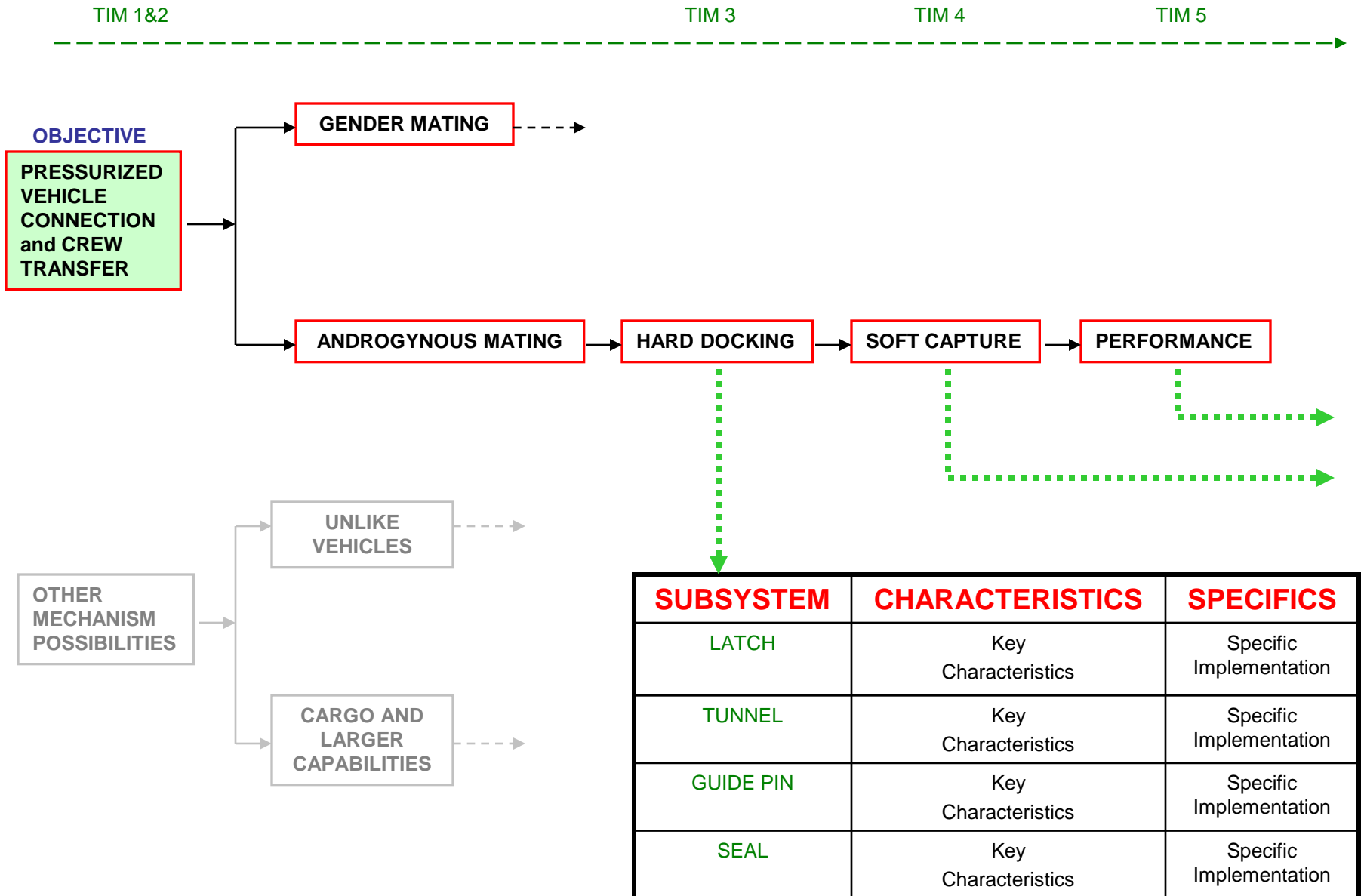


# INTERNATIONAL DOCKING STANDARDIZATION

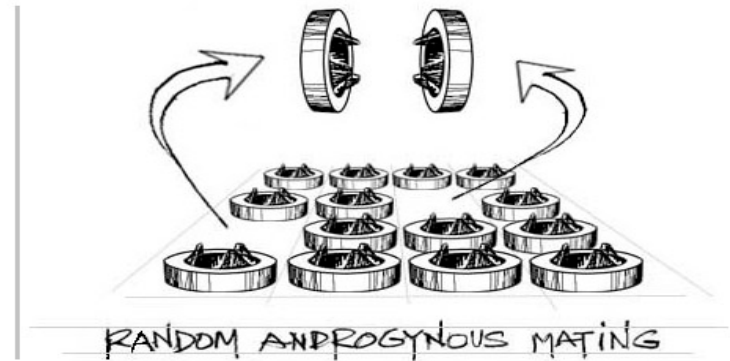
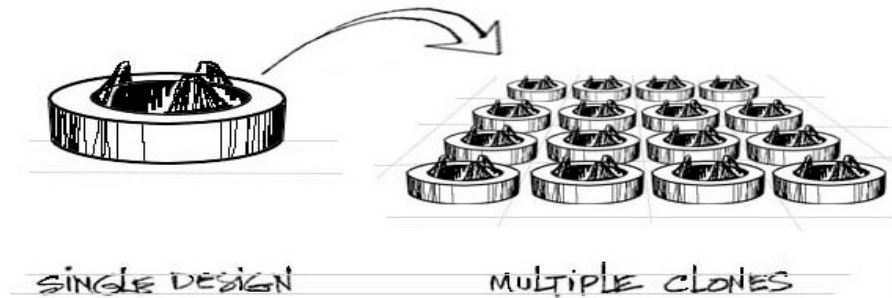
NASA

# DECISIONAL FLOW



# ANDROGYNY

- Allows rescue and collaboration between any two vehicles.
- System level redundancy (role reversing)
- Flexible mission implementation (allowing simpler versions to be compatible with the standard)
- Reduce unique mission analysis and training
- Single design which connects to duplicates of itself



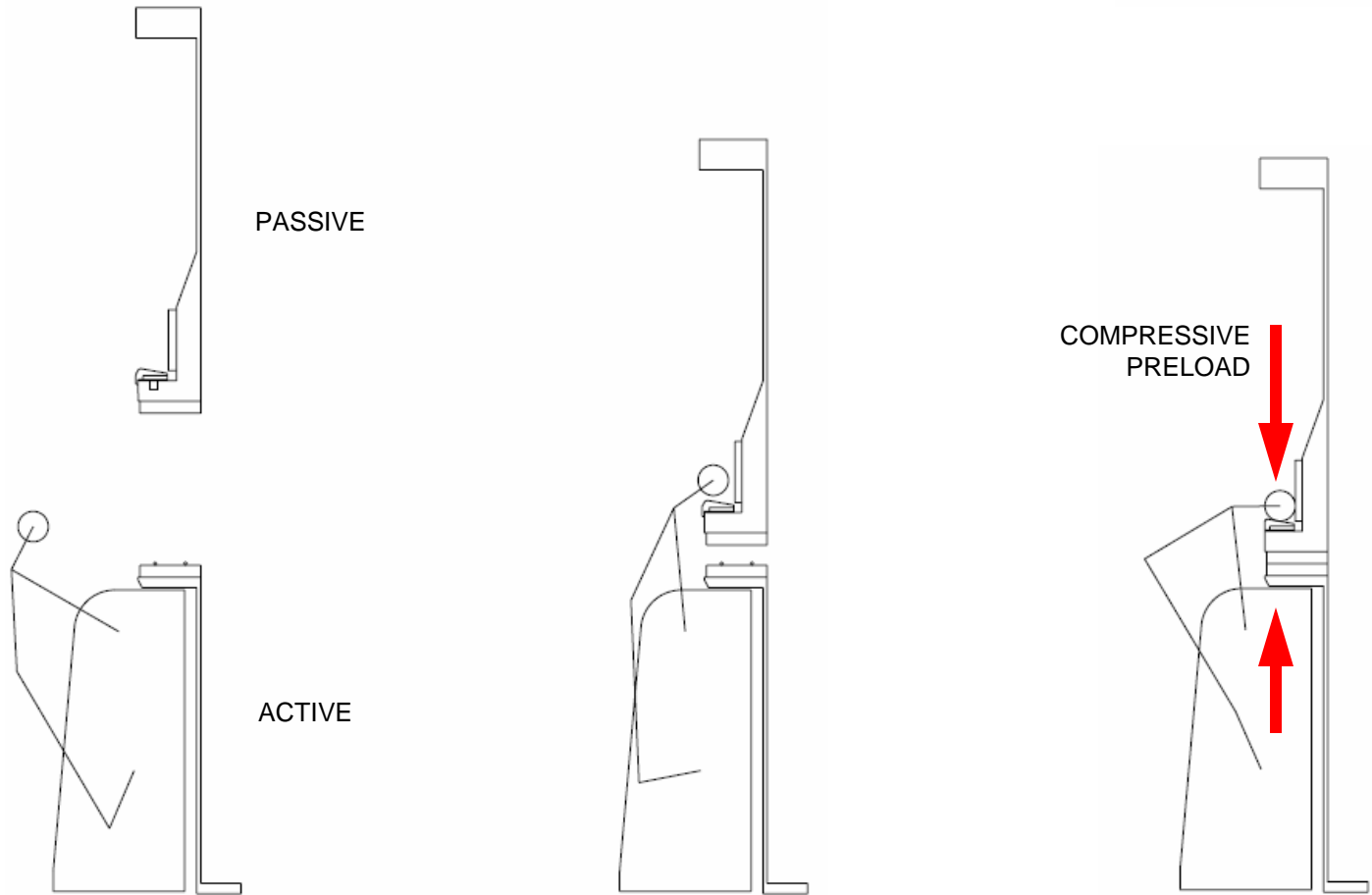
# HARD DOCKING SYSTEM

<b>SUBSYSTEM</b>	<b>KEY CHARACTERISTICS</b>	<b>SPECIFIC IMPLEMENTATION</b>
<u><b>LATCH SYSTEM</b></u>	<ul style="list-style-type: none"> <li>• Androgynous arrangement at interface. A single component is not androgynous.</li> <li>• Internal Mounting: for protection and fault correction possibilities</li> <li>• Active-on-Passive mating: Having redundant mating for malfunctions (having 24 points and uses only 12 points at a time)</li> <li>• Simplified passive mate: Passive side can be very light</li> <li>• Radial: Clamping on seal interface</li> <li>• Self compliant: Spring-biased, more mating tolerance.</li> </ul>	[to be addressed In future TIM]
<u><b>TUNNEL HOUSING</b></u>	<ul style="list-style-type: none"> <li>• Accommodating crew passage internally.</li> <li>• Internal mounting for all components, e.g. electronics, cable harnesses, mechanisms...</li> <li>• External Enclosure: Larger bending moment capabilities.</li> </ul>	[to be addressed In future TIM]
<u><b>ALIGNMENT SYSTEM</b></u>	<p>Androgynous arrangement at interface. A single component is not androgynous.</p> <p>Radial slot arrangement:</p> <ul style="list-style-type: none"> <li>• Symmetrical radial compliant guide pin arrangement</li> <li>• Self-centering</li> <li>• Preserving axis co-linearity</li> <li>• Insensitive to thermal differentials</li> <li>• Single direction constraint locally, less prone to binding</li> <li>• Ease of fabrication and assembling</li> </ul> <p>Six engagement locations equally spaced.</p>	[to be addressed In future TIM]
<u><b>SEAL</b></u>	<ul style="list-style-type: none"> <li>• Seal-on-seal at interface.</li> <li>• Redundant dual seal beads.</li> </ul>	[to be addressed In future TIM]

## **JUSTIFICATIONS AND RATIONALES**

# LATCH SYSTEM Overview

CENTERLINE



[return to Hard Docking page](#)

# LATCH SYSTEM

## Features and Rationales

Androgynous arrangement at interface:

Allowing latching between any two vehicles to facilitate rescue missions anywhere anytime with any space craft.

Internal Mounting:

For protection and fault correction possibilities. All mechanisms and sensory devices are located within the Tunnel Housing for protection from orbital debris and environmental extremes. Internal mounting also allows intra-vehicular access for fault corrections as desired.

Active-on-Passive mating:

Each side has 12 active latches and 12 passive mates. Nominal operations require only 12 active latches from one side. Role reversing between the two sides allows system level redundancy and flexibility. Role reversing also permits docking to a scarred interface by using the unscathed twelve points.

Simplified passive mate:

The passive mate is simplified to a minimal level that allows extremely light weight options. This approach provides flexibilities for vehicles that are weight sensitive such as Lunar or Martial ascent modules.

Radial operational plane:

Clamping on seal interface. The C-clamp latch configuration is most effective when allowed to clamp directly on the sealing area to retain air pressure. The radial operation permits the C-clamp to reach behind the seals to compress them. Tangential operation will have an offset distance and will be less effective for this purpose.

Self compliant:

Spring-biased self compliance between an active latch and its passive mate renders the mating interface more tolerant. This tolerance facilitates both operational matings and system hardware productions where high precision mating features are not required.

# TUNNEL HOUSING

## Features and Rationales



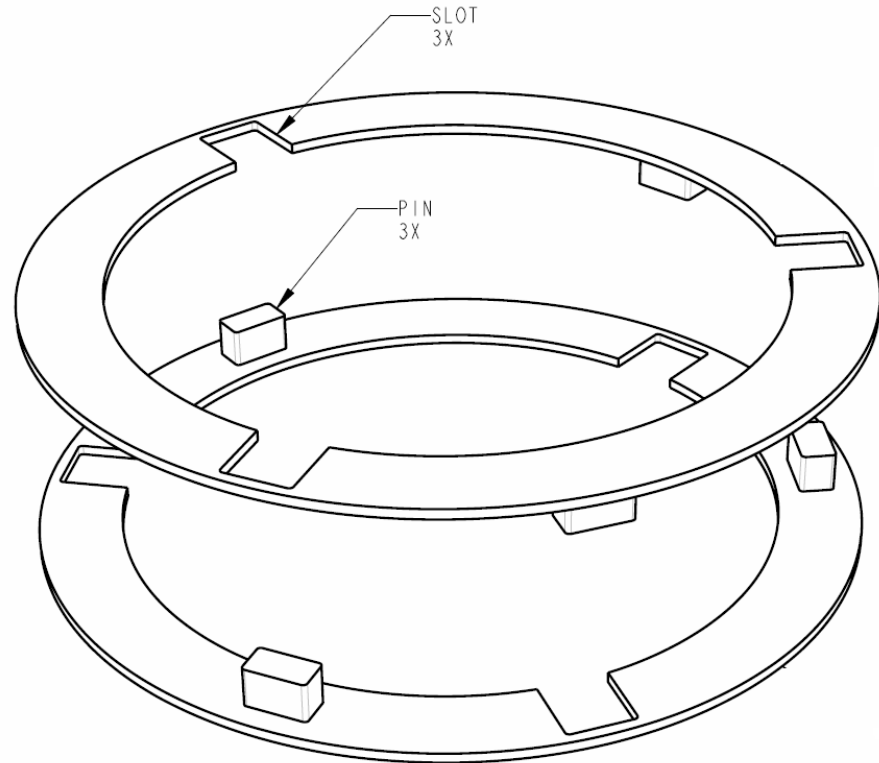
- Accommodating crew passage internally:  
The Tunnel Housing harbors a standard crew member passage way, a Soft Capture System, and all mechanisms of the Hard Docking System.
- Internal mounting for all components:  
All internal components such as electronics, cable harnesses, mechanisms, etc... for protection from orbital debris and environmental extremes.
- External Enclosure:  
For a given system, placing the structural Housing at a larger diameter to enclose all subsystems results in larger bending moment capabilities at the docking connection.
- Weight Optimization:  
With the above properties and characteristics, the Tunnel Housing shall be optimized for weight savings, e.g. Tunnel diameter to be only necessarily sufficient to accommodate the above features.



# ALIGNMENT SYSTEM Overview



GUIDE PIN USING  
CROWN GEAR CONCEPT



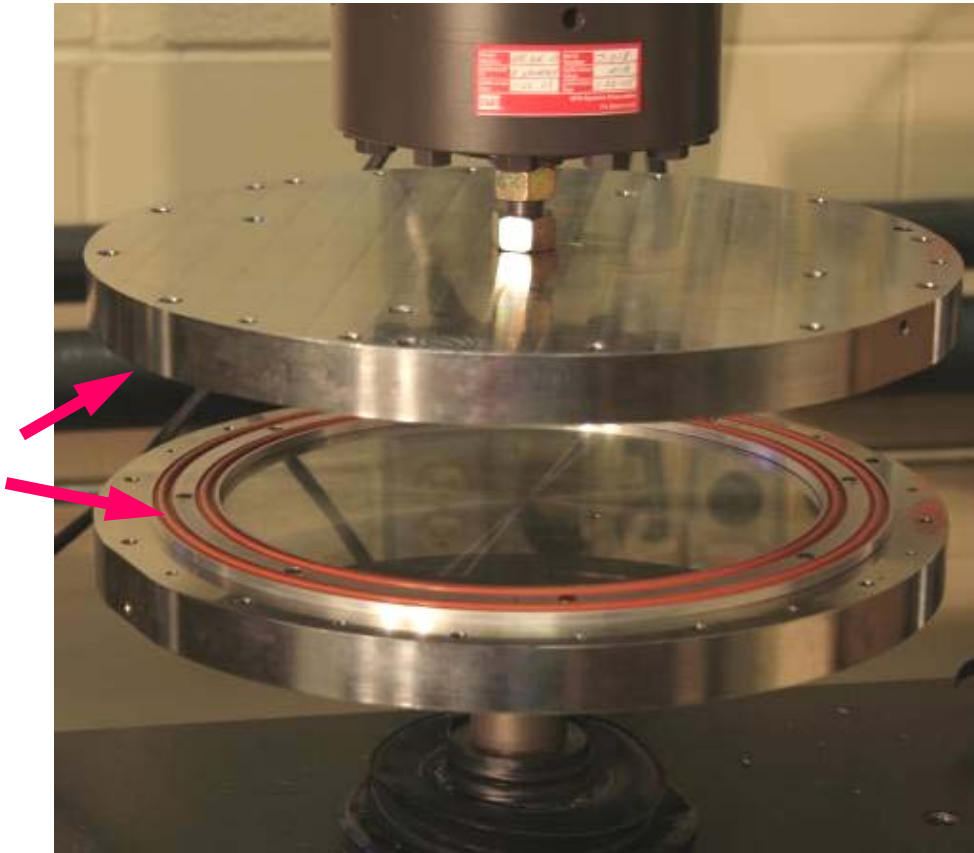
GUIDE PINS USING  
ONLY RADIAL ALIGNMENT

# ALIGNMENT SYSTEM

## Features and Rationales

- Symmetrical radial compliant guide pin arrangement:  
This radial compliant system provides the two mating sides a self-centering feature. With such an alignment system, the mating between the two sides is insensitive to diametrical tolerance and can be more easily achieved.
- Preserving axis co-linearity:  
Mating sides are coaxial due to the self-centering assistance.
- Insensitive to thermal differentials:  
Thermal differentials can cause diametrical mis-matches which have minimal effects on the radial compliant guide pin system.
- Single direction constraint locally:  
Number of constraint directions at each local pin location is minimized. Only a single degree of freedom is constrained. Minimal number of constraints allows ease of mating and insertion, and also facilitates hardware production.
- Ease of fabrication and assembling.

# PRESSURE SEALS



- Seal-On-Seal arrangement:  
To satisfy the androgynous interface, each side shall have the seal beads at an identical location. This results in a seal-on-seal configuration.
- Redundant dual seal beads:  
Two seal beads are concentric and provides sealing redundancy. For any leak path from the pressure side to vacuum to form, both seal beads must fail.

## **SPECIAL TOPICS**

# SPECIAL TOPICS

- KEEP-OUT ZONES

Discussion of keep-out zones for the standard docking system and measures for keep-out zones for future expansions.

- BERTHING IMPACTS OF OTHER DOCKING MECHANISMS (CSA)

## **DEFINITION OF TERMS**

- Docking  
The joining or coming together of two separate free flying space vehicles
- Androgynous Docking  
The joining or coming together of two free flying space vehicles with ***alike*** interfaces