience in the Skylab program showed the problems of movement in microgravity. Stopping, starting, and changing direction all require forces that are best generated by the hands or feet. Appropriately located mobility aids make this possible. Mobility aids are to be designed to accommodate a pressurized-suited crewmember by providing clearance, non-slip surfaces, and noncircular cross sections. Without predefined mobility aids, personnel may use available equipment that may be damaged from induced loads. For reference on ISS mobility aids, see SSP 50005 section 11.8.

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| [AX-417](http://192.168.10.14:8080/browse/AX-417) | **Axiom module crew restraints shall be designed to accommodate the crewmember for the duration of the task.** |  |

Crew restraints provide for operator stability. Where it is critical that a workstation operator remain stable for task performance, e.g., view through an eyepiece, operate a keyboard, or repair a circuit, foot restraints and other ad hoc positioning techniques may be sufficient. However, tasks that require a stabilized crewmember to maintain position for long periods of time, e.g., 1 hour of continuous use or longer, require a restraining system designed with task duration, stability, and training to operate in mind.

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| [AX-418](http://192.168.10.14:8080/browse/AX-418) | **Axiom module crew restraints to be used in microgravity applications shall be designed for compatibility with the neutral body posture.** |  |

The neutral body posture in microgravity places the human in a position unlike the vertical nature of 1-g. Most notable are changes in the angle of the foot, arm, and shoulder elevation, the forward and down head tilt, and hip/knee flexion displacing the torso backward. Crewmembers will fatigue and experience discomfort if equipment does not accommodate the neutral body posture. This can then lead to decreased performance and task execution.

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| [AX-419](http://192.168.10.14:8080/browse/AX-419) | **Axiom module crew restraints shall not interfere with crewmember's performance of tasks.** |  |

Some simple tasks can be easily performed with one hand while using the other hand for stability. More complex tasks, however, require coordination of both hands, and some type of body or foot restraint system may be required.

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| [AX-420](http://192.168.10.14:8080/browse/AX-420) | **Axiom module crew restraints shall provide for the operation of controls during reduced gravity, as well as during dynamic or multi-axis accelerations.** |  |

Maintaining a position and orientation during controls operation is necessary to ensure that controls can be activated without motion being imparted to the crewmember. Restraints are meant to support and stabilize the crewmember and protect against inadvertent operation of controls.

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| [AX-421](http://192.168.10.14:8080/browse/AX-421) | **Axiom module mobility aids shall be standardized, clearly distinguishable, and located to aid the crew in starting or stopping movement, changing direction or speed, or translating equipment.** |  |

Mobility aids, such as hand holds and foot restraints, allow crewmembers to efficiently move from one location to another in microgravity, as well as reduce the likelihood of inadvertent collision into hardware that may cause damage to the vehicle or injury to the crew. Without predefined mobility aids, personnel may use available equipment that may be damaged from induced loads. By standardization of the mobility aids, reduction in crew training can occur, and the aids can be easily identified when translating within a spacecraft volume. Commonality among visual cues is important so that crews can easily distinguish intended mobility aids from non-mobility aids that may be damaged by the application of crew-induced loads. During emergencies, crews need to be able to quickly discern mobility aids from the surrounding structures. Visual cues such as color coding may aid in this function.

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| [AX-422](http://192.168.10.14:8080/browse/AX-422) | **Axiom module fixed and portable IVA mobility aids shall be designed to withstand expected forces of the crew without failure or sustaining damage.** |  |

The tasks expected of a space flight crew are varied, and mobility aids are to support crewmember translation, as well as the translation of equipment or other crew, suited or unsuited, pressurized or unpressurized. Mobility aids assist in the stabilization of the crew, as well as stopping, starting, or changing of direction.

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| [AX-423](http://192.168.10.14:8080/browse/AX-423) | **Axiom module mobility aids shall be provided for the assisted ingress and egress of an incapacitated crewmember.** |  |

Incapacitated pressurized-suited or unpressurized crew may be unable to ingress spacecraft and may also be in a constrained position that requires assistance. Moving the crew may include ingress from EVA or ingress/egress to/from another spacecraft from EVA or any vehicle or module to which a spacecraft is docked. Assisting crew will need mobility aids not only for translating but also for stabilization during the translation of the incapacitated crewmember.

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| [AX-424](http://192.168.10.14:8080/browse/AX-424) | **Axiom module mobility aids shall be provided for ingress, egress, and escape of suited crewmembers.** |  |

Because a suited crewmember has limited maneuverability, mobility aids allow crewmembers safe and efficient ingress and egress of the vehicle.

###### Windows

This section provides requirements for geometry and optical properties of windows on the spacecraft.

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| [AX-426](http://192.168.10.14:8080/browse/AX-426) | **Delete: Axiom module windows shall have optical properties commensurate with their tasking.** |  |

System windows are required to have the necessary optical properties so that they do not degrade visual acuity and optical performance. For design guidance, JSC 63307 specifies optical properties for different types of system windows according to their associated tasks (the uses to which they will be put). These optical properties provide system windows with the minimal optical performance necessary to support those tasks and permit the retrieval of imagery through windows so that the retrieved images are not blurred, degraded, or distorted. Detailed architectural design considerations, lessons learned, and verification methodologies to meet this requirement are specified in the HIDH, Appendix D, Optical Performance Requirements for Windows in Human Spaceflight Applications, the parent document from which JSC 63307 was derived.

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| [AX-427](http://192.168.10.14:8080/browse/AX-427) | **Delete: Axiom window fields of view shall not be obstructed except for hardware designed to protect windows; COAS or similar equipment; the vehicle hull; and other windows and mullions.** |  |

Fixed equipment, such as window instrumentation, hardware, or a condensation prevention system, that would obscure the field of view from the normal crew position for window viewing may interfere with piloting and photography tasks. For detailed design considerations for inboard and outboard window view obscuration exclusion zones, consult section 8.6, Windows, in the NASA-SP-2010-3407.

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| [AX-428](http://192.168.10.14:8080/browse/AX-428) | **Axiom module windows shall allow for a light blocking interior cover** |  |

External illumination can interfere with internal spacecraft operations, such as crew sleep and onboard still and motion imaging, particularly if the illumination causes glare. Shades and shutters block external illumination from entering the habitable compartments through windows. Guidance on effectiveness is that interior light is reduced to 2 lux at 0.5 m (20 in) from each window.

###### Lighting

This section includes requirements for levels, colors and controls of internal, external, and emergency lighting.

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| [AX-429](http://192.168.10.14:8080/browse/AX-429) | **The Axiom module shall provide illumination levels to support the range of expected crew tasks.** |  |

A wide range of crew tasks is expected to be performed within the vehicle. The required lighting levels vary, depending on the task being performed. For instance, cabin reconfiguration after orbit insertion may require simultaneous reading of labels and checklists, crew translation, mechanical assembly, and manual control at a variety of vehicle locations, each of which requires sufficient lighting without blockage from crew and equipment in transit. Similarly, rendezvous and proximity operations may require general cabin darkening for out-the-window viewing but sufficient lighting for crew translation and manual control. A single type of lighting at a single illumination level is insufficient to support all tasks; therefore, both general and task illumination are necessary.

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| [AX-430](http://192.168.10.14:8080/browse/AX-430) | **Delete: The Axiom module shall provide exterior lighting to aid the crew in assembly, maintenance, navigation, rendezvous and docking, ingress and egress, EVA operations, and external task operations.** |  |

External operations are performed on a routine basis. Lighting types and illumination levels appropriate to the expected tasks are necessary to accomplish mission objectives.

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| [AX-431](http://192.168.10.14:8080/browse/AX-431) | **The Axiom module shall provide emergency lighting for crew egress and/or operational recovery in the event of a general power failure.** |  |

Emergency lighting is a part of the overall lighting system for all vehicles. It allows for crew egress and/or operational recovery in the event of a general power failure. The emergency lighting system is to be automatically activated to allow operators and other occupants of a vehicle to move to a safe location and allow efficient transit between any inhabited location and designated safe haven(s). Efficient transit includes appropriate orientation with respect to doorways and hatches, as well as obstacle avoidance along the egress path.

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| [AX-432](http://192.168.10.14:8080/browse/AX-432) | **Delete:During waking hours, Axiom module lighting systems shall provide the crew with retinal light exposure that is sufficient in intensity and optimal in wavelength to entrain the human circadian pacemaker to a 24-hour day.** |  |

Lighting systems are to provide the proper light for circadian entrainment to address disruptions in the sleep/wake cycles of space flight crews. Difficulties in establishing stable circadian cycles are similar to those experienced by people on Earth who work rotating shifts, by air travelers traversing multiple time zones (jet lag), submariners, and some individuals enduring winter months at high latitudes. The human circadian cycle may be entrained (synchronized) by a variety of environmental stimuli, but the most influential is the exposure to bright light.

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| [AX-433](http://192.168.10.14:8080/browse/AX-433) | **Axiom module lighting systems shall have on-off controls.** |  |

Controls for turning lighting on and off within each module allow crewmembers to see the effect of changes to lighting controls without changing their location. Easy access to the controls is necessary. Light sources are to be capable of being turned completely off and returned to on. This control allows for the execution of operations that require observation through windows or photography and for crew functions such as sleep.

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| [AX-434](http://192.168.10.14:8080/browse/AX-434) | **Axiom module interior lights shall be adjustable (dimmable) from their maximum output level to their minimum luminance.** |  |

Interior lighting is to be adjustable to permit the crew to use out-the-window views when there is little external light, for example, during rendezvous, and to allow the selection of lower light levels when crewmembers are resting.

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| [AX-435](http://192.168.10.14:8080/browse/AX-435) | **Delete: The Axiom module shall prevent both direct and indirect glare that causes discomfort to humans or impairs their vision.** |  |

Eye discomfort can occur and visual performance can be negatively affected by glare. If a light source within the observer's field of view provides much more luminance than its surroundings (higher range of contrast) and occupies a significant portion of the field of view, it may act as a direct glare source. If the reflection of a light source from a surface within the field of view provides an area whose luminance greatly exceeds that of its surroundings, it may act as a reflected (indirect) glare source. The types of tasks expected to be performed are to be considered, as well as the location where the tasks occur, whether they are internal or external to the vehicle. Glare should first be eliminated though proper arrangement of workstations and light sources (including windows). In situations where this perfect arrangement is not possible, mitigating measures, such as lighting source baffles, window shades, and computer monitor glare shields, can be used.

##### Hardware and Equipment

###### Standardization

This section includes requirements for commonality and ease-of-use of crew hardware.

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| [AX-436](http://192.168.10.14:8080/browse/AX-436) | **Axiom module hardware and equipment performing similar functions shall have commonality of crew interfaces.** |  |

The intent of this requirement is to ensure commonality and consistency within a given human space flight program. This facilitates learning and minimizes crew error.

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| [AX-437](http://192.168.10.14:8080/browse/AX-437) | **Axiom module hardware and equipment that have the same or similar form but different functions shall be readily identifiable, distinguishable, and not be physically interchangeable.** |  |

The intent of this requirement is to avoid potential confusion crewmembers may experience that can lead to errors when items with similar form are not readily identifiable or physically distinguishable.

###### Hazard Minimization

This section includes requirements for avoiding mechanical, electrical, and spill hazards.

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| [AX-502](http://192.168.10.14:8080/browse/AX-502) | **Axiom hardware and equipment that may be exposed to crew contact shall be designed to prevent hazards to the crew.** |  |

Crew safety is critical to mission and program success. Hazards that result in minor crew injury can affect the ability of the crew to effectively perform their required duties and result in loss of productive time. Significant injuries carry a human cost and can result in emergency situations or lead to loss of program viability.

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| [AX-438](http://192.168.10.14:8080/browse/AX-438) | **Axiom module systems, hardware, and equipment shall be designed to protect the crew from moving parts that may cause injury to the crew.** |  |

Known mechanical hazard sources can be defined in a requirement. Consistently moving equipment is easy to identify and guard. Infrequent or unpredictable movement may be a less obvious hazard. If possible, system requirements are to identify potential sources of unpredictable or infrequent movement and spell out specific guarding requirements for these systems.

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| [AX-439](http://192.168.10.14:8080/browse/AX-439) | **Axiom module systems, hardware, and equipment shall be designed to protect the crew from entrapment (tangles, snags, catches, etc.).** |  |

This applies to items with which the crew will come into direct contact. Entrapment can occur in places where loose cables or equipment items block passageways or where crewmembers purposely fasten motion restraints (seat belts and shoulder harnesses, foot restraints, tethers, etc.). Entrapment can also occur from protrusions or openings that snag body parts or personal equipment. For example, if holes are small, then fingers may be entrapped. Larger holes, on the other hand, allow free movement. Crewmembers are likely to be under time-critical conditions when they need to evacuate or return to safety. If possible, requirements are to focus on those situations.

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| [AX-440](http://192.168.10.14:8080/browse/AX-440) | **Axiom module hardware and equipment shall not release stored potential energy in a manner that causes injury to the crew.** |  |

Requirements are to identify all known sources of stored potential energy. As with all hazards, this can be mitigated by designing out the hazard, the use of safety devices, providing warnings, or through procedures and training. These mitigations are arranged in descending order of preference: designing out the hazard is the most preferred, and relying on procedures or training is the least preferred.

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| [AX-441](http://192.168.10.14:8080/browse/AX-441) | **Axiom module hardware mounting and habitat enclosures shall be configured such that the crew is protected from projectiles and structural collapse in the event of sudden changes in acceleration or collisions.** |  |

Chances for crew survivability in otherwise catastrophic conditions can be greatly increased by attention (early in the design process) to structure and mounting designs such that the crew habitable volume remains intact and free of secondary projectiles.

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| [AX-442](http://192.168.10.14:8080/browse/AX-442) | **Corners and edges of fixed and handheld equipment in the Axiom module to which the bare skin of the crew could be exposed shall be rounded.** |  |

Sharp corners and edges in passageways, maintenance areas, stowage compartments, or workstations present hazardous conditions and are to be avoided. Also, hand-held items, such as tools, present a hazard to the crew. In addition to potential hazards from IVA exposure, EVA exposure to sharp surfaces could damage suit integrity. This requirement applies to bare skin. Gloves and clothing may protect skin; however, some clothing or equipment items may be more vulnerable to tears and cuts; separate requirements need to be established for those items. The crew may be exposed to items manufactured by a variety of companies, and this requirement is to be reflected in requirements for all of them.

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| [AX-443](http://192.168.10.14:8080/browse/AX-443) | **Functionally sharp items in the Axiom module shall be prevented from causing injury to the crew or damage to equipment when not in use.** |  |

Functionally sharp items are those that, by their function, do not meet the requirement for exposed corners and edges, i.e., syringes, scissors, and knives. These items are to be prevented from causing harm when not in nominal use. Capping sharp items is one way of doing this.

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| [AX-444](http://192.168.10.14:8080/browse/AX-444) | **Corners and edges of loose equipment to which the crew could be exposed in the Axiom module shall be rounded.** |  |

The force (and resulting damage) in contact with fixed items depends on the mass and speed of the crewmember. The damage from loose items, however, depends on the weight of the item. For example, a person running into a fixed clipboard will cause more damage than if the clipboard were thrown at that person. Therefore, the corners and edges of a loose item do not have to be as rounded as a fixed item.

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| [AX-445](http://192.168.10.14:8080/browse/AX-445) | **Exposed surfaces in the Axiom module shall be free of burrs.** |  |

Burrs are manufacturing artifacts or can occur during a mission as a result of maintenance or assembly operations. Burrs cause damage to equipment and skin. They are to be removed as a part of the manufacturing process, or if it is likely that they will be created during a mission, a means is to be provided to eliminate crew exposure to the burrs.

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| [AX-446](http://192.168.10.14:8080/browse/AX-446) | **Pinch points in the Axiom module shall be covered or otherwise prevented from causing injury to the crew.** |  |

Pinch points can cause injury to the crew but may exist for the nominal function of equipment, i.e., equipment panels. This may be avoided by locating pinch points out of the reach of the crew or by providing guards to eliminate the potential to cause injury.

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| [AX-447](http://192.168.10.14:8080/browse/AX-447) | **Any surface in the Axiom module to which the bare skin of the crew is exposed shall not cause epidermis/dermis interface temperature to exceed the pain threshold limit of 44 deg. C (111.2 deg. F).** |  |

Research by Greene, et al., (1958) on human tolerance to heat pain showed that the pain threshold is reached at 43.7 deg. C (110.6 deg. F) skin temperature. Lloyd-Smith and Mendelssohn (1948) found the pain threshold to be 44.6 deg. C (112.3 deg. F). Defrin, et al., (2006) investigated heat pain threshold across the body and found the lowest level in the chest (42 deg.C (107.6 deg. F)), the highest in the foot (44.5 deg. C (112.1 deg. F)), and in the hand 43.8 deg. C (110.8 deg. F). In a study by Moritz and Henriques (1947), 44 deg. C (111.2 deg. F) was the lowest temperature at which significant epidermal damage occurred, after exposure was sustained for 6 hours. As the contact temperature increased above 44 deg. C (111.2 deg. F), the time to damage was shortened by approximately 50 percent for each 1 deg. C (1.8 deg. F) rise in temperature up to about 51 deg. C (123.8 deg. F). Increasing contact pressure was not sufficient to increase the risk of thermal injury. At contact skin temperatures above 70 deg. C (158 deg. F), it took less than 1 second to produce complete epidermal cell death. Pain threshold, rather than damage threshold, should be used to (a) preclude skin damage and (b) prevent a startle pain reaction, i.e., pulling a hand away quickly, which may cause injury from flailing

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| [AX-448](http://192.168.10.14:8080/browse/AX-448) | **Any surface in the Axiom module to which the bare skin of the crew is exposed shall not cause skin temperature to drop below the pain threshold limit of 10 deg. C (50 deg. F).** |  |

Studies on the thermal performance of spacesuit gloves have shown that pain from cold occurring at hand skin temperatures of 10 deg. C (50 deg. F) was deemed tolerable (JSC 39116, EMU Phase VI Glove Thermal Vacuum Test and Analysis Final Report; Bue, 2009). Previous research on human tolerance to cold has shown that numbness occurs at 7 deg. C (44.6 deg. F) skin temperature (Provins and Morton, 1960) and risk of frostbite at 0 deg. C (32 deg. F) (Havenith, et al., 1992). Pain threshold, rather than damage threshold, should be used to (a) preclude skin damage and (b) prevent a startle pain reaction, i.e., pulling a hand away quickly, which may cause injury from flailing. In addition, staying above the numbness threshold is important, both because numbness can mask skin damage, which may impact flight safety, and also to allow normal touch sensation for tasks after contact with cold objects.

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| [AX-449](http://192.168.10.14:8080/browse/AX-449) | **All items in the Axiom module designed to be carried or removed and replaced shall have a means for grasping, handling, and carrying (and, where appropriate, by a gloved hand).** |  |

Grasping, gripping, and moving hardware using hardware features that are not intended to be handles can damage the hardware or slip away and injure the crewmember or damage surrounding hardware. This can be prevented by designing obvious features that are intended for grasping, gripping, or moving the item.

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| [AX-450](http://192.168.10.14:8080/browse/AX-450) | **The Axiom module shall provide the crew with capability to control the power to an electrical circuit.** |  |

This assumes that, at some point in a mission, all circuits could require crew contact with exposed conductors. There is to be a way for the crew to eliminate this exposure. At the least, it could interfere with task performance, and at the most, it could cause serious injury or death.

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| [AX-451](http://192.168.10.14:8080/browse/AX-451) | **The Axiom module shall provide and display the de-energized status (interruption of electrical power) of a circuit to the crew.** |  |

When de-energizing a system, the user should always be provided with feedback that confirms the function has occurred. Because of the critical nature of this information, the complexity of some circuits, and the possibility of a false indication, many times circuit status is verified using a separate tool, such as an electromagnetic sensor.

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| [AX-452](http://192.168.10.14:8080/browse/AX-452) | **The Axiom module systems, hardware, and equipment shall be designed to protect the crew from any incidental or intentional exposure above 32 V RMS.** |  |

Safe touch DC voltages, as determined by the International Electrotechnical Commission (IEC) TR 60479-5 Edition 1.0, Effects of current use on human beings and livestock - Part 5: Touch voltage threshold values for physiological effects, for a startle reaction can range from 1 to 78 V RMS. The ISS and Shuttle Programs have set 32 V as catastrophic (JSC Interpretation Letters: Electrical Shock TA-94-029, On-Orbit Boarding and Grounding MA2-99-142, and Mate/Demate MA2-299-170). Therefore, it is reasonable that voltages not exceed this conservative crew exposure limit without hazard controls to ensure safety of the crew.

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| [AX-453](http://192.168.10.14:8080/browse/AX-453) | **Delete: The Axiom program shall determine the physiological effects of current exposure in accordance with IEC TR 60479, Edition 1.0, for systems designed to operate at or below 32 V RMS and protect the crew in a manner commensurate with those effects.** |  |

The IEC is the leading global organization that prepares and publishes international standards for all electrical, electronic, and related technologies. Programs are to use this information to determine hazard severity based on physiological reaction (IEC TR 60479-5, Edition 1.0, table 1) during the conditions of exposure, e.g., skin resistance, surface area contact, current pathway through the body. IEC TR 60479-5, Edition 1.0, table 2, provides the minimum touch voltage threshold for AC and DC corresponding to startle reaction, strong muscular reaction, and ventricular fibrillation.

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| [AX-454](http://192.168.10.14:8080/browse/AX-454) | **Delete: For Axiom module equipment designed to contact the human body, electrical leakage currents caused by contact with exposed surfaces shall be kept below the levels specified in the accompanying rationale.** |  |

Some equipment needs to pass small amounts of current through the body to accomplish its intended function, e.g., bias currents in medical monitoring equipment. The amount of current allowed depends on the frequency and whether the part of the equipment contacting the crewmember is isolated from the power source. Examples of isolated equipment are intra-aortic catheters and electrocardiogram (ECG) monitors. Examples of non-isolated equipment are blood pressure cuffs and digital thermometers. These levels of leakage current are consistent with those in IEC 60601-1, Medical Electrical Equipment - Part 1: General Requirements for Basic Safety and Essential Performance, for patient auxiliary and patient leakage currents in isolated (type CF) and non-isolated (types B and BF) equipment. These leakage currents are measured across parts applied to the crewmember and also from the applied parts to ground. The summation of all the currents should be compared to the current limits below.

===Maximum Current in mA RMS===  
￼  
External Body Contact

* Frequencies from DC\* to 1 kHz
  + Normal operating condition: 0.1
  + Single Fault operation condition: 0.5
* Frequencies above 1 kHz
  + Normal operating condition: Lesser of (0.1 x frequency in kHz) or 5
  + Single Fault operation condition: Lesser of (0.5 x frequency in kHz) or 5

Internal\*\* Body Contact

* Frequencies from DC to 1 kHz
  + Normal operating condition: 0.01
  + Single Fault operation condition: 0.05
* Frequencies above 1 kHz
  + Normal operating condition: Lesser of (0.01 x frequency in kHz) or 1
  + Single Fault operation condition: Lesser of (0.05 x frequency in kHz) or 1

\*For DC currents, there is a small risk of heating and tissue necrosis for prolonged duration of contact.  
\*\*Non-Isolated equipment is not allowed for internal contact.

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| [AX-455](http://192.168.10.14:8080/browse/AX-455) | **Axiom module hardware and equipment shall not release stored fluids or gases in a manner that causes injury to the crew.** |  |

Crew injuries are likely to be caused by either highly pressurized fluids and gases or toxic fluids and gases. In both cases, design requirements are to be developed so that the crew is protected during both storage and handling of these fluids and gases.

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| [AX-456](http://192.168.10.14:8080/browse/AX-456) | **The Axiom module shall provide for the isolation or shutoff of fluids and gases in hardware and equipment.** |  |

Gases and fluids are most likely to be temporarily shut off at service and maintenance points. System developers are to identify those points and create isolation capabilities. Without dedicated isolation controls, crews could create bypasses, which waste crew time and possibly damage systems. Also, to save time and reduce the possibilities of error, e.g., forgetting to shut them off or to turn them back on when maintenance is complete, the shut-off valves are to be located near those service points.

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| [AX-457](http://192.168.10.14:8080/browse/AX-457) | **Delete: The Axiom module shall provide for containment and disposition of fluids and gases that might be released.** |  |

Excess gases and fluids are likely to be released during draining and filling of systems. Designs are to accommodate these possibilities to ensure capture, containment, and disposal that is safe and effective. Capture facilities are to be located near the points where release is likely to occur (maintenance or service points).

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| [AX-458](http://192.168.10.14:8080/browse/AX-458) | **The Axiom module shall provide protective equipment to protect the crew from expected hazards.** |  |

Analyses are to define anticipated hazards and appropriate protective equipment. Protective equipment might include gloves, respirators, goggles, and pressure suits. The equipment is to fit the full range of crewmembers. This might require adjustable gear or multiple sizes (with consideration of the number of crewmembers that may have to use the equipment at the same time.) Because the gear could be used under emergency conditions, it is to be located so that it is easily accessed and is to be simple to adjust and don. Protective equipment shall not interfere with ability to conduct nominal or contingency operations, which the crew is expected to perform while using the protective equipment, including communication between crewmembers and with the ground.

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| [AX-459](http://192.168.10.14:8080/browse/AX-459) | **Delete: Axiom module protective equipment shall not interfere with ability to conduct nominal or contingency operations, which the crew is expected to perform while using the protective equipment, including communication between crewmembers** |  |

Analyses are to be performed of the situations and operations in which protective equipment is to be used. This analysis is to define the task demands and the requirements for protective equipment design. Task performance demands might include visibility, range of motion, dexterity, and ability to communicate.

###### Design for Maintainability

This section includes requirements for designs to be easily and efficiently maintained by the crew.

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| [AX-460](http://192.168.10.14:8080/browse/AX-460) | **The Axiom module shall provide the means necessary for the crew to safely and efficiently perform routine service, maintenance, and anticipated unscheduled maintenance activities.** |  |

Maintenance and servicing are not directly related to mission goals. Reduction in the time devoted to maintenance and servicing can mean more crew time devoted to achieving mission goals. Also, because of the complexity of space missions and the interdependency of many factors (equipment, supplies, weather, solar flares, political considerations, etc.), designs are to minimize reliance on outside maintenance support. Designs are to provide the tools, parts, supplies, training, and documentation necessary for crews to maintain efficient and safe operations.

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| [AX-461](http://192.168.10.14:8080/browse/AX-461) | **Delete: Maintenance for commercial off-the-shelf equipment in the Axiom module shall be suitable to the space flight environment.** |  |

Systems designed for terrestrial environments may be adapted for space missions. This adaptation is to include procedures and features that will allow maintenance tasks to be performed safely and effectively in a space mission environment. Major changes that likely need accommodation are differences in gravity or crewmembers wearing gloves.

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| [AX-462](http://192.168.10.14:8080/browse/AX-462) | **The Axiom program shall establish a set of in-flight tools necessary to maintain or reconfigure the module.** |  |

Tool set design is to be based partly on reducing the demands on the crew: selecting tools that are likely to be familiar to crewmembers and minimizing the number of different tools. Also, tools are to be usable by the full range of crew sizes and strengths wearing any protective equipment (EVA suits, protective eyewear, gloves, etc.).

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| [AX-463](http://192.168.10.14:8080/browse/AX-463) | **Delete: Planned maintenance for the Axiom module and associated hardware and equipment shall be capable of being performed within the allotted crew schedule.** |  |

Maintenance and servicing are not directly related to mission goals. Reduction in the time devoted to maintenance and servicing can mean more crew time devoted to achieving mission goals. Also, because of the complexity of space missions and the interdependency of many factors (equipment, supplies, weather, solar flares, political considerations, etc.), designs are to minimize reliance on outside maintenance support. Designs are to provide the tools, parts, supplies, training, and documentation necessary for crews to maintain efficient and safe operations.

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| [AX-464](http://192.168.10.14:8080/browse/AX-464) | **All Axiom module systems and equipment will be designed to reduce the need for maintenance.** |  |

Maintenance and servicing are not directly related to mission goals. Reduction in the time devoted to maintenance and servicing can mean more crew time devoted to achieving mission goals. Also, because of the complexity of space missions and the interdependency of many factors (equipment, supplies, weather, solar flares, political considerations, etc.), designs are to minimize reliance on outside maintenance support. Designs are to provide the tools, parts, supplies, training, and documentation necessary for crews to maintain efficient and safe operations.

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| [AX-465](http://192.168.10.14:8080/browse/AX-465) | **Delete: Where possible, Axiom module equipment shall be replaceable as modular units.** |  |

Modular units can reduce maintenance times by eliminating removal, replacement, and checkout of individual components. Modular units may also reduce training times.

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| [AX-466](http://192.168.10.14:8080/browse/AX-466) | **Fasteners used by the crew during Axiom module maintenance shall be captive.** |  |

Fasteners can be lost either by loosening during normal use or by becoming misplaced during maintenance operations. Space missions are generally isolated, and replacement parts are not available. This is particularly important in zero gravity environments because small items such as fasteners can be very difficult to find.

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| [AX-467](http://192.168.10.14:8080/browse/AX-467) | **Delete: For items that may be serviceable by the Axiom crew, the number of fasteners used shall be the minimum required to meet structural engineering design practices.** |  |

Designers can add a safety factor to some configurations by increasing the number of fasteners. However, when crews are to routinely remove the fasteners, selection of the number of fasteners is also to consider reduction of crew time devoted to maintenance activities.

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| [AX-468](http://192.168.10.14:8080/browse/AX-468) | **The Axiom module will to the extent possible use a common set of fasteners that meet structural engineering design practices.** |  |

Different fasteners require different tools and procedures for removal and replacement. Commonality of fasteners can reduce times to access and the need for different tools. It can also reduce training times necessary to introduce crews to the fastener types.

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| [AX-469](http://192.168.10.14:8080/browse/AX-469) | **The Axiom module shall make accessible items that require routine maintenance not require the removal or disabling of other systems or components.** |  |

Location of items depends on many factors (physical room, interface with other items, manufacturing considerations, etc.), and maintenance can be easily overlooked. It is important, therefore, that, early in a design, system developers identify those items that will require maintenance. Accessibility to those items then becomes a higher priority in selecting the location of these items.

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| [AX-470](http://192.168.10.14:8080/browse/AX-470) | **Check points and service points for Axiom systems, hardware, and equipment shall be directly accessible.** |  |

System designs are to support mission goals that do not normally devote crew time to maintenance tasks. Removal of items to access check and service points increases maintenance times. Also, complex and time-intensive maintenance procedures could discourage performance of scheduled tasks.

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| [AX-471](http://192.168.10.14:8080/browse/AX-471) | **Delete: Physical work access envelopes in the Axiom module shall accommodate the crew and any protective equipment needed to perform maintenance.** |  |

Maintenance tasks are to be defined and analyzed with worst-case assumptions. Volume is to be provided to allow the size extremes in the crewmembers performing the tasks using proper tools and protective equipment within the prescribed times.

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| [AX-472](http://192.168.10.14:8080/browse/AX-472) | **Delete: Axiom module maintenance tasks that require visual feedback shall be directly visible during task performance.** |  |

Efficient and safe performance of many maintenance tasks requires vision during task performance. In crowded spaces, hands and tools can block vision of the task. On those tasks that require vision during task performance (such as alignments or adjustments), designers are to locate and design equipment to provide this vision.

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| [AX-473](http://192.168.10.14:8080/browse/AX-473) | **Clearance shall be provided for the crewmember to obtain hand access during Axiom module maintenance.** |  |

Hand clearance for in-flight maintenance tasks is to be provided by the hardware developer to ensure that maintenance tasks can be performed. For reference, ISS accommodates human body dimensions from a 95th percentile American male to a 5th percentile Japanese female in the design of all ISS IVA flight crew interfaces as stated in SSP 50005, paragraph 3.3.1.3.

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| [AX-474](http://192.168.10.14:8080/browse/AX-474) | **The Axiom module shall provide tool clearances for tool installation and actuation for all tool interfaces during in-flight maintenance.** |  |

Tools to be used for in-flight maintenance are to be identified by the hardware developer, and clearance for application is to be accommodated to ensure that maintenance tasks can be performed.  
For reference on ISS tool clearances, see SSP 50005, paragraphs 11.2.3.6 and 11.10.3.6.  
Note: On-orbit tools available to the ISS crew are listed in SSP 41000, (Table XLIX Standard IVA Tool List and Table L IVA Diagnostic Equipment List) and JSC 28918, Extravehicular Activity (EVA) Design Requirements and Considerations, Table 1-1.

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| [AX-475](http://192.168.10.14:8080/browse/AX-475) | **Delete: The Axiom module shall provide rapid and positive fault detection and isolation of defective items.** |  |

Fault detection is a means to reduce crew time devoted to maintenance activities. Properly designed aids to fault detection and isolation can also reduce crew training requirements. Terminology, references, and graphics used are to be coordinated with other crew task demands so as to minimize additional training. Designers are to define systems that are likely to fail and then create features that help identify these failures when they occur. In addition to the fault detection and isolation capabilities, the crew is to be provided tools and supplies to maintain and repair the defective systems.

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| [AX-476](http://192.168.10.14:8080/browse/AX-476) | **The Axiom module shall alert the crew when critical equipment has failed or is not operating within tolerance limits.** |  |

An alerting system decreases the cognitive load on the crew: they do not have to try to surmise a system failure based on symptoms. Terminology, references, and graphics used are to be coordinated with other crew task demands so as to minimize additional training.

##### Crew Interfaces

###### General

This section includes requirements for usability, standardization, distinction, ease-of-use of crew interfaces. It also provides requirements for system interaction and procedures.

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| [AX-477](http://192.168.10.14:8080/browse/AX-477) | **The Axiom module shall provide a positive indication of crew-initiated control activation.** |  |

A positive indication of control activation is used to acknowledge the system response to the control action. For example, a physical detent, an audible click, an integral light, or a switch position may be used to provide a positive indication of control activation.

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| [AX-478](http://192.168.10.14:8080/browse/AX-478) | **Delete: The Axiom module shall indicate to the crew which step in the electronically displayed procedure is currently being executed.** |  |

The current procedure line is to be highlighted in some way to prevent the crew from missing steps, which can result in errors and wasted time. In addition, if the crew becomes distracted or called to support a different task and needs to be able to come back to the last completed step, devices/markers should be available to support resuming the interrupted procedure.

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| [AX-479](http://192.168.10.14:8080/browse/AX-479) | **Delete: The Axiom module shall indicate to the crew which steps in the electronically displayed procedure have been completed.** |  |

This requirement prevents the crew from re-executing steps in a procedure by highlighting the steps that have been completed. Completed steps need to be highlighted in some way to prevent the crew from re-executing steps, which can result in errors and wasted time.

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| [AX-480](http://192.168.10.14:8080/browse/AX-480) | **Delete: The Axiom module shall provide a method for viewing prior and future steps in the electronically displayed procedure.** |  |

The crew is to be able to look back in procedures to see what has been completed and to be able to look forward in procedures to see upcoming steps.

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| [AX-481](http://192.168.10.14:8080/browse/AX-481) | **Delete: The Axiom module shall provide a method for the crew to make real-time insertion, deletion, and rearrangement of electronic procedures.** |  |

During the course of a mission, the crew may need to make real-time modifications of procedures. In addition, performance can often be more effective if the sequence of procedures remains flexible throughout the mission. For lunar robotic activities, a priori information (resolution of maps, simulation of mobility over lunar regolith) of the lunar surface (or lack thereof), plans, and timelines for activities will be subject to change in real time. Real-time replanning of lunar surface activities will be necessary, and corresponding electronic procedures will need to be rearranged and assessed accordingly.

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| [AX-482](http://192.168.10.14:8080/browse/AX-482) | **Axiom module control systems shall be designed to prevent inadvertent operation.** |  |

This requirement allows for the design to preclude inadvertent operation. For example, accidental activation by bumping can be prevented by the use of guards, covers, and physical separation from other controls. Accidental activation of commands using a computer display can be prevented with an "arm-fire" mechanism. This requirement is not intended to prevent operators from initially selecting the wrong control. This requirement allows for the design of mechanisms for undoing a control input. If there has been an inadvertent input or a mistake in input, design requirements are to ensure the crew can recover with minimal impact.

###### Layout of Displays and Controls

This section includes requirements for location and relationships between displays and controls.

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| [AX-483](http://192.168.10.14:8080/browse/AX-483) | **Delete: Axiom module displays and controls shall be visible and be within the functional reach envelope of the crew.** |  |

Controls are to be within the operator's reach envelope under all vehicle conditions, e.g., g-loads and vibration, and all crew conditions, e.g., suited, seated, restrained, and unrestrained. Controls can include display devices such as touch screens. For reference, ISS accommodates human body dimensions from a 95th percentile American male to a 5th percentile Japanese female in the design of all ISS IVA flight crew interfaces as stated in SSP 50005, paragraph 3.3.1.3.

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| [AX-484](http://192.168.10.14:8080/browse/AX-484) | **Delete: Emergency, critical, important, and most frequently used Axiom module displays and controls shall be provided privileged positions in the crew's viewing and operating zones.** |  |

During the design process, trade-off of location of critical controls is to be made; however, all controls are required to be within the functional reach envelope of the crew. The most important or critical displays and controls are to be located in the most prominent, noticeable locations and also be quickly accessible. This helps ensure quick processing and reaction to important displays and controls.

###### Displays

This section includes requirements for design, content (readability and interpretation) and labeling of displays and specific requirements for legibility of visual displays and intelligibility of audio displays.

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| [AX-485](http://192.168.10.14:8080/browse/AX-485) | **Frequency content of Axiom module auditory alarms shall correspond to maximal human sensitivity (200 Hz to 4 kHz).** |  |

Auditory alarms are to use frequencies that are appropriate for human hearing. Using frequencies below or above those appropriate for human hearing makes auditory displays inaudible for the crew.  
For reference on how ISS ensures alarm audibility –  
ISS requires the SPL at the operating position of the intended receiver of the alarm signal to meet at least one of the following criteria:  
1. Using measurements of A-weighted sound levels [ISO 7731:2003(E), method a) in 5.2.2.1], the difference between the two A-weighted sound pressure levels of the signal and the ambient noise shall be greater than 15 dBA (LS,A - LN,A > 15 dBA). This criteria shall be satisfied if the alarm signal is intended to arouse sleeping occupants,  
2. Using measurements of octave-band sound-pressure levels [according to ISO 7731:2003(E), method b) in 5.2.3.1], the sound-pressure level of the signal in one or more octave-bands shall exceed the effective masked threshold by at least 10 dB in the frequency range from 250 Hz - 4000 Hz (LSi,oct - LTi,oct > 10 dB). The method given in ISO 7731:2003(E) Annex B to calculate the effective masked threshold shall be used to verify this requirement,  
3. Using measurements of 1/3 octave-band sound-pressure levels [according to ISO 7731:2003(E), method c) in 5.2.3.2], the sound-pressure level of the signal in one or more 1/3 octave-bands shall exceed the effective masked threshold by 13 dB in the frequency range from 250 Hz - 4000 Hz (LSi,1/3oct - LTi,1/3oct > 13 dB).  
Note [1]: effective masked threshold - level of auditory danger signal just audible over the ambient noise, taking account of the acoustic parameters of both the ambient noise in the signal reception area and the listening deficiencies (hearing protection, hearing loss and other masking effects). The method for calculating the masked threshold is given in ISO 7731:2003(E) Annex B.

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| [AX-486](http://192.168.10.14:8080/browse/AX-486) | **Labels and location coding shall be provided so that the Axiom crew can identify items, interpret and follow nominal and contingency procedures, and avoid hazards.** |  |

Crew interface items are to have identifiers (labels) to aid in crew training and error-free operation. Labels reduce memory load and improve accuracy of tasks. This includes identification of locations within the vehicle, emergency equipment and procedures.  
For reference on ISS labeling, see SSP 50005, section 9.5.3.1. For reference on location coding used on ISS see, SSP 30575, Space Station Interior and Exterior Operational Location Coding System, paragraph 3.1.1.

###### Children

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| [AX-487](http://192.168.10.14:8080/browse/AX-487) | **Axiom module labels shall be consistent and standardized throughout the system.** |  |

Standardization of labels reduces learning and recognition times, which is especially important in emergencies. Specific labels are always to be used for the same type of item, and similarities are reflected by using similar nomenclature on the label.

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| [AX-488](http://192.168.10.14:8080/browse/AX-488) | **Delete: Axiom moduel labels shall use a font height of 0.4 degrees or greater.** |  |

Font height in degrees refers to the angle subtended at the eye by the height of an uppercase letter in the font. Labels are to use a large enough font size to ensure legibility. Small fonts can make labels difficult to perceive by the crew, consequently increasing the time needed for item identification. The font height given is a minimum. The font may have to be larger for readability when taking into account the ambient illumination, glare, reflections, vibration, position, and orientation of the label relative to the crew.

###### Controls

This section includes requirements for shape, identification, accesibility, and feedback of controls.

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| [AX-489](http://192.168.10.14:8080/browse/AX-489) | **Delete: Axiom module controls that are intended for out-of-view operation shall be spatially or tactually distinct from one another.** |  |

When the crew inadvertently operates the wrong control, serious errors can result. Controls designed to be out-of view while being operated are to be spaced or shaped/textured such that the control can be identified with a pressurized gloved hand without line of sight. This would include controls for vehicle operation, as well as other controls, e.g., seat positioning). It has been shown that human operators can use simple tactile coding to reliably distinguish between items.

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| [AX-490](http://192.168.10.14:8080/browse/AX-490) | **The Axiom module shall provide coding for emergency controls that are distinguishable from non-emergency controls.** |  |

When the crew inadvertently operates the wrong control, serious errors can result. Controls designed to be out of view while being operated are to be spaced or shaped/textured such that the control can be identified with a pressurized gloved hand without line of sight. This would include controls for vehicle operation, as well as other controls, e.g., seat positioning. It has been shown that human operators can use simple tactile coding to reliably distinguish between items.

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| [AX-491](http://192.168.10.14:8080/browse/AX-491) | **Delete: The size and spacing of Axiom module controls shall be optimized for operation by the expected body part, e.g., finger, hand, foot, and expected clothing.** |  |

The size of a control is to be appropriate for the way it is intended to be used. Controls operated by finger are to be smaller than controls operated by hand to ensure optimal manipulation. Incorrectly sized controls may cause errors during control operation.

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| [AX-493](http://192.168.10.14:8080/browse/AX-493) | **Delete: Axiom module controls shall be designed such that the input direction is compatible with the resulting system response.** |  |

The relation between input direction and system responses is to be intuitive and easy to perceive. This makes sure that when a control is used, system response is easy to link and conforms to crew expectations. Operator confusion may result, should system responses not be compatible with input directions.

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| [AX-494](http://192.168.10.14:8080/browse/AX-494) | **Delete: The Axiom module shall provide controls such that the crew is unimpeded by the time lag between the operation of a control and the associated change in system state.** |  |

State changes associated with the operation of a control are to be easy to link together in time. If the two events occur with a time lag, it is difficult to identify whether the operation of the control had the intended effect.

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| [AX-495](http://192.168.10.14:8080/browse/AX-495) | **Axiom module control resistive force shall be sufficient to prevent unintended drifting or changing of position.** |  |

Controls are not to be capable of being accidentally actuated by unintended actions. This reduces the number of errors and increases safety.

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| [AX-496](http://192.168.10.14:8080/browse/AX-496) | **Axiom module detent controls shall be provided when control movements occur in discrete steps.** |  |

Mechanisms that provide control feedback to crewmembers are to be based on the amount of the movement applied to the control. This is usually provided using auditory and haptic feedback.

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| [AX-497](http://192.168.10.14:8080/browse/AX-497) | **For Axiom module controls, stops shall be provided at the beginning and end of a range of control positions, if the control is not required to be operated beyond the end positions or specified limits.** |  |

Limits within which controls can be operated are to be obvious to the crew by the provision of easy-to-perceive stops in the mechanism of the controls. Failure to include stops can result in increased operations time, as the operator may needlessly continue to turn a dial after it has reached its functional end point.

###### Children

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| [AX-498](http://192.168.10.14:8080/browse/AX-498) | **Delete: Controls to be used by suited Axiom crewmembers shall be operable by a suited crewmember.** |  |

Controls that are intended to be used by suited crewmembers are to have the appropriate features for suited use. For instance, these controls may have to be adjusted to increase haptic feedback when used with gloved hand to make sure that the speed and accuracy of suited use is comparable to unsuited performance.

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| [AX-499](http://192.168.10.14:8080/browse/AX-499) | **Controls to be used by suited Axiom crewmembers shall be spaced such that they can be operated by a suited crewmember without inadvertent operation of adjacent controls.** |  |

Control layout is to take into account the fact that pressurized suited operators cannot operate with the same precision and dexterity as lightly clothed crewmembers in expected conditions, e.g., g-loads, vibration, and acceleration. Insufficient spacing may lead to inadvertent operation of an adjacent control.

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| [AX-492](http://192.168.10.14:8080/browse/AX-492) | **Delete: Axiom module controls used by a restrained or unrestrained crewmember shall be located within the functional reach zones of the crew.** |  |

A control that is required to be used at any time in a task is to be readily available and reachable by the crew to ensure smooth operation. Controls that are not readily available or not reachable can increase the time to perform operations.

#### Payload

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| [AX-530](http://192.168.10.14:8080/browse/AX-530) | **The Axiom module shall provide 10/100/1000 base-T ethernet for payloads.** |  |

Ethernet serves as a backup for the wifi, and also as a resource for those payloads which need gigabit data transfer rates.

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| [AX-532](http://192.168.10.14:8080/browse/AX-532) | **The Axiom payloads shall be capable of sending data.** |  |

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| [AX-531](http://192.168.10.14:8080/browse/AX-531) | **Th Axiom payloads shall be capable of receiving commands and data** |  |

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| [AX-529](http://192.168.10.14:8080/browse/AX-529) | **The Axiom module shall provide wifi networking for payloads.** |  |

Use of wifi instead of ethernet will substantially reduce wiring and make it significantly easier to upgrade networking infrastructure.

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| [AX-552](http://192.168.10.14:8080/browse/AX-552) | **Delete:The Axiom module shall house a high resolution/magnification nadir facing video camera on the end zone (so as to fit within the LV fairing)** |  |

Desired feature

##### Pressurized Payloads

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| [AX-534](http://192.168.10.14:8080/browse/AX-534) | **Pressurized payload accommodations shall be reconfigurable for a variety of sizes of payloads.** |  |

We would like to establish a standard system which is useful for deep space missions. If our system is not sufficient for a mission to Mars, it may end up becoming deprecated for the purposes of payloads designed for such a mission.

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| [AX-538](http://192.168.10.14:8080/browse/AX-538) | **The Axiom module shall provide accommodations for EXPRESS rack mid-deck locker equivalent (MLE) payloads to fit in the Axiom module rack space.** |  |

We may need to accommodate a limited number of payloads from ISS.

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| [AX-539](http://192.168.10.14:8080/browse/AX-539) | **The Axiom module shall accommodate up to 4 (TBD) legacy racks.** |  |

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| [AX-535](http://192.168.10.14:8080/browse/AX-535) | **The Axiom module shall provide nitrogen gas to the pressurized payloads.** |  |

The boiling point for liquid nitrogen is -195 C, which allows for cooling through a standard refrigeration cycle (e.g. Stirling) down to near 77 K. In a pinch, nitrogen gas could also potentially be used for Brayton cycle refrigeration (which handles the standard fridges and the -80 freezer). How many other payloads require nitrogen gas depends largely on what other refrigerants are permissible on ISS (e.g. R-508A and R-508B are both fairly safe and boil at -88 C; R-116 has a boiling point of -78 C and is even safer; and R-14 is safer still with a boiling point of -127.8 C).

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| [AX-536](http://192.168.10.14:8080/browse/AX-536) | **The Axiom module will provide lab freezers at appropriate temperatures for the science being conducted.** |  |

Such freezers are extremely useful for cell biology.

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| [AX-528](http://192.168.10.14:8080/browse/AX-528) | **The Axiom module shall provide a waste gas removal system.** |  |

Some experiments or payloads may produce waste gas which can be safely vented into space, but not into the cabin. This requirement is consistent with the existing ISS requirement.

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| [AX-527](http://192.168.10.14:8080/browse/AX-527) | **The Axiom module shall provide a vacuum resource system.** |  |

Some experiments may need to make use of a hard vacuum. In particular, a hard vacuum may be useful for insulation in the minus-eighty freezer and the cryo-freezer. This requirement is consistent with the existing ISS requirement.

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| [AX-526](http://192.168.10.14:8080/browse/AX-526) | **The Axiom module shall allow for the air-cooling of pressurized payloads.** |  |

Normally, express racks include an air avionics assembly (AAA), which is responsible for air cooling of payloads. However, we have identified a rack setup which is not based on express racks, which necessitates either a centralized air cooling system or a semi-centralized one (where there are numerous "payloads" consisting of AAAs).

SSP 57000P 3.10.

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| [AX-525](http://192.168.10.14:8080/browse/AX-525) | **The Axiom module pressurized payloads shall receive an interface to the ITCS low-temperature water loop.** |  |

Refrigeration cycles generally require cold water flow over the condenser. While other media may possess higher specific heat, water is non-toxic.

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| [AX-524](http://192.168.10.14:8080/browse/AX-524) | **The Axiom module pressurized payloads shall receive an interface to the ITCS moderate-temperature water loop.** |  |

This loop is responsible for water-cooling payloads. It needs to be above the dewpoint to avoid condensation of water vapor inside the payloads.

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| [AX-521](http://192.168.10.14:8080/browse/AX-521) | **Pressurized payloads shall conform to SSP 57000P 3.9 (environmental interface requirements).** |  |

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| [AX-515](http://192.168.10.14:8080/browse/AX-515) | **Pressurized payloads shall conform to electromagnetic compatibility requirements specified in TBD.** |  |

SSP 57000P 3.2.4 and subparagraphs.

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| [AX-514](http://192.168.10.14:8080/browse/AX-514) | **The Axiom module pressurized payloads' disturbing effects on the microgravity environment during Microgravity Mode periods shall be limited as specified in SSP 57000P 3.1.2 and subparagraphs.** |  |

##### External Attached Payloads

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| [AX-547](http://192.168.10.14:8080/browse/AX-547) | **The Axiom module shall provide connectors and mounting points for TBD nadir-viewing external payload interface units.** |  |

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| [AX-545](http://192.168.10.14:8080/browse/AX-545) | **External payload locations shall provide for an unobstructed 60 (TBD)-degree field-of-view from the Axiom module's solar panels (30 (TBD/2) degrees from any panel normal vector).** |  |

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| [AX-543](http://192.168.10.14:8080/browse/AX-543) | **Attached payloads designed to the 1.85m x 1.0m x 0.8m form factor shall be accessible to the SSRMS via PDGF, PVGF, or FRGF (power–data, power–video–data, and unpowered grapple fixtures, respectively).** |  |

This requirement dramatically reduces the need for EVAs, translation paths, etc., and almost totally eliminates for our purposes SSP 50005F Sec. 14.6 (EVA Tools, Fasteners, and Connectors). Additionally, customers have indicated they would prefer not to rely on EVAs at all.

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| [AX-540](http://192.168.10.14:8080/browse/AX-540) | **External payload locations shall provide for an unobstructed 60 (TBD)-degree field-of-view from crew quarter windows (30 (TBD/2) degrees from the window normal vector located at the window center).** |  |

SSP 50005F 8.11.3.A(6) specifies a "45.0 inch field of view for an eye reference point located along a normal to the window opening which passes through the geometric center of this opening" and that "This reference point shall be located half the window opening dimension from the inner pane." However, this requirement is only for those windows which are "for observation of decompression through airlock and pressure hatch covers."

11.11.2 suggests crew quarter windows are category B ("window ports to support crew viewing and crew photography"); however, 11.11.3.1.1 indicates that such windows "shall have a minimum clear viewing area equal to that of a 20.0 inch diameter circle." In 11.11.3.1.3.2 A(1), "viewing angles of 30 degrees from normal incidence" are mentioned as the field-of-view in which to minimize wavefront distortion through category B windows.

That suggests we should support a view out the window with no obstructions 30 degrees from the normal, or a field-of-view of 60 degrees. However, the choice is arbitrary.

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| [AX-840](http://192.168.10.14:8080/browse/AX-840) | **The Axiom module shall be able to provide 1.5 kW (TBR) of power to each unpressurized attached payload.** |  |

This was the power requirement suggested by one of our customers; they also asked for the JEM-EF form factor.

#### EVA

## Verification

Verification items to be linked to the requirements.