MECHANICAL DESIGN of ACOP for PDR

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Mar. 2 , 2005

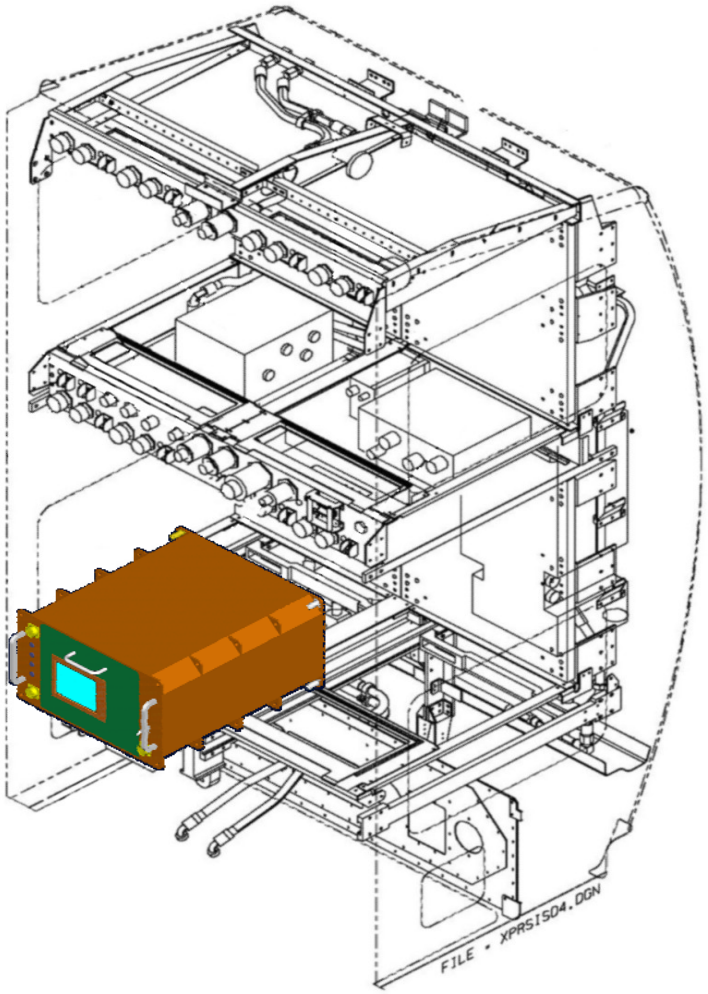
CSIST

OUTLINE

1. **Requirements and Constraint**
2. **Mechanical Architecture**
3. **Mechanical Design**
4. **Mechanical Interfaces**
5. **Crew Interfaces**
6. **Mass Budget**
8. **Improvements**

Requirements & Constraint
— Location

ACOP is installed in the location of MDL of EXPRESS Rack as shown in the figure and should blind mate with the back plate of the Rack.



Requirements & Constraint (Conti.1)

- **Dimension (SSP52000-IDD-ERP p3-18)**

  The ACOP envelope shall meet the Mid Deck Locker (MDL) form factor for STS aft flight deck transportation.

- **Payload Zero-G Requirement (SSP52000-IDD-ERP p3-14)**

  ACOP shall have a zero-G retention feature to prevent any equipment from floating out of the tray/locker during on-orbit activities.

Requirements & Constraint (Conti.2)

- **Main Electrical Parts**
  - **5 Compact PCI cards**
  - **1 Power supply**
  - **4 Hard Drives**
  - **1 LCD**
  - **Back plane**
  - **Cable harness**

Requirements & Constraint (Conti.3)

- **Accessibility to Hard Drives for Replacement**

  The four installed hard drives will require periodic replacement by the ISS crew from the onboard stock of empty drives. (Be replaced about every 20 days.)

- **Main Front Panel Requirement**

  Main front Panel shall be mounted with LCD Panel and can be opened with friction hinge. It is locked by four 1/4 turn fasteners and one magnetic latch .

Requirements & Constraint (Conti.4)

- **Fixed Front Panel Requirement**

  Fixed Front Panel shall be mounted with

  - Four Momentary Push Buttons

  - One Circuit Breaker On/Off Switch

  - One HRDL Connector

  - One Power Connector

  - One MRDL Connector with expansion 100bt and RS422

Requirements & Constraint (Conti.5)

- **Structural Load Factors And Analysis (SSP 52000-IDD-ERP & SSP52005)**

  ACOP structure shall meet the load factors defined in SSP 52000-IDD-ERP (chap.4) by using the methodology defined in SSP 52005.

- **Structural Safety Factor (SSP 52000-IDD-ERP Chap 4)**

  ACOP structural safety factor shall require 1.25 for yield, and 2.0 for ultimate.

Requirement & Constraint (Conti.6)

- **Structural First Natural Frequency (SSP 52000-IDD-ERP Chap. 4)**

  First natural frequency of ACOP shall exceed 35Hz.

- **Thermal Design And Limit (SSP 52000-IDD-ERP Chap. 5)**

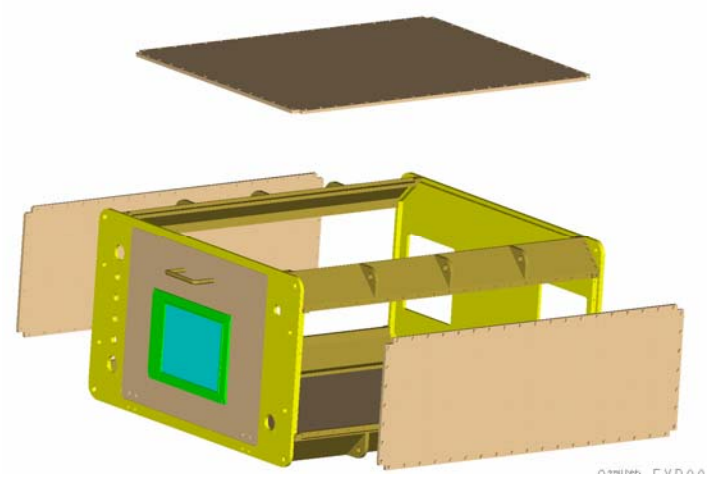
  ACOP shall meet the temperature limit in SSP 52000-IDD-ERP.

Mechanical Architecture

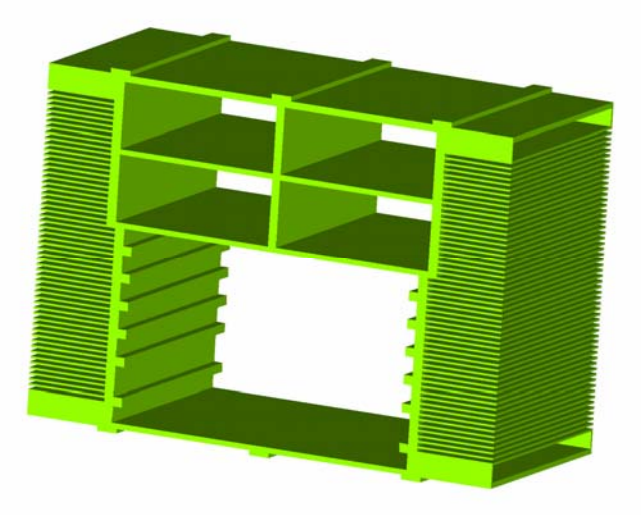
—— Main Structure Parts

Mechanical structure of ACOP is mainly constructed by an outer structure (LOCKER) and an inner structure (CHASSIS) ，LOCKER will be mounted to the back plate of the RACK and CHASSIS will support the electric components.

LOCKER

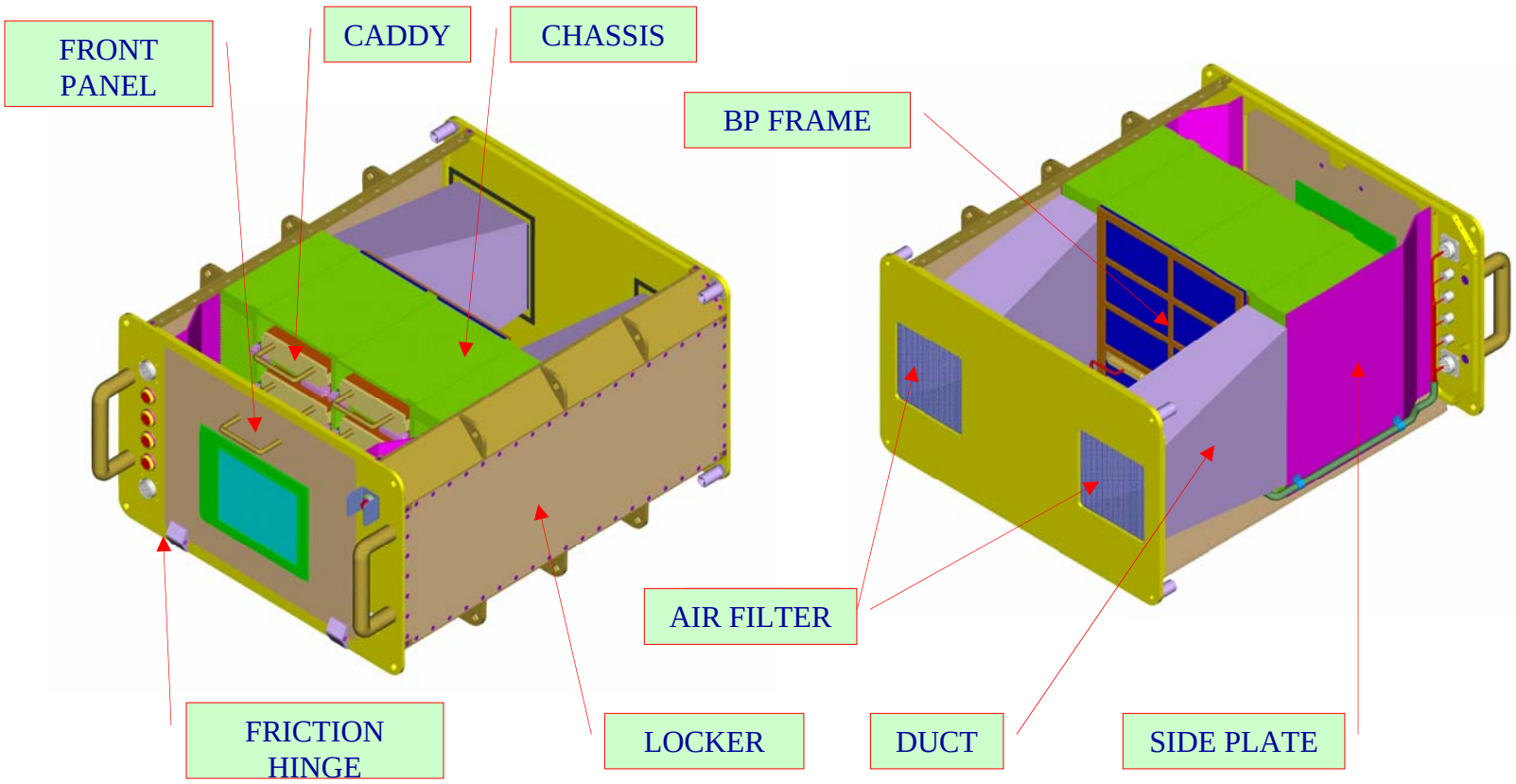


CHASSIS



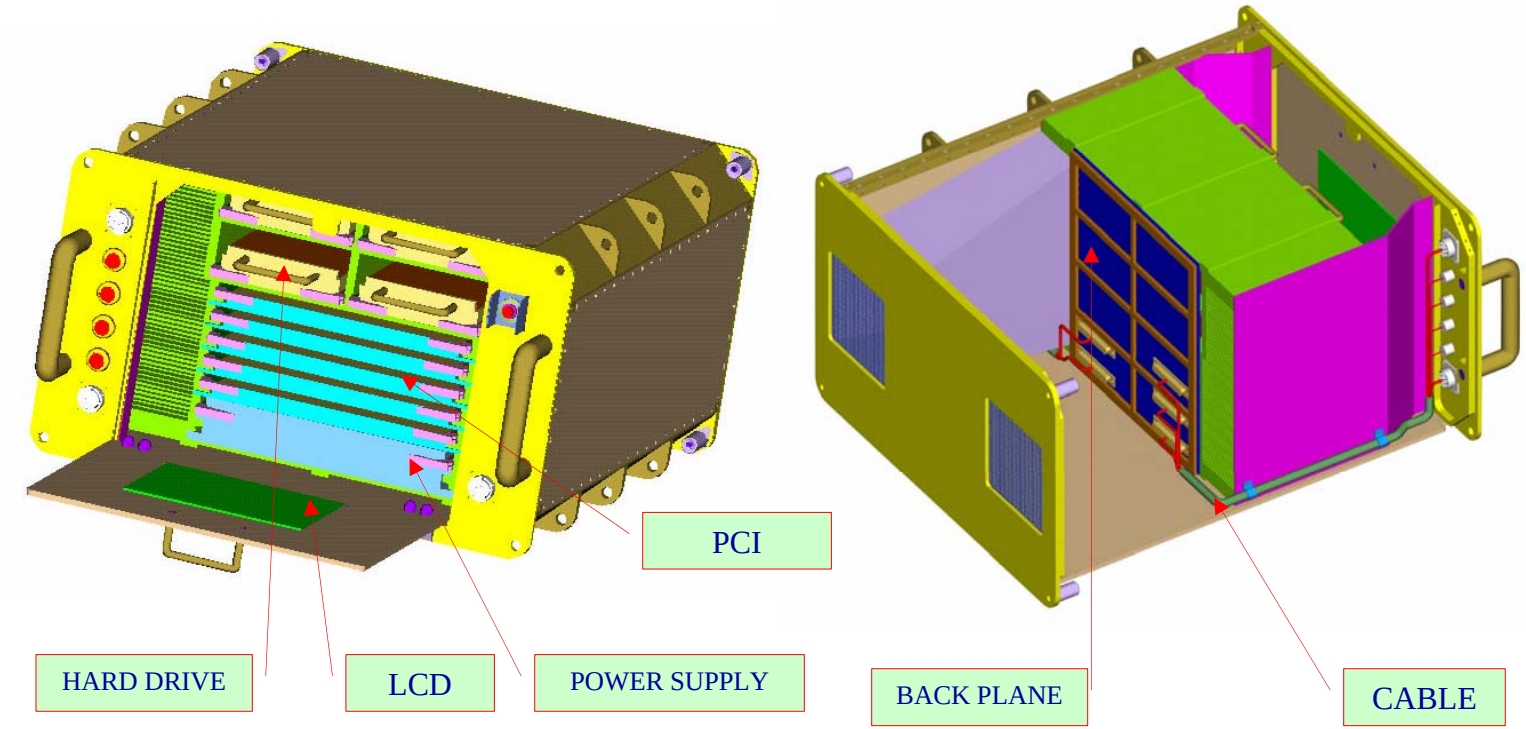
Mechanical Architecture (Conti.1)

— Main Mechanical Parts



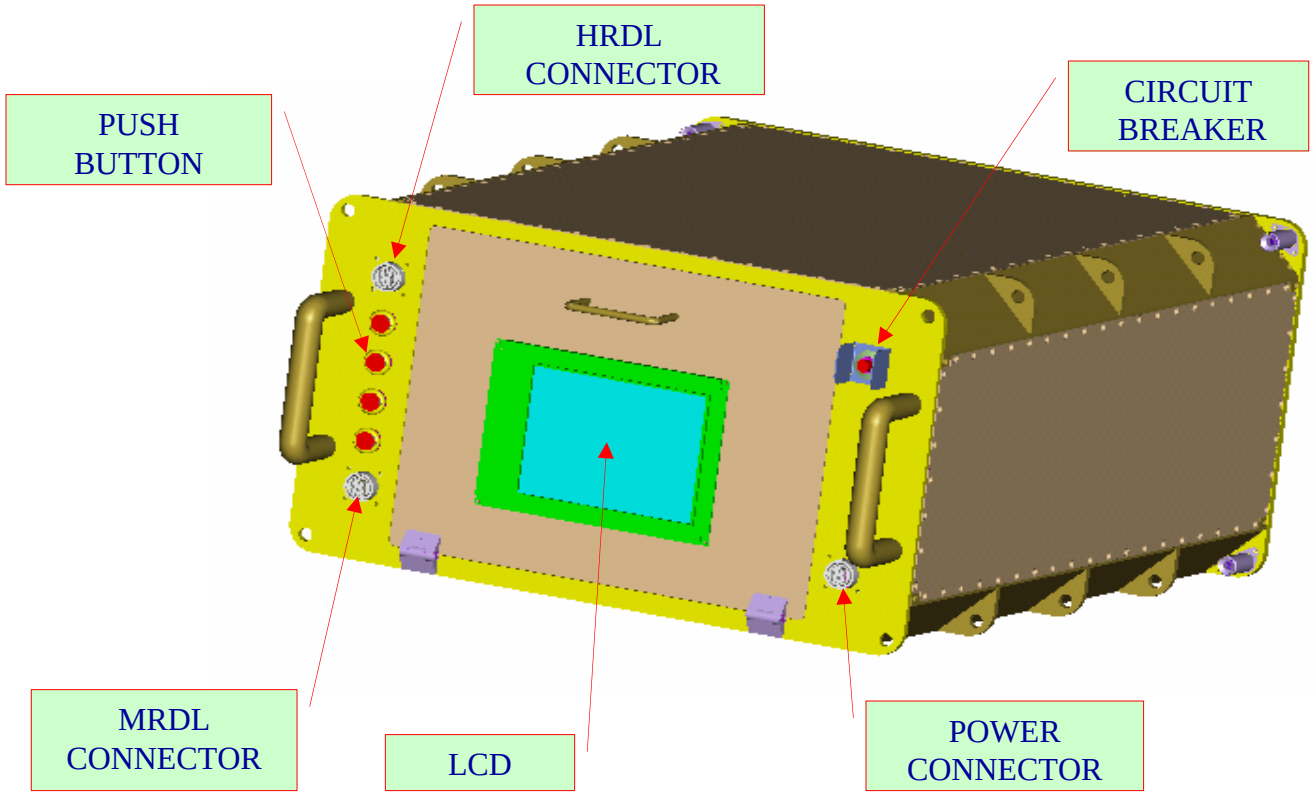
Mechanical Architecture (Conti.2)

—— Electric Component Lay Out



Mechanical Architecture (Conti.3)

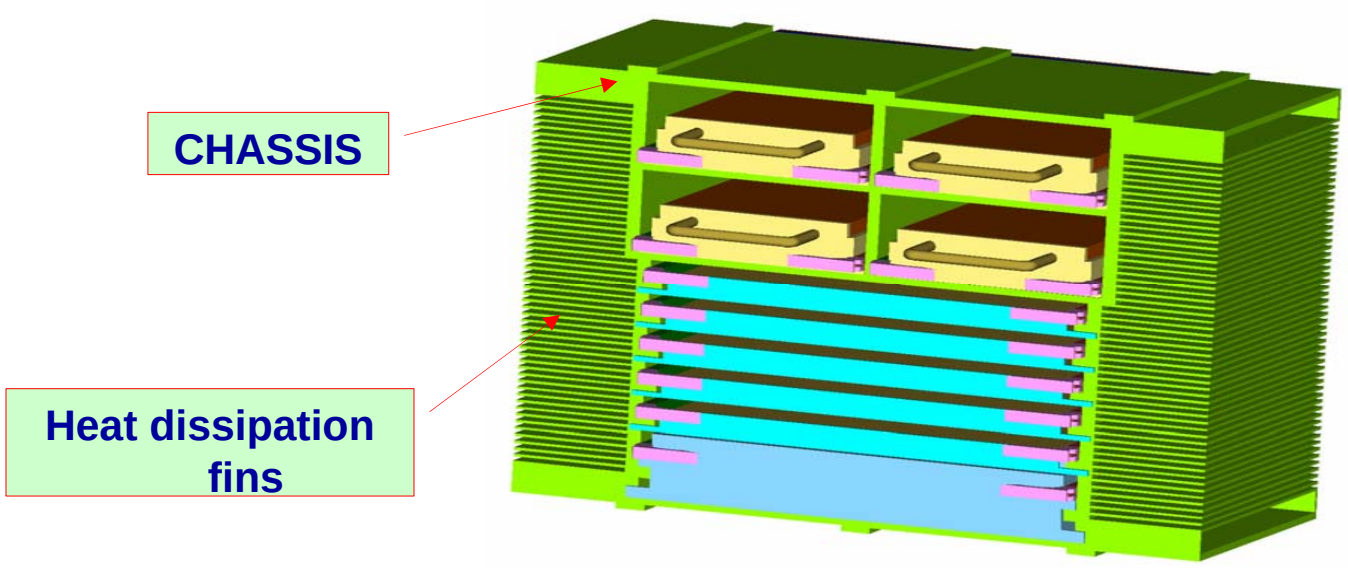
— Lay Out of Connectors and LCD (on Front Panel)



Mechanical Architecture (Conti.4)

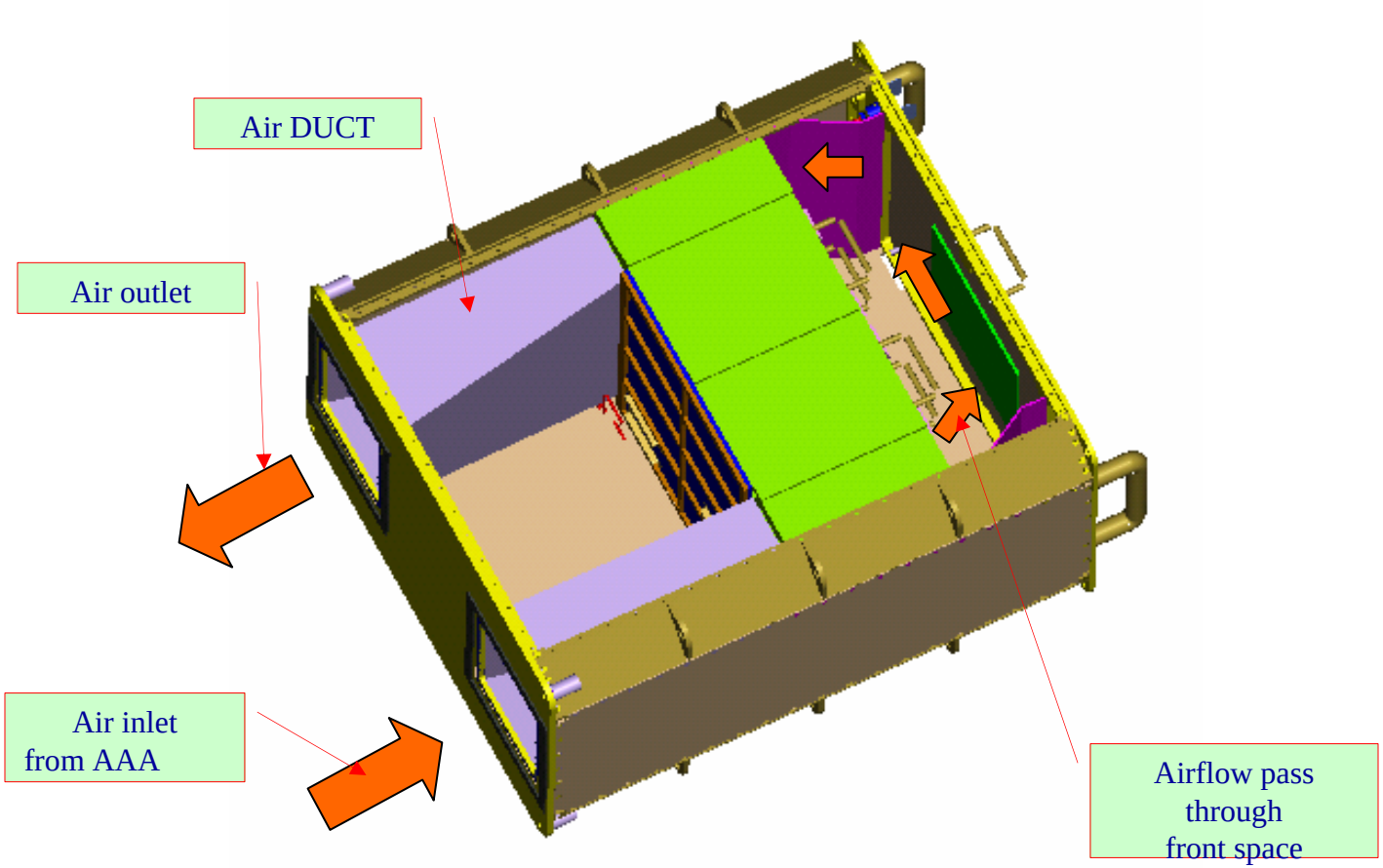
— Thermal Design (Front View)

Heat dissipation of hard disk drives and compact PCI will be conducted to the fins (wall) by conduction and rear access ducted cooling airflow (via Avionics Air Assembly) will blow through the fins and remove the heat by forced convection.



Mechanical Architecture (Conti.5)

— Thermal Design (Top View)



Mechanical Architecture (Conti.6)

- Assembly Process

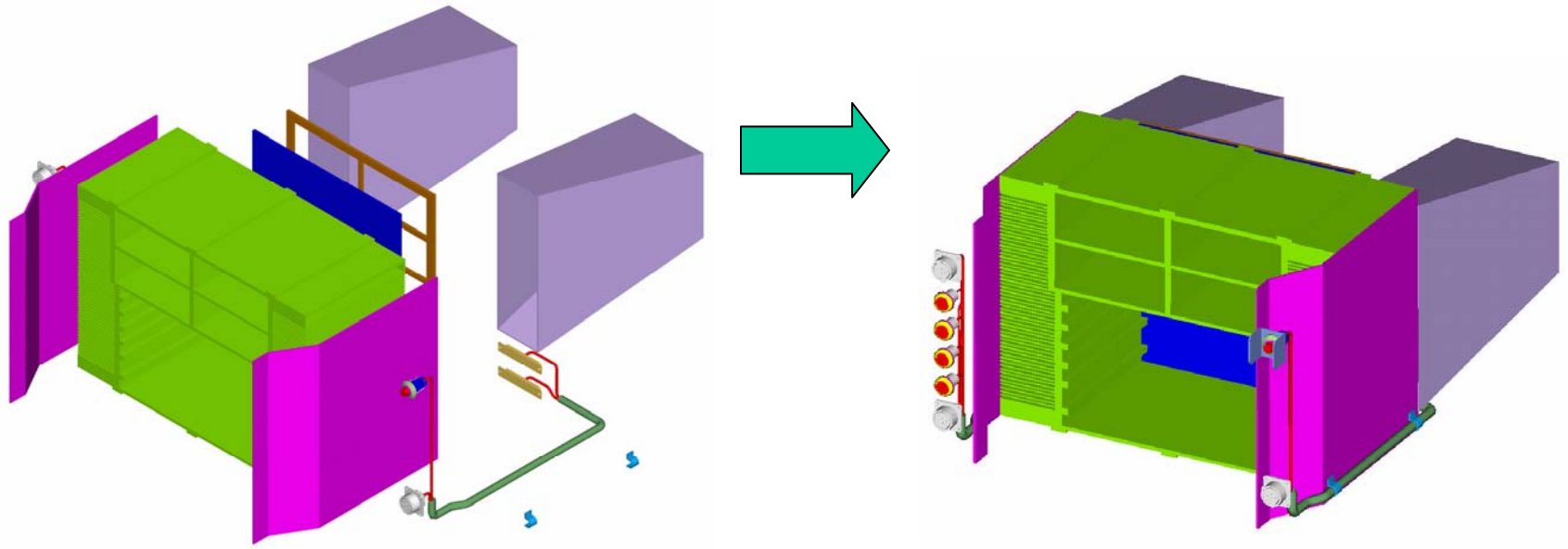
ACOP will be assembled by the following procedure：

- Step 1 Integrate the CHASSIS with all the components connected to it.
- Step 2 Put the CHASSIS assembly into LOCKER's bottom plate and fasten them together.
- Step 3 Integrate the top plate and side plates with the LOCKER by screws.
- Step 4 Plug the Compact PCI cards, power supply, and hard drives into the CHASSIS.

Mechanical Architecture (Conti.7)

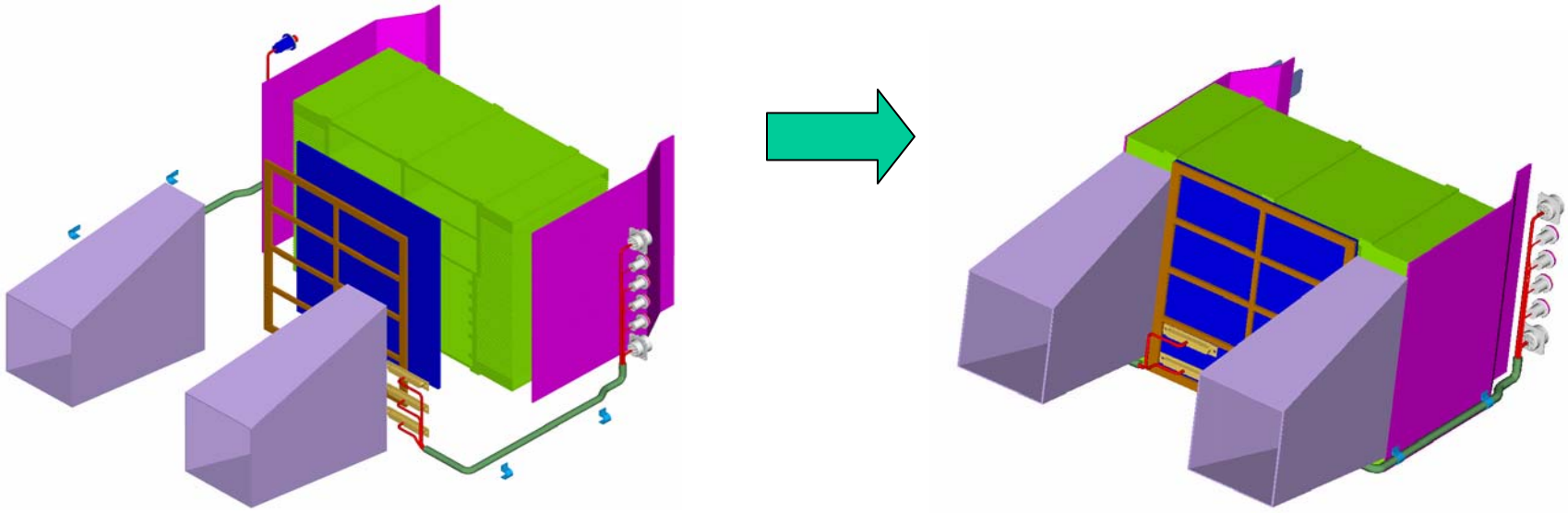
—— Assembly Step 1 (Front View)

Integrate the CHASSIS with all the components connected to it .



Mechanical Architecture (Conti.8)

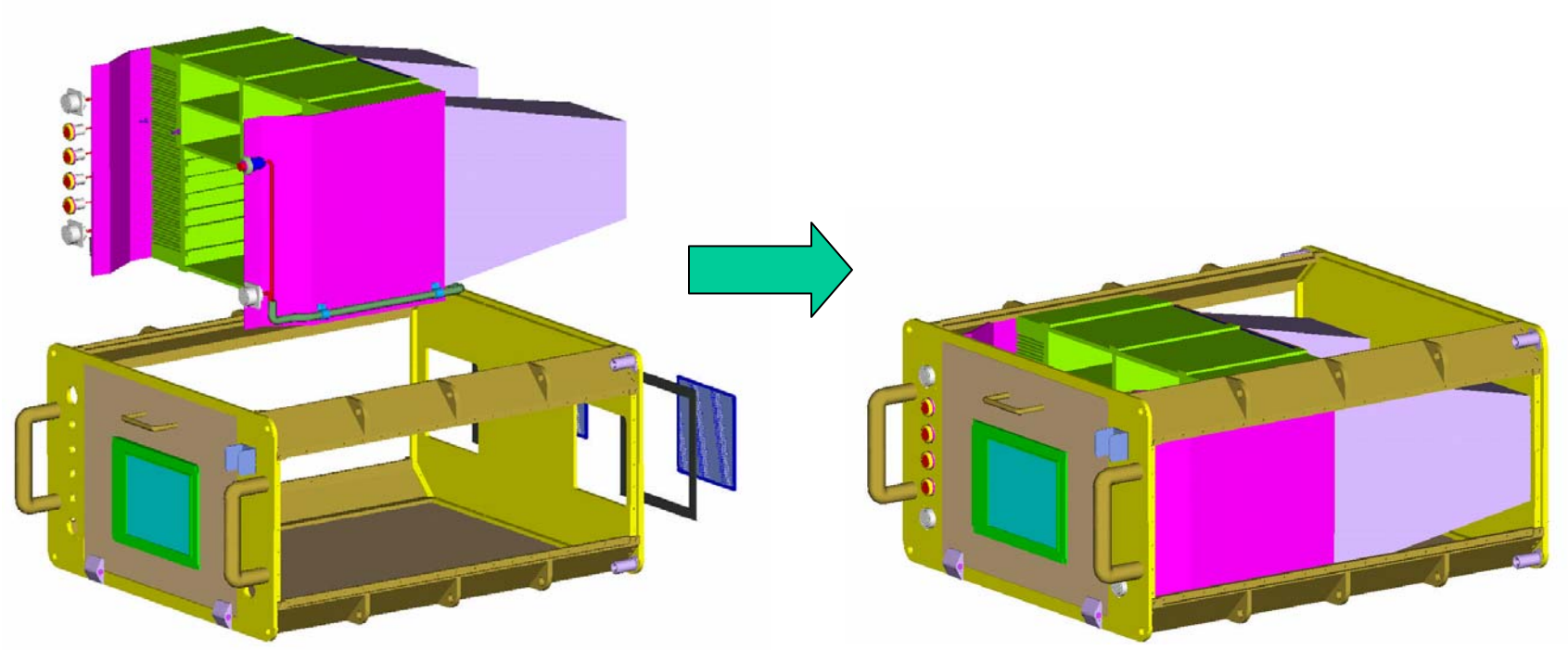
— Assembly Step 1 (Rear View)



Mechanical Architecture (Conti.9)

—— Assembly Step 2

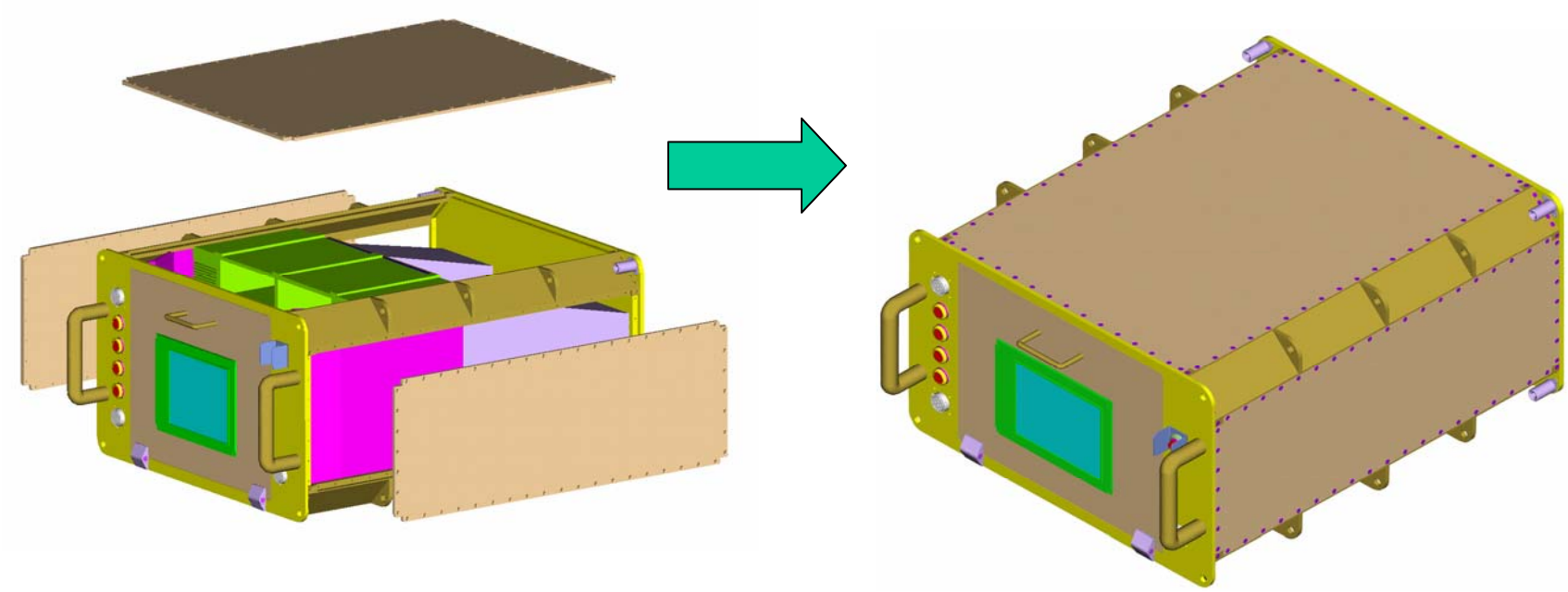
Put the CHASSIS assembly into LOCKER's bottom plate and fasten them together, also fasten the connectors、filters and ducts to the LOCKER by screws.



Mechanical Architecture (Conti.10)

—— Assembly Step 3

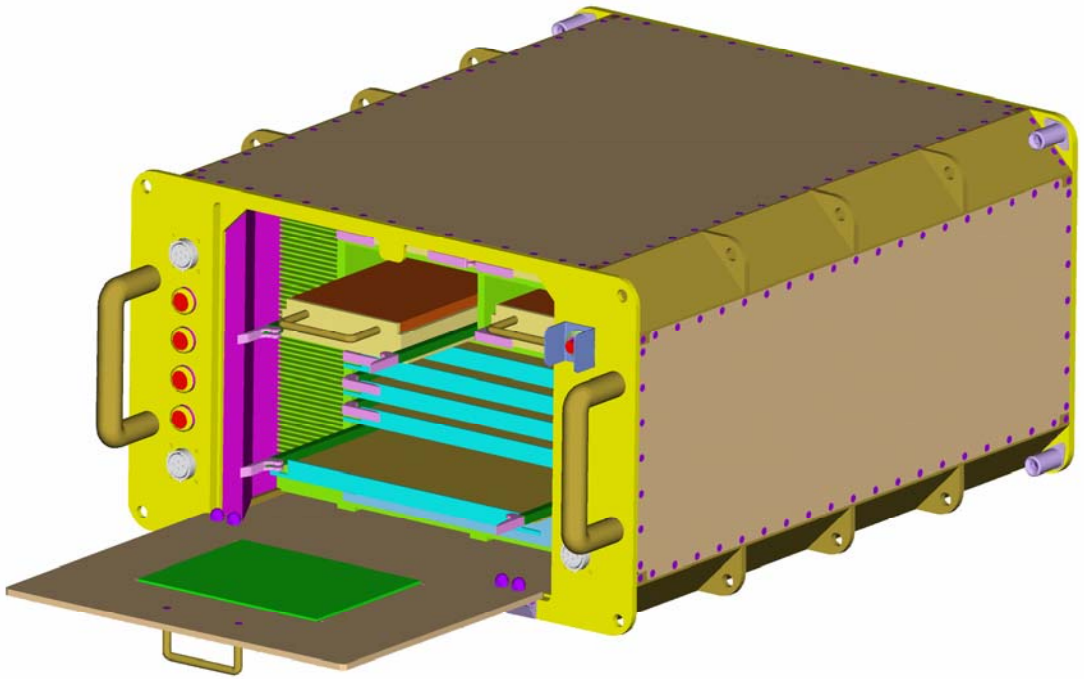
Integrate the top plate and 2 side plates with the LOCKER and CHASSIS by screws.



Mechanical Architecture (Conti.11)

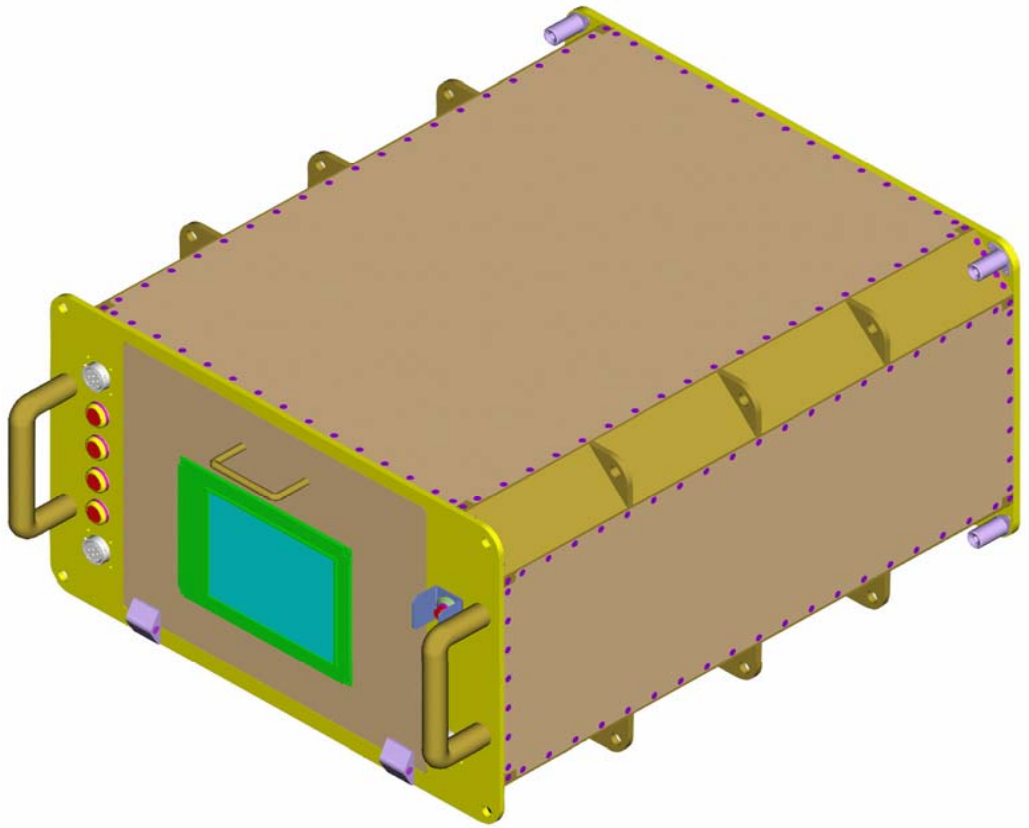
—— Assembly Step 4

Plug the Compact PCI cards, power supply, and hard drives into the CHASSIS.



Mechanical Architecture (Conti.12)

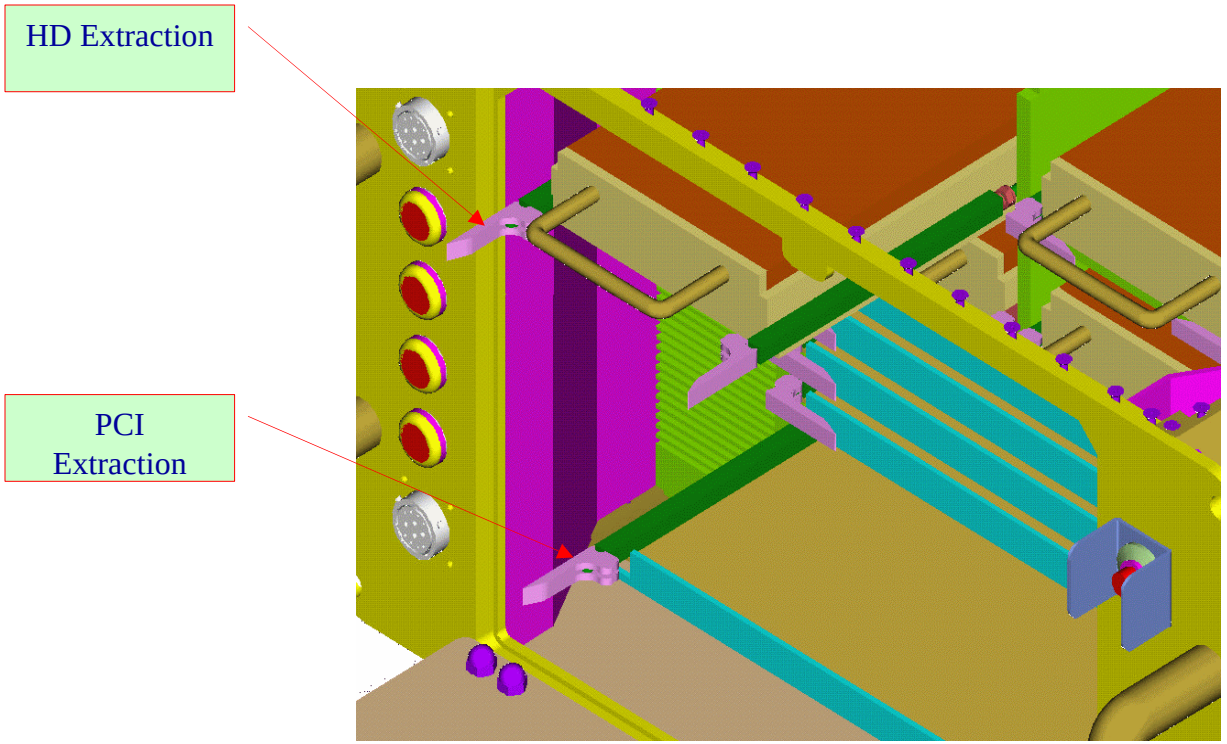
—— Assembly Complete



Mechanical Architecture (Conti.13)

—— Card Lock

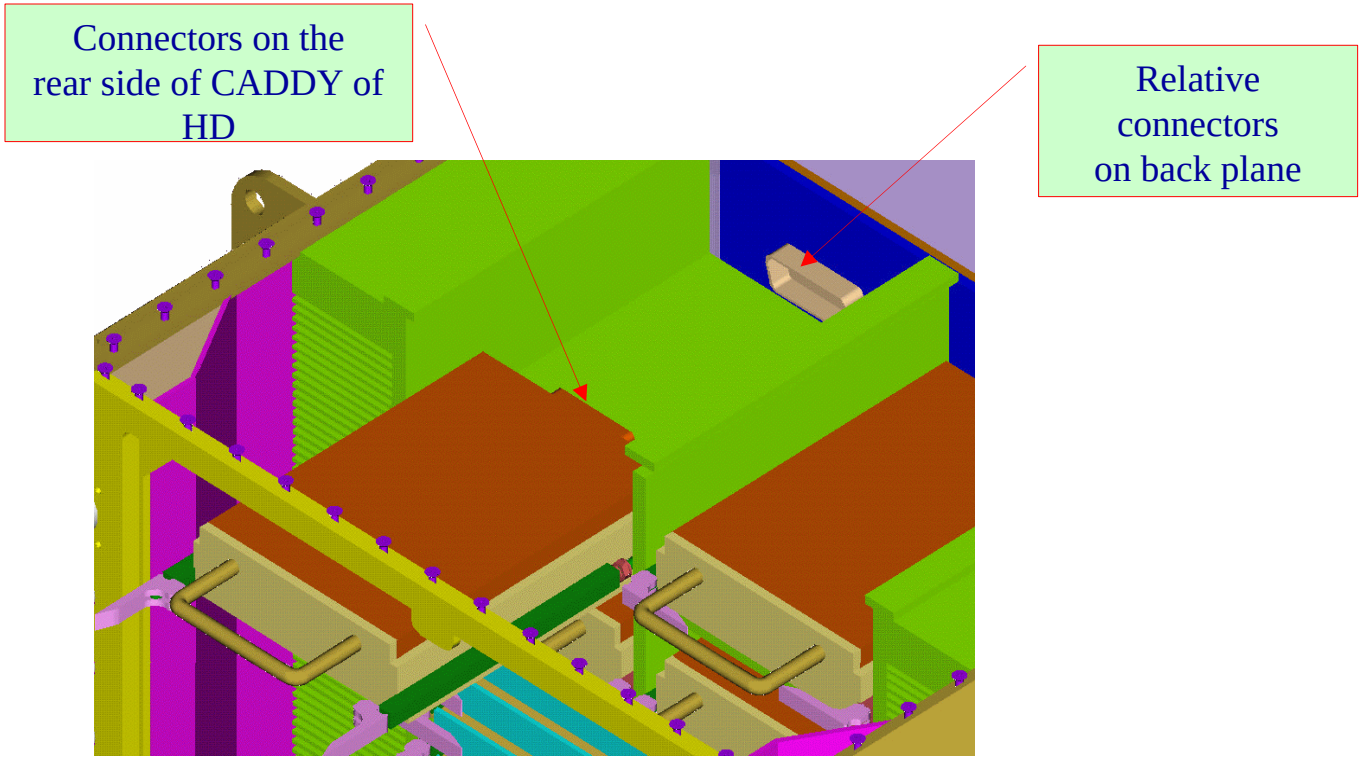
All Compact PCI, Hard Drives, and the Power Supply are fixed and extracted by hand operated card locks. No tools are required.



Mechanical Architecture (Conti.14)

— Hard Drive Installation

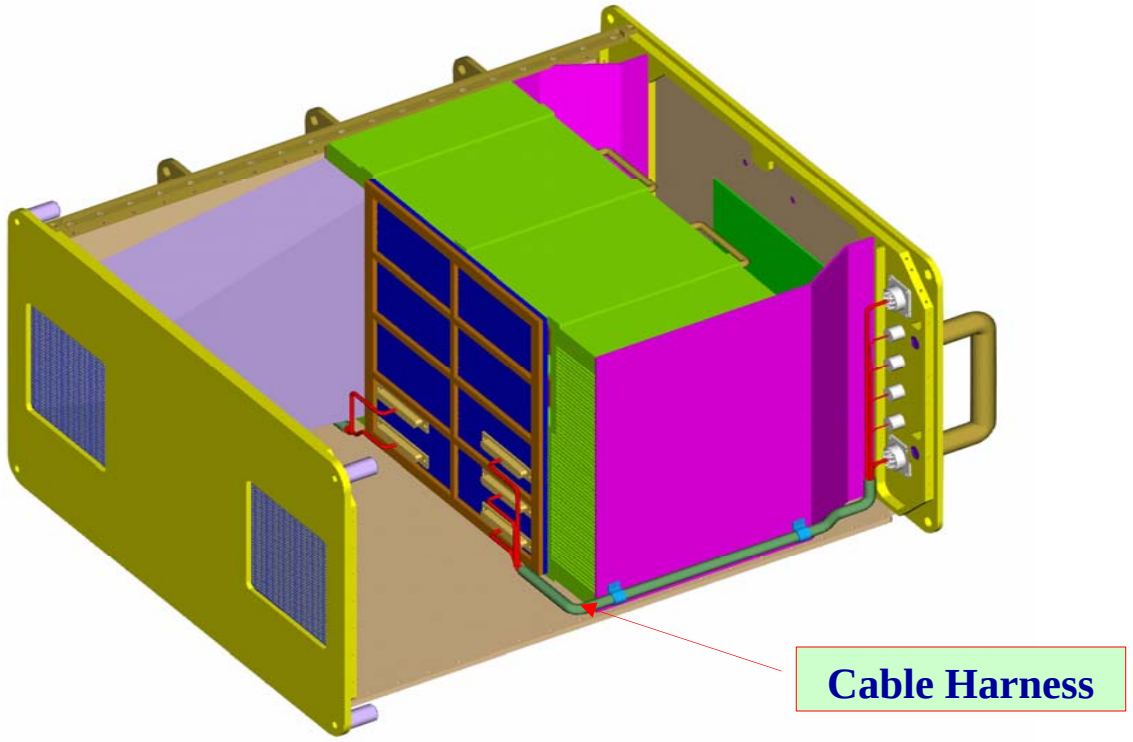
Connector will be put on the rear side of CADDY of HD and plugged into relative connector on back plane.



Mechanical Architecture (Conti.15)

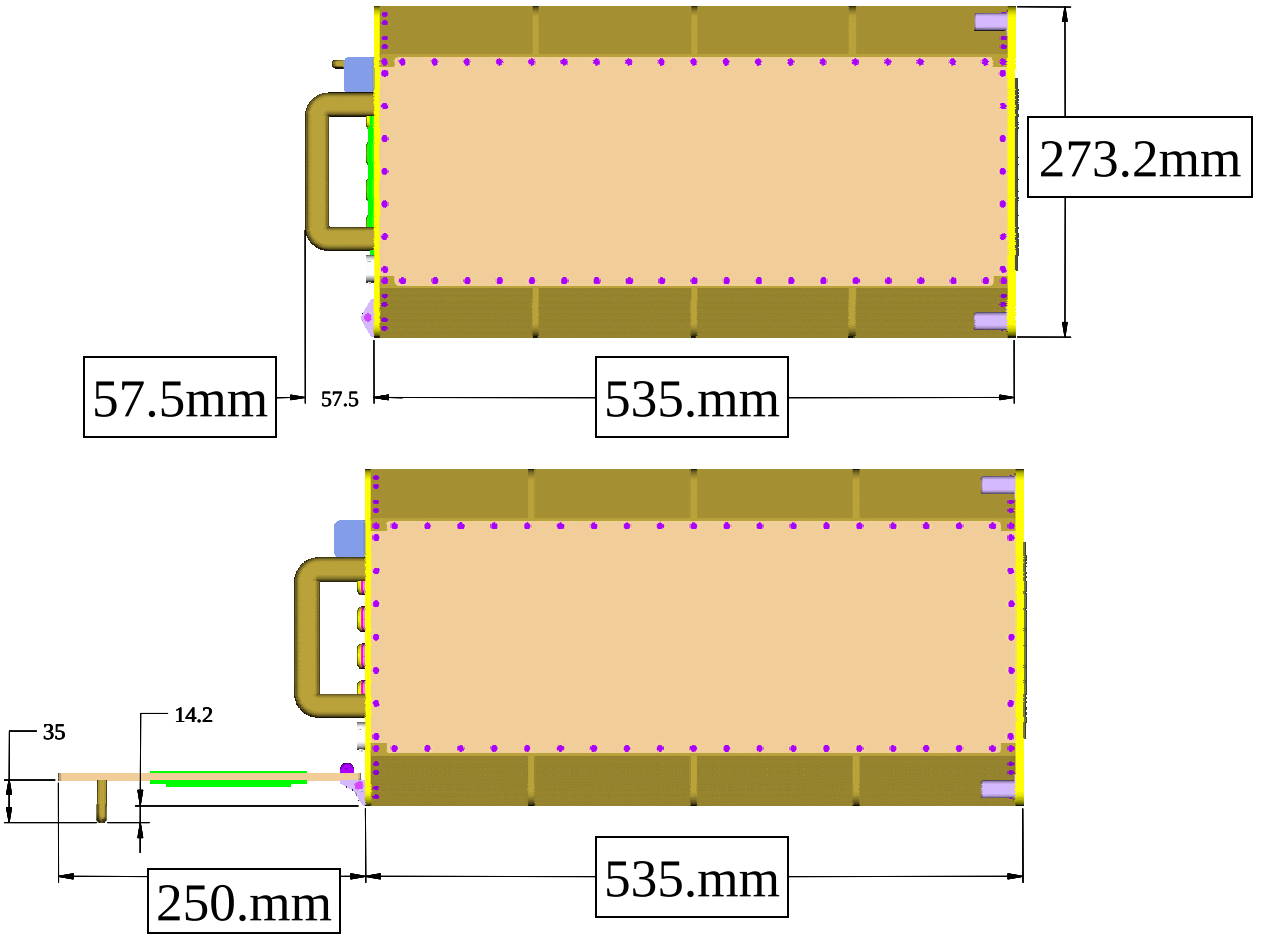
—— Cable Harness

Cable come from the Back Plane and pass through the space between CHASSIS and LOCKER on both sides and go to the Front Panel.



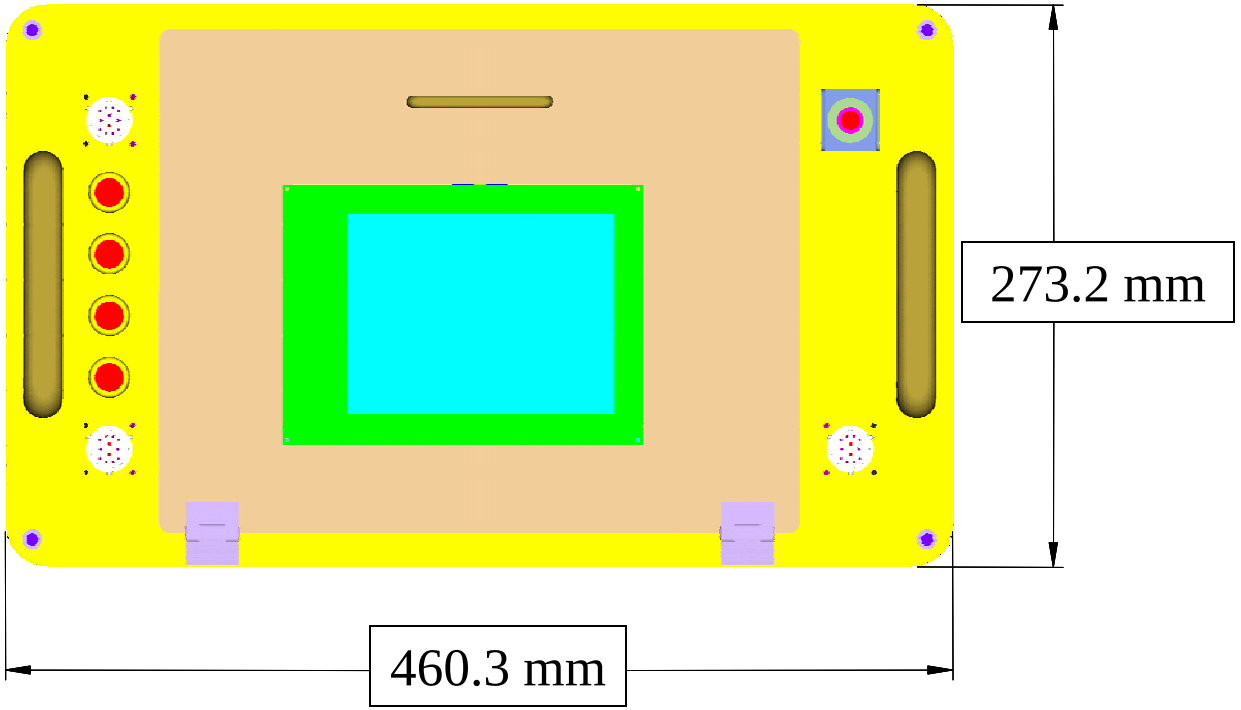
Mechanical Design

—— Dimension (Side View)



Mechanical Design (Conti.1)

— Dimension (Front View)



Mechanical Design (Conti.2)

- **Materials**

  Mechanical parts of FM and QM will be fabricated with alloy aluminum 7075T7351.

- **Machining And Assembly**
  - **Both Locker and Chassis will be assembled by several parts which are mainly produced by machine milling.**
  - **Assembly are integrated by stainless fastener according to MIL-SPEC**
  - **Materials and process will meet the requirements in section 13 of the IDD.**

Mechanical Design (Conti.3)

- **Surface Treatment**

  Surface treatments will be either Clear Anodizing according to Spec.: MIL-A-8625 TYPE II CLASS 1

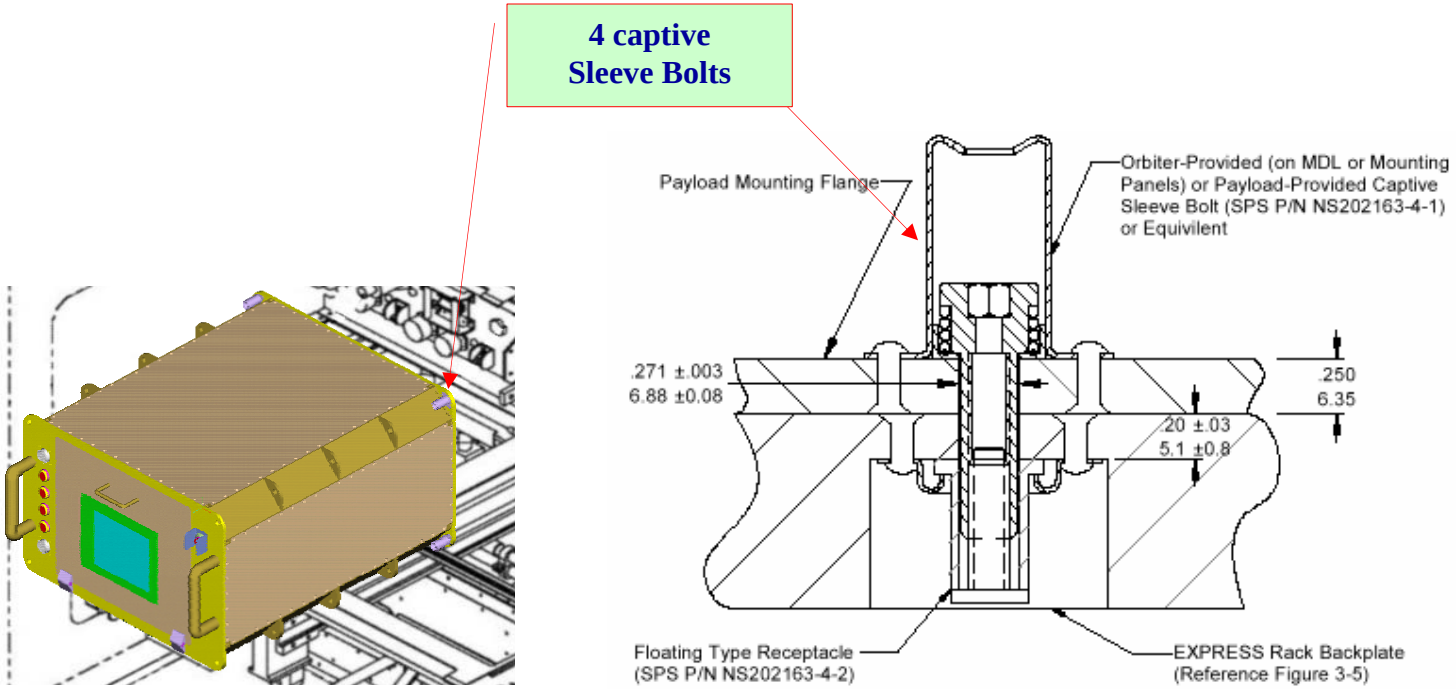
  or

  Alodyne 1200 according to Spec.MIL-C-5541 CLASS 3

Mechanical Interfaces

— Structure Mounted Interface

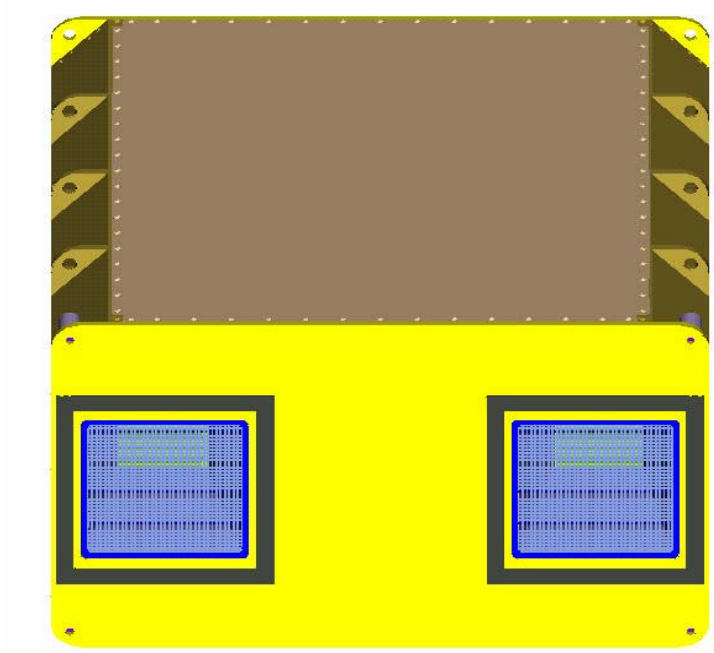
ACOP is mounted to the back plate of the Rack by 4 Captive Sleeve Bolts (SPS NS202163-4-1) .

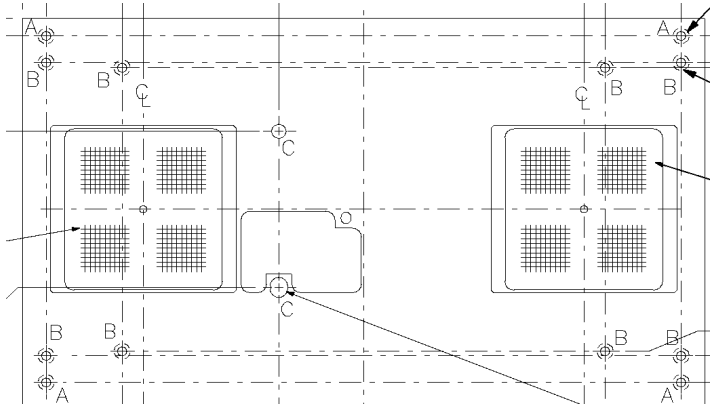


Mechanical Interfaces (Conti.1)

— Airflow Interface

Cooling airflow via Avionics Air Assembly (AAA) will blow in and out through the holes on back plate of the Rack. The ACOP airflow holes are protected by screens and optionally will provide mountings for suitable filters.





Crew Interfaces

- **Installing ACOP**

  The crew should push ACOP into Rack and use the rack mounting tool to screw it on the back plate of the EXPRESS Rack.

- **Connecting External Cable**

  The crew should connect the external cable from Rack to ACOP.

- **Opening Front Panel**

  The crew should open the front panel by standard GFE tool before replacing the hard drives.

Crew Interfaces (Conti.1)

- **Replacing Hard Drives**

  The crew should plug out and in the 4 Hard Drives every 20 days.

- **Tools**

  ACOP will be designed to be operated and maintained using standard GFE tools.

Mass Budget

— ACOP Mass Budget (Excluding HD)

Total now is 30.1 kg

Item	Mass [Kg]
LOCKER	11.99
FRONT PANEL	0.857
HANDDLE	0.326
CHASSIS	8.91
SIDE PLATE	0.46
BP FRAME	0.37
FASTENERS	0.45
DUCT	1.13
SLOT1	0.4
SLOT2	0.35
SLOT3	0.35
SLOT4	0.35
SLOT5	0.0
BACK PLANE	0.22
POWER	1.005
LCD Monitor	0.335
Backlight Inverter	0.435
HDD BACK PLANE	0.2
CONNECTORS, CABLE	2.0
Total	**30.1**

Mass Budget (Conti.1)

— Softbag Mass Budget

Total now is 29.3 kg

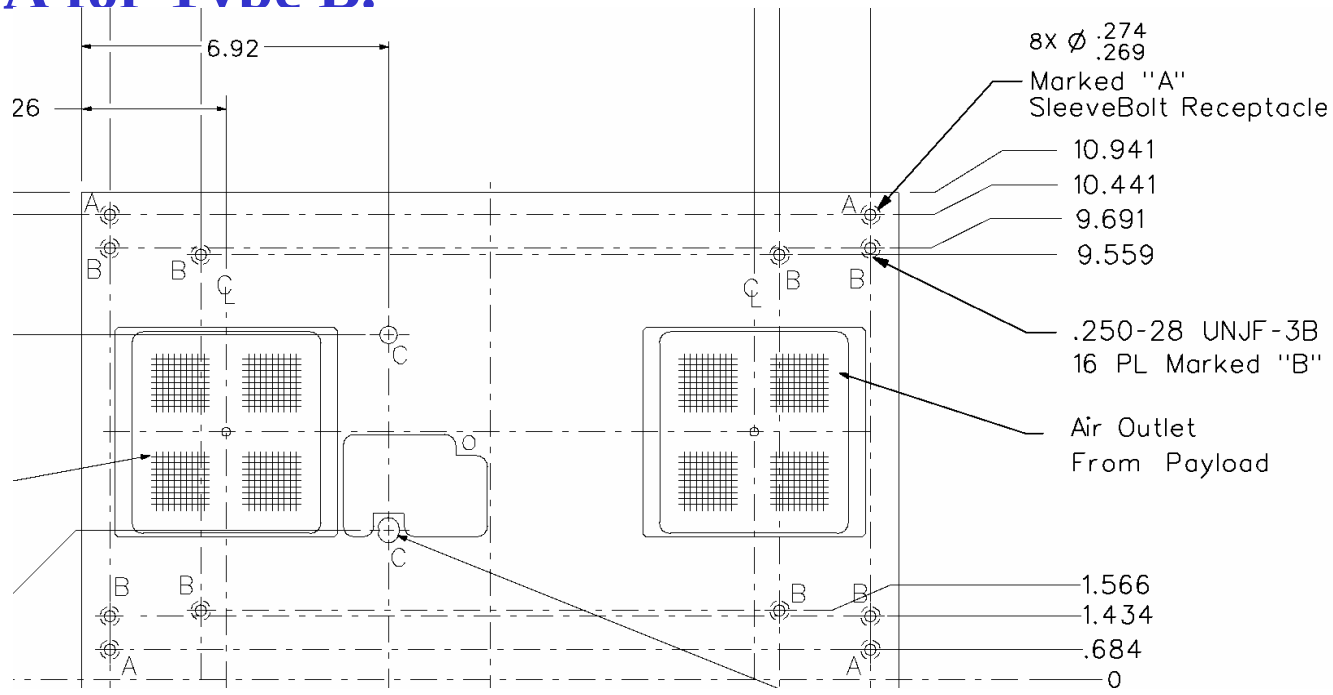
Item	Mass [Kg]
Softbag	1.5
Padding	2.0
HRDL cable	3.0
Power cable	0.6
Data cable	0.6
ACOP-T101	0.8
ACOP-SBJ	0.8
(20) Hard drives @ 1kg	20
total	**29.3**

Improvements

(Two Major Changes Since PDR Document Delivery)

— 1. Change of Mounting Holes

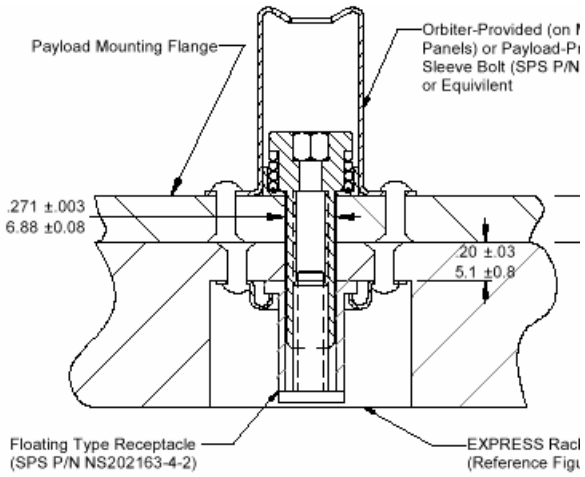
According to the structural analysis，the original chosen mounting holes (Type A) on the EXPRSS RACK back plate are not strong enough for ACOP. So we shall change the Type A for Type B.



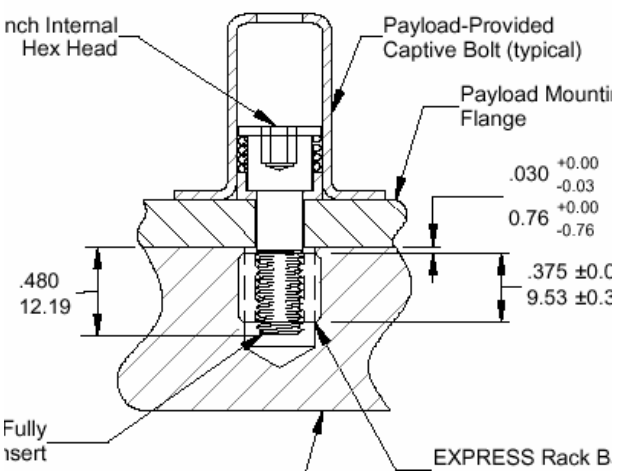
Improvements (Conti.1)

— 1. Change of Mounting Holes

Type A



Type B



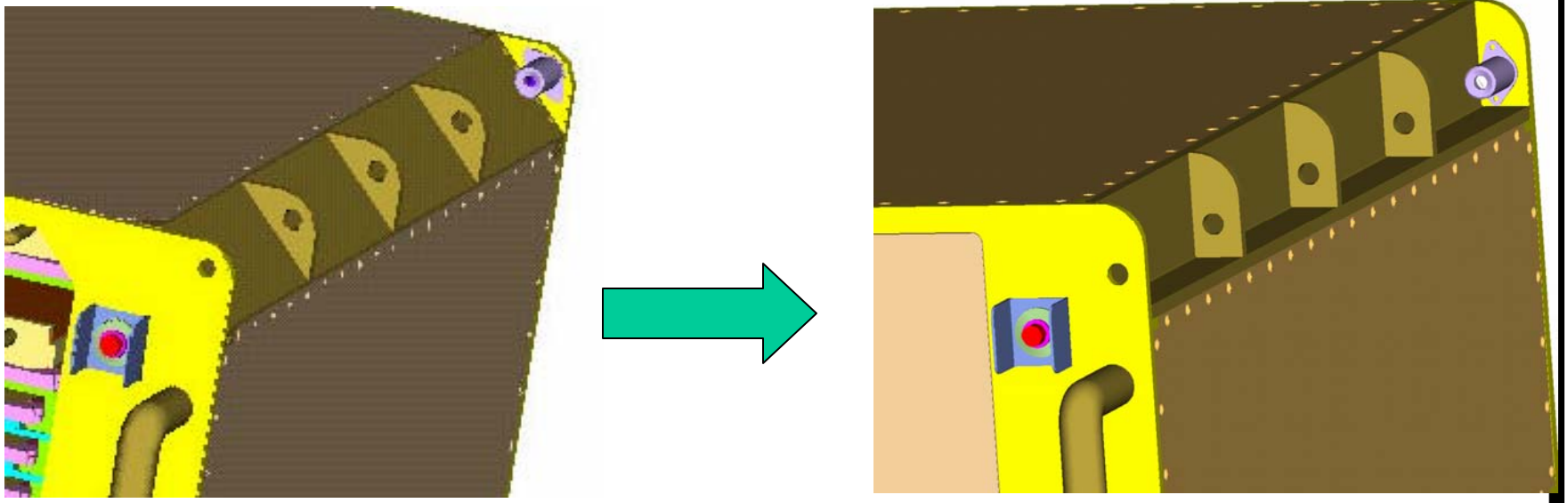
BACK PLATE INTERFACE	INTERFACE CONFIGURATION	Ultimate force allowables	
		tensile (lbf)	shear (lbf)
Type A[1]	Sleeve Bolt Receptacle P/N SPS 202163-4-2	2500[2]	1660[2]
Type B[1]	Threaded Insert P/N MS51831CA-202	8900[3]	19600[3]

Improvements (Conti.2)

— 1. Change Of Mounting Holes

ACOP shall have little change in configuration and no any influence on other design.

Type A **Type B**



Improvements (Conti.3)

— 2. Adding Two Cooling Fans

Following the correct decision during the last TIM in KSC in Jan.12,2005，we knew that the cooling air is not ducted into ACOP but passes through the back plate of ACOP. Thus, two fans are needed. Both fans and filters shall be mounted on the back plate of ACOP and can be replaced from the outside of ACOP.