JMX-2017108
Rev.NC

IVA-replaceable Small Exposed Experiment Platform (i-SEEP)/ Payload Interface Control Document

July 2017

Japan Aerospace Exploration Agency (JAXA)

Contents

1. Scope

This document defines the interface between the IVA-replaceable Small Exposed Experiment Platform (hereinafter referred to as "i-SEEP") (Figure 1-1), which will be installed onto the Exposed Facility Unit (EFU) of the Japanese Experiment Module (hereinafter referred to as "JEM") of the International Space Station (hereinafter referred to as "ISS") and serve as a platform for payloads. Figure 1-2 shows the interface boundary between i-SEEP and payloads. Maximum two units of payloads can be attached on i-SEEP.

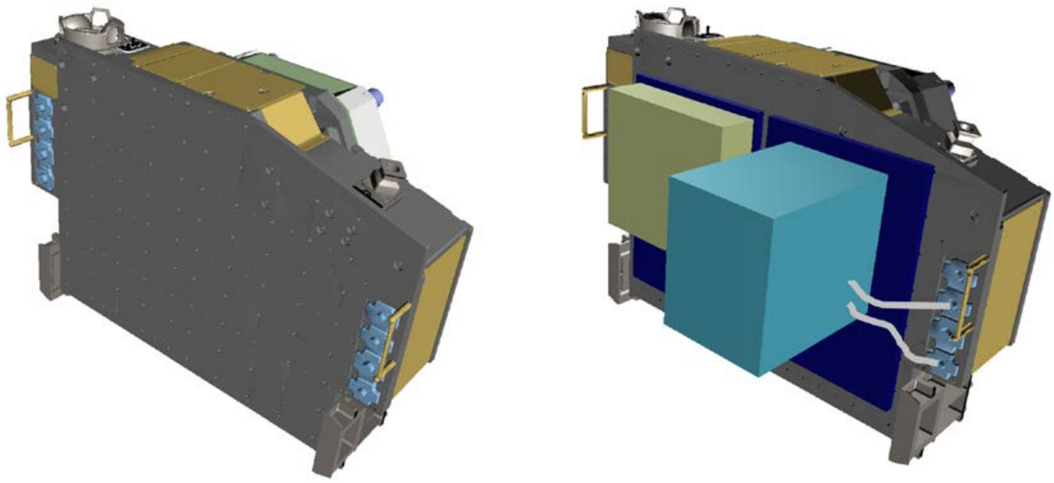


Figure 1-1. i-SEEP configuration and payloads attachment example (without MLI)

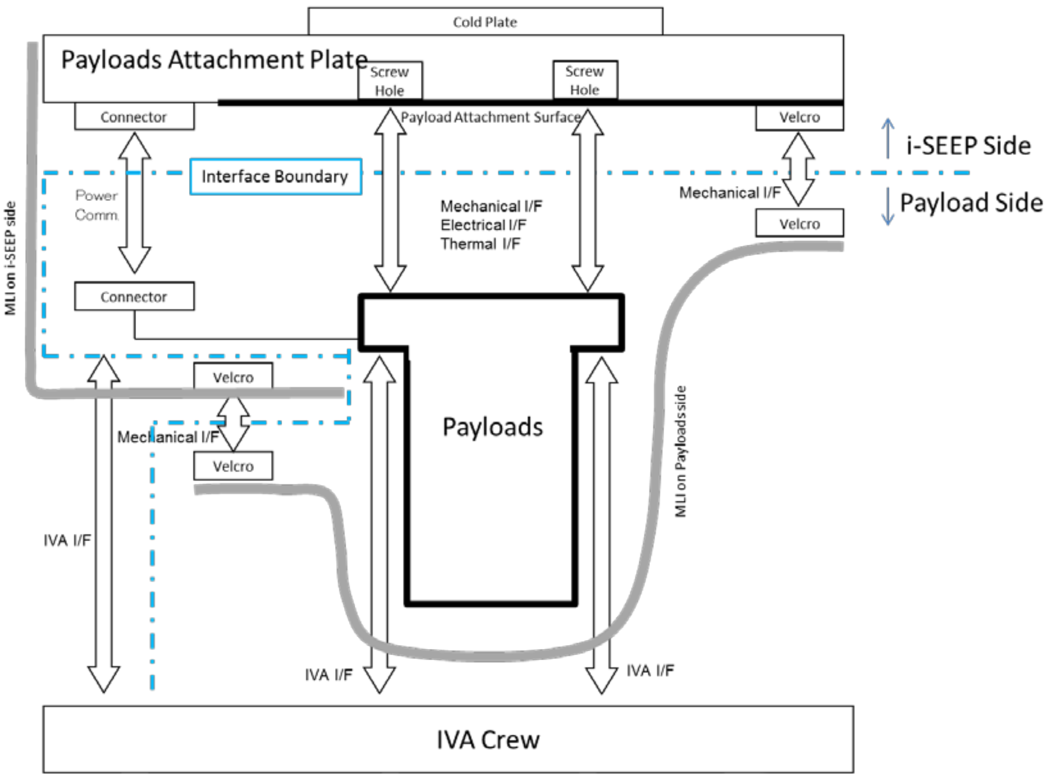


Figure 1-2. Interface boundary between i-SEEP and payload

2. Applicable Documents

The following documents shall serve as part of this interface control document within the extent specified in this document. Any documents without clarified versions shall be considered the latest version.

In case the requirements of the documents below do not comply with those of this document, the requirements of this document shall have precedence over those of the documents below.

(1) NASDA-ESPC-2561	JEM Payload Accommodation Handbook Vol. 1
(2) NASDA-ESPC-2563	JEM Payload Accommodation Handbook Vol. 3
(3) NASDA-ESPC-2564	JEM Payload Accommodation Handbook Vol. 4
(4) NASDA-ESPC-2566	JEM Payload Accommodation Handbook Vol. 6
(5) CR-99050	JEM EEE Parts Management Plan
(6) CR-99287	EEE Parts ESD Management Requirement
(7) CR-99117	JAXA Requirements for ISS Program Materials and Process Control
(8) IEEE-ASTM-SI-10	Standard for Use of the International System of Units (SI)
(9) SSP50005	ISS Flight Crew Integration Standards
(10) SSP30219	Space Station Reference Coordinate Systems
(11) SSP30237	Space Station Electromagnetic Emission and Susceptibility Requirements for EMC
(12) SSP30238	Space Station Electromagnetic Techniques
(13) SSP30242	Space Station Program Cable/Wire Design and Control Requirements for EMC
(14) SSP30243	Space Station Requirements for Electromagnetic Compatibility
(15) SSP30256:001	Extravehicular Activity System Standard ICD
(16) SSP30420	Space Station Electromagnetic, Ionizing Radiation and Plasma Environment Definition and Design Requirements
(17) SSP30245	Space Station Electrical Bonding Requirements
(18) JCX-95068	JEM Environmental Condition Regulation
(19) JMX-2011420	JSC Radio Frequency Spectrum Management HP Application Guide
(20) JX-ESPC-101205	Development Specifications for IVA-replaceable Small Exposed Experiment Platform
(21) SSP50835	ISS Pressurized Volume Hardware Common Interface Requirements Document
(22) SSP51700	Payload Safety Policy and Requirements for the International Space Station

3. Interface Requirements

3.1 Coordinate and Engineering units / tolerance

3.1.1 Coordinate system

Figure 3.1.1-1 shows the coordinate system/origin for the payload attachment surface, along with the coordinate system/origin for small fine arm payload, and the coordinate system/origin for JEM-EF experiment payload.

3.1.2 Engineering units and tolerance

This document shall employ the SI Unit System (Metric System) with an addition of applied tolerance. In case numeric values derived from the engineering unit system or the English Unit System (inch-pound-second) are used, such values shall be enclosed in parentheses. The conversion between the English Unit System and the SI Unit System shall follow (8) IEEE-ASTM-SI-10, “Standard for Use of the International System of Units (SI),” in 2. Applicable Documents above.

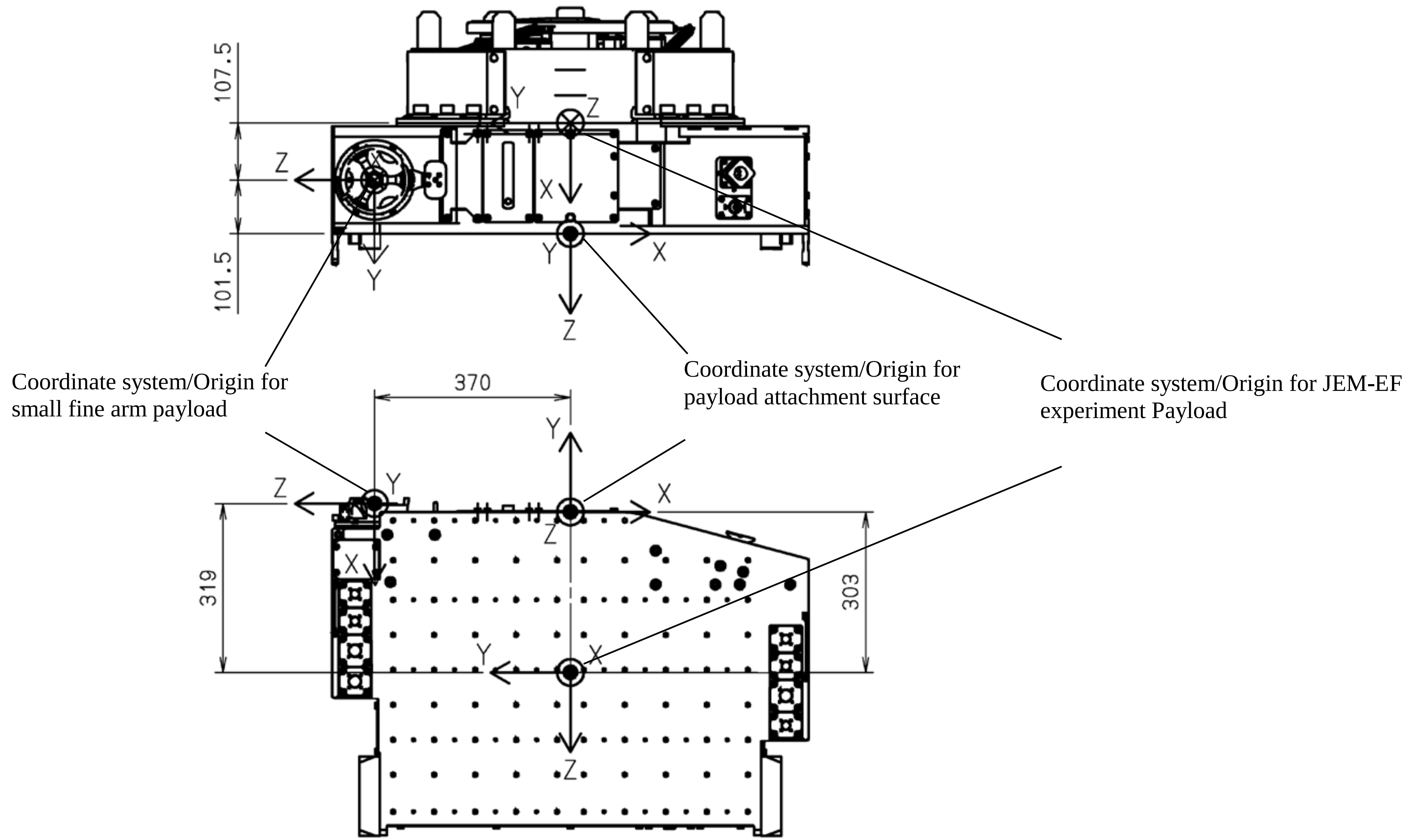


Figure 3.1.1-1 Overview of the coordinate systems for payload attachment surface, small fine arm payload, and JEM-EF experiment Payload

3.2 Mechanical interface

The Mechanical interface of i-SEEP and payload is described as follows:

(1)	Envelope	Figure 3.2-1 shows a dynamic envelope for payload (including cables and Multi Layer Insulation (MLI)). During operation, in case of any deviation from the envelope requirements such as deployment of the equipment, PD shall be coordinated with the i-SEEP side, assuming that the payload will be stowed within the envelope when passed through the Airlock. Figure 3.2-1 shows the case when two payloads are attached. When only 1 payload is installed, the conbined envelope of two payloads above is applied.
(2)	Attachment surface	Figure 3.2-2 shows the payload attachment surface.
(3)	Attachment hole (including requirements for fastening unit)	Payload shall be installed with screws. The payload attachment surface has screw holes at the locations shown in Figure 3.2-2. Screws for attachment (captive fasteners) shall be prepared by the payload side. In case captive fasteners cannot be prepared, PD shall be coordinated with the i-SEEP side. For screws for attaching payload, locking fasteners (patch bolts) conforming to MIL-DTL-18240F, which are approved as a locking method, are recommended. In case screws with locking feature are not available, use a washer to provide that function instead (ex. NordLock washer). Attachment screws shall be fastened with the IVA standard tool (Table 3.2-1) from vertically upward. The tool clearance shall meet 11.2.3.6 TOOL ACCESS DESIGN REQUIREMENTS of SSP50005. Figure 3.2-3 shows the IVA tool access requirements.
(4)	Division of equipment	When the payload is divided into several sub-devices, the payload side shall prepare cables between the sub-devices, as well as brackets and clamps.
(5)	Connector layout	Figure 3.2-2 shows the interface connector layout between the payload and i-SEEP. The type of connector and pin assignment shall be pursuant to 3.3 and 3.4.
(6)	Alignment	To secure an alignment for attaching payload to i-SEEP, it is recommended to set alignment pins for the payload. Consideration must be paid to prevent alignment pins from becoming Foreign Object Debris (FOD) on orbit. The location and shape of holes for alignment pins on the i-SEEP side shall be pursuant to Figure 3.2-4.
(7)	Locations of Velcro for MLI	See 3.5.1 for the locations of Velcro for applying MLI to payload.
(8)	Mass properties	The mass of payload, including attachment screws, cables between sub-devices, and such items as MLI for which the payload side is responsible shall be as follows:

When two payloads are attached: 100 kg or less per each payload[*1]
200 kg or less in total
When one payload is attached : 200 kg or less.

[*1] Basically, the mass of each payload should be 100 kg. However, within the extent where the total mass and center of mass requirements are met, the approvable weight may be changed after coordination between the experiment sub-devices and the one between the payload and i-SEEP.

Figure 3.2-5 shows an example of the center of mass tolerance in the in-plane direction and height direction of the payload attachment surface. The tolerance, which also depends on the payload mass, should be appropriated by the i-SEEP side.

(9)	Stiffness	Natural frequency of payload during on-orbit transfer shall be 25 [Hz] or more for each payload (or each sub-device when a payload is divided into several sub-devices).
(10)	Mechanical Disturbance	To maintain the microgravity environment provided by the JEM EF, mechanical disturbance caused by payload shall meet the requirements stipulated in Figure 3.2-6 on the payload attachment surface.
(11)	Angular momentum restriction for ISS attitude change rate	Steady-state disturbances (lasting more than 10 seconds) caused by disturbance sources in payload shall have the moment of impulse around the axes for a random successive 9-minute period less than the values shown in Table 3.2-2. However, this shall not apply to steady-state disturbances with their impulse of moment around axes for 110 minutes less than 135 N-m-sec in total.
(12)	Angular momentum restriction for CMG (Control Moment Gyroscope) Control	Disturbances (steady-state or unstable disturbances) caused by disturbance sources in payload shall have the moment of impulse around the axes under CMG control for a random successive 110-minute period, calculated with a formula shown in Table 3.2-3, less than 13,558 N-m-sec. However, this shall not apply to steady-state disturbances with their impulse of moment around axes for 110 minutes less than 135 N-m-sec in total.
(13)	Field of View from payload	When i-SEEP is berthed to the JEM-EF Port#5, Field of View of Payload and the sizes of the peripheral attached payload.[*2] is shown in Figure 3.2-7. Figure 3.2-8 shows the envelope for the i-SEEP itself that may interfere with the FOV of the payload. [*2] the configurations as of summer 2015
(14)	Restriction due to the FOV for robotic operation	Payload shall have no materials that cause specular reflections, such as aluminum metallized Kapton and silver Teflon, on their positive Y plane (coordinate system for payload attachment surface). White paint and beta-cloth are accepted.

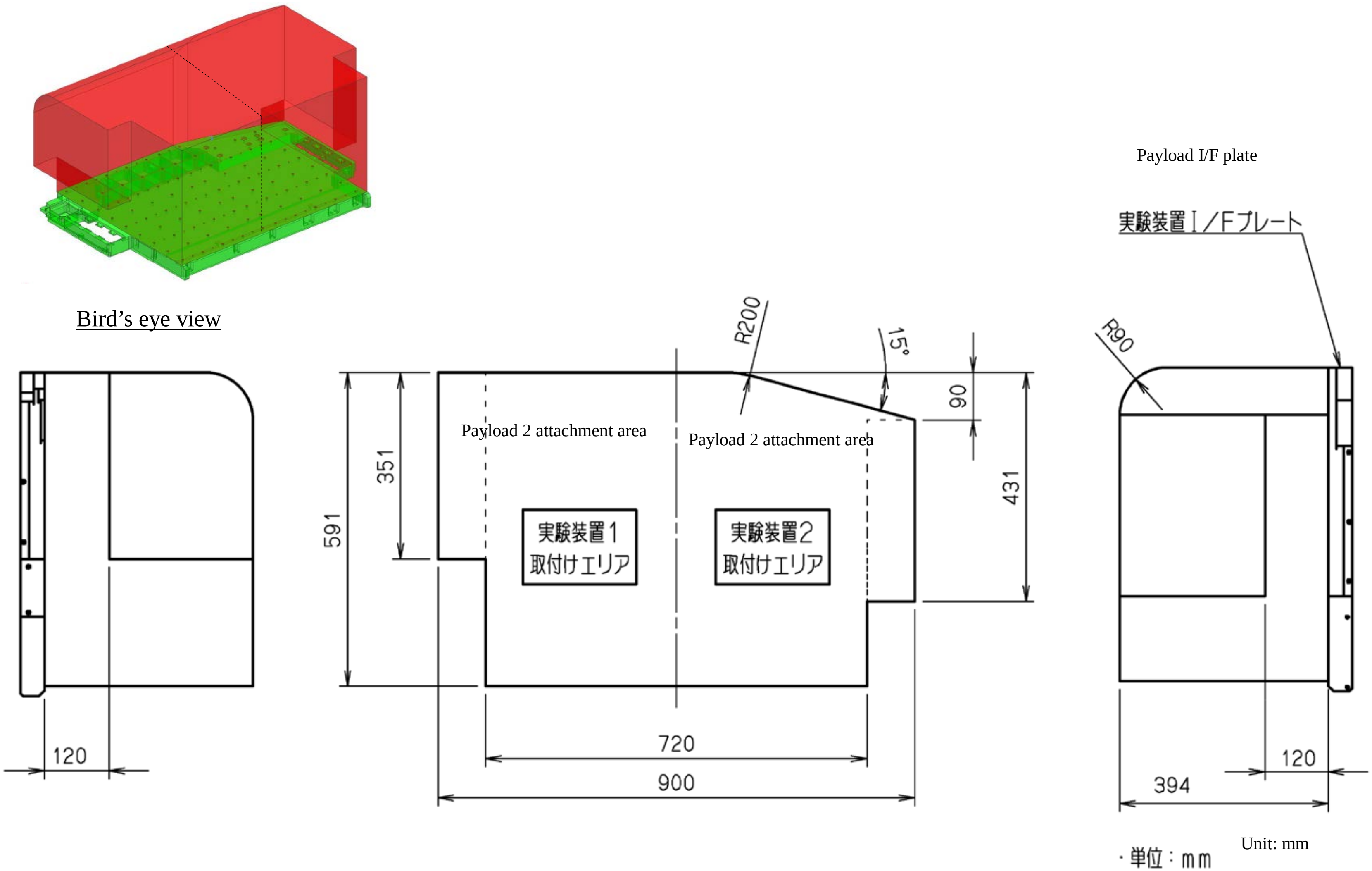
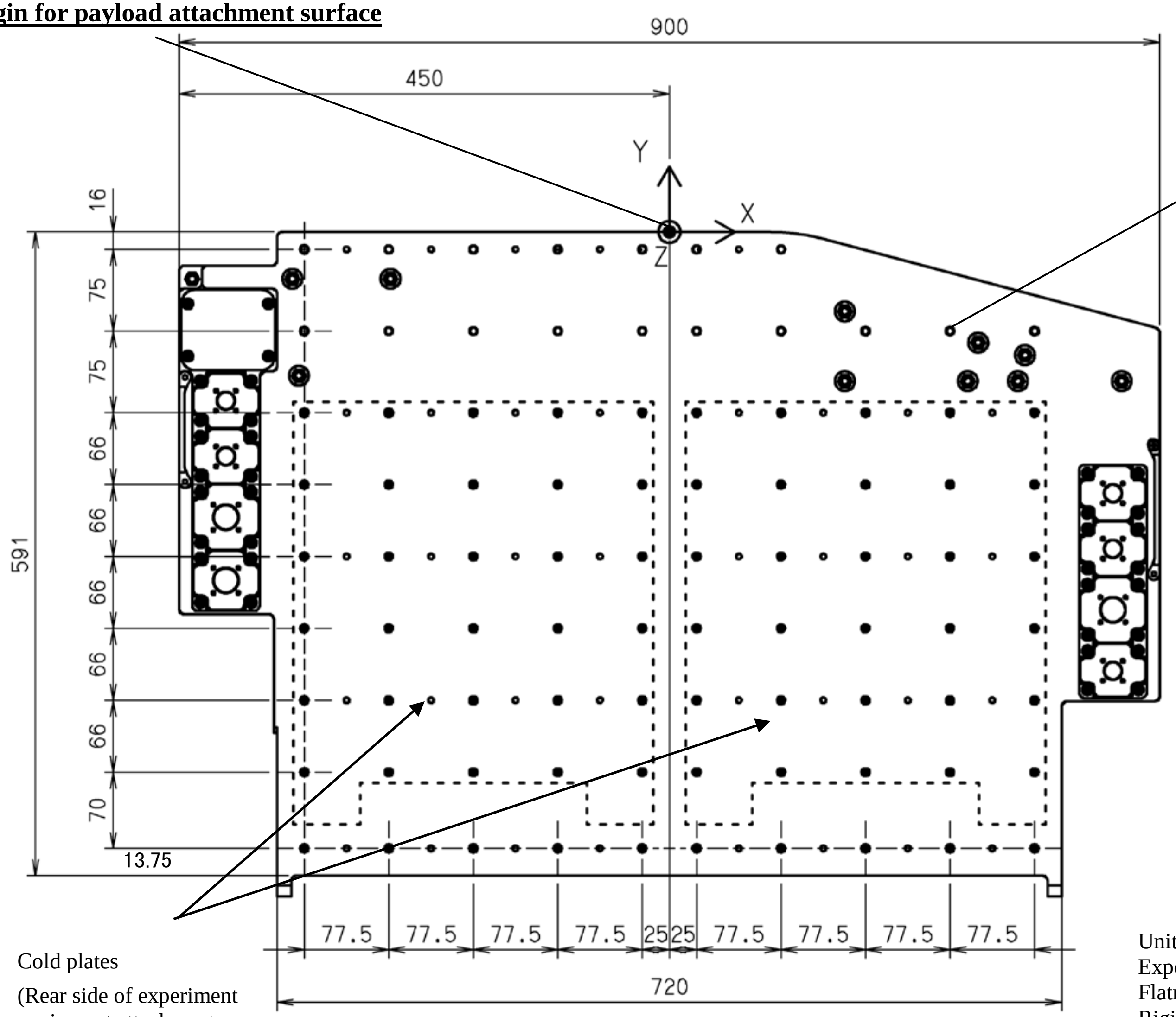


Figure 3.2-1: Payload envelope (including MLIs)

Origin for payload attachment surface



Insert 1/4-UNF × 1D
For fixing experiment equipment
87 locations on surface, no locking mechanism
Hole before threading: depth 9±0.3
Positional tolerance φ0.35
Tightening torque 6.72 - 7.90N・m (for reference)

(Note) For screws on the side of an experiment equipment, locking fasteners (patch bolts) conforming to MIL-DTL-18240F are recommended.
In case screws with locking functions cannot be selected, use a washer to provide that function instead (ex. NordLock washer).
Tightening torques, which depend on the screw specifications of the experiment equipment, should be set in appropriation with the i-SEEP side.

Unit: mm

Cold plates
(Rear side of experiment equipment attachment surface)

Unit: mm
Experiment equipment attachment surface
Flatness: 0.33
Rigidness: Ra 3.2
Surface processing: chemical conversion coating (iridite)

Figure 3.2-2 (1/2): Payload attachment surface, alignment of attachment screw holes, and connector locations

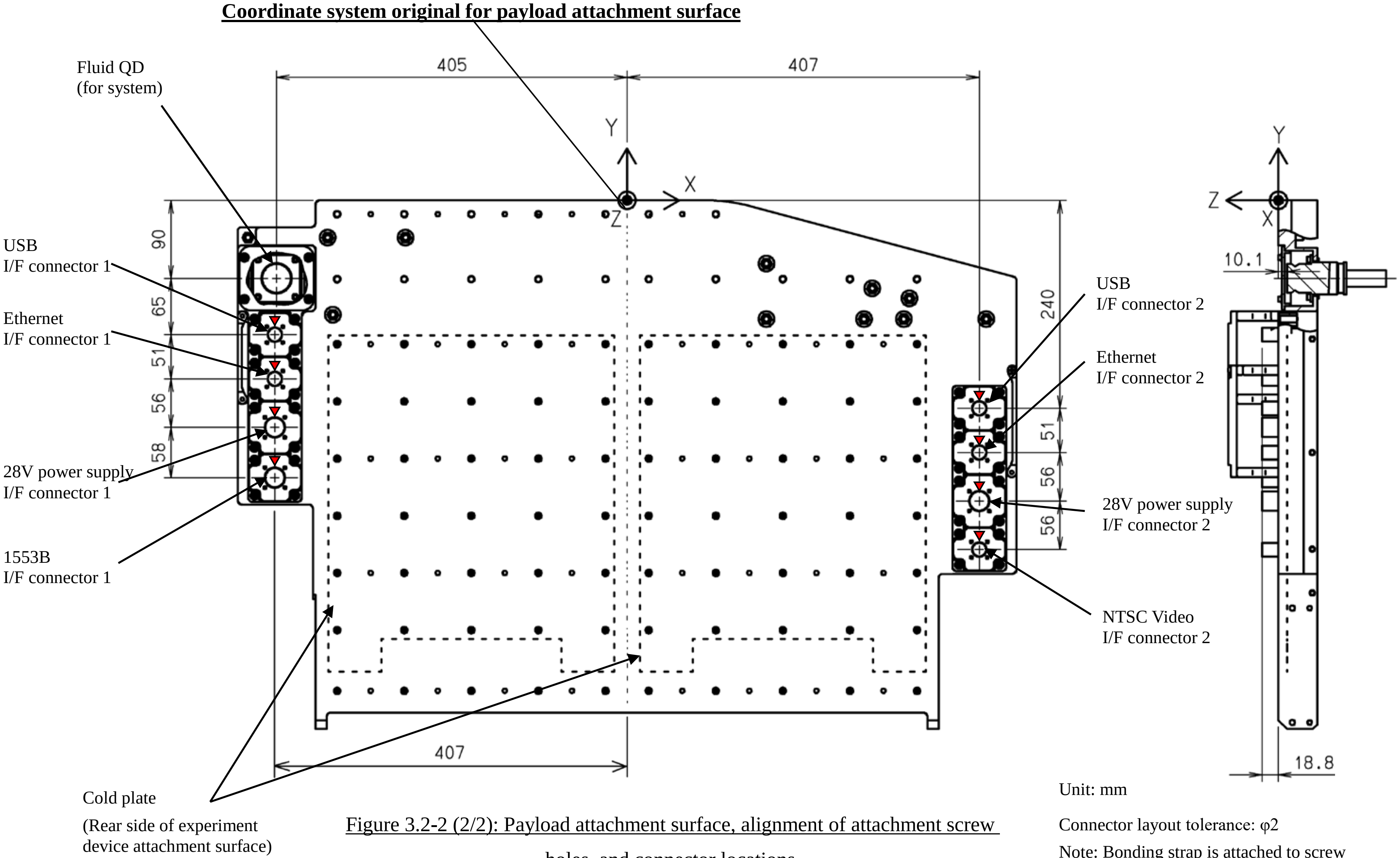


Figure 3.2-2 (2/2): Payload attachment surface, alignment of attachment screw holes, and connector locations

Unit: mm

Connector layout tolerance: φ2

Note: Bonding strap is attached to screw holes for fixing experiment equipment. The position of the Main key is indicated by ▼ .

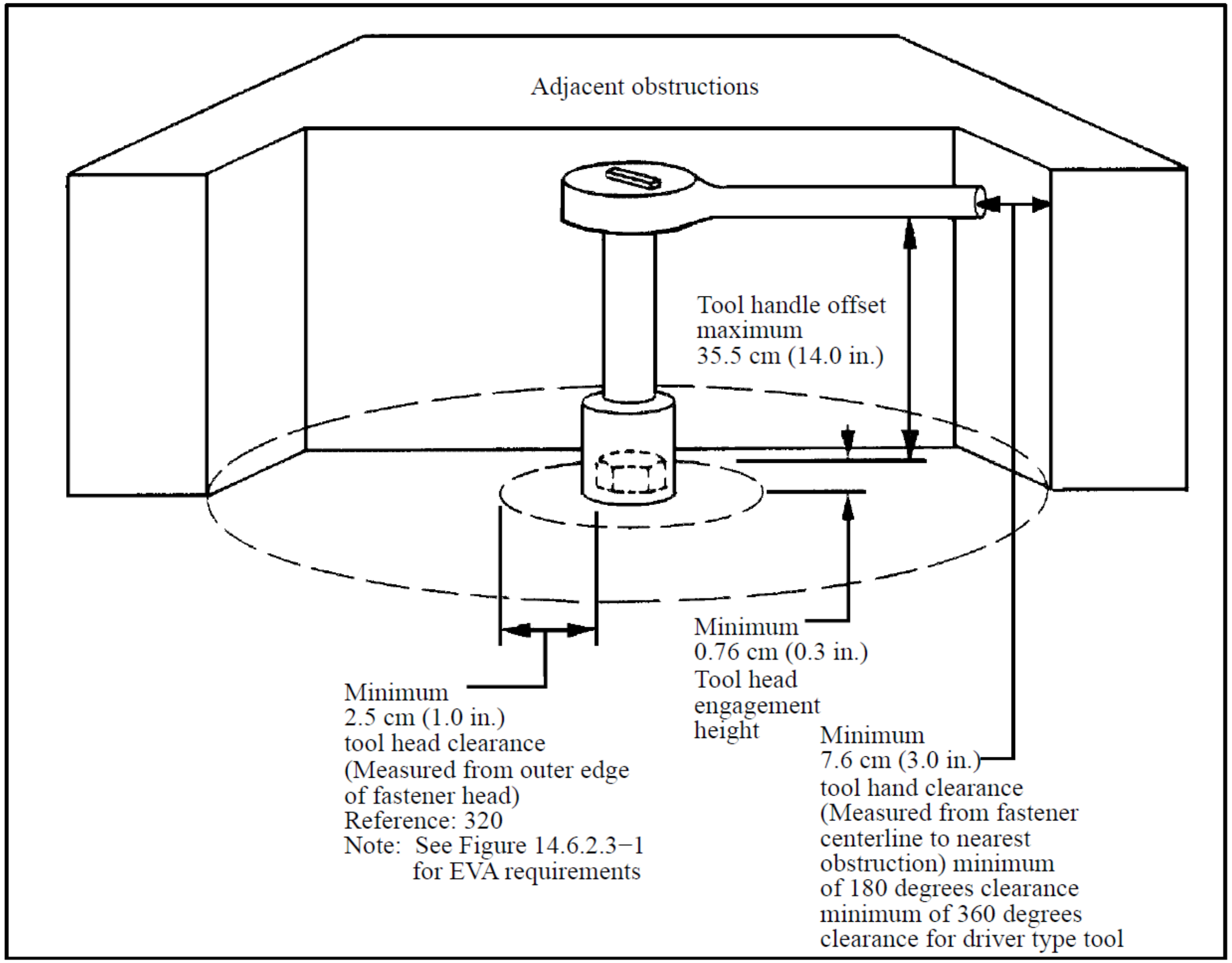
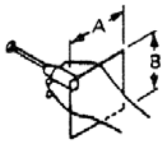
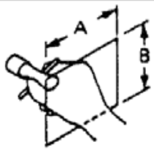
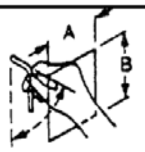


Figure 3.2-3 (1/2) IVA tool access requirements

Opening Dimensions		Task
	A = 117 mm (4.6 in.) B = 107 mm (4.2 in.)	Using common screwdriver with freedom to turn hand throughout 180 degrees
	A = 133 mm (5.2 in.) B = 115 mm (4.5 in.)	Using pliers and similar tools
	A = 155 mm (6.1 in.) B = 135 mm (5.3 in.)	Using T−handle wrench with freedom to turn wrench through 180 degrees
	A = 203 mm (8.0 in.) B = 135 mm (5.3 in.)	Using open−end wrench with freedom to turn wrench through 62 degrees
	A = 122 mm (4.8 in.) B = 155 mm (6.1 in.)	Using Allen−type wrench with freedom to turn wrench through 62 degrees

Notes:

(1) Also refer to Figure 12.3.1.2−1 for other hand and arm access hole dimensions.

(2) Also refer to Figure 11.2.3.6−1.

Figure 3.2-3 (2/2) IVA tool access requirements

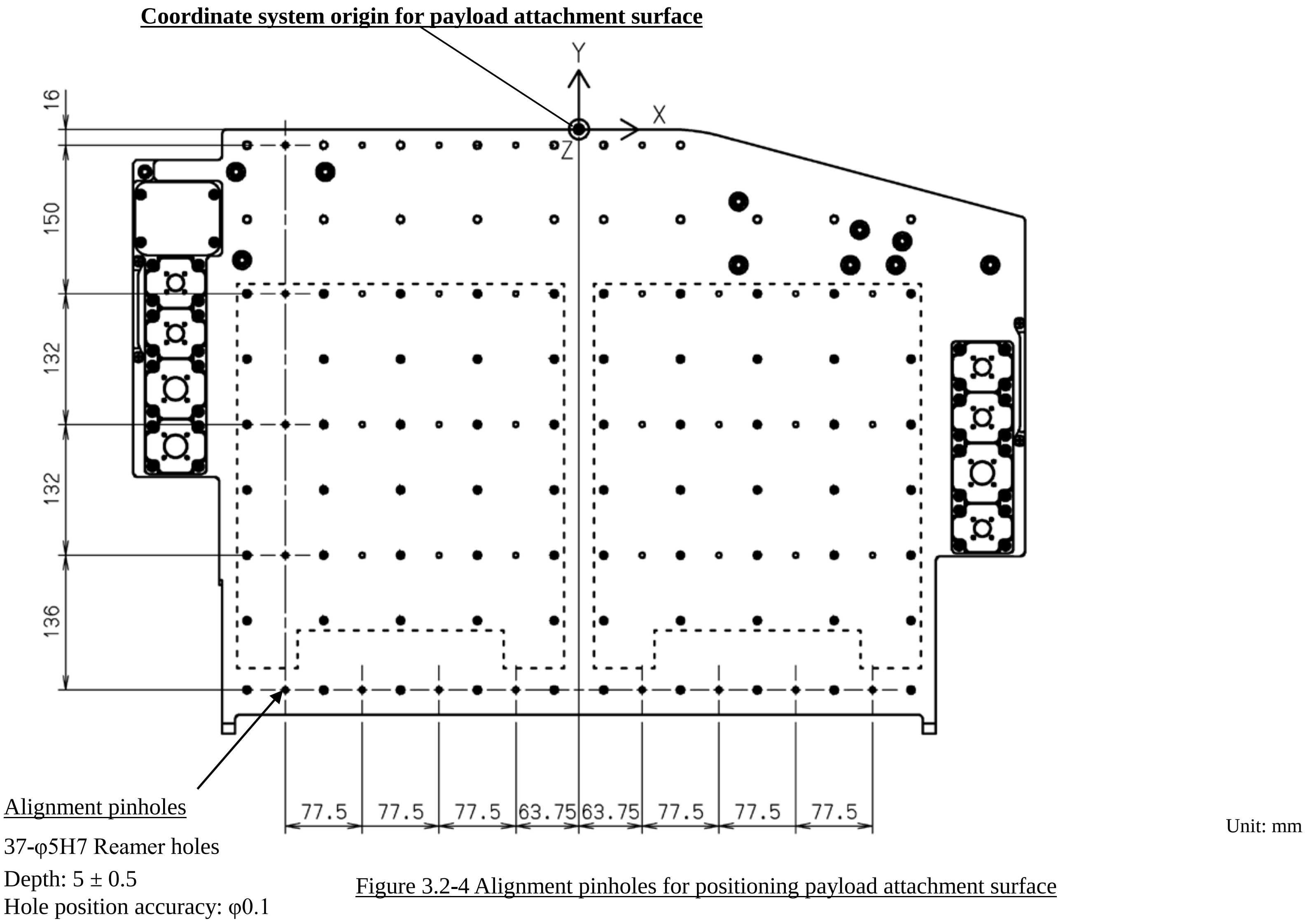
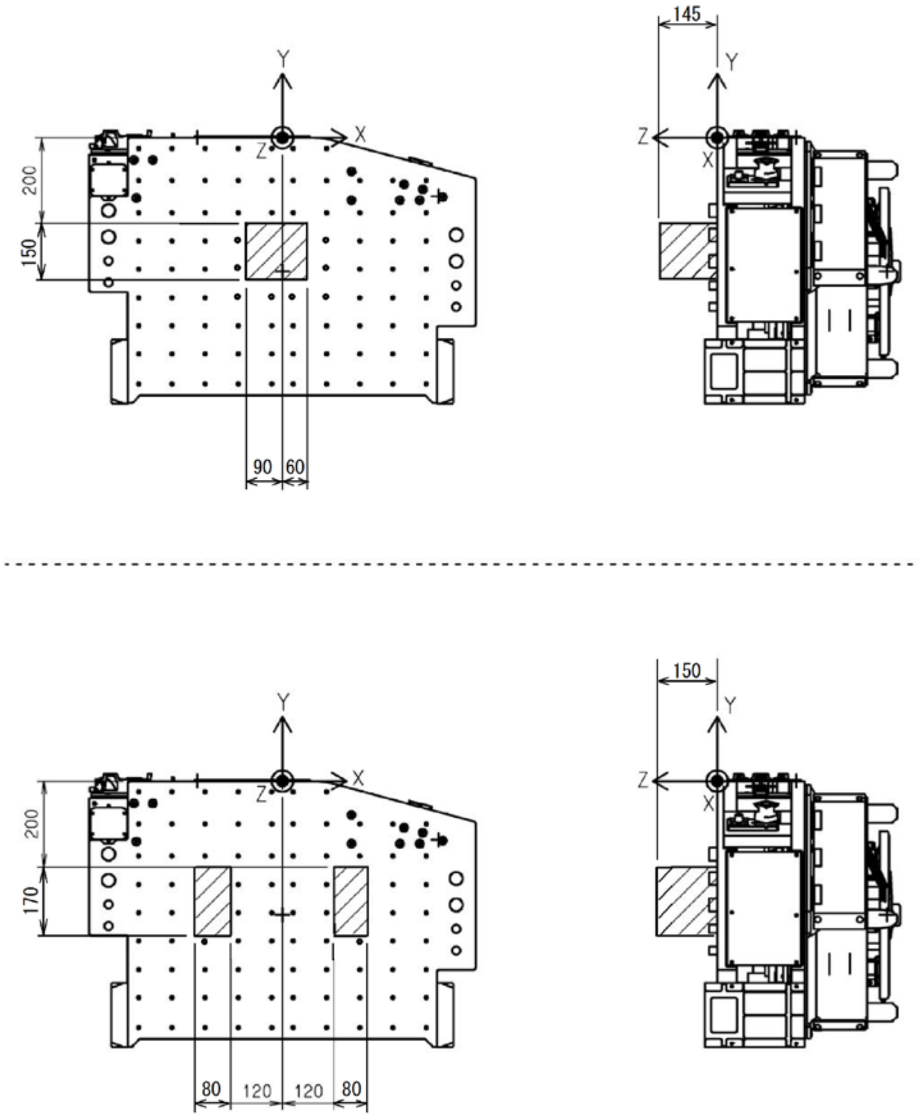


Figure 3.2-4 Alignment pinholes for positioning payload attachment surface



When one 200-kg payload is attached

When two 100-kg payloads are attached

Figure 3.2-5 CG Offset area (example)

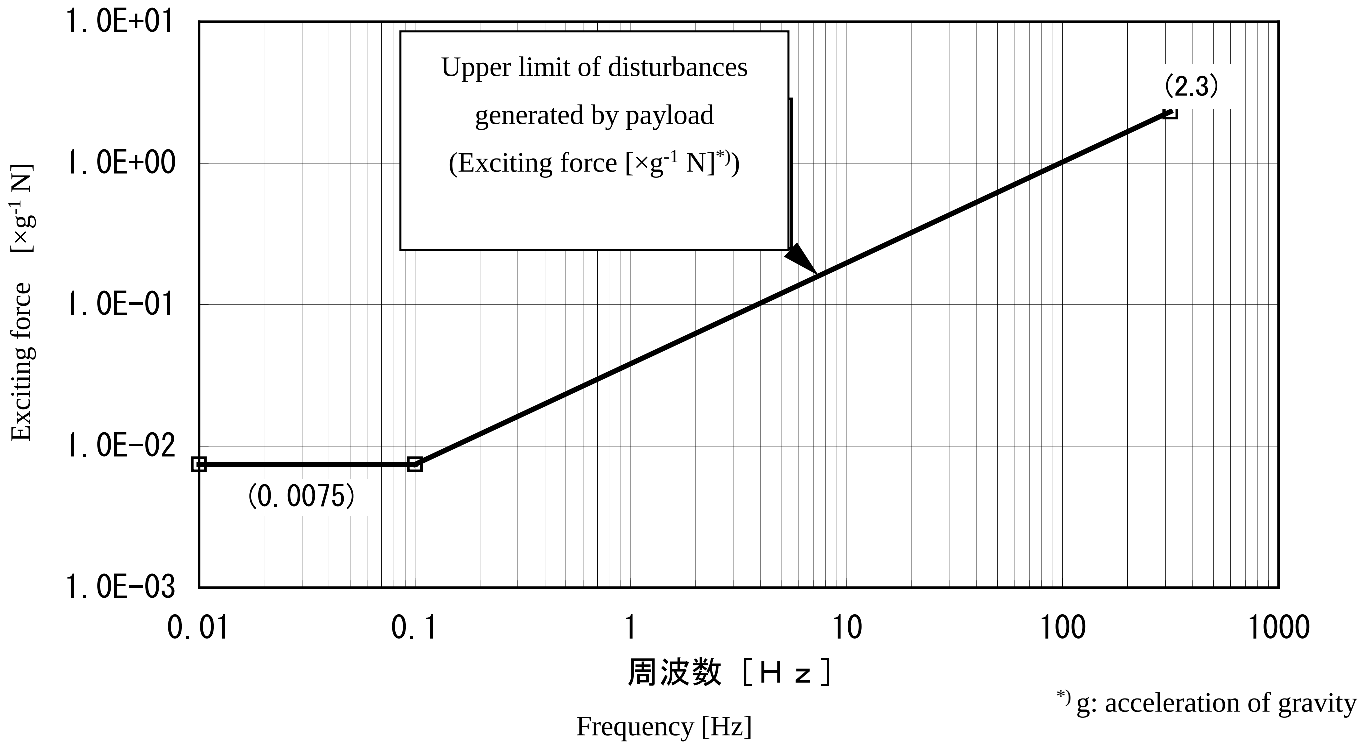


Figure 3.2-6 Restraint for mechanical disturbances generated by Payload

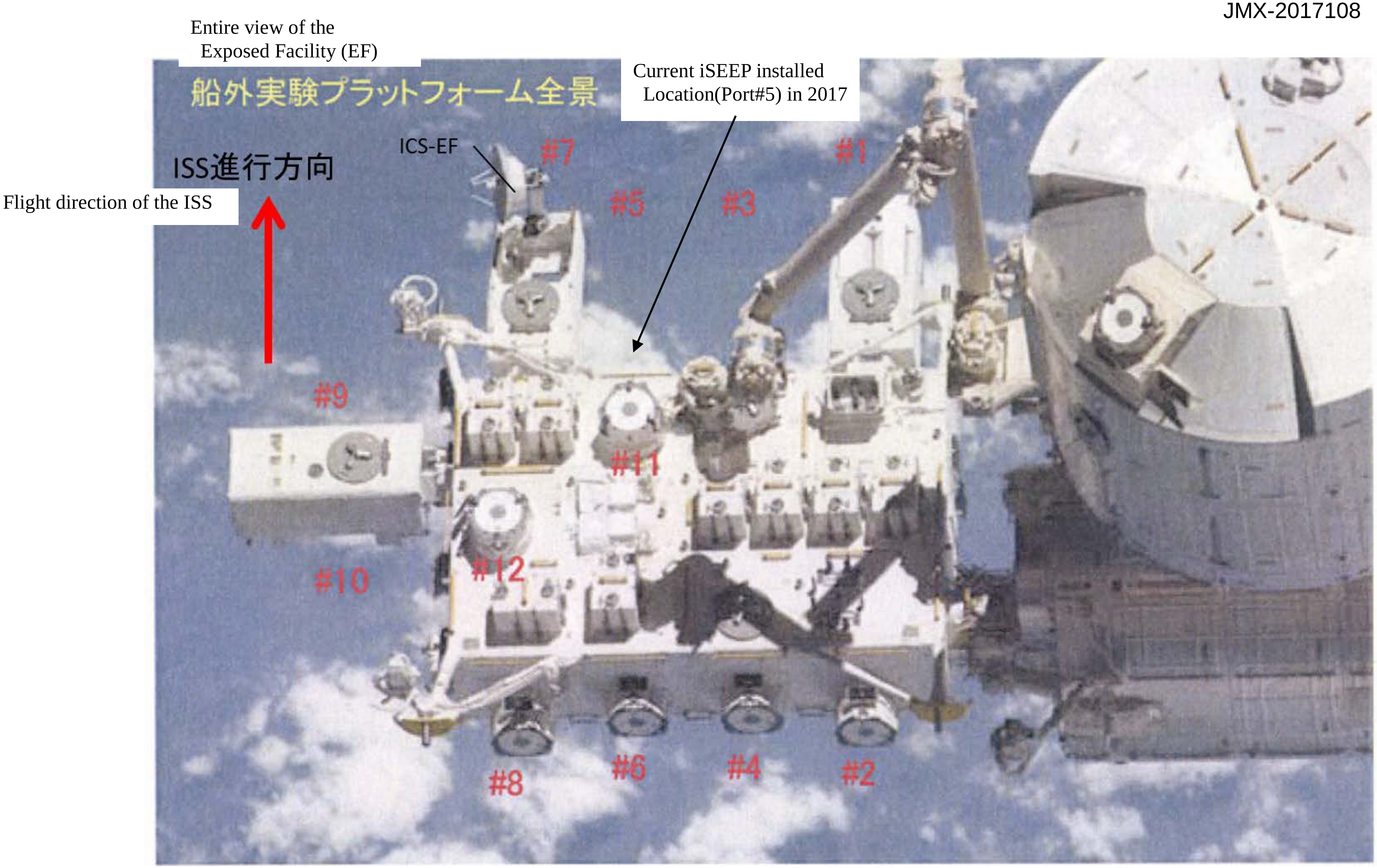


Figure 3.2-7 Exposed Facility (EF) overview and payload attaching location [Note: The photo shows the EF as of July 2009.]

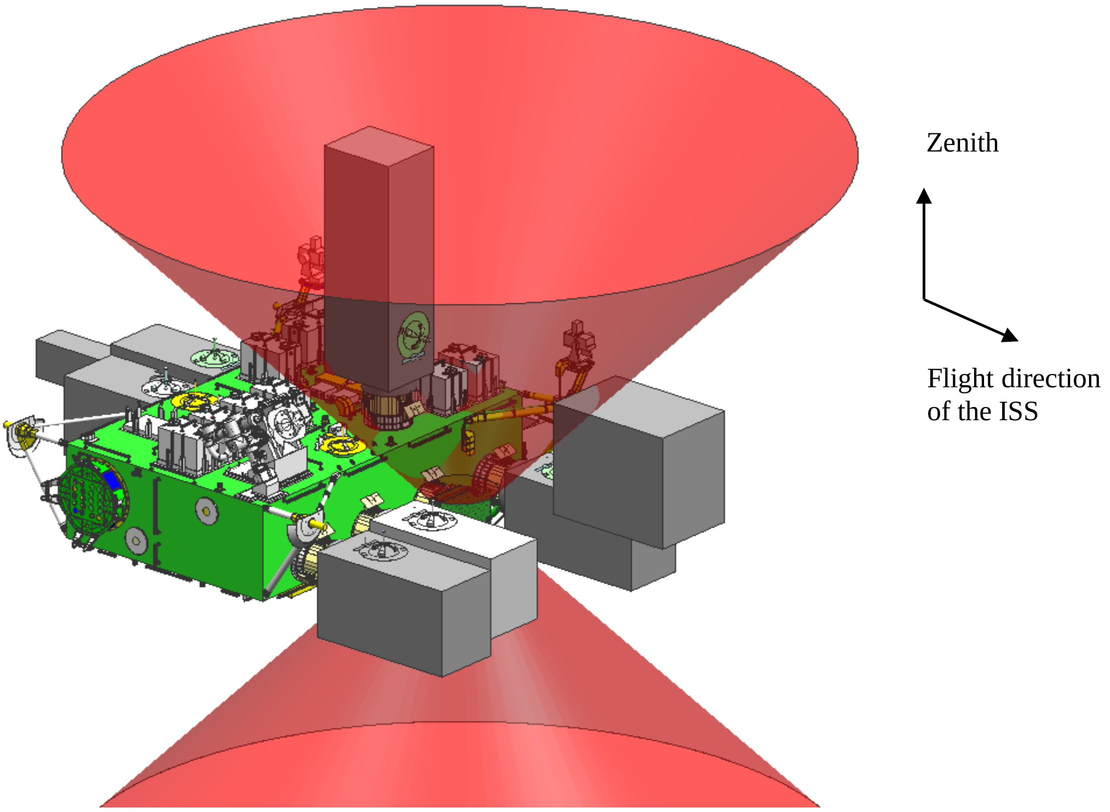


Figure 3.2-8 (1/9) (Reference) View of payload (zenith side) (when operated at EFU5 with a half apex angle of 45°)

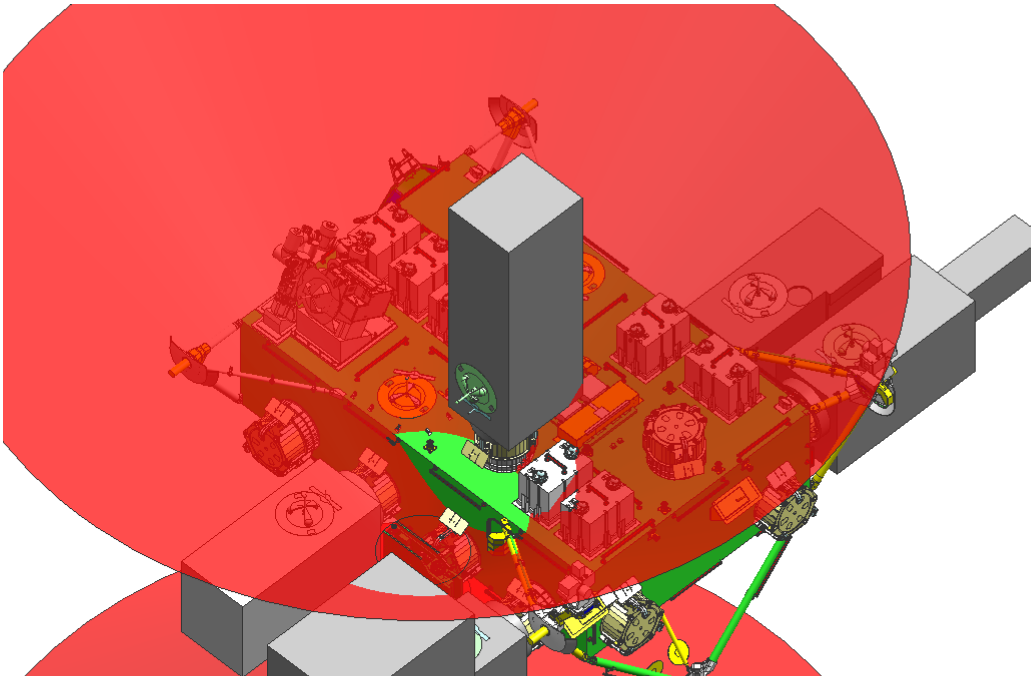


Figure 3.2-8 (2/9) (Reference) View of payload (interfering object of the zenith side) (when operated at EFU5 with a half apex angle of 45°)

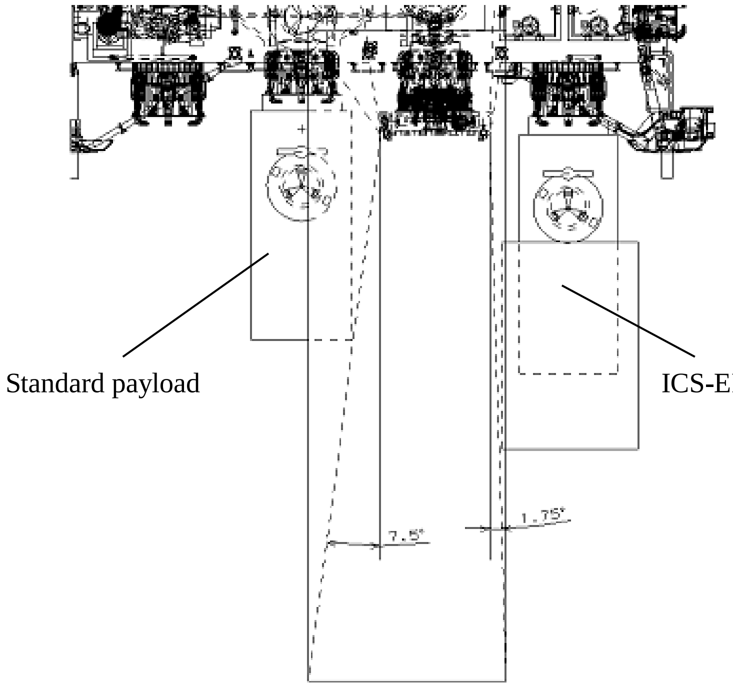


Figure 3.2-8 (3/9) (Reference) View of payload (flight direction of the ISS) (when operated at EFU5)

[EFU#3 (left) is the envelope for a standard payload; EFU#7 (right) is the largest envelope for ICS-EF.]

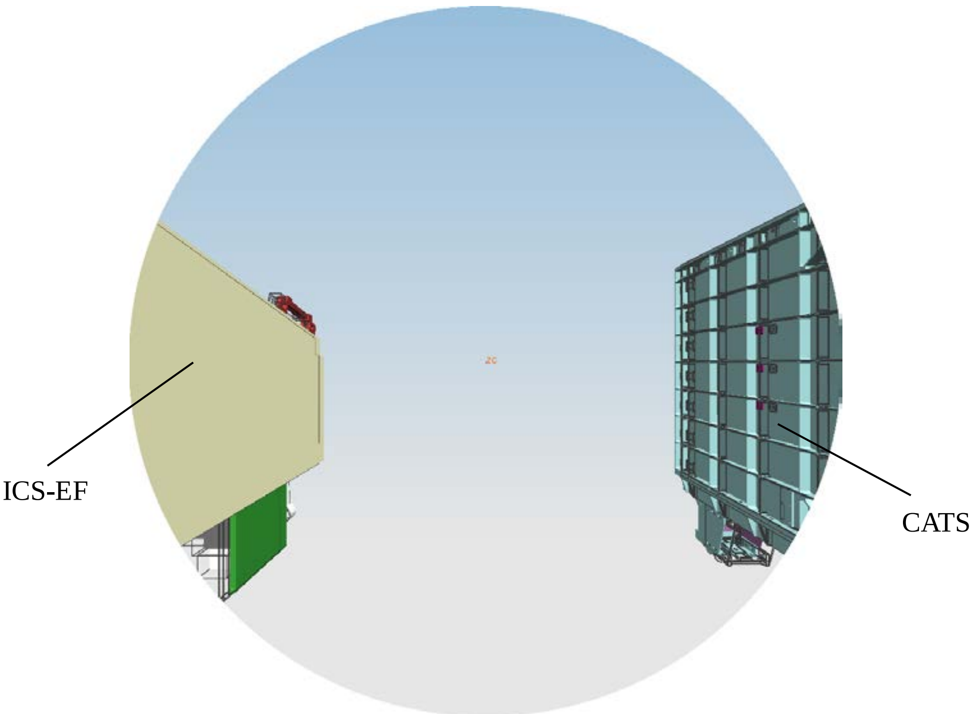


Figure 3.2-8 (4/9) (Reference) View of payload (flight direction of the ISS) (when operated at EFU5)
[EFU#3 (right): US payload CATS and EFU#7 (left): ICS-EF]

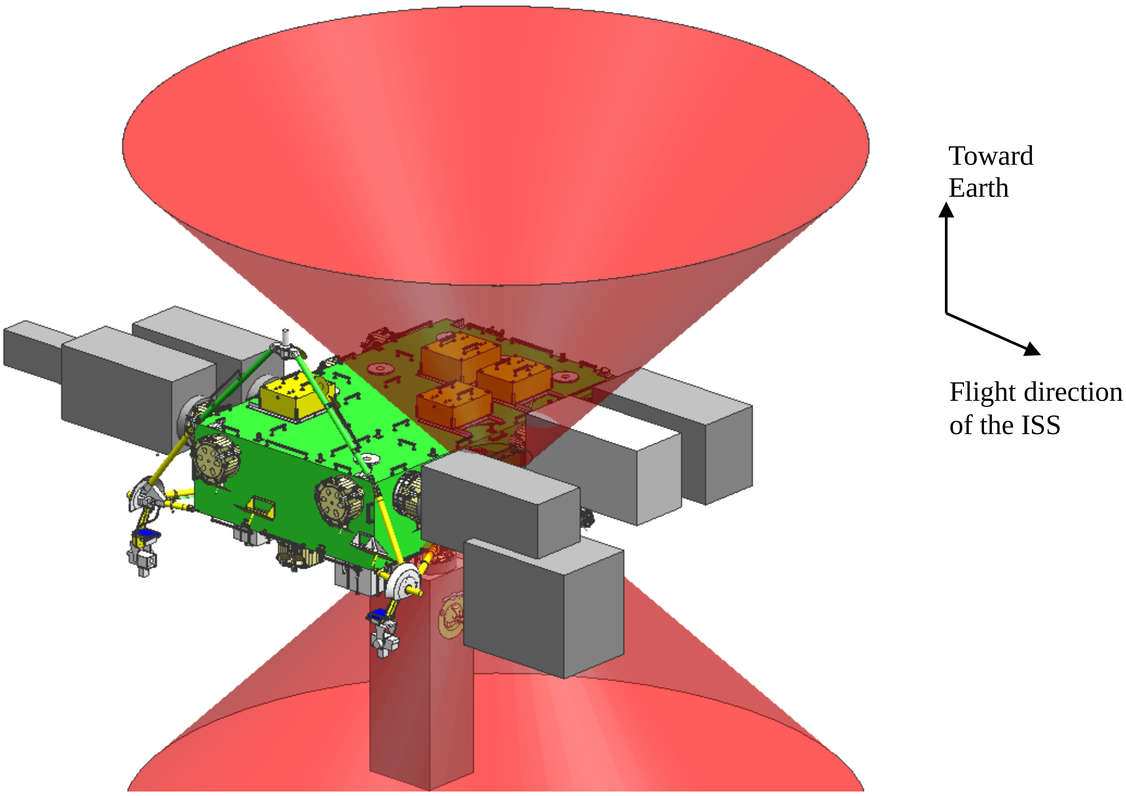
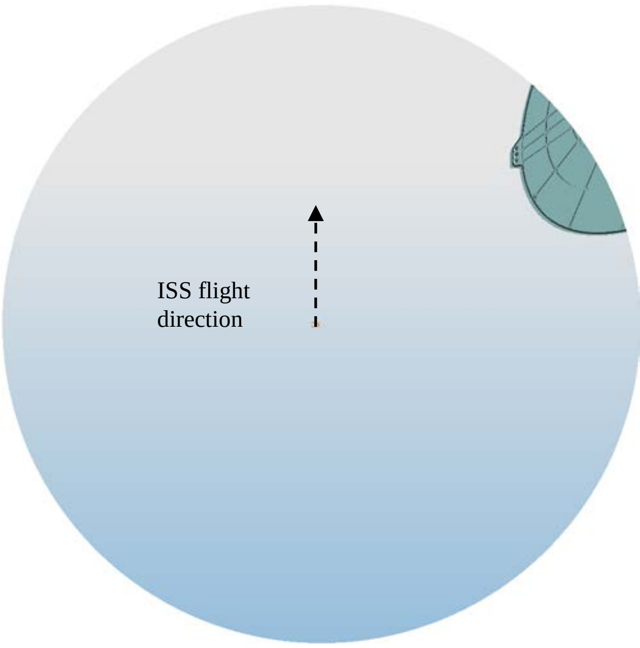


Figure 3.2-8 (5/9) (Reference) View of payload (Earth side) (when operated at EFU5 with a half apex of 45°)



Flight 3.2-8 (6/9) (Reference) View of payload (toward Earth) (when operated at EFU5)

[Note: The CATS sensor cover, which is usually open, interferes with the view.]

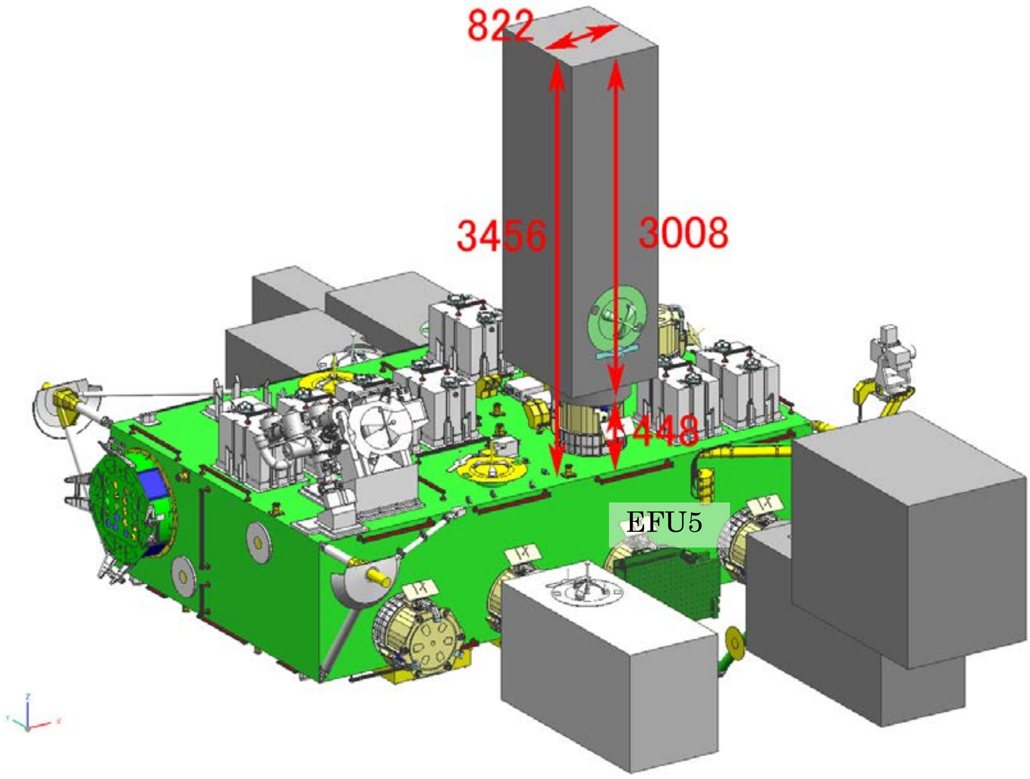


Figure 3.2-8 (7/9) (Reference) View of payload (EFU11 Earth side) (the largest envelope of SEDA-AP) being attached to EFU11

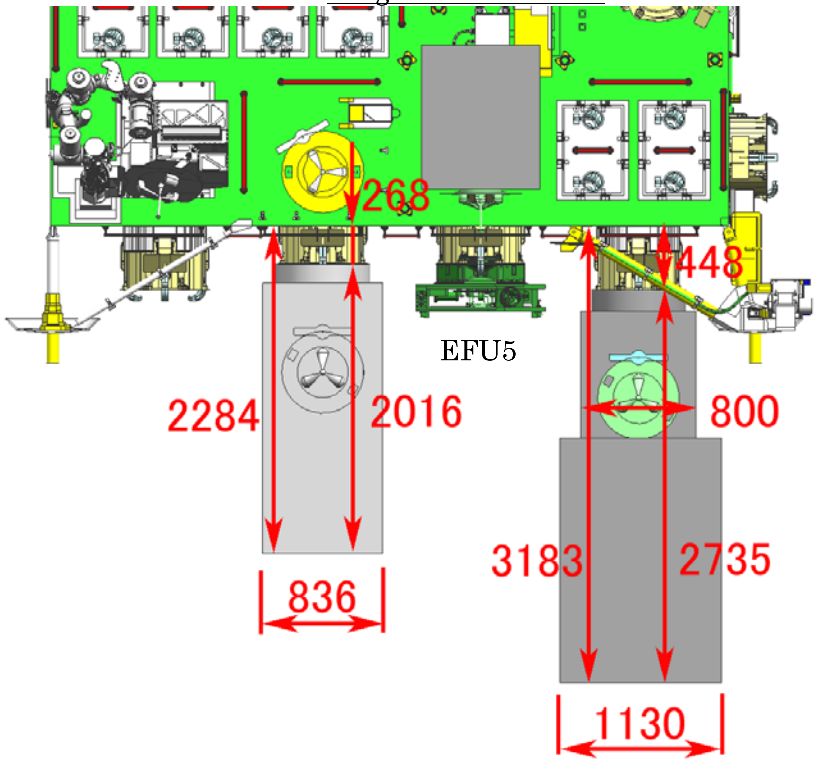


Figure 3.2-8 (8/9) (Reference) View of payload

[EFU#3 (left) is an envelope for a standard payload; EFU#7 (right) is the largest envelope for ICS-EF.]

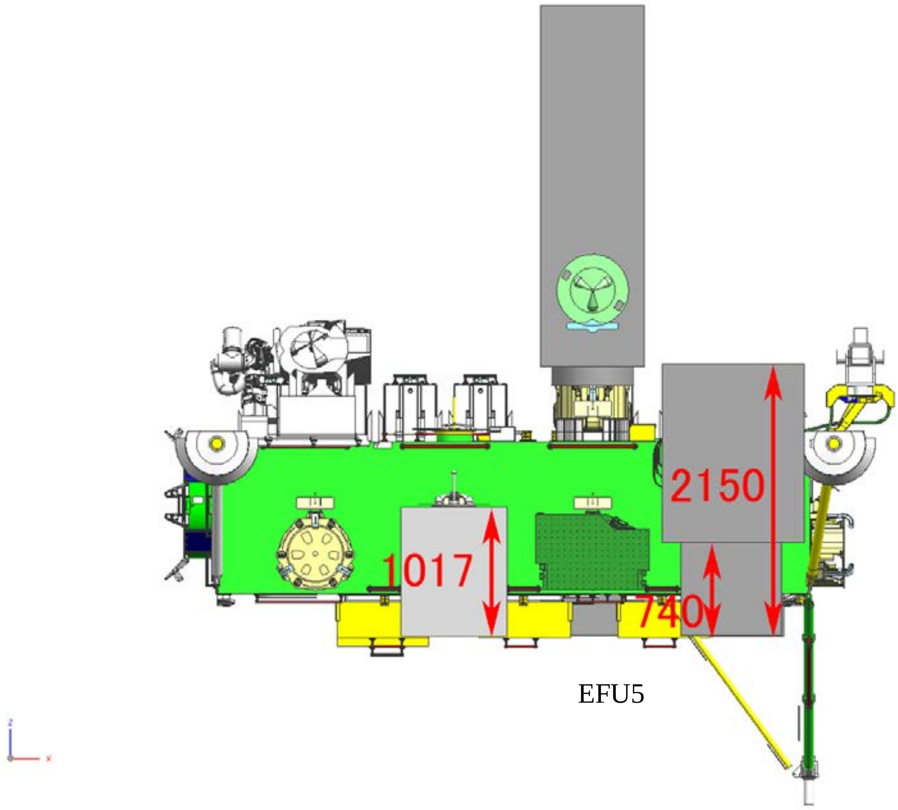


Figure 3.2-8 (9/9) (Reference) View of payload
[(EFU#3 (left) is an envelope for a standard payload; EFU#7 (right) is the largest envelope for ICS-EF.]

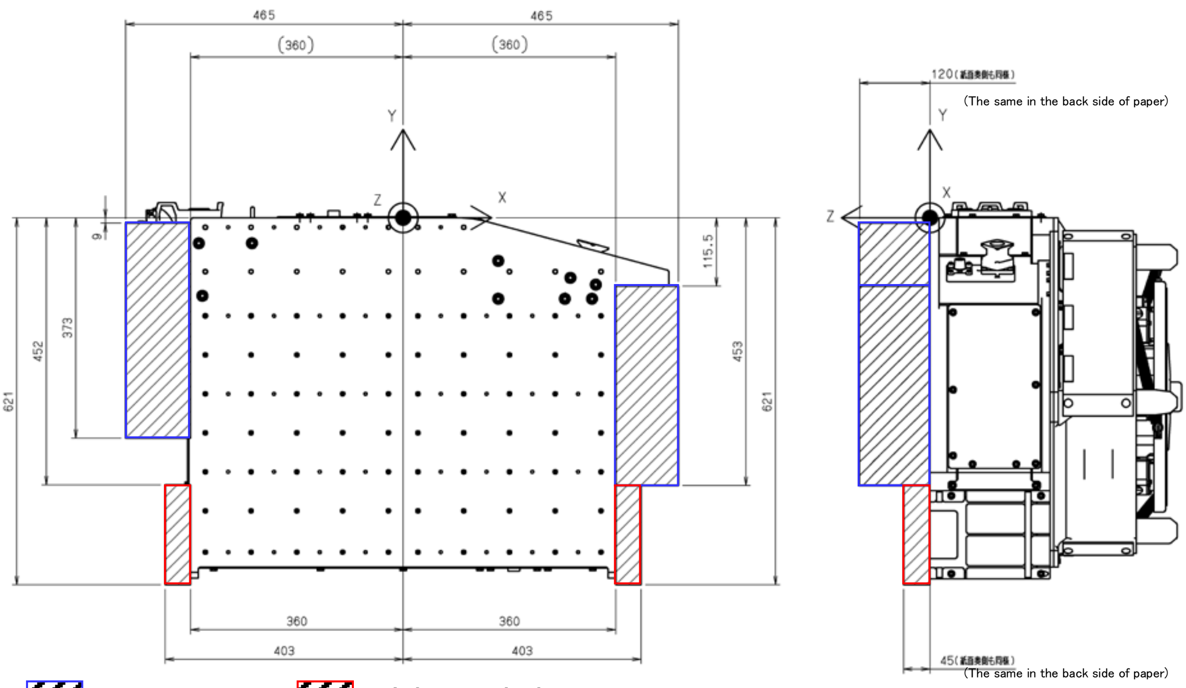


Figure 3.2-9 Envelope for i-SEEP that interferes with the view of payload

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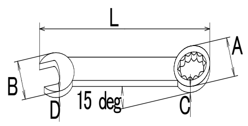
Table 3.2-1 (1/2) IVA standard tools

OPEN END BOX WRENCHES 	Dimension				
	L(inch)	A(inch)	B(inch)	C(inch)	D(inch)
1/4 inch	5	13/32	17/32	3/16	5/32
5/16 inch	5 3/4	1/2	21/32	7/32	5/32
3/8 inch	6 1/2	19/32	13/16	1/4	3/16
7/16 inch	7 1/4	21/32	29/32	5/16	7/32
1/2 inch	8	3/4	1 1/16	11/32	1/4
9/16 inch	8 3/4	27/32	1 3/16	3/8	9/32
5/8 inch	9 1/2	15/16	1 5/16	13/32	9/32
3/4 inch	11	1 1/8	1 9/16	15/32	11/32
7/8 inch	12 1/2	1 9/32	1 13/16	9/16	3/8
1 inch	14	1 15/32	2 1/32	21/32	7/16

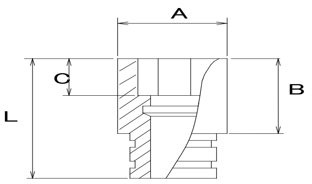
STANDARD SOCKETS, 3/8inch drive,12 point 	Length (inch)	Outer Diameter (inch)	Bolt Clearance Depth (inch)	Opening Depth (inch)
1/4 inch	29/32	13/32	7/16	7/32
5/16 inch	29/32	15/32	7/16	1/4
3/8 inch	29/32	9/16	7/16	9/32
7/16 inch	29/32	39/64	7/16	9/32
1/2 inch	15/16	23/32	1/2	5/16
9/16 inch	15/16	25/32	1/2	3/8
5/8 inch	1 1/16	27/32	19/32	1/2
3/4 inch	1 3/16	1	11/16	5/8
7/8 inch	1 1/4	1 5/32	23/32	9/16
1 inch	1 5/16	1 5/16	13/16	19/32

Table 3.2-1 (2/2) IVA standard tools

HEX HEAD DRIVERS,1/4 inch drive	Length(inch)	Torque(inch･lbf)
1/8 inch	1 7/8	
5/32 inch	1 7/8	
3/16 inch	1 15/16	
1/4 inch	1 7/8	
HEX HEAD DRIVERS,3/8 inch drive	**Length(inch)**	**Torque(inch･lbf)**
3/8 inch	2 3/32	
5/16 inch	2 1/16	
HEX HEAD DRIVERS,1/2 inch drive	**Length(inch)**	**Torque(inch･lbf)**
7/16 inch	2 7/8	
HANDLES	**Length(inch)**	**Torque(inch･lbf)**
Square drive Ratchet,1/4 inch drive	4 1/2	
Square drive Ratchet,3/8 inch drive	7 3/8	
Torque wrench,3/8 inch drive	9 1/2	30 to 200 (4 to 22 Nm)
Breaker bar,3/8 inch drive	9 9/16	
Driver handle,3/8 inch drive	9 15/16	
Driver handle,1/4 inch drive	5 3/4	
Rechargeable power driver,3/8 inch drive	10 3/4	3 1/2 to 26
MISCELLANEOUS	**Length(inch)**	**Torque(inch･lbf)**
Adapter,3/8 inch to 1/4 inch drive	1 1/8	
Adapter,3/8 inch to 1/2 inch drive	1 5/16	
Drive extension,square drive,1/4 inch drive	4	
Drive extension,square drive,3/8 inch drive	4	
Drive extension,square drive,3/8 inch drive	6	
Drive extension,square drive,3/8 inch drive	11	
Connector pliers,3/4 inch to 2 1/4inch diameter grip	9 3/4	
Protective Covers for Wireway and Coldplate	made to fit	

Table 3.2-2 Maximum value of force of impulse around the ISS center of mass

ft-lb-sec	$\sqrt{(1.25 \times Hx + 1069)^2+(1.25 \times Hy + 6885)^2+(1.25 \times Hz + 779)^2}$	<	10000
N-m-sec	$\sqrt{(1.25 \times Hx + 1449)^2+(1.25 \times Hy + 9334)^2+(1.25 \times Hz + 1056)^2}$	<	13558

Note 1) Values in the table show the maximum values (absolute values) of the force of impulse around axes in the ISS center of mass, upon the completion of ISS assembly.

Note) The values 1069, 6885, 779 (ft-lb-sec), 1449, 9334, 1056 (N-m-sec) are all allocations of CMG angular momentum around axes, caused by disturbances resulting from their environment.

The distance of each axis direction from the ISS center of mass in the ISS coordinate system for payload (SSP30219 in Figure 4.0-1) on i-SEEP (when i-SEEP is jointed to EFU#5) shall be as follows:

	ISS X-axis (flight) direction	ISS Y-axis direction	ISS Z-axis (Earth) direction
Distance (m)	16.010	19.323	2.406

Note) When i-SEEP is jointed except to EFU#5, the distance shall be calculated by confirming the difference between the coordinate origin for the payload of EFU#5 and that of the EFU concerned according to Figure 3.1.3-3 of NASDA-ESPC-2563 JPAH, Vol. 3.

3.3 Electrical Power system interface

Figure 3.3.1-1 shows the power and communication schematics of i-SEEP.

3.3.1 28V power

i-SEEP provides 28VDC, 1ch for 2 payloads each, 2ch in total. The power interface characteristics is shown below.

(1)	Steady-state supply voltage	: 26-30 [V] (Rated value: 28[V])
(2)	Maximum power supply	: 200 W nominal (per each payload), total 400 W
(3)	Rise time	: within 120 [ms] (measured waveform: 10% - 90%)
(4)	Ripple	: within 1 [Vp-p], not including spike
	Spike	: 3 [Vp-p] or less (reference information)
(5)	Switching frequency	: 500 - 600 [kHz]
(6)	Equivalent circuit	: Figure 3.3.2-1 shows the equivalent circuit on the i-SEEP side (reference information).
(7)	Requirements on wiring for payload	The design of the wire harness shall be based on SSP 30242, “Space Station Program Cable/Wire Design and Control Requirements for EMC.”
(8)	Current limit	
a)	Overcurrent detecting current	: 10 [A] or more
b)	Response when overcurrent is detected	: Turning output OFF
c)	Shutdown time	: 10 [msec] or longer (period from when overcurrent occurs until the completion of shutdown)
d)	Maximum current when overcurrent is detected	: 16.8[A] or less
(9)	Abnormal disturbance properties and requirements for payload	: Normal operation shall be continued under the voltage described in (1), Because upstream abnormal disturbance may cause voltage fluctuation between 26 – 30 [V].
(10)	Inrush current	: Shown in Figure 3.3.2-2 (when 200W maximum resistance is loaded)
(11)	Capacitive and inductive loads	
a)	Capacitive load	: 1,000 [μF] or less
b)	Inductive load	: less than 1 [mH]
(13)	Prohibition of power-line butting	When a single payload is attached, the payload can use 2ch, but the 2ch shall be electrically separated.

3.3.2 Connector types and pin assignment

Connector types and pin assignment shall be as listed in Table 3.3.2-1.

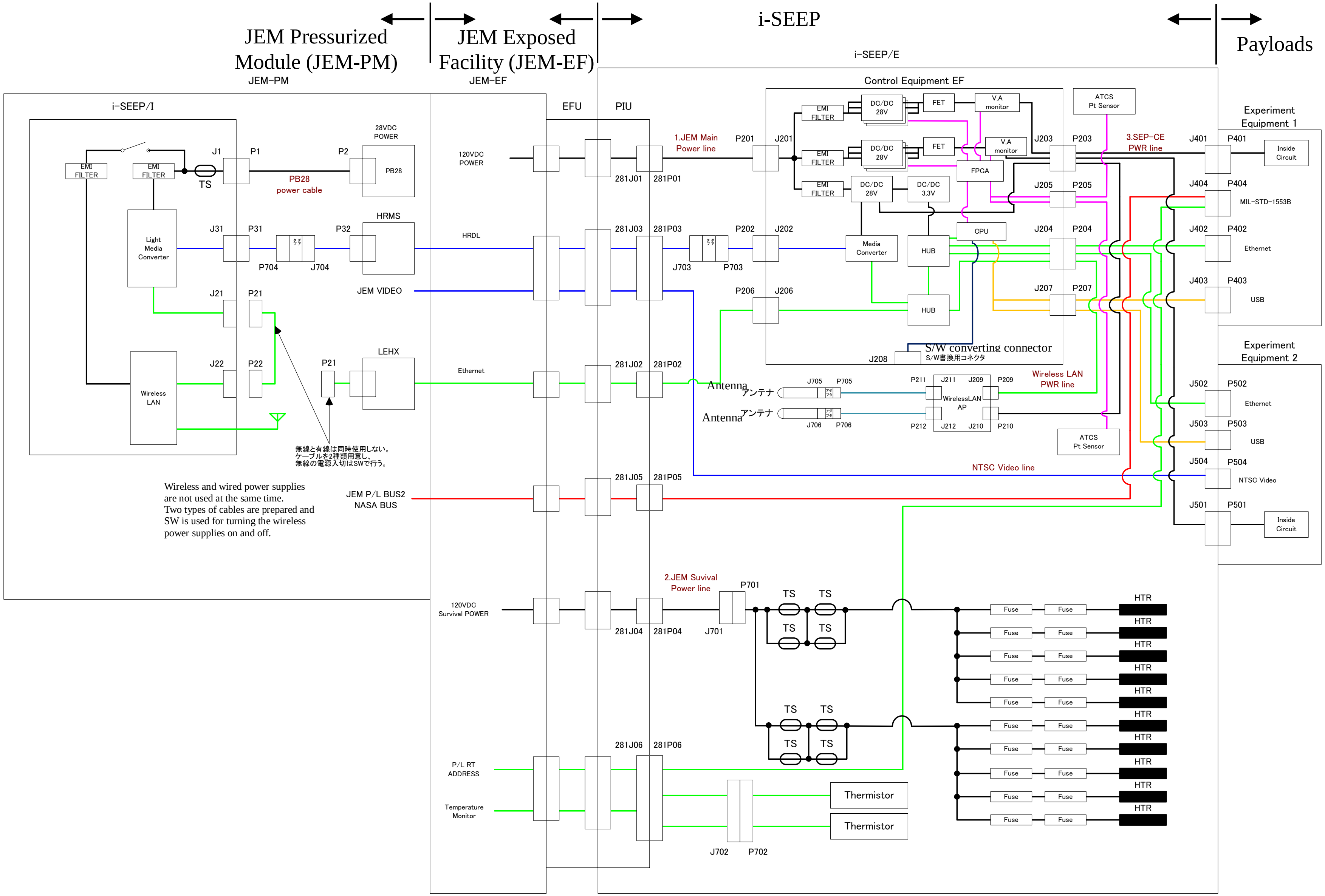


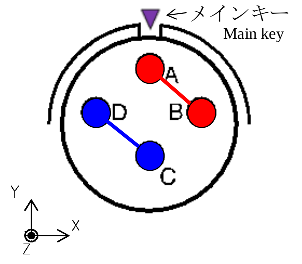
Figure 3.3.1-1 i-SEEP power and communication schematics

Table 3.3.2-1. Connector types and pin assignment (power)

(a-1) power supply connector for Payload 1

ITEM No.	J401	P401
CONNECTOR P/N	D38999/20FC4SN	D38999/26FC4PN
MODULE	W/H	Experiment Equipment 1 W/H

PIN No.	TWIST (SHIELD)	DESCRIPTION	VOLT. (MAX)	CURR. (MAX)	AWG	CONTACT SIZE	EMC CLASS	CUTOUT FIGURE
A	┐	28VDC HOT	28V		16	16	HO	
B	┘	28VDC RTN			16	16	HO	
C	┐	28VDC RTN			16	16	HO	
D	┘	28VDC HOT	28V		16	16	HO	



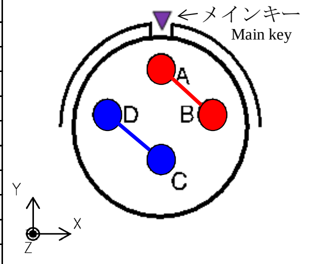
（ピン側嵌合面視）
(Fitting surface view on the pin side)

* PITFE wires rated 200°C or higher shall be used for cables.
* The 28 V DC line have a redundant. But only 1 line can feed 200 W to the payload.

(b-1) power supply connector for Payload 2

ITEM No.	J501	P501
CONNECTOR P/N	D38999/20FC4SN	D38999/26FC4PN
MODULE	W/H	Experiment Equipment 2 W/H

PIN No.	TWIST (SHIELD)	DESCRIPTION	VOLT. (MAX)	CURR. (MAX)	AWG	CONTACT SIZE	EMC CLASS	CUTOUT FIGURE
A	┐	28VDC HOT	28V		16	16	HO	
B	┘	28VDC RTN			16	16	HO	
C	┐	28VDC RTN			16	16	HO	
D	┘	28VDC HOT	28V		16	16	HO	



（ピン側嵌合面視）
(Fitting surface view on the pin side)

* PITFE wires rated 200°C or higher shall be used for cables.
* The 28 V DC line have a redundant. But only 1 line can feed 200 W to the payload.

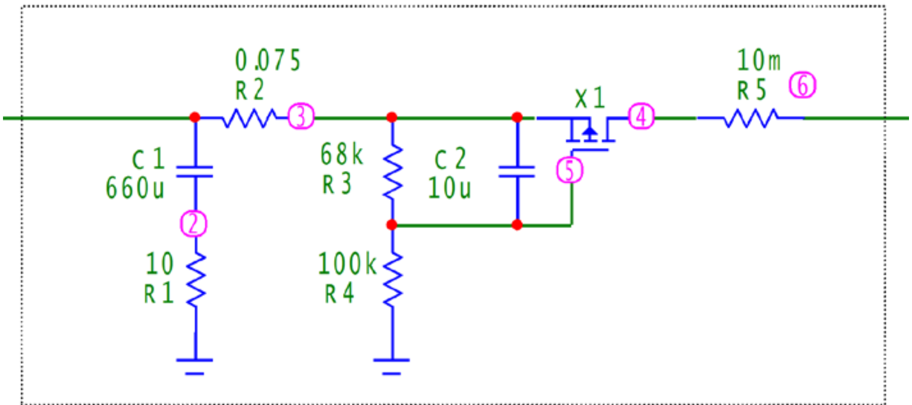


Figure 3.3.2-1 i-SEEP equivalent circuit

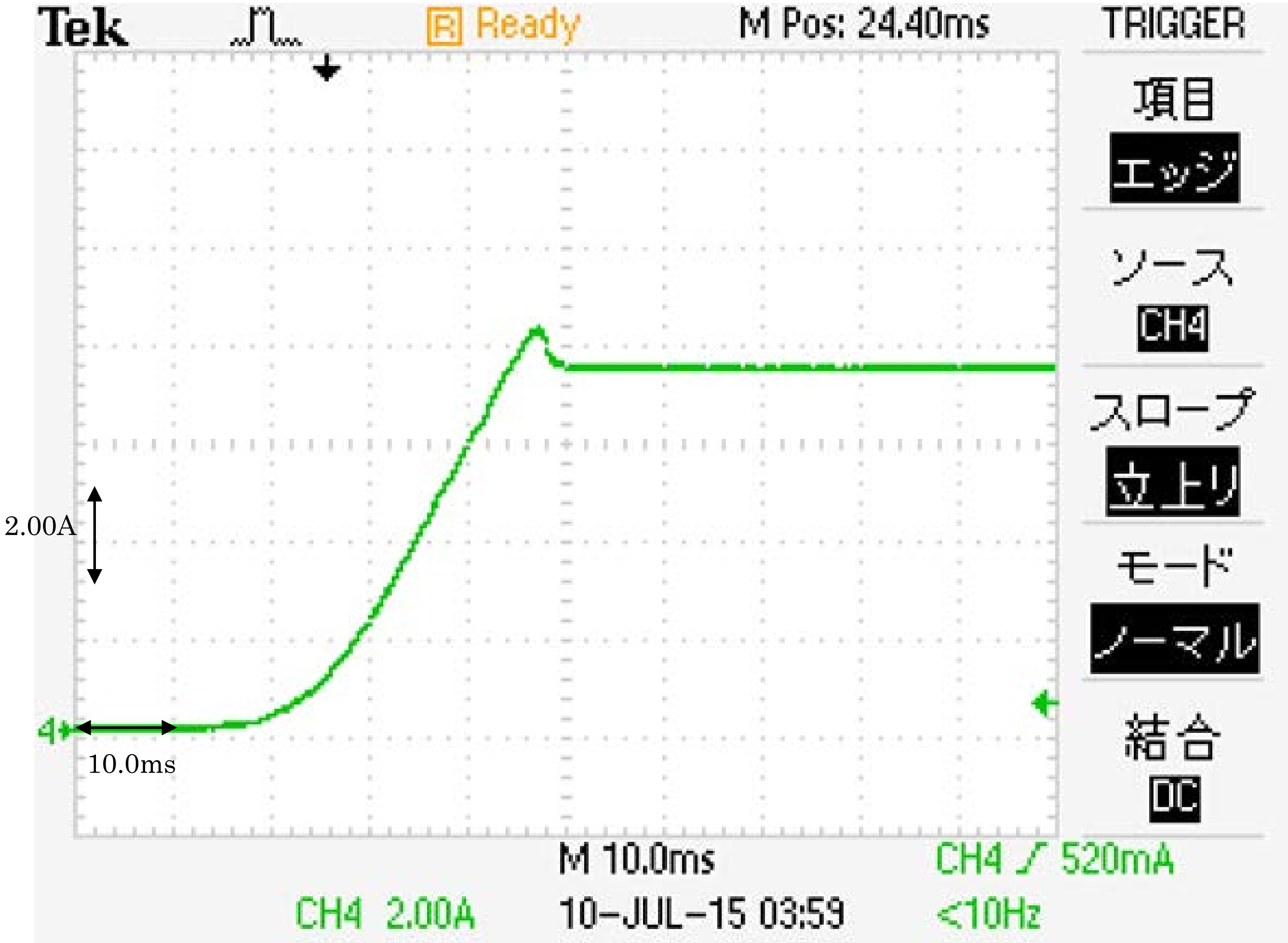


Figure 3.3.2-2 Inrush current properties

3.3.3 Grounding and bonding requirements

(1) Grounding and insulation
Figure 3.3.3-1 shows the insulation and grounding schematics of i-SEEP.

(2) Return
(a) Be sure to use a wire harness for the primary electricity return. Never use the structure as a return.
(b) Signal returns and reference shall be put outside from the equipment via connector pins for each unit. Equipment that uses a common power supply should be grounded onto the same single point.
(c) DC-DC converter input (the primary side) return and output (the secondary side) return of each payload shall be isolated (1 mΩ or more at DC). Input return shall be also isolated at 1 mΩ or more from the structure of the payload.

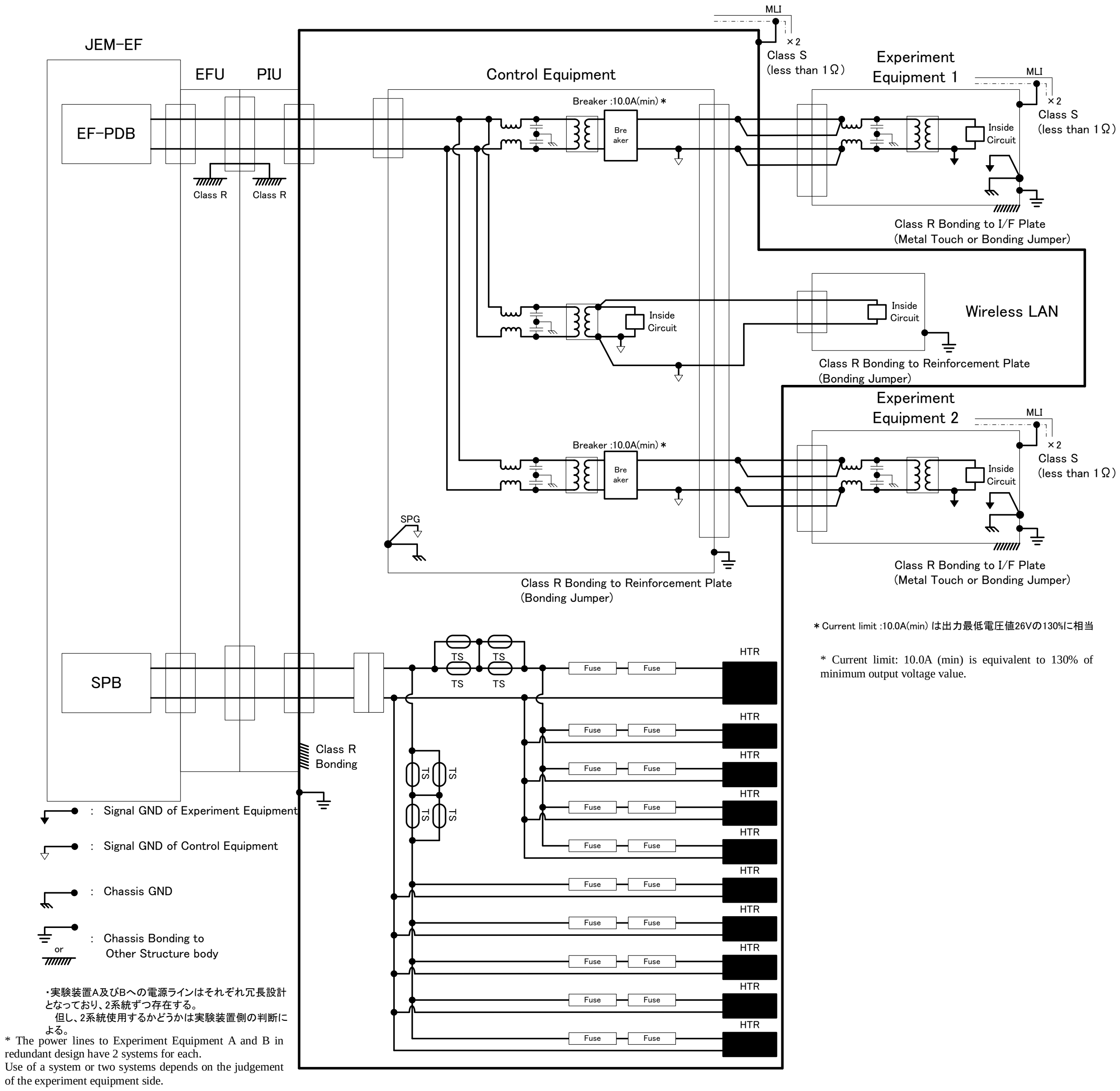
(3) Electrical bonding
Electrical bonding shall be according to SSP30245 requirements as follows:
The payload attachment surface is conductive coated. A bonding strap and attaching bolts are necessary for attaching equipment to the surface via thermal filler or other tools. The position for attaching the bonding strap is defined in Figure 3.2-2.

(a) Between payload – payload attachment surface:

	DC resistance	Prevention item
Class R	2.5 mΩ or less	Interference by high-frequency equipment
Class H	100 mΩ or less	Shock hazard
Class S	1 Ω or less	Static electricity/charging

Note) AC resistance need no measurement.

(b) Between MLI-Payload casing or payload attachment surface
DC current: 1 Ω or less



・エアロックとのボンディングI/Fは把持ブラケット面にクラスSボンディングを満足するよう、無電解ニッケル処理を施す。
・ツールフィクスチャとのボンディングI/FはクラスSボンディングを満足するよう、化学皮膜処理を施す。
・マイクロフィクスチャとのボンディングI/FはクラスSボンディングを満足するよう、化学皮膜処理を施す。
・配管系は配管ブラケットとi-SEEP構体間でクラスSボンディングを満足するよう、化学皮膜処理を施す。
また、SUSの配管は継手及び溶接で結合されている。

* The bonding I/F with the Airlock is electroless-nickel plated to satisfy Class S bonding on the surface of the capturing bracket.
* The bonding I/F with the tool fixture is chemical-film-processed to satisfy Class S bonding.
* The bonding I/F with the micro-fixture is chemical-film-processed to satisfy Class S bonding
.* The piping system is chemical-film-processed to satisfy Class S bonding between the piping bracket and the i-SEEP structure. The piping of SUs is bound with coupling and welding.

Figure 3.3.3-1 Grounding schematics

3.3.4 Static discharge

Payload damaged by static discharge shall be handled in accordance with requirements of CR-99287: EEE Parts Control Management, and shall be labeled.

Payload parts susceptible to the influence of static discharge shall be handled in accordance with CR-99050: JEM EEE Parts Management Plan.

3.3.5 Electromagnetic compatibility

(1) EMI・EMC

Electromagnetic compatibility shall be designed in accordance with following documents:

- SSP30237, "Space Station Electromagnetic Emission and Susceptibility Requirements for EMC"
- SSP30238, "Space Station Electromagnetic Techniques"
- SSP30243, "Space Station Requirements for Electromagnetic Compatibility"

(2) Payload with wireless communication function

The document requirements stipulated in 3.3.5 (1) shall also apply to payload having a wireless communication function.

Payload with a RF transmitter must be coordinated regarding the electric field intensity of spurious radiation with the JEM system side.

(3) Magnetic field requirements

The requirements of SSP30237 in Appendix D shall apply to those of magnetic fields generated by payload.

However, this shall not cover solenoid valves, solenoid relays, and electric motors with current of 1[A] or less in the AC MAGNETIC FIELDS requirements, and consumption electricity of 120 [W] or less in the DC MAGNETIC FIELDS requirements.

3.4 Communication control system interface

3.4.1 JEM medium-rate data interface

i-SEEP provides 1ch for each payload, 2ch in total, of the JEM medium rate interface (Ethernet). It also has a wireless LAN access point (1ch). Payload interfaces the JEM intermediate-rate interface (Ethernet) via the hub of the control unit (see Figure 3.4.1-1) The communication interface requirements are as follows:

(1) Ethernet interface

- Transmitting standard and communication media
  10 Base-T/100 Base-Tx(Auto)
- Date frame
  Ethernet II or IEEE802.3 frame (JPAH Vol. 7 3.5.3.2 or 3.5.3.3)

(2) Command format

- The command format for payload and the interface with LEHX shall be in accordance with JPAH Vol. 7, 3.5.7.4.3.2.

(3) Transmitting media:

- SSQ21655 NDBC-TFE-22-2SJ-100 twin-axial cable is recommended.

(4) Wireless LAN access point

- Transmitting standard and communication media

IEEE802.11n (ch100, 5500 MHz)
- Data frame
  IEEE802.11 frame
- The wireless LAN converter does not support STP protocol.
- Users who use communication service via the wireless LAN access point are recommended to confirm compatibility with FXE2000 (manufactured by CONTEC) in advance.

3.4.2 JEM low-rate data interface

i-SEEP provides payload the low-rate data interface with the JEM Exposed Facility. For details of the interface are described in NASDA-ESPC-2563, JPAH Vol. 3.
The stab of payload shall be maximum 1.0 m.

3.4.3 JEM video-system interface

i-SEEP provides payload the video-system low-rate interface with the JEM Exposed Facility. For details of the interface, see NASDA-ESPC-2563, “JEM Payload Accommodation Handbook Vol. 3.”

3.4.4 USB interface

i-SEEP provides payload 1ch of the USB interface for each, 2ch in total as follows:

Table 3.4.4-1 USB interface

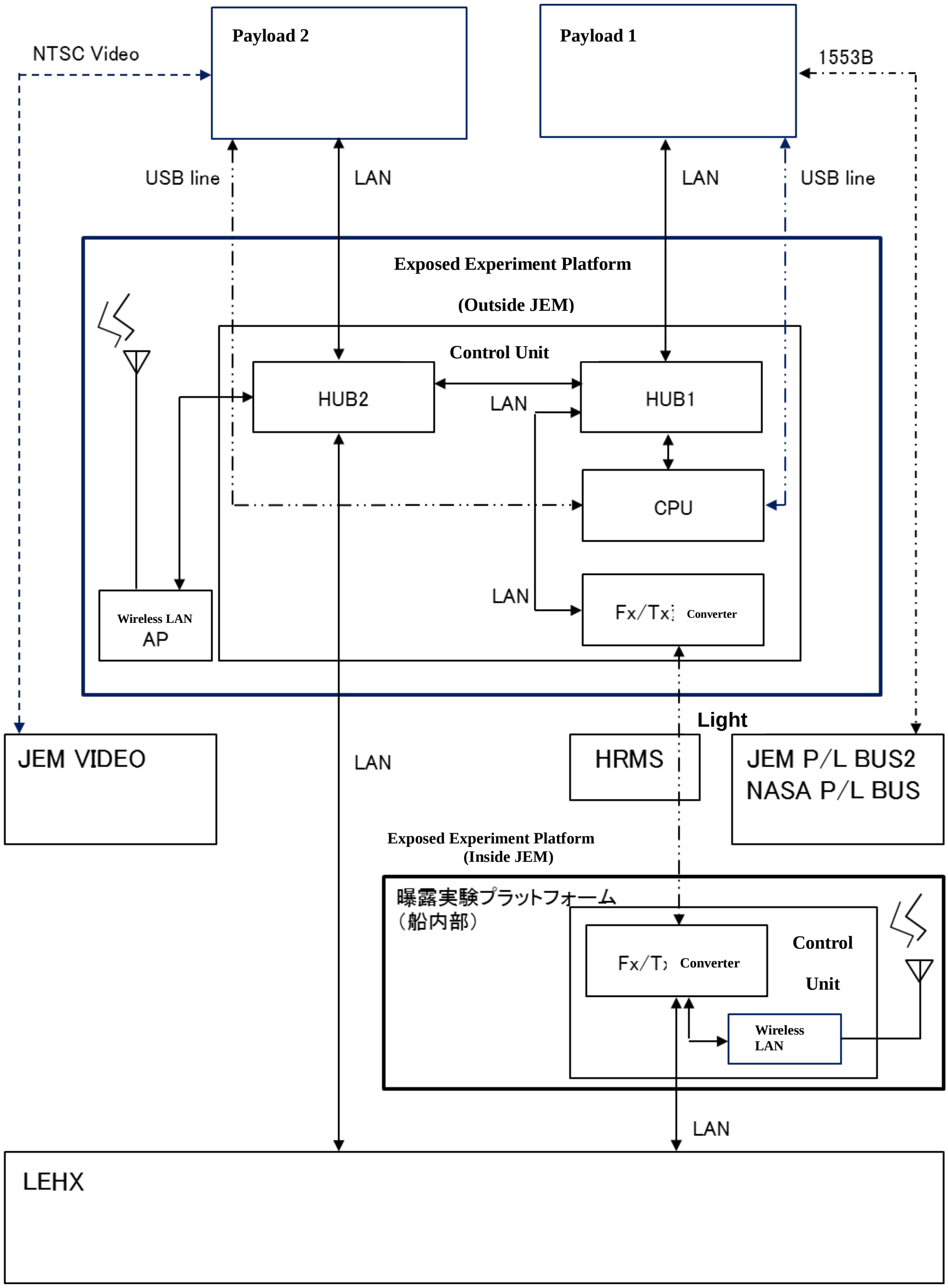
Payload	Type	Interface provided
USB (Payload 1)	USB2.0	Power (200 mA max) Communication (High Rate)
USB (Payload 2)	USB2.0	Communication (Full Rate)

3.4.5 Approval of RF frequency use

When the payload is to use RF frequency (even only for receiving), approval by the Ministry of Internal Affairs and NASA shall be obtained in advance. JAXA applies to NASA on behalf of the payload side, based on information presented by that side.
The design information of payload using RF frequency, which is necessary for application to NASA, shall be submitted to JAXA, according to the application guide of JMX-2011420: JSC Radio Frequency Spectrum Management HP.

3.4.6 Connector types and pin assignment

Connector types and pin assignment shall be as listed in Table 3.4.6-1.



*When there are ports for both high-rate and intermediate-rate communication system interfaces, command/data responses are made via either of them.

*Data communication between the intravehicular control unit and LEHX is performed via a wireless or wired power supply (as wireless and wired power supplies are NOT used at the same time).

*Wireless LAN AP is mainly intended to provide other payload on/around the JEM Exposed Facility with communication service.

Figure 3.4.1-1 Command/Data communication interface

Table 3.4.6-1 (1/2) Connector types and pin assignment (Communication control)

(a-2) ETHERNET connector for Payload 1

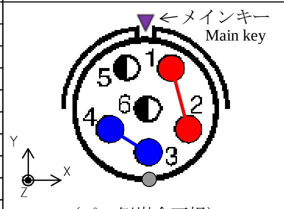
ITEM No.	J402	P402
CONNECTOR P/N	D38999/20FA35SN	D38999/26FA35PN
MODULE	W/H	Experiment Equipment 1 W/H

PIN No.	TWIST (SHIELD)	DESCRIPTION	VOLT. (MAX)	CURR. (MAX)	AWG	CONTACT SIZE	EMC CLASS
1		Output Channel(+)			22	22	RF
2		Output Channel(-)			22	22	RF
4		Input Channel(+)			22	22	RF
3		Input Channel(-)			22	22	RF
SHELL							
5		NC					
6		NC					

＊ツイストペアのシールドはバックシェルに落とす。

***The shield of the twist pair is dropped on the back shell.**

CUTOUT FIGURE



(ピン側嵌合面視)
(Fitting surface view on the pin side)

Note) Output in the table refers to transmission from experiment equipment to i-SEEP; Input refers to transmission from i-SEEP to experiment equipment.

(a-3) USB Connector for Payload 1

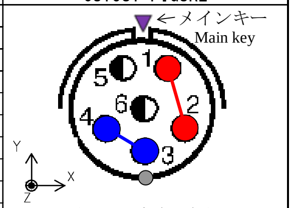
ITEM No.	J403	P403
CONNECTOR P/N	D38999/20FA35SA	D38999/26FA35PA
MODULE	W/H	Experiment Equipment 1 W/H

PIN No.	TWIST (SHIELD)	DESCRIPTION	VOLT. (MAX)	CURR. (MAX)	AWG	CONTACT SIZE	EMC CLASS
4		5VDC HOT (High)	5.25V		22	22	ML
3		5VDC RTN (High)			22	22	ML
1		Data(+) (High)			22	22	RF
2		Data(-) (High)			22	22	RF
SHELL		SHIELD			22		
5		NC					
6		NC					

＊ツイストペアのシールドはバックシェルに落とす。

***The shield of the twist pair is dropped on the back shell.**

CUTOUT FIGURE



(ピン側嵌合面視)
(Fitting surface view on the pin side)

(a-4) 1553B connector for Payload 1

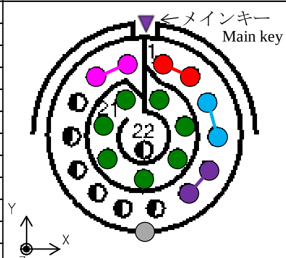
ITEM No.	J404	P404
CONNECTOR P/N	D38999/20FC35SN	D38999/26FC35PN
MODULE	W/H	Experiment Equipment 1 W/H

PIN No.	TWIST (SHIELD)	DESCRIPTION	VOLT. (MAX)	CURR. (MAX)	AWG	CONTACT SIZE	EMC CLASS
1		LOCAL BUS P/L JEM a-P	28.0V	0.4A	22	22D	RF
2		LOCAL BUS P/L JEM a-N		0.4A	22	22D	RF
14		LOCAL BUS P/L JEM b-P	28.0V	0.4A	22	22D	RF
13		LOCAL BUS P/L JEM b-N		0.4A	22	22D	RF
3		P/L BUS-2 a-P	28.0V	0.4A	22	22D	RF
4		P/L BUS-2 a-N		0.4A	22	22D	RF
6		P/L BUS-2 b-P	28.0V	0.4A	22	22D	RF
5		P/L BUS-2 b-N		0.4A	22	22D	RF
SHELL							
15		P/L RT ADDRESS RTN			22	22D	ML
16		P/L RT ADDRESS P			22	22D	ML
17		P/L RT ADDRESS A1			22	22D	ML
18		P/L RT ADDRESS A2			22	22D	ML
19		P/L RT ADDRESS A3			22	22D	ML
20		P/L RT ADDRESS A4			22	22D	ML
21		P/L RT ADDRESS A5			22	22D	ML
7		NC					
8		NC					
9		NC					
10		NC					
11		NC					
12		NC					
22		NC					

＊ツイストペアのシールドはバックシェルに落とす。

***The shield of the twist pair is dropped on the back shell.**

CUTOUT FIGURE



(ピン側嵌合面視)

(Fitting surface view on the pin side)

Table 3.4.6-1 (2/2) Connector standard/pin assignment

(b-2) ETHERNET connector for Payload 2

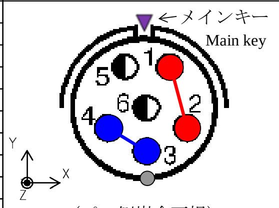
ITEM No.	J502	P502
CONNECTOR P/N	D38999/20FA35SN	D38999/26FA35PN
MODULE	W/H	Experiment Equipment 2 W/H

PIN No.	TWIST (SHIELD)	DESCRIPTION	VOLT. (MAX)	CURR. (MAX)	AWG	CONTACT SIZE	EMC CLASS
1	┐	Output Channel(+)			22	22	RF
2	┘	Output Channel(-)			22	22	RF
4	┐	Input Channel(+)			22	22	RF
3	┘	Input Channel(-)			22	22	RF
SHELL							
5		NC					
6		NC					

＊ツイストペアのシールドはバックシェルに落とす。

*The shield of the twist pair is dropped on the back shell.

CUTOUT FIGURE



（ピン側嵌合面視）
(Fitting surface view on the pin side)

Note) Output in the table refers to transmission from experiment equipment to i-SEEP; Input refers to transmission from i-SEEP to experiment equipment.

(b-3) USB connector for Payload 2

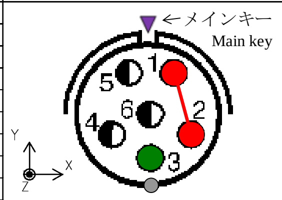
ITEM No.	J503	P503
CONNECTOR P/N	D38999/20FA35SA	D38999/26FA35PA
MODULE	W/H	Experiment Equipment 2 W/H

PIN No.	TWIST (SHIELD)	DESCRIPTION	VOLT. (MAX)	CURR. (MAX)	AWG	CONTACT SIZE	EMC CLASS
1	┐	Data(+) (Full)			22	22	RF
2	┘	Data(-) (Full)			22	22	RF
SHELL		SHIELD			22		
3		5VDC RTN			22	22	ML
4		NC					
5		NC					
6		NC					

＊ツイストペアのシールドはバックシェルに落とす。

*The shield of the twist pair is dropped on the back shell.

CUTOUT FIGURE



（ピン側嵌合面視）
(Fitting surface view on the pin side)

(b-4) NTSC Video connector for Payload 2

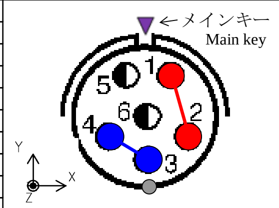
ITEM No.	J504	P504
CONNECTOR P/N	D38999/20FA35SB	D38999/26FA35PB
MODULE	W/H	Experiment Equipment 2 W/H

PIN No.	TWIST (SHIELD)	DESCRIPTION	VOLT. (MAX)	CURR. (MAX)	AWG	CONTACT SIZE	EMC CLASS
1	┐	SYNC/CTL EXP OUT P	1.0V	10mA	22	22	RF
2	┘	SYNC/CTL EXP OUT S	1.0V	10mA	22	22	RF
4	┐	VIDEO EXP IN P	1.0V	10mA	22	22	RF
3	┘	VIDEO EXP IN S	1.0V	10mA	22	22	RF
SHELL							
5		NC					
6		NC					

＊ツイストペアのシールドはバックシェルに落とす。

*The shield of the twist pair is dropped on the back shell.

CUTOUT FIGURE



（ピン側嵌合面視）
(Fitting surface view on the pin side)

3.5 Thermal interfaces

3.5.1 Protection by Muti Layer Insulation (MLI)

During extravehicular operation (including transferring by JEMRMS), Payload shall be basically covered with Multi Layer Insulation (MLI). Figure 3.5.1-1 illustrates an image of the equipment with MLI applied. Figure 3.5.1-2 shows the MLI to be prepared by the Payload side and the location of velcros on i-SEEP for attaching MLI of payload to i-SEEP.

Velcro of i-SEEP shall be covered with MLI of payload, in order to prevent them from long-period exposure to space.

MLI to cover the connector part shall be prepared by the i-SEEP side. In case covering with MLI is inappropriate for some reason including mission requirements, PD shall coordinate with i-SEEP side.

3.5.2 Installation on JEM Exposed Facility

Payload can waste heat through the Cold Plate (CP) attached to the rear side of the payload attachment plate, nominally up to 200 W per payload (hereinafter the values shown are those per payload).

Figure 3.5.2-1 shows the ATCS schematics of i-SEEP; Figure 3.5.2-2 shows the CP layout on the rear side of the Payload attachment plate.

The temperature of the payload attachment surface shall be 16 – 40 [˚C] (margin not included).

The following shall be set according to the Payload: processing of the Payload surface, the necessity and type of thermal filler, the number of attaching bolts, and tightening torques. For reference, Appendix-1 shows the data (test results) of waste heat characteristics of the Payload attachment surface via the CP when a dummy waste heat payload was attached to i-SEEP. Waste heat from the part overlapped with the CP to the Payload attachment surface, and uneven waste heat (even in the part overlapped with the CP) shall be adjusted with the i-SEEP side.

For payload, waste heat applied to the payload attachment surface as well as heat input from sunlight, radiation in deep space, and the radiation and albedo from the surface of Earth shall be taken into consideration. The details shall be in accordance with JCX-95068C.

3.5.3 Survival mode after installation

At the survival mode of JEM EF, the temperature of the payload attachment surface may reach -40 to 60 [˚C] (including a margin).

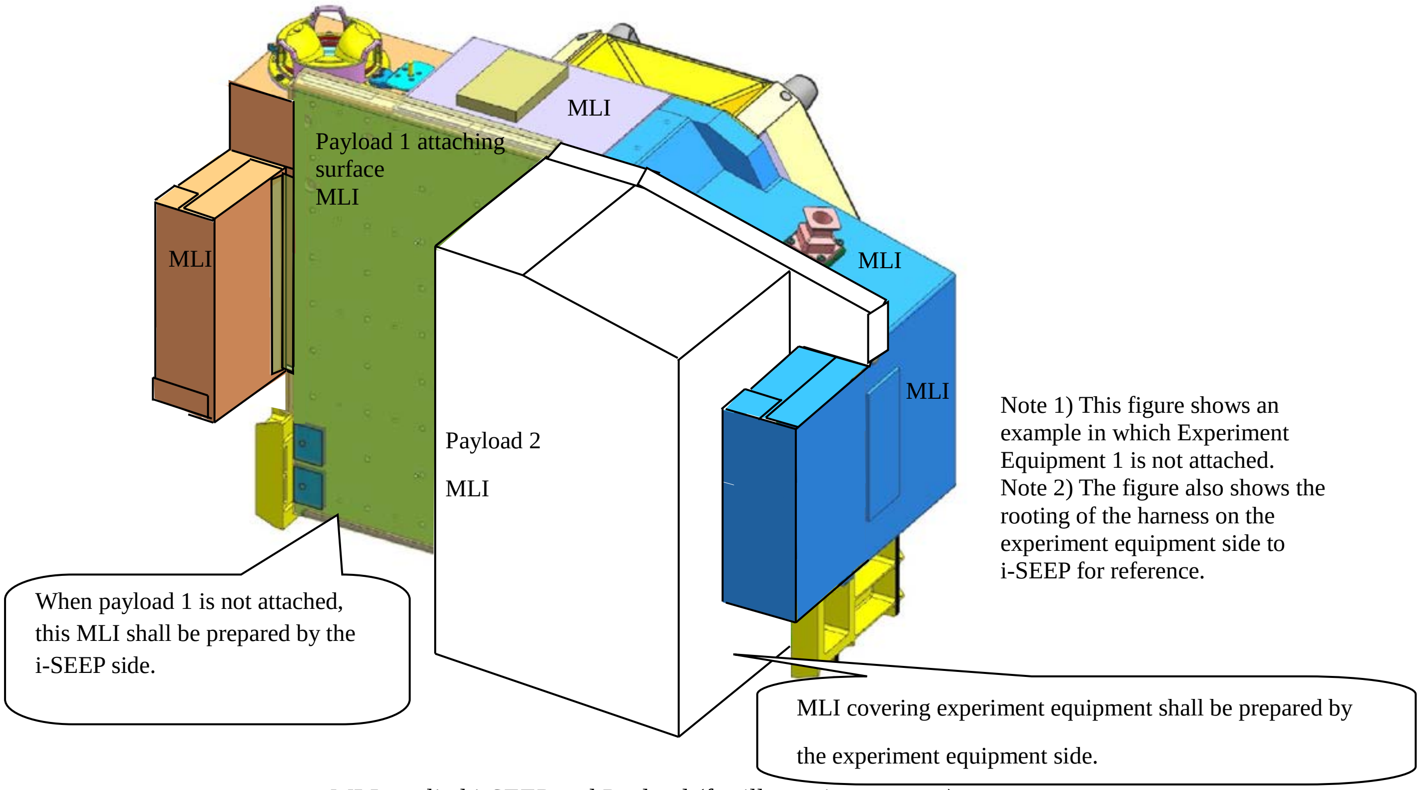
The PD shall be coordinated with the i-SEEP side when an endothermic reaction occurs from the I/F panel in the low-temperature part, or when waste heat occurs on the I/F panel in the high-temperature part.

3.5.4 Airlock – JEM-EF transfer operation

The temperature of the plate of the Payload attaching surface may reach -40 to 60 [˚C] (including a margin).
The Payload shall be adjusted with the i-SEEP side when an endothermic reaction occurs from the I/F panel in the low-temperture part, or when waste heat occurs on the I/F panel in the high-temperature part.

3.5.5 Others
In operation phases other than the above, that is, when Payload is in the JEM Pressurized Module (PM) or in the Airlock, observe the conditions described in 3.6.

3.5.6 Thermal mathematical model
The operability assessment of the overall JEM system including said Payload is based on thermal analysis conducted by i-SEEP. The Payload side shall present the i-SEEP side with the thermal mathematical model along with information related to thermal mathematical model. The details of the thermal mathematical model shall be adjusted with the i-SEEP side.



MLI-applied i-SEEP and Payload (for illustrative purpose)

(with only Payload 2 attached)

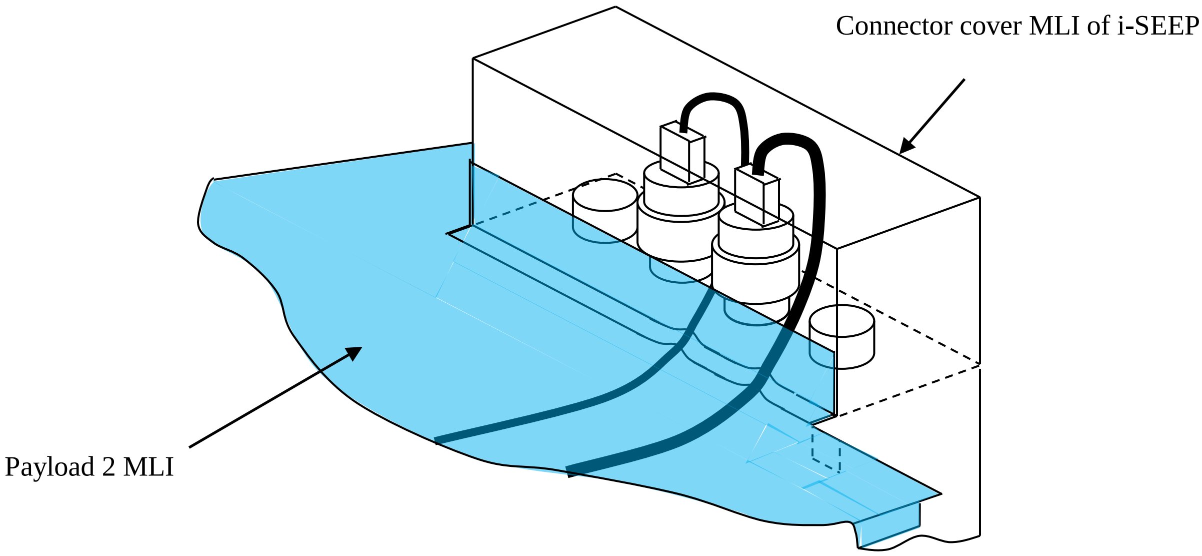


Illustration of connector cover MLI of experiment equipment cable running through MLI

Figure 3.5.1-1 MLI applied i-SEEP and Payload (for illustrative purpose)

(with only payload 2 attached)

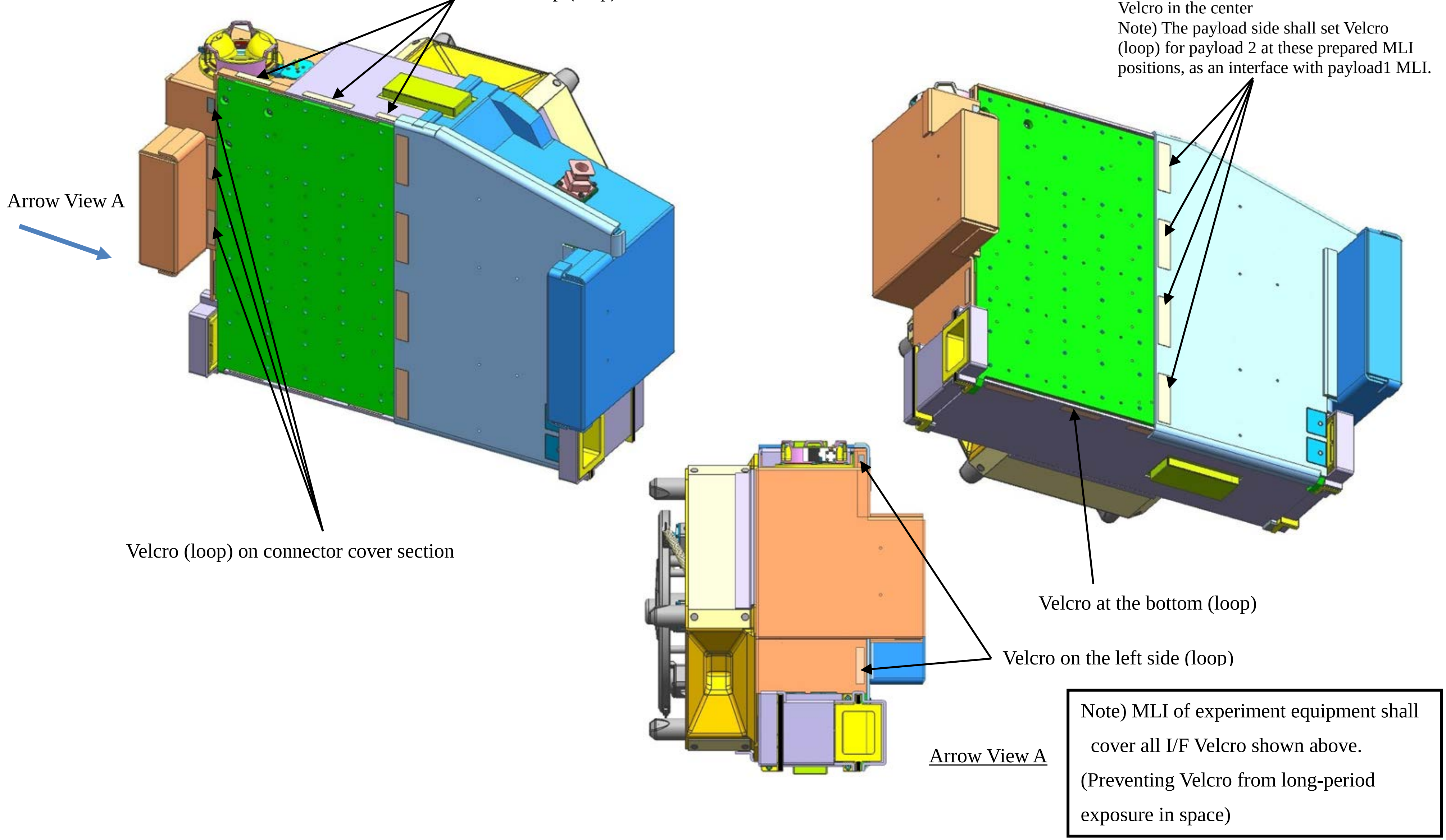


Figure 3.5.1-2 (1/12) Location of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent Payload (for attaching Payload 1)

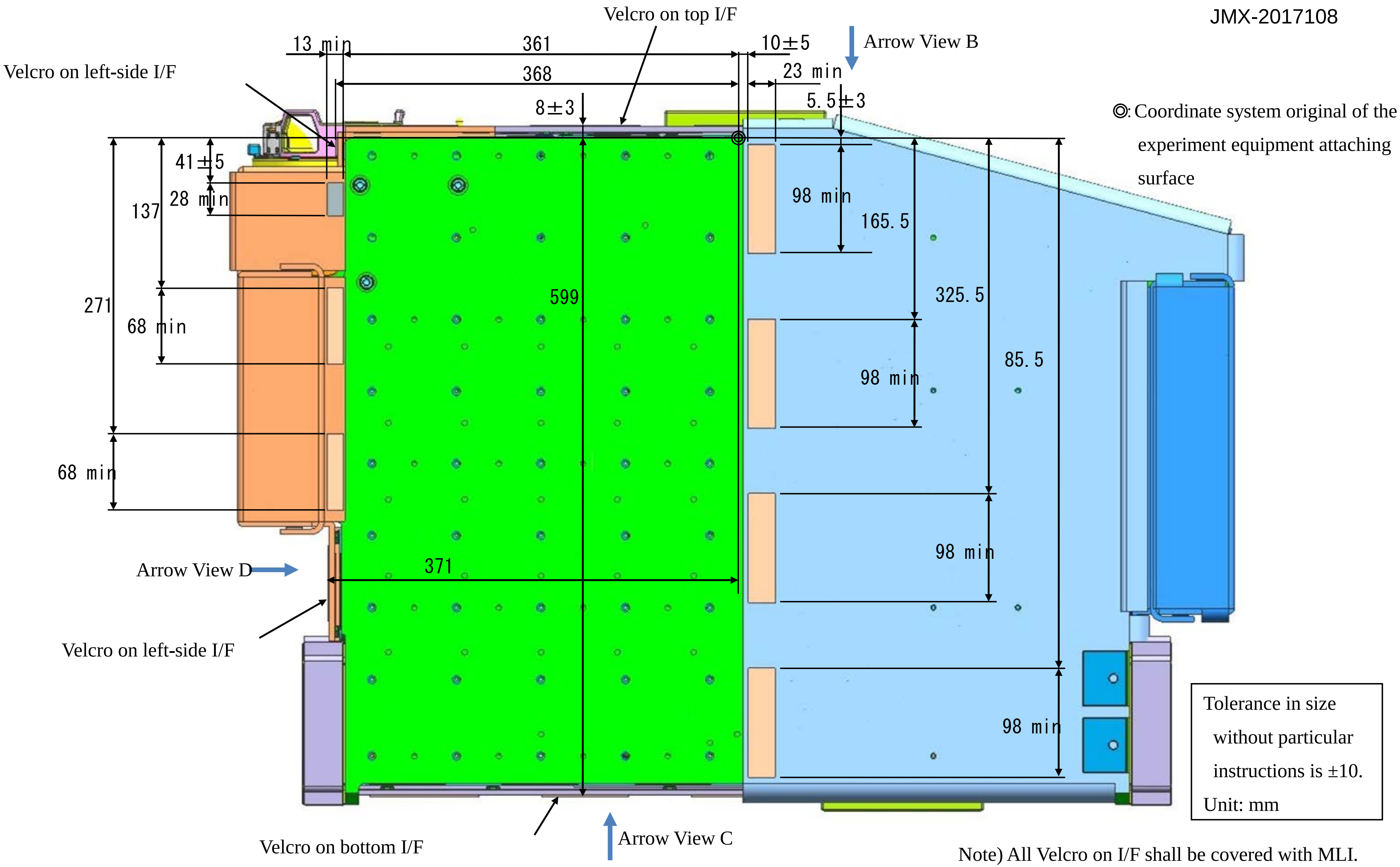
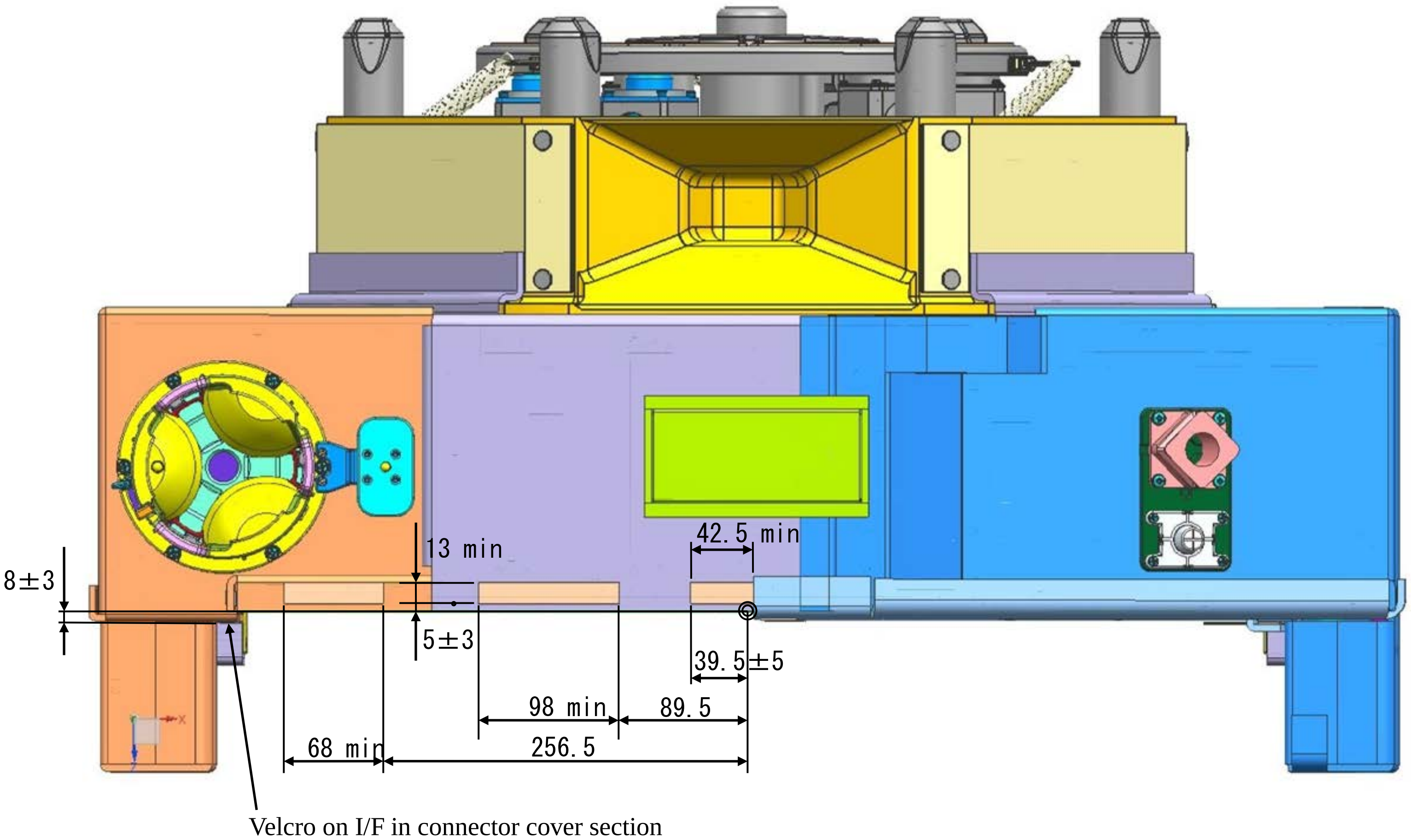


Figure 3.5.1-2 (2/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent Payload(for attaching Payload 1)

Arrow View B

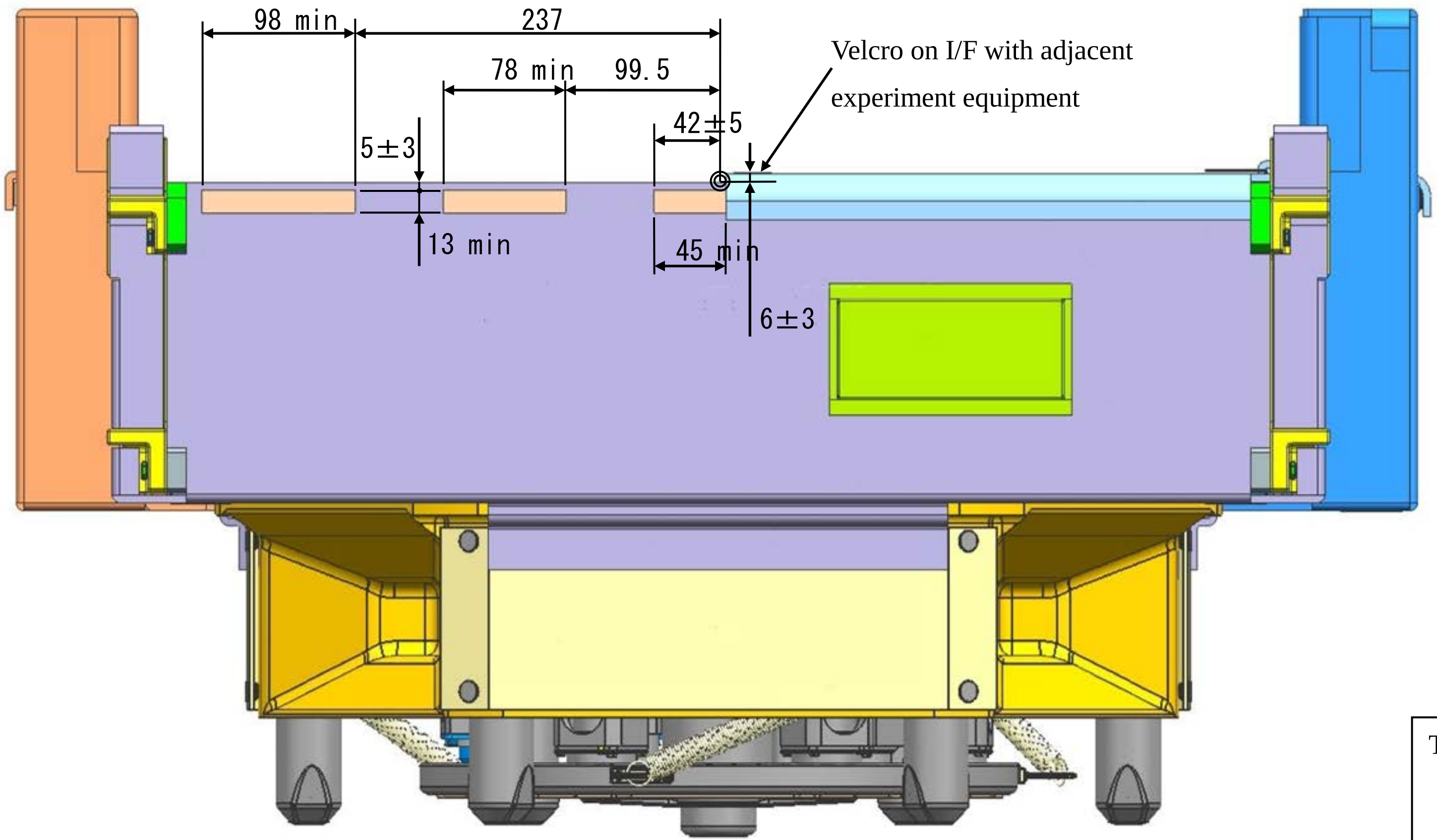


Tolerance in size without particular instructions is ±10.
Unit: mm

Note) All Velcro on I/F shall be covered with MLI.

Figure 3.5.1-2 (3/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent Payload (for attaching Payload 1)

Arrow View C

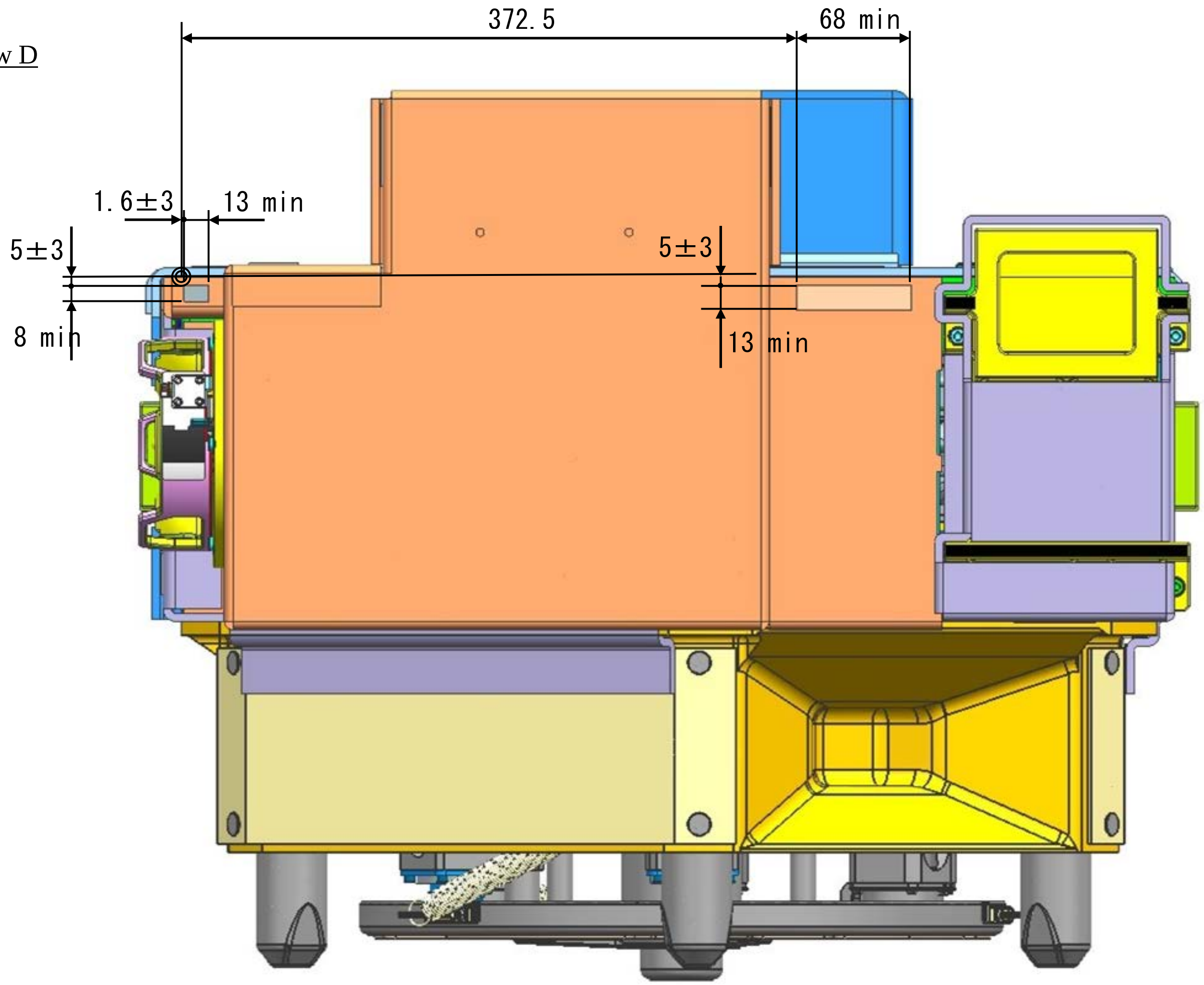


Tolerance in size without particular instructions is ±10.
Unit: mm

Note) All Velcro on I/F shall be covered with MLI.

Figure 3.5.1-2 (4/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent Payload (for attaching Payload 1)

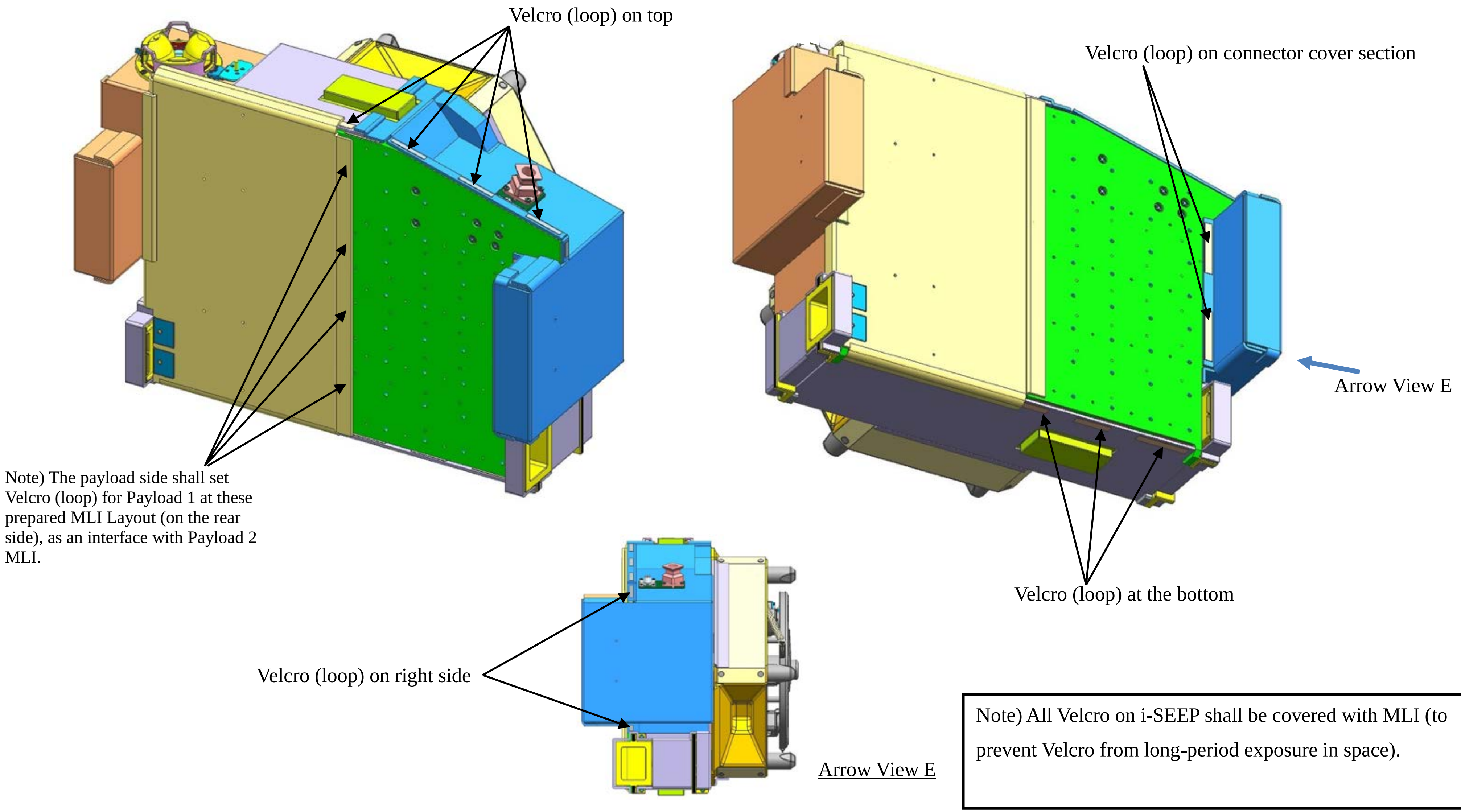
Arrow View D



Tolerance in size without particular instructions is ±10.
Unit: mm

Note) All Velcro on I/F shall be covered with MLI.

Figure 3.5.1-2 (5/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent Payload (for attaching Payload 1)



Note) All Velcro on i-SEEP shall be covered with MLI (to prevent Velcro from long-period exposure in space).

Figure 3.5.1-2 (6/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent payload (for attaching Payload 2)

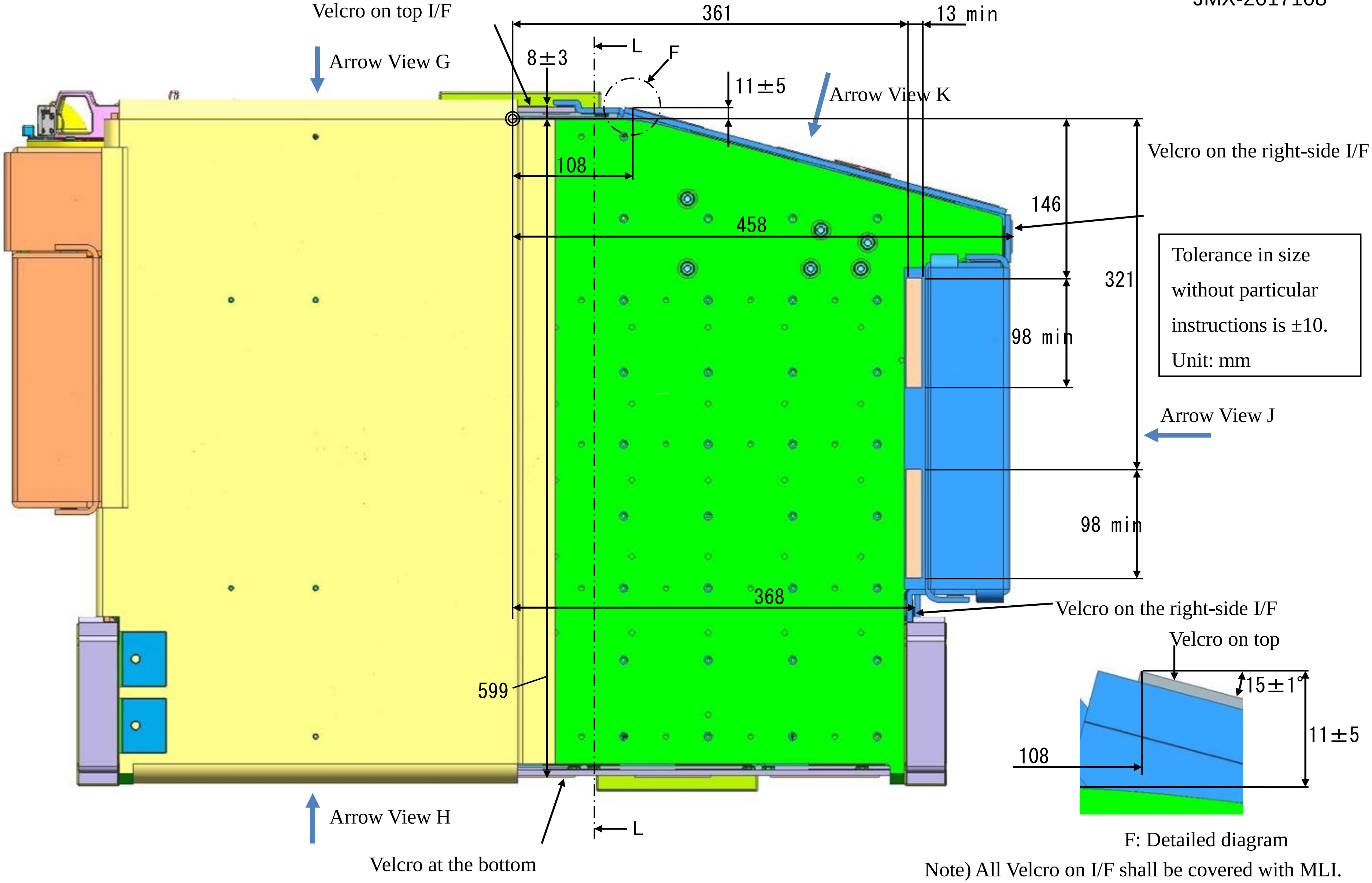
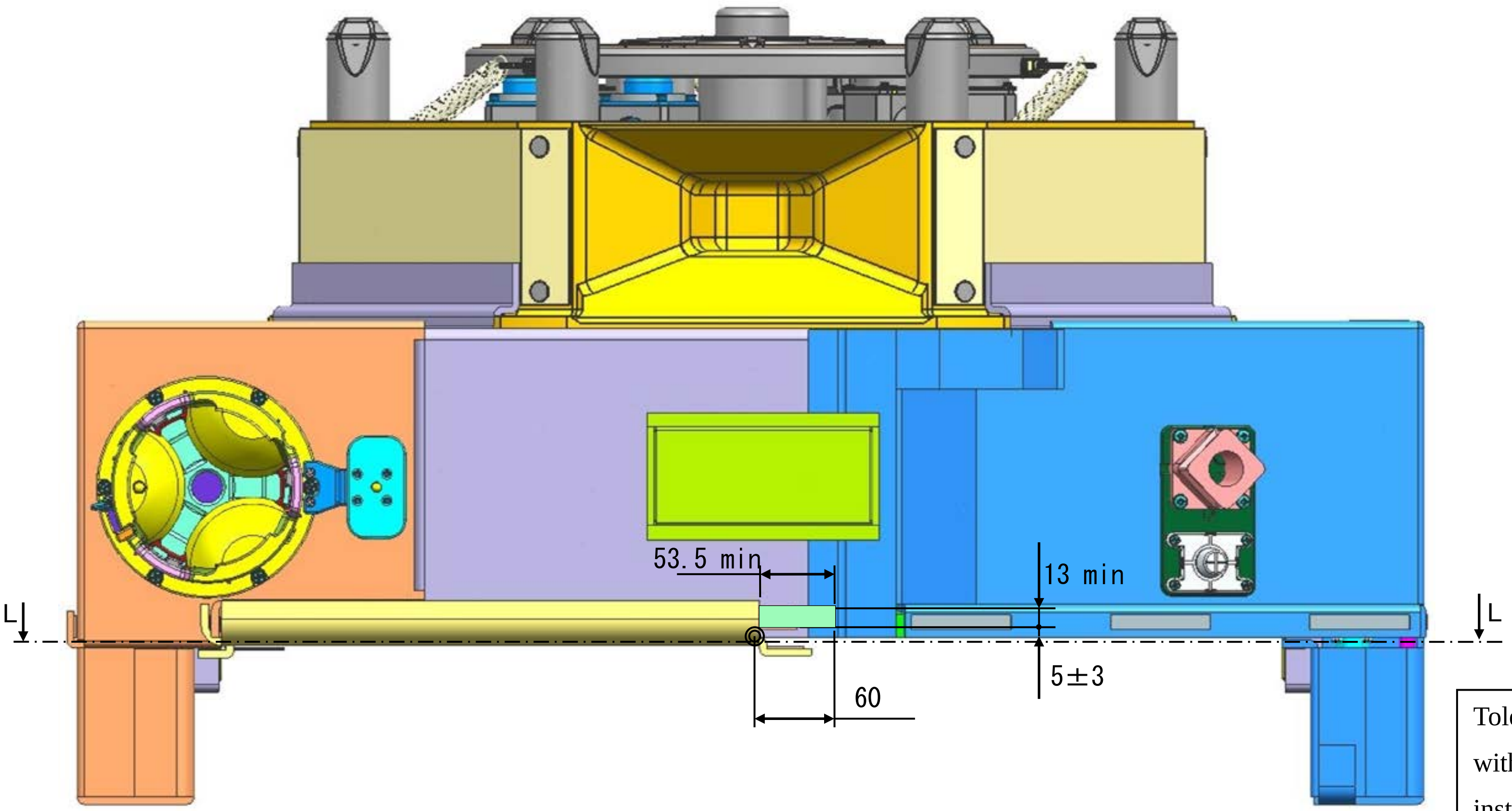


Figure 3.5.1-2 (7/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent payload (for attaching Payload 2)

Arrow View G

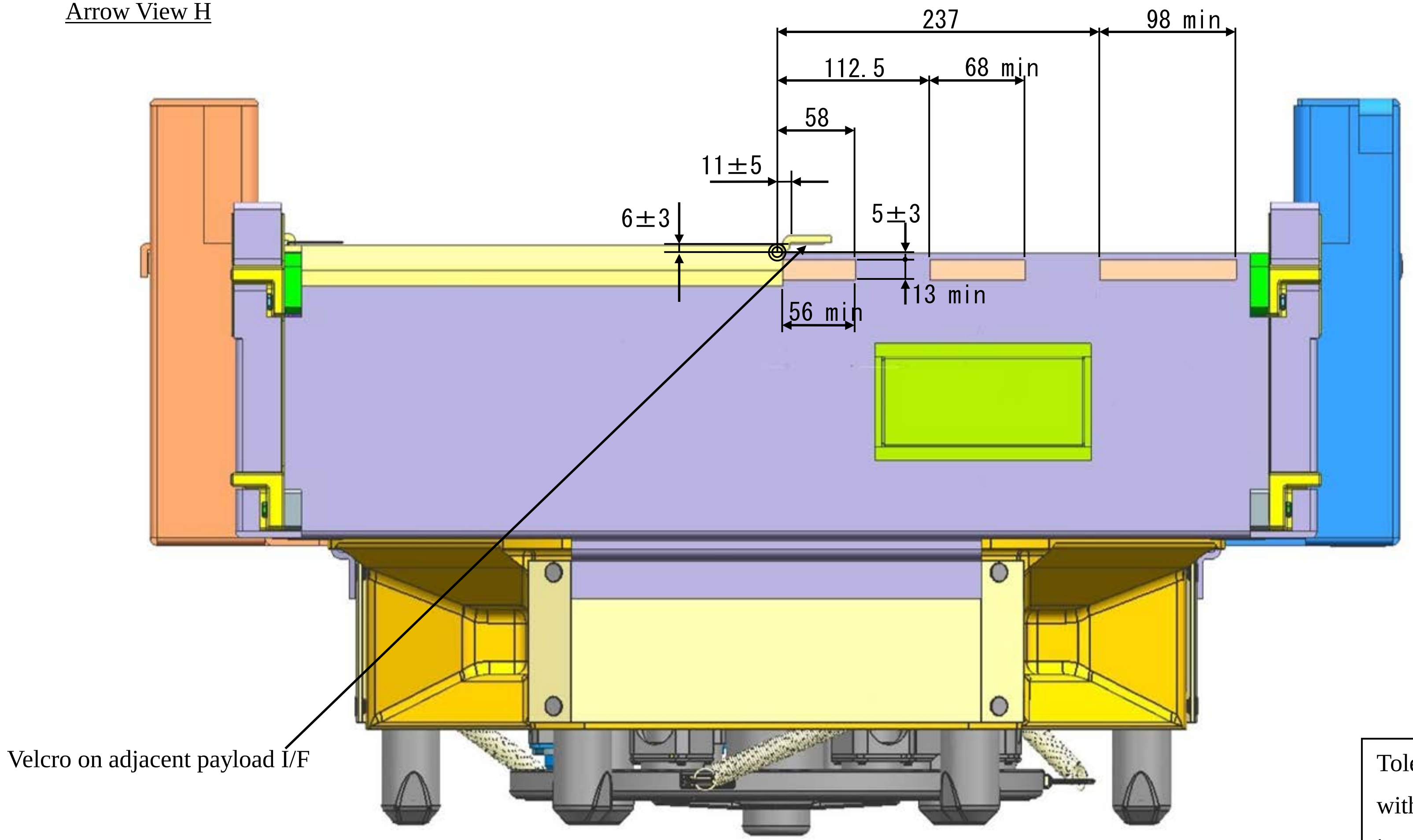


Tolerance in size without particular instructions is ±10.
Unit: mm

Note) All Velcro on I/F shall be covered with MLI.

Figure 3.5.1-2 (8/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent payload (for attaching Payload 2)

Arrow View H

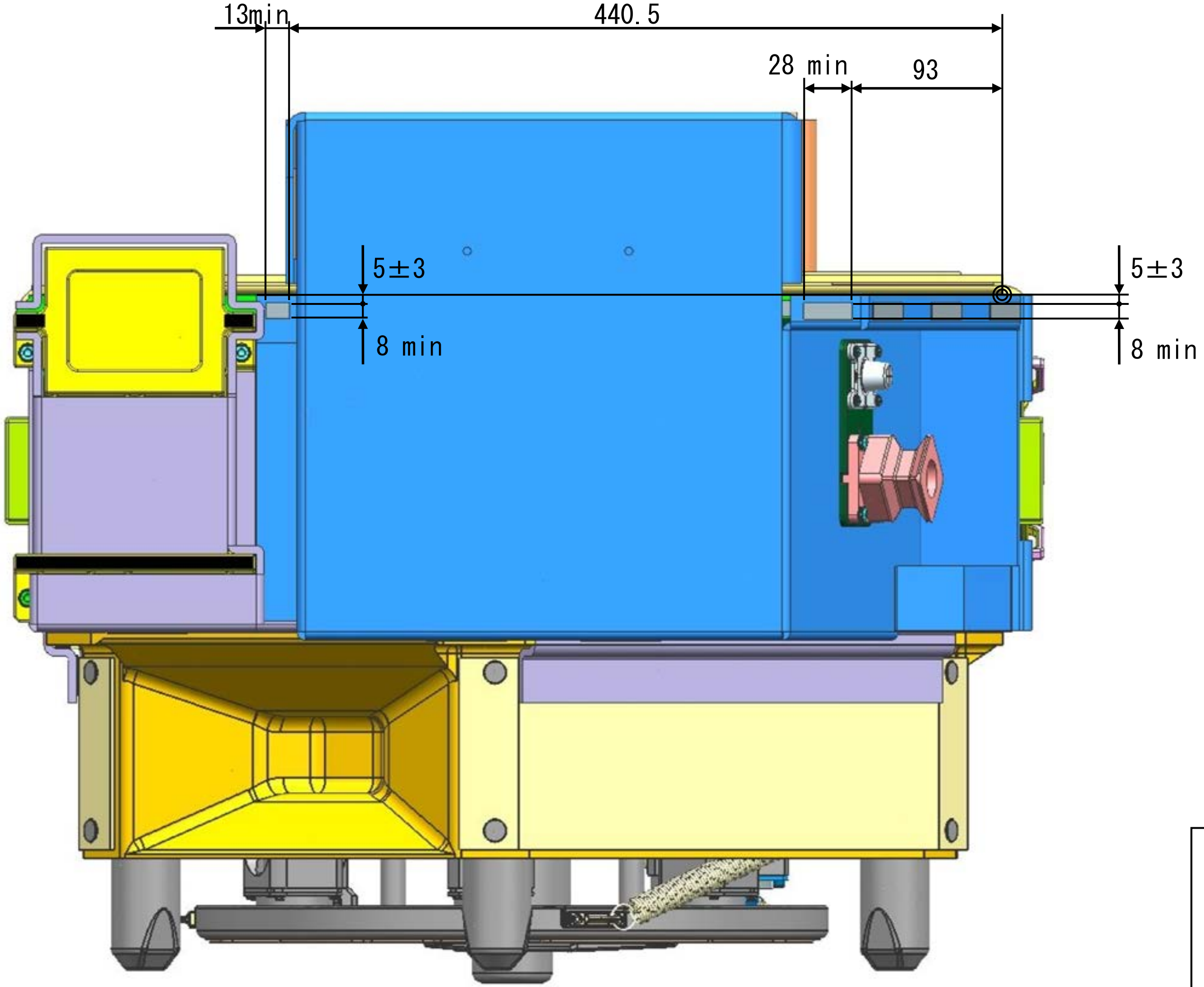


Tolerance in size without particular instructions is ±10.
Unit: mm

Note) All Velcro on I/F shall be covered with MLI.

Figure 3.5.1-2 (9/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent payload (for attaching Payload 2)

Arrow View J

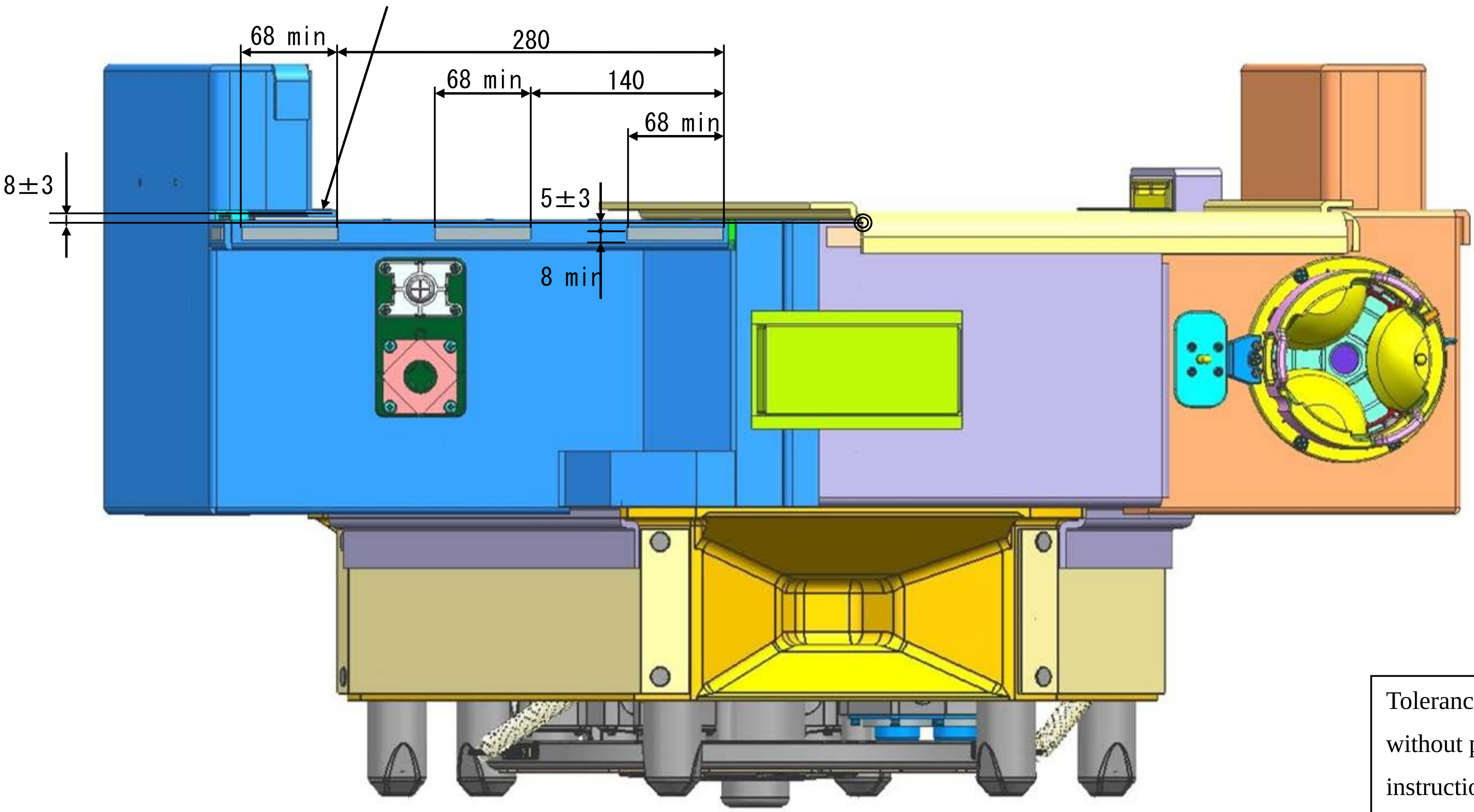


Tolerance in size without particular instructions is ±10. Unit: mm

Note) All Velcro on I/F shall be covered with MLI.

Figure 3.5.1-2 (10/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent payload (for attaching Payload 2)

Arrow View K

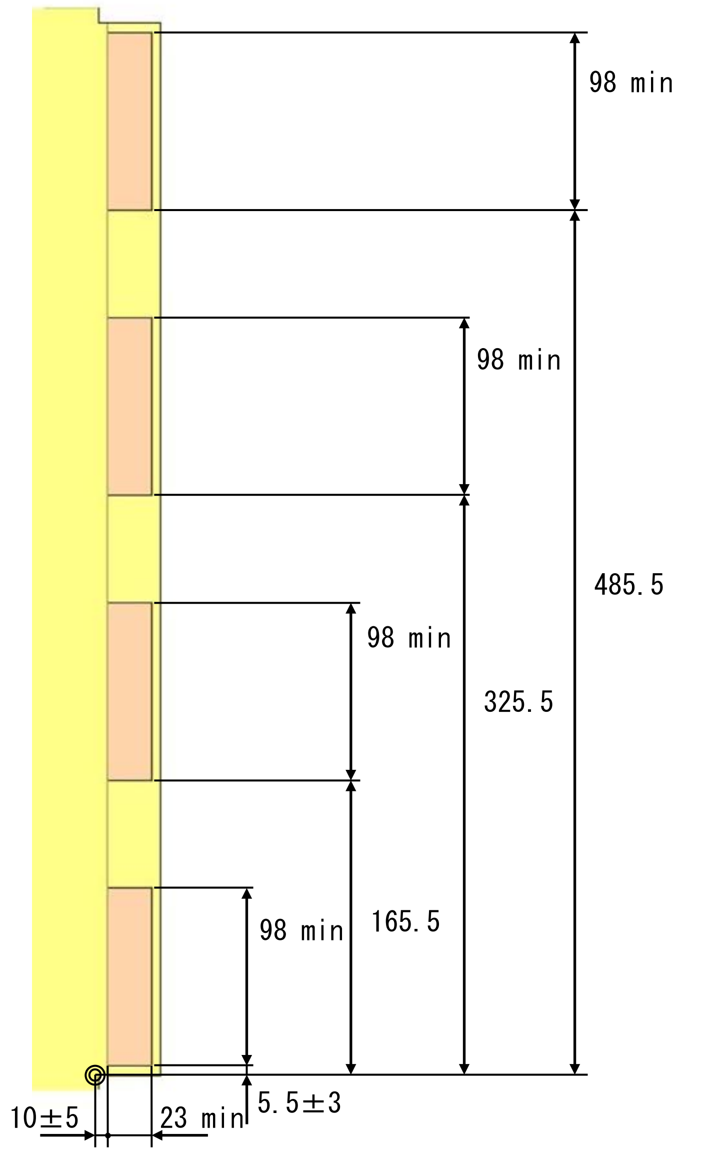


Tolerance in size without particular instructions is ±10.
Unit: mm

Note) All Velcro on I/F shall be covered with MLI.

Figure 3.5.1-2 (11/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent payload (for attaching Payload 2)

Cross section L-L



Note 1) This figure shows the Layout of Velcro (hook) prepared by Payload 1.

Note 2) All Velcro on I/F shall be covered with MLI.

Tolerance in size without particular instructions is ±10.
Unit: mm

Figure 3.5.1-2 (12/12) Layout of Velcro (loop) on the i-SEEP structure and interface of i-SEEP with MLI of adjacent payload (for attaching Payload 2)

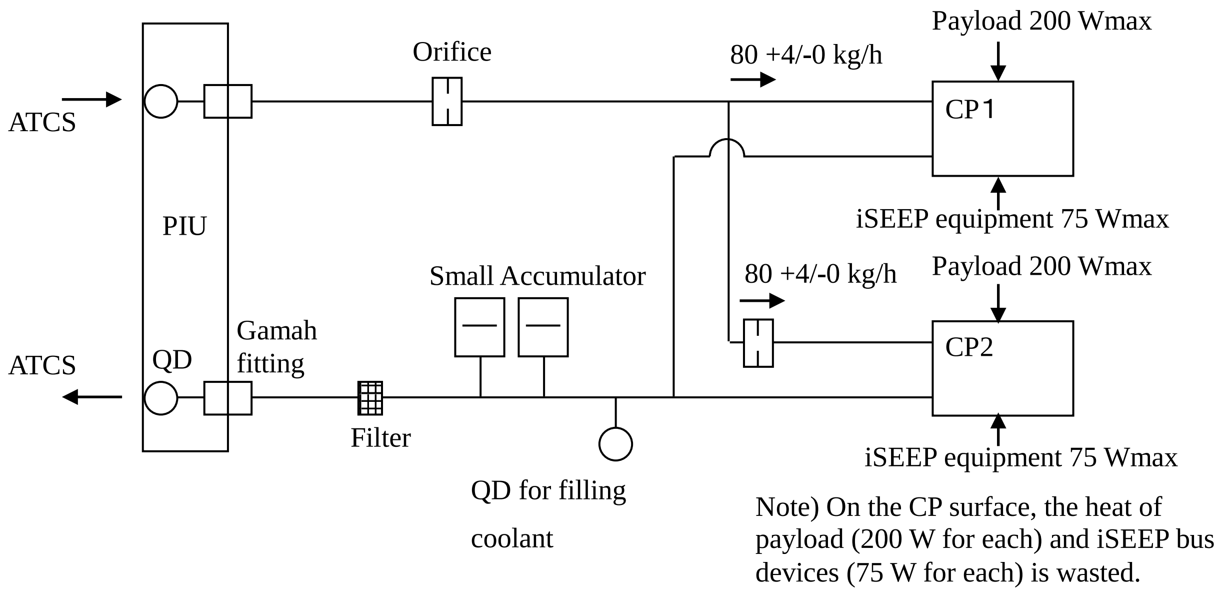


Figure 3.5.2-1 i-SEEP ATCS schematics

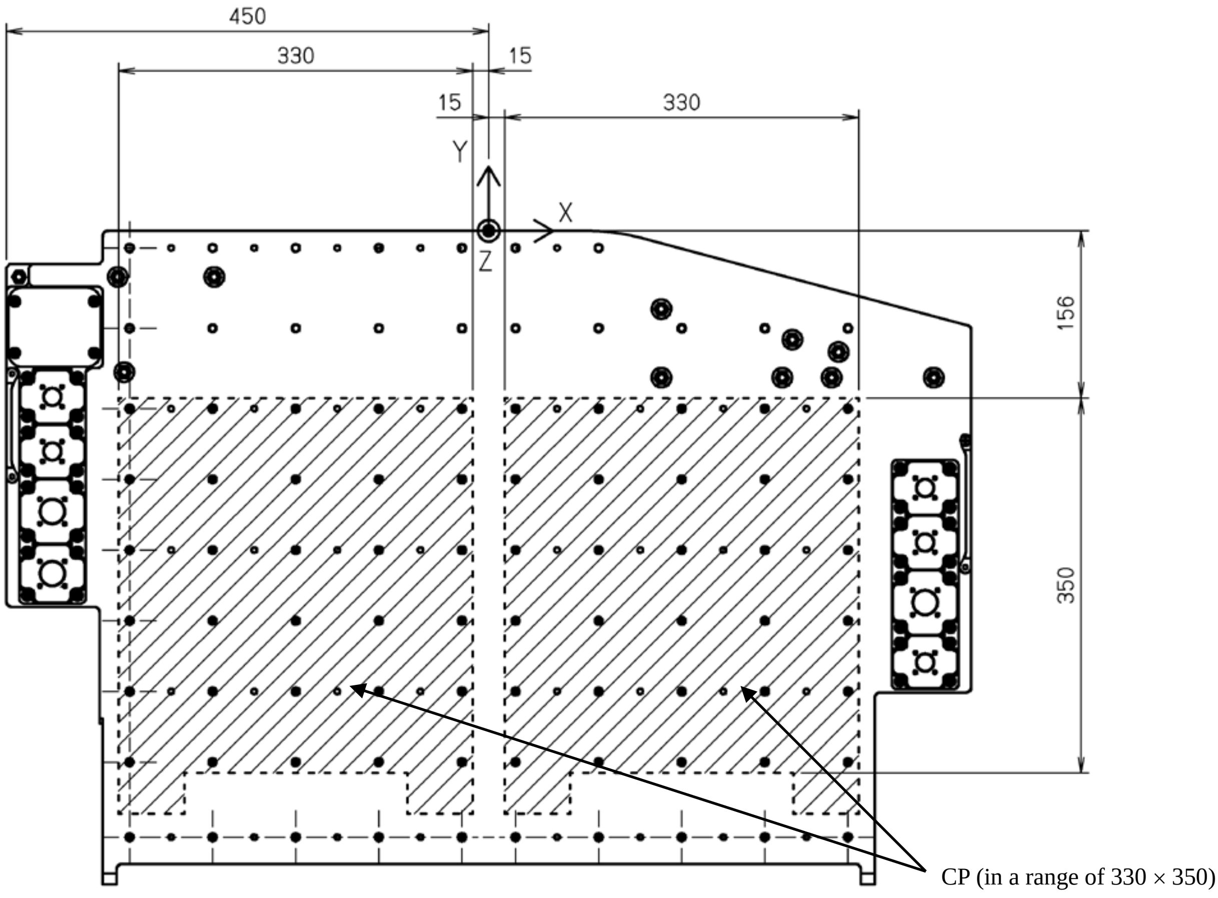


Figure 3.5.2-2 Layout of CP on the rear side of Payload attachment plate

Unit: mm

3.6 Environmental interface

The general natural environment shall be in accordance with the JCX-95068 JEM Environmental Design Standard.

Payload shall have tolerance to the environmental conditions provided in the items below.

3.6.1 Vibration and acceleration speed

(1) At launch

According to SSP50835, "ISS Pressurized Volume Hardware Common Interface Requirements Document," payload shall have a tolerance to a load environment corresponding to that of the launch vehicle (including the random vibration environment).

(2) On-orbit acceleration

(a) Acceleration on the JEM Airlock table and EF: 2.0 m/sec^2 at maximum

(b) Acceleration at emergency stop during transfer of the JEMRMS:

At the emergency stop of the small fine arms, payload will have an acceleration environment up to 500 mm/s^2 and 55deg/s^2 in any direction, with the coordinate system origin for the small fine arm payload being fixed.

At the emergency stop of the main robotic arm, payload will have an acceleration environment up to 950 mm/s^2 and 18deg/s^2 in any direction, with the coordinate system origin for the small fine arm payload being fixed.

Angular acceleration shall be loaded around the coordinate system origin for the small fine arm payload as the rotation center.

3.6.2 Crew induced load

Limit load of 556N and ultimate load of 778N shall apply to the IVA load (Table 4.5.2-2 of JCX-95068).

Quasi-static concentrated load of 556N shall apply to the EVA load (Table 4.5.2-1 of JCX-95068).

In case that withstanding the loads is inappropriate for the mission purpose, PD shall coordinate with the NASA Crew Office.

3.6.3 Collision load

(1) During transfer of i-SEEP by the robotic arm

Table 3.6.3-1 shows the collision speeds in case of inadvertent movement of the joint of the small fine arm. The collision energy, calculated from these velocities and the mass of i-SEEP (presumed to weigh up to 300 kg) and equivalent mass of the small fine arm tip (50 kg), is loaded onto any points on the surface of the payload in the range of R400 mm from the X-axis of the coordinate system for the small fine arm payload.

Collision energy up to 5.5 J occurs during inadvertent movement of the main arm.

Table 3.6.3-1 Collision speeds during inadvertent movement of the small fine arm

Vx max (mm/s)	Vy max (mm/s)	Vz max (mm/s)
83.7	431	328

* The direction of velocity depends on the coordinate system for the small fine arm payload.

(2) i-SEEP on JEM EF

When the main arm berth or unberth an exposued payload to the adjacent EFU, collision energy to the payload on i-SEEP is up to 5.5 J.

3.6.4 Pressure environment

(a) Maximum pressure

For the maximum pressure at the launch of a specific launch vehicle, see SSP50835, “ISS Pressurized Volume Hardware Common Interface Requirements Document.”

The maximum pressure inside the ISS is shown below. The pressure in the JEM Airlock (when depressurized) and outside is 0 [Pa].

- Inside the ISS: 104.8 [kPa]

(b) Rate of pressure change

For the rate of pressure change at the launch of a specific launch vehicle, see SSP50835, “ISS Pressurized Volume Hardware Common Interface Requirements Document.”

The rate of pressure change inside the ISS is as follows:

- Inside the ISS : 0.878 [kPa/sec] (7.64 [psi/min])
- In JEM Airlock: 1.0 [kPa/sec] (8.7 [psi/min])

3.6.5 Thermal environment

For the thermal environment at the launch of a specific launch vehicle, see SSP50835, "ISS Pressurized Volume Hardware Common Interface Requirements Document."

The environmental temperature inside the ISS is as follows:

- Inside the ISS: +16.7 - +29.4 [˚C]

Payload shall meet the following requisites regarding the external thermal environment where payload is exposed outside the JEM on the ISS.

(a) Payload shall exhibit its performance even when exposed to solar radiation, albedo, Earth's infrared radiation, and space background temperature of 3K.

(b) Payload shall not cause any hazard even when exposed to solar radiation, albedo, Earth's infrared radiation, and space background temperature of 3K as prescribed in Table 3.6.5-2.

Table 3.6.5-3 shows the attitude conditions of the ISS.

Table 3.6.5-1 External thermal environment conditions (nominal)

Condition (1, 2)	ALBEDO	OLR (W/m^2)
Cold A	0.27	217
Cold B	0.22	241
Mean	0.27	241
Hot A	0.27	273
Hot B	0.35	241
Solar Constants (W/m^2) Cold 1321 Mean 1371 Hot 1423		
Notes: (1) Values in this table are expected to be exceeded no more than 0.5 percent of the time. Albedo and OLR are adjusted to the top of the atmosphere (30-kilometer altitude). (2) Both Set A and Set B are design requirements. Set A represents worst-case OLR values with corresponding albedo values. Set B represents worst-case albedo values with corresponding OLR values.		

Table 3.6.5-2 External thermal environment conditions (extreme)

Condition (1, 2)		ALBEDO	OLR (W/m^2)
Cold	A	0.27	206
	B	0.20	241
Hot	A	0.30	286
	B	0.40	241

Notes:

(1) Values in this table are expected to occur no more than 0.05 percent of the time. Albedo and OLR are adjusted to the top of the atmosphere (30-kilometer altitude).

(2) Both Set A and Set B are design requirements. Set A represents worst-case OLR values with corresponding albedo values. Set B represents worst-case albedo values with corresponding OLR values.

Table 3.6.5-3 ISS attitude conditions

Flight attitude	Solar β angle	Yaw, Pitch, Roll angle	Time limit
+XVV Z Nadir	-75° ≤ β ≤ +75°	-15° to +15° (yaw) +15° to -20° (pitch) -15° to +15° (roll)	Continuous (No limit)
+ZVV -X Nadir	-75° ≤ β ≤ +75°	-15° to +15° (yaw) +75° to +105° (pitch) -15° to +15° (roll)	3 hours
-ZVV -X Nadir	-75° ≤ β ≤ +75°	+165° to +195° (yaw) +75° to +105° (pitch) -15° to +15° (roll)	3 hours
+YVV Z Nadir	-55° ≤ β ≤ +10°	-97° to -87° (yaw) -9° to +1° (pitch) -5° to +5° (roll)	100 hours per year
-YVV Z Nadir	-10° ≤ β ≤ + 55°	84° to 94° (yaw) -9° to +1° (pitch) -5° to +5° (roll)	100 hours per year
-XVV Z Nadir	-75° ≤ β ≤ +75°	+165° to +195° (yaw) -20° to +15° (pitch) -15° to +15° (roll)	168 hours per year

3.6.6 Humidity environment

For the humidity environment at the launch of a specific launch vehicle, see SSP50835, "ISS Pressurized Volume Hardware Common Interface Requirements Document."

The humidity environment inside the ISS is as follows:

- Inside the ISS: Dew point +4.4 - +15.6 [˚C] and relative humidity 25 - 75 [%]

3.6.7 Static electricity environment

The static electricity environment during on-orbit operation shall be in accordance with SSP30243.

3.6.8 Electromagnetic induction, ionizing radiation, and plasma environment

The electromagnetic induction, ionizing radiation, and plasma environment shall meet the requirements specified in SSP30420.

3.6.8.1 Induced current from exposed equipment to i-SEEP

During the operation (experiment), induced current of 0.25 mA or higher shall not be applied to the i-SEEP structure from payload that induces current to the i-SEEP structure.

3.6.8.2 Induced potential of payload to floating potential of JEM EF

During the operation (experiment), voltage of ±1 V or higher shall not be applied to the floating potential of the JEM EF from payload that induces voltage changes in the floating potential of the JEM EF.

3.6.9 Internal contamination environment

Visibly Clean, Level Sensitive as defined by SN-C-0005 shall apply.

3.6.10 External contamination environment

Table 3.6.10-1 shall apply.

Table 3.6.10-1 External contamination environment

Source: SSP30426D, SS Ext Contami Control Reqts

	Quiescent period	Nonquiescent period
Molecular Column Density (MCD)	1.0×10^{14} molecular/cm^2 for each species*	N/A
Molecular Deposition (MD)	1.0×10^{-14} g/cm^2/sec (Daily average)	1.0×10^{-6} g/cm^2/year
Particulate Background (PB)	1 particle 100 microns or larger per orbit per 1×10^{-5} steradian field of views seen by a 1 meter diameter aperture telescope	N/A

*) The target shall be the contaminants specified in 3.3.7.2 of SSP41002D ISPR to NASA/ESA/NASDA Modules ICD.

3.7 Safety assurance requirements for payload

Payload shall remain safe in a condition that combines any of the following (without causing a hazard).

- When power supply to the payload stops
- When ATCS coolant supply to i-SEEP stops
  (when waste heat from the payload to i-SEEP cold plates stops)

3.8 Others: Interface requirements

3.8.1 IVA interface

When the checkout of payload inside the JEM is planned, PD shall coordinate with the i-SEEP side.

3.8.2 EVA interface

Any operation or design that requires EVA operation is not allowed.

However, payload shall have designs conforming to the requirements for kick load and sharp edges as specified in the documents below, to respond to EVA in case of a contingency.

- SSP50005, “ISS Flight Crew Integration Standards”
- SSP30256:001, “Extravehicular Activity System Standard ICD”

3.8.3 Robotics interface

Robotics operations to be conducted solely by payload shall not, in principle, be planned.

4. Safety and Product Assurance Requirements

4.1 General safety requirements

Safety design shall be carried out in accordance with SSP 51700, “Payload Safety Policy and Requirements for the International Space Station.” A Safety Assessment Report on safety from the launch of payload through completion of the operation shall also be prepared and approved at the safety review by JAXA.

4.2 EEE parts-related requirements

The Electrical, Electronic, and Electromechanical parts (EEE Parts) used for payload shall be selected and controlled in accordance with CR-99050, “JEM EEE Parts Control Plan.” According to the above document, an As-Designed Parts List (ADPL) and EEE parts applicability analysis report shall be prepared and approved by JAXA.

4.3 Material and process requirements

Materials and processes for payload shall be selected and controlled in accordance with CR-99117, “JAXA Requirements for ISS Program Materials and Process,” in order to provide tolerance to the environment where the payload will be used and prevent any impact on the ISS environment.

According to the above document, a Material Identification and Usage List (MIUL) that lists all materials used for the payload shall be prepared and approved by JAXA.

(EOF)

Appendix-1 Data on Waste Heat Properties (Test Results)

1. Objective

This appendix summarizes the test results of i-SEEP simulation that examined the waste heat properties on the payload attachment surface using cold plates on which dummy waste heat payloads were mounted.

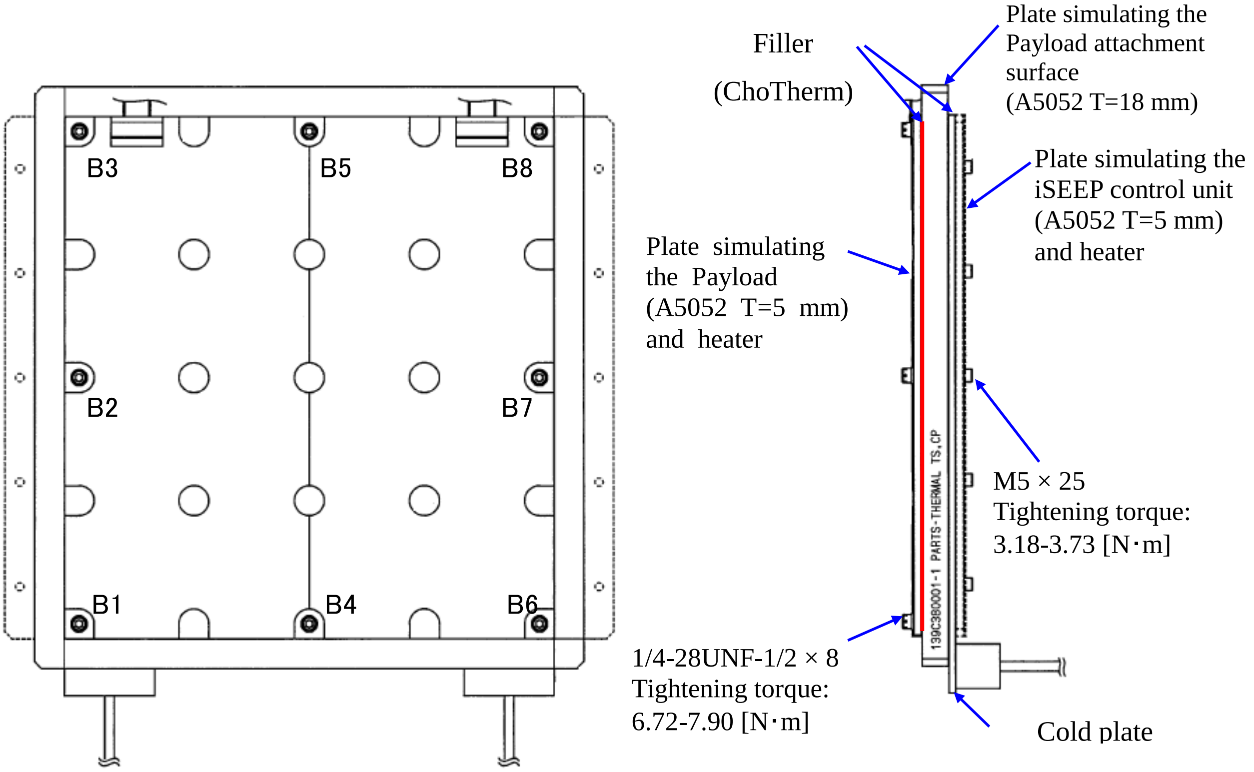
2. Test conditions

The test was conducted on two cold plates.

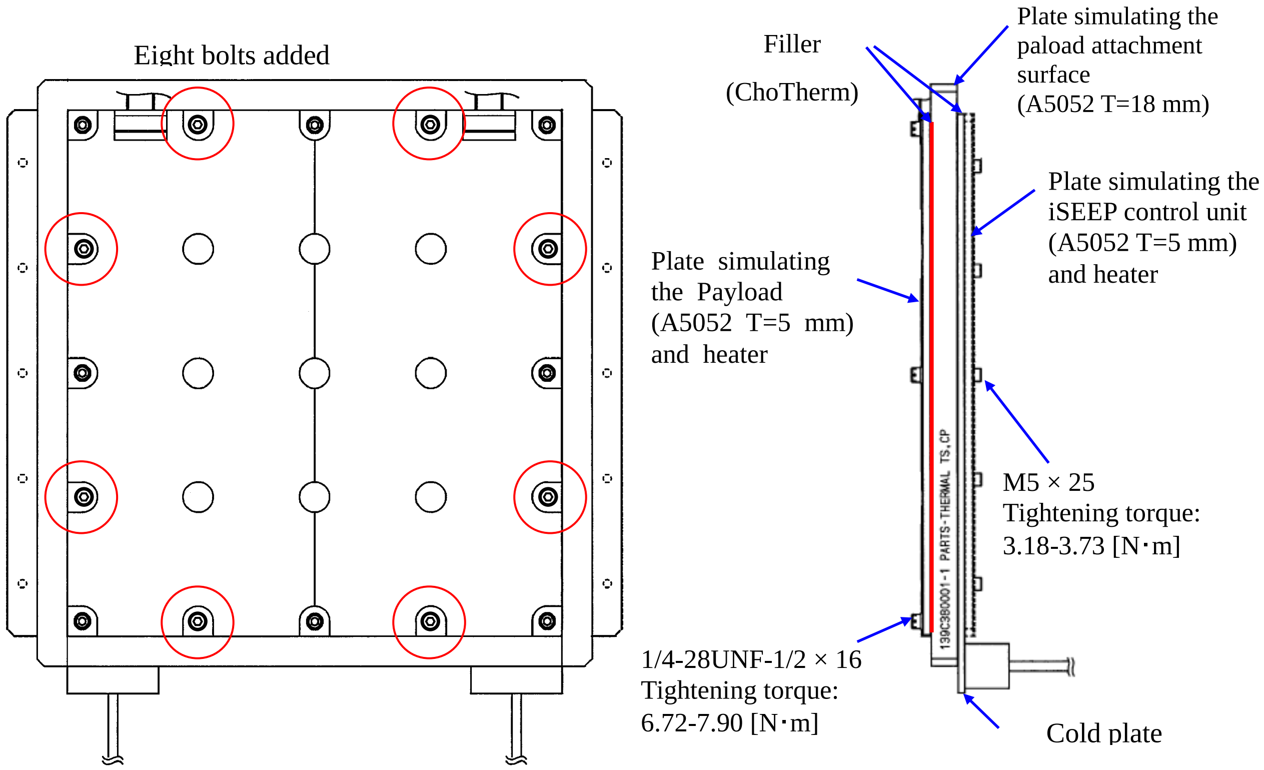
Figure 2-1 shows the cold plates with dummy waste heat payloads mounted; Figure 2-2 shows the temperature measurement points; and Table 2-1 lists the test conditions.

3. Test results

Table 3-1 summarizes the overall test results; Table 3-2 shows summaries of each test case.

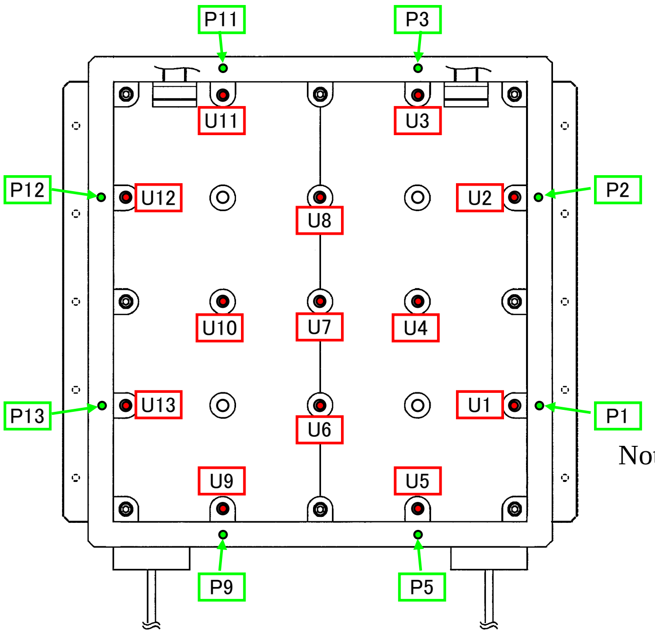


When eight bolts were used to attach the plate simulating the Payload



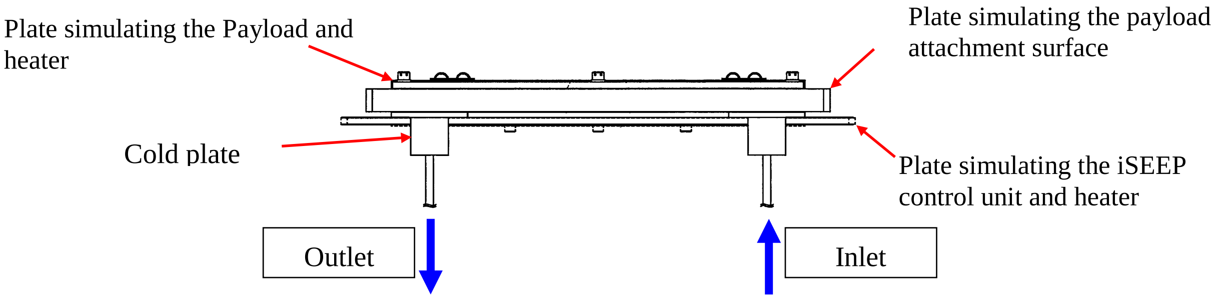
When 16 bolts were used to attach the plate simulating the Payload

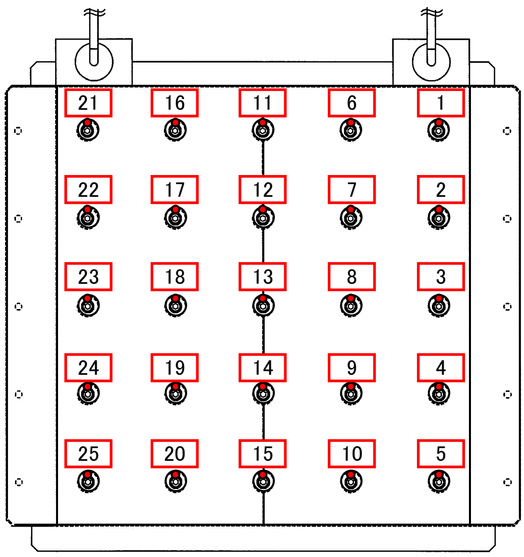
Figure 2-1 Dummy waste heat payload mounted on cold plates



Note) UN on the plate simulating the payload; PN on the plate simulating the paylaod attachment surface

Thermocouple placement on the plate simulating the payload





Thermocouple placement on the plate simulating the iSEEP control unit

Figure 2-2 Points of temperature measurement

Table 2-1 Test conditions for waste heat properties

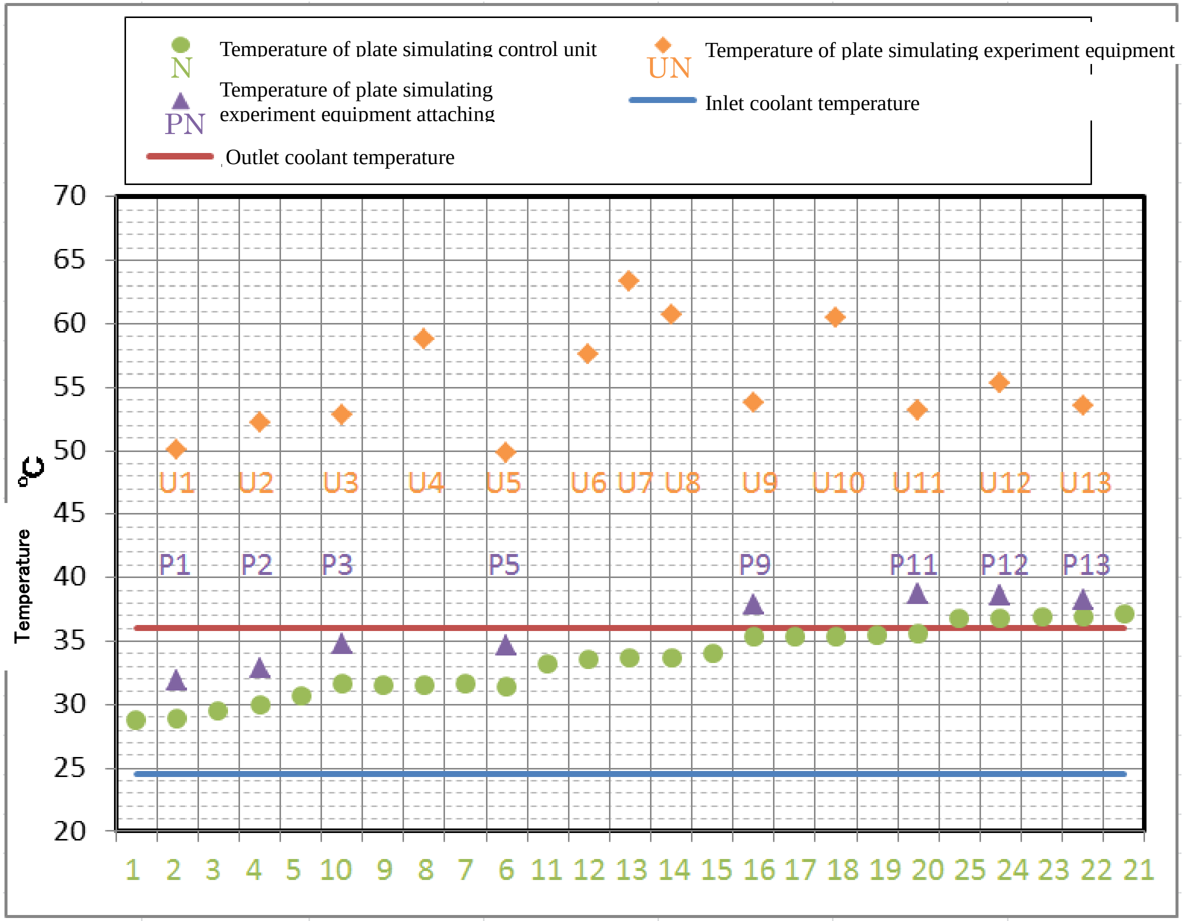
	No.	Environment	Temperature at coolant inlet	Flow rate	Heat input at control unit simulation side	Heat input at experiment equipment simulation side	Note
Cold Plate 1	1-1	Room temp. & Vacuum (less than 1.3 × 10-2 [Pa]{1 × 10-4[Torr]})	24 ℃	80 kg/hr	80 W	200 W	Conditions simulating heat generated at maximum, 8 bolts for attaching payload.
	1-2		24 ℃	80 kg/hr	80 W	100 W	Conditions simulating heat generated at 50 % of maximum, 8 bolts for attaching payload
	1-3		24 ℃	80 kg/hr	80 W	50 W	Conditions simulating heat generated at 25 % of maximum, 8 bolts for attaching payload
	1-4		24 ℃	80 kg/hr	80 W	200 W	Conditions with heat input of heat generated at maimum only on one side (coolant exit) on the payload simulation side, 8 bolts for attaching payload
Cold Plate 2	2-1		24 ℃	80 kg/hr	80 W	200 W	Conditions simulating heat generated at maimum, 8 bolts for attaching payload
	2-2		24 ℃	80 kg/hr	80 W	200 W	Conditions simulating heat generated at maimum, 16 bolts for attaching payload

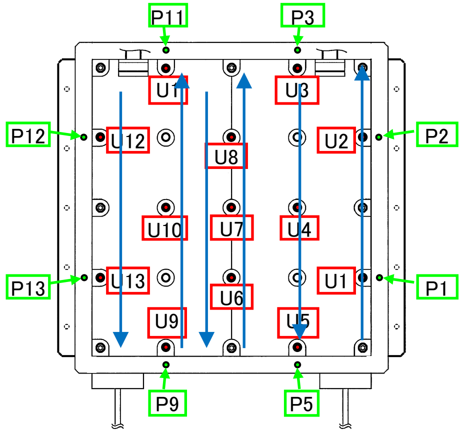
Table 3-1 Summary of test results of waste heat properties

				1−1	1−2	1−3	1−4	2−1	2−2
	Test case No.			1−1	1−2	1−3	1−4	2−1	2−2
Test conditions	CP flow		[kg/h]	80±1	80±1	80±1	80±1	80±1	80±1
	Heater's power of plate simulating control unit		[W]	80	80	80	80	80	80
	Heater's power of plate simulating experiment equipment		[W]	200	100	50	200 (At	200	200
Test result	Pressure in chamber		[Torr]	2.3×10^{-5}	1.9×10^{-5}	1.8×10^{-5}	1.8×10^{-5}	2.3×10^{-5}	4.4×10^{-5}
	Pressure in chamber		[Pa]	3.1×10^{-3}	2.5×10^{-3}	2.4×10^{-3}	2.4×10^{-3}	3.1×10^{-3}	5.9×10^{-3}
	CP flow		[kg/h]	80	79.7	79.9	79.9	79.8	80.1
	Inlet fluid temperature		[°C]	24.6	24.6	24.4	24.4	25.4	25.4
	Outlet fluid temperature		[°C]	36.1	32.0	29.8	35.9	36.9	37.0
	Heater on plate simulating control unit	Voltage	[V]	44.3	44.3	44.3	44.3	44.9	44.9
		Current	[A]	1.9	1.9	1.9	1.9	1.9	1.9
		Power	[W]	81.1	80.9	81.4	80.9	81.0	81.1
	Heater on plate simulating experiment equipment	Voltage	[V]	72.3	50.8	35.9	102.5	72.6	72.3
		Current	[A]	2.8	2.0	1.4	2.0	2.8	2.8
		Power	[W]	200.7	101.3	50.9	200.6	200.6	201.1
	Temperature of plate simulating control unit	1	[°C]	28.8	27.7	26.9	28.3	29.3	29.3
		2	[°C]	28.9	27.7	26.9	28.2	29.6	29.7
		3	[°C]	29.6	28.1	27.2	28.5	30.2	30.3
		4	[°C]	30.0	28.3	27.3	28.6	30.7	30.8
		5	[°C]	30.8	28.9	27.8	29.0	31.4	31.6
		6	[°C]	31.5	29.4	28.2	30.1	31.9	32.1
		7	[°C]	31.7	29.6	28.3	30.2	32.1	32.2
		8	[°C]	31.5	29.4	28.2	30.0	32.0	32.2
		9	[°C]	31.6	29.5	28.2	29.9	32.2	32.4
		10	[°C]	31.7	29.5	28.3	29.9	32.4	32.6
		11	[°C]	33.3	30.8	29.2	32.6	34.2	34.2
		12	[°C]	33.6	30.9	29.3	32.6	34.2	34.2
		13	[°C]	33.7	31.0	29.3	32.5	34.3	34.3
		14	[°C]	33.7	31.0	29.2	32.4	34.4	34.4
		15	[°C]	34.1	31.2	29.4	32.6	34.8	34.8
		16	[°C]	35.4	31.9	30.1	34.5	36.0	36.2
		17	[°C]	35.4	31.9	30.1	34.6	35.8	36.0
		18	[°C]	35.4	31.9	30.1	34.5	35.9	36.0
		19	[°C]	35.5	32.0	30.1	34.5	36.2	36.2
		20	[°C]	35.7	32.2	30.2	34.6	36.5	36.7
		21	[°C]	37.1	33.1	31.0	37.6	37.9	38.0
		22	[°C]	37.0	33.0	30.7	37.2	37.7	37.8
		23	[°C]	36.9	33.0	30.7	36.9	37.7	37.7
		24	[°C]	36.9	32.9	30.7	36.4	37.4	37.6
		25	[°C]	36.9	32.9	30.8	36.3	37.5	37.5
	Temperature of plate simulating experiment equipment	U1	[°C]	50.1	38.3	32.5	37.4	50.6	35.3
		U2	[°C]	52.2	39.4	33.0	38.2	53.0	36.9
		U3	[°C]	52.8	39.8	33.3	40.9	53.0	39.0
		U4	[°C]	58.8	43.1	34.9	46.0	60.1	51.6
		U5	[°C]	49.8	38.4	32.5	39.1	49.0	36.2
		U6	[°C]	57.6	42.6	34.9	56.0	59.0	51.1
		U7	[°C]	63.4	45.5	36.4	62.5	64.9	56.6
		U8	[°C]	60.8	44.2	35.6	58.8	62.2	53.6
		U9	[°C]	53.8	40.7	34.0	63.1	52.7	40.5
		U10	[°C]	60.5	44.1	35.7	70.1	61.8	54.0
		U11	[°C]	53.2	40.4	34.0	61.9	53.2	40.9
		U12	[°C]	55.3	41.6	34.6	66.7	55.9	42.9
		U13	[°C]	53.5	40.7	34.2	64.0	54.2	42.0
	Temperatre of plate simulating experiment equipment attaching surface	P1	[°C]	31.9	28.9	27.3	29.3	32.4	32.8
		P2	[°C]	32.9	29.7	27.9	30.1	33.5	34.1
		P3	[°C]	34.8	30.8	28.6	32.6	35.6	36.0
		P5	[°C]	34.6	30.6	28.5	32.6	35.0	34.9
		P9	[°C]	37.9	32.7	30.2	38.5	37.9	38.4
		P11	[°C]	38.7	33.1	30.4	39.4	39.2	39.1
		P12	[°C]	38.6	33.3	30.6	39.9	38.8	39.5
		P13	[°C]	38.2	33.0	30.0	39.6	39.1	39.0

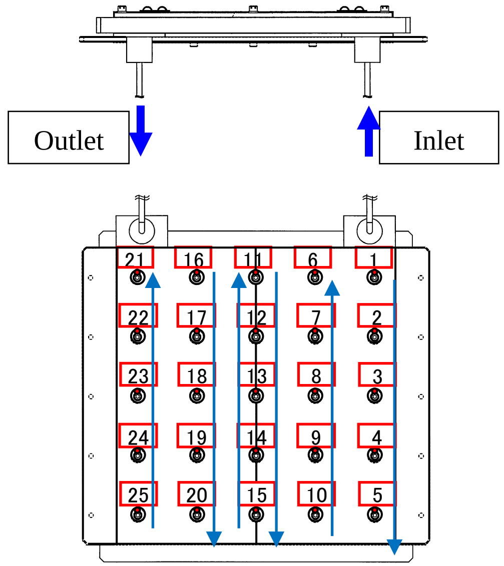
Table 3-2 (1/6) Summaries of test case results

Test case: 1-1	
Coolant flow: 79.8 kg/h	
Heat value generated by the heater on a plate simulating the base plate: 81.1 W	
Heat value generated by the heater on a plate simulating payload: 200.7 W	





Thermocouple placement on the plate simulating experiment equipment



Thermocouple placement on the plate simulating the control unit

Table 3-2 (2/6) Summaries of test case results

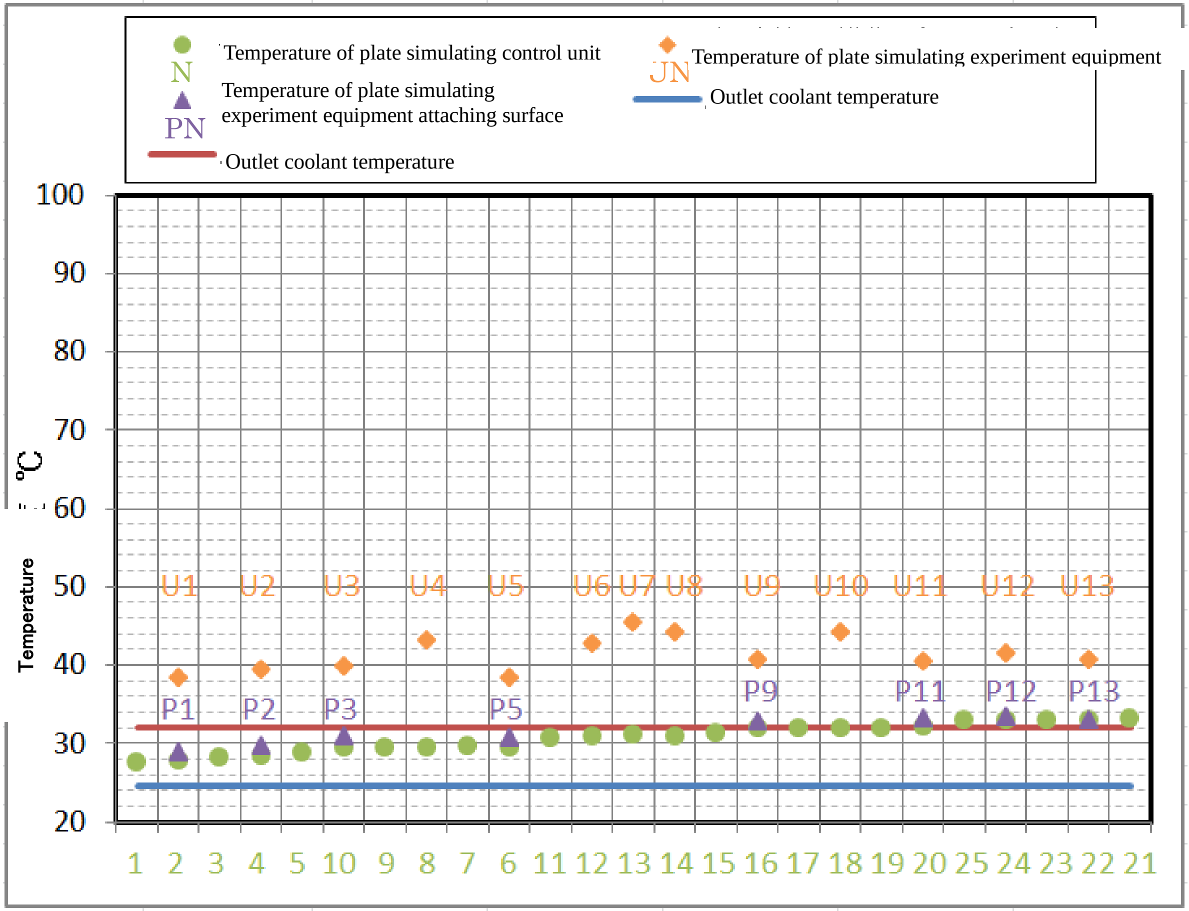
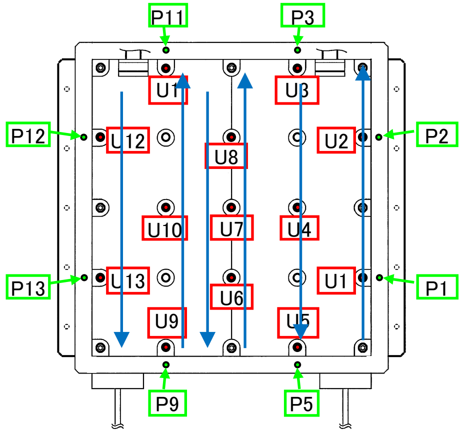
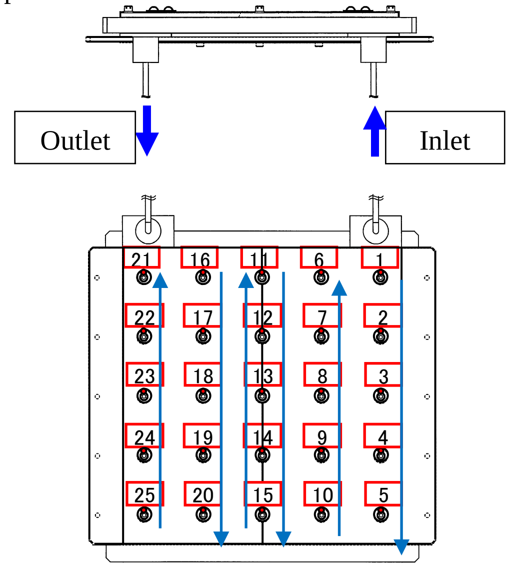
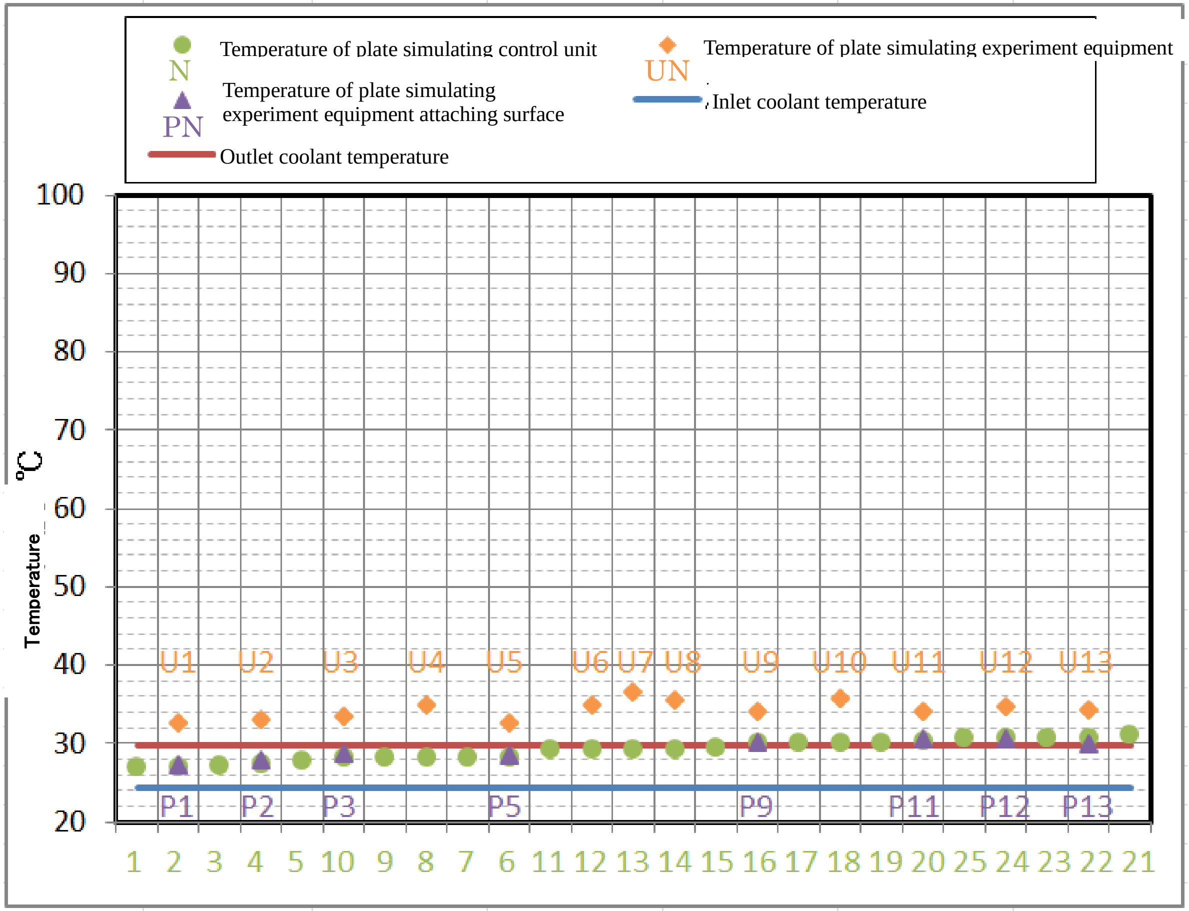
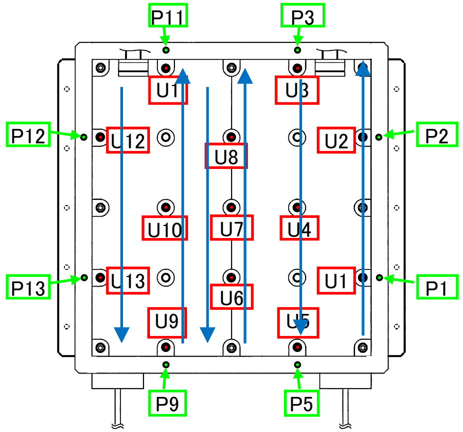
Test case: 1-2	
Coolant flow: 79.7 kg/h	
Heat value generated by the heater on a plate simulating the base plate: 80.94 W	
Heat value generated by the heater on a plate simulating payload: 101.28 W	
	 Thermocouple placement on the plate simulating experiment equipment  Thermocouple placement on the plate simulating the control unit

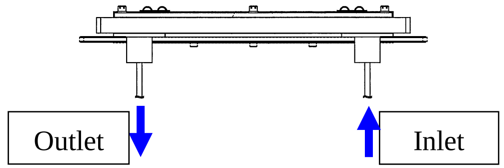
Table 3-2 (3/6) Summaries of test case results

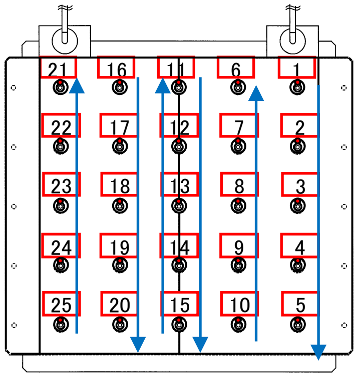
Test case: 1-3
Coolant flow: 79.9 kg/h
Heat value generated by the heater on a plate simulating the base plate: 81.36 W
Heat value generated by the heater on a plate simulating payload: 50.88 W





Thermocouple placement on the plate simulating experiment equipment





Thermocouple placement on the plate simulating the control unit

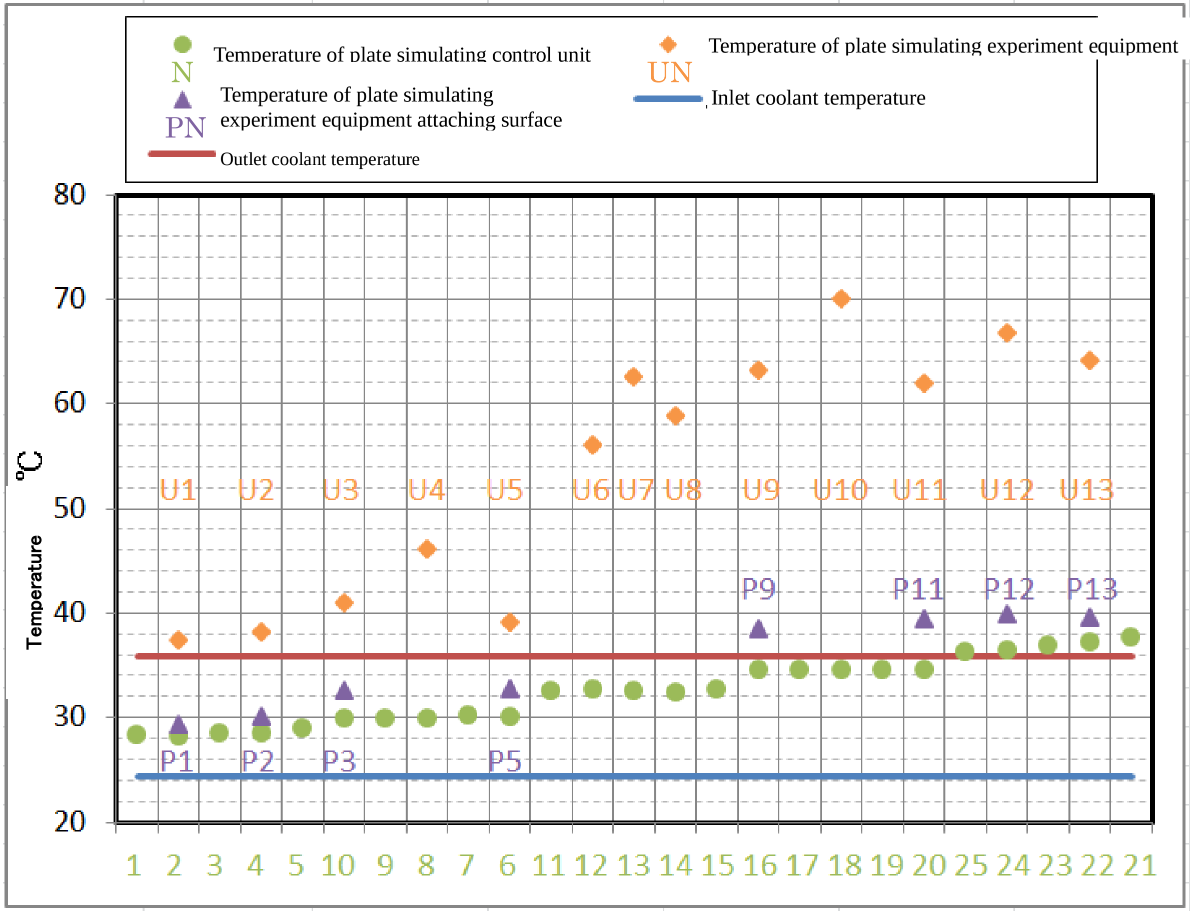
Table 3-2 (4/6) Summaries of test case results

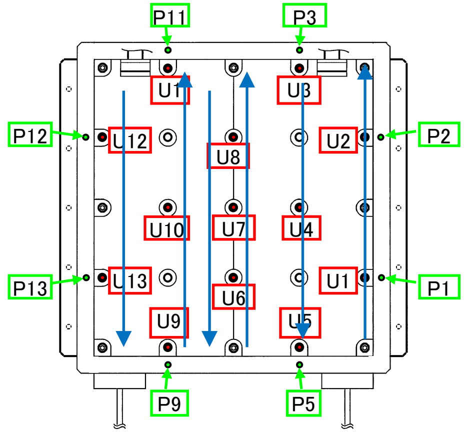
Test case: 1-4

Coolant flow: 79.9 kg/h

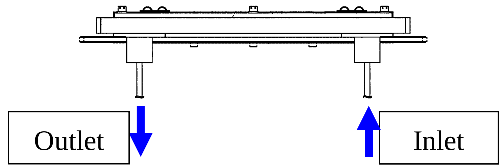
Heat value generated by the heater on a plate simulating the base plate: 80.92 W

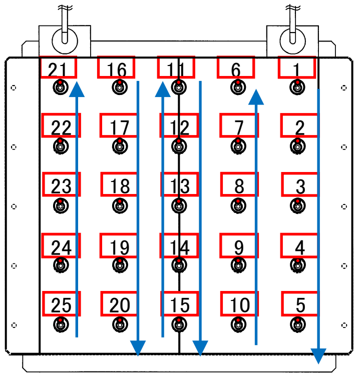
Heat value generated by the heater on a plate simulating payload: 200.60 W





Thermocouple placement on the plate simulating experiment equipment

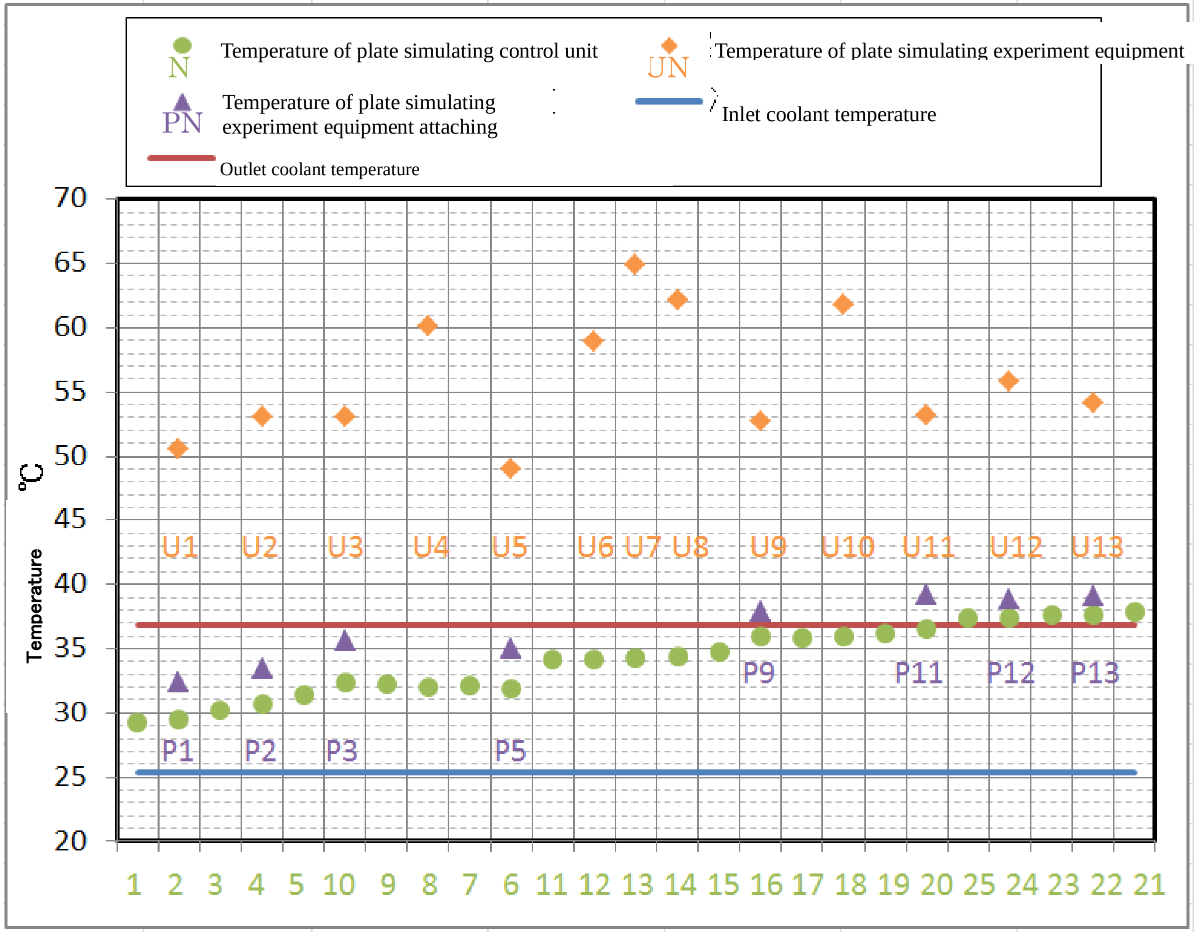


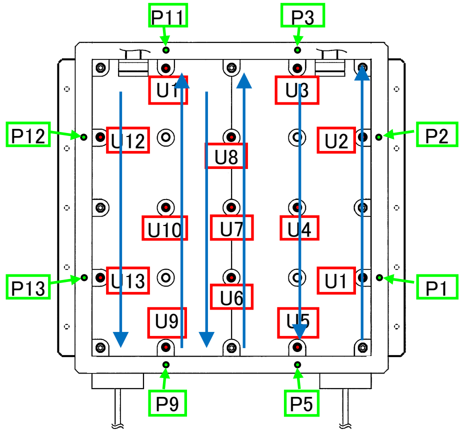


Thermocouple placement on the plate simulating the control unit

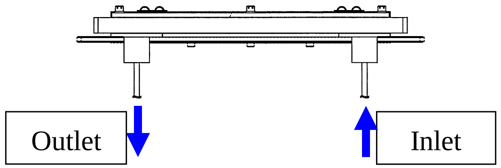
Table 3-2 (5/6) Summaries of test case results

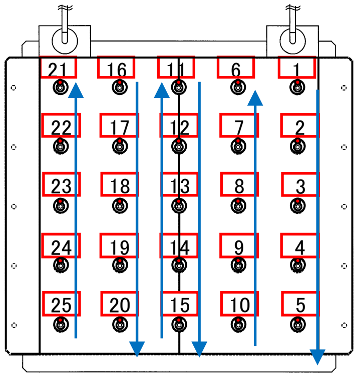
Test case: 2-1
Coolant flow: 79.8 kg/h
Heat value generated by the heater on a plate simulating the base plate: 81.0 W
Heat value generated by the heater on a plate simulating payload: 200.6 W





Thermocouple placement on the plate simulating experiment equipment





Thermocouple placement on the plate simulating the control unit

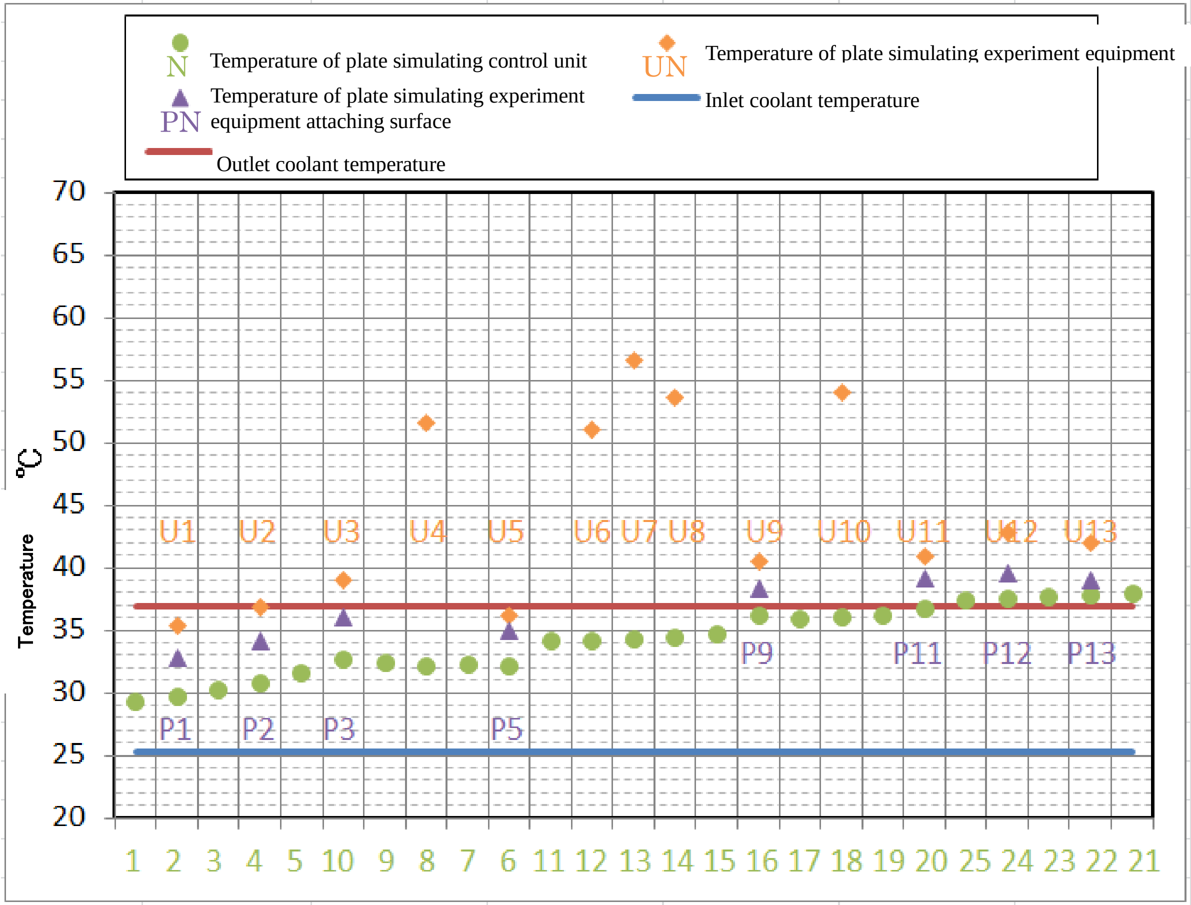
Table 3-2 (6/6) Summaries of test case results

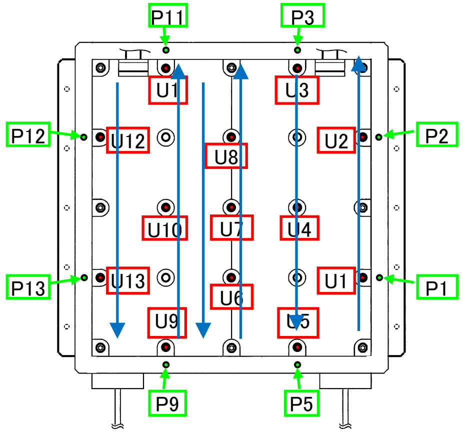
Test case: 2-2

Coolant flow: 80.1 kg/h

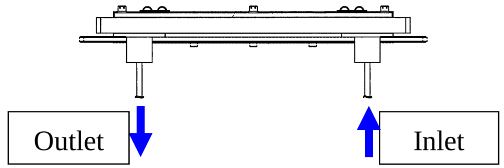
Heat value generated by the heater on a plate simulating the base plate: 81.1 W

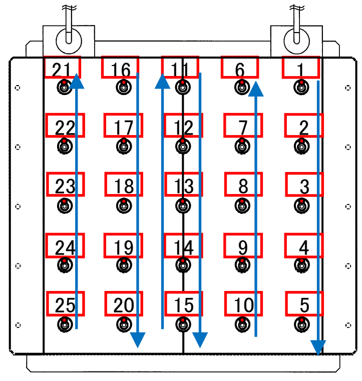
Heat value generated by the heater on a plate simulating payload: 201.1 W





Thermocouple placement on the plate simulating experiment equipment





Thermocouple placement on the plate simulating the control unit