



**Statement of Work  
 aLIGO TCS Ring Heater  
 Upper and Lower Assembly Components**

The following documents are incorporated into and made a part this purchase order. Click on the following LIGO Document Control Center (DCC) links to access these documents or go on line to the LIGO Public DCC at <https://dcc.ligo.org/> to access the DCC#.

**1.0 Terms:**

<u>DCC #</u>	<u>Description</u>
<a href="#">C080185-v1</a>	Laser Interferometer Gravitational Wave Observatory (LIGO) Commercial Items or Services Contract General Provisions California Institute of Technology "Institute", LIGO Rev 11/12/08
<a href="#">F0810001-v4</a>	Technical Direction Memorandum.

**2.0 Quality Control:**

<u>DCC #</u>	<u>Description</u>
<a href="#">Q0900001-v4</a>	Advanced LIGO Supplier Quality Requirements, dated 2/10/10, describes following contractor/supplier QA/QC actions for this procurement:
<input type="checkbox"/> 3.1 Pre-Award Inspection	<input checked="" type="checkbox"/> 3.9 Discrepant Material Storage
<input type="checkbox"/> 3.2 Supplier In Process Quality Control	<input checked="" type="checkbox"/> 3.10 Quality Records
<input type="checkbox"/> 3.3 In Process Inspection	<input type="checkbox"/> 3.11 Drawing and Specification Change Control
<input checked="" type="checkbox"/> 3.4 Pre-Ship Inspection	<input type="checkbox"/> 3.12 Welding Certification
<input checked="" type="checkbox"/> 3.5 Receiving Inspection	<input checked="" type="checkbox"/> 3.13 End Item Data Package (including Certifications of Compliance)
<input checked="" type="checkbox"/> 3.6 Discrepant Material	<input type="checkbox"/> 4.1 Design Verification
<input checked="" type="checkbox"/> 3.7 Material Review Action	<input checked="" type="checkbox"/> 4.2 Raw Material Procurement
<input checked="" type="checkbox"/> 3.8 Material Review Actions at Contractor	<input checked="" type="checkbox"/> 4.3 Traceability of Materials
	<input checked="" type="checkbox"/> 4.4 Calibration Program
	<input type="checkbox"/> 4.5 Critical Interface
	<input checked="" type="checkbox"/> 4.6 Cleanliness
	<input checked="" type="checkbox"/> 4.7 Packaging
	<input checked="" type="checkbox"/> 4.8 Storage
	<input checked="" type="checkbox"/> 4.9 Transport
	<input type="checkbox"/> 4.10 Customs

For the above list the Supplier shall: 1) Identify the corresponding sections/paragraphs in their existing QA/QC system 2) meet or exceed the design requirements contained in the attached engineering documents for each area called out.

**3.0 End Item Data Package:**

- At the time of delivery of the parts, the Supplier shall also provide the following data, as a minimum:
- o Any as-built modifications (with approval of the LIGO Contracting Officer) as mark-ups to the drawings
  - o Material certifications
  - o Dimensional & QC inspection reports—this shall include a report showing that parts have been inspected and fall within specified tolerances.
  - o Certificate or statement of compliance with all contract and drawing process restrictions.

#### 4.0 Scope and Included Documents:

The Institute is seeking a qualified firm to manufacture the components identified as "made-to-specification" (MTS) items in the formal drawing tree, [LIGO-E1000295-v1](#). Components designated as "off-the-shelf" (OTS) will be provided by Caltech. Also, the formed Glass Rod Insulator (D1000682-v2) is being provided by Caltech. The list of drawings (by part number, revision and name) for particular MTS components is included in Table 1 of this document. The set of drawings is also included with this document.

**Table 1.** Drawings Associated with Particular MTS Components of each Assembly, D1001838-v1 and D1001895-v1

Item No.	Rev.	Description	Type	Source	Quantity			
					Required	Spare	Total	Unit
<a href="#">D1001838</a>	V1	<b>aLIGO [TCS] UPPER SEGMENT RING HEATER ASSY</b>	<b>ASSY</b>	<b>MTS</b>	1		1	EA
<a href="#">D1001679</a>	V1	ALIGO TCS UPPER MONOLITH RH SHIELD	PRT	MTS	1		1	EA
D1000682	V2	[TCS] RH GLASS ROD INSULATOR	PRT	MTS	1	1	2	EA
		NICHROME WIRE, 24 BNC [DIA .5 MM]	PRT	OTS	19.8	19.8	40	FT
<a href="#">D1001819</a>	V1	RH ELEMENT RETAINER LEFT [9 O'CLOCK POSITION]	PRT	MTS	1	1	2	EA
<a href="#">D1001858</a>	V1	RH ELEMENT RETAINER RIGHT [3 O'CLOCK POSITION]	PRT	MTS	1	1	2	EA
<a href="#">D1001849</a>	V1	UPPER COPPER PLATE	PRT	MTS	2	2	4	EA
<a href="#">D1001850</a>	V1	LOWER COPPER PLATE	PRT	MTS	2	2	4	EA
C-210		SS SHCS-V #2-56 UNC 2A X .625 LONG	HW	OTS	2	2	4	EA
N-256		SS HEX NUT #2-56 UNC 2B	HW	OTS	2	2	4	EA
FA-404		SS FSHCS-V #4-40 UNC 2A X .25 LONG	HW	OTS	4	2	6	EA
CZ1105		PFA COATED 28 AWG Cu WIRE, 2x 6 IN LENGTH	PRT	OTS	12	12	24	IN
100170		ACCUGLASS PIN CONTACT 100170, MALE TYPE T-1, CRIMPED	PRT	OTS	2	2	4	EA
<a href="#">D1001895</a>	V1	<b>aLIGO [TCS] LOWER SEGMENT RING HEATER ASSY</b>	<b>ASSY</b>	<b>MTS</b>	1		1	EA
<a href="#">D1001680</a>	V1	ALIGO TCS UPPER MONOLITH RH SHIELD	PRT	MTS	1		1	EA
D1000682	V2	[TCS] RH GLASS ROD INSULATOR	PRT	MTS	1	1	2	EA
		NICHROME WIRE, 24 BNC [DIA .5 MM]	PRT	OTS	19.8	19.8	40	FT
<a href="#">D1001819</a>	V1	RH ELEMENT RETAINER LEFT [3 O'CLOCK POSITION]	PRT	MTS	1	1	2	EA
<a href="#">D1001858</a>	V1	RH ELEMENT RETAINER RIGHT [9 O'CLOCK POSITION]	PRT	MTS	1	1	2	EA
<a href="#">D1001849</a>	V1	LOWER UPPER PLATE	PRT	MTS	2	2	4	EA
<a href="#">D1001850</a>	V1	LOWER COPPER PLATE	PRT	MTS	2	2	4	EA
C-210		SS SHCS-V #2-56 UNC 2A X .625 LONG	HW	OTS	2	2	4	EA
N-256		SS HEX NUT #2-56 UNC 2B	HW	OTS	2	2	4	EA
FA-404		SS FSHCS-V #4-40 UNC 2A X .25 LONG	HW	OTS	4	2	6	EA
CZ1105		PFA COATED 28 AWG Cu WIRE, 2x 6 IN LENGTH	PRT	OTS	12	12	24	IN
100170		ACCUGLASS PIN CONTACT 100170, MALE TYPE T-1, CRIMPED	PRT	OTS	2	2	4	EA

The solid models (SolidWorks Professional 2009) used to create the drawings and assemblies as well as e-drawings can be made available to the contractor once an award is made. Further information to aid with assembly will be provided at the time of contract.

Finally, specific manufacturing guidelines for metal components (as in Table 1), which are intended for use in the aLIGO Vacuum System, are included with this document.

[E0900364-v3](#) *Metal components intended for use in the AdvLIGO Vacuum System*

#### **4.1 Quantity Required**

The total quantity required for each part, by drawing number, is indicated in Table 1. Note that the "Required Quantity" for each component is a direct indication of minimum number of parts required to make each Assembly. "Total Quantity" is considered a complete assembly kit, including spares.

The required delivery, under this Statement Of Work, is (1) *total assembly* kit, for each D1001838-v1 and D1001895-v1.

### **5.0 Delivery Requirements:**

The deliveries are FOB at these destinations, i.e. the contractor has 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.

Shipping Location:

The parts are to be delivered to:

California Institute of Technology  
Mindy Jacobson  
PMA-LIGO, MS 18-34  
391 S. Holliston St.  
Pasadena, CA 91125  
626.395.3209

Shipping Containers:

The contractor is responsible for providing shipping containers and transportation which protects these parts from damage from the transportation environment (weather, handling, accidents, etc.). Mating edges of parts should be especially protected from damage during shipping.

### **6.0 Manufacturing:**

#### **6.1 Precedence**

The Statement of Work (SOW) sections below regarding processing or fabrication of the parts are meant to convey the scope and nature of the requested work. If there is a conflict between the SOW and the drawing, the drawing has precedence.

## 6.2 Cleaning requirements for machining

1. Machine all surfaces to remove oxides and mill finish. Abrasive removal techniques are not acceptable.
2. All machining fluids must be water soluble (not simply water miscible) and free of sulfur, chlorine, and silicone, such as Cincinnati Milacron Cimtech 410.
3. Thoroughly clean part to remove all oil, grease, dirt, and chips with soap and water. Follow with solvent (acetone) wipe. Pay close attention to the tapped holes.

## 6.3 Material

Specific material grades are called out on each drawing. (If aluminum is called out, but a specific grade or temper is not specified, use 6061-T6 aluminum.)

Material certifications are required for all parts. Cast tooling plate is not permitted.

All materials specified on drawings or SOW have been approved for use in the UHV environment in LIGO. No materials may be substituted or added without prior knowledge and testing by LIGO.

## 6.4 Machining

All parts are to be machined. No grinding or lapping with abrasive wheels, cloth or stones is permitted. No parts shall be cast or molded.

## 6.5 Finishing

The required surface roughness is defined in the drawings. Except as noted, no surface coatings or plating are required.

## 6.6 Marking

Unless too small, all parts must be marked with a part number, revision code and serial number at the location indicated on the drawing. Marking is to be accomplished by mechanically scribing, stamping or engraving (no dyes or inks). Otherwise, all parts are to be bagged and tagged with information that is to be engraved, as follows:

<drawing number> - <revision code>, <type number if applicable>

<unique 3 digit serial number starting at 001 for the first part and incrementing thereafter>

As an example:

D071314-V2

S/N – 001

The serial number must be a sequential 3-digit number, starting with 001, for each part. Also where indicated, mechanically scribe, stamp, or engrave (no dyes or inks) any additional markings called out on drawing sheets.

## 6.7 Hardware

All hardware indicated on the assembly drawings will be provided by Caltech.