

International Docking System Standard (IDSS) Interface Definition Document (IDD)

September 21, 2010

REVISION LOG

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1 INTRODUCTION

The IDSS IDD is the result of a working group established in 2009 by the International Space Station partners (the Canadian Space Agency (CSA), the European Space Agency (ESA), the Ministry of Education, Culture, Sports, Science and Technology (MEXT) assisted by the Japan Aerospace Exploration Agency (JAXA), the National Aeronautics and Space Administration (NASA), and the Russian Space Agency (Roscosmos)). This collaboration is the result of this endeavor.

The figures and tables in this initial IDSS IDD release depict the features of the docking interface. Some docking system features are defined by the basic IDD standard, some will be defined in the future and some are left to the discretion of the individual docking system designer.

This IDSS IDD contains a subset of the family of figures and tables that are necessary to provide the description of IDSS physical interfaces. Some features are not ready to be baselined and are marked with a TBD/TBR/TBC. Additional text is required to address other docking requirements, docking principles, docking system general description, vehicle characteristics, initial contact conditions and environments. Additional revisions will be developed in order to incorporate the additional text.

1.1 Purpose and Scope

This Interface Definition Document (IDD) defines the interface characteristics and requirements of the IDSS, which 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 the docking system interface definitions supporting the following missions:

- A. International Space Station (ISS)
- B. Lunar mission
- C. Crew rescue
- D. International cooperative demonstration

1.2 Responsibility and Change Authority – TBD

1.3 Convention and Notation – TBD

1.4 Docking Principles – TBD

1.5 Berthing

NOTE: The docking mechanism should not prevent berthing with a robotic arm that can provide a closing force of 150 N.

2 APPLICABLE AND REFERENCE DOCUMENTS – TBD

3 INTERNATIONAL DOCKING SYSTEM STANDARD

3.1 General - TBD

3.1.1 System Description- TBD

3.1.2 Engineering Units of Measure

All dimensions are in millimeters. All angular dimensions are in degrees. Unless otherwise specified, the dimensional tolerance is implied as follows:

xx implies $xx \pm 2$ [TBR]

xx.x implies $xx.x \pm 0.5$ [TBR]

xx° implies $xx^\circ \pm 0.5^\circ$ [TBR]

3.1.3 Coordinate System

Figures within this document use a coordinate system intended for reference only as shown in Figures 3.2-1 and 3.2-2.

3.2 Mating Interface Definition

The Hard Capture System (HCS) Mating Plane is defined as the seal plane between HCS Tunnels when structurally mated.

The Soft Capture System (SCS) Mating plane is defined as follows:

The SCS Mating Plane is the plane normal to the Soft Capture Ring's axis and intersects the conic outline of the Guide Petals at a diameter of 1045 mm (TBC).

In the case of Magnetic Soft Capture, the Soft Capture Ring is stowed in the passive mode, the magnetic Strikers are co-planar with the SCS Mating Plane. When the Soft Capture Ring is in the active mode, the Magnets are co-planar with the SCS Mating Plane and the Strikers shall be at least 1.5mm below this plane.

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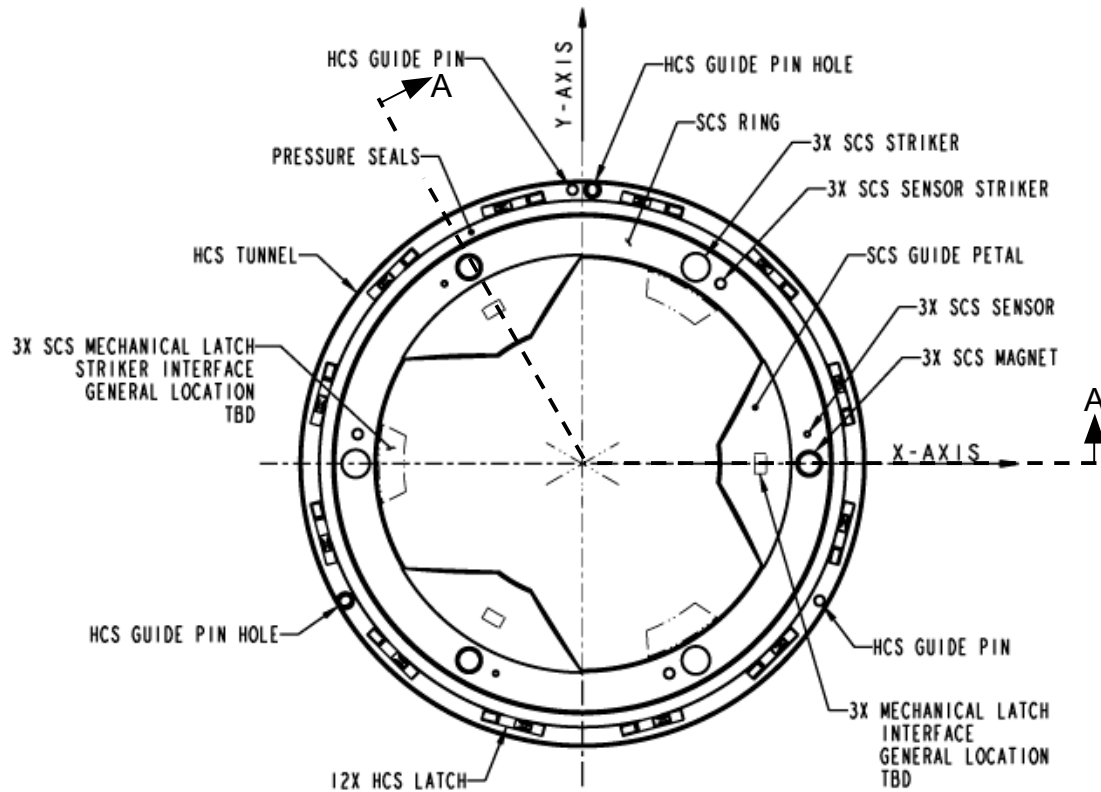
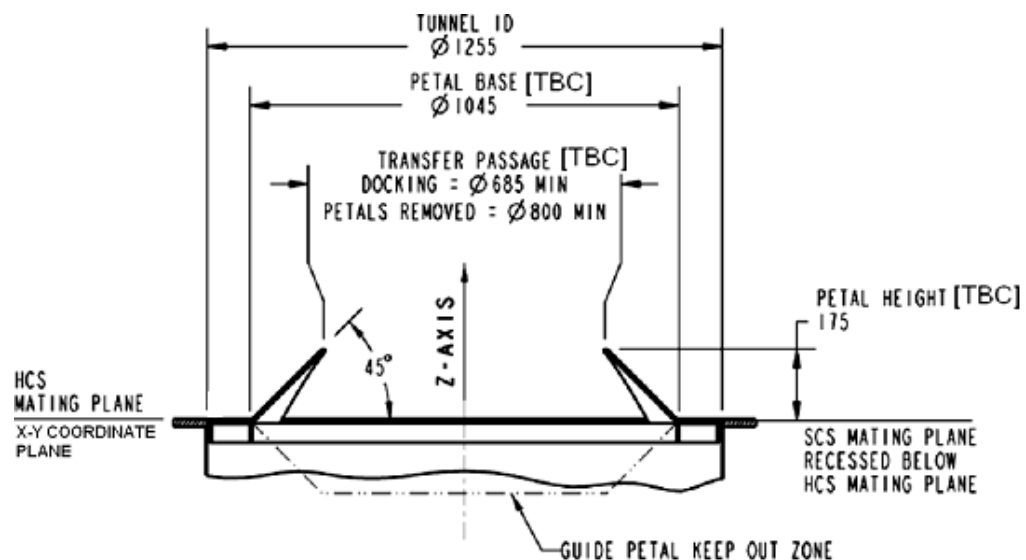


Figure 3.2-1: Androgynous Docking Interface - Axial View



NOTE: Cross-section through mid-plane of two petals (Section A-A, Figure 3.2-1).

Figure 3.2-2: Androgynous Docking Interface - Cross Section

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3.2.1 Soft-Capture System

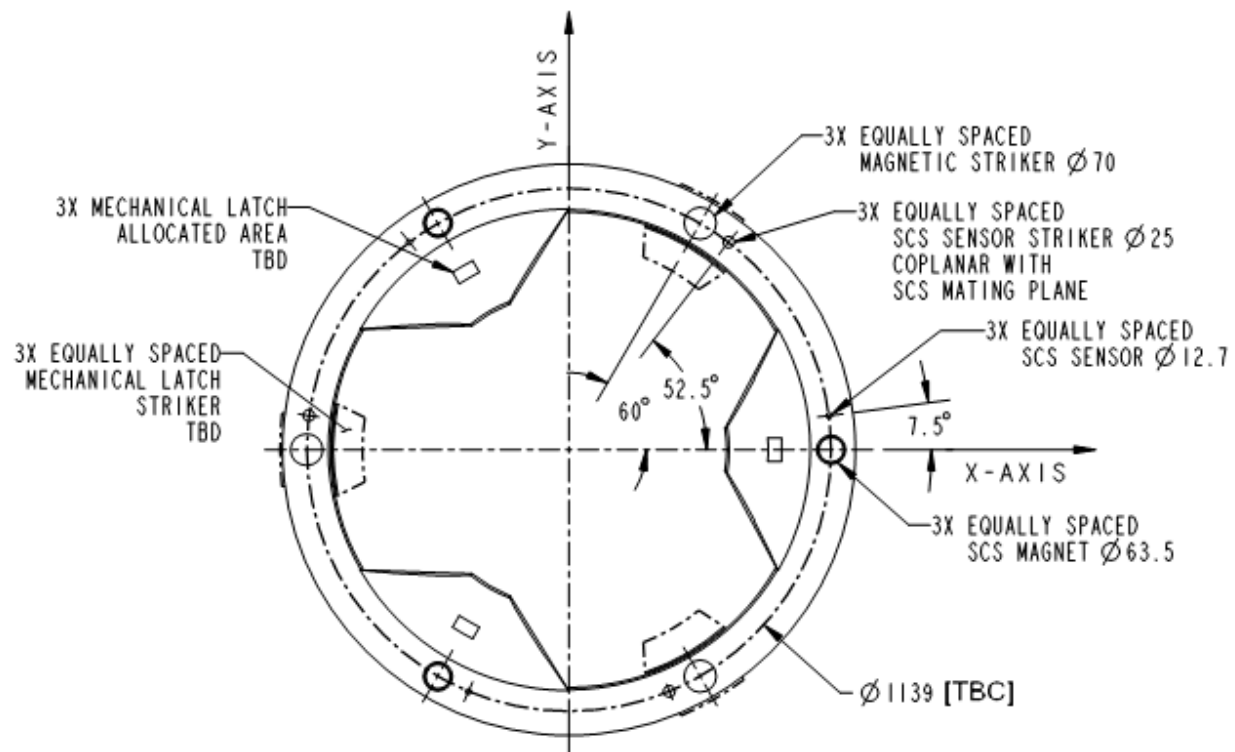


Figure 3.2.1-1: SCS Interface

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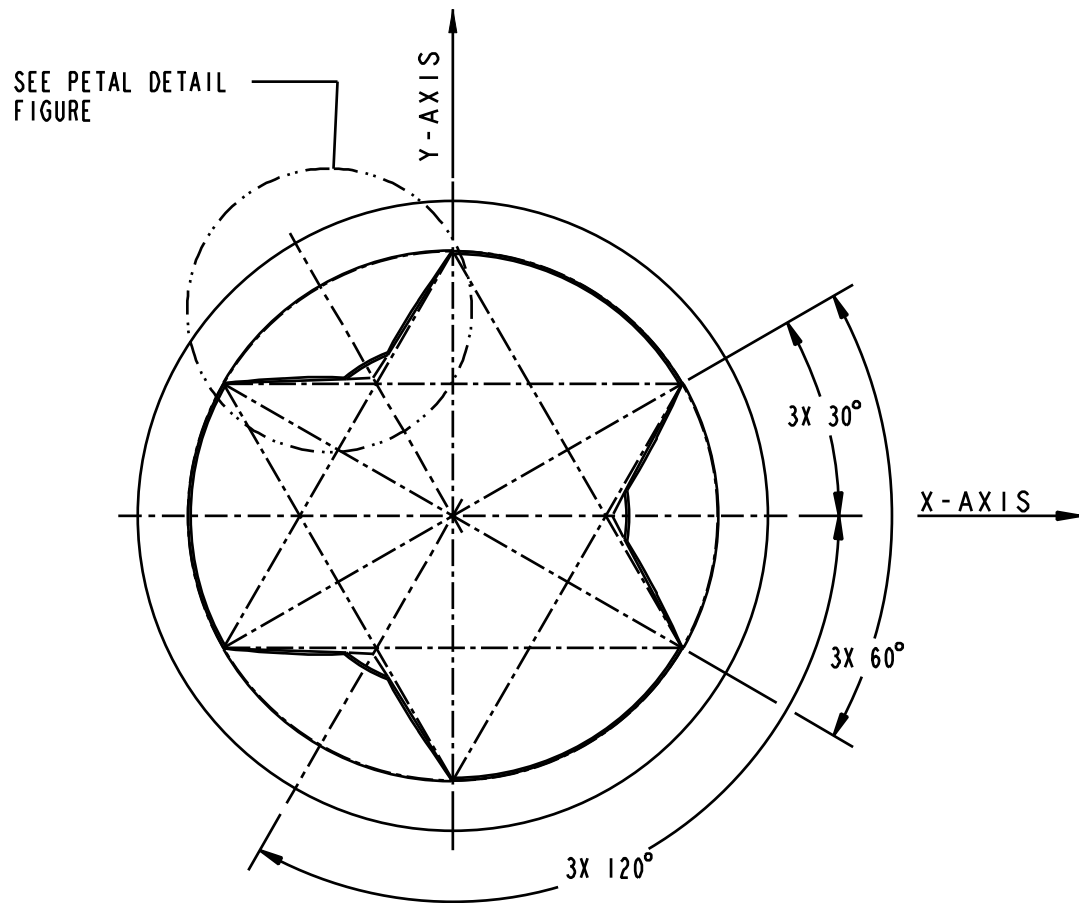


Figure 3.2.1-2: SCS Interface – Guide Petal System Overview

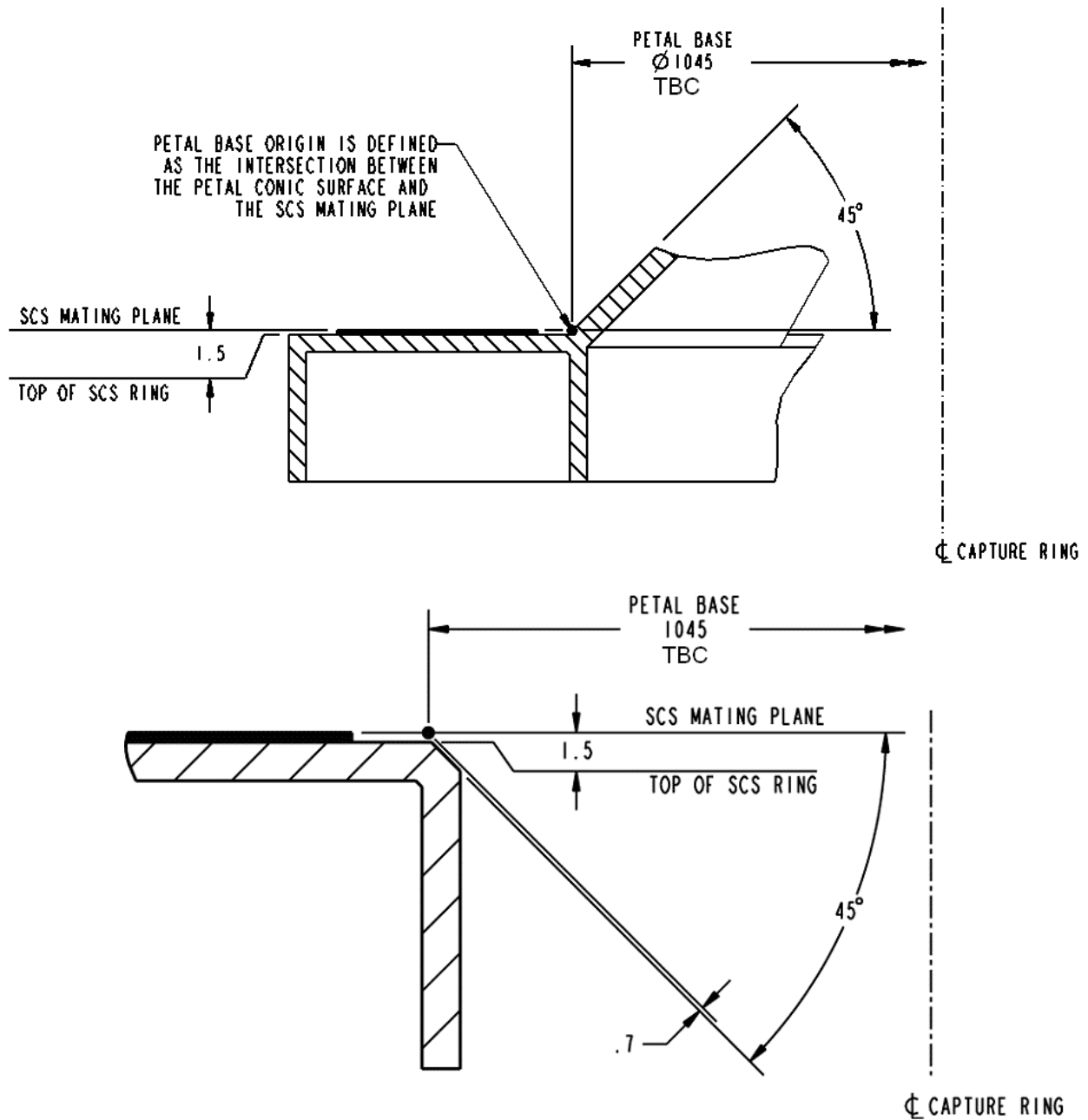


NOTE: Dimensions projected on the SCS mating plane are shown.
Petal outline shown is on the external conic surface of the petal system.
Petal thickness is not shown for clarity.

Figure 3.2.1-3: SCS Interface – Guide Petal System Details

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NOTE: Upper view indicates cross section of the capture ring through a guide petal.
Lower view indicates cross section of the capture ring between the guide petals.

Figure 3.2.1-4: SCS Interface – Guide Petal Profile

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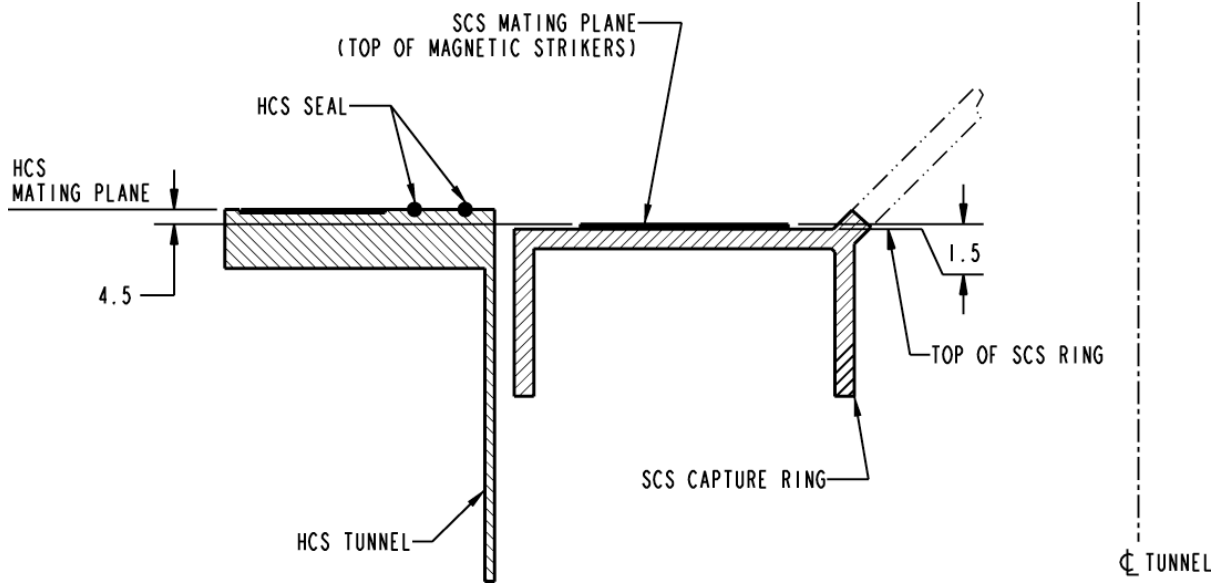


Figure 3.2.1-5: SCS Interface – Passive Mode Capture Ring Profile

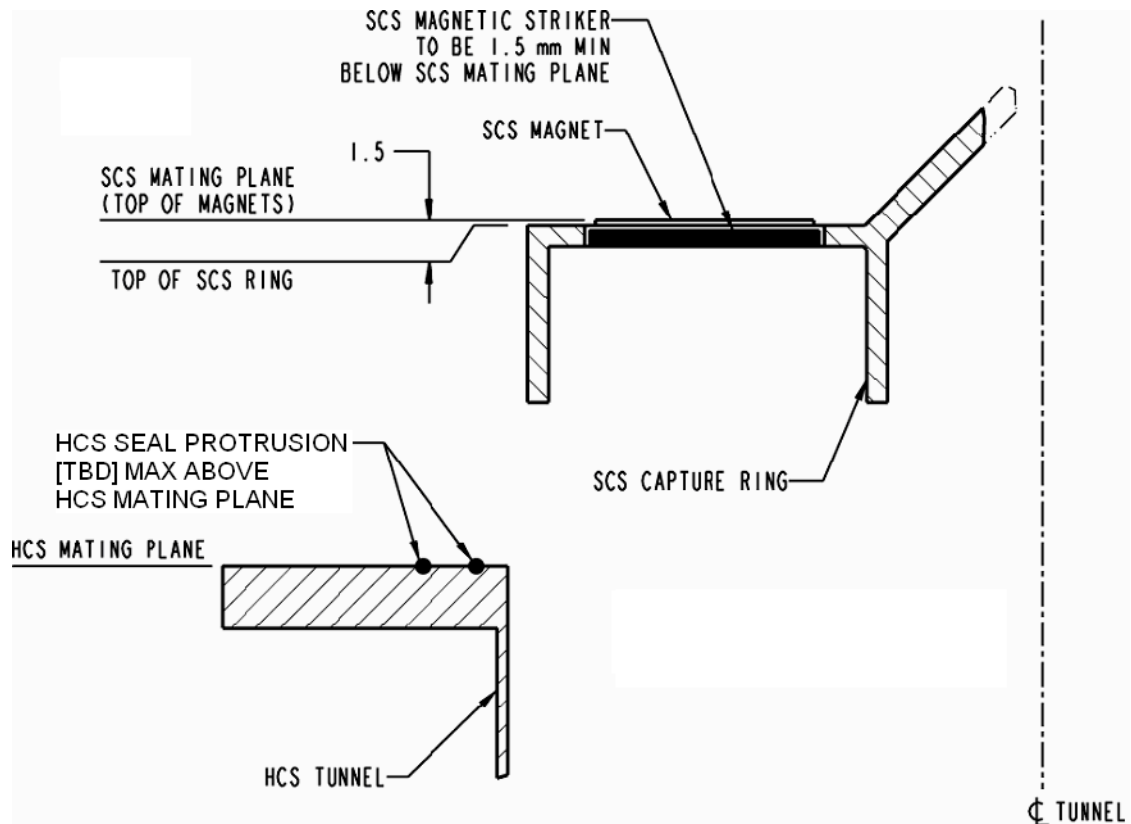


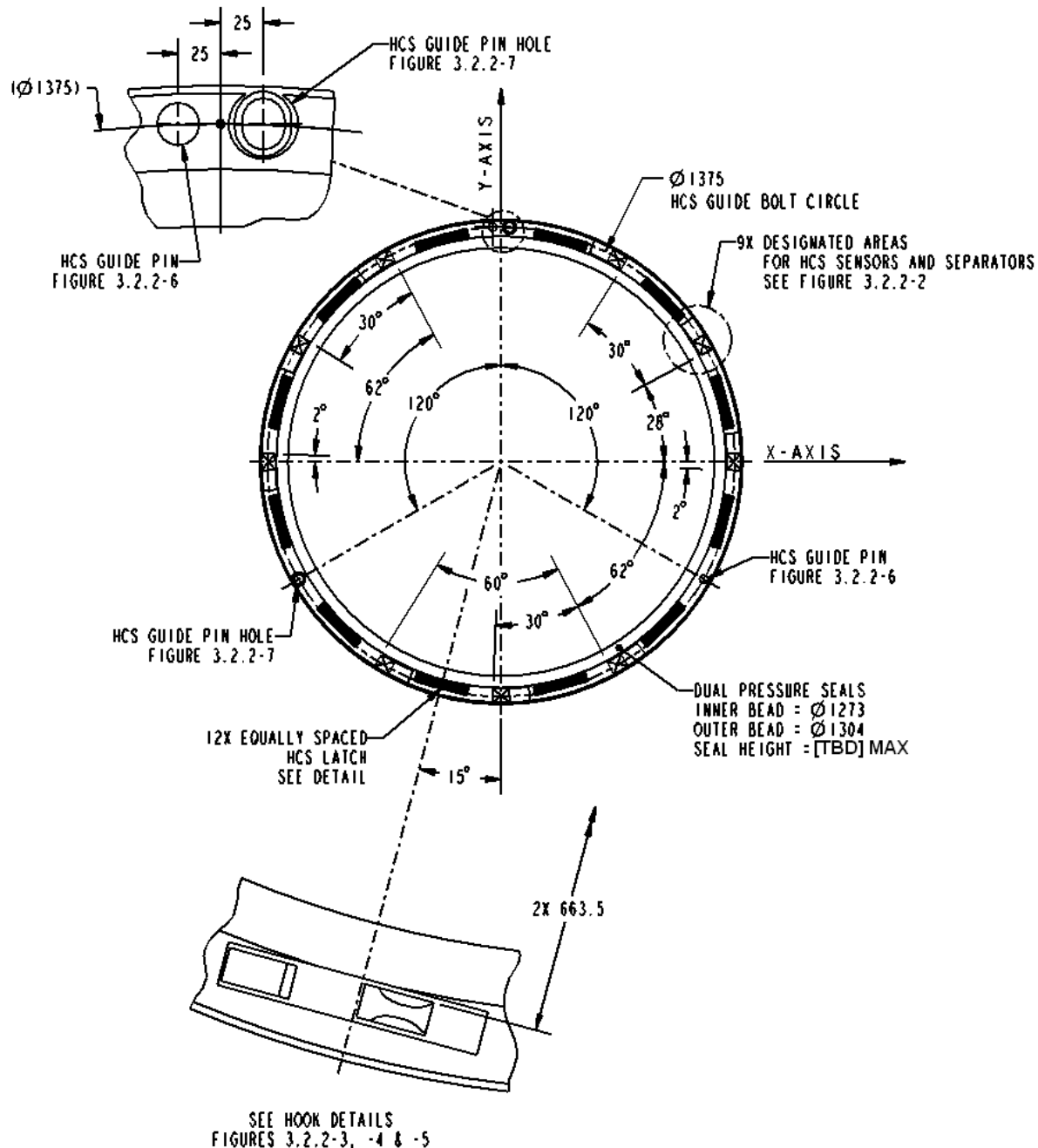
Figure 3.2.1-6: SCS Interface – Active Mode Capture Ring Profile

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3.2.2 Hard-Capture System

The Hard-Capture System (HCS) is depicted in the following figures. HCS components that are not critical for transferring mated loads or maintaining pressurization are intentionally omitted. Designated striker regions are identified for participants to configure peripheral hardware (Separation System and Sensors).

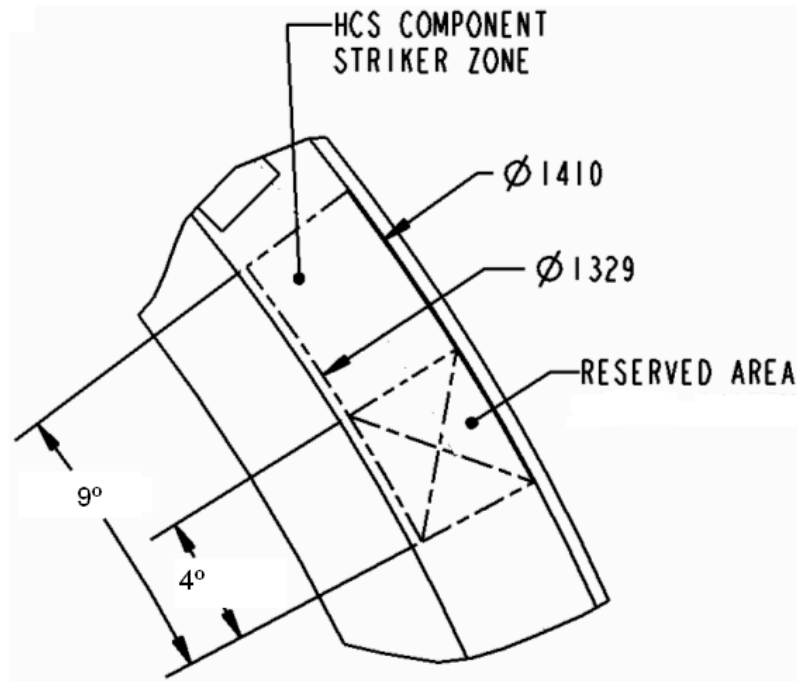


NOTE: Separation systems shall be retracted below the HCS mating plane prior to closure of HCS interface (TBC).

Figure 3.2.2-1: HCS Interface - Axial View

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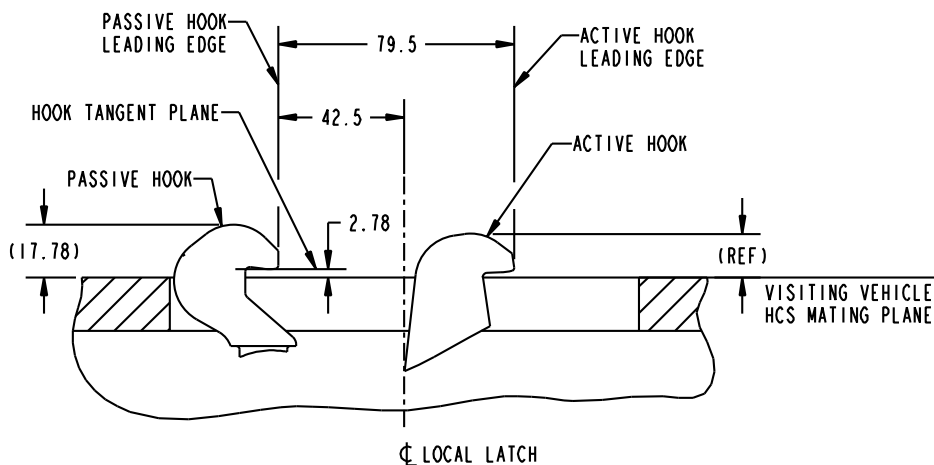
NOTES:

- 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 strikes.
- c) "HCS Component Striker Zone" and "Reserved Area" are recessed 1mm from HCS mating plane
- d) HCS Component Striker Zone may contain features that require accommodation. See Appendix (TBD) for details.

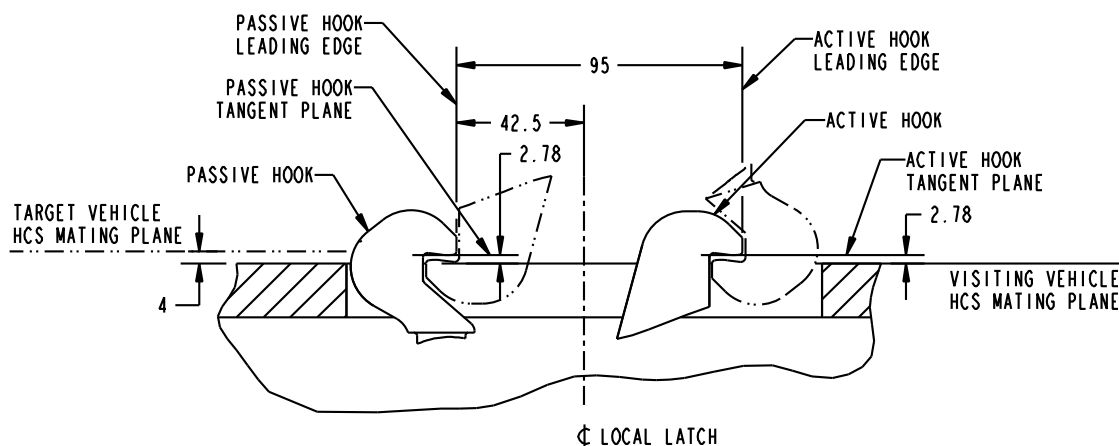
Figure 3.2.2-2: HCS Interface - Sensor Striker Zone

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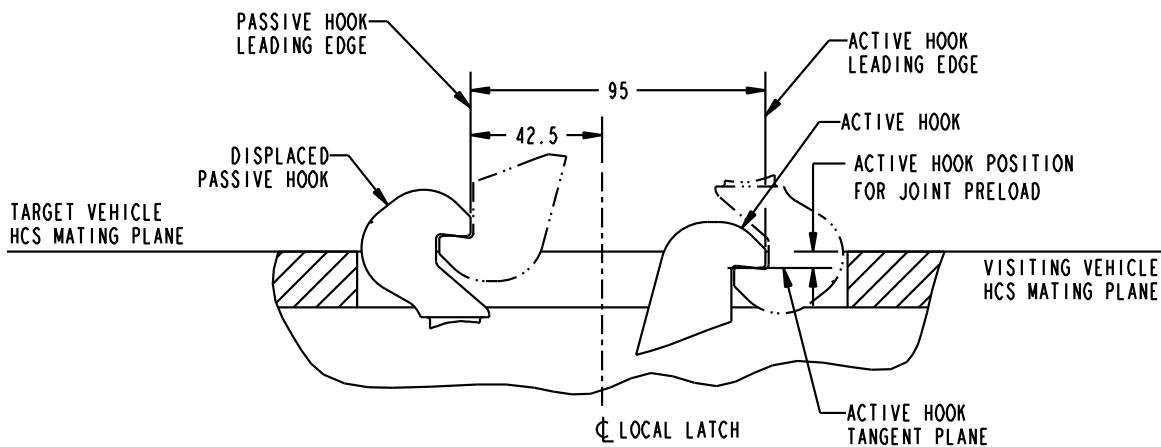
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READY-TO-DOCK CONFIGURATION



READY-TO-HOOK CONFIGURATION



FULLY MATED CONFIGURATION

Figure 3.2.2-3: HCS Hooks - Side View

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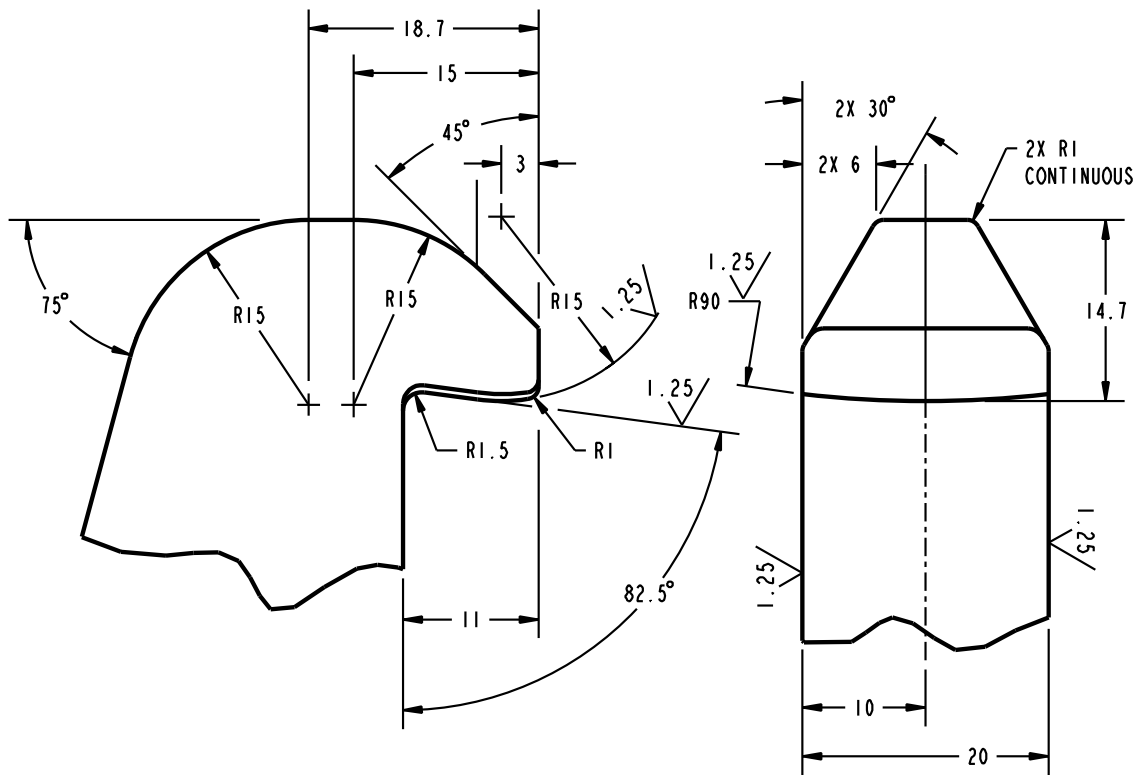
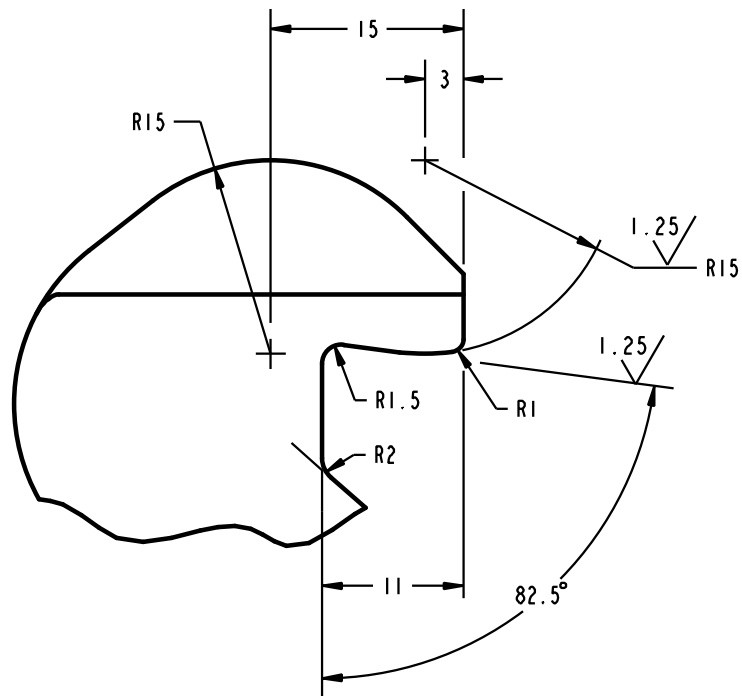
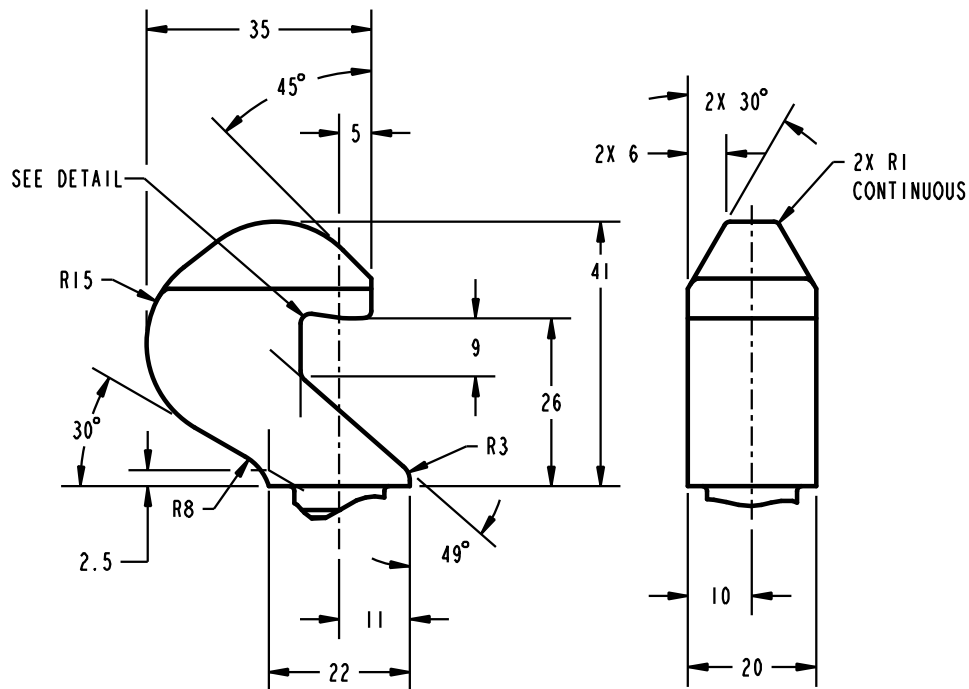


Figure 3.2.2-4: HCS Active Hook

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DETAIL VIEW

Figure 3.2.2-5: HCS Passive Hook

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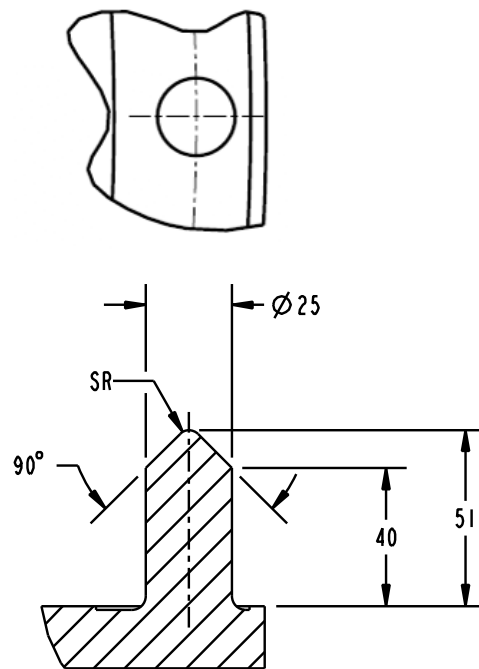


Figure 3.2.2-6: Guide Pin Details

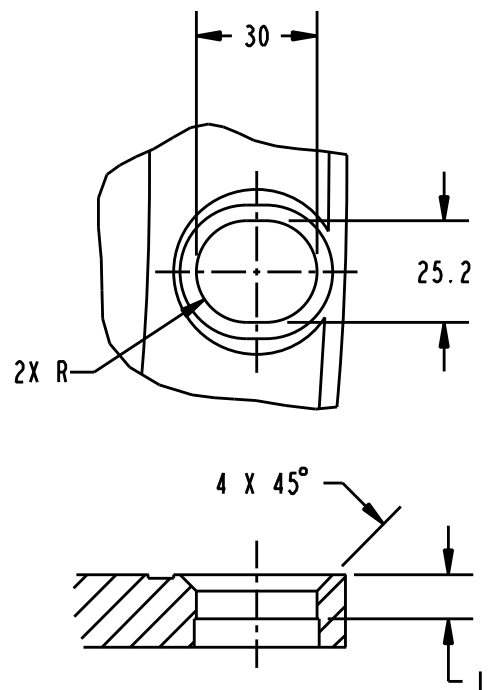


Figure 3.2.2-7: Guide Pin Hole Details

3.3 Loads

3.3.1 Hard Capture Mated Loads

Table 3.3.1-1: HCS Maximum Mated Loads

	Mated ISS	Trans-Lunar
Maximum Design Pressure	1 100 hPa	0 h Pa
Seal Closure Force	24 000 N/m	24 000 N/m
Compressive Axial Load	17 700 N	300 000 N
Tensile Axial Load	17 700 N	100 000 N
Shear Load	16 700 N	10 000 N
Torsion Moment	15 000 Nm	15 000 Nm
Bending Moment	68 700 Nm	40 000 Nm

Table 3.3.1-2: HCS Mated Load Sets

Load Set	Case 1	Case 2	Case 3	Case 4
Compressive Axial	5 000 N	17 700 N	13 700 N	300 000 N
Tensile Axial	5 000 N	17 700 N	13 700 N	100 000 N
Shear	5 000 N	14 800 N	16 700 N	10 000 N
Torsion	15 000 Nm	15 000 Nm	15 000 Nm	15 000 Nm
Bending	65 300 Nm	39 200 Nm	68 700 Nm	40 000 Nm

Notes for Tables 3.3.1-1 and 3.3.1-2

- a) Values are design limit loads.
- b) 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.
- c) Seal closure force to be included in all cases in Table 3.3.1-2.
- d) Cases 1 through 3 in Table 3.3.1-2 are pressurized mated cases.
- e) Case descriptions:
 - i) Case 1 – Attitude control by Orbiter-like, combined with crew activity.
 - ii) Case 2 – Berthing of ISS segment while mated.
 - iii) Case 3 – Orbiter-like translation with payload attached to ODS.

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- iv) Case 4 – TLI-like, modified from Constellation analysis. Not pressurized.

3.3.2 Soft Capture Loads

Table 3.3.2-1: SCS Maximum Interface Loads

Tension	3 900 N
Compression (Static)	3 500 N
Compression (Dynamic, < 0.1 sec)	6500 N (TBC)
Shear	3 200 N
Torsion	1 500 Nm
Bending	2 800 Nm

Table 3.3.2-2: SCS Maximum Component Loads

Mechanical Latch Striker Tension	3 000 N			
Magnetic Latch Striker Tension	2 300 N			
Striker Compression	3 000 N			
Petal Edge Length	0%	10%	60%	80%
Petal Contact Loads	3500 N	2300 N	2300 N	1000 N

Notes for Tables 3.3.2-1 and 3.3.2-2

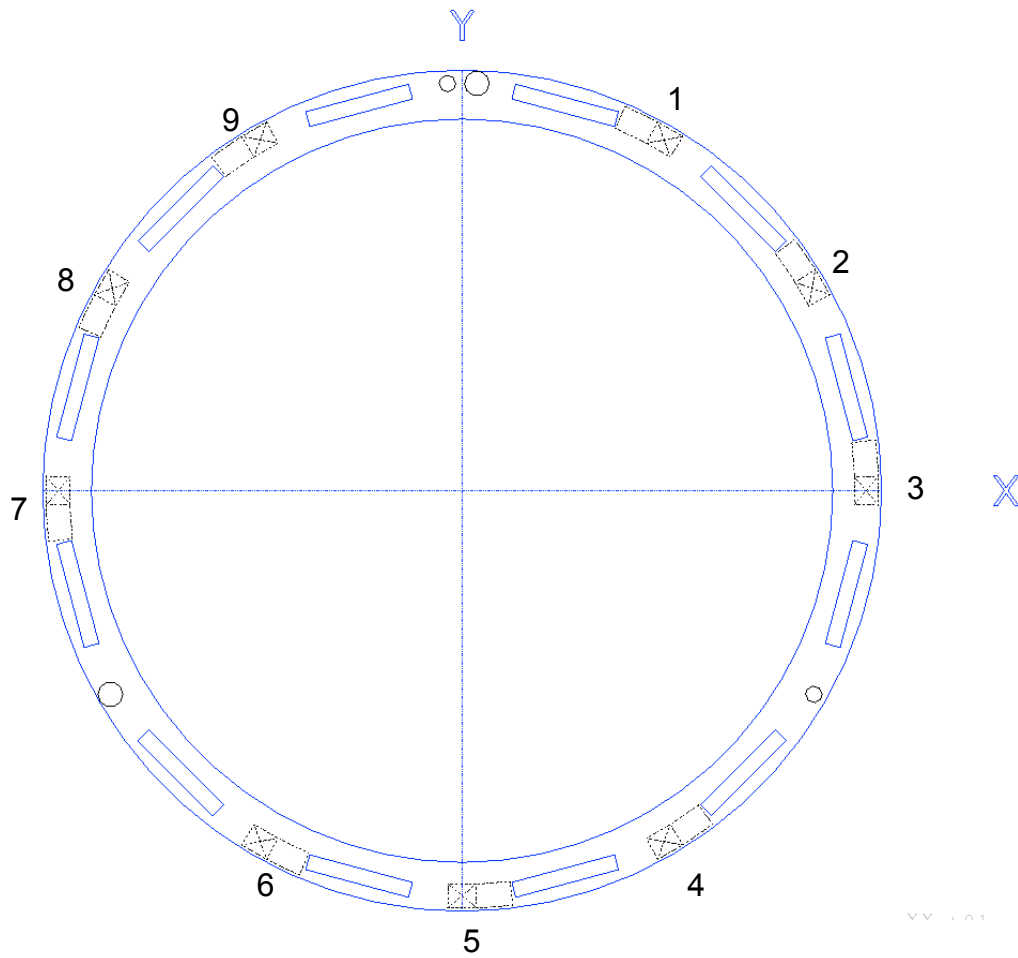
- Values are design limit loads.
- Values in Table 3.3.2-1 are defined at the center of the SCS mating plane (Figure 3.2.1-5).
- Values are 3σ maxima and are to be applied simultaneously as provided in Table 3.3.2-1, not to exceed the component values in Table 3.3.2-2.
- Shear and bending loads are vector sums in the plane of the SCS mating plane (Figure 3.2.1-5).
- The active soft capture system must meet all of its functional and performance requirements without exceeding loads defined in Table 3.3.2-1.
- The passive soft capture interface, or active soft capture system in the passive mode, must meet all of its functional and performance requirements during and after exposure to loads defined in Table 3.3.2-1 and Table 3.3.2-2.
- The petal contact load is applied to the edge of the petal or the outer face of the petal. The load can only be applied to the petal edge from the root of the petal to 80% of the petal length. The load can only be applied to the outer face from the root of the petal to 60% of the petal length from the base.

4 REFERENCE MISSIONS - TBD

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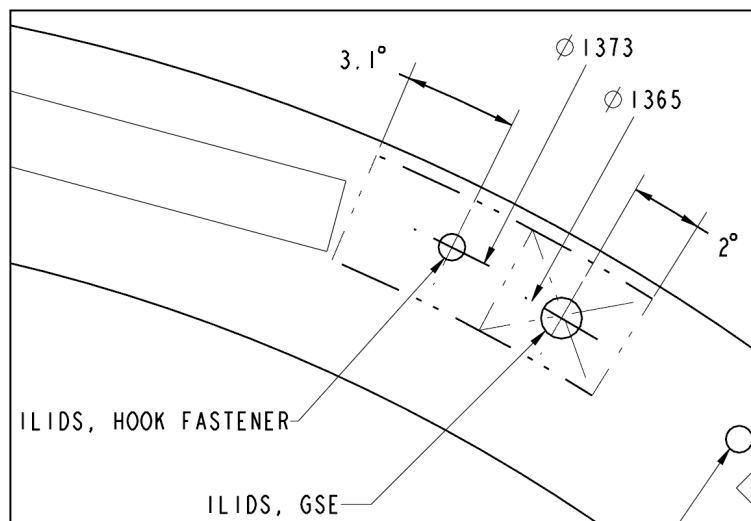
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APPENDIX

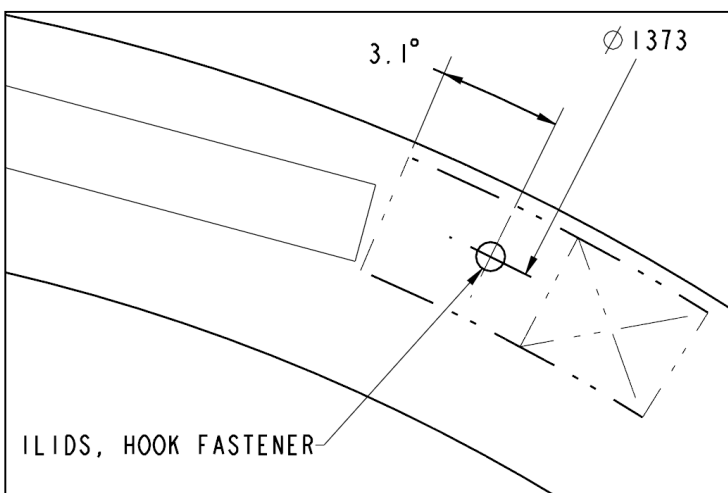


APAS Striker Zone Violations (TBD):

iLIDS Striker Zone Violations:



Detail Applies at the following
locations:
1, 3, 4, 6, 7, 9



Detail Applies at the following
locations:
2, 5, 8

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