



Statement of Work Nickel Plating/Heat Treatment of Maraging Steel Blades for Advanced LIGO HAM Suspensions

The following documents are incorporated into and made a part of 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 Scope:

This SOW is for the nickel plating and heat treatment of the maraging steel spring blades for the HAM suspensions. The specification, [E0900023-v10](#) for the fabrication of the maraging steel blades includes the nickel plating and heat treatment requirements. Blades sizes are detailed in the unique drawings included in this package. Blade quantities are detailed in Section 6, below. Details of the scope of this procurement are covered in Section 8, part 4, below.

2.0 Terms:

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

3.0 Quality Control:

<u>DCC #</u>	<u>Description</u>
Q0900001-v4	Advanced LIGO Supplier Quality Requirements, dated 2/10/10, describes following contractor/supplier QA/QC actions for this procurement:

- | | | |
|---|---|---|
| <input checked="" type="checkbox"/> 3.1 Pre-Award Inspection | <input checked="" type="checkbox"/> 3.9 Discrepant Material Storage | <input checked="" type="checkbox"/> 4.4 Calibration Program |
| <input checked="" type="checkbox"/> 3.2 Supplier In Process Quality Control | <input checked="" type="checkbox"/> 3.10 Quality Records | <input type="checkbox"/> 4.5 Critical Interface |
| <input checked="" type="checkbox"/> 3.3 In Process Inspection | <input checked="" type="checkbox"/> 3.11 Drawing and Specification Change Control | <input checked="" type="checkbox"/> 4.6 Cleanliness |
| <input checked="" type="checkbox"/> 3.4 Pre-Ship Inspection | <input type="checkbox"/> 3.12 Welding Certification | <input checked="" type="checkbox"/> 4.7 Packaging |
| <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"/> 4.8 Storage |
| <input checked="" type="checkbox"/> 3.6 Discrepant Material | <input type="checkbox"/> 4.1 Design Verification | <input checked="" type="checkbox"/> 4.9 Transport |
| <input type="checkbox"/> 3.7 Material Review Action | <input type="checkbox"/> 4.2 Raw Material Procurement | <input type="checkbox"/> 4.10 Customs |
| <input checked="" type="checkbox"/> 3.8 Material Review Actions at Contractor | <input type="checkbox"/> 4.3 Traceability of Materials | |

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 linked engineering documents for each area called out.

4.0 Included Documents:

The drawings cited below are fully dimensioned. In addition to the drawings, the contractor will be provided with CAD solid model of the part (SolidWorks Professional 2010, SP4.0).

<u>DCC#</u>	<u>Description</u>
E0900023-v10	Manufacturing Process for Cantilever Spring Blades for Advanced LIGO
D080018-v1	OMC Upper Blade
D080019-v1	OMC Lower Blade
D1001812-v1	HSTS Upper Blade
D080761-v3	HSTS Lower Blade
D020617-v2	HLTS Upper Blade
D020615-v2	HLTS Lower Blade

5.0 End Item Data Package:

At the time of delivery of the parts, the Supplier shall also provide the following data, as a minimum:

- Any as-built modifications (with approval of the LIGO Contracting Officer) as mark-ups to the specification.
- QC inspection reports—this shall include a report showing that parts have been inspected and fall within specified plating tolerances.
- Certificate or statement of compliance with all contract and drawing process restrictions

6.0 Quantity Required:

Document No.	Revision	Description	Quantity
D080018	v1	OMC Upper Blade	20
D080019	v1	OMC Lower Blade	40
D1001812	v1	HSTS Upper Blade	96
D080761	v3	HSTS Lower Blade	192
D020617	v2	HLTS Upper Blade	32
D020615	v2	HLTS Lower Blade	64

7.0 Delivery Requirements:

1. Packaging and Shipping Requirements

Take care that the blades are completely dry before bagging in plastic. Double bag each blade individually. Bags should be made from polyethylene. Heat sealed or zip lock is preferred. Insert small desiccant package in between the bag layers, not in contact with the blades. It is our preference that the blades be bagged and then put back into the age hardening comb fixture (LIGO-provided) for shipment. This allows the blades to stay on their sides, so as to avoid undo sag or stresses. However, if an alternative packing approach will meet these requirements, please contact LIGO Engineering for review and approval at procurement kick-off meeting. Add additional desiccant packages to the shipping container. Shipping container should be stiff enough so as to avoid any damage to the blades during shipment. LIGO Engineering can provide guidance on successful packaging and shipping procedures.

2. Delivery Schedule

All deliveries must be shipped within **4 weeks ARO**. If this cannot be accommodated, please provide an alternative delivery schedule for consideration with your bid package. Early and/or partial deliveries are welcome.

8.0 Manufacturing:

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.

2. Cleanliness and handling

Treatment of raw materials and work-in-process materials with respect to cleanliness is covered in the manufacturing process specification, Section 2.4. Localized scratches, digs and blemishes should be minimized, as the nickel plating is very thin.

3. Blade information

All blade springs are made from Maraging C-250. Each blade is marked with a drawing number and serial number. The nickel plating should not obscure this marking.

4. Scope of the Procurement

It is assumed that the fabrication method for the maraging steel blades has followed the Alternative process, Section 3, of the Manufacturing Process for Cantilever Spring Blades for Advanced LIGO, E0900023-v10. According to the specification, these are Thin Blade Springs, per Section 2.7.1.

This procurement includes the nickel plating and the after-plating heat treatment. The requirements for the nickel plating are detailed in Section 2.5. Since the blade vendor is utilizing the alternative manufacturing process, detailed in Section 3, the post-plating heat treatment is meant to drive off any unbound phosphorous and to avoid hydrogen embrittlement. The requirements for the heat treatment are detailed in Section 3. Our preference is to have the blades hang freely from wires for the heat treatment process. A fixture that allows the blades to sit upon their sides is also acceptable.