SPECIFICATION FOR SHOP BAKEOUT

APPROVALS	DATE	REV	DCN NO.	BY	CHECK	DCC	DATE
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1.0 PURPOSE

The purpose of this is to define the necessary steps to perform a factory Bakeout on LIGO Vacuum Component. The Seller shall incorporate these requirements in their procedures.

2.0 GENERAL

The procedure will apply to any LIGO Vacuum Component.

Each LIGO Vacuum Component shall be Baked-out under vacuum to 150'C as specified in this specification.

Prior to Bakeout, each component shall pass the Cleanliness requirements of LIGO specification for Vacuum Component Design and Fabrication # LIGO e0900411-v1.

The Seller shall have the option of selecting the method for controlled heating of each component during Bakeout (Electric resistance heaters, Hot Air heating, Etc.).

Only Dry Oil-Free Vacuum Pumps shall be used for Bakeout vacuum pumping. (Oil-Free Scroll type backing pumps and Mag-Lev Turbopumps shall be used). Vacuum pumps and associated equipment shall be purchased new for this contract and shall be delivered to the Buyer in working condition at the end of the contract as specified in specification E0900411.
The Seller is responsible for verifying that a Vacuum Component is Clean and has passed the contract Cleanliness test. If the Seller Bakes a component that has not passed the Cleanliness Test, the Buyer reserves the right to Reject the specific component completely and require the Seller to build the component from new raw material again. (Note: Once a dirty component is Baked to 150'C, it may be impossible to clean it to Ultra-High Vacuum requirements).

A detailed procedure shall be prepared by the Seller and submitted to the buyer for approval. The procedure shall include a diagram include Bakeout Equipment setup showing vacuum pumps, valves, instrumentation, etc. All procedures must be approved by the Buyer prior to use.

3.0 RESPONSIBILITY

The seller is responsible for incorporating the requirements of this specification into all procedures and purchase orders for this contract.

4.0 BAKEOUT REQUIREMENTS

4.1 Bakeout System

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4.1.1 Bakeout System

Proper operation of the Bakeout System Heating and Data Logging system shall be verified before each Bakeout cycle.

4.1.2 Preparation for Bakeout

The following components will also be baked with the Vacuum Component:

Cold cathode/ Pirani Gauge pairs on isolatable section.

Main Turbo Pump inlet

Test temperature and pressure instrumentation shall be attached to the component and tested prior to test.

4.2 Bakeout Setup

4.2.1 Vacuum Pump(s)

The Dry backing pump and Turbopump shall be connected to the vacuum component.

4.2.2 Pressure gauges: Pirani and High vacuum gauge

In order to monitor pressure during the bake, a high operating temperature vacuum gauge is required. The gauge pair can be mounted on the RGA assembly.
Do not start warm-up of pressure gauges until a pressure of less than $1X10^{-4}$ Torr has been reached.
Refer to: Vacuum Gauges Operating Manuals

4.3 Bakeout Steps

4.3.1 Pumpdown

Start the roughing back.
Pumpdown until a pressure of less 0.1 Torr is reached.
Close bypass valve and start the turbo pump and pump to less than $5X\ 10^{-5}$ Torr.

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4.3.2 Ramp-up

Ramp Rates:
Vacuum Components: Warm-up will be set to occur over a period of 24 hours at a ramp rate of approximately 6°C/hr. Set target setpoint to 150°C.

Do not start warm-up until the pressure has dropped to less 5X 10^{-5} Torr otherwise hydrocarbons may be baked onto the component and gauge.

The pressure shall be monitored during Bakeout and the Temperature Ramp-rate shall be halted if the pressure rises to 1 x 10^{-3} torr. Once the pressure drops, the Ramp-rate can be resumed.

Pressure gauge pairs: Ramp-rate of the pressure gauge pairs will be at least 8 °C/hr to ensure that the gauges remain hotter than the vacuum envelope at all times.
The pressure gauge will be use to monitor pressure during the bake.
Set ramp rate for the gauge heating system to 8°C/hr. with a target setpoint of 160' F.

4.3.3 Soak for 48 hours

The Vacuum Component will be heated to 150°C and soaked for 48 hours at 150°C ±20°. The pressure gauge pairs will be operating at 160°C to monitor pressure during the bake.

4.3.4 Cooldown

Cooldown will be controlled by ramping the setpoints of the system to ambient temperature at a ramprate of -6°/hr. The heating jackets for the pressure gauge pair will remain on and turned off when the system has cooled down.

4.4 Bakeout Cleanliness Verification

After Bakeout, the component shall be Re-Leak Checked per specification E0900411.