



**SPECIFICATION FOR CONTAMINATION CONTROL**

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## **1.0 PURPOSE**

This plan defines measures to be taken to limit contamination of the ultra high vacuum surfaces of the LIGO vacuum equipment and Research Buildings during installation activities. Contamination from both particulate and hydrocarbons must be prevented.

The components to be installed on this project are part of the Advanced LIGO upgrade of the Laser Interferometer Gravitational-Wave Observatory (LIGO). LIGO is operated by Caltech and the Massachusetts Institute of Technology (MIT) under a NSF grant and includes two observatories, one located in the Hanford Reservation (near Richland, WA) and a second in Livingston, LA.

The California Institute of Technology (Caltech) is the Buyer for these components. The Seller is the successful bidder who is awarded this contact.

## **2.0 RESPONSIBILITIES**

The Seller shall handle materials and install components in accordance with the various specifications relating to this project. These specifications define measures to be taken to limit particulate and hydrocarbon contamination, including that by carbon steel.

Personnel performing cleaning operations shall be trained by the Seller in the proper Contamination Control procedures.

Personnel performing work inside Cleanrooms shall be trained by the Seller in the required cleanroom procedures and behavior.

## **3.0 REFERENCE DOCUMENTS**

The following documents shall be used in conjunction with this plan:

- LIGO\_E1000712 Anchor Bolts and Grouting
- LIGO\_E1000716 Component Alignment
- LIGO\_E0900431 Oring and Flange Installation
- LIGO Site Cleanroom Procedure



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### 4.0 GENERAL

While it is critical that all vacuum surfaces (internal surfaces and flange faces) be kept free of contamination, exterior surfaces must also be kept clean. This will not only facilitate keeping the interior surfaces clean, but it is necessary in order to maintain the Cleanrooms at Class 5 conditions. Care shall be taken to minimize exposure to corrosive environments, such as those containing chloride compounds.

### 5.0 HYDROCARBON CONTROL

The Seller and their subcontractors shall handle materials in accordance with the various specifications relating to them. These specifications define measures to be taken to limit contamination, including by carbon steel.

Contact of LIGO stainless steel components by uncontrolled materials shall be avoided. This includes materials such as work gloves, work boots and unprotected shop floors.

Liquids, gases or vapors containing hydrocarbons or other contaminants shall not be allowed to come into contact with the stainless steel at any time. This includes fluids such as machining lubricants.

Leak testing shall be done only with the use of oil-free vacuum pumps.

### 6.0 PARTICULATE CONTROL

#### Material Protection

Materials shall be handled in such a manner as to limit contamination, including by carbon steel. This includes the following precautions:

No carbon steel hooks, fork lift forks, grapples or chains shall be allowed to contact the stainless steel.

Raw materials shall not be stored in direct contact with materials of different composition, but shall be separated by suitable spacers or sheeting. Depending on the parts level of cleanliness (raw material vs. cleaned part).

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Stored materials (raw materials or work in process) shall be protected from the shop atmosphere when not being handled (or worked on) by plastic sheets or similar protective covers.

During transportation, components shall be shrink wrapped in plastic and shipped in closed trucks or under tight fitting tarpaulins.

Finished components shall be shipped to the sites under vacuum where possible.

Anchor Bolts Installation Holes- Anchor Bolt installation holes shall be drilled while minimizing contamination caused by drilling dust and drilling mud. Special vacuums and plastic enclosures shall be used to minimize contamination to the LIGO research buildings.

#### Cleanrooms

Components to be installed and existing LIGO vessels shall not be opened unless they are inside a Class 5 cleanroom and Class 5 air conditions have been established and verified.

#### During Installation

Components shall be moved into position and prepared to the greatest extent possible before breaching the protective wrapping or bagging. The outer protection is then removed, and a portable soft-wall cleanroom is moved into position over the component before it is opened. Once the cleanroom is in position and a Class 5 environment is established, Class 5 air will be used to break the vacuum (if necessary) or to purge the component. Once atmospheric pressure has been reached or the class 5 purge is established, covers may be removed for final installation of the component. The component and all of its access ports and openings shall be closed (by cleanroom rated cloth or shipping covers) or connected to another component before the cleanroom can be moved or shut down.