

2.1 Bubble Chamber Glycol Fill Procedure

Written Procedure

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This procedure covers filling of the bubble chamber pressure vessel with its nominal charge of hydraulic fluid. Because it is possible to damage the inner vessel/bellows assembly, this procedure is raised to the level of “written procedure.” The filling of the bubble chamber pressure vessel with glycol is fundamentally the same as any other glycol filling procedure, but with the added complication of the presence of the inner vessel assembly. The technical problem is that when the pressure vessel is evacuated for filling or de-gassing, the net pressure on the bell jar and bellows can be reversed from 15 psi compression to as >1 psi expansion force. This could cause the bellows to over-extend and be damaged.

- 1) Ensure that the hydraulic pressure cart is filled to an appropriate level with glycol and isolated.
- 2) Ensure that the cameras and lighting system are fully operational.
- 3) Use the camera alignment tool to monitor the position of the inner vessel. Register the initial position of the evacuated inner vessel within the pressure vessel at 1 atm. Adjust the index marks to reflect the correct maximum bellows extension.
- 4) Arrange the external plumbing appropriately.
 - a. The drain valve at the hydraulic cart should be connected to a flexible line with the tip-valve draw pipe.
 - b. The top flange valve (Vx) should be connected to a vacuum pump through a liquid trap.
- 5) Turn on the vacuum pump and *slowly*¹ crack open Vx while watching closely the position of the inner vessel.
- 6) Hold the vacuum at a level that does not cause the vessel to droop.
- 7) Open the bubble chamber isolation valve and the drain valve.
- 8) Open the draw-pipe tip valve and begin to draw in glycol.
- 9) Raise the level of the glycol to near the 24” diameter top flange but stop (close off the chamber isolation valve) a bit short, leaving a small void space with the full diameter of the pressure vessel. The object is to leave a large surface area for de-gassing.

¹ Remember this is the place where you can break the vessel!

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- 10) Raise the temperature of the glycol in the pressure vessel to near the operating temperature, 40°C.
- 11) Continue to pump on the glycol while maintaining control of the inner vessel position until the bubbling is sufficiently diminished.
- 12) Crack the Bubble Chamber Isolation Valve slightly open and slowly draw in the balance of the fluid while maintaining the inner vessel position. The degassing will continue.
- 13) When the fluid level extends out through the top flange valve Vx, close Vx and close the drain valve.
- 14) The chamber is now filled and degassed, but it is not stable because there is no pressure balancing mechanism to compensate for the contraction of the fluid when the chamber cools.
- 15) Open the hydraulic cart isolation valve and use the main hydraulic piston to set the inner vessel assembly near bellows neutral position.
- 16) [It may be possible to use pressure regulation to hold a 1-2 psig pressure so that the cart can manage thermal expansion/contraction compensation.]