National Aeronautics and Space Administration

Collaborative Forum 2: Paving a Path to an EVA Suit Standard

Spring 2019

The xEVA Standard: Purpose

Collaborative Discussion regarding industry's utilization of other NASA or external design standards and feedback and recommendations to support the possibility of an EVA suit standard.

- **The "xEVA Standard" is a concept that facilitates capture and communication of NASA's xEMU specification**
- **NASA has a range of options for what level of detail is published in the Standard**
- **Successful demonstration of the xEMU on ISS provides *validation* that there is at least one way the Standard can be met**

NASA Standards: Recent Examples

- **There are several relevant examples within current NASA activities which provide precedence for a publicly available xEVA Standard**
- **NASA may take an approach similar to the International Docking System Standard (IDSS) which is publicly posted:**
  - The IDSS IDD includes performance characteristics of the system such as OML/SWAP/Functions
  - The IDSS IDD heavily emphasizes the interfaces and component features allowing two separately built docking collars to join as intended

http://www.internationaldockingstandard.com/

Samples from the International Docking Standard

- **The IDSS example reveals an key underlying idea- in this case, the publicly available IDSS Standard does NOT "tell someone *how* to build a Docking Collar"**
- **Instead, assuming the user will design their own docking collar the standard simply establishes an interface so that *what* gets built is compatible with anyone else's implementation**
  - Users are free to develop their own unique design implementation as long as it meets the interface
  - This approach provides for alternative solutions/implementations that can still dock together and provide the necessary functions and performance

IDSS IDD Revision E
October 2016

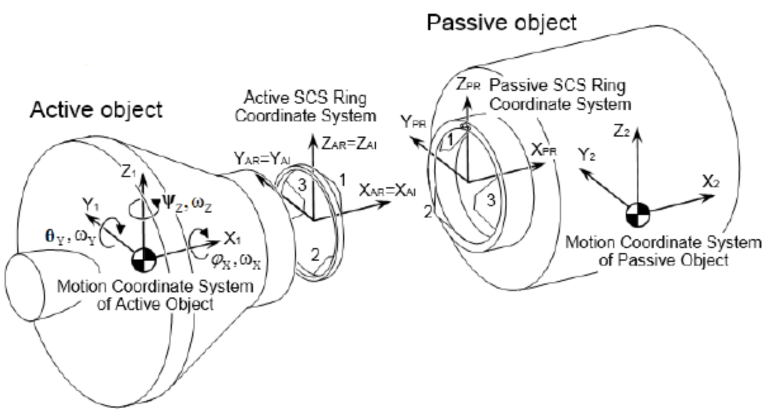
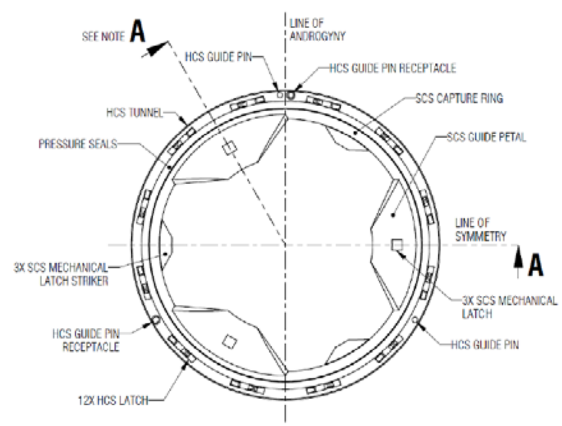


FIGURE 3.3.1.1-2 COORDINATE SYSTEM OF DOCKING OBJECTS (ACTIVE AND PASSIVE)

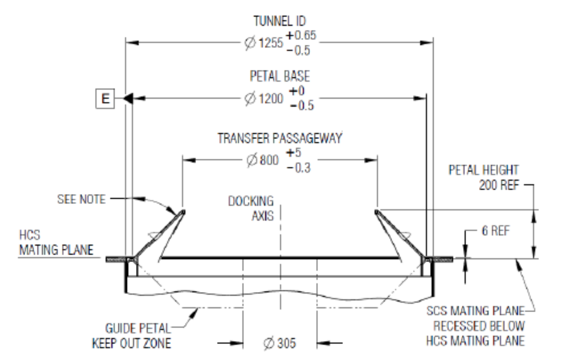
IDSS IDD Revision E
October 2016



Note: Refer to Figure 3.1.1.1-2 for Section A-A.

FIGURE 3.1.1.1-1 ANDROGYNOUS DOCKING INTERFACE – AXIAL VIEW

IDSS IDD Revision E
October 2016

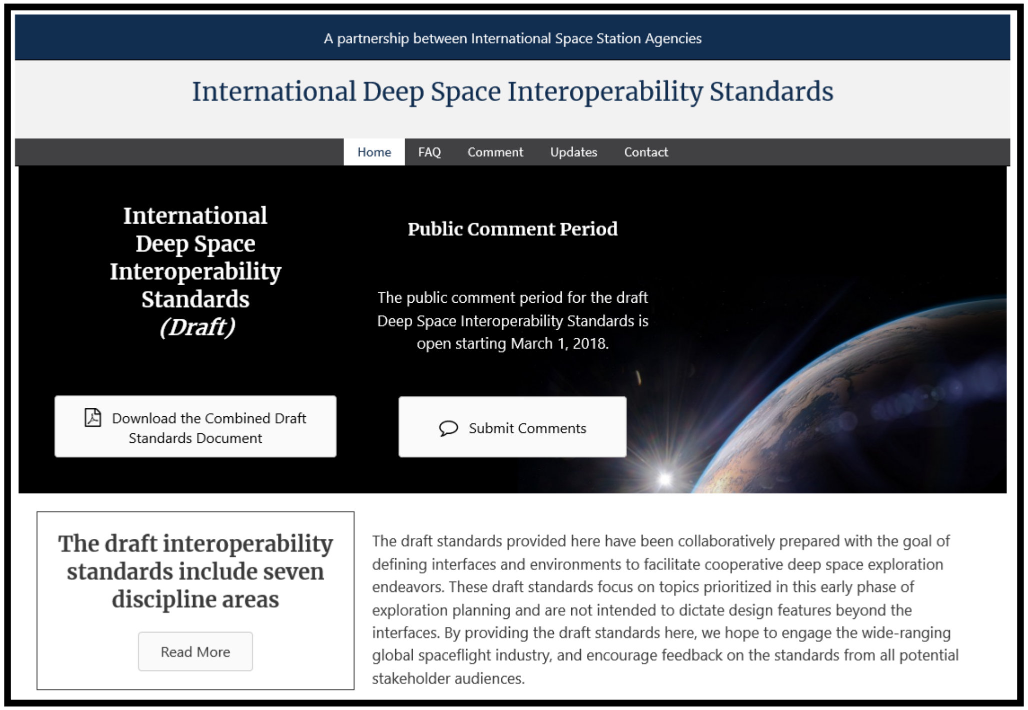


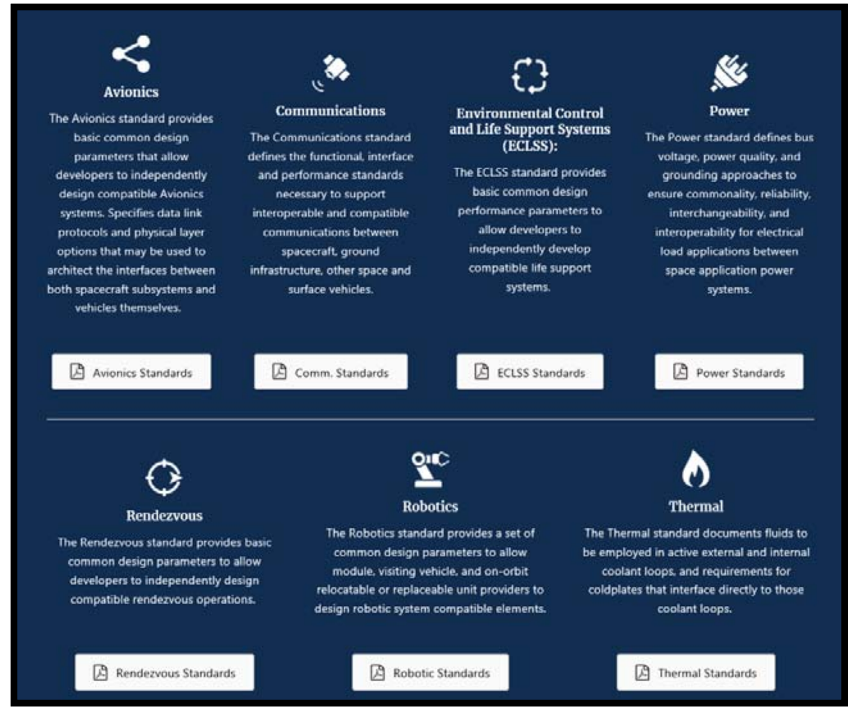
Note: Refer to Figure 3.1.1.1-3 for details

FIGURE 3.1.1.1-2 SECTION A-A (CROSS-SECTION THROUGH MID-PLANE OF TWO PETALS)

NASA Standards: Recent Examples

- **Similarly, work underway with NASA and international partners includes interoperability standards for vehicle elements and systems:**





https://www.internationaldeepspacestandards.com/

Samples from the International Deep Space Standards

- **The Deep Space Standards currently cover spacecraft-level systems:**
  1. Avionics
  2. Communications
  3. ECLSS
  4. Power
  5. Rendezvous
  6. Robotics
  7. Thermal

- **NASA opened the Deep Space Standards to Public Comment**
- **Initial Comment Period was March 1, 2018 to May 2018**
- **Through various mechanisms, 300-400 comments were collected**
- **Comments were incorporated into the July 2018 revision**
- **The comment mechanism is still open and any new comments will be considered for future revisions**

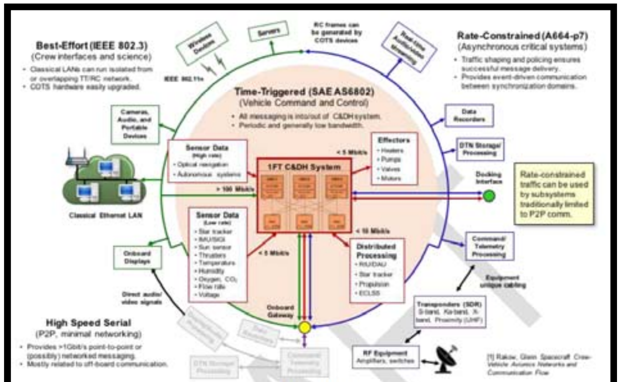


FIGURE 1

Avionics Standard Example: Network interrelationships and performance

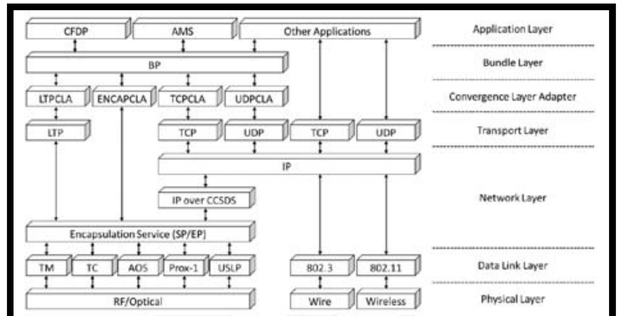


FIGURE 3.2-2 PROTOCOL STACK – OPTIONS

Comm Standard Example: Protocol Stack Optons

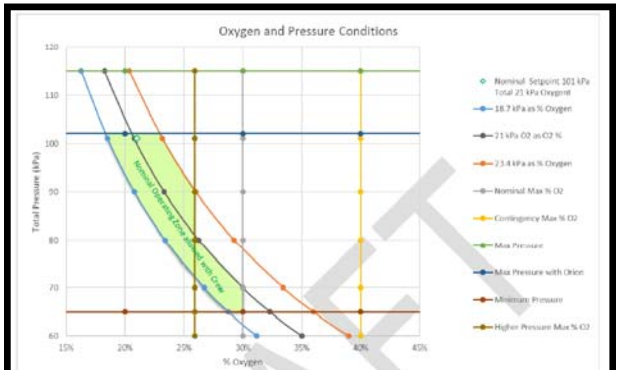


FIGURE 1 OXYGEN AND TOTAL PRESSURE CONDITIONS.

THIS FIGURE DOES NOT DESCRIBE THE CONTROL BOX AROUND ANY PARTICULAR SET POINT.

ECLSS Standard Example: Spacecraft Atmospheres and setpoints

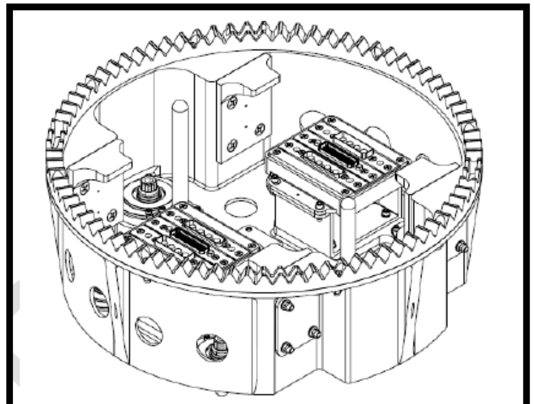
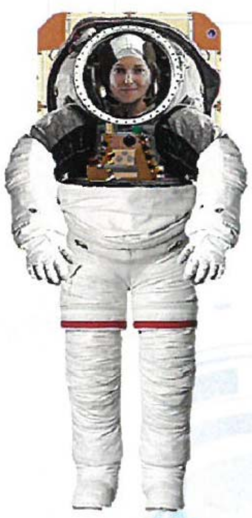


FIGURE 13 LPGF (INTERFACE TO ROBOT END EFFECTOR)

Robotics Standard Example: Grapple fixture option for ORU builders to design to

Towards an xEVA Standard

- **NASA has begun to take steps towards component-level standards for xEVA/xEMU components**
- **In late 2017/early 2018, NASA posted an RFI on https://www.fbo.gov/ (Fed Biz Ops) for Alternate Component options supporting several xEMU components (Ref. Keyword # 80JSC018EVASUIT)**
- **NASA used design-agnostic component End Item Specs (EIS') to explain the functions, performance levels and interface requirements for xEMU parts**
- **Although this particular RFI is long since archived an inactive, it serves as an example of how xEMU component-level EIS' are conceptually similar to the publicly available IDSS IDD**
  - The xEMU EIS' do not state how or what technology is used to do the job, but rather opens the door to any equivalent alternate that does the required job
- **This is a step towards a complete open standard for the entire suit assembly, facilitating a growing supplier base which retires risk and lowers the barriers for participation**
- **Next steps might include Assembly-level Drawings that do not prescribe specific parts but instead provide system level resource allocations (such as physical envelope) for each component**



Component	*Reference Capability Description*
1. Fan	Provide breathing gas circulation within the space suit under a range of load conditions
2. Pump	Provide water circulation through a closed loop to facilitate heat transport and transfer
3. Carbon Dioxide and Humidity Control Unit (CDHCU)	Provide carbon dioxide and humidity control within the space suit
4. Positive Pressure Relief Valve (PPRV)	Provide the ability to limit the pressure in the PLSS ventilation loop to the maximum design pressure in the event of a failed open primary or secondary regulator
5. Space Suit Bearings	Provide the ability to rotate joints of a space suit during extra-vehicular activities in various environments
6. Space Suit Elbow Joint Restraint Bladder	Provide the ability to enclose the elbow joint of the suited user

The xEVA Standard: Next Steps

- **The xEVA team is evaluating several options for structure, depth of detail and review process for the Standard**

- **NASA would like to understand Industry's perspectives on "what makes a good standard"**
  - What design standards have proven valuable and useful?
  - What design standards or content are more burdensome than helpful?
  - What structure and communication/transmission methodology has been seen to work well? What works poorly?
  - What metrics exist in terms of review and feedback on standards?
  - How "open" should the ecosystem the Standard established be?

Questions?