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# Full EC testing

# Full EC testing at Liverpool/Frascati

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- We will thermal cycle each individual HC.
- We can thermal cycle a full EC
- Testing is assumed to be limited to LP mode
- For the testing of full EC, we need to decide if we want to test :
  - Inside thermal enclosure+environmental chamber
    - Need to ensure physical access for connections required for the different configurations
      - (not trivial)
  - Inside transport box
    - This is needed anyway ?
- If we run warm CO<sub>2</sub> for a single layer, we should verify through FEA any issues with temperature differential between layers?

## 22.OEC Reception Test and OS Integration

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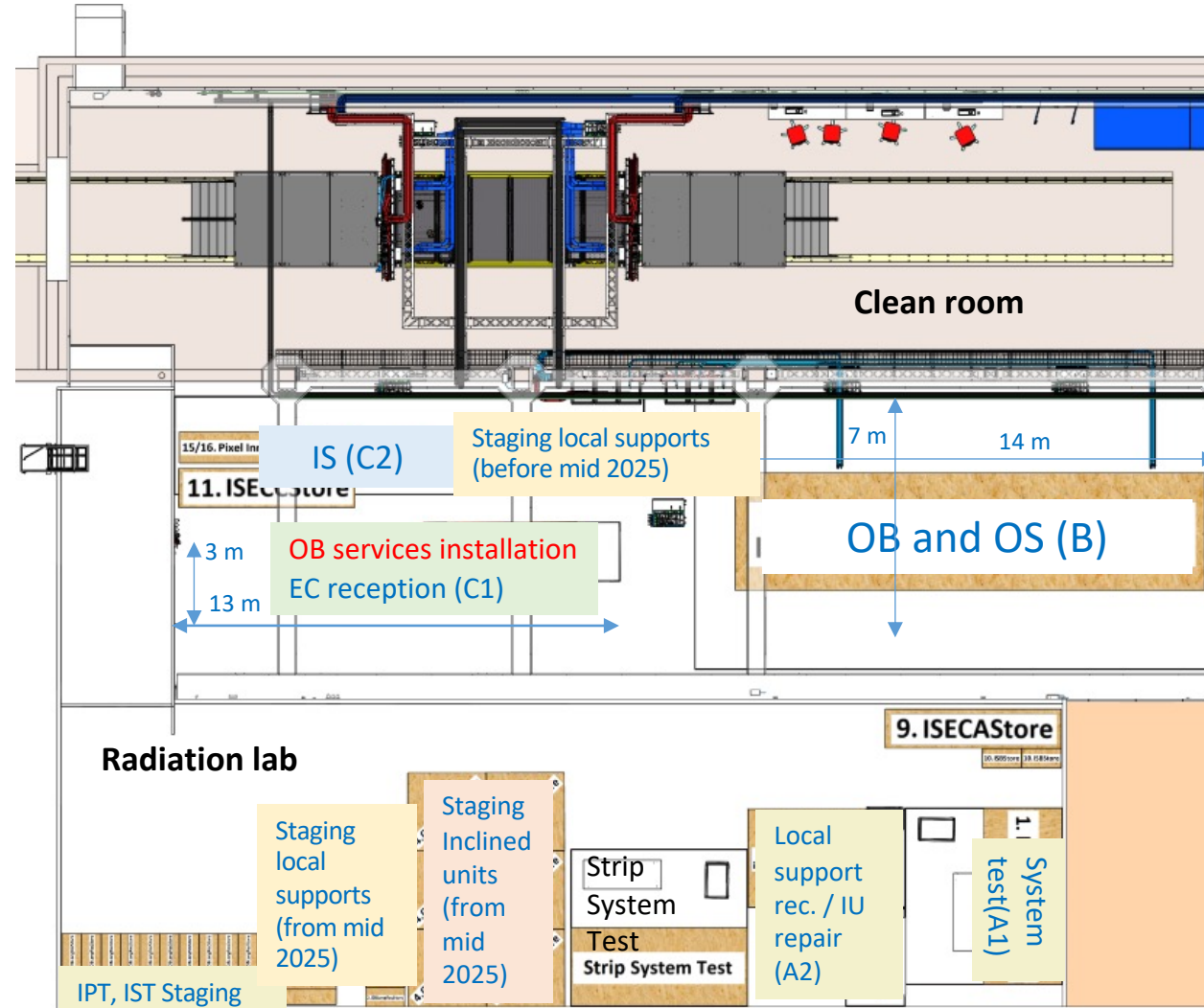
- The transport box is used as a test box for the EC for a set of warm connectivity tests before and after shipment to SR1
- The granularity of the electrical testing is derived by the infrastructure at CERN which is based on allowing approximately 12.5% of the detector in one testing step. The testing steps of the EC are guided by the electrical and cooling grouping and manifolding.
- The 10 integration units per EC are:

Test step	Detector Tested Section	Number of Serial Power Chains	Number Data (Up/Down) Links
1/6	5 HR L2 (0.5 link/FE) left/right	10	160/80
2/7	6 HR L2 (1 link/FE) left/right	12	384/96
3/8	8 HR L3 (0.5 link/FE) left/right	16	352/176
4/9	4 HR L4 (0.25 link/FE) left/right	8	104/104
5/10	5 HR L4 (0.5 link/FE) left/right	10	182/130

- The electrical equipment for the tests are detailed:[EDMS](#)

# Reception Test at CERN

- EC Test box arrives at SR1 and the warm LP tests are repeated allowing a direct comparison
- Until the mount points for the support rails are attached, either the UK and IT endcap can be Endcap A or C.
- Which ever endcap is ready first will be Endcap C
- Both EC will be tested in same orientation in SR1
- One EC will need to be rotated 180deg before insertion into OB



# OEC reception test program

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- The set of warm temperature tests at the LLS sites is repeated before and after the ECs are shipped to CERN
  - [LLS tests documentation \(EDMS\)](#)
- The equipment used in the integration sites will be shipped with the endcaps to CERN and re-used in the same configuration during reception test of each EC and during testing of the ECs in the Outer System and during dressing of PP1 after insertion of the OS in ITk.
- Warm testing definition:
  - CO2 cooling plant is operating
  - active cooling at close-to room temperature
  - enough margin to safely power up and operate full LLS even in case of bad thermal contact of some detector modules in order to stay below the interlock temperature of 40 degC
- Low Power mode tests:
  - Tilock and MOPS readback
    - Readback of all values from MOPS chips (T, dV)
    - LV ON, HV OFF
  - front end temperature readback
    - Use FE ADC to readback front end temperature after configuration
    - Currently being investigated if other registers could be used in LP mode
    - LV ON, HV OFF

# Full power mode testing at SR1

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After reception testing, full power mode testing proceeds following the outline in the [LLS tests documentation \(EDMS\)](#)

Tests are performed per integration unit (slide 2)

- Warm testing, CO<sub>2</sub> of 0-5°C
  - Connectivity checkout
    - TiLock and MOPS check (LV on, HV off)
    - Bit Error Rate test (LV on, HV off)
    - FE temperature readback (LV on, HV off)
    - Tilock and MOPS readback (LV on, HV off)
  - Performance:
    - Digital scan
      - (LV on, HV on)
    - Analog scan
      - (LV on, HV on)
    - Threshold/ noise measurement
      - (LV on, HV on/off)

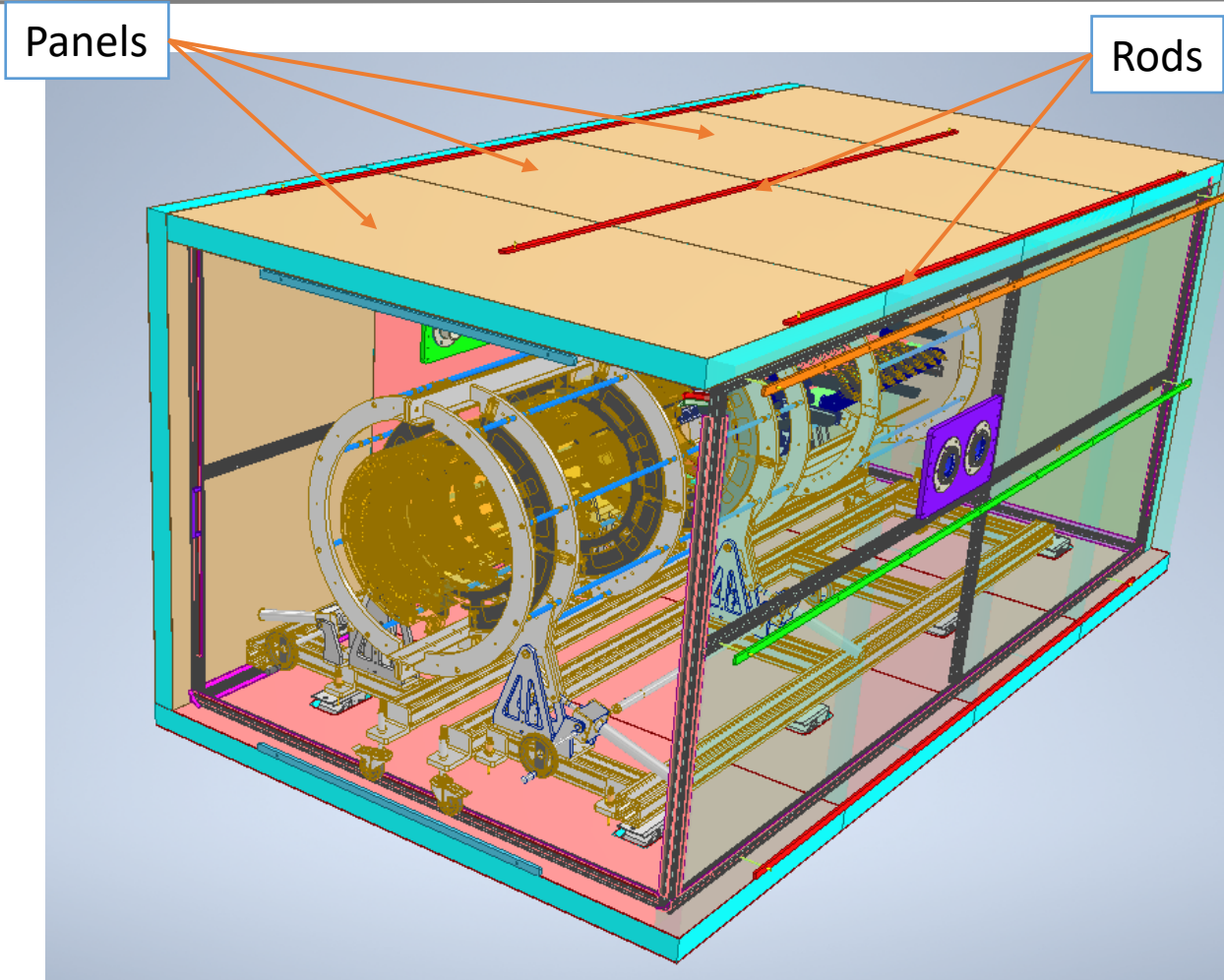
# Testing after OEC installed into OS

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Tests are performed per integration unit (slide 2)

- Warm testing, CO<sub>2</sub> of 0-5°C
  - (possibility to test at cold CO<sub>2</sub> at -35 °C)
- Repeat full electrical test:
  - Digital scan
    - (LV on, HV on)
  - Analog scan
    - (LV on, HV on)
  - Threshold/ noise measurement
    - (LV on, HV on/off)
- Integration leads: Susanne Kuehn, Marianna Testa

# Transport Box



Under study the system to switch the load from the Heads to the lateral guides, after completing the L4.

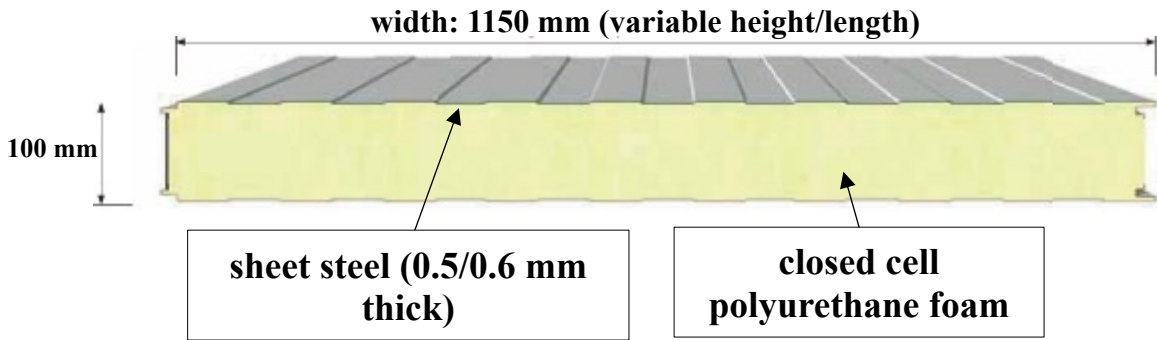
Every wall is composed by panels, inserted one by one using sliders and fixed by pins and aluminum rods.

The system is clever but we need to test the tightness.

by Antonio Croce



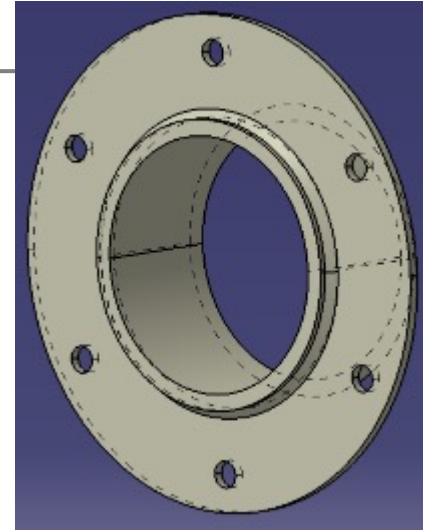
# Transport Box: panels and feedthroughs



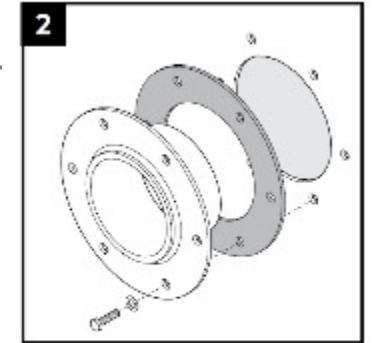
Nominal Panel Thickness mm	100	120	150	200
Thermal Transmittance U (W/m <sup>2</sup> K)	0.22	0.18	0.15	0.11

Annex A.10 of the European standard EN 14509

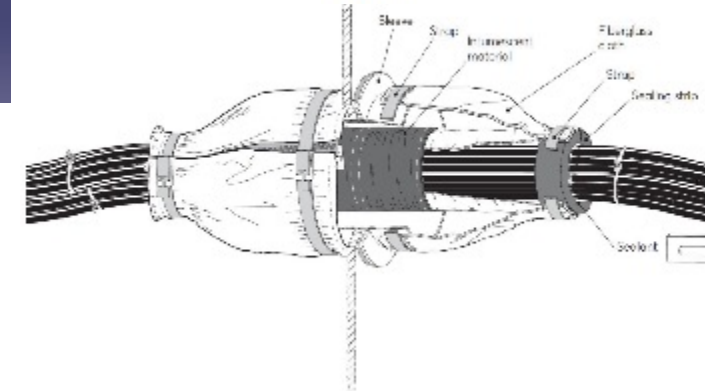
by Gianmario Cesarini



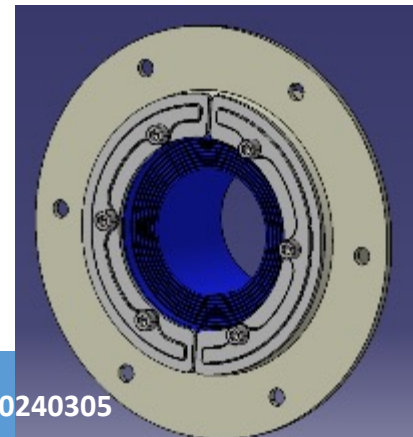
Sleeve gasket



Round sleeve with pre-punched gasket.



Lighter (AISI316 1.6 kg)- to be used for sensor cables, for Type II ones and for those of the optoboxes (multiplicity to be defined)



Feedthrough for single CO<sub>2</sub> line (AISI316 – Φ 66-98 mm – 3.6 kg)