	ERNEST ORLANDO LAWRENCE BERKELEY NATIONAL LABORATORY		BaBar Detector
	SPECIFICATION NOTE		
	Mechanical Engineering Department		
WBS#: 1.3.1.1	LBNL Serial #: M871	DIRC Note #: 73	Page 1 of 11
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First Line: BaBar Detector
Second Line: DIRC PID
Title: Support Structure Technical Specification

MAS

TABLE OF CONTENTS

1.0 GENERAL INFORMATION

This specification, together with the referenced drawings and documents (see Section 2) states the requirements for the materials procurement, fabrication, assembly, inspection, and shipping of the DIRC Support Structure. The structure has been designed by the Berkeley Lab and will be installed at the Stanford Linear Accelerator Center (SLAC) as part of a high energy physics apparatus known as the BaBar Detector.

The DIRC Support Structure weighs approximately 30 tons and is comprised of 8 components made of carbon steel, stainless steel, and aluminum. When mated to a structure to be constructed at the Berkeley Lab called the Central Support Tube (CST), the assembly forms a 5 meter long cylinder. This cylinder has 12 azimuthal, rectangular slots running from one end to the other into which 12 assemblies called barboxes will be inserted. Each barbox contains quartz bars which extend the entire 5 meter length of the barbox. In order to assure that the barboxes will fit into the rectangular slots in the support structure and the CST without obstruction, the 12 slots must be accurately aligned between components. This alignment is a crucial requirement of the support structure and is discussed in further detail in section 6.1 of this specification. Critical overall dimensions of the complete assembly have been specified in order to ensure that the support structure can be installed and aligned within the BaBar Detector.

Figures 1 and 2 show schematically the DIRC Particle Identification System and the BaBar detector.

Components	Approximate Weight	Material
1. Transition Flange (TF)	600 lb.	Aluminum
2. Strong Support Tube Assembly (SST)	17000 lb.	Carbon Steel
3. Coil Mounting Ring (CMR)	2100 lb.	Stainless Steel
4. Horse Collar (HC)	19000 lb.	Carbon Steel
5. Assembly Flange (AF)	1500 lb.	Stainless Steel
6. Upper Gusset Weldment	5700 lb.	Carbon Steel
7. Lower Gusset Weldment	7800 lb.	Carbon Steel
8. Upper Horizontal Gusset	7100 lb.	Carbon Steel

Figure 1: DIRC Particle Identification System

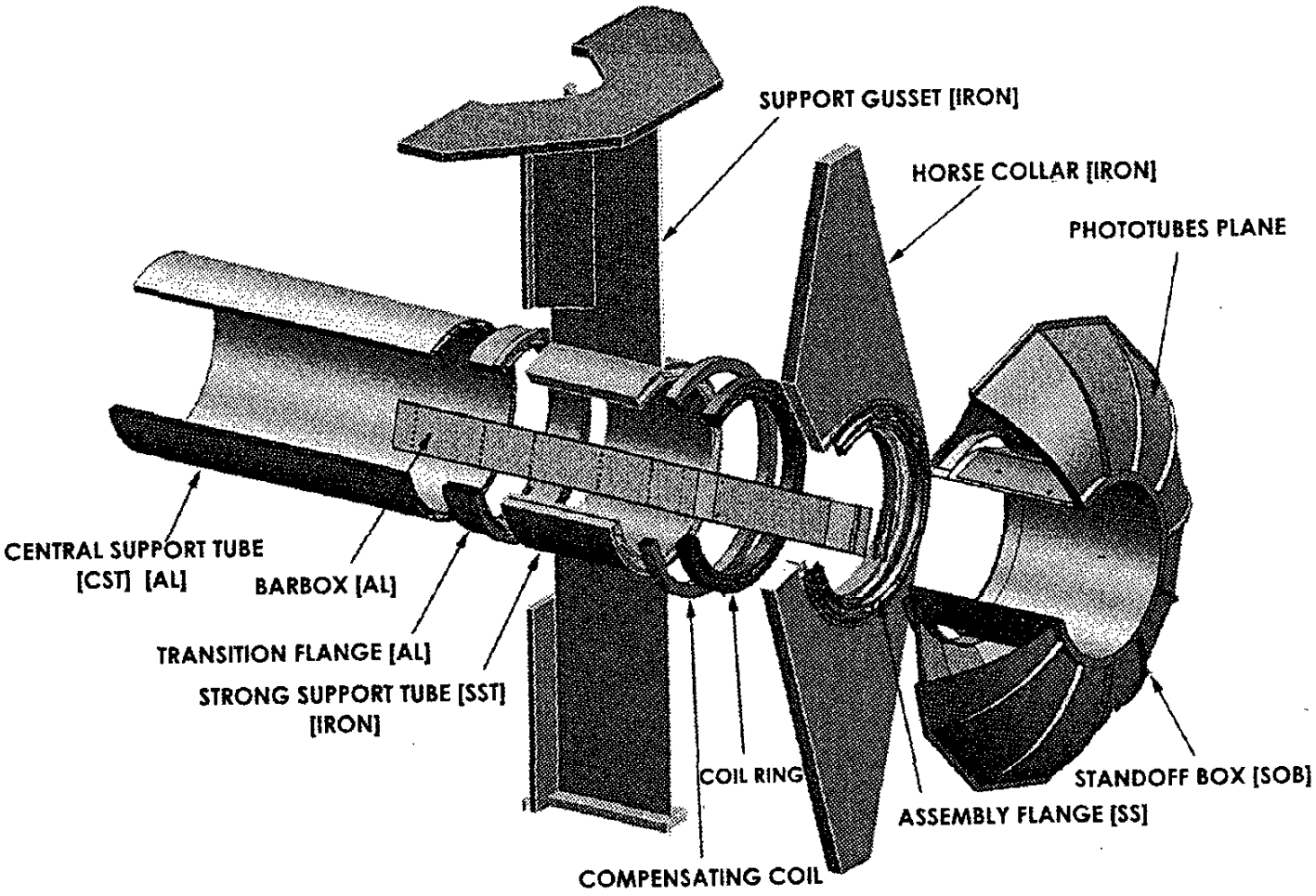
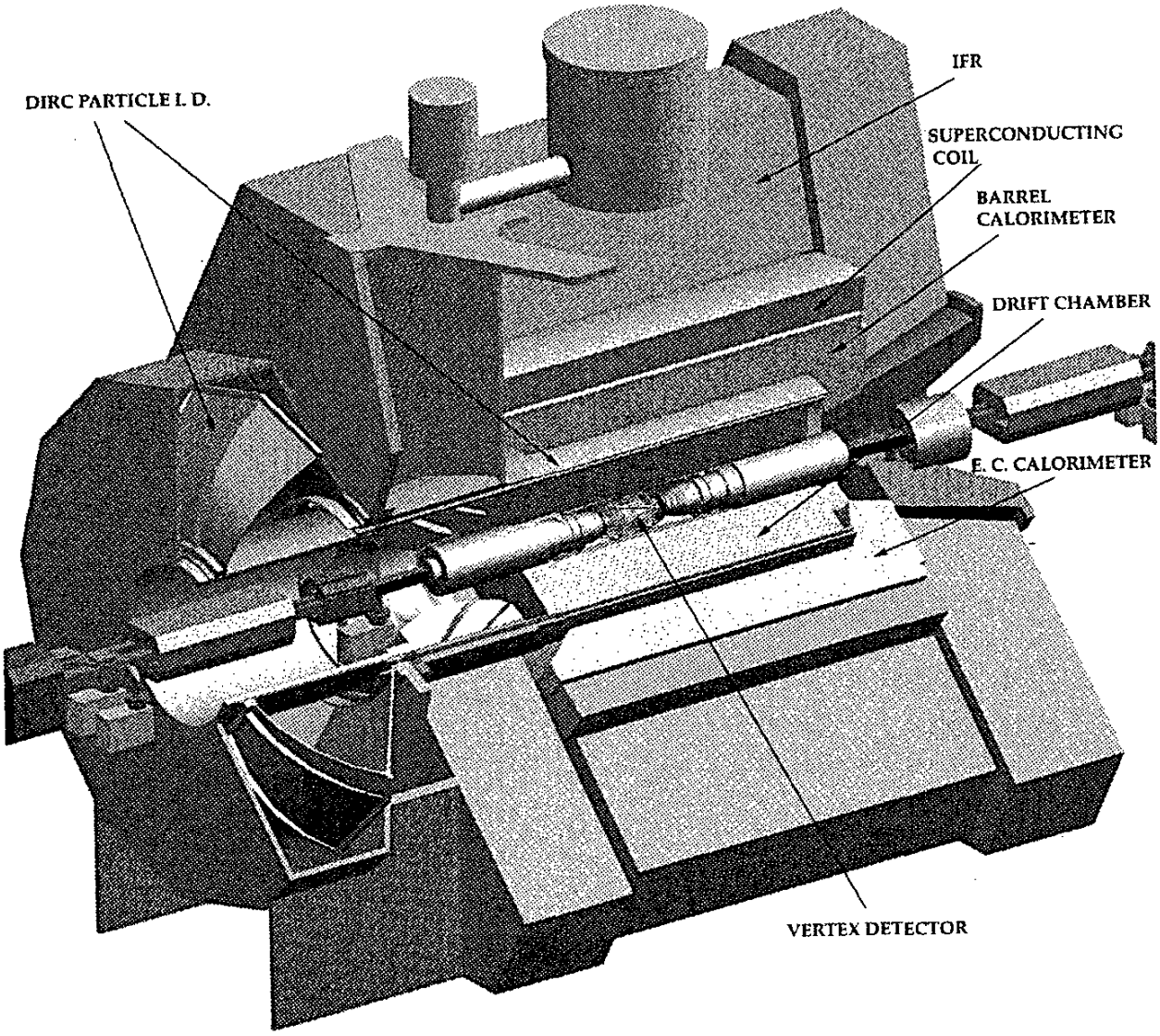


Figure 2: BaBar Detector



2.0 APPLICABLE DOCUMENTS

The following documents and documents referenced therein form a part of this specification to the extent specified herein. In the event of a conflict between the referenced documents and the contents of this specification the Subcontractor shall immediately notify the Berkeley Lab for clarification before completing the proposal or proceeding with work on the affected part.

2.1 Drawing Package

The attached drawing package contains the following:

Part Name	Berkeley Lab Drawing Number
CST Transition Flange	22L7236
SST - Inner Cylinder	22L7246
SST - Outer Cylinder Segment	22L7274
SST - Plug Stop	22L7283
SST - Cylinder Assembly	22L7296
Coil Mounting Ring	22L7316
Horse Collar	22L7326
Assembly Flange	22L7336
Lower Gusset Weldment	22L7346
Upper Gusset Weldment	22L7356
Upper Horizontal Gusset	22L7366
SST - Gusset Bracket	22L7434
SST - Outer Cylinder Segment (Special)	22L7444
Support Structure Assembly	22L7456
Support Structure Bolting	22L7466
Support Structure Alignment Requirements	22L7476
Support Structure Alignment Gauge	22L7484

All references to Berkeley Lab design drawings in this specification refer to the latest revision of each of the drawings. The Subcontractor shall be responsible for using the latest revision of the drawings in the package. All accompanying drawings are in millimeters. For convenience, electronic files (CAD files) can be supplied by the Berkeley Lab in either DXF or IGES format, but it is particularly emphasized that the supplied (paper) design drawings are the final authority as to all feature size, tolerance and locations. The Berkeley Lab is not responsible for the contents or use of the electronic files.

2.2 Nationally Recognized Codes and Standards

The support structure shall be fabricated and inspected in accordance with the applicable sections of the current issue of the codes and standards common to the industry including those listed herein. The current issue of a code or standard is the latest revision of that document on the date of issue of the subcontract. If other comparable codes and standards are to be used in lieu of any of those listed, the Subcontractor must first obtain written approval from the Berkeley Lab.

American Institute of Steel Construction (AISC) Manual of Steel Construction, 9th edition, Part 5, Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design, and Specification for Structural Joints Using ASTM A325 or A490 Bolts

Aerospace Material Specification (AMS) 2404C, Electroless Nickel Plating

American National Standards Institute, ANSI Y14.5, Dimensioning and Tolerancing

ANSI Z49.1 Safety in Welding and Cutting

American Society for Testing and Materials (ASTM) ASTM A-6 General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use

ASTM A-36 Specification for Structural Steel

American Welding Society, AWS D1.1 Structural Welding Code - Steel

AWS D2.4 Symbols for Welding, Brazing and Non-Destructive Testing

International Organization for Standardization (ISO) 898/1-1988, Mechanical Properties for property classes 3.6 to 12.9 for screws bolts and studs

MIL-C-26074E, Electroless Nickel Requirements for Military Specification Coatings

3.0 POST AWARD CONFERENCE

A post award conference will be held to review the design drawing package, address seller and the Berkeley Lab concerns, and coordinate in-process inspections by the Berkeley Lab or its designate with the Subcontractor's fabrication schedule. The location date and time of this meeting shall be acceptable to both the Berkeley Lab and the Subcontractor.

Specific Discussion Items at the Conference:

1) The Berkeley Lab will provide at the time of the conference a document specifying a top-coat paint and the color scheme for all external surfaces, see sections 4.2 and 5.2.

2) The Subcontractor shall prepare a detailed description of the process proposed to accomplish alignment between parts, see section 5.1, which the Berkeley Lab will review.

3) The installation of the compensating coil onto the Coil Mounting Ring, the Berkeley Lab Drawing Number 22L7316, and the integration of this assembly into the Subcontractor's manufacturing schedule will be discussed, see section 6.3.

4) Inspection milestones, details for inspection reporting, and coordination of inspection visits by the Berkeley Lab or its representative with the Subcontractor's fabrication schedule will be discussed and finalized, see section 7.0.

5) The fabrication and inspection of the CST Transition Flange template, to be used during final inspection of the entire assembly, see section 6.0, will be discussed and finalized.

4.0 MATERIAL AND PART PROCUREMENT REQUIREMENTS

In general, all materials are specified on the referenced design drawings. Certification of all materials and fasteners from suppliers are to be provided.

4.1 Fasteners

Unless otherwise specified, all fasteners are metric and of the property class 8.8 (Ref. ISO 898/1-1988). All fasteners shall be zinc plated or otherwise protected against corrosion. All washers shall conform to the dimensional and material specifications of the TP 200 Special Flat Washer, except as noted on the drawings These steel washers have a Brinell hardness of 200 which qualifies them for use in high strength joints in conjunction with bolts and studs of the 8.8 property class. All dowel pins shall have a minimum yield strength of 95 kpsi. The subcontractor shall provide certified material test results for all bolts, studs, and shear pins used in the support structure.

4.2 Primer and Paint

All exposed carbon steel surfaces, with the exception of those surfaces which have been nickel plated, shall be primed with IC 531 (Inorganic Coatings, Inc., 500 Lapp Road, Malvern, PA., 19355, TEL: 610-640-2880), a high ratio zinc silicate. This coating provides long term corrosion protection and is qualified as a Class B coating (slip coefficient greater than or equal to 0.50) in accordance with Appendix A of the AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts.

A top-coat of colored paint shall be applied over the zinc primer on exterior surfaces of the completed assembly. At the post award conference Berkeley Lab will specify this top-coat paint, see section 3.0.

4.3 Steel Forging for SST Inner Cylinder

The 1020/1030 steel forging specified for the SST Inner Cylinder, the Berkeley Lab Drawing Number 22L7246, **shall have a minimum yield strength of 35 kpsi.**

4.4 Aluminum Forging for the CST Transition Flange

The CST Transition Flange, the Berkeley Lab Drawing Number 22L7236, shall be manufactured from a 6061-T651 aluminum forging. If the subcontractor exercises the option to use the forging supplied by the Berkeley Lab, material properties shall be certified by the forging house providing the material. However, the Subcontractor shall assume ultimate responsibility for the material.

5.0 FABRICATION REQUIREMENTS

The Subcontractor shall fabricate the support structure in accordance with the Berkeley Lab design drawings listed in section 2.1, the specifications cited in section 2.2, and this document.

5.1 Electroless Nickel Plating

All components in the SST Cylinder Assembly, the Berkeley Lab Drawing Number 22L7296, with the exception of the SST Gusset Bracket, the Berkeley Lab Drawing Number, 22L7434, shall be plated with electroless nickel according to Aerospace Material Specification (AMS) 2404C. A Class 1 (as plated, no subsequent heat treatment), Grade A (0.0010 inch minimum thickness) coating shall be applied, as described in MIL-C-26074E, to

exterior surfaces of parts. Threaded holes and dowel holes shall not be plated. Plated parts shall be manufactured so as to meet design drawing dimensions and tolerances after the plating process.

5.2 Priming and Painting of Carbon Steel Parts

The Subcontractor is responsible for surface preparation, priming, and painting of all carbon steel parts, except those parts receiving electroless nickel plating. Surfaces shall be prepared for priming by abrasive blasting to a minimum SSPC SP-10 (SA2 1/2) Near-White Blast. IC 531 Primer shall be applied to all surfaces. This primer shall be applied with a 1 mil dry film thickness (DFM) in accordance with the manufactures recommendations. A colored top-coat, see section 4.2, will be applied over the primer only on those surfaces which are visible on the finished assembly and which are not mating with other parts. the Berkeley Lab will provide a document specifying the color scheme for all external surfaces at the post award conference.

5.3 Cleanliness, Identification and Weight of Parts

Cutting fluids, metal chips, dye penetrant materials, and all other extraneous material shall be removed from all parts as the support structure is fabricated and assembled.

All parts shall be marked by die stamp or some other Berkeley Lab approved method with the drawing number and weight in at least 12 millimeter high characters. Additionally, the weight of each weldment and component shall be painted on the part in 100 mm high characters in at least two locations that would be obvious to a person rigging that component into place. The weights shall be given in pounds.

5.4 Welding, Weld Inspection, and Weld Repair

The Subcontractor must insure that distortion of welded parts is minimized in order to assure proper alignment and fit at assembly.

The Subcontractor shall insure that weld filler metal and flux are procured, stored, and used in accordance with applicable requirements of AWS D 1.1.

All welding, including temporary welds, shall be done in accordance with applicable requirements of AWS D 1.1. All welders and weld operators shall be qualified and documented in accordance with applicable requirements of AWS D 1.1.

All welds shall be inspected in accordance with applicable requirements of AWS D 1.1. Weld inspectors shall be qualified in accordance with applicable requirements of AWS QC1.

All welds areas containing defects exceeding the standards of acceptance in AWS D 1.1 shall be repaired in accordance with applicable requirements of AWS D 1.1.

5.5 Part Repair

Repairs to any part of the support structure assembly during the fabrication or assembly process must not include welding, soldering, or brazing of any sort. If repairs need to be effected, approval by the Berkeley Lab will be required, subsequent to submission by the Subcontractor of a written description of the problem and the location, the repair to be done, and the proposed methodology to be used.

5.6 Notification

In the event that the Subcontractor detects a mistake in the drawing, machining or fabrication of the parts listed herein, the Subcontractor shall notify Berkeley Lab within 24 hours. Berkeley Lab will have 72 hours to

respond to such notification without incurring any costs due to idle equipment, manpower, or temporary storage space.

6.0 ASSEMBLY REQUIREMENTS

The Subcontractor shall fully assemble the support structure as shown in the referenced design drawings and as described in this document at the Subcontractor's plant, with the exception of the CST Transition Flange, the Berkeley Lab Drawing Number 22L7236. The CST Transition Flange, 22L7236, will be shipped to the Berkeley Lab before the Support Structure Assembly, 22L7456, is complete. The Subcontractor shall fabricate a template along with the CST Transition Flange to be used in place of the CST Transition Flange during the final assembly alignment test.

6.1 Alignment Requirements

In addition to the feature inspections described in section 7.0 through 7.3, the Berkeley Lab drawings numbers 22L7296 and 22L7476 show how the parts are to be aligned. Drawing 22L7296 shows how the 4 grooves in each of the 12 rectangular slots are to be aligned with respect to each other. As indicated on the drawing, the Subcontractor should choose process and feature tolerances in order to guarantee that the grooves are aligned properly after the SST Outer Cylinder Segments are pinned to the SST Inner Cylinder. The alignment of the grooves will be inspected using either a gauge tool or CMM.

The critical features to be aligned in drawing 22L7476 are the 12 large rectangular slots that go through the assembly. The parts and subassemblies containing these slots must be aligned such that Support Structure Alignment Gauge (SSAG), the Berkeley Lab Drawing Number 22L7484, will pass freely through each of the 12 slots after final assembly. This test will be the criteria by which the Berkeley Lab will accept or reject the alignment of the 12 rectangular slots in the final assembly. The SSAG will additionally verify that the alignment of the small grooves within each slot has been achieved as described above. The SSAG profile will be nominally 0.75 mm smaller all around than the slot opening in the SST - Cylinder Assembly. In the area of the 4 grooves, there will be less clearance between the SSAG and the grooves. The final alignment inspection will take place after all assembly work is completed. During final assembly, the Horse Collar, the Berkeley Lab Drawing Number 22L7326, may be horizontal so that the 12 rectangular slots are oriented vertically. This may simplify assembly work as well as eliminate the need to counter balance the SSAG to keep it horizontal. The Subcontractor shall not disassemble the support structure following final inspection at the manufacturing facility, with the exception of those items discussed in section 8.0.

To aid in alignment of the 12 rectangular slot features between parts, dowel holes have been specified in the mating surfaces of the slotted parts. These dowel holes locate datum -C- in the drawings for the Assembly Flange, Horse Collar, Coil Mounting Ring, SST - Cylinder Assembly, SST - Inner Cylinder, and CST Transition Flange. During the alignment procedure, the CST Transition Flange template will be used in place of the CST Transition Flange as described in section 6.0. The slot features are located accurately with respect to these alignment dowel holes. At final assembly, when parts are aligned using dowel pins in these holes, the required slot alignment between the parts should be achieved such that the SSAG Gauge will pass freely through the slots.

The Berkeley Lab does not guarantee that use of the specified dowel holes will enable the final assembly to successfully pass the alignment test described in the above paragraph. The Subcontractor should study the drawing of the SSAG in order to assure that the chosen method of fabrication and alignment will enable the final assembly to meet this alignment test.

6.2 Lifting and Handling

The Subcontractor is responsible for providing temporary bracing and lifting fixtures which may be required to safely lift and handle parts and assemblies. The complete assembly weighs approximately 60,000 pounds. Specific tapped holes have been provided in the large components for lifting and handling parts and assemblies. These holes should be used with a swivel type safety hoist ring rated for the weight of the part or assembly being rigged. Additional holes may be added for rigging purposes with the Berkeley Lab approval. The final assembly may need to be rotated between the vertical and horizontal orientations which may require an auxiliary crane. The final Support Structure Assembly will be shipped with the Horse Collar oriented horizontally. The Subcontractor

6.3 Mounting of Compensating Coil to Coil Mounting Ring

An electromagnetic coil will be mounted on the outside diameter of the Coil Mounting Ring, the Berkeley Lab Drawing Number 22L7316, before this component is installed in the final Support Structure Assembly, the Berkeley Lab Drawing Number 22L7456. The Berkeley Lab shall provide the compensating coil to the Subcontractor no less than one week before it is required for assembly. The installation of this coil onto the Coil Mounting Ring and the integration of this activity into the Subcontractor's manufacturing schedule will be discussed at the post award conference.

The coil will be secured to the Coil Mount Ring using tapped holes to be specified at a later date on the Coil Mount Ring drawing. No other interface or connection to other parts of the Support Structure Assembly is required. The actual mounting of the coil will be completed at the Subcontractor's plant by technicians from SLAC. Preparation and mounting shall take no more than 3 days. The coil should be mounted after all preparatory assembly work such as drilling, reaming, and cleaning is completed. After installation, the Berkeley Lab will provide a protective cover for the coil. The Subcontractor must take precautions not to damage the coil during subsequent assembly work. The subcontractor will be responsible for all material supplied by the Berkeley Lab in accordance with the Addendum to the Terms and Conditions, Article XXIII-Property, attached to the Subcontract.

6.4 Fastener Installation

All bolts and studs shall be installed and tightened according to section 8, Installation and Tightening, of the AISC Manual of Steel Construction, 9th edition, Part 5, Specification for Structural Steel Joints Using ASTM A325 or A490 Bolts. Although metric property class 8.8 bolts have been specified, rather than A325 bolts, in general the Calibrated Wrench Tightening procedures described in the aforementioned AISC document shall be followed.

Pretension values for all bolts and studs are specified on the Berkeley Lab Drawing Number 22L7466. These values ensure pretension to approximately 70 percent of yield strength of property class 8.8 metric coarse thread bolts. The Subcontractor is responsible for determining appropriate torque values to achieve the specified bolt pretensions. The Subcontractor shall supply an inspection report verifying all bolt torques.

7.0 INSPECTION REQUIREMENTS

The Subcontractor shall inspect all parts using coordinate measuring equipment of sufficient accuracy to verify dimensions and tolerances shown on the Berkeley Lab design drawings. All dimensions and tolerances shown apply at a reference temperature of 20° C. (68°F). The Subcontractor shall perform the required inspections and shall supply the Berkeley Lab with written reports of these inspections as soon as is practical after the inspections are made. The Berkeley Lab shall have the option to perform inspections upon the parts and assemblies to validate certain dimensions with inspectors under separate contract to the Berkeley Lab or by the Berkeley Lab inspectors. This may involve inspection while parts are still located on certain fabricating equipment, at which point

the seller's fabrication progress could be delayed during inspection by the Berkeley Lab. Inspection milestones, details for inspection reporting, and coordination of inspection visits by the Berkeley Lab or its representatives with the Subcontractor's fabrication schedule will be discussed and finalized at the post award conference.

7.1 Part Level Inspection

Unless otherwise specified, parts and assemblies will be measured in the free state in the orientation best suited for the Subcontractor to accomplish inspection. With the exception mentioned in section 7.2, the Berkeley Lab will not require inspection reports for dowel and tapped holes. The Subcontractor is responsible for pinning and bolting required on assembly drawings 22L7296 and 22L7466. It is the Subcontractors responsibility to ensure that these features are correctly located and sized in each part to enable proper assembly of mating parts without excessive clearance or interference between bolts or pins. Inspection reports on all other features on each part are required. Of particular importance will be the profile on each of the 12 slots in the SST - Inner Cylinder, the Berkeley Lab Drawing Number 22L7246. The septum between slots is a highly stressed region and its thickness must be verified.

7.2 Special Inspection Requirements for Assembly Flange

The Assembly Flange, the Berkeley Lab Drawing Number 22L7336, has unique inspection requirements because it contains many features which mate to parts not included in the support structure contract. The flatness of the Assembly Flange can be inspected with the part in a constrained condition as specified on the part drawing. The Subcontractor must submit inspection reports for all features, including tapped and dowel holes.

7.3 Assembly Level inspection

Both the SST - Cylinder Assembly, the Berkeley Lab Drawing Number 22L7296, and the Support Structure Assembly, the Berkeley Lab Drawing Number 22L7456, will require inspection. Only the dimensions shown on these drawings will be inspected on these two assemblies. Alignment of the slot and track features in these assemblies will be checked following the procedure in section 6.1.

8.0 SHIPPING REQUIREMENTS

The Subcontractor shall be responsible for preparing and packing all components to prevent damage or deterioration of components during shipping. All shipping fixtures, packaging material, and crating will be furnished by the Subcontractor. Shipping fixtures, packaging and crating provided by the Subcontractor is to be such that all finish and tolerance requirements as noted on the drawings apply upon receipt of the CST Transition Flange at the Berkeley Lab and upon receipt of all other components at SLAC. The assembly will be inspected at SLAC and any damage incurred during shipping shall be the responsibility of the Subcontractor.

The support structure shall be shipped completely assembled as shown in the Support Structure Assembly, the Berkeley Lab Drawing Number 22L7456, with the exception of the CST Transition Flange, the Berkeley Lab Drawing Number 22L7236. At the Subcontractor's discretion, the Berkeley Lab will permit the structure to be shipped without the Upper Horizontal Gusset, the Berkeley Lab Drawing Number 22L7366, bolted in place.