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Moon to Mars (M2M)

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REVISION G

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International Docking System Standard (IDSS)

Interface Definition Document (IDD)

Approved by the Exploration Systems Development Mission Directorate in August 2025.

National Aeronautics and Space Administration
James L. Lewis
Johnson Space Center
Houston, Texas
January 2026

REVISION AND HISTORY

Revision No.	Change No.	Description	Release. Date
-		Initial Release	09/21/2010
A		Revised, rearranged, and added text to nearly all sections of document. Revised & renumbered figures. Added requirements on mechanical soft capture, soft capture sensors, HCS seals, hook stiffness, separation system, electrical bonding, environments, and materials. Added Docking Performance section, and Appendix A.	05/13/2011
B		Document Hard Capture System parameter values, figure updates, separation system force addition, editorial correction, and updates.	11/15/2012
C		Document the narrow ring Soft Capture System (SCS) geometric parameters and update applicable figures. Added Appendix B on Magnetic Soft Capture.	11/20/2013
D		Revision D is the first version of the document under NASA configuration control and released by NASA ERU. Revision D includes the following DCNs: DCN 001 DCN 002 DCN 003 DCN 004C DCN 005 DCN 006 DCN 007 DCN 008A DCN 009B DCN 010 DCN 011 DCN 012 DCN 013	08/04/2015
E		Revision E includes the following DCNs: DCN 014 DCN 015A DCN 017 DCN 018	01/04/2017

Revision No.	Change No.	Description	Release. Date
		DCN 020 DCN 021	
F		DCN 022 DCN 023 DCN 024 DCN 025 DCN 027A DCN 029 DCN 032 DCN 033 DCN 037 DCN 038 DCN 039 Revision F updates the following: ▪ The ongoing development work in cis-lunar (Gateway, Orion, HLS) is a proving ground for standardization and interoperability. Additional requirements for cis-lunar have driven programs to make specific implementation decisions for resource umbilical, rendezvous targets, and berthing that are different than earlier definition associated with the ISS while honoring geometry and keep out zones (KOZ). Other developments in LEO are coming in the future. The committee has chosen to remove some information from the standard (reference below) and point to program specific ICDs and specification while referencing this information at the IDSS website, www.internationaldeepspacestandards.com and or www.internationaldockingstandard.com. ▪ Reference the preface for future goals of the committee with regards to these evolving interface definition. ▪ Incorporate previously approved DCNs ▪ Updates to Preface, Change Authority sections, and signature page. ▪ Updated section 3.4 and moved resource transfers specifications (sections 3.4.1 thru 3.4.5) to program specific Interface Definition Documents (IDDs) and Specifications.	01/31/2022

Revision No.	Change No.	Description	Release. Date
		▪ Updated section 3.5, Navigation and alignment Aids information (Section 3.5). Removed specific navigation target in Lieu of program specific IDDs and International Rendezvous System Interoperability Standard (IRSIS) document. ▪ Update Appendix C and D ▪ Remove Appendix E, Magnetic Capture Latch System since it is out of scope. ▪ Remove Appendix F, Berthing Compatibility Requirements, to IERIIS and CSA-GWY-ID-0001 documents. These documents are referenced in section 3.1.1.2.	
G		DCN 040A DCN 041A Revision G updates the following: ▪ **Updates to clarify requirements for docking developers, incorporate more lessons learned from docking systems developments, and improve manufacturability** o Updated section 3.1.2 to add general surface smoothness requirement. o Clarify soft capture ring dimension, figure 3.2.2.1-5 o Ring and guide locations figure 3.2.2.3-1 o Updated section 3.2.2.4 soft capture system section to clarify and interpret parameters of the system. o Added new requirement, Mechanical Capture Latch Configuration Control. o Added section 3.2.3.2 defining passive sealing surface o Updated section 3.3 to add new high torsion load case for vehicles with offset masses in relation to overall primary stack. o Updated figure 3.2.3.3-2 to add guide pins buttress base feature for high torsion load case o Provided clarification to paragraph 3.2.3.6 defining requirements for separation system (must be retracted below the	08/21/2025

Revision No.	Change No.	Description	Release. Date
		interface prior to docking), added generic statement to section 1.0 addressing unique program implementations and risk. o Section 3.2.3.4 Hard Capture Hooks, Hook motion figures clarifications o Updated section 3.2.4.2 Bonding, fault bond and contact o Section 3.2.5 Clarified interface environments. o Updated Section 3.4 and Figure 3.4-1 to define umbilical connector locations and removed all references to umbilical connector keep out zones and dimensions. o Other editorial and clarification updates ▪ **Evolve in-space vehicles mass property envelopes** o Updated section 3.3 mass properties and load tables after assessment of current vehicle developments o Added guidance for mass class vehicles that do not fall in the range of IDSS class ▪ **Add optional berthing requirements for docking system developers** o Added berthing requirements Section 3.6 (provides critical requirements. for docking developers that want berthing compatibility) ▪ **Add requirements IDs, titles, and rationale statements for existing and new shall statements for docking and berthing sections of the IDD.** o 37 Docking Shall Statements o 12 Docking Berthing Shall Statements	

PREFACE

INTERNATIONAL DOCKING SYSTEM STANDARD (IDSS) INTERFACE DEFINITION DOCUMENT (IDD)

This International Docking System Standard (IDSS) Interface Definition Document (IDD) establishes a standard docking interface to enable collaborative endeavors between the international spacefaring community while also supporting possible crew rescue operations. The IDSS was developed by the ISS participating partners and first baselined in 2010.

As the space community grows and in space activities expand beyond low earth orbit (LEO) and towards deep space, it is important to sustain the IDSS agreement and continue to evolve the original standard and prepare for future standards in-space and to surface systems on the moon and beyond.

The IDSS Committee will continue to pursue the goal of interoperability and standardization. In pursuing this goal, it is the intent of the IDSS Committee to engage the global commercial spaceflight industry and Agency Programs for their perspectives. It is the Committee's vision by including industry and programs that buy-in will be achieved and future projects and programs will give the highest consideration for meeting the intent of the IDSS IDD. This will be critically important for future commercial and international cooperation and efficient operations of human and robotic space exploration.

The IDSS Committee, NASA and contributing International Partners (IP) are committed partners in managing the IDSS. The IDSS committee chair, has and currently chaired by NASA, may in the future be sustained by rotating chair among other committee members. Additionally, new members may be added to the committee by the chair and the concurrence of a majority of the current members.

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1.0 INTRODUCTION

This International Docking System Standard (IDSS) Interface Definition Document (IDD) is the result of a collaboration by the ISS Program International Partners (IPs) to establish a standard docking interface to enable collaborative endeavors between the international spacefaring community while also supporting possible crew rescue operations,

This IDSS IDD details the physical geometric mating interface and design loads requirements. The physical geometric interface requirements must be strictly followed to ensure physical spacecraft mating compatibility. This includes both defined components and areas that are void of components. The IDD also identifies common design parameters as identified in Section 3.0, e.g., docking initial conditions and vehicle mass properties. This information represents a recommended set of design values enveloping a broad set of design reference missions and conditions, which if accommodated in the docking system design, increases the probability of successful docking between different spacecraft.

This IDD does not address operational procedures or off-nominal situations, nor does it dictate implementation or design features behind the mating interface. It is the responsibility of the spacecraft developer to perform all hardware verification and validation, to perform final docking analyses to ensure the needed docking performance.

While there are many other critical requirements needed in the development of a docking system such as fault tolerance, reliability, and environments (e.g. vibration, radiation, etc.), it is not the intent of the IDSS IDD to mandate all of these requirements; these requirements must be addressed as part of the specific developer's unique program, spacecraft, and mission needs. Whether to implement all of the features of the full IDSS system (androgyny) is determined by the designer when implementing unique program objectives. While unique implementations offer advantages (such as mass savings), they may also jeopardize the fundamental purpose and scope of the International Standard. Agencies should fully review and approve unique designs that do not meet the intent of the agreed purpose and scope of the IDSS and acknowledge acceptance of the associated risks. This approach allows designers the flexibility to design and build docking mechanisms to their unique program needs and requirements.

1.1 PURPOSE AND SCOPE

The purpose of the IDSS IDD is to provide basic common design parameters to allow developers to independently design compatible docking systems. The IDSS is intended for uses ranging from crewed to autonomous space vehicles, and from Low Earth Orbit (LEO) to deep-space exploration missions.

This document defines docking system interface definitions supporting the following missions:

A. International Space Station (ISS) visitation and other Low Earth Orbit (LEO) platforms.

B. Exploration missions beyond LEO.

C. Crew rescue.

D. International cooperative missions.

Vehicles using this interface standard may include light to heavy vehicles. Docking performance requirements and guidance are provided in section 3.0 for currently documented vehicles. New classes of vehicles are in development that may not be bounded by this standard. In section 3.0, guidance is also provided for emerging vehicle developers.

The figures and tables in this document depict the features of the docking interface that are standardized. Some docking features (e.g., sensors, separation systems) are not standardized and are left to the discretion of docking system designers, though they must follow the designated striker zone requirements.

1.2 RESPONSIBILITY AND CHANGE AUTHORITY

Configuration Management (CM) of the IDSS will be the responsibility of NASA. The NASA Directorate Program Management Council (DPMC) has directed that the Moon to Mars program perform the CM function for the IDSS Committee which includes keeping the official record of the IDSS agreement and archive of all change proposal material documentation. The IDSS committee will be made up of International Partners CSA, ESA, JAXA, ROSCOSMOS, and NASA. The Chair will maintain a list of all the current members of the IDSS Committee. All changes to the IDSS or any new docking standards, including proposals for new membership to the IDSS committee will be submitted to the IDSS Committee for review. Changes must be approved by a majority of the committee and documented via a concurrence sheet, which should be submitted as part of the change package, initiating the change management process. The Moon-to Mars Control Board (M2MCB) will be the responsible change board for all changes to the IDSS. However, each IP will be formally represented at the M2MCB by the appropriate M2M program.

1.3 CONVENTION AND NOTATION

IDSS defines its implementation of requirement verbs as follows:

a. “Shall” – Used to indicate a requirement that is binding, which must be implemented, and its implementation verified in the design.

b. “Should” – Used to indicate good practice or a goal which is desirable, but not mandatory and does not require formal verification.

c. “May” – Used to indicate permission.

d. “Will” – Used to indicate a statement of fact or declaration of purpose on the part of the government that is reflective of decisions or realities that exist and are to be taken as a given and not open to debate or discussion.

e. "Is” or “Are” – Used to indicate descriptive material.

Rationales, included for many of the requirements, are intended to provide clarification, justification, purpose, and/or the source of a requirement. In the event that there is an inconsistency between a requirement and its rationale, the requirement always takes precedence.

2.0 DOCUMENTS

2.1 APPLICABLE DOCUMENTS

Applicable documents are directly related to this document and cited within. The context and how to apply the applicable documents will be included as part of the document citation.

TABLE 2.1-1 APPLICABLE DOCUMENTS

Document Number	Document Title
None	

2.2 REFERENCE DOCUMENTS

A reference document is a document that provides additional information for the reader and may or may not be cited in this document.

TABLE 2.2-1 REFERENCE DOCUMENTS

Document Number	Document Title
None	

3.0 INTERNATIONAL DOCKING SYSTEM STANDARD

3.1 GENERAL

The following subsections describe the system interfaces for the IDSS.

3.1.1 SYSTEM DESCRIPTION

3.1.1.1 DOCKING

The IDSS IDD presumes a pre-docking rendezvous phase along with a 2-stage approach to docking. The rendezvous stage involves an active docking vehicle navigating to the passive docking vehicle to align their docking interfaces for the docking stage. The passive vehicle provides three types of targets to assist the active vehicle in performing the precise alignment needed to mesh the mechanical interfaces at the start of the docking stage. Targets are available for longer to mid-range operations, as well as for short-range operations when the active vehicle is on the docking axis of the passive vehicle. These shorter range targets are available to the active vehicle for alignment to within the capture envelope specified by the docking system's initial contact condition (ICC) requirements. This completes the rendezvous stage.

The first stage of docking establishes the initial capture of the docking vehicles and is performed by the Soft Capture System (SCS). During the capture phase, the active docking mechanism's SCS aligns with and latches to the passive docking mechanism, then stabilizes the newly joined spacecraft relative to each other. The soft capture system then pulls the docking spacecraft together in order to initiate the second stage of docking, performed by the Hard Capture System (HCS). The HCS performs structural latching and sealing at the docking interface in order to transfer structural loads between the spacecraft and to create a transfer tunnel which can be pressurized for crew and cargo transfer for joint mission operations. The docking operation needs to be completed within a maximum time to ensure a safe docking operation.

The IDSS docking interface is fully androgynous about one axis, meaning the interface configuration is capable of mating to an identical configuration. During docking, one androgynous soft capture interface must be active (active mode), while the other androgynous soft capture interface remains retracted and locked in place, or passive (passive mode). The active interface controls the soft capture function and all sequences of docking through hard capture. Figure 3.2-1, Androgynous Docking Interface – Axial View and the Androgynous Docking Interface – Cross Sections [Figures 3.2-2, Section A-A (Cross-section through mid-plane of two petals) and 3.2-3, Detailed Section of Petal] depict the Androgynous IDSS interface.

The androgynous SCS interface consists of a capture ring, guide petals, mechanical latches, mechanical latch strikers, sensors, and sensor strikers. The term "striker" refers to the area on the passive side of the mating interface which is intended to be a contact surface for an active component on the active side of the mating interface. During docking soft capture, the guide petals are the first element to make contact; this is referred to as initial contact. The SCS then responds to correct the lateral and angular misalignment between the two opposing interfaces. Soft capture is complete when the two capture rings are in full contact and the active mechanical capture latches are fully engaged with the mechanical latch strikers on the opposing vehicle.

The SCS then aligns the two mating vehicles and retracts to bring the two hard capture interfaces into hard capture range. Fine alignment is accomplished by a combination of SCS retraction and HCS guide pins.

The HCS uses active hooks to engage opposing passive hooks to provide the structural connection and pressure seal compression. The HCS interface consists of a tunnel, 12 active/passive hook pairs on each side, dual concentric pressure seals, fine alignment guide pins and guide pin receptacles, sensors, sensor strikers, separation system, and resource umbilicals.

The docking operation is complete when the mechanical hooks are fully engaged.

3.1.1.2 BERTHING

Berthing spacecraft together using a manipulator/mechanical robot arm has been a crucial capability for spaceflight operations. This capability has been used extensively as part of international space programs to support the capture and installation of visiting vehicles. Unberthing, the separation of two vehicles using a manipulator, has also been used extensively to disconnect a vehicle and release it for departure or relocate it to another berthing port.

Docking systems can be developed under specific mission requirements. Some systems may support docking only while others may support both docking and berthing. The additional set of optional requirements that permits a berthing and docking compatible IDSS implementation (IDSS+B) are defined in section 3.6 of this document. Meeting these additional requirements may permit the IDSS implementation to be used for either docking or manipulator berthing.

The requirements in section 3.6 support two methods for manipulator berthing of an International Docking System (IDS). The methods are as follows:

1. **Manipulator Driven Berthing**

   In this method, the manipulator functions as the active control system, providing sufficient force and compliance to effect soft capture, while the SCS is configured as passive.

2. **SCS Driven Berthing**

   In this method, the manipulator holds the user vehicle stationary while the active SCS functions as the active control system providing sufficient force and compliance to effect soft capture.

A third method of berthing, where the manipulator berths two purely passive docking ports together, is also possible. This method, along with additional berthing system operational concepts and guidelines, are described in CSA-SE-CO-0001, IDSS Berthing Concept of Operations and may be found at the IDSS website www.internationaldockingstandard.com.

Note that due to other constraints and considerations (mass, operations), it may be preferable to have a dedicated berthing-only interface. In this scenario, an accepted international berthing interface may be utilized that employs some combination of peripheral active controlled devices and passive capture mechanisms (e.g., the ISS Common Berthing Mechanism (CBM), Probe-Cone, etc.). For clarity, note that the IDSS and IDSS+B standards do not define or address these berthing only interfaces.

3.1.2 ENGINEERING UNITS OF MEASURE

All dimensions are in millimeters. All angular dimensions are in degrees. **Surface finish designations apply prior to finish coating.** Unless otherwise specified, the dimensional tolerances are as follows:

xx implies xx ± 1 mm

xx.x implies xx.x ± 0.5 mm

xx° implies xx° ± 30’

3.2 MATING INTERFACE DEFINITION

Dimensions and features called out in section 3.2 and its subsections will be implemented on IDSS-compatible systems; these are requirements which must be met to ensure docking interface compatibility. Each requirement dimension is specified only once with its required value and tolerance. For increased clarity, some requirement dimensions are repeated elsewhere without tolerance, and are marked with “REF”. “REF” stands for “REFERENCE” and denotes a repeated callout of a primary requirement dimension that can be found elsewhere in this document. Some dimensions in the figures are enclosed in braces, i.e., “{ }”. These dimensions are not a requirement of the standard but are dimensions from existing proven heritage systems. Deviations from these dimensions may be possible. A complete list of drawing symbols used throughout the document is identified in Appendix A.

DOCK-001 Mating Interface Definition

The IDSS docking interface shall conform to the definition as shown in Figure 3.2-2 and Figure 3.2-3. An overview of the IDSS interface is shown in Figure 3.2-1.

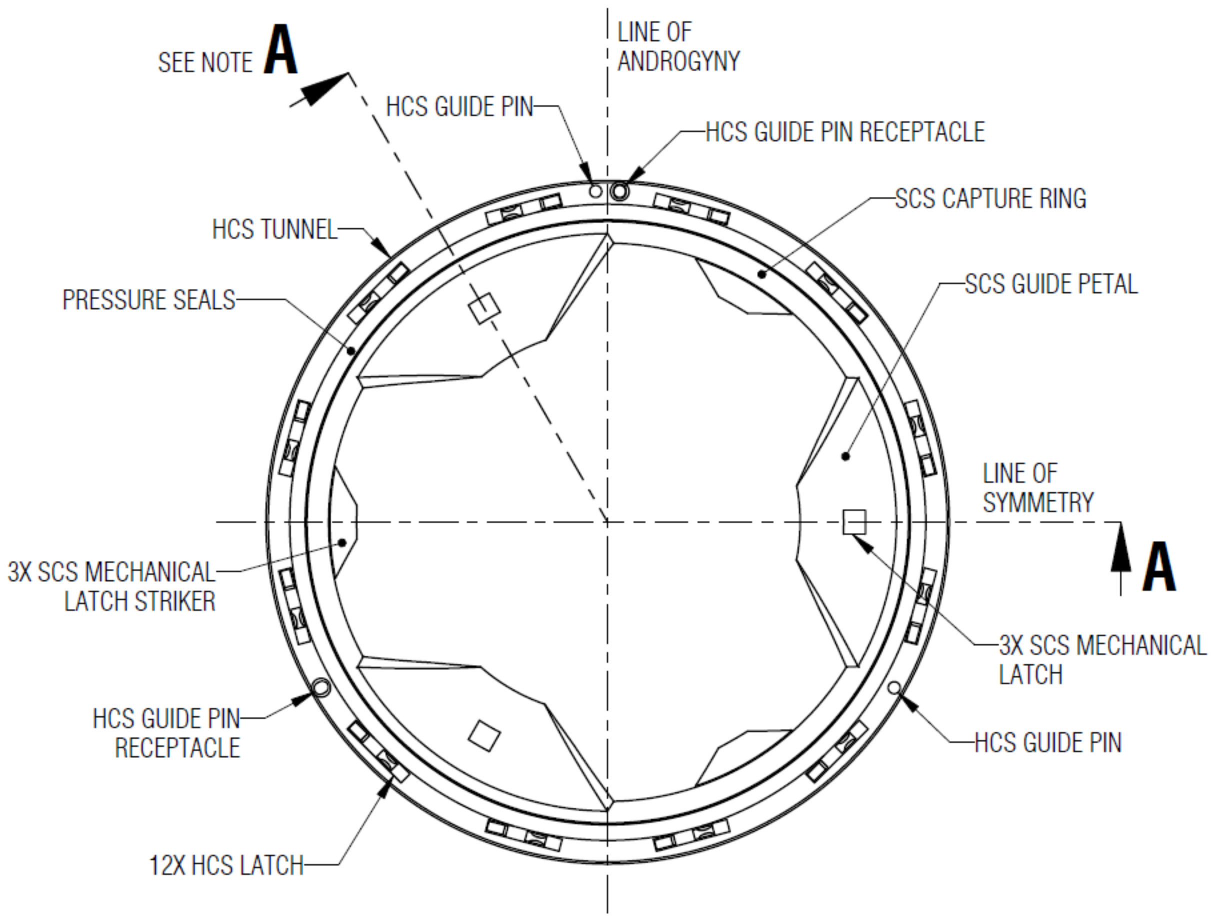
Rationale: The HCS Mating Plane is defined as the seal plane between two vehicles’ HCS tunnels when structurally mated.

Two reference lines are a Line of Androgyny and a Line of Symmetry as shown in Figure 3.2-1. The docking axis is defined as shown in Figure 3.2-2.

Figure 3.2-4, Naming Convention for Hooks, Guide Pins, Petals, Latches and Latch Strikers, defines the naming convention for the docking system principal components.

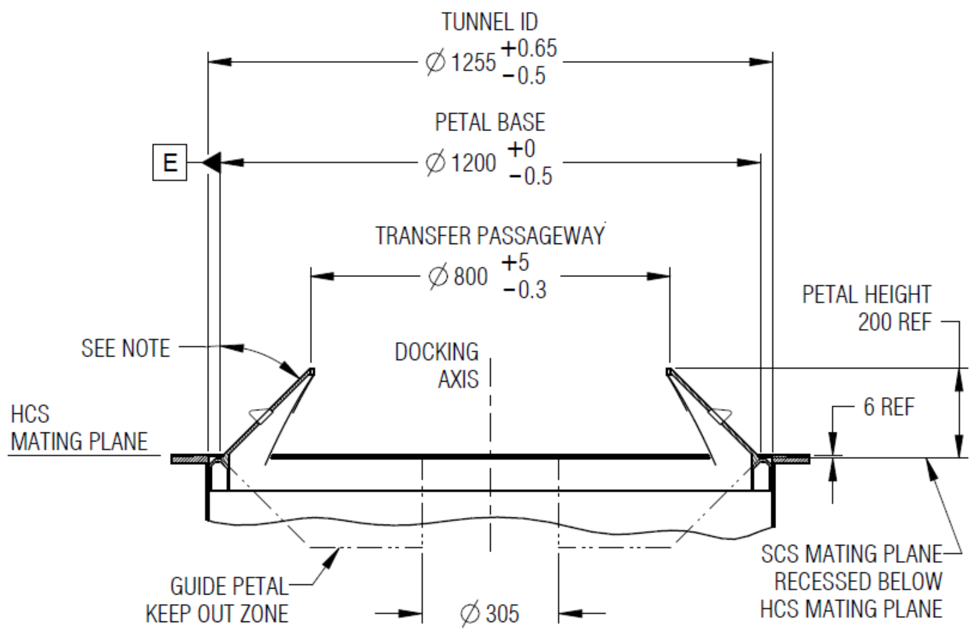
The SCS Mating plane is defined as the plane normal to the Soft Capture Ring's axis which intersects the conic outline of the Guide Petals at a diameter of 1200 mm.

The SCS mating plane is the top surface of the capture ring for both active and passive modes.



Note: Refer to Figure 3.2-2 for Section A-A.

FIGURE 3.2-1 ANDROGYNOUS DOCKING INTERFACE – AXIAL VIEW



Note: Refer to Figure 3.2-3 for details

FIGURE 3.2-2 SECTION A-A (CROSS-SECTION THROUGH MID-PLANE OF TWO PETALS)

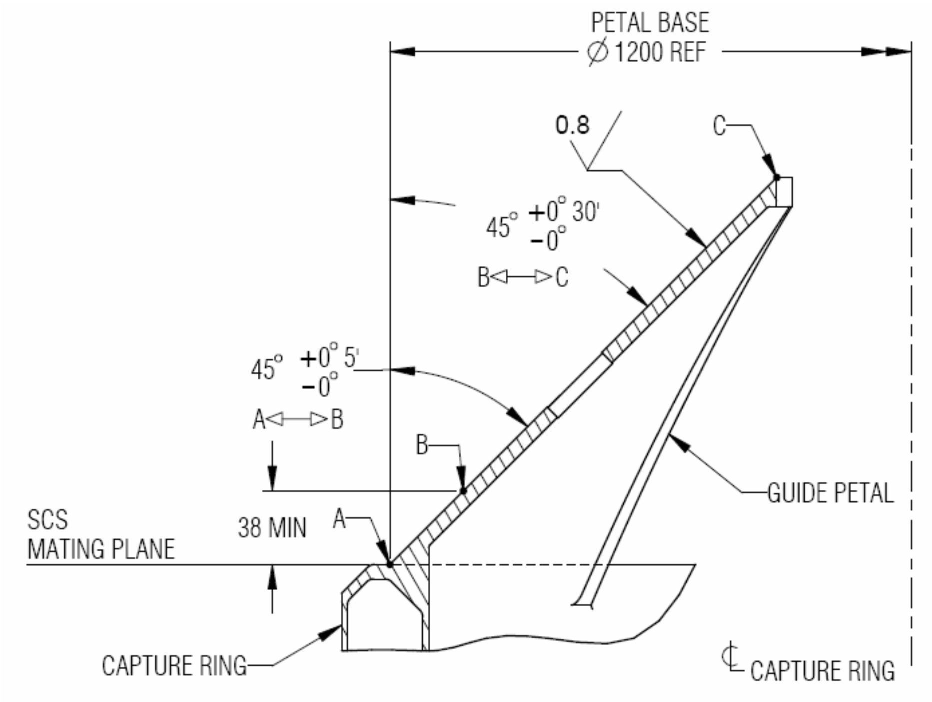
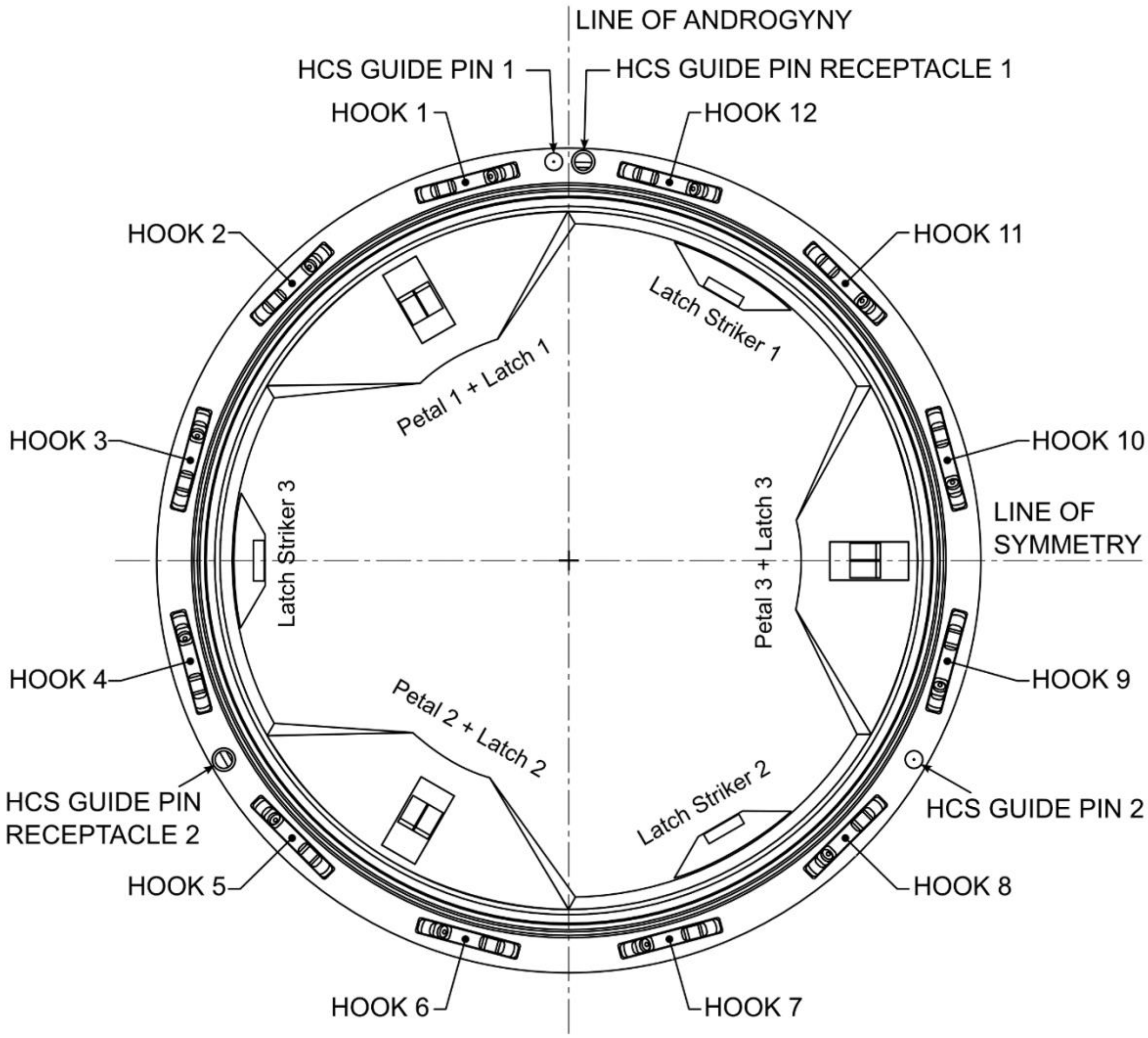


FIGURE 3.2-3 DETAILED SECTION OF PETAL



Note: The naming convention given here is to provide a common way to reference these items, and it is the designer's choice whether, or how, to place physical labels on the items themselves.

FIGURE 3.2-4 NAMING CONVENTION FOR HOOKS, GUIDE PINS, PETALS, LATCHES AND LATCH STRIKERS

3.2.1 TRANSFER PASSAGEWAY

DOCK-002 Transfer Passageway

The docking system shall maintain the minimum transfer passageway diameter as shown in Figure 3.2-2.

Rationale: To support crew and cargo transfer operations.

3.2.2 SOFT CAPTURE SYSTEM

DOCK-003 Soft Capture System

The soft capture system shall conform to the definition as shown in the SCS Interface Capture System [Figure 3.2.2-1, Capture System Overview, and Figure 3.2.2-2, Striker Zone Detail].

Rationale: The SCS performs soft capture using mechanical capture latches with mechanical strikers. Soft capture is the initial mechanical mating between the docking systems. It is the first stage of attachment in the docking sequence for the purpose of soft capture system docking interface alignment, capture, arrest, and stabilization of dynamic motion between the spacecraft, and finally, interface alignment prior to hard capture system engagement.

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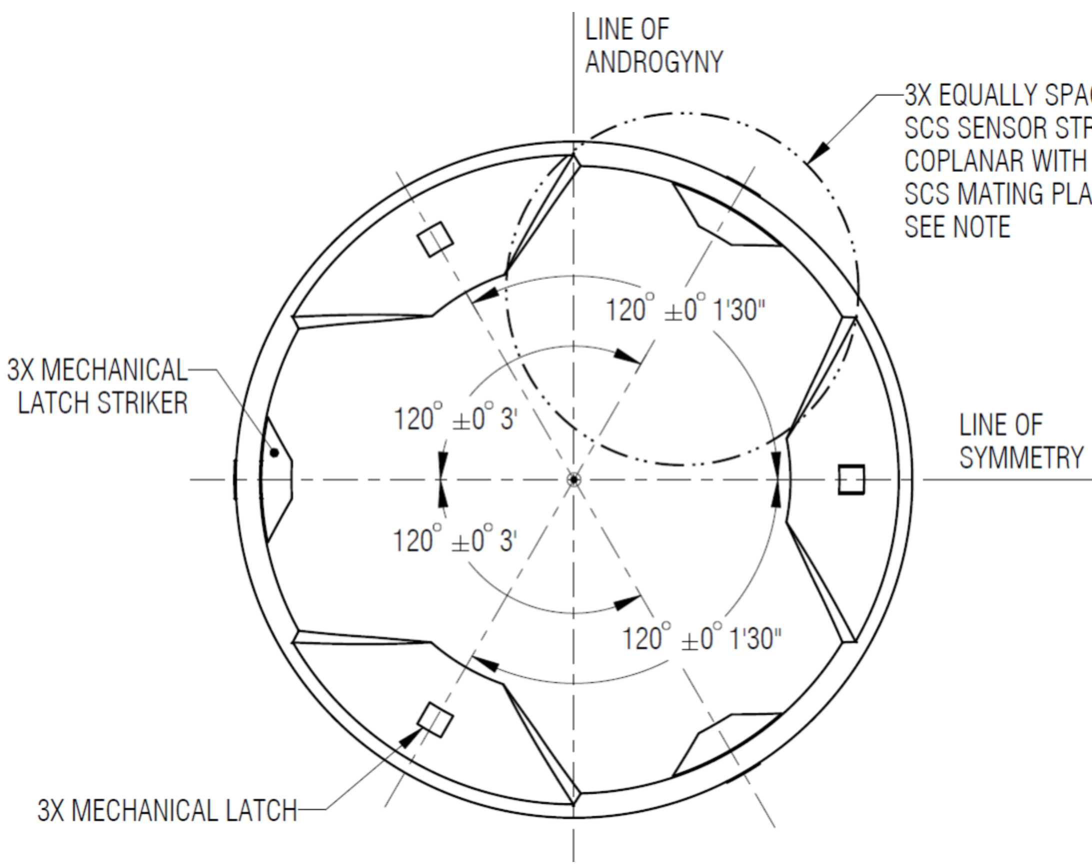
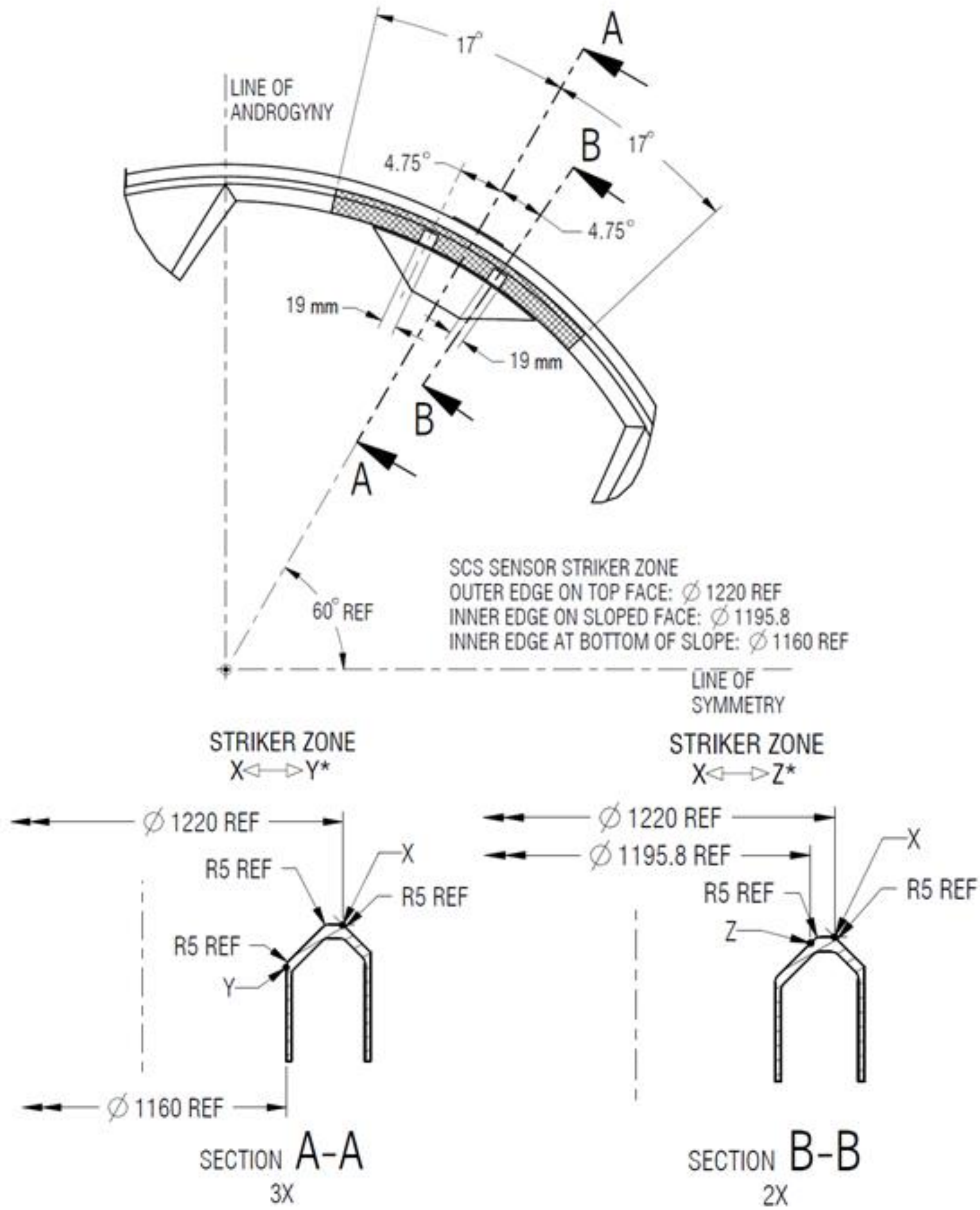


Note: Refer to Figure 3.2.2-2 for striker zone details

FIGURE 3.2.2-1 CAPTURE SYSTEM OVERVIEW



* SCS sensor striker zone is the actual contour of the capture ring surfaces as shown.

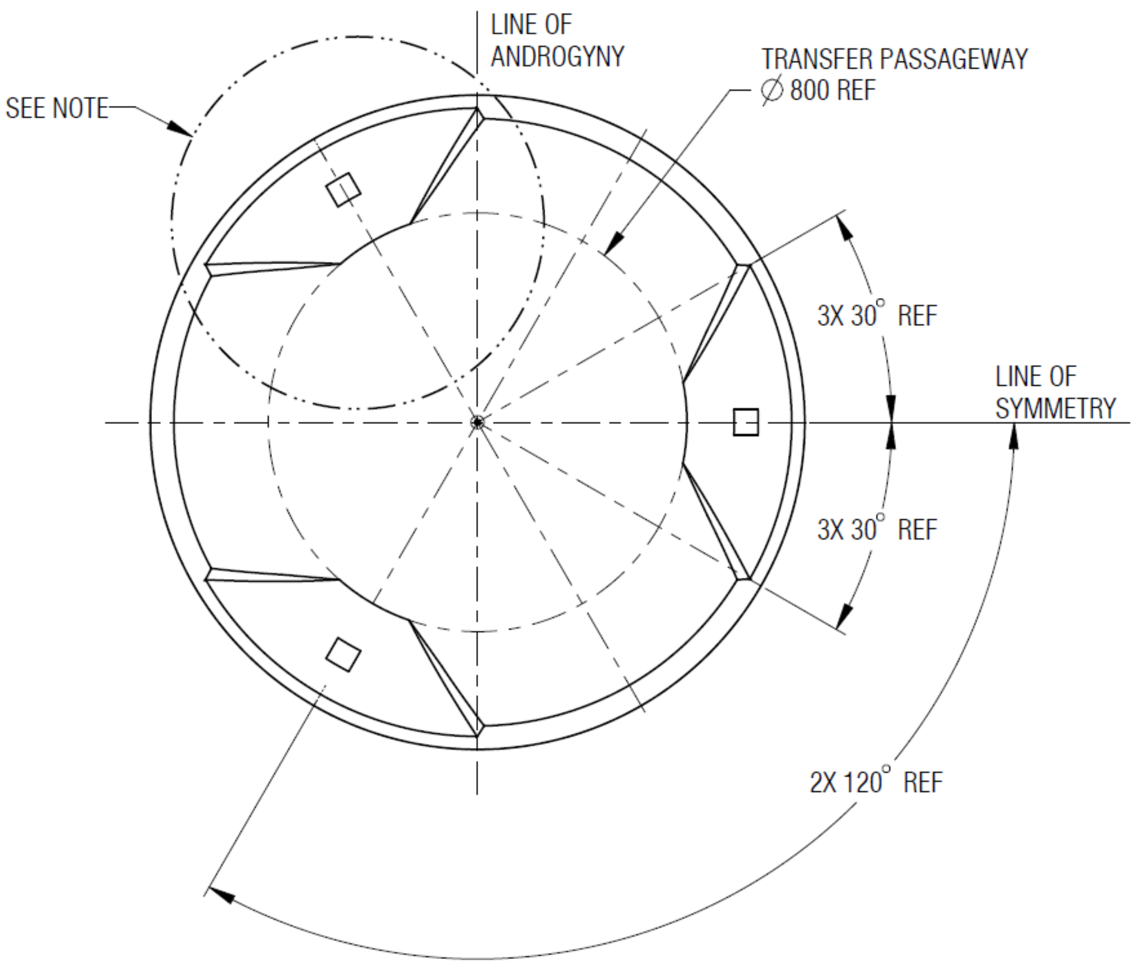
FIGURE 3.2.2-2 STRIKER ZONE DETAIL

3.2.2.1 GUIDE PETAL SYSTEM

DOCK-004 Guide Petal System

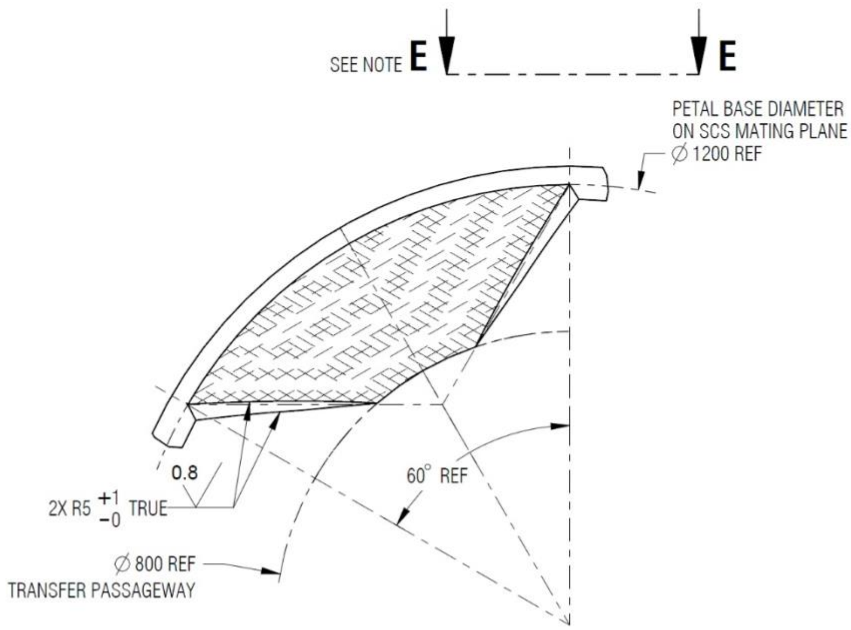
IDSS compliant systems shall implement three inward pointing guide petals integrated on the soft capture ring, equally spaced around the circumference of the soft capture docking ring as shown in Figure 3.2.2.1-1, SCS Interface – Guide Petal System Overview. Additional SCS interface details that are to be implemented are shown in the SCS Interface – Guide Petal System Details [Figures 3.2.2.1-2, Petal Detail, 3.2.2.1-3, Petal Profile Detail, and 3.2.2.1-4, View E-E – Guide Petal Outline] and Figure 3.2.2.1-5, SCS Interface – Capture Ring Profile.

Rationale: Guide petals provide course alignment to support soft capture.



Note: Refer to Figure 3.2.2.1-2 and Figure 3.2.2.1-3 for Petal details.

FIGURE 3.2.2.1-1 SCS INTERFACE – GUIDE PETAL SYSTEM OVERVIEW



Notes:

1. Refer to Figure 3.2.2.1-4 for View E-E.

FIGURE 3.2.2.1-2 PETAL DETAIL

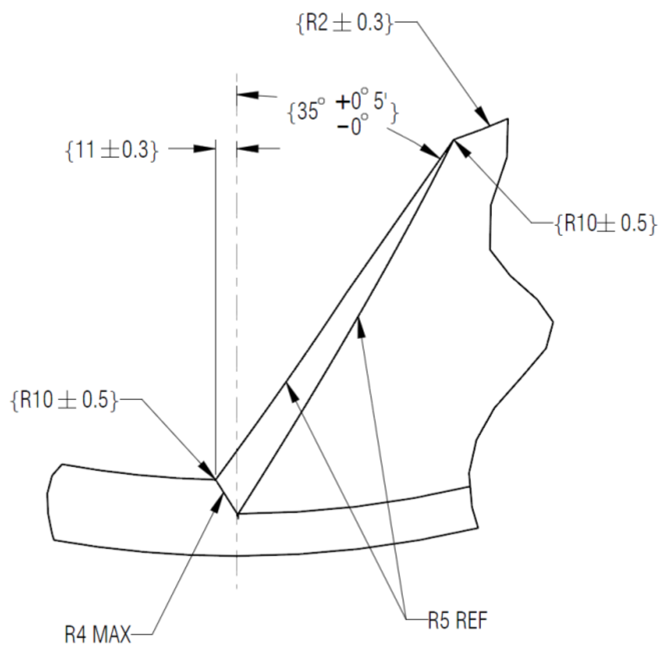
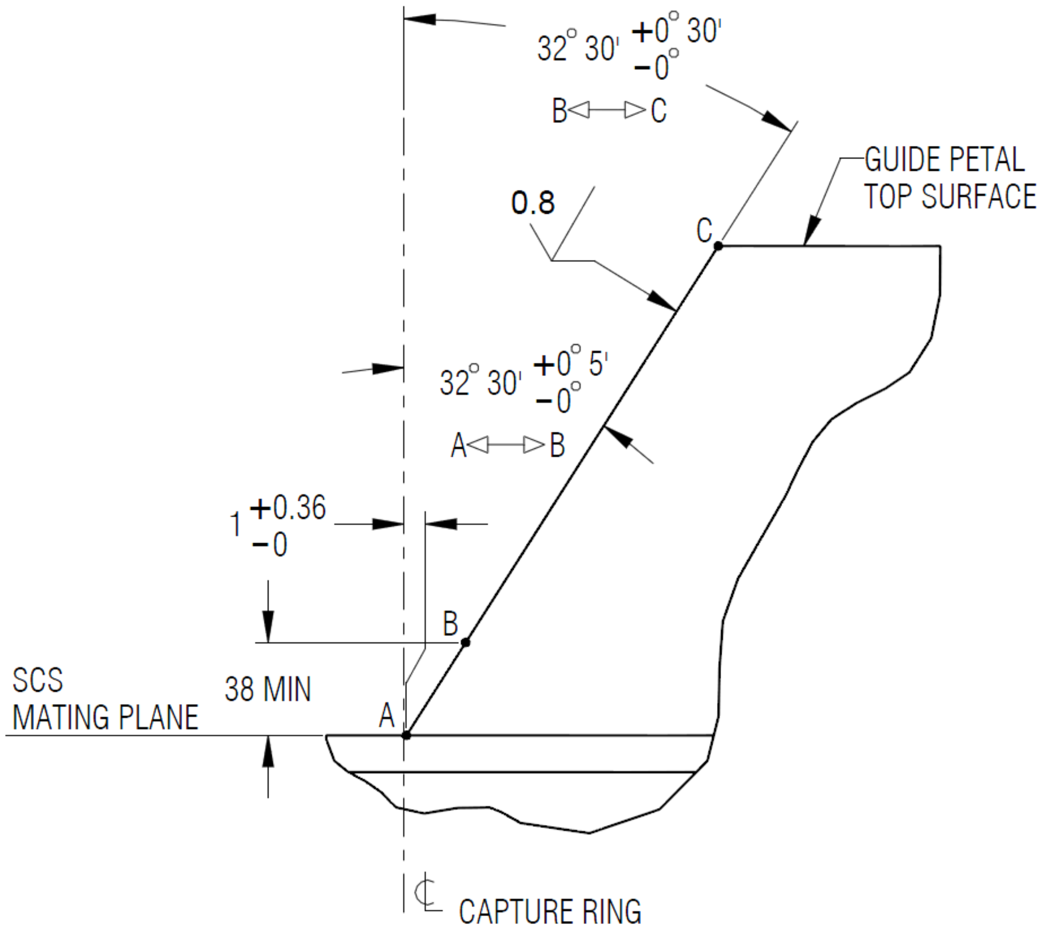


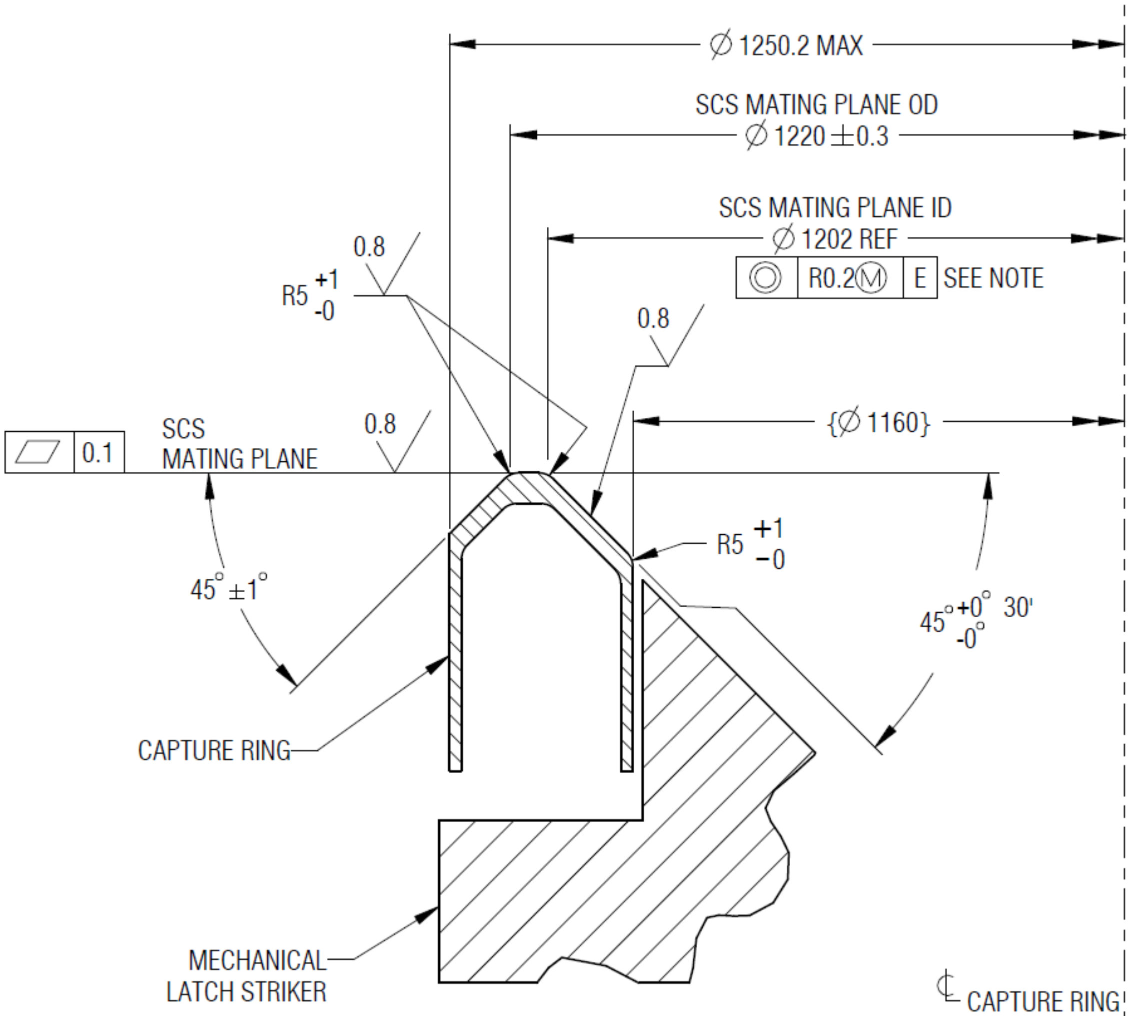
FIGURE 3.2.2.1-3 PETAL PROFILE DETAIL



Notes:

1. In Petal Detail view, dimensions projected on the SCS mating plane are shown.
2. Petal outline shown is on the external conic surface of the petal system.

FIGURE 3.2.2.1-4 VIEW E-E - GUIDE PETAL OUTLINE



Cross Section View of Capture Ring in Passive Mode through the Striker

Notes: Datum E is defined in IDSS Figure 3.2-2.

FIGURE 3.2.2.1-5 SCS INTERFACE – CAPTURE RING PROFILE

3.2.2.2 SOFT CAPTURE RING

DOCK-005 Soft Capture Restrained Location

The SCS Ring shall be restrained in place below the HCS mating plane per Figure 3.2.2.4-1 when in passive mode.

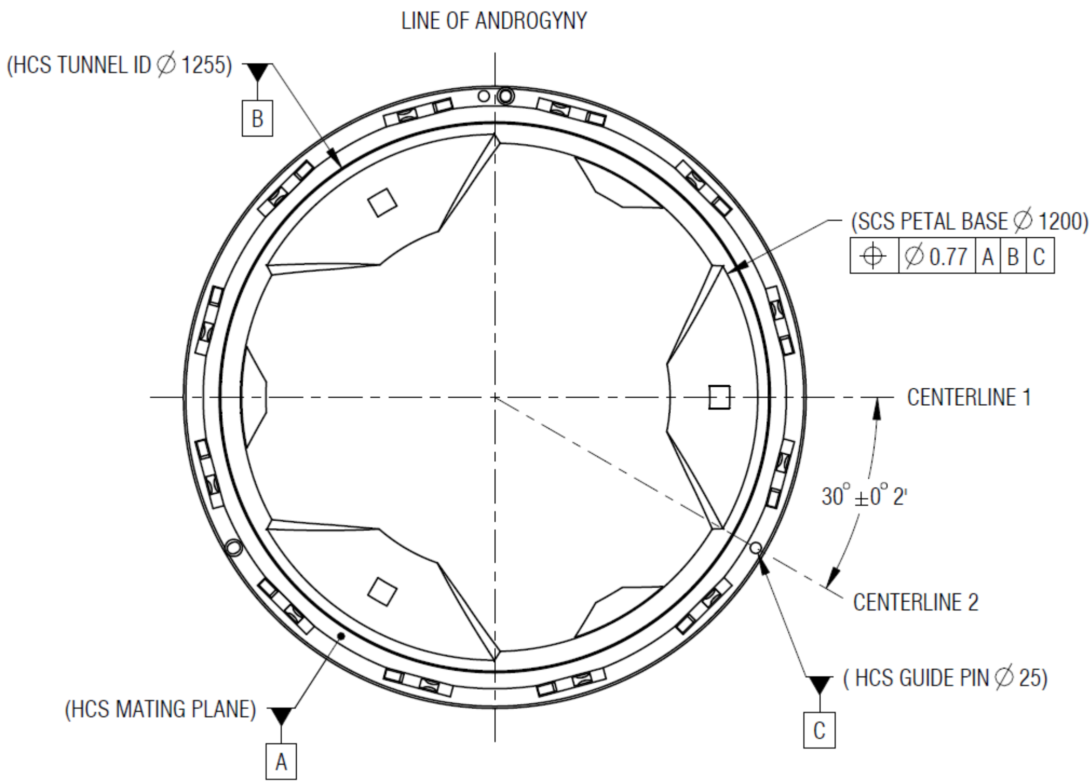
Rationale: To *prevent engagement of capture latches of an androgynous system in passive mode at completion of the retraction phase.*

3.2.2.3 RING AND GUIDE LOCATION ACCURACY

DOCK-006 Ring and Guide Location Accuracy

The SCS Guide Petal System shall be located and clocked relative to the HCS as shown in Figure 3.2.2.3-1 when in passive mode.

Rationale: To support proper engagement of the HCS guide pins and guide pin receptacles.



Notes:

1. The SCS to HCS angular clocking accuracy is applicable between Centerline 1 and 2 as defined below.
2. The SCS guide petal CENTERLINE 1 as defined by the intersection of the Petal Base center (Ø 1200) and the midpoint of petal number 3 (IDSS IDD Figure 3.2-4) on the SCS mating plane. The petal midpoint is established by the lower petal edge surfaces in the 38mm zones noted A ↔B in IDSS IDD Figure 3.2.2.1-4
3. The HCS CENTERLINE 2 as defined by the center of the HCS tunnel ID (Ø 1255) and the HCS guide pin ID (Ø 25) on the HCS mating plane.

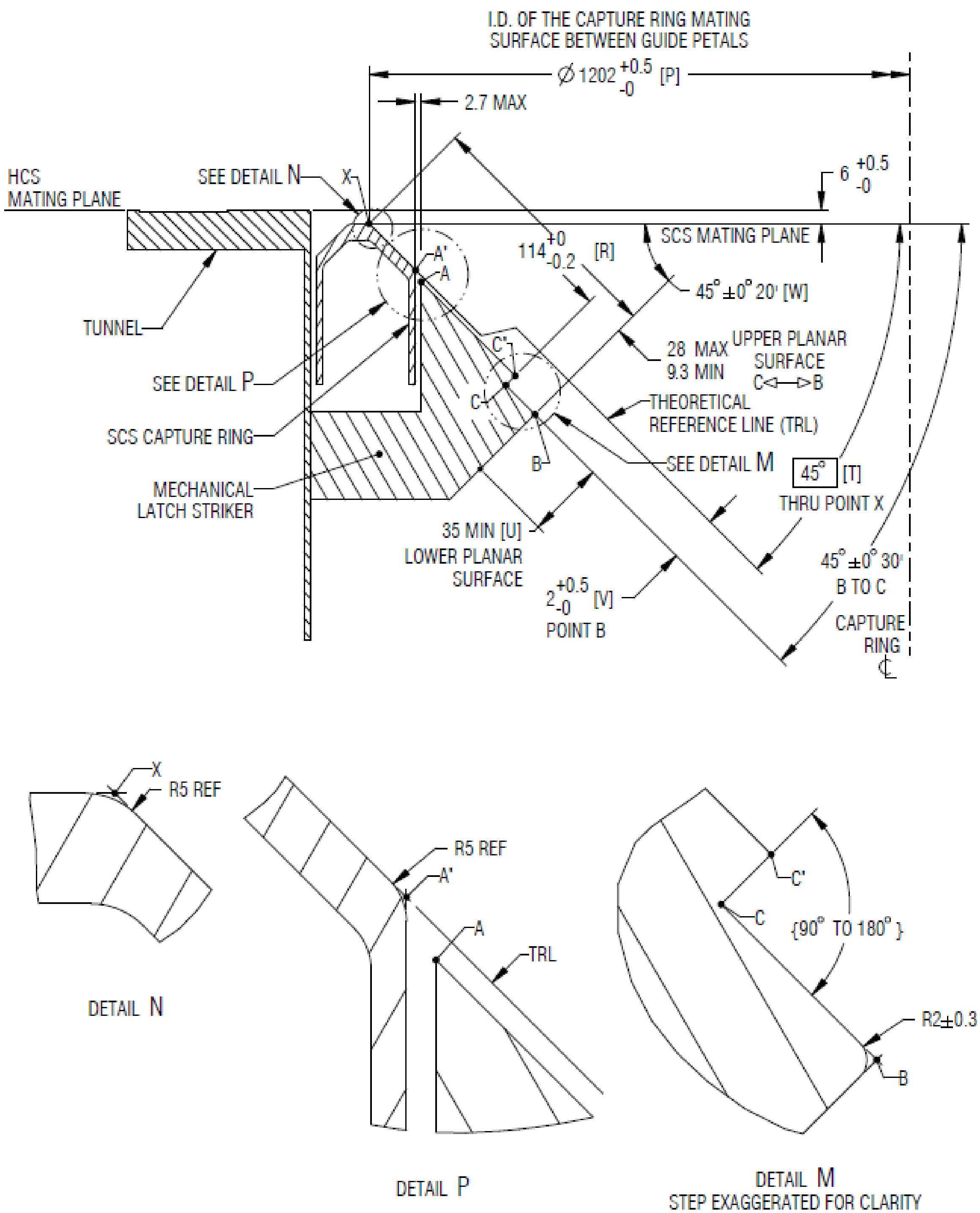
FIGURE 3.2.2.3-1 GUIDE PETAL SYSTEM LOCATION

3.2.2.4 MECHANICAL CAPTURE LATCH SYSTEM

DOCK-007 Mechanical Capture Latch System

The mechanical latches and strikers shall conform to the definition of the Latch Striker for Mechanical Systems shown in Figures 3.2.2.4-1, Cross Sectional View through Centerline of Mechanical Latch Striker; 3.2.2.4-2, Radial View; and 3.2.2.4-3, Top View; and Figure 3.2.2.4-4, Active Mechanical Soft Capture Latch Interface.

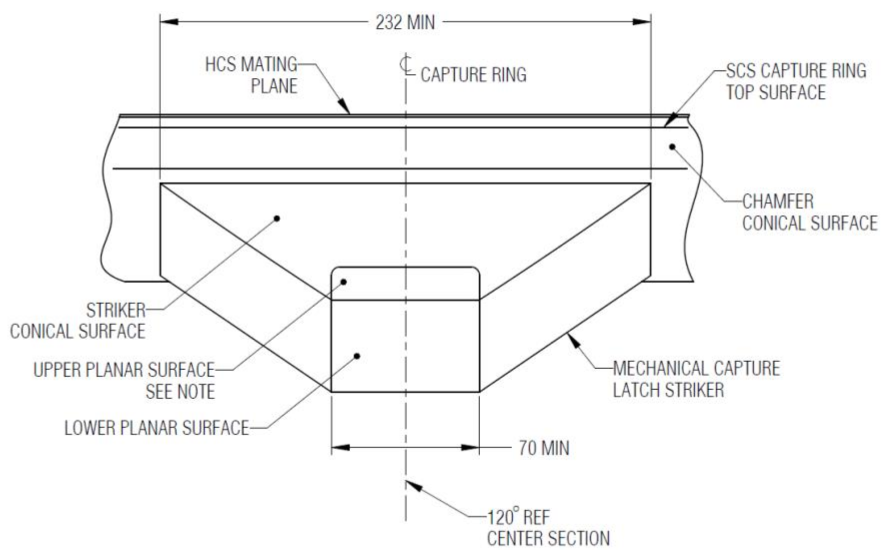
Rationale: The IDSS SCS interface includes three mechanical latch strikers to accommodate mechanical latching systems as shown in Figures 3.2.2-1 and 3.2.2-2. Interpretation of the dimensional parameters describing the mechanical capture latch striker is critical in terms of its performance. The ability to achieve successful capture is highly dependent upon the implementation of the parameters as defined in the noted figures. A detailed explanation of the relationship between the interface dimensions defined in Figure 3.2.2.4-1 can be found in section 3.2.2.4.1.


I.D. OF THE CAPTURE RING MATING SURFACE BETWEEN GUIDE PETALS
∅ 1202 +0.5 -0 [P]
2.7 MAX
HCS MATING PLANE
SEE DETAIL N
X
6 +0.5 -0
SCS MATING PLANE
114 +0 -0.2 [R]
45° ±0° 20' [W]
A'
A
TUNNEL
SEE DETAIL P
28 MAX 9.3 MIN
UPPER PLANAR SURFACE C⊲—⊳B
C'
C
THEORETICAL REFERENCE LINE (TRL)
SCS CAPTURE RING
MECHANICAL LATCH STRIKER
B
SEE DETAIL M
45° [T] THRU POINT X
35 MIN [U]
LOWER PLANAR SURFACE
45° ±0° 30' B TO C
2 +0.5 -0 [V] POINT B
CAPTURE RING ℄
X
R5 REF
DETAIL N
R5 REF
A'
A
TRL
DETAIL P
C'
C
{90° TO 180°}
R2±0.3
B
DETAIL M
STEP EXAGGERATED FOR CLARITY

Notes:

1. Boxed angular dimension (Dimension [T]) is Basic Dimension specifying the Theoretical Reference Line (TRL). No dimensional tolerances are to be applied to the Basic Dimension.
2. Point C’: at the same distance or closer to the TRL then Point C
3. Point A: at the same distance or closer to the TRL than Point C’
4. Point A: at the same distance or farther from TRL than Point A'.
5. The major aspects of this definition are remaining below the TRL, transitioning from the Striker Conical Surface to the Upper Planar Surface, and accurately locating Point B.

FIGURE 3.2.2.4-1 CROSS SECTIONAL VIEW THROUGH CENTERLINE OF MECHANICAL LATCH STRIKER



Notes:

1. All dimensions are linear dimensions.
2. Two orthogonal planar surfaces are required to form a straight edge at nose. The Upper Planar Surface transitions into the Striker Conical Surface as required in such a way that the Upper Planar Surface is either flush or slightly recessed below the Striker Conical Surface. This will ensure there is no obstruction on the striker during SCS capture.

FIGURE 3.2.2.4-2 RADIAL VIEW

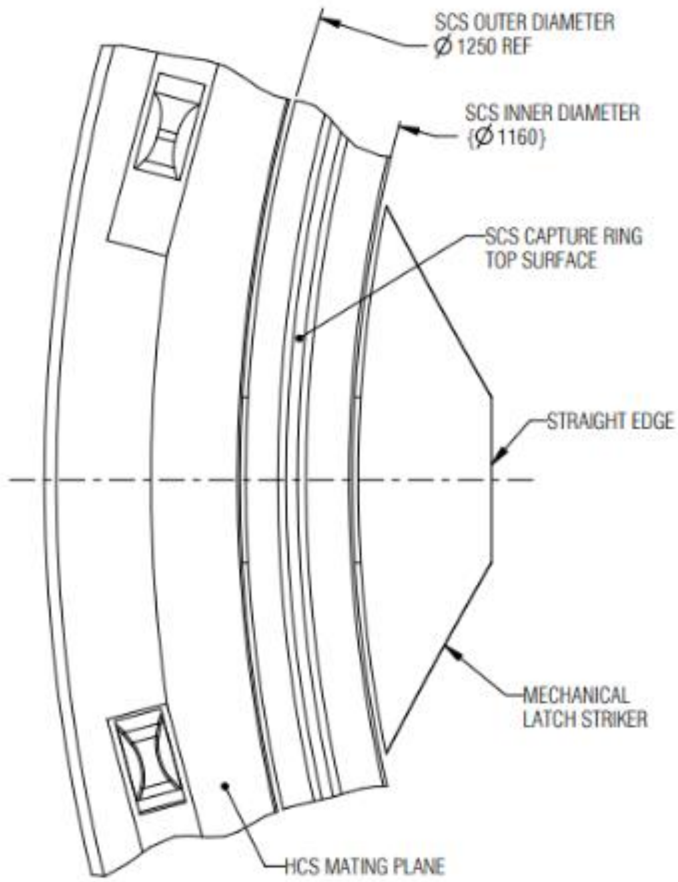
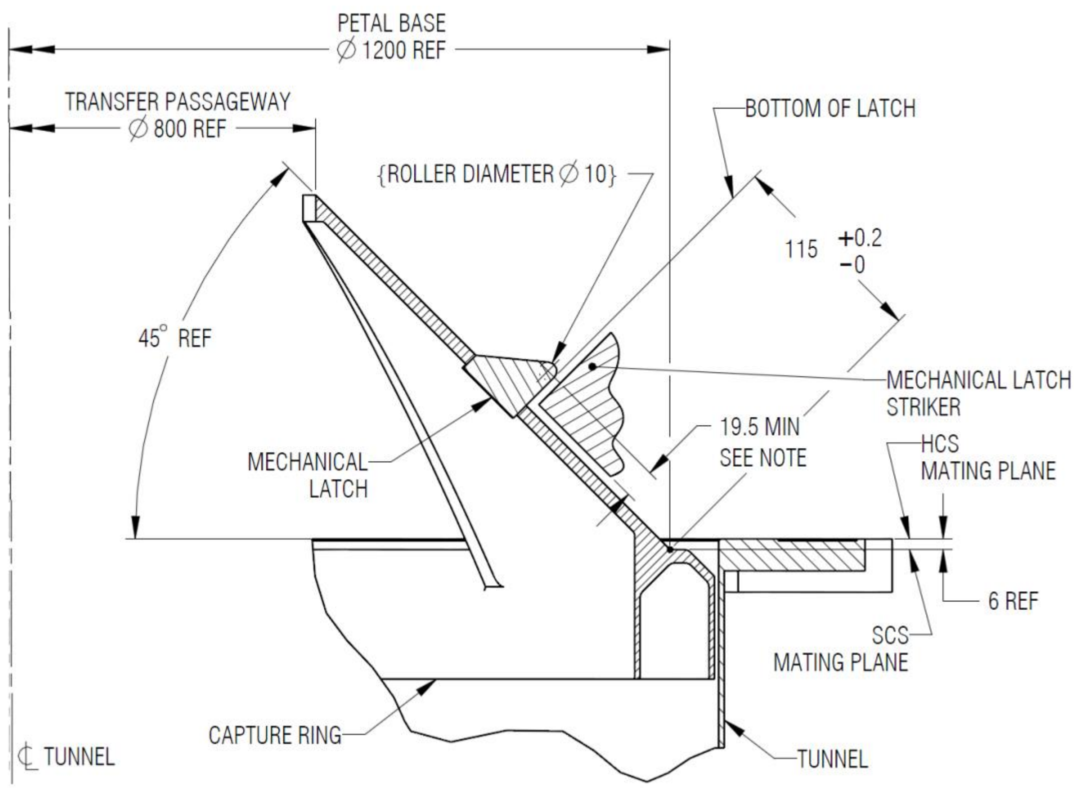


FIGURE 3.2.2.4-3 TOP VIEW



Note: Nominal minimum latch engagement.

FIGURE 3.2.2.4-4 ACTIVE MECHANICAL SOFT CAPTURE LATCH INTERFACE

DOCK-007a Mechanical Capture Latch Configuration Control

The mechanical capture latch on an androgynous system in passive mode shall be capable of being configured to a state with the inability to capture the active side latch striker.

Rationale: The mechanical capture latches on the passive side could inadvertently engage with a capture striker attached to the soft capture ring on the active side or could significantly interfere with the ability to perform soft capture or retraction in preparation to perform hard capture.

Note: this adverse situation does not exist if either side is an active only system (without capture strikers) or a passive only system (without mechanical capture latches).

3.2.2.4.1 MECHANICAL CAPTURE LATCH STRIKER DIMENSIONS DESCRIPTION

The dimensional parameters that describe the mechanical capture latch striker and its location as shown in Section 3.2.2.4 and Figures 3.2.2.4-1, 3.2.2.4-2, 3.2.2.4-3, and 3.2.2.4-4 may be implemented in a variety of ways. In order to achieve the desired performance characteristics for soft capture, it is necessary to establish a common interpretation of the parameters in order to maintain a consistent set of interfaces. Systems that implement the mechanical capture latch striker feature as part of the design of the soft capture system will adhere to the following interpretation of parameters.

3.2.2.4.1.1 INTERFACE INTERPRETATION OF PARAMETERS

The key parameters that define the critical mechanical capture latch striker interfaces are identified below. Reference designations are assigned to each of the dimensions (noted as [P], [R], [T], [U], [V], [W]) and to each of the points (noted as A, A', B, C, C', X). These designations are used in establishing the critical features of Figure 3.2.2.4-1.

The key geometry definitions are defined as follows:

Surface Definitions:

Center Section Plane is the vertical radial plane that cuts through the center of the Striker. Center sections are referenced at 120-degree intervals relative to primary datum as shown in Figure 3.2.2.4-2.

Line Definition:

Basic 45° Line is a theoretical reference, which is established by the intersection of two planes:

- The Center Section Plane
- The plane normal to the Center Section Plane at Point **X** and forms a 45º angle (Dimension **[T]**) with the SCS Mating Plane.

Dimension Definitions:

1. Dimension **[P]** is the inner diameter of the Capture Ring mating surface between Guide Petals.
2. Dimension **[R]** is the distance between Point **X** and Point **B** projected on the Basic 45º Line.
3. Dimension **[T]** is a basic 45° angle formed by the SCS Mating Plane and the theoretical plane normal to the Center Section Plane at the Point **X.**
4. Dimension **[U]** is the minimum dimension required for the Lower Planar Surface for Capture Latch operations.
5. Dimension **[V]** is the distance from the Basic 45º Line to Point **B**.
6. Dimension **[W]** is the angle formed by the SCS Mating Plane and the Lower Planar Surface.

Point Definitions:

Point **X** is established by the intersection of:

- Center Section Plane
- Chamfer Conical Surface
- SCS Mating Plane

*Note: Point **X** to be within the limits of Dimension [P].*

Point **A'** is established by the intersection of:

- Center Section Plane
- Chamfer Conical Surface
- lower edge of *Chamfer Conical Surface*

Point **A** is established by the intersection of:

- Center Section Plane
- Striker Conical Surface
- top edge of Striker Conical Surface

Point **B** is established by the intersection of:

- Center Section Plane
- Upper Planar Surface
- Lower Planar Surface

Point **C**' is established by the intersection of:

- Center Section Plane
- Striker Conical Surface
- lower edge of Striker Conical Surface

Point **C** is established by the intersection of:

- Center Section Plane
- Upper Planar Surface
- top edge of Upper Planar Surface

3.2.2.5 SOFT CAPTURE SENSOR ACTUATION

DOCK-008 Total Actuation Force

The total actuation force due to all passive SCS sensors shall be ≤ 50N.

Rationale: To ensure successful soft capture performed by various active docking systems that may utilize different technologies, a limit on the total resistance force produced by a passive SCS, including force to simultaneously actuate all SCS sensors (Example: Capture sensors).

3.2.2.6 SOFT CAPTURE SENSOR STRIKERS

DOCK-009 Soft Capture Sensor Strikers

Docking systems shall place their sensors such that they will strike the mating IDSS interface within defined zones in Figures 3.2.2-1 and 3.2.2-2.

Rationale: Designated areas for striker zones used by all SCS sensors from the opposing docking system are defined as shown in Figures 3.2.2-1 and 3.2.2-2. Passive and active docking systems will provide a smooth striking surface within these zones to accommodate active docking system sensors.

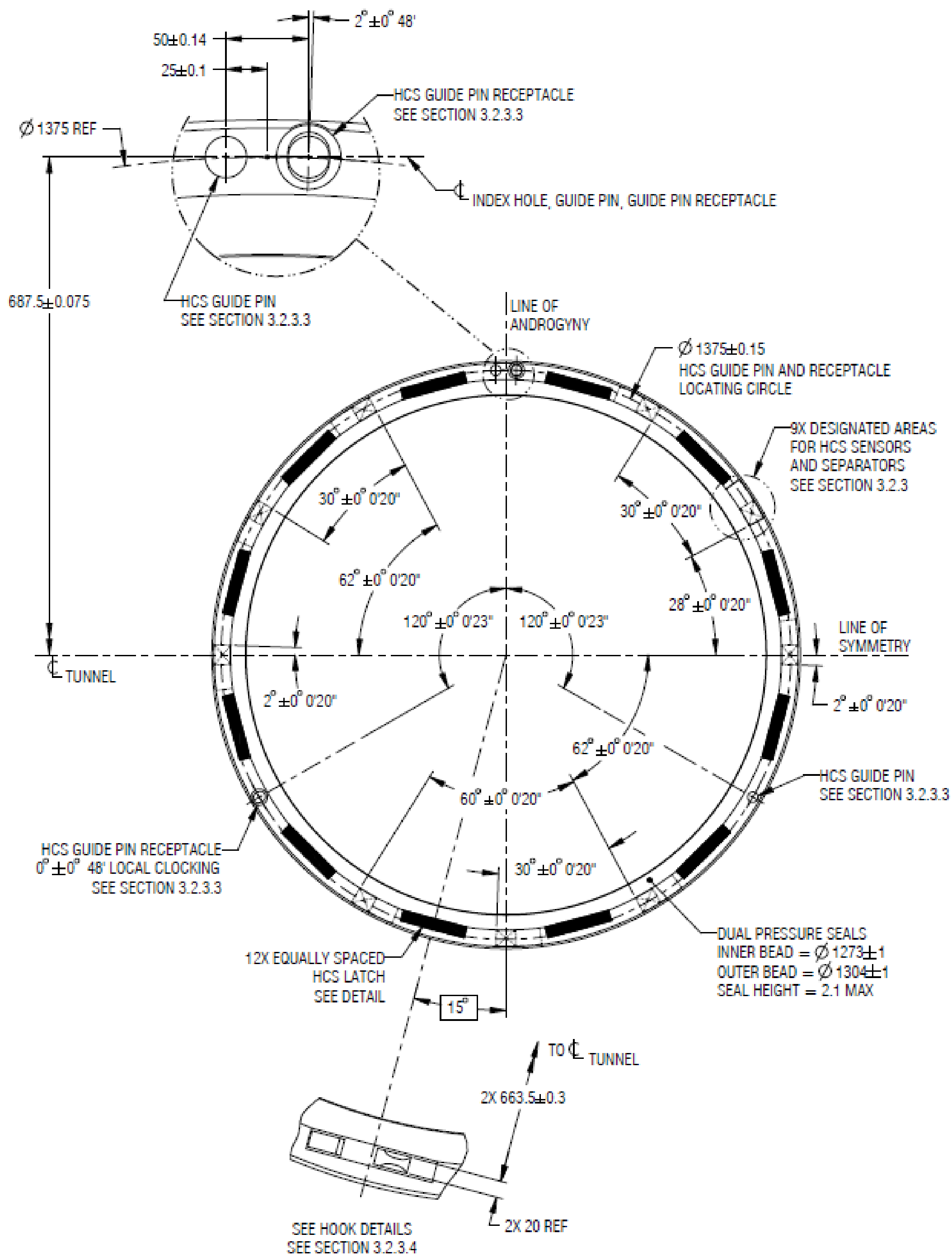
3.2.3 HARD CAPTURE SYSTEM

The Hard Capture System (HCS) performs the final structural mating between the two vehicles, establishing a connection capable of withstanding atmospheric pressure combined with the loads from planned mated operations of the two spacecraft.

DOCK-010 Hard Capture System

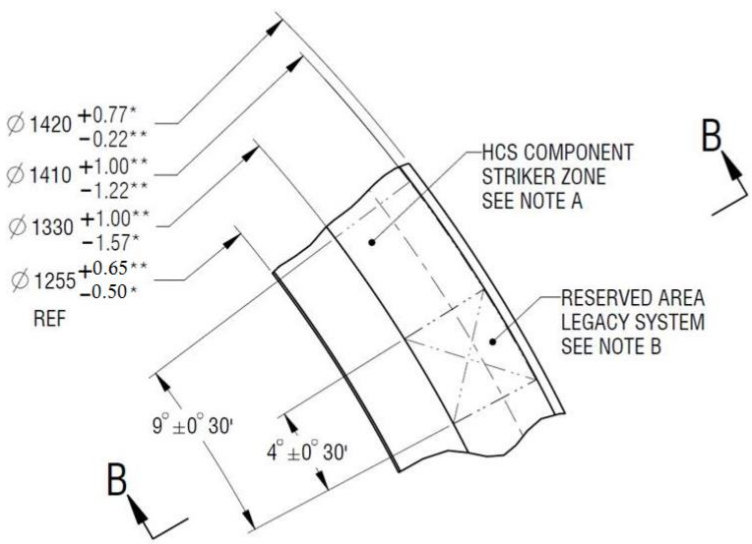
The HCS interface shall conform to the definition as shown in Figure 3.2.3-1, HCS Interface – Axial View, and Figure 3.2.3-2, HCS Interface – Sensor Striker Zone.

Rationale: Designated striker regions are identified for participants to configure peripheral hardware (e.g., separation system and sensors). HCS components that are not critical for transferring mated loads or maintaining pressurization are intentionally omitted from these figures for clarity.

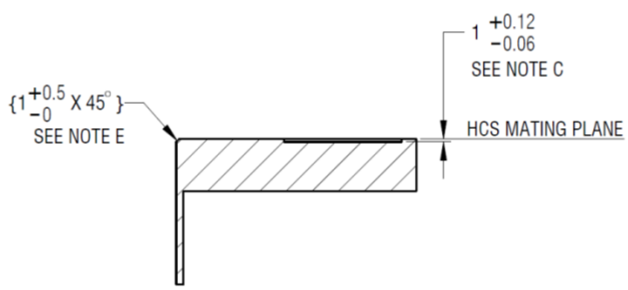


Notes: **1.** Boxed angular dimension is shown as Basic Dimension to illustrate the theoretical construction lines. No dimensional tolerances are to be applied to the Basic Dimensions.

FIGURE 3.2.3-1 HCS INTERFACE - AXIAL VIEW



Sensor Striker Zone



Section B-B

Notes:

* To accommodate NDS legacy.

** To accommodate Androgynous Peripheral Attachment System (APAS) legacy.

a) "HCS Component Striker Zone" is to depict the area for any international partner's components to strike. This zone provides the area for HCS sensors and separation mechanisms to contact.

b) "Reserved Area" is the area inside the "HCS Component Striker Zone" for legacy HCS components and strikers. Refer to Appendix D, D.1.1 for details.

c) "HCS Component Striker Zone" and "Reserved Area" are recessed from HCS mating plane as shown in Section B-B.

d) HCS Component Striker Zone may contain features that require accommodation. See Appendix D, D.1.1 for details.

e) A chamfer is shown as a required minimum clearance cutout all around the circumference. The cutout may have a different form and size as long as it meets the above minimum material removal requirement.

FIGURE 3.2.3-2 HCS INTERFACE - SENSOR STRIKER ZONE

3.2.3.1 TUNNEL

The tunnel is the main housing of the docking system that includes the interface flange for structural mating.

3.2.3.2 SEAL

The IDSS compliant docking system as defined in paragraph 3.1.1 System Description is fully androgynous. Paragraph 3.2.3.2.1 Seal on Seal Mating describes the seal on seal requirements supporting the androgynous configuration of the IDSS. As described in paragraph 1.0 Introduction whether to implement all of the features of the full IDSS system is determined by the designer and the implementing program. As such, a passive only configuration is utilized in multiple programs to date. Paragraph 3.2.3.2.2 Seal on Metal Mating described requirements for the passive sealing surface per figure 3.2.3.2.2-1.

3.2.3.2.1 SEAL ON SEAL MATING

The HCS uses two concentric pressure seals that accommodate seal-on-seal mating.

DOCK-011 Seal Locations and Height

Seal locations and height shall be as defined in Figure 3.2.3-1.

DOCK-012 Seal Adhesion force

Total seal adhesion force for both concentric seals shall be ≤ 900 N

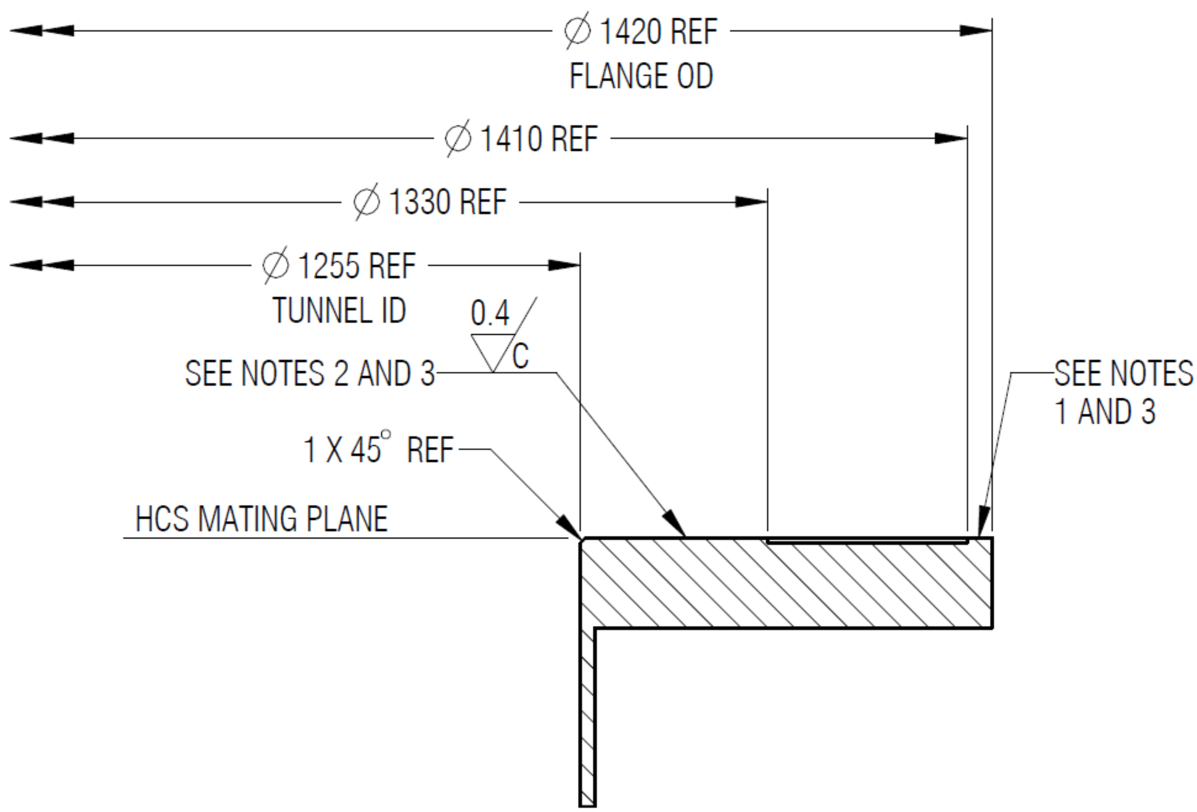
Rationale for DOCK-011 and 012: The HCS pressure seals, concentric seals that accommodate seal-on-seal mating, are located internally with respect to the tangential hook location. "Seal adhesion force" is defined as the force that is required to pull the docking pressure seals apart after they have been pressed together. Also see Table 3.3.2.1-1, HCS Maximum Mated Loads, for seal closure (compression) force.

3.2.3.2.2 SEAL ON METAL MATING

DOCK-013 Seal on Metal Mating

The sealing surface shall be per Figure 3.2.3.2.2-1, for seal on metal mating. The pressure seals are located internally with respect to the tangential hook location.

Rationale: This requirement specifies the metal surface geometry for the seal on metal configuration



Notes: Refer to Figure 3.2.3-2 for dimension tolerances

1. Surface treatment to meet the HCS electrical bonding described in section 3.2.4.2
2. Surface treatment to allow seals to maintain pressure at operational environmental limits.
3. Global surface not to exceed 0.25 mm on indicated surfaces. Local surface flatness not to exceed 0.08 mm across any area on indicated annular surface for an arbitrary 30° arc.

FIGURE 3.2.3.2.2-1 HCS SEALING SURFACES

3.2.3.3 GUIDE PINS AND GUIDE PIN RECEPTACLES

DOCK-014 Guide Pins and Guide Pin Receptacles

The HCS shall have two guide pins and two guide pin receptacles, as shown in the Guide Pin Details [Figures 3.2.3.3-1, Guide Pin, and 3.2.3.3-2, Section C-C] and the Guide Pin Receptacle Details [Figures 3.2.3.3-3, Guide Pin Receptacle, and 3.2.3.3-4, Section D-D].

Rationale: To support the final alignment of the hard mate interface and load capability.

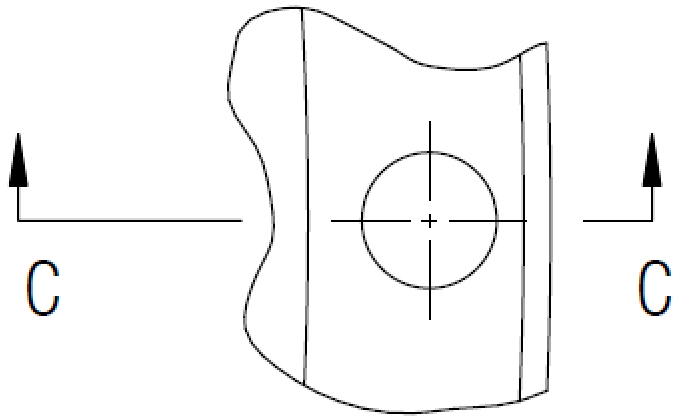
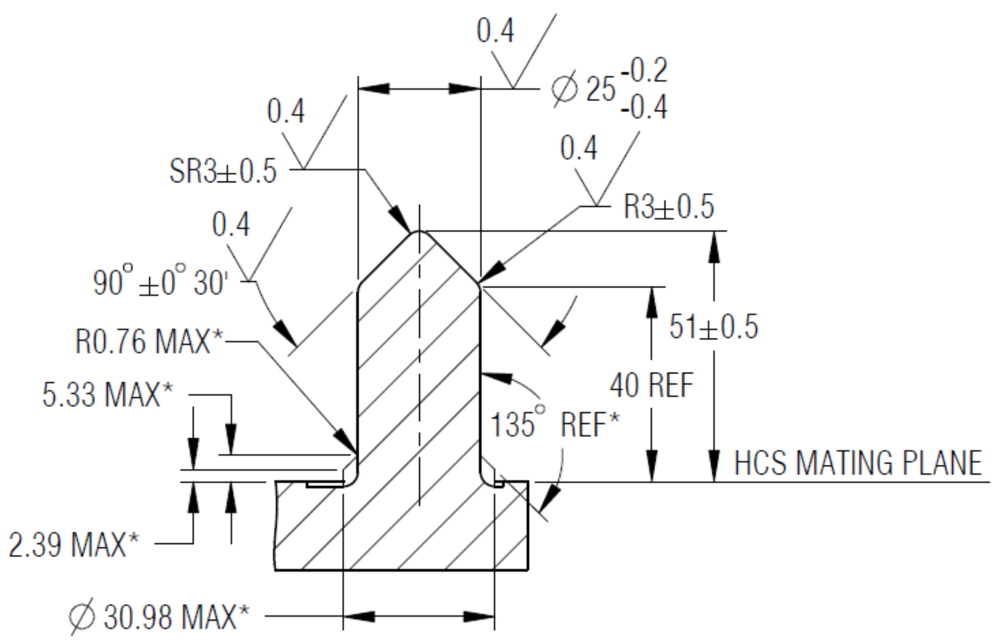


FIGURE 3.2.3.3-1 GUIDE PIN



*** Note:** Additional volume available based on docking provide needs. If extra volume is not required, starred dimensions are not necessary.

FIGURE 3.2.3.3-2 SECTION C-C

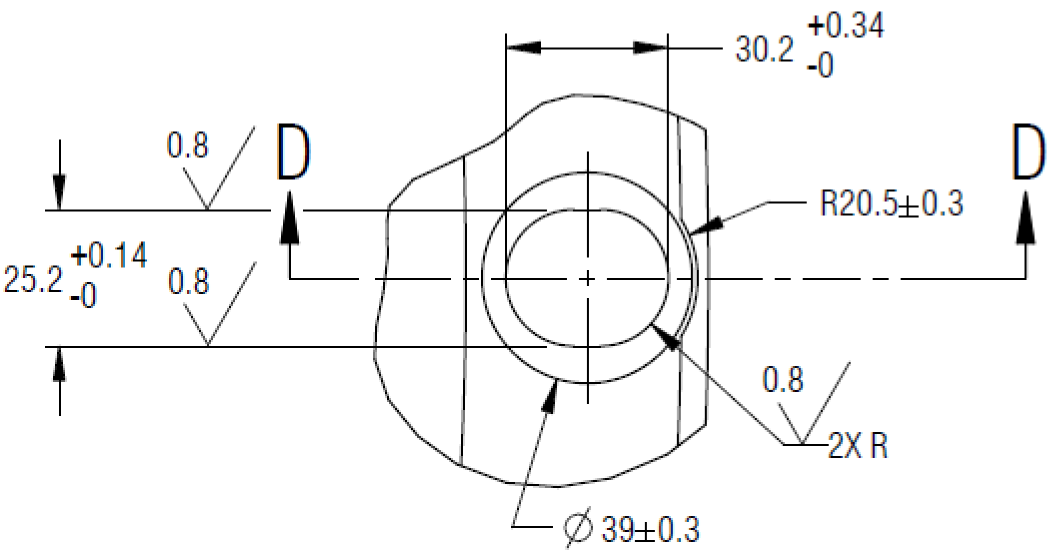
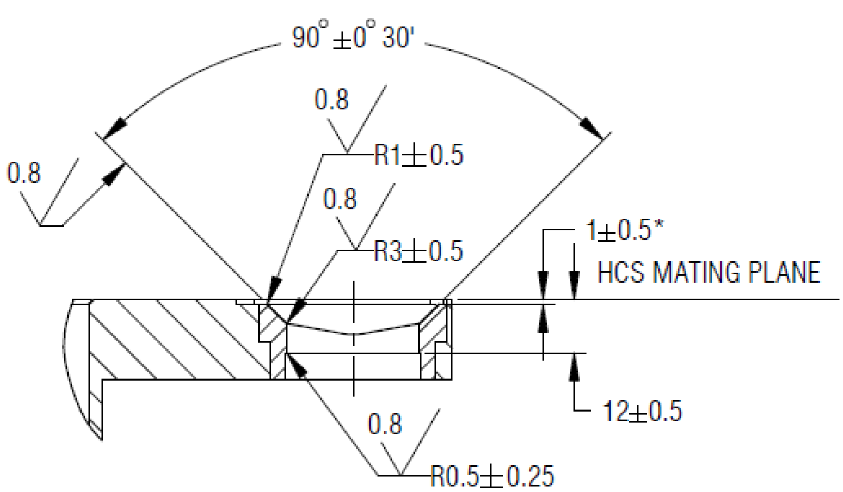


FIGURE 3.2.3.3-3 GUIDE PIN RECEPTACLE



SECTION D-D

*** Note:** As the Guide Pin Receptacle is located in a recessed area, this dimension depicts the distance from the HCS Mating Plane to the start of the hole chamfer.

FIGURE 3.2.3.3-4 SECTION D-D

3.2.3.3.1 GUIDE PIN DESIGN FOR HIGH TORSION LOAD CASE

Figure 3.2.3.3-2 Section C-C describes a guide pin design for high torsion load case (see Section 3.3.2.1) that is fully compliant with the IDSS system. The design reserves volume for a buttress base feature to the guide pin supporting greater capability to the high torsion load case.

3.2.3.4 HARD CAPTURE HOOKS

DOCK-015 Hard Capture Hook Arrangements

The HCS shall incorporate 12 pairs of active and passive hooks, located as shown in Figure 3.2.3-1.

Rationale: To carry nominal loads, 12 active hooks on one docking system engage 12 passive hooks on an opposing docking system interface. On a fully androgynous system, the 12 active hooks on each side of the interface may be engaged with the 12 passive hooks on the opposing interface for a total of 24 active hook engagements. Although engaging 24 hooks is not a requirement, this capability can be used to carry additional mated interface loads. The HCS implements a passively compliant passive hook.

DOCK-016 Hard Capture Hook Geometry

The hooks shall conform to the definition as shown in the HCS Hooks – Side Views [Figures 3.2.3.4-1, Ready to Dock Configuration, 3.2.3.4-2, Ready to Hook Configuration, and 3.2.3.4-3, Fully Mated Configuration], Figure 3.2.3.4-4, HCS Active Hook, and the HCS Passive Hook [Figures 3.2.3.4-5, Passive Hook, and 3.2.3.4-6, Passive Hook Detail View] and Figure 3.2.3.4-7, HCS Active Hook Motion Envelope.

Rationale: Conformance to these geometric configurations ensure proper hook operations.

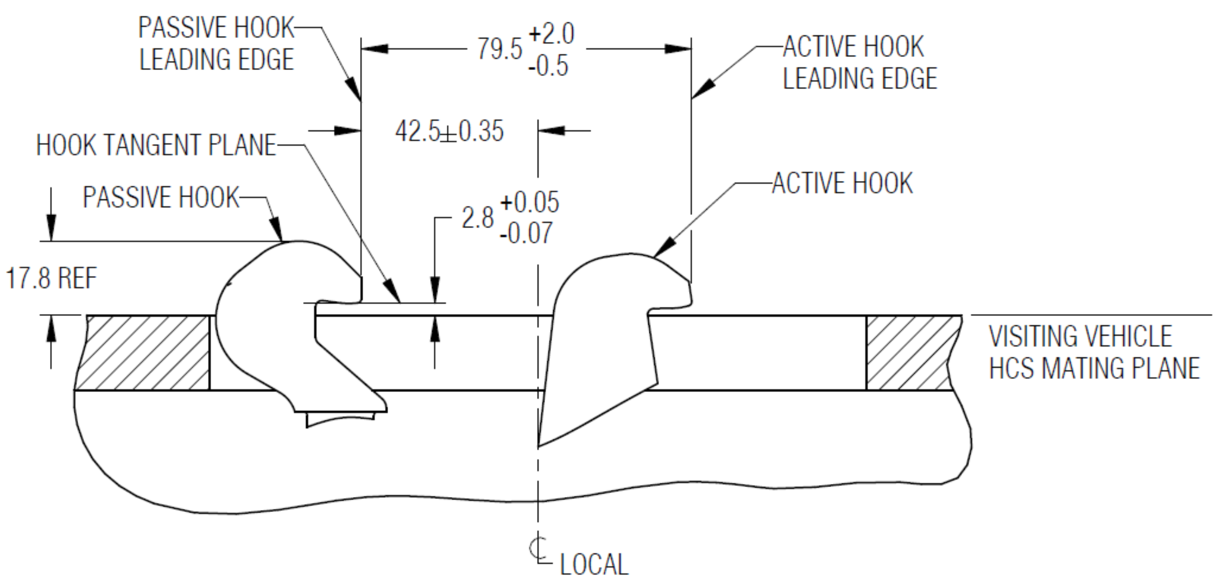
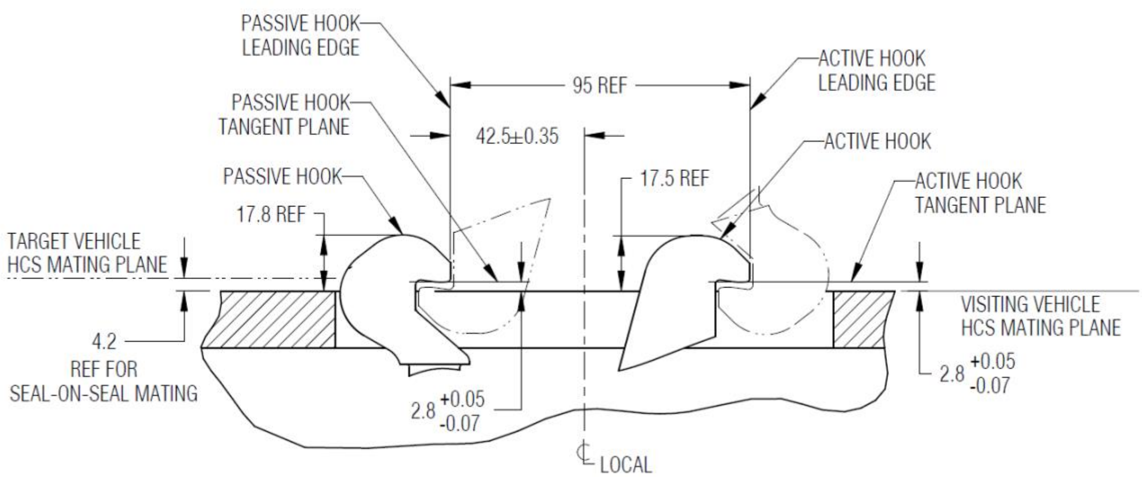


FIGURE 3.2.3.4-1 READY TO DOCK CONFIGURATION



Note: "Ready to Hook" reflects fully engaged (maximum horizontal travel), but not preloaded (pull down).

FIGURE 3.2.3.4-2 READY TO HOOK CONFIGURATION

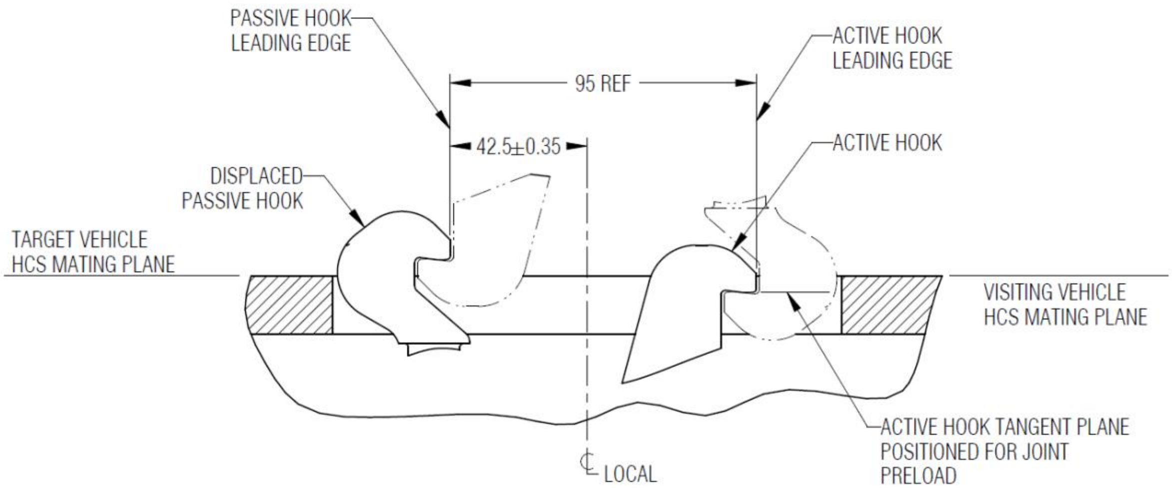


FIGURE 3.2.3.4-3 FULLY MATED CONFIGURATION

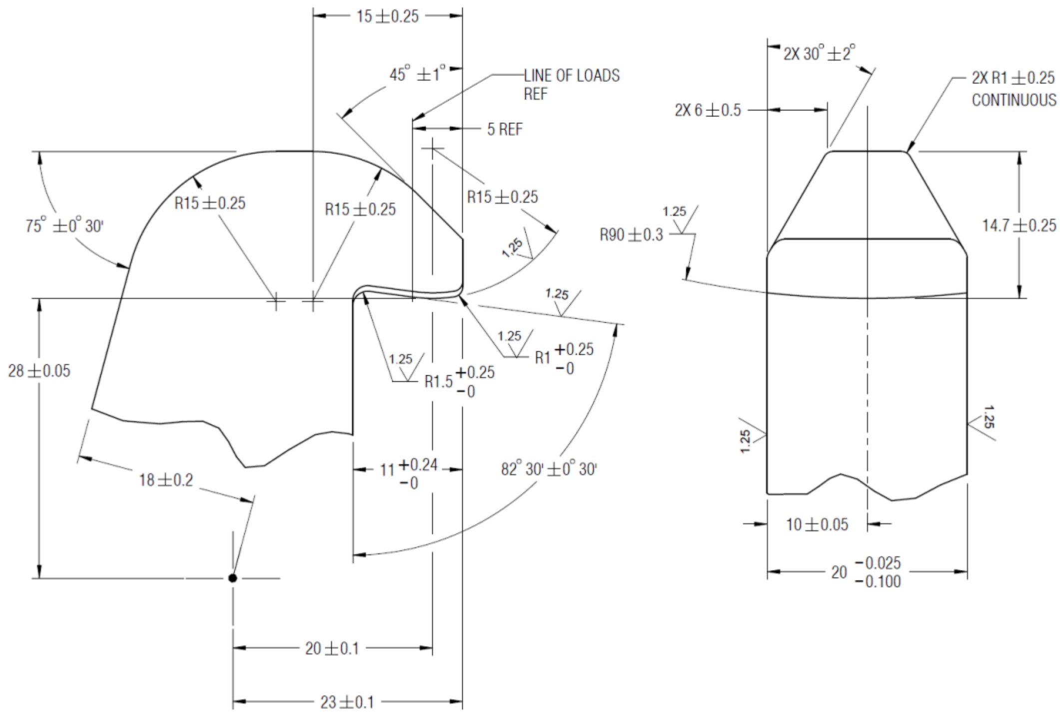


FIGURE 3.2.3.4-4 HCS ACTIVE HOOK

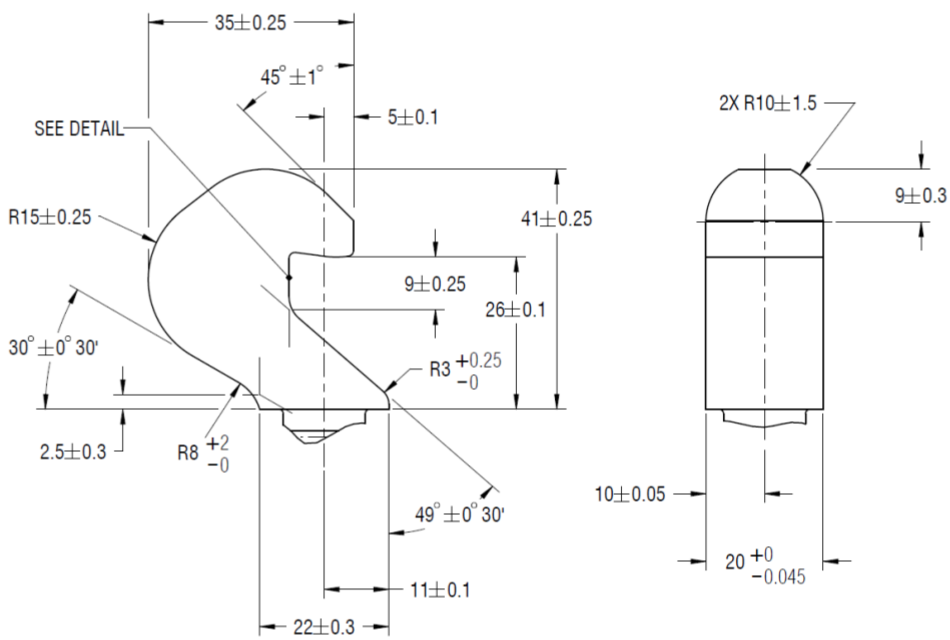


FIGURE 3.2.3.4-5 PASSIVE HOOK

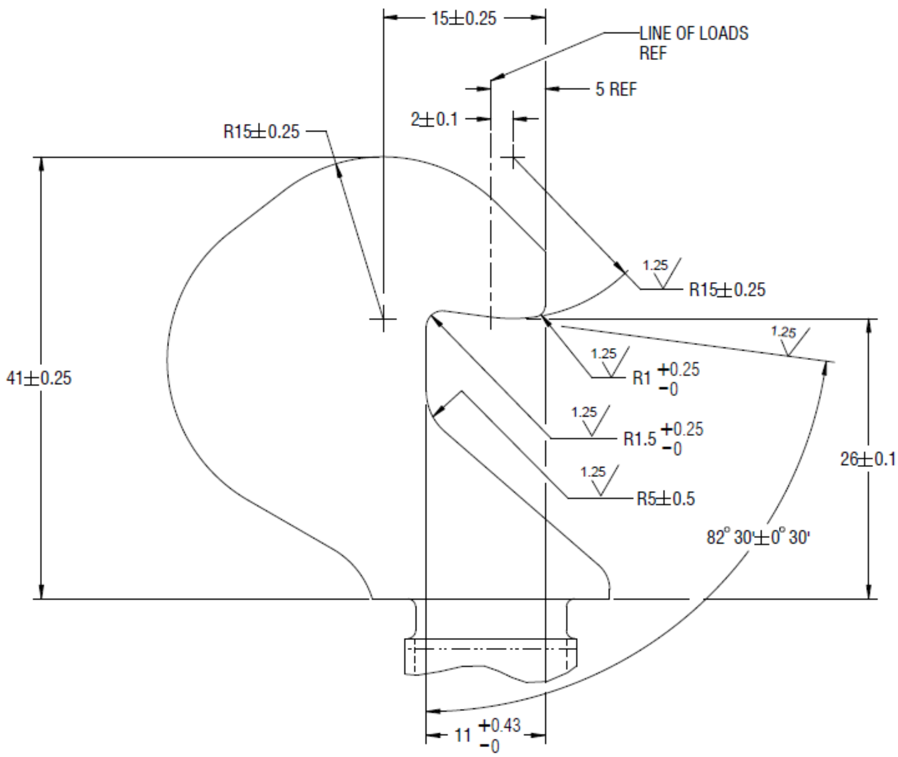


FIGURE 3.2.3.4-6 PASSIVE HOOK DETAIL VIEW

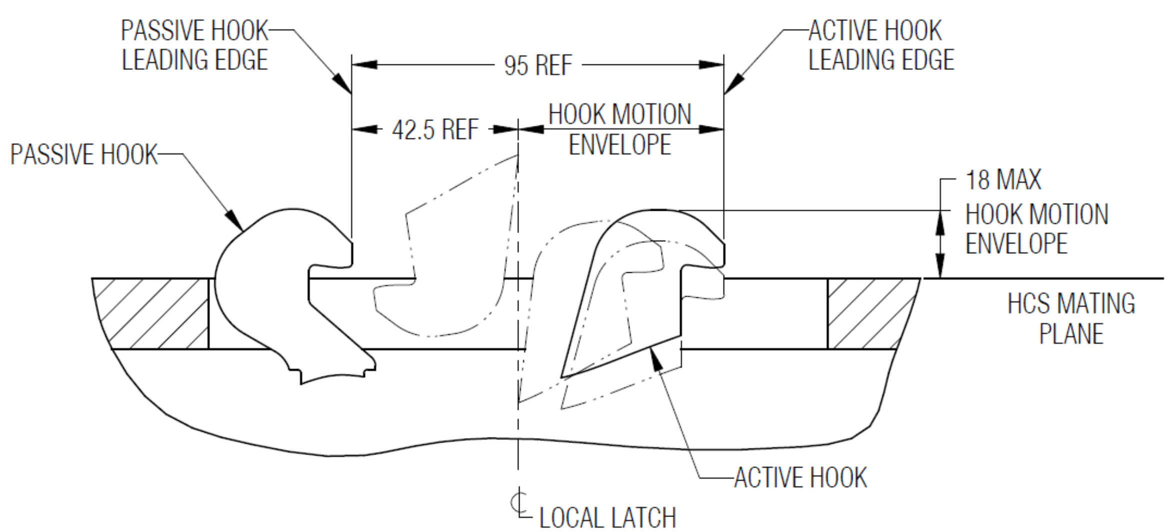


FIGURE 3.2.3.4-7 HCS ACTIVE HOOK MOTION ENVELOPE

The Hook System is defined as the serial combination of a single pair of Active and Passive Hook Mechanisms and the structural elements that are in compression.

DOCK-017 Hard Capture Hook Preload

The Preload of each Active and Passive Hook pair after locking shall be between the following values:

Minimum Preload of Hook System after locking = 31 300 N

Maximum Preload of Hook System after locking = 44 340 N

DOCK-018 Hard Capture Hook Load Limit Capability

The Design Limit Capability of the Active and Passive Hook pair shall be 50 000 N

DOCK-019 Active Hard Capture Hook Mechanism Stiffness

The load response (stiffness) of each Active Hard Capture Hook Mechanism shall be between the upper and lower curves as defined Figure 3.2.3.4-8, Load Response of Active Hook Mechanism.

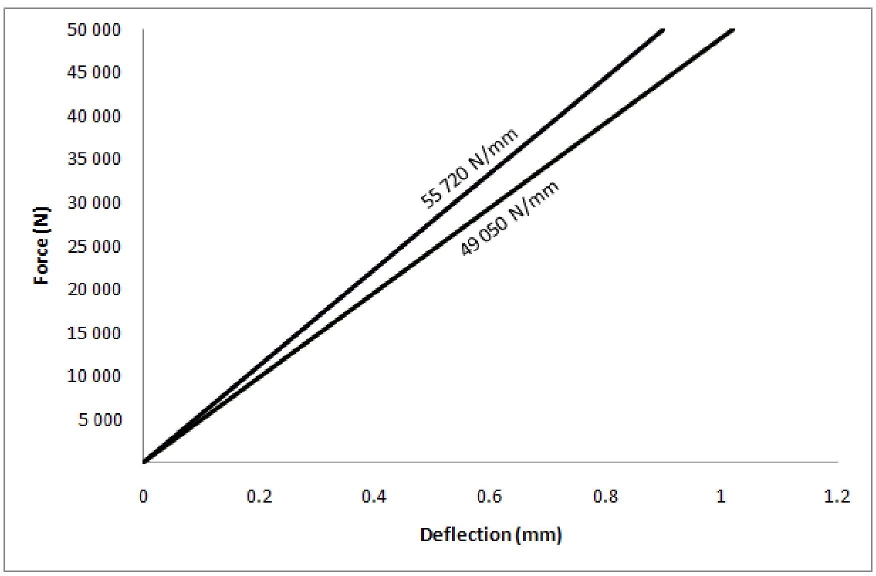


FIGURE 3.2.3.4-8 LOAD RESPONSE OF ACTIVE HOOK MECHANISM

DOCK-020 Passive Hard Capture Hook Mechanism Stiffness

The load response (stiffness) of each Passive Hard Capture Hook Mechanism shall be between the upper and lower curves as defined in Figure 3.2.3.4-9, Load Response of Passive Hook Mechanism (including Spring Washer Stack).

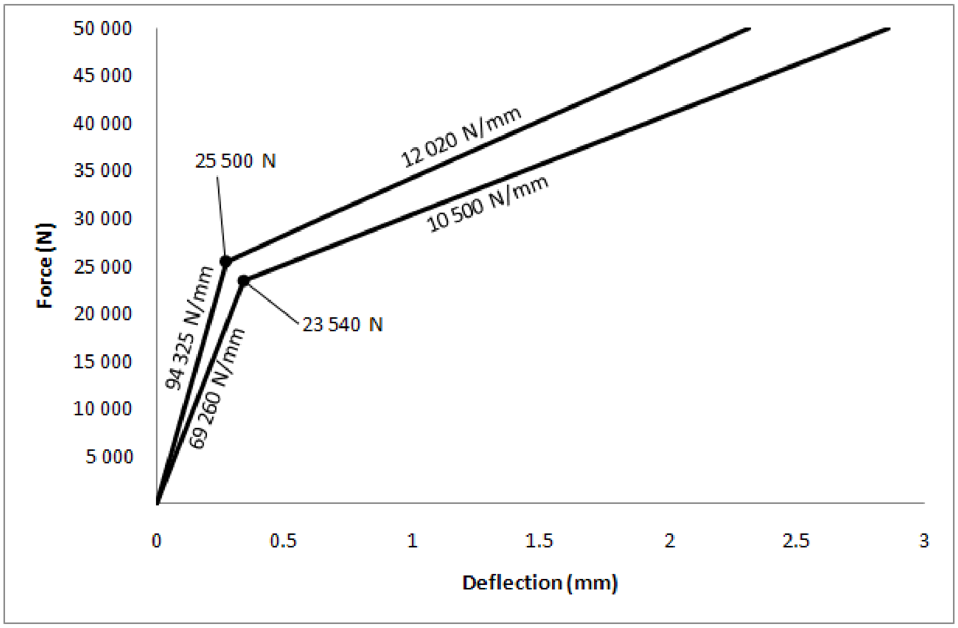


FIGURE 3.2.3.4-9 LOAD RESPONSE OF PASSIVE HOOK MECHANISM (INCLUDING SPRING WASHER STACK)

Rationale for DOCK-017, 018, 019 and 020: To support sufficient pre-load at the interface to handle mated loads.

3.2.3.5 HARD CAPTURE STRIKER AREAS

DOCK-021 Hard Capture Striker Areas

IDSS compliant systems shall abide by the designated striker zones defined in Figure 3.2.3-1 and Figure 3.2.3-2.

Rationale: The HCS has designated areas for striker zones used by the opposing docking system. These striker areas can be used for various HCS sensory components or other subsystems such as separation system push-off devices.

3.2.3.6 SEPARATION SYSTEM - GENERAL

Separation systems that are integrated and part of the IDSS compliant docking system will adhere to the following parameters:

DOCK-022 Separation System Retraction

The separation system shall fully retract below the interface plane prior to docking without application of external forces.

DOCK-023 Separation Force

The separation system shall provide a symmetric undocking separation force. The number of separators is a choice left to the docking system designer, provided that they comply with the hard capture striker designated areas (see Section 3.2.3.5).

Rationale for DOCK 022 and 023: To support mating of different technologies and to support proper undocking.

3.2.3.6.1 SEPARATION FORCE LIMITS

DOCK-024 Separation Force Limit

Total separation force shall be < 2670 N when the HCS interface is fully mated.

DOCK-025 Separation Force for Initial Velocity

Total separation force shall be ≥ 1778 N at 4.2 mm above the HCS Mating Plane.

Rationale for DOCK 024 and 025: To ensure structural integrity when mated and initial velocity when separating.

3.2.3.6.2 SEPARATION ENERGY

DOCK-026 Separation Energy

Total separation energy shall be between 39.2 N-m and 47.5 N-m when the HCS interface is fully mated.

Rationale: To ensure total separation when undocking.

3.2.3.7 HCS COMPRESSIVE FORCE RESISTANCE DURING SCS RETRACTION

During the SCS retraction for hard mate, sensors on the mating HCS mechanisms, such as “Ready-to-Hook” or “Undocking-Complete” indicators, will be compressed. A limit on the total resistance force produced by all sensors on the passive HCS system during SCS retraction is to be defined as follows:

DOCK-027 HCS Sensor Force Limit

The total resistance force contributed by all HCS sensors on the passive side shall be ≤ 85 N at a separation of ≥ 4.2 mm between the HCS Mating Planes.

Rationale: To provide a limit for resistive forces on the active SCS due to HCS sensor activation but excluding sensor forces that occur during Hook seal compression. Sensor forces at HCS mating plane distances within 4.2 mm are considered to be part of Seal Closure Force in accordance with Table 3.3.2.1-2.

3.2.4 ELECTRICAL BONDING

IDSS compliant systems establish bond paths to mitigate hazards on the integrated subsystem.

3.2.4.1 SOFT CAPTURE SYSTEM

SCS to SCS Bonding Resistance:

Spacecraft docking in the radiation belt as well as other solar events may drive excessive electro-static charging of spacecraft and potential voltage differentials between spacecraft to several thousand volts. A large bonding resistance across the two docking spacecraft to protect for arcing and potential damage of docking systems avionics should be considered. The resistance capability between mating interfaces should be in the range of 10 kiloohm up to 1 megaohm.

Implementation of this capability may result in impacts to developing docking systems as well as legacy systems. Programs should assess the environments for planned operational usages of implementing docking systems and make program specific risk-based decision whether to invoke this capability.

DOCK-028 SCS to Host Vehicle Bonding Resistance

Bonding resistance between the SCS and its host vehicle shall be 1 ohm or less.

Rationale: This provides a common minimum capability to dissipate electrostatic discharge through the SCS. The bond path from the soft capture interface through the docking mechanism may be any metal-to-metal contact provisions for this purpose. .

3.2.4.2 HARD CAPTURE SYSTEM

DOCK-029 HCS Bonding Resistance After Latching Hooks

Bonding resistance for the HCS after latching hooks shall be 2.5 milliohms or less.

Rationale: To protect against RF emissions. The bond path is through metal to metal contact on the seal interface between two IDSS compliant HCS mechanisms as shown via Note 1 in Figure 3.2.3.2.2-1.

DOCK-030 Fault Bonding Path Resistance

The resistance for fault bonding path shall be 0.1 ohm or less.

Rationale: To protect against shock hazard while transferring of power across the docking Interface,

3.2.5 ENVIRONMENTS

There are many critical requirements needed in the development of a docking system such as fault tolerance, reliability, and environments (e.g. vibration, radiation, etc.), it is not the intent of the IDSS IDD to mandate all of these requirements; these requirements must be addressed as part of the specific developer's unique program, spacecraft, and mission needs.

3.2.5.1 DOCKING INTERFACE TEMPERATURE DIFFERENTIAL

Designers of docking systems need to consider the combined effects of thermal deflections due to temperature differentials, structural and pressure deflections, and dimensional variability when evaluating a docking system's ability to interface without binding or jamming. Tolerance analysis which includes all deflections and variations is recommended to evaluate design capability and document allowable temperature differentials. Individual program requirements are expected to provide definition of the thermal environment and mating docking systems will need to exchange data to describe expected structural and pressure deflections as well as predicted temperatures.

Note: A temperature differential of 55 degree C was used as the basis for the dimensions and tolerances described in this document, as derived from the heritage design.

DOCK-031 Reserved

3.2.5.2 DOCKING INTERFACE EXTERNAL PRESSURE ENVIRONMENT

DOCK-032 Docking Interface External Pressure Environment

The docking interface shall accommodate external pressure environment < 1.0 x 10-4 Pa.

Rationale: Materials used in the construction of the docking interface allow proper mating while experiencing vacuum conditions.

3.2.6 MATERIALS AND SURFACE FINISHES

In general, the interface features defined herein, except for the pressure seals, should have stiffness and hardness comparable to that of metal alloys commonly used in aerospace vehicle primary structures, and which do not significantly impede relative motion. Interface surfaces which slide against each other to assist in docking interface alignment should incorporate a surface coating or finish that has low friction characteristics. The resultant coefficient of friction between two mating systems is an integrated performance characteristic which affects soft capture success.

Specific material selection for the pressure seals will be at the designer's discretion.

3.3 DOCKING PERFORMANCE

In addition to the physical geometric interface requirements, a set of common design parameters enveloping the reference missions and conditions is provided. For the SCS, this set includes interface loads, vehicle mass properties, and ICCs. For the HCS, this set includes mated loads. Of these common design parameters, only the loads have been defined as requirements. The other common design parameters, if accommodated in the docking system design, increase the probability of successful docking between different spacecraft.

Note: New space craft continue to be developed in the thriving space economy. The set of interface loads, vehicle mass properties, and ICCs defined in this revision of the IDSS represent vehicles known at this time. New vehicles may not align well with these vehicle definitions. When a new vehicle that does not fall within the boundaries defined in this standard, unique mission loads, and ICCs may be required and to be assessed for acceptability within the operating program. Furthermore, even for vehicles within the boundaries defined, unique loads and ICCs may be required based on the unique performance characteristics of the integrated docking system and host vehicle. Sharing analysis data and vehicle specifics with the participating IDSS developers is recommended in support of the overall objectives of the IDSS described in the Preface and paragraph 1.0.

3.3.1 SOFT CAPTURE SYSTEM

The SCS docking performance is defined by the mechanism's ability to capture and attenuate. During the capture phase, the mechanism is contending with the spacecraft misalignment to achieve capture. During the attenuation phase, the mechanism is limiting the relative motion and limiting the loads.

3.3.1.1 INITIAL CONTACT CONDITIONS AND COORDINATE SYSTEMS

ICCs are instantaneous relative states of the active docking interface with respect to the passive docking interface at docking interface first contact (first physical touch). They are used to define the lateral and angular misalignment, and translational and angular velocity errors when compared to perfect alignment and zero relative velocity at the docking interfaces.

The coordinate systems of docking units and docking objects are used to define the motion during docking and ICCs. An overview and description of coordinate systems is provided in Table 3.3.1.1-1, Coordinate Systems Used for Docking Motion Description. Figures 3.3.1.1-1 and 3.3.1.1-2 define the coordinate systems of the docking system and the docking objects.

The transition between coordinate systems is achieved by three rotations, performed in order corresponding to ISO 1151-1:1988, Flight Dynamics – Concepts, quantities and symbols – 4th edition, Part 1: Aircraft motion relative to the air.

A. Yaw – yaw angle Ψ_Z is defined positive about +Z-axis, using right-handed rule.

B. Pitch – pitch angle θ_Y is defined positive about +Y-axis, using right-handed rule.

C. Roll – roll angle φ_X is defined positive about +X-axis, using right-handed rule.

To increase the probability of successful docking between different spacecraft, it is recommended that IDSS-compliant mechanisms capture and attenuate vehicles within ICCs shown in Table 3.3.1.1-2, Initial Contact Conditions.

The set of limiting ICCs provided in Table 3.3.1.1-2 represents the values used in the derivation of the loads defined in Table 3.3.1.4-1, SCS Maximum Interface Loads, and Table 3.3.1.4-2, SCS Maximum Component Loads, and represents the achievable capture envelope provided by IDSS-compatible mechanism's passive interface.

TABLE 3.3.1.1-1 COORDINATE SYSTEMS USED FOR DOCKING MOTION DESCRIPTION

#	Name	Symbol	Position	Orientation	Purpose
1. Coordinate systems of docking system interfaces					
1.1	Active SCS ring coordinate system	$X_{AR}Y_{AR}Z_{AR}$	Active ring center	$+X_{AR}$: closing direction, $+Y_{AR}$: line of symmetry, through petal number 3 $+Z_{AR}$: make right coordinate system, (see Figure 3.3.1.1-2)	• Docking mechanism motion description • Description of ring contact interaction
1.2	Passive SCS ring coordinate system	$X_{PR}Y_{PR}Z_{PR}$	Passive ring center	$X_{PR}Y_{PR}Z_{PR}$ – according to $X_{AR}Y_{AR}Z_{AR}$	• Description of ring contact interaction
1.3	Coordinate system of initial position of active docking mechanism	$X_{AI}Y_{AI}Z_{AI}$	Active ring center before first contact	$+X_{AI}$: closing direction, $+Y_{AI}$: line of symmetry, through petal number 3 $+Z_{AI}$: make right coordinate system, (see Figure 3.3.1.1-1)	• Description of initial position for docking
1.4	Coordinate system of active docking mechanism base	$X_{AB}Y_{AB}Z_{AB}$	Center of active docking mechanism base	$X_{AB}Y_{AB}Z_{AB}$ – according to $X_{AD}Y_{AD}Z_{AD}$, (see Figure 3.3.1.1-1)	• Docking mechanism motion description
1.5	Coordinate system of active docking/HCS mating plane	$X_{AD}Y_{AD}Z_{AD}$	Center of active docking plane	$+X_{AD}$: closing direction, $+Y_{AD}$: line of symmetry, through petal number 3 $+Z_{AD}$: make right coordinate system, (see Figure 3.3.1.1-1)	• Docking mechanism movement description relative to active docking/HCS mating plane • Contact interaction analysis of HCS elements
1.6	Coordinate system of passive docking/HCS mating plane	$X_{PD}Y_{PD}Z_{PD}$	Center of passive docking plane	$X_{PD}Y_{PD}Z_{PD}$ – according to $X_{AD}Y_{AD}Z_{AD}$	
2. Coordinate systems of docking objects					
2.1	Motion coordinate system of active object (1)	$X_1Y_1Z_1$	At the active object center of gravity (CG)	$+X_1$: closing direction, $+Y_1$: according to + Y_{AD} $+Z_1$: make right coordinate system, (see Figure 3.3.1.1-1 and Figure 3.3.1.1-2)	• Objects motion description relative to inertial coordinate system

TABLE 3.3.1.1-1 COORDINATE SYSTEMS USED FOR DOCKING MOTION DESCRIPTION

#	Name	Symbol	Position	Orientation	Purpose
2.2	Motion coordinate system of passive object (2)	$X_2Y_2Z_2$	At the passive object CG	$X_2Y_2Z_2$ – according $X_1Y_1Z_1$ by zero mis-alignments	• Active object motion description relative to passive object

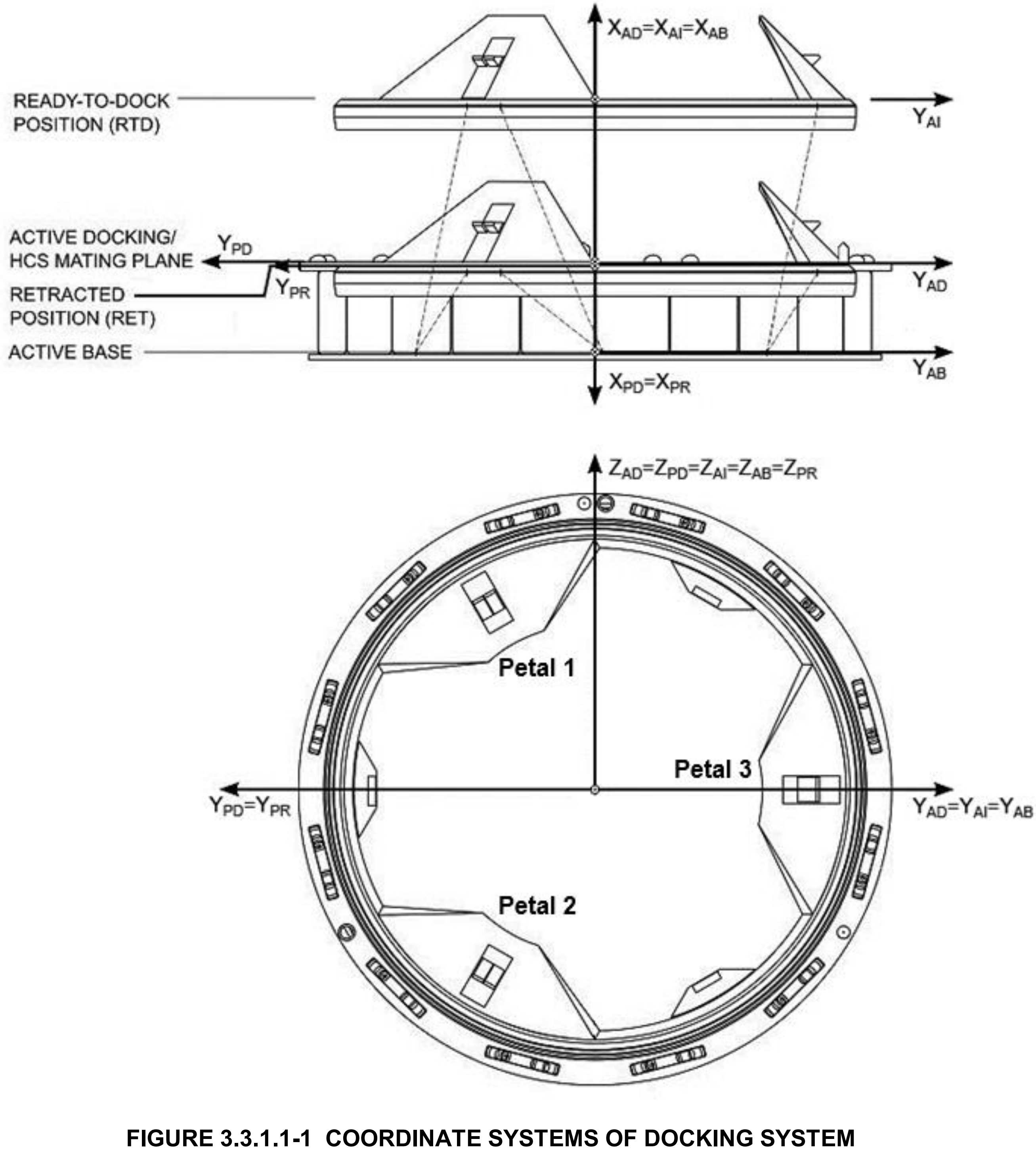


FIGURE 3.3.1.1-1 COORDINATE SYSTEMS OF DOCKING SYSTEM

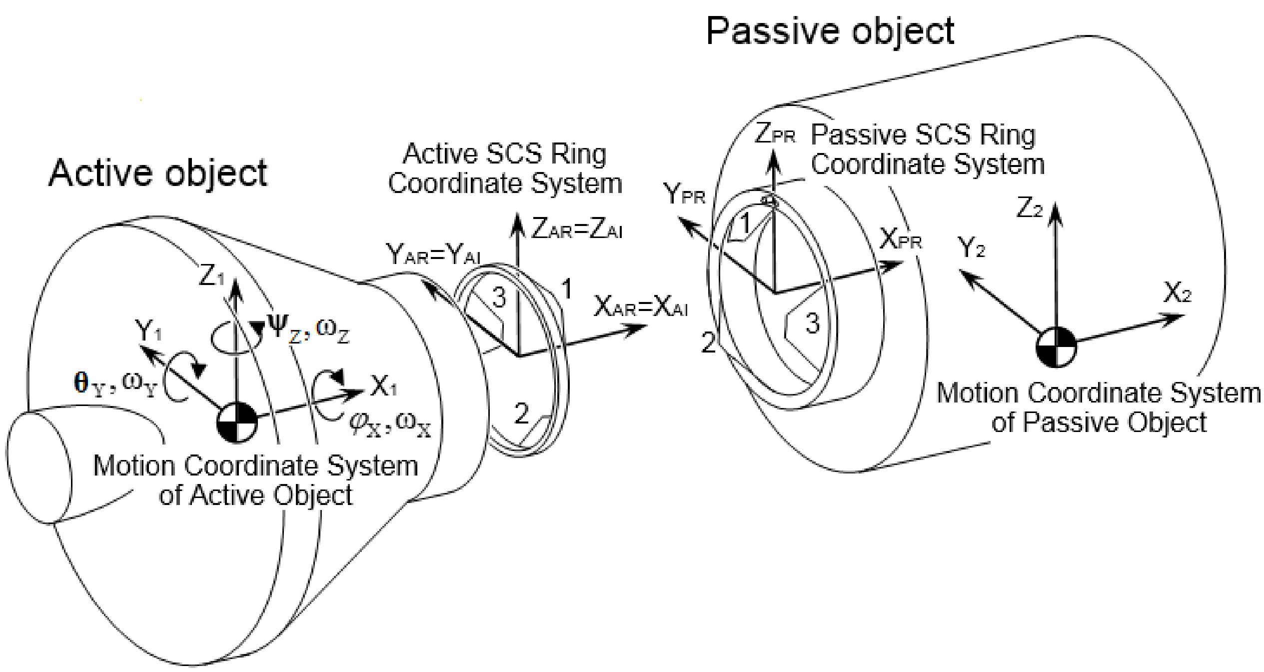


FIGURE 3.3.1.1-2 COORDINATE SYSTEM OF DOCKING OBJECTS (ACTIVE AND PASSIVE)

TABLE 3.3.1.1-2 INITIAL CONTACT CONDITIONS

Initial Condition	Limiting Value
Closing (axial) rate	0.05 to 0.10 m/sec
Lateral (radial) rate	0.04 m/sec
Pitch/Yaw rate	0.20 deg/sec (vector sum of pitch/yaw rate)
Roll rate	0.20 deg/sec
Lateral (radial) misalignment	0.10 m
Pitch/Yaw misalignment	4.0 deg (vector sum of pitch/yaw)
Roll Misalignment	4.0 deg

Notes:
1. Initial contact conditions are independent and are to be applied simultaneously, with the exception that the lateral rate at the vehicle CG resulting from the combination of lateral (radial) rate and the pitch/yaw angular rate should not exceed the lateral (radial) rate limit.

Initial Condition	Limiting Value
2. Mean closing (axial) rate may be adjusted depending on vehicle mass combinations. Refer to Table 3.3.1.2-1. 3. Post contact thrust may be used to achieve necessary capture performance. 4. Lateral (radial) misalignment is defined as the minimum distance between the center of the active soft capture ring and the longitudinal axis of the passive soft capture ring at the moment of first contact between the guide petals.	

3.3.1.2 VEHICLE MASS PROPERTIES

To increase the probability of successful docking between different spacecraft, it is recommended that IDSS-compliant mechanisms capture and attenuate vehicles with the mass properties shown in Table 3.3.1.2-1, Vehicle Mass Properties. The set of design case vehicle mass properties provided in Table 3.3.1.2-1 represents the values used in the derivation of the loads defined in Table 3.3.1.4-1 and Table 3.3.1.4-2.

TABLE 3.3.1.2-1 VEHICLE MASS PROPERTIES

Article	Mass (kg)	Moment of Inertia (kg*m2)						Coordinates of the Hard Capture System Mating Plane Center (m)		
		Ixx	Iyy	Izz	Ixy	Ixz	Iyz	X	Y	Z
IDSS-440T	4.40e05	1.30e08	7.50e07	1.90e08	-3.60e06	-5.10e06	-1.10e06	20.0	0.0	2.0
IDSS-100TA	1.0e05	7.60e06	1.70e06	8.60e06	-5.40e05	2.40e04	-2.10e04	9.6	-2.8	0.0
IDSS-100TR	1.0e05	1.70e06	7.60e06	8.60e06	5.40e05	2.10e04	2.40e04	4.7	6.5	0.0
IDSS-45T	45000	120000	1.20e06	1.20e6	0	0	0	8.8	0.0	0.0
IDSS-30T	30000	84000	430000	430000	0	0	0	8.1	0.0	0.0

IDSS-25T	25000	70000	169000	169000	0	0	0	5.4	0	0
IDSS-20T	20000	55000	135000	135000	0	0	0	4.3	0	0
IDSS-15T	15000	41000	71000	71000	0	0	0	4.1	0	0
IDSS-10T	10000	17000	42000	42000	0	0	0	3.5	0	0
IDSS-5T	5000	3400	18000	18000	0	0	0	2.3	0.0	0.0

Notes:

1. Moments of Inertia (MOI) are about center of gravity (CG) and products of Inertia (POI) are positive integral.
2. Mass properties defined in coordinate system located at CG with X-axis along vehicle longitudinal axis and positive toward the docking interface.

3.3.1.3 VEHICLE MOTION LIMITS

Vehicle motion limits are to be determined by vehicle and docking system designers to prevent collisions between structural members of the docking vehicles.

3.3.1.4 LOADS

DOCK-033 Active SCS Interface Loads

The active SCS of IDSS-compliant mechanisms shall meet all of its functional and performance requirements without exceeding the loads defined in Table 3.3.1.4-1 and Table 3.3.1.4-2.

DOCK-034 Passive SCS Interface Loads

When in passive mode, IDSS-compliant mechanisms shall withstand the SCS interface loads defined in Table 3.3.1.4-1 and Table 3.3.1.4-2.

Rationale for DOCK-033 and 034: To ensure structural integrity of the SCS

TABLE 3.3.1.4-1 SCS MAXIMUM INTERFACE LOADS

Load	Limiting Value
Tension	3 900 N
Compression (Static)	3 500 N
Compression (Dynamic, up to 0.1sec)	6 500 N
Shear	4450 N
Bending	2 800 N*m
Torsion	1 500 N*m

Notes:
1. Values are design limit loads.
2. Values are defined at the center of the SCS mating plane (Figure 3.2-1).
3. Values are 3σ maxima and are to be applied simultaneously, not to exceed the component values shown in Table 3.3.1.4-2.
4. Shear loads may be applied in any direction in the SCS mating plane.
5. Bending moment may be applied about any axis in the SCS mating plane.

TABLE 3.3.1.4-2 SCS MAXIMUM COMPONENT LOADS

Load	Limiting Value			
Mechanical Latch Striker Tension	3 000 N			
Magnetic Latch Striker Tension	2 300 N			
Striker (Ring to Ring) Compression	3 000 N			
Petal Edge Length	0%	10%	60%	80%
Petal Contact Loads	4870N	2 300 N	2 300 N	1 000 N

Notes:
1. Values are design limit loads.
2. The petal contact load is to be applied to the petal edge from the root of the petal to 80% of the petal length.
3. The petal contact load is to be applied to the outer face of the petal from the root of the petal to 60% of the petal length.

3.3.2 HARD CAPTURE SYSTEM

3.3.2.1 MATED LOADS

DOCK-035 HCS Mated Loads

IDSS-compliant mechanisms shall certify to the loads shown in Table 3.3.2.1-2, HCS Mated Load Sets, for design loads, as a minimum. These loads are applied at the center of the HCS interface, as defined in Figure 3.2.3-1. Shown in Table 3.3.2.1-1 is a maximum loads summary of the cases in Table 3.3.2.1-2, and is provided as ancillary information for definition of maximum design load limits based on unique program needs.

TABLE 3.3.2.1-1 HCS MAXIMUM MATED LOADS

Load Set	Mated ISS	Trans-Lunar	Future In-Space Habitats
Maximum Design Pressure	1 100 hPa	0 hPa	1100hPa
Seal Closure Force	97 150 N	97 150 N	97150 N
Compressive Axial Load	17 700 N	300 000 N	17 700 N
Tensile Axial Load	17 700 N	100 000 N	17 700 N
Shear Load	16 700 N	10 000 N	16 700 N
Torsion Moment	15 000 Nm	15 000 Nm	65215 Nm
Bending Moment	68 700 Nm	40 000 Nm	68700 Nm

TABLE 3.3.2.1-2 HCS MATED LOAD SETS

Load Set	Case 1	Case 2	Case 3	Case 4	Case 5
Design Pressure	1 100 hPa	1 100 hPa	1 100 hPa	0 hPa	1100 hPa
Seal Closure Force	97 150 N	97 150 N	97 150 N	97 150 N	97 150 N
Compressive Axial	5 000 N	17 700 N	13 700 N	300 000 N	5000 N
Tensile Axial Load	5 000 N	17 700 N	13 700 N	100 000 N	5000 N
Shear Load	5 000 N	14 800 N	16 700 N	10 000 N	5000 N
Torsion Moment	15 000 Nm	15 000 Nm	15 000 Nm	15 000 Nm	65215 Nm
Bending Moment	65 300 Nm	39 200 Nm	68 700 Nm	40 000 Nm	39200 Nm

Notes: (for Table 3.3.2.1-1 and Table 3.3.2.1-2)

1. Values are design limit loads.
2. Hard capture hook preload and tunnel stiffness will be such that, when under external loading within limits, there remains metal-to-metal contact in the local vicinity of the hooks.
3. Shear loads may be applied in any direction in the HCS mating plane.
4. Bending moment may be applied about any axis in the HCS mating plane.
5. The outer seal bead is to be used for all pressure calculations.
6. Case descriptions:

Case 1 – Attitude control by Orbiter-sized vehicle, combined with crew activity.
Case 2 – Interface loads due to space station segment berthing.
Case 3 – Orbiter-sized vehicle translation with payload attached to docking system.
Case 4 – Unpressurized high axial tension load case; modified from moon program Trans-lunar Injection loads applied to the dock interface.
Case 5 – High torsion shear case for vehicle offset masses to overall vehicle primary stack

Rationale: To ensure structural integrity of the HCS.

3.4 RESOURCE TRANSFER UMBILICALS

The IDSS accommodates umbilical connectors for transfer of electrical and fluid resources between two docked vehicles.

DOCK-036 Umbilical Connector Retraction

All umbilical connectors shall be recessed below the docking mating plane during docking.

Rationale: Recessed connector designs will enable potential crew rescue for cross program or cross world developer implementations. During undocking, the connectors are nominally deactivated and driven to the unmated recessed position prior to unlatching the hooks. Ten umbilical connector locations are available for utilization by docking system developers as shown in Figure 3.4-1. Specific implementations are defined based on unique requirements of programs and agencies.

Program specific resource transfer specifications can be found in program specific Interface Definition Documents (IDDs) and Specifications. Reference material for program resource umbilical implementations is provided at the International Deep Space Interoperability Standards website www.internationaldeepspacestandards.com and or www.internationaldockingstandard.com.

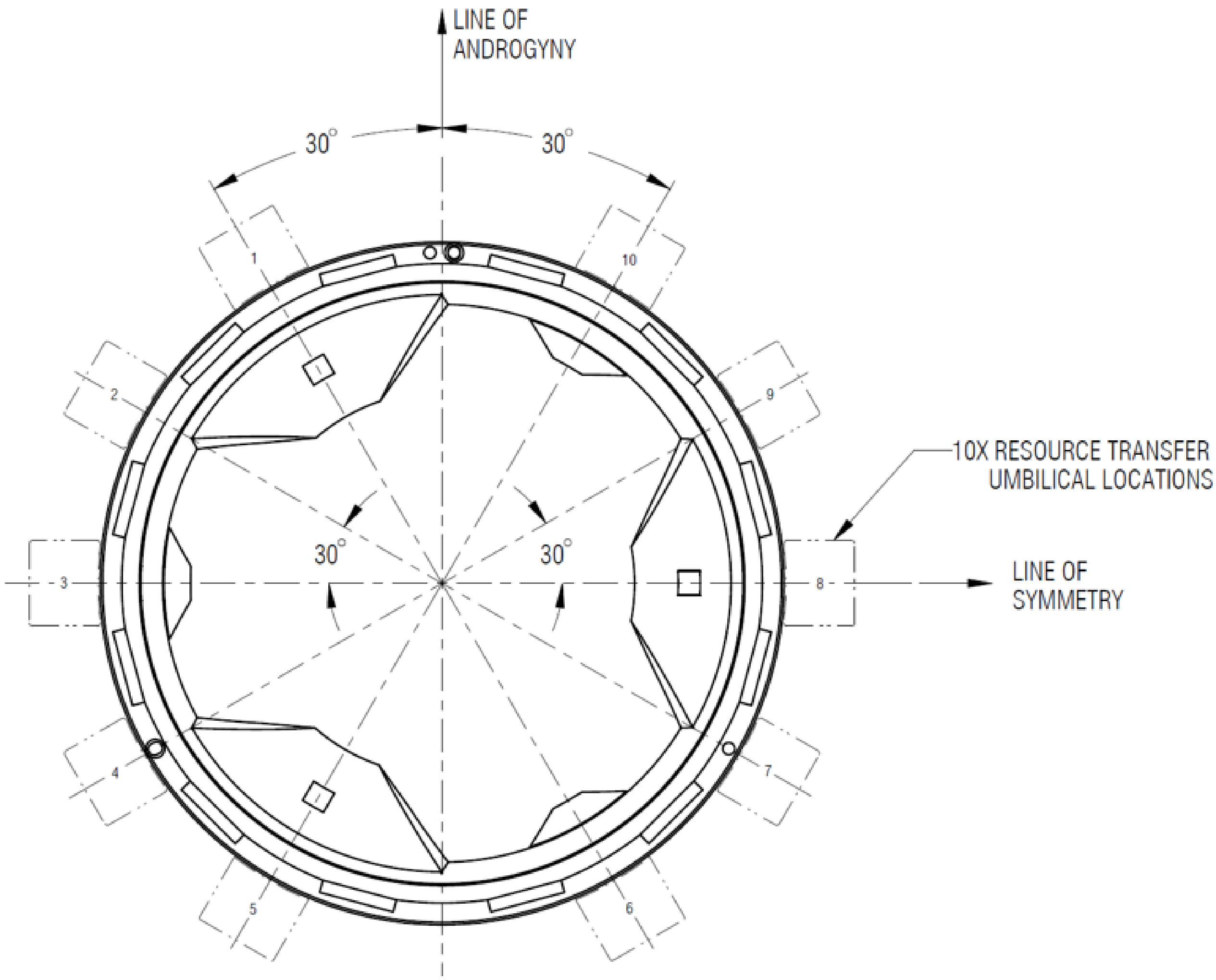


FIGURE 3.4-1 UMBILICAL CONNECTOR LOCATIONS

3.5 RENDEZVOUS AND ALIGNMENT AIDS

Program specific Rendezvous and Alignment Aids are not defined in this standard. Program specific rendezvous and alignment aid specifications may be found in program specific Interface Definition Documents (IDDs). Guidance for program specific R & A IDDs may be found at www.internationaldockingstandard.com. For ISS International Docking Adapter (IDA), IDSS Revision E may be utilized. This revision may also be found on the IDSS website.

3.6 BERTHING

An IDSS compliant docking system that requires berthing system compatibility (IDSS+B) will meet the minimum set of requirements defined in this section. Con Ops for berthing operations are not addressed in this section and may be found on the IDSS website in the IDSS Berthing Concept of Operations document CSA-SE-CO-0001.

3.6.1 COMMON BERTHING REQUIREMENTS

These requirements apply to manipulator driven and SCS driven berthing methods.

3.6.1.1 MAXIMUM RESISTIVE FORCE – PASSIVE

DOCK-BER-001 Passive Docking Resistive Force

The passive docking system total pre-capture resistive force shall be ≤ 50N.

Rationale: Limiting the total pre-capture resistive force ensures IDSS passive docking systems will support berthing operations. 50N was allocated to the passive docking system from the total pre-capture resistive force defined in Section 3.6.2.1.

3.6.1.2 SOFT CAPTURE SYSTEM – CAPTURE INDICATION

DOCK-BER-002 Capture Indication

The active side of the docking port shall provide an indication when the soft capture system has detected capture during berthing.

Rationale: A soft capture indication is necessary to support berthing and unberthing operations. Soft capture status can be used by the manipulator to signal the completion of active commands, or to inform that the SCS is ready to progress to the next step in the operation. It is unsafe for the manipulator to release the vehicle if soft capture has not been confirmed.

3.6.1.3 SOFT CAPTURE SYSTEM – RELEASE INDICATION

DOCK-BER-003 Release Indication

The active side of the docking port shall provide an indication when the soft capture system has detected release.

Rationale: A soft capture indication is necessary to support berthing and unberthing operations. Soft capture status can be used by the manipulator to signal the completion of active commands, or to inform that the SCS is ready to progress to the next step in the operation. It is unsafe for the manipulator to grapple a visiting vehicle with an extended SCS if soft capture has not been confirmed.

3.6.1.4 GRAPPLE FIXTURE CAPTURE AND RELEASE LOADS

During the capture and release of the grapple fixture, the active SCS will be subjected to forces of up to 200 N RSS and 700 Nm RSS expressed in the SCS coordinate system over a period of up to 180 seconds.

To capture the grapple fixture, the manipulator may apply loads at the GF interface for engagement and rigidization.

3.6.1.5 BERTHING LOADS

Tables 3.3.1.4-1 and 3.3.1.4-2 of the IDSS IDD define the IDSS compliant mechanism capability based on expected docking soft capture loads. Berthing operations must remain within this capability.

These tables define the IDSS compliant mechanism capability based on expected docking soft capture loads.

3.6.1.6 BRAKED MODE

DOCK-BER-004 Brake Mode

If the docking system is equipped with mechanical brakes, then the extendable SCS shall support transitioning to a braked mode at a predefined position.

Rationale: The extendable SCS will be required to transition to a passive mode prior to manipulator driven contact operations. Braked mode is the preferred SCS mode of operation for manipulator grapple fixture operations.

3.6.1.7 SCS PASSIVE MODE

DOCK-BER-005 Passive Mode

The extendable SCS shall provide a passive mode to enable grappling/ungrappling operations and active arm berthing/unberthing.

Rationale: Passive means the SCS is not actively controlling its position to avoid dual active control systems. A passive mode is needed to prevent control system interactions between SCS and manipulator during grapple/ungrapple and active manipulator berthing/unberthing. Separation of control systems simplifies operations and reduces the need for integrated dynamic control analyses. If this passive mode is achieved with active control, further analysis will be required.

3.6.2 MANIPULATOR DRIVEN BERTHING

These requirements apply to IDSS designs to support manipulator driven berthing methods.

3.6.2.1 MAXIMUM SCS RESISTIVE FORCE FOR MANIPULATOR DRIVEN BERTHING

DOCK-BER-006 Manipulator Driven Berthing Resistive Force

The total resistive force of the SCS systems (Active, Passive) to be overcome by the manipulator during berthing, including active and passive sensors, latches, mating connectors and any other features, shall be less than or equal to 150 N, where the SCS resistive force is defined along centerline of the docking port.

Rationale: The passive and active docking systems must limit the total resistive force to be overcome by the manipulator or SCS during berthing operations. Forces above 150 N are possible for select scenarios with optimized arm configurations. For details on these configurations, please see CSA-SE-CO-0001.

3.6.2.2 TOTAL RESISTIVE FORCE FOR MANIPULATOR DRIVEN UNBERTHING

DOCK-BER-007 Manipulator Driven Unberthing Resistive Force

If a mechanical capture latch system is used, to ensure the docking port interface does not preclude unberthing by a manipulator, the total force to disengage the docking port SCS latches, and sensors shall be less than or equal to 150 N.

Rationale: The passive and active docking systems must limit the total resistive force to be overcome by the manipulator or SCS during unberthing operations. Forces above 150 N are possible for select scenarios with optimized arm configurations. For details on these configurations, please see CSA-SE-CO-0001. Note that the docking port provides the seal breaking force.

3.6.2.3 PASSIVE MODE DURATION

DOCK-BER-008 Passive Mode Duration

The active SCS shall be able to remain in the passive extended mode for a duration of up to 60 minutes.

Rationale: To support autonomous or manual berthing using the manipulator, the active SCS will need to remain in an extended position until soft capture is complete. This number was derived from ISS berthing operations from hover through soft capture and does not include delays resulting from Loss of Signal (LOS) communication dropouts.

3.6.2.4 SOFT CAPTURE SYSTEM READY TO BERTH BEHAVIOUR DURING MANIPULATOR DRIVEN BERTHING

For manipulator driven berthing, the SCS is required to provide sufficient resistance to enable the SCS latches to engage during manipulator motion. Two options are outlined below. Docking system providers may select the option that is most compatible with their design. Only one is required to support manipulator driven berthing.

The first is for the SCS to provide the minimum stiffness in 3.6.2.4.1. The second option is the damping requirement detailed in 3.6.2.4.2.

3.6.2.4.1 SOFT CAPTURE SYSTEM STIFFNESS

DOCK-BER-009 SCS Stiffness

The active SCS, while in the passive extended mode for soft capture engagement, shall provide a minimum interface stiffness as defined in Table 1 "SCS Stiffness" so long as the applied force or moment is less than the value also specified in Table 1 "SCS Stiffness".

Rationale: A minimum stiffness is required to enable the manipulator to align the docking port and engage the soft capture latch system. The stiffness of the active SCS may vary with the platform height, and therefore the appropriate ready to berth positions may vary with design implementation. SCS engagement force is applied by the manipulator. Section 3.6.2.4.2 Soft Capture System Damping can be used as an alternative to this requirement.

TABLE 3.6.2.4.1-1 SCS STIFFNESS

Stiffness	Min Value[1]	Applied Force Range[2]
Axial/Compression	5000 N/m	0-500 N
Lateral	5000 N/m	0-500 N
Bending	21500 Nm/rad	0-750 Nm
Torsion	21500 Nm/rad	0-750 Nm
Notes: 1. Minimum value is determined by measuring the force resulting from a unit displacement purely in the indicated direction. 2. Applied force range values are below SCS maximum interface loads in table 3.3.1.4-1		

3.6.2.4.2 SOFT CAPTURE SYSTEM DAMPING

DOCK-BER-010 SCS Damping

The SCS, while in the passive extended mode for soft capture engagement, shall provide a passive axial damping level of 1 to 65 N/(mm/s), and a passive bending / torsion damping of 150 to 585 (N*m) / (deg/s).

Rationale: A minimum damping level is required to enable the manipulator to align the docking port and engage the soft capture latch system, i.e., push through up to 150N. Requirement 3.6.7.4.1 can be used as an alternative to this requirement. The manipulator will limit the applied rate such that the push-through force is less than or equal to 150N, which will result in a rate of movement of less than or equal to 15mm/s.

3.6.3 SCS DRIVEN BERTHING

These requirements apply to IDSS designs to support SCS driven berthing methods.

3.6.3.1 SCS DRIVEN BERTHING FORCE

DOCK-BER-011 SCS Driven Berthing Force

For active SCS berthing to a manipulator held vehicle, the active SCS shall apply sufficient force to engage sensors and capture latches, while simultaneously maintaining the applied forces of ≤ 150 N axial and ≤ 100 N lateral. Forces are defined in the passive SCS ring coordinate system.

Rationale: The SCS must apply sufficient force to engage latches without applying undue loads on braked manipulator. This is based on an assumed total SCS axial resistance fore of 150N with an allowance for lateral forces. See the IDSS Berthing Guide for manipulator compliance requirements and maximum vehicle deflections. Higher interface forces may be possible for select scenarios with optimized arm configurations and integrated analysis. For details on these configurations, please see CSA-SE-CO-0001.

3.6.3.2 SCS DRIVEN UNBERTHING FORCE

DOCK-BER-012 SCS Driven Unberthing Force

If the SCS is used for unberthing, the active SCS shall apply sufficient force to disengage sensors and capture latches, while maintaining the applied force ≤ 150 N axial and ≤ 100 N lateral. Forces are defined in the passive SCS ring coordinate system.

Rationale: The passive and active docking systems must limit the total resistive force to be overcome by the manipulator or SCS during unberthing operations. Higher interface forces may be possible for select scenarios with optimized arm configurations and integrated analysis. For details on these configurations, please see CSA-SE-CO-0001.

APPENDIX A - ACRONYMS, ABBREVIATIONS AND SYMBOLS DEFINITION

APAS	Androgynous Peripheral Attachment System
C	Celsius
CBM	Common Berthing Mechanism
CG	Center of Gravity
CM	Configuration Management
deg	degree
DPMC	Directorate Program Management Council
e.g.	for example
F	Fahrenheit
HCS	Hard Capture System
hPa	Hecto Pascal(s)
IBDM	International Berthing and Docking Mechanism
ICC	Initial Contact Condition
IDA	International Docking Adapter
IDD	Interface Definition Document
IDSS	International Docking System Standard
IDSS+B	Berthing compatible IDSS implementation
IERIIS	International External Robotics Interface Interoperability Standards
In	Inches
IRSIS	International Rendezvous System Interoperability Standards
ISS	International Space Station
kg	kilogram
KOZ	Keep Out Zone
LEO	Low Earth Orbit
m	meters
MIN	Minimum
mm	Millimeters
MOI	Moments of Inertia
N	Newton(s)
NASA	National Aeronautics and Space Administration
NDS	NASA Docking System
nm	nanometers
Nm	Newton-Meter(s)
ohm	Ohms

Pa	Pascal
R	Radius
rad	Radian
REF	Reference
RSS	Root Sum Square
SCS	Soft Capture System
Sec	Second
US	United States

APPENDIX B - GLOSSARY <RESERVED>

APPENDIX C - OPEN WORK

C1.0 TO BE DETERMINED

The table To Be Determined Items lists the specific To Be Determined (TBD) items in the document that are not yet known. The TBD is inserted as a placeholder wherever the required data is needed and is formatted in bold type within carets. The TBD item is numbered based on the document number, including the annex, mission specific indication, volume, and book number, as applicable (i.e., **<TBD-XXXXX-001>** is the first undetermined item assigned in the document). As each TBD is resolved, the updated text is inserted in each place that the TBD appears in the document and the item is removed from this table. As new TBD items are assigned, they will be added to this list in accordance with the above described numbering scheme. Original TBDs will not be renumbered.

TABLE C1-1 TO BE DETERMINED ITEMS

TBD	Section	Description
None		

C2.0 TO BE RESOLVED

The table To Be Resolved Issues lists the specific To Be Resolved (TBR) issues in the document that are not yet known. The TBR is inserted as a placeholder wherever the required data is needed and is formatted in bold type within carets. The TBR issue is numbered based on the document number, including the annex, mission specific indication, volume, and book number, as applicable (i.e., **<TBR-XXXXX-001>** is the first unresolved issue assigned in the document). As each TBR is resolved, the updated text is inserted in each place that the TBR appears in the document and the issue is removed from this table. As new TBR issues are assigned, they will be added to this list in accordance with the above described numbering scheme. Original TBRs will not be renumbered.

TABLE C2-1 TO BE RESOLVED ISSUES

TBR	Section	Description
None		

C3.0 FORWARD WORK

The table Forward Work (FWD) Issues, lists the specific FWD issues in the document that are not yet completed. The FWD is inserted as a placeholder wherever the required data is needed and is formatted in bold type within carets. The FWD issue is numbered based on the document number including the annex, mission specific indication, volume, and book number, as applicable (i.e., **<FWD-xxxxx-001>** is the first forward work issue assigned in the document). As each FWD is resolved, the updated text is inserted in each place that the FWD appears in the document and the issue is removed from this table. As new FWD issues are assigned, they are added to this list in accordance with the above described numbering scheme. Original FWD are not renumbered.

TABLE C3-1 FORWARD WORK ISSUES

FWD	Section	Description
None		

APPENDIX D - LEGACY HARDWARE

D.1.0 DOCKING SYSTEM

D.1.1 HARD CAPTURE SYSTEM HERITAGE STRIKER ZONES

To maintain simplicity for the standard, a set of generic zones, called the HCS component striker zones, are defined on the HCS mating flange (shown in Figure 3.2.3-1) as striker zones for various peripheral components and sensors. These zones are the passive flat surface that a docking system designer may choose to use as striker areas for the corresponding devices.

The HCS component striker zones are nine identical segments around the circumference of the HCS. A reference numbering scheme for the segments is shown in Figure D.1.1-1, HCS Component Striker Zone Reference Numbers. Each segment consists of a Free Area and a Reserved Area.

For both the Free Area and the Reserved Area, the striker area is a flat surface with a few local exceptions. These exceptions are various small holes used for the underlying subsystems (such as attach points for the Latching System), and for other purposes. Many times, these small holes will not interfere with the striking device. The details of these small holes and other features are provided herein for a designer to consider when utilizing the striker zone.

In the Free Area, the same small exceptions occur repeatedly, and these features should be easier to work around to place striking components. The Reserved Area is where legacy systems, such as APAS, NDS and IDA, have already located components which will be difficult to work around in some locations, and the use of these areas will require careful, detailed coordination with those designs to assure no interference. These features within the striker zones are shown in Figure D.1.1-2, APAS Features within Striker Zones, Figure D.1.1-3, NDS Features within Striker Zones and Figure D.1.1-4, IDA Features within Striker Zones.

The International Docking Adapter implementation of spring pusher separation devices lies within areas noted as being “reserved” legacy zone regions. Verification of docking operations with visiting vehicles equipped with both current and future implementations of IDSS compliant systems has been performed and it has been determined that there is no impact to performance. The locations of the separator devices within the “reserved” zones are shown in Figure D.1.1-5, Radial and Angular Locations of IDA Separator Installations within Striker Zones, and Figure D.1.1-6, IDA Separator Installation Cutout Details.

In summary, using the Free Areas is recommended, though the locations of some small holes must be considered. Using the Reserved Areas will require collaboration with the relevant legacy system and/or mission specific information.

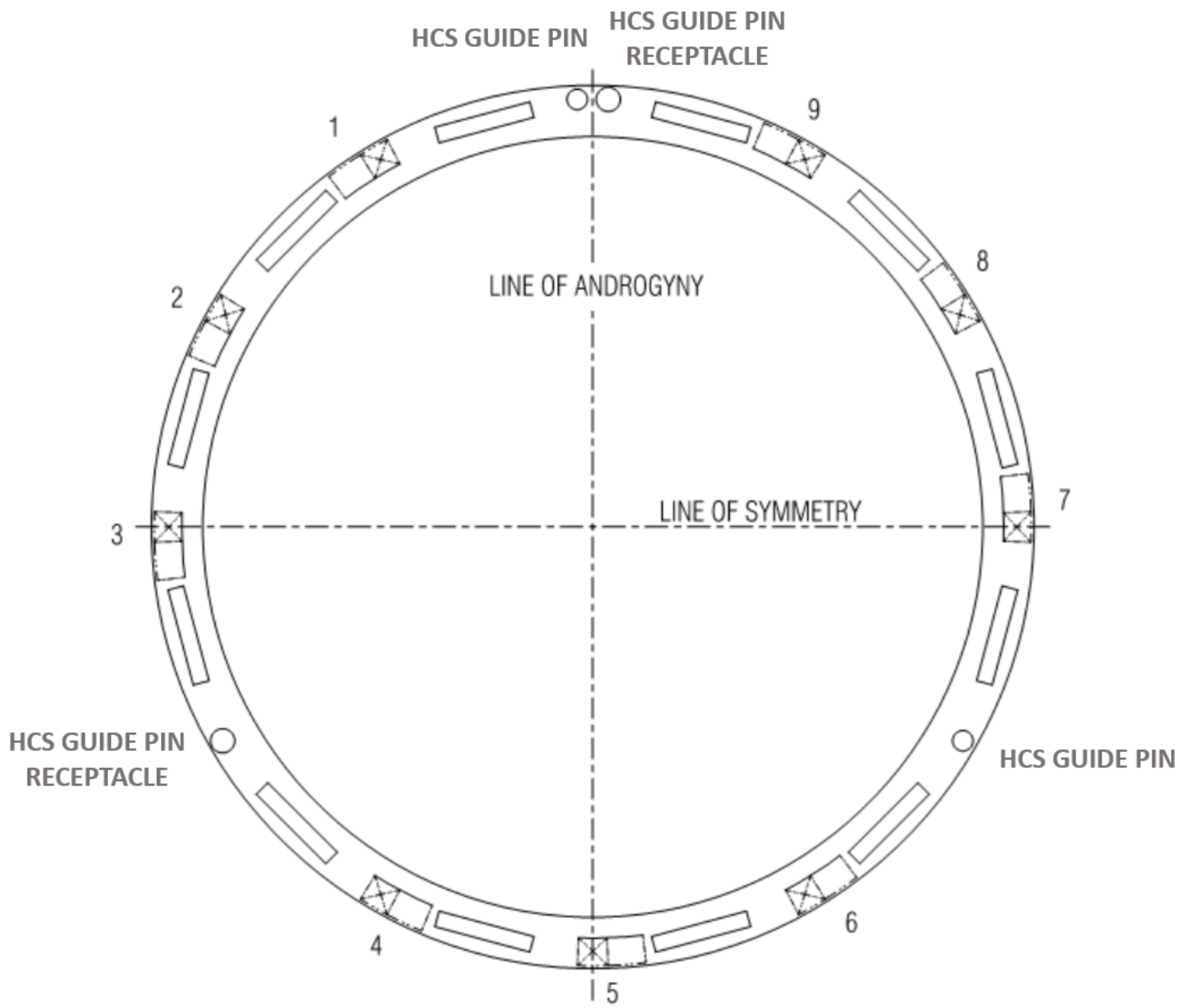
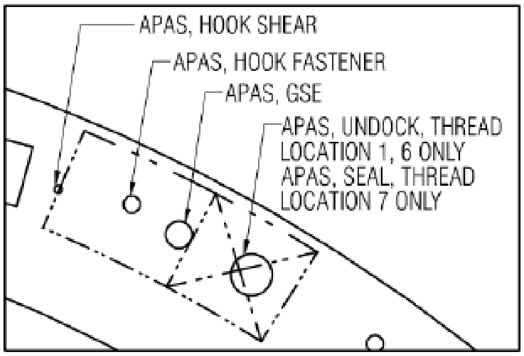
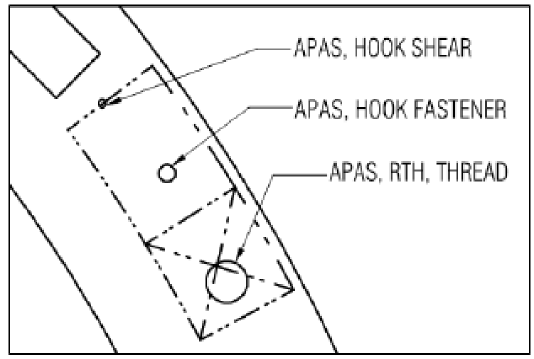


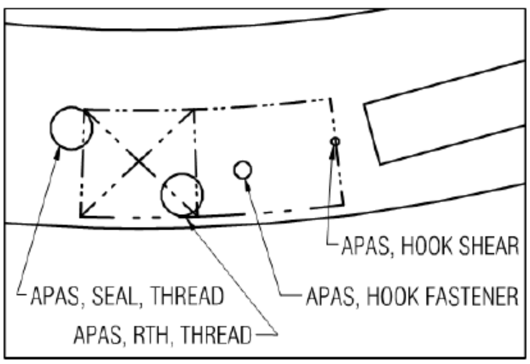
FIGURE D.1.1-1 HCS COMPONENT STRIKER ZONE REFERENCE NUMBERS



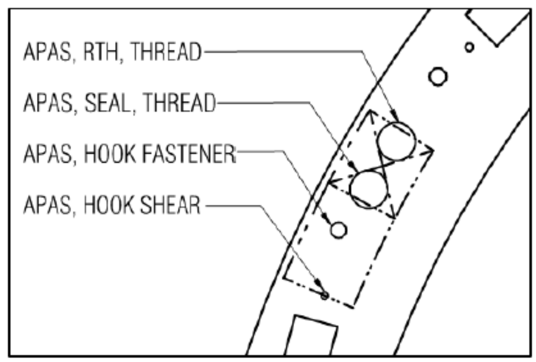
Detail applies at the following locations:
1, 6, 7



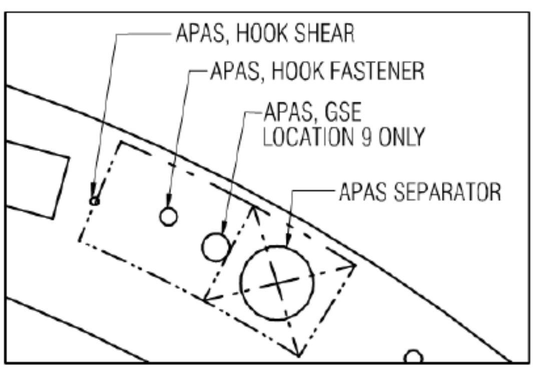
Detail applies at the following location:
8



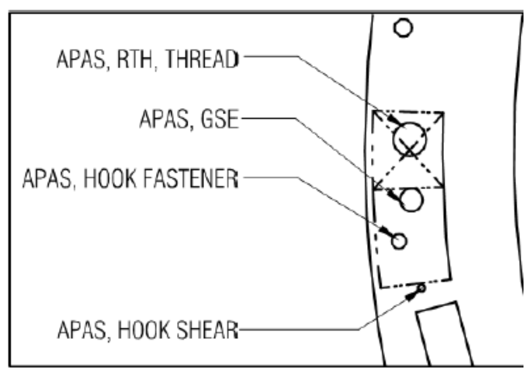
Detail applies at the following location:
5



Detail applies at the following location:
2

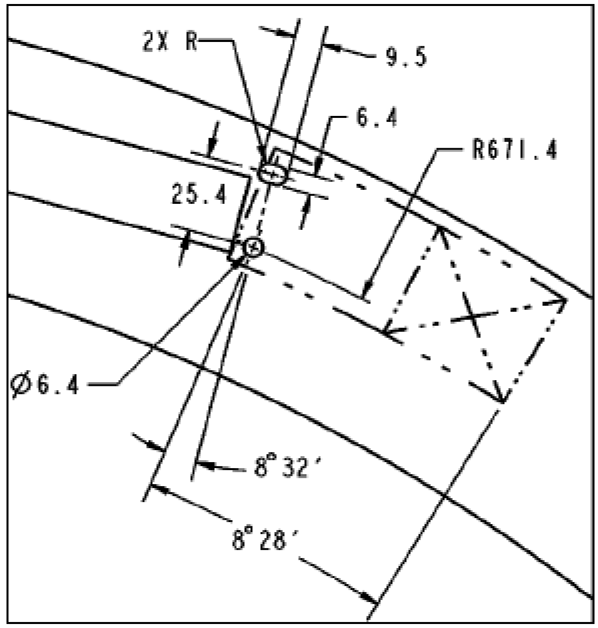


Detail applies at the following locations:
4, 9



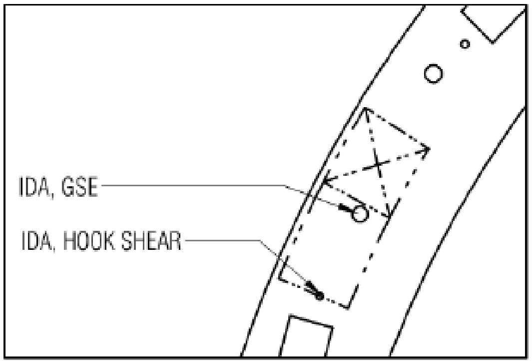
Detail applies at the following location:
3

FIGURE D.1.1-2 APAS FEATURES WITHIN STRIKER ZONES

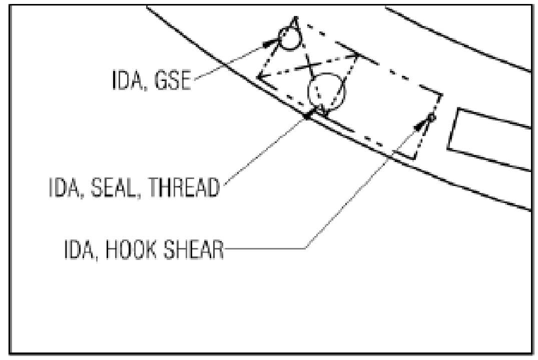


Detail applies at all locations.

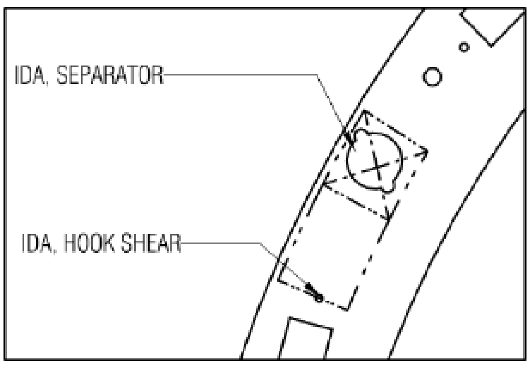
FIGURE D.1.1-3 NDS & IBDM FEATURES WITHIN STRIKER ZONES



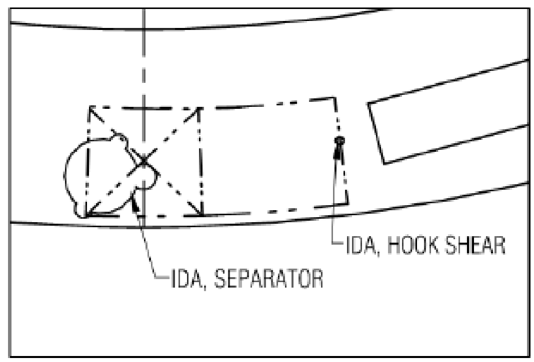
Detail applies at the following locations:
1, 6



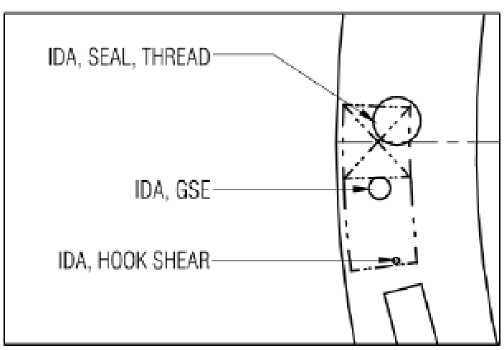
Detail applies at the following location:
4



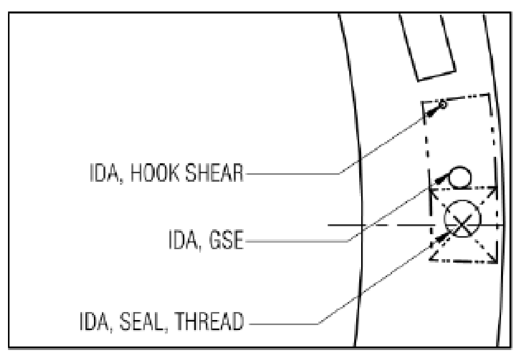
Detail applies at the following locations:
2, 8*



Detail applies at the following location:
5*



Detail applies at the following location:
3



Detail applies at the following locations:
7, 9

* For separator location and cutout details, see Figures D.1.1-5 and D.1.1-6

FIGURE D.1.1-4 IDA FEATURES WITHIN STRIKER ZONES

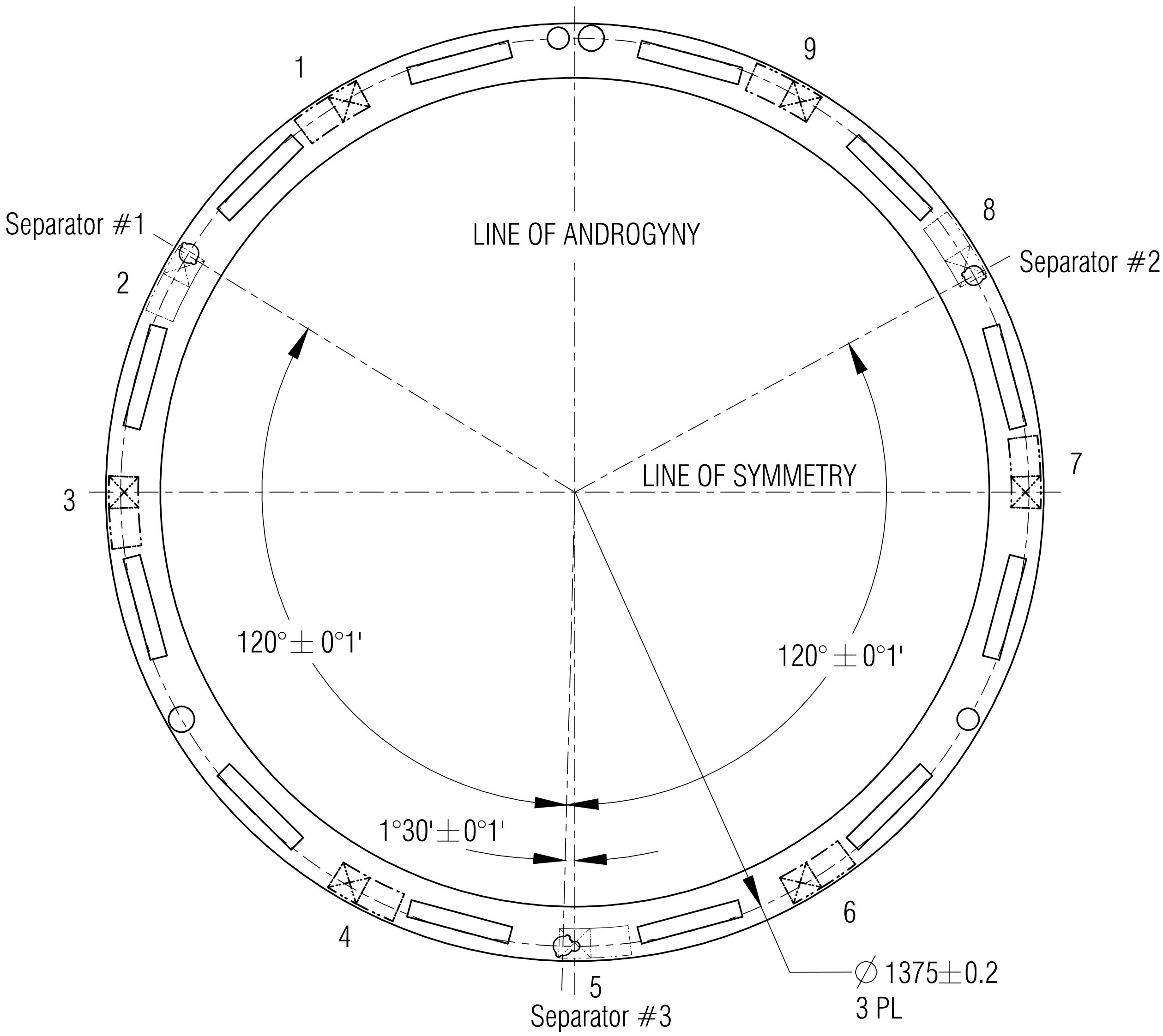
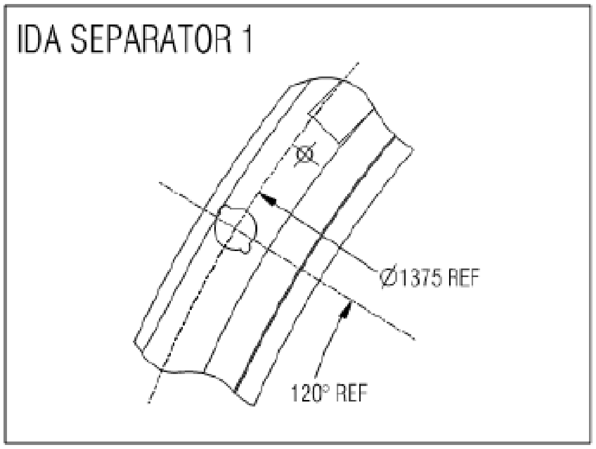
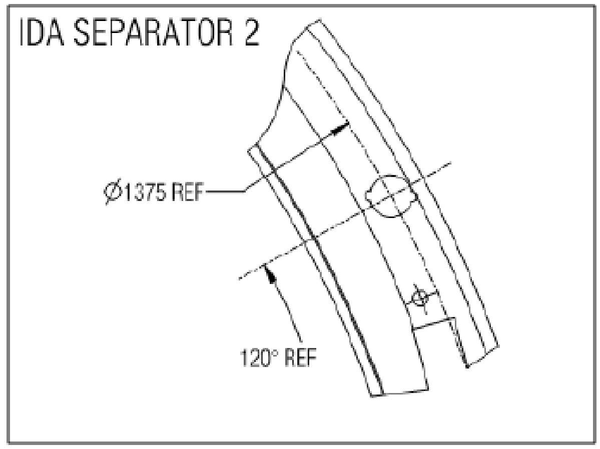


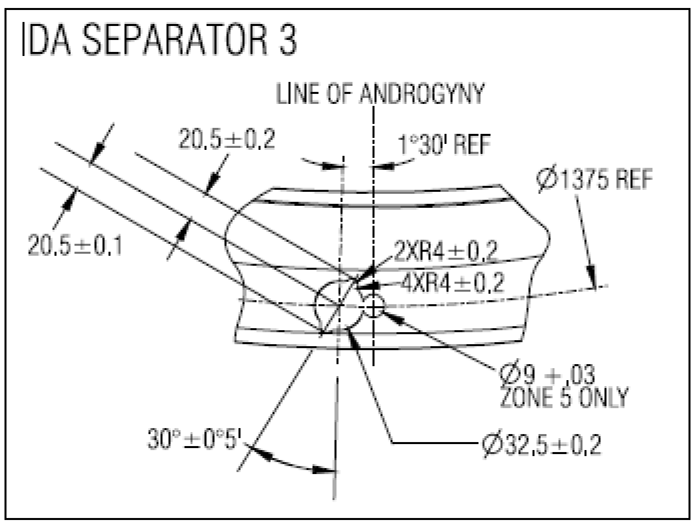
FIGURE D.1.1-5 RADIAL AND ANGULAR LOCATIONS OF IDA SEPARATOR INSTALLATIONS WITHIN STRIKER ZONES



Detail Applies at the following locations: 2



Detail Applies at the following locations: 8



Detail Applies at the following locations: 5

Note: Separator cutout details apply at zones 2, 5, and 8 except as noted

FIGURE D.1.1-6 IDA SEPARATOR INSTALLATION CUTOUT DETAILS

APPENDIX E - CONCURRENCE

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Date: 2025.04.28 13:21:04 -04'00'
Name | Date
Canadian Space Agency

Name | Date
JAXA