Amorphous Silicon Solar Cell Plant, BHEL, Gurgaon

Revised Specifications of the Vacuum Chamber for the Deposition of Aluminum coatings using DC Magnetron Sputtering Technique:

S.No	Item Description	Unit
1.	**VACUUM CHAMBER** (suitable for 10^{-7} Torr base pressure) 1. Horizontal Rectangular [Overall Size: 1620 mm x 610 mm x 330 mm approx]. Thickness of ss sheet of chamber is ~6 mm. Sideband top flanges are shown in the schematic. Photographs of the similar process chamber are also enclosed. 2. All SS 304 L TIG Welded construction. Elecropolished from Inside & outside 3. Following ports to be fixed to the chamber for: ❖ Plasma Viewing (3 Nos. size KF 50) ❖ Gauges (2 Nos., KF 25) ❖ Gas (1 No. KF 40) ❖ Rotary feed through (2 No. KF 40) ❖ Dummy on the lid (4 Nos. KF40) with blinds. ❖ Vacuum Pumping (1 No. ISO 160 NW) ❖ Magnetron Sputtering Cathode (4 Nos. for Electrodes) ❖ Others: 2 No., KF 16 4. Provision to mount Slit Valves/gate valves at both Sides of the chamber to isolate the chamber from the adjacent chambers. 5. Removable Top Plate Assembly with O-rings of Viton material. 6. HV Compatible quartz windows (Size KF 50, 3 numbers) Vacuum chamber to be supplied with: i. **Transport mechanism,** suitable to transport substrate carrier plate horizontally of size 15"(W) x 36"(L) x 0.25"(H) on abrasive ss endless belts with the help of geared motor coupled with rotary feed-through. The substrate carrier plate entry and exit in the chamber has to be sensed and displayed on the control panel using ceramic micro switches. Transport frame, guide wheels, endless belt should be made of ss and the bearings of the transport mechanism should be high vacuum compatible. **ii. Sputtering Cathodes (2 numbers):** Sputter-Up Configuration, HV Compatible Mounting Arrangement suitable to mount two numbers 15" x 5" Targets. Magnetron design should be based on Rare earth magnets and cathodes should have the provision to CLAMP Targets of thickness ranging from 5 to 15 mm. The cathodes should have provision to cool the targets by flowing chilled water and suitable electrical connectors to connect the power supply to the target. Chilled water at 15 °C temp. and 2.5-kg/cm^2 pressure will be provided by BHEL at ASSCP Gurgaon. The chamber should have accordingly 4 ports to fix two cathode assemblies. iii. **Gate valve with throttling:** Bellows sealed Motorised Throttling Gate Valve with ISO NW 160 bolted tapped Flanges compatible with Turbo Pump to be fixed with single claw clamp kit. Turbo pump will be provided by BHEL at ASSSCP, Gurgaon. The Gate Valve to be throttled to a desired position by a motor Forward-reverse switch with a percentage open digital display on the power supply/read-out. Limit switches at both ends to be provided at both ends for indication. iv. **Slit Valves (Custom built)/ Gate valve**: Two numbers, one compatible with one adjacent process chamber and other compatible with adjacent isolation chamber of the existing process line. The gate valve should be electro pneumatically operated. Compressed air at 6-kg/cm^2 pressure through a ¼" flexible PVC tube will be provided by BHEL. v.**Chamber Mounting Structure**: Suitable powder coated MS square Channel frame for mounting the chamber	1 set.

Additional information:

1. The vacuum chamber will have to be integrated to the present multi chamber PECVD process line, available at BHEL, ASSCP, Gurgaon. Smooth transfer of sample carrier plate in vacuum from one chamber to other and the deposition of Al layers will have to be ensured by the supplier. **The dimensions in the schematics must be considered as approximate**. The supplier has to take exact measurements and prepare drawings to ensure proper matching of mechanical parts to ensure perfect alignment of chambers for smooth carrier movement in the modified deposition system.

2. The slit valves will be of rectangular shape or standard gate valves. These slit valves will vacuum seal the sample entry and exit slits, between the chambers, when switched on and will leave the slit clear for sample transfer, when switched off. The valve will be operated electro pneumatically and should have the provision of air to open and air to close. A suitable arrangement will have to be designed by the supplier to mount it between two adjacent chambers. The operation of the slit valves should have the bellow seal arrangement suitable for high vacuum chambers.

3. The chamber will have to be mounted on a frame of square powder coated MS channel frame compatible with the present arrangement.

4. Pre-dispatch acceptance criteria:
   The supplier will have to demonstrate following at his works:

   A. Smooth movement of the substrate carrier in the chamber. The substrate carrier will be provided by BHEL.
   B. Base pressure of the chamber should be better than $5x10^{-6}$ while pumping with a 500 liter per second turbo pump backed by a suitable rotary vane pump. The leak up rate with vacuum valve closed should be better than $5X10^{-3}$ sccs nitrogen max to outside environment. **The low leak-up rate and good base pressure of the chamber is very important for the quality of the process and will be examined very critically.**

5. Acceptance criteria for commissioning of the system at BHEL Gurgaon:

   The supplier will have to demonstrate:

   A. Installation of the chamber at BHEL, ASSCP, Gurgaon, by integrating the vacuum chamber with gate valves on both sides to the existing chambers of the present process line.
   B. Smooth transfer of sample carrier in the modified system from chamber to chamber (sample carrier will be supplied by BHEL).
   C. Uniform sputtering of Al film from the Magnetron sputter target assembly with non-uniformity not exceeding 10% on an area of one sq. ft. for thickness of 1000 Angstrom.

The technical members at BHEL Gurgaon will inspect commissioning of the chamber.

6. Scope of supply of BHEL:
   BHEL will provide following items at BHEL Gurgaon:
   - Capacitance manometer and power supply/read out.
   - Convectron pressure gauge and read out.
   - Al Target
   - Roots-rotary pumping system
   - Turbo pump and backing rotary pump
   - DC sputtering supply
   - MFC for gases and their readout.
   - A suitable gas manifold.
   - Compressed air at 6 kg/cm^2
   - Chilled water at 2.5 kg/cm^2 and at 15 C temperature.
   - 12 V DC supply for the geared motor.
   - ½ ton hoist to lift and position the ss chamber.

7. Scope of supply of the vendor:
   - The vacuum chamber
   - Chamber lid.
   - Suitable transport frame fitted with endless belts, rollers, guide wheels
   - Ports for pumps and gauges.
   - 2 number Gate valves (one for each side of the chamber).
   - Cathode assembly with target cooling arrangement by chilled water.
   - Mechanism to adjust the height of the cathode
   - Rotary feed through.
   - Top lid shield to protect deposition of Al on the lid.
   - Ceramic limit switches.
   - Feed throughs for bringing limit switch connections out of the chamber with BNC connector
   - Mounting frame
   - Miscellaneous items like nuts and bolts for fixing the chamber in position.
   - Gate valve with throttling of size NW 160

NOTE:

1.The new Chamber has to be integrated with the existing set of Vacuum chambers and the mechanical alignment is of utmost importance for smooth operation.

2. Prior Site inspection can be carried out to understand the exact requirement.

3. Test certificate of SS material used for chamber and bought out items to be furnished.

4. Acceptance criteria to be read carefully as the same shall be strictly followed.

5. For any technical clarification please contact –

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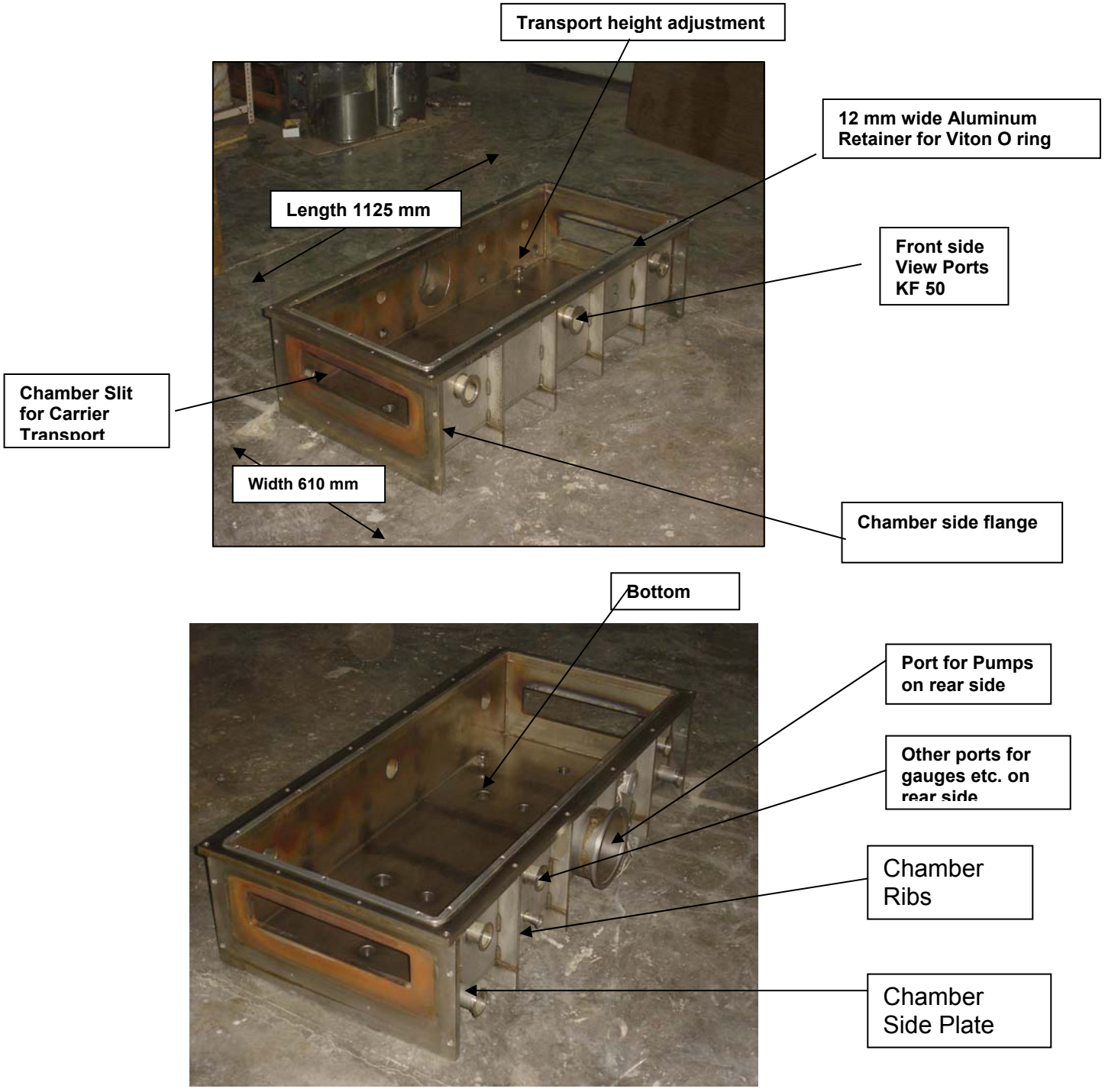
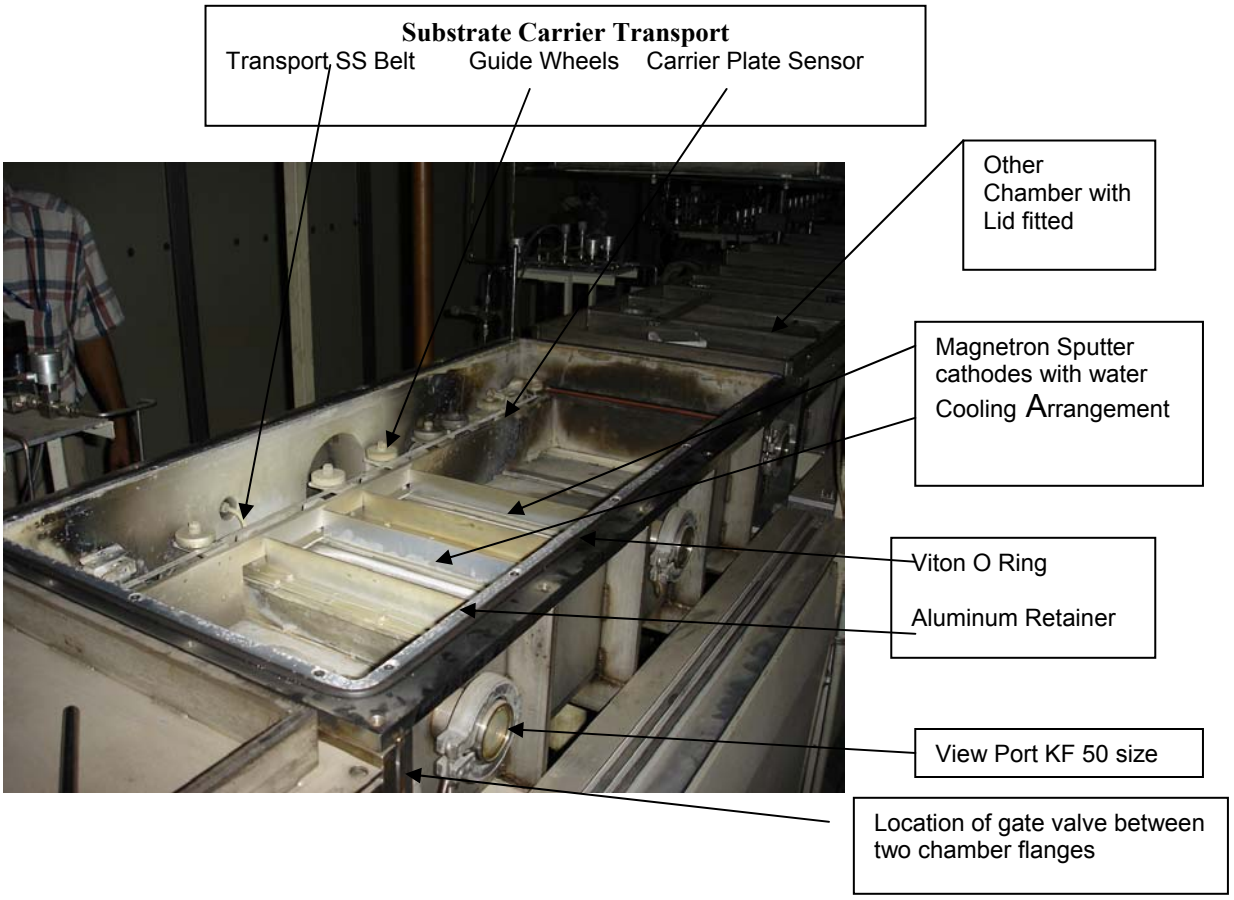
Photographs of the existing Process Chamber, removed from the process line, are enclosed to give an idea to the vendor about the existing process chamber without the transport assembly



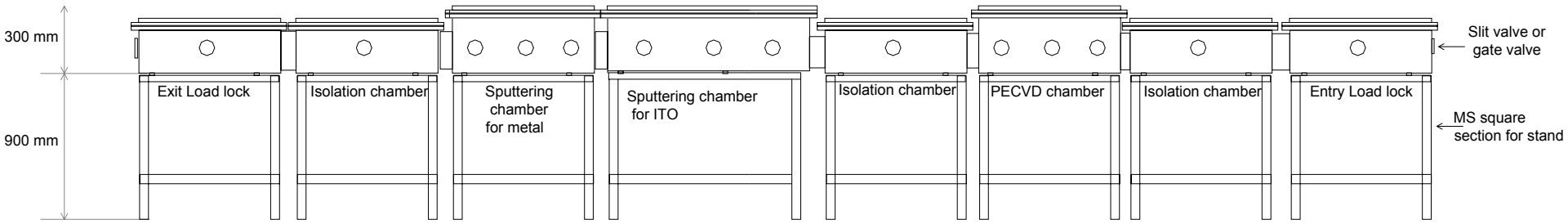
Photograph of the existing Ag sputtering chamber in the existing PECVD system.



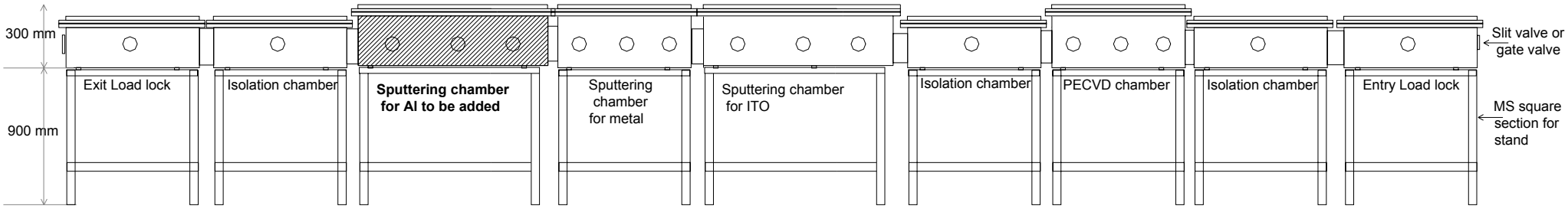
Chamber with Lid:

PROPOSED SCHEME FOR MODIFYING EXISTING PECVD SYSTEM FOR INCORPORATING Al SPUTTERING

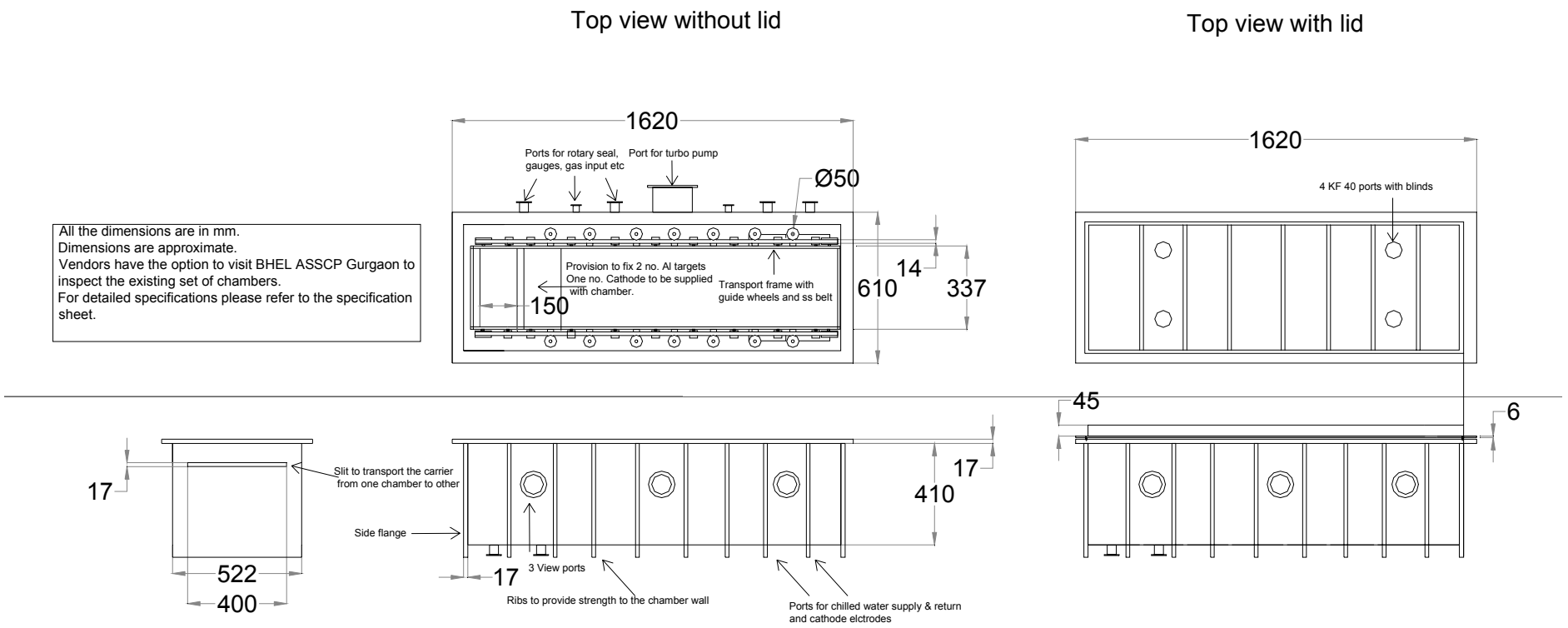
Existing set of vacuum chambers



Proposed Modified Set of Vacuum Chambers



Schematic of the vacuum chamber required for the sputtering of Al



Technical members at ASSCP:

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Sr.DGM	AGM	DGM