LIGO Clean and Bake Best Practices

Specific training for those involved in preparing parts for vacuum and other interested parties

LIGO-G1000478

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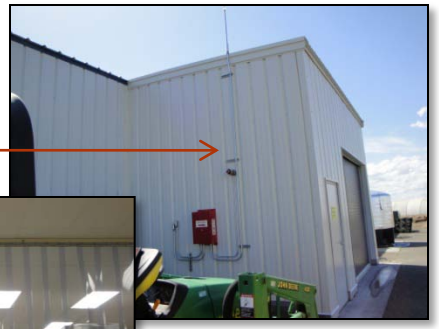
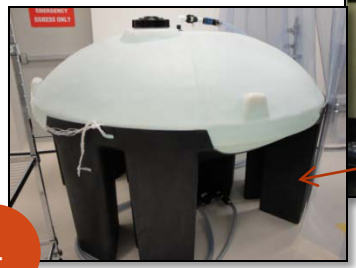
Clean and Bake: A Line of Defense in Contamination Control

- Standards and procedures in DCC
  - E0900047-LIGO Contamination Control Plan
  - E960022-LIGO Vacuum Compatibility, Cleaning Methods and Qualification Procedures
    - "Watch this document" due to changes
    - SYS has requested that any clean and bake other than the default be submitted for items already in the procurement/production pipeline
    - FDR should trigger any special cleaning/baking needs for items still in design
    - Changes in protocol since ILIGO
      - DI water is the solvent of choice
      - Alcohols etc. should only be used in special cases
      - Specific cleaning procedures added for maraging steel spring blades, SEI ISI diamond-turned target faces, etc.

Facility Modifications

- Warehouse build-out
  - Exterior
    - Air Lock/Receiving
  - Interior
    - Vacuum prep facility
    - Clean storage





- DI water capacity
  - Exterior
  - Interior
- Cleaning capacity
- Baking capacity

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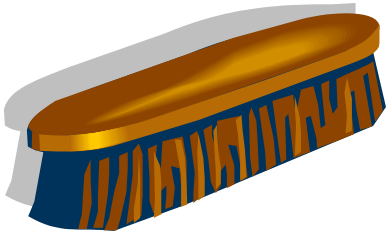
Parts Inspection

- During receiving
  - Obvious problems like
    - Weld slag
    - Hydrocarbons
      - Barrel nuts
    - Inks
      - Marker
      - Stamps
    - Adhesives
      - Tape
      - Tags
  - Send to gross cleaning
    - Removes "bad actors"
      - Vendor
      - In-House
- Before taking into clean space
  - Check for
    - Shedders
      - Wood/Paper/Cardboard
      - Styrofoam
      - Production residue
    - Other "owies"

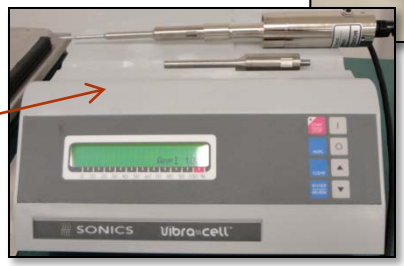
Gross Cleaning



- Prepares parts for precision cleaning
  - For parts that are, well, gross
    - Expected
      - Fasteners
      - Copper
    - Unexpected
      - Barrel nuts
- Should not be located in clean space
- Should have dedicated equipment
- Can be fairly aggressive
  - Mechanical
    - Example: scrub brush
  - Chemical
    - Example: Citranox, Protex

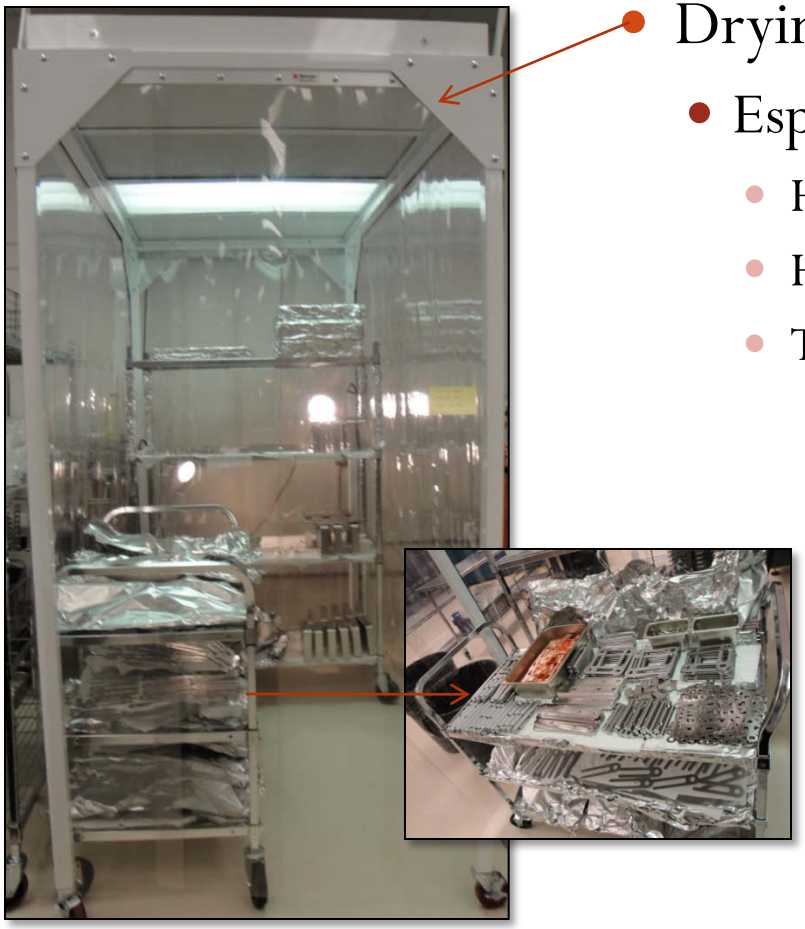
Precision Cleaning

- Prepares parts for vacuum bake
- Tools
  - Cabinet washers
  - Ultrasonic cleaners
    - Wands (Vibracell)
      - For holes
    - Counter-top models (Branson)
      - For small parts
    - Huge models (Omegasonics)
      - For large parts
      - For large batches of small parts



Drying

Requires special attention due to DI water cleaning protocol



- Drying station
  - Especially useful for light parts
    - HEPA filtered air
    - Heat lamps
    - Time

- Air bake oven
  - Especially useful for heavy parts
    - Relatively low temperature
      - 60 to 80 degrees C
    - Relatively short time
      - 15 to 30 minutes

*NOTE: Do not mix drying loads and Class B loads

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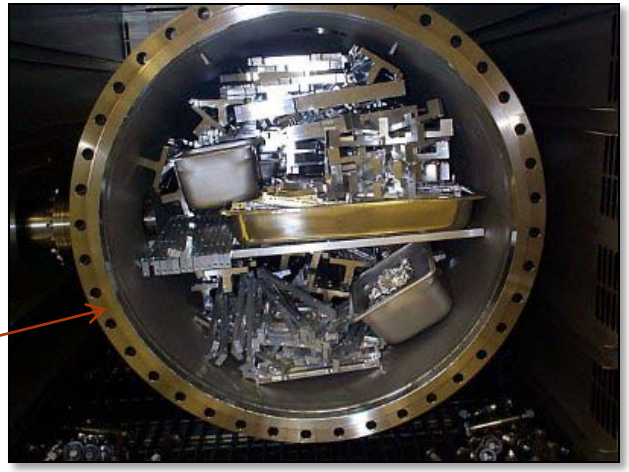
Baking

- Prepares parts for vacuum service
  - Drives off unwanted gasses
- Ovens
  - Air Bake
    - Class B prep (mostly)
      - Small (3)
      - Large (named LABO)
        - For SEI and SUS large parts (Class A)

- Vacuum Bake
  - Class A prep
    - VBO-A in OSB, large
    - VBO-B in OSB, small
    - VBO-C in VPW, large
    - VBO-D in procurement



Wrap, Bag, and Tag

- Stainless steel tables

- Space for containers, bags, etc.
- WBT ASAP after unloading
- Kit if possible
  - Use Class B worksheet
- Labels
  - Class A → 

  - Class B

- Foil: Friend or Foe?

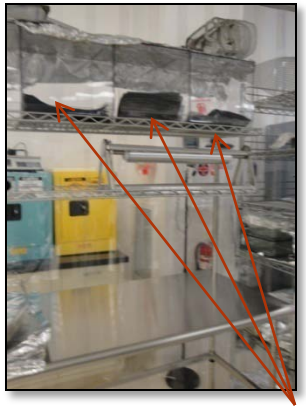
  - The blue box
    - Serrations vs shearing
    - Glue/adhesive
  - The art of the bag
  - Crumpling is not a good thing

Zones in Wrap, Bag, and Tag

- "Clean" zones
  - Change outer gloves after working in any two consecutive clean zones
    - Zone 1 and Zone 2 **or** Zone 2 and Zone 3

- Zone 1 = Clean parts

- Zone 2 = Foil bag/container

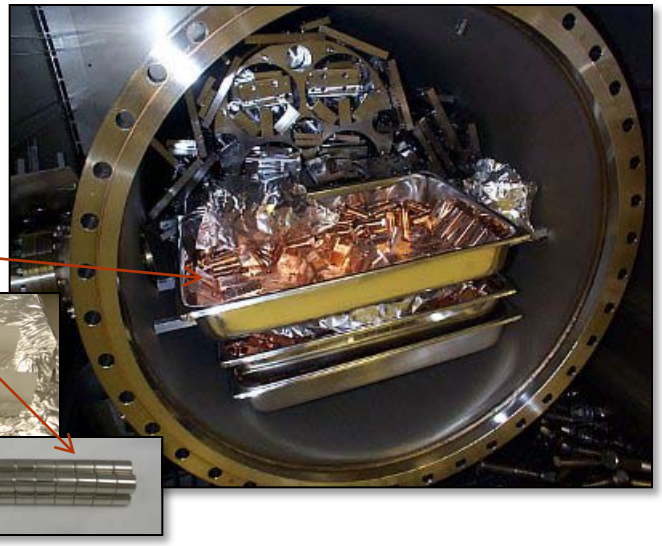


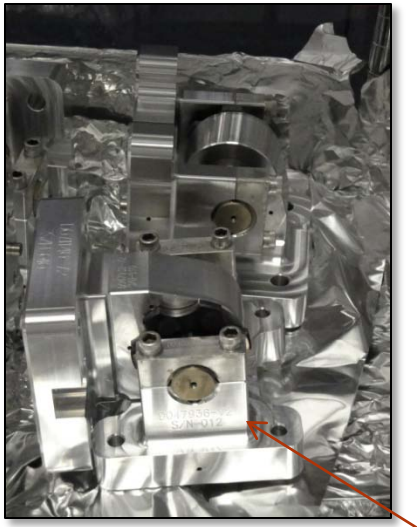
- Zone 3 = Inner bag

- "Dirty" zone
- Don't work in clean zones without changing outer gloves
  - Zone 4 = Outer bag and label

Gotchas

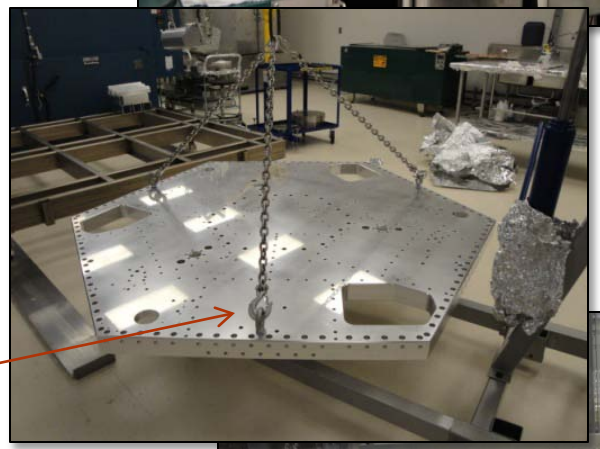
- Special cleaning requirements
  - Uncommon materials
  - Parts
    - Blind holes
      - Check with probe
      - Always wand
      - Inspect after cleaning
    - Threaded holes
      - Check with solvent soaked swab
      - Wand if necessary
      - Inspect after cleaning
    - Corners and odd geometries
      - Inspect before and after cleaning





More Gotchas

- Ultrasonic cleaning cycle times
  - HULK is fierce
- Liquinox is persistent
  - Rinse 3 times
  - Use clean water each time
- Lingering water
  - Holes, corners, channels
- Installed lifting eyes/helicoils
  - Remove and clean holes before bake
- Incorrect materials in stock batches
- Overloading ultrasonic cleaners
- Blocking ports on VBO



Resources

- The Living Legends
  - CIT
    - Dennis Coyne (System level contamination control, material science)
    - Bob Taylor (Material qualification, prototype clean and bake)
  - LHO
    - Betsy Bland (Production clean and bake, site contamination control)
    - Kyle Ryan (Vacuum bake ovens, maximizing bake loads)
  - LLO
    - Tom Evans/Gary Traylor (Production clean and bake)
    - Mike Myers/Harry Overmier (Vacuum bake ovens)
- The Aqueous Cleaning Handbook
  - http://www.alconox.com/section_customer/book_info.asp
- John Worden's Vacuum System Basics Presentation