



**Statement of Work: Coating Development and Delivery**  
**Two End Test Masses (ETM) S1, Two Input Test Masses (ITM) S1 and S2**  
**LIGO-C2100241-v1**

The LIGO Project at Caltech seeks a contractor to provide coating services for mirrors to be used in the A+ upgrade for the LIGO Observatories. The contractor shall provide Coating services for development of High Reflective (HR) coatings and delivery of two End Test Masses (ETM) and two Input Test Masses (ITM). Caltech will supply polished substrates per the referenced specifications.

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#.

## **1.0 Scope**

1. Demonstrate repeatable success using the Process for Optimized Deposition (POD) provided by the Center for Coating Research (CCR.) Reference [LIGO-M2100225](#). This demonstration will consist of single layer coatings and will be performed on LIGO-provided 75 mm substrates. The resulting loss angle will be verified at LIGO and will be equivalent or superior to that demonstrated by the CCR.
2. Demonstrate thermal noise as well as optical properties of an Advanced LIGO End Test Mass, per [LIGO-E0900068](#) on 1" test samples.
3. Demonstrate the required coating uniformity per [LIGO-T2000643](#), and other optical properties of an Advanced LIGO End Test Mass, per [LIGO-E0900068](#). This full-size demonstration will be accomplished using LIGO provided substrates per [LIGO-D080658](#).
4. Support the joint Coating Production Readiness Review which will be held in advance of AdV+ and A+ committing to the first O5 production coatings. Upon successful completion of this review and recommendation by the review committee, produce coatings described in items 5 and 6 below.
5. Coat for O5 production: only the HR surface of two (2) End Test Masses equivalent to [LIGO-E0900068-v5](#) and optimized for low thermal noise per this coating development program. The coater is not required to coat the AR surface or to deliver cantilever witness samples. The polished glass is provided by Caltech according to [LIGO-D080658](#).
6. Coat for O5 production: HR and AR surfaces of two (2) Input Test Masses equivalent to [LIGO-E0900041-v6](#) and optimized for low thermal noise per this coating development program. The polished glass is provided by Caltech according to [LIGO-D080657](#).
7. The coater will provide inspection and certification data as described in the coating specifications.
8. The coater will accept in-scope technical direction from the Caltech Technical Representative through the issuance of Caltech Technical Direction Memorandums (TDMs), Reference the form [LIGO-F0810001](#).

## 1.1. Exclusions:

Supplier is NOT responsible for coating the AR surface of the ETMs or to deliver cantilever witness samples for any coating runs.

## 1.2. Parts/Assemblies to be manufactured, Quantity Required:

Drawing #	Part Description	Total Qty:
<a href="#">LIGO-E0900068-v5</a>	ETM Coating HR only	2
<a href="#">LIGO-E0900041-v6</a>	ITM Coating HR and AR	2

## 2.0 Manufacturing:

### 2.1. Precedence:

The drawings typically represent the finished part as needed for use in service. There may be requirements on the drawing (such as polish) 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

### 2.2. Customer Furnished Material:

1. Caltech will supply all 75 mm x 1 mm and 340 mm x 200 mm fused silica substrates as Customer Furnished Material (CFM), shipped in clean containers and transit cases. These substrates are available upon award of Purchase Order.
2. Caltech will provide the substrate inspection certifications.

### 2.3. End Item Data Package:

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

1. Any as-built modifications (with approval of the LIGO Contracting Officer) as mark-ups to the drawings
2. Material certifications
3. Heat Treat and/or Stress Relief certifications, if applicable

## 3.0 Commercial Terms and Applicable LIGO Specifications:

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-v3](#) 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. Any existing contractor QA system shall include, but not be limited to the following:

1. Drawing and Specification Change Control
2. Raw Material Procurement
3. Traceability of Materials
4. Calibration Program
5. Cleanliness
6. Storage and Preservation
7. Transport
8. Customs
9. Inspections and Audits
10. End Item Data Package
11. Certificates of Compliance
12. Defect Reports and nonconforming materials

## **5.0 Delivery Requirements**

### **5.1. Shipping, Containers and Packaging:**

Caltech is responsible for providing shipping containers which protect these parts from damage due to the transportation environment (weather, handling, accidents, etc.)

Caltech is responsible for cost of shipping the CFM to and from the Contractor's facility, insurance costs and any customs, export or import duties or taxes.

### **5.2. Delivery Schedule:**

Delivery to begin in February 2023

## **6.0 CONTRACT MANAGEMENT/REPORTING**

### **6.1. Format and Submittal**

Wherever feasible, all documents shall be submitted in an electronic format acceptable to the LIGO Document Control Center. Adobe Portable Document Format (PDF) is an acceptable format for all documents that would normally be printed on paper.

Electronic copies of documentation submissions shall be provided via email or CD-ROMS. All documentation shall be submitted to the designated Technical Manager for approval.

### **6.2. Weekly Meetings**

The Contractor shall be available for weekly meetings for status update.

### **6.3. Designated representatives:**

The Contractor shall designate a technical and administrative representative.

### **6.4. The Caltech representatives are:**

Technical Representative: GariLynn Billingsley,  
Member of the Professional Staff  
California Institute of Technology  
LIGO Project, Mail Station: 100-36  
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Administrator: Dolly Richards,  
LIGO Sr. Procurement Specialist  
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