

Test box for ProtoDUNE SP – Integration Test

Box specifications

- Dimensions around 2.5x6.7x0.3m (LxHxP) (TBC)
- Faraday cage
- Dark inside to test the Photo-Detectors
- Have one humidity/temperature sensor to measure dew point
- Input line for Gas N
- May need a line for dry gas to avoid condensation while lowering temperature. TBC.
- Sealed to avoid gas leaks
- Need perforations to get the Cold Electronics signal cables (20 in total) out of the box and 10 cables for PD. Or a kind of feedthru to get all cables out.
- Hook(s) to hang from the rail that holds the APA inside the clean room
- Be able to open and close around the APA

Open issues

- **SEALING:** Probably bolting, rubber gasket will not be good for cryo-temperature; the best would be an indium sealing, but it will cost: 20-85 CHF/m for $\varnothing = 1-2$ mm.
- **PENETRATIONS:** possibly one, connected to an actual ProtoDUNE SP flange.
- **APA HANDLING:** if we keep the APA hanging on the rails during the test, we will need further penetrations for these cables: Can we hang the APA from inside the box? See the following.
- **COLD TEMPERATURE CONTROL:** continuous flushing? In this case we need an exhaust line, but in order not to waste too much we will need some insulation, or a double-wall structure (vacuum pumped).
- **SPACE AND GAS LINES IN 182:** not too much space, possibly will do test horizontally. New lines may be needed, besides existing ones, to allow coexistence with other systems.
No cold N₂ storage so far, one will be installed (LN₂) for WA105 1x1x3 m³.
- **GAS LINE IN EHN1:** Can we take gas from the main cryogenic plant (i.e.: connect one line going into the clean room)?

Hypothesis of Cold Box design

Carved box containing the APA, with flat cover to close.

Single or double wall? Depending on thermal insulation request.

Related to this: gas continuous flushing or filling and static operation?

Completely covered with passive insulation, if needed to maintain cold the gas.

Sealing

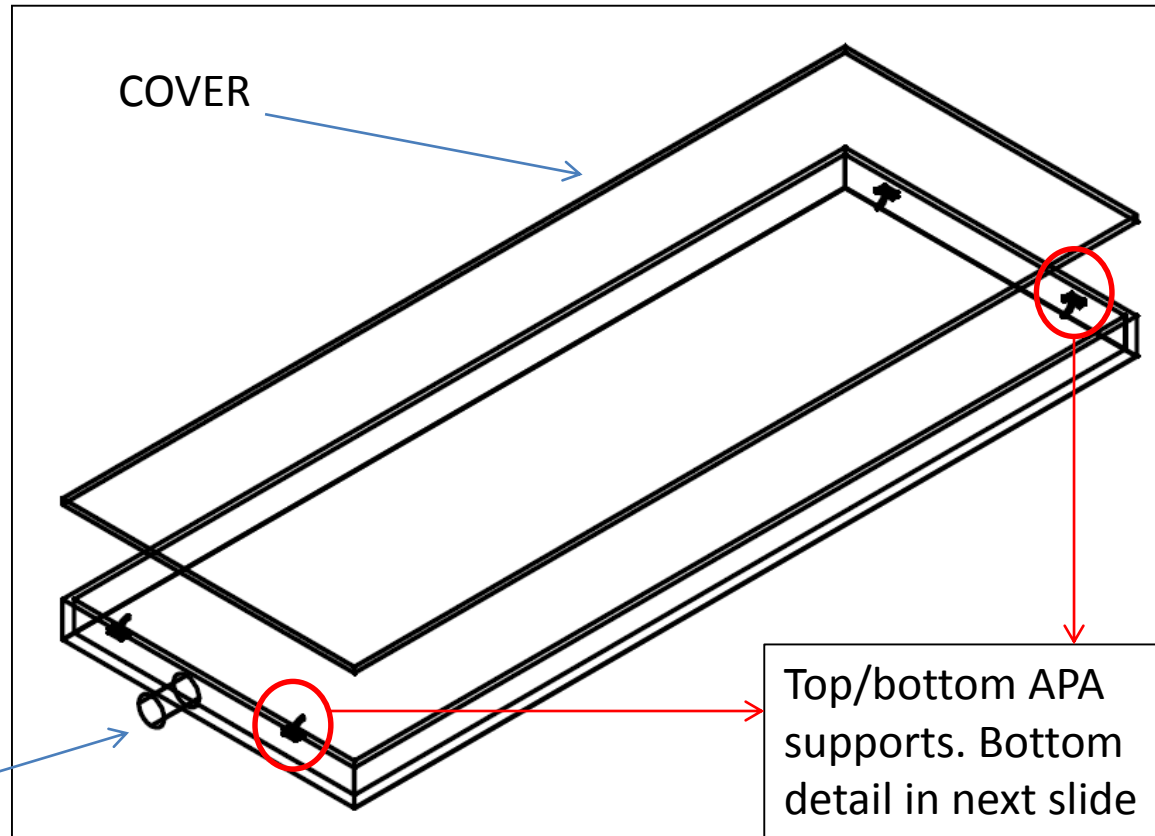
- best solution: bolted cover and use indium (2 mm) -> high cost
- Otherwise? Bolting, double wall and rubber gasket on the outer side?

Supports on the box inner walls, on the bottom (to sustain APA frame during positioning inside the box) and on the top (to hang APA).

- Holes, used to screw in the supports, may be foreseen on all internal walls, in case we need to operate the box horizontally for the initial test.

Box drawing

- Some kind of support/clamp can be used to hang the APAs, from INSIDE the box ceiling.
- This will allow to disconnect from the rail system during this particular stage.
- Best would be the same type of clamp to hang the APA to the rail.

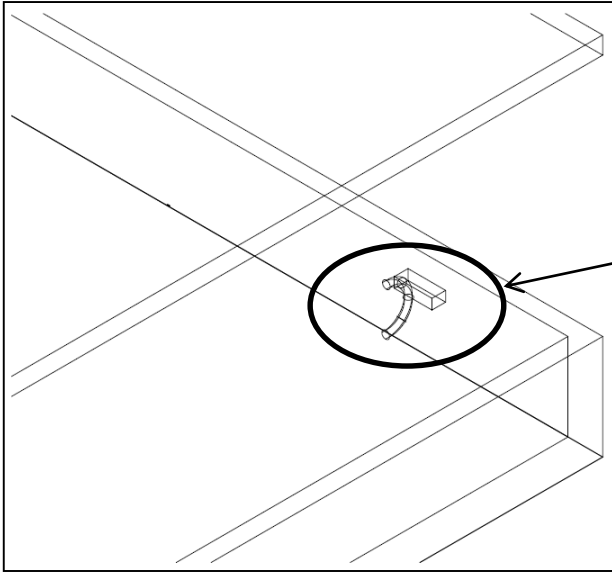


Connection (welded on the box ceiling) to a flange with feed-throughs, to extract cables (cold electronics, photon detectors, slow control).

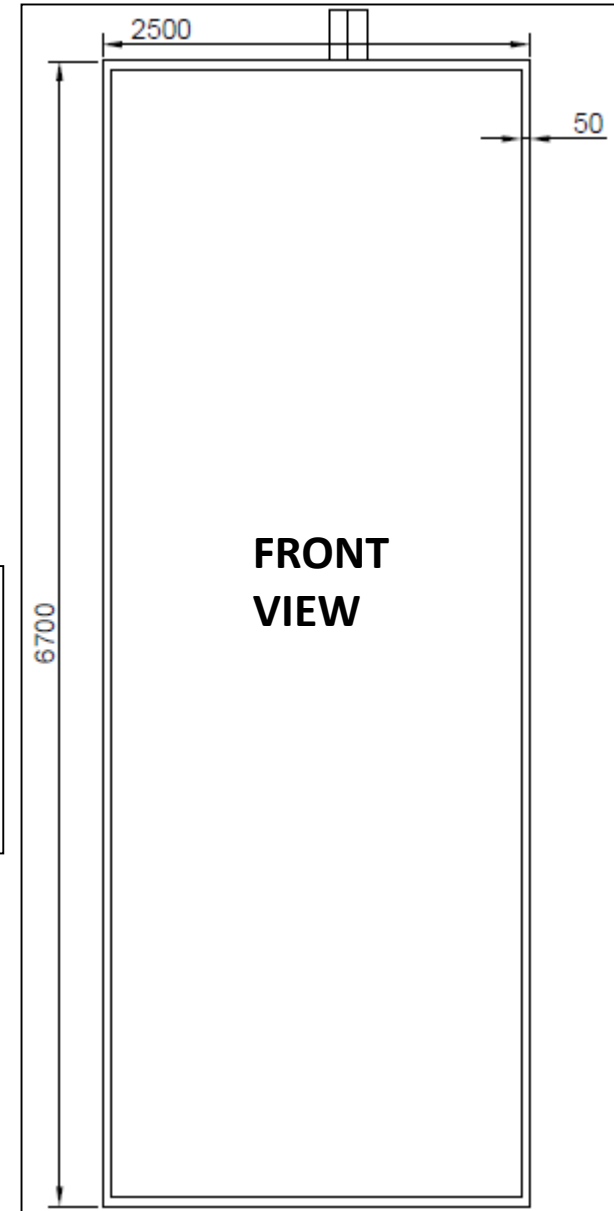
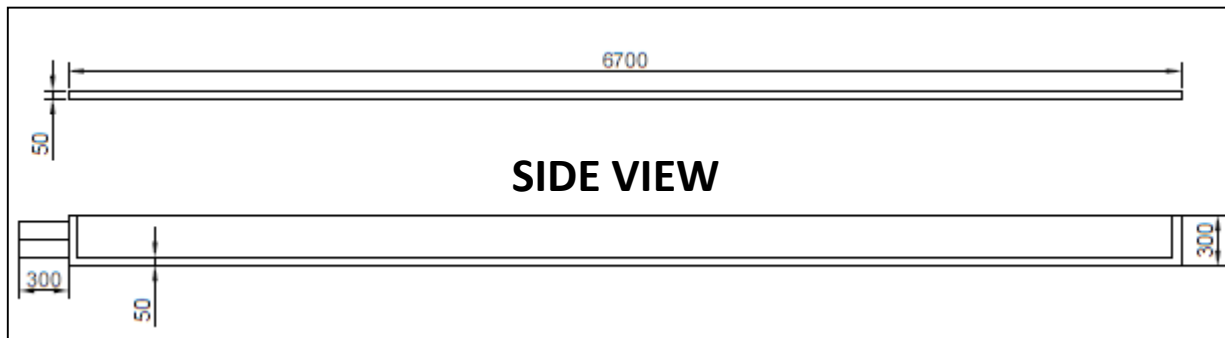
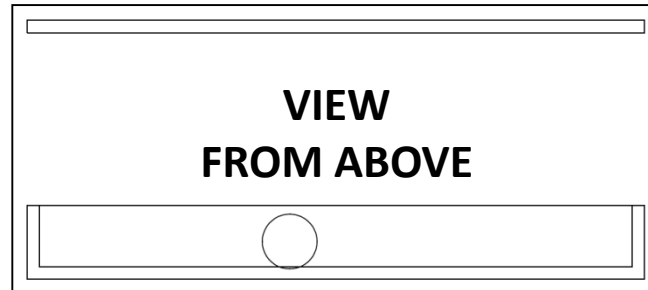
Dimensions TBD.

Possibly to be connected to an actual ProtoDUNE SP flange.

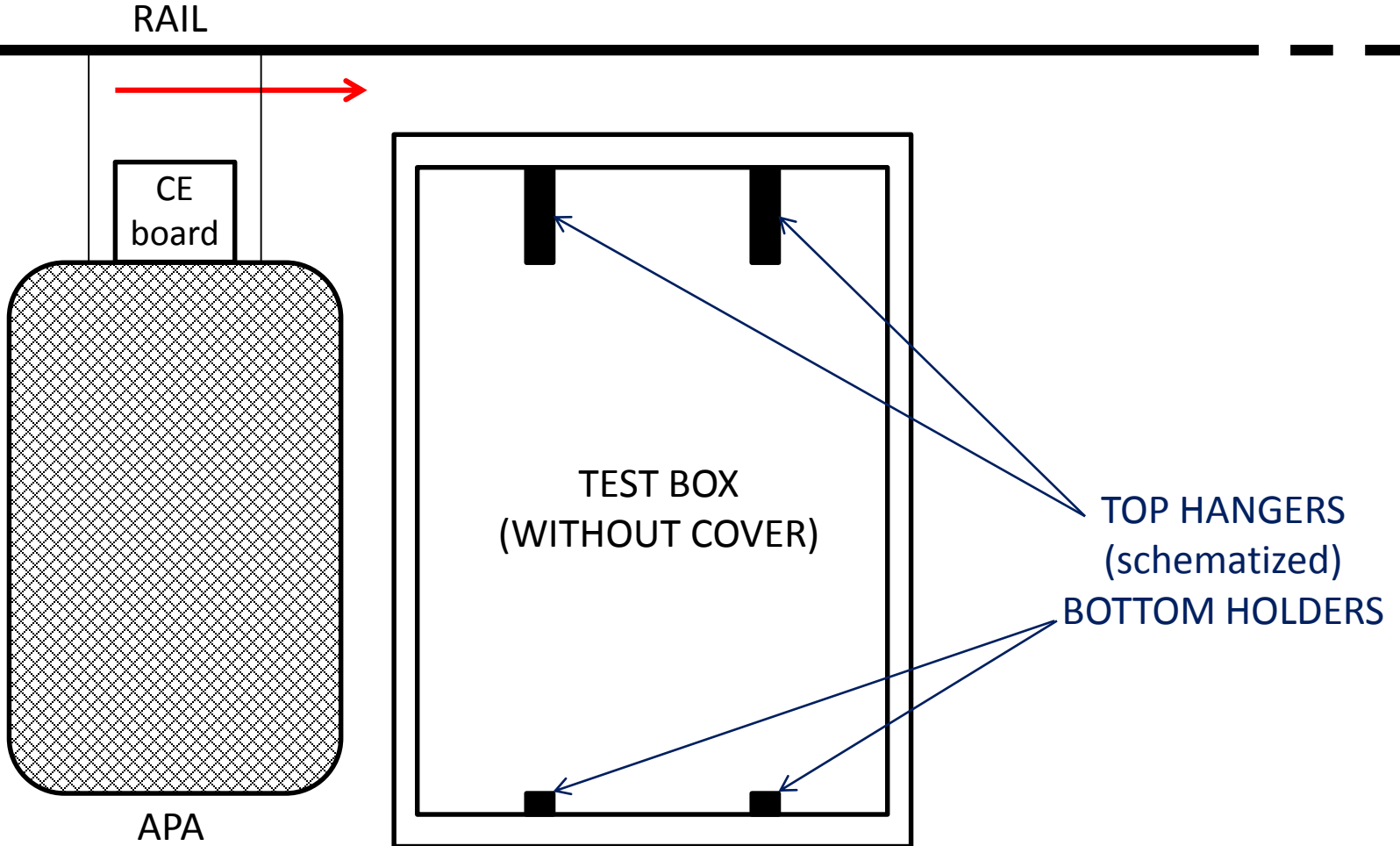
Box drawings - II



- Support for APAs, to be used during movement in/out of the box.
- Not meant to constraint APA.
- Bottom, side if necessary.



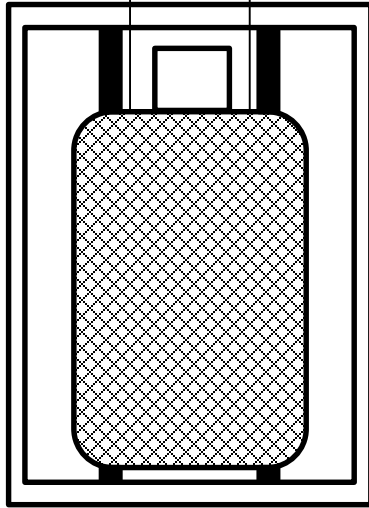
Hanging procedure -sketches



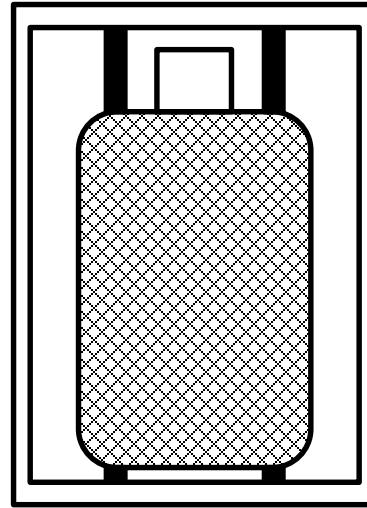
1) Starting position (no penetration or flanges shown).

Hanging procedure –sketches – II

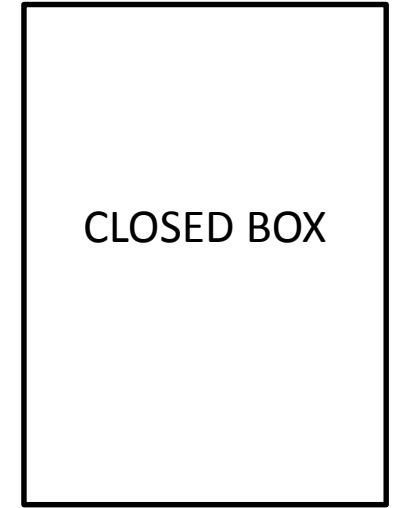
RAIL



2) Bring APA in front of Box; lean it on bottom holders, while still hanging on the rail.



3) Hang APA on top hangers; remove connections with rail.



4) Put cover and close, seal.

Electrical connections not shown here.

After the test, the box is opened and the procedure is reversed, to re-hang the APA on the rail and bring it towards the cryostat.