



COMPONENT SPECIFICATION

TITLE **Cryopump for Beam Tube Bakeout**

APPROVALS:	DATE	REV	DCN NO	BY	CHK	DCC	DATE
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Description: LIGO will bake out 2 km long by 1.25 m diameter stainless steel beam tube modules under high vacuum at up to 170 °C. There are eight modules, which will be baked one at a time. Each module has nine 250 mm ID ports with gate valves distributed at 250 m intervals. We will install 8 cryopumps on 8 of the 9 ports (the ninth, center port will be dedicated to residual gas analysis) to maximize pumping speed during the bakeout for H₂O and hydrocarbons. We do not want to pump CO₂ or NO on the cryopumps, but we may have to compromise this desire in order to ensure that all hydrocarbons with mass > 60 AMU are adequately pumped. We will install two turbomolecular pumps, 2000 liter/sec each, on two of the ports to pump H₂, CO₂, CO, NO, CH₄ and other uncondensed gases. The cryopumps will be operated at temperatures around 100±25 K (adjustable), should have high pumping speed for H₂O (limited by the 250 mm valve and port aperture) and should have high conductance for H₂ and N₂ to accommodate the turbopumps. On the six ports with a cryopump but no turbopump, we will install a blanking flange with a 40 mm valve for roughing the cryopump volume. The beam tube, cryopump housings, blanking flanges, valves, and turbopump inlets will be heated to the bakeout temperature. The bakeout period will last 30 days, during which we expect to achieve a H₂O partial pressure of <10⁻⁸ torr. After cooling to ambient temperature, the H₂O partial pressure is expected to drop below 10⁻¹² torr. When equilibrium is achieved the 250 mm gate valves will be closed and the cryopumps will be air-released, removed and installed on the next module to be baked. No regeneration/purge cycle is planned while installed on the beam tube modules.

Requirements:

- Cold head temperature:** Adjustable from less than 75 K to at least 125 K with pump body and beam tube at ambient temperature or at bake temperature (pump body and front and rear apertures at 170 °C)
- Pumping speed:** > 4000 liter/sec at inlet flange for H₂O
- Conductance for turbopump:** >2000 liter/sec at inlet flange for N₂
- Bake out compatibility:** All surfaces of the volume exposed to the beam tube vacuum shall be bakeable to >150 °C
- Mounting flange:** 10" ID/13.25" OD Conflat with 30 bolt hole centers on 12.06" circle
- Compressor:** Air cooled, hose length >20 ft, convenient to disconnect and move to next beam tube module
- Data outputs:** Relay closures or other bistate signals indicating 1) unit is on and operating; and 2) cold head is at proper temperature
- Power available:** 115VAC 1Φ and 208VAC 3Φ
- Ambient conditions:** Operating temperature range: -20 °C (-4 °F) to +43 °C (110 °F)
Relative humidity: 0 to 100% (must work outdoors, with only direct rain shelter)
- Special conditions:** The beam tube will be at a DC voltage of up to 80 V with respect to ground
There will be a stray DC magnetic field of about 3 gauss (~6X the earth's magnetic field) at the location of the cryopumps