LIGO LABORATORY
California Institute of Technology
1200 E. California Blvd.
Pasadena, CA 91125

Statement of Work
Fabrication of High Quality, Wedged, Windows
C1104441-v1

1.0 Scope (LIGO sub-system)

This SOW is for the manufacture, test, and delivery of high quality 6 inch diameter, anti-reflection coated optical windows with a 0.75 degree wedge. The windows are to be used for viewports on the chamber where a wedged optic is needed and on the Septum Plates inside ultra-high vacuum chambers.

2.0 Document Access

Many supplemental documents and specifications are incorporated into and made a part this Statement of Work. Click on the document links to access these documents from the LIGO Document Control Center (DCC) or go on line to the LIGO Public DCC at https://dcc.ligo.org/ to access the DCC#.

3.0 Commercial Terms and Applicable LIGO Specifications:

Note: The documents listed below are invoked for this Statement of Work and comprise additional requirements which are integral to this Statement of Work.

- LIGO-C080185-v1 LIGO Commercial Items or Services Contract General Provisions
- LIGO-Q0900001-v5 Advanced LIGO Supplier Quality Requirements

4.0 Quality System:

Referring to the above referenced LIGO Specification Q0900001, Suppliers should include a copy of their current ISO 9001, AS9100, or TS16949 certification in their bid package. Suppliers lacking current certification should send a copy of their Quality Manual with their bid package.

5.0 Parts/Assemblies to be manufactured, Quantity Required, and Inspection requirements:

Note 1: Refer to Section 8.0 for delivery schedule and location.
Note 2: Refer to Section 6.4 for additional inspection requirements.

Drawing #	Part Description	Quantity	AQL Number
LIGO-D1101005-v1	aLIGO, high quality, .75 deg wedged, 6" Viewport, Optic	35	0.25

Small adjustments to these quantities may be made based on the lot size of the Supplier, in order to make most efficient use of the Supplier's capabilities. Therefore the quotation should include information about the bidder's lot or batch size for parts processing.

6.0 Manufacturing:

6.1 Requirements:

Suppliers must refer to the LIGO Specifications referenced in Section 3 for additional, and in some cases, non-industry standard requirements.

6.2 Sub-Contracted Work:

- LIGO expects that at least 2/3 (by dollar value) of the contracted work be performed by the Supplier named on the Purchase Order. The Supplier shall be responsible for all sub-contracted work.

6.3 Precedence:

The drawings typically represent the finished part as needed for use in service. Suppliers should always contact a LIGO representative to resolve any discrepancies uncertainties in the documentation or instructions. If there is a conflict between the SOW and the specification, the specification has precedence.

6.4 Special Instructions:

- Windows are to be fabricated in accordance with the following specifications -

Drawing #	Part Description
LIGO-E070069-v1	Specifications for High Quality Window Polish, Advanced LIGO
LIGO-E070124-v2	Septum Window Coating Specification

- 100% dimensional inspection required of thickness and wedge angle.
- Supply witness samples for each coating run.
- Coating performance measurements can be supplied with witness samples.

6.5 Exclusions:

- None.

7.0 End Item Data Package:

Before delivery of the parts, the Supplier shall provide the following data, as a minimum:

- Any as-built modifications (with approval of the LIGO Contracting Officer) as mark-ups to the drawings
- Material certifications
- Inspection reports for polish surface quality and figure error
- Inspection reports for coating AR performance
- Inspection reports of all dimensional features for the number of parts specified per the AQL number and referenced in the AQL table LIGO-Q1100003-v1 and any other inspection requirements detailed in Section 5 of this SOW
- Certificate of compliance for each part number stating conformance to contract and drawing requirements

8.0 Delivery Requirements:

8.1 Shipping Containers and Packaging:

The contractor is responsible for providing shipping containers and transportation which protects these parts from damage from the transportation environment (weather, handling, accidents, etc.) and maintains their cleanliness in their original condition.

8.2 Shipping Destination(s):

The deliveries are FOB at these destinations, i.e. the Supplier has the responsibility for shipping title and control of goods until they are delivered and the transportation has been completed. The contractor selects the carrier and is responsible for the risk of transportation and for filing claims for loss or damage.

These items will be shipped to:

California Institute of Technology (CIT)
Attn: Mike Smith
LIGO Project MS 100-36
391 S. Holliston Ave.
Pasadena, CA 91125

8.3 Delivery Schedule:

Partial and/or early deliveries are acceptable.

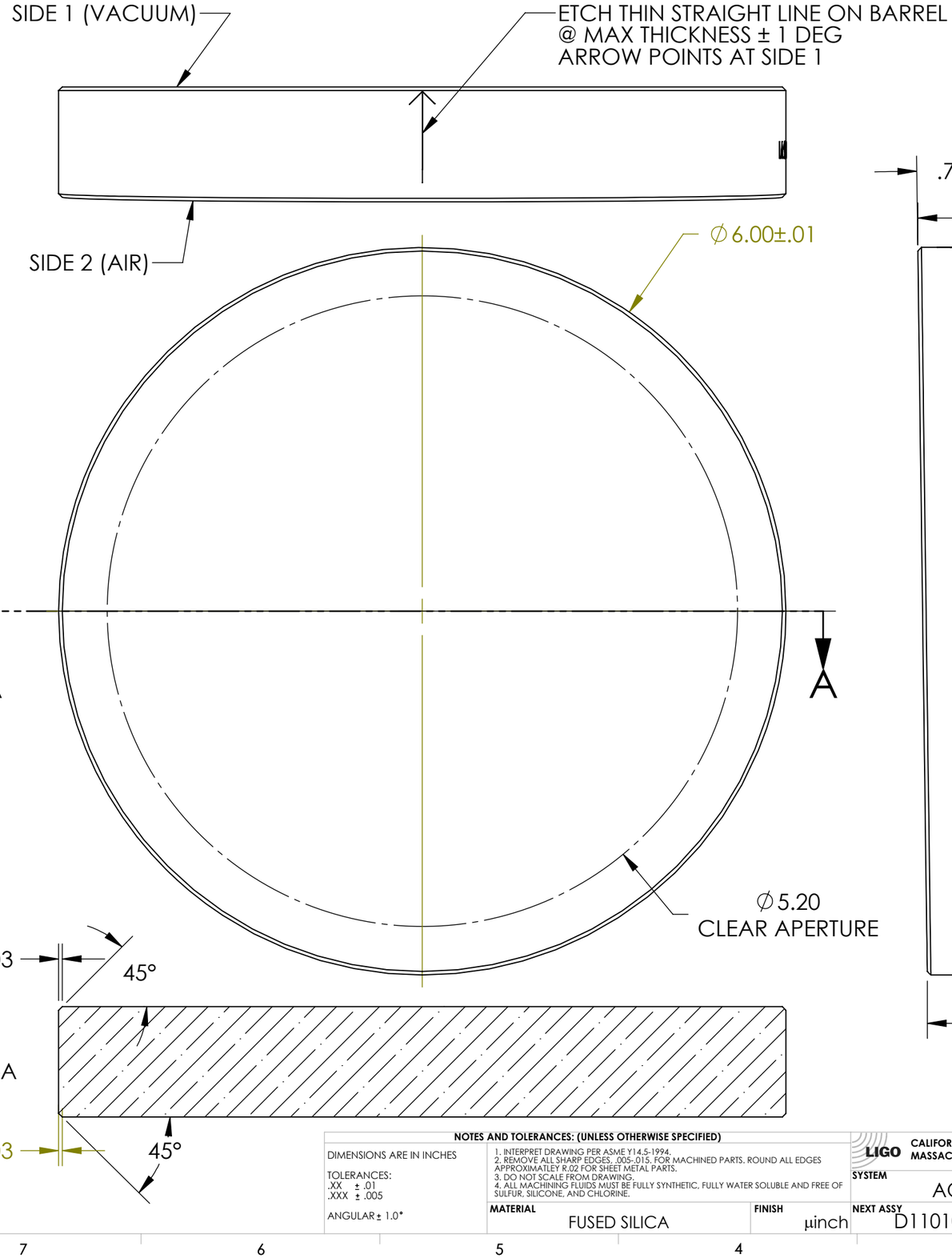
Quantity	Ship Date
10	18-Aug-2011
10	17-Sep-2011
10	17-Oct-2011
5	16-Nov-2011

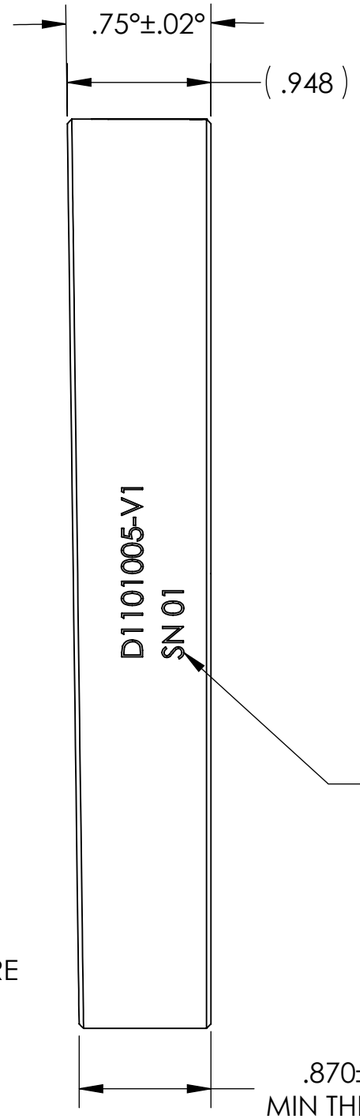
NOTES CONTINUED:

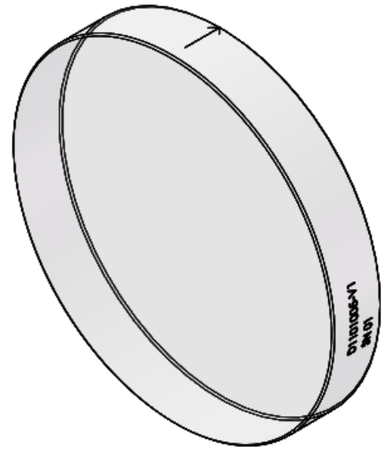
PERMANENTLY MARK DRAWING PART NUMBER, REVISION AND SERIAL NUMBER AT NOTED LOCATION. NO INKS OR DYES ARE TO BE USED. SERIAL NUMBERS START AT 01. USE MINIMUM .12" HIGH CHARACTERS. EXAMPLE: D1101005-V1, SN 01

6. APPROXIMATE WEIGHT = 2.0 LB.
7. MATERIAL IS FUSED SILICA PER SPECIFICATION LIGO-E070069
8. POLISH PLANO/PLANO PER SPECIFICATION LIGO-E070069
9. COATING IS AR/AR PER SPECIFICATION LIGO-E070124

REV.	DATE	DCN #	DRAWING TREE #
V1	9 JUN 2011	E1100521	NA
-	-	-	-
-	-	-	-







NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

DIMENSIONS ARE IN INCHES

TOLERANCES:
.XX ± .01
.XXX ± .005

ANGULAR ± 1.0°

1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES, .005-.015. FOR MACHINED PARTS. ROUND ALL EDGES APPROXIMATLEY R.02 FOR SHEET METAL PARTS.
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.

MATERIAL FUSED SILICA

FINISH µinch

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PART NAME High Quality 6in, wedged Viewport Optic

SYSTEM AOS

SUB-SYSTEM SLC

NEXT ASSY D1101000, D1101092

DESIGNER	Dennis Coyne	9 Jun 2011	
DRAFTER	Dennis Coyne	27 May 2011	
CHECKER	Mike Smith	27 May 2011	
APPROVAL	SEE DCN		

SIZE B **DWG. NO.** D1101005 **REV.** v1

SCALE: 1:2 **PROJECTION:** SHEET 1 OF 1

D1101005 aLIGO, high quality, wedged, 6in Viewport, Optic, PART PDM REV: X-001, DRAWING PDM REV: X-003

Septum Window Polish

AUTHOR:	CHECKED:	DATE	APPROVALS		
			DCN NO.	REV	DATE
G. Billingsley	M. Zucker	**4-27-07**	**E070094**	**A**	**4-27-07**
L. Austin	**D. Coyne**	**6-13-11**			

Applicable Documents

LIGO-D1101005 aLIGO High Quality .75 Deg Wedged 6" Viewport, Optic

Requirements

Physical Configuration

According to

LIGO-D1101005 aLIGO High Quality .75 Deg Wedged 6" Viewport, Optic

Fabricate from
Corning grade 0AA fused silica or equivalent

Part and Serial Number

The Serial number shall be per D1101005 and of the format:
ESW YY Where
YY is incremental for each optic starting at 01

Registration Mark

Registration mark shall be etched, ground or sandblasted

Side and Bevel Polish

All sides and Bevels shall be polished from a five micrometer grit finish. These surfaces shall appear transparent with no gray, scuffs or scratches visible to the naked eye when viewed in normal room light against a black background.

Scratches and Point defects within the clear aperture defined by D1101005

Scratches and point defects are to be minimized as scattered light is highly detrimental to the project.
Requirement: 20/10
Goal: 10/5

Septum Window Polish

Surfaces 1 and 2, measured over the central 140 mm diameter

Surface Figure: deviation from flat < 10 nm rms

High Spatial Frequency Band: Micro-roughness is measured with a commercial microscopic interferometer or surface profiler.
σ_{rms} < 0.1 nanometers

Measured at the following locations:
1. The center of the mirror substrate.
2. Four positions equally spaced along the circumference of a centered, 60 mm diameter circle.

Specification	Test Method	Frequency of Inspection	Data Delivered
Physical Dimensions	Visual Inspection	100%	Certification
Side and Bevel Polish	Visual Inspection	100%	Certification
Scratches and Point defects	Visual Inspection	100%	Certification
Surface Figure	Interferometry	100%	Surface Map
Surface Errors – High Spatial Frequency	High resolution Surface Map	100%	Certification

Septum Window– Coating Specifications

APPROVALS	DATE	REV	DCN NO.	BY	CHECK	DCC	DATE
AUTHOR: L. Austin	**6-16-2011**	**v2**					
CHECKED: Mike Smith							
APPROVED**: Dennis Coyne**							
DCC RELEASE							

1 Material

Fused Silica 7980, OA

2 Applicable Documents

LIGO- E070069-v1 Septum Window Polish
LIGO-D1101005 aLIGO, high quality, .75 deg wedged, 6" Viewport, Optic

3 Coating

Wavelength: 1064 nm
Angle of incidence: 0 degrees
Scatter <15 ppm

Side 1 and 2

AR ï Reflection:
Goal: < 10ppm
Requirement: < 50ppm

Coating vendor to provide:

One 1ò wedged coating sample ahead of time to evaluate vendorôs capability to meet coating specifications.

1. One 1ò wedged witness sample from each coating run
2. Spectrophotometer graphs of the reflectance of the AR coating from 800nm to 1200nm
3. Spectrophotometer graphs of the reflectance of the AR coating with increased sensitivity, to show wavelengths from 950nm to 1100nm