



COMPONENT SPECIFICATION

Conflat/Viewports - COS

APPROVALS:	DATE	REV	DCN NO	BY	CHK	DCC	DATE
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CHECKED:							
APPROVED:							
DCC RELEASE:							

1 SCOPE

This is a specification for a vacuum flange mounted, fused silica optical window assembly (Conflat/Viewports) which consists of 1) a stainless steel 10" vacuum flange, 2) a vacuum brazed bellows, 3) a fused silica optical window and 4) a removable aluminum cover to protect the exterior surface of the window. These Conflat/Viewports will be used in a ground-based high vacuum environment, as optical input and output windows.

2 APPLICABLE DOCUMENTS

2.1. LIGO Documents

LIGO-960641-05, Electronic Submissions to the Document Control Center

- http://ligo.caltech.edu/LIGO_web/dcc/docs/L960641-05.pdf

LIGO-E960022-03, Vacuum Compatibility, Cleaning Methods and Compatibility Procedures

- http://ligo.caltech.edu/LIGO_web/dcc/docs/E960022-03.pdf

LIGO-E960050-A, Vacuum Compatible materials list

- http://ligo.caltech.edu/LIGO_web/dcc/docs/E960050-A.pdf

LIGO-L970196, Part Numbers and Serialization of Detector Hardware

- http://ligo.caltech.edu/LIGO_web/dcc/docs/L970196.pdf

2.2. Non-LIGO Documents

MIL-C-675C, Coating Adhesion and Durability

3 REQUIREMENTS

3.1. Performance characteristics

3.1.1. Optical Characteristics

3.1.1.1 General Characteristics

Wedge	30 min. +/- 5 min
Surface Roughness	<0.8 Å (Superpolish)
Unobstructed diameter	3.00 inches
Clear Aperture	2.75 inches min



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Thickness	0.500 inches
Transmissivity across optical aperture	>99.9% at 1060nm and normal incidence
Wavefront distortion	<1/10 λ @ 633 nm wavelength

3.1.1.2 Antireflection Coating

3.1.1.2.1 Type 1 (purchase from REO (Research Electro Optics))

Applied to both surfaces of window optic

Protective overcoating	SiO_2 overcoat on outside surface
Polarization	S
Wavelength	1064 nm
Incidence angle	5 deg
Transmissivity per surface	>99.9%
Durability	MIL-C-675C

3.1.1.2.2 Type 2

Applied to both surfaces of window optic

Protective overcoating	SiO_2 overcoat on outside surface
Polarization	S
Wavelength	1064 nm
Incidence angle	5 deg
Transmissivity per surface	>99.6%
Durability	MIL-C-675C

3.1.2. Mechanical Characteristics

3.1.2.1 Flange Configuration

Standard 10" conflat (see figure 1)

3.1.2.2 Protective cover

An aluminum cover, of at least 0.250" thick and 5.5" diameter shall be provided to protect the exterior surface of the window. A pattern of six #8-32 x 0.500" deep blind holes shall be provided surrounding, and concentric with the off axis window (see figure 1), for attaching the cover. This cover shall be machined flat on one surface, to mount to the stainless steel flange without a gasket, and relieved if necessary, to clear the face of the optical window by >0.040 inch.

3.2. Design and Construction



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3.2.1. Materials

3.2.1.1 Windows

Material - Optical grade "A" fused silica (Hereaus Infrasil 301-A, Herasil 1-A, Suprasil 311-A, Suprasil 312-A)

A substitution of any other window material must be approved by cognizant LIGO personnel.

3.2.1.2 Window assembly

bellows seal	braze alloy to be 97.5% lead, 2.5% silver alloy
Edging	edge chips shall not exceed 10% of the total perimeter, or be larger than 0.03" max width.
Location	center of optical window to be placed 0.95 inches from the center of the conflat flange (see figure 1).

3.2.1.3 Flange

Material - Typ 304 low hydrogen Stainless Steel

3.2.1.4 Allowed material:

All materials must conform to LIGO document "LIGO-E960050, Vacuum Compatible materials list". No anodizing, or organic lubricants are permitted. Some elastomers may be allowed subject to approval by cognizant technical personnel.

3.2.1.4.1 Part Machining

3.2.1.4.1.1 Liquid contaminants/Machining Lubricants

Liquids containing hydrocarbons or other contaminants, other than the machining fluids specified herein, shall not be allowed to come into contact with suspension material at any time. All machining fluids shall be water soluble and free of sulfur, chlorine and silicone; such as Cincinnati Milacron's Cimtech 410 (stainless steel).

3.2.1.4.1.2 Grinding & Abrasive Cloth/Paper

Grinding (with abrasive wheels, cloth, or stones), or use of abrasive cloth or paper, is permitted, except where noted, if the ground or impacted surface is subsequently skimmed with a carbide tool to remove any residual contaminants. The use of oil free Arkansas stones are also approved to remove slight imperfections in the machined surfaces.

3.2.2. Vacuum compatibility

Assembled device shall be compatible with ultra high vacuum practice. All metal to metal welds shall be TIG, or MIG machine welded. No obvious asymmetries or weld metal buildup shall be obvious in a visual inspection conducted from 16 inches. Proper welding current and component cooling shall be selected so that no discoloration, or other evidence of overheating is visually evident from the same distance.



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3.3. Quality Assurance/Control

3.3.1. Identification

Separate (non-welded) parts and assemblies shall be marked with laser marking or acid etch techniques. A vibratory tool with a minimum tip radius of 0.0005" is acceptable for marking on surfaces which are not hidden from view. Engraving is also permitted.

Separate (non-welded) parts and assemblies to be serialized according to the document titled Part Numbers and Serialization of Detector Hardware, LIGO-L970196. This document allows for "bag-and-tag" type of identification for small parts.

3.3.1.1 Serial Number

3.3.1.1.1 Serial Number

A serial number shall be etched, embossed, or marked with a stylus on each conflat.

3.3.1.1.2 Serial Number Format

The Serial number shall be of the format:

E980263-y S/N *nnn-c* Where

E980263-y is the LIGO piece part or assembly drawing number, E980263, including the revision letter, -y, to which the hardware item was built, and

nnn is the sequential serial number, 001 through 999, in the order produced; and *c=1* describes the type 1 AR coating, *c=2* describes the type 2 AR coating.

3.3.2. Quality Assurance Provisions

A first article shall be produced and inspected for form, dimensions and workmanship.

3.3.3. Purchaser Access

Non-escort privileges for the buyer, owner, government and owner representatives to all areas of the facilities where work is being performed shall be arranged. This will include access to all areas where material is being processed and stored. The purchaser shall have the right to witness all manufacturing processes.

3.3.4. QA Approval

LIGO QA reserves the right to inspect and approve vendor/fabricator QA plan and processes.



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4 TEST PROCEDURES

4.1. Optical window

4.1.1. Visual Surface Inspection Test

Both surfaces of the optical window shall be free of visible stains and surface defects, when the window is illuminated with a high-intensity light source and viewed in a darkened environment with the unaided eye.

4.1.2. Transmissivity Test

Transmissivity through the clear aperture shall be measured with a collimated laser beam, 1064 nm wavelength. The beam diameter shall fill the clear aperture when making transmissivity measurements.

4.1.3. Wavefront Distortion Test

Wavefront distortion over the clear aperture shall be measured at 633 nm wavelength with an appropriate interferometer.

4.2. Flange and seals

4.2.1. Visual inspection

No obvious asymmetries or weld metal buildup shall be evident, and no discoloration shall be visible in a visual inspection conducted from 16 inches.

4.2.2. Ultrasonic cleaning Test

The conflats/viewports shall yield no visible debris in an ultrasonic bath after a single cleaning, done in the following manner.

- Ultrasonic clean in Alcinox (1 tbs to 1 gal water) for 10 minutes
- Rinse in distilled water
- Ultrasonic clean in ethanol for 10 minutes
- Rinse in distilled water

4.2.3. Q-Tip test

The conflats shall yield no debris or visible contamination to a manually applied Q-Tip wipe, following the Ultrasonic cleaning procedure (4.2.2.).



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4.3. Vacuum tightness test

No leak shall be detectable on Helium Mass Spectrometer leak detector with sensitivity of 2×10^{-10} std. cc/sec

5 DOCUMENTATION

- 1) Interferogram of transmitted wavefront across clear aperture
- 2) Transmissivity through clear aperture
- 3) Results of Helium leak test
- 4) Compliance Certification for this specification
- 5) Calibration certification for the test equipment, as appropriate
- 6) Inspection report
 - dimensional verification
 - test results
 - materials list
 - inspection test procedure

6 ENVIRONMENTAL CHARACTERISTICS

The PO Telescope will operate in a non-vibrational, ultra high vacuum environment, at room temperature (68F,+/-4F).

7 HANDLING AND SHIPPING PROCEDURES

7.1. Cleaning

Approved cleaning procedures for UHV components are detailed in LIGO-E960022, Vacuum Compatibility, Cleaning Methods and Compatibility Procedures.

7.1.1. Optical Surfaces

All optical surfaces shall be cleaned in accordance with good commercial practice. Nothing shall contact the optical surfaces after cleaning, except for lint-free lens tissue.

7.1.2. Mechanical Parts

Mechanical parts shall be degreased in a clean solvent and shall be subsequently cleaned in an ultrasonic bath in the following manner.

- Ultrasonic clean in Alconox (1 tbs to 1 gal water) or Liquinox for 10 minutes
- Rinse in distilled water
- Ultrasonic clean in ethanol for 10 minutes
- Rinse in distilled water



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7.2. Packaging for Shipment

7.2.1. Optical Parts

The cleaned optical components shall be protected with 6 layers of lint-free lens tissue. In addition, all components shall be wrapped in UHV quality aluminum foil and placed in a sealed, clean polyethylene bag before shipping, as described in Mechanical Parts

7.2.2. Mechanical Parts

Cleaned mechanical parts shall be wrapped for shipping as follows:

- (a) wrap the part(s) with UHV quality aluminum foil
- (b) Place each part(s) in a clean polyethylene bag. Optionally use an anti-static bag fabricated from "CP Stat 100(TM) ESD poly sheet cleaned to Class 100".
- (c) Place "PRE-CLEAN PART..." and identification labels outside bag.
- (f) Place the bagged part(s) in an appropriate shipping container, using care to not puncture or cut the bag. Seal the shipping container closed. Attach a label with the LIGO part number (drawing number(s), including revision letter) and serial number(s) to the outside of the container.

The shipping containers must be such that they insure that the bag does not get punctured and that the parts are properly supported during transit.

The CP Stat material is ordered as follows:

CP Stat 100 ESD sheeting cleaned to Class 100 with CFC certification that it passes JPL specifications. At the time of this writing, it is available in various sheet and bag sizes from: Caltex Plastics, Inc.

P.O. Box 58546
2380 E. 51st Street
Vernon, CA 90058
(213) 583-4140

At the time of this writing, one source for UHV Quality Aluminum Foil is:

ASTM B-479 Dry Annealed A Allfoil
4597 Vanepps Rd.
Brooklyn, OH 44131
(216) 661-0211



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8 CONFLAT PLAN DRAWING

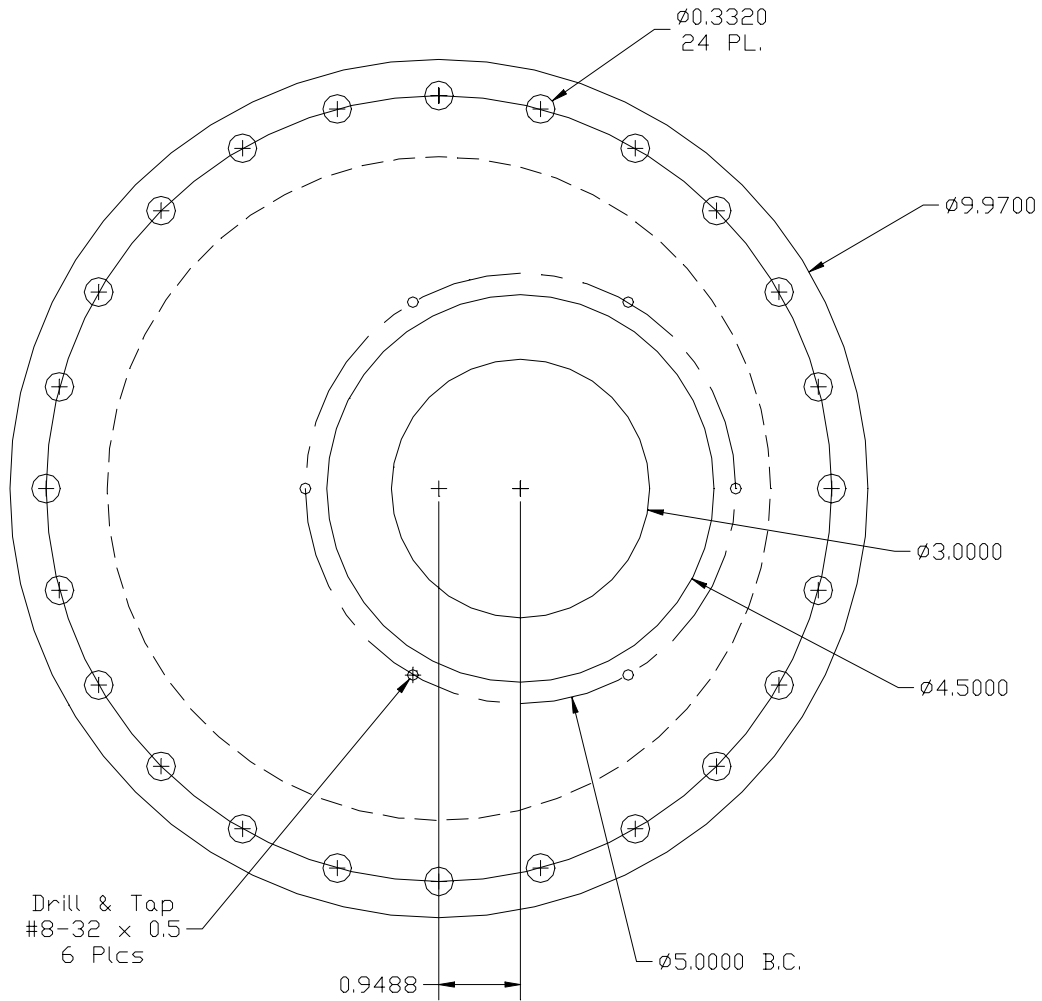


Figure 1: Conflat Plan