



## Statement of Work End Test Mass Re-Polishing

**C1900175-v3**

### 1.0 End Test Mass Polishing Scope

The polisher must provide all facilities, tooling, services, materials and staff to take the existing fused silica test mass optic, provided by Caltech, remove existing ears and HR coating and re-polish according to the polishing specifications and drawings. The polisher must provide inspection and certification data as called out in the polishing specifications. The contractor is not responsible for applying dielectric coatings.

### 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-v2](#) 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: refer to Section 8.0 for delivery schedule and location

Part Description	Drawing #	Specification #	Material Supplied	Total Qty:
End Test Mass	<a href="#">LIGO-D1900269-v1</a>	<a href="#">LIGO-E1900199-v1</a>	<a href="#">LIGO-D0902455-v3</a>	4 <b>+2 optional</b>

## 6.0 Manufacturing:

### 6.1 Precedence:

The drawings typically represent the finished part as needed for use in service. There may be requirements on the drawing (such as coatings) which are specifically defined as not the responsibility of the supplier in this SOW. Suppliers should always contact a LIGO representative to resolve any discrepancies or uncertainties in the documentation or instructions.

### 6.2 Special Instructions:

- a) Removal of the "production ear," item 2 on assembly D0902455, 2 places, is required.
- b) Re-polish of the flats "S3" and "S4" and placement of reference grooves is required.
- c) "S2" coating must be protected during rework.
- d) Do not change serial number.
- e) Please propose minimal tolerance increase on thickness and horizontal width at locations C8 and B5 of LIGO-D1900269. The current dimensions of each optic are shown in Appendix A.
- f) Option Item to add a custom S1 figure per Appendix B.
- g) Option item to include two (2) additional ETMs for a total of six (6).

### 6.3 Exclusions:

- a) The contractor is not responsible for supplying dielectric coatings.
- b) The contractor is not responsible for modification of etched serial numbers or top and bottom fiducial markings.
- c) The contractor is not responsible for supplying shipping containers, these are supplied by Caltech.
- d) Caltech will supply at least one dummy test mass with ears for use in process testing.

## 7.0 End Item Data Package:

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

- o All items named in the polishing specification LIGO-E1900199, version noted in section 5.

## 8.0 Delivery Requirements:

### 8.1 Shipping Containers and Packaging:

Caltech will supply clean containers and transit cases for each polished substrate. Optics are to be shipped clean, and packaged per [LIGO-E0900394-v6](#).

### 8.2 Shipping Destination(s):

The deliveries are FOB at the Origin, i.e. Caltech has the responsibility for shipping title and control of goods until they are delivered and the transportation has been completed. Caltech 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:

**GariLynn Billingsley**  
**California Institute of Technology (CIT)**

LIGO Project MS 100-36  
391 S. Holliston Ave.  
Pasadena, CA 91125

### **8.3 Delivery Schedule:**

The first ETM is to be delivered on or before November 1, 2019, followed by at least one optic per month until completion. Material for four (4) ETMs is available immediately. Material for two (2) optional ETMs will become available November 18, 2019.

### **9.0 POINTS OF CONTACT**

Technical POC: GariLynn Billingsley, 626-395-2184, [Billingsley\\_G@ligo.caltech.edu](mailto:Billingsley_G@ligo.caltech.edu)

Contractual POC: Eric Garcia, 509-372-8134, [elgarcia@caltech.edu](mailto:elgarcia@caltech.edu)

Invoice POC: Caltech Procurement Hotline, 626-395-8900, [procurementhotline@caltech.edu](mailto:procurementhotline@caltech.edu)

## Appendix A. Description of optics to be reworked

SN	Thick.(mm)	Dia. (mm)	Mass (g)	Wedge	Vendor polish report
ETM07	199.75	340.18	39620	0.08	C1000485
ETM08	199.75	340.13	39603	0.08	C1000486
ETM09	199.59	340.13	39564	0.07	C1000487
ETM12	199.725	340.156	39597	0.076	C1106292

Vendor polish reports may be furnished upon request.

**HR Coating:** Ti:Ta2O5 and SiO2 total thickness 6  $\mu\text{m}$

**AR Coating:** Ti:Ta2O5 and SiO2, final layer SiO2

**Ear/Optic interface material:** sodium silicate

**Optic material:** fused silica

**Ear material:** fused silica

## Appendix B. Custom S1 Figure

An aspheric coating and thermal stress pre-compensation may be added to the S1 optical surface. The pre-compensation shall be provided by Caltech. The vendor would apply the correction to the S1 surface, but would not be responsible for its overall effectiveness as they do not control the coating process. A software null would be used to subtract the pre-compensation from the optical surface data. Surface RMS specifications will apply to the corrected data. Only features with spatial frequencies  $> 0.166\text{mm}^{-1}$  will be corrected. The slope of the correction file will be less than 2.5 nm / mm with a 6mm baseline, and a maximum deviation of less than 100nm PTV error.