ISS Unpressurized Payload Accommodations

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Purpose and Overview

- Purpose of Presentation – To present an overview of the Unpressurized Payload Accommodations available on the International Space Station

- Presentation Overview
  - ISS External Payload Accommodation Locations
  - Columbus EPF Overview
  - ELC Overview
  - JEM-EF Overview
  - Testing
  - Documentation
Planned External Payload Attachment Locations

- **Express Logistics Carrier**
  - total of ten adapter sites located on the 6 truss attach sites at P3 and S3

- **Columbus External Payload Facility (COF-EPF):** 4 each Flight Releasable Attachment Mechanism (FRAM) sites (2 allocated to US Payloads)

- **Kibo Exposed Facility (JEM-EF):**
  - 12 each Payload Interface Unit (PIU)/FRAM sites; 10 for payload use (49% allocated to US Payloads)
Planned ISS External Payload Attachment Locations

ITS S3

ITS P3:

COF-EPF

JEM-EF

Small Payloads Mission of Opportunity TIM
The Columbus Module has four Exposed payload sites to perform external science investigations

- Payloads are integrated onto a special adapter plate (Columbus Adapter Plate Assembly CEPA)
- Each site is equipped with interface hardware that permits CEPA mounted payloads to be installed and removed on-orbit
- Payloads can be installed by Astronauts performing Extravehicular Activity (Space walks)
- Payloads can also be installed using the Special Purpose Dextrious Manipulator (SPDM)
  - The SPDM can perform fine robotic operations that would be difficult for the large robotic arm)
CEPA Overview

CEPA Assembly
Small Payloads Mission of Opportunity TIM

1E Payloads

SOLAR on CEPA

- SOLAR Payload with Integrated Carrier (EVA mass = ~ 800 lbs)

EuTEF on CEPA

- EuTEF (European Technology Exposure Facility) Payload with Integrated Carrier (EVA mass = ~ 752 lbs)
Small Payloads Mission of Opportunity TIM

- EPF with Integrated External Payloads
- 4 External Payload Sites

- EPF Mechanical Support Platform for Passive FRAM
Columbus EPF Viewing

Orbit Sunrise

[Images of Columbus EPF viewing at sunrise]

Orbit Noon

[Images of Columbus EPF viewing at noon]

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SPDM Located on the end of the SSRMS
Installation of a Payload on the Columbus EPF using an EVA Crewman
Installation of a Payload on the Columbus EPF using SPDM and SSRMS
Express Logistics Carrier
ExPRESS Logistics Carrier (ELC)

- **ELC Overview**
  - Launched in Shuttle Payload Bay (pre-integrated with payloads for initial delivery)
  
  - There are two Science Sites on each ELC to accommodate external payloads and 10 sites for Unpressurized ISS Logistics Storage
    - Each Science Site Employs an Express Payload Adapter (ExPA) to accommodate payloads
      - 28 VDC and 120 VDC power
      - 1553, Ethernet Data
      - Digital and Analog Discretes
    - Each Logistics site only provides 120V Heater power
    - The 2 Science sites can be located at any site on the ELC (prelaunch only)
  
  - Individual payloads can be removed and replaced on orbit via EVA or EVR using the same method that payloads are removed and replaced on the Columbus EPF
Small Payloads Mission of Opportunity TIM

S3 Truss (Up to 4 ELCs)  P3 Truss (Up to 2 ELCs)

On-orbit Sites
S3 Truss Viewing

Orbit Sunrise

Orbit Noon

+X

+Z

+Y

+X

+Z

+Y

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S3 Truss Viewing

Orbit Sunrise

- X

- Z

Orbit Noon

- X

- Z
Kibo Exposed Facility Sites
JEM-EF Carrier Attachments for Transport to the ISS

PAM-PU....Payload Attach Mechanism - Payload Unit

UCM-P (Umbilical Connect Mechanism-Payload Side)
TS-P (Trunnion Structure-Payload side)
NASA Has 8 Payload Interface Units in Inventory for Payload Use
JEM-EF Viewing

Orbit Sunrise

Orbit Noon

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JEM-EF Viewing

Orbit Sunrise

Orbit Noon

-X

-Z

-X

-Z
## Power and Data Availability

<table>
<thead>
<tr>
<th>ISS Location</th>
<th>Power</th>
<th>Voltage (Nominal VDC)</th>
<th>High Rate Data (Optical Fiber)</th>
<th>Medium Rate Data (Ethernet)</th>
<th>Low Rate (1553)</th>
<th>Active Cooling</th>
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<tbody>
<tr>
<td>Columbus</td>
<td>1.25kW</td>
<td>120VDC</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>JEM-EF</td>
<td>3kW</td>
<td>120VDC</td>
<td>X</td>
<td>X</td>
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<td>ELC</td>
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<td>120VDC</td>
<td>X</td>
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<td></td>
<td>500 W(28)</td>
<td>28 VDC</td>
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### TABLE 3.5.1.2–1  HOT AND COLD NATURAL THERMAL ENVIRONMENTS

<table>
<thead>
<tr>
<th>Case</th>
<th>Solar Constant (W/m²)</th>
<th>Earth Albedo</th>
<th>Earth Outgoing Long Wave Radiation (W/m²)</th>
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<tr>
<td>Cold</td>
<td>1321</td>
<td>0.2</td>
<td>206</td>
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<tr>
<td>Hot</td>
<td>1423</td>
<td>0.4</td>
<td>286</td>
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</table>

### TABLE 3.5.1.2–2  INDUCED THERMAL ENVIRONMENTS

<table>
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<tr>
<th>Induced Environment</th>
<th>Assumed Parameters</th>
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<tbody>
<tr>
<td>Beta Angle</td>
<td>+/- 75°</td>
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<tr>
<td>Altitude</td>
<td>150 nmi. to 270 nmi.</td>
</tr>
<tr>
<td>Attitude Envelope Without Orbiter (¹)</td>
<td>Any combination of</td>
</tr>
<tr>
<td></td>
<td>+/-15° Roll (about X axis) (²)</td>
</tr>
<tr>
<td></td>
<td>+/-15° Yaw (about Z axis) (²)</td>
</tr>
<tr>
<td></td>
<td>+15 to -20° Pitch (about Y axis) (²)</td>
</tr>
<tr>
<td>Attitude Envelope With Orbiter Docked to ISS (¹)</td>
<td>Any combination of</td>
</tr>
<tr>
<td></td>
<td>+/- 15° Roll</td>
</tr>
<tr>
<td></td>
<td>+/- 15° Yaw</td>
</tr>
<tr>
<td></td>
<td>0 to 25° Pitch</td>
</tr>
</tbody>
</table>

Note(s):  
1. The attitude variations include variations in the Torque Equilibrium Attitude (TEA) as well as variations in the ISS attitude from the TEA attitude, both with Orbiter docked, and without Orbiter.  
2. XYZ axes refer to ISS coordinate system orientation.
Payload Testing

- Individual payloads are given a “Suitcase Simulator” to perform development testing on their payload.
- ELC payloads are tested using an ELC simulator.
  - ELC Payloads launched on the ELC are tested using the flight ELC and simulators of the ISS.
- Columbus Payloads are tested via the Suitcase Simulator or the Rack Level Test Facility in Bremen Germany.
- JEM-EF Payloads are tested via the Suitcase Simulator or at the JAXA launch facility in Tanegashima Japan.
RLTF Testing of The SOLAR Payload
- Columbus Documentation
  - COL-RIBRE-SPE-0165

- ELC Documentation
  - SSP 57003-ELC Attached Payload IRD-ELC Cargo Interface Requirements

- JEM-EF Payloads
  - JEM JPAY Vol 4 JEM RMS/Payload Standard Interface Control Document
Window Observational Research Facility (WORF)

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Project Objectives

• The **Window Observational Research Facility (WORF)** Rack is a unique facility designed for use with the US Lab Destiny Module window.

• WORF will provide valuable resources for Earth Science payloads along with serving the purpose of protecting the lab window. The facility can be used for remote sensing instrumentation test and validation in a shirt sleeve environment. WORF will also provide a training platform for crewmembers to do orbital observations of other planetary bodies. WORF payloads will be able to conduct terrestrial studies utilizing the data collected from utilizing WORF and the lab window.

Description

• Originally manifested and loaded for ULF1 Flight (impacted by Columbia accident)– Now planned for ISS Flight 19A (2009). Rack Hardware is at KSC “ready for flight”

• Rack Facility using standard ISPR and EXPRESS heritage hardware

• Provides Power and Data interfaces for up to 5 payloads

• Provides avionics air cooling for instruments and crew comfort; Moderate Temperature Loop Water cooling for avionics

• Provides stable mounting platform and “darkroom” environment for payload instruments
Developed as an EXPRESS Rack derivative for simplified design process and utilization of common avionics

- 1 flight rack (KSC), 1 ground rack (JSC)
- Two Small Camera Brackets provided for payload use

**Interfaces**
- Seat Track locations in payload volume
- Payload Support Shelf - 161 threaded inserts for payload mounting
- QD (Water)
- Power & Data Connectors
- SCSI, Data, Video Pass-through connectors
- Cables & Hoses Available

**Resources**
- 28Vdc Power (20 amp) – 5 locations
- Data (1553, Ethernet, Video) - 5 locations
- Moderate Temp Loop Cooling – 2 locations
- Avionics Air Cooling – Payload Volume
- SCSI, Data, Video Pass-through connectors
- Payload Support Computer

International Standard Payload Rack
Secondary Structure & Subsystems
~22.6cu.ft Payload Volume
The WORF Rack front face consists of the following:

1. Front connector panel
2. Aisle side hatch
3. Hatch vent assemblies
4. Shutter Actuator Handle
5. Bump Shield Handle
6. Stowage Volume
7. Utility Outlet Panel (UOP) connection
WORF Subsystems

- PAYLOAD ETHERNET HUB/BRIDGE (PEHB)
- BRP ENHANCED MEMORY UNIT (BEMU)
- SOLID STATE POWER CONTROL MODULE (SSPCM)
- AREA SMOKE DETECTOR (ASD)
- -7 COLDPLATE
- -6 COLDPLATES, 2 PLACES
- BUMP SHIELD
- AIR KNIFE
- AVIONICS AIR ASSEMBLY (AAA)
- MTL SUPPLY & RETURN
- STOWAGE VOLUME
- PAYLOAD SUPPORT SHELF
- SEAT TRACKS, 5 PLACES, EACH SIDE
- RACK INTERFACE CONTROLLER (RIC)
- UPPER SHELF
- PAYLOAD ASSEMBLY
- The WORF Aisle Hatch prevents unwanted light from entering the WORF Rack volume.
- Prevents loose items and debris from entering rack volume.
- Prevents installed payloads from being disturbed by passing crew members.
- Can be installed/removed very quickly without the use of tools. Designed to be stowed (folded) in the rack stowage drawer.
The Bump Shield provides protection to the US Lab window when crewmembers are working inside the payload volume.

- It consists of three rectangular sections 9 inches, 14 inches, and 6 inches high, respectively.
- Provides optical quality sufficient for low fidelity photographic operations.
- The bump shield can be retracted for higher quality imagery.
- Made of Tuffak CM-2 (a transparent polycarbonate).
WORF Payload Volume

ADDITIONAL VOLUME WITH BUMP SHIELD IN THE RETRACTED POSITION

SEAT TRACK REF

24.8 (629.9) 9.8 (248.9)

BUMP SHIELD REF

SCRATCH PANE REF

10.7 (271.8)

U.S. LAB NADIR WINDOW

13.3 (337.8) 23.5 (596.9)

U.S. LAB PRIMARY STRUCTURE

WINDOW CENTER LINE

18.7 (475.0)

RACK SIDE VIEW

RACK PACKAGING OMITTED FOR CLARITY

AVAILABLE PAYLOAD VOLUME

REF FIGURE 3-6

REF FIGURE 3-7

REF FIGURE 3-8

FWD SIDE

AFT SIDE

35.4 (899.2) 35.2 (894.1)

Dimensions: Inches (mm)

FINAL XXX REFERENCE DIMENSIONS

WORF PAYLOAD VOLUME

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The moment produced on the seat track by payload hardware shall be less than 750 in-lbs.
The payload shall use the following fastener to attach to the payload support shelf: thread size: 0.19-32 (#10-32).

The payload shall prevent fastener seize through dry film lubrication, silver plating, or application of approved anti-seize compound.

Payload fasteners shall be held captive to the payload side of the interface.

Payload fasteners shall be self-retracting (i.e., spring loaded) and at least flush with the payload mounting flange.

Payload alignment guides are recommended. Payload alignment guides shall be non-metallic, self-retracting, and not pose a damage hazard to the surface of the payload support shelf.

Maximum payload mass on lower shelf is 299 lb/136kg.
WORF Small Camera Bracket

- Mounts to Payload Shelf with four base plate knobs
- Supports multiple size cameras or imagers
- Interface to standard camera shoe or 1/4-20 fastener
- Adjustable in any axis
- Shaft is adjustable by loosening the ball stack.
- Camera mount is adjustable in pan and tilt by loosening retaining screws.
- Maximum payload mass of 22lbs/10 kg allowable
- Two Small Camera Brackets are manifested with WORF.
WORF Front Connector Panel

- 2 Payload Connections (Data, Power)
- 1 MTL Connection
- Pass thru Connectors (Data, SCSI, Video)
- Smoke Indicator LED
- WORF Laptop Connections
- Internal Payload Power Indicators
- Rack Maintenance Switch
- PFE Port
The main camera connector panel:

1. Two Payload connections (power, data)
2. Portable Light connections (120v)
3. Pass thru connections
4. Smoke indicator LED
The auxiliary connector panels:

1. 1 Payload connection (power, data)
2. MTL Cooling (to support 1 payload)
WORF Soft goods

- WORF Payload Shroud available for hand-held imagery
  - Kayak skirt that seals out ambient light with a crewmember in the rack
- WORF stowage bags available to be use in payload volume
  - Stow payload hardware; lenses, film, etc
- WORF Light Curtain is installed on front face to provide more light blockage
### WORF Resources

#### Power
- Solid State Power Controller Module (SSPCM) converts station power for payload use
- 28Vdc Power (+1.5, -2.5 Vdc) provided to payloads
- Current limiting available at 5, 10, 15, 20 amp settings
- 1900 W possible but total is restricted by thermal constraints and overall vehicle capability
- 120 Vdc interface in rack not for nominal payload use (can be negotiated)

#### Thermal
- Avionics Air Assembly (AAA) ducted cooling (50 cfm) provides 336 W heat rejection from the payload volume. An air knife provides air flow across the window to prevent condensation
- Moderate Temp Loop (MTL) water cooling (40 lbm/hr) is available for 500 W heat rejection using the connections either on the rack front or internal connector panels.
- Passive heat rejection to the cabin air is limited and allocated based on actual payload compliment.
- Smoke detection available for air-cooled payloads

#### Data
- Each data connector includes pins for 1553, RS-422, Ethernet, NTSC RS-170A Video
- 5 Vdc bi-directional differential discrete
- +/- 5Vdc differential analog
- Pass-through connectors include SCSI-2, S-Video, Ethernet, RS-232, RS-422
- WORF Laptop Computer available for payload-specific software and/or crew interfaces
- Parameter monitoring available for water-cooled payloads

**Not Available: Vacuum Resource, Vacuum Exhaust, Nitrogen, Low Temperature Loop**
WORF Internal Systems

Front Connector Panel
- PL 1 Power
  - 28 Vdc (0-20A)
- PL 2 Power
  - 28 Vdc (0-10A)
- Differential Analog (2)
- Bi-Directional Discrete (3)
  - Video (Differential)
- PL 1 Data
  - RS-422
  - Ethernet
  - PPC Bus
  - Differential Analog (2)
  - Bi-Directional Discrete (3)
  - Video (Differential)
- PL 2 Data
  - RS-422
  - Ethernet
  - PPC Bus
- Laptop Video
  - Single Ended Video
- Laptop Data
  - RS-232
  - Ethernet
- Laptop Ethernet
- Pass-Through Connectors

SSPCM

Payload Volume Panel
- PL 3 Power (Camera Connector Panel (CCP))
  - 28 Vdc (0-20A)
- PL 4 Power (CCP)
  - 28 Vdc (0-20A)
- PL 5 Power (Auxiliary Panel 1)
  - 28 Vdc (0-20A)
- Differential Analog (2)
- Bi-Directional Discrete (3)
  - Ethernet
  - PPC Bus
  - RS-422
  - Video (Differential)
- PL 3 Data (CCP)
  - PPC Bus
- PL 4 Data (CCP)
  - PPC Bus
  - Video (Differential)
  - RS-422
  - Ethernet
  - PPC Bus
- PL 5 Data (Auxiliary Panel 1)
  - PPC Bus
  - Bi-Directional Discrete (3)
  - Video (Differential)
  - RS-422
  - Ethernet
  - PPC Bus

PEHB
RIC

Pass-Through Connectors
Pass-Through Connectors (CCP)
The Rack Interface Controller (RIC) processes telemetry, health and status data, as well as commands to the payload.
The Lab Window Scratch Pane can be removed for higher quality optical requirements.

- WORF Payloads should design their hardware to minimize glare or ambient light reflections.
- WORF payloads should be designed to be installed with the bump shield deployed to prevent contact with the Lab Window.
- Payloads should maintain a 0.5 in keep-out zone around the window assembly.
- Payload lenses should incorporate bumper rings to prevent damage to the Lab Window in case of inadvertent contact.
- There are a number of flight rules that govern window use during certain events.
- Crewmembers are restricted to 30 minutes of operation in the payload volume without the rack powered due to concerns of CO$_2$ concentrations.
Destiny Window

Cross Section of US Lab Research Window Mount

OUTBOARD

External Window Shutter

Surface Protection Ring Assembly

Debris Pane Assembly

Anti-Reflectant (AR) Coating

AR Coating

AR Coating

Redundant Pressure Pane

AR Coating

AR Coating

Primary Pressure Pane

Conductive AR Coating

Inboard

Indium Tin Oxide (ITO)

Conductive AR Coating

Borosilicate - BKT

Scratch Pane Assembly

.46/.44

AR Coating & Lexan Film

.46/.44

BOROSILICATE - BKT

Scratch Pane Assembly

.46/.44

INBOARD

L26/L24 Fused Silica

L26/L24 Fused Silica

.39/.37 Fused Silica

20,000 +/- 0.00
Destiny Window Transmittance
( scratch pane removed)

Destiny Window Port Transmittance
(Three 7940 fused silica panes)

- Witness Sample Con
- VNIR (Est)
- VNIR KSC
- SWIR Witness
- SWIR KSC

Wavelength (nm)
Transmittance (%)
51.6° Inclination

Shuttle Primary Launch and Landing Site

Primary Russian Launch Site

DFRC
-KSC
-Baikonur

Approximate ISS re-visit time for ground targets is 3 days
WORF Payloads will follow the standard ISS Payload Integration Template as outlined in SSP 57057. The general timeline is depicted below.

For payload integration, the following products will be developed:
- Payload Integration Agreement
- Interface Control Document
- Design and configuration drawings
- Verification packages to be submitted to ISS Program
- Certificate of Flight Readiness (CoFR) products

Each payload will participate in the ISS Payload Safety Process by developing Phase 0/I, II, III Flight Safety Data Packages for submittal to the Payload Safety Review Panel (PSRP).

Payload testing support is available using an EXPRESS Rack to simulate WORF data and power interfaces.
The following steps represent a general flow for subrack operations in WORF:

1. **Payload hardware launched and transferred to station**
2. **Crew removes WORF Hatch and mounts payload hardware in WORF Payload Volume**
3. **Crew mates payload connections to WORF interface panels**
4. **Crew lowers bump shield and moves imagery into place**
5. **Crew egresses from payload volume and installs WORF Hatch.**
6. **Crew/ground commands power to rack and payload locations**

WORF and subrack operations are conducted at the Huntsville Operations Support Center (HOSC)

- The Payload Rack Officer (PRO) will be the ground operator of the WORF Rack
- The PRO will be responsible for the following activities:
  - **WORF Ground Activation and Checkout**
  - **WORF Nominal Activation and Deactivation**
  - **Monitoring of WORF H&S Data**
  - **Selected payload H&S may be monitored if payloads utilize the WORF for data throughput.**
  - **Configuration of WORF Rack and resources to support payload operations**
  - **WORF troubleshooting and recovery of off-nominal situations**
Reference Documents

- SSP 52000-PIH-WRP, Volume II – WORF Payload Accommodations Handbook (currently at Revision B)
- SSP 52000-PIH-WRP, Volume III – WORF Interface Definition Document (currently at Revision B)
- SSP 57057, ISS Payload Integration Template
Questions?
Launch Vehicle (JAXA HTV)

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ISSP Payload Engineering and Hardware Integration Office
12/19/07
H-IIB/HTV Launch Rocket
Integrated Assembly

- Fairing
- Second Stage
- First Stage
- LH₂ Tank
- LOX Tank
- LE-5B Engine
- LOX Tank
- LH₂ Tank
- SRB-A x4
- LE-7A Engine x2

H-IIA
H-IIB Launch Rocket Introduction

- Japan has been developing its own launch vehicles, based upon various researches and experiments. Among launch vehicles, the H-IIA launch vehicle has been supporting satellite launch missions as a major large-scale launch vehicle with high reliability.

- H-IIB is the launch vehicle that is an upgraded version of the current H-IIA launch capacity.

- The H-IIB launch vehicle has two major purposes.

  - To launch the H-II Transfer Vehicle (HTV) to the ISS.
    - HTV will carry not only necessary daily commodities for the crew astronauts, but also experimental devices, samples, spare parts and other necessary research items for the ISS.

  - To broader launch needs by making combined use of both H-IIA and H-IIB launch vehicles.
    - H-IIB's larger launch capacity will make it possible to perform a simultaneous launch of more than one satellite, and will reduce the cost.
The HTV is an unmanned orbital carrier, designed to deliver up to six metric tons of goods to the ISS in orbit at an altitude of about 400 kilometers and return with spent equipment, used clothing, and other waste materials on the return trip. These waste materials will be incinerated when HTV makes re-entry into the atmosphere.
HTV Mission Cycle

- Launch
- 1st Stage Separation
- 2nd Stage Separation
- HTV Free Fly
- HTV Ready to Berth
- HTV Berth
- HTV Re-Entry (Burn Down)
- HTV Mission Cycle
ISS Un-Pressurized Cargo
On Orbit Site Layout (Post ULF 5)
HTV Cargo Accommodation
Pressurized Cargo

JAXA "KOBAIRO" rack

- Gradient Heating Furnace (GHF)
- Type1 (18 CTBs)
- Type2 (26 CTBs)
- ISPR
- Tube
- Water Tank
- Exposed Pallet
- Pressurized Section
- Un-pressurized Section
Payload can be soft stow or hard mounted to HRR in HTV PLC

Current Baseline Configuration
- HTV PLC Acoustic level is defined in Cargo IRD
- HTV PLC rack to PLC interface random vibration level is defined in Cargo IRD
- Soft-stow characteristics and hard mounted interface vibration characteristics are not defined in Cargo IRD. It will be measured during HTV PLC vibro acoustic testing.
- For standard cargo stowed in CTBs, only the loads analysis of the cargo will be performed. Vibro-acoustic, structural, or thermal analysis will not be required.
  - Mass and Dimensions of cargo
HTV Un-Pressurized Cargo Accommodation
Type I a (Berthed to JEM EF)

- HCAM Type EF Payload
- EP Main Structure
- FRGF for JEM RMS
- PIU for JEM EF
Volumetric Envelope For JEM EF Payload

JEM EF EFU Payload Envelop

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<th>ft</th>
<th>inch</th>
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<td>W</td>
<td>800</td>
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<td>7.50</td>
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<td>H</td>
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<td>L</td>
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Payload Envelope per FRAM IDD

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<td>L</td>
<td>47”</td>
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HTV EP Configuration

Type 1 (Berthed to JEM EF)
Type III c (Berthed to MBS POA)
HTV EP Configuration
Multiple Purpose Pallet (under development)
Examples Of HTV EP-MP Capability (under development)

- JEM EF Payload on EP-MP

Additional upper plate needs to be add.
HTV un-pressurized cargo manifest approach are as follows:

(1) HTV#1 (07/2009) JEM EF payload

(2) HTV#2 (10 TBD/2010) JEM EF and/or one FRAM payload (with height constraint)

(3) HTV#3 (07/2011) to HTV#7 (07/2015) (Under Development)
   a) JEM EF payload only flight
      i. Berth to JEM EF
   b) FRAM cargo only flight
      i. Berth to MBS POA
   c) Mixed configuration flight
      i. Berth to both locations
HTV Un-Pressurized Cargo Interface

- **FRAM Interface**
  - Express Pallet Adapter Plate
  - Columbus External Payload Adapter

- **Direct Mount Cargo**
  - EVA compatible bolt mechanism
  - No Orbit Attach Site available

- **JEM EF Payload (HCAM Type)**
  - Payload Interface Unit
  - Flight Releasable Grapple Fixture
  - Four HTV Cargo Attachment Mechanism
  - One HTV Connector Separation Mechanism
Mandatory Accommodation Hardware

- **JEM EF payload**
  1. Flight Releasable Grapple Fixture
  2. Payload Interface Unit
  3. HTV Cargo Attachment Mechanism (HCAM)
  4. HTV Connector Separation Mechanism (HCSM)

- **FRAM payload (ExPA, CEPA)**
  1. Flight Support Hardware
  2. Adapter plate
  3. ExPA or CEPA
  4. Passive FRAM
  5. PFRAM adapter plate
HTV Cargo Attachment Mechanism

- Nominally operated by crew command
- Active half on EP, Passive on payload
- Four for each cargo
- Cargo released by opening the arms
- Triggered by retraction of pin puller rod – one shot mechanism
- Mounting hole locations on payload are specified in HTV Cargo IRD
HTV Cargo Electrical Interface
HCSM

- Automatic on orbit demating
- Active half on EP, Passive on payload
- One for each cargo
- One shot mechanism, no on orbit mating capability
- Mounting hole locations on payload are specified in HTV Cargo IRD
Payload Translation To Work Site Concept

1. Rendezvous & Proximity
2. ISS/NODE2
3. HTV (Mars/Logistics Carrier)
4. Detach from HTV
5. Attach to MBS by SSMS
6. Departure from ISS
7. Detach from MBS POA
8. Attach to HTV
9. EP-MP
10. H II-B
11. Re-entry
12. Cargo Exchange by SPDM/SSRM5 or EVA

OR

JEM EF

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After HTV berth to Node 2 Nadir port, EVR Operation is

- EP will be robotically removed from HTV by SSRMS and handed off to JEM RMS to translate to JEM EF
- Each payload will then be robotically deployed to JEM EF EFU site after remotely releasing the HCAMs attachment
- Payload attached to JEM EF EFU port and ready to perform scientific experiment
HTV #x will carry ISSP ORUs and ExPA (or CEPA) science payload
- FRAM mounted or directed mount ORU are all within options
- HTV EP will be translated to POA by SSRMS
- FRAM mounted ORUs and ExPA (or CEPA) Science Payload can be deployed robotically to ELC
HTV EP-MP Maximum Cargo Envelope
(After FRGF Forward Structure Removal)
Payload Provider’s Responsibility Summary

Cargo’s responsibility includes the following
• Integration of the interface hardware to payload
• Provides analytical models per HTV project team’s schedule template
• Supports JAXA analytical and physical integration
• Provides Safety Data Package to NASA/JAXA safety review panel and participates the safety review
• Performs post delivery functional testing
• Provides launch support
Conceptual Flow of Safety Process for On-Orbit Safety

Phase 0/1/2

NASA P/L to be carried by HTV EP

Hazard Report (HR) prepared by P/L Organization

Phase 0/1/2

Safety Review by NASA PSRP (Franchise under coordination between NASA PSRP and JAXA SRP)

Phase 3

JEM Integrator

Integrated HR prepared by JEM Integrator

Acceptance Data Package (ADP) including Approved HRs

Integrated HR prepared by HTV Cargo Integrator

Safety Review by JAXA SRP

HTV Cargo Integrator

Safety Review by NASA PSRP (Franchise under coordination between NASA PSRP and JAXA SRP)

Integrated HR prepared by HTV Cargo Integrator
Conceptual Flow of Safety Process for Ground Safety

1. TNSC Launch Site
2. Ground Operations
3. NASA GSE
4. NASA P/L to be carried by HTV EP
5. Ground Hazard Report prepared by P/L Organization
6. Safety Review by JAXA SSRP (System Safety Review Panel)
Pressurized Cargo:

- HTV pressurized cargo manifest will be baseline at L-12 months
- Cargo to HTV PLC ICD baseline at L-12 months (or at CDR)
- HTV preliminary Couple Load Analysis cycle starts at L-18 months
  - Preliminary model delivery to JAXA is required
- Cargo delivery to Bench Review: TBD
- Cargo handover to Tanegashima: L-25~21 wks (preliminary)

Integration Process Highlight

Pressurized Cargo

<table>
<thead>
<tr>
<th>Cargo Accommodation System</th>
<th>PLC</th>
<th>HTV/H-IIB</th>
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</thead>
<tbody>
<tr>
<td>Oversized Items</td>
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<tr>
<td>Loose Items</td>
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<td>ORUs</td>
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<td>Consumables</td>
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<td>Experiments</td>
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<td>Water</td>
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<tr>
<td>ISPR</td>
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</tbody>
</table>

- Hard Mounting Equipment
- Crew Transfer Bag (CTBs), M01/M02 Bags
- Water Resupply System
- HTV Resupply Rack (HRR)

<table>
<thead>
<tr>
<th>CTB</th>
<th>ISPR</th>
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<tbody>
<tr>
<td>L-17 week</td>
<td>L-17 week</td>
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<tr>
<td>before 4.5 months</td>
<td>before 3.5 months</td>
</tr>
<tr>
<td>L-25 week</td>
<td>L-20 week</td>
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<tr>
<td>before 5.2 months</td>
<td>before 4.2 months</td>
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</tbody>
</table>

( Note ) Based on the launch day
**Integration Process Highlight**

**Un-Pressurized Cargo**

Un-Pressurized Cargo:
- Payload commitment delivery date to NASA: L-24 months
- JAXA HTV EP configuration baseline: L-24 months
- HTV Preliminary Analytical Integration Cycle: L-18 months
- Cargo to HTV EP ICD baseline at L-12 months (or at CDR)
- Cargo delivery: L- 4.2~3.5 months

### Un-pressurizing cargo

<table>
<thead>
<tr>
<th>Un-pressurizing cargo</th>
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</thead>
<tbody>
<tr>
<td>L-17 week</td>
<td>before 3.5 months</td>
</tr>
<tr>
<td>L-20 week</td>
<td>before 4.2 months</td>
</tr>
<tr>
<td>( Note )</td>
<td>Based on the launch day</td>
</tr>
</tbody>
</table>
Summary

- All requirement document will be provided in NASA EDMS via a web link in ISSP payload office SMEX Q/A website