WE LOOK AFTER THE EARTH BEAT

Double Walled Isolator (DWI) System for a Mars Sample Receiving Facility (MSRF) - outline of activities and early results of European Space Agency (ESA) Technology Development

activity financed by the Mars Robotic Exploration Technology Programme (MREP) of D/HRE, supported technically by D/TEC

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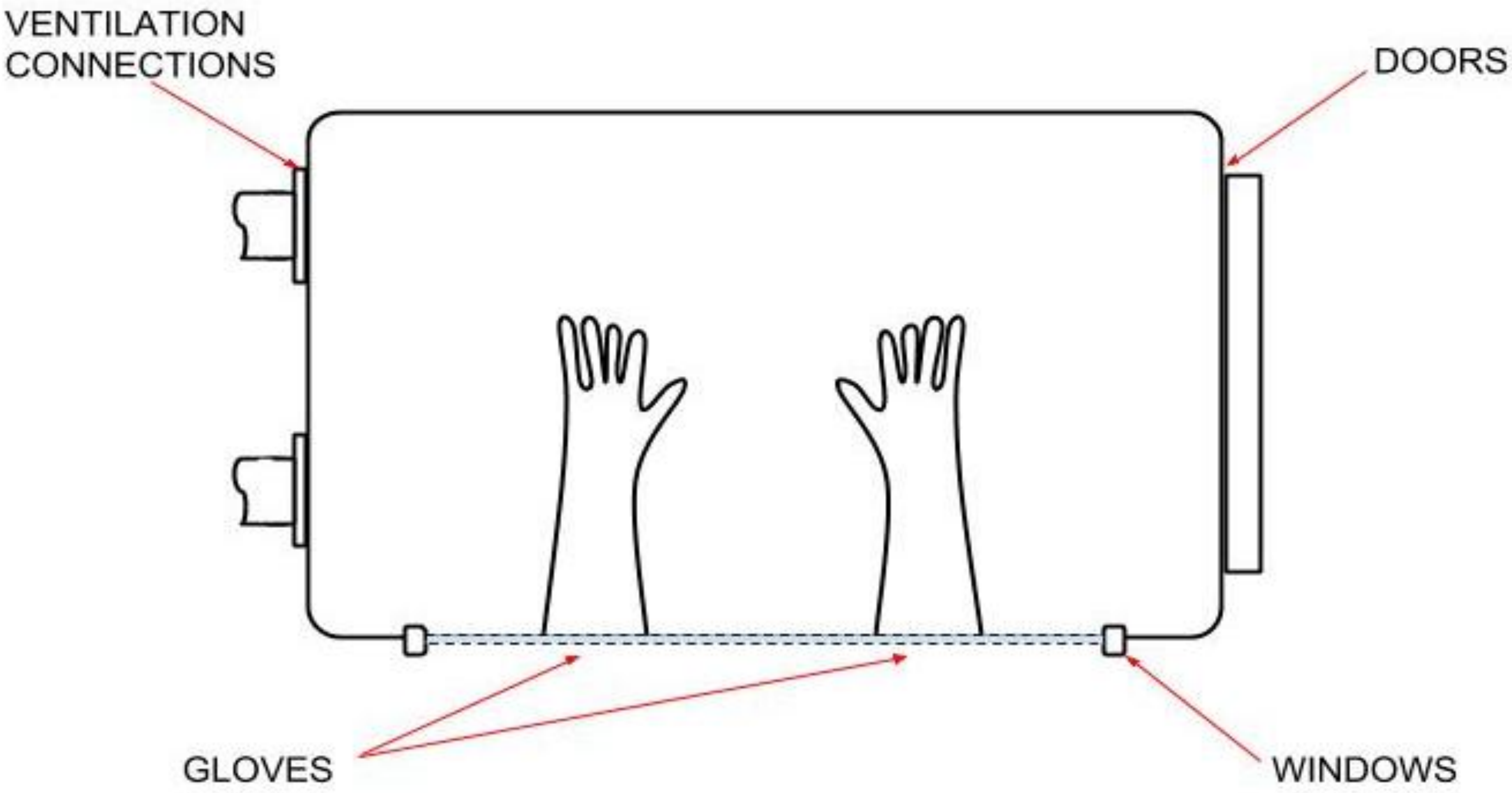
Introduction to the principles of a DWI

What is a Double Walled Isolator (and why?)

1. Conventional Isolators always leak
   (or are prone to leakage)
2. You can protect the outside from the inside using negative pressure
3. You can protect the inside from the outside using positive pressure
4. You cannot confidently do both.

Introduction to the Double Wall Principle (1)

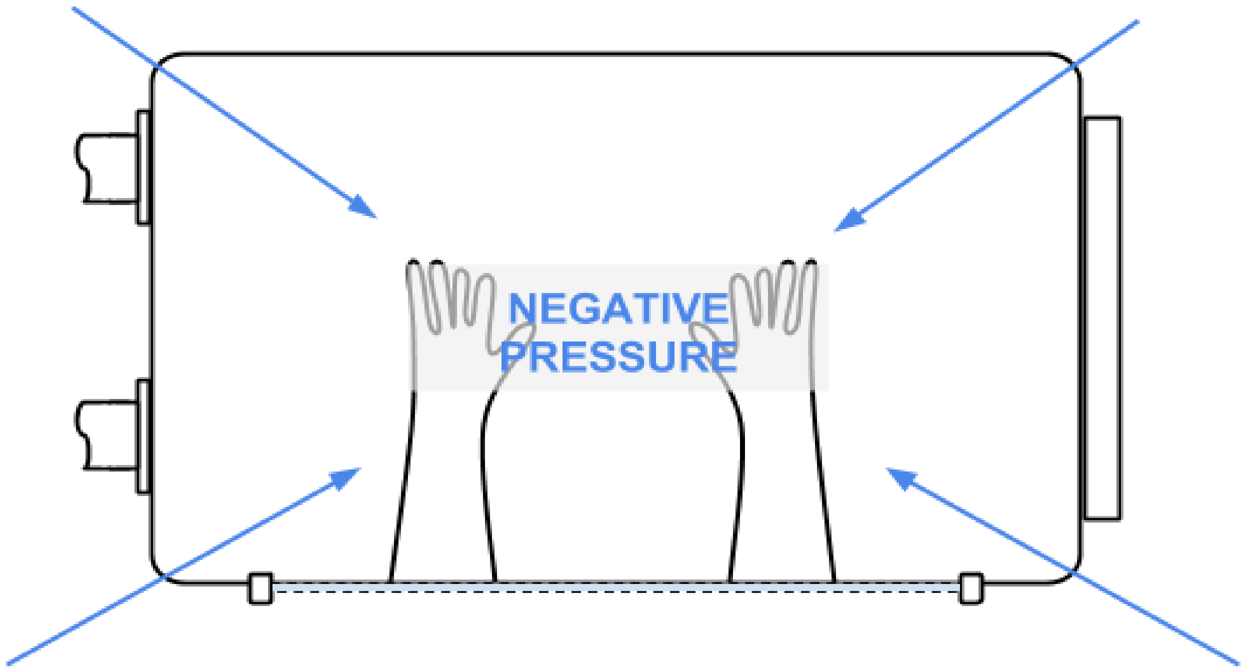
Conventional Isolators always leak (or are prone to leakage):



POTENTIAL LEAK PATHS

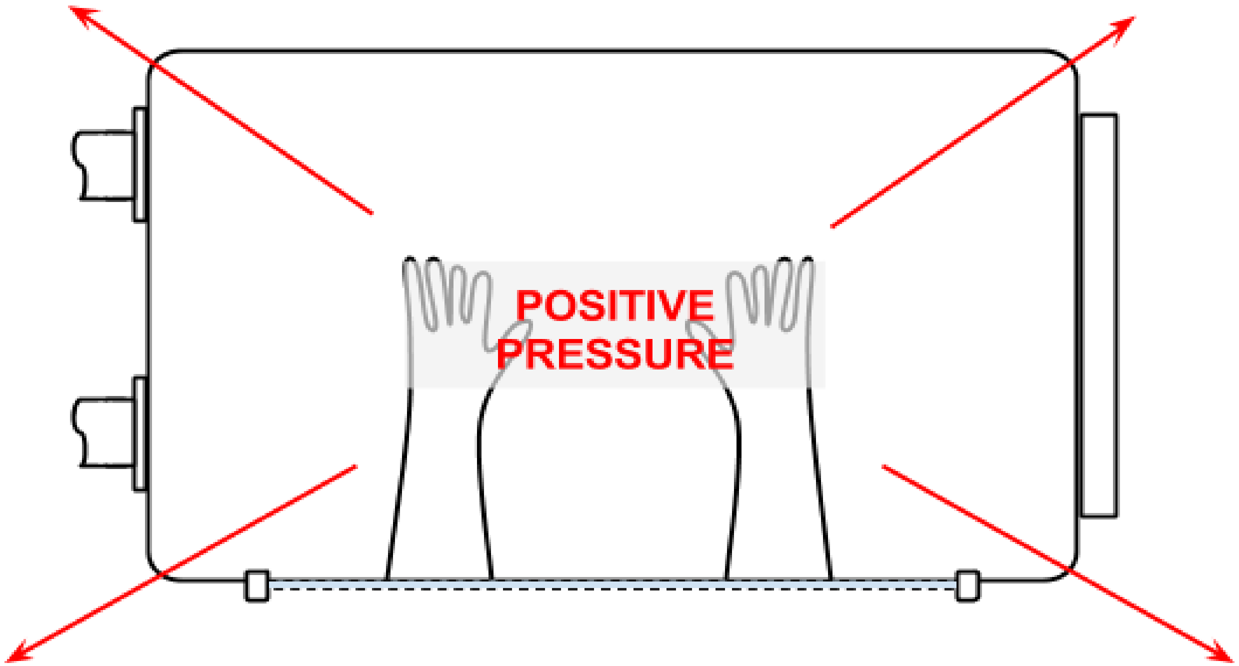
Introduction to the Double Wall Principle (2)

You can protect the **outside** from the **inside** using negative pressure:



Introduction to the Double Wall Principle (3)

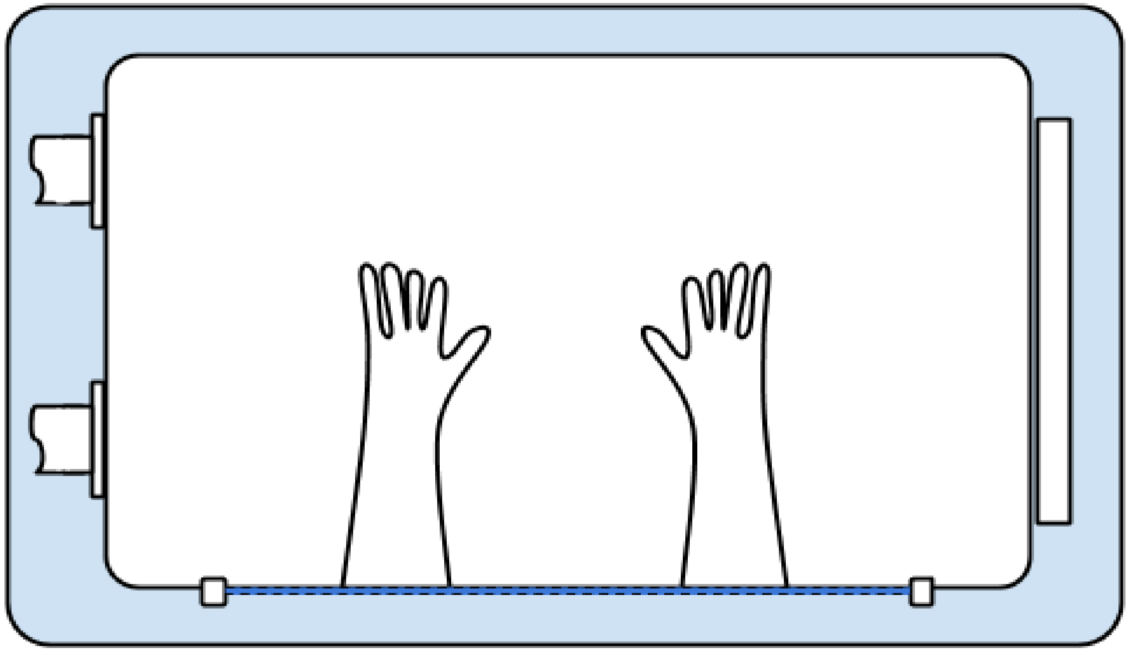
You can protect the **inside** from the **outside** using positive pressure:



Introduction to the Double Wall Principle (4)

You cannot confidently do both

... and still be able to use it:

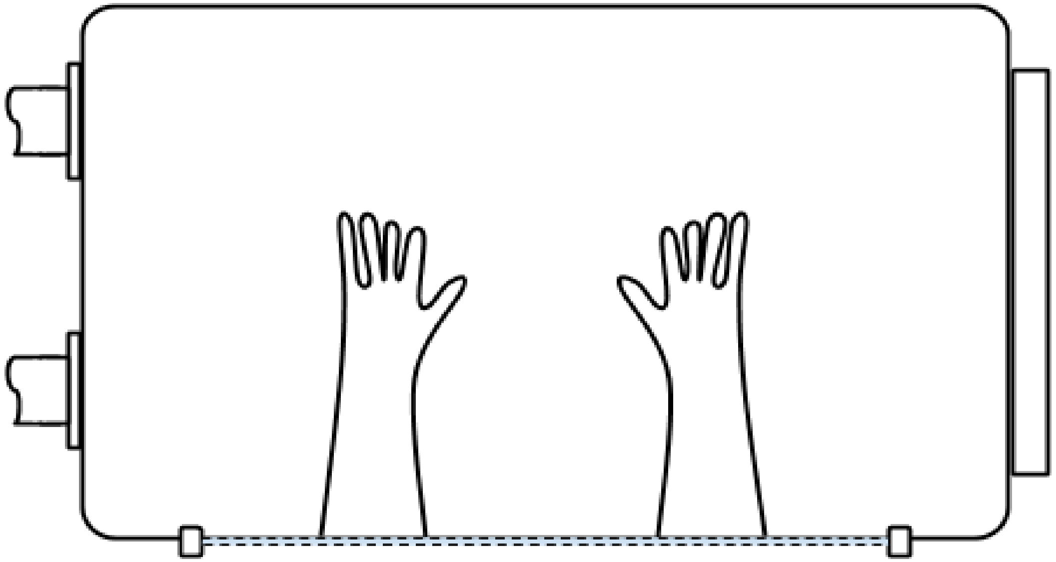


Introduction to the Double Wall Principle (5)

A simple closed box does not leak...

... but you cannot do anything inside it

Gloves and windows can be replaced with robots and cameras...



Introduction to the Double Wall Principle (6)

Gloves and windows can be replaced with robots and cameras...

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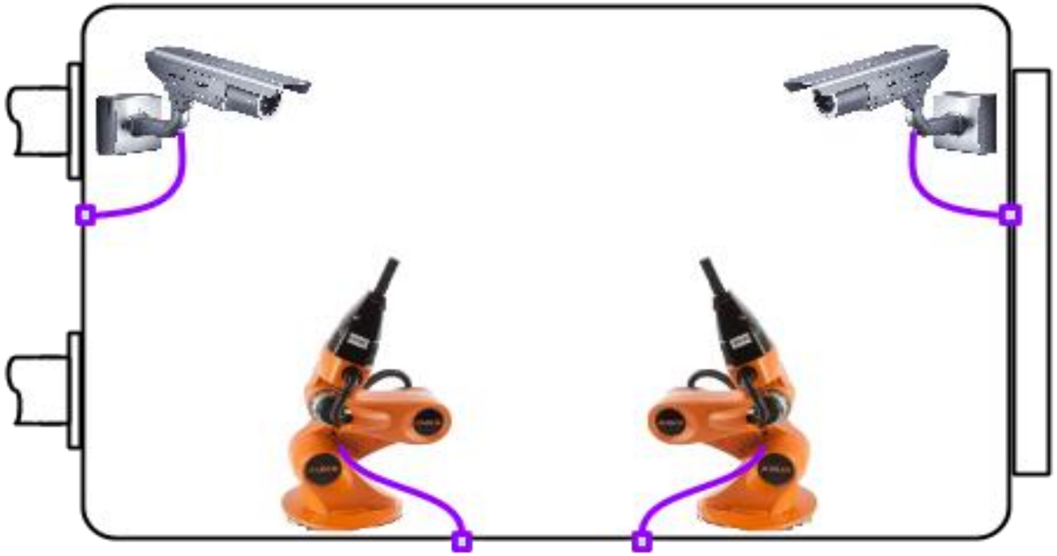
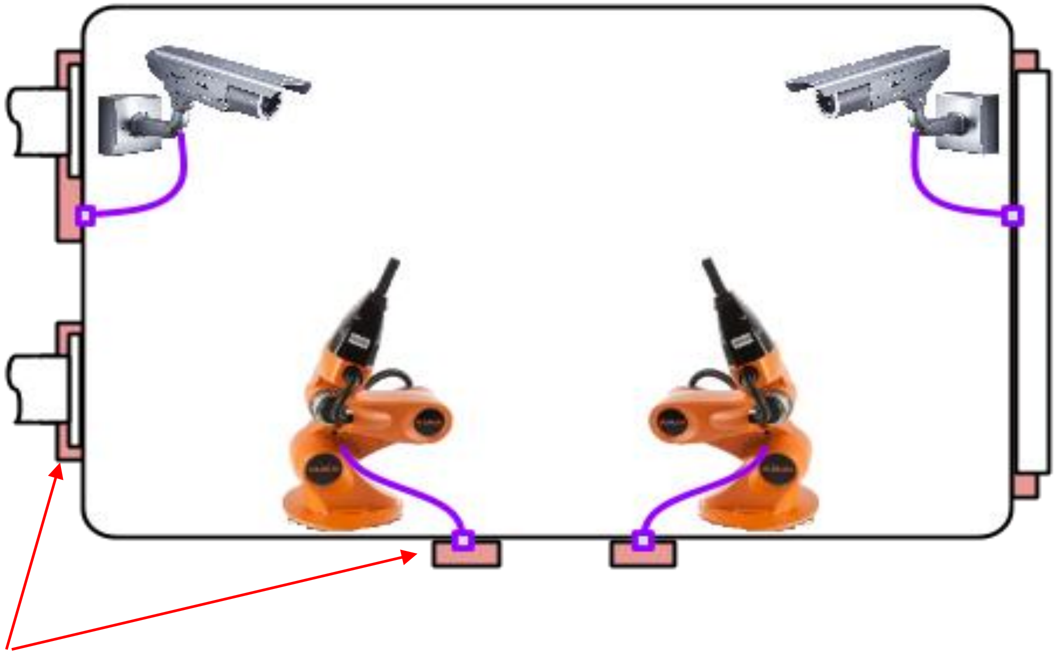


... but you still need to make connections

...but the double wall is only needed where there are penetrations or joints



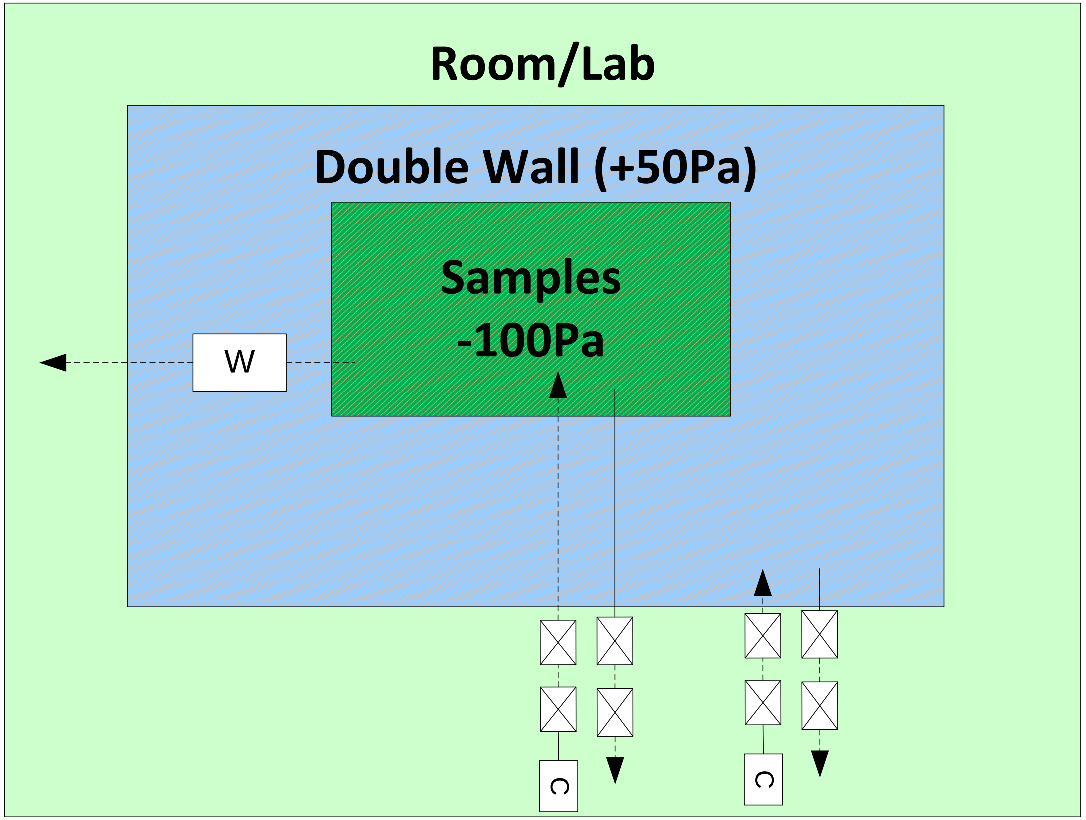
Double Wall sections

Introduction to the Double Wall Principle (8)

A double wall ensures any leaks are clean gas from the intermediate zone into the isolator or out to the room

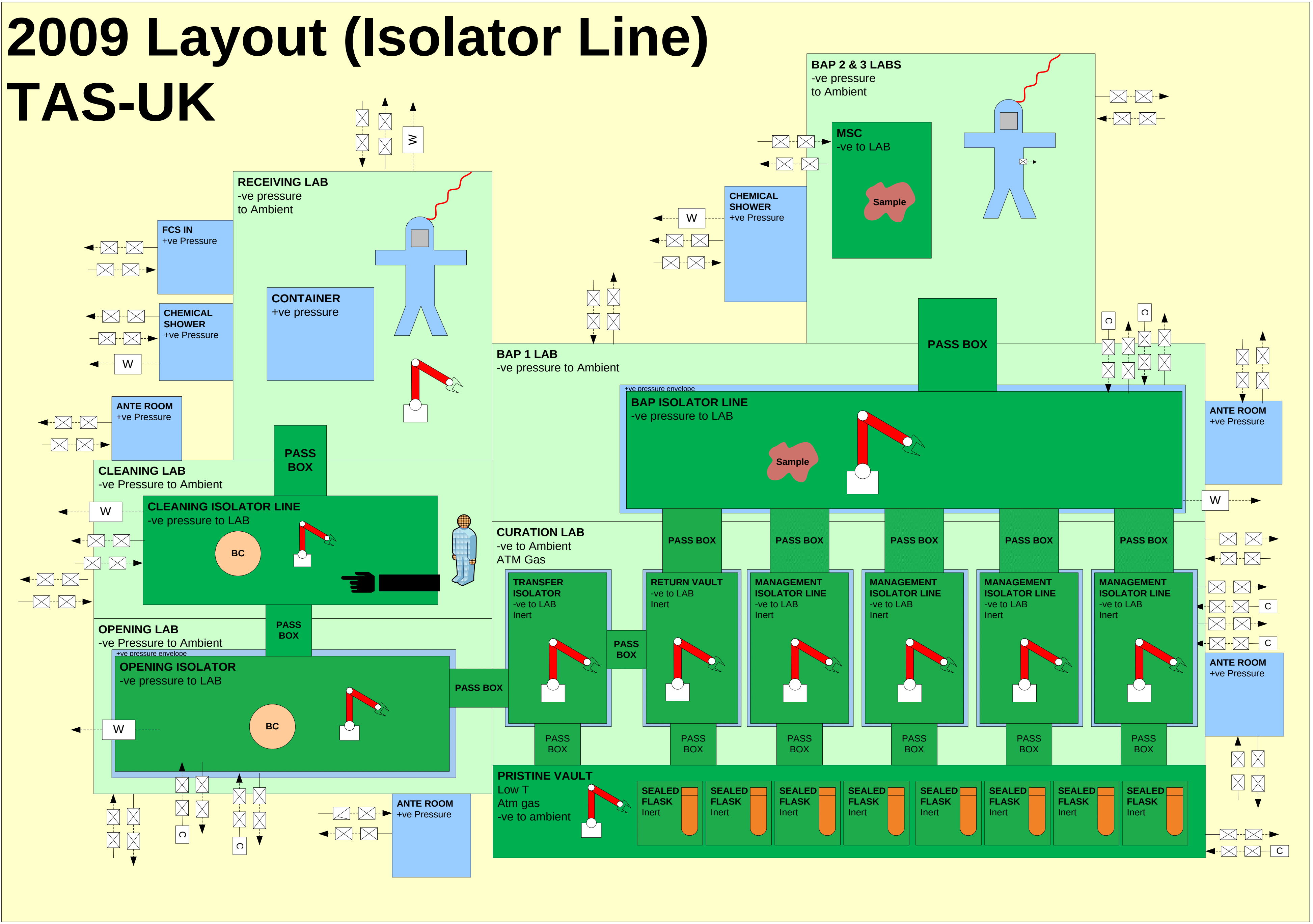
KEY

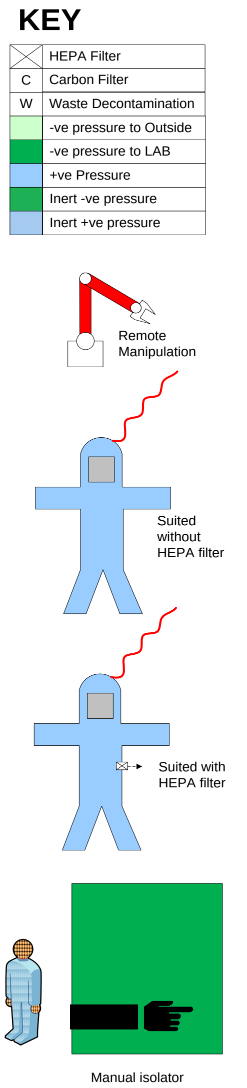
	HEPA Filter
C	Carbon Filter
W	Waste Decontamination
	-ve pressure to Outside
	-ve pressure to LAB
	+ve Pressure
	Inert -ve pressure
	Inert +ve pressure



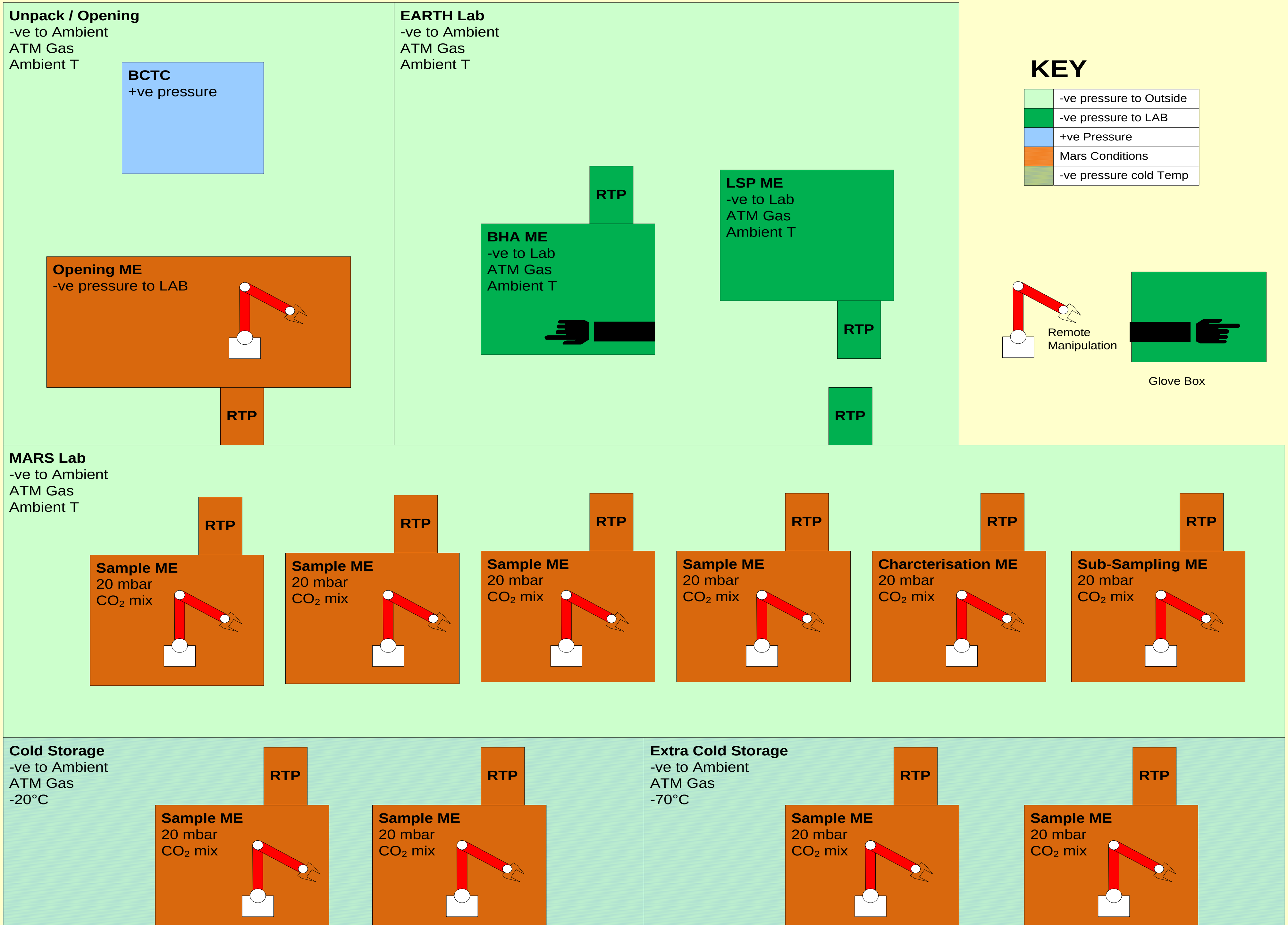
Note, simultaneous containment and cleanliness is achieved through the pressure regime using filtered dry inert gas

MSRF 2009 Layout (Isolator Line TAS-UK)

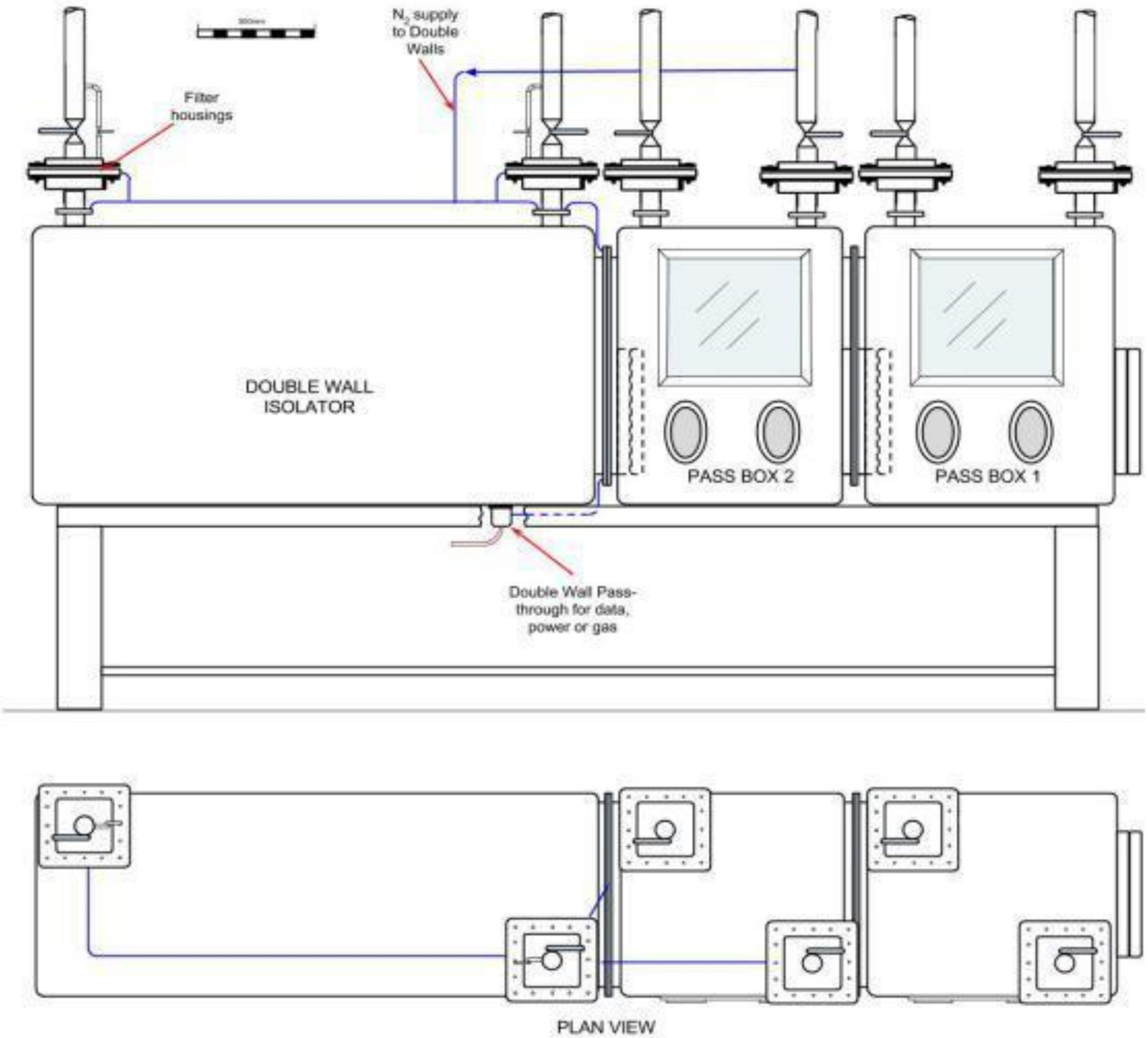




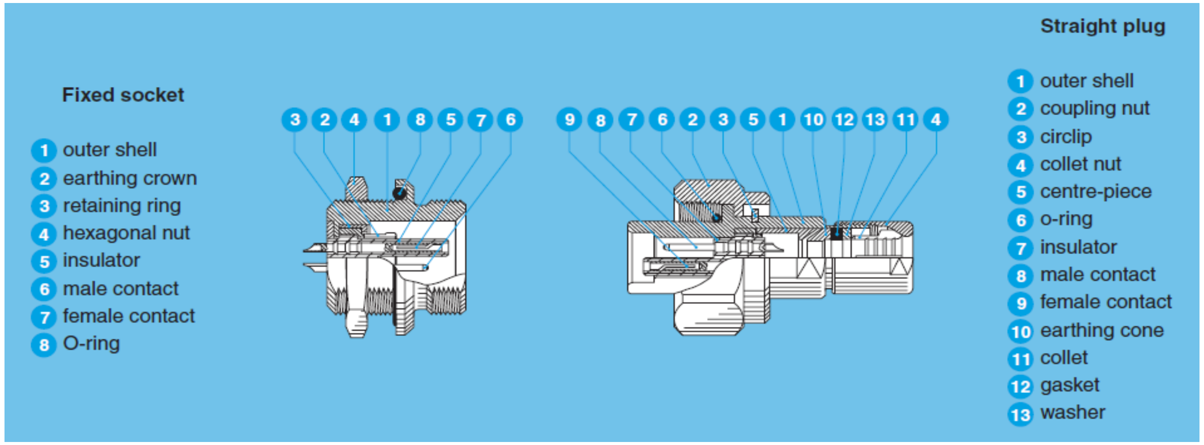
MSR SRF – parallel Tecrisk study (2011)

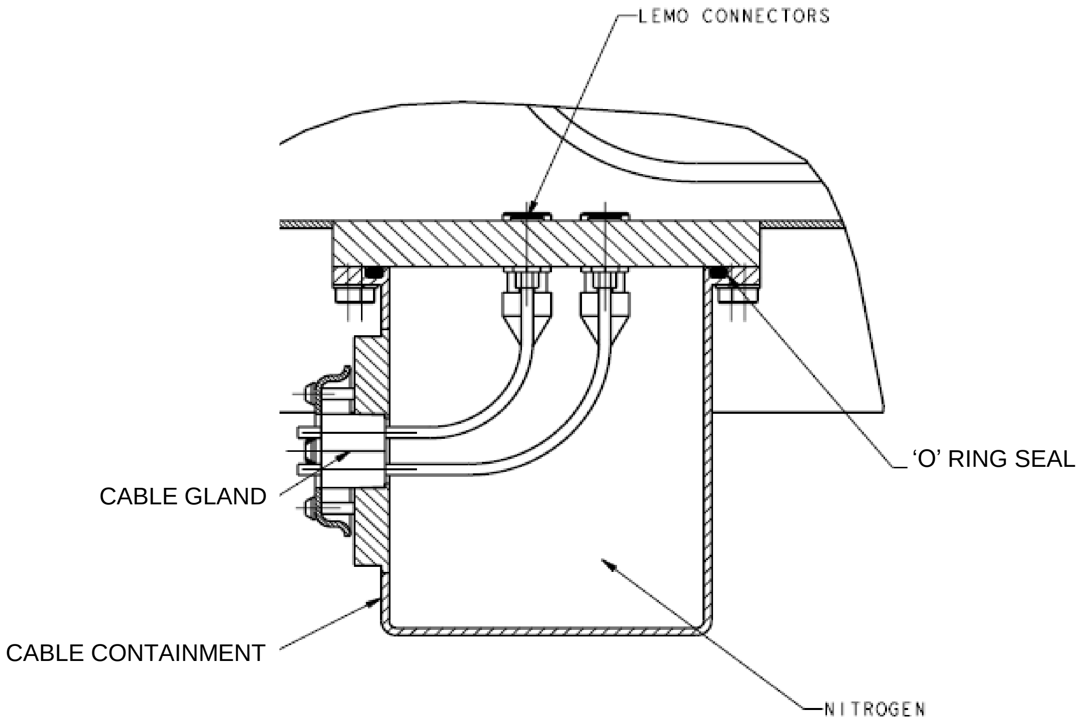


DWI Preliminary Concept Design (2013) 1/2

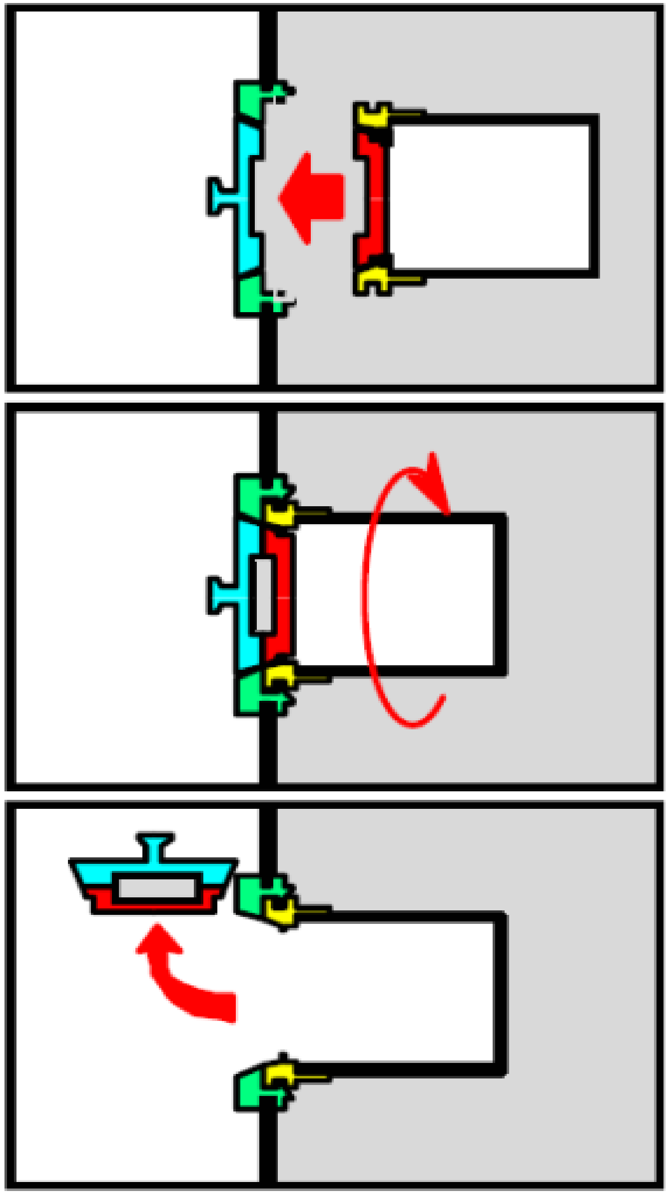


DWI Preliminary Concept Design (2013) 1/2





Single Walled Rapid Transfer Port (RTP)



Approach

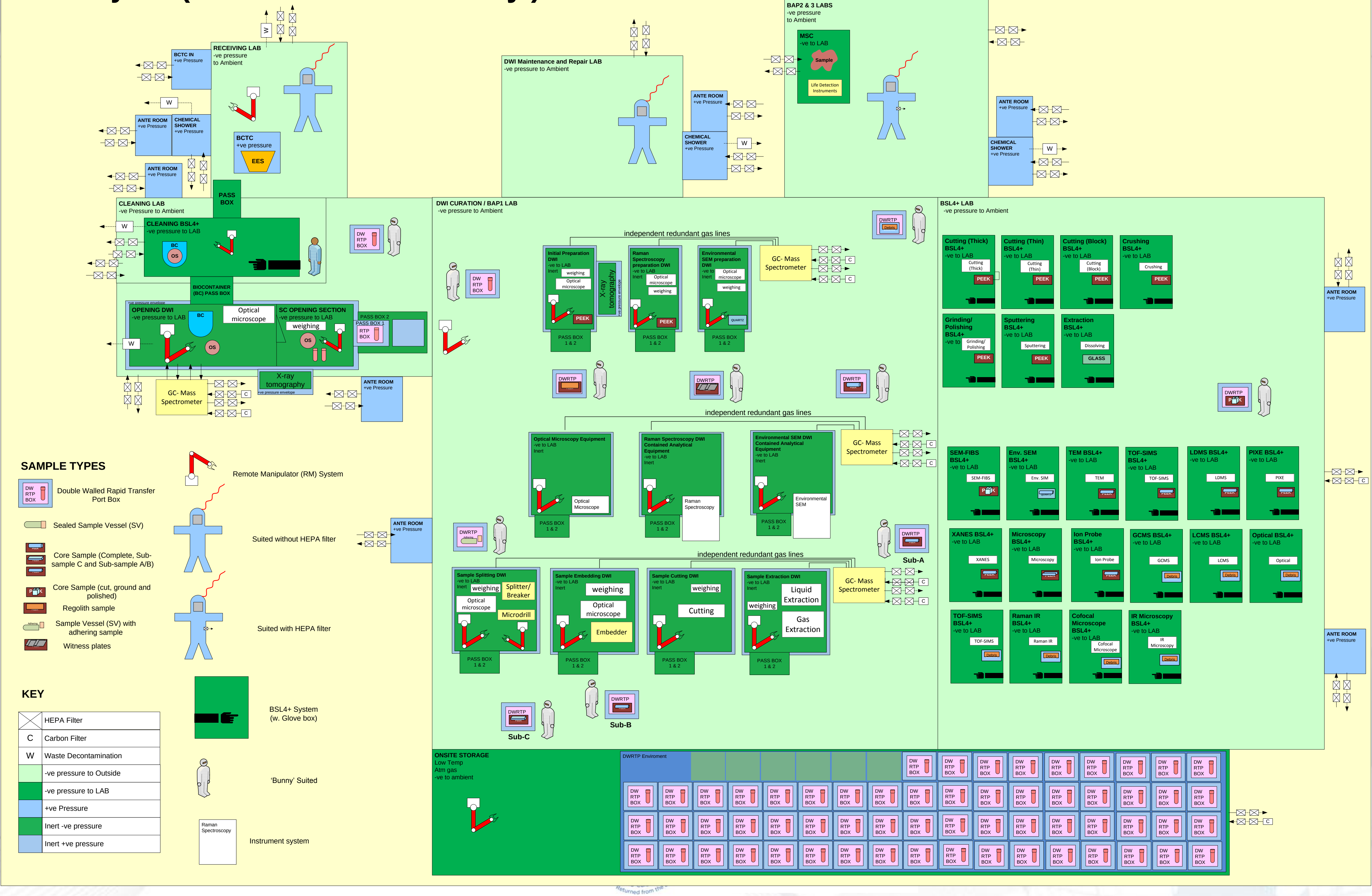
Connection

Opening

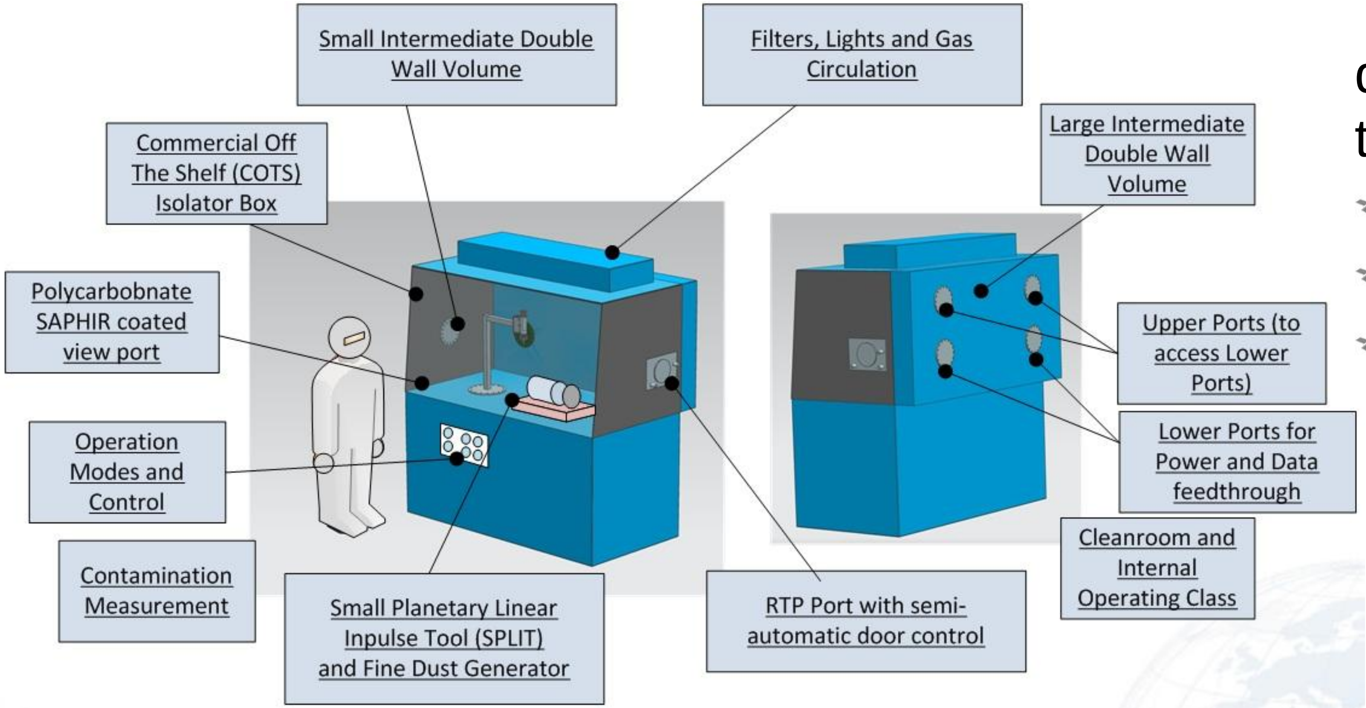
Results of DWI Feasibility Study (2014) & Breadboard (2016)

- A preliminary concept for a Double Walled Isolator (DWI) was developed with double walls only where required
- To transport sample material between DWIs, development ofr Rapid Transfer Port (RTP) Boxes used
- Layout updated to replace isolator lines with DWRTP Boxes
- Proposed DWI Breadboard and technology demonstrations

2016 Layout ('Consolidated Inventory')



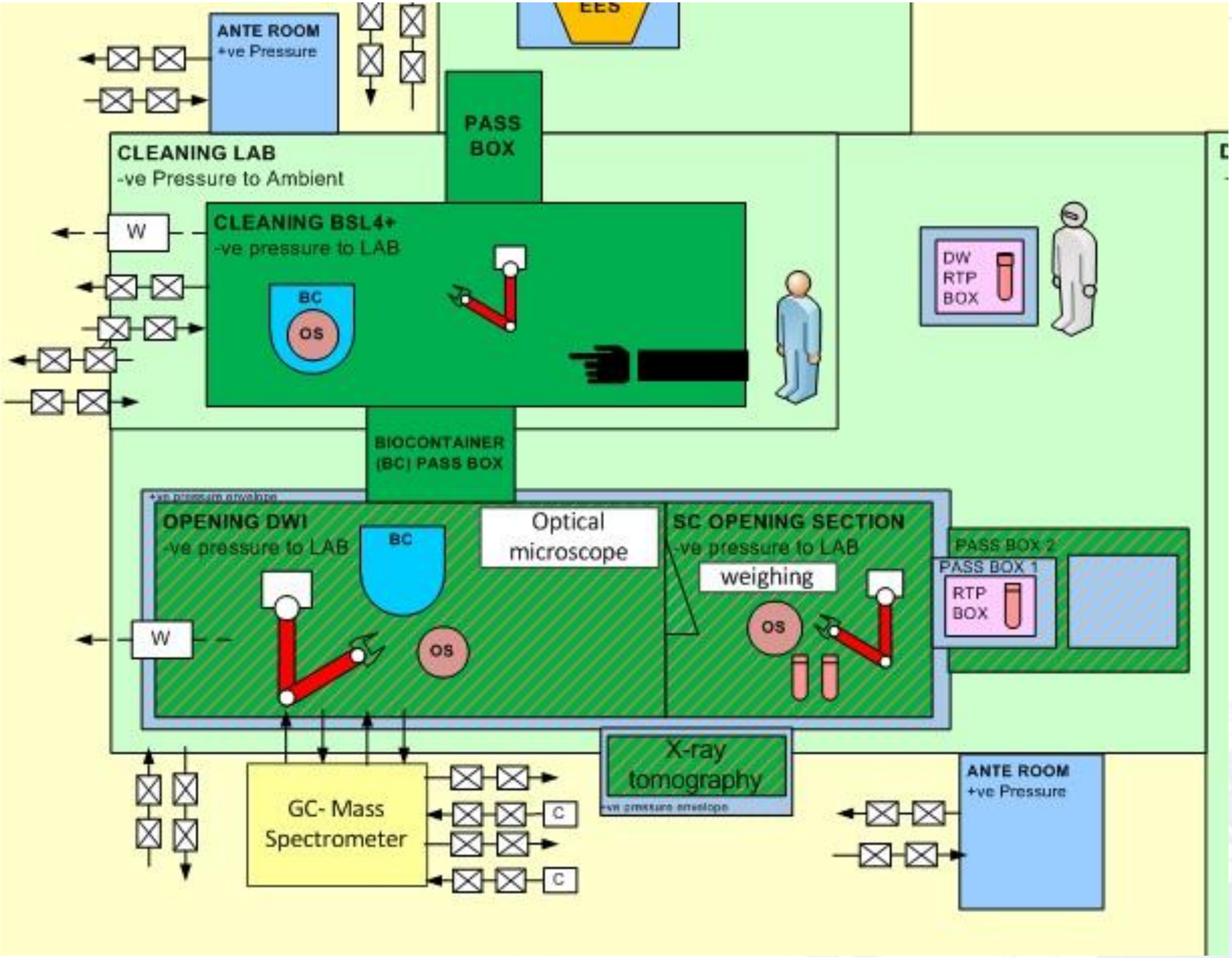
TAS-UK Current Activities – proposed* DWI systems breadboard & 3 technology demonstration tests



- 3 Technology Demonstration Tests (using 'breadboards' to determine performance of technology)
  - Cleanliness Demonstration
  - Containment Demonstration
  - Equipment Impact Demonstration
    - Semi-automatic rapid transfer port (RTP)
    - Power and data interfaces
    - Representative scientific equipment; contaminants (SPLIT and fine dust generator)

*as costed for in proposal, but exact breadboard and demonstrations depends on detailed design

Any questions?

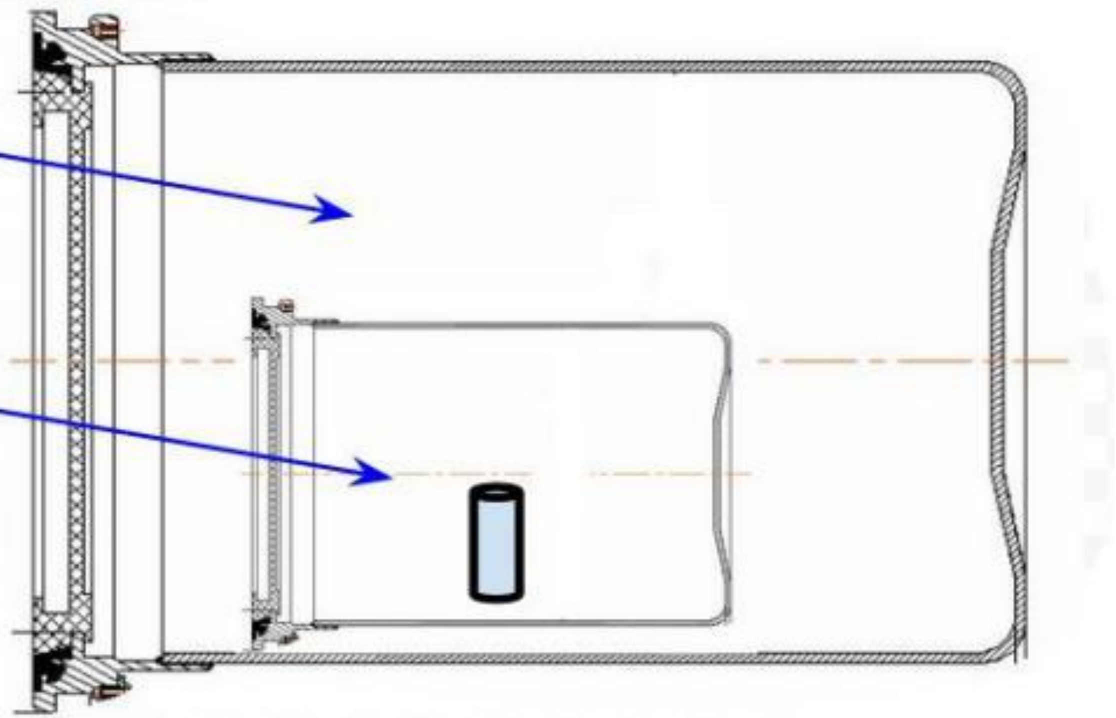


Additional Material (if time allows)

- Slide 25 ‘Russian Doll’ - Double Walled Rapid Transfer Port (DWRTP)
- Slide 30 ‘Top Hat’ - Double Walled Rapid Transfer Port (DWRTP)

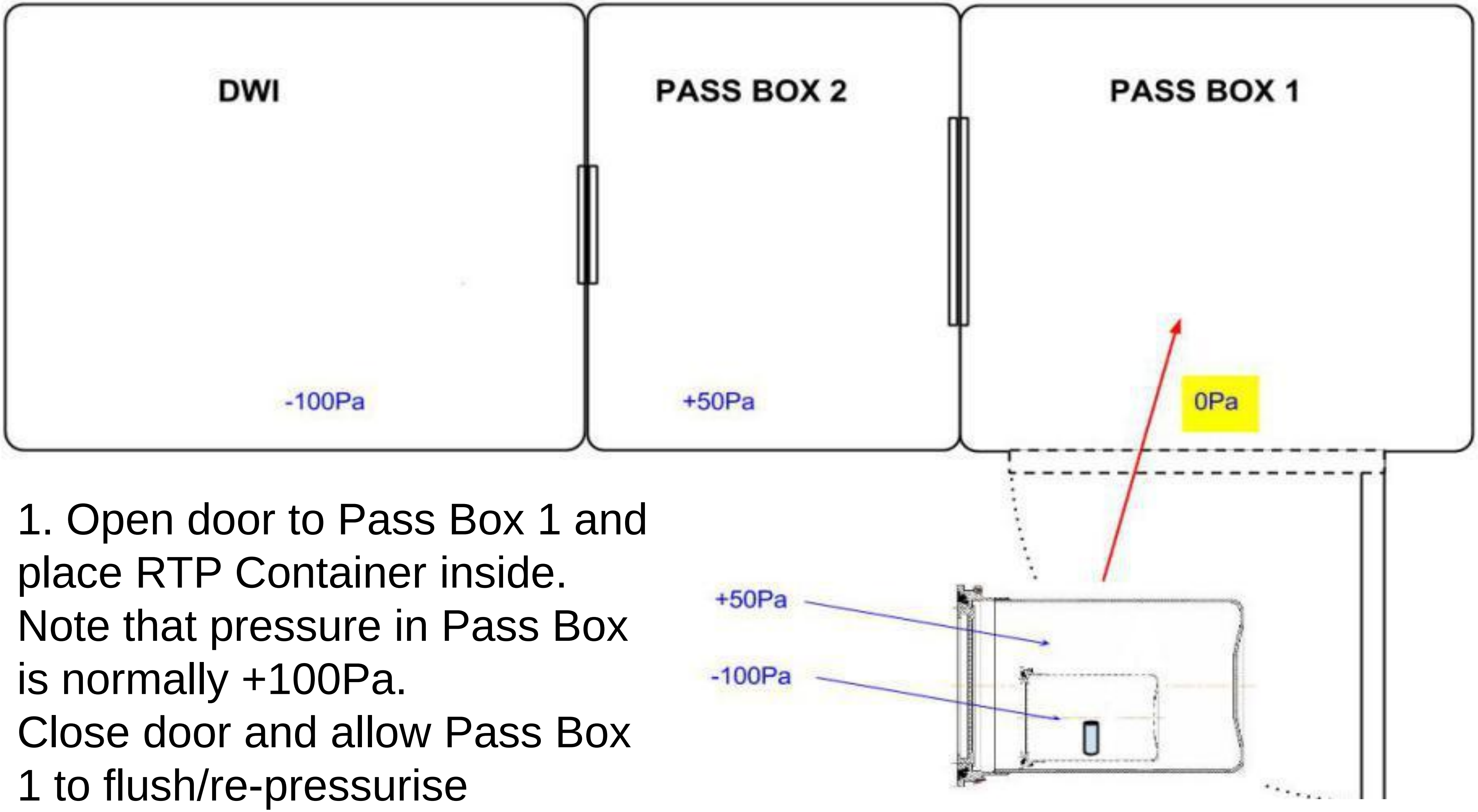
DWRTP Sub-System – Russian Doll (1)

RUSSIAN DOLL approach



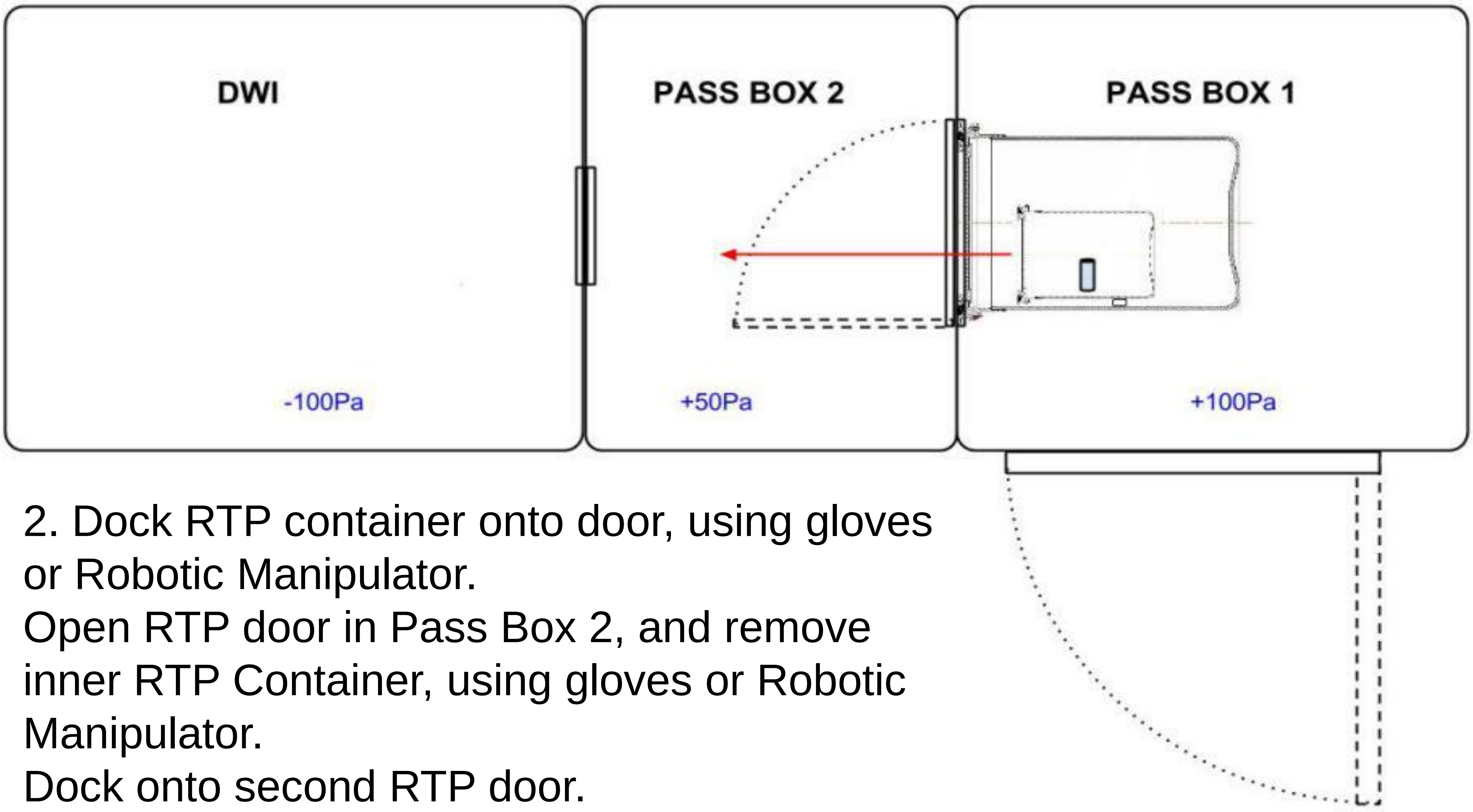
The combined transfer unit is larger and heavier than the single RTP container used in the other methods, with an overall weight of 14 kg, a length of 500mm and diameter of 350mm (500mm across docking handles.

DWRTP Sub-System – Russian Doll (2)



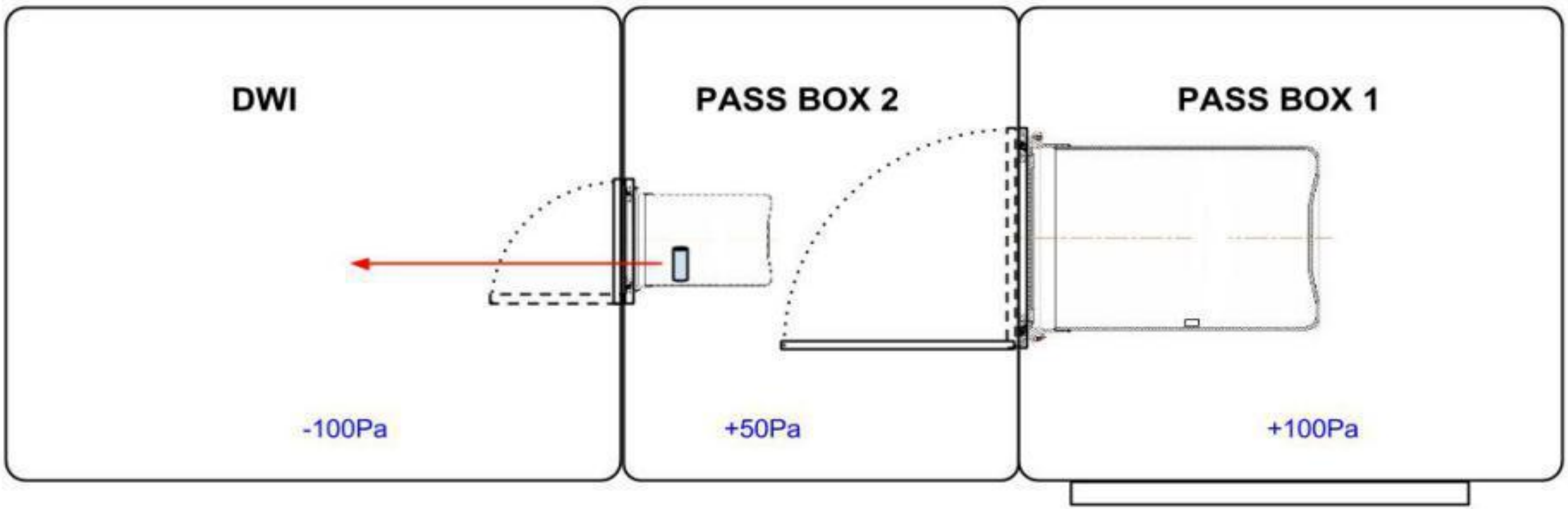
1. Open door to Pass Box 1 and place RTP Container inside. Note that pressure in Pass Box is normally +100Pa. Close door and allow Pass Box 1 to flush/re-pressurise

DWRTP Sub-System – Russian Doll (3)



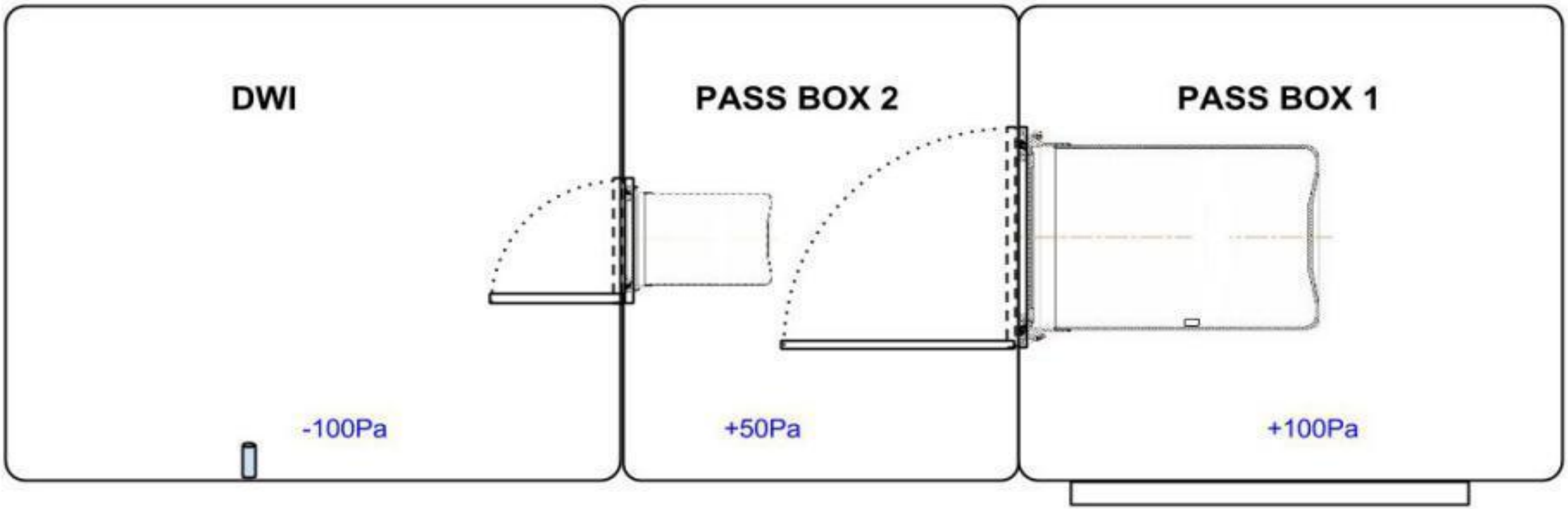
2. Dock RTP container onto door, using gloves or Robotic Manipulator.
Open RTP door in Pass Box 2, and remove inner RTP Container, using gloves or Robotic Manipulator.
Dock onto second RTP door.

DWRTP Sub-System – Russian Doll (4)



3. Using a Robotic Manipulator, open RTP door in the DWI and withdraw Sample Vessel.
Note that both RTP containers can remain in place, unless the route is required for posting in other materials or equipment.

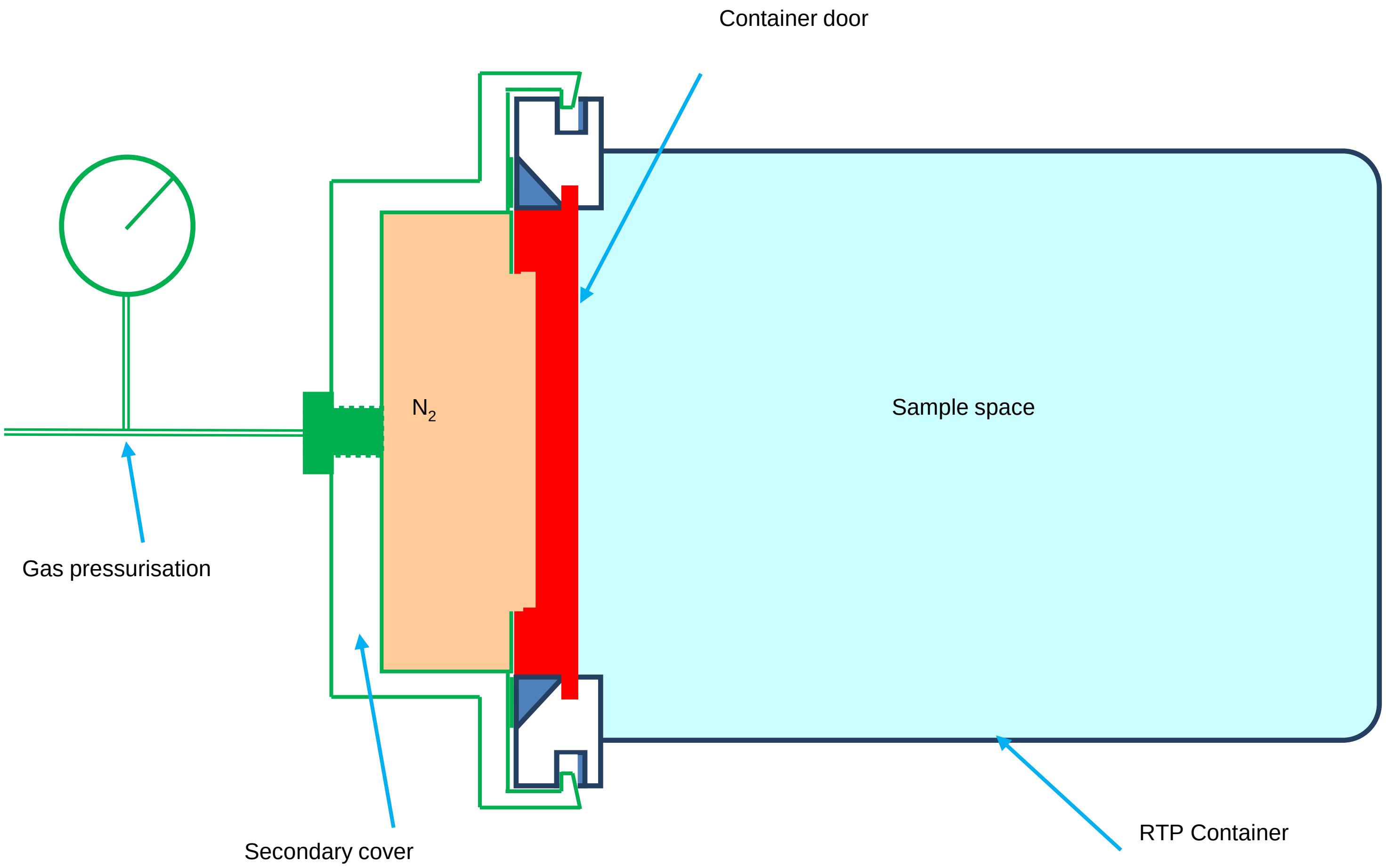
DWRTP Sub-System – Russian Doll (5)



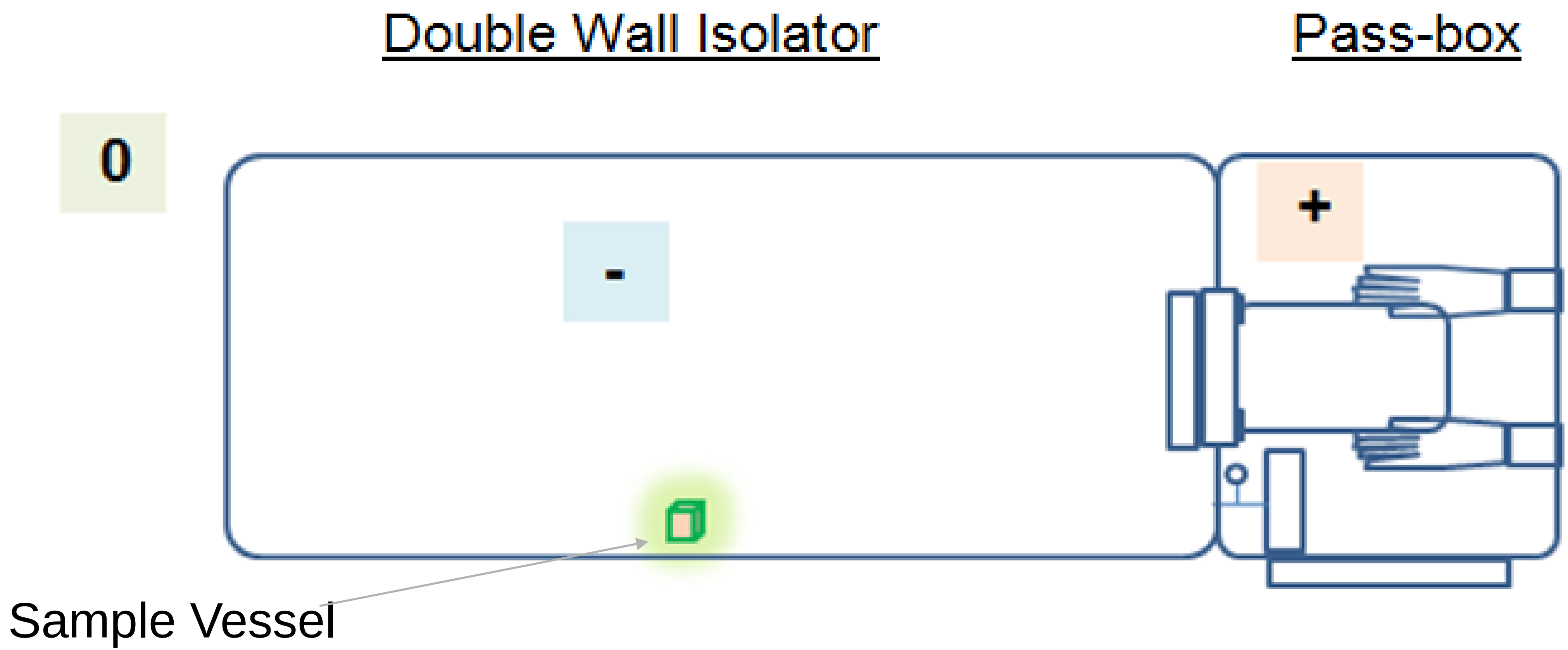
Due to the restricted internal space in the inner RTP container (90mm diameter x 400mm), a secondary route through the Pass Boxes may be required for the posting in or out of equipment and materials – this has been omitted for clarity.

DWRTP Sub-System – Top Hat (1)

TOP HAT configuration

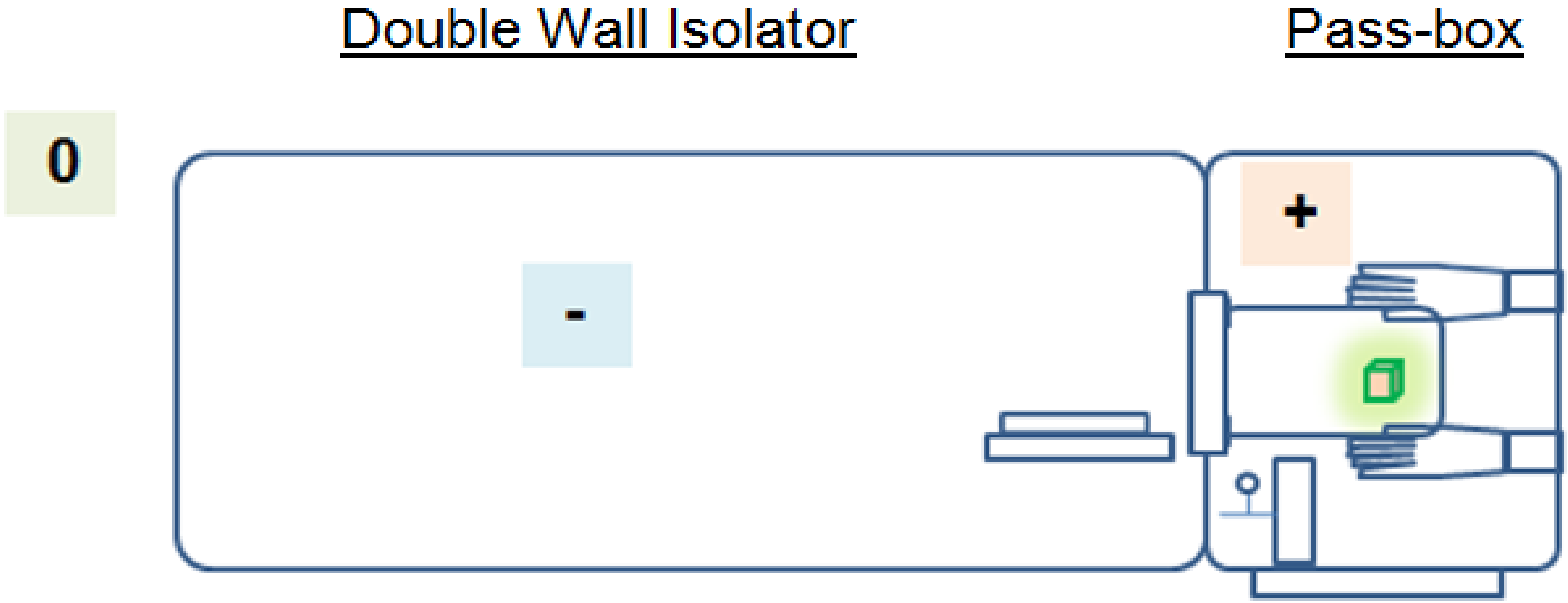


DWRTP Sub-System – Top Hat (2)



1. Sample in DWI, RTP Container being attached to Port

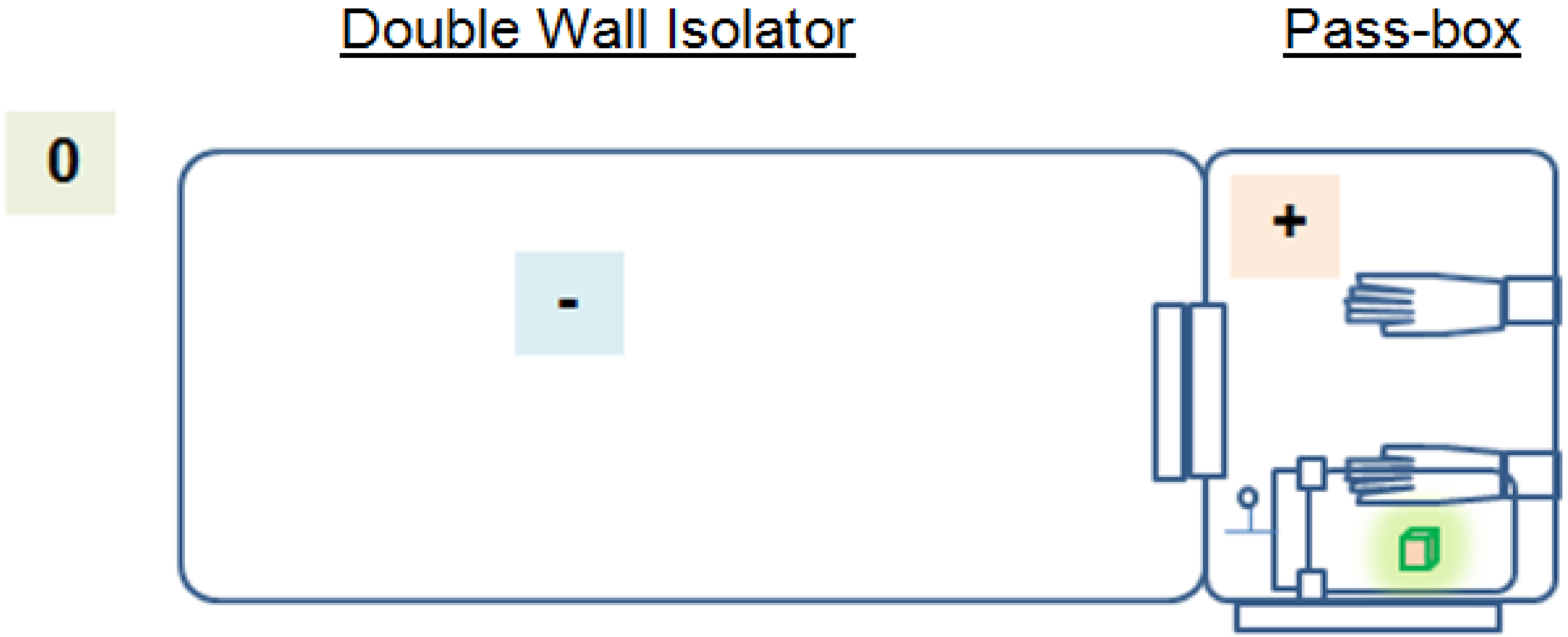
DWRTP Sub-System – Top Hat (3)



2. Rapid Transfer Port opened, SV transferred into container using RM

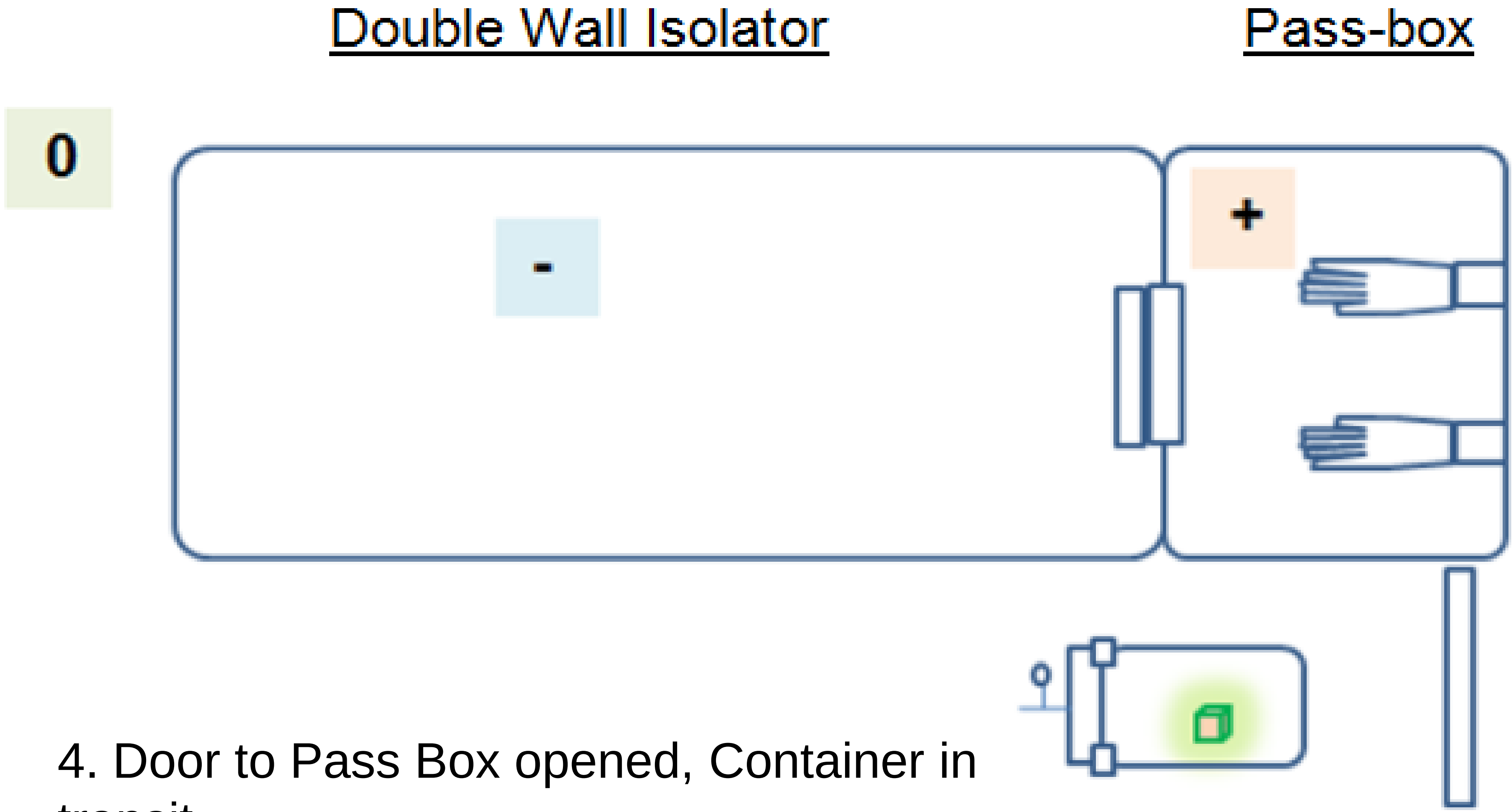
During this operation, the Pass Box acts as the Double Wall protection

DWRTP Sub-System – Top Hat (4)



3. Port closed, Container attached to cover and pressurised

DWRTP Sub-System – Top Hat (5)



4. Door to Pass Box opened, Container in transit