



LIGO LABORATORY
California Institute of Technology
1200 E. California Blvd.
Pasadena, CA 91125

Statement of Work

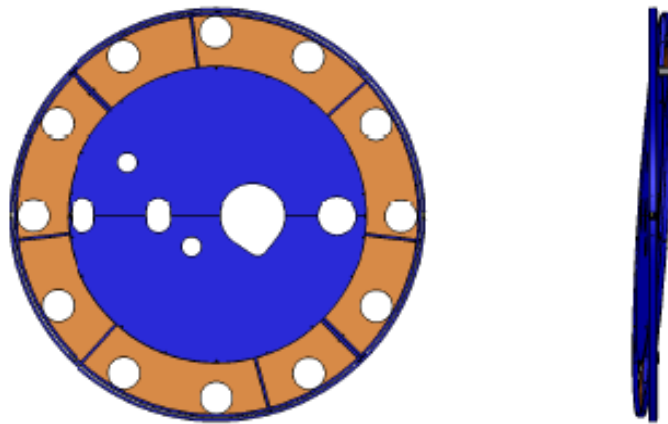
AO-120 Mode Cleaner Tube Baffle

C1101260-v1

1.0 Scope

This Statement of Work (SOW) is for the fabrication of the Mode Cleaner Tube Baffle machined parts. The parts will be assembled and a baffle will be installed at each end of a Mode Cleaner Tube. The rings will form a compression fit against the interior of the tube. The baffle will be fastened to the rings at four locations. The primary baffle piece parts are large; they are semi-circles of 3.5 feet diameter. A completely assembled baffle will fill an 8' by 8' area.

The Mode Cleaner Tube baffle will reside inside vacuum. Materials, fabrication processing and cleanliness must adhere to the requirements specified within the LIGO control documents.



2.0 Document Access

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#.

3.0 Commercial Terms and Applicable LIGO Specifications:

Note: 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-v1](#) LIGO Commercial Items or Services Contract General Provisions
- [LIGO-Q0900001-v5](#) Advanced LIGO Supplier Quality Requirements
- [LIGO-Q1100003-v1](#) Acceptable Quality Level (AQL) for Inspection of LIGO Components
- [LIGO-E0900364-v8](#) Metal Components for use in the Advanced LIGO Vacuum System
- [LIGO-E1000083-v5](#) Specification for Enameled Steel to be used in the LIGO Ultra-High Vacuum System

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.

5.0 Parts/Assemblies to be manufactured and Quantities required:

Note: refer to Section 8.0 for delivery schedule and location

ITEM No.	PART NUMBER	REV	DESCRIPTION	First Article QTY	Production QTY	Total QTY
1	D1000776	v1	ALIGO MODE CLEANER TUBE BAFFLE RING, BOTTOM	4	8	12
2	D1000777	v1	ALIGO MODE CLEANER TUBE BAFFLE RING, TOP	4	8	12
3	D1000778	v1	ALIGO MODE CLEANER TUBE BAFFLE,TURN BUCKLE SCREW	10	20	30
4	D1000779	v1	MOUNT BRACKET_BOTTOM	4	8	12
5	D1000780	v1	MOUNT BRACKET_TOP	4	8	12
6	D1000783	v1	ALIGO MODE CLEANER TUBE BAFFLE, STANDOFF SPACER, RIGHT	4	8	12
7	D1000784	v1	ALIGO MODE CLEANER TUBE BAFFLE, STANDOFF SPACER, LEFT	4	8	12
8	D1001926	v1	TUBE BAFFLE RIGHT BRACE	4	8	12
9	D1002867	v1	TUBE BAFFLE LEFT BRACE	4	8	12
10	D1002868	v1	TUBE BAFFLE INNER RIGHT BRACE	4	8	12
11	D1002869	v1	TUBE BAFFLE INNER LEFT BRACE	4	8	12
12	D1002871	v1	TUBE BAFFLE SPOKE	42	84	126
13	D1002995	v1	APERTURE PLATE_1500MM	2	4	6
14	D1002996	v1	APERTURE SUPPORT	6	12	18
15	D1002997	v1	APERTURE BRACE	6	12	18
16	D1002998	v1	APERTURE SIDE BRACE	12	24	36
17	D1003059	v1	APERTURE CLIP	4	8	12
18	D1003109	v1	APERTURE PLATE_75MM	2	4	6
19	D1003110	v1	APERTURE PLATE_200MM	2	4	6
20	D1003118-00	v1	TUBE BAFFLE PLATE_UPPER - MCA	2	4	6
21	D1003118-01	v1	TUBE BAFFLE PLATE_UPPER - MCB1	1	1	2
22	D1003118-02	v1	TUBE BAFFLE PLATE_UPPER - MCB2	1	1	2
23	D1003118-03	v1	TUBE BAFFLE PLATE_UPPER - MCB3	0	1	1
24	D1003118-04	v1	TUBE BAFFLE PLATE_UPPER - MCB4	0	1	1
25	D1003119-00	v1	TUBE BAFFLE PLATE_LOWER - MCA	2	4	6
26	D1003119-01	v1	TUBE BAFFLE PLATE_LOWER - MCB1	1	1	2
27	D1003119-02	v1	TUBE BAFFLE PLATE_LOWER - MCB2	1	1	2
28	D1003119-03	v1	TUBE BAFFLE PLATE_LOWER - MCB3	0	1	1

ITEM No.	PART NUMBER	REV	DESCRIPTION	First Article QTY	Production QTY	Total QTY
29	D1003119-04	v1	TUBE BAFFLE PLATE_LOWER - MCB4	0	1	1
30	D1100468	v1	UPPER APERTURE PLATE, MCA1	1	1	2
31	D1100469	v1	LOWER APERTURE PLATE, MCA1	1	1	2
32	D1100512	v1	UPPER APERTURE PLATE, MCA3	0	1	1
33	D1100513	v1	LOWER APERTURE PLATE, MCA3	0	1	1
34	D1100987	v1	MODE CLEANER TUBE BAFFLE, AL APERTURE CLIP	4	8	12

Note: **AQL = 1.0**, refer to LIGO-Q1100003-v1 for the AQL table, see link in Section 3.0.

6.0 Manufacturing:

6.1 Requirements:

- Suppliers must refer to the LIGO Specifications referenced in Section 3 for additional, and in some cases, non-industry standard, requirements.
- All material must be of domestic origin. Exclusions must be obtained in writing from LIGO before manufacturing.
- The raw material used for items to be electro-polished must be free of nicks, dings and smeared metal from the rolling/extrusion process.

6.2 Sub-Contracted Work:

- LIGO expects that at least 2/3 (by dollar value) of the contracted work be performed by the Supplier named on the Purchase Order. The Supplier shall be responsible for all sub-contracted work.

6.3 Precedence:

The drawings typically represent the finished part as needed for use in service. There may be requirements on the drawing (such as coatings) 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 and/or uncertainties in the documentation or instructions.

6.4 Special Instructions:

- Acceptance Test: One set of First Article Assemblies will be assembled by LIGO personnel at the vendor site for fit check prior to approval of fabrication of remaining order. Assembly instructions and fasteners will be supplied by LIGO.
- Upon acceptance, all parts fabricated from 18 GA Enamel Steel A424 Type I will be satisfactorily packaged and shipped to vendor specified by LIGO for porcelain coating, see Section 8.2. Porcelain coat processing will be the responsibility of LIGO.
- Inspect using AQL Level 1.0.
- Some parts will require electro-polish processing, as specified in drawing. Processing is the responsibility of the awarded vendor. LIGO recommends Cal Tech Plating of San

Fernando, CA or another LIGO approved supplier. These parts must be handled with clean gloves after electro-polish process.

- All parts will be shipped as specified in Section 8.0. Shipping containers will be supplied by the awarded vendor and constructed for multiple use.
- ALIGO will supply material required to fabricate parts made of *18 GA Enamel Steel A424 Type I*.

Return unused materials to:
LIGO Laboratory
California Institute of Technology
Attn: Michael Smith
MS 100-36
391 S. Holliston Ave.
Pasadena, CA 91125

6.5 Exclusions:

- Supplier is NOT responsible for the application of Porcelain Coating.
- Parts made of *18 GA Enamel Steel A424 Type I* do not need all surfaces machined to remove oxides.

7.0 End Item Data Package:

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

- Any as-built modifications (with approval of the LIGO Contracting Officer) as mark-ups to the drawings
- Material certifications
- Electro-polish certifications, if applicable
- Pickle/Passivation certifications, if applicable
- Inspection reports of all dimensional features for the number of parts specified per the AQL number and referenced in the AQL table LIGO-Q1100003-v1, see link in Section 3.0, and any other inspection requirements detailed in Section 5 of this SOW
- Certificate of compliance for each part number stating conformance to contract and drawing requirements

8.0 Delivery Requirements:

8.1 Shipping Containers and Packaging:

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.

8.2 Shipping Destination(s):

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

- All parts are to be shipped to these locations in the quantities listed in Section 5 above.
- All parts designated for porcelain coating (listed below) are to be shipped to the LIGO selected vendor:

West Coast Porcelain Industries, Inc.
 Attn: Liam O'Byrne, General Manager
 133 N. Sherman Avenue
 Corona, CA 92882
liam@hkfinc.com
 Tel: 951-278-8680

PART NUMBER	REV	DESCRIPTION	First Article QTY	Production QTY	Total QTY
D1002995	v1	APERTURE PLATE_1500MM	2	4	6
D1002996	v1	APERTURE SUPPORT	6	12	18
D1002997	v1	APERTURE BRACE	6	12	18
D1002998	v1	APERTURE SIDE BRACE	12	24	36
D1003059	v1	APERTURE CLIP	4	8	12
D1003109	v1	APERTURE PLATE_75MM	2	4	6
D1003110	v1	APERTURE PLATE_200MM	2	4	6
D1003118-00	v1	TUBE BAFFLE PLATE_UPPER - MCA	2	4	6
D1003118-01	v1	TUBE BAFFLE PLATE_UPPER - MCB1	1	1	2
D1003118-02	v1	TUBE BAFFLE PLATE_UPPER - MCB2	1	1	2
D1003118-03	v1	TUBE BAFFLE PLATE_UPPER - MCB3	0	1	1
D1003118-04	v1	TUBE BAFFLE PLATE_UPPER - MCB4	0	1	1
D1003119-00	v1	TUBE BAFFLE PLATE_LOWER - MCA	2	4	6
D1003119-01	v1	TUBE BAFFLE PLATE_LOWER - MCB1	1	1	2
D1003119-02	v1	TUBE BAFFLE PLATE_LOWER - MCB2	1	1	2
D1003119-03	v1	TUBE BAFFLE PLATE_LOWER - MCB3	0	1	1
D1003119-04	v1	TUBE BAFFLE PLATE_LOWER - MCB4	0	1	1

- All parts not designated for porcelain coating (listed below) and are of the First Article grouping are to be shipped to the LIGO Observatory in Livingston, Louisiana:

LIGO Livingston Observatory (LLO)

Attn: Chris Guido
 19100 LIGO Lane
 Livingston, LA 70754

PART NUMBER	REV	DESCRIPTION	First Article QTY
D1000776	v1	ALIGO MODE CLEANER TUBE BAFFLE RING, BOTTOM	4
D1000777	v1	ALIGO MODE CLEANER TUBE BAFFLE RING, TOP	4
D1000778	v1	ALIGO MODE CLEANER TUBE BAFFLE,TURN BUCKLE SCREW	10
D1000779	v1	MOUNT BRACKET_BOTTOM	4
D1000780	v1	MOUNT BRACKET_TOP	4
D1000783	v1	ALIGO MODE CLEANER TUBE BAFFLE, STANDOFF SPACER, RIGHT	4
D1000784	v1	ALIGO MODE CLEANER TUBE BAFFLE, STANDOFF SPACER, LEFT	4
D1001926	v1	TUBE BAFFLE RIGHT BRACE	4
D1002867	v1	TUBE BAFFLE LEFT BRACE	4
D1002868	v1	TUBE BAFFLE INNER RIGHT BRACE	4
D1002869	v1	TUBE BAFFLE INNER LEFT BRACE	4
D1002871	v1	TUBE BAFFLE SPOKE	42
D1100468	v1	UPPER APERTURE PLATE, MCA1	1
D1100469	v1	LOWER APERTURE PLATE, MCA1	1
D1100987	v1	MODE CLEANER TUBE BAFFLE, AL APERTURE CLIP	4

- All parts not designated for porcelain coating (listed below) and are of the Production grouping are to be shipped to the LIGO Observatory in Hanford, Washington:

LIGO Hanford Observatory (LHO)

Attn: Gerardo Moreno
 127124 North Route 10
 Richland, WA 9935

PART NUMBER	REV	DESCRIPTION	Production QTY
D1000776	v1	ALIGO MODE CLEANER TUBE BAFFLE RING, BOTTOM	8
D1000777	v1	ALIGO MODE CLEANER TUBE BAFFLE RING, TOP	8
D1000778	v1	ALIGO MODE CLEANER TUBE BAFFLE,TURN BUCKLE SCREW	20
D1000779	v1	MOUNT BRACKET_BOTTOM	8
D1000780	v1	MOUNT BRACKET_TOP	8
D1000783	v1	ALIGO MODE CLEANER TUBE BAFFLE, STANDOFF SPACER, RIGHT	8
D1000784	v1	ALIGO MODE CLEANER TUBE BAFFLE, STANDOFF SPACER, LEFT	8
D1001926	v1	TUBE BAFFLE RIGHT BRACE	8
D1002867	v1	TUBE BAFFLE LEFT BRACE	8
D1002868	v1	TUBE BAFFLE INNER RIGHT BRACE	8
D1002869	v1	TUBE BAFFLE INNER LEFT BRACE	8
D1002871	v1	TUBE BAFFLE SPOKE	84
D1100468	v1	UPPER APERTURE PLATE, MCA1	1
D1100469	v1	LOWER APERTURE PLATE, MCA1	1
D1100512	v1	UPPER APERTURE PLATE, MCA3	1
D1100513	v1	LOWER APERTURE PLATE, MCA3	1
D1100987	v1	MODE CLEANER TUBE BAFFLE, AL APERTURE CLIP	8

8.3 Delivery Schedule:

Deliveries are to be completed as specified below. If this cannot be accommodated, please provide an alternative delivery schedule for consideration with your bid package. Early or partial deliveries are welcome. Partial deliveries will not be received for the Fit Check.

- First Articles and Fit Check - 6 weeks ARO.
- Production - 8 weeks after Acceptance of First Article.



REQUIREMENTS

Metal Components for use in the Advanced LIGO Vacuum System

APPROVALS	DATE	Document Change Notice
AUTHOR(S): Calum Torrie, Dennis Coyne, Ken Mailand	27-Oct-2010	see DCC record Status:

1 Introduction

All metal components intended for vacuum service shall have quality finishes on all surfaces, suitable for service in an Ultra-High Vacuum (UHV) system. These requirements define the restrictions and practices which must be followed for parts to be used in the LIGO UHV system.

Exceptions, additions or clarifications shall be obtained in writing from the LIGO Contractual Officer or the Contractual Officer's Technical Representative.

2 Scope

These requirements apply to metal components intended for in-vacuum service.

These requirements do not apply to cantilever blade springs. For this application please refer to LIGO-E0900023, Process for Manufacturing Cantilever Spring Blades

3 Purchase Order Specific Requirements

In addition to the requirements defined in this specification, additional requirements, specific to a particular procurement or part, may be defined in the Statement of Work (SOW) or Request for Quotation (RFQ).

4 General Requirements for Metal parts for use in Vacuum

4.1 Materials

The following requirements apply to all raw materials used for LIGO UHV components. **Substitutions and exceptions to these requirements must be in obtained in writing from LIGO in advance of manufacturing any components.**

- Only materials specified on the drawing may be used.
- Material Certifications are required for all materials. Tooling plate grade materials are not permitted.
- Materials must be of domestic (United States) origin.
- All materials are to be virgin material (i.e. no weld repairs or plugs; see also section 4.7))
- No cast or molded parts are permitted.

4.1.1 Welded (Seamed) Stainless Steel Tubing

Stainless steel seamed tubing, although an option, should not be the first choice if seamless tubing is available. The use of seamed steel tubing requires prior approval from LIGO.

If seamed tubing is utilized, the weld seam and any weld flash must meet the requirements listed below. If the weld flash does not meet the requirements, then it must be removed. Details, including fixtures and/or tooling required to remove this flash and a method for removal should be included in the quotation. The flash removal process must be inspected 100% visually and certified by the vendor and approved by LIGO.

With prior approval from a LIGO Contract Officer stainless steel seamed tubing can be used under the following conditions: -

1. Take a cross-sectional sample of the tube weld for every ~20 ft. of every continuous weld run (batch) and verify that the weld is Class B in Table V of Mil-Std-2219. The verification requires:
 - a) Visual inspection for weld discontinuities, porosity and inclusions,
 - b) X-ray for complete penetration and fusion and



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Metal Components for use in the Advanced LIGO Vacuum System

- c) Weld flash must not extend into the interior of the tube more than .02". The weld flash must not be so rough or porous as to prevent adequate cleaning.
 - d) Microstructural examination of weld samples cross-sections. Cross-sections of weld samples, for microstructural examination, shall be prepared by cutting in an orientation perpendicular to the direction of the weld bead so that the size and shape of the weld and the heat-affected zone (HAZ) can be observed. Each weld sample shall be sectioned and polished by standard metallographic procedures (for example, mounted in an epoxy, polished with a 5 micron diamond paste and then be etched with Keller's reagent). The section samples shall be examined and photo-micrographed at approximately 15x. Any weld discontinuities shall be further examined and photographed at 50x to 200x magnification.
2. Supply inspection report for approval to the LIGO contract officer confirming that the as-received seamed welds conform to class B prior to continuing.
 3. Note: Prior to welding, all seamed tubing (inside and out) must be electro-polished per ASTM B-912- (reference LIGO E0900048 Welding Spec)

4.2 Final Surface Finishes

All final surfaces of all parts are to be machined. Machined surfaces must not have smeared metal or galling because these conditions can trap contaminants which could out-gas when the part is in service in the vacuum environment. No as-received or as-rolled rough surfaces will be accepted unless otherwise noted on the drawing or as an exception here:

4.2.1 Exceptions (allowable non-machined surfaces)

4.2.1.1 Extruded Sections (seamless tubes, angles, etc.) and Welded Stainless Steel Tubing

If extruded tubular sections (or angles or other stock shapes) are to be used, then machining the interior surfaces is not practical and machining the outer radius on the corners is prohibitive. In this case either

- a) All surfaces of all parts are to be machined, except those not practical to machine. In this case the inner surface and outer radius will be accepted "as extruded" or "as rolled", or
- b) The part is electro-polished to remove all surface oxides and potentially embedded contaminants refer to section 5.2.1.2 or 5.2.2.2.
- c) (For aluminum) The part is chemically cleaned / etched by acid or caustic process, refer to 5.2.1.
- d) As per section 11 of ASTM A554-10 the finished tubes shall be free of injurious defects and have a workmanlike finish. Surface imperfections such as handling marks, shallow pits and scratches shall not be considered as serious defects provided they are within 10% of the specified wall or 0.002 inch, whichever is greater.
- e) Each tube shall be individually wrapped and protected from scratches, pitting and digs during transport and handling. Each tube shall be inspected and handled appropriately.

4.2.1.2 Thin Sheet

Sheet metal shall be purchased in the 2B finish condition which should normally have a surface finish of 12-20 Ra. However, if the surface finish exceeds 32 Ra then:

- a) the surface finish should be discussed with LIGO Contractual office prior to acceptance, or
- b) the sheet shall be electro-polished as per section 5.2.2.2
- c) the sheet shall be chemically cleaned / etched by acid and / or caustic process, refer to section 5.2.1

Further questions related to machining all surfaces can be discussed with the LIGO Contractual officer or the Contracting Officer's Technical Representative. Under no circumstances shall the parts be anodized.



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Metal Components for use in the Advanced LIGO Vacuum System

4.2.2 Surface Roughness

The required surface roughness is defined in the drawing block entitled "finish". Please note if finish is called out on the drawing it is in Ra. If no call-out is included in this block, then the maximum surface finish shall default to:

- 63 micro-inch (Ra) for stainless all surfaces
- 63 micro-inch (Ra) for aluminum all surfaces
- 32 micro-inch (Ra) for sheet metal. See section 4.2.1.2.

Localized scratches, digs and blemishes should be minimized and addressed through visual inspection and QA. If such blemishes compromise the function or performance of the part (e.g. a stray light control baffle), then limits on acceptable scratches and digs should be defined in the drawing or associated process specification.

4.3 Machining Fluids / Coolant

All machining, and tapping, fluids must be fully synthetic, water soluble (not simply water miscible) and free of sulfur, chlorine, and silicone. Reference LIGO document [LIGO-E0900237-v5](#) for a list of approved coolants. If this is difficult or expensive please talk to LIGO staff about an exemption.

4.4 Abrasive Removal Techniques

4.4.1 Grinding

No grinding or lapping with abrasive wheels, cloth or stones is permitted for the final surface, unless otherwise noted on the drawing. Grinding (e.g. Blanchard grinding) is acceptable if all ground surfaces are machined afterwards.

4.4.2 Sanding

No parts are to be sanded with abrasive techniques e.g. sanding, grinding. Stainless steel wool can be used.

4.4.3 Scotch-Brite™

The use of Scotch-Brite™ or similar products is not permitted at any time.

4.4.4 Water Jet Cutting

The use Water Jet Cutting is permitted on sheet metal parts which will later be porcelain coated. For all other parts, the Water Jet Cut surface must be removed by traditional machining methods. Electro-polishing may be used to remove the Water Jet Cut surface if a written exemption is granted by LIGO.

4.5 Electrical Discharge Machining (EDM)

The use of EDM is not permitted unless the porous re-cast layer is removed by conventional machining techniques. Removal of the re-cast layer by electro-polishing may be used if a written exemption is granted by LIGO.

4.6 De-burring

All sharp edges and corners shall be rounded or chamfered per the drawing. De-burring should be done on the lathe or mill as much as possible or with de-burring tools, filing and / or stainless steel wire brushes. Tumbling or use of standard steel wool is not acceptable for de-burring, however clean stainless steel wool is okay. All de-burring tools, files and stainless wire brushes must be clean and free of oils and contaminants.



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4.7 Repairs

No repairs shall be made unless approved in advance, and in writing, by LIGO Laboratory. In general weld repairs and press fit insert repairs are never acceptable. The material shall be virgin material. Special circumstances can be reviewed if/when brought to the attention of LIGO. Complete LIGO form [Q110001 Request for Deviation](#) and email to quality@ligo.org.

4.8 Heli-Coil Holes

All Heli-Coil holes are to be machined according to the steps specified in the Emhart Heli-Coil Product catalog, HC2000 Rev. 4 page 17. These steps include drilling, countersinking, tapping, and gauging the holes to sizes specified on the LIGO part drawings. All Heli-Coil threaded holes shall be 100% gauged with appropriate gauge tools according to the [Emhart catalog](#).

5 Cleaning

5.1 Standard Cleaning of Metal Components before delivery to LIGO

- Unless otherwise specified on the drawing, SOW, or RFQ the standard requirement is for all components to be thoroughly cleaned to remove all ink, oil, grease, dirt, and chips.
- All inks (stamping, Sharpie, etc) should be removed with solvent such as acetone or isopropanol.
- Use Soap (such as Simple Green) and water to remove machining fluids.
- Thoroughly rinse soap with clean water (DI or distilled preferred).
- Parts should be dried thoroughly with clean air, nitrogen, or lint-free cloth.
- Wrap parts to protect from damage and to maintain cleanliness during shipment. Avoid the use of materials that shed particulates such as newspaper. Bubble wrap is recommended for many parts.

5.2 Further Cleaning (only if specified)

These cleaning steps only apply if called out in the individual SOW and/or RFQ and/or drawing or other LIGO Specification. Additional questions related to this section on further cleaning can be discussed with the LIGO Contractual officer or the Contracting Officer's Technical Representative.

5.2.1 Aluminum

5.2.1.1 Chemical cleaning of Aluminum

- Standard clean parts per 5.1 above.
- Wash parts with Alkaline Soak Cleaner and inspected for cleanliness using the water break test (refer to ASTM A380-06 and ASTM F22).
- Acid etch the parts to achieve less than 0.0005 material removal. Under no circumstances should the parts be anodized. Section 10 of LIGO document [E960022](#) can be referred to for additional information.
- Thoroughly rinse parts with DI or distilled water and inspect all surfaces for cleanliness.
- Thoroughly dry parts with clean air, nitrogen, or lint-free cloth.
- Wrap parts to protect from damage and to maintain cleanliness during shipment. Avoid the use of materials that shed particulate such as newspaper. Bubble wrap is recommended for many parts.

5.2.1.2 Electro-polishing of Aluminum

Aluminum may be electro-polished to achieve a material removal of .001 inch per surface. Due to the lack of commonly recognized industry standards, please talk to LIGO about proposed suppliers and processes before proceeding.



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5.2.2 Stainless Steel

5.2.2.1 Pickling & Passivation of Stainless Steel


1. Clean parts per section 5.1 above, inspect for cleanliness using the water break test (refer to ASTM A380-06 and ASTM F22).
2. Stainless steel parts shall be pickled and passivated (citric acid preferred) at room temperature, with special attention paid to sufficiently agitate the solution or flush the inside of the box section. The pickling and passivation process formulation, time and temperature should be chosen to achieve slight chemical etching (<0.0005 inch). (Ref. ASTM A380 for pickling and ASTM A967 for passivation)
3. Rinse parts with DI or distilled clean water. After rinsing, visually inspect the surfaces for cleanliness.
4. Dry Parts using dry nitrogen blow-off or bake at approximately 130°F. Re-inspect for cleanliness.
5. Wrap parts to protect from damage and to maintain cleanliness during shipment. Avoid the use of materials that shed particulate such as newspaper. Bubble wrap is recommended for many parts.

5.2.2.2 Electro-polishing of Stainless Steel

Electro-polishing of Stainless Steel parts is allowed. If using electro-polishing on a part, follow similar steps to those outlined in section 5.2.2.1 Pickling and Passivation of Stainless Steels. The use of Scotch-Brite™ or similar products is never permitted.

6 Coatings

- No coatings are to be applied unless specified on the drawing or associated process specification. In particular, no aluminum parts are to be anodized.
- The Statement of Work should define if the machining vendor is responsible to apply coatings specified on the drawing. If in doubt, ask.
- As applicable, refer to the process specification for coatings as defined on drawings (for example, LIGO E1000083 Specification for Enameled Steel to be used in the LIGO Ultra High Vacuum System).
- Autocatalytic (Electroless) Nickel Plating, when required, should be applied per ASTM B733-97 Type III (2-4 wt% Phosphorus). Due to the outgassing concerns for UHVV service, the specific cleaning/etching and plating process steps proposed by the plating company shall be submitted to LIGO for approval. Refer to section 2.5 of [LIGO-E0900023-v10](#) for suggested process steps.

 LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY SPECIFICATION	E1000083 -v5
	Document No Rev.
Sheet 1 of 2	
Specification for Enameled Steel to be used in the LIGO Ultra-High Vacuum System	

APPROVALS	DATE
AUTHORS: Heidi Kelman, Jeff Lewis	5 Apr 2011
APPROVED: (refer to associated DCC file card to confirm approval)	

1 Scope

This process specification is for the application of enamel (porcelain) coating, primarily for use on sheet steel baffles for Advanced LIGO. It includes material requirements and the process and preparation for applying porcelain onto the baffle. These baffles are for use in an Ultra-High Vacuum (UHV) system.

2 Manufacturing Process

2.1 Material

The substrate shall be 304, 304L, or enameling steel ASTM A424 Types I and III (not Type II)

2.2 Shaping

The requirements of LIGO document E0900364 for machining, allowable machining fluids, and standard cleaning practices (post machining/stamping and forming) should have been followed prior to enameling.

2.3 Surface Preparation and Cleaning


2.3.1 ASTM A424 Type I or III Enameling Steel

Use a multiple bath high-alkaline aqueous degreasing solution heated to approximately 160°F. Soak for 10 minutes then rinse and dry. A light film of oxidation is acceptable but moderate to heavy rust with pitting must be removed. Contact LIGO if such a condition exists.

2.3.2 304 and 304L Stainless Steel

Sandblasting of all surfaces must be performed to produce a surface to which the porcelain will adhere. Use only new Fused Silica grade G-36. A minimal blast should be used, just sufficient to produce a light etch on the stainless steel surface.

Use a multiple bath high-alkaline aqueous degreasing solution heated to approximately 160°F. Soak for 10 minutes then rinse and dry.

 LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY SPECIFICATION	E1000083 -v5
	Document No Rev.
Sheet 2 of 2	
Specification for Enameled Steel to be used in the LIGO Ultra-High Vacuum System	

2.4 Porcelain Process

2.4.1 Masking around designated holes

The part drawings will indicate which holes, if any, have masking requirements. The method of masking should be discussed and agreed upon with a LIGO representative prior to beginning work.

2.4.2 Frit application

Unless otherwise specified, the frit material used shall be Ferro Corp. Part #RM108, gloss black. No substitutions shall be allowed. The porcelain vendor shall provide copies of material conformance specification certificates upon request by LIGO. Apply frit to achieve a final enamel thickness of .003" min - .010" max.

2.4.3 Firing

The parts can be fired in a continuous or batch furnace depending on the size of the part. Parts should be either hung or placed on horizontal tooling to minimize warpage during the firing process. Please discuss the workholding method with a LIGO representative prior to beginning work. Follow the Ferro Corporation's guidelines but generally 1510°F for 4 minutes or 1430°F for 6-10 minutes will be acceptable.

2.4.4 Testing

2.4.4.1 Thickness

Inspect the coating thickness by means of a magnetic or eddy current thickness meter to ensure a minimum of .003" and a maximum of .010".

2.4.4.2 Adhesion

An adherence check must be performed on test coupons to ensure the enamel is fired correctly and the sheet has been prepared properly. The vendor is to perform ASTM B916-01, "Standard Test Method for Adherence of Porcelain Enamel Coatings to Sheet Metal", or a similar/equivalent test with prior approval from a LIGO Laboratory representative. The porcelain enamel must achieve a rating of "very good adherence", or better, by this test method.

3 Packaging for shipment

3.1.1 Standard

Package parts for protection during shipment. Care must be taken to prevent chipping of the porcelain from handling and shipping damage.



Specification for Enameled Steel to be used in the LIGO Ultra-High Vacuum System

3.1.2 LIGO Class A cleanliness level (only if specified)

Immediately after firing, all LIGO parts must be transferred into a Class 100 cleanroom adjacent to the firing furnace for cooling and packaging. Personnel must be dressed according to Class 100.

Tables in the cleanroom must be covered with a base layer of Ameristat and then covered with UHV grade aluminum foil.

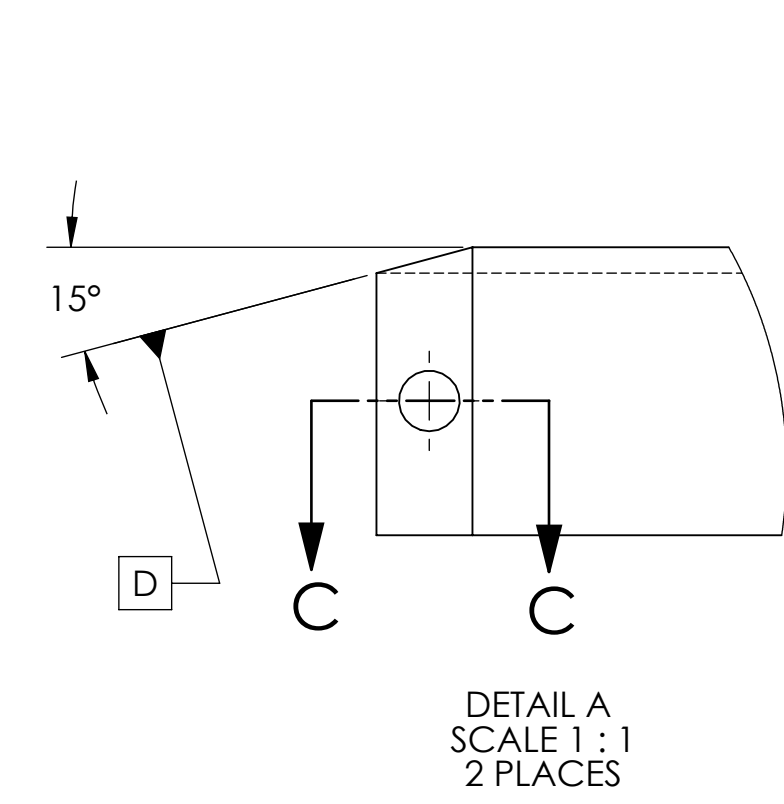
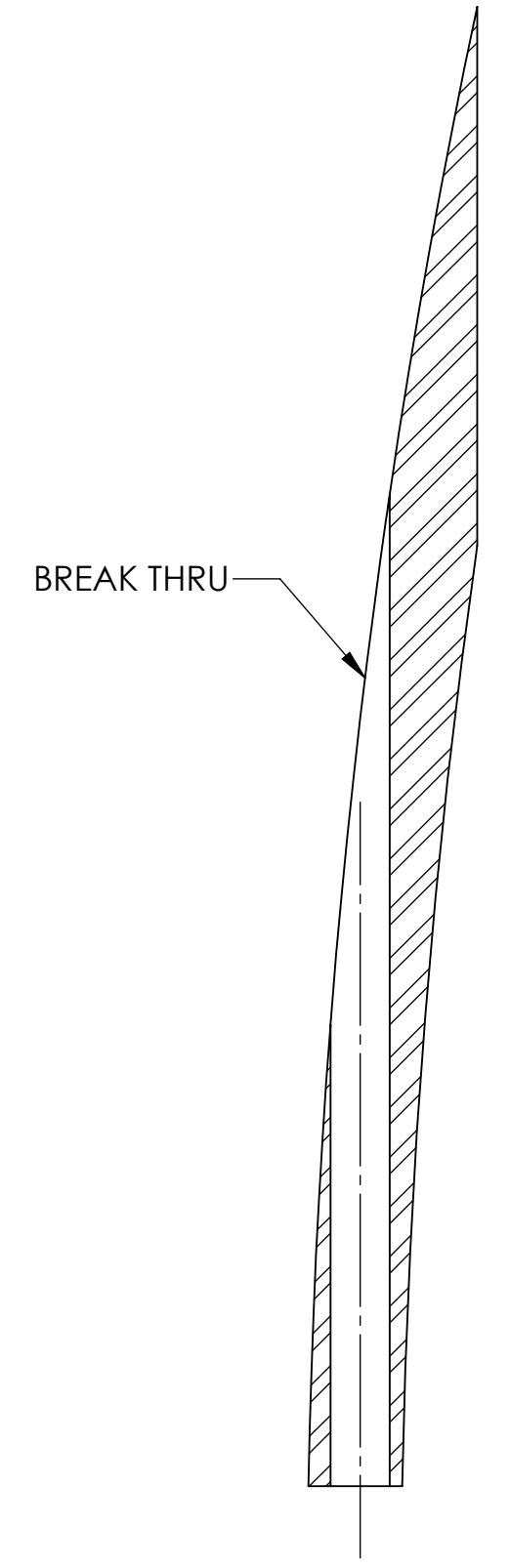
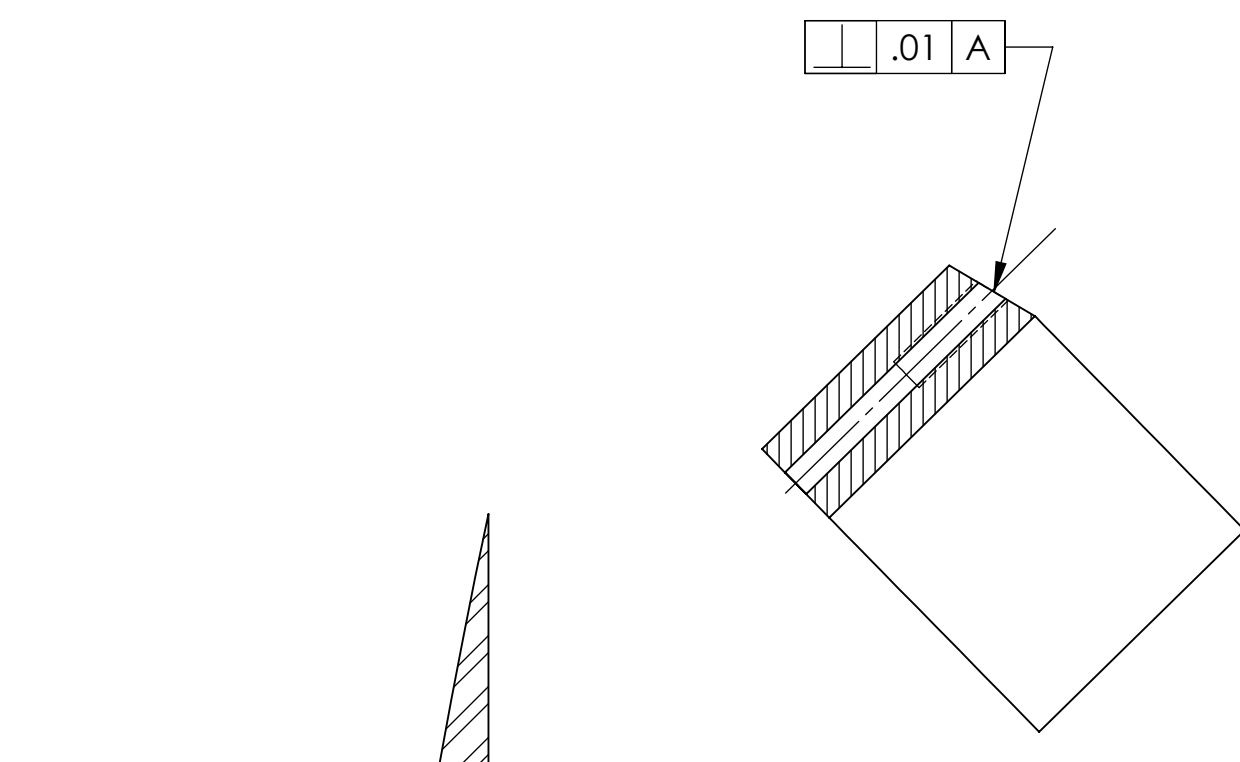
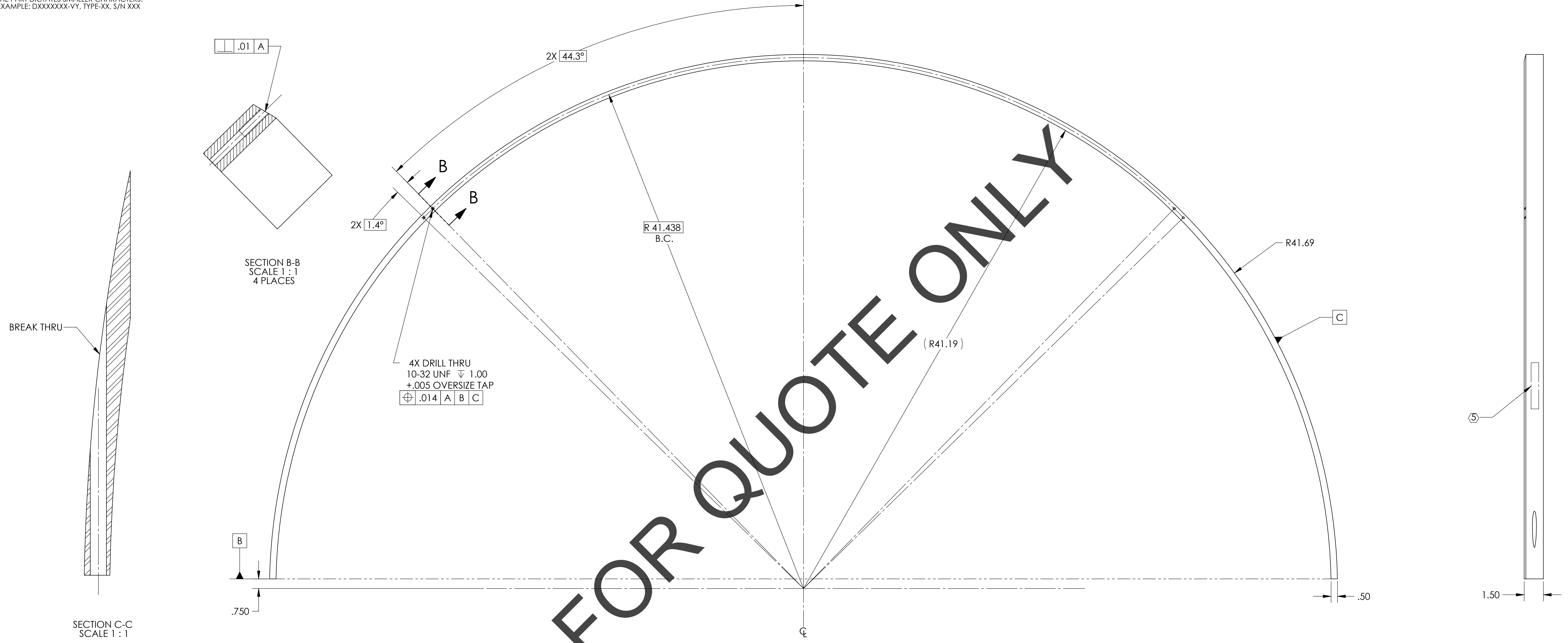
The newly enameled parts are to be completely wrapped in UHV grade aluminum foil and then completely wrapped in Ameristat and sealed with Kapton tape.

D1000776.dwg: Models: Cleaner: Tube_Baffle_Ring_Bottom: PART PDM REV: X:020: DRAWING PDM REV: X:024

NOTES: UNLESS OTHERWISE SPECIFIED

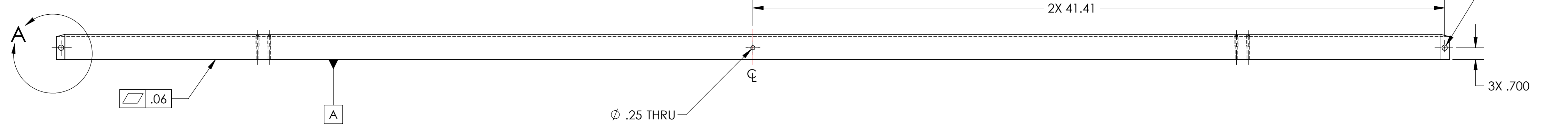
1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES 0.005" to 0.015".
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS. UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
6. APPROXIMATE WEIGHT = 8.92 LB.
7. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
8. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
9. ELECTRO POLISH TO REMOVE .0005-.001 PER SIDE.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-1	-
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-	-	-	-



4X DRILL THRU
10-32 UNF ∇ 1.00
+.005 OVERSIZE TAP
 \oplus .014 | A | B | C

.750



FOR QUOTE ONLY

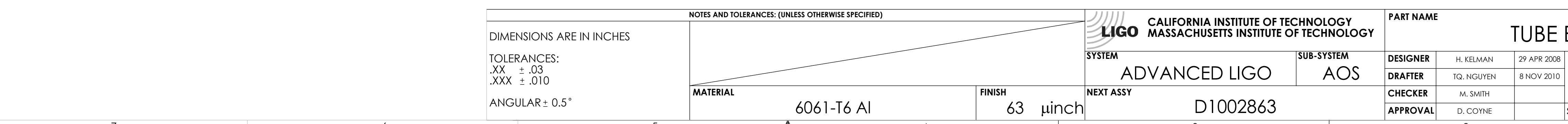
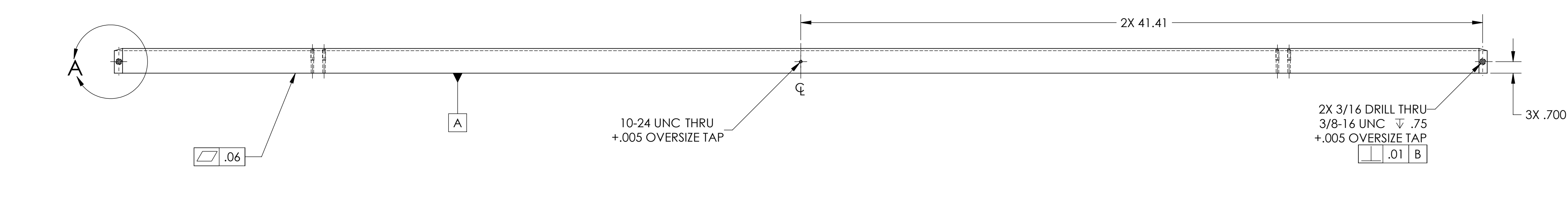
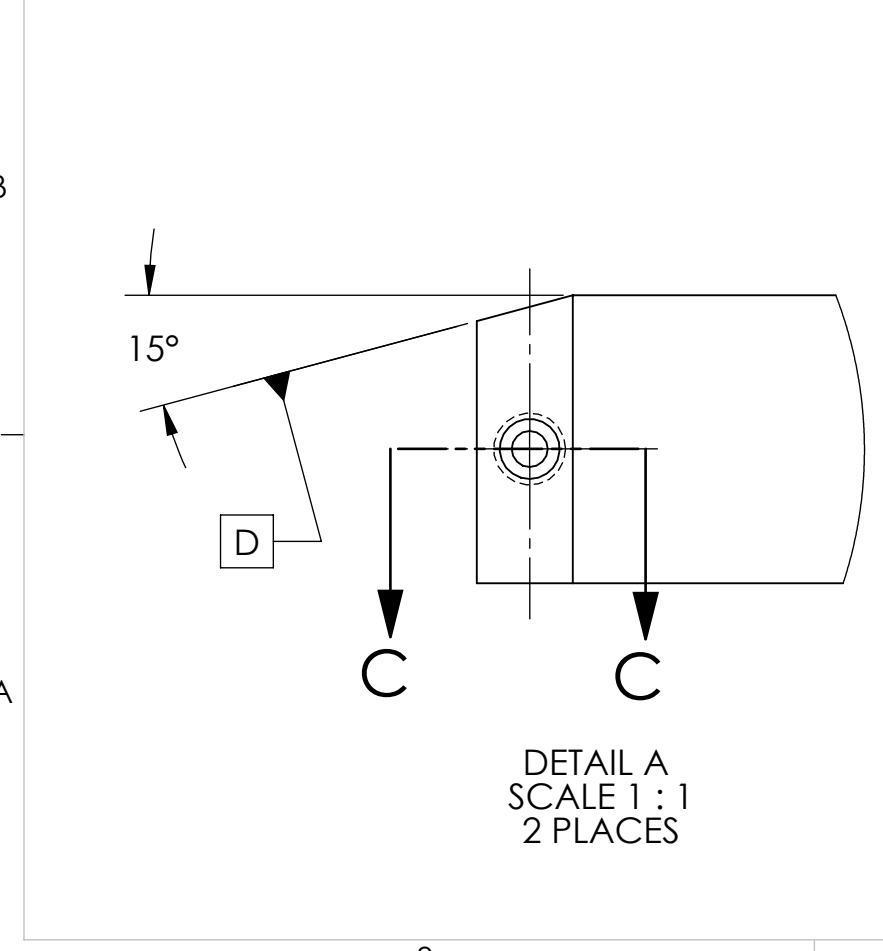
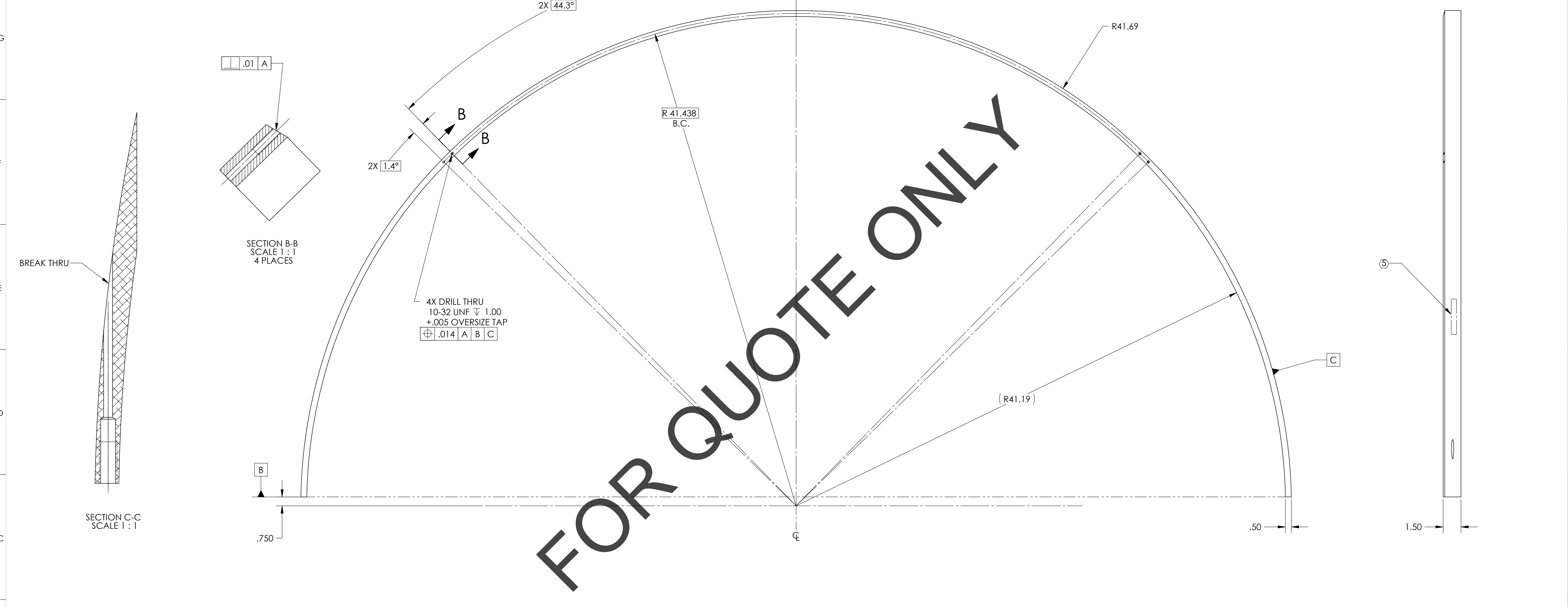
NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME											
DIMENSIONS ARE IN INCHES				<table border="1"> <tr> <td>SYSTEM</td> <td>ADVANCED LIGO</td> <td>SUB-SYSTEM</td> <td>AOS</td> </tr> <tr> <td>NEXT ASSY</td> <td colspan="3">D1002863</td> </tr> </table>		SYSTEM	ADVANCED LIGO	SUB-SYSTEM	AOS	NEXT ASSY	D1002863			TUBE BAFFLE RING_BOTTOM			
SYSTEM	ADVANCED LIGO	SUB-SYSTEM	AOS														
NEXT ASSY	D1002863																
TOLERANCES: .XX \pm .03 .XXX \pm .010						DESIGNER	H. KELMAN	29 APR 2008	SIZE	D	DWG. NO.	D1000776	REV.	v1			
ANGULAR \pm 0.5°						DRAFTER	TG. NGUYEN	8 NOV 2010									
MATERIAL				6061-T6 Al		CHECKER	M. SMITH										
FINISH				63 μ inch		APPROVAL	D. COYNE										
						SCALE: 1:4		PROJECTION:		SHEET 1 OF 1							

D1000777_d:\LIGO_Modes\Clevers_Tube_Baffle_Ring_Top_PART_PDM_REV_X.021_DRAWING_PDM_REV_X.024

NOTES: UNLESS OTHERWISE SPECIFIED

- INTERPRET DRAWING PER ASME Y14.5-1994.
- REMOVE ALL SHARP EDGES 0.005" TO 0.015".
- DO NOT SCALE FROM DRAWING.
- ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
- SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR 'TYPE' IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS. UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
- APPROXIMATE WEIGHT = 8.95 LB.
- ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
- ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO LIGO-REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO E0900364.
- ELECTRO POLISH TO REMOVE .0005 - .001 PER SIDE.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
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-	-	-	-



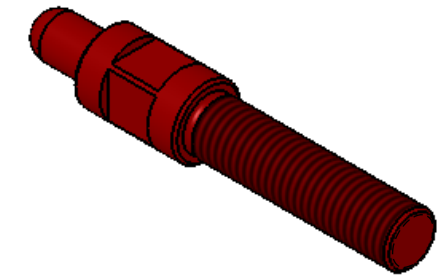
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DIMENSIONS ARE IN INCHES		SYSTEM ADVANCED LIGO		SUB-SYSTEM AOS	
TOLERANCES: .XX ± .03 .XXX ± .010		NEXT ASSY D1002863		DESIGNER	H. KELMAN 29 APR 2008
ANGULAR ± 0.5°		MATERIAL 6061-T6 Al		FINISH	63 μinch
				CHECKER	M. SMITH 8 NOV 2010
				APPROVAL	D. COYNE
				SIZE	D
				DWG. NO.	D1000777
				REV.	v1
				SCALE: 1:4	PROJECTION:
				SHEET 1 OF 1	

NOTES: UNLESS OTHERWISE SPECIFIED

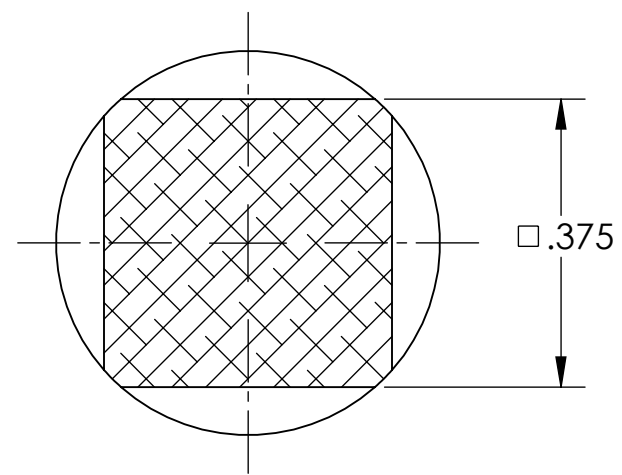
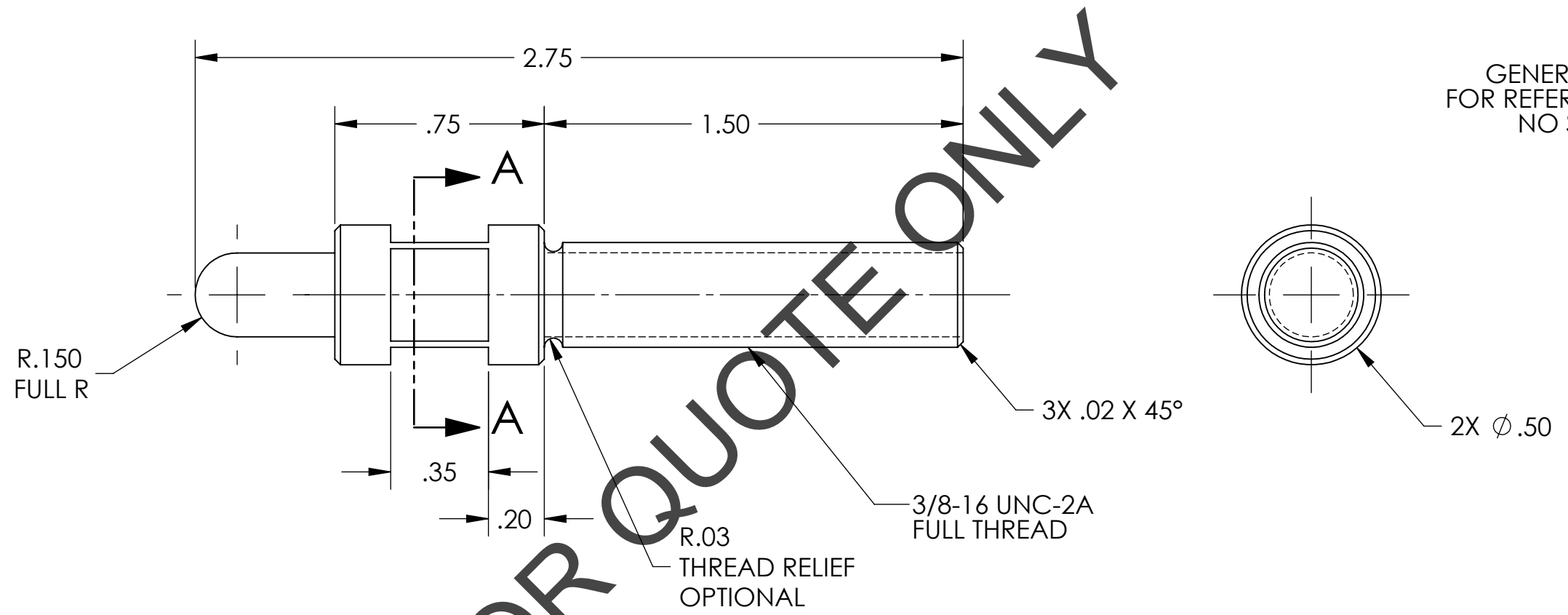
1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES 0.005" to 0.015".
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
5. SCRIBE, ENGRAVE, LASER MARK OR MECHANICALLY STAMP (NO DYES OR INKS) A UNIQUE THREE DIGIT SERIAL NUMBER & REVISION NUMBER ON EACH PART. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. BAG AND TAG PARTS WITH THEIR DRAWING PART NUMBER, REVISION, VARIANT OR "TYPE" (IF APPLICABLE), AND QUANTITY. IF PARTS ARE TOO SMALL TO SCRIBE, BAGGING AND TAGGING ALONE IS SUFFICIENT. EXAMPLE (PART): 001-v1
EXAMPLE (TAG): DXXXXXX-VY, TYPE-XX, QTY: TBD

6. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
7. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
8. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.

REV.	DATE	DCN #	DRAWING TREE #
v1	12 MAY 2011	E1000360-v2	-
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-	-	-	-



GENERAL VIEW FOR REFERENCE ONLY NO SCALE



SECTION A-A
SCALE 4:1

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

DIMENSIONS ARE IN INCHES	
TOLERANCES: .XX ± .01 .XXX ± .005 ANGULAR ± 0.5°	
MATERIAL	304 SSTL
FINISH	63 μinch

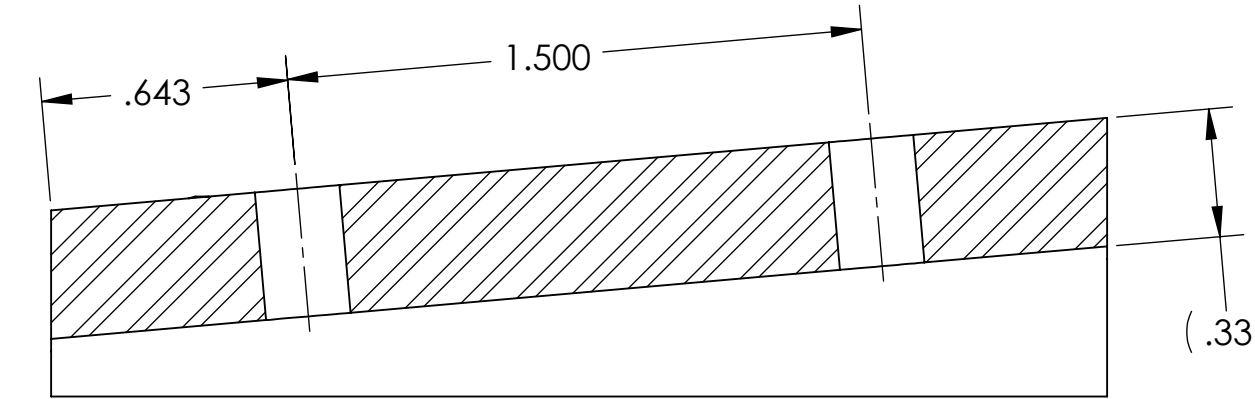
CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY	PART NAME		TURN BUCKLE SCREW	
	SYSTEM	SUB-SYSTEM	DESIGNER	DATE
	ADVANCED LIGO	AOS	H. KELMAN	28 APR 2008
	CHECKER	APPROVAL	TQ. NGUYEN	19 NOV 2010
NEXT ASSY		SIZE	DWG. NO.	REV.
D1002863 & D1002084		B	D1000778	v1
		SCALE:	PROJECTION:	SHEET 1 OF 1
		2:1	ASME	

D1000778_d1lGO_Mode_Cleaner_Tube_Baffle_Turn_Buckle_Screw_PART PDM REV: X-031, DRAWING PDM REV: X-018

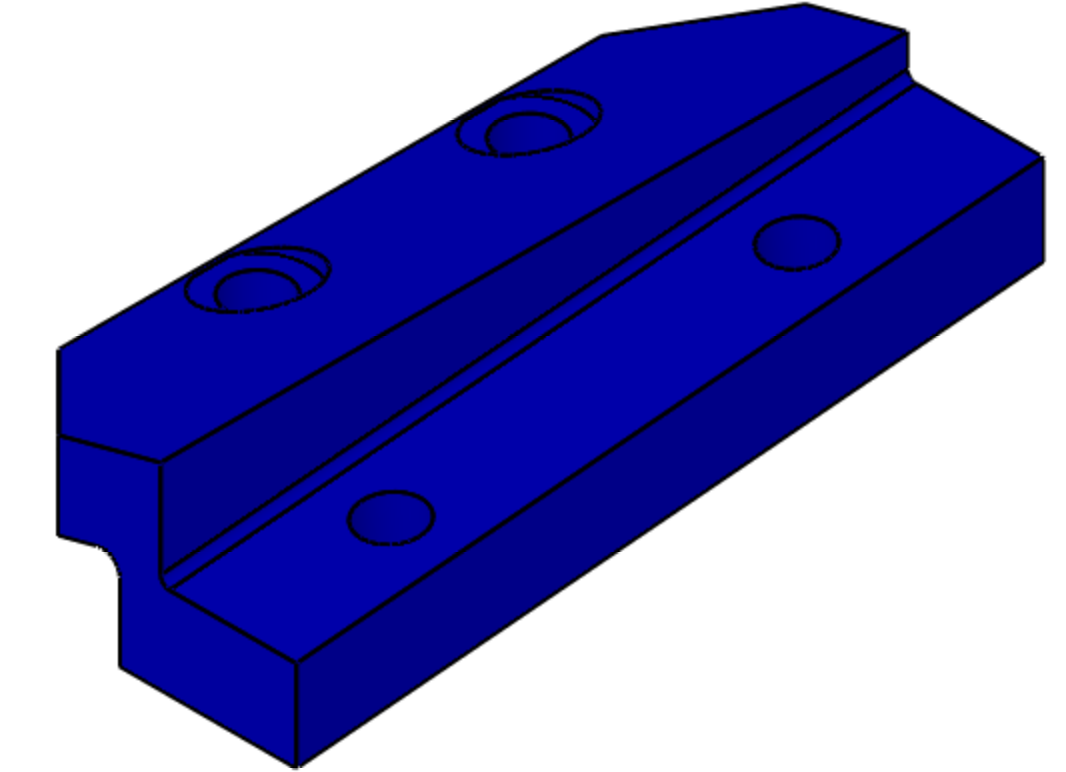
NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES 0.005" to 0.015".
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
6. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH, USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
7. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
8. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.

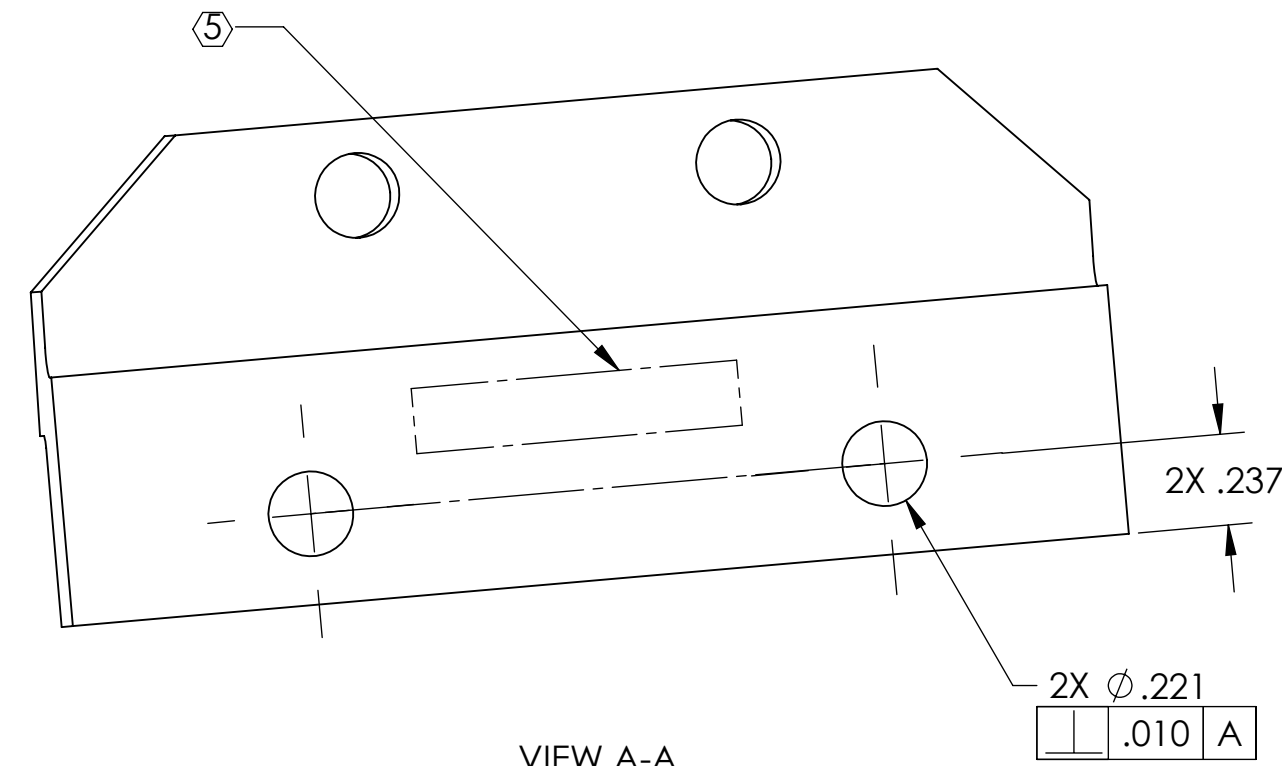
REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
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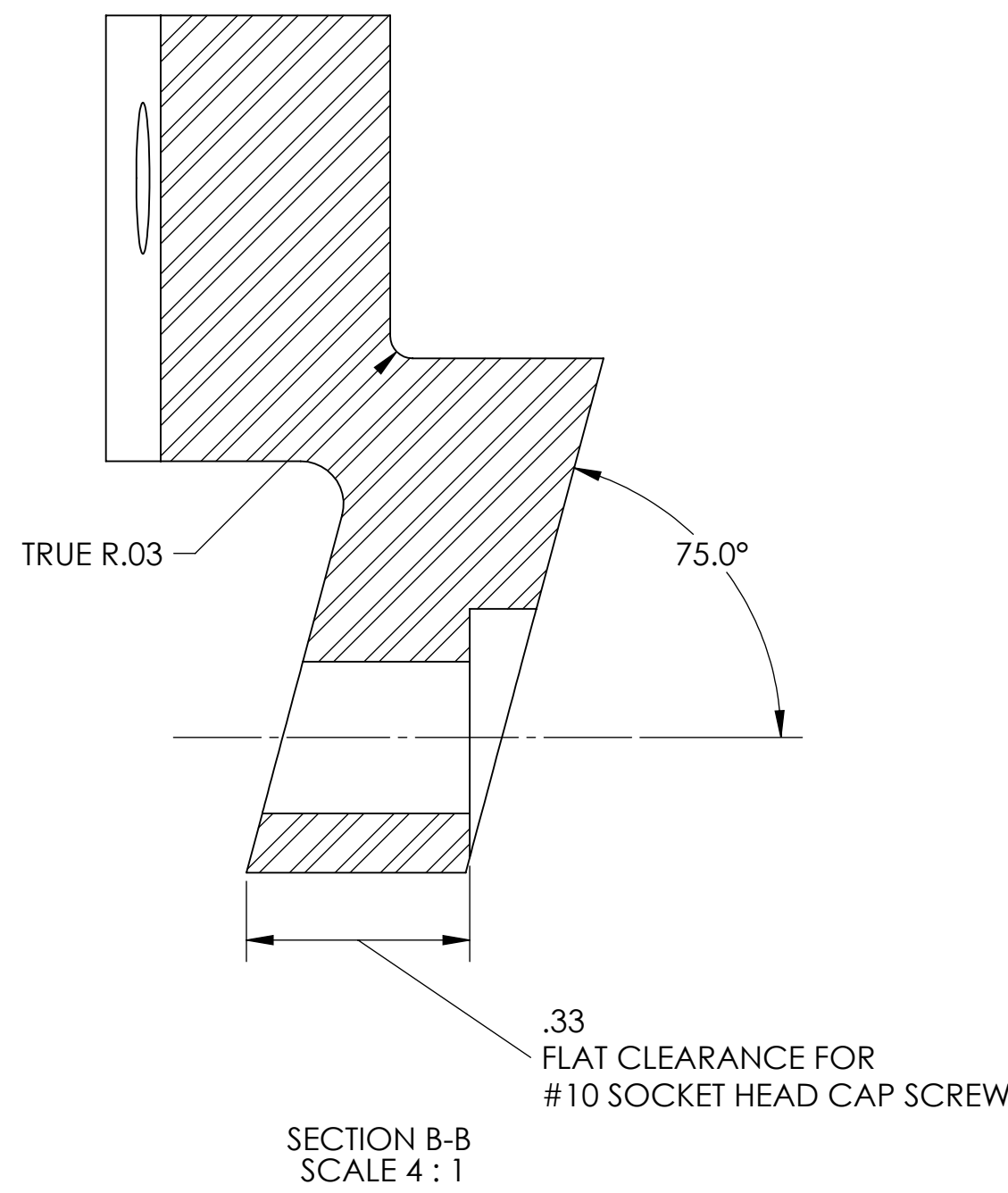
SECTION C-C



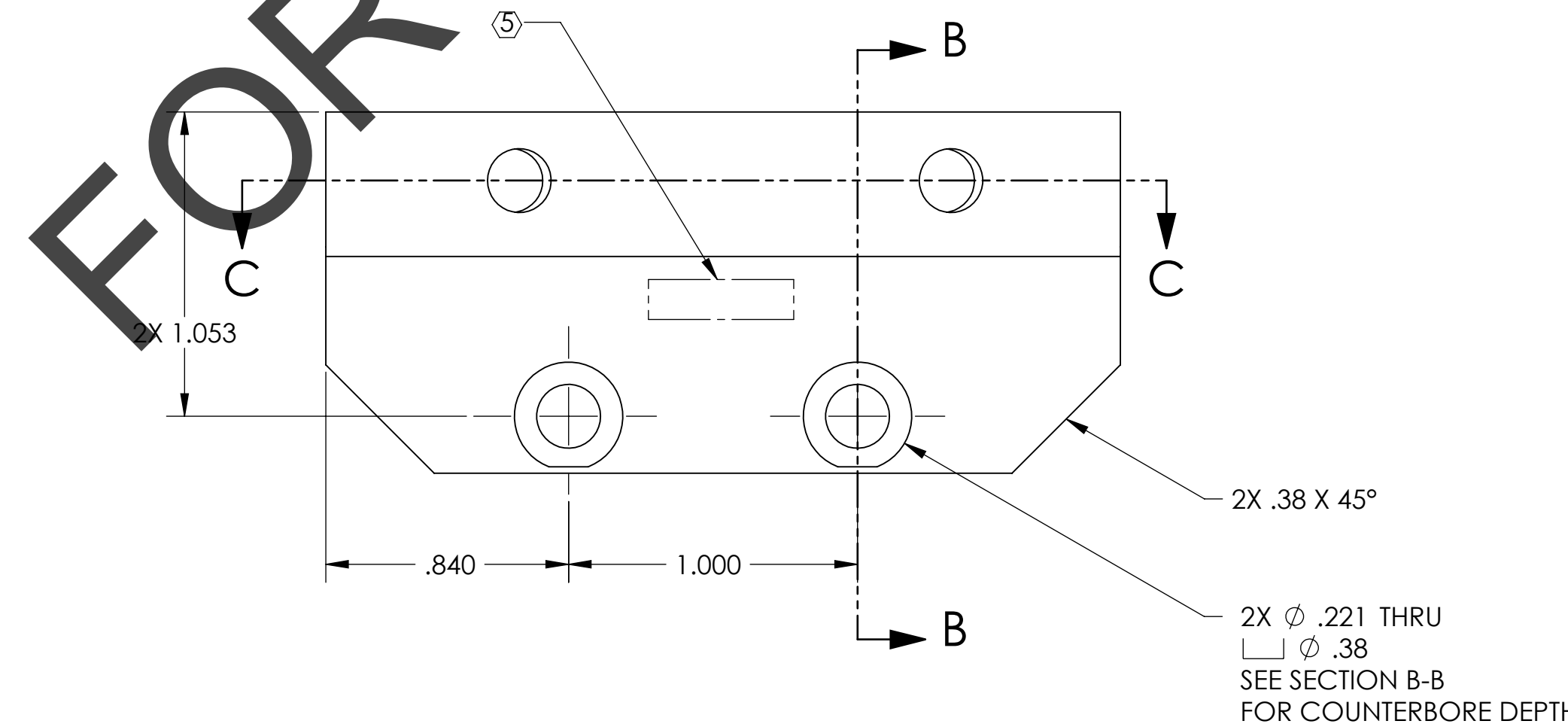
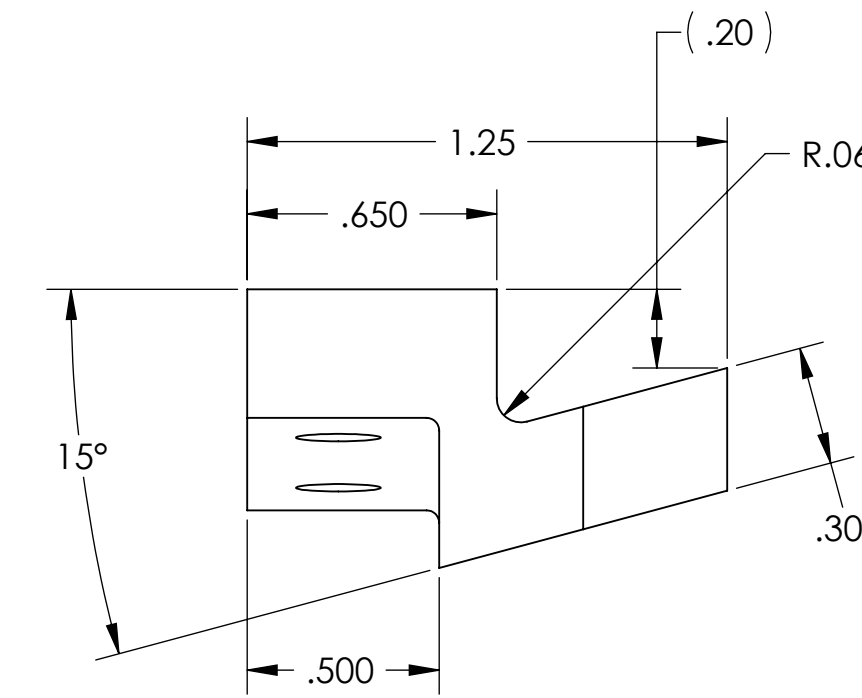
GENERAL VIEW FOR REFERENCE ONLY NO SCALE



VIEW A-A



SECTION B-B SCALE 4:1



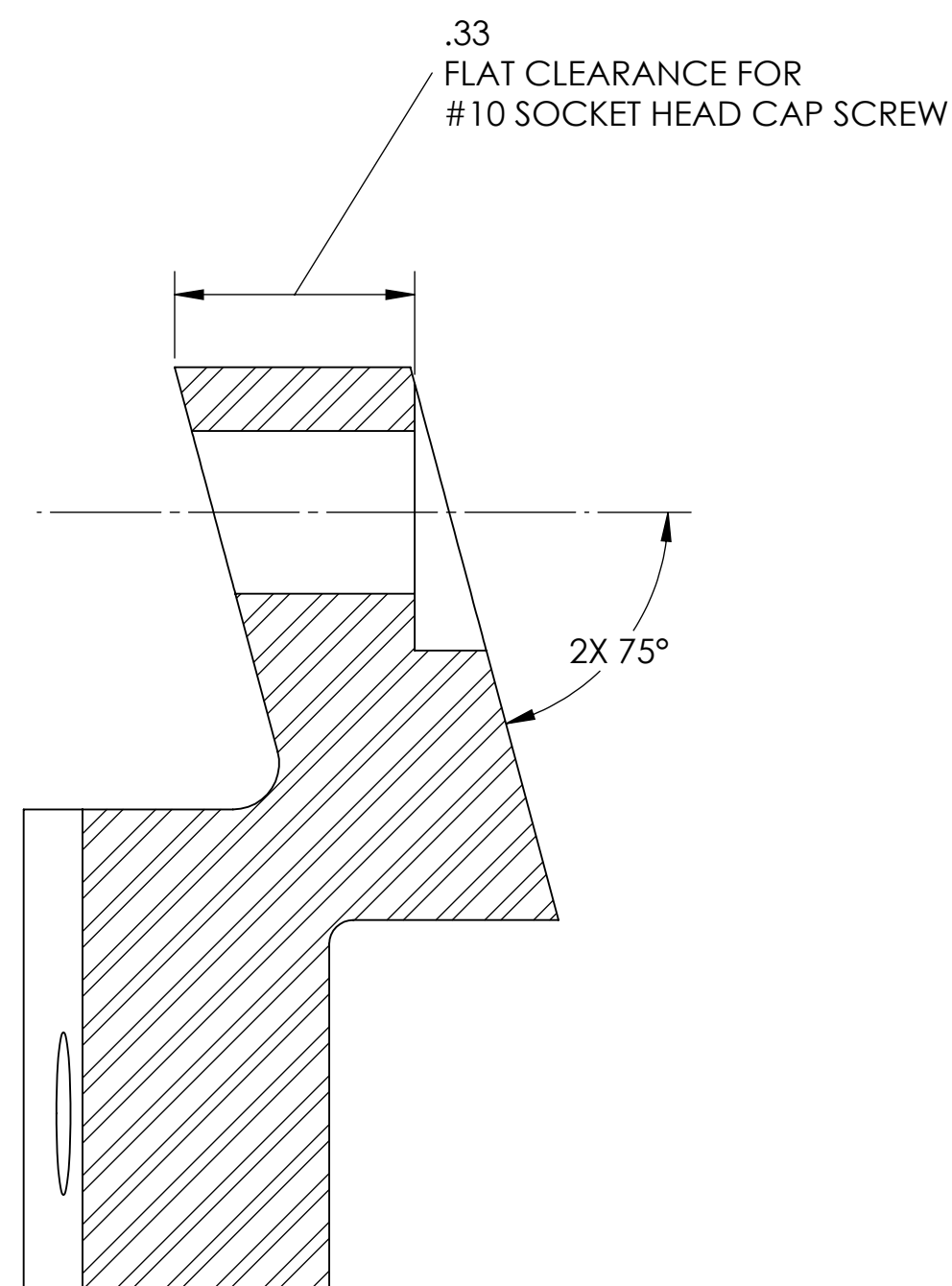
FOR QUOTE ONLY

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME					
DIMENSIONS ARE IN INCHES						MOUNT BRACKET_BOTTOM					
TOLERANCES: .XX ± .01 .XXX ± .005											
ANGULAR ± 0.5°				MATERIAL 6061-T6 Al		FINISH 63 μinch		SYSTEM ADVANCED LIGO SUB-SYSTEM AOS		DESIGNER TQ. NGUYEN 28 OCT 2010 DRAFTER TQ. NGUYEN 9 NOV 2010 CHECKER M. SMITH APPROVAL D. COYNE	SIZE DWG. NO. D D1000779 REV. v1
				NEXT ASSY D1002864		SCALE: 2:1		PROJECTION:		SHEET 1 OF 1	

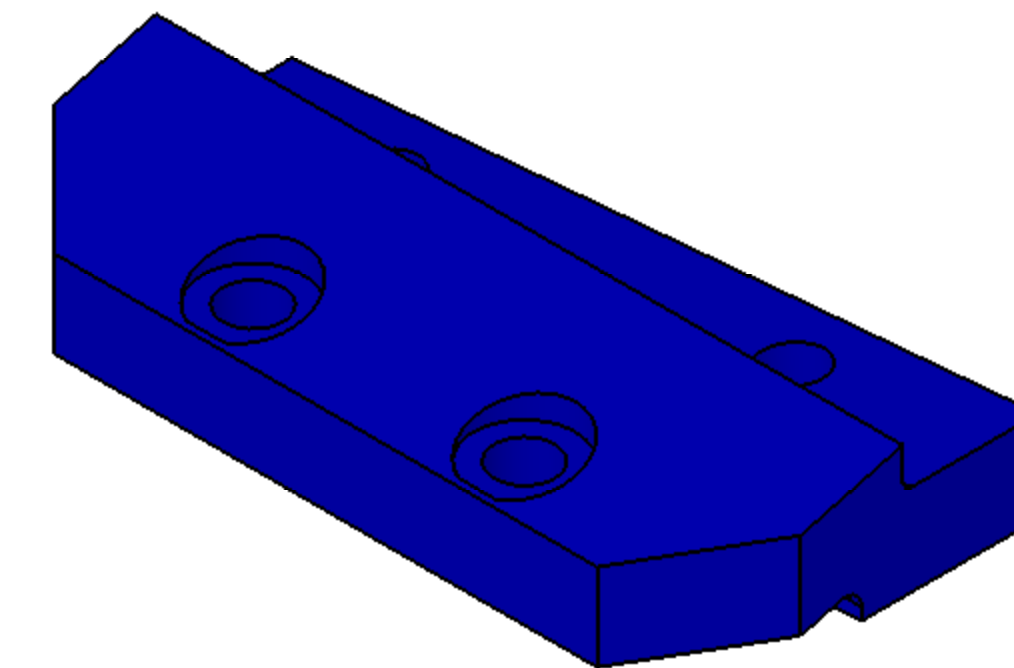
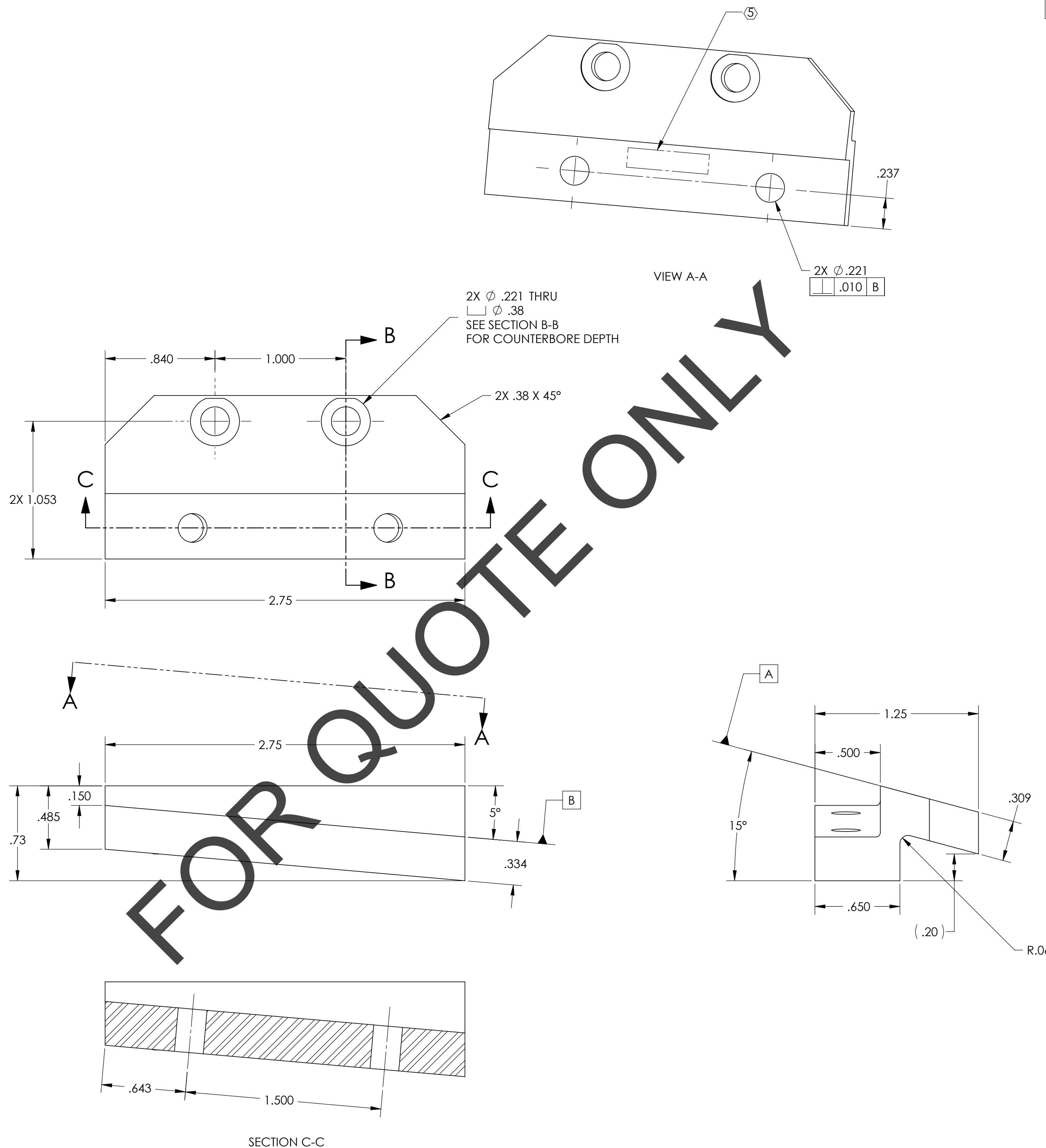
NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES 0.005" TO 0.015".
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
6. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
7. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
8. ALL MATERIAL IS TO BE VIRGIN MATERIAL (I.E. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
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-	-	-	-



SECTION B-B
SCALE 4:1



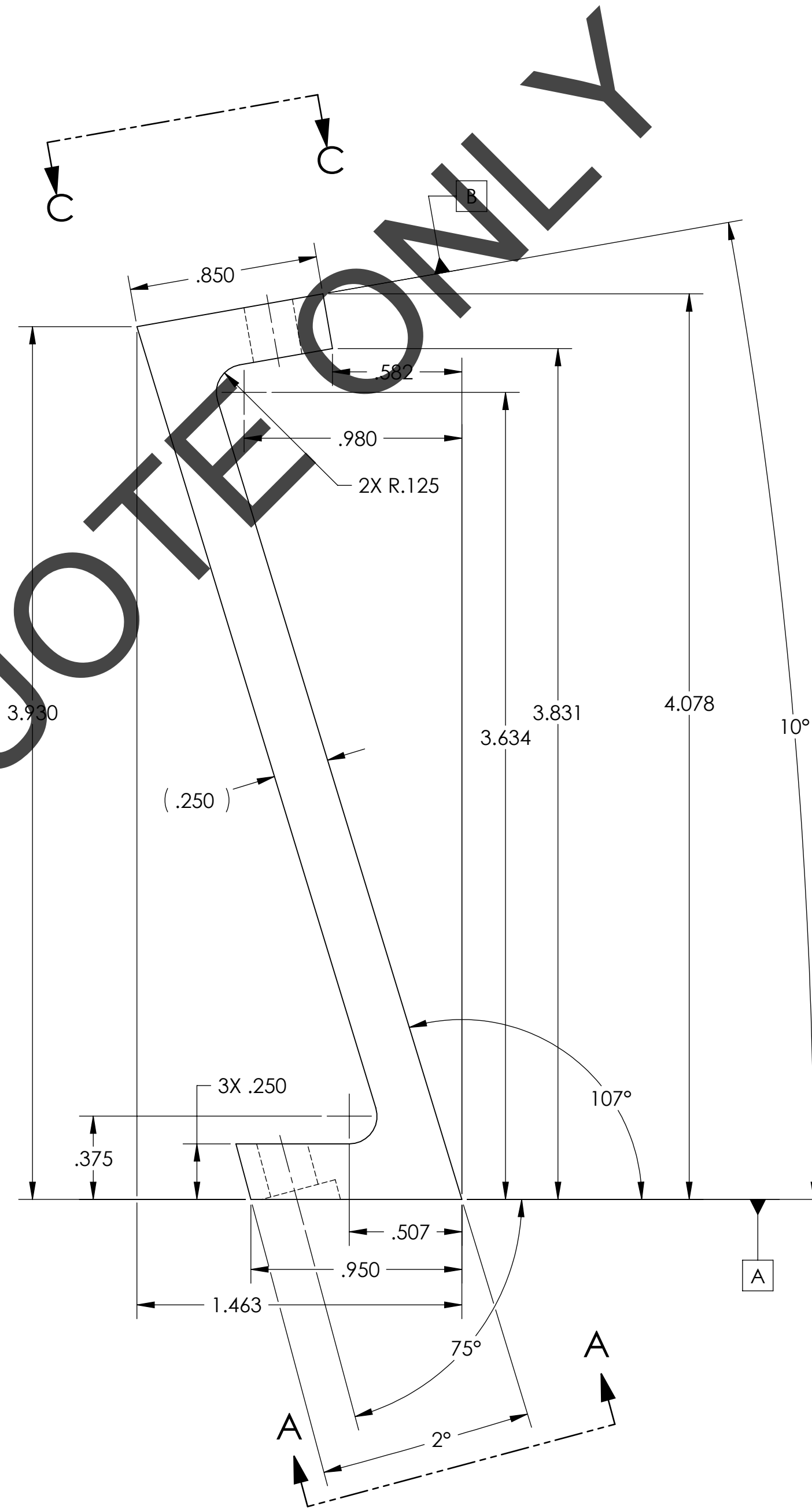
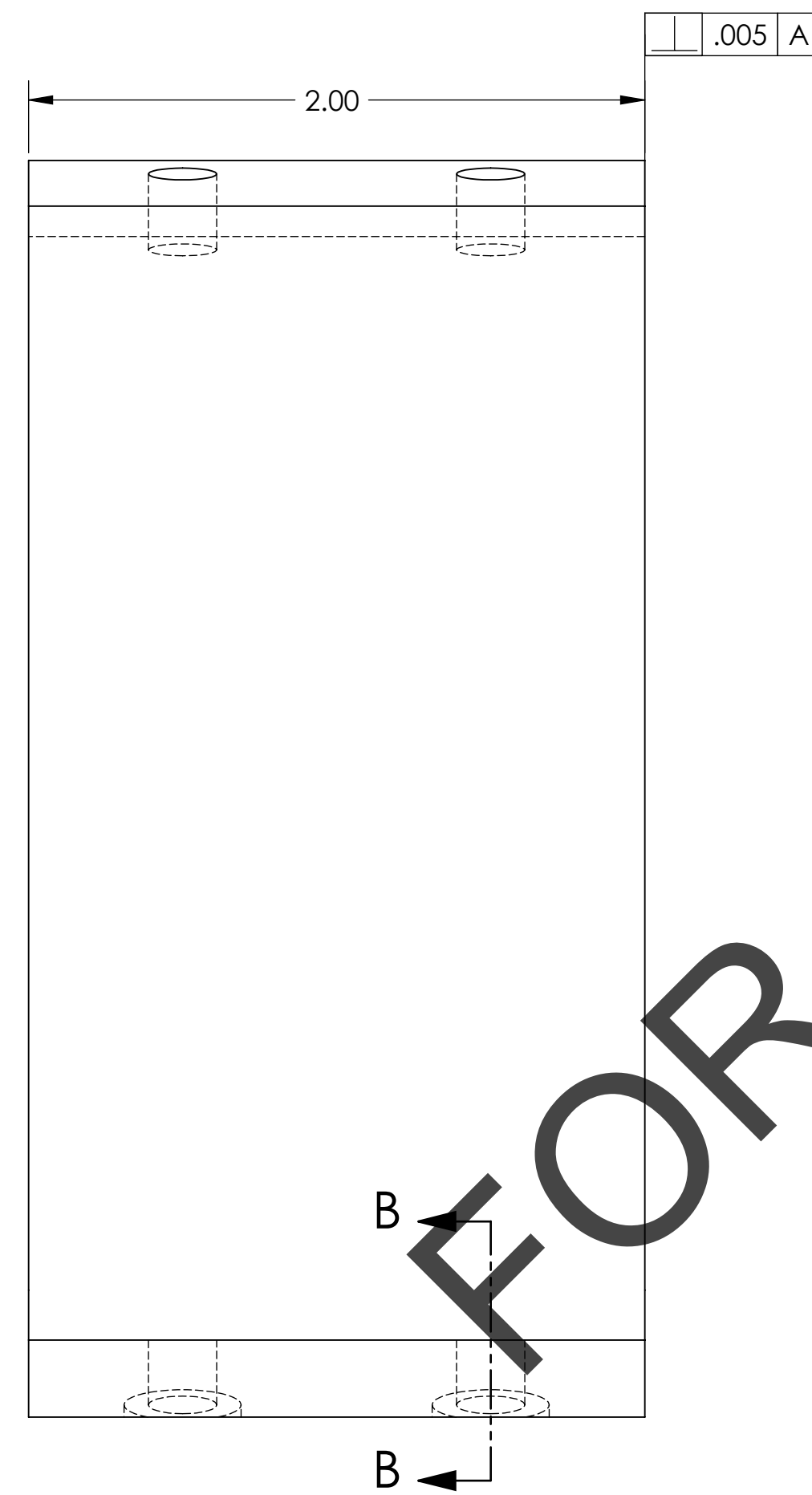
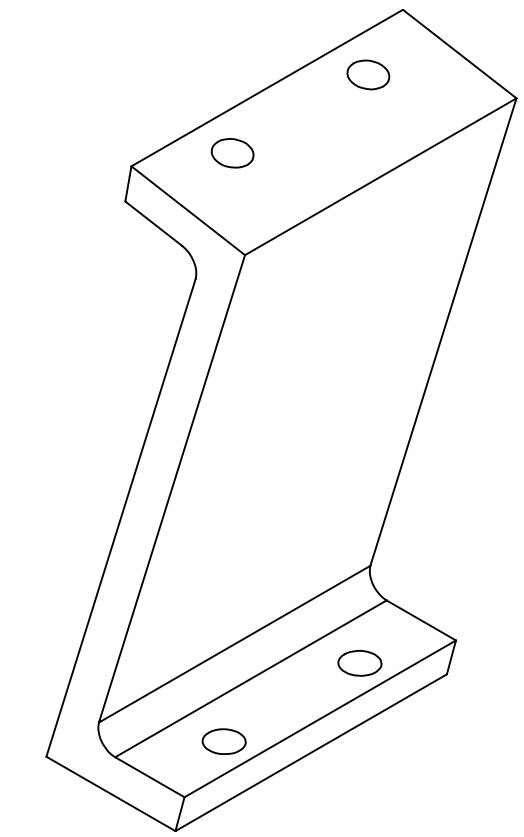
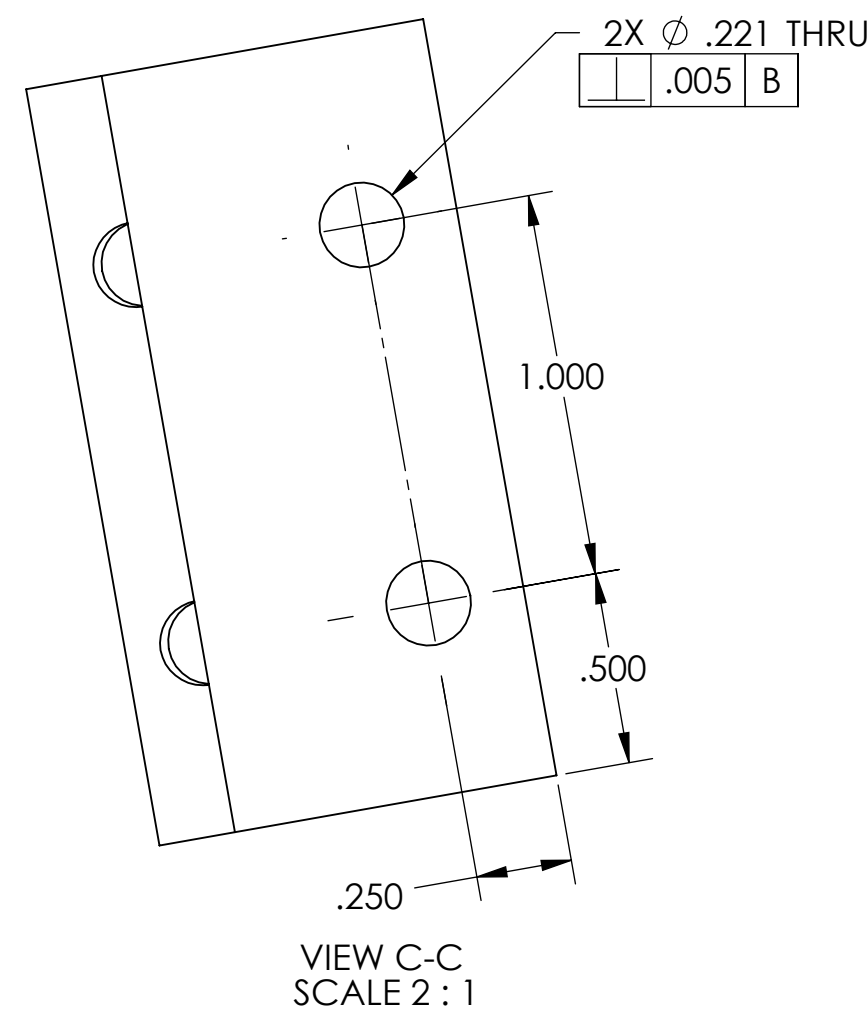
GENERAL VIEW
FOR REFERENCE ONLY
NO SCALE

FOR QUOTE ONLY

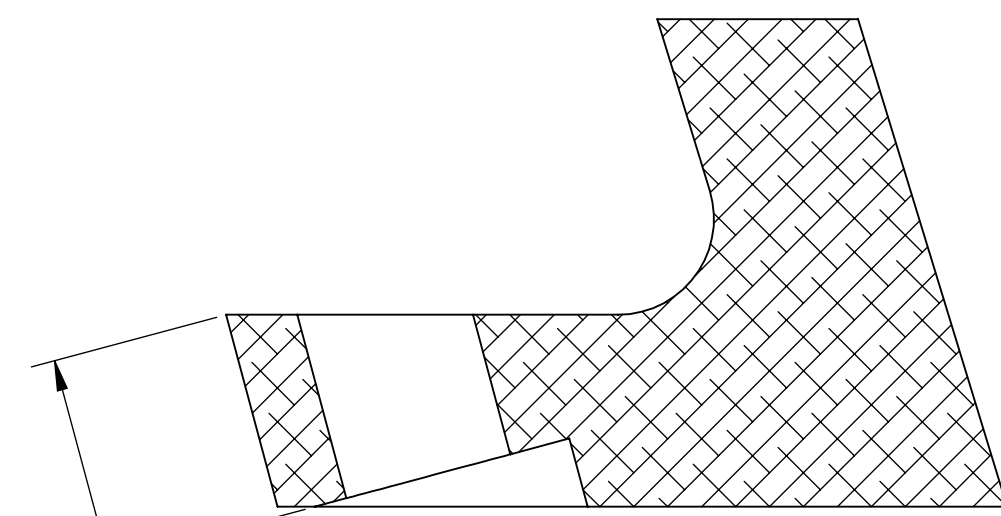
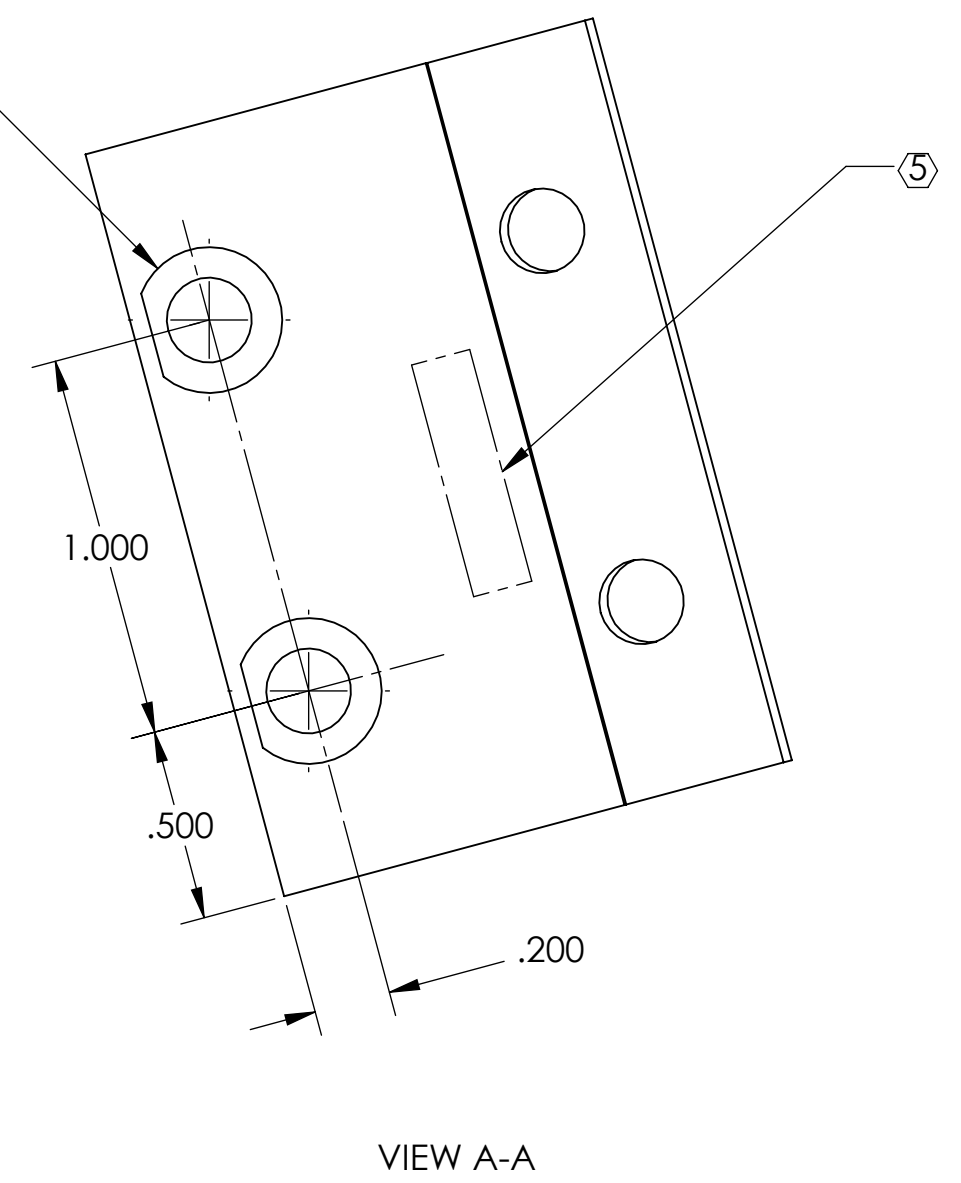
NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME							
DIMENSIONS ARE IN INCHES						MOUNT BRACKET_TOP							
TOLERANCES: .XX ± .01 .XXX ± .005													
ANGULAR ± 0.5°				SYSTEM ADVANCED LIGO		SUB-SYSTEM AOS		DESIGNER TQ. NGUYEN	30 APR 2008	SIZE D	DWG. NO. D1000780	REV. v1	
MATERIAL 6061-T6 Al				FINISH 63 μinch		NEXT ASSY D1002864		CHECKER M. SMITH	9 NOV 2010	SCALE: 2:1		PROJECTION: 	SHEET 1 OF 1
								APPROVAL D. COYNE					

- NOTES: UNLESS OTHERWISE SPECIFIED**
1. INTERPRET DRAWING PER ASME Y14.5-1994.
 2. REMOVE ALL SHARP EDGES 0.005" to 0.015".
 3. DO NOT SCALE FROM DRAWING.
 4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
 5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
 6. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
 7. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
 8. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



2X ϕ .221 ∇ .50
 \square ϕ .38
 SEE SECTION B-B FOR
 COUNTERBORE DEPTH



NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

DIMENSIONS ARE IN INCHES
 TOLERANCES:
 .XX \pm .01
 .XXX \pm .005
 ANGULAR \pm 0.5°

MATERIAL 6061-T6 Al
 FINISH 63 μ inch

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY
 MASSACHUSETTS INSTITUTE OF TECHNOLOGY

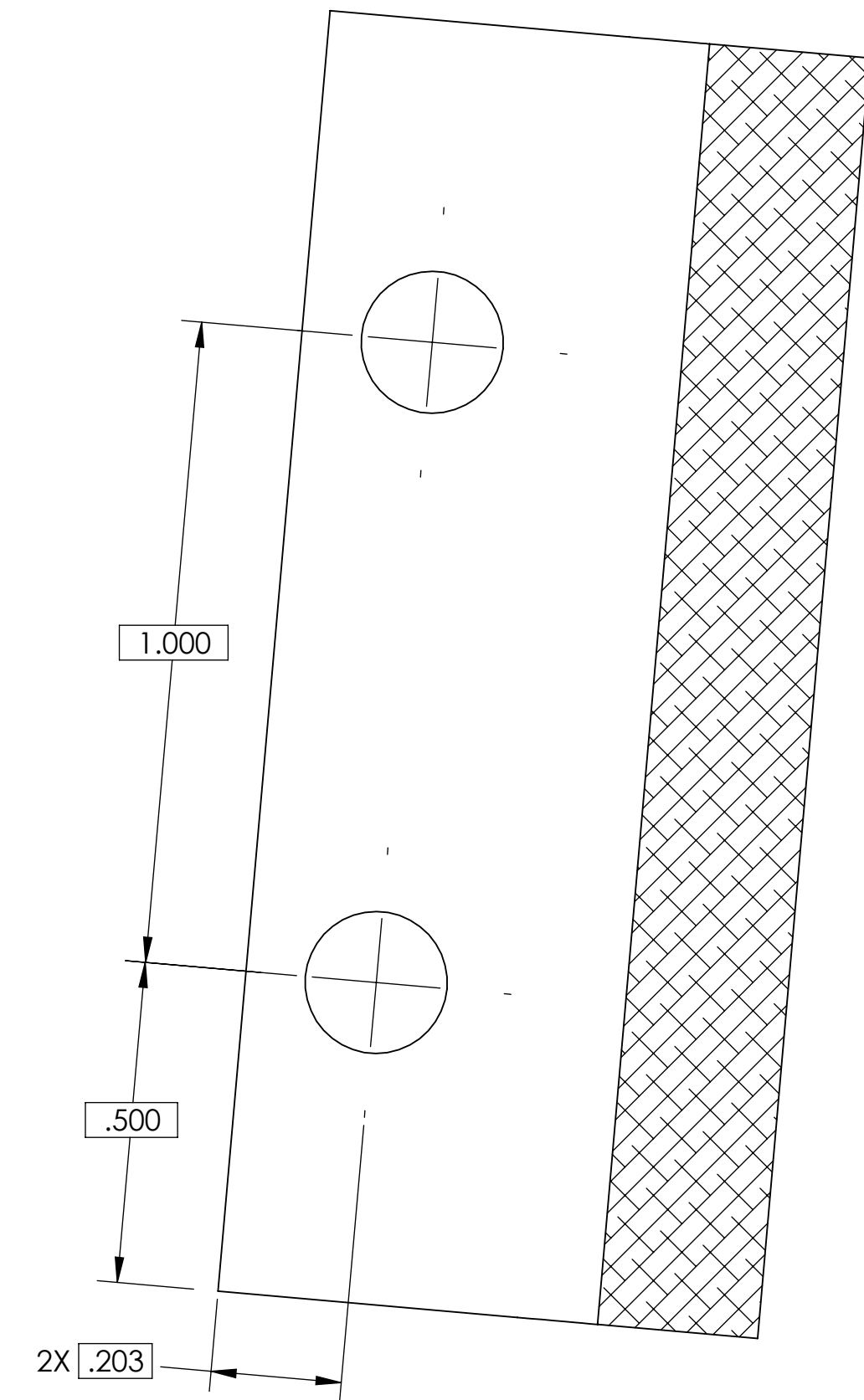
SYSTEM ADVANCED LIGO
 SUB-SYSTEM AOS
 NEXT ASSY D1002863

PART NAME				SIZE		DWG. NO.		REV.
STANDOFF SPACER_RIGHT				D	D1000783		v1	
DESIGNER	H. KELMAN	8 OCT 2010	CHECKER	M. SMITH	9 NOV 2010	APPROVAL	D. COYNE	
SCALE: 2:1				PROJECTION:		SHEET 1 OF 1		

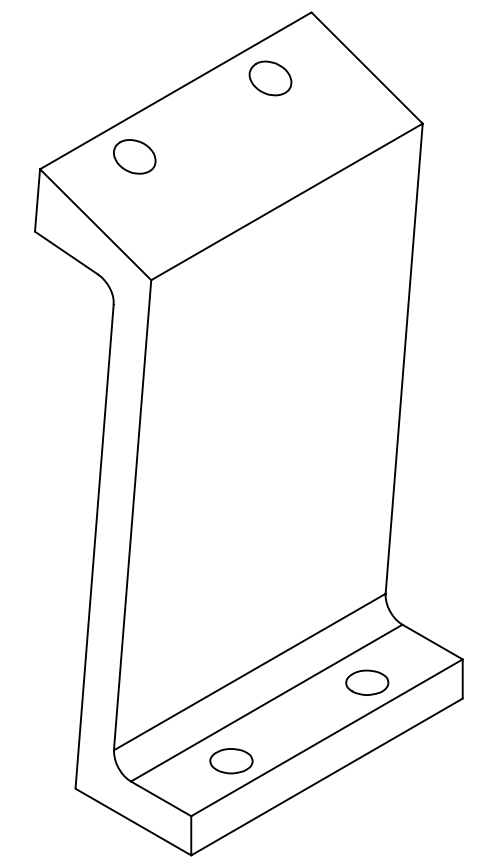
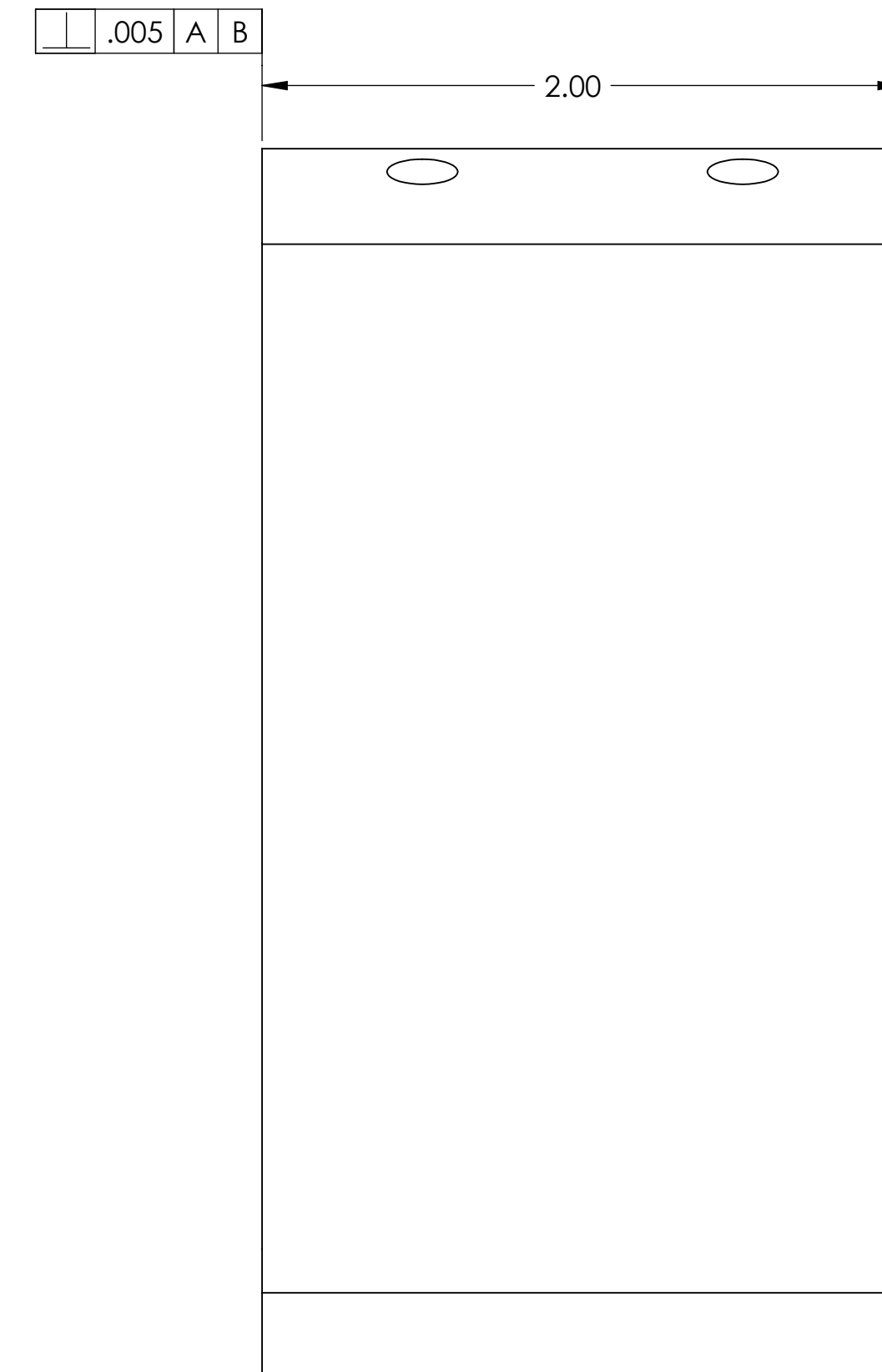
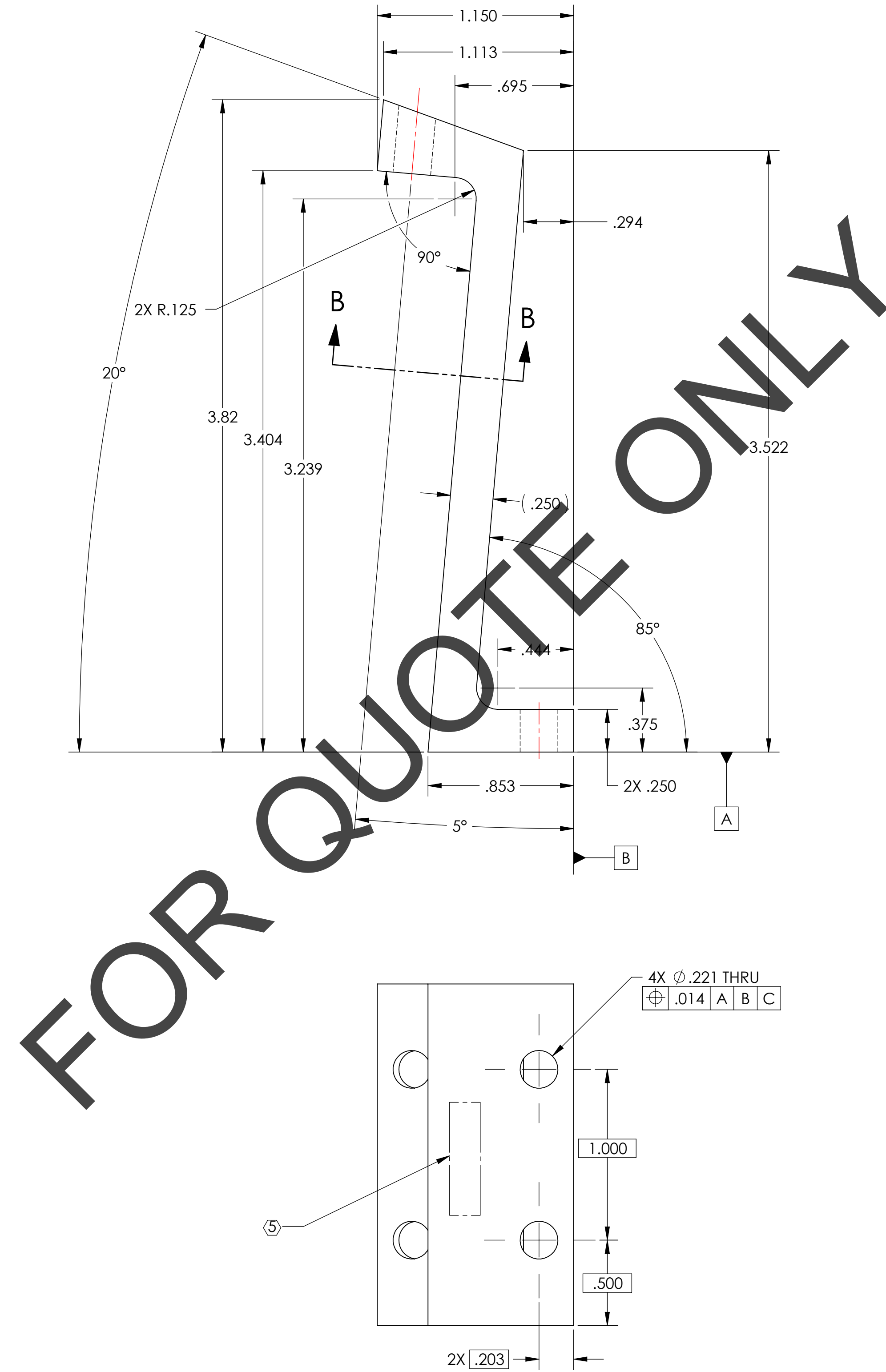
REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-

NOTES: UNLESS OTHERWISE SPECIFIED

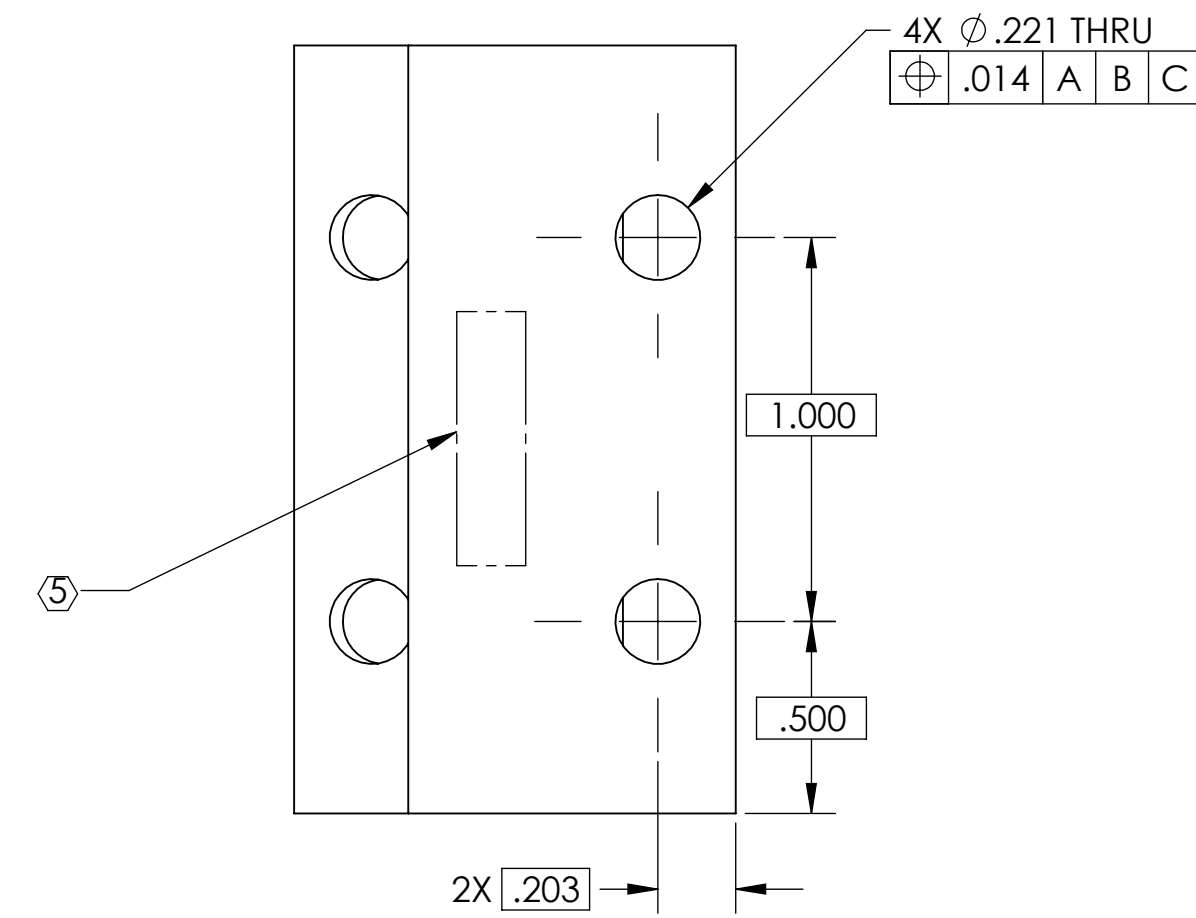
1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES 0.005" to 0.015".
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS. UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
6. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364
7. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
8. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.



SECTION B-B
SCALE 4:1



GENERAL VIEW
FOR REFERENCE ONLY
NO SCALE



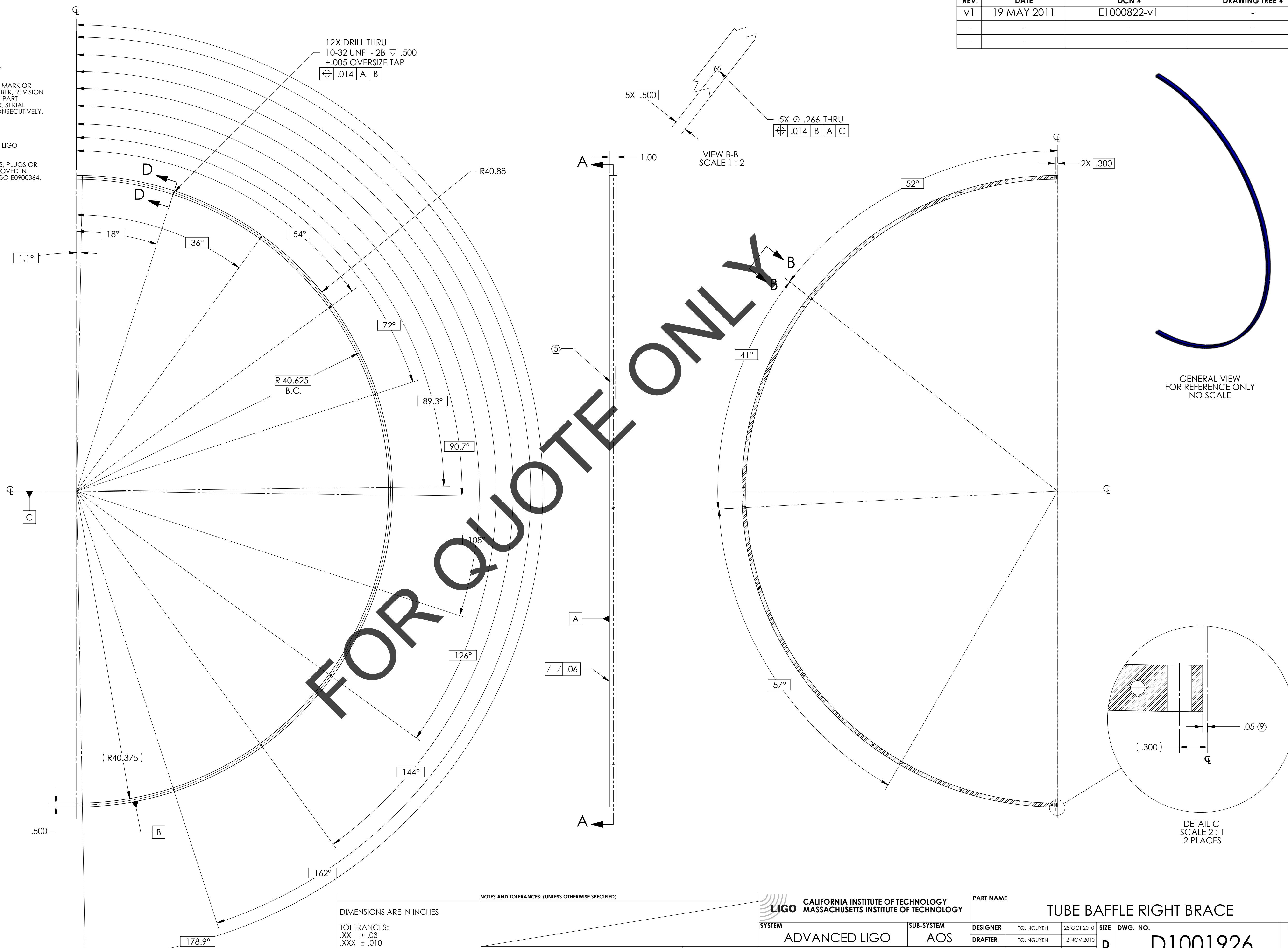
NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME	
DIMENSIONS ARE IN INCHES				SYSTEM		SUB-SYSTEM	
TOLERANCES: .XX ± .01 .XXX ± .005				ADVANCED LIGO		AOS	
ANGULAR ± 0.5°				MATERIAL		DESIGNER	
6061-T6 Al				FINISH		H. KELMAN 8 OCT 2010	
63 μinch				NEXT ASSY		D. NGUYEN 8 NOV 2010	
D1002863				D		SIZE DWG. NO.	
				APPROVAL		D1000784	
				D. COYNE		REV.	
				SCALE: 2:1		v1	
				PROJECTION:		SHEET 1 OF 1	

D:\000784_d\lgo_m\c_tube_baffle_mount_standoff_spacer_left.dwg PDM REV: X014, DRAWING PDM REV: X019

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-

NOTES: UNLESS OTHERWISE SPECIFIED

- INTERPRET DRAWING PER ASME Y14.5-1994.
- REMOVE ALL SHARP EDGES 0.005" TO 0.015".
- DO NOT SCALE FROM DRAWING.
- ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
- SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
- ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
- ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
- ELECTRO POLISH TO REMOVE .0005-.001 PER SIDE
- PART NOT TRUE HALF CIRCLE.



NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

DIMENSIONS ARE IN INCHES
 TOLERANCES:
 .XX ± .03
 .XXX ± .010
 ANGULAR ± 0.5°

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME TUBE BAFFLE RIGHT BRACE	
SYSTEM ADVANCED LIGO	SUB-SYSTEM AOS	DESIGNER TQ. NGUYEN	DATE 28 OCT 2010
DRAFTER TQ. NGUYEN	CHECKER M. SMITH	DATE 12 NOV 2010	SIZE D
APPROVAL D. COYNE	SCALE 1:6	DWG. NO. D1001926	REV. v1
MATERIAL 6061-T6 Al	FINISH 63 μinch	NEXT ASSY D1002864	PROJECTION

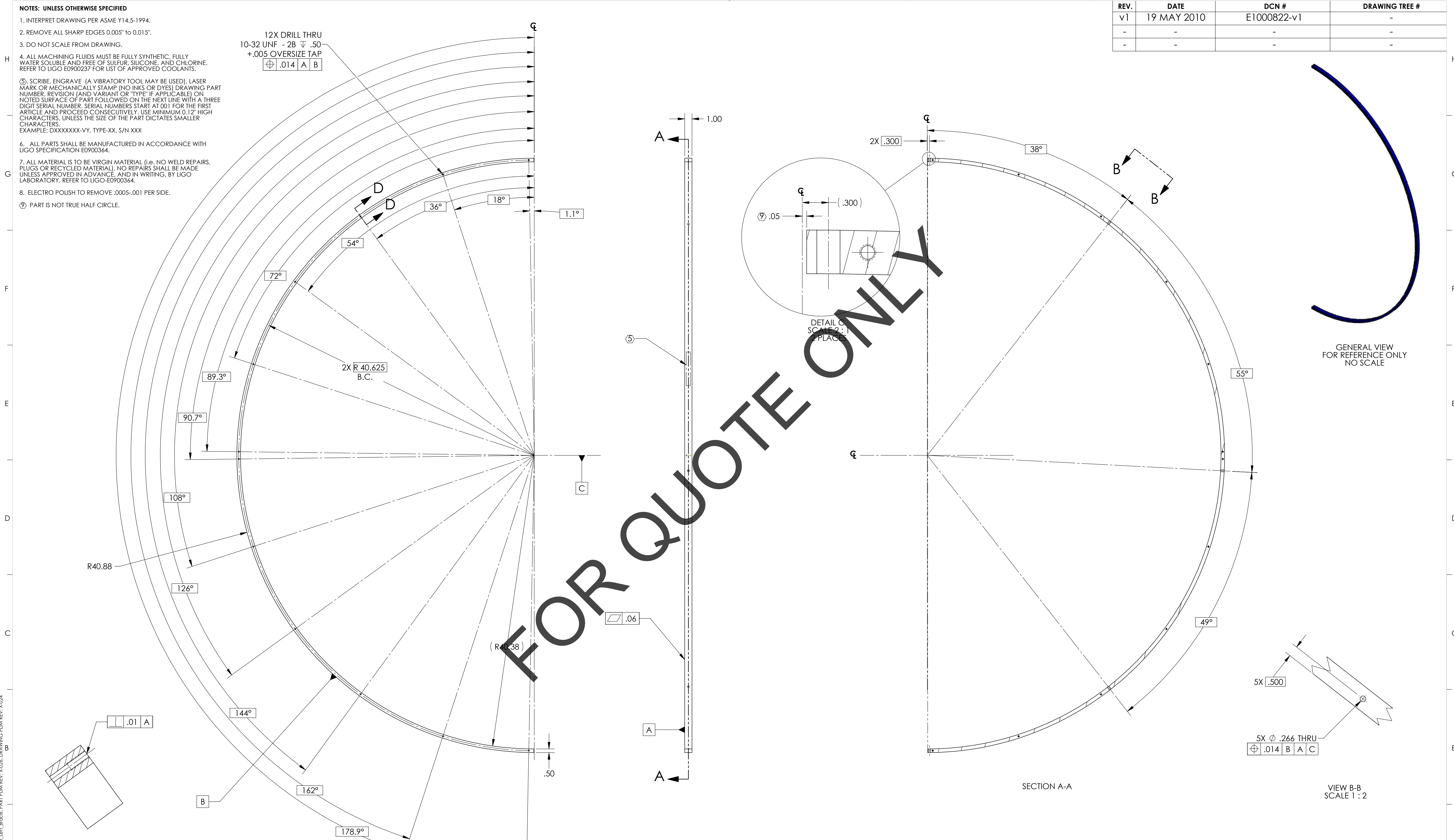
GENERAL VIEW FOR REFERENCE ONLY NO SCALE

DETAIL C SCALE 2:1 2 PLACES

SECTION D-D SCALE 2:1 (12X)

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2010	E1000822-v1	-
-	-	-	-
-	-	-	-

- NOTES: UNLESS OTHERWISE SPECIFIED**
1. INTERPRET DRAWING PER ASME Y14.5-1994.
 2. REMOVE ALL SHARP EDGES 0.005" to 0.015".
 3. DO NOT SCALE FROM DRAWING.
 4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
 5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
 6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
 7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
 8. ELECTRO POLISH TO REMOVE .0005-.001 PER SIDE.
 9. PART IS NOT TRUE HALF CIRCLE.



GENERAL VIEW FOR REFERENCE ONLY NO SCALE

SECTION D-D SCALE 1 : 1 (12X)

SECTION A-A

VIEW B-B SCALE 1 : 2

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				PART NAME	
DIMENSIONS ARE IN INCHES				TUBE BAFFLE LEFT BRACE	
TOLERANCES: .XX ± .03 .XXX ± .010				CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY	
MATERIAL		FINISH		NEXT ASSY	
6061-T6 Al		63 μinch		D1002864	
SYSTEM: ADVANCED LIGO SUB-SYSTEM: AOS				DESIGNER: TQ. NGUYEN DRAFTER: TQ. NGUYEN CHECKER: M. SMITH APPROVAL: D. COYNE	
SIZE: D SCALE: 1:6 PROJECTION:				DWG. NO.: D1002867 REV.: v1 SHEET 1 OF 1	

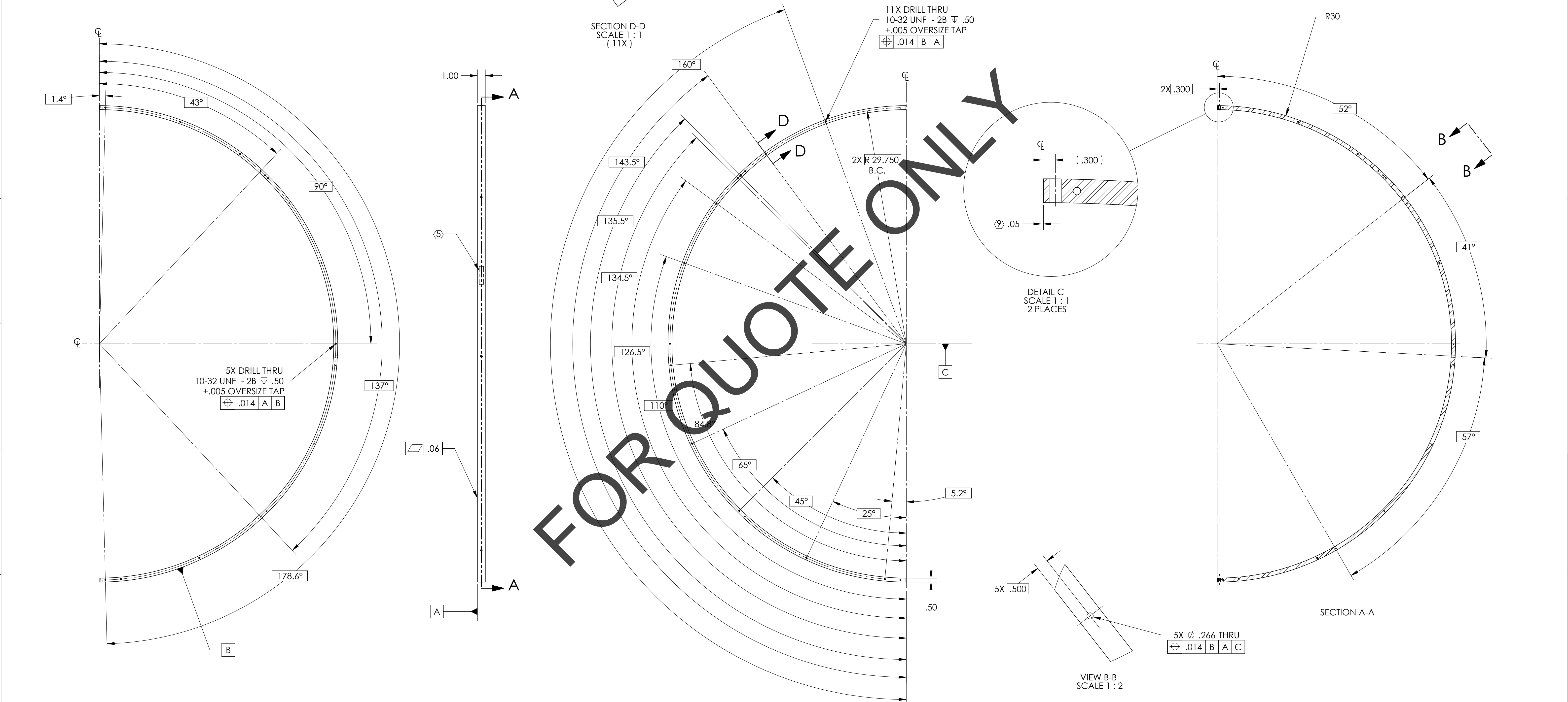
D1002867.dwg; JAC; Tube_Baffle_Left_Brace; PART FDM; REV: X026; DRAWING FDM; REV: X024

NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES 0.005" to 0.015".
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX

6. ELECTRO POLISH TO REMOVE .0005-.001 PER SIDE
 7. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
 8. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
- Ⓢ PART NOT TRUE HALF CIRCLE.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2010	E1000822-v1	-
-	-	-	-
-	-	-	-



FOR QUOTE ONLY

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME											
DIMENSIONS ARE IN INCHES				<table border="1"> <tr> <td>SYSTEM</td> <td>ADVANCED LIGO</td> <td>SUB-SYSTEM</td> <td>AOS</td> </tr> <tr> <td>NEXT ASSY</td> <td colspan="2">D1002864</td> <td></td> </tr> </table>		SYSTEM	ADVANCED LIGO	SUB-SYSTEM	AOS	NEXT ASSY	D1002864			TUBE BAFFLE INNER RIGHT BRACE			
SYSTEM	ADVANCED LIGO	SUB-SYSTEM	AOS														
NEXT ASSY	D1002864																
TOLERANCES: .XX ± .03 .XXX ± .010 ANGULAR ± 0.5°				DESIGNER	TQ. NGUYEN	27 OCT 2010	SIZE	D	DWG. NO.	D1002868	REV.	v1					
MATERIAL				6061-T6 Al		FINISH		63 μinch		CHECKER	M. SMITH	APPROVAL	D. COYNE				
						SCALE: 1:6		PROJECTION:		SHEET 1 OF 1							

D1002868.dwg, LIGO, IAC, Tube Baffle Inner Right Brace, PART PDM REV: X-026, DRAWING PDM REV: X-024

NOTES: UNLESS OTHERWISE SPECIFIED

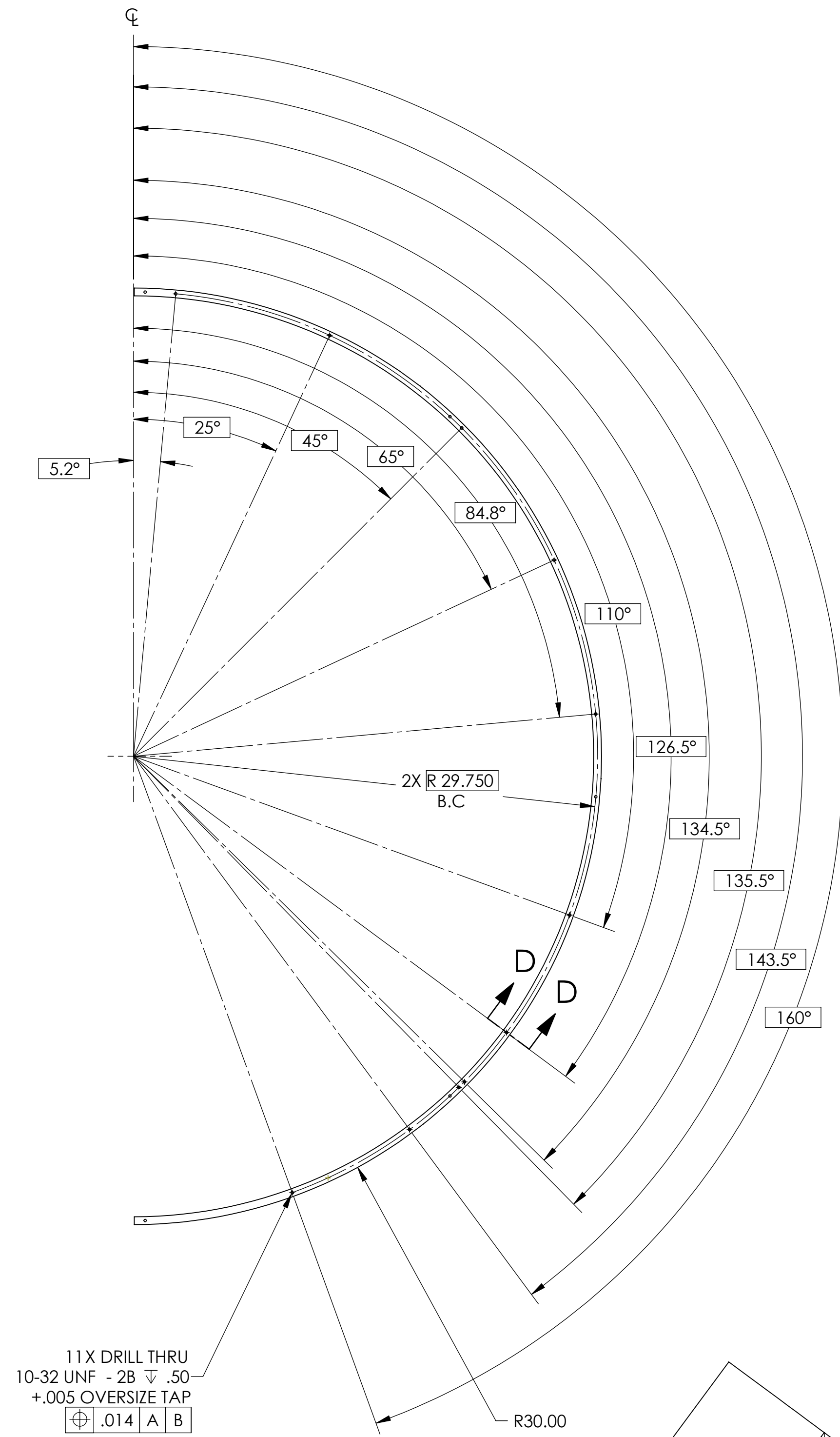
1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES 0.005" TO 0.015".
3. DO NOT SCALE FROM DRAWING.

4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.

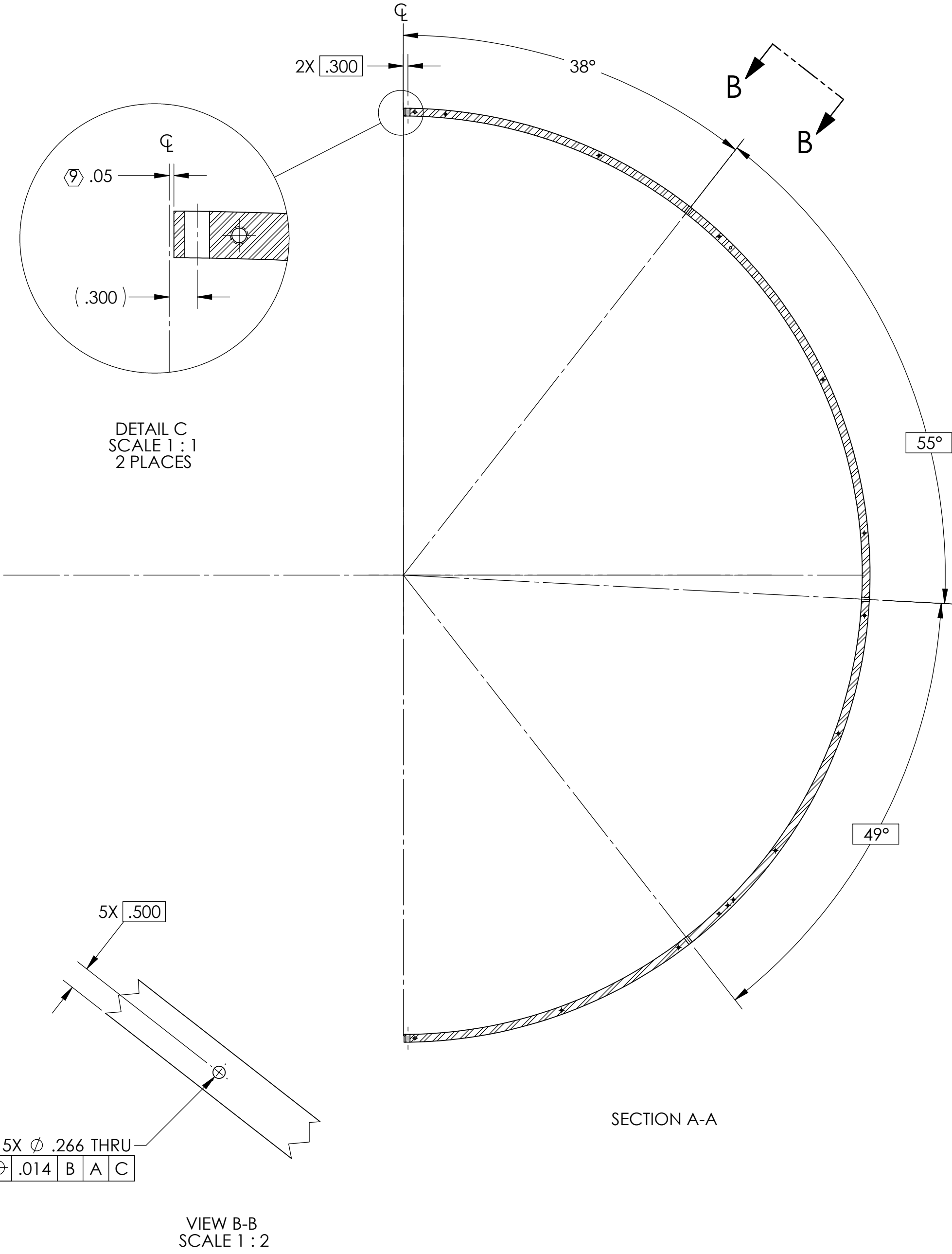
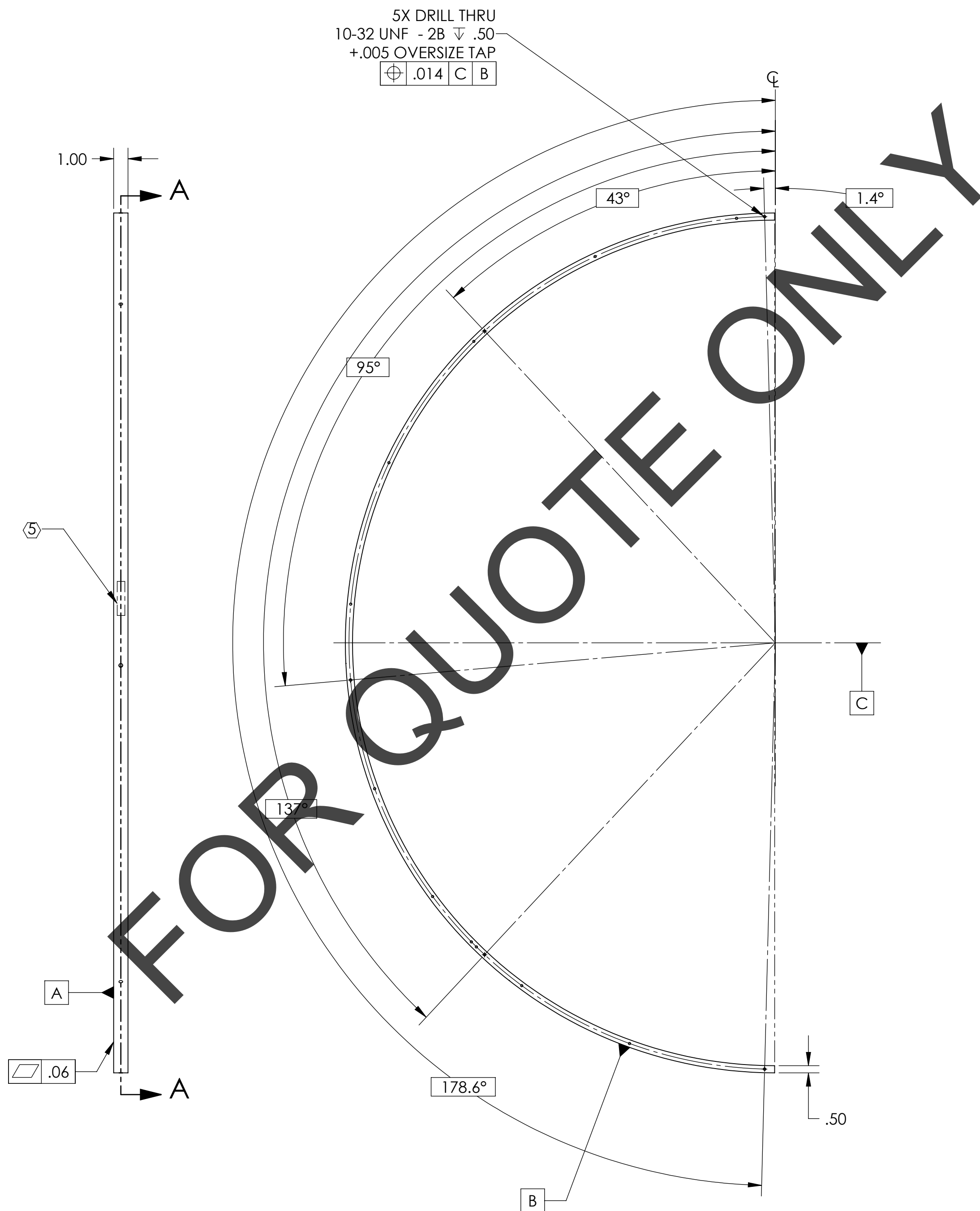
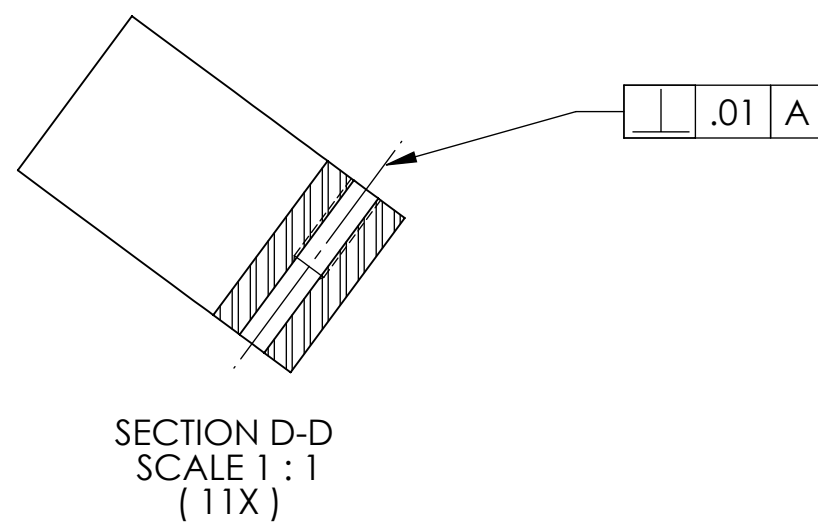
5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR 'TYPE' IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS. UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX

6. ELECTRO POLISH TO REMOVE .0005 TO .001 PER SIDE.
 7. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
 8. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
9. PART NOT TRUE HALF CIRCLE

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



11X DRILL THRU
10-32 UNF - 2B ∇ .50
+.005 OVERSIZE TAP
 \oplus .014 A B



NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME							
DIMENSIONS ARE IN INCHES				SYSTEM		SUB-SYSTEM		TUBE BAFFLE INNER LEFT BRACE					
TOLERANCES: .XX \pm .03 .XXX \pm .010				ADVANCED LIGO		AOS		DESIGNER	TQ. NGUYEN	27 OCT 2010	SIZE	DWG. NO.	REV.
ANGULAR \pm 0.5°				MATERIAL		NEXT ASSY		CHECKER	M. SMITH	16 NOV 2010	D	D1002869	v1
				6061-T6 Al		D1002864		APPROVAL	D. COYNE		SCALE: 1:6	PROJECTION:	SHEET 1 OF 1

D1002869.dwg LIGO_MSC_Tube_Baffle_Inner_Left_Brace_PART_PDM_REV_X.001_DRAWING_PDM_REV_X.025

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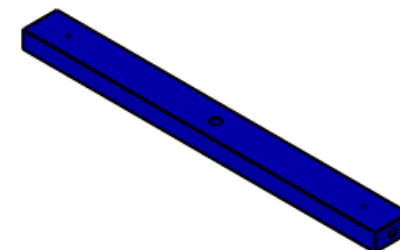
2

1

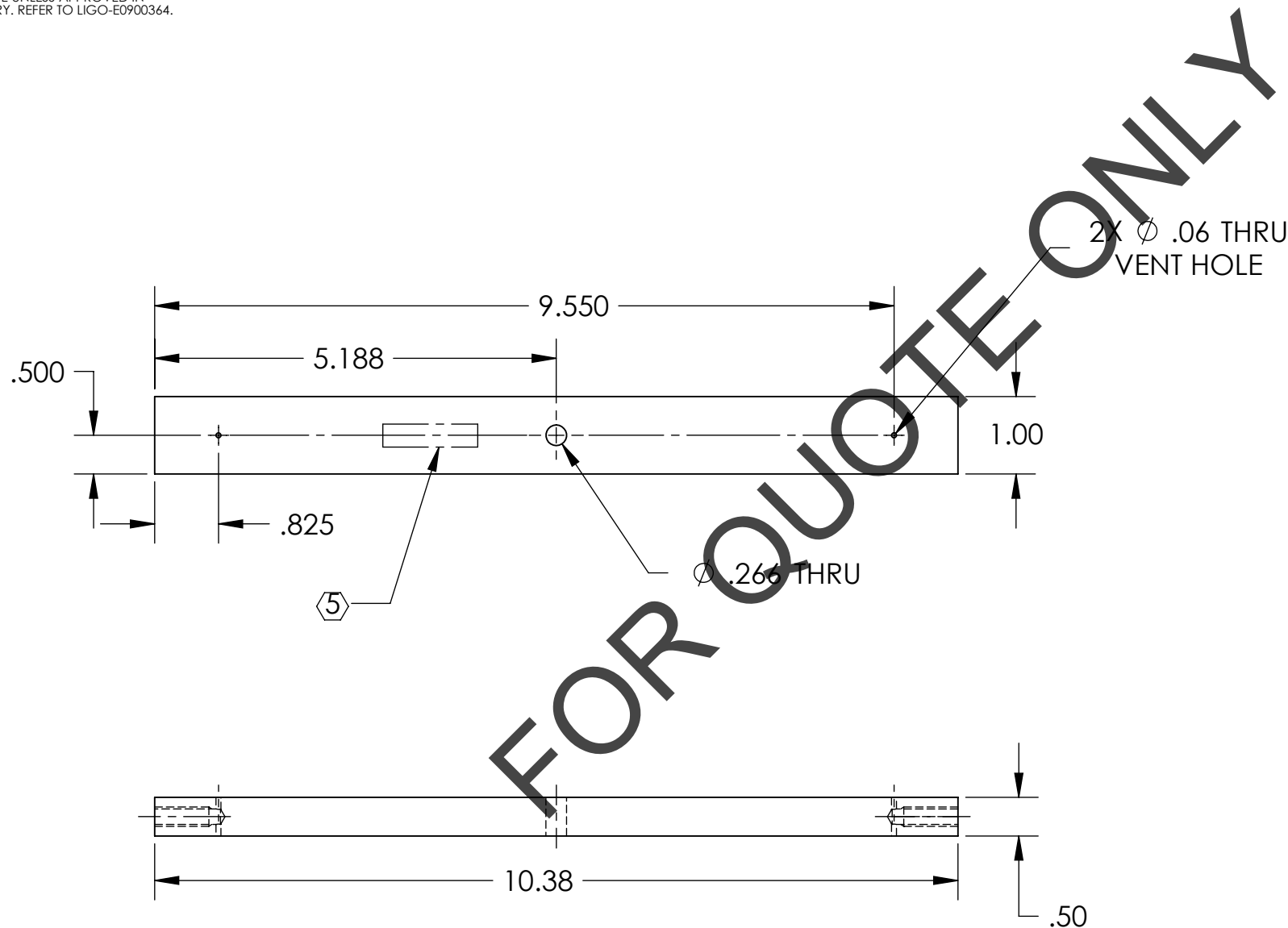
NOTES: UNLESS OTHERWISE SPECIFIED

- 1. INTERPRET DRAWING PER ASME Y14.5-1994.
- 2. REMOVE ALL SHARP EDGES 0.005" TO 0.015".
- 3. DO NOT SCALE FROM DRAWING.
- 4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
- 5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
- 6. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED.
- 7. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
- 8. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



GENERAL VIEW
FOR REFERENCE ONLY
NO SCALE



NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

DIMENSIONS ARE IN INCHES
TOLERANCES:
.XX ± .02
.XXX ± .005
ANGULAR ± 0.5°

MATERIAL 6061-T6 Al FINISH 63 μinch

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SYSTEM ADVANCED LIGO SUB-SYSTEM AOS

NEXT ASSY D1002864

PART NAME			TUBE BAFFLE SPOKE		
DESIGNER	TQ. NGUYEN	28 OCT 2010	SIZE	DWG. NO.	REV.
DRAFTER	TQ. NGUYEN	12 NOV 2010	B	D1002871	v1
CHECKER	M. SMITH		SCALE: 1:2	PROJECTION:	SHEET 1 OF 1
APPROVAL	D. COYNE				

D1002871_d1lIGO_MC_Tube_Baffle_Spoke, PART PDM REV: X-016, DRAWING PDM REV: X-015

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5

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2

1

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-

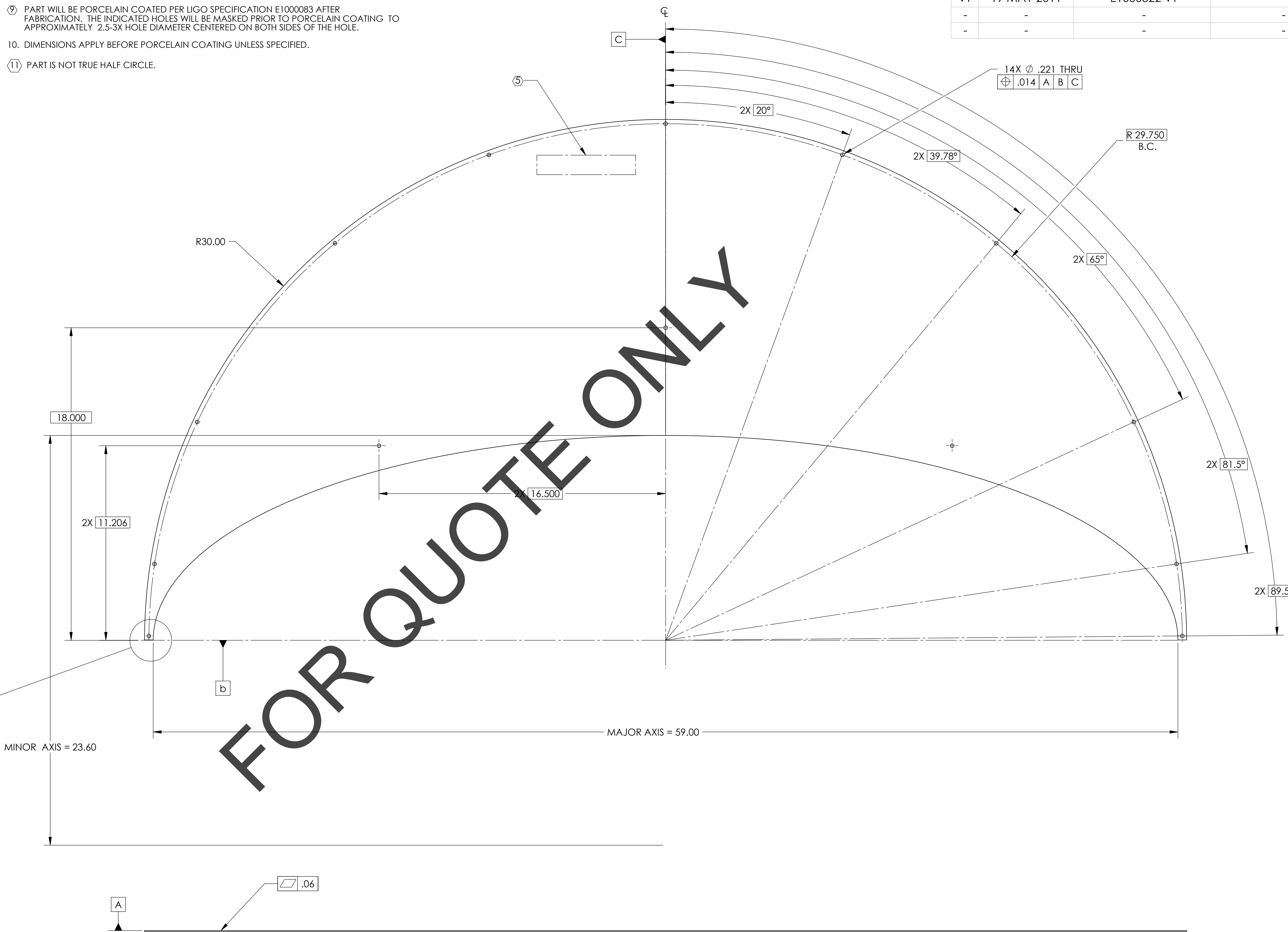
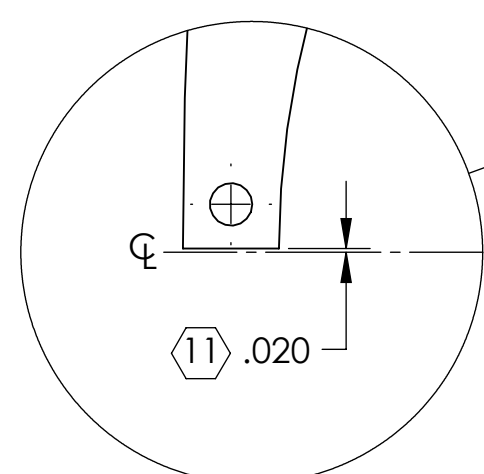
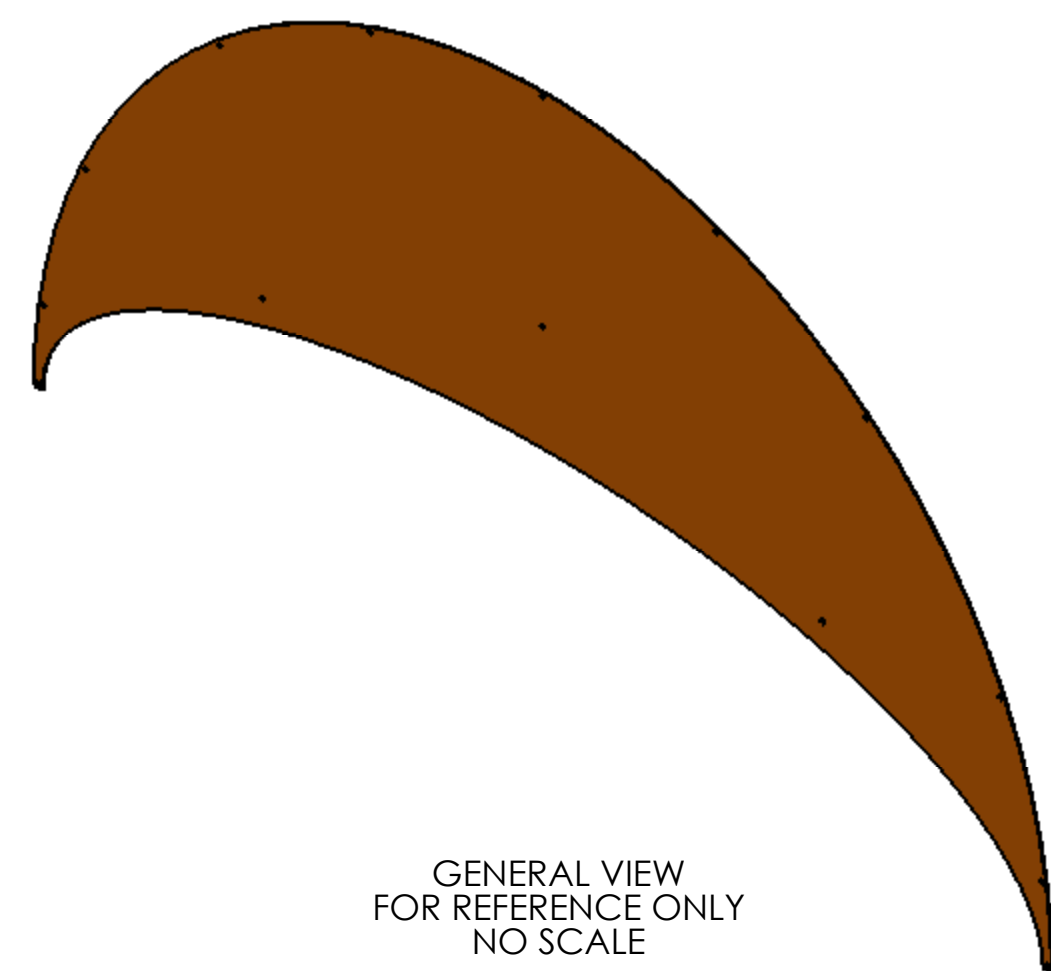
NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES AND BURRS AND ROUND EDGES APPROXIMATELY R.02.
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINE FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE AND CHLORINE PER LIGO DOCUMENT E0900237.
5. MECHANICALLY STAMP (NO INKS OR DYES) PART NUMBER, REVISION AND SERIAL NUMBER .020 DEEP WITH MINIMUM CHARACTER HEIGHT .156 APPROXIMATELY WHERE SHOWN. SERIAL NUMBER WILL START AT 001 AND PROCEED CONSECUTIVELY. EXAMPLE: D100XXXX-V1 S/N 001
6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPEC E0900364.
7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (I.E. NO WELD REPAIRS OR PLUGS) UNLESS APPROVED IN ADVANCE, IN WRITING, BY LIGO PER SPECIFICATION E0900364.
8. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.

9. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.

10. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.

11. PART IS NOT TRUE HALF CIRCLE.



FOR QUOTE ONLY

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

DIMENSIONS ARE IN INCHES
 TOLERANCES:
 .XX ± .03
 .XXX ± .010
 ANGULAR ± 0.5°

MATERIAL		FINISH		NEXT ASSY	
18GA A424 TYPE 1 STEEL		8 9		D1002864	

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY
 MASSACHUSETTS INSTITUTE OF TECHNOLOGY

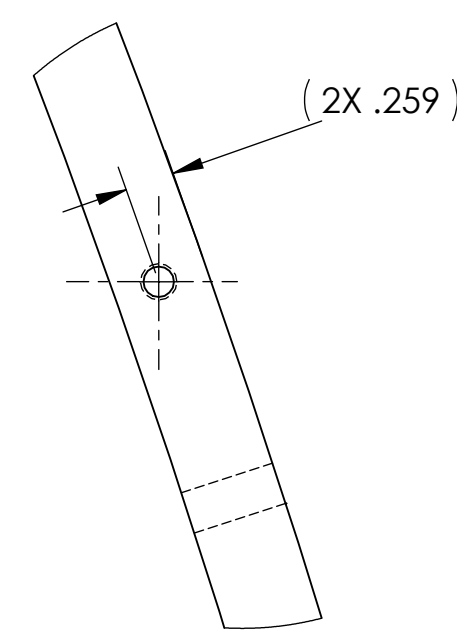
SYSTEM: ADVANCED LIGO SUB-SYSTEM: AOS

PART NAME				APERTURE PLATE_1500 MM			
DESIGNER	TQ. NGUYEN	10 NOV 2010	SIZE	DWG. NO.	REV.		
DRAFTER	TQ. NGUYEN	12 NOV 2010	D	D1002995	v1		
CHECKER	M. SMITH		SCALE: 1:4	PROJECTION:	SHEET 1 OF 1		
APPROVAL	D. COYNE						

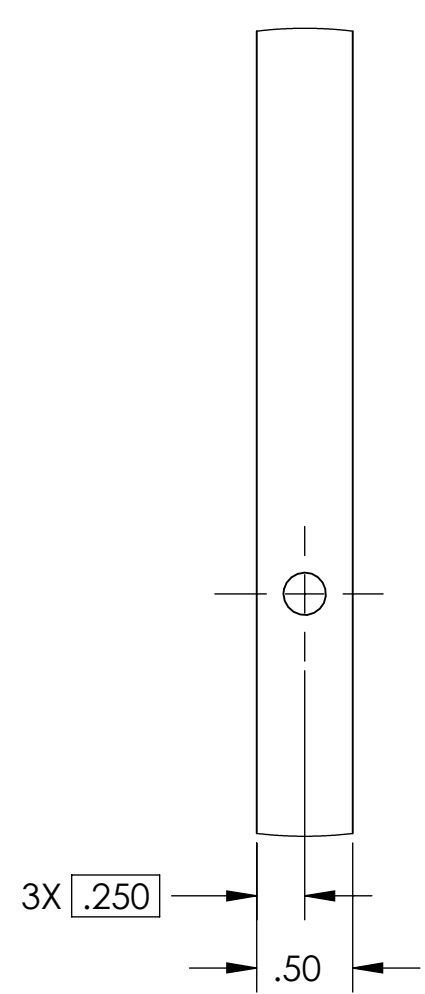
NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES 0.005" TO 0.015".
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
5. MACHINE DRAWING PART NUMBER, REVISION, AND SERIAL NUMBERS .020" DEPTH WITH MINIMUM .156" HIGH CHARACTERS, WHERE SHOWN.
6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
7. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER FREE FROM SCRATCHES OR GOUGES
8. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
9. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
10. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.

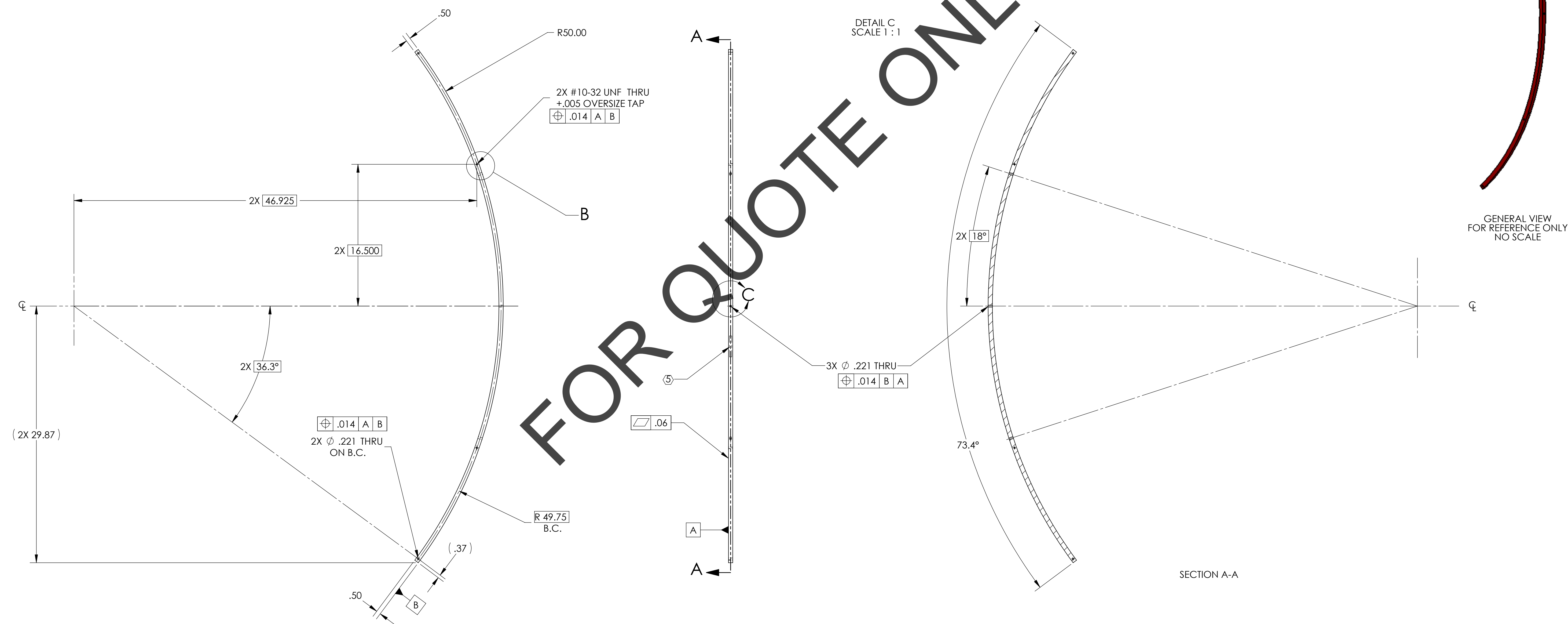
REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



DETAIL B
SCALE 1 : 1



DETAIL C
SCALE 1 : 1



FOR QUOTE ONLY

GENERAL VIEW
FOR REFERENCE ONLY
NO SCALE

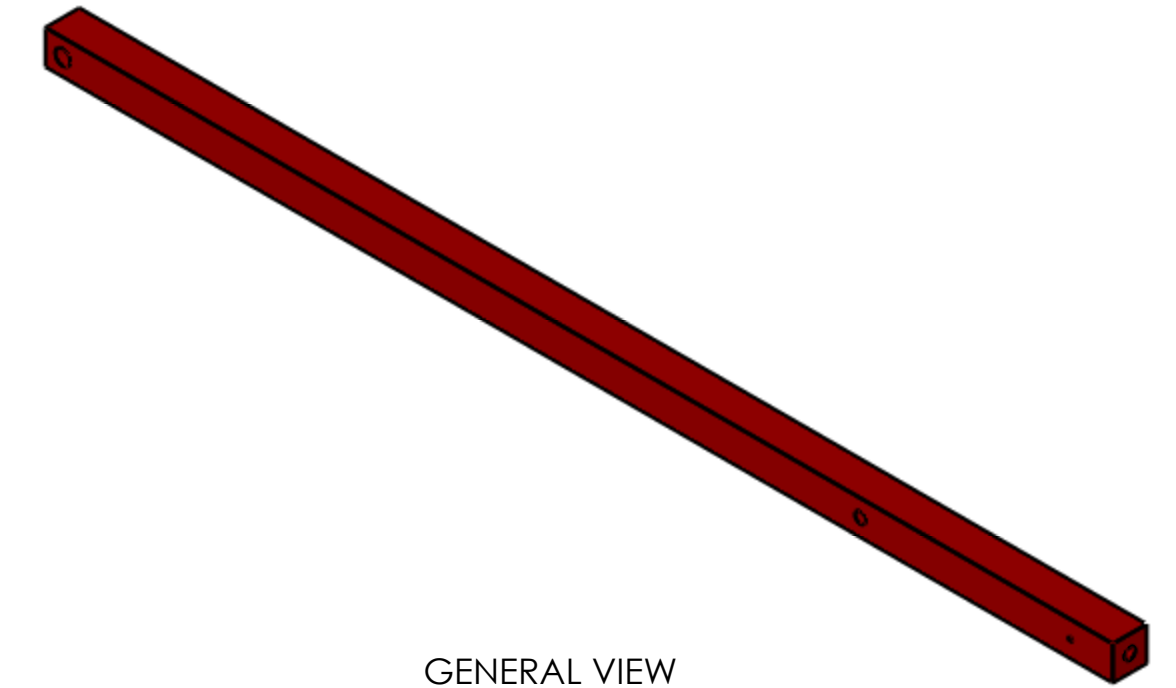
SECTION A-A

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME						
DIMENSIONS ARE IN INCHES						APERTURE SUPPORT						
TOLERANCES: .XX ± .03 .XXX ± .010 ANGULAR ± 0.5°												
MATERIAL		FINISH		SYSTEM		SUB-SYSTEM		DESIGNER	DATE	SIZE	DWG. NO.	REV.
304 SSSL				ADVANCED LIGO		AOS		TQ. NGUYEN	15 NOV 2010	D	D1002996	v1
				NEXT ASSY				CHECKER				
				D1002864				APPROVAL				
										SCALE: 1:6	PROJECTION:	SHEET 1 OF 1

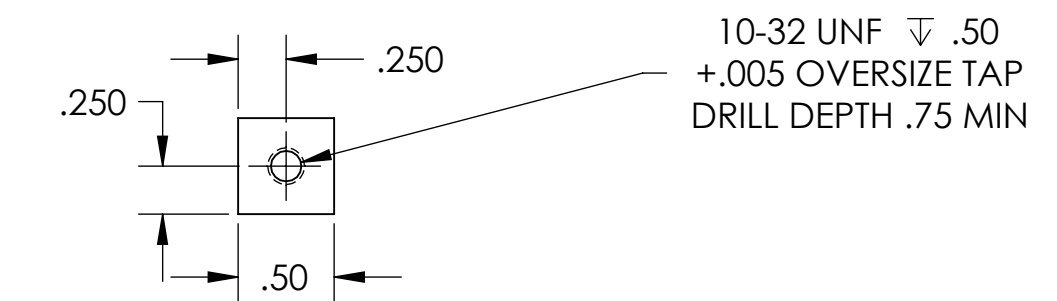
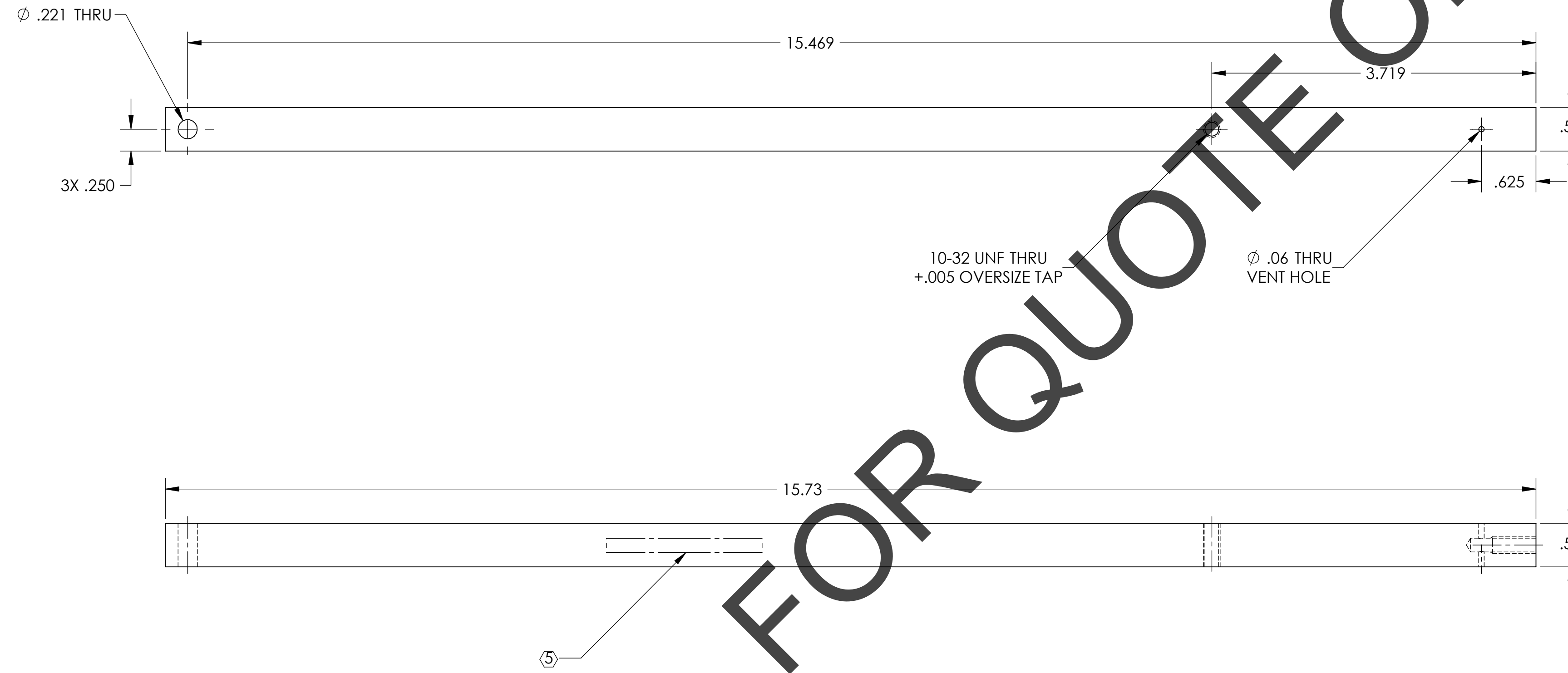
D1002996.dwg; LIGO; MC; Tube; Beffle; Aperture; Support; WAW; MC; B1; PART PDM; REV: X013; DRAWING PDM; REV: X027

- NOTES: UNLESS OTHERWISE SPECIFIED**
1. INTERPRET DRAWING PER ASME Y14.5-1994.
 2. REMOVE ALL SHARP EDGES 0.005" to 0.015".
 3. DO NOT SCALE FROM DRAWING.
 4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
 5. MACHINE DRAWING PART NUMBER, REVISION, AND SERIAL NUMBERS .020" DEPTH WITH MINIMUM .156" HIGH CHARACTERS, WHERE SHOWN.
 6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
 7. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER FREE FROM SCRATCHES OR GOUGES
 8. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
 9. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
 10. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	D1000822-v1	-
-	-	-	-
-	-	-	-



GENERAL VIEW
FOR REFERENCE ONLY
NO SCALE



FOR QUOTE ONLY

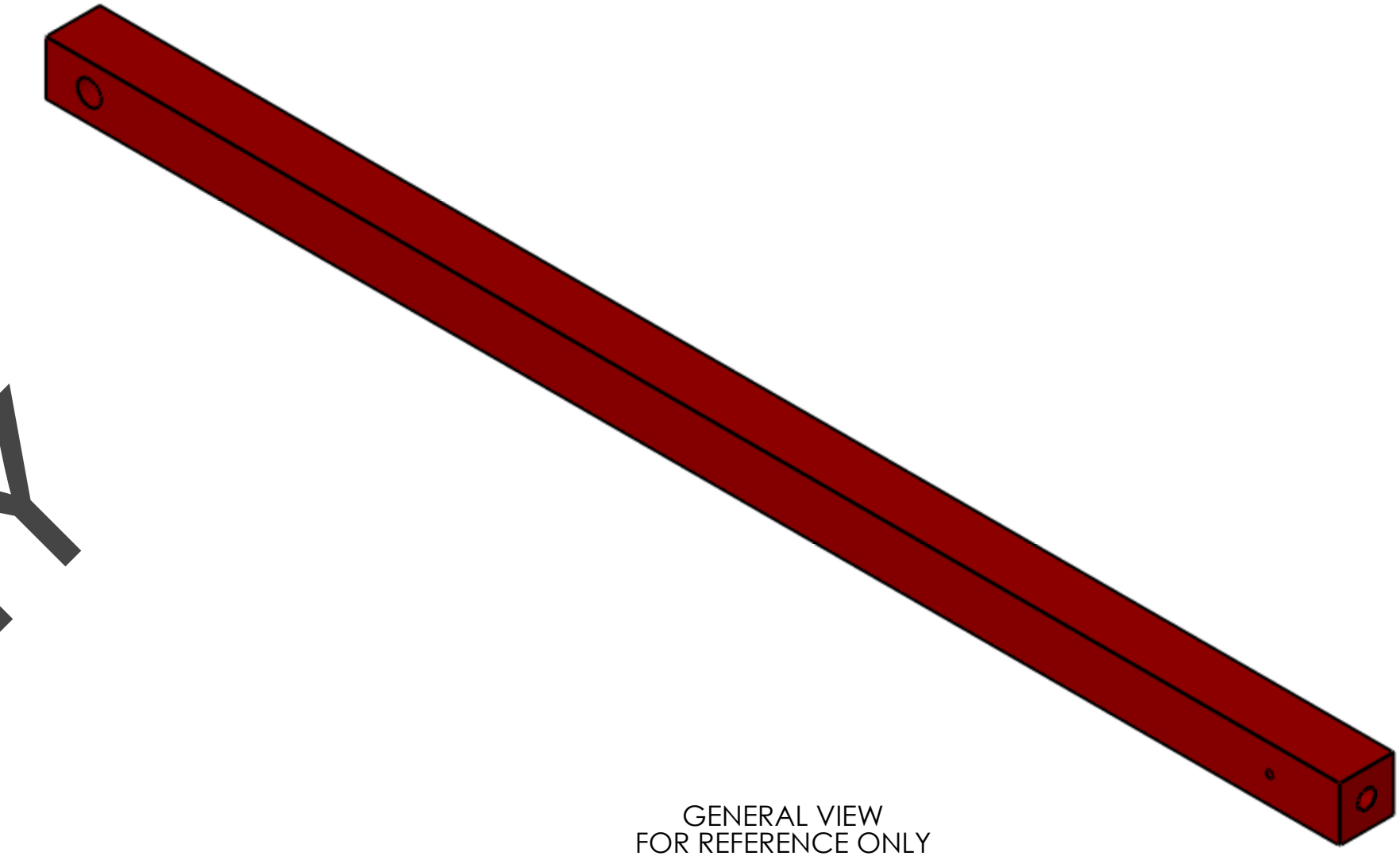
NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME						
DIMENSIONS ARE IN INCHES TOLERANCES: .XX ± .03 .XXX ± .010 ANGULAR ± 0.5°				SYSTEM ADVANCED LIGO		SUB-SYSTEM AOS		DESIGNER TQ. NGUYEN 11 NOV 2010		SIZE DWG. NO.		REV. v1
								CHECKER M. SMITH		D		
MATERIAL 304 SSSL				FINISH (7) (8)		NEXT ASSY D1002864		APPROVAL D. COYNE		SCALE: 1:1 PROJECTION:		SHEET 1 OF 1

D1002997.dwg; LIGO; MC; Tube; Beffle; Aperture; Mfg; Support; LYANCSB; PART; PDM; REV; X; 012; DRAWING; PDM; REV; X; 021

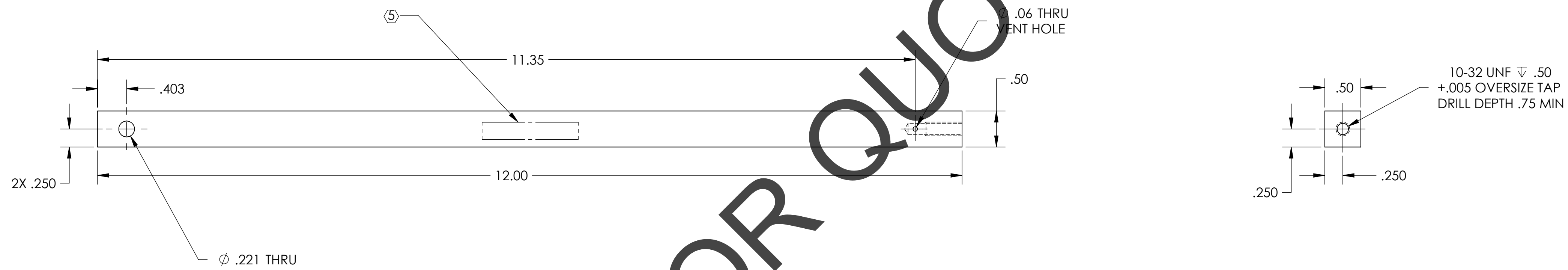
REV.	DATE	DCN #	DRAWING TREE #
v1	18 MAY 2011	E1000822-v1	

NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES 0.005" to 0.015".
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
5. MACHINE DRAWING PART NUMBER, REVISION, AND SERIAL NUMBERS .020" DEPTH WITH MINIMUM .156" HIGH CHARACTERS, WHERE SHOWN.
6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
8. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
9. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
10. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.



GENERAL VIEW
FOR REFERENCE ONLY
NO SCALE



FOR QUOTE ONLY

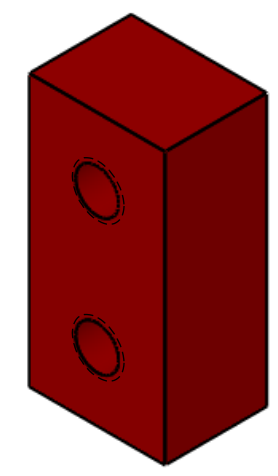
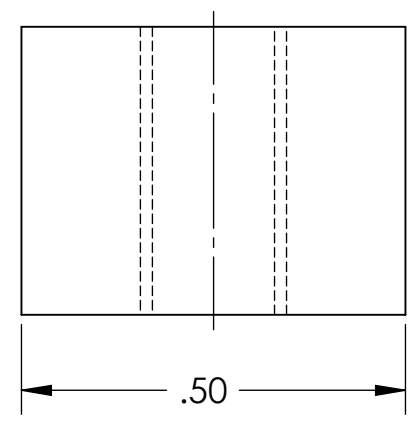
NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME					
DIMENSIONS ARE IN INCHES						APERTURE SIDE BRACE					
TOLERANCES: .XX ± .03 .XXX ± .010 ANGULAR ± 0.5°						SYSTEM ADVANCED LIGO	SUB-SYSTEM AOS	DESIGNER TQ. NGUYEN	11 NOV 2010	SIZE D	DWG. NO. D1002998
MATERIAL 304 SSSL				FINISH 8 9		NEXT ASSY D1002864		CHECKER M. SMITH	15 NOV 2010	SCALE: 1:1	
						APPROVAL D. COYNE		PROJECTION:		SHEET 1 OF 1	

D1002998.dwg; LIGO; MC; Tube; Bellis; Aperture; Site; Barco; WAM; CB1; PART; PDM; REV; X.012; DRAWING; PDM; REV; X.014

NOTES: UNLESS OTHERWISE SPECIFIED

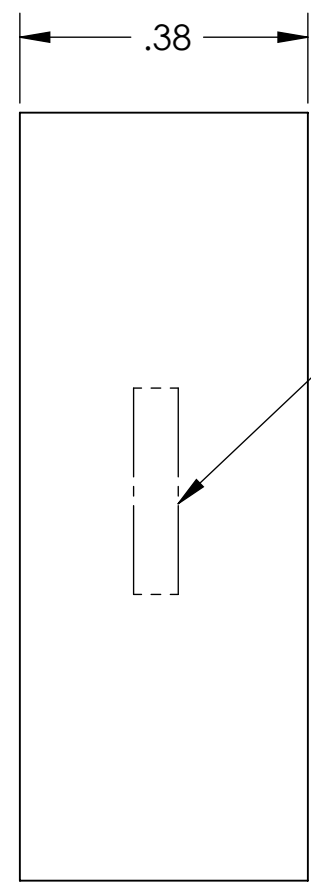
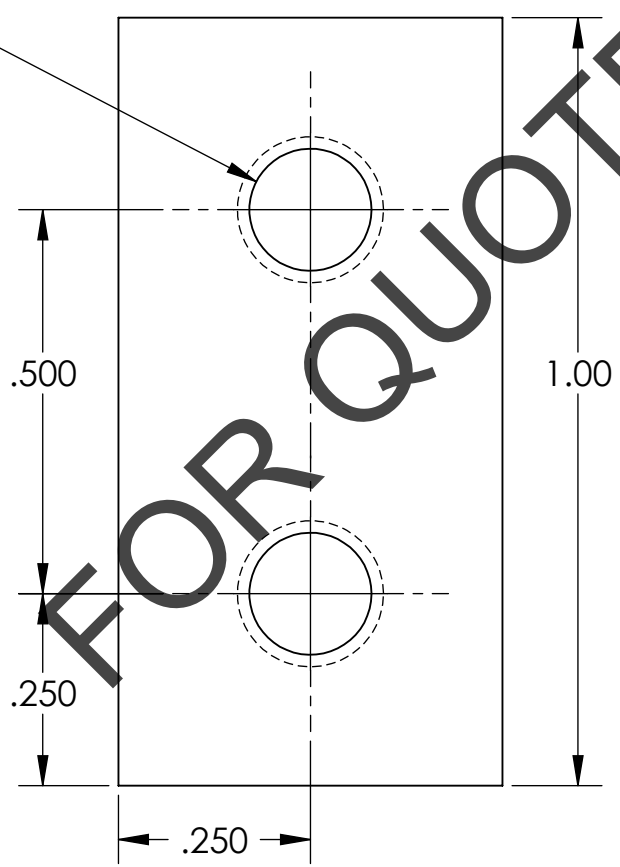
1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES 0.005" to 0.015".
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE. REFER TO LIGO E0900237 FOR LIST OF APPROVED COOLANTS.
5. MACHINE DRAWING PART NUMBER, REVISION, AND SERIAL NUMBERS .020" DEPTH WITH MINIMUM .156" HIGH CHARACTERS, WHERE SHOWN.
6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
7. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER FREE FROM SCRATCHES OR GOUGES
8. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
9. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
10. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.

REV.	DATE	DCN #	DRAWING TREE #
v1	18 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



GENERAL VIEW FOR REFERENCE ONLY NO SCALE

2X 10-32 UNF THRU
+.005 OVERSIZE TAP



NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

DIMENSIONS ARE IN INCHES

TOLERANCES:
.XX ± .03
.XXX ± .010
ANGULAR ± 0.5°

MATERIAL	304 SSTL	FINISH	7 8
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CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME		APERTURE CLIP	
SYSTEM	ADVANCED LIGO	SUB-SYSTEM	AOS	DESIGNER	TQ. NGUYEN 29 NOV 2010
NEXT ASSY	D1002864	DRAPER	TQ. NGUYEN 29 NOV 2010	SIZE	DWG. NO. B D1003059
CHECKER	M. SMITH	APPROVAL	D. COYNE	REV.	v1
				SCALE:	4:1
				PROJECTION:	
				SHEET 1 OF 1	

D1003059_alIGO_Mode_Cleaner_Tube_Baffle_Mnt_Clip_PART PDM REV: X-009, DRAWING PDM REV: X-017

NOTES: UNLESS OTHERWISE SPECIFIED

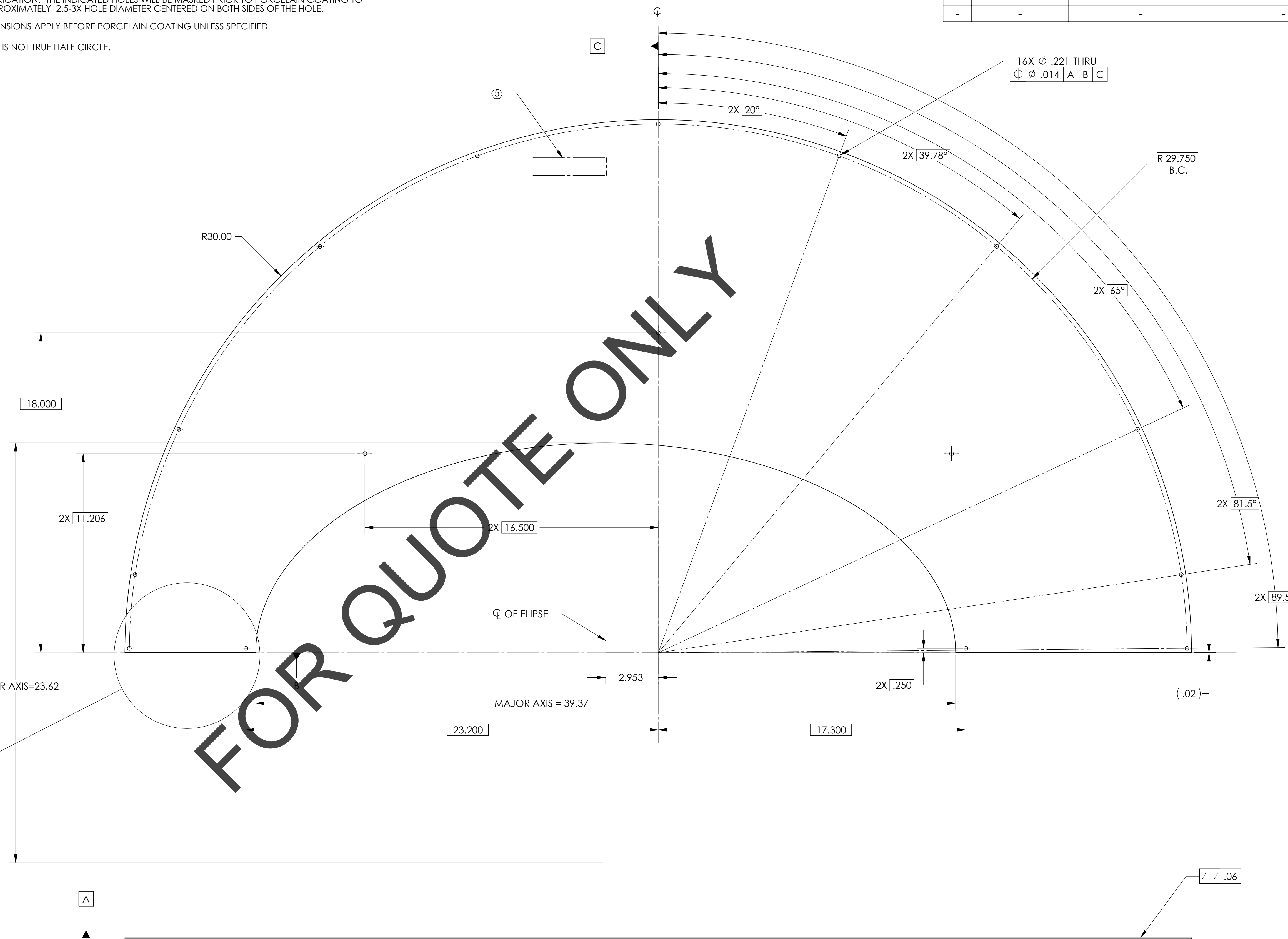
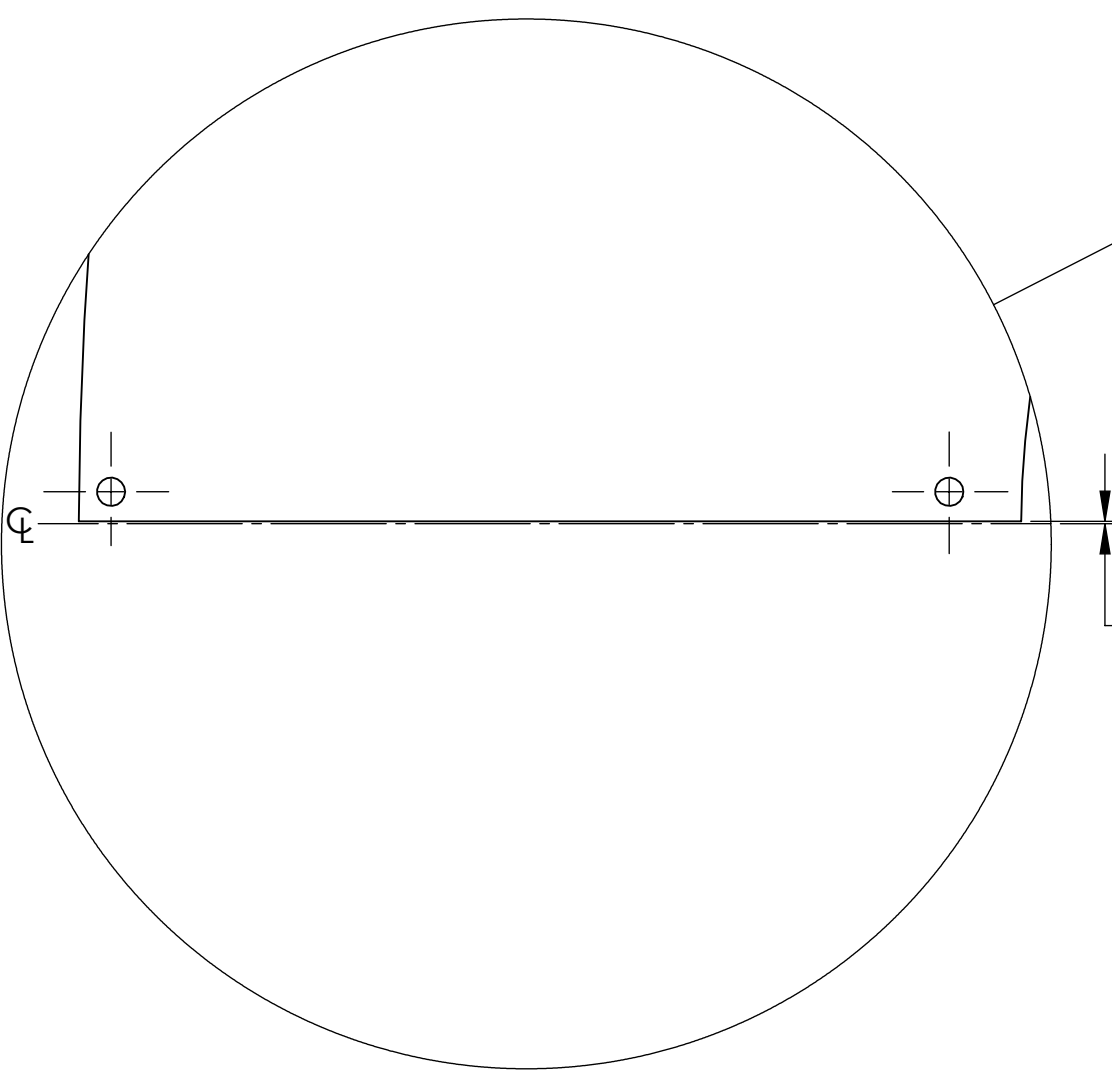
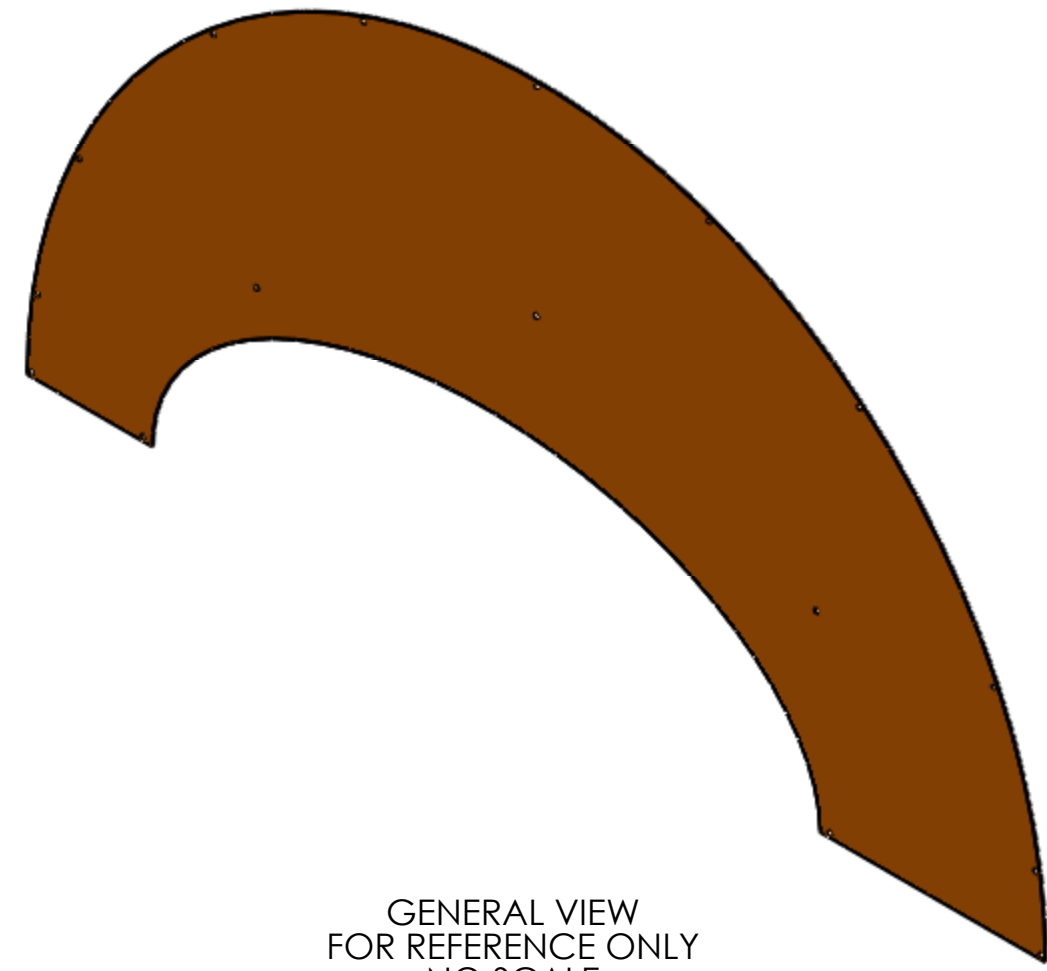
1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES AND BURRS AND ROUND EDGES APPROXIMATELY R.02.
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINE FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE AND CHLORINE PER LIGO DOCUMENT E0900237.
5. MECHANICALLY STAMP (NO INKS OR DYES) PART NUMBER, REVISION AND SERIAL NUMBER .020 DEEP WITH MINIMUM CHARACTER HEIGHT .156 APPROXIMATELY WHERE SHOWN. SERIAL NUMBER WILL START AT 001 AND PROCEED CONSECUTIVELY. EXAMPLE: D100XXXX-V1
S/N 001
6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPEC E0900364.
7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (I.E. NO WELD REPAIRS OR PLUGS) UNLESS APPROVED IN ADVANCE, IN WRITING, BY LIGO PER SPECIFICATION E0900364.
8. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.

9. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.

10. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.

11. PART IS NOT TRUE HALF CIRCLE.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)

DIMENSIONS ARE IN INCHES
TOLERANCES:
.XX ± .03
.XXX ± .010
ANGULAR ± 0.5°

MATERIAL	18GA A424 TYPE 1 STEEL
FINISH	8 9

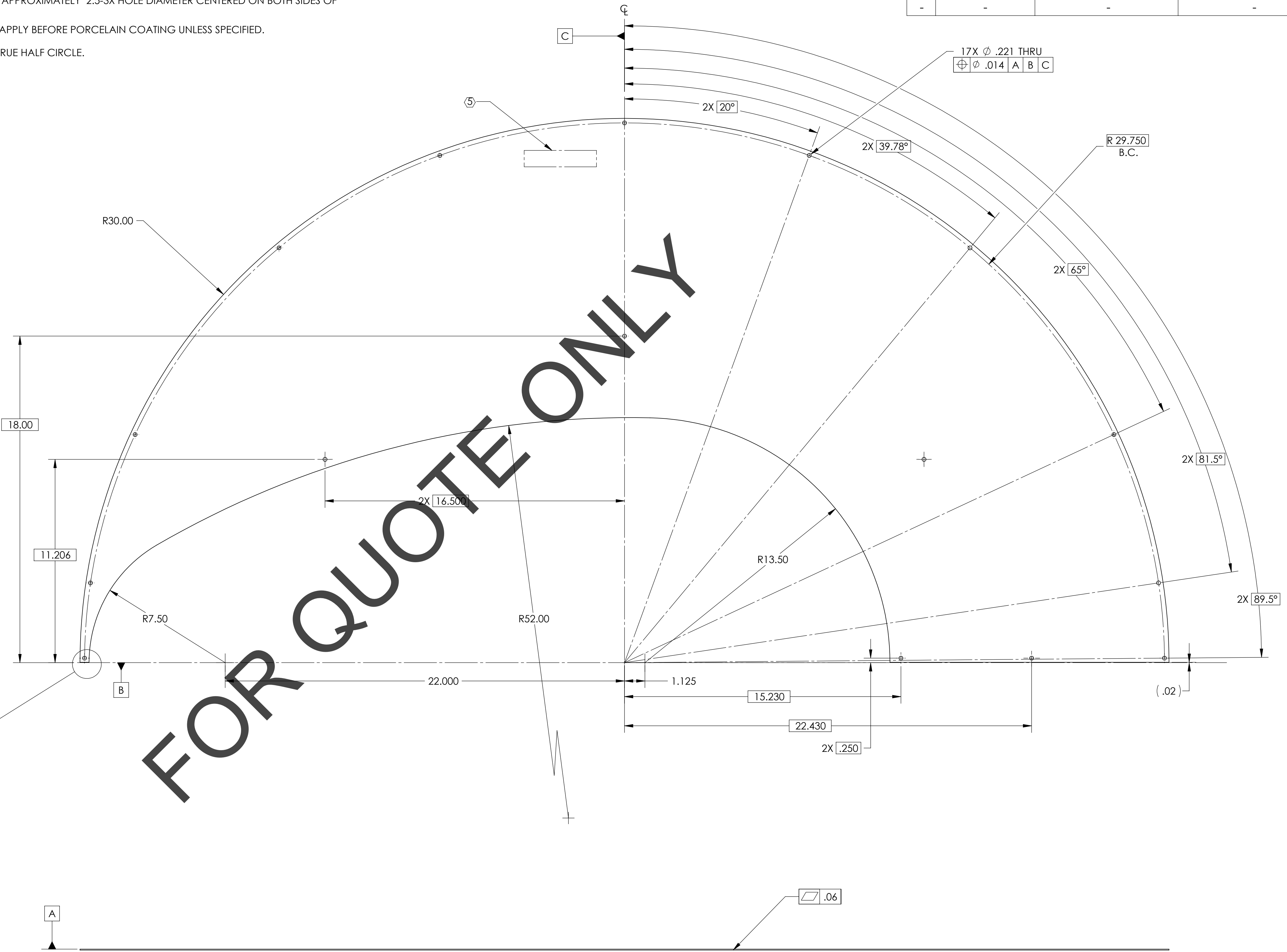
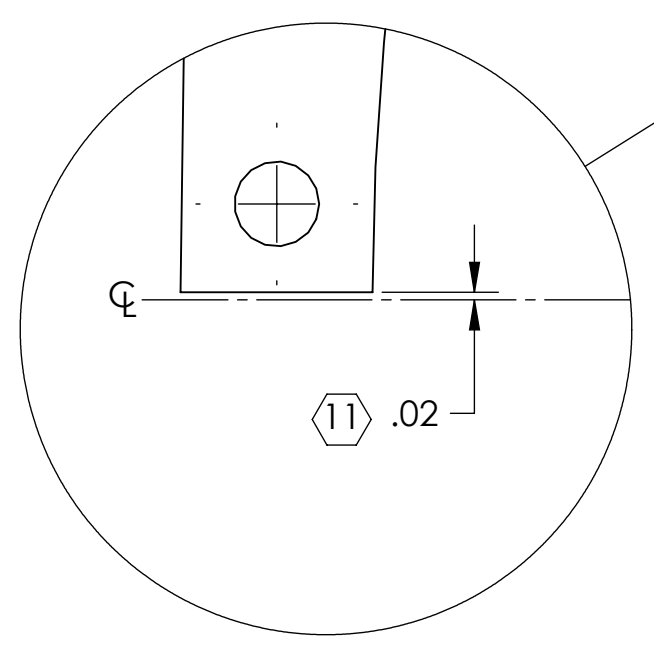
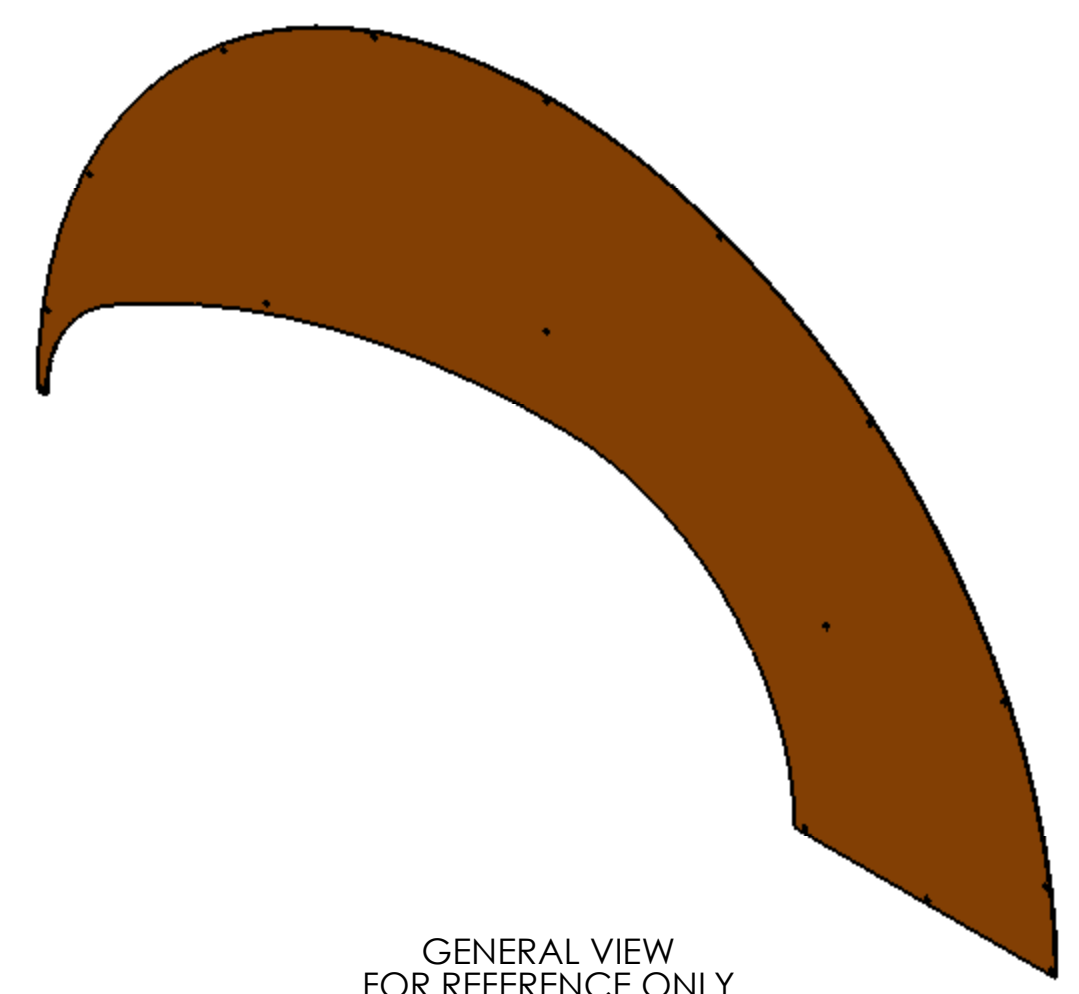
LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SYSTEM: ADVANCED LIGO
SUB-SYSTEM: AOS
NEXT ASSY: D1002864

PART NAME		APERTURE PLATE_75MM	
DESIGNER	TQ. NGUYEN	10 NOV 2010	SIZE DWG. NO.
DRAFTER	TQ. NGUYEN	30 NOV 2010	D
CHECKER	M. SMITH		D1003109
APPROVAL	D. COYNE		REV. v1
SCALE: 1:3		PROJECTION:	SHEET 1 OF 1

- NOTES: UNLESS OTHERWISE SPECIFIED**
1. INTERPRET DRAWING PER ASME Y14.5-1994.
 2. REMOVE ALL SHARP EDGES AND BURRS AND ROUND EDGES APPROXIMATELY R.02.
 3. DO NOT SCALE FROM DRAWING.
 4. ALL MACHINE FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE AND CHLORINE PER LIGO DOCUMENT E0900237.
 5. MECHANICALLY STAMP (NO INKS OR DYES) PART NUMBER, REVISION AND SERIAL NUMBER .020 DEEP WITH MINIMUM CHARACTER HEIGHT .156 APPROXIMATELY WHERE SHOWN. SERIAL NUMBER WILL START AT 001 AND PROCEED CONSECUTIVELY. EXAMPLE: D100XXXX-V1 S/N 001
 6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPEC E0900364.
 7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (I.E. NO WELD REPAIRS OR PLUGS) UNLESS APPROVED IN ADVANCE, IN WRITING, BY LIGO PER SPECIFICATION E0900364.
 8. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
 9. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
 10. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
 11. PART IS NOT TRUE HALF CIRCLE.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



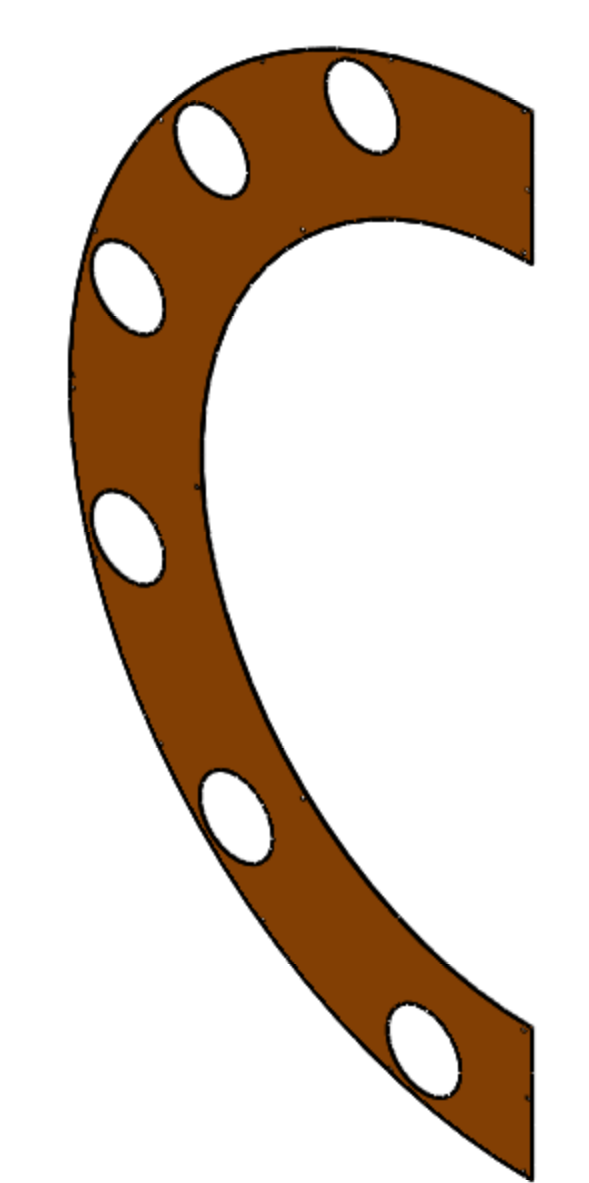
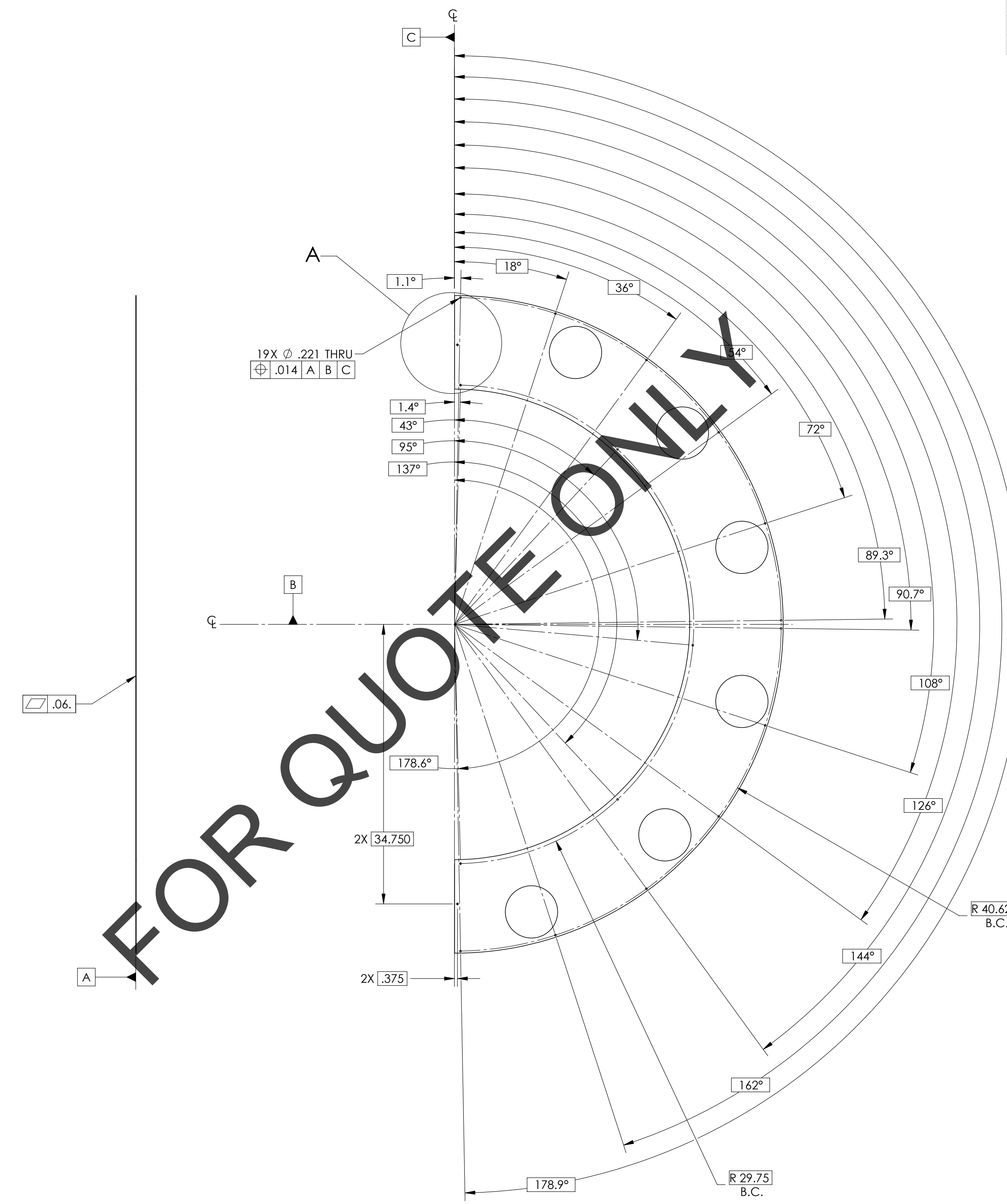
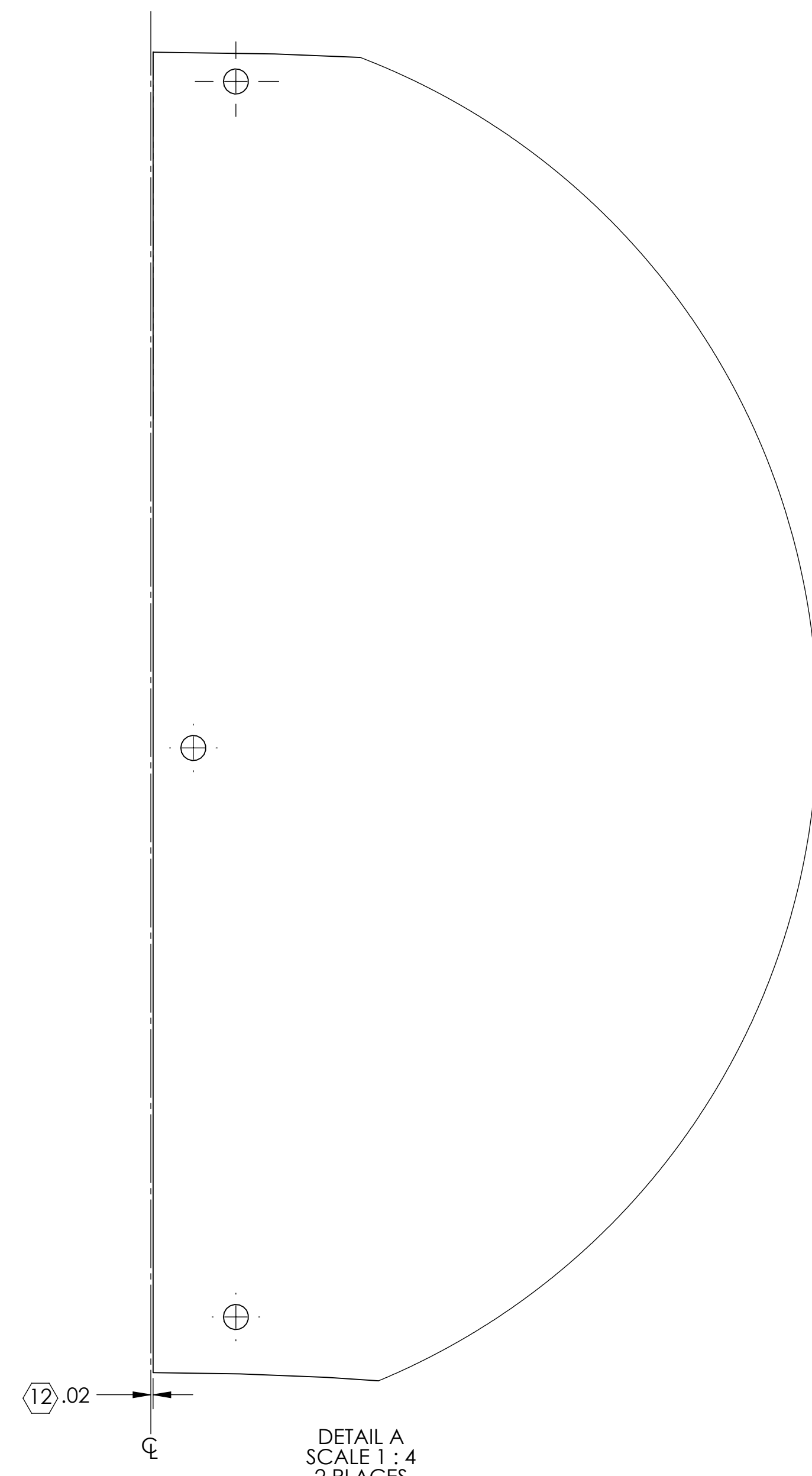
NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)		LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME					
DIMENSIONS ARE IN INCHES		SYSTEM ADVANCED LIGO		SUB-SYSTEM AOS		APERTURE PLATE_200MM			
TOLERANCES: .XX ± .03 .XXX ± .010 ANGULAR ± 0.5°						DESIGNER TQ. NGUYEN	10 NOV 2010	SIZE D	DWG. NO. D1003110
MATERIAL 18GA A424 TYPE 1 STEEL		FINISH (8) (9)		NEXT ASSY D1002864		CHECKER M. SMITH	APPROVAL D. COYNE	SCALE: 1:3 PROJECTION:	SHEET 1 OF 1

D1003110.dwg; LIGO; MC; Tube; Beffle; 200; Aperture; Plate; PART; PDM; REV; X; 019; DRAWING; PDM; REV; X; 031

NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET DRAWING PER ASME Y14.5-1994.
2. REMOVE ALL SHARP EDGES AND BURRS AND ROUND EDGES APPROXIMATELY R.02.
3. DO NOT SCALE FROM DRAWING.
4. ALL MACHINE FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE AND CHLORINE PER LIGO DOCUMENT E0900237.
- ⑤ MECHANICALLY STAMP (NO INKS OR DYES) PART NUMBER, REVISION AND SERIAL NUMBER .020 DEEP WITH MINIMUM CHARACTER HEIGHT .156 APPROXIMATELY WHERE SHOWN. SERIAL NUMBER WILL START AT 001 AND PROCEED CONSECUTIVELY. EXAMPLE: D100XXXX-V1
S/N 001
6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPEC E0900364.
7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (I.E. NO WELD REPAIRS OR PLUGS) UNLESS APPROVED IN ADVANCE, IN WRITING, BY LIGO PER SPECIFICATION E0900364.
- ⑧ SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
- ⑨ PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.
10. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.
- ⑪ CAREFULLY NOTE THAT THESE ANGLE ARE GREATER THAN 360°
- ⑫ PART IS NOT TRUE HALF CIRCLE.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



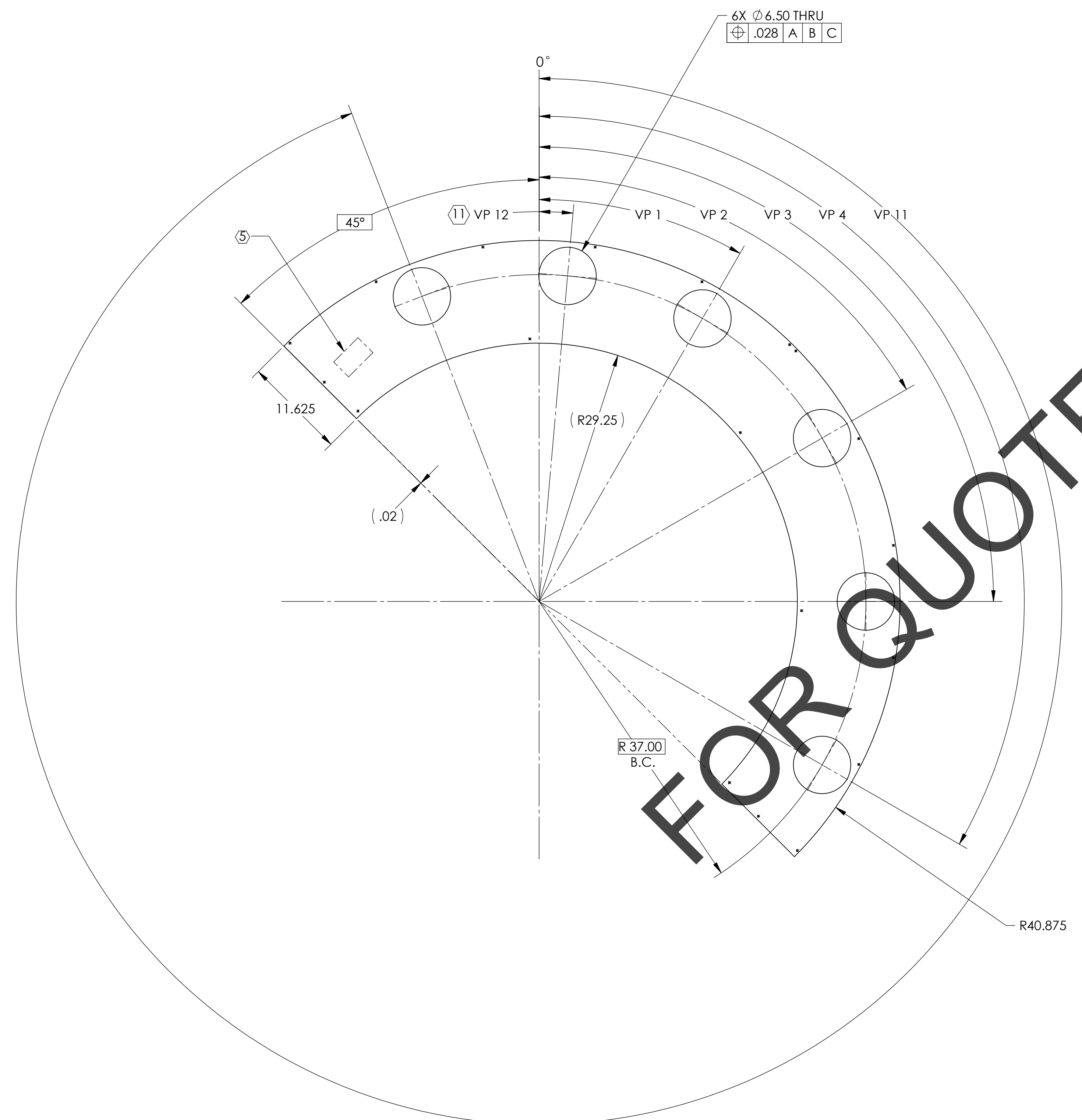
GENERAL VIEW FOR REFERENCE ONLY
NO SCALE

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME	
DIMENSIONS ARE IN INCHES				SYSTEM		SUB-SYSTEM	
TOLERANCES: .XX ± .03 .XXX ± .005				ADVANCED LIGO		AOS	
ANGULAR ± 0.5°				NEXT ASSY		D1002864	
MATERIAL				FINISH		DESIGNER	
18GA A424 TYPE 1 STEEL				⑧ ⑨		TQ NGUYEN 28 OCT 2010	
						SIZE DWG. NO.	
						D D1003118	
						REVISION	
						v1	
						APPROVAL	
						D. COYNE	
						SCALE: 1:8 PROJECTION:	
						SHEET 1 OF 2	

D1003118.dwg; LIGO; MC_Tube_Baffle_Plate_Upper; PART PDM REV: X.017; DRAWING PDM REV: X.036

8 7 6 5 4 3 2 1

H
G
F
E
D
C
B
A



FOR QUOTE ONLY

TABLE I: VIEWPORT LOCATIONS

VIEWPORT No.	MCA -00	MCB1 -01	MCB2 -02	MCB3 -03	MCB4 -04
VP 1	30°	30°	23°	30°	30°
VP 2	60°	60°	60°	60°	60°
VP 3	90°	90°	90°	90°	90°
VP 4	120°	120°	120°	120°	120°
VP11	330°	339°	330°	322°	346°
VP12	360°	365° (11)	360°	344°	368° (11)

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SIZE DWG. NO. REV.
D D1003118 v1

SCALE: 1:8 PROJECTION: SHEET 2 OF 2

8 7 6 5 4 3 2 1

D:\003118_d1003118.dwg; LMC Tube Baffle Plate Upper Part PDM REV: X.017; DRAWING PDM REV: X.036

NOTES: UNLESS OTHERWISE SPECIFIED

1. INTERPRET DRAWING PER ASME Y14.5-1994.

2. REMOVE ALL SHARP EDGES AND BURRS AND ROUND EDGES APPROXIMATELY R.02.

3. DO NOT SCALE FROM DRAWING.

4. ALL MACHINE FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE AND CHLORINE PER LIGO DOCUMENT E0900237.

5. MECHANICALLY STAMP (NO INKS OR DYES) PART NUMBER, REVISION AND SERIAL NUMBER .020 DEEP WITH MINIMUM CHARACTER HEIGHT .156 APPROXIMATELY WHERE SHOWN. SERIAL NUMBER WILL START AT 001 AND PROCEED CONSECUTIVELY. EXAMPLE: D100XXX-V1 S/N 001

6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPEC E0900364.

7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (I.E. NO WELD REPAIRS OR PLUGS) UNLESS APPROVED IN ADVANCE, IN WRITING, BY LIGO PER SPECIFICATION E0900364.

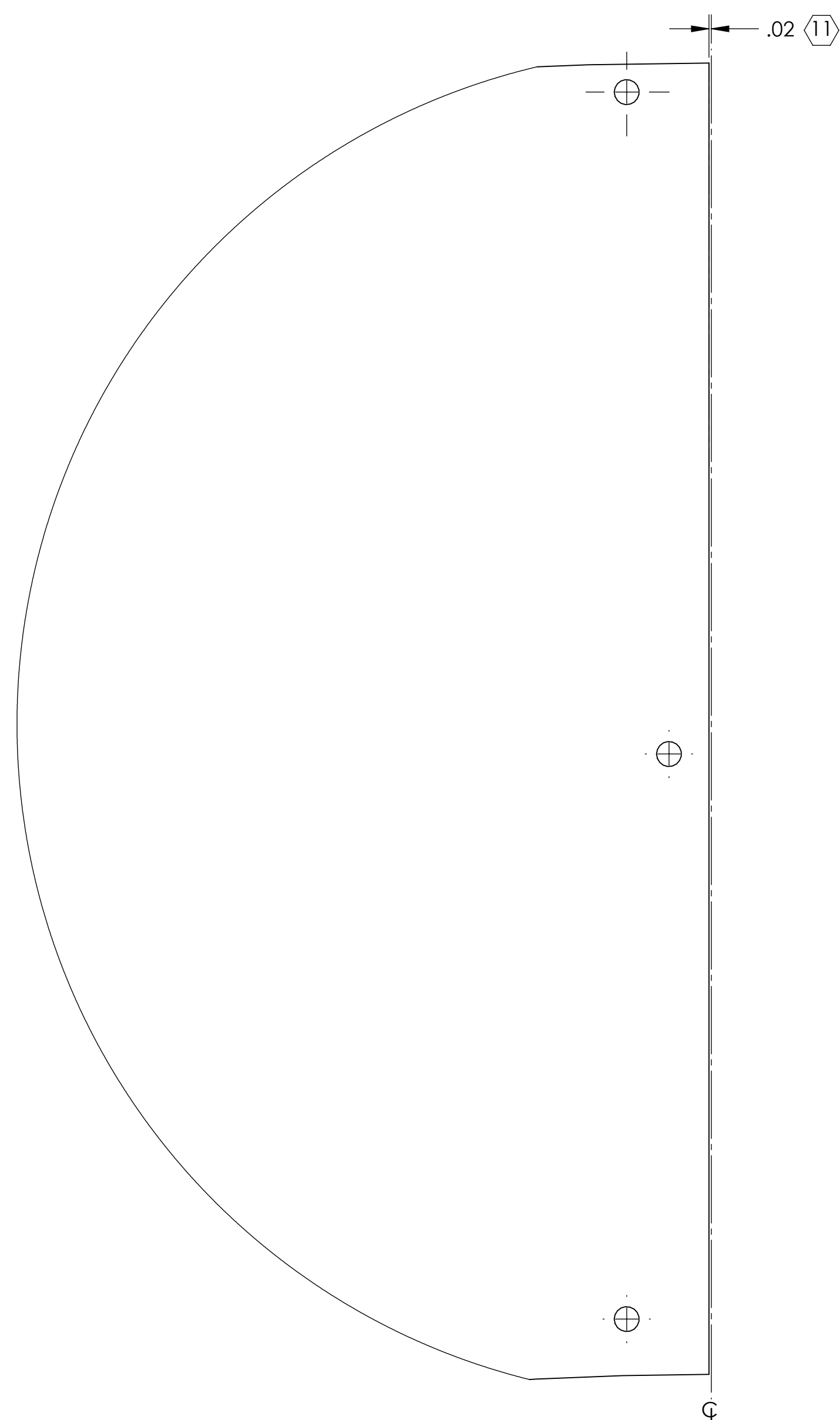
8. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.

9. PART WILL BE PORCELAIN COATED PER LIGO SPECIFICATION E1000083 AFTER FABRICATION. THE INDICATED HOLES WILL BE MASKED PRIOR TO PORCELAIN COATING TO APPROXIMATELY 2.5-3X HOLE DIAMETER CENTERED ON BOTH SIDES OF THE HOLE.

10. DIMENSIONS APPLY BEFORE PORCELAIN COATING UNLESS SPECIFIED.

11. PART IS NOT TRUE HALF CIRCLE.

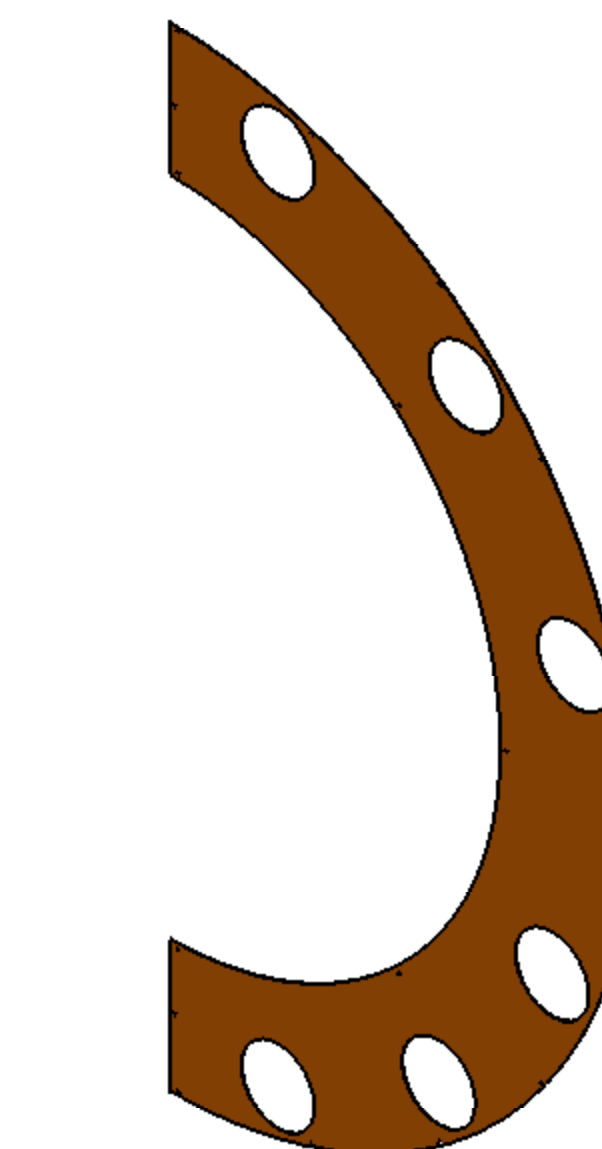
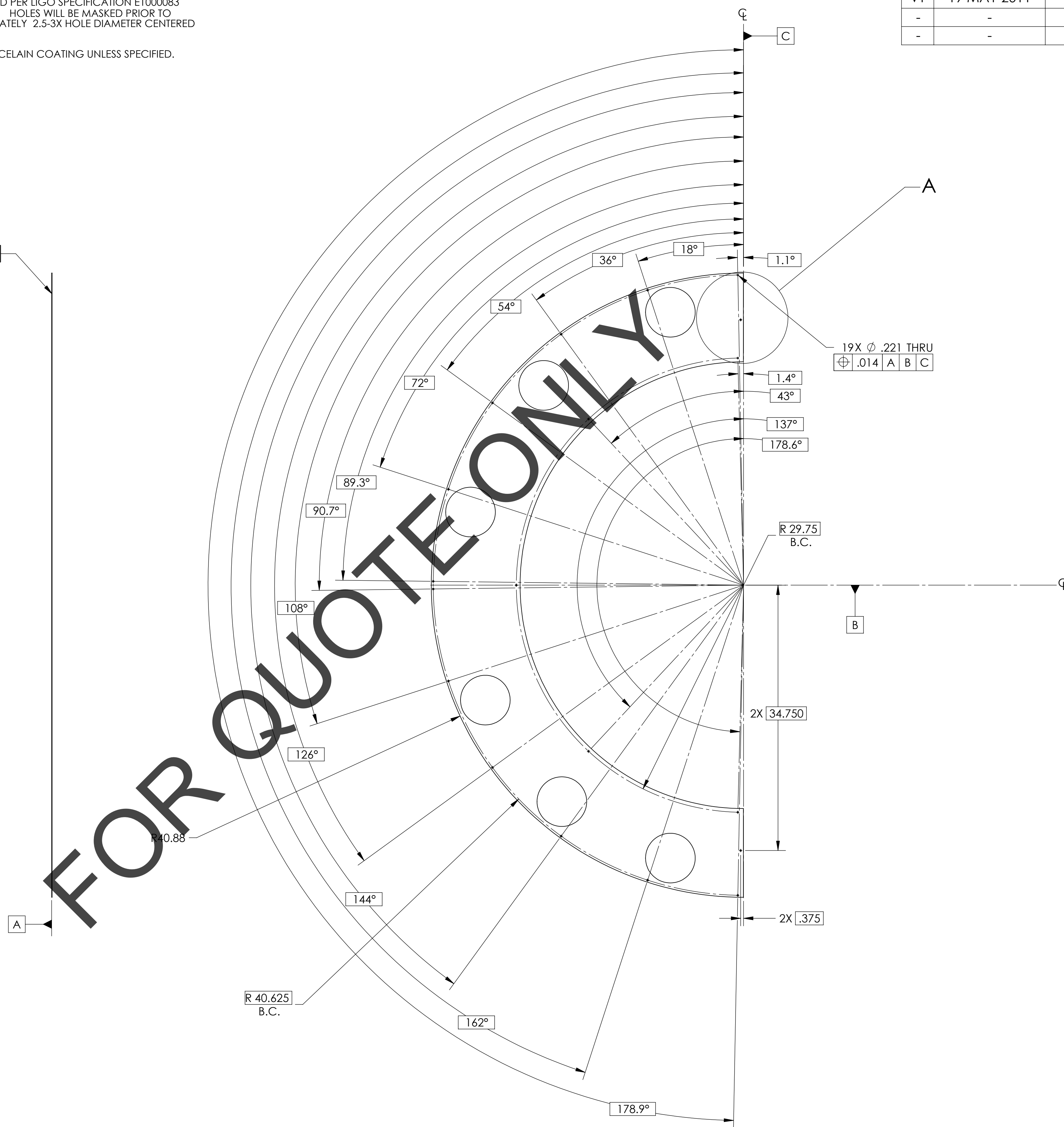
REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



DETAIL A
SCALE 1 : 1
2 PLACES

\square .06

FOR QUOTE ONLY



GENERAL VIEW
FOR REFERENCE ONLY
NO SCALE

NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME					
DIMENSIONS ARE IN INCHES				ADVANCED LIGO AOS		MODE CLEANER BAFFLE VIEWPORT PLATE, LOWER					
TOLERANCES: .XX ± .03 .XXX ± .005 ANGULAR ± 0.1°						SYSTEM NEXT ASSY		DESIGNER TQ. NGUYEN 28 OCT 2010 DRAFTER N. KILPATRICK 29 NOV 2010 CHECKER M. SMITH APPROVAL D. COYNE		SIZE D DWG. NO. D1003119 REV. v1	
MATERIAL 18GA A424 TYPE 1 STEEL				FINISH 8 9		NEXT ASSY D1002864		SCALE: 1:8 PROJECTION:		SHEET 1 OF 2	

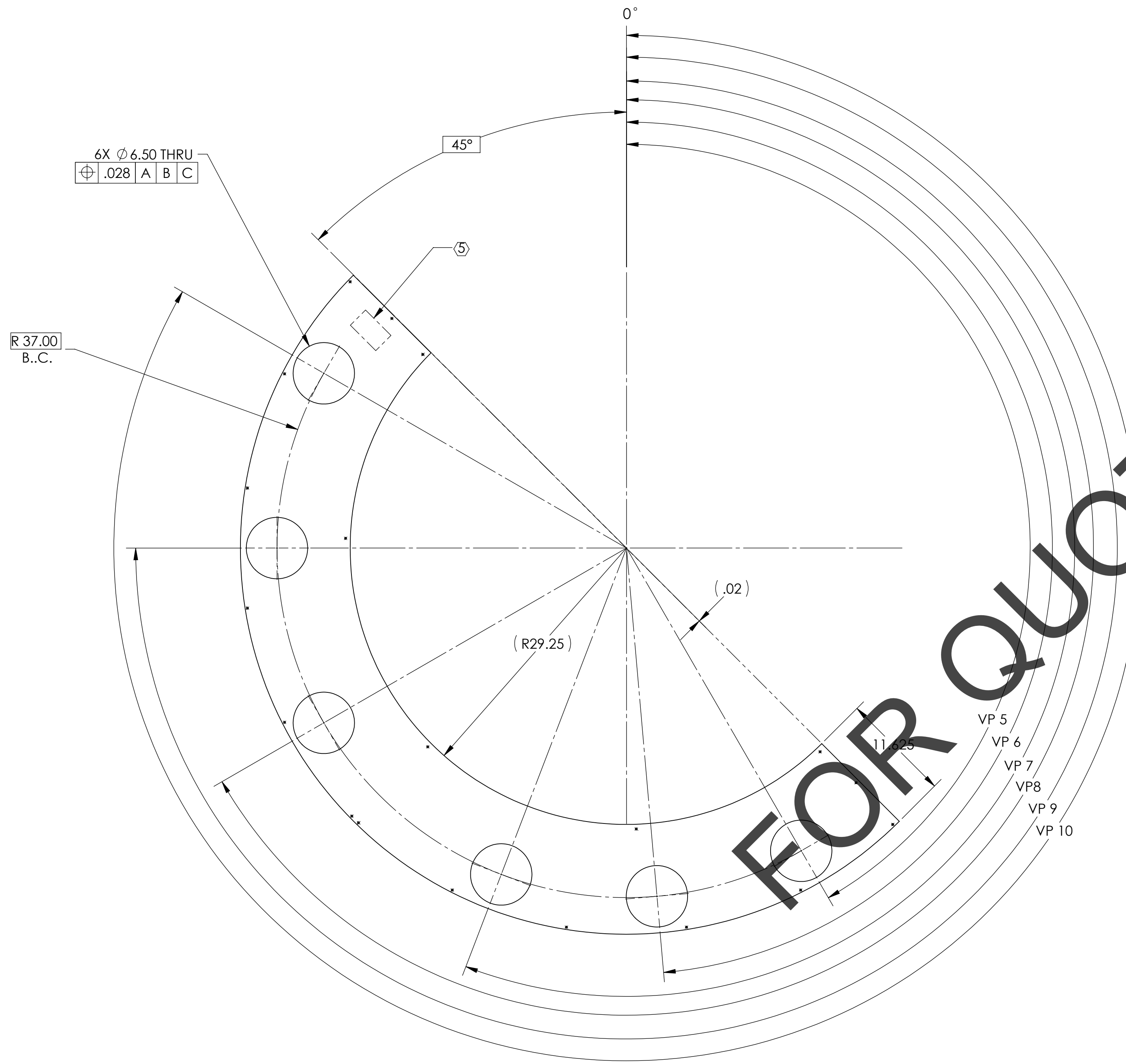


TABLE I: VIEWPORT LOCATIONS

VIEWPORT No.	MCA -00	MCB1 -01	MCB2 -02	MCB3 -03	MCB4 -04
VP 5	150°	150°	157°	150°	146°
VP 6	180°	175°	180°	190°	172°
VP 7	210°	201°	210°	215°	194°
VP 8	240°	240°	240°	240°	240°
VP 9	270°	270°	270°	270°	270°
VP 10	300°	300°	300°	300°	300°

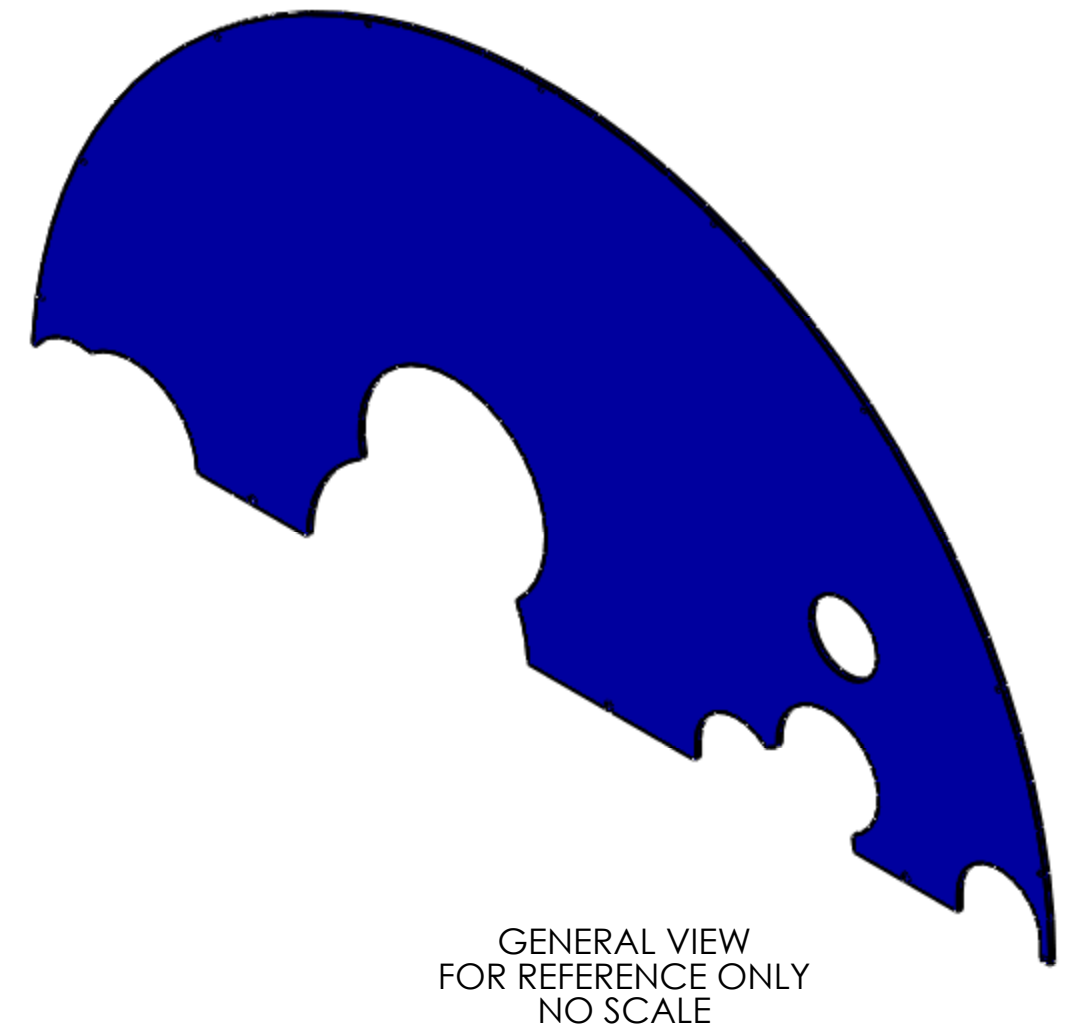
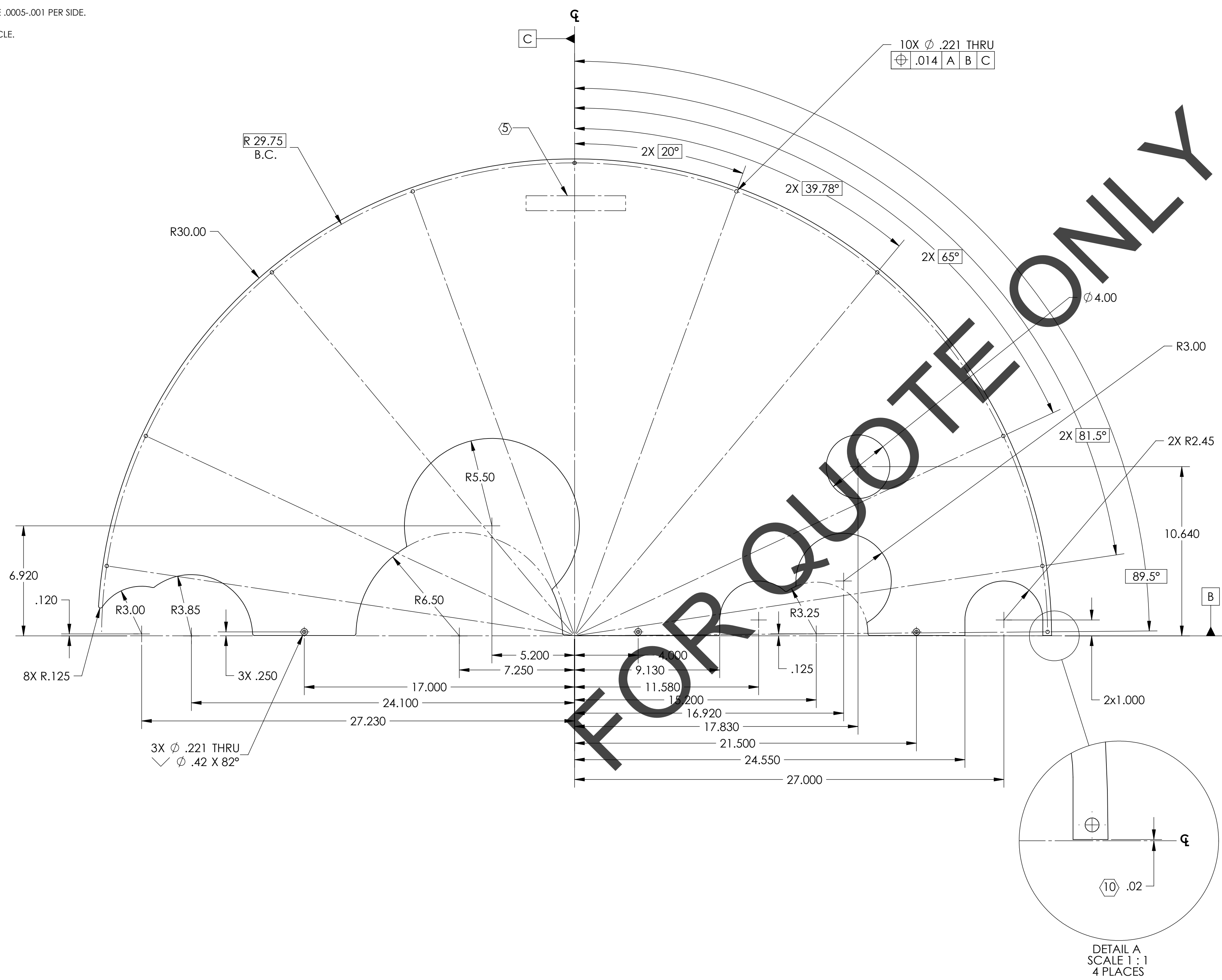
D:\003119_d\UGO_MC_Tube_Baffle_Plate_Lower_PART.PDM REV: X.014, DRAWING.PDM REV: X.033

NOTES CONTINUED:
 5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX

- 6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
- 7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
- 8. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
- 9. ELECTRO POLISH TO REMOVE .0005-.001 PER SIDE.

10. PART IS NOT TRUE HALF CIRCLE.

REV.	DATE	DCN #	DRAWING TREE #
v1	18 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)	
DIMENSIONS ARE IN INCHES	1. INTERPRET DRAWING PER ASME Y14.5-1994.
TOLERANCES: .XX ± .03 .XXX ± .010	2. REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS.
ANGULAR ± 0.5°	3. DO NOT SCALE FROM DRAWING.
	4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.
MATERIAL	6061-T6 Al
FINISH	2B

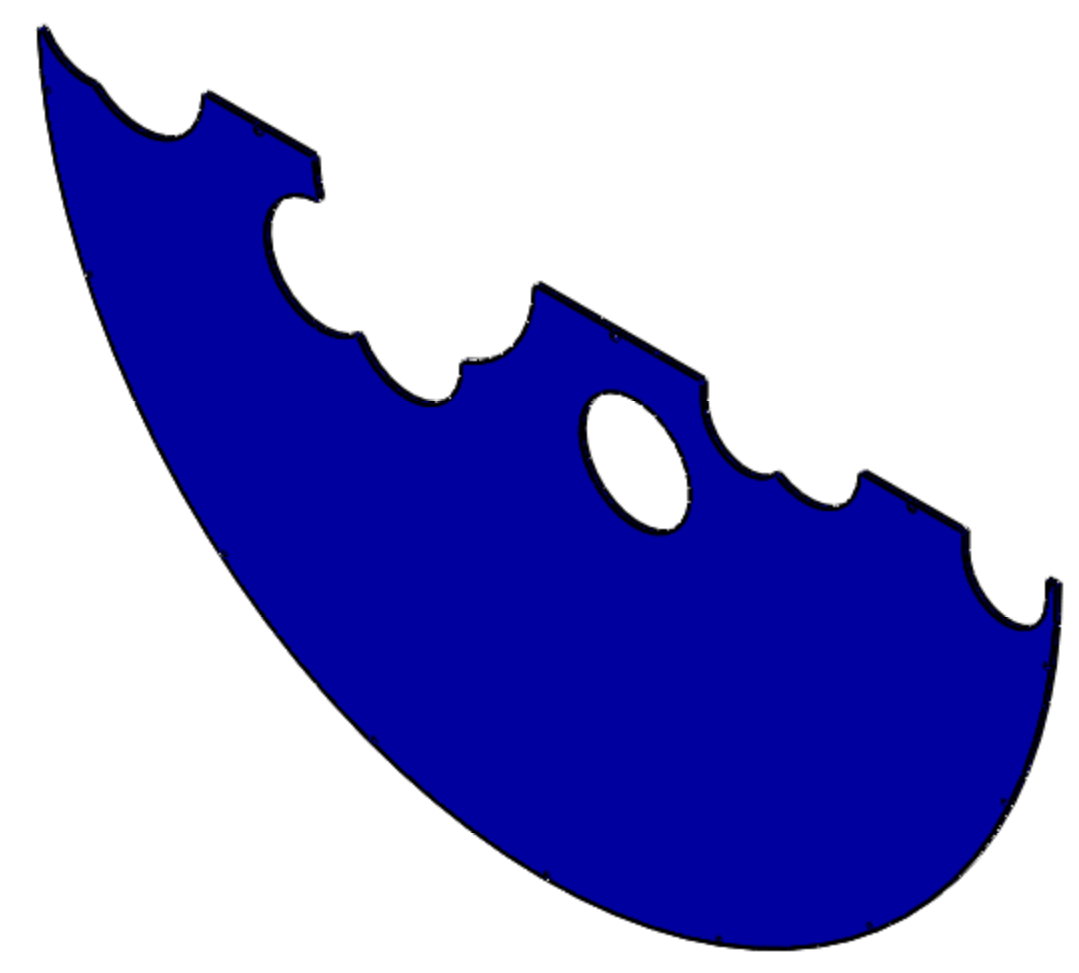
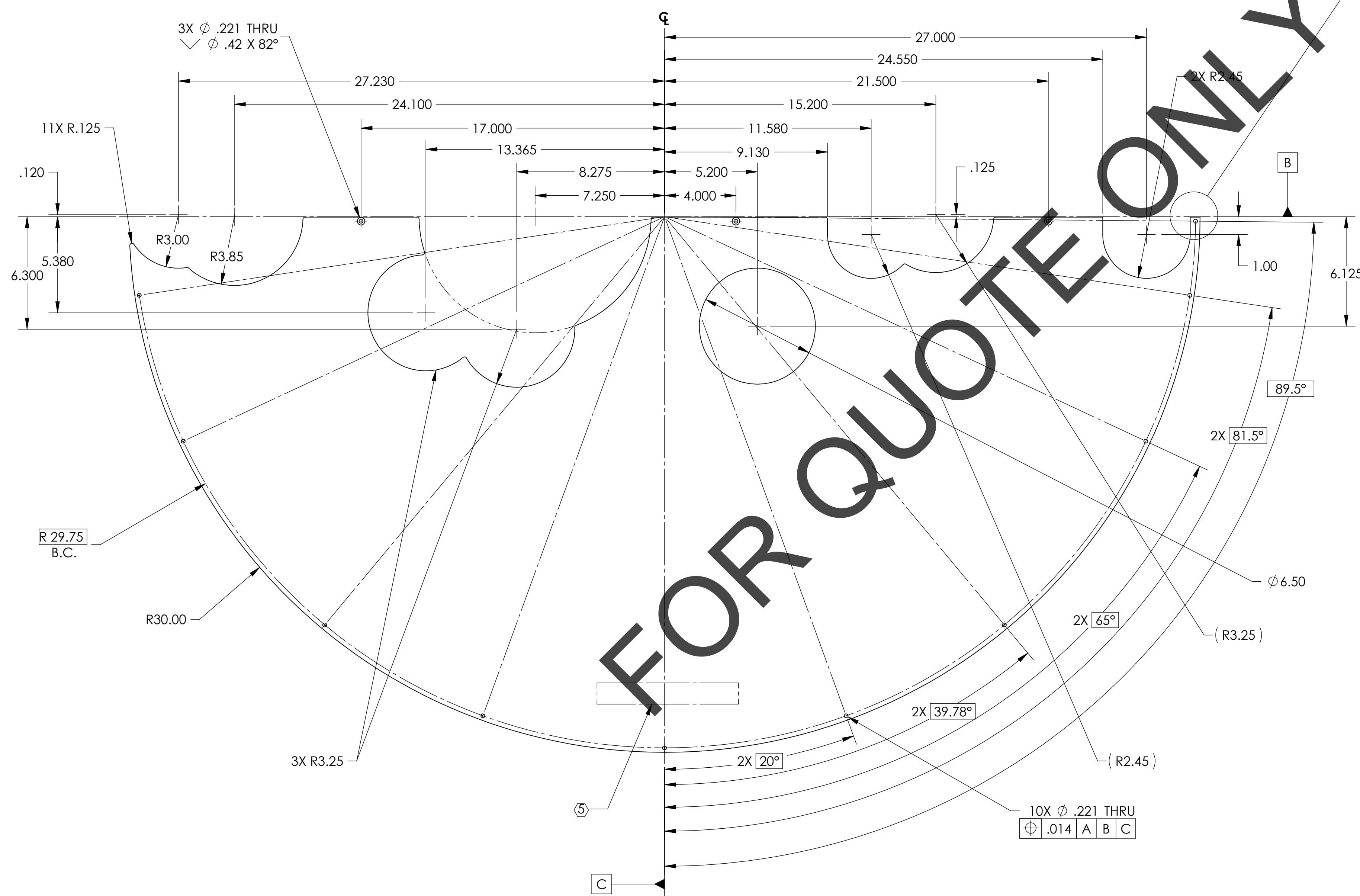
CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY	
SYSTEM	SUB-SYSTEM
ADVANCED LIGO	AOS
NEXT ASSY	D1002864

PART NAME			
UPPER APERTURE PLATE, MCA1			
DESIGNER	TQ. NGUYEN	12 MAR 2011	SIZE DWG. NO.
DRAFTER	TQ. NGUYEN	15 MAR 2011	D D1100468
CHECKER	M. SMITH		REV. v1
APPROVAL	D. COYNE		SCALE: 1:4 PROJECTION:

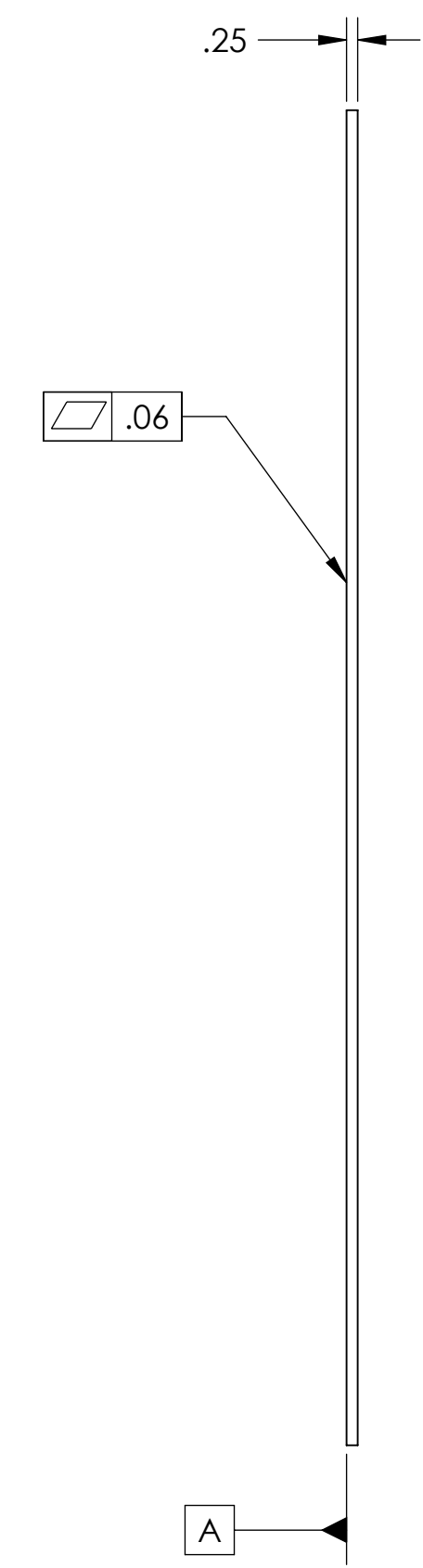
D1100468.dwg; MCA1; Upper Aperture Plate; MCA1; PART PDM; REV: X.015; DRAWING PDM; REV: X.015

- NOTES CONTINUED:**
- 5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
 - 6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
 - 7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL), NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
 - 8. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
 - 9. ELECTRO POLISH TO REMOVE .0005-.001 PER SIDE.
- (10) PART IS NOT TRUE HALF CIRCLE.

REV.	DATE	DCN #	DRAWING TREE #
v1	18 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



GENERAL VIEW
FOR REFERENCE VIEW ONLY
NO SCALE



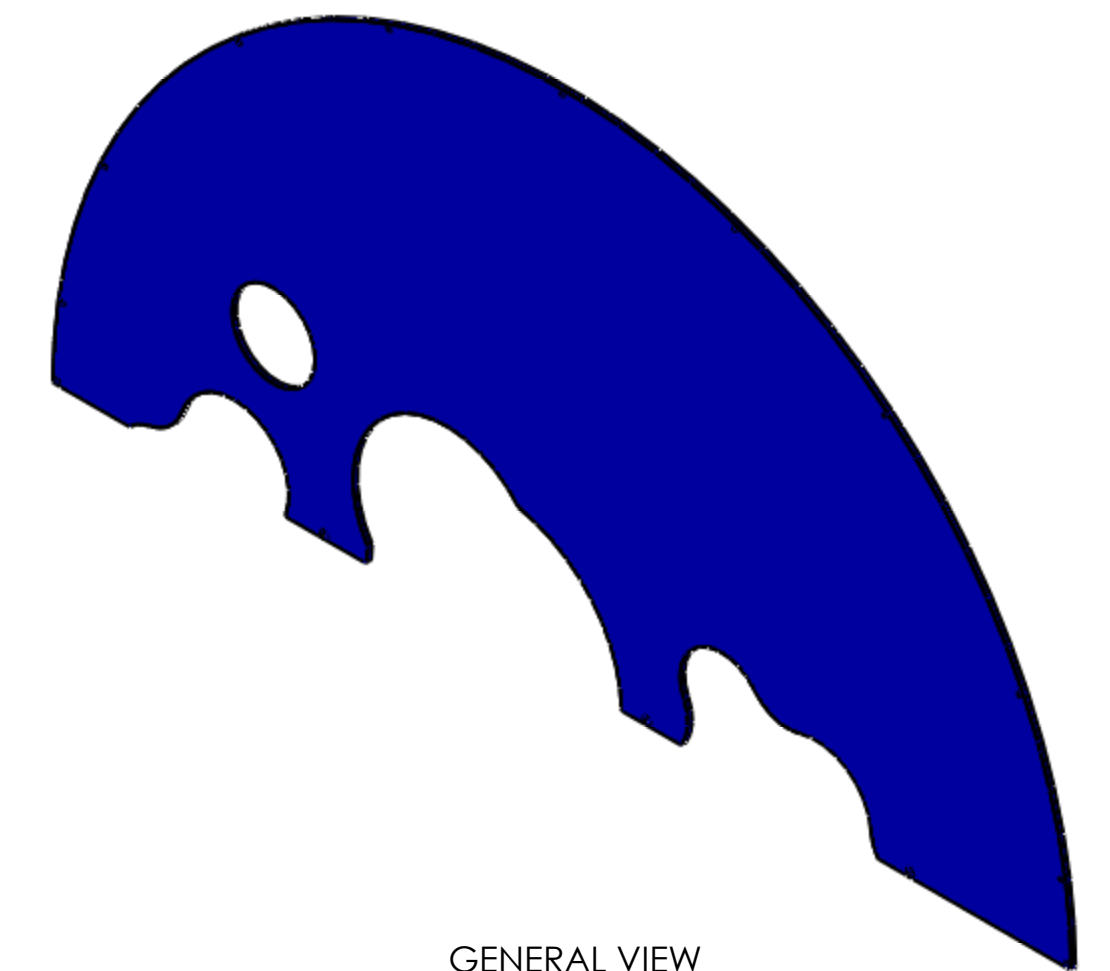
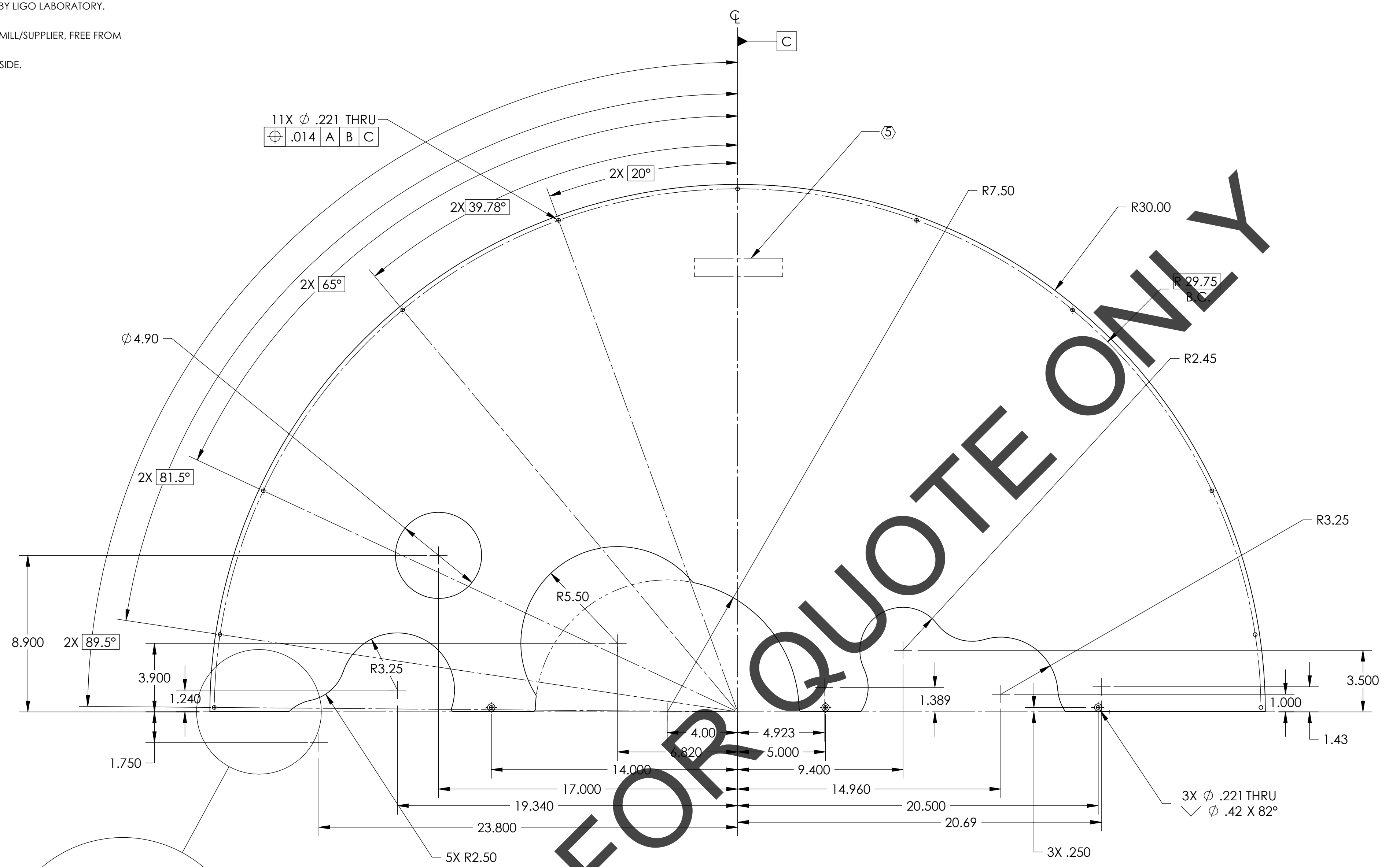
NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME	
DIMENSIONS ARE IN INCHES				ADVANCED LIGO		LOWER APERTURE PLATE, MCA1	
TOLERANCES: .XX ± .02 .XXX ± .005				SUB-SYSTEM AOS		DESIGNER	TQ. NGUYEN 12 MAR 2011
ANGULAR ± 0.5°				NEXT ASSY D1002864		DRAFTER	TQ. NGUYEN 15 MAR 2011
MATERIAL 6061-T6 Al		FINISH 2B		CHECKER	M. SMITH	SIZE	D
				APPROVAL	D. COYNE	DWG. NO.	D1100469
				SCALE: 1:4		PROJECTION:	SHEET 1 OF 1
						REV.	v1

D1100469.dwg; LIGO; MC; Tube; Baffle; Lower Aperture Plate; MCA1; PART PDM; REV: X.017; DRAWING PDM; REV: X.014

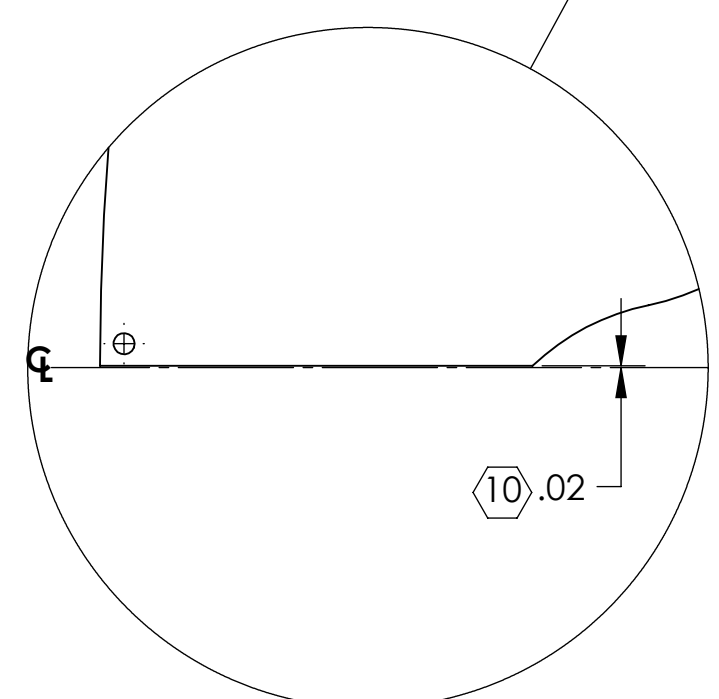
NOTES CONTINUED:
 5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX

- 6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
- 7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
- 8. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
- 9. ELECTRO POLISH TO REMOVE .0005-.001 PER SIDE.
- 10. PART IS NOT TRUE HALF CIRCLE.

REV.	DATE	DCN #	DRAWING TREE #
v1	19 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



GENERAL VIEW FOR REFERENCE ONLY NO SCALE



DETAIL A SCALE 1 : 2 4 PLACES

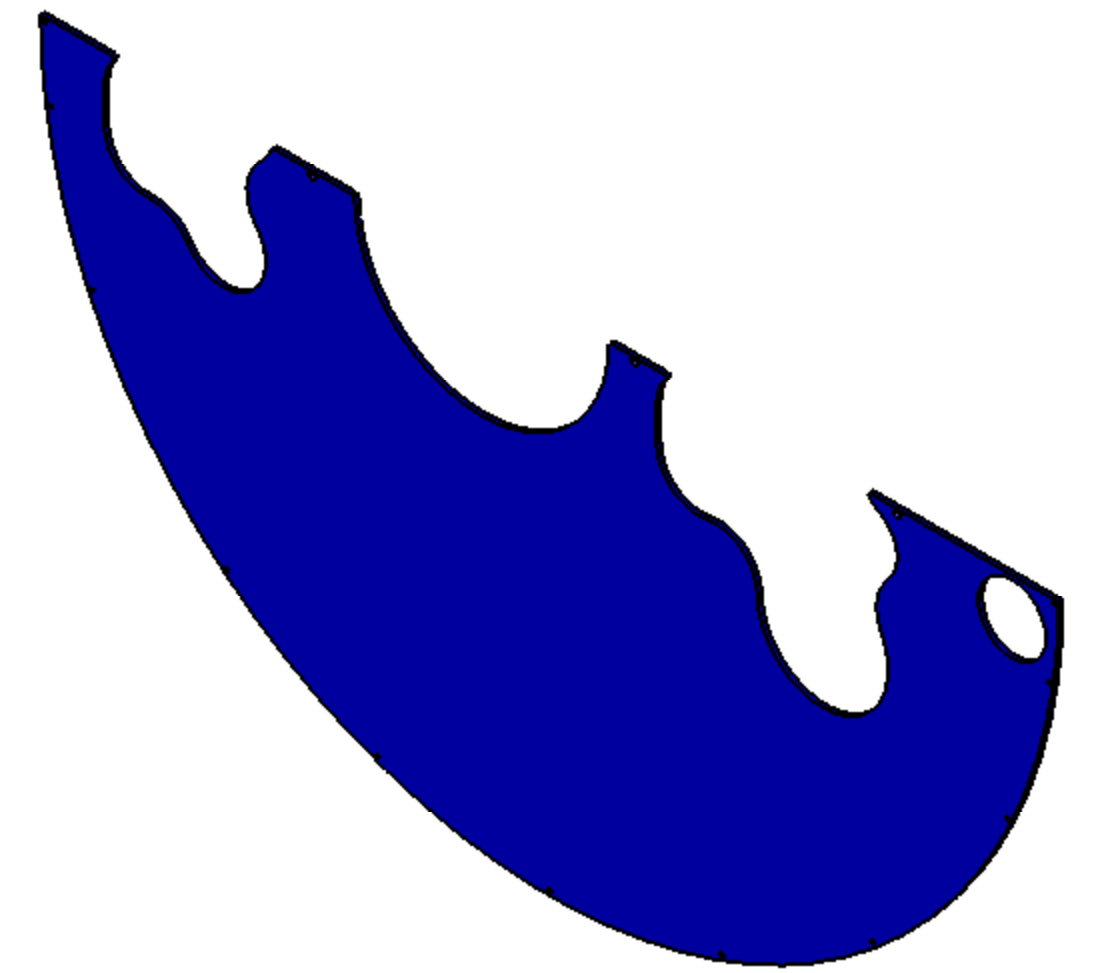
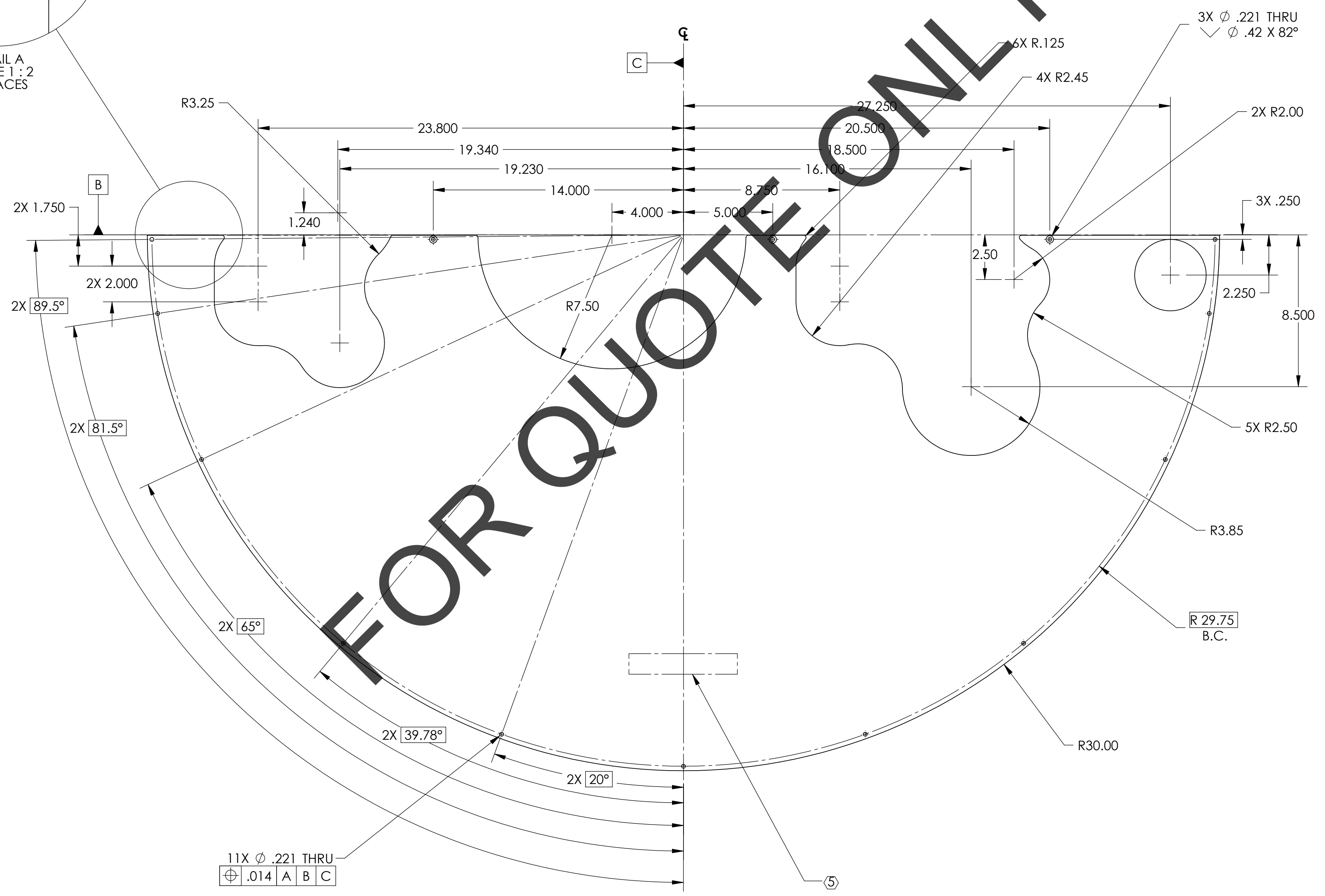
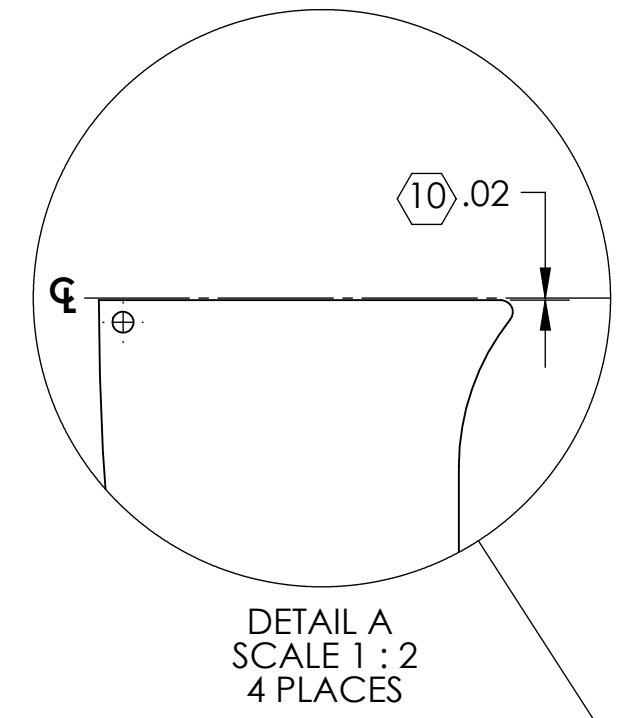
NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)	
DIMENSIONS ARE IN INCHES [MM]	
TOLERANCES: .XX ± .02 .XXX ± .010	
ANGULAR ± 0.5°	
MATERIAL	FINISH
6061-T6 Al	2B

CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY	
SYSTEM	SUB-SYSTEM
ADVANCED LIGO	AOS
NEXT ASSY	D1002864

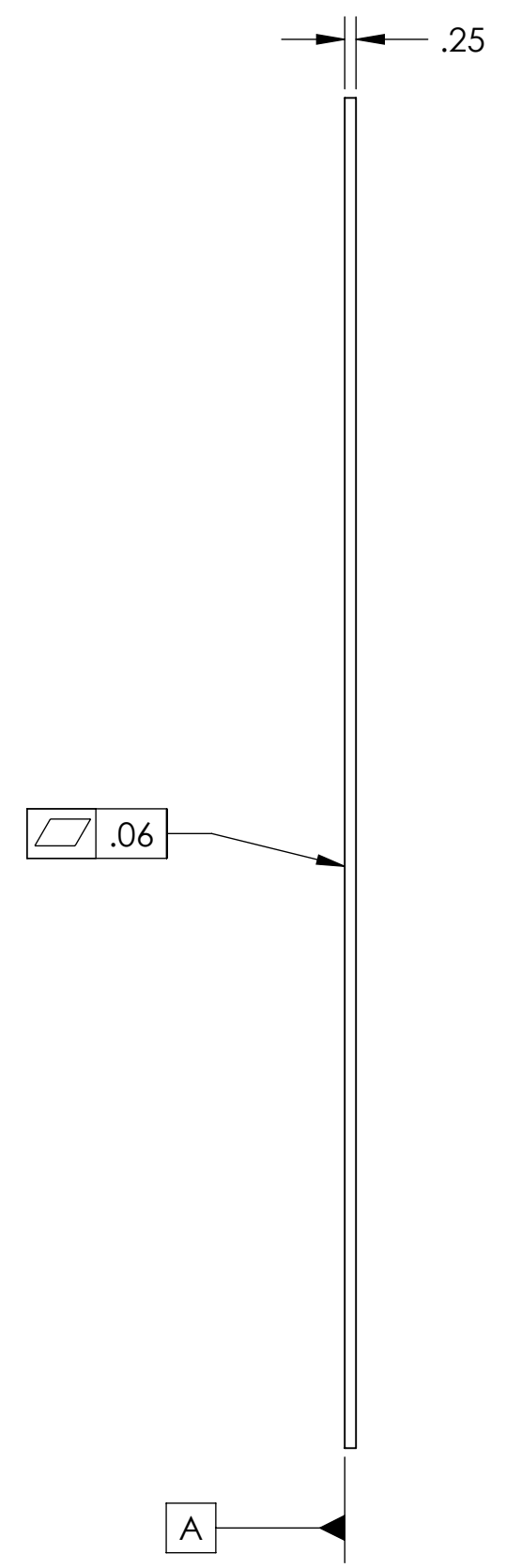
PART NAME				UPPER APERTURE PLATE, MCA3			
DESIGNER	TQ. NGUYEN	19 MAR 2011	SIZE	DWG. NO.	REV.		
DRAFTER	TQ. NGUYEN	4 APR 2011	D	D1100512	v1		
CHECKER	M. SMITH		SCALE: 1:4	PROJECTION:	SHEET 1 OF 1		
APPROVAL	D. COYNE						

- NOTES CONTINUED:**
- 5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX
 - 6. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.
 - 7. ALL MATERIAL IS TO BE VIRGIN MATERIAL (I.E. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.
 - 8. SURFACE FINISH TO BE AS-PROCESSED FROM MILL/SUPPLIER, FREE FROM SCRATCHES OR GOUGES.
 - 9. ELECTRO POLISH TO REMOVE .0005-.001 PER SIDE.

10. PART IS NOT TRUE HALF CIRCLE.



GENERAL VIEW
FOR REFERENCE ONLY
NO SCALE



DIMENSIONS ARE IN INCHES [MM]		NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)	
TOLERANCES: .XX ± .02 .XXX ± .005		1. INTERPRET DRAWING PER ASME Y14.5-1994. 2. REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. 3. DO NOT SCALE FROM DRAWING. 4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.	
MATERIAL	6061-T6 Al	FINISH	2B
ANGULAR	± 0.5°		

LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

SYSTEM: ADVANCED LIGO SUB-SYSTEM: AOS

NEXT ASSY: D1002864

PART NAME		LOWER APERTURE PLATE, MCA3	
DESIGNER	TQ. NGUYEN	129 MAR 2011	SIZE DWG. NO.
DRAFTER	TQ. NGUYEN	2 APR 2011	D
CHECKER	M. SMITH		D1100513
APPROVAL	D. COYNE		REV. v1
SCALE: 1:4		PROJECTION:	SHEET 1 OF 1

FOR QUOTE ONLY

D:\100513_d\UGO_MCA3_Tube_Baffle_Lower_Aperture_Plate_MCA3_PART_PDM_REV-X-018_DRAWING_PDM_REV-X-013

NOTES CONTINUED:

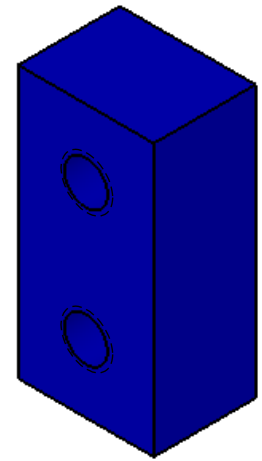
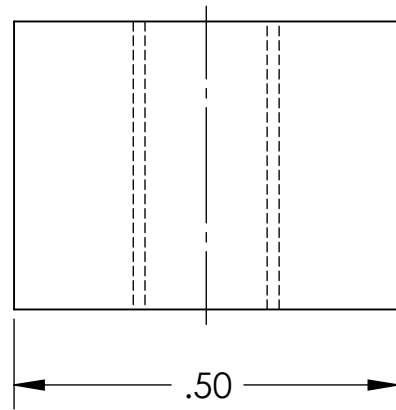
5. SCRIBE, ENGRAVE (A VIBRATORY TOOL MAY BE USED), LASER MARK OR MECHANICALLY STAMP (NO INKS OR DYES) DRAWING PART NUMBER, REVISION (AND VARIANT OR "TYPE" IF APPLICABLE) ON NOTED SURFACE OF PART FOLLOWED ON THE NEXT LINE WITH A THREE DIGIT SERIAL NUMBER. SERIAL NUMBERS START AT 001 FOR THE FIRST ARTICLE AND PROCEED CONSECUTIVELY. USE MINIMUM 0.12" HIGH CHARACTERS, UNLESS THE SIZE OF THE PART DICTATES SMALLER CHARACTERS. EXAMPLE: DXXXXXX-VY, TYPE-XX, S/N XXX

6. MACHINE ALL SURFACES TO REMOVE OXIDES AND MILL FINISH. USE OF ABRASIVE REMOVAL TECHNIQUES IS NOT ALLOWED. REFER TO LIGO-E0900364

7. ALL PARTS SHALL BE MANUFACTURED IN ACCORDANCE WITH LIGO SPECIFICATION E0900364.

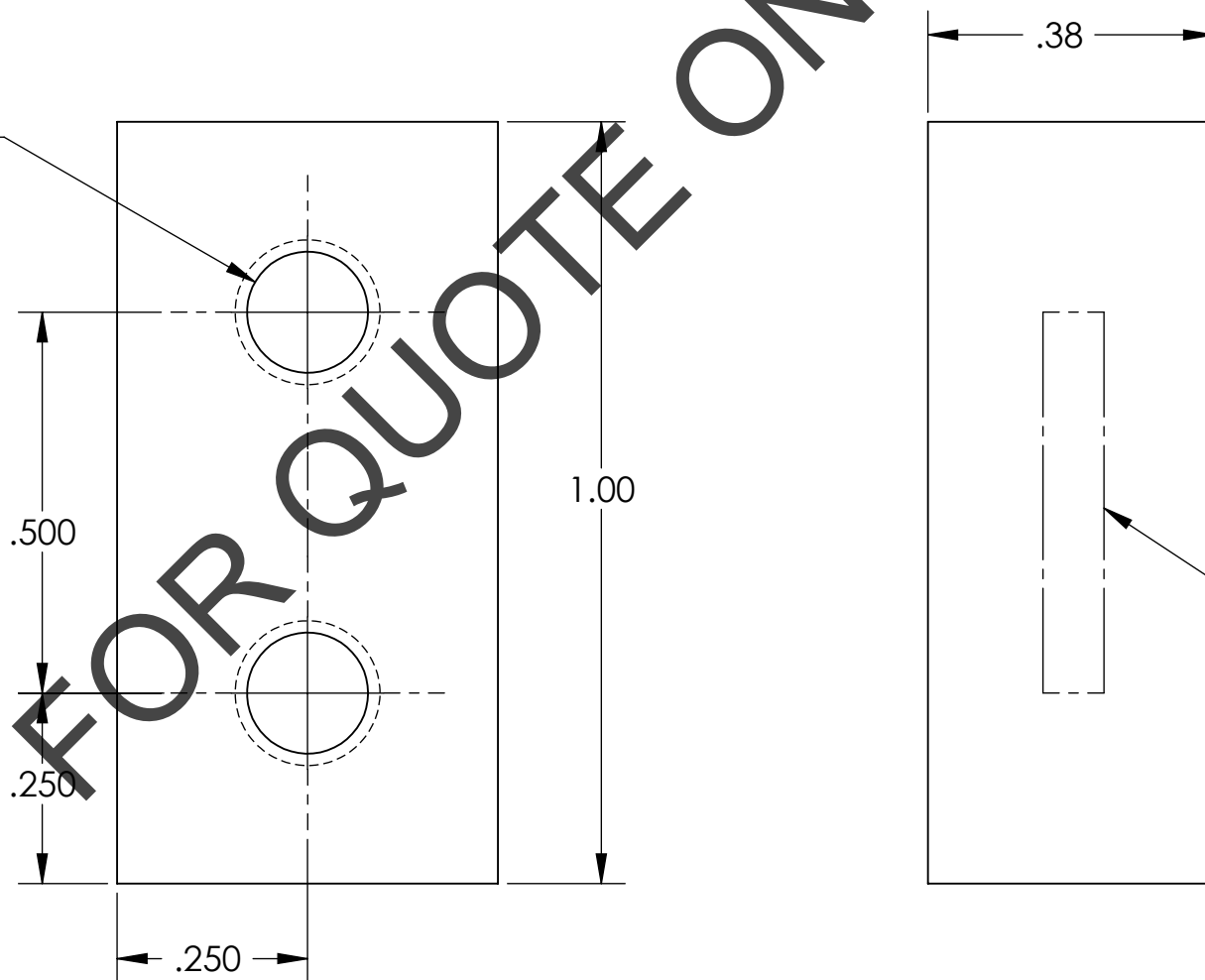
8. ALL MATERIAL IS TO BE VIRGIN MATERIAL (i.e. NO WELD REPAIRS, PLUGS OR RECYCLED MATERIAL). NO REPAIRS SHALL BE MADE UNLESS APPROVED IN ADVANCE, AND IN WRITING, BY LIGO LABORATORY. REFER TO LIGO-E0900364.

REV.	DATE	DCN #	DRAWING TREE #
v1	24 MAY 2011	E1000822-v1	-
-	-	-	-
-	-	-	-



GENERAL VIEW FOR REFERENCE ONLY NO SCALE

2X 10-32 UNF - 2B THRU +.005 OVERSIZE TAP



NOTES AND TOLERANCES: (UNLESS OTHERWISE SPECIFIED)				LIGO CALIFORNIA INSTITUTE OF TECHNOLOGY MASSACHUSETTS INSTITUTE OF TECHNOLOGY		PART NAME	
DIMENSIONS ARE IN INCHES		1. INTERPRET DRAWING PER ASME Y14.5-1994. 2. REMOVE ALL SHARP EDGES, .005-.015, FOR MACHINED PARTS. 3. DO NOT SCALE FROM DRAWING. 4. ALL MACHINING FLUIDS MUST BE FULLY SYNTHETIC, FULLY WATER SOLUBLE AND FREE OF SULFUR, SILICONE, AND CHLORINE.		ADVANCED LIGO		AL APERTURE CLIP	
TOLERANCES: .XX ± .01 .XXX ± .005		MATERIAL 6061-T6 Al		SUB-SYSTEM AOS		DESIGNER TQ. NGUYEN 24 MAY 2011	
ANGULAR ± 0.5°		FINISH 2B		NEXT ASSY D1002864		DRAFTER TQ. NGUYEN 24 MAY 2011	
						CHECKER M. SMITH	
						APPROVAL D. COYNE	
						SIZE DWG. NO. B D1100987	
						REV. v1	
						SCALE: 4:1 PROJECTION: SHEET 1 OF 1	

D1100987_alIGO_Mode_Cleaner_Tube_Baffle_AL_Mnt_Clip_PART PDM REV: X-003, DRAWING PDM REV: X-003