



IDENTIFICATION			
C-SUPT-1			
LIGO-0950028-02-B			
TITLE	BEAM TUBE SUPPORT SPECIFICATION	REFERENCE NO.	SHT 1 OF 7
		930212	
PRODUCT	LIGO BEAM TUBE MODULES CALIFORNIA INSTITUTE OF TECHNOLOGY	OFFICE	REVISION
		NOE-C	2
MADE BY	CHKD BY	MADE BY	CHKD BY
WJC	RJW	SWP	MLT
DATE	DATE	DATE	DATE
3/9/94	3/10/94	5/10/95	5/12/95

**0.1 SCOPE**

This specification provides the technical requirements for the supply, fabrication, welding and galvanizing of structural steel and miscellaneous steel for the beam tube supports. The supports shall be installed by the Purchaser.

**1.0 APPLICABLE DOCUMENTS**

- 1.1 ASME SA-240, "Specification for Heat-Resisting and Chromium Nickel Stainless Steel Plate, Sheet, and Strip".
- 1.2 ASTM A36, "Specification for Structural Steels".
- 1.3 AISC "Manual of Steel Construction", 9th Edition.
- 1.4 AISC "Code of Standard Practice for Steel Buildings and Bridges".
- 1.5 AWS D1.1, "Structural Welding Code".
- 1.6 AWS D19.0, "Welding Zinc Coated Steel".
- 1.7 CBI Drawings Contained in Appendix A.

**2.0 FABRICATOR SUPPLY**

- 2.1 The Fabricator shall supply all fabricated structural and miscellaneous steel details as described on the design sketches listed in Appendix A. All bolts, washers and nuts required for erection shall be supplied, including 5 percent more than the computed quantity. All shims, wedges and leveling plates required for proper fit-up shall also be furnished by the Fabricator.
- 2.2 Any exceptions or exclusions to Fabricator-supplied items will be noted by the Purchaser in the Purchase Order.

**3.0 MATERIALS**

- 3.1 Only new material meeting the specified ASTM or ASME designation shall be used unless approved, in advance, by the Purchaser.
- 3.2 All structural steel shall conform to the requirements of ASTM A36 unless noted otherwise. All miscellaneous steel plates and bars shall conform to the requirements of ASTM A36 unless noted otherwise. All structural tube sections shall conform to the requirements of ASTM A500 Grade B unless noted otherwise.

APPROVED  
 J. Bond LIGO 11/10/95  
 M. T. O. D. 11/10/95  
 GO 168X FEB 91



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3.3 All stainless steel shall conform to the requirements of ASME Specification SA-240 Type 304L.

3.4 Welding electrodes shall meet requirements of AWS D1.1, E70XX, unless noted otherwise.

**4.0 INFORMATION REQUIRED WITH QUOTATION**

4.1 The Fabricator shall state in his quotation that the quotation complies with this technical specification with any exceptions or alternates noted and explained. The Purchaser will assume complete conformance unless exceptions are noted.

4.2 A description of the Fabricator's facility and the equipment required to perform the work covered by this Specification.

4.3 Country of Origin of all materials. This project contains a "Buy American" clause.

**5.0 INFORMATION REQUIRED AFTER RECEIPT OF ORDER AND PRIOR TO FABRICATION FOR REVIEW AND APPROVAL**

5.1 The Fabricator shall supply shop drawings to the Purchaser for review and approval prior to the start of fabrication. Refer to Section 7.2 of this Specification for additional information.

5.2 Welder personnel qualification records. Refer to Section 9.2 of this Specification for additional information.

5.3 Galvanizing procedures, including cleaning methods used prior to galvanizing.

5.4 Packaging and shipping procedures.

**6.0 DOCUMENTATION REQUIRED AFTER COMPLETION OF FABRICATION PRIOR TO SHIPMENT**

6.1 Certificates of Compliance (COC) for all material including weld material.

**7.0 DRAWINGS**

7.1 The Purchaser will furnish design drawings to the Fabricator. These drawings will show the following:

- The principal views of the structures.
- The controlling dimensions.
- The member sizes.
- Special details.



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7.2 The Fabricator shall supply shop drawings to the Purchaser for review and approval prior to the start of fabrication. These shop drawings shall include fabrication details, bills of material, weight lists, field bolt lists, and product data information as required. Review by the Purchaser is to assure the correct interpretation of the work and compatibility with the erection plan, and does not relieve the Fabricator of the responsibility for the accuracy of the detailing. The Fabricator shall assume full responsibility for the correctness of details and dimensions. The cost of rectifying fabricating or detailing errors in the field will be charged to the Fabricator. The Fabricator shall show the weights of all shipping pieces either on the erection drawings or bill of material. Changes in details, splices in members, or substitution of member sizes shall not be made without the authorization of the Purchaser.

8.0 FABRICATION

8.1 All workmanship shall follow standard structural shop practice and shall be in accordance with the AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" and the AISC "Code of Standard Practice of Steel Buildings and Bridges".

9.0 WELDING

9.1 Shop welding, where required, shall conform to the American Welding Society D.1.1, "Structural Welding Code".

9.2 Welder certification and weld procedures shall be as follows:

9.2.1 All welders shall have certification showing their qualification according to AWS Standard D1.1. Welders qualified in accordance with ASME Code Section IX are acceptable. These documents must be submitted to the Purchaser prior to the commencement of any welding.

9.2.2 A copy of certified welding procedures not prequalified by AWS shall be submitted to the Purchaser for review prior to the commencement of any welding. Welding procedures qualified in accordance with ASME Code Section IX are acceptable.

9.2.3 Groove welds, where used, shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates, if used, shall be removed upon completion of the weld and the ends of the weld made smooth and flush with the abutting parts.

9.3 Welds shall be inspected by the Fabricator according to the provisions of AWS D1.1 with respect to technique, equipment and acceptance criteria.



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#### 10.0 GALVANIZING

- 10.1 All galvanizing shall be performed in accordance with the requirements of Appendix B of this Specification.
- 10.2 Unless noted otherwise on the design drawings, all carbon steel plates and tubes, bolts, washers and nuts shall be galvanized. Stainless steel plates, bolts, washers and nuts shall **not** be galvanized.

#### 11.0 PACKAGING FOR SHIPPING

- 11.1 After galvanizing, the support material shall be packaged for shipping. The Fabricator shall submit a packaging and shipping procedure to the Purchaser for review and approval.

#### 12.0 SCHEDULE

- 12.1 Material shall be shipped as specified in the Purchase Order.

#### 13.0 INSPECTION

- 13.1 The Purchaser shall have the right of inspecting the Fabricator's facility and witnessing the fabrication of the supports.
- 13.2 Written notification shall be provided to the Purchaser no less than five working days prior to beginning fabrication.

#### 14.0 NON-ESCORT PRIVILEGES AND INSPECTION RIGHT

The National Science Foundation (NSF) and Caltech, through their authorized representatives, have the right to inspect and evaluate the work performed or being performed under this specification, including the premises where the work is being performed at all reasonable times. The NSF and Caltech shall have non-escort privileges to all areas of the facilities where the work is being performed under this specification. This shall include access to fabrication, assembly, cleaning, and test areas for the purpose of monitoring activities. The vendor shall furnish all reasonable facilities and assistance for the safe and convenient inspection of the work if requested.



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APPENDIX A  
CBI DRAWING LIST

FIXED SUPPORT

- CBI Drawing #006 - "Beam Tube Fixed Support - Elevation"
- CBI Drawing #007 - "Beam Tube Fixed Support - Plan View & Details"
- CBI Drawing #008 - "Beam Tube Fixed Support - Support Lug Assembly & Section Details"

GUIDED SUPPORT

- CBI Drawing #017 - "Beam Tube Guided Support - Elevation"
- CBI Drawing #018 - "Beam Tube Guided Support - Section Details"
- CBI Drawing #019 - "Beam Tube Guided Support - Section Details"



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**APPENDIX B**  
**SPECIFICATION FOR GALVANIZING STRUCTURAL STEEL**

**1.0 SCOPE**

- 1.1 This specification provides the technical requirements for hot dipped galvanizing of fabricated structural steel. The requirements in this specification are designed to minimize the risk of cracking in structural steel, sometimes caused by the galvanizing process, and to insure that an examination is performed to detect any cracking.
- 1.2 The Fabricator shall be responsible for the visual inspection of all material both before and after the galvanizing process.
- 1.3 The Fabricator shall furnish fabricated material free of defects in material and workmanship. Costs incurred by others to correct defects shall be at the Fabricator's expense.

**2.0 PURCHASING OF MATERIALS**

- 2.1 The structural steel material supplied shall be suitable for hot-dip galvanizing without undue risk of cracking.

**3.0 INSTRUCTIONS TO THE FABRICATOR**

- 3.1 When the Fabricator's scope of supply includes materials, the material shall be furnished in accordance with the requirements of Section 2.0 above.
- 3.2 All cuts, copes and blocks shall be fabricated following American Institute of Steel Construction (AISC) recommended practices as set forth in the AISC Manual of Steel Construction, Ninth Edition. Unless noted otherwise on the design drawings, all re-entrant corners shall be shaped, and ground notch-free to a radius of at least  $1/2$  inch.
- 3.3 All attachment welds, flame cut edges, and re-entrant corners of cutouts, copes and blocks shall be visually inspected for cracks before galvanizing, and prior to shipment after galvanizing.
- 3.4 If any cracks are found after galvanizing, all members with similar details shall be inspected. Defective members and welds shall be rejected or repaired at the Purchaser's discretion. Repair procedures must be submitted to the Purchaser for review and approval before any repairs are permitted.



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#### 4.0 INSTRUCTIONS TO THE GALVANIZER

- 4.1 Galvanizing shall be performed after completion of all cutting, drilling, forming, punching and welding operations.
- 4.2 Galvanizing shall be performed in accordance with the latest editions of ASTM A123, A143, A384 and A385.
- 4.3 The Galvanizer shall have a written procedure for hot dip galvanizing. This procedure shall be submitted to the Purchaser for review and approval prior to galvanizing.

#### 5.0 SURFACE PREPARATION OF STEEL TO BE GALVANIZED

- 5.1 All material to be galvanized shall be chemically cleaned to ensure a proper galvanizing bond. Abrasive blasting shall be employed in the following situations:
  - Mill or heat scale deeply embedded in the surface of the steel.
  - Welding slag is present.
  - Severe cold working of the steel has occurred.

Cleaning procedures shall be submitted to the Purchaser for review and approval prior to galvanizing.

#### 6.0 QUALITY CONTROL & INSPECTION

- 6.1 It shall be the responsibility of the Galvanizer to supply a finished product, ready for shipment, that is free of bare spots, stalactites, and inclusions of flux or ash. Inspection shall be completed at the Galvanizer's facility. The Purchaser reserves the right to reject any or all galvanized items for imperfections, distortion, or warpage.
- 6.2 Touch-up of minor coating defects shall be allowed in the Galvanizer's facility according to the methods covered in ASTM A780, "Standard Practice for Repair of Damaged Hot-Dip Galvanized Coatings".
- 6.3 The Purchaser shall have the right to inspect the Galvanizer's facility and witness all galvanizing procedures, inspections and repair procedures.