

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY  
- LIGO -  
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**LIGO Hanford Observatory  
Contamination Control Plan**

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*Distribution of this draft:*

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# 1 ABSTRACT

The LIGO interferometers are extremely sensitive to optical scattering or absorption losses induced by both particulate and hydrocarbon contamination. In order to minimize the likelihood of contamination of optical surfaces, numerous operational practices have been implemented at the LIGO Hanford Observatory. The purpose of this document is to describe the operational practices that have been implemented so that it can serve as a reference for observatory staff and visitors. It is expected that this document will be continuously updated as practices evolve as we gain experience with the interferometer hardware.

# 2 KEYWORDS

Contamination-sensitive area, contamination-sensitive hardware, contamination control orientation, CLASS A hardware, CLASS B hardware, contamination control supplies, ultra high vacuum (UHV), portable clean rooms, vacuum preparation.

# 3 GENERAL WORKING GUIDELINES

To the maximum extent practicable, persons working in the vicinity of contamination-sensitive hardware should strive to reduce the possibility of particulate or hydrocarbon contamination introduced by themselves, their clothes, or items that they transport into the contamination-sensitive areas. Items that will be transported into the areas should be unpacked outside the area and particulates should be removed by vacuuming (either with a HEPA filtered vacuum cleaner or one that exhausts to the outside of the building) or other suitable method.

Concerning hydrocarbon contamination, the basic operating guideline is “**if you can smell it, it’s bad.**”

Specifically, persons working in the vicinity of contamination-sensitive hardware should:

- not wear articles of clothing that obviously shed particles (e.g., wool sweaters)
- launder clothing frequently, but not use overly fragrant detergents (the LHO apartments have clothes washers and dryers inside and there is a set on the site)
- bathe often to minimize body odor
- not use particularly fragrant body soap or shampoo
- not wear cologne, perfume, or excessively fragrant deodorant
- not wear make-up such as mascara, eye shadow, powder, etc.
- not smoke cigarettes or other forms of tobacco on days that they will be working in the vicinity of contamination-sensitive hardware
- not undergo strenuous physical exercise (significant perspiration) without showering prior to working in the vicinity of contamination-sensitive hardware
- not eat particularly odorous foods (e.g., lots of garlic) on days that they will be working in the vicinity of contamination-sensitive hardware
- not be coughing, sneezing, or have a runny nose

In general, clean room garb should not be worn outside the contamination-sensitive areas<sup>1</sup>. Hanging racks for clean room garb are provided in the Change Rooms and in the Portable Change Rooms adjacent to the Portable Clean Rooms in the LVEA and VEAs. Lockers are provided in the Change Rooms. Change clean room garb regularly (daily, at least) to ensure cleanliness. Place soiled garments in designated receptacles in the Change Rooms.

A one-page list of primary points for clean work, *Abbreviated Clean Work Protocol*, is included in Appendix 3. This list is posted on the Portable Change Rooms adjacent to the Portable Clean Rooms in the LVEA and VEAs.

Any modifications to the interferometer vacuum hardware, including the vacuum chambers and the beam tubes, must be coordinated with and approved by John Worden, the LHO Vacuum Engineer (509-372-8136, [worden\\_j@ligo-wa.caltech.edu](mailto:worden_j@ligo-wa.caltech.edu)). This includes tasks such as door removal or replacement and installation of hardware such as viewports.

The procurement, stocking, and distribution of contamination control supplies, the items listed in Appendix 1, are strictly controlled by LHO staff. These items are available to all workers at the LHO. NONE of the items should be brought onto the site except by the designated LHO staff member, Kyle Ryan (509-372-8129, [ryan\\_k@ligo-wa.caltech.edu](mailto:ryan_k@ligo-wa.caltech.edu)). When a stocked contamination control item is specifically referred to in the text of this document, *italics* are used, e.g. *Bouffant Cap*.

*Fast Sorb Towels* and *Lens 90 Tissue*<sup>2</sup> are not “lint free.” They are intended for cleaning optics in the optics lab only.

Cardboard and packing material are prohibited in all Contamination-sensitive Areas. Plastic baskets and carts are available on site and should be used to transport items into the contamination-sensitive areas.

To the maximum extent practicable, we discourage the use of any paper products in Contamination Sensitive Areas (due to particulate contamination). If drawings, notebooks, and other paperwork are required in the contamination-sensitive areas, please minimize the volume and duration in the areas. **If you pack it in, pack it out.** Ameristat bags work well for transporting papers and are available on site.

BEFORE bringing any chemicals to the site, authorization must be obtained from Otto Matherny, the LHO Safety Officer ([matherny\\_o@ligo-wa.caltech.edu](mailto:matherny_o@ligo-wa.caltech.edu), 509-372-8118).

## 3.1. Specific work practices

### 3.1.1. UHV Gloves

Maintaining the cleanliness of *UHV gloves* is particularly challenging. First, it takes care and practice to get the *UHV gloves* on without touching the outside surfaces of them except at the very top of the cuff. Also, it is often difficult to avoid accidentally touching surfaces that are neither Class A nor Class B when wearing *UHV gloves* intended for handling of contamination sensitive

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1. See Section 6.4.1.

2. Refer to Appendix 1.

hardware. *UHV gloves* must be changed after such incidents and, because hands typically perspire under the *UHV gloves*, changing can be time consuming; it is very difficult to don the gloves unless ones hands are completely dry. Alternatives are to wear several layers of *UHVgloves* and remove layers as they become contaminated or to just add clean *UHVgloves* over the top of the contaminated pair.

## **4 PROCUREMENT AND DISTRIBUTION OF CONTAMINATION-CONTROL SUPPLIES**

Numerous items related to contamination control are procured, stocked, and distributed by LIGO Hanford Observatory (LHO) staff as a service to observatory and visiting staff in order to ensure availability and consistency. Reasonable quantities of each item will be on hand at all times. Anyone expecting to require an unusually large quantity of a stocked item should contact Kyle Ryan (509-372-8129, ryan\_k@ligo-wa.caltech.edu) in advance to ensure availability.

The specific items stocked are described in detail in Appendix 1.

The following rules apply to their procurement, receiving, stocking, and distribution:

- Only the designated LHO staff member (Kyle Ryan) or his designee may procure, receive and introduce controlled supplies into the on-site inventory. Only wrapped, unopened packages of contamination control supplies are stocked.
- Supplies which have been delivered but have not yet been unboxed, examined, and approved are to be stored in the Long-term Storage room.
- Upon examination and approval, supplies are added to the available inventory and are stored in labeled cabinets in the Active Storage Area. Solvents are stored in the outside Chemical Storage Area located between the Operations Support Building (OSB) and the water tank.
- Site and visiting staff may remove required contamination control supplies from the Active Storage Area or the Chemical Storage Area. Please notify LHO staff (Kyle Ryan) when stock of any item is running low or when one has advance knowledge of an unusually large demand for specific items.  
DO NOT return opened, partially-used packages of supplies to the Contamination Control Supplies Cabinets in the Active Storage Area.
- Upon removal from the Active Storage Area or the Chemical Storage Area, it is the user's responsibility to ensure that supplies are handled in a manner that does not compromise their cleanliness. Contaminated items are to be immediately discarded or placed in garment cleaning receptacles located in the Change Room.

## **5 CONTAMINATION-SENSITIVE HARDWARE**

**CLASS A** hardware is defined as any item that will be temporarily or permanently mounted inside of or on the inner surfaces of the interferometer vacuum equipment and will be exposed to vacuum.

**CLASS B** hardware is defined as any item that will come into contact with **CLASS A** hardware or the surfaces of the interferometer vacuum equipment that will be exposed to vacuum (including the o-rings).

## 5.1. CLASS A Hardware

Included in this category are the interferometer optics and suspensions and all in-vacuo interferometer hardware that has been prepared for installation. All **CLASS A** hardware is to be manufactured, cleaned, baked, and packaged in accordance with the specifications detailed in LIGO-E960022-E *LIGO Vacuum Compatibility, Cleaning Methods, and Qualification Procedures*. Typically, **CLASS A** hardware is wrapped with *UHV Aluminum Foil* then sealed in bags made of *Ameristat*.

## 5.2. CLASS B Hardware

Included in this category are tools and fixtures that will come into contact with **CLASS A** hardware **OR** be used inside the interferometer vacuum envelope. Typically they are ultrasonically cleaned, then baked in air. When practicable, the cleaning follows the procedure dictated in LIGO-E960022-E *LIGO Vacuum Compatibility, Cleaning Methods, and Qualification Procedures*. **CLASS B** hardware that cannot be baked or cannot be cleaned in accordance with LIGO-E960022-E must be thoroughly wrapped in *UHV Aluminum Foil*.

### 5.2.1. CLASS B hardware cleaning service and air bake oven use

A **CLASS B** hardware cleaning service is provided to anyone working at the observatory. To have **CLASS B** parts cleaned, one must complete a *Cleaning Request/Air Bake Oven Log* form. Blank forms are located in a hanging file on the south wall of the Vacuum Bake Oven room. A sample form is included in Appendix 2. The form, along with the parts to be cleaned should be placed on the “**CLASS B** Hardware To Be Cleaned” shelf of the wheeled rack located in the center of the Vacuum Bake Oven room.

Parts will be cleaned and air baked in accordance with LIGO-E960022-E, or following any special instructions provided by the requestor on the request form. Once processed, the parts will be packaged, labeled, and stored on the “**CLASS B** Hardware Ready For Use” rack located in the center of the Vacuum Prep. and Assembly Area. The turn-around time for this service is dependent on the availability of staff and facilities; 48 hours turn-around time is typical. For time-critical requests, specific arrangements should be made with either B. Rivera or K. Ryan. In the event that they cannot process the parts in time, the requestor may utilize the facilities to process the parts himself.

#### 5.2.1.1 Air bake ovens

There are two air bake ovens located in the Vacuum Prep. and Assembly Area. One is only to be used for curing epoxy on optics and magnets. It is clearly labeled and is not to be used for baking **CLASS B** hardware. The other air bake oven can be used for **CLASS B** hardware that has been cleaned in accordance with LIGO-E960022-E.

A log of air bake oven use is kept on the wall next to the air bake oven. It contains in-process *Cleaning Request/Air Bake Oven Log* forms for items currently in the oven. If one chooses to bake his own parts, it is his responsibility to verify the compatibility of his parts with any other parts that will be in the oven concurrently. If applicable, this requires contacting the listed “Parts Custodian” (found on the form) and obtaining permission to combine loads. Before using the

oven, fill out a *Cleaning Request/Air Bake Oven Log* form (blank forms are available in a binder located near the oven).

### 5.3. Handling

**CLASS A** and **CLASS B** hardware should never come into contact with anything except other **CLASS A** or **CLASS B** hardware, *UHV Gloves*, *UHV Aluminum Foil*, *Lint-free Wipes*, or the in-vacuo surfaces of the interferometer vacuum equipment.

**CLASS A** and **CLASS B** hardware are to be unwrapped and handled only in a contamination-sensitive area (see Section 6). All persons handling or working in the vicinity of **CLASS A** and **CLASS B** hardware shall at all times wear, *Overshoe Covers* or *Boots*, *Frock* or *Coverall*, *Bouffant Cap* or *Hood*, *Mask*, and *UHV Gloves*. While working with **CLASS A** and **CLASS B** hardware, *UHV Gloves* should contact only **CLASS A** or **CLASS B** hardware; they must be changed immediately after contacting any other surfaces.

Note: When the white cleanroom fabric similar to that used for the chamber door soft covers (Burlington C3, white static-dissipative, cleanroom fabric) is contacting or will come into contact with Class A or Class B hardware, it should be treated as Class B hardware itself. In particular, persons working with or in the vicinity of it should wear *Overshoe Covers* or *Boots*, *Frock* or *Coverall*, *Bouffant Cap* or *Hood*, *Mask* and *UHV Gloves*.

## 6 CONTAMINATION-SENSITIVE AREAS AND ACCESS PROTOCOL

Contamination sensitive areas are locations where personnel will be working in the vicinity of exposed Class A or Class B hardware. The contamination-sensitive areas in the corner station are the Optics Laboratory, the Vacuum Prep. and Assembly Area, the Vacuum Bake Oven Area, the Cleaning Area, the Active Storage Area, the Laser and Vacuum Equipment Area (LVEA), and the Portable Clean Room Enclosures in the LVEA. The contamination-sensitive areas in the mid and end stations are the Cleaning Areas, the Vacuum Equipment Areas (VEA), and the Portable Clean Room Enclosures in the VEAs. All of these areas have HEPA-filtered air supplies. Access to all of these areas is restricted. Each person entering any of these areas must wear the required clean-area clothing (described below) and follow the required procedures for handling and working in the vicinity of contamination-sensitive hardware as described in Section 5.

### 6.1. Optics Laboratory and Vacuum Prep and Assembly Area

*Frock*, *Bouffant Cap*, *Mask*, and *Overshoe Covers* required at all times. *UHV Gloves* required when handling or working in the immediate vicinity of contamination-sensitive hardware.

Whenever, **CLASS A** or **CLASS B** hardware such as optics will be left exposed and unattended (e.g., under a laminar flow bench), the area will be clearly marked by, for instance, a yellow plastic chain with an attached warning sign. When ever possible, the exposed items will be covered with *Lint-free Wipes* or *UHV Aluminum Foil*.

## 6.2. Vacuum Bake Oven Area

*Frock, Bouffant Cap, and Overshoe Covers* required at all times. *Mask* and *UHV Gloves* required when handling or working in the vicinity of contamination-sensitive hardware.

Access to the Bake Oven Area is further restricted when an oven is being loaded or unloaded. This condition will be clearly marked by, for instance, a yellow plastic chain with attached warning sign strung across the entrance doors.

## 6.3. Cleaning Areas, Active Storage Area, Laser and Vacuum Equipment Area, and Vacuum Equipment Areas

*Overshoe Covers* required at all times. Dedicated clean-area shoes can be worn instead of the *Overshoe Covers*. It is the responsibility of the wearer to ensure that the dedicated clean-area shoes are kept clean.

## 6.4. Portable Clean Room Enclosures

All inside-chamber work must be coordinated with the LHO Installation Contamination Control point of contact, Corey Gray (509-372-8116, gray\_c@ligo-wa.caltech.edu). Those unfamiliar with working with contamination-sensitive hardware will be given a brief Contamination Control Orientation prior to beginning contamination-sensitive work.

The fans for the HEPA filters in the Portable Clean Room Enclosures are to be running whenever practicable.

When inside a portable clean room enclosure positioned over the interferometer vacuum equipment and when any of the enclosed vacuum equipment ports are covered by temporary covers (e.g., the soft fabric covers), *Frock, Bouffant Cap, and Overshoe Covers* required at all times. *Mask* required when in the vicinity of any **CLASS A** or **CLASS B** hardware, especially optics. *UHV Gloves* required when handling contamination-sensitive hardware.

When inside a portable clean room enclosure positioned over an **open** vacuum chamber port, *Coverall, Hood, Boots, and Mask* required at all times. *UHV Gloves* required when handling contamination-sensitive hardware.

### 6.4.1. Brief periods outside the Clean Room Enclosures while garbed

During extended periods of work inside the portable clean room enclosures, an “outside helper” is usually utilized to avoid the need for gowned workers to exit the enclosure to retrieve supplies or perform other functions outside the enclosure. Portable radios also facilitate communication between portable clean rooms and reduce the need to physically transition between them.

If leaving and reentering a portable clean room while garbed is absolutely necessary, it is permitted for limited periods with the following specific requirements:

- The total time outside the portable clean room enclosures while garbed is limited to a maximum of 60 seconds per hour.

- Once a garbed person has left a portable clean room while garbed, he should consider himself “exposed” and should defer contamination-sensitive work (such as reaching inside a chamber to adjust an optic mount) to others, when possible.
- In cases where work requires standing inside the vacuum chambers (see Section 6.5., below), an “exposed” garbed person must change his clean room garb before entering a chamber.

## **6.5. Standing Inside Interferometer Vacuum Chambers**

*Clean Room Boots, Inside-chamber Overshoe Covers (over Clean Room Boots), Coverall, Hood, Mask, and UHV Gloves* required at all times. *Inside-chamber Overshoe Covers* must not contact any surface outside the vacuum chambers.

# **7 AVAILABILITY AND DISPOSAL OF CHEMICAL SOLVENTS**

Copies of Material Safety Data Sheets (MSDS) for all chemicals on site are available in a yellow notebook labeled “MSDS” that is kept on a shelf in the LHO conference room.

Acetone, Isopropanol and Methanol intended for class A and class B parts cleaning are available and stored in yellow cabinets marked “FLAMMABLE”. These cabinets are located in the VEAs of the mid and end stations, the cleaning area of the corner station and the optics lab. Each of these solvents are kept in individual 60ml or 250ml dispensing bottles sealed within antistatic bags. The bags allow for the use of easy to read solvent identification labels. Once a dispensing bottle has been removed from an antistatic bag, the only way to identify it’s contents is via lightly etched wording on the bottles outer surface. Only Kyle Ryan (509-372-8129, ryan\_k@ligo-wa.caltech.edu) or his designee are permitted to introduce the above listed solvents into the yellow flammable cabinets located in the Contamination Sensitive Areas described above.

The contents of chemical dispensing bottles are to be used only on the day they are initially opened. Dispose of any unused portion into the correspondingly labeled red waste containers located within the yellow flammable cabinet and discard the empty dispensing bottle into the yellow waste can located immediately underneath the cabinet.

## APPENDIX 1      CONTAMINATION-CONTROL SUPPLIES AND CLOTHING

Item	Description	Vendor
<i>Acetone</i>	VWR brand, reagent grade Part # VW0330-3 4 L bottles	VWR Scientific  Account # 05-117460
<i>Ameristat</i>	Clean room sheeting Class 100 stratogrey, single wound, rollstock	Bay Stat 3575 Haven Avenue Menlo Park, CA 94025-1009 (650)364-3205 Voice (650)363-8079 Fax
<i>Clean Room Boots</i>	White C3, knee-high, polyester clean-room overshoe boots with 939 sole Sizes M, L, XL	Overall Laundry Services, Inc. P.O. Box 9040 Everett, WA 98206-9040 (800)926-6996 ext. 261 Bud Granger
<i>Bouffant Cap</i>	Tyvek bouffant cap, 21" Part # 1060-802	Cintas-Eastwater Scientific 23161 Antonio Parkway Rancho Santa Margarita, CA 92688 (800)786-6027 Voice (949)549-9579 Fax
<i>UHV Aluminum Foil</i>	Part # ASTM B 479 0.015" x 24" x 500' and 0.015" x 48" x 500' UHV Certified Aluminum Foil	All Foil 4597 Van Epps Road Brooklyn Heights, Ohio 44131 (216)661-0211 Voice (216)398-4161 Fax
<i>Coverall</i>	White C3 polyester clean-room coverall Sizes S, M, L, XL, XXL	Overall Laundry Services, Inc. (see above)
<i>Carbon Dioxide</i>	Instrument grade 50 lb. refill Part # X35530	Oxarc 716 South Oregon Street Pasco, Wa 99301 (509)547-2494
<i>Ethanol</i>	Pending identification of suitable reagent grade supplier, <i>Methanol</i> is substituted	

<b>Item</b>	<b>Description</b>	<b>Vendor</b>
<i>Fast Sorb Towels</i>	Berkshire Fast Sorb #820 Class 100 wipers, 9" x 9" Part # 21914-208	VWR Scientific (see above)
<i>Frock</i>	White C3 polyester clean- room frock (knee-length coat) Sizes M, L, XL	Overall Laundry Services, Inc. (see above)
<i>UHV Gloves</i>	Ansell Edmont LP latex gloves Sizes 6 1/2, 7, 8, 9 Part# 1009-395763,764, 766, 768	Cintas-Eastwater Scientific 23161 Antonio Parkway Rancho Santa Margarita, CA 92688 (800)786-6027 Voice (949)549-9579 Fax
<i>Hood</i>	White C3 polyester clean- room hood Sizes S, M, L, XL	Overall Laundry Services, Inc. (see above)
<i>Inside-chamber Overshoe Covers</i>	Non-marking shoe covers for standing inside the vac- uum chambers (worn over the <i>Clean Room Boots</i> ) Sizes M, L, XL Part # LD-100 style 1096- M,L,XL	Superior Uniform Group Worklon Division 10099 Seminole Blvd. Seminole, FL 33772-2539 (206)935-8011 Paul Berg (Sales Rep.) (800)298-7896
<i>Isopropanol</i>	VWR brand, reagent grade Part # VW5520-3 4 liter bottles	VWR Scientific (see above)
<i>Lens 90 Tissue</i>	Berkshire Lens 90 9" x 9" lens tissue Part # 52847-149	VWR Scientific (see above)
<i>Lint-free Wipe</i>	Multi-knit polyester wipe, 9" x 9" Part # 1022-00699	Cintas-Eastwater Scientific (see above)
<i>Mask</i>	Part # 10843-103	VWR Scientific (see above)
<i>Methanol</i>	Reagent grade Part #VW4300-3 4ea. 4 liter brown glass bot- tles	VWR Scientific (see above)

<b>Item</b>	<b>Description</b>	<b>Vendor</b>
<i>Overshoe Covers</i>	C3 white polyester slip on overshoe covers with rubber soles Sizes S, M, L, XL	Overall Laundry Services, Inc. (see above)
<i>Soft Cover-HAM Door</i>	C3 white polyester with elastic drawcord. For HAM door flanges.	Overall Laundry Services, Inc. (see above)
<i>Soft Cover-BSC Dome-Flat</i>	C3 white polyester with elastic drawcord. For BSC dome flange.	Overall Laundry Services, Inc. (see above)
<i>Soft Cover-BSC Dome Tall</i>	C3 white polyester with elastic drawcord. For BSC dome flange, with stack installed.	Overall Laundry Services, Inc. (see above)
<i>Soft Cover-68" O.D.</i>	C3 white polyester with elastic drawcord. For BSC door flanges.	Overall Laundry Services, Inc. (see above)
<i>Ultra-high-purity Compressed Nitrogen</i>	Cylinders of compressed gas.  Part number C34380	Oxarc 716 S. Oregon Street Pasco, WA 99301 (509)547-2494

# APPENDIX 2      *SAMPLE CLEANING REQUEST/AIR BAKE OVEN LOG FORM*

## CLEANING REQUEST/ AIR BAKE OVEN LOG

1 DATE AND TIME OF REQUEST: \_\_\_\_\_

2 PARTS QUANTITY AND MATERIAL DESCRIPTION:

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3 PARTS CUSTODIAN: \_\_\_\_\_

4 CLEANING INSTRUCTIONS:

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5 PARTS CLEANED BY: \_\_\_\_\_

6 PARTS LOADED INTO OVEN BY: \_\_\_\_\_

7 TEMPERATURE OF AIR BAKE: \_\_\_\_\_

8 AIR BAKE DURATION IN HOURS: \_\_\_\_\_

9 PART REMOVED BY: \_\_\_\_\_

10 DATE & TIME REMOVED: \_\_\_\_\_

**\*PLEASE FILL OUT THE APPLICABLE SECTIONS AND LEAVE WITH PARTS TO BE CLEANED ON WHEELED RACK IN THE VACUUM BAKE OVEN ROOM OR, IF PROCESSING PARTS YOURSELF, PLACE INCOMPLETE FORM IN BINDER ADJACENT TO THE AIR BAKE OVEN\***

# APPENDIX 3            ABBREVIATED CLEAN WORK PRO- TOCOL

## Subject: Abbreviated Clean Work Protocol

**GOAL:** To instill a mindset of cleanliness for all work around open vacuum chambers or exposed UHV hardware. For a more in depth description of Contamination Control related subjects see the LIGO Hanford Observatory Contamination Control Plan, LIGO-M990034-W. Ultimately want to limit introduction of hydrocarbons and particles onto clean/ Class A surfaces (see below & LIGO-M990034-W). **Acquire a habit of always being mindful of what is entering a clean room; “ask yourself each time something comes through the clean room drapes: Is this object (or part of a human body!) clean”**(as for a definition of “clean” see LIGO-E960022-E).

### MAIN REQUIREMENT:

Clean surfaces (see below) can only be touched by:

- 1) other clean surfaces,
- 2) clean UHV gloves\*,
- 3) clean UHV foil\*,
- 4) and clean lint-free wipes\*.

### CLEAN SURFACES:

Interior of vacuum system, ClassA/B hardware, UHV gloves\*, lint-free Wipes\*, and UHV foil\*.

### CONTAMINATED SURFACES:

Exterior of vacuum and seismic systems, cleanroom curtains, UHV gloves\*, lint-free wipes\*, UHV foil\*, etc.

### CONTAMINATION SENSITIVE HARDWARE:

**Class A hardware**--any item that will contact interferometer vacuum equipment or other detector equipment under vacuum.

**Class B hardware**--any item that will contact Class A hardware.

*Rules of thumb:* have extra sets of clean tools; hardware needs to be cleaned by standards set in LIGO-960022-04-E; on-site cleaning service is available (contact Kyle Ryan (ext. -129)/Bartie Rivera).

### GENERAL RULES OF CLEAN ROOM ETIQUETTE:

\*Intricacies about use of UHV gloves, Lint-free wipes, and UHV foil; **items should not touch anything other than ClassA/B surfaces(otherwise it is considered contaminated)**; for example, this requires the frequent replacement of UHV gloves during “clean work”.

For installation work, try and designate a person to work outside to carry out tasks which cannot be done from within the clean room. If this is not possible, the following is acceptable:

- **One may exit a clean room while fully garbed for one minute per hour.**
- **If one temporarily exits a cleanroom, they need to consider them “more exposed” than a fully-garbed person who has not exited a cleanroom; therefore this person should defer tasks which are contaminant-sensitive to a “cleaner person”. Working completely inside a chamber is not permitted.**

What to wear and not wear in and around vacuum chambers:

- Cloth cover over vacuum chamber ports----**frock & bouffant cap**
- Open vacuum chambers----**complete clean room garb outfit**
- In chamber----**complete clean room garb outfit and special shoe covers for cleanroom boots.**
- Refrain from wearing make-up, cologne, and other cosmetics

**Please contact Corey Gray (ext. -116) if you have any questions.**