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MPO B593110 - Final Report

C. Brooksby

July 26, 2011

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This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

MPO B593110 - Final Report
NSTec Mechanical Engineering Support to the
Linear Collider Subsystem Development Program
Craig Brooksby, NSTec, 7/14/11

The Scope of Work for this MPO was as follows:

National Security Technologies, LLC (NSTec) shall provide one (1) Mechanical Engineer to support the Linear Collider Subsystem Development Program at Lawrence Livermore National Security, LLC (LLNS). The NSTec Mechanical Engineer's efforts will include engineering, design, and drawing support for the Vacuum Seal Test. NSTec will also provide a final report of the setup and input to LLNL's project management on project status.

The NSTec Mechanical Engineer's efforts will also include engineering, design, and drawing support to the conceptual design for manufacturing of the Flux Concentrator Magnet. NSTec will also contribute to LLNS's final report on the Flux Concentrator Magnet.

The deliverables are drawings, sketches, engineering documents, and final reports delivered to the LLNS Technical Representative.

Time and Effort Summary:

This contract was put in place on 10/4/10 and the project ran until 6/2/11. This contract was funded to a level of \$78,731 of which \$67,253.84 were used. Craig Brooksby, the mechanical engineer, spent 454.5 hours on the project. See **Figure 1** for the profile of the hours spent on the project. This averages to about 13hrs/wk, or about 1/3 time.

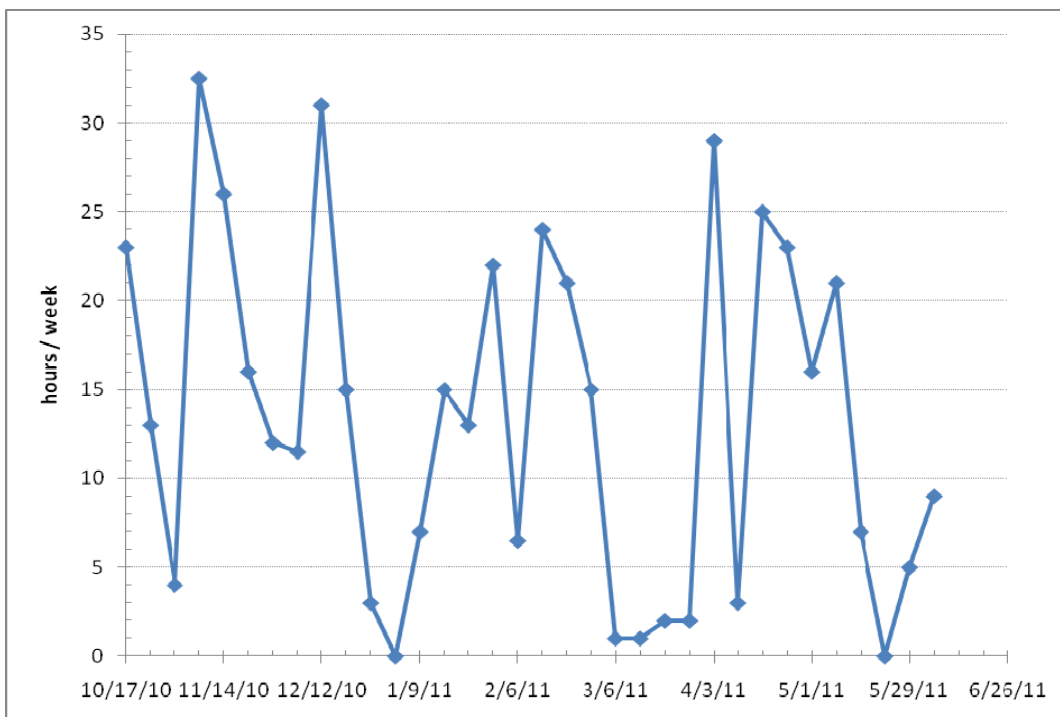


Figure 1 – Engineering Hours per Week spent on project

See **Figure 2** for a summary of the FY11 budget and spending profile.

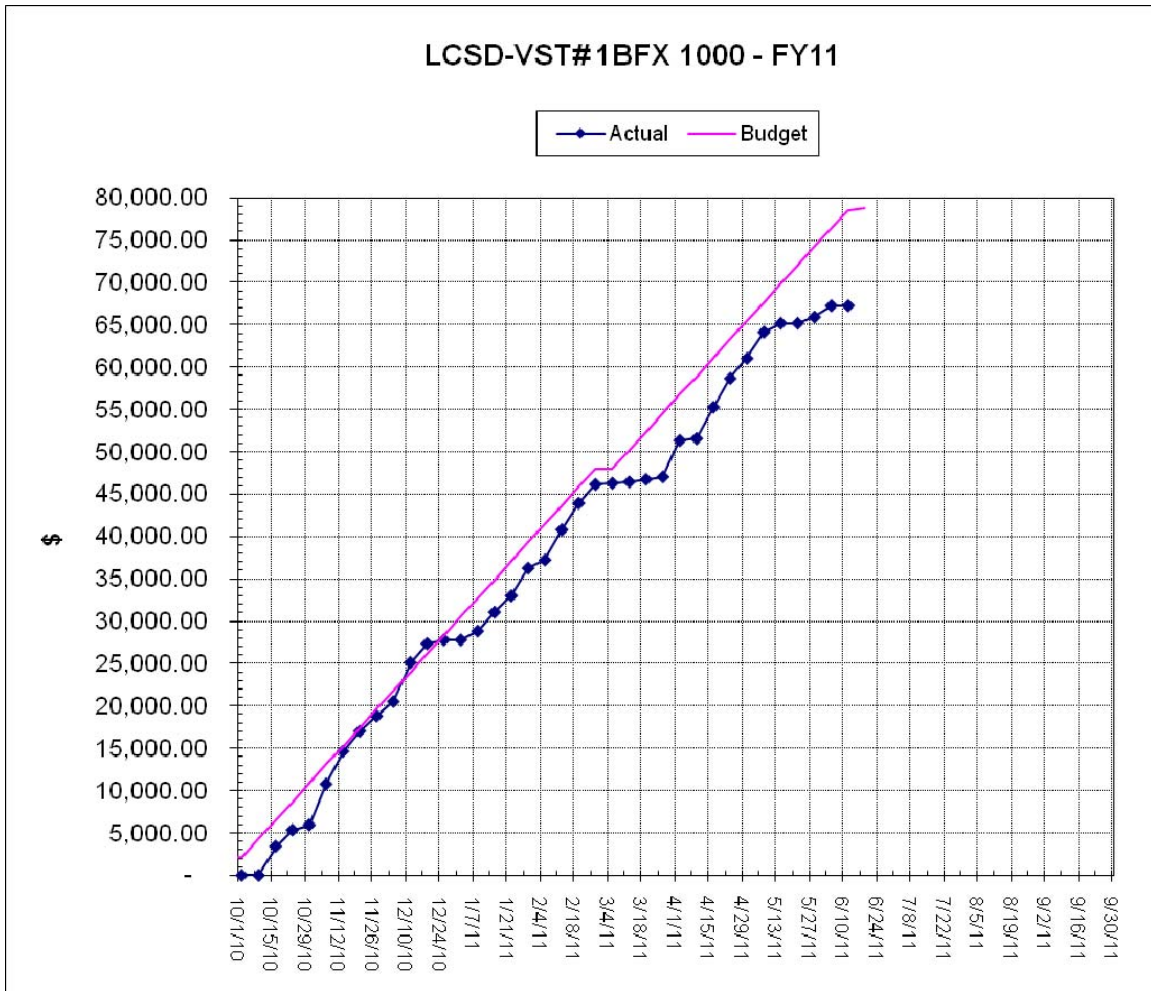


Figure 2 - FY11 Budget and Spending Profile

Linear Collider Subsystem Development - FY11 - Monthly Work Performed Bullet Summary:

Oct 10

Started seal assembly layout on ProE. Initial contact with seal and water union companies.

Nov 10

Worked out basic design of seal assembly and started detail drawings. Researched hollow shaft motors. Found vacuum vessel to use for tests.

Dec 10

Found vacuum pumps and valves to use for tests. Worked on motor issues. More ProE modeling and drawings.

Jan 11

Found new hollow shaft motor that was available. Bearing design. Finalize much of design.

Feb 11

Got detail drawings ready of checking and implemented LLNL's new drawing formats.

Mar 11

Finished specifying motor with Nick Killingsworth and got final quote and placed orders for this and may other components. Found space in B431 for tests. Updated all detail drawings in prep for fabrication quotes.

Apr 11

Parts out for fab quotes and then released for fab. Completed assembly drawings. Did several calculations on vacuum vessel and components.

May 11

More calculations and prep for MESN. Followed all fabrications and purchase of other components.

Design Effort Summary:

Because of LLNL's requirements all the engineering and design effort went into the Vacuum Seal Test part of the Scope of Work. No effort was done on the Flux Concentrator Magnet part of the Scope of Work.

I did all the ProE CAD modeling to design up the configuration for the Vacuum Seal Test. This is shown in **Figure 3**.

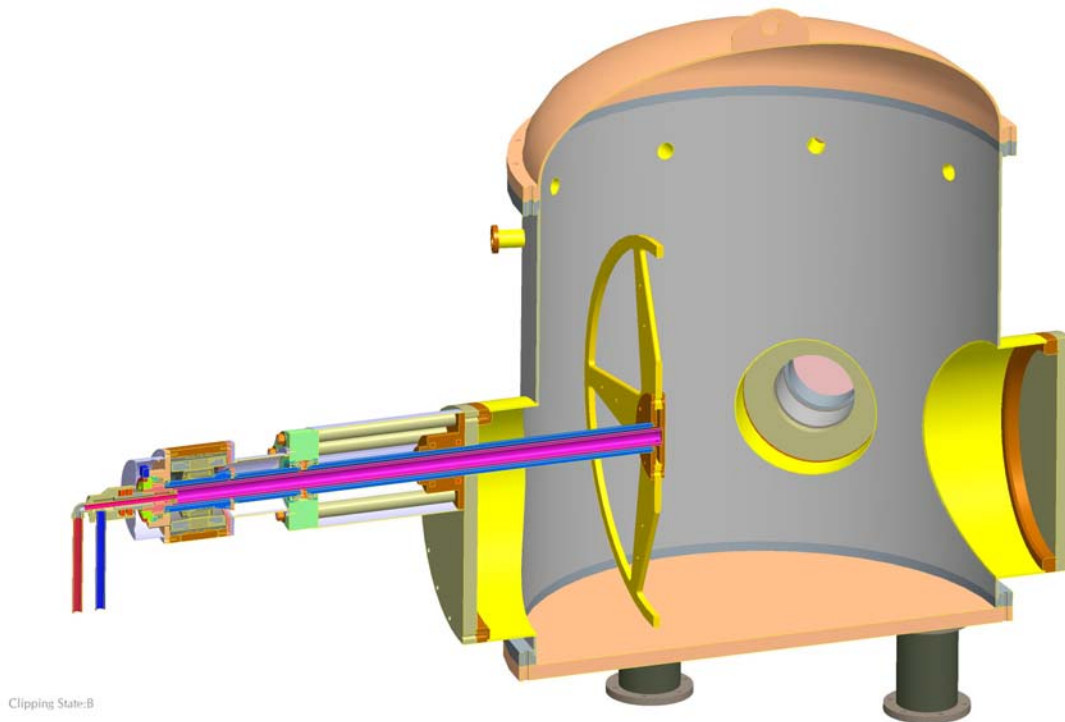


Figure 3 – Vacuum Seal Test Assembly

I worked with the LLNL engineer Lisle Hagler, and the motor and vacuum seal companies, to design the support system for the cantilevered flywheel. See **Figure 4**.

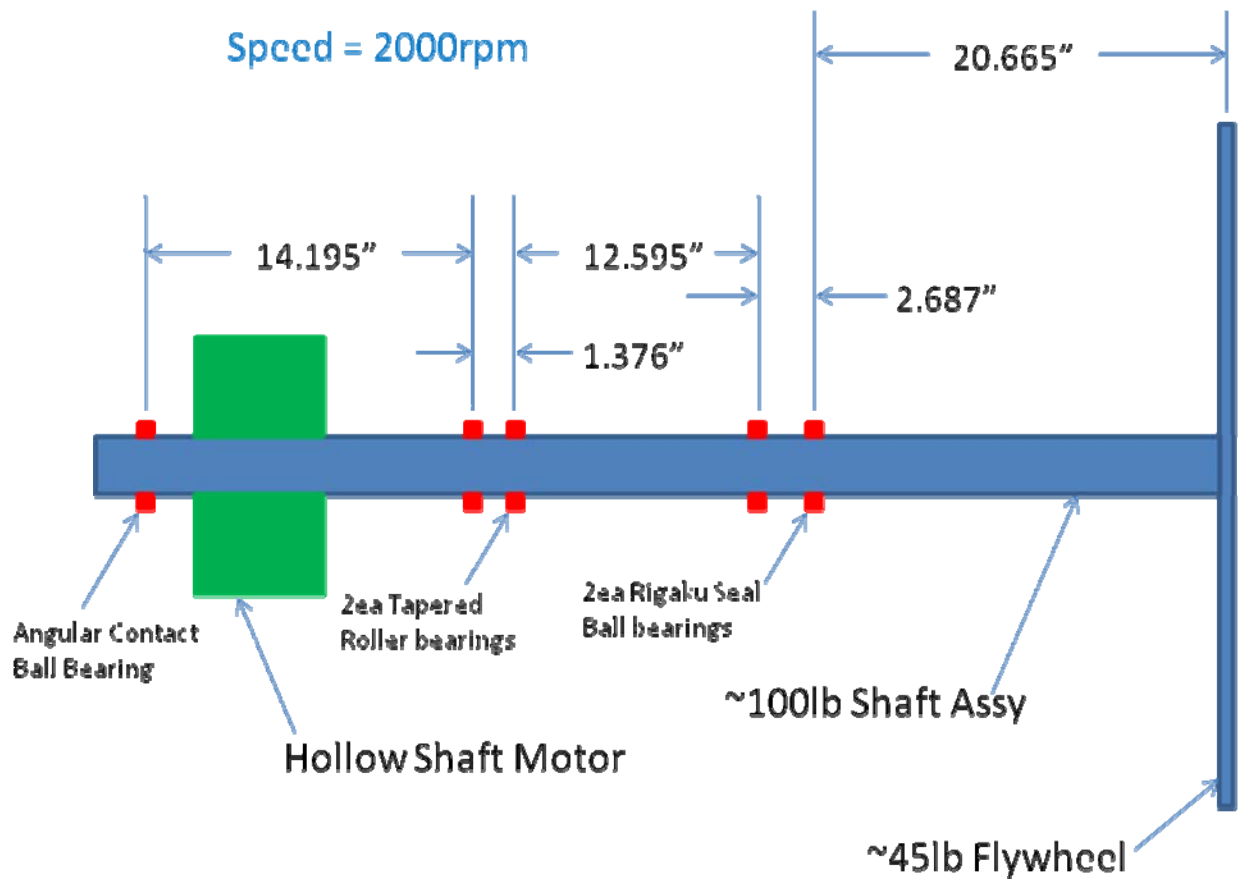


Figure 4 - Vacuum Seal Test Free-Body Diagram (FBD)

I did all the detail drawings and assembly drawings for the full assembly. See **Figures 5 thru 8** for the four sheets of the main assembly drawing.

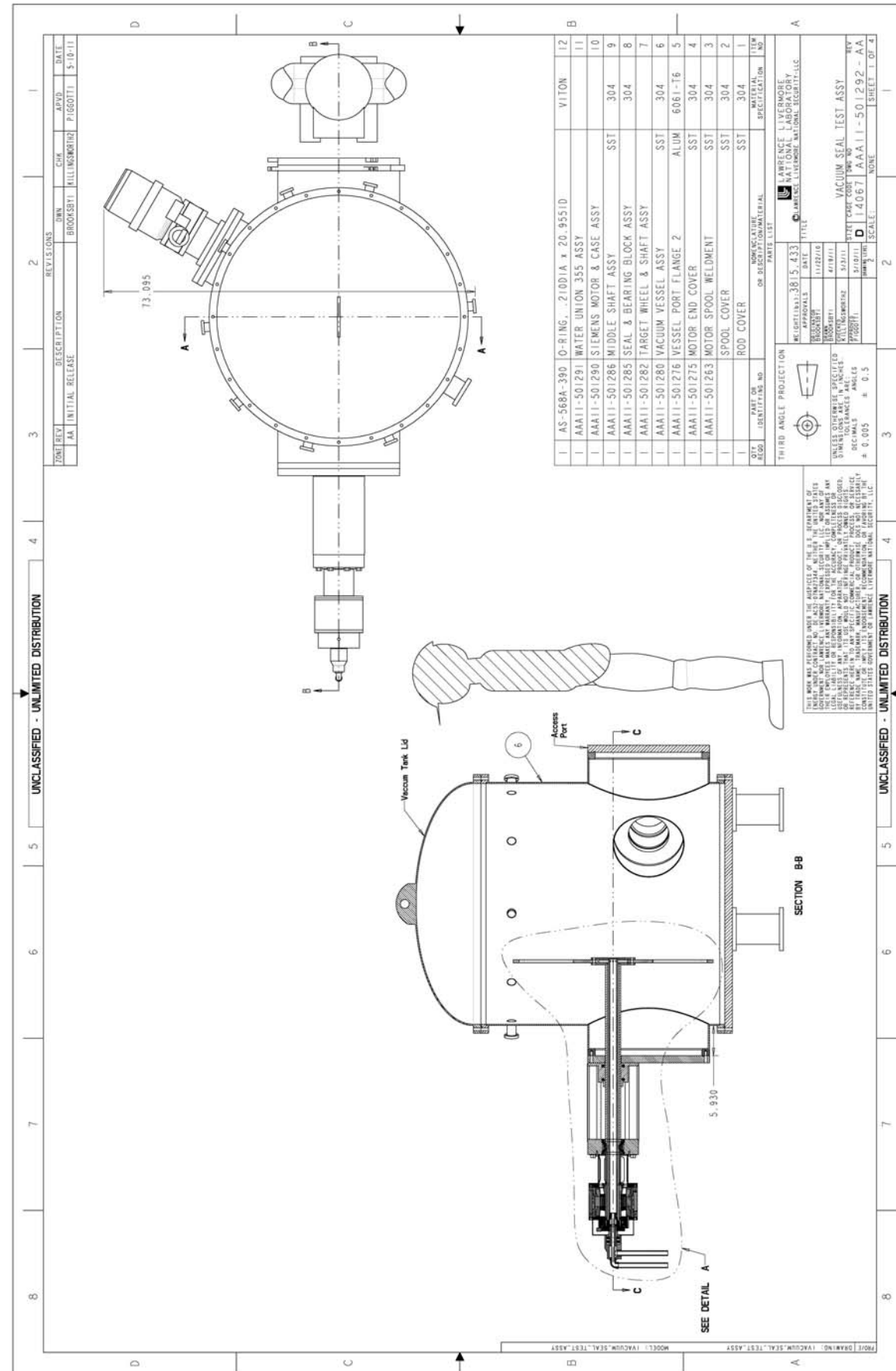


Figure 5 – Assembly Drawing AAA11-501292-AA, Sheet 1

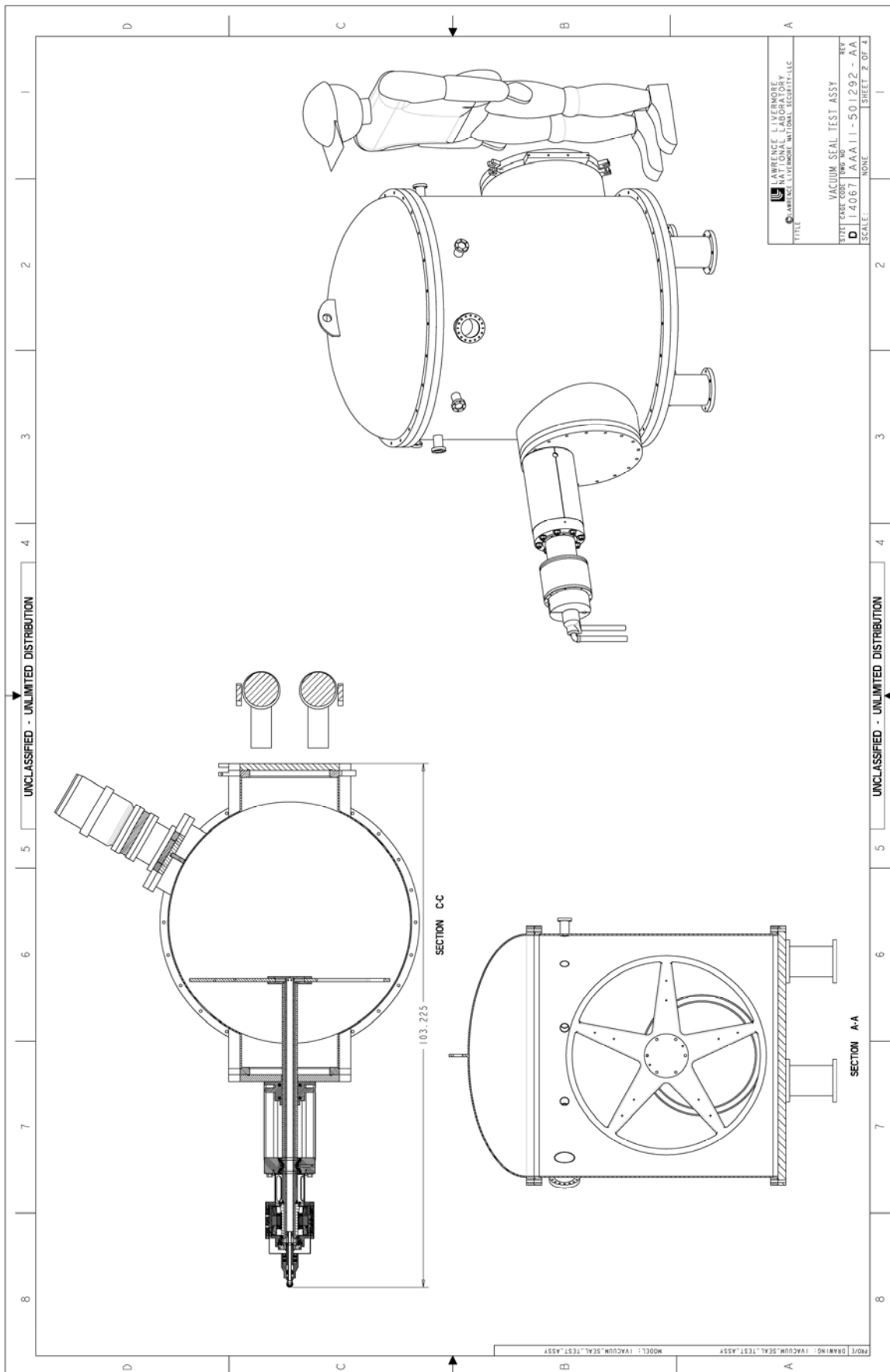


Figure 6 - Assembly Drawing AAA11-501292-AA, Sheet 2

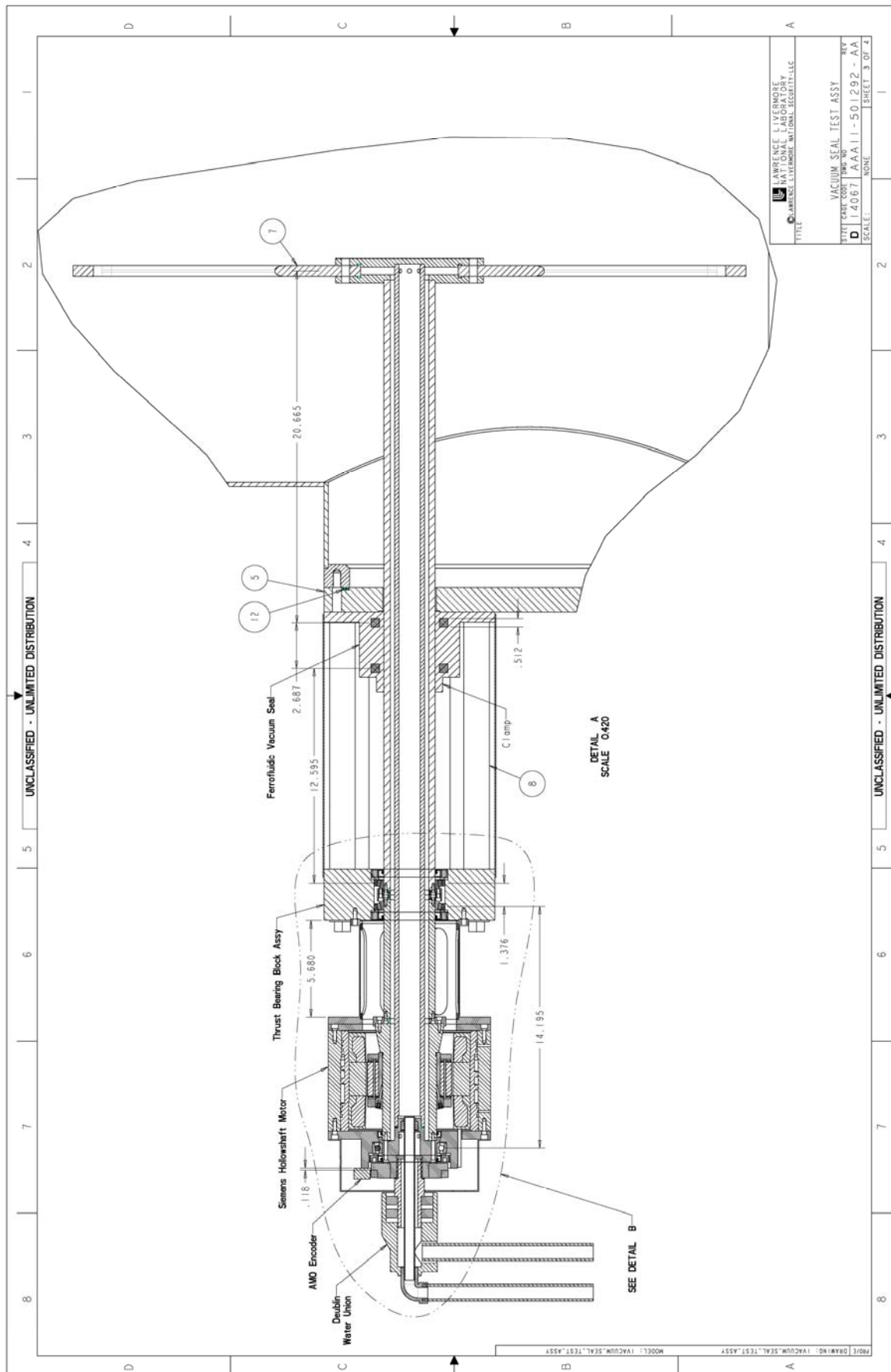


Figure 7 - Assembly Drawing AAA11-501292-AA, Sheet 3

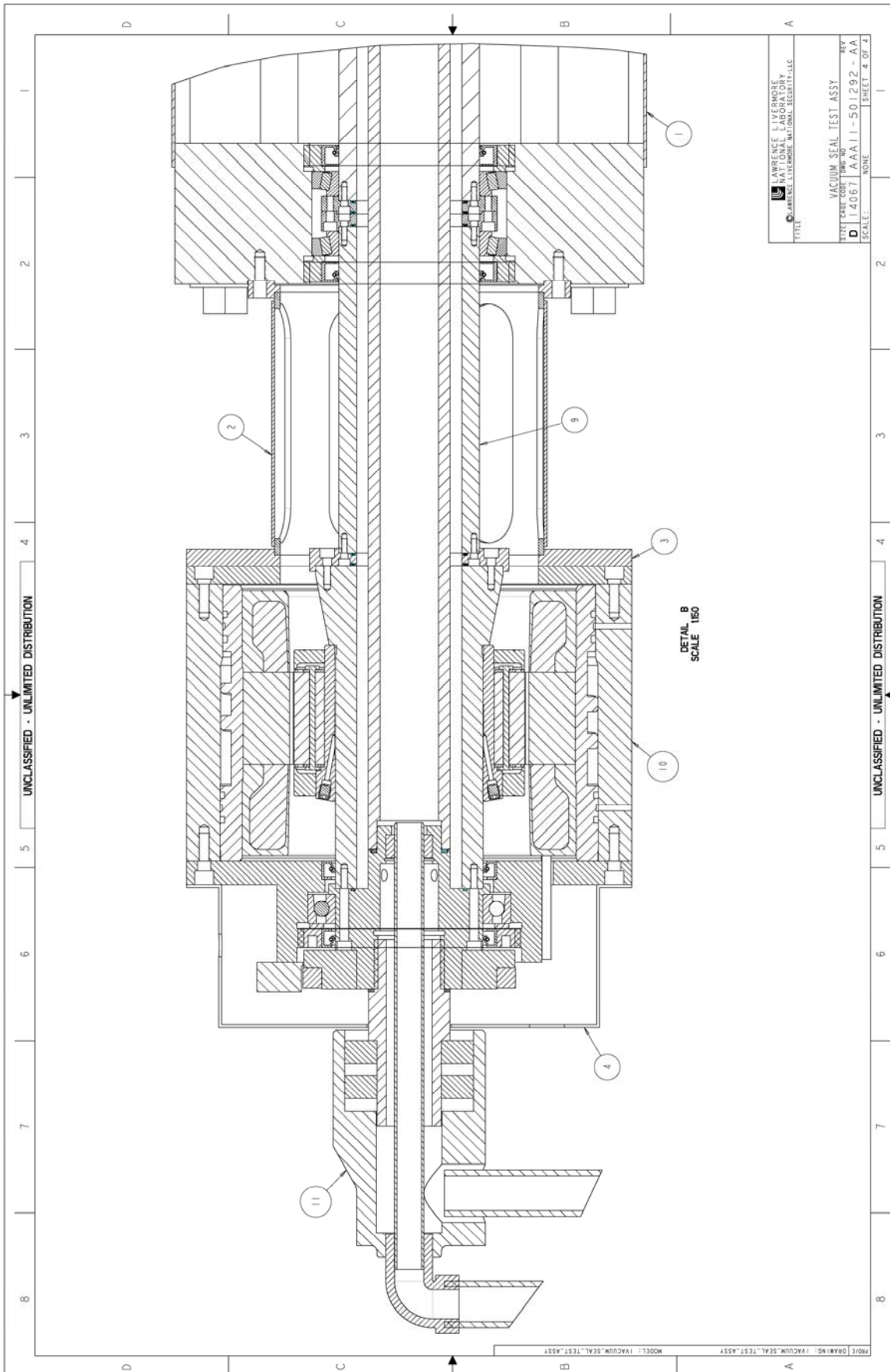


Figure 8 - Assembly Drawing AAA11-501292-AA, Sheet 4

Over the 8 months of the life of this project I completed the 40 detail and assembly drawings shown in **Figure 9**. These drawings and the assembly drawings are attached to the end of this report.

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2	AAA11-501254	AA	1	D	Inner Shaft Weldment	1
3	AAA11-501255	AA	1	D	Shaft - Middle	1
4	AAA11-501256	AA	1	D	Bearing Standoff	8
5	AAA11-501257	AA	1	D	Bearing Block	1
6	AAA11-501258	AA	1	D	Bearing Nut	2
7	AAA11-501259	AA	1	D	Bearing Nut 2	1
8	AAA11-501260	AA	1	D	Motor Spool Flange 1	1
9	AAA11-501261	AA	1	D	Motor Spool Tube	1
10	AAA11-501262	AA	1	D	Motor Spool Flange 2	1
11	AAA11-501263	AA	1	D	Motor Spool Weldment	1
12	AAA11-501264	AA	1	D	Shaft Flange 3	1
13	AAA11-501265	AA	1	D	Shaft Flange 4	1
14	AAA11-501266	AA	1	D	Shaft Flange 5	1
15	AAA11-501267	AA	1	D	Shaft - Motor	1
16	AAA11-501268	AA	1	D	Motor Case Flange 1	1
17	AAA11-501269	AA	1	D	Motor Outer Case	1
18	AAA11-501270	AA	1	D	Motor Case Flange 2	1
19	AAA11-501271	AA	1	D	Water Union 355 Inner Tube	1
20	AAA11-501272	AA	1	D	Water Union PTFE Bearing	1
21	AAA11-501273	AA	1	D	Shaft Flange 7	1
22	AAA11-501274	AA	1	D	Encoder Mounting Disk	1
23	AAA11-501275	AA	1	D	Motor End Cover	1
24	AAA11-501276	AA	1	D	Vessel Port Flange 2	1
25	AAA11-501277	AA	1	D	Vessel Port Flange 1B	1
26	AAA11-501278	AA	1	D	10in CF Spool	1
27	AAA11-501279	AA	1	D	Rod Assy Weldment	8
28	AAA11-501280	AA	1	D	Vacuum Vessel Assy	1
29	AAA11-501281	AA	1	D	Target Wheel Shaft Assy	1
30	AAA11-501282	AA	1	D	Target Wheel & Shaft Assy	1
31	AAA11-501283	AA	1	D	Bearing Nut & Seal Assy 1	1
32	AAA11-501284	AA	1	D	Bearing Block Assy	1
33	AAA11-501285	AA	1	D	Seal & Bearing Block Assy	1
34	AAA11-501286	AA	1	D	Middle Shaft Assy	1
35	AAA11-501287	AA	1	D	Bearing Nut & Seal Assy 2	1
36	AAA11-501288	AA	1	D	Motor Bearing Assy	1
37	AAA11-501289	AA	1	D	Siemens Rotor & Motor Shaft Assy	1
38	AAA11-501290	AA	1	D	Siemens Motor & Case Assy	1
39	AAA11-501291	AA	1	D	Water Union 355 Assy	1
40	AAA11-501292	AA	4	D	Vacuum Seal Test Assy	1

Figure 9 – Drawing List

I located several major components that were onsite at LLNL that could be used for these tests. These included the main vacuum vessel (**Figure 10**) and the main vacuum turbo pump and valve (**Figure 11**). The main vacuum vessel is 4' in diameter and the main tank section is 4' tall. The vacuum turbo pump is a 1000l/s turbo on a 10" gate valve. I also negotiated the use of the ETA II experimental tunnel as a location to house this experiment.



Figure 10 – Main Vacuum Vessel

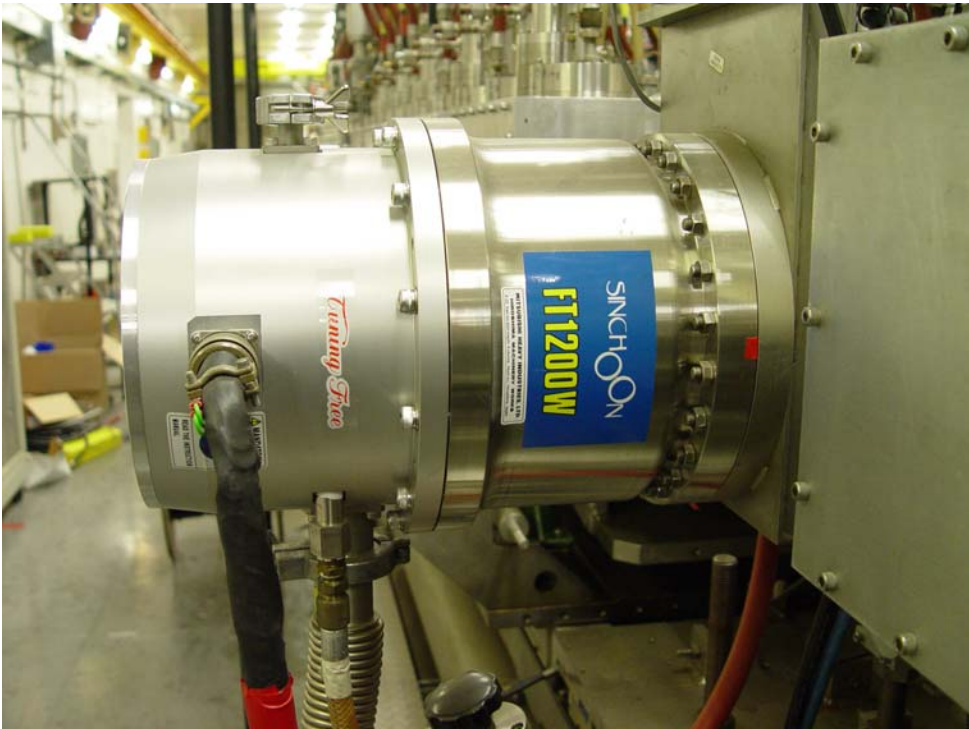


Figure 11 – Vacuum Turbo Pump and Gate Valve

I worked all the vendors to specific and order the main components for the test. Shown below are the main rotating vacuum seal from Rigaku (Figure 12) and the rotating water union from Deublin (Figure 13). I also worked closely with Nick Killingsworth to specify the 3” hollow shaft motor from Siemens.

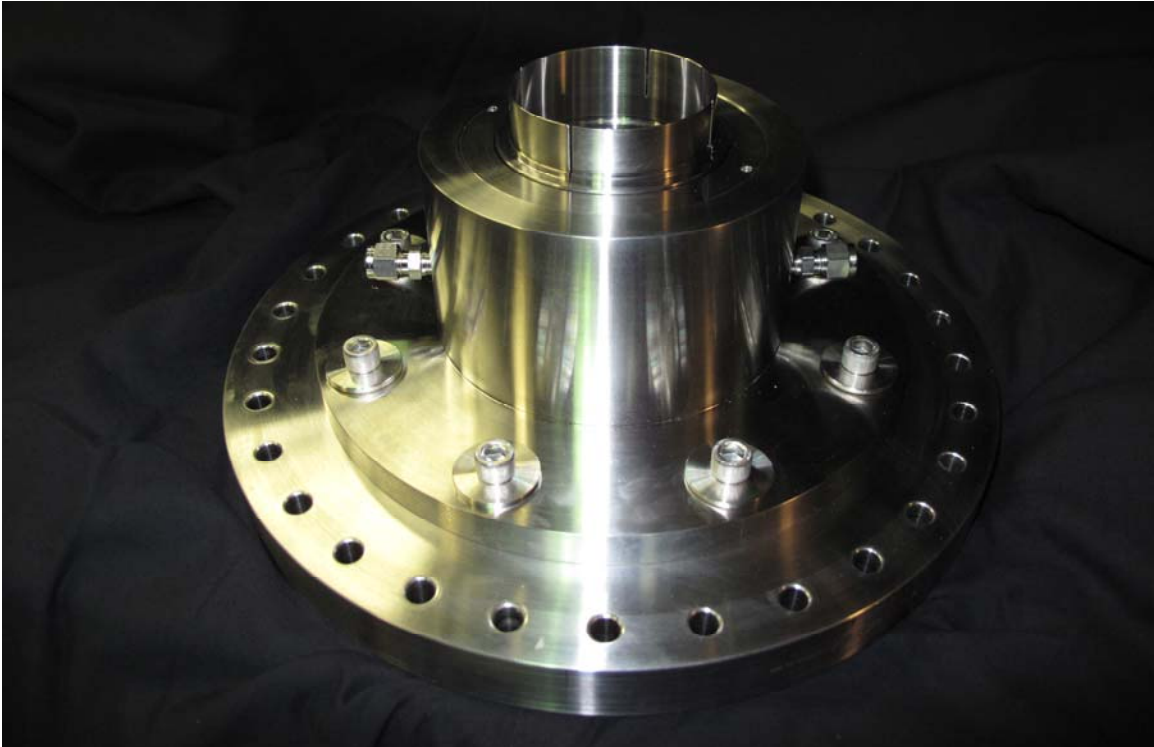


Figure 12 – Rigaku Ferrofluidic Rotating Vacuum Seal with 3” Bore



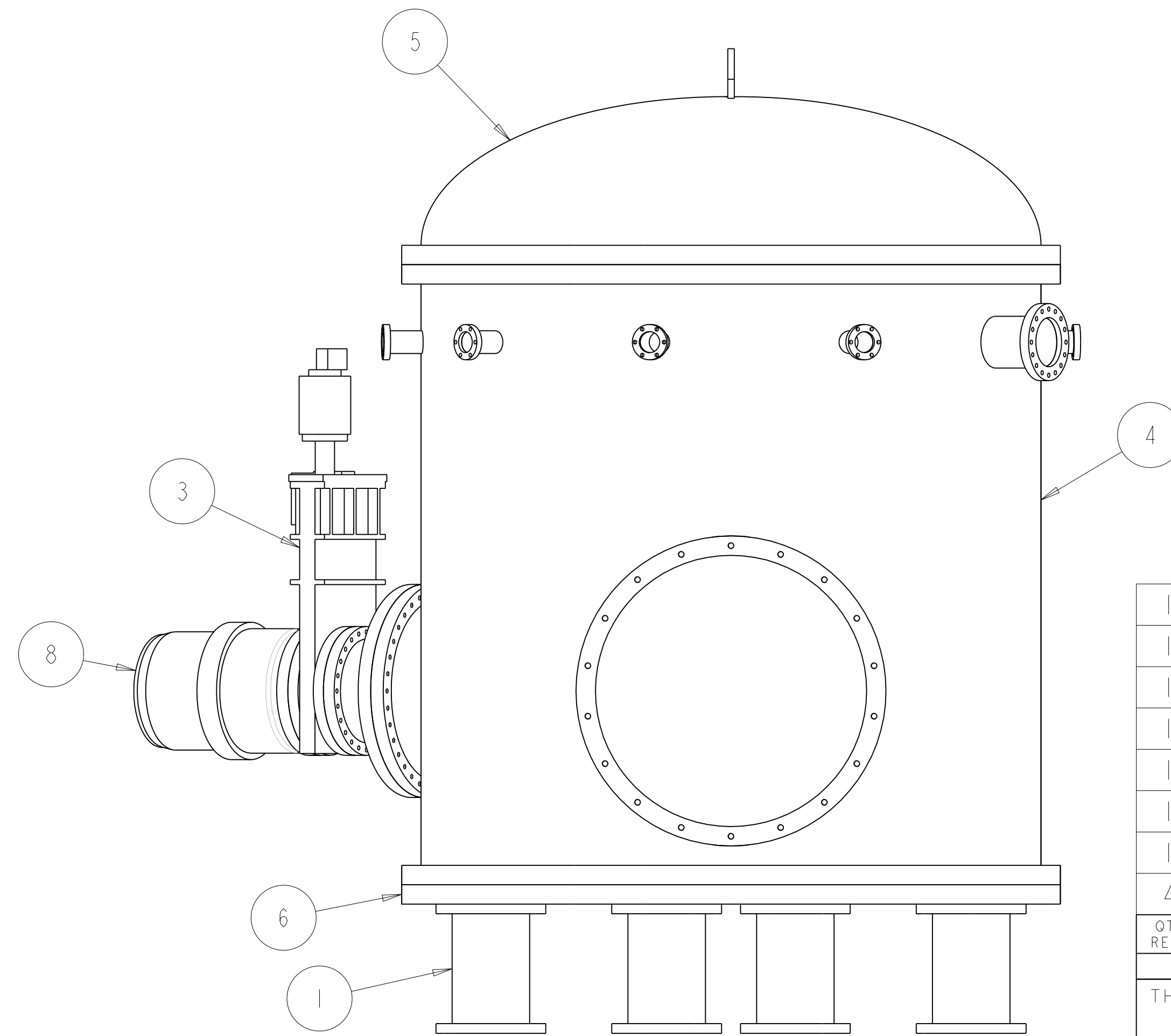
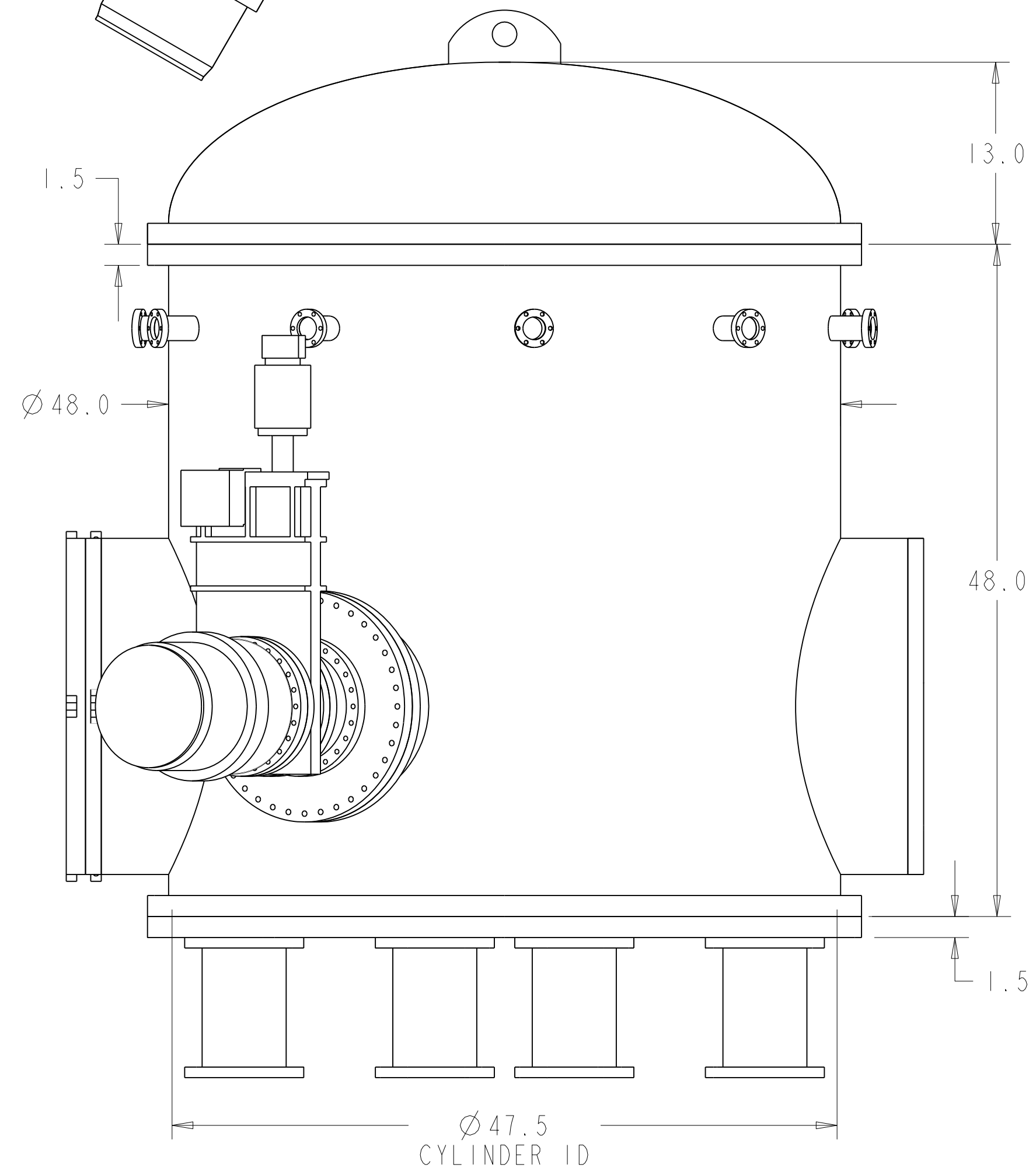
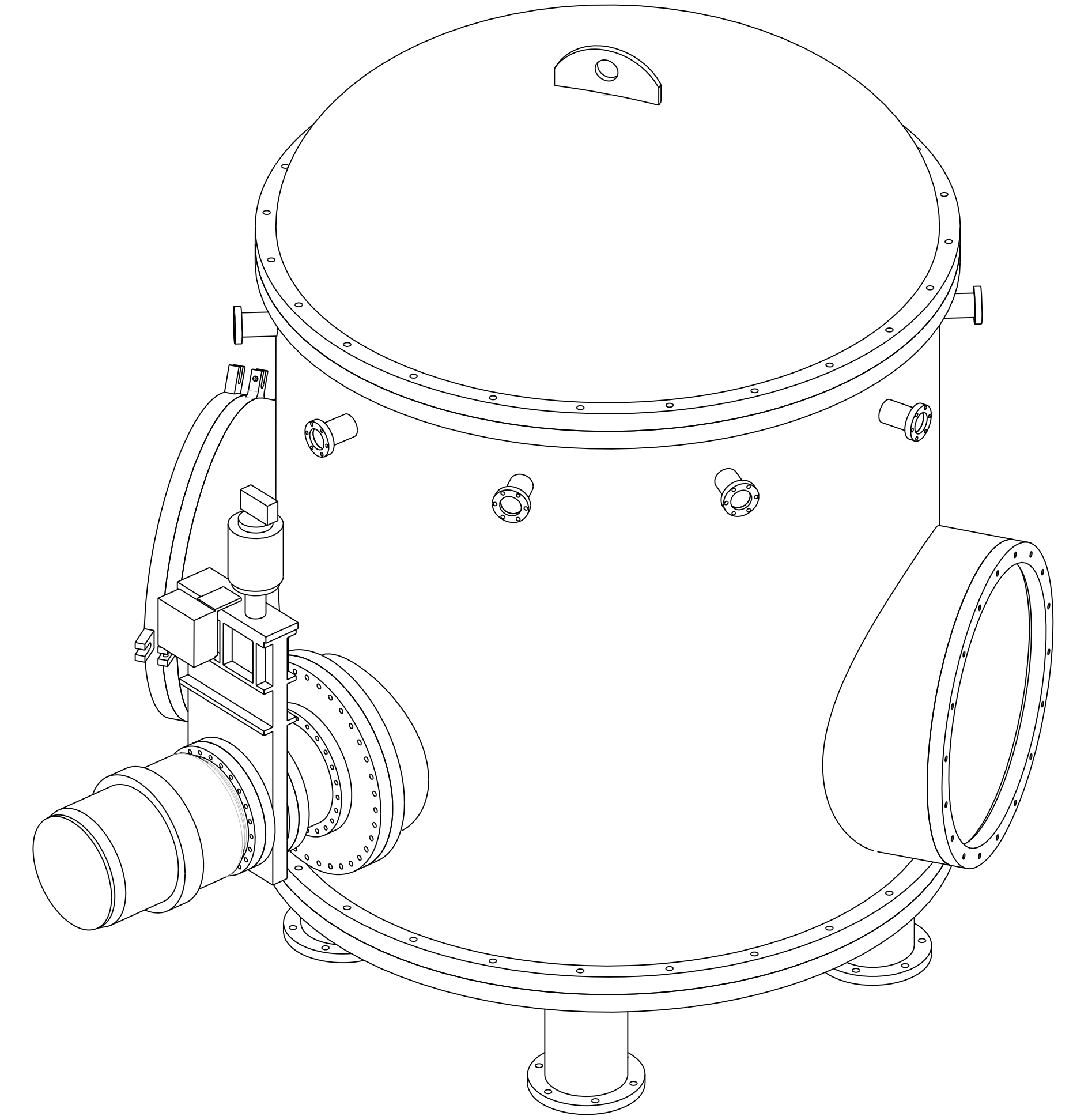
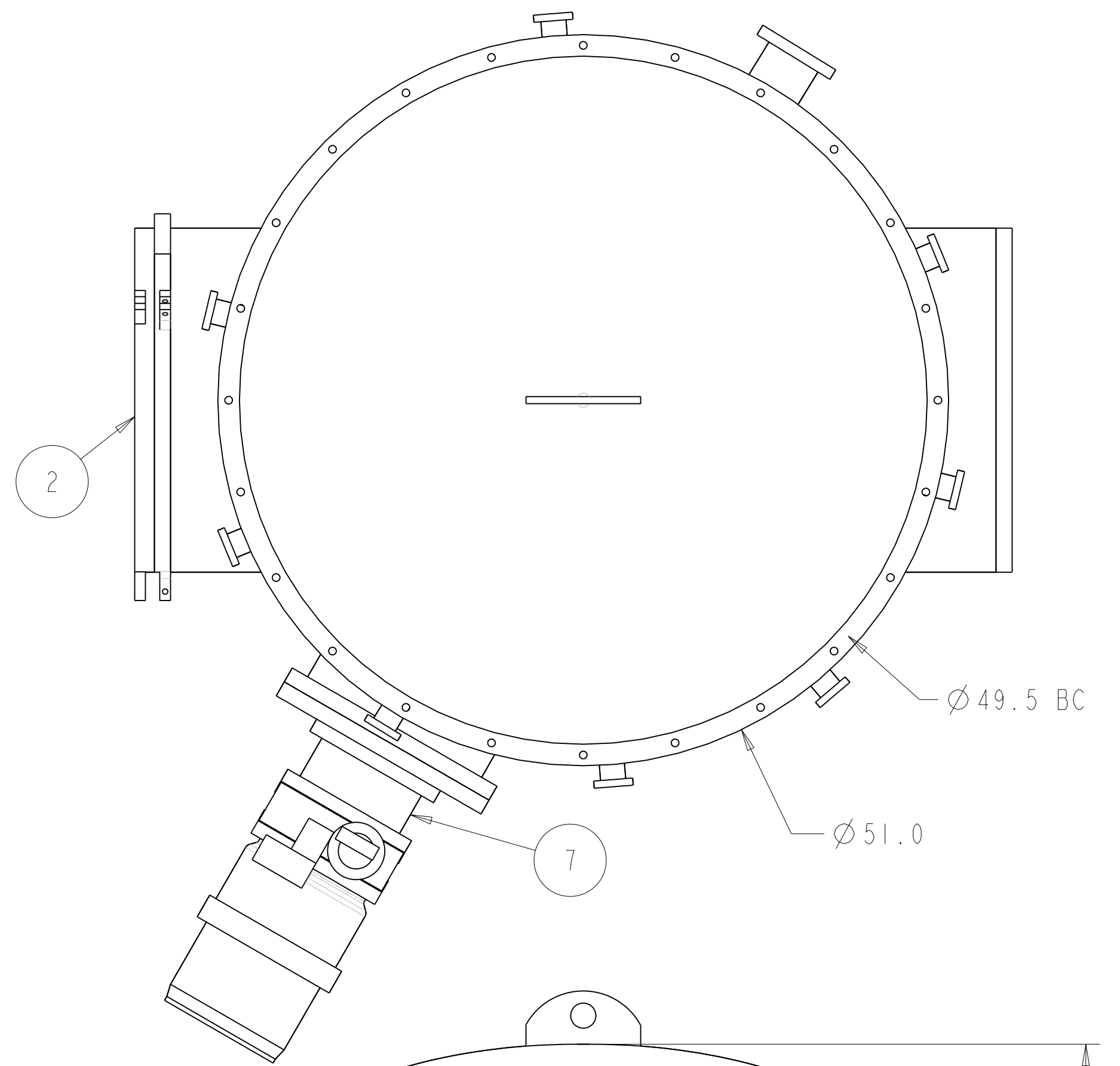
Figure 13 – Deublin Rotating Water Union

Attachments:

Following this page are attached all the assembly and detailed drawings generated for this project.

UNCLASSIFIED - UNLIMITED DISTRIBUTION

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1		VACUUM VESSEL, FLAT END PLATE SST	304	6
1		VACUUM VESSEL, END DOME SST	304	5
1		VACUUM VESSEL, 4' ID x 4' TALL SST	304	4
1		VACUUM GATE VALVE, 10in SST	304	3
1		ACCESS PORT FLANGE ASSY ALUM	6061-T6	2
4		TANK FOOT SPOOL	ST	1

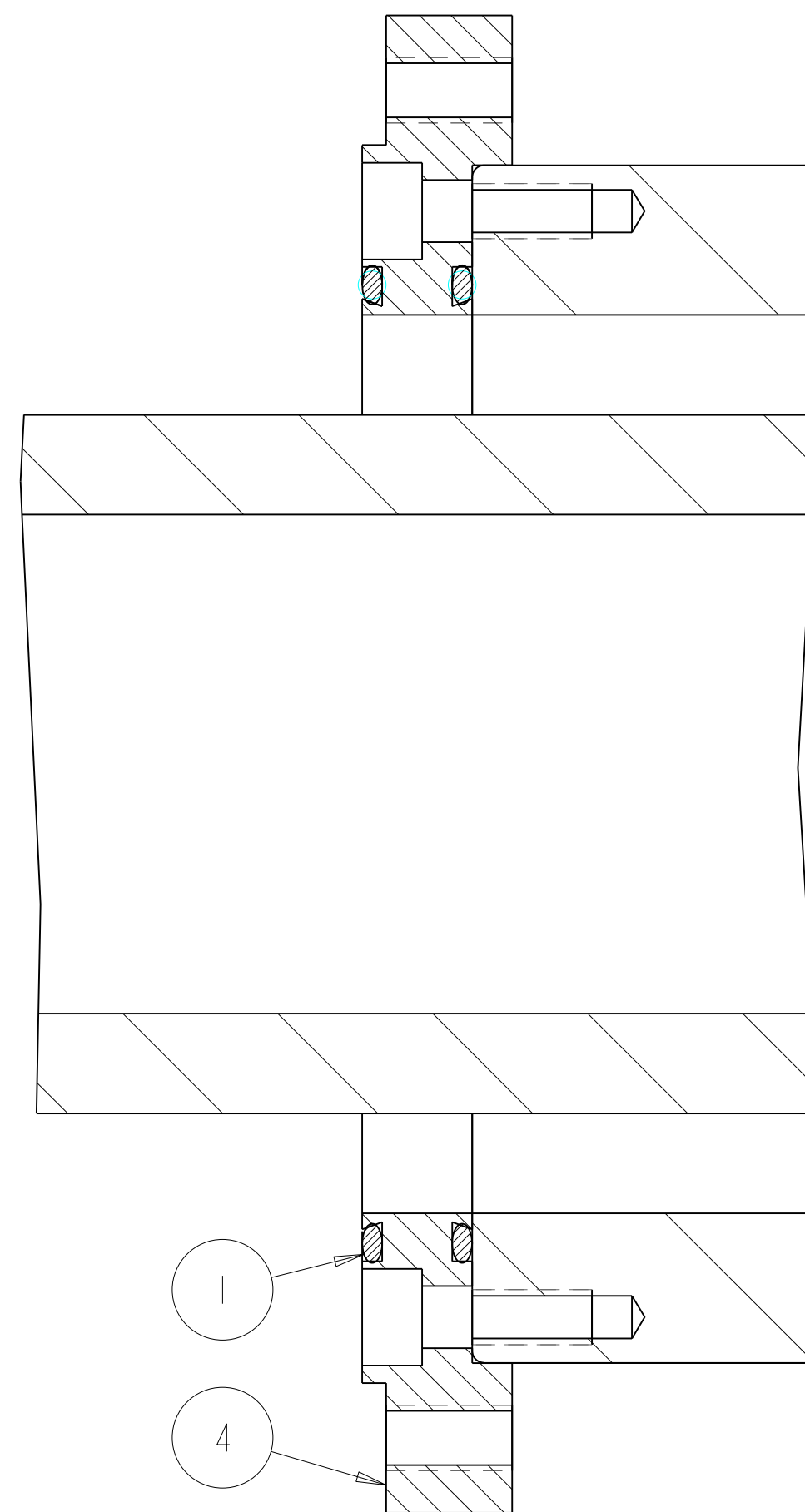
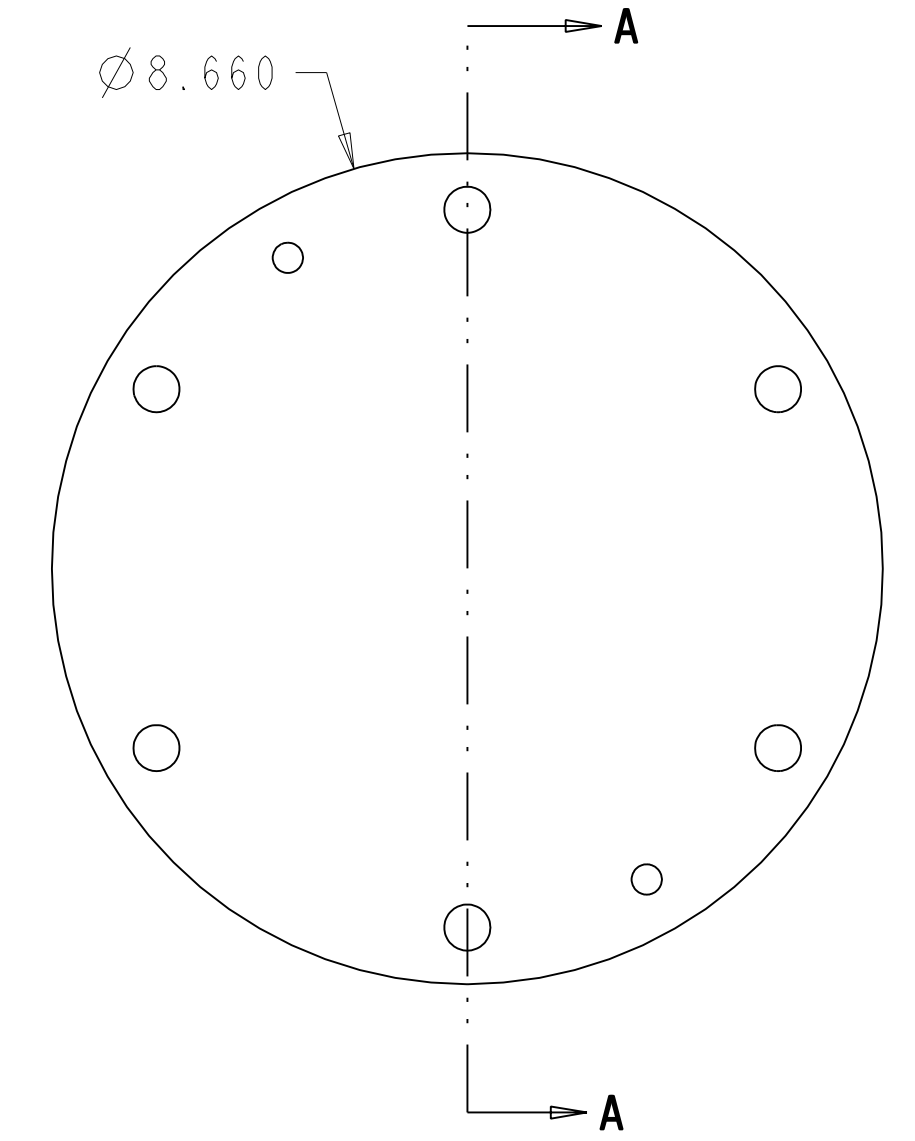
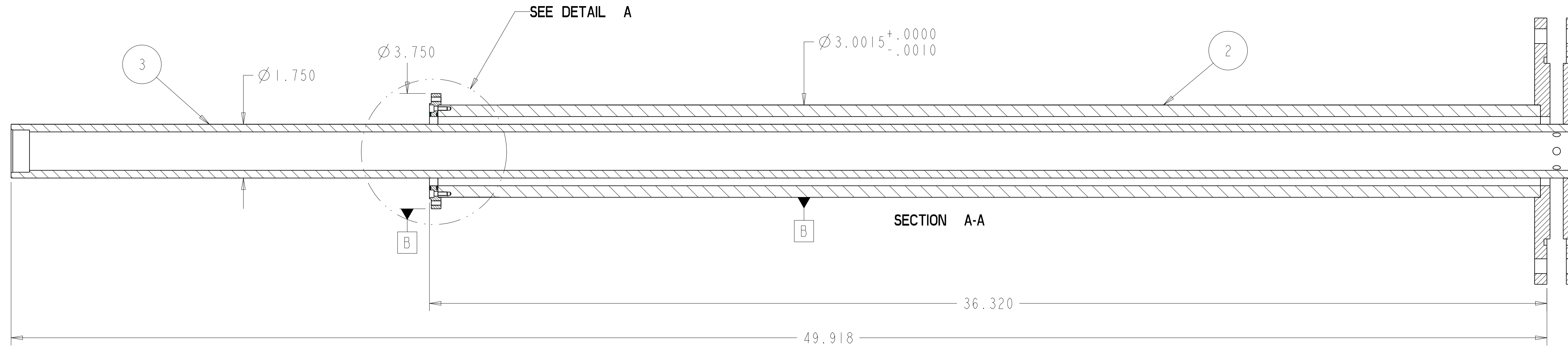
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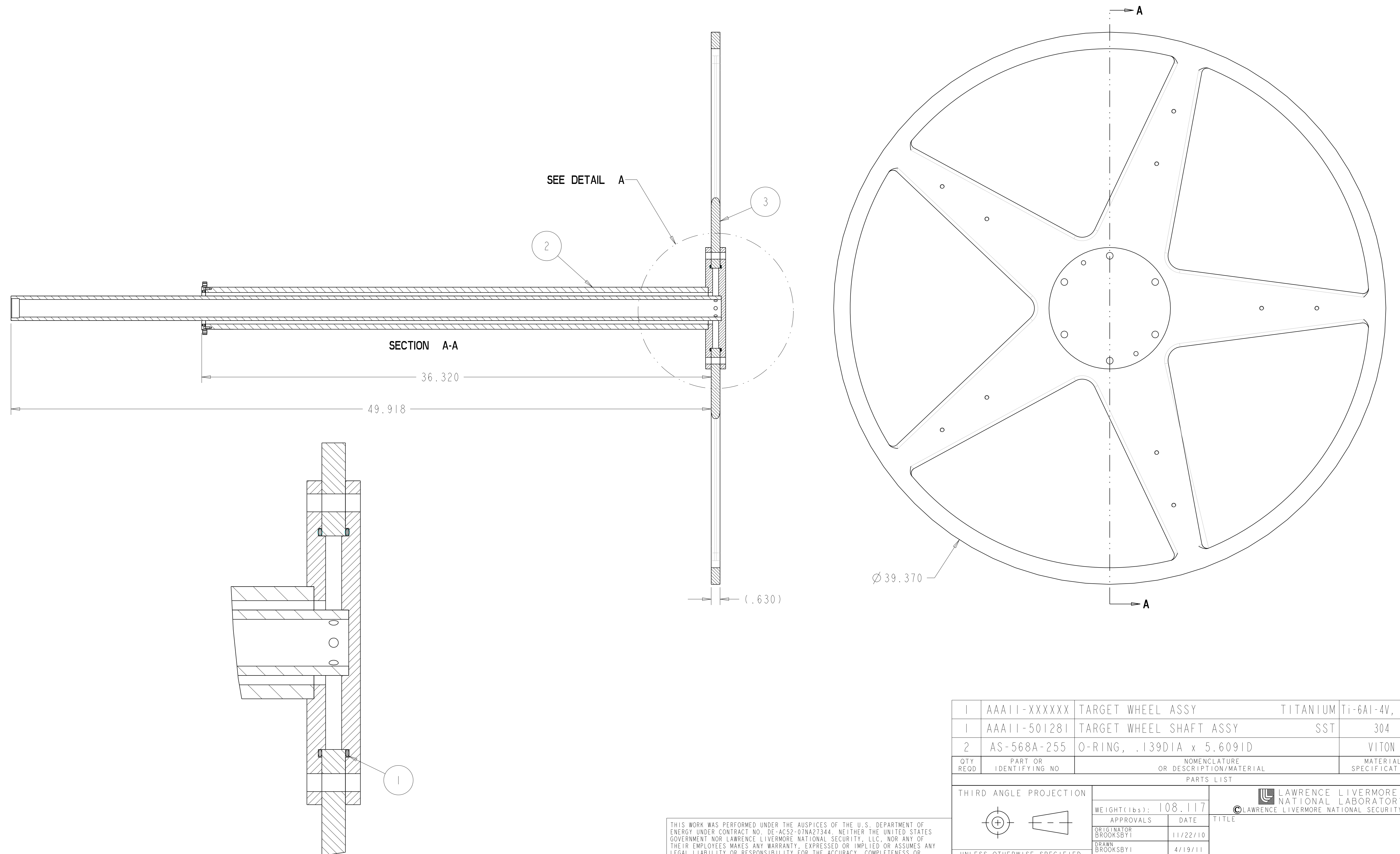
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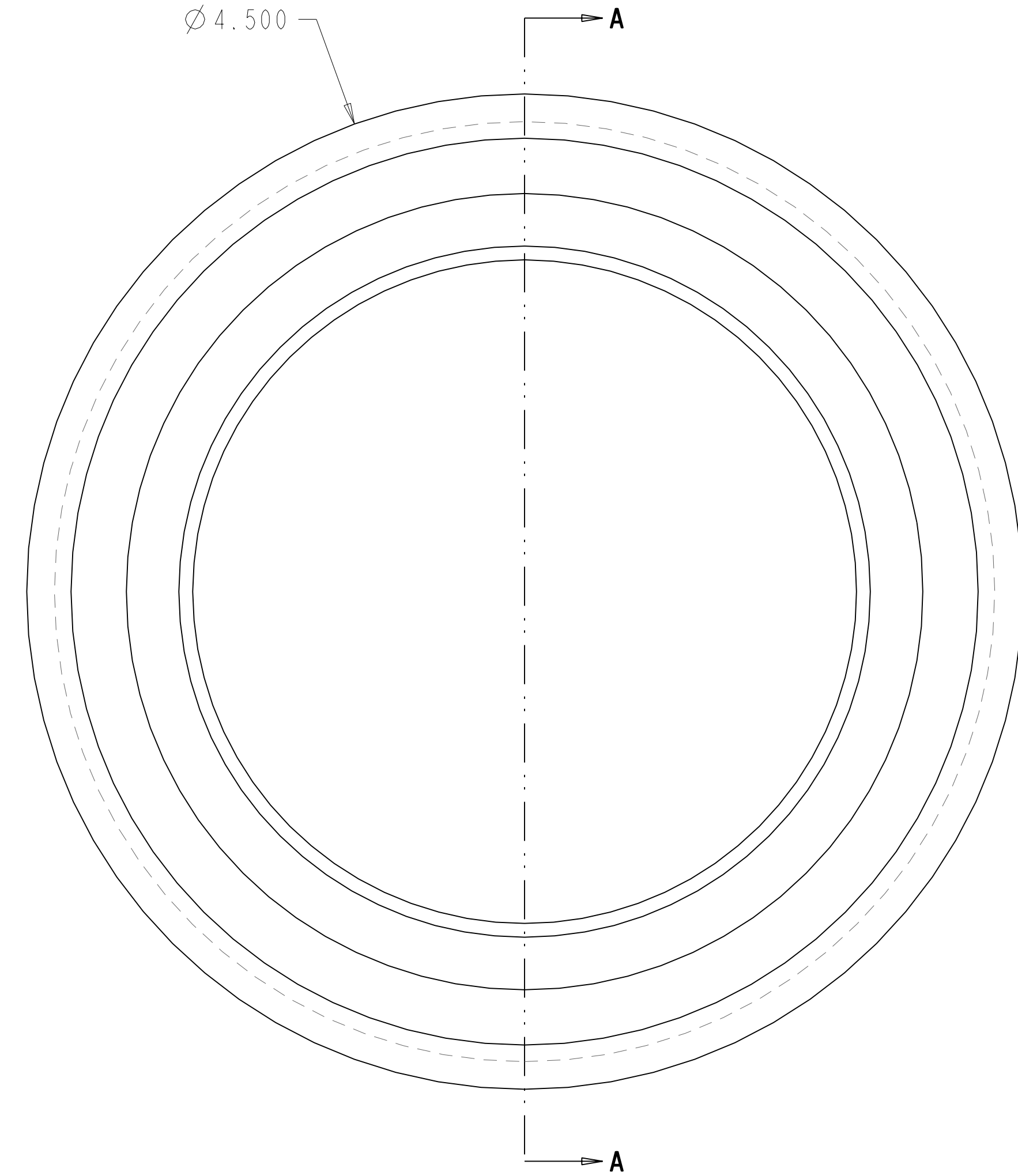
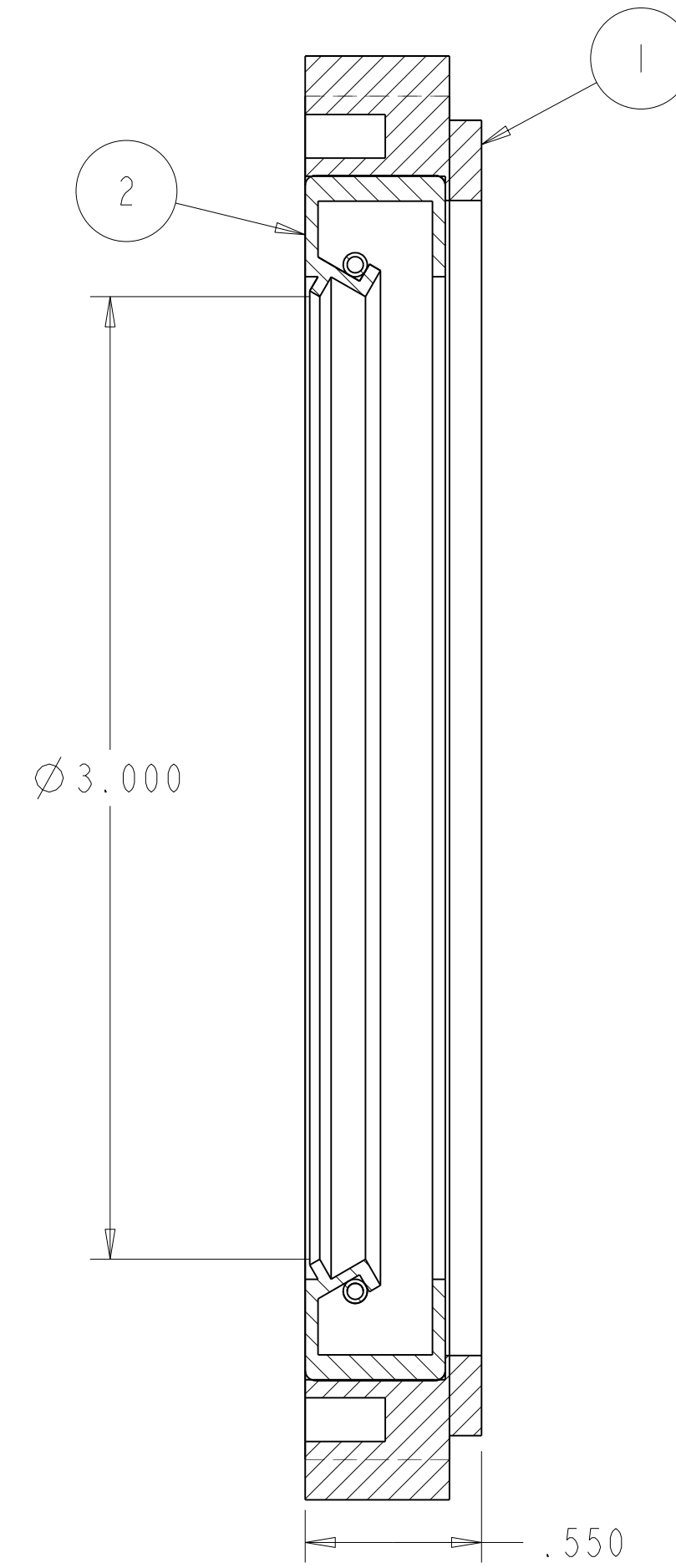
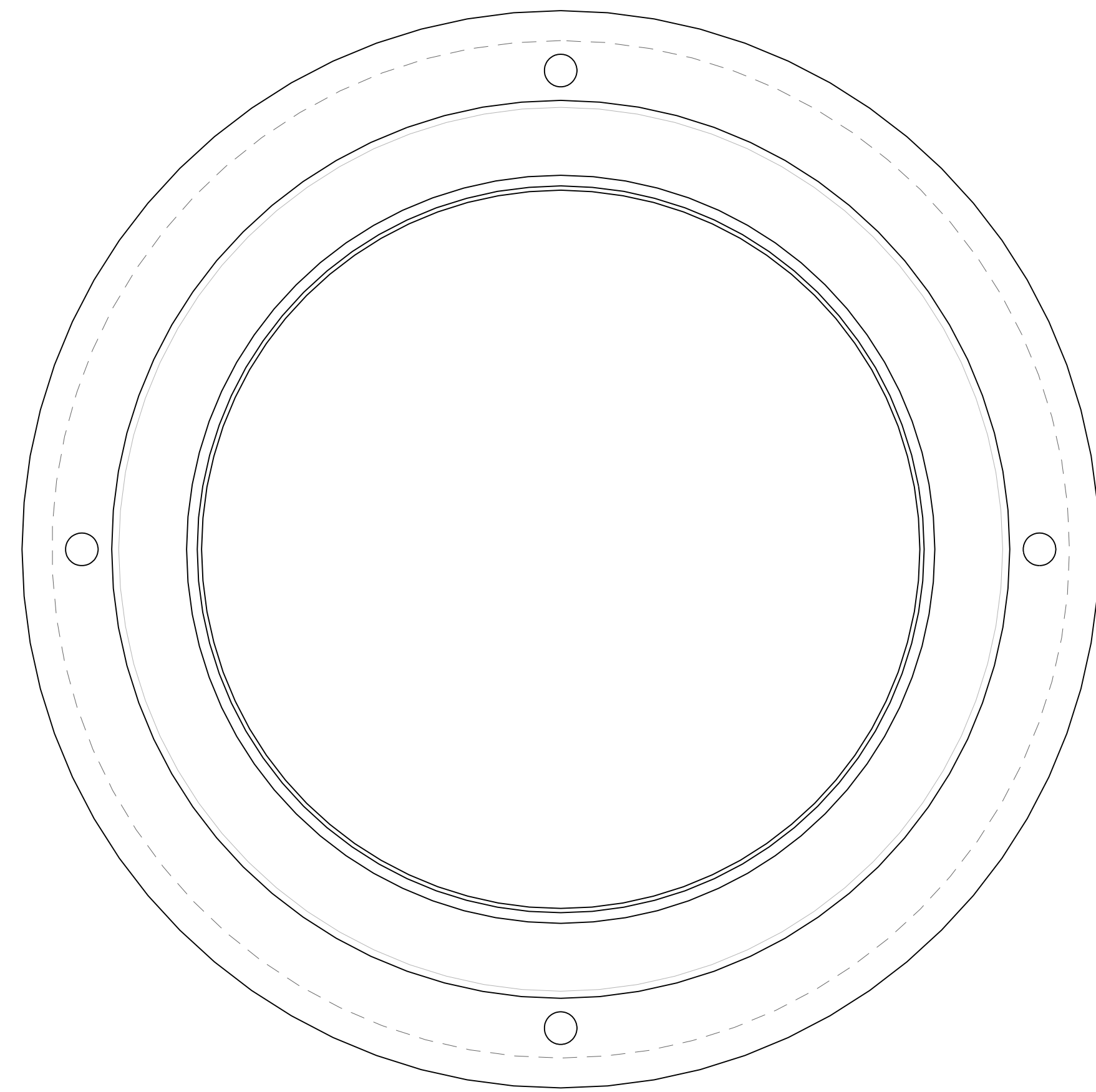
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1	AAA11-501281	TARGET WHEEL SHAFT ASSY	SST	2
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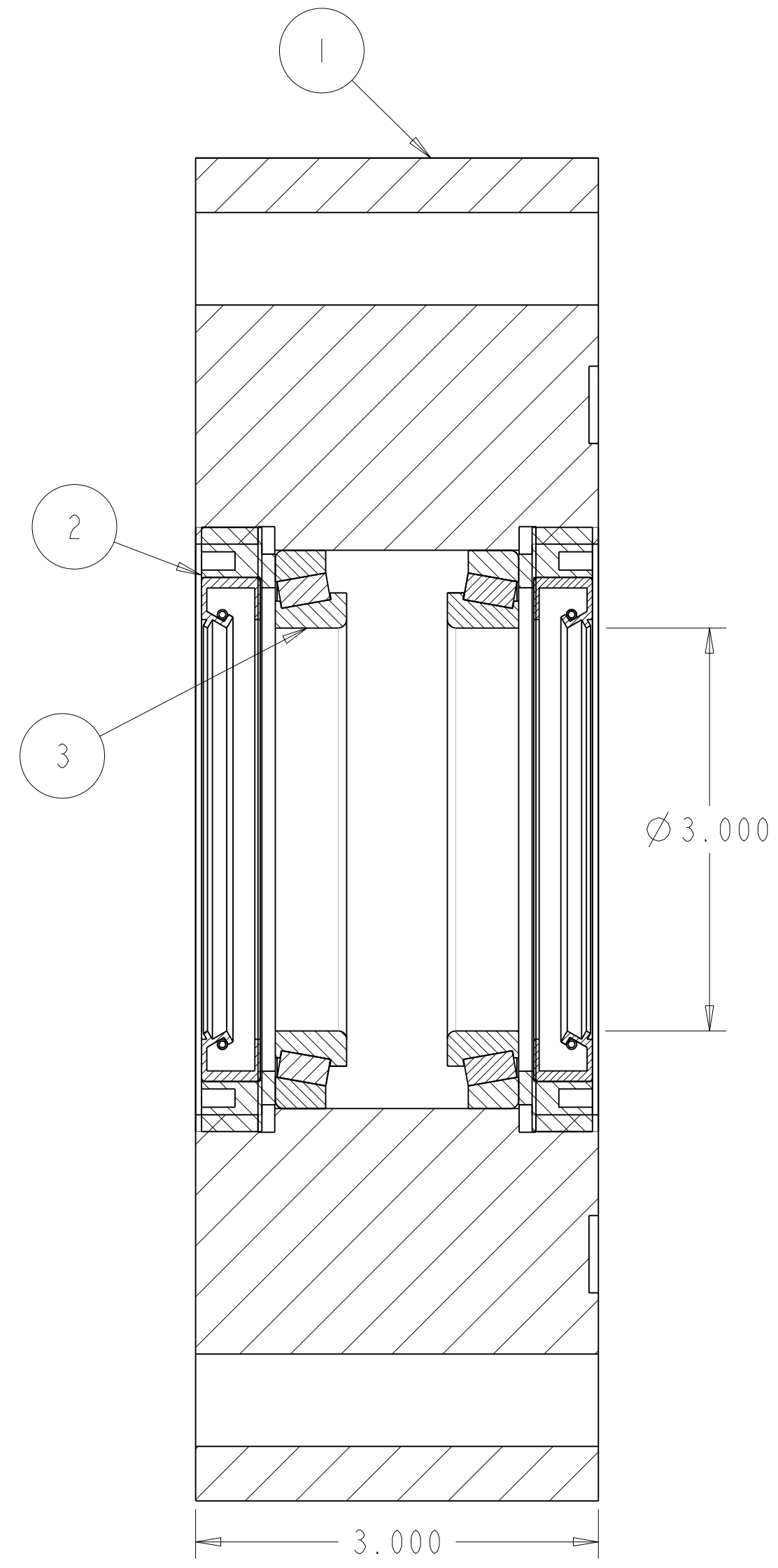
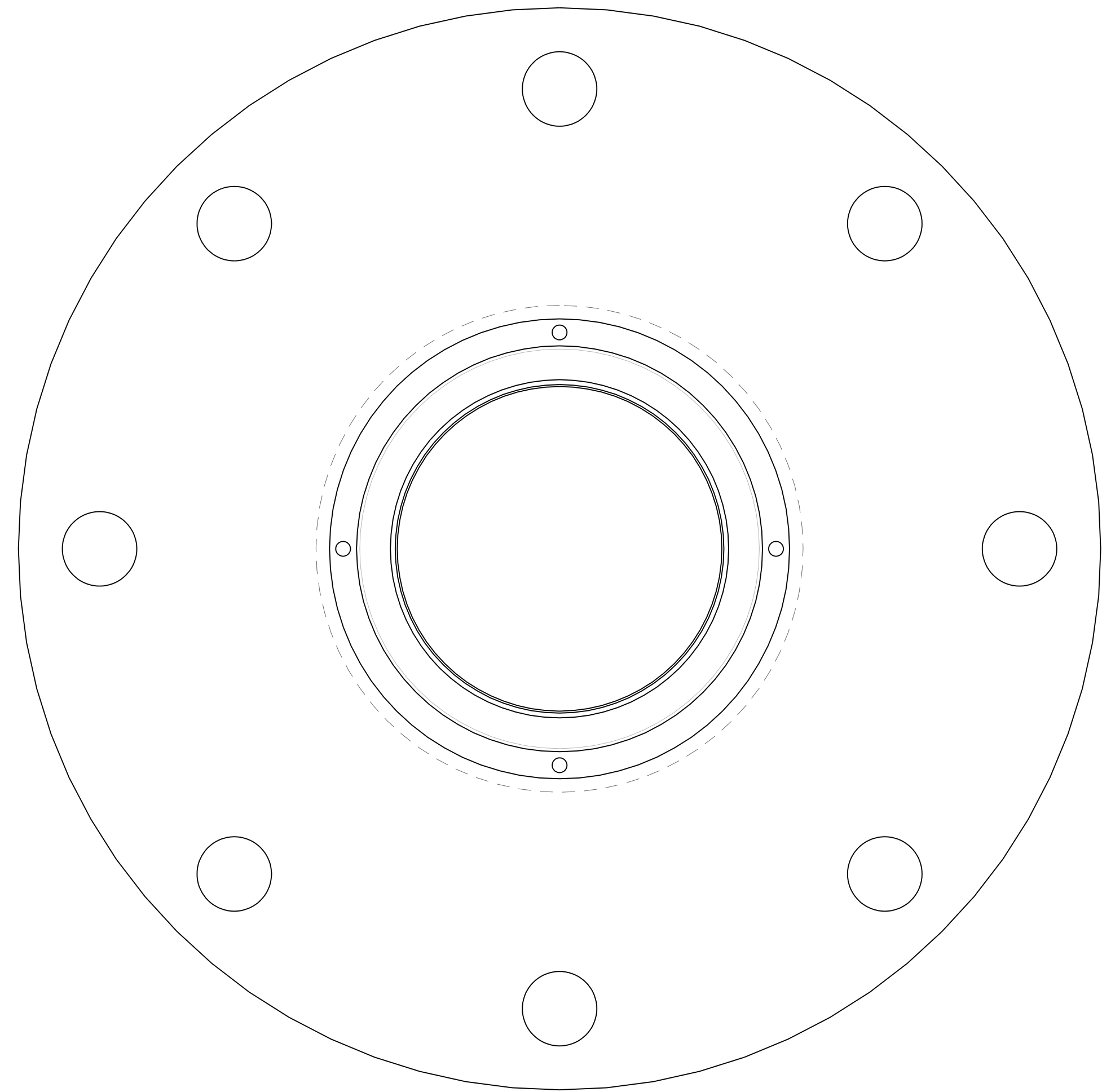


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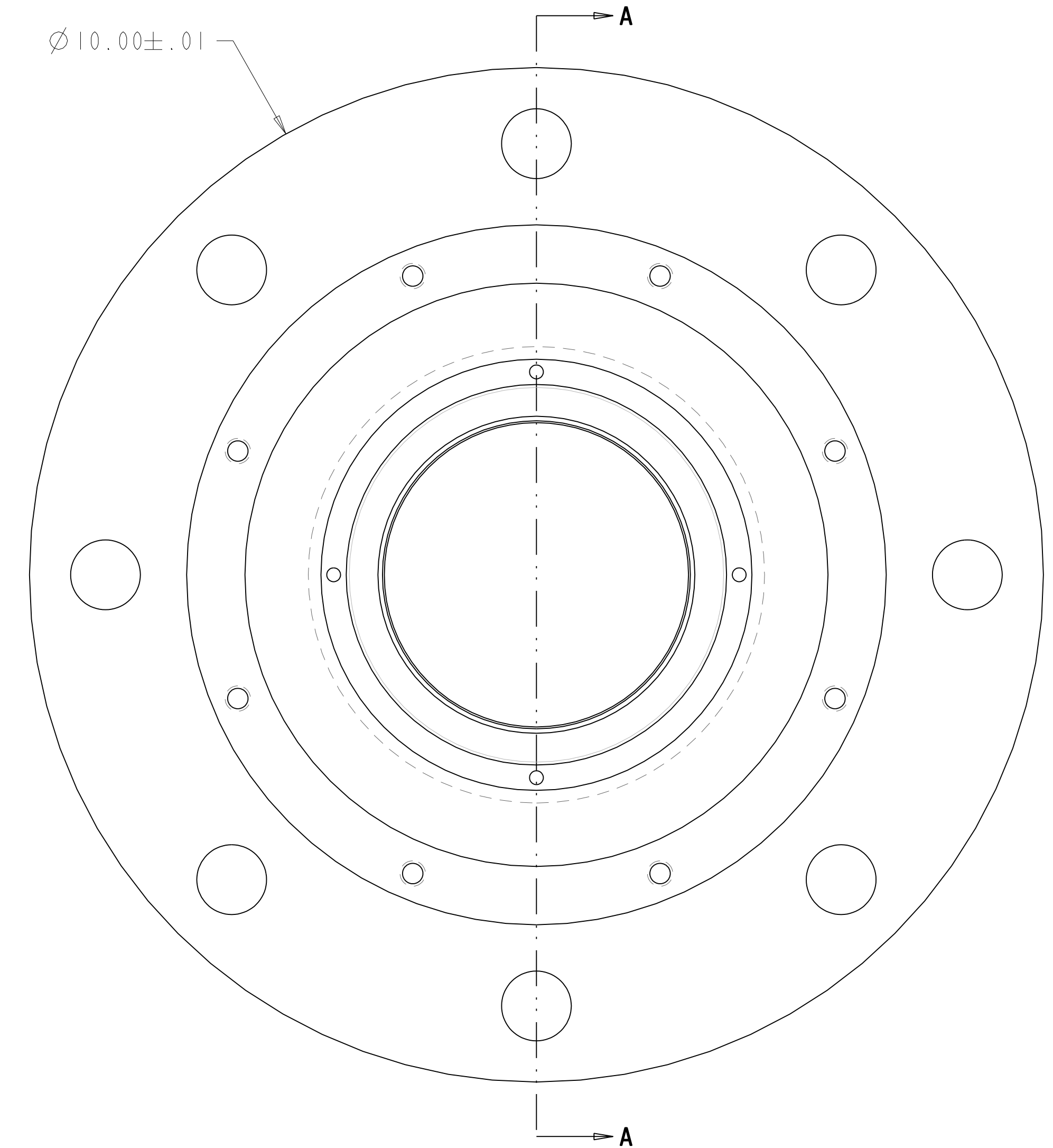
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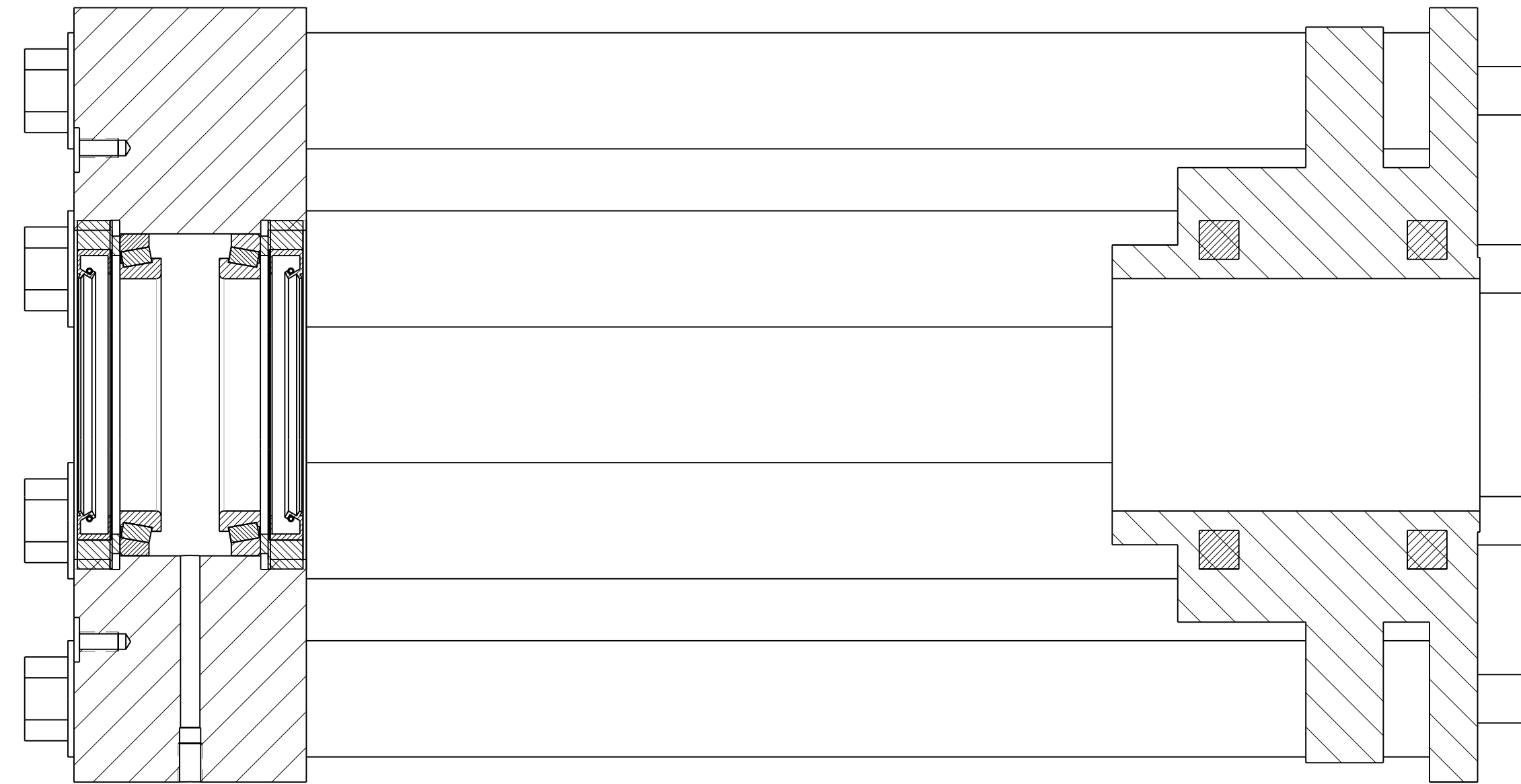
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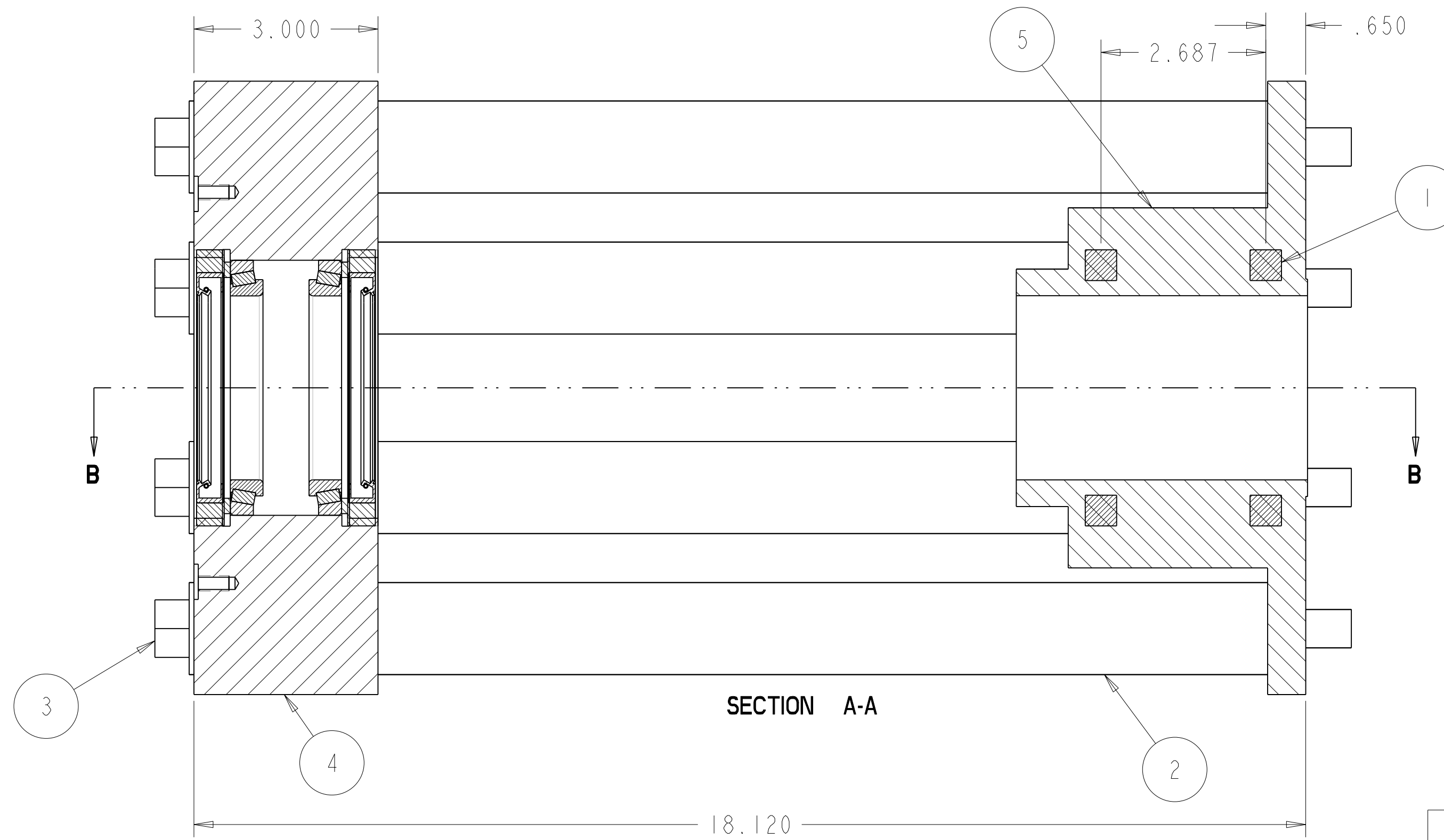
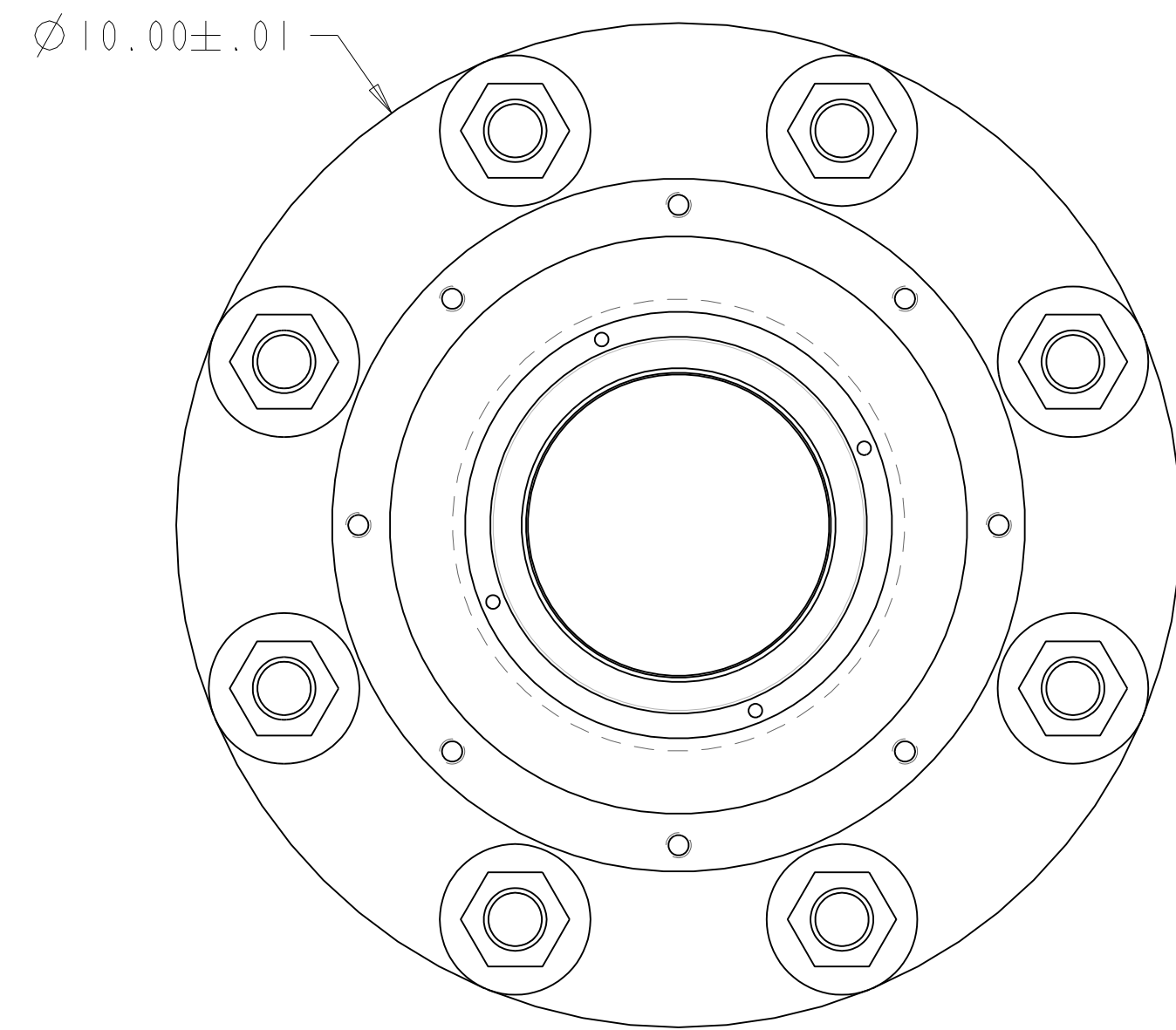
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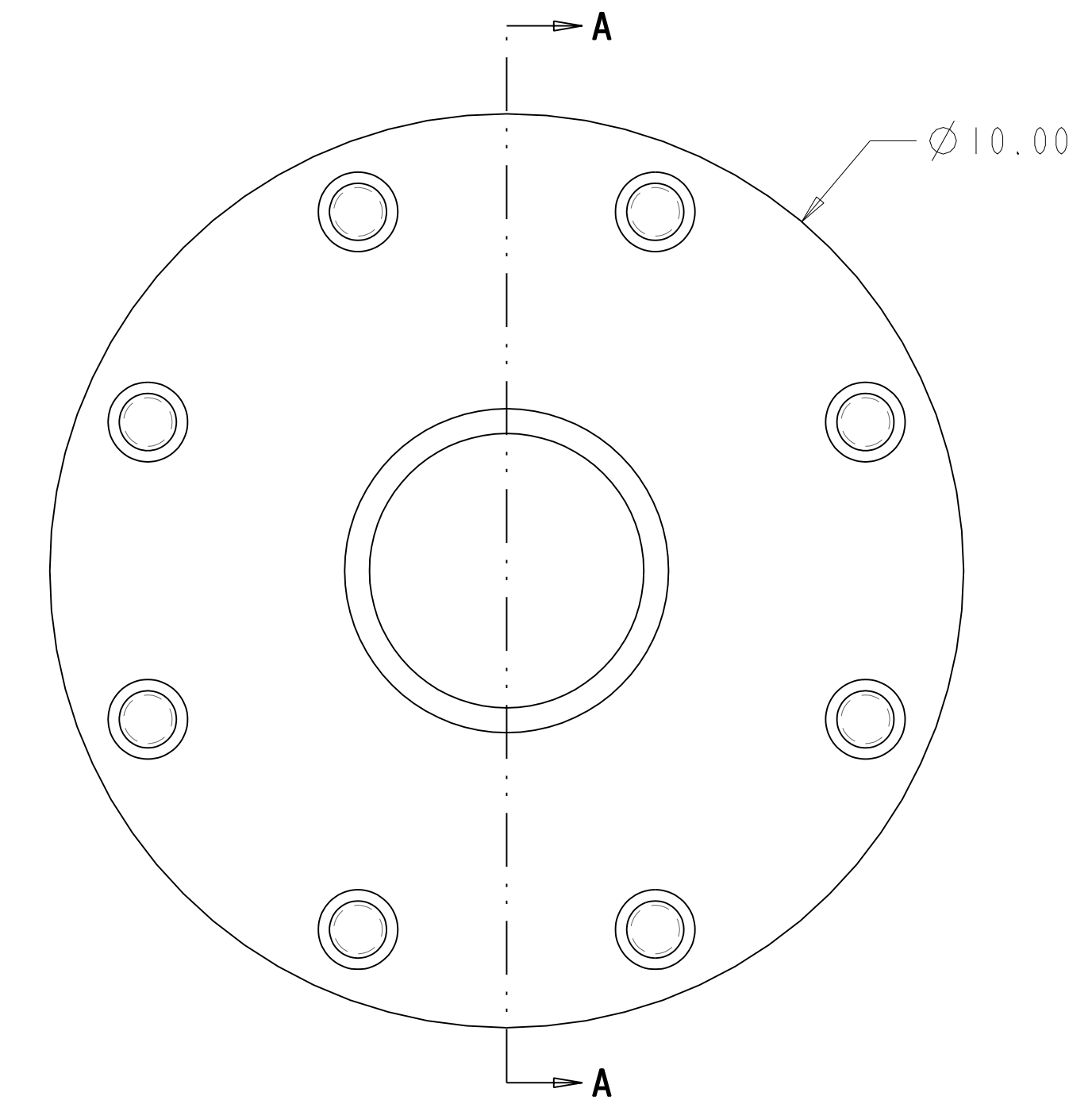
ZONE		REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA		INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	5-10-11



SECTION B-B



SECTION A-A



QTY	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO
1	FD-FI-HS-3000-F-W-C-S2	RIGAKU SEAL, 3in		5
1	AAA11-501284	BEARING BLOCK ASSY ALUM		4
8	AAA11-501279	ROD ASSY WELDMENT SST	304	3
8	AAA11-501256	BEARING STANDOFF SST	304	2
2		BEARING MOCKUP - RIGAKU SEAL		1

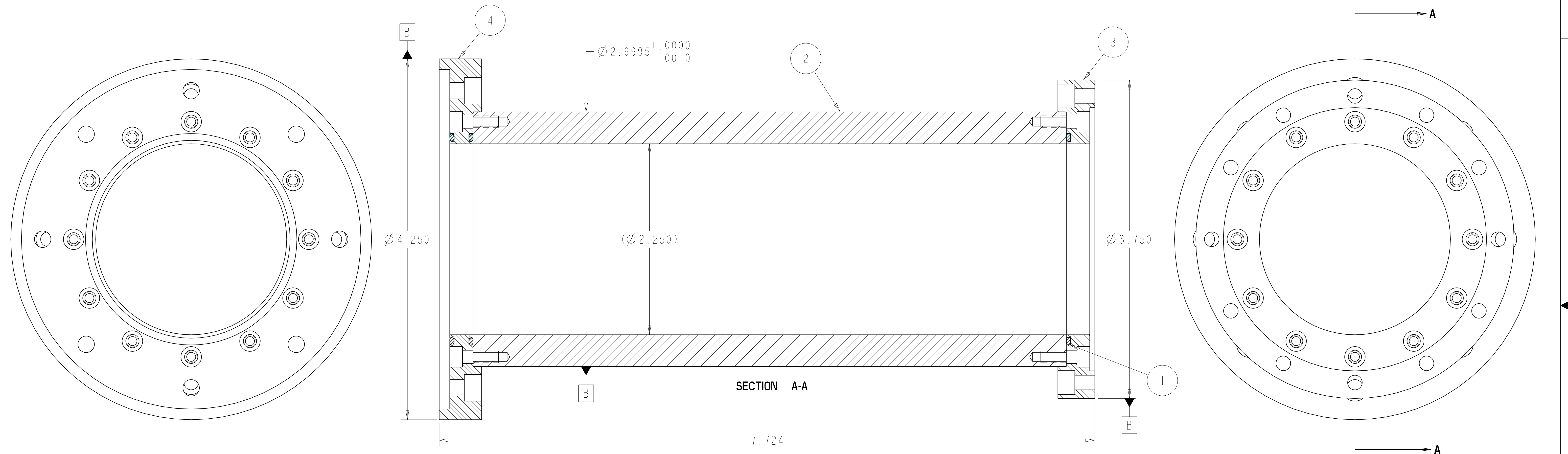
THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY	
		WEIGHT(lbs):	96.043	LAWRENCE LIVERMORE NATIONAL SECURITY-LLC	
		APPROVALS	DATE	TITLE	
		ORIGINATOR BROOKSBYI	11/22/10	SEAL & BEARING BLOCK ASSY	
		DRAWN BROOKSBYI	4/19/11	SIZE	CAGE CODE
		CHECKED KILLINGSWORTH2	5/3/11	DWG NO	REV
		APPROVED PIGGOTTI	5/10/11	D	14067
		DECIMALS	± 0.005	DRAWING LEVEL	2
		ANGLES	± 0.5	SCALE:	NONE
				SHEET 1 OF 1	

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MODEL: SEAL-BEARING-ASSY
 PROJ: DRAWING: SEAL-BEARING-ASSY

ZONE		REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA		INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	5-10-11



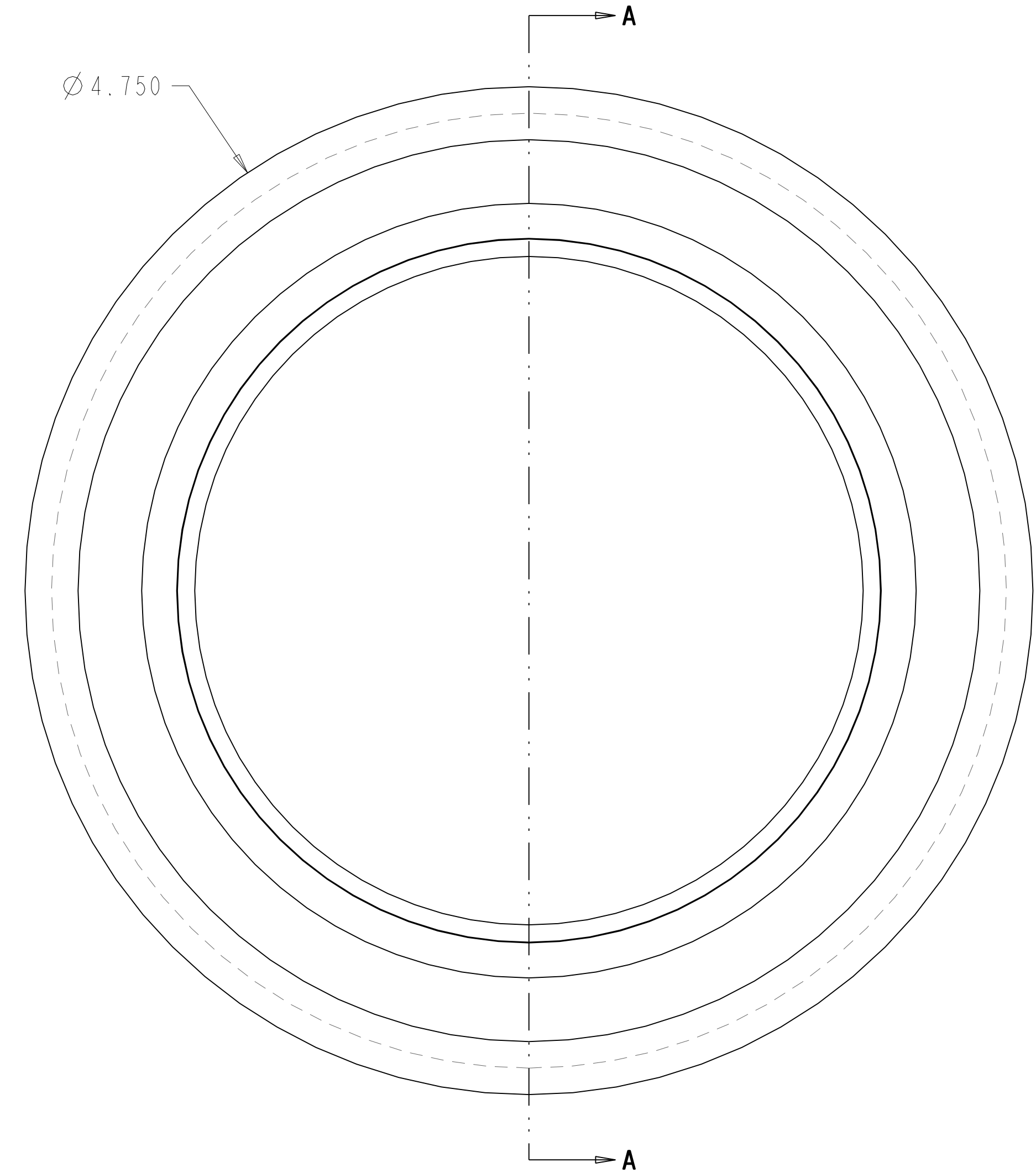
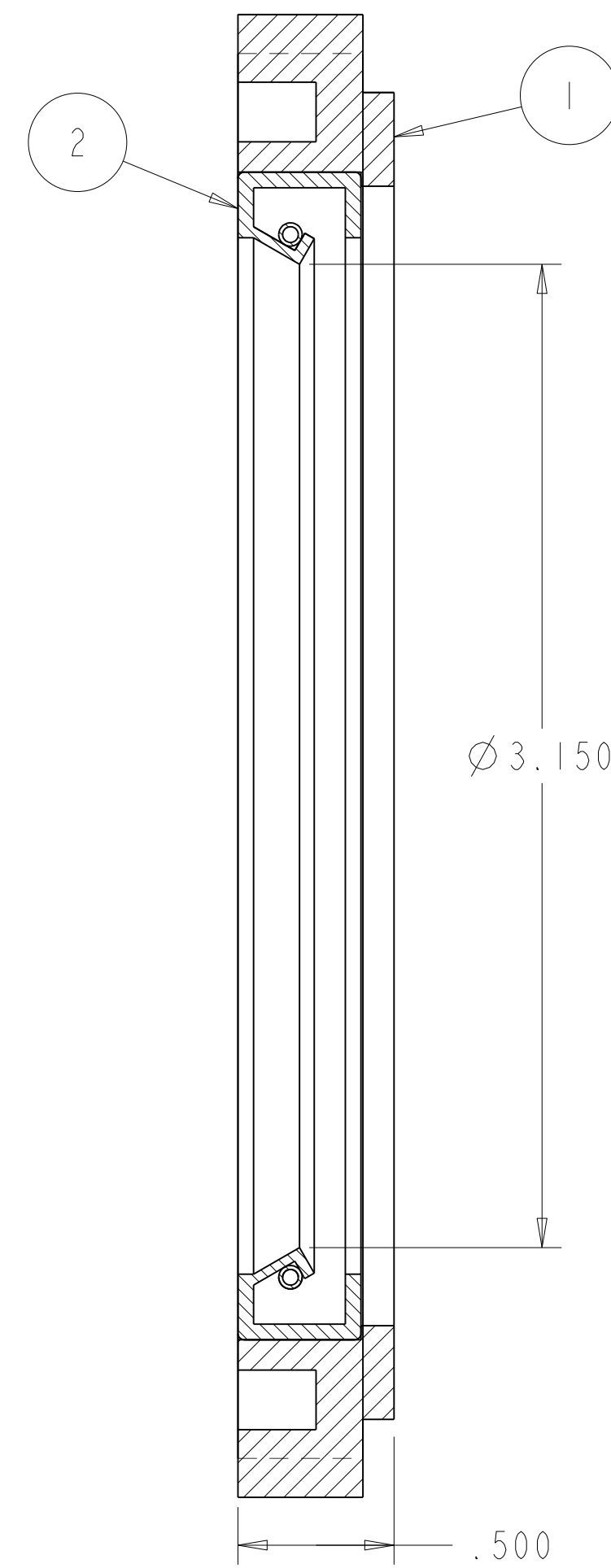
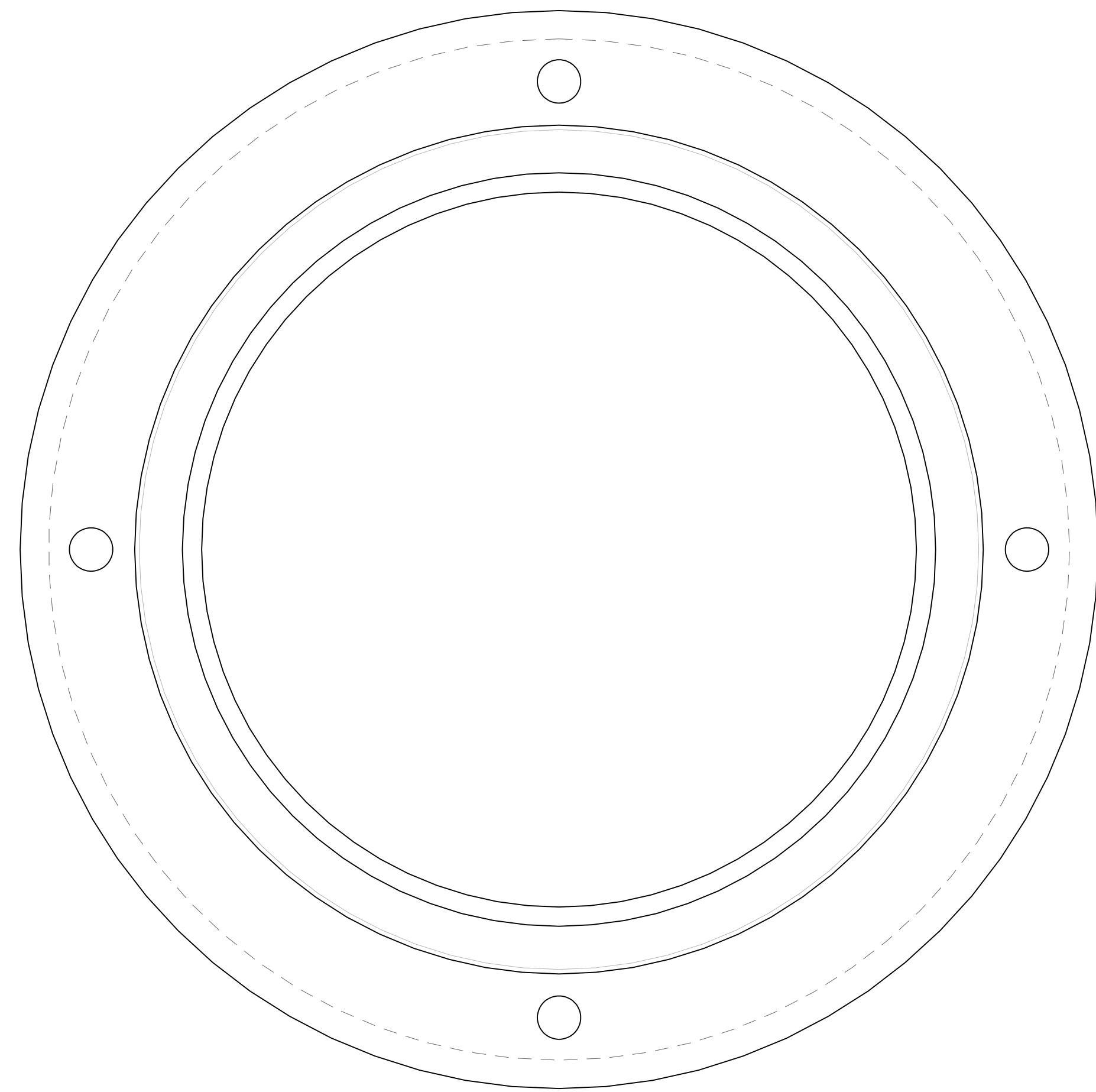
QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO	
1	AAA11-501266	SHAFT FLANGE 5	SST	304	4
1	AAA11-501265	SHAFT FLANGE 4	SST	304	3
1	AAA11-501255	SHAFT - MIDDLE	SST	304	2
3	AS-568A-035	O-RING, .070DIA x 2.239ID	VITON		1

THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY	
		WEIGHT(lbs):	7.747	LAWRENCE LIVERMORE NATIONAL SECURITY-LLC	
		APPROVALS	DATE	TITLE	
		ORIGINATOR	11/22/10	MIDDLE SHAFT ASSY	
		DRAWN	4/19/11	SIZE	CAGE CODE
		CHECKED	5/3/11	D	14067
		APPROVED	5/10/11	DWG NO	AAA11-501286 - AA
		DRAWING LEVEL	2	SCALE:	NONE
					SHEET 1 OF 1

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MODEL: SHAFT_MIDDLE_ASSY
 PROJECT: SHAFT_MIDDLE_ASSY

ZONE		REV	DESCRIPTION	REVISIONS			
DWN	CHK	APVD	DATE				
AA			INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTT1	5-10-11



SECTION A-A

QTY	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO
	31501	SKF SEAL, CR 80x95x10mm CRSH13 R		2
	AAA11-501259	BEARING NUT 2	SST 304	1

THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY	
		WEIGHT(lbs):	1.006	TITLE	
		APPROVALS	DATE	BEARING NUT & SEAL ASSY 2	
		ORIGINATOR	11/22/10	SIZE	CAGE CODE
		DRAWN	4/19/11	D	14067
		CHECKED	5/3/11	DWG NO	AAA11-501287-AA
		APPROVED	5/10/11	SCALE:	NONE
		DRAWING LEVEL	2	SHEET 1 OF 1	

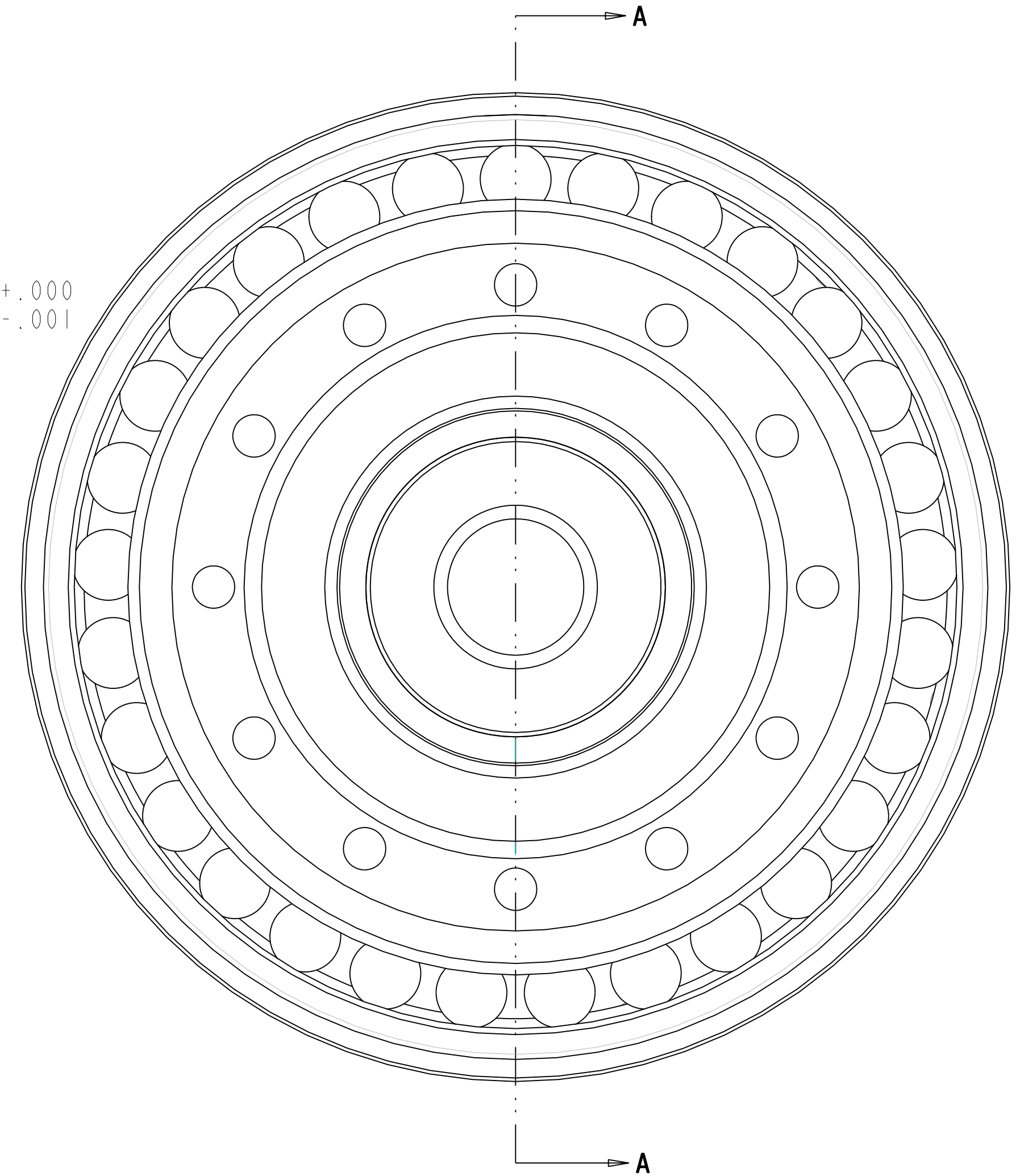
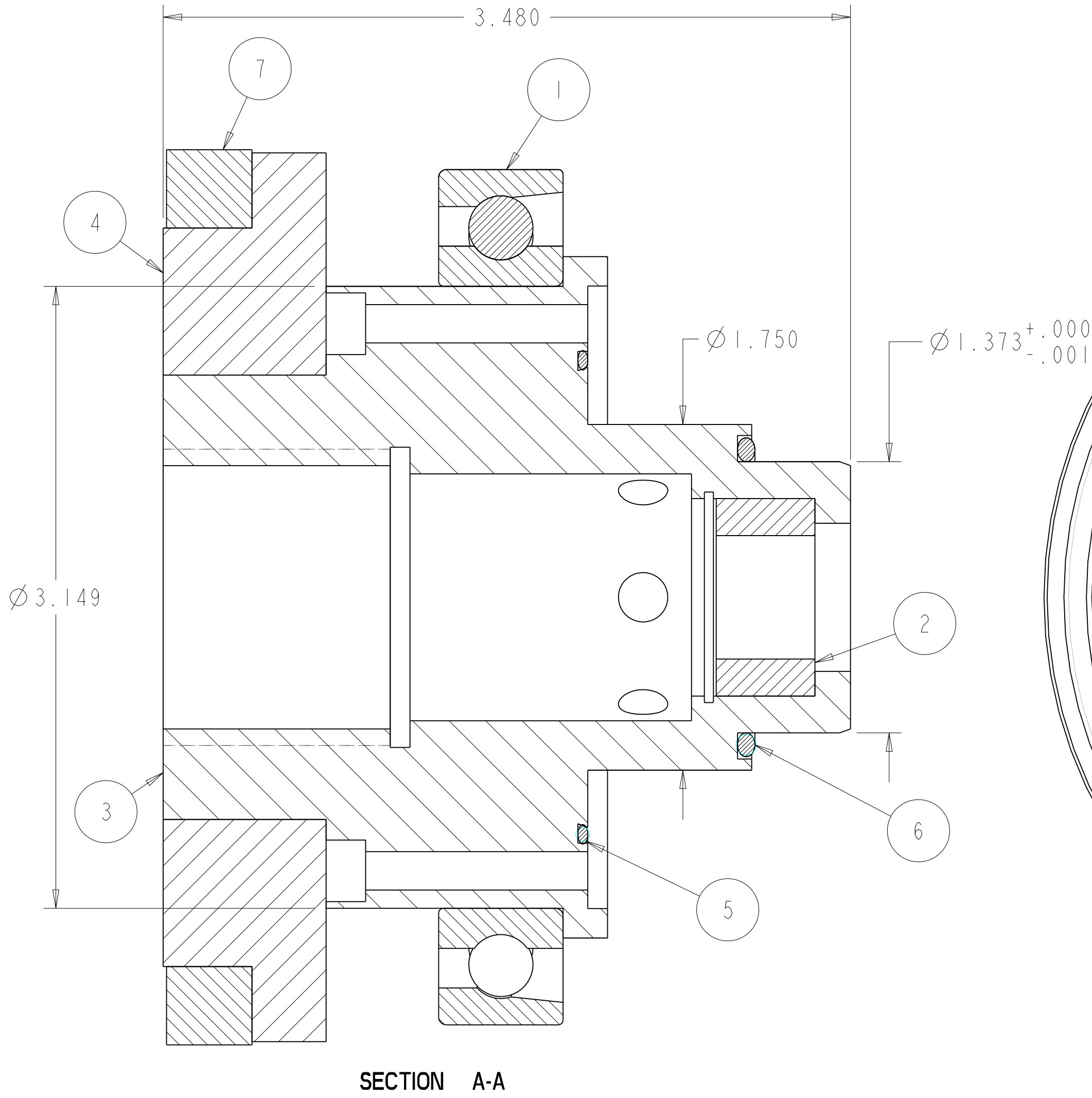
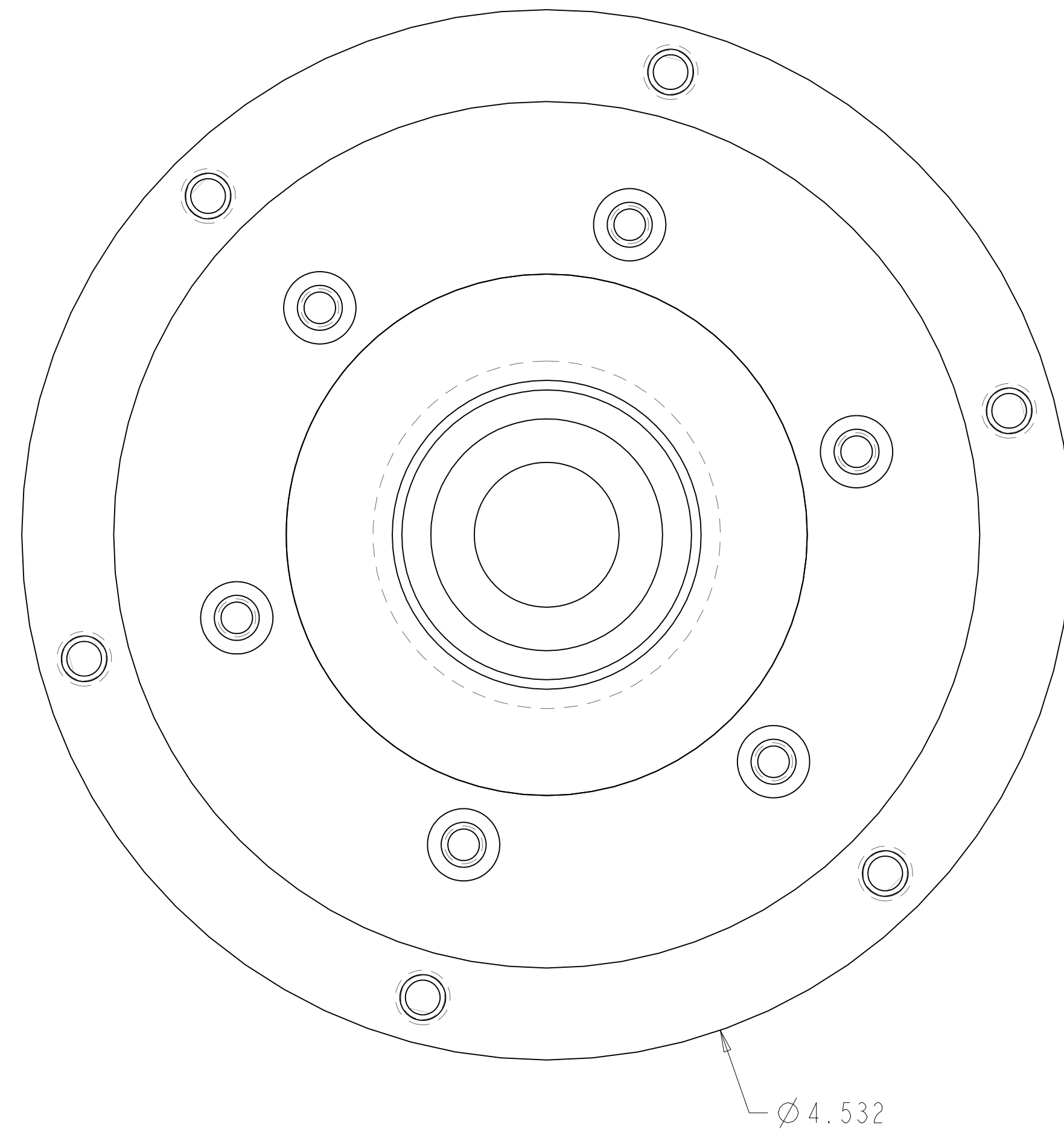
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PROJ: DRAWING: BEARING_NUT_SEAL2 MODEL: BEARING_NUT_SEAL2

8 7 6 5 4 3 2 1

8 7 6 5 4 3 2 1

ZONE		REV	DESCRIPTION	REVISIONS			
REV	DATE	BY	CHK	APVD	DATE		
AA			INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	5-10-11



SECTION A-A

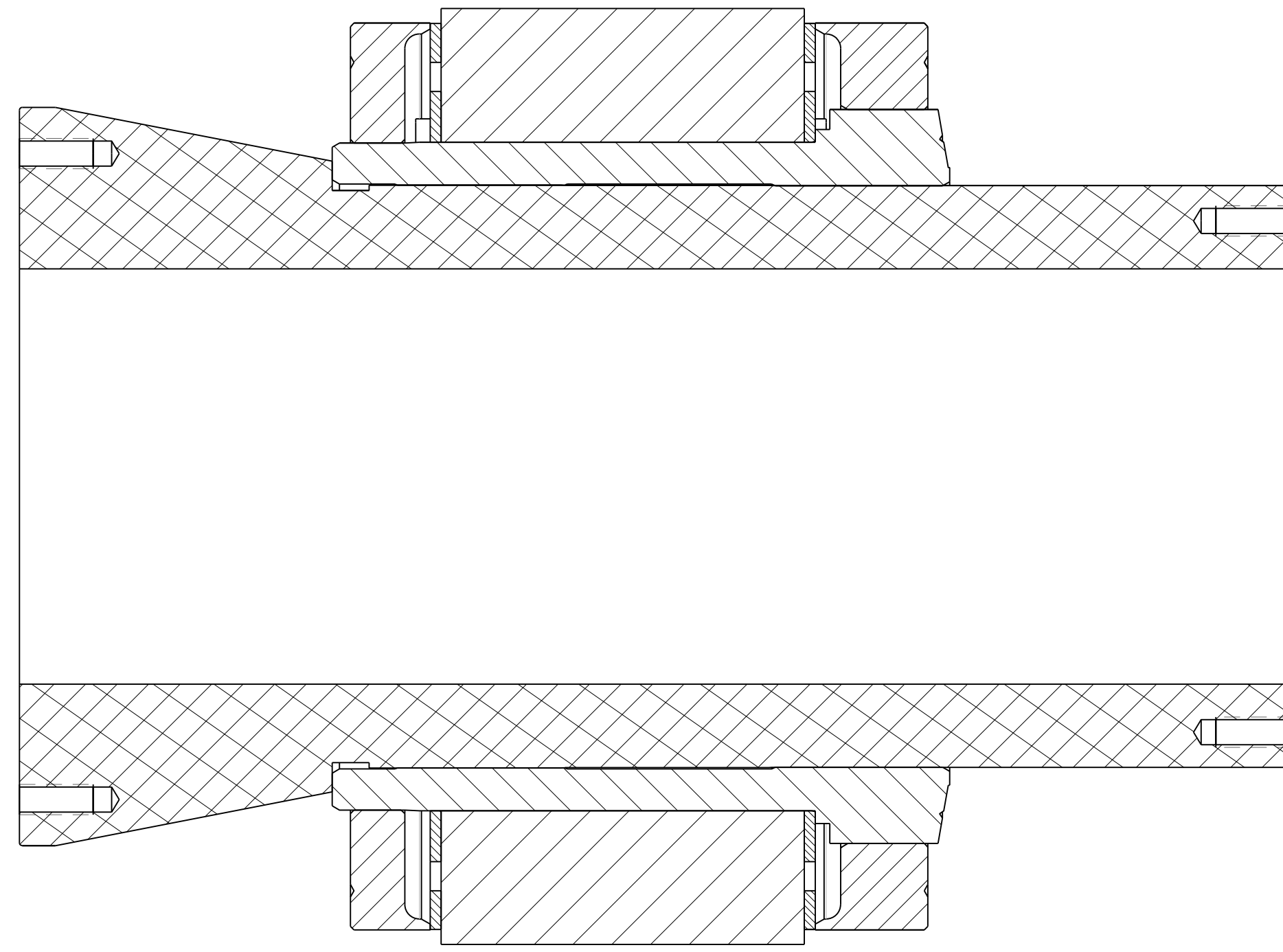
QTY	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO	
	WMF-100-0360-1	ENCODER MEASURING FLANGE, AMO		7	
	AS-568A-126	O-RING, .103DIA x 1.362ID	VITON	6	
	AS-568A-035	O-RING, .070DIA x 2.239ID	VITON	5	
	AAA11-501274	ENCODER MOUNTING DISK	ALUM	6061-T6	4
	AAA11-501273	SHAFT FLANGE 7	SST	304	3
	AAA11-501272	WATER UNION PTFE BEARING		PTFE	2
	7916 CTR SUL P4Y	ANGULAR CONTACT BALL BEARING, NSK			1

THIRD ANGLE PROJECTION		WEIGHT(lbs): 5.147		LAWRENCE LIVERMORE NATIONAL LABORATORY	
APPROVALS		DATE		TITLE	
ORIGINATOR: BROOKSBYI		11/22/10		MOTOR BEARING ASSY	
DRAWN: BROOKSBYI		4/19/11		SIZE: D	
CHECKED: KILLINGSWORTH2		5/3/11		CAGE CODE: 14067	
APPROVED: PIGGOTTI		5/10/11		DWG NO: AAA11-501288-AA	
DECIMALS: ± 0.005		ANGLES: ± 0.5		REV: 1	
DRAWING LEVEL: 2		SCALE: NONE		SHEET 1 OF 1	

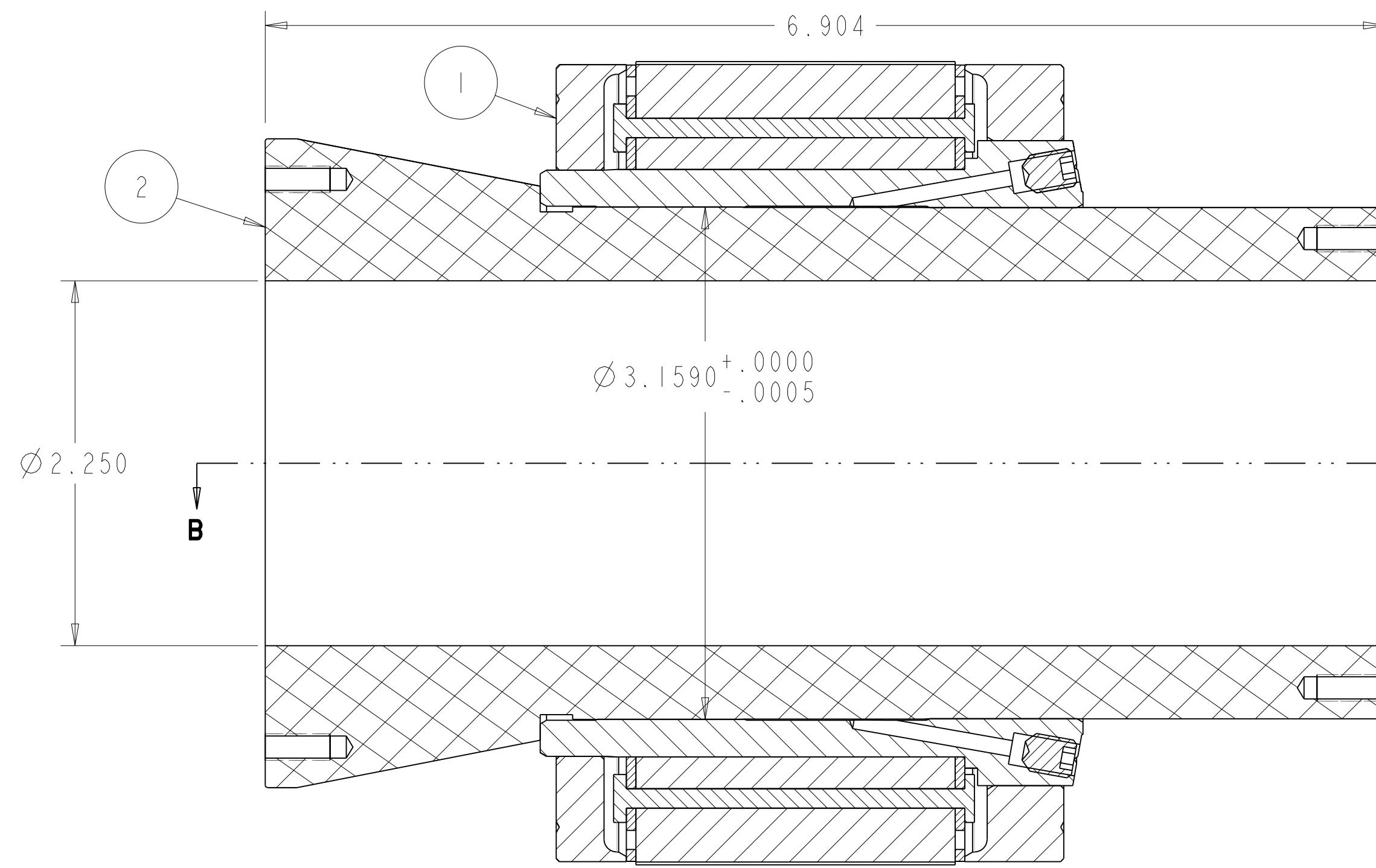
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PROJECT: MOTOR-BEARING-ASSY
 MODEL: MOTOR-BEARING-ASSY

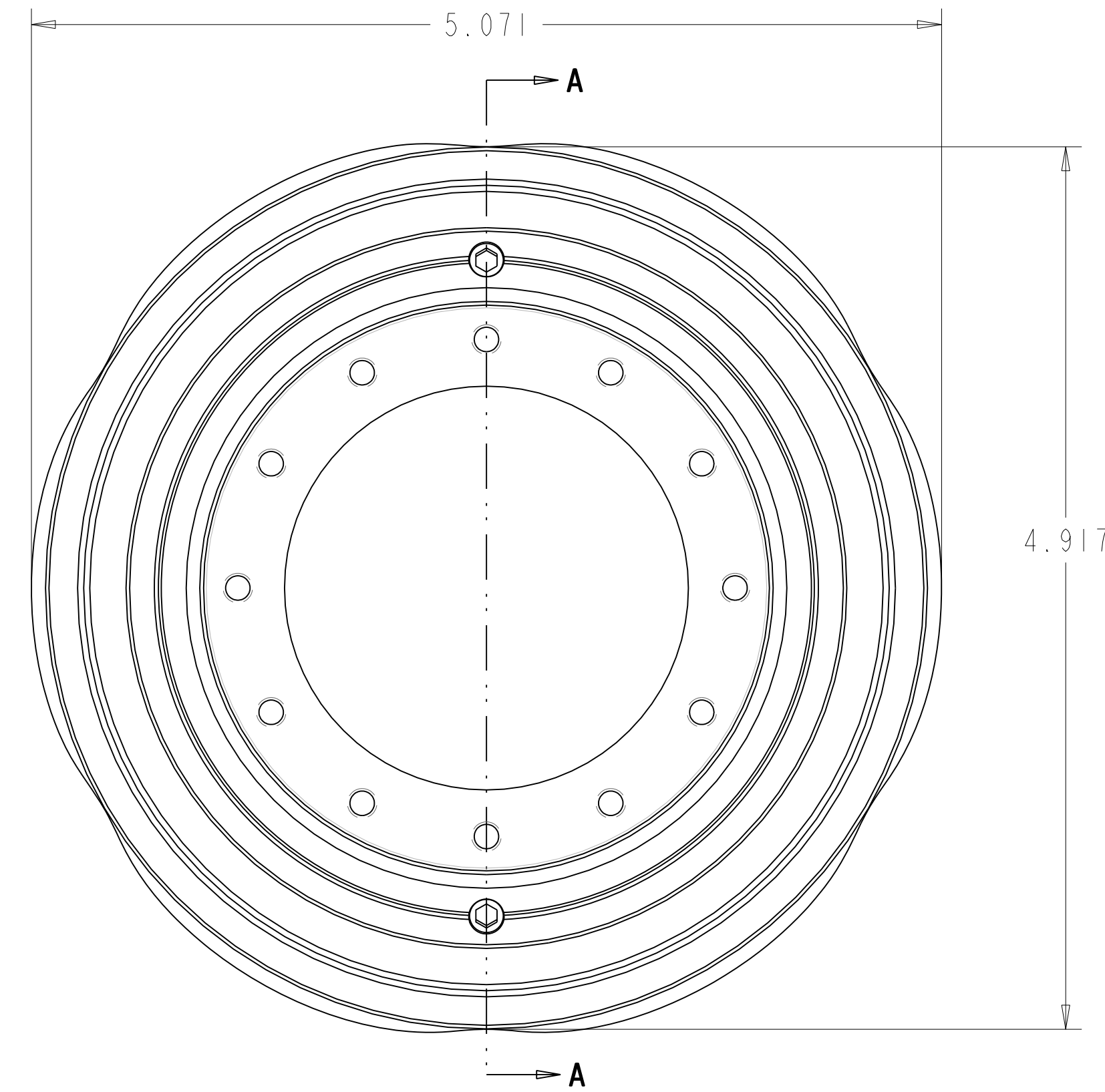
ZONE	REV	DESCRIPTION	REVISIONS			
			DWN	CHK	APVD	DATE
	AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	5-10-11



SECTION B-B



SECTION A-A



AA11-501267	SHAFT - MOTOR	SST	416	2
IFE1091-6WS	SIEMENS MOTOR - ROTOR ASSY			1
QTY RECD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO

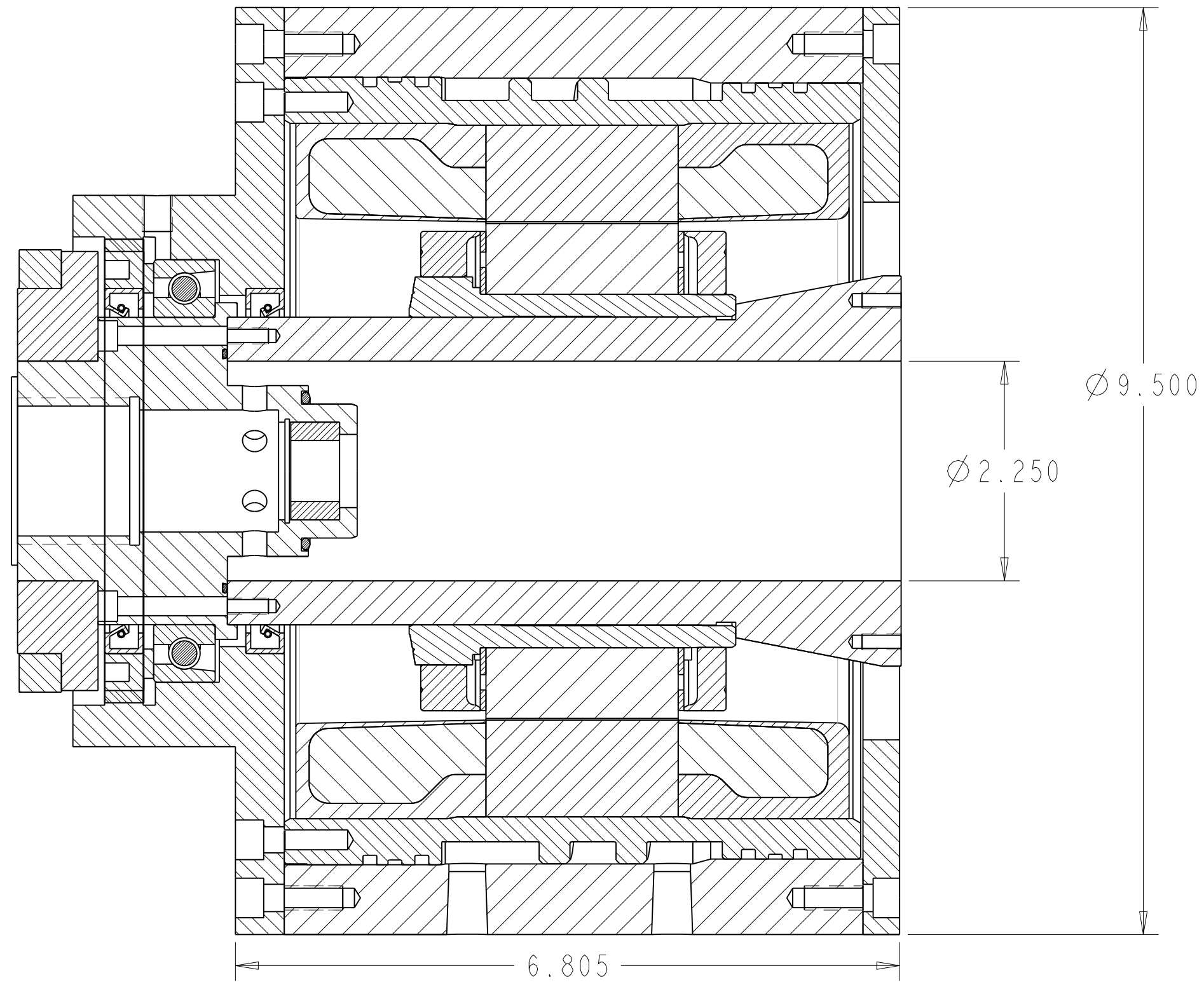
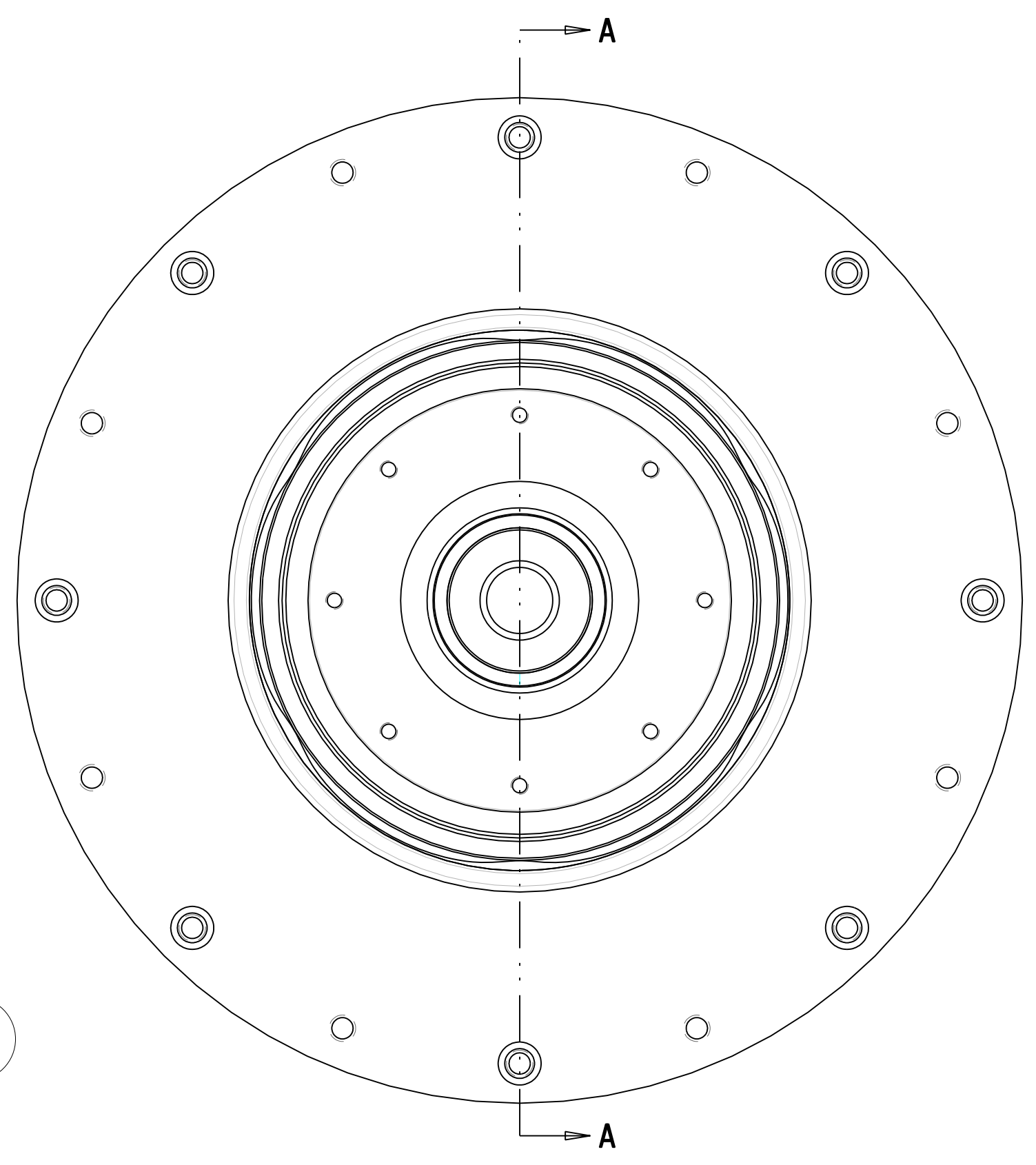
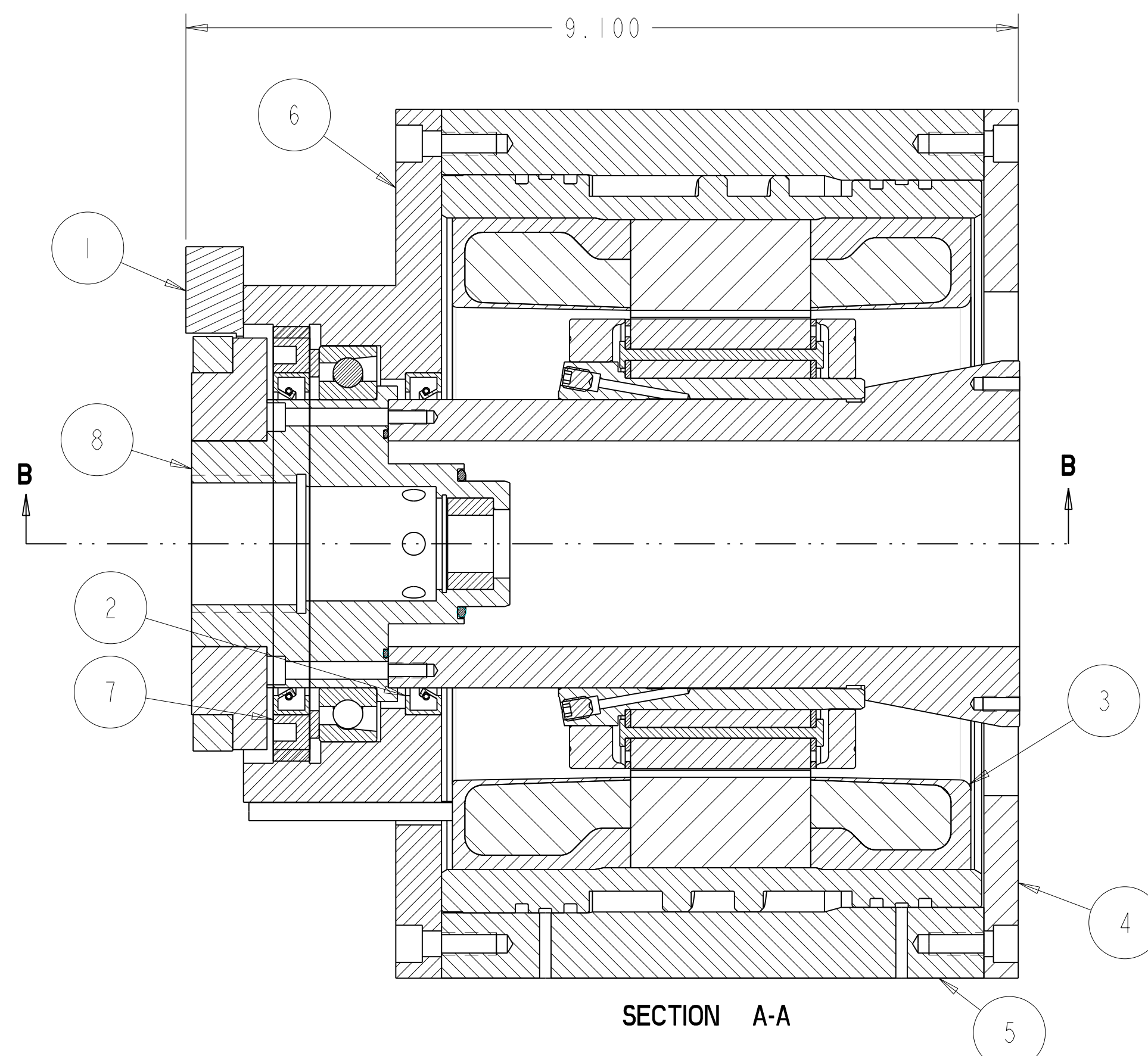
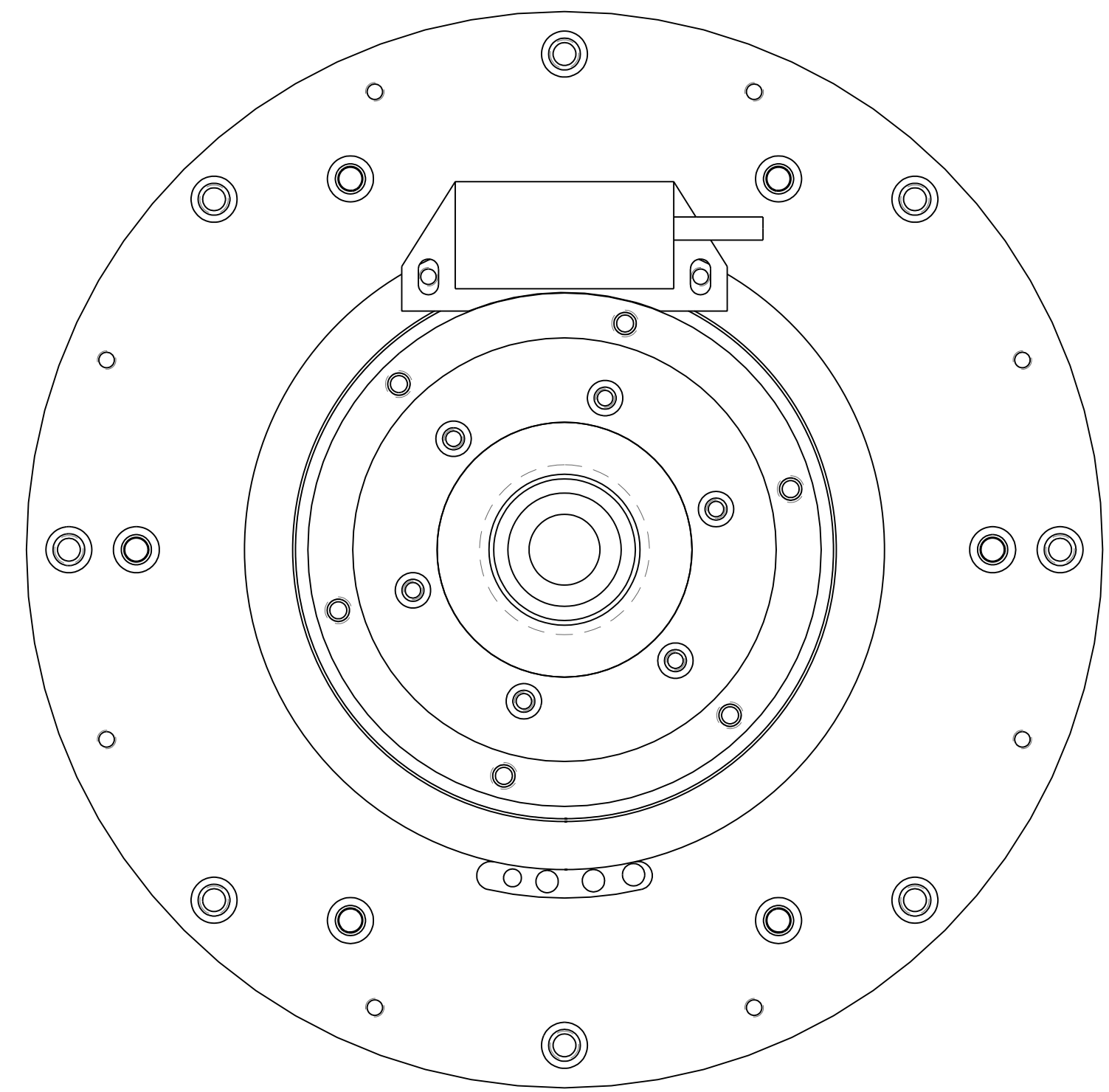
THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY	
		WEIGHT(lbs):	19.086	SIZE	D
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:		APPROVALS	DATE	CAGE CODE	14067
DECIMALS	ANGLES	ORIGINATOR		DWG NO	AAA11-501289-AA
± 0.005	± 0.5	BROOKSBYI	11/22/10	DRAWING LEVEL	2
		DRAWN	4/19/11	SCALE:	NONE
		CHECKED	5/3/11	SHEET 1 OF 1	
		APPROVED	5/10/11		
		PIGGOTTI			

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PROJ: DRAWING: MOTOR_SIEMENS_ROTOR
 MODEL: MOTOR_SIEMENS_ROTOR

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ZONE		REV	DESCRIPTION	REVISIONS			
		AA	INITIAL RELEASE	DWN	CHK	APVD	DATE
		AA	INITIAL RELEASE	BROOKSBY1	KILLINGSWORTH2	PIGGOTT1	5-10-11



QTY RECD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO
	AAA11-501288	MOTOR BEARING ASSY		8
	AAA11-501287	BEARING NUT & SEAL ASSY 2		7
	AAA11-501270	MOTOR CASE FLANGE 2	ALUM 6061-T6	6
	AAA11-501269	MOTOR OUTER CASE	ALUM 6061-T6	5
	AAA11-501268	MOTOR CASE FLANGE 1	ALUM 6061-T6	4
	IFE1091-6WS	SIEMENS MOTOR		3
	31501	SKF SEAL, CR 80x95x10mm CRSH13 R		2
		ENCODER HEAD, WMK-201.22-0360-3,0-5		1

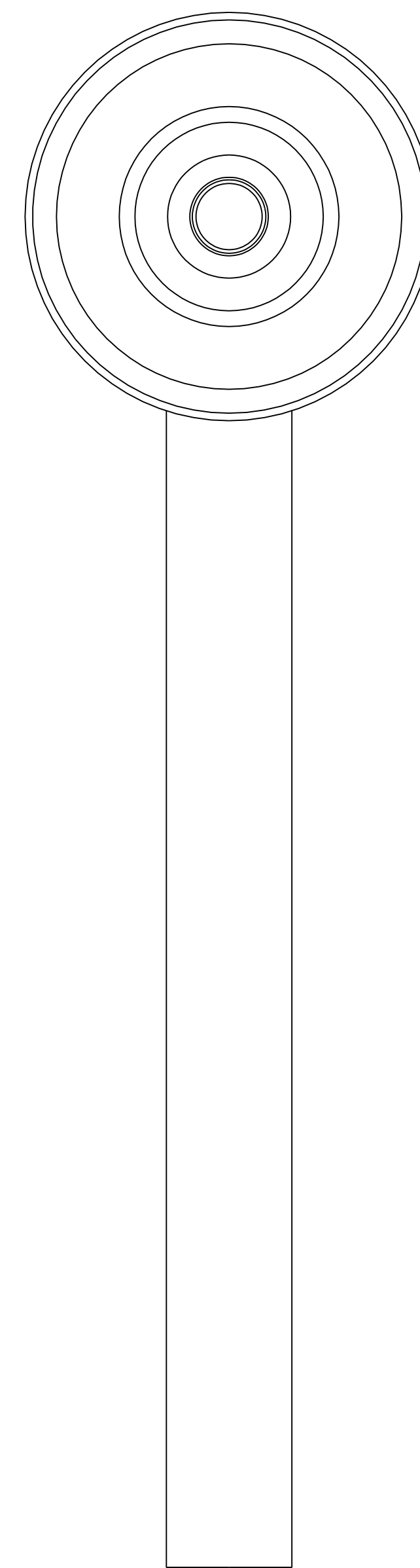
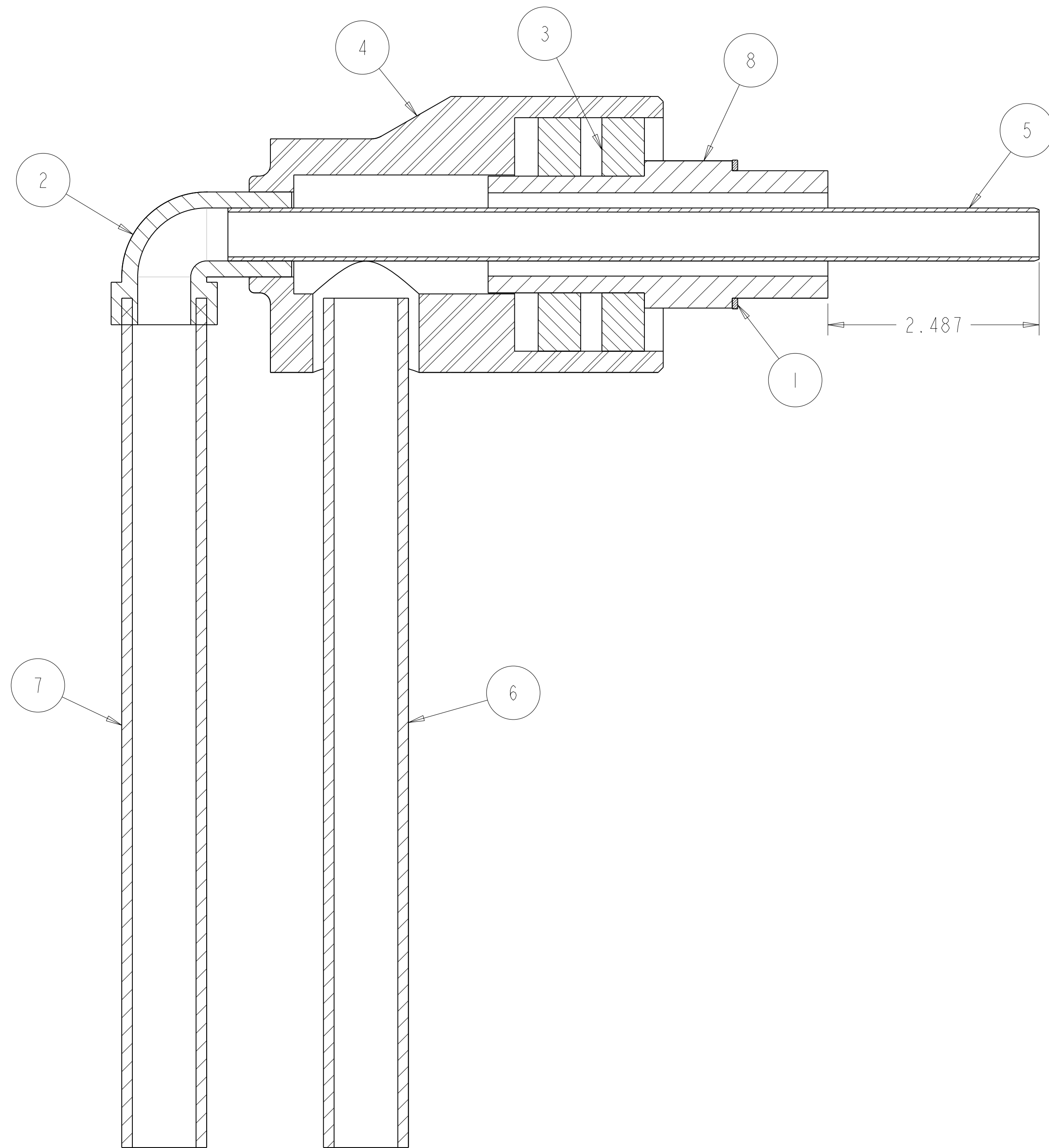
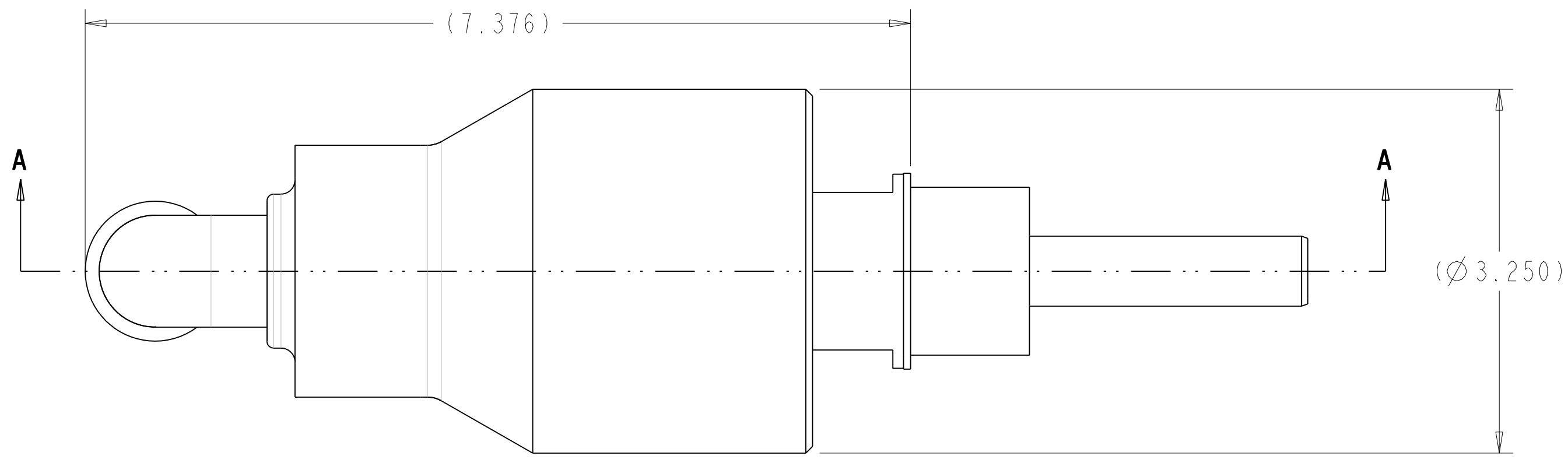
THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY	
		WEIGHT(lbs):	119.490	TITLE	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:		APPROVALS	DATE	SIEMENS MOTOR & CASE ASSY	
DECIMALS	ANGLES	ORIGINATOR		SIZE	CAGE CODE
± 0.005	± 0.5	BROOKSBY1	11/22/10	D	14067
		DRAWN	4/19/11	DWG NO	AAA11-501290-AA
		CHECKED	5/3/11	SCALE:	NONE
		APPROVED	5/10/11	SHEET 1 OF 1	
		DRAWING LEVEL	2		

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PROJ: DRAWING: MOTOR_SIEMENS_CASE MODEL: MOTOR_SIEMENS_CASE

REVISIONS						
ZONE	REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	5-10-11



NOTES, UNLESS OTHERWISE SPECIFIED:
 1. BRAZE ITEM #5 INTO ITEM #2.

QTY	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO	
1		WATER UNION ROTOR	SST	304	8
1		OUTLET WATER PIPE	SST	304	7
1		INLET WATER PIPE	SST	304	6
1	AAA11-501271	WATER UNION 355 INNER TUBE	SST	304	5
1	355-000-019-163	WATER UNION HOUSING			4
2		WATER UNION 355 BEARING			3
1		WATER UNION ELBOW			2
1		WATER UNION COPPER GASKET	COPPER		1

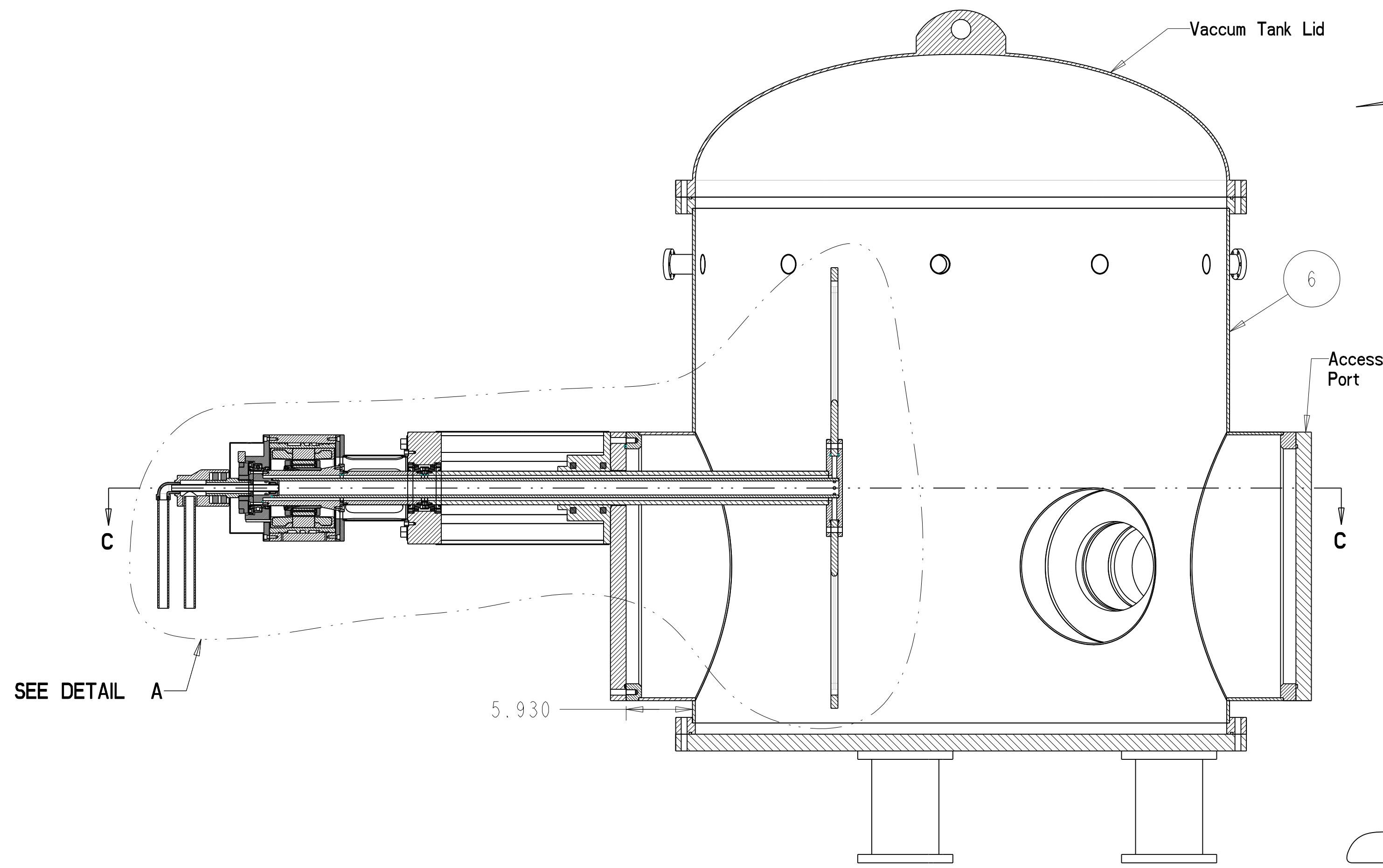
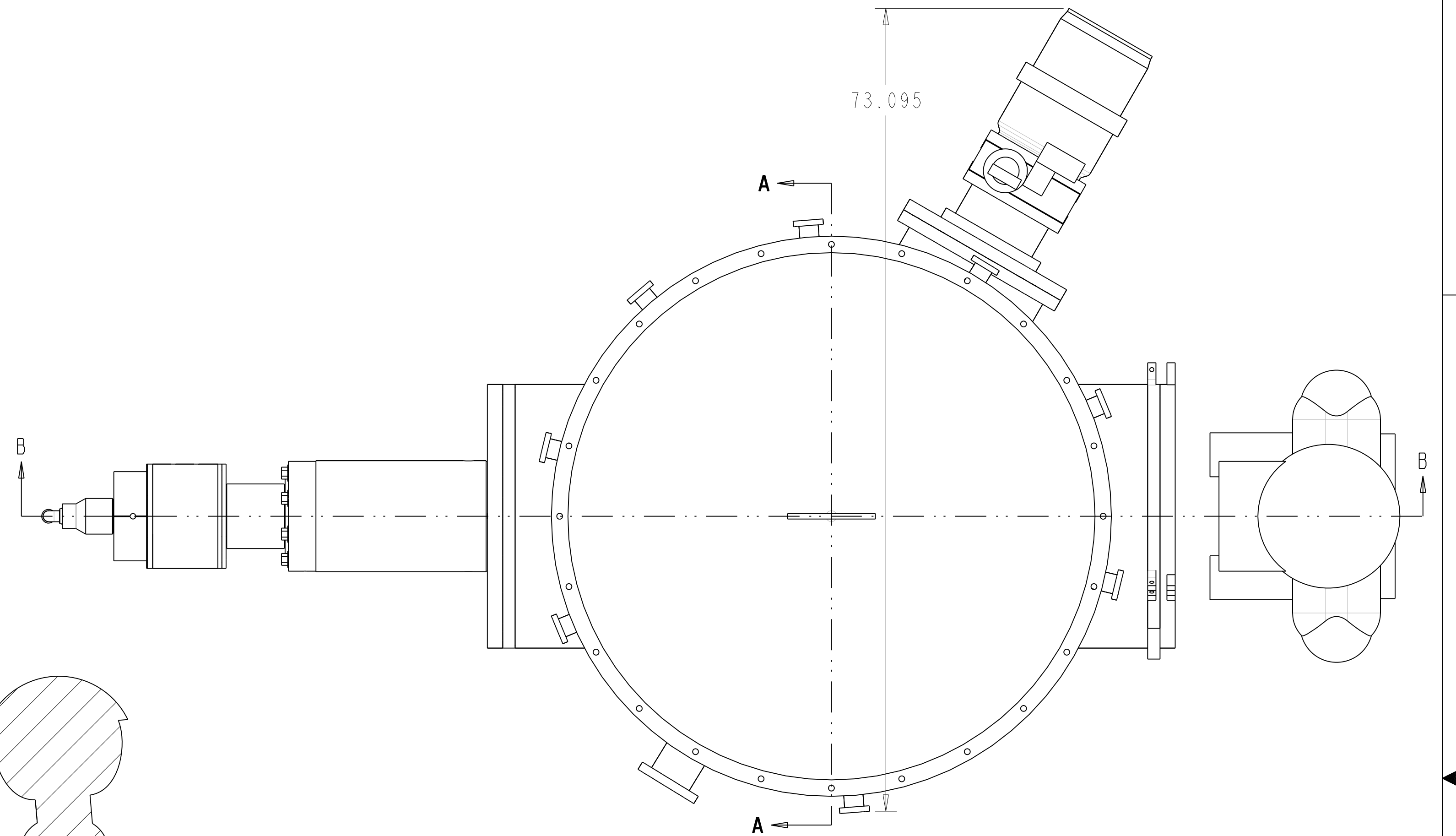
THIRD ANGLE PROJECTION				PARTS LIST	
		WEIGHT(lbs):	57.440	LAWRENCE LIVERMORE NATIONAL LABORATORY	
APPROVALS		DATE	TITLE		
ORIGINATOR	BROOKSBYI	11/22/10	WATER UNION 355 ASSY		
DRAWN	BROOKSBYI	4/19/11	SIZE	CAGE CODE	DWG NO
CHECKED	KILLINGSWORTH2	5/3/11	D	14067	AAA11-501291-AA
APPROVED	PIGGOTTI	5/10/11	SCALE:	NONE	SHEET 1 OF 1
DECIMALS		ANGLES	DRAWING LEVEL		
± 0.005	± 0.5	2			

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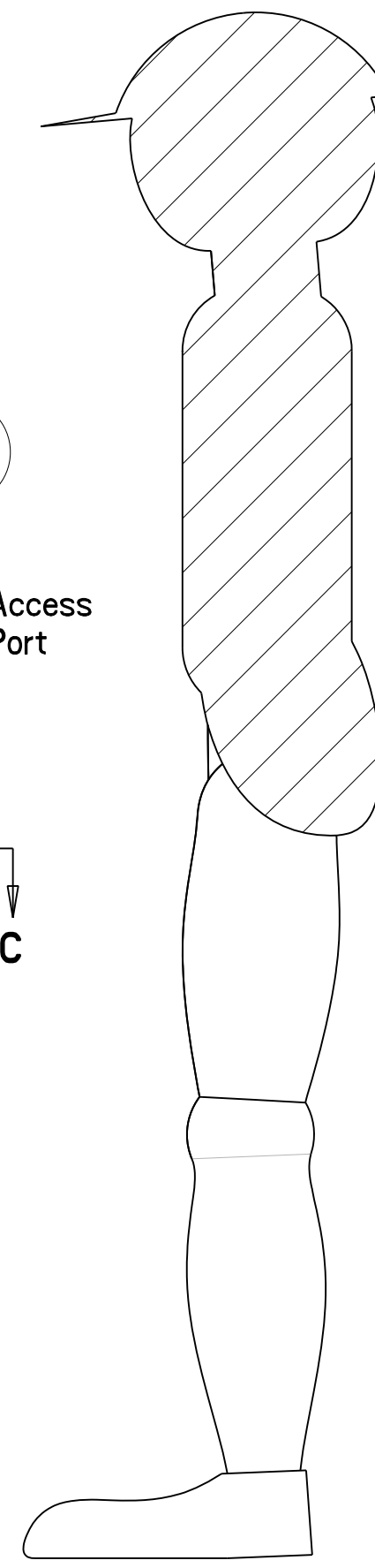
PROJ: DRAWING: WATERUNION_355_000_019_163 MODEL: WATERUNION_355_000_019_163

SECTION A-A

ZONE		REV	DESCRIPTION	REVISIONS			
REV	DATE	BY	CHK	APVD	DATE		
AA			INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	5-10-11



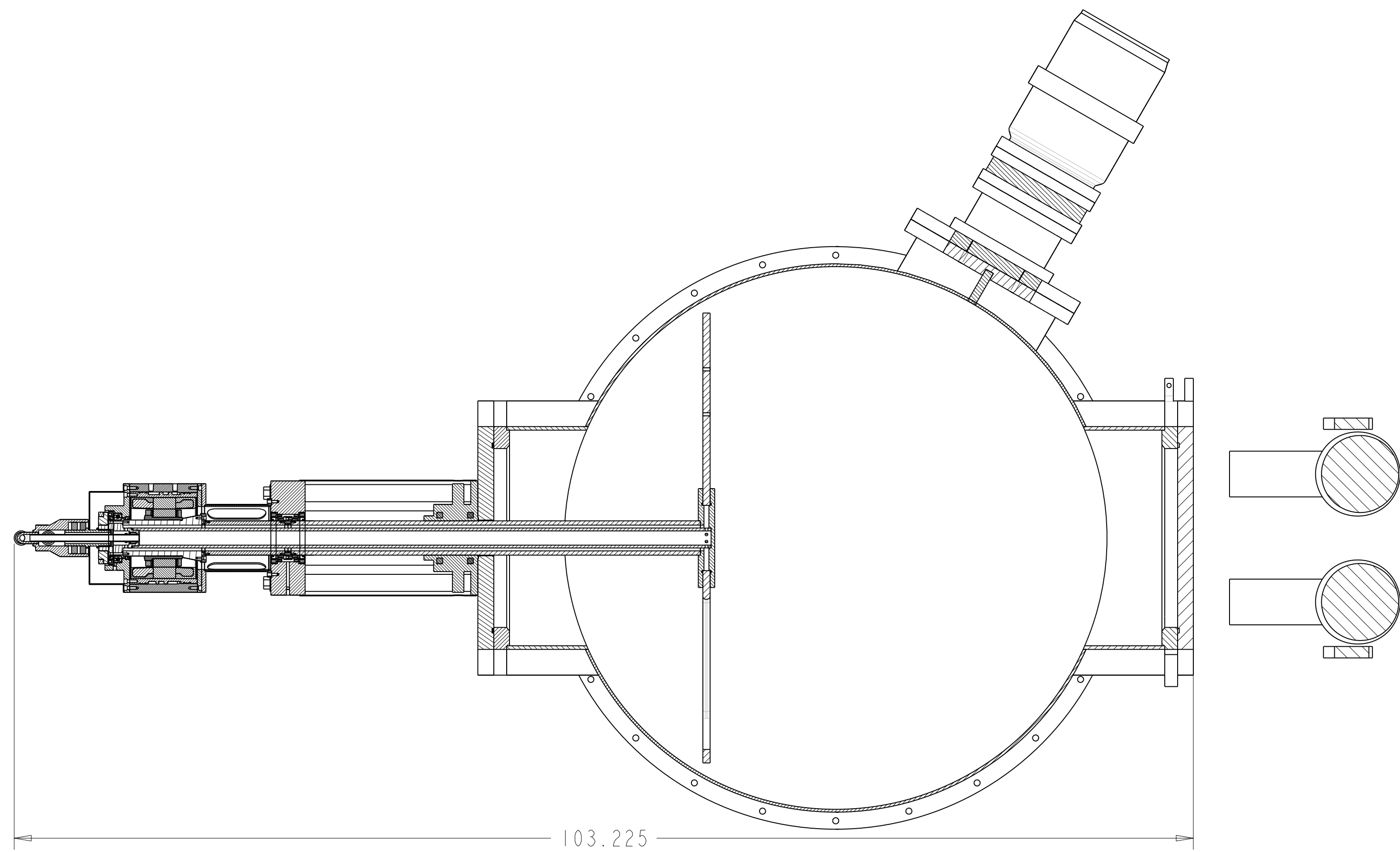
SECTION B-B



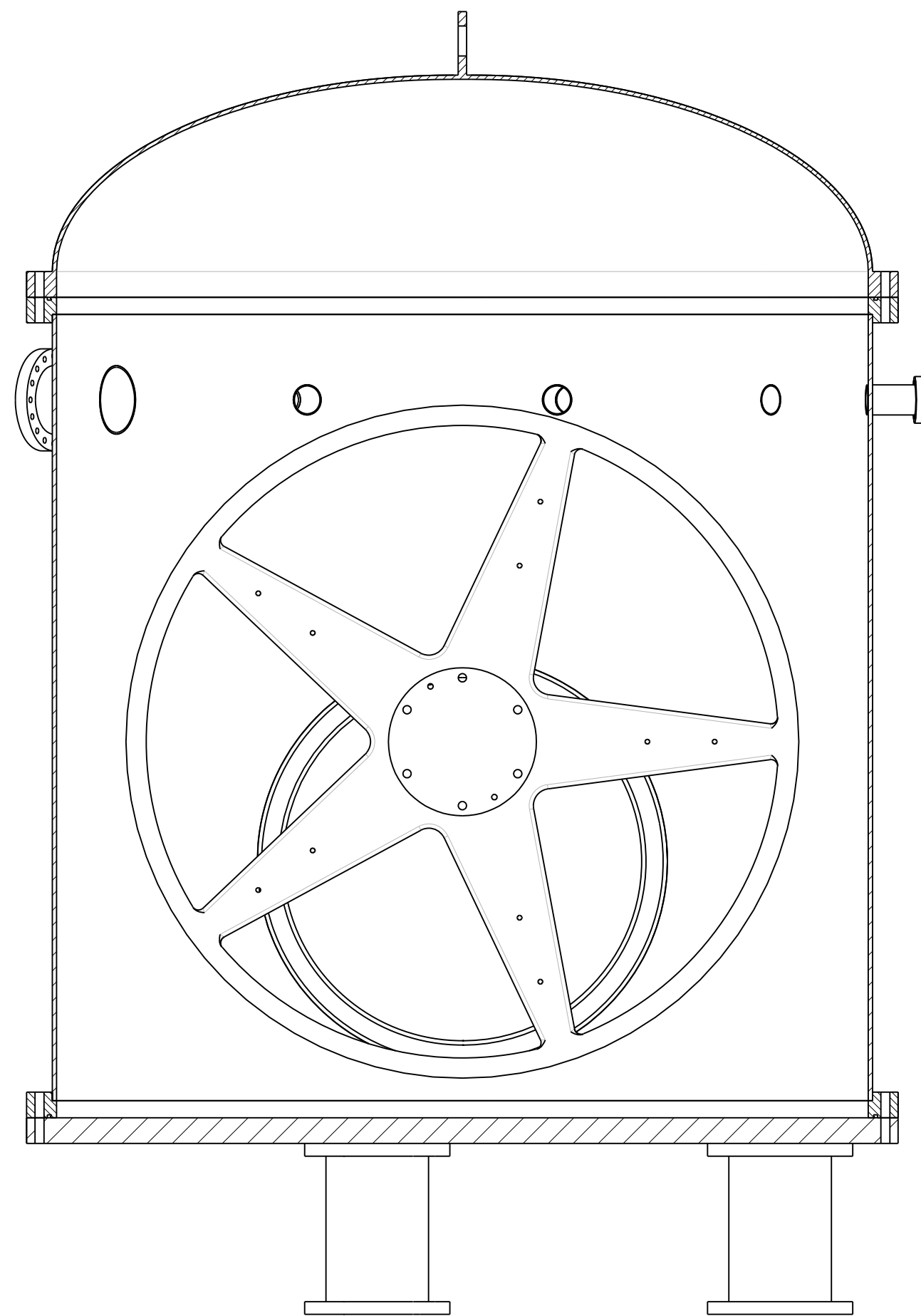
QTY	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO
1	AS-568A-390	O-RING, .210DIA x 20.955ID	VITON	12
1	AAA11-501291	WATER UNION 355 ASSY		11
1	AAA11-501290	SIEMENS MOTOR & CASE ASSY		10
1	AAA11-501286	MIDDLE SHAFT ASSY	SST 304	9
1	AAA11-501285	SEAL & BEARING BLOCK ASSY	304	8
1	AAA11-501282	TARGET WHEEL & SHAFT ASSY		7
1	AAA11-501280	VACUUM VESSEL ASSY	SST 304	6
1	AAA11-501276	VESSEL PORT FLANGE 2	ALUM 6061-T6	5
1	AAA11-501275	MOTOR END COVER	SST 304	4
1	AAA11-501263	MOTOR SPOOL WELDMENT	SST 304	3
1		SPOOL COVER	SST 304	2
1		ROD COVER	SST 304	1

QTY REOD		PARTS LIST		MATERIAL SPECIFICATION		ITEM NO	
		THIRD ANGLE PROJECTION		LAWRENCE LIVERMORE NATIONAL LABORATORY		A	
		WEIGHT(lbs): 3815.433		LAWRENCE LIVERMORE NATIONAL SECURITY-LLC			
		APPROVALS DATE		TITLE			
		ORIGINATOR BROOKSBYI 11/22/10		VACUUM SEAL TEST ASSY			
		DRAWN BROOKSBYI 4/19/11		SIZE CAGE CODE DWG NO REV			
		CHECKED KILLINGSWORTH2 5/3/11		D 14067 AAA11-501292-AA			
		APPROVED PIGGOTTI 5/10/11		SCALE: NONE		SHEET 1 OF 4	
		DRAWING LEVEL 2					

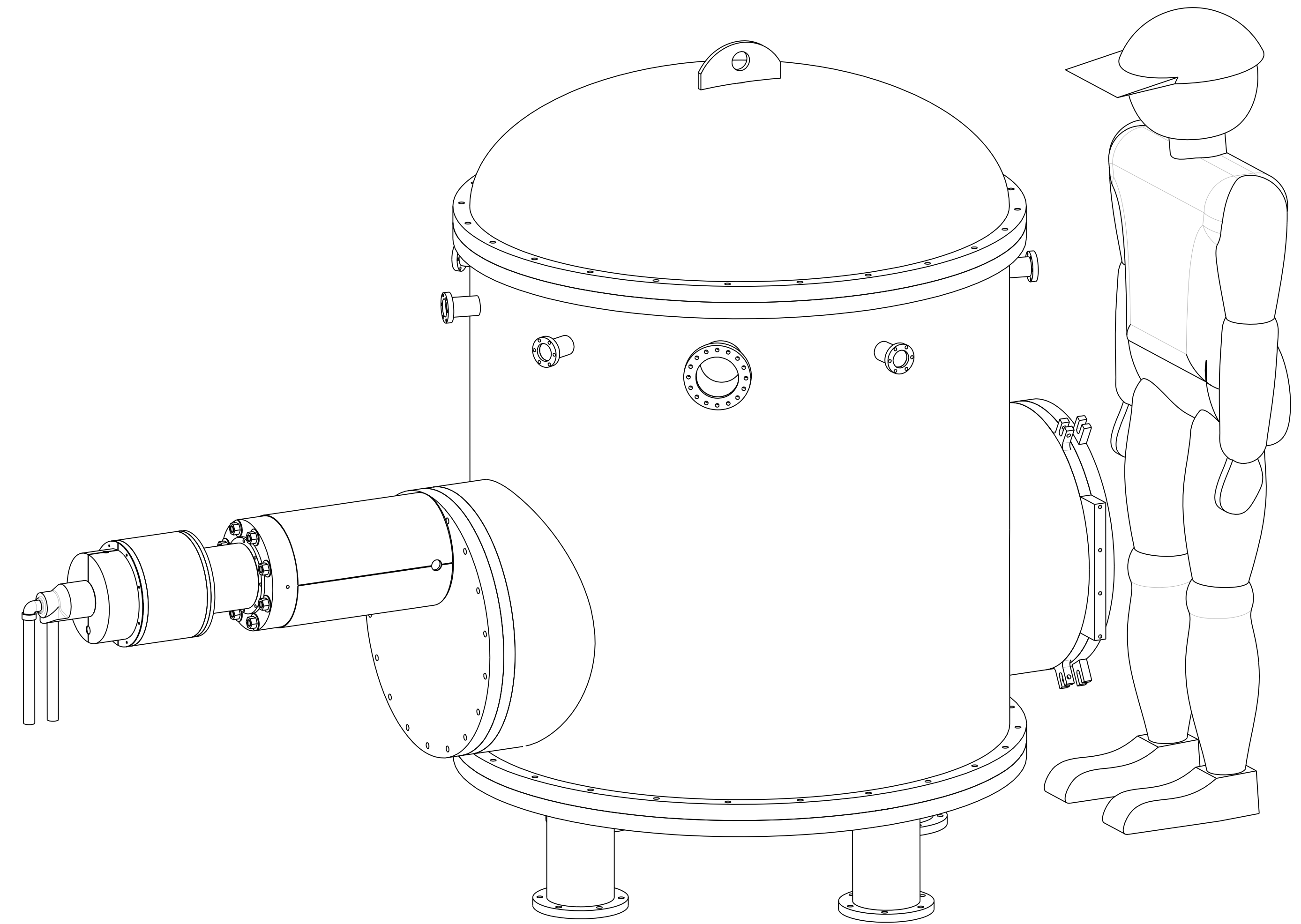
THIS WORK WAS PERFORMED UNDER THE AUSPICES OF THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC52-07NA27344. NEITHER THE UNITED STATES GOVERNMENT NOR LAWRENCE LIVERMORE NATIONAL SECURITY, LLC, NOR ANY OF THEIR EMPLOYEES MAKES ANY WARRANTY, EXPRESSED OR IMPLIED OR ASSUMES ANY LEGAL LIABILITY OR RESPONSIBILITY FOR THE ACCURACY, COMPLETENESS OR USEFULNESS OF ANY INFORMATION, APPARATUS, PRODUCT, OR PROCESS DISCLOSED, OR REPRESENTS THAT ITS USE WOULD NOT INFRINGE PRIVATELY OWNED RIGHTS. REFERENCE HEREIN TO ANY SPECIFIC COMMERCIAL PRODUCT, PROCESS, OR SERVICE BY TRADE NAME, TRADEMARK, MANUFACTURER, OR OTHERWISE DOES NOT NECESSARILY CONSTITUTE OR IMPLY ITS ENDORSEMENT, RECOMMENDATION, OR FAVORING BY THE UNITED STATES GOVERNMENT OR LAWRENCE LIVERMORE NATIONAL SECURITY, LLC.



SECTION C-C

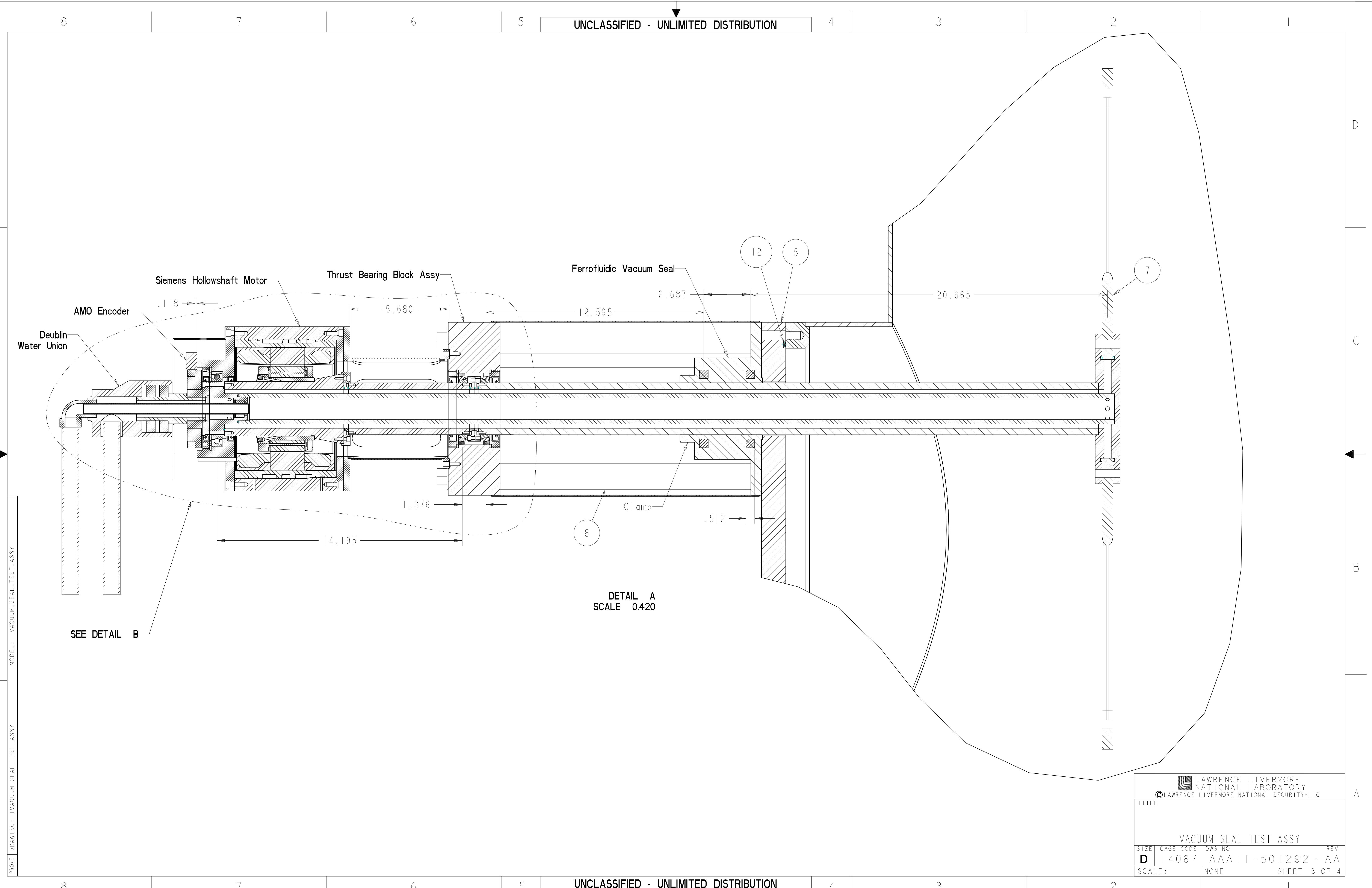


SECTION A-A



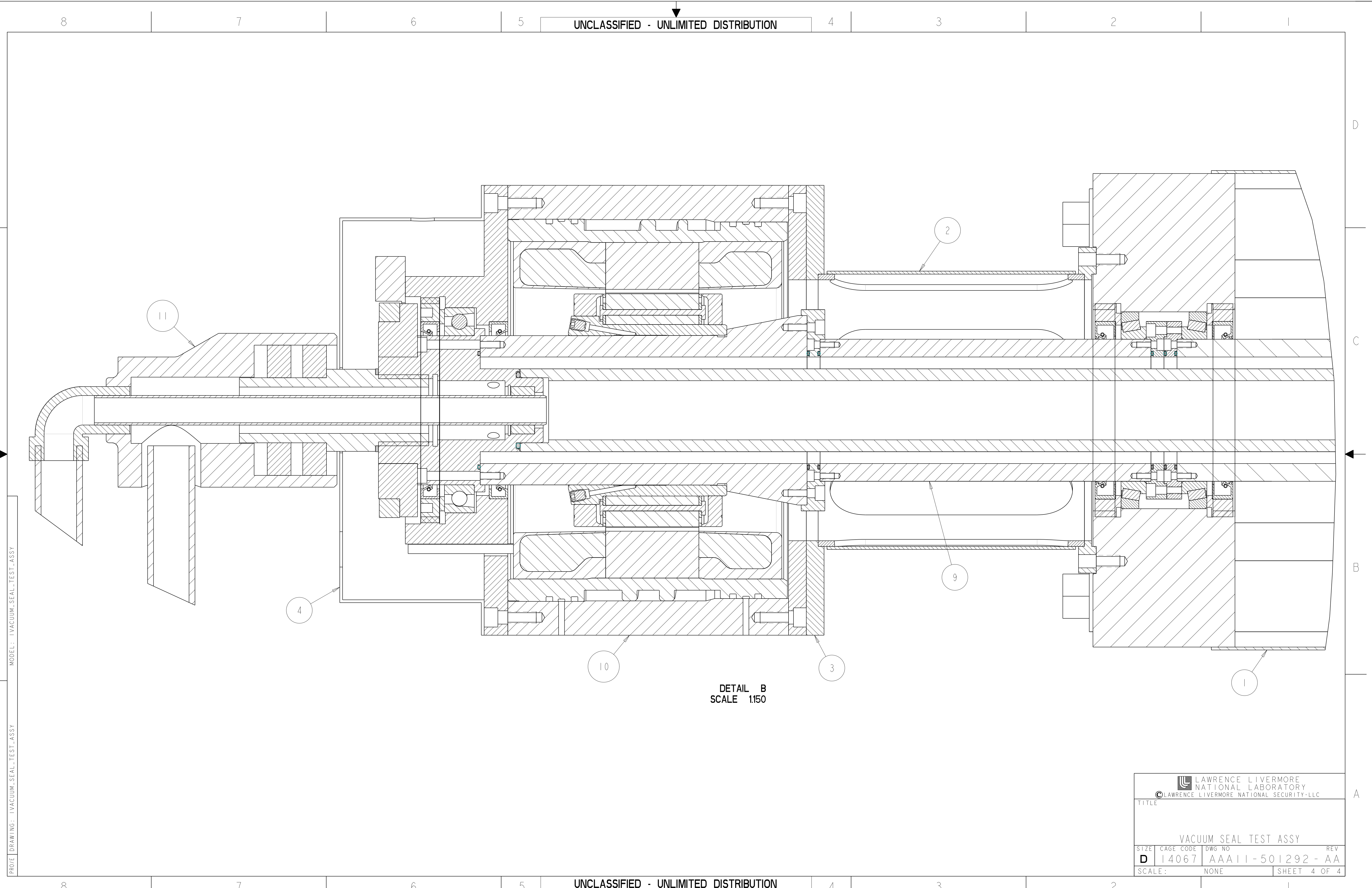
 LAWRENCE LIVERMORE NATIONAL LABORATORY ©LAWRENCE LIVERMORE NATIONAL SECURITY-LLC			
TITLE			
VACUUM SEAL TEST ASSY			
SIZE	CAGE CODE	DWG NO	REV
D	14067	AAA11-501292-AA	
SCALE:		NONE	SHEET 2 OF 4

PROJ: DRAWING: IVACUUM_SEAL_TEST_ASSY MODEL: IVACUUM_SEAL_TEST_ASSY



PROJ: DRAWING: I VACUUM_SEAL_TEST_ASSY MODEL: I VACUUM_SEAL_TEST_ASSY

LAWRENCE LIVERMORE NATIONAL LABORATORY ©LAWRENCE LIVERMORE NATIONAL SECURITY-LLC			
TITLE VACUUM SEAL TEST ASSY			
SIZE	CAGE CODE	DWG NO	REV
D	14067	AAA11-501292-AA	
SCALE: NONE		SHEET 3 OF 4	

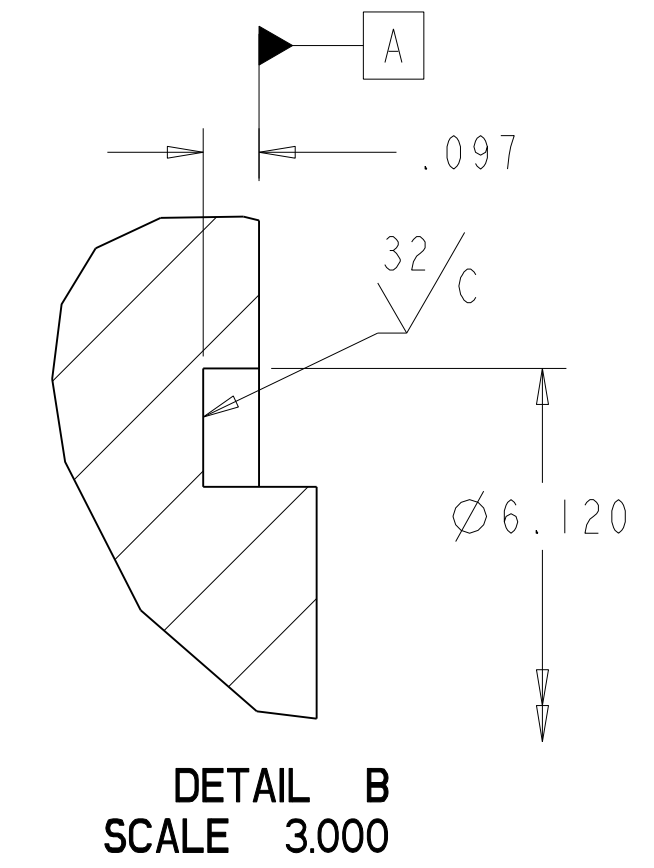
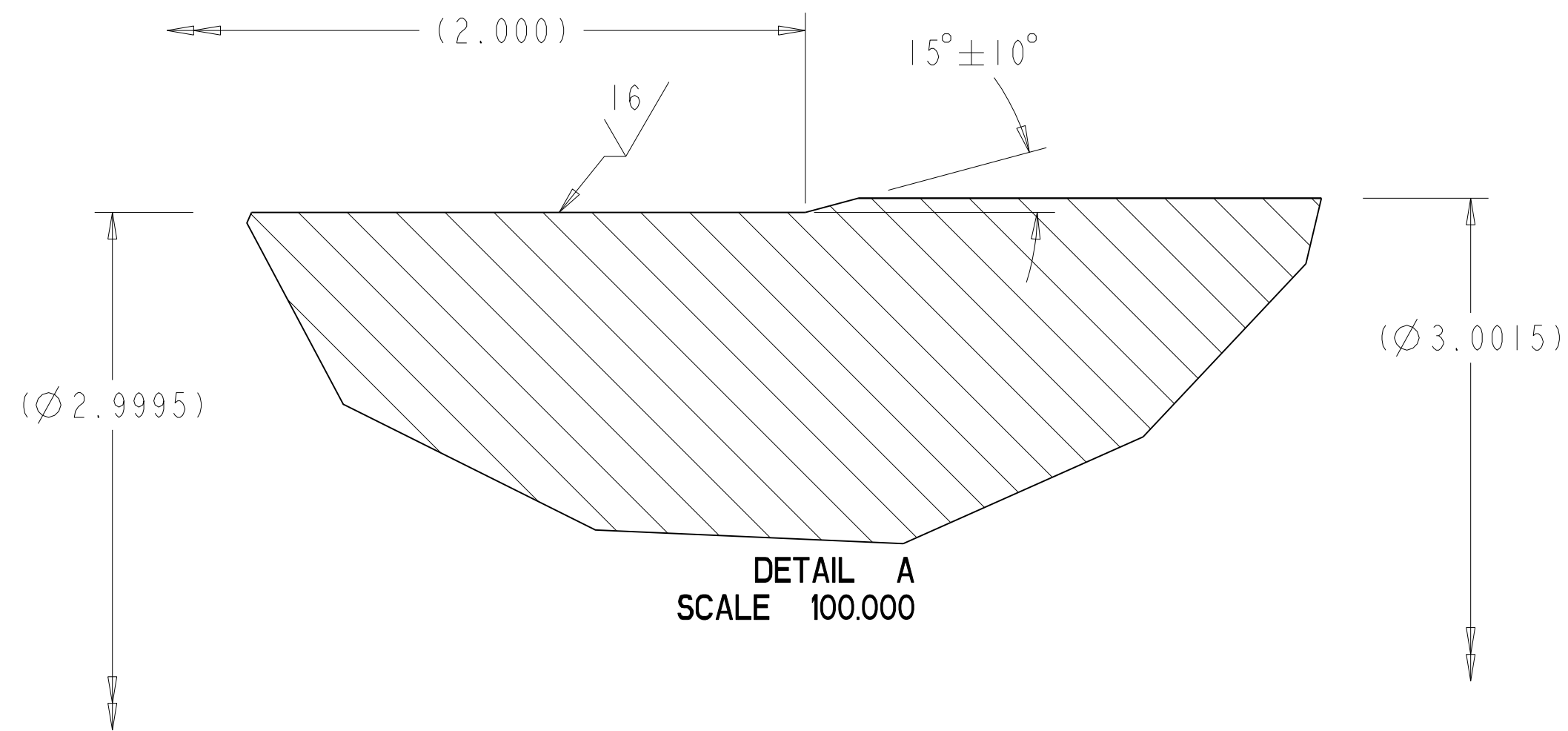
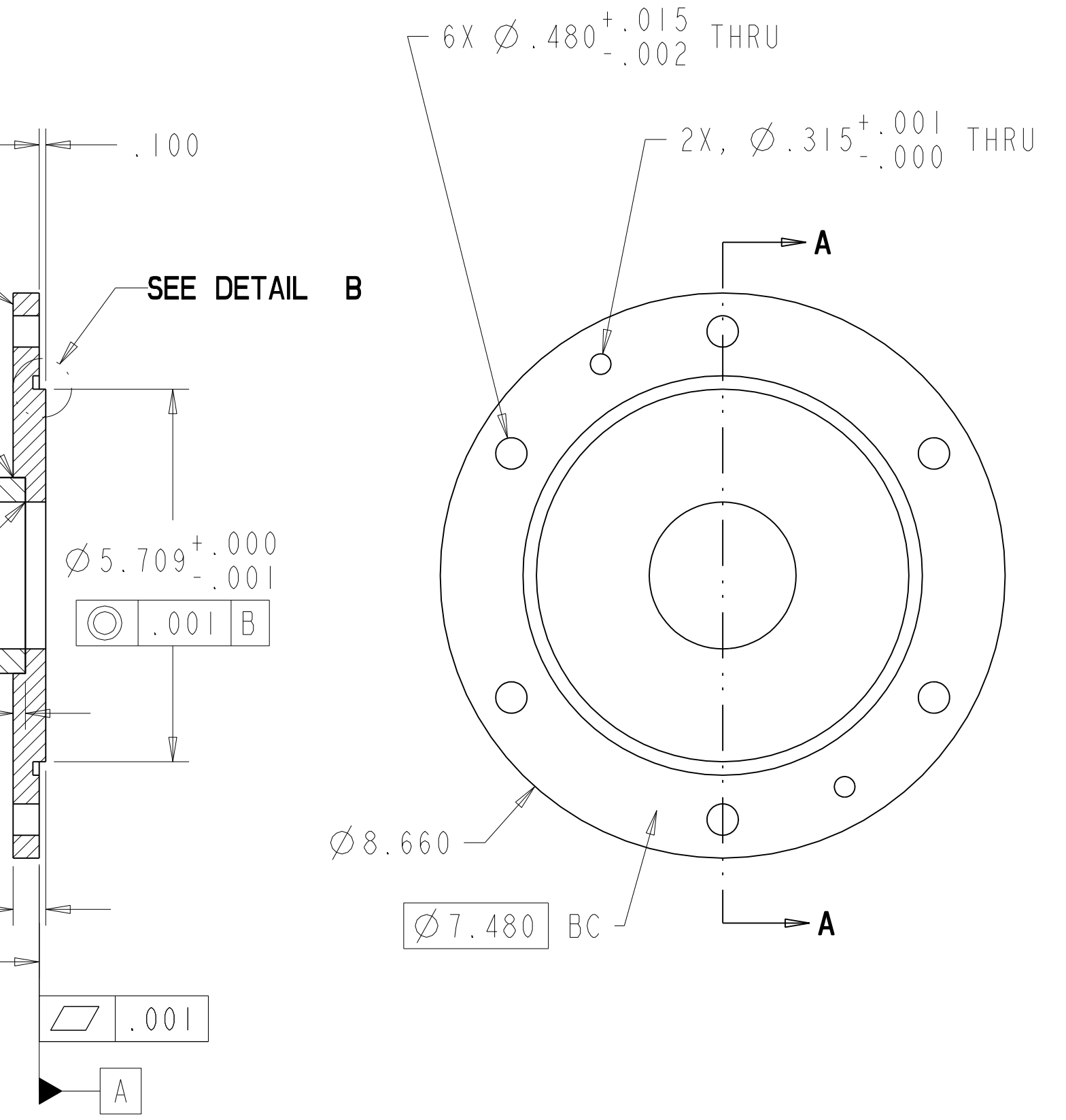
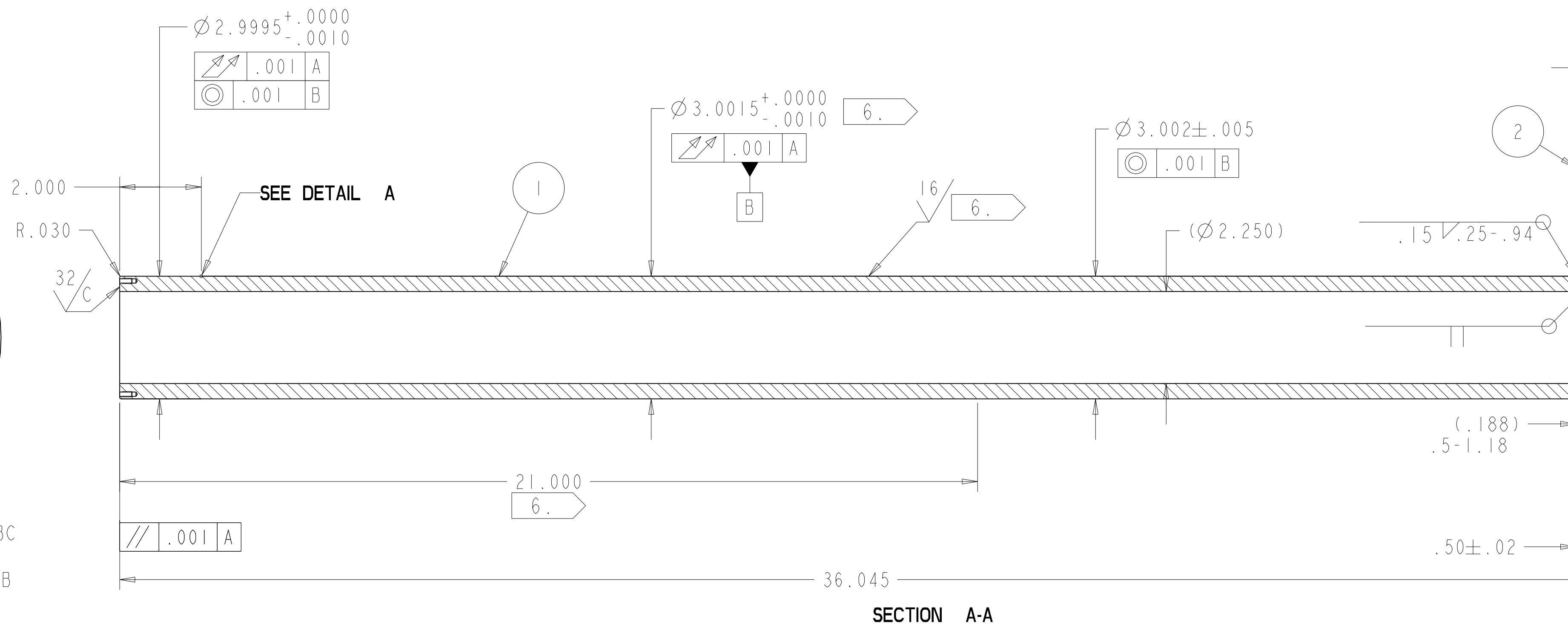
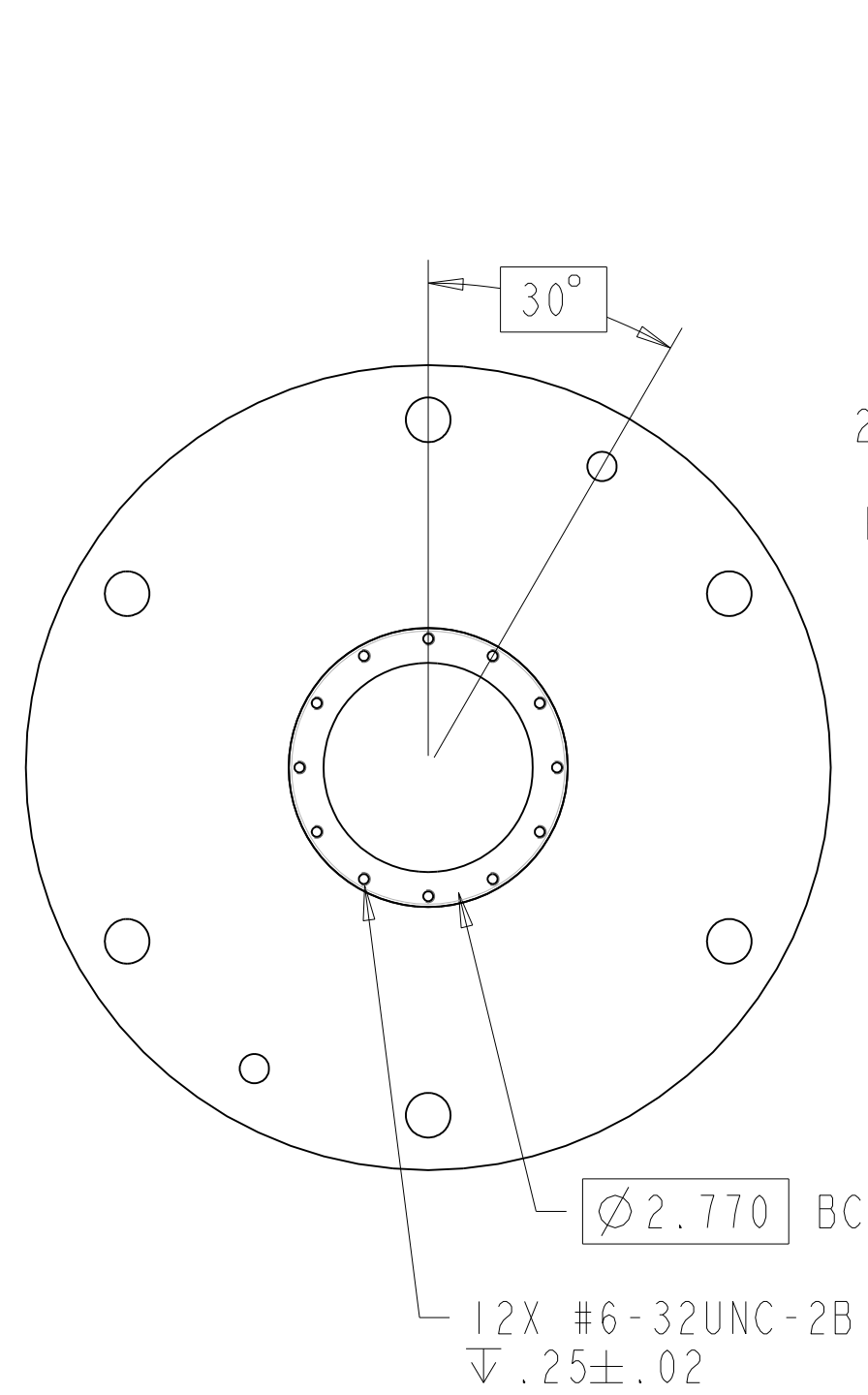


DETAIL B
SCALE 1:150

PROJ: DRAWING: I VACUUM_SEAL_TEST_ASSY
MODEL: I VACUUM_SEAL_TEST_ASSY

LAWRENCE LIVERMORE NATIONAL LABORATORY ©LAWRENCE LIVERMORE NATIONAL SECURITY-LLC			
TITLE			
VACUUM SEAL TEST ASSY			
SIZE	CAGE CODE	DWG NO	REV
D	14067	AAA11-501292-AA	
SCALE:		NONE	SHEET 4 OF 4

ZONE		REV	DESCRIPTION	REVISIONS			
AA	INITIAL RELEASE			DWN	CHK	APVD	DATE
				BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



NOTES, UNLESS OTHERWISE SPECIFIED:

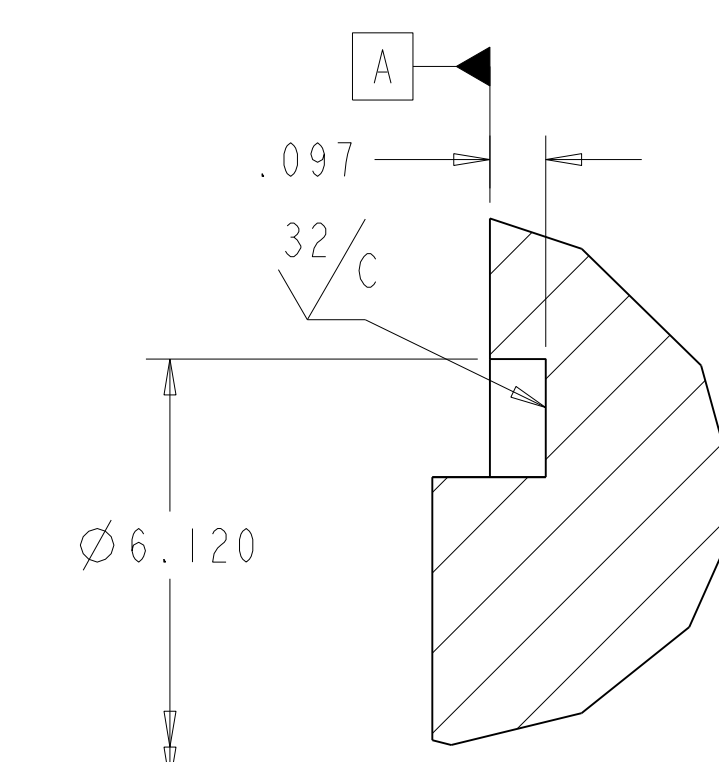
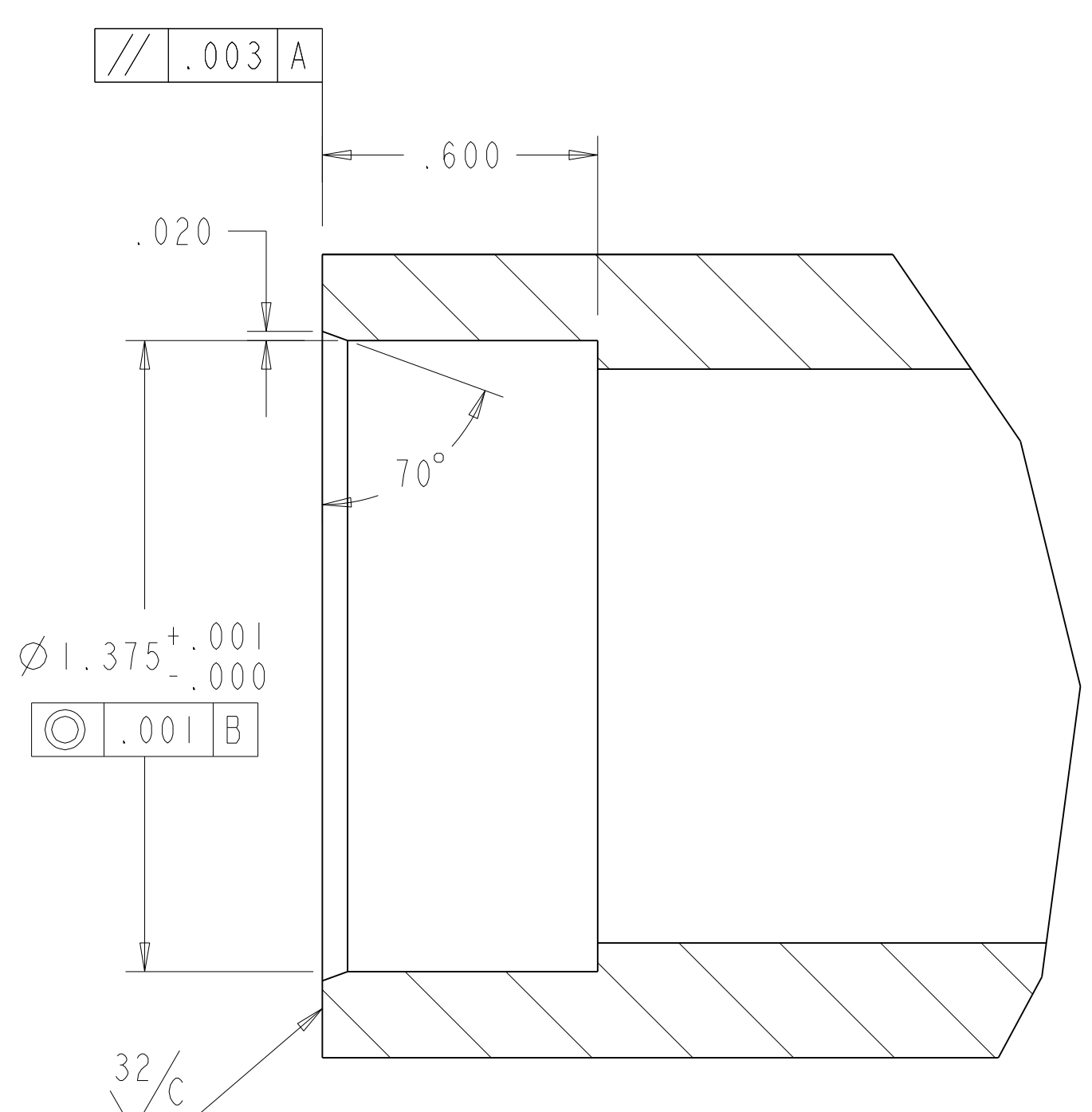
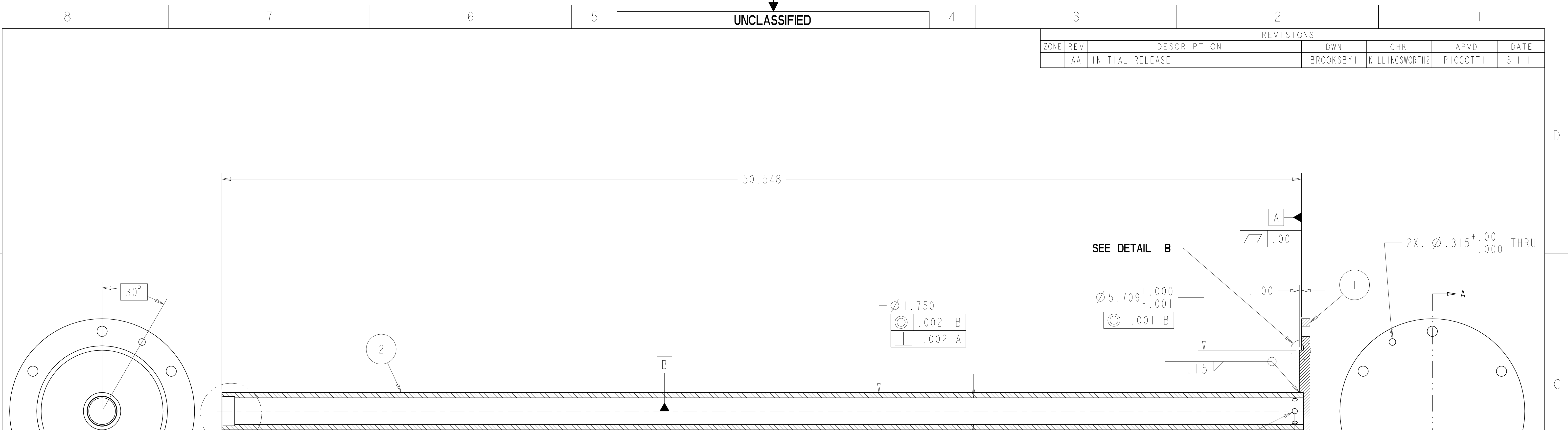
- PART DIMENSIONS FROM CAD MODEL. IGES OR STEP FILE TO BE PROVIDED. CRITICAL DIMENSIONS WILL BE NOTED ON THIS DRAWING. ALL OTHERS WILL BE PER THE GENERAL TOLERANCES NOTED IN TITLE BLOCK, AND PER INDUSTRY STANDARDS AND TYPICAL MACHINE TOOL CAPABILITIES.
- REMOVE ALL BURRS AND BREAK SHARP EDGES [.010 MAX] CHAMFER OR RADIUS.
- ALL MACHINED SURFACES WILL BE 62 FINISH OR BETTER. NO PITS, DENTS, SCRATCHES, ETC. PERMITTED.
- PART WILL BE FREE OF ALL FOREIGN MATERIALS, LOOSE SCALE, CHIPS, GREASE AND OIL.
- PROTECT FROM DAMAGE THRU-OUT ALL PHASES OF MACHINING, SHIPPING AND HANDLING.
- OVER LENGTH SPECIFIED.

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QTY	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO	
			SST	304	2
		TUBE, 3.1250D X 2.251D	SST	304	1

THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY	
WEIGHT(lbs):	38.279	APPROVALS	DATE	TITLE	
ORIGINATOR	BROOKSBYI		11/22/10	OUTER SHAFT WELDMENT	
DRAWN	BROOKSBYI		2/16/11	SIZE	CAGE CODE
CHECKED	KILLINGSWORTH2		2/28/11	DWG NO	REV
APPROVED	PIGGOTTI		3/1/11	D	14067
			DRAWING LEVEL	AAA11-501253-AA	
			2	SCALE:	NONE
					SHEET 1 OF 1

ZONE		REV	DESCRIPTION	REVISIONS			
REV	DATE	BY	CHK	APVD	DATE		
AA			INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



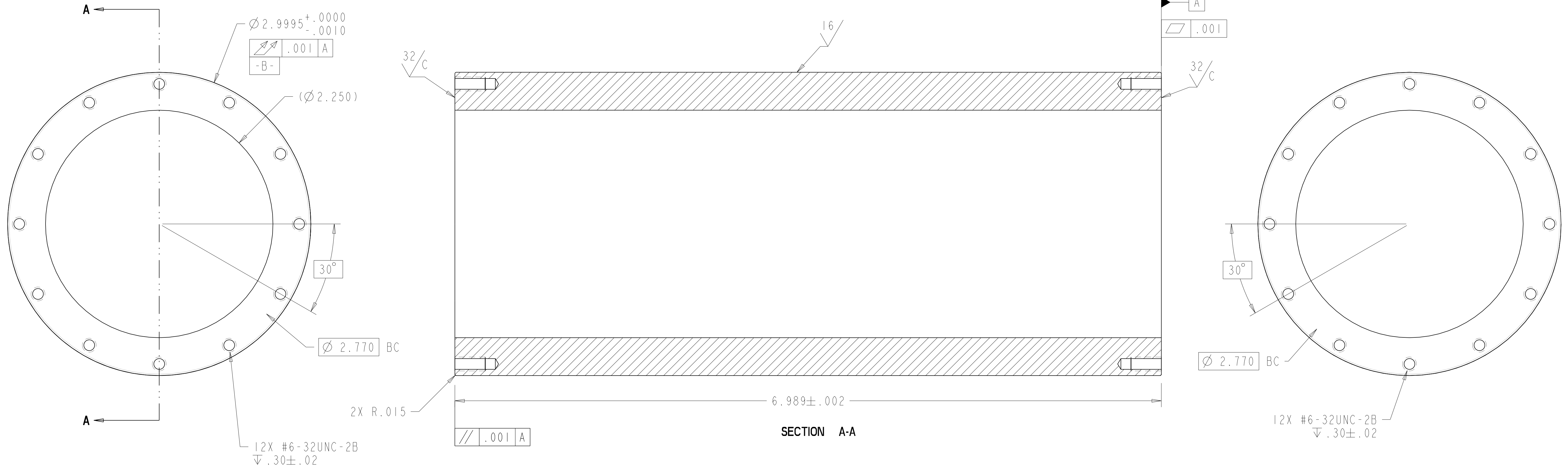
- NOTES, UNLESS OTHERWISE SPECIFIED:
- PART DIMENSIONS FROM CAD MODEL. IGES OR STEP FILE TO BE PROVIDED. CRITICAL DIMENSIONS WILL BE NOTED ON THIS DRAWING. ALL OTHERS WILL BE PER THE GENERAL TOLERANCES NOTED IN TITLE BLOCK, AND PER INDUSTRY STANDARDS AND TYPICAL MACHINE TOOL CAPABILITIES.
 - REMOVE ALL BURRS AND BREAK SHARP EDGES [.010 MAX] CHAMFER OR RADIUS.
 - ALL MACHINED SURFACES WILL BE 62 FINISH OR BETTER. NO PITS, DENTS, SCRATCHES, ETC. PERMITTED.
 - PART WILL BE FREE OF ALL FOREIGN MATERIALS, LOOSE SCALE, CHIPS, GREASE AND OIL.
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QTY REOD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO
		TUBE, 1.750D x 1.251D	SST 304	2
			SST 304	1

THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL SECURITY-LLC	
		WEIGHT(lbs):	24.194	TITLE	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:		APPROVALS	DATE	INNER SHAFT WELDMENT	
DECIMALS	± 0.005	ORIGINATOR	BROOKSBYI	SIZE	D
ANGLES	± 0.5	DRAWN	BROOKSBYI	CAGE CODE	14067
		CHECKED	KILLINGSWORTH2	DWG NO	AAA11-501254-AA
		APPROVED	PIGGOTTI	REV	2
		DRAWING LEVEL	2	SCALE:	NONE
				SHEET	1 OF 1

ZONE		REV	DESCRIPTION	REVISIONS			
		AA	INITIAL RELEASE	DWN	CHK	APVD	DATE
		AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



NOTES, UNLESS OTHERWISE SPECIFIED:

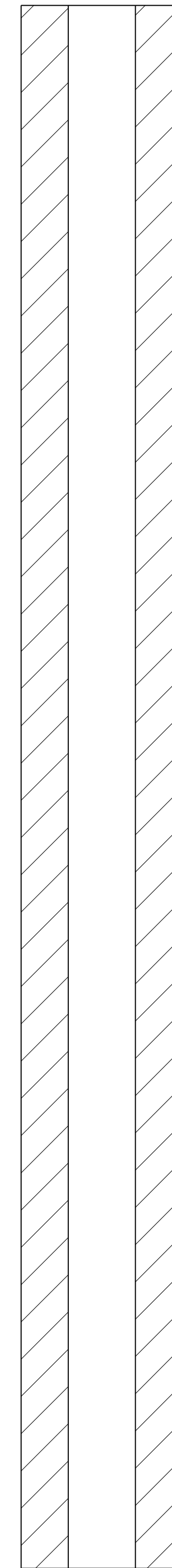
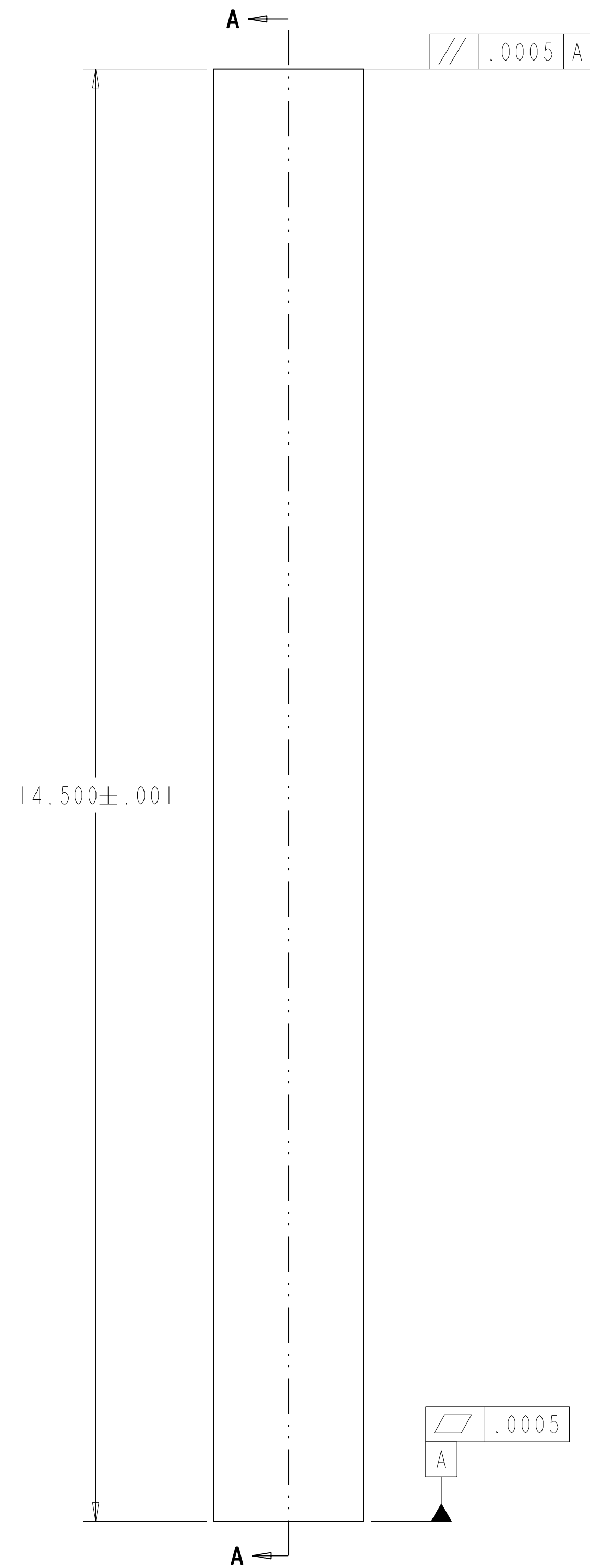
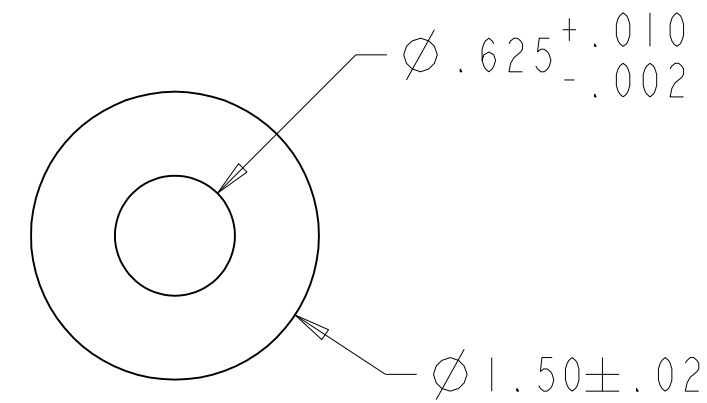
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		TUBE, 3.1250D x 2.251D		SST	304	I
QTY REOD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL		MATERIAL SPECIFICATION	ITEM NO	
PARTS LIST						
THIRD ANGLE PROJECTION			LAWRENCE LIVERMORE NATIONAL LABORATORY ©LAWRENCE LIVERMORE NATIONAL SECURITY-LLC			
WEIGHT(lbs):		6.151		TITLE		
APPROVALS		DATE		SHAFT - MIDDLE		
ORIGINATOR BROOKSBYI		11/22/10		SIZE		
DRAWN BROOKSBYI		2/16/11		CAGE CODE		
CHECKED KILLINGSWORTH2		2/28/11		DWG NO		
APPROVED PIGGOTTI		3/1/11		REV		
DECIMALS		ANGLES		SCALE:		
± 0.005		± 0.5		NONE		
DRAWING LEVEL		2		SHEET 1 OF 1		

UNCLASSIFIED

ZONE		REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA		INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



SECTION A-A

NOTES, UNLESS OTHERWISE SPECIFIED:

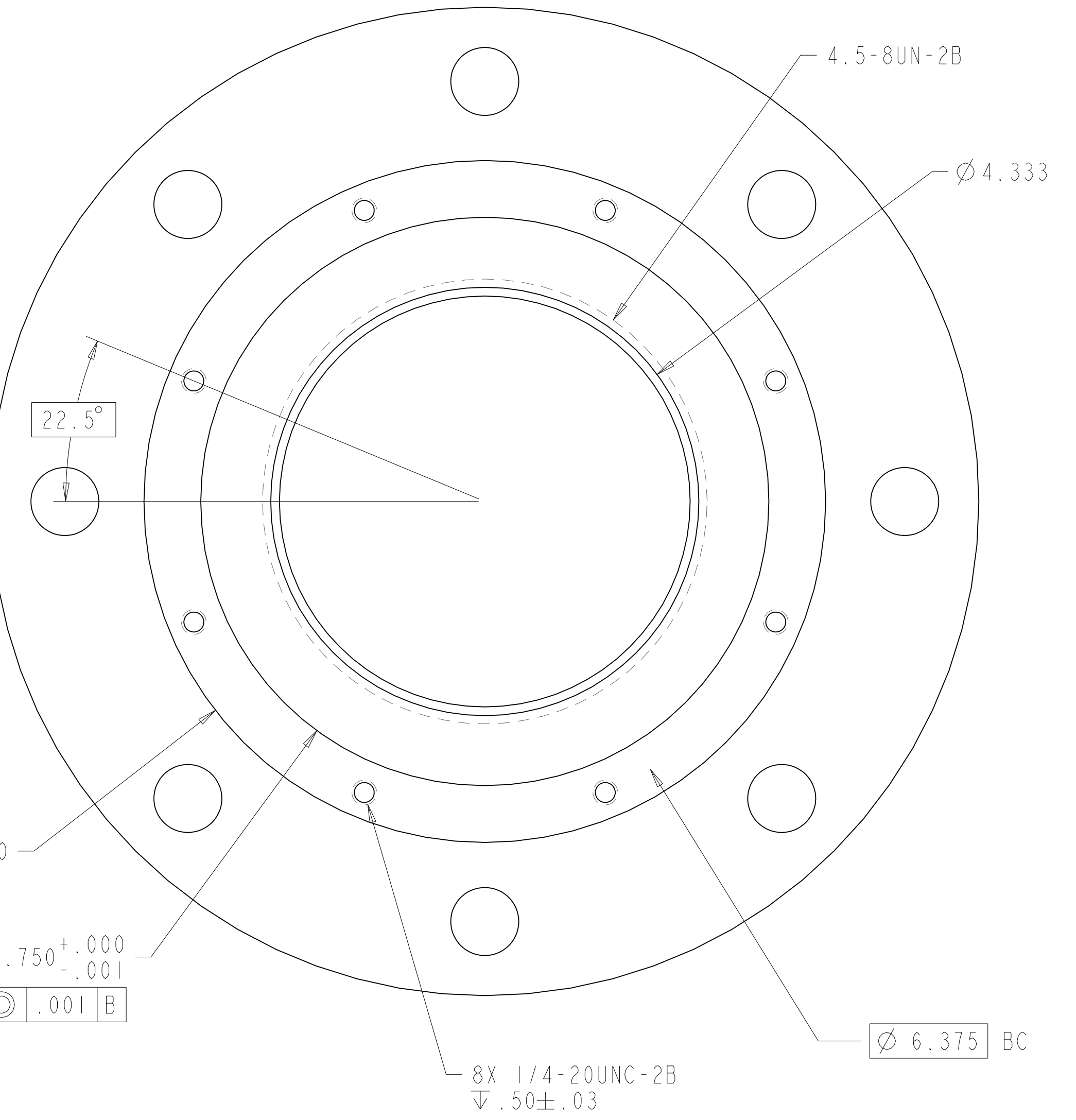
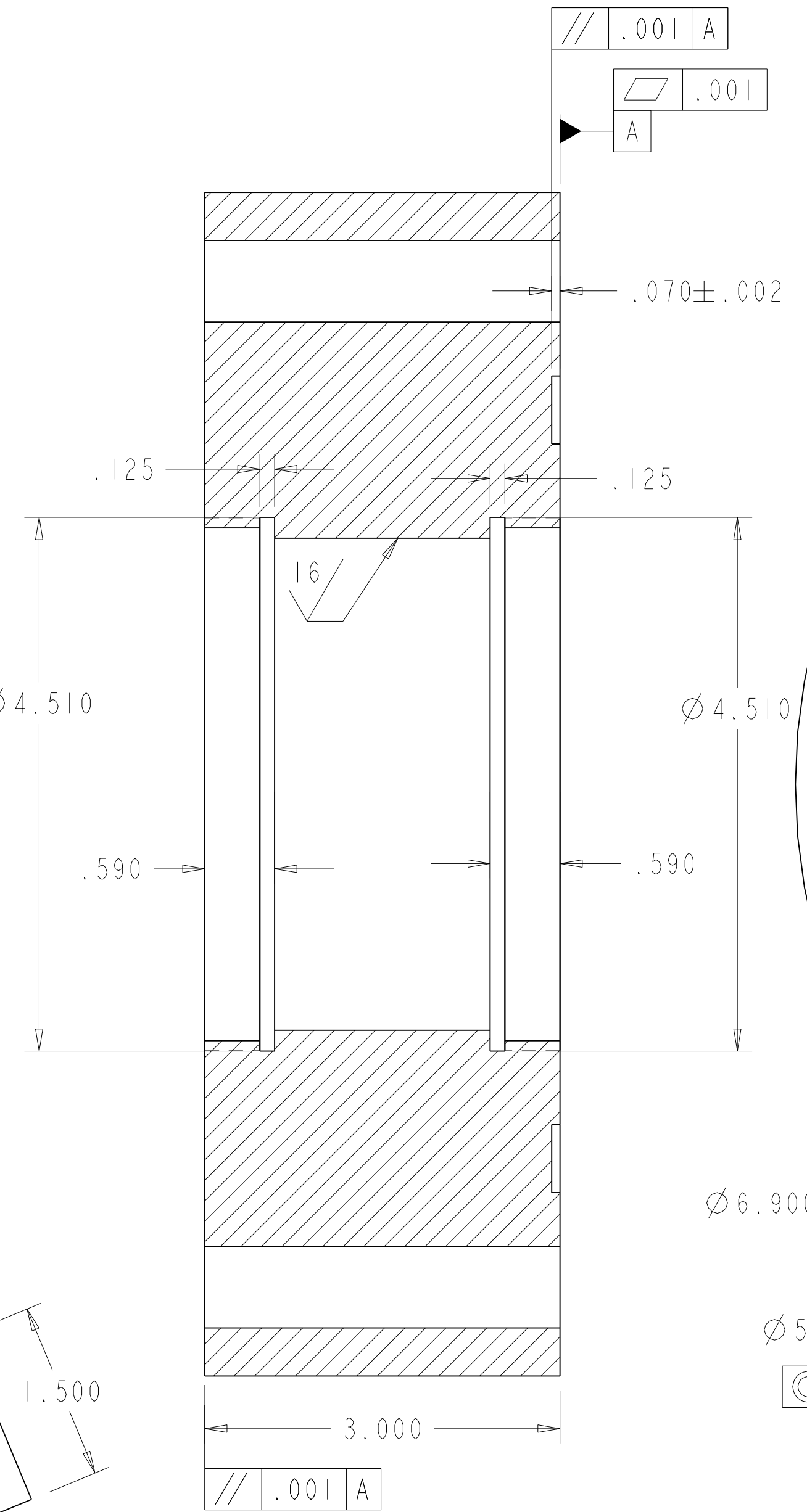
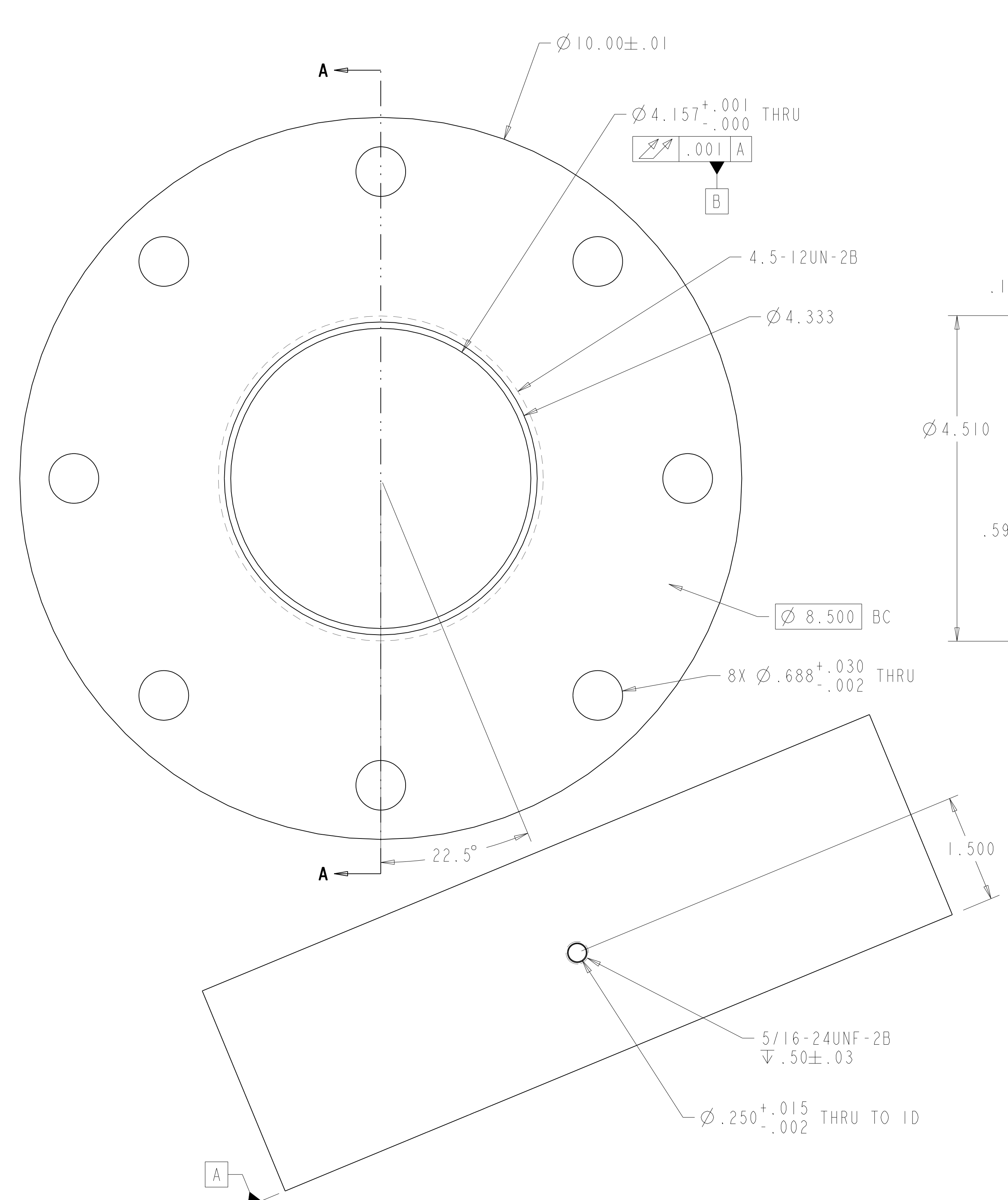
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QTY REQD		PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	SST	304	I
THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY ©LAWRENCE LIVERMORE NATIONAL SECURITY-LLC		
WEIGHT(lbs):		6.056		TITLE		
APPROVALS		DATE		BEARING STANDOFF		
ORIGINATOR		11/22/10		SIZE	CAGE CODE	DWG NO
DRAWN		2/16/11		D	14067	AAA11-501256-AA
CHECKED		2/28/11		SCALE:	NONE	
APPROVED		3/1/11		SHEET 1 OF 1		
PIGGOTTI		DRAWING LEVEL		2		

UNCLASSIFIED

ZONE		REV	DESCRIPTION	DWN	CHK	APVD	DATE
AA		INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTT1	3-1-11	
AB		CHANGED 4.5-8UN TO 4.5-12UN	BROOKSBYI	KILLINGSWORTH2	PIGGOTT1	5-4-11	



SECTION A-A

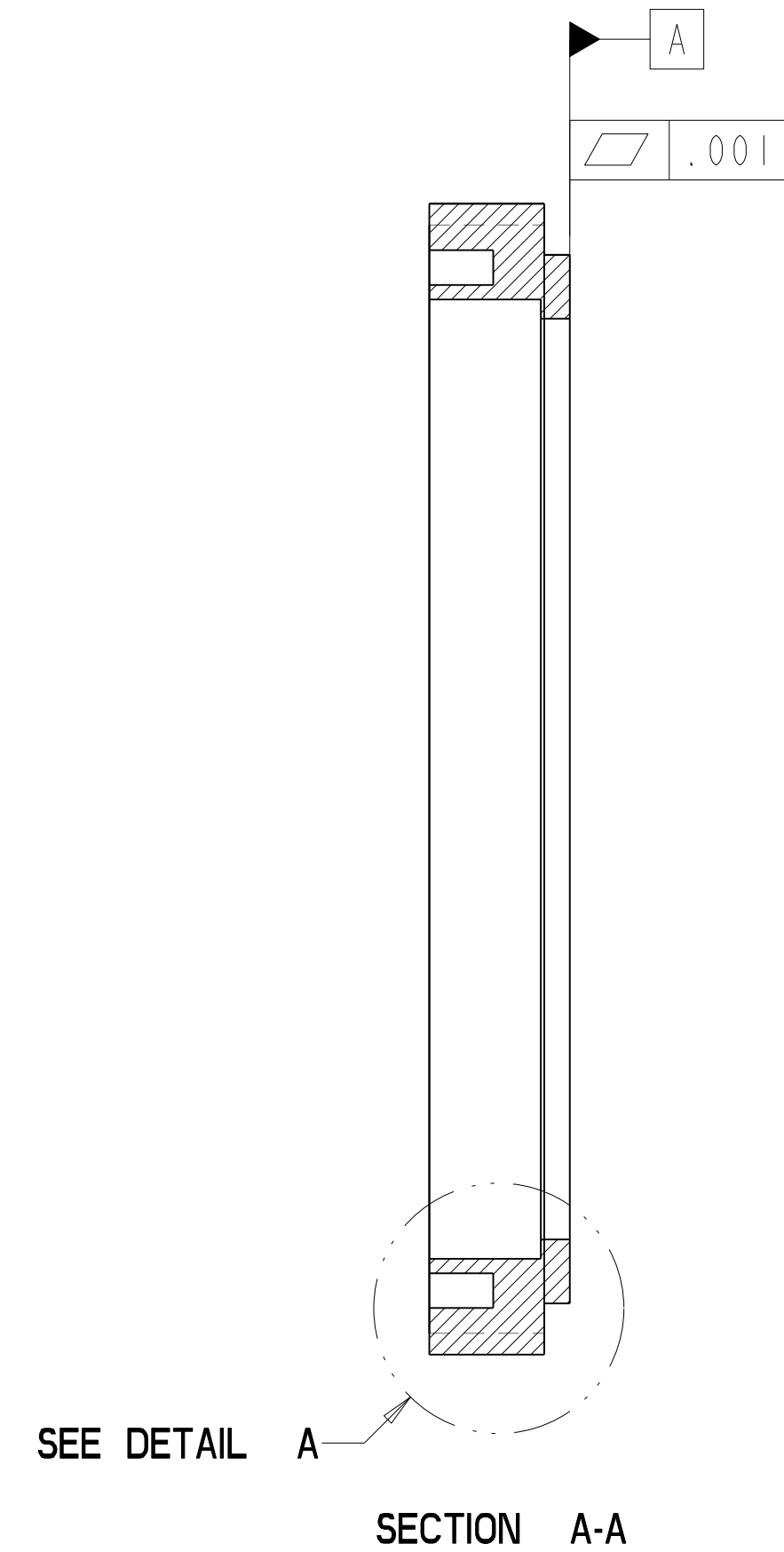
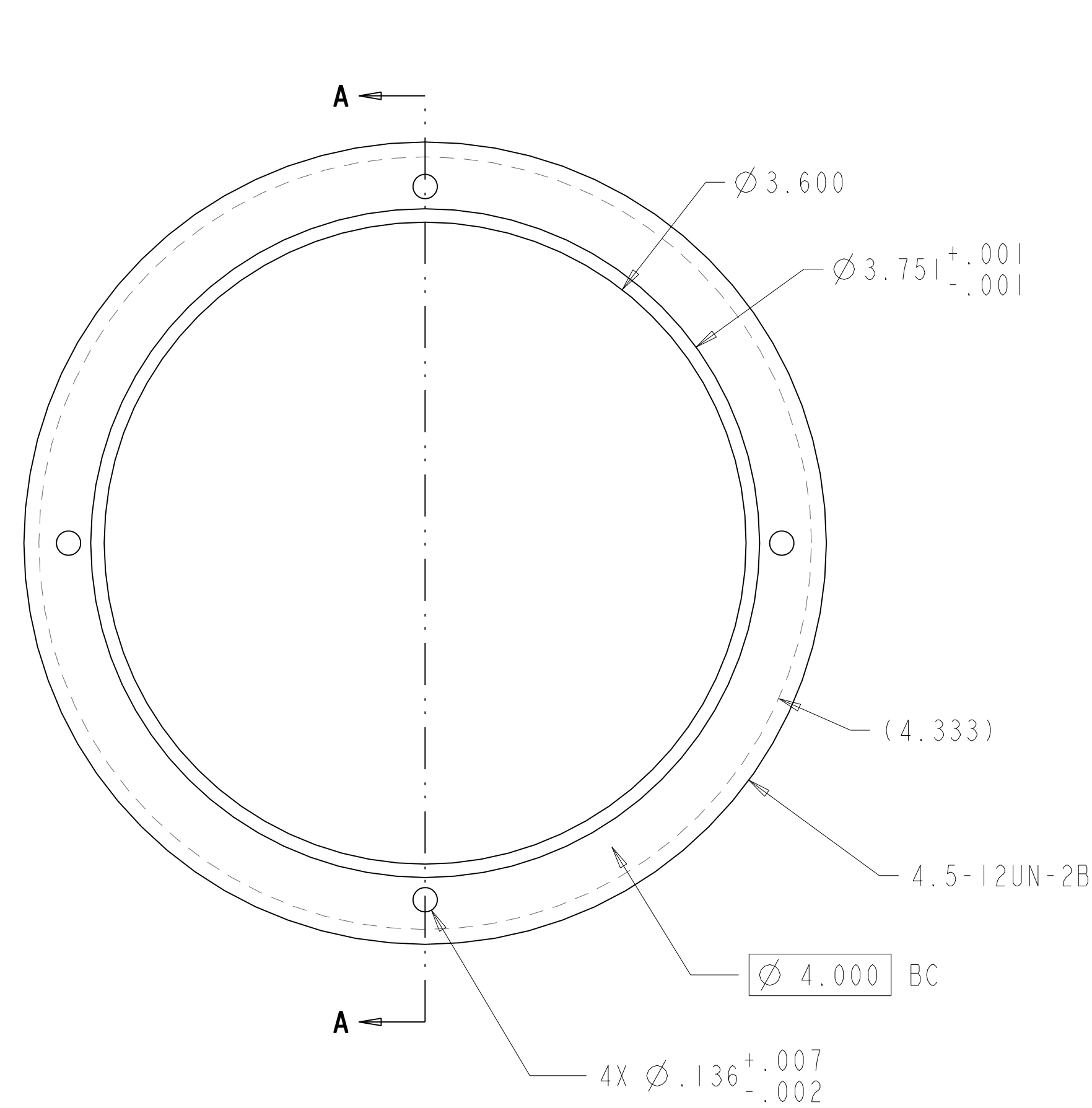
NOTES, UNLESS OTHERWISE SPECIFIED:

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- PART WILL BE FREE OF ALL FOREIGN MATERIALS, LOOSE SCALE, CHIPS, GREASE AND OIL.
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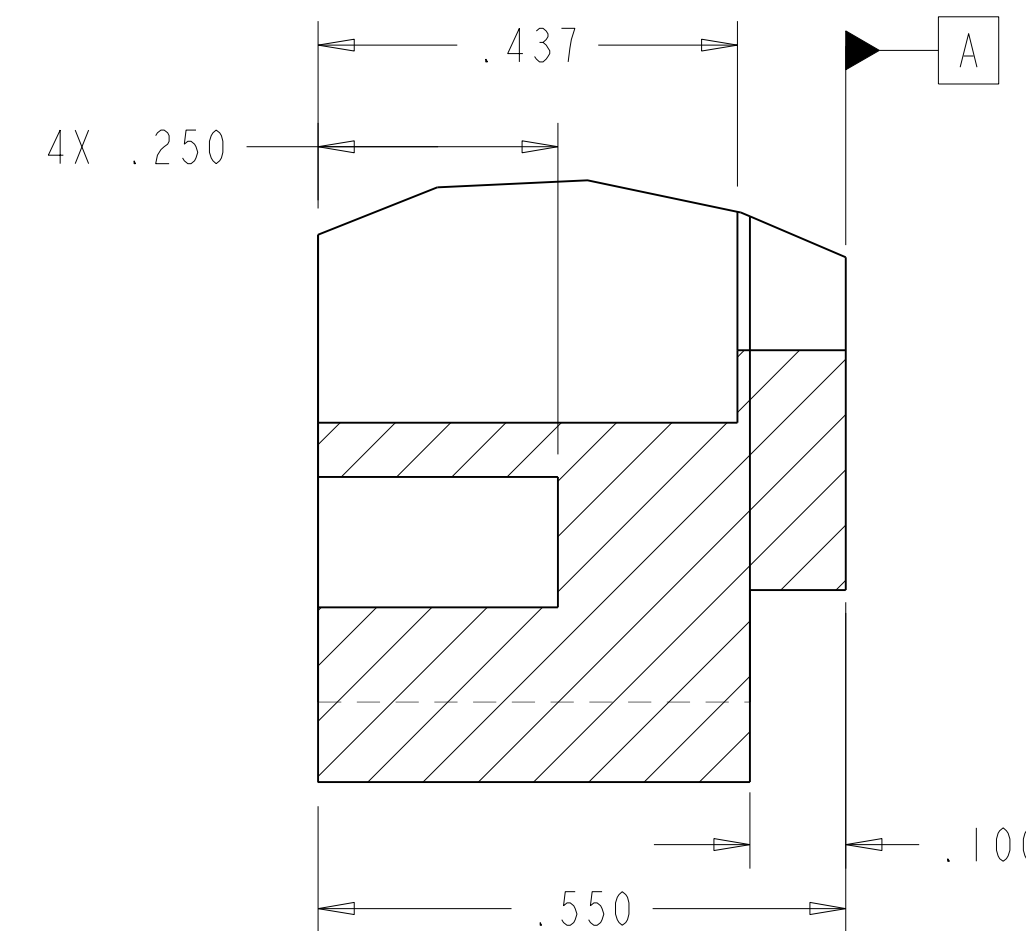
QTY RECD		PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	ALUM 6061-T6	6061-T6	I
THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY		
WEIGHT(lbs): 17.952		APPROVALS		DATE		
ORIGINATOR BROOKSBYI		DRAWN BROOKSBYI		CHECKED KILLINGSWORTH2		
APPROVED PIGGOTT1		DATE 2/16/11		DATE 2/28/11		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:		DECIMALS ± 0.005		ANGLES ± 0.5		
TITLE BEARING BLOCK		SIZE D		CAGE CODE 14067		DWG NO AAA11-501257-AB
SCALE: NONE		DRAWING LEVEL 2		REV		SHEET 1 OF 1

		REVISIONS				
ZONE	REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11
	AB	CHANGED 4.5-8UN TO 4.5-12UN	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	5-4-11



SEE DETAIL A

SECTION A-A



DETAIL A
SCALE 5.000

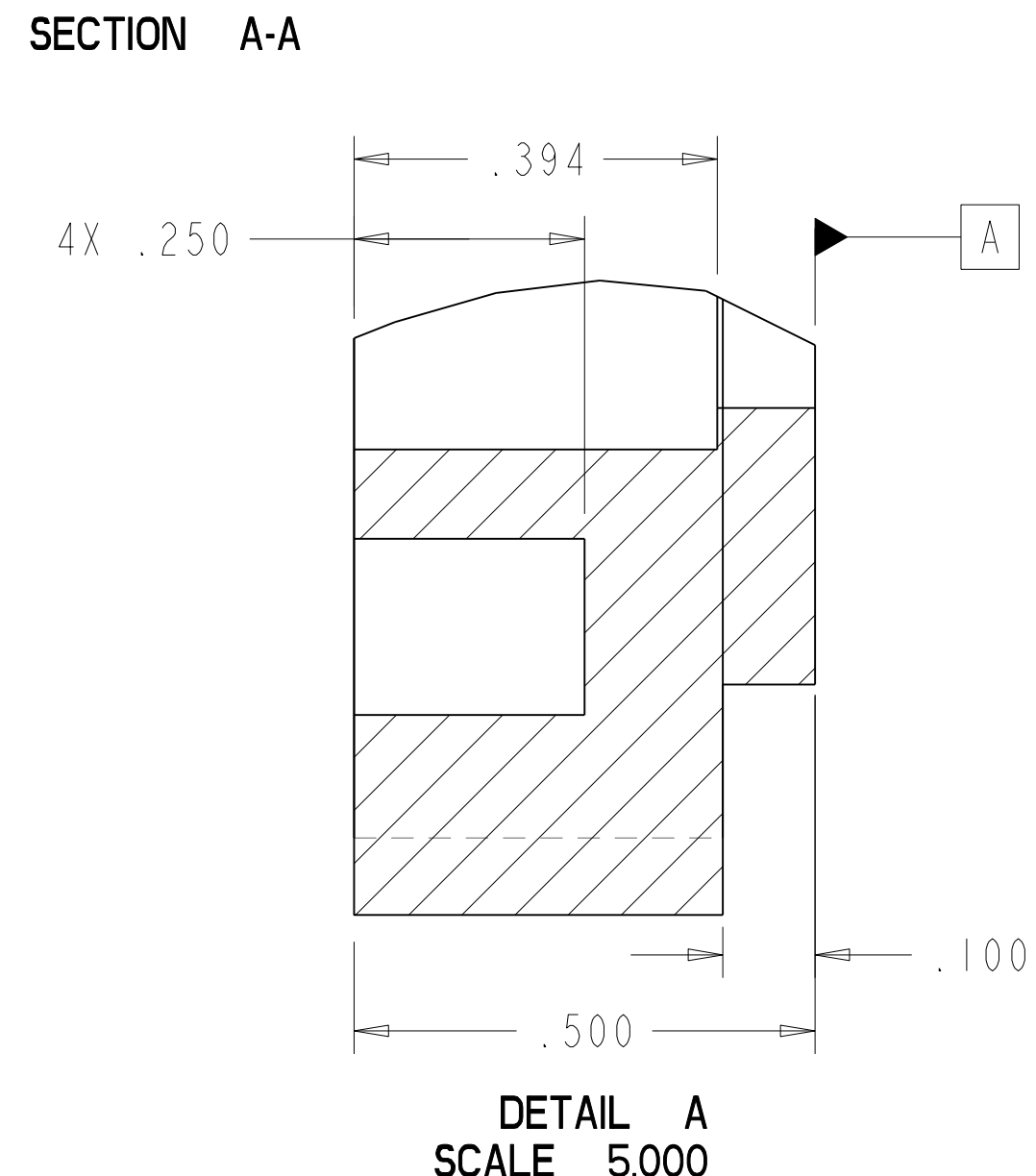
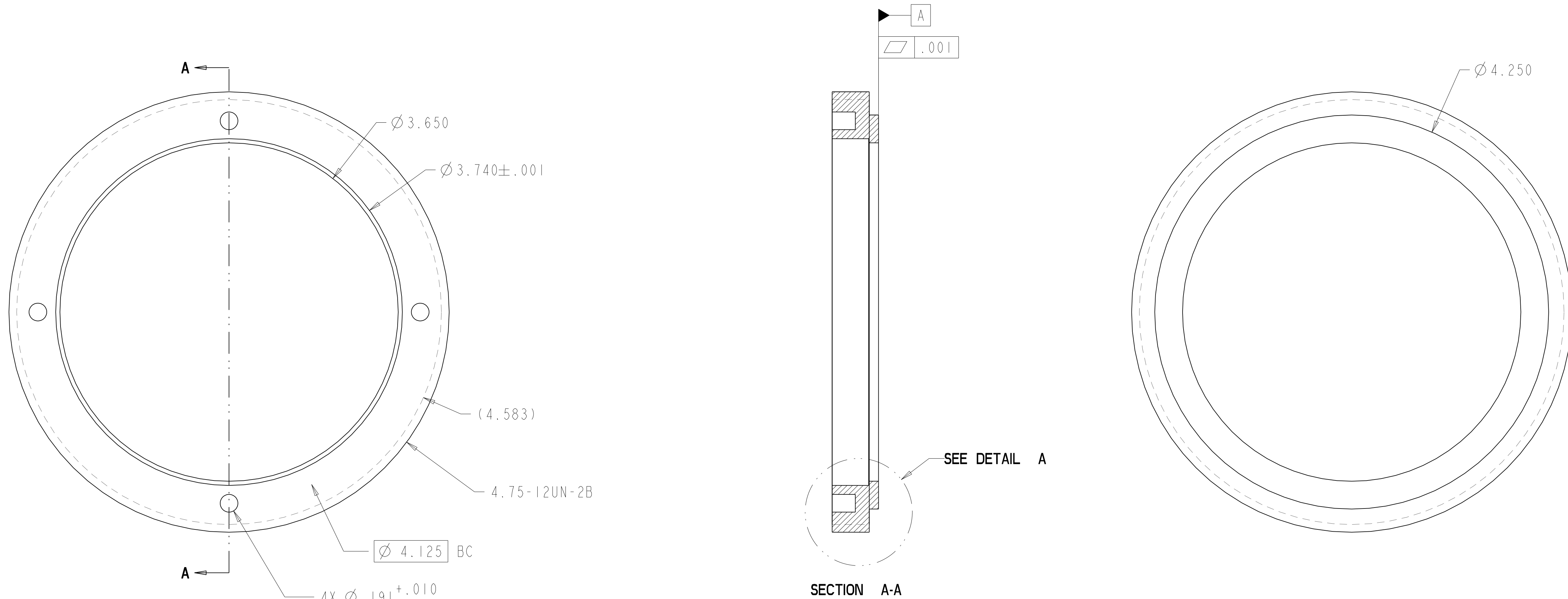
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		SST		304	I
QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL		MATERIAL SPECIFICATION	ITEM NO
PARTS LIST					
THIRD ANGLE PROJECTION		WEIGHT(lbs): 0.710		LAWRENCE LIVERMORE NATIONAL LABORATORY ©LAWRENCE LIVERMORE NATIONAL SECURITY-LLC	
APPROVALS		DATE			
ORIGINATOR: BROOKSBYI		11/22/10		BEARING NUT	
DRAWN: BROOKSBYI		2/16/11			
CHECKED: KILLINGSWORTH2		2/28/11			
APPROVED: PIGGOTTI		3/1/11		SIZE: D	CAGE CODE: 14067
		DRAWING LEVEL: 2		DWG NO: AAA11-501258-AB	REV: I
		SCALE: NONE		SHEET 1 OF 1	

		REVISIONS				
ZONE	REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11
	AB	CHANGED 4.75-8UN TO 4.75-12UN	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	5-4-11



NOTES, UNLESS OTHERWISE SPECIFIED:

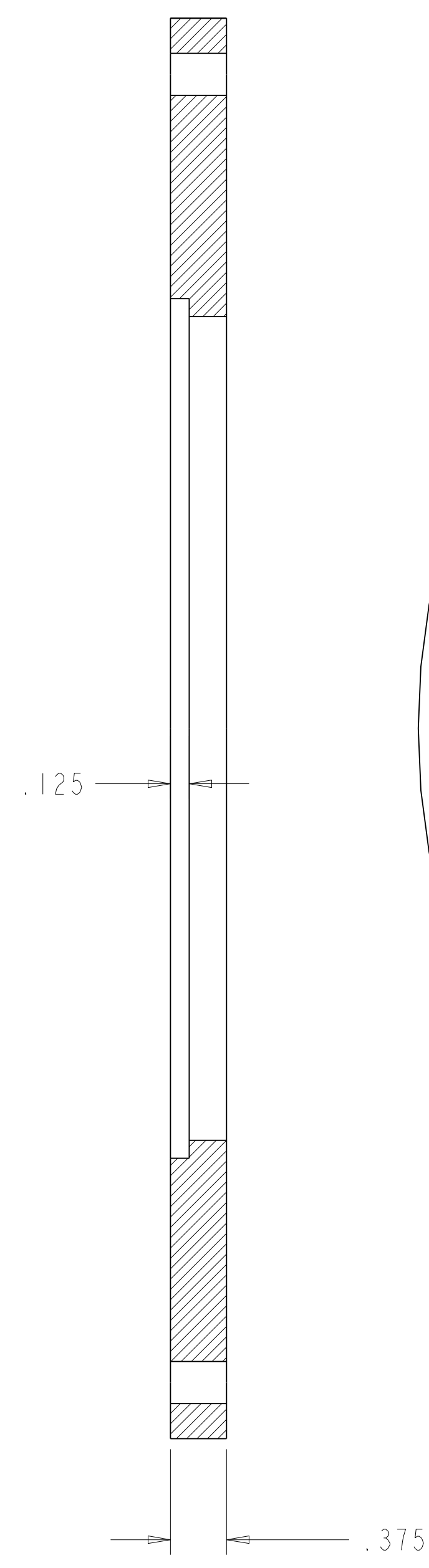
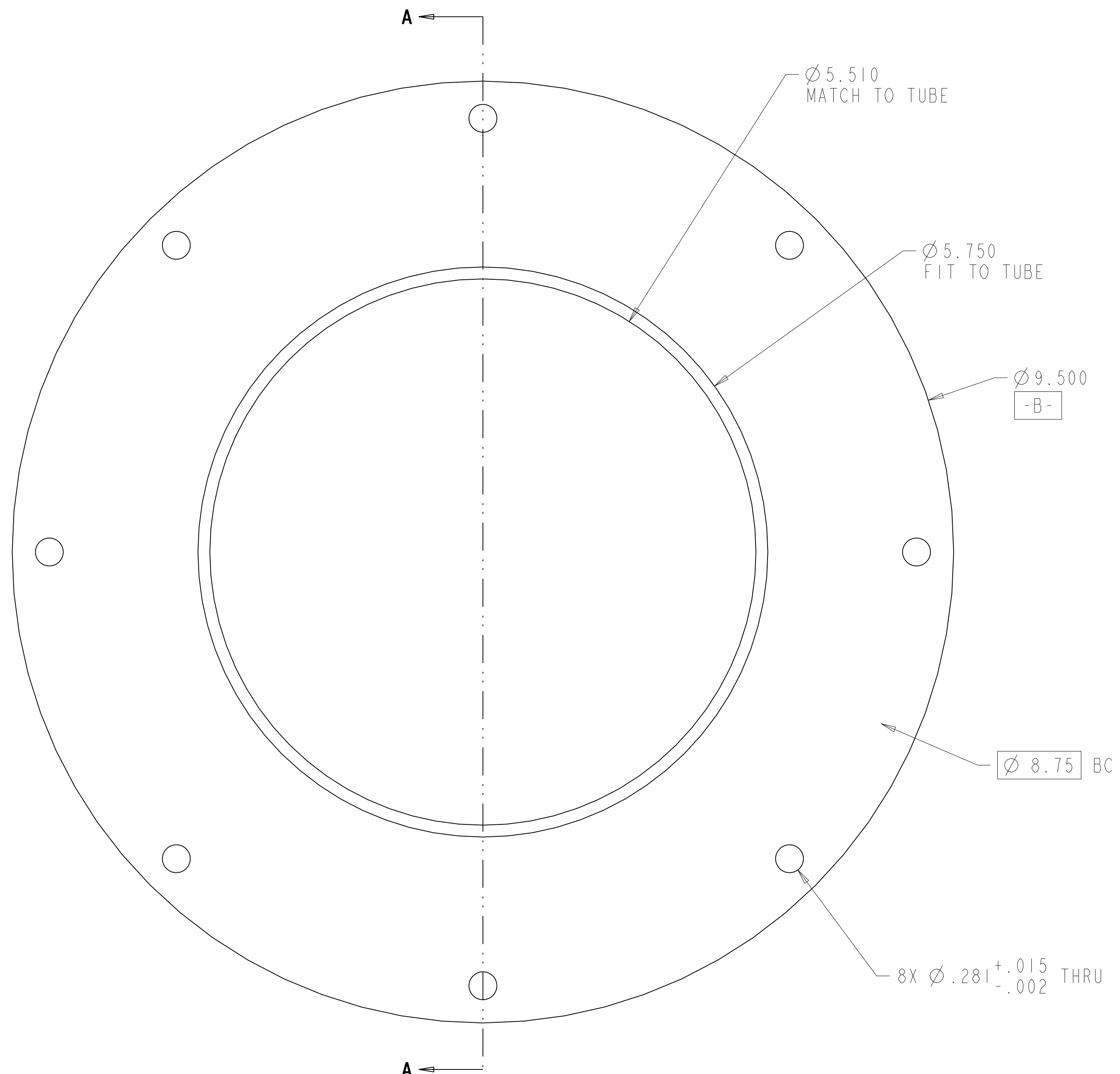
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- REMOVE ALL BURRS AND BREAK SHARP EDGES [.010 MAX] CHAMFER OR RADIUS.
- ALL MACHINED SURFACES WILL BE 62 FINISH OR BETTER. NO PITS, DENTS, SCRATCHES, ETC. PERMITTED.
- PART WILL BE FREE OF ALL FOREIGN MATERIALS, LOOSE SCALE, CHIPS, GREASE AND OIL.
- PROTECT FROM DAMAGE THRU-OUT ALL PHASES OF MACHINING, SHIPPING AND HANDLING.

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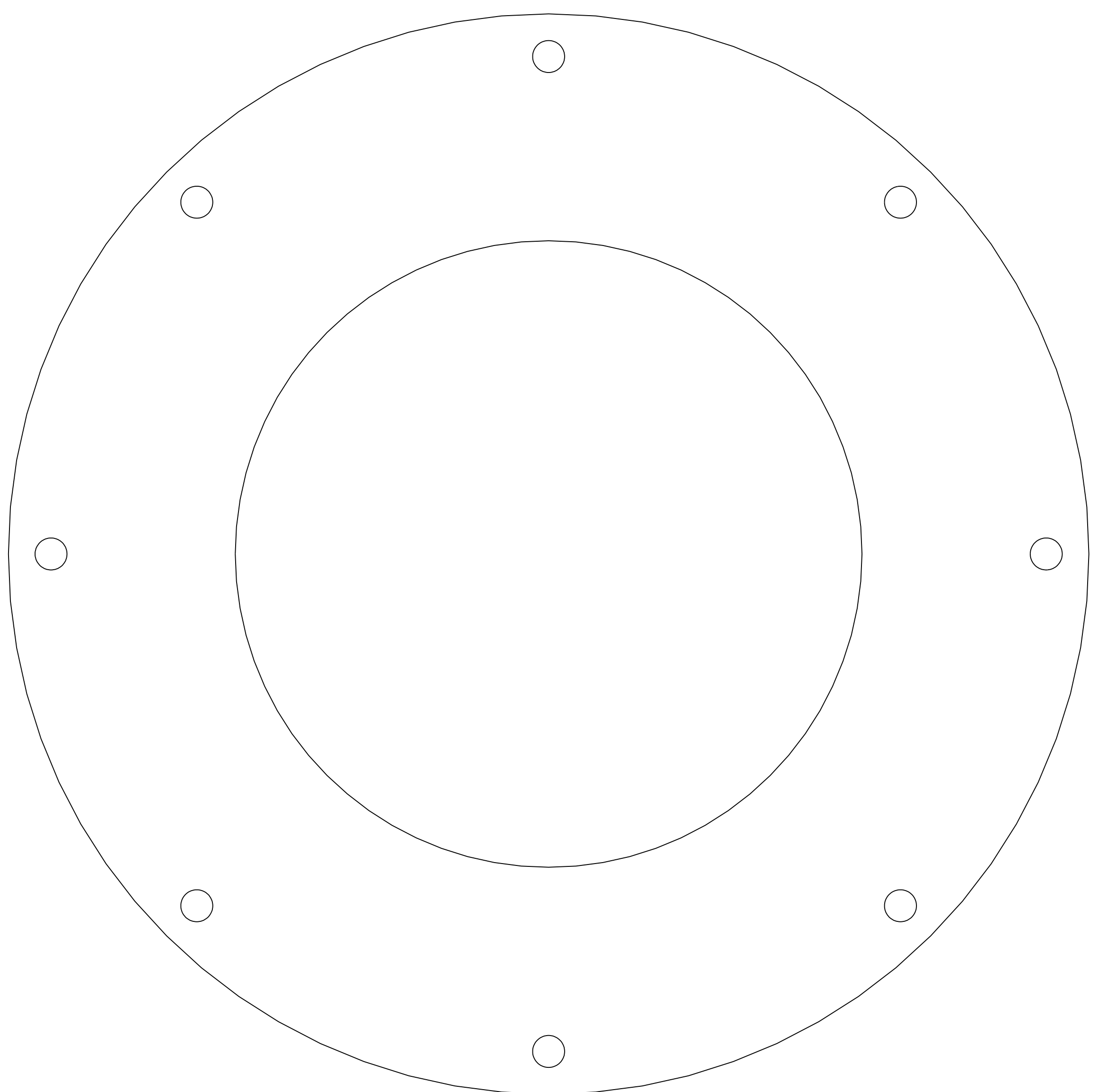
		SST		304	I
QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL		MATERIAL SPECIFICATION	ITEM NO
PARTS LIST					
THIRD ANGLE PROJECTION		WEIGHT(lbs): 0.870		LAWRENCE LIVERMORE NATIONAL LABORATORY	
APPROVALS		DATE		TITLE	
ORIGINATOR BROOKSBYI		11/22/10		BEARING NUT 2	
DRAWN BROOKSBYI		2/16/11		SIZE CAGE CODE DWG NO REV	
CHECKED KILLINGSWORTH2		2/28/11		D 14067 AAA11-501259-AB	
APPROVED PIGGOTTI		3/1/11		SCALE: NONE SHEET 1 OF 1	
		DRAWING LEVEL 2			

UNCLASSIFIED

ZONE		REV	DESCRIPTION	REVISIONS			
		AA	INITIAL RELEASE	DWN	CHK	APVD	DATE
		AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



SECTION A-A



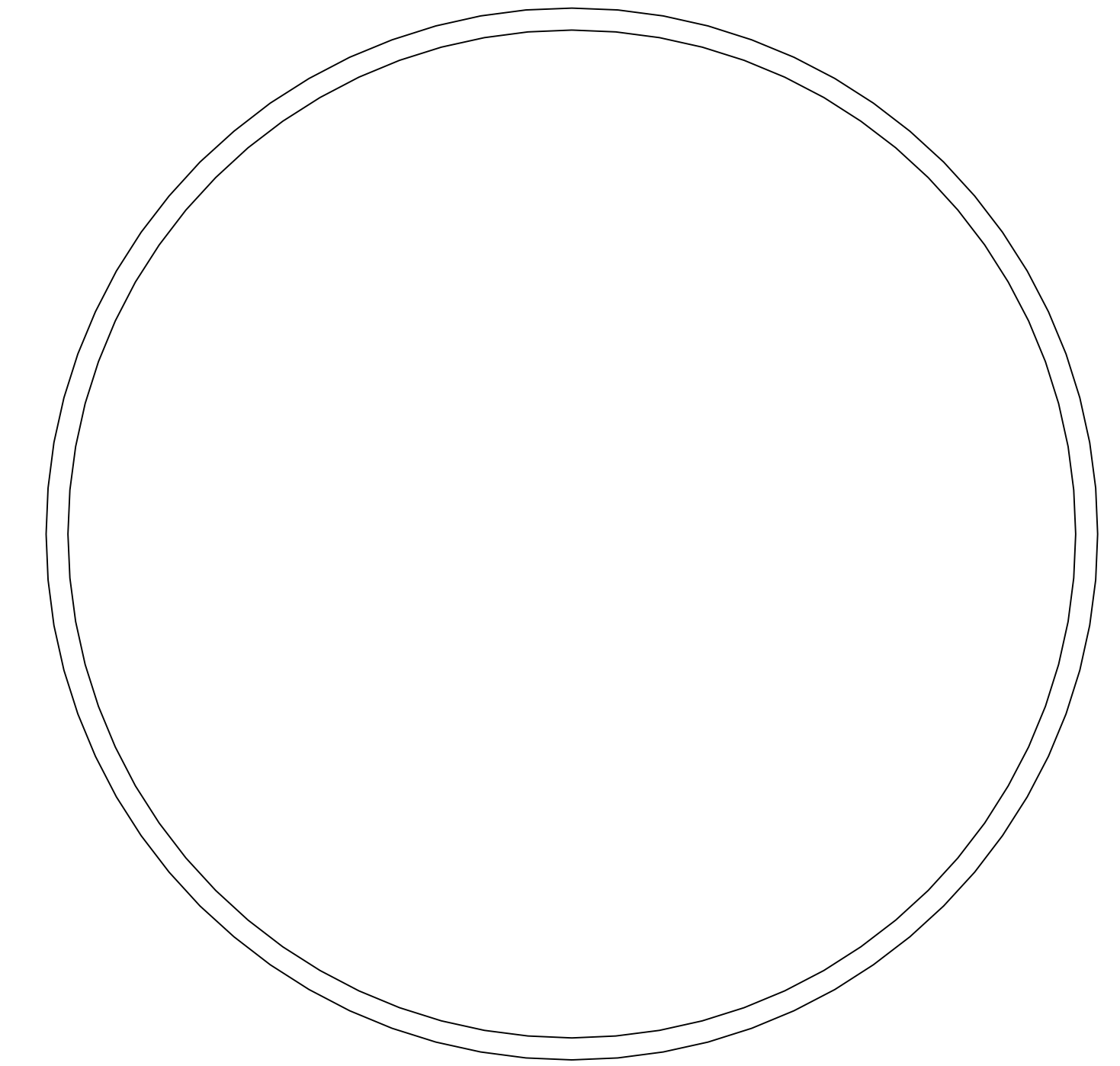
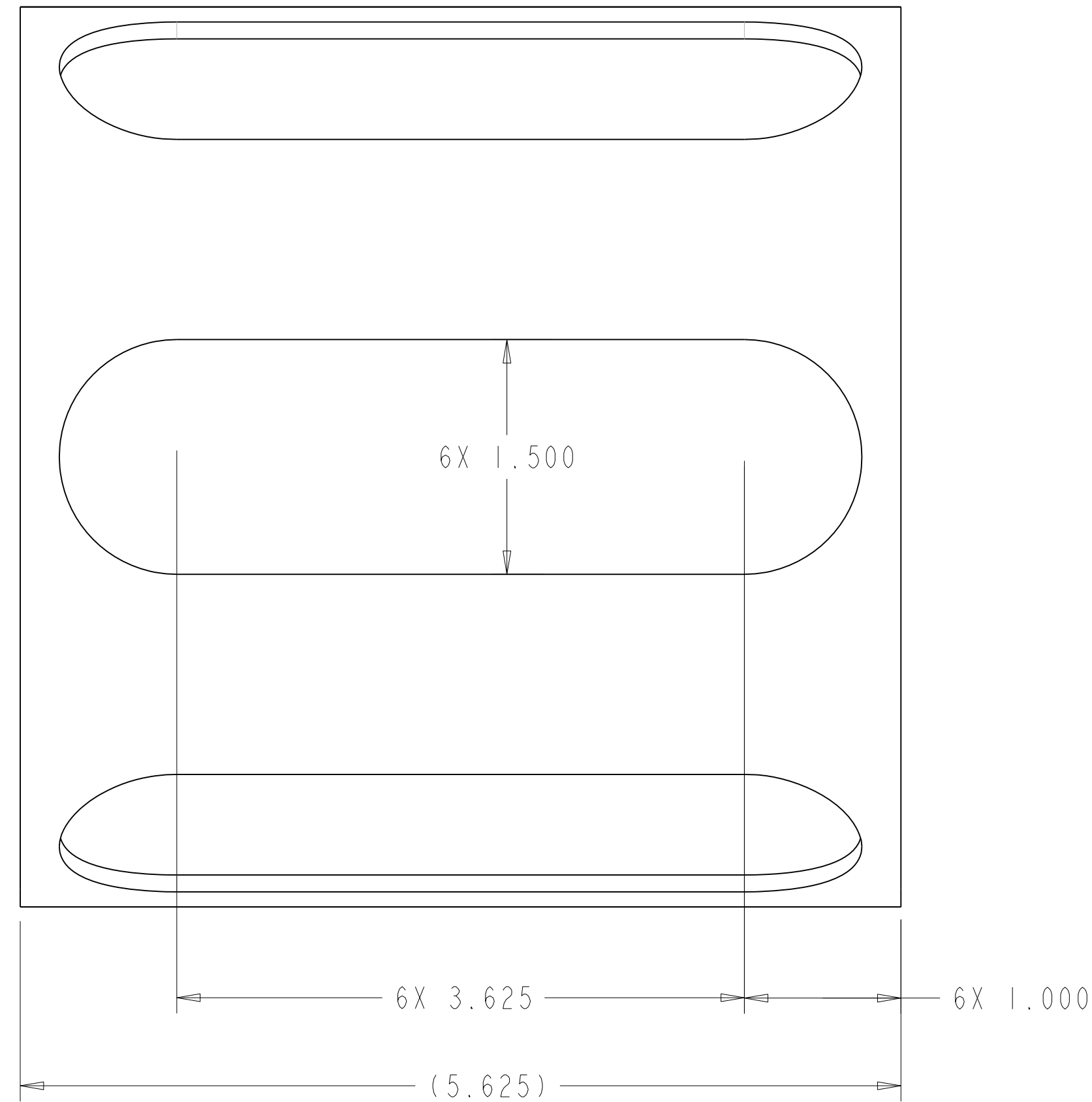
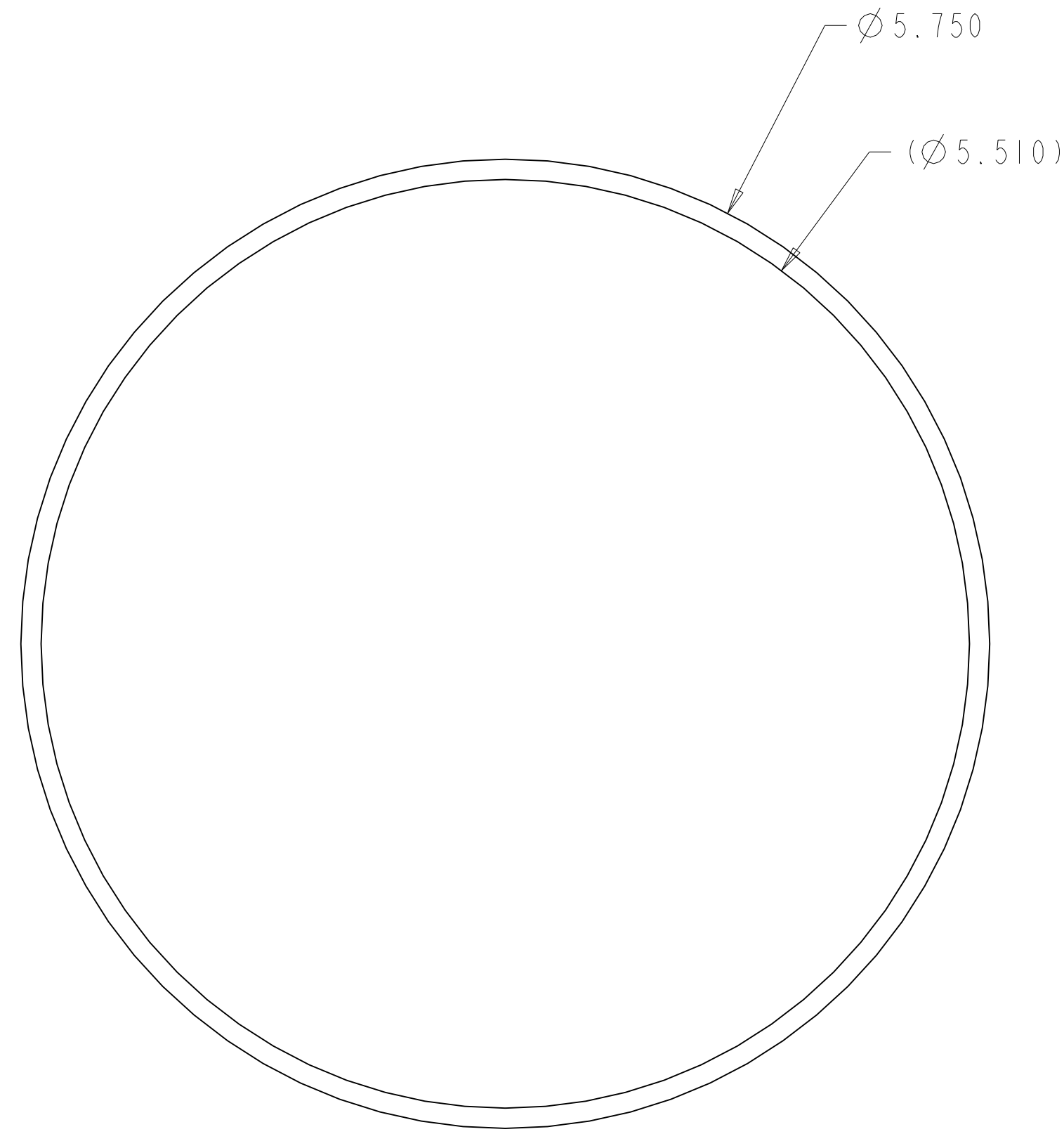
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QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	SST	304	I
PARTS LIST					
THIRD ANGLE PROJECTION		LAWRENCE LIVERMORE NATIONAL LABORATORY ©LAWRENCE LIVERMORE NATIONAL SECURITY-LLC			
WEIGHT(lbs): 4.916		TITLE			
APPROVALS		DATE			
ORIGINATOR BROOKSBYI		11/22/10			
DRAWN BROOKSBYI		2/16/11			
CHECKED KILLINGSWORTH2		2/28/11			
APPROVED PIGGOTTI		3/1/11			
DECIMALS: ± 0.005		ANGLES: ± 0.5		DRAWING LEVEL: 2	
SIZE: D		CAGE CODE: 14067		DWG NO: AAA11-501260-AA	
SCALE: NONE		REV: 1			
		SHEET 1 OF 1			

UNCLASSIFIED

REVISIONS						
ZONE	REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11
	AB	ADDED 6X CALLOUT	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	5-4-11



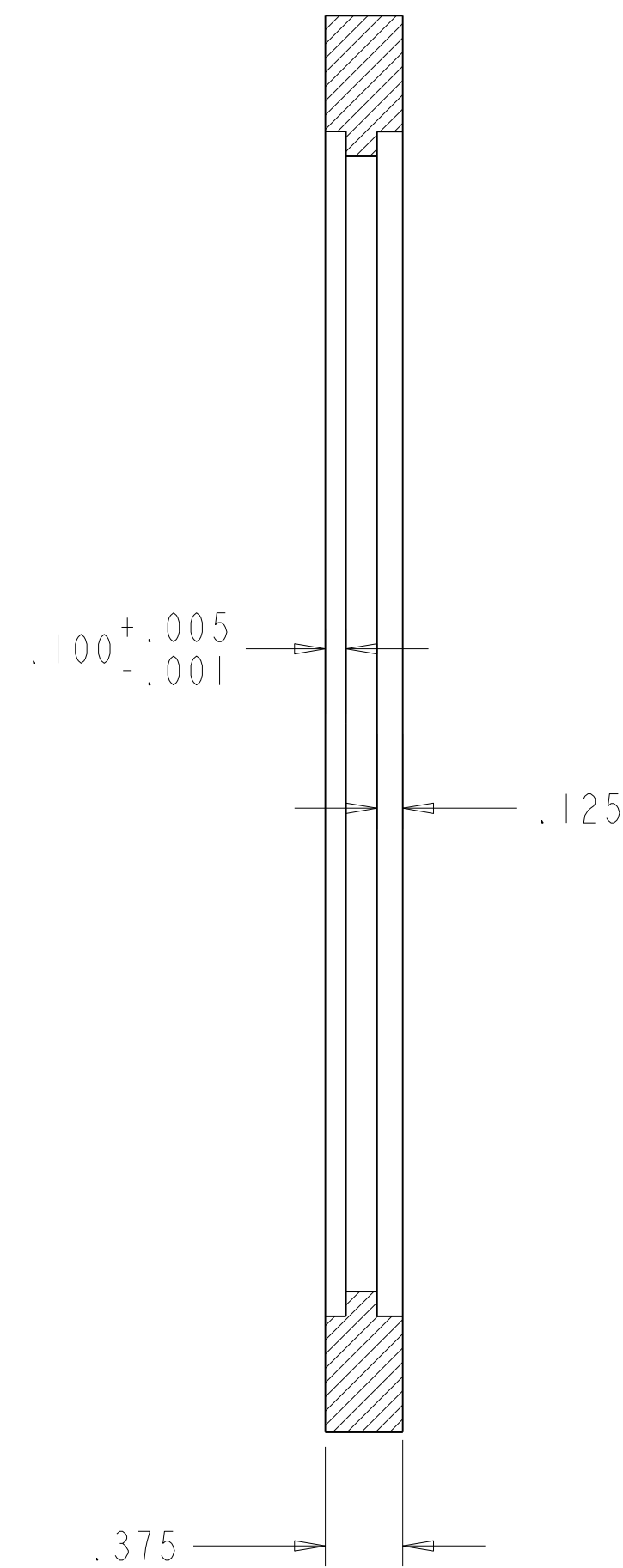
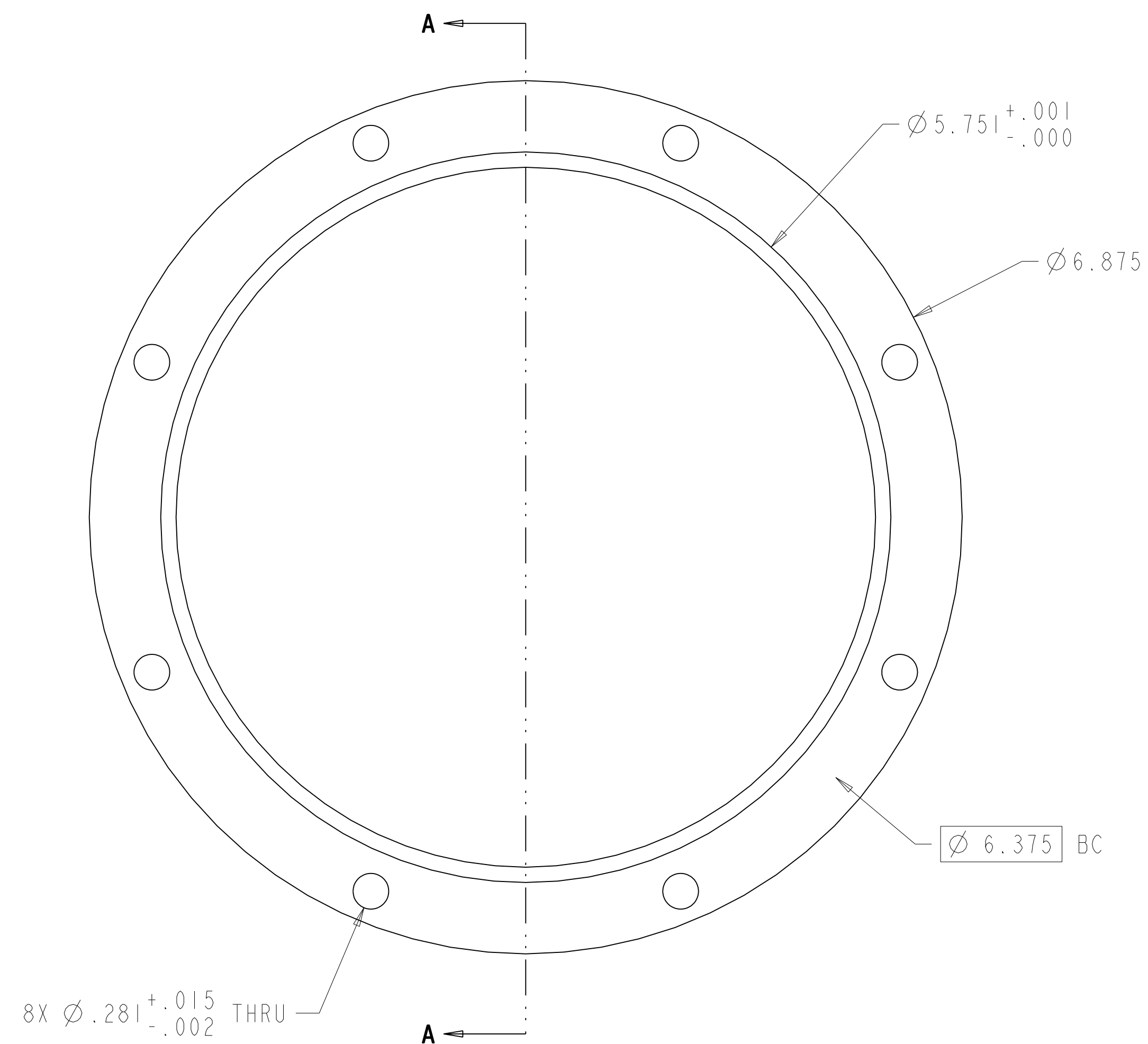
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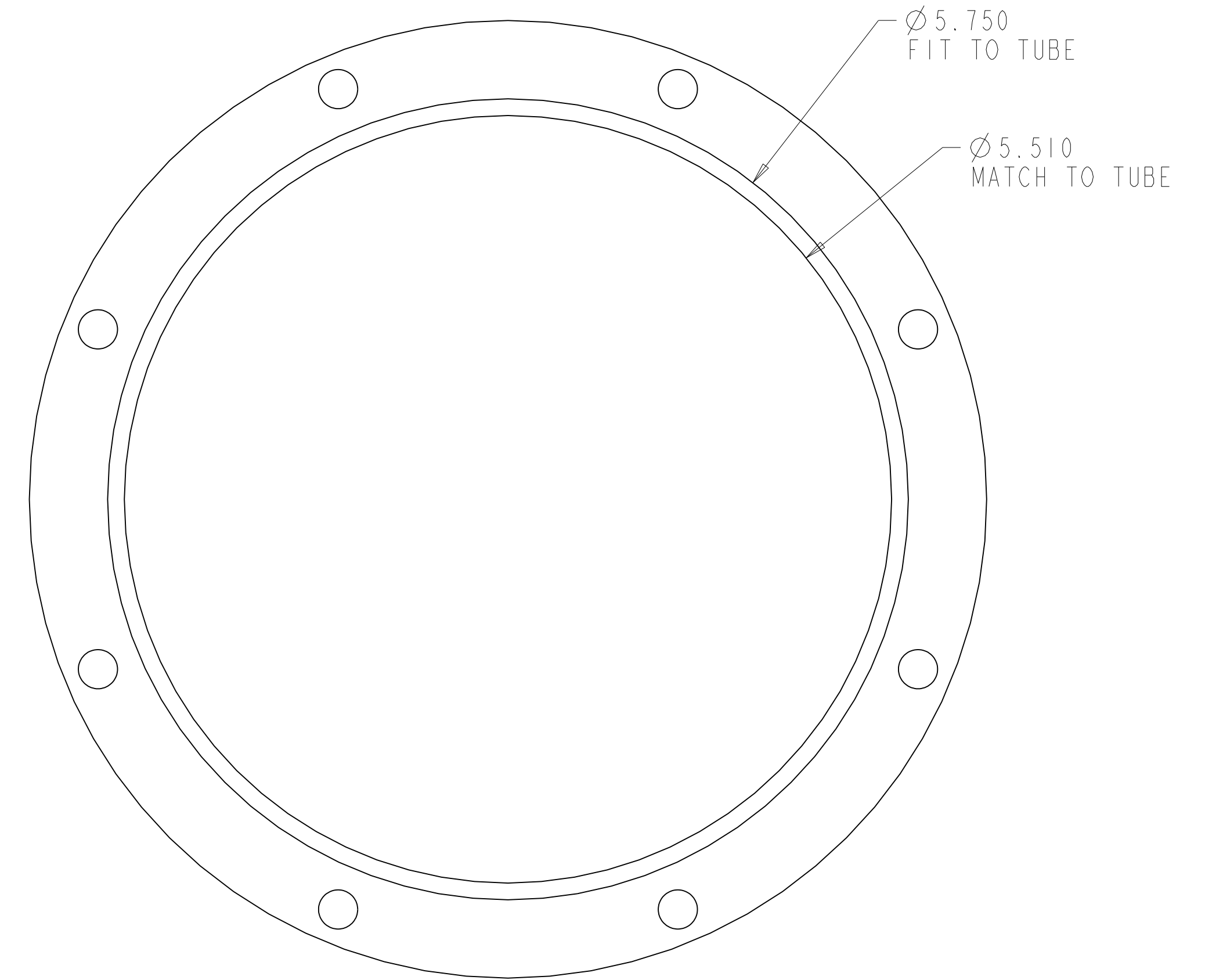
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SHEET, 11GA, 0.12THK		SST	304	1
QTY RECD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL		ITEM NO
PARTS LIST				
THIRD ANGLE PROJECTION		LAWRENCE LIVERMORE NATIONAL LABORATORY		
		LAWRENCE LIVERMORE NATIONAL SECURITY-LLC		
WEIGHT(lbs): 1.914		TITLE		
APPROVALS		DATE		
ORIGINATOR BROOKSBYI		11/22/10		
DRAWN BROOKSBYI		2/16/11		
CHECKED KILLINGSWORTH2		2/28/11		
APPROVED PIGGOTTI		3/1/11		
DECIMALS ± 0.02		ANGLES ± 0.5		DRAWING LEVEL 2
SIZE D		CAGE CODE 14067	DWG NO AAA11-501261-AB	REV 1
SCALE: NONE		SHEET 1 OF 1		

ZONE		REV	DESCRIPTION	REVISIONS			
		AA	INITIAL RELEASE	DWN	CHK	APVD	DATE
		AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



SECTION A-A



NOTES, UNLESS OTHERWISE SPECIFIED:

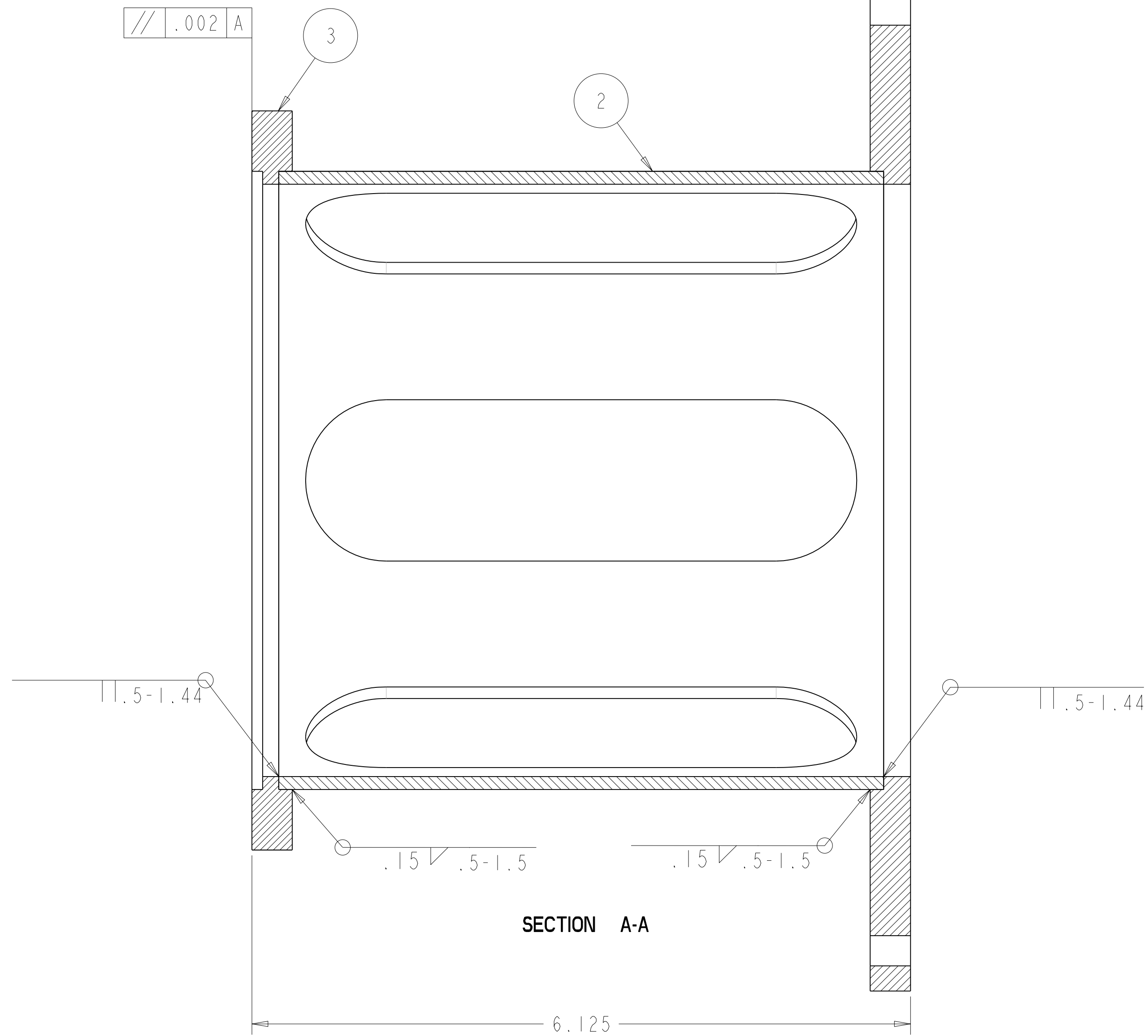
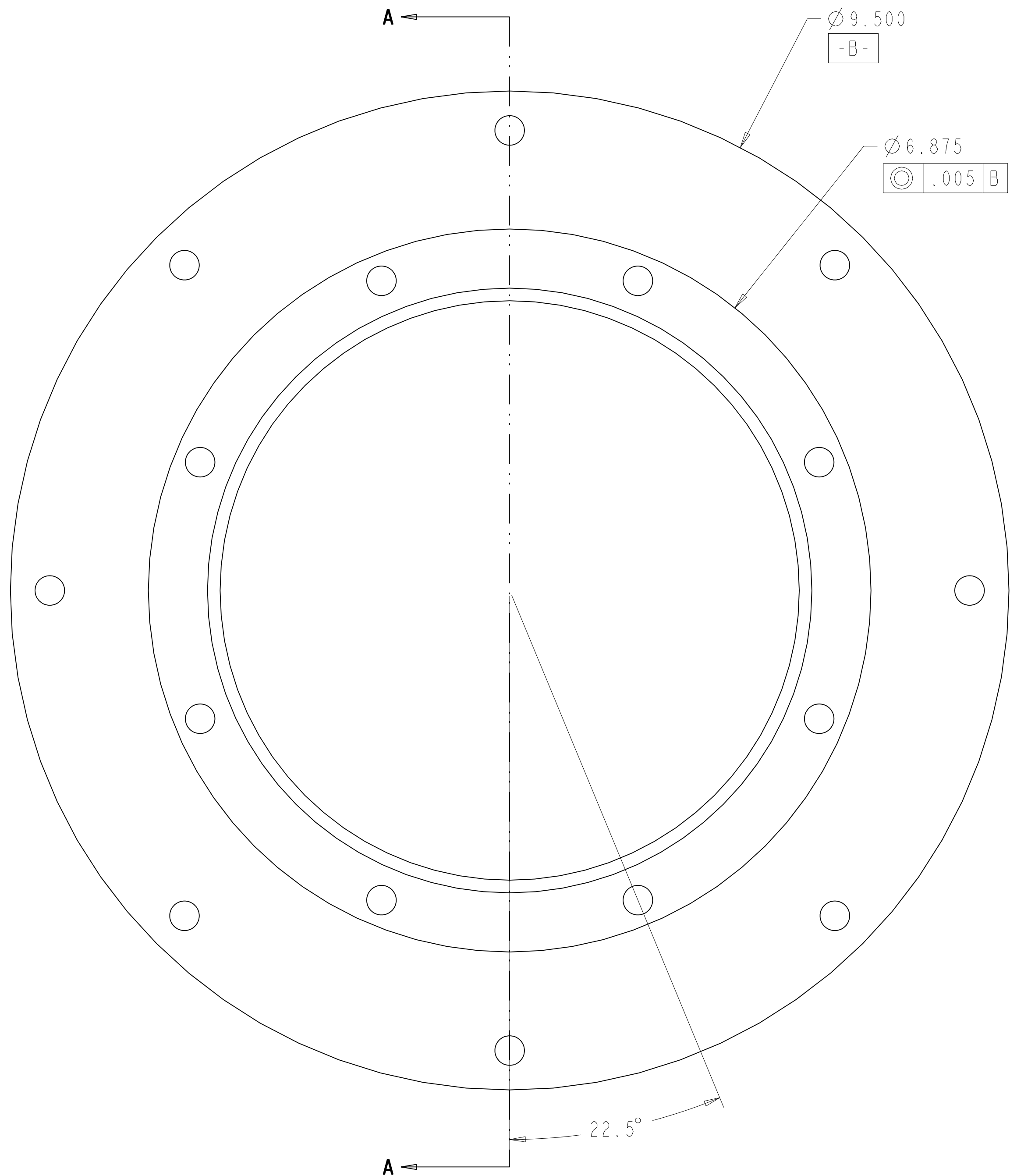
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QTY	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	SST	304	I
REQD					ITEM NO
PARTS LIST					
THIRD ANGLE PROJECTION		WEIGHT(lbs): 1.234		LAWRENCE LIVERMORE NATIONAL LABORATORY	
APPROVALS		DATE		TITLE	
ORIGINATOR BROOKSBYI		11/22/10		MOTOR SPOOL FLANGE 2	
DRAWN BROOKSBYI		2/16/11		SIZE CAGE CODE DWG NO	
CHECKED KILLINGSWORTH2		2/28/11		D 14067 AAA11-501262-AA	
APPROVED PIGGOTTI		3/1/11		REV	
DRAWING LEVEL 2				SCALE: NONE SHEET 1 OF 1	

UNCLASSIFIED

ZONE		REV	DESCRIPTION	REVISIONS			
AA	AA	INITIAL RELEASE		DWN	CHK	APVD	DATE
				BROOKSBYI	KILLINGSWORTH2	PIGGOTT1	3-1-11



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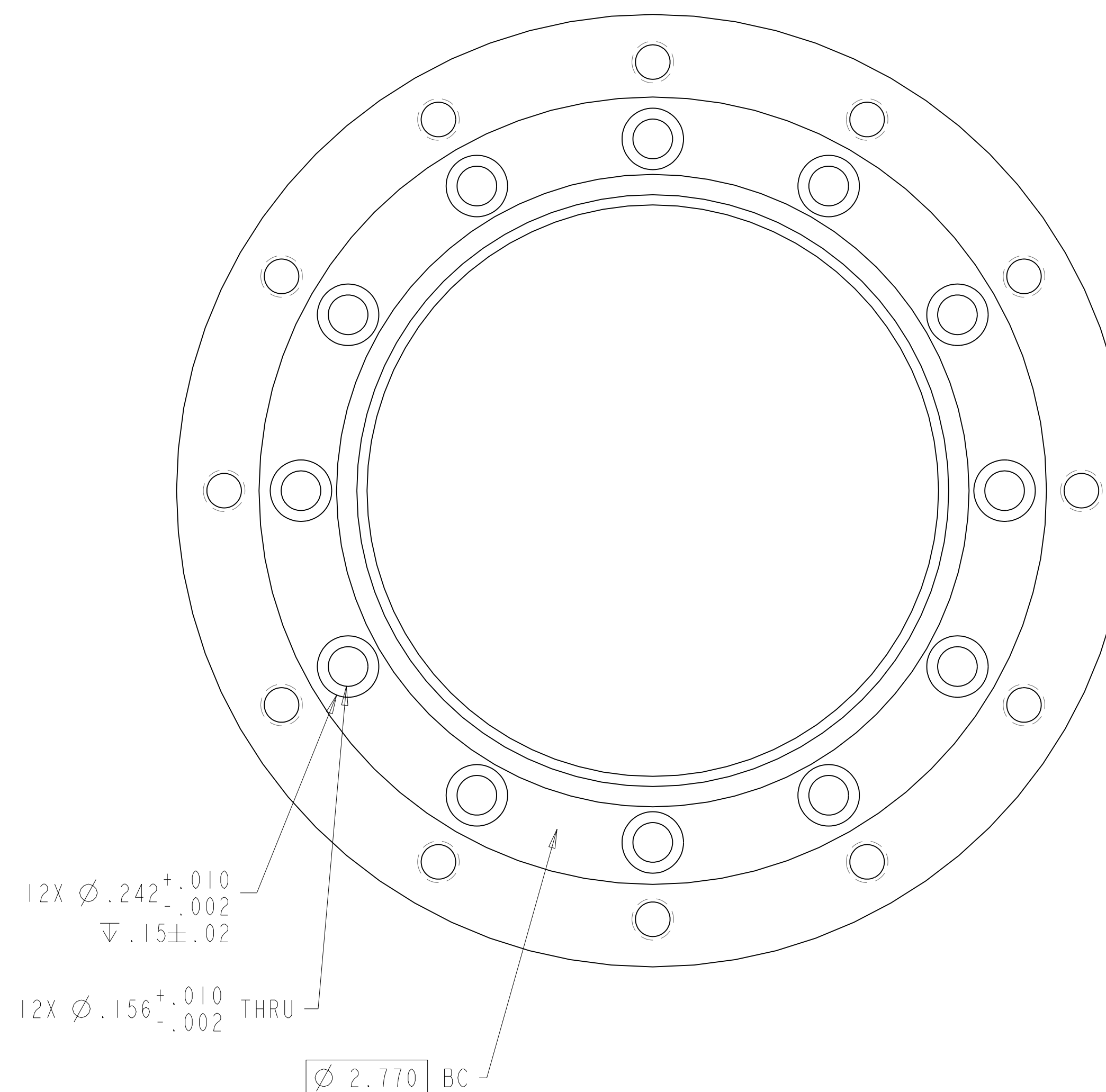
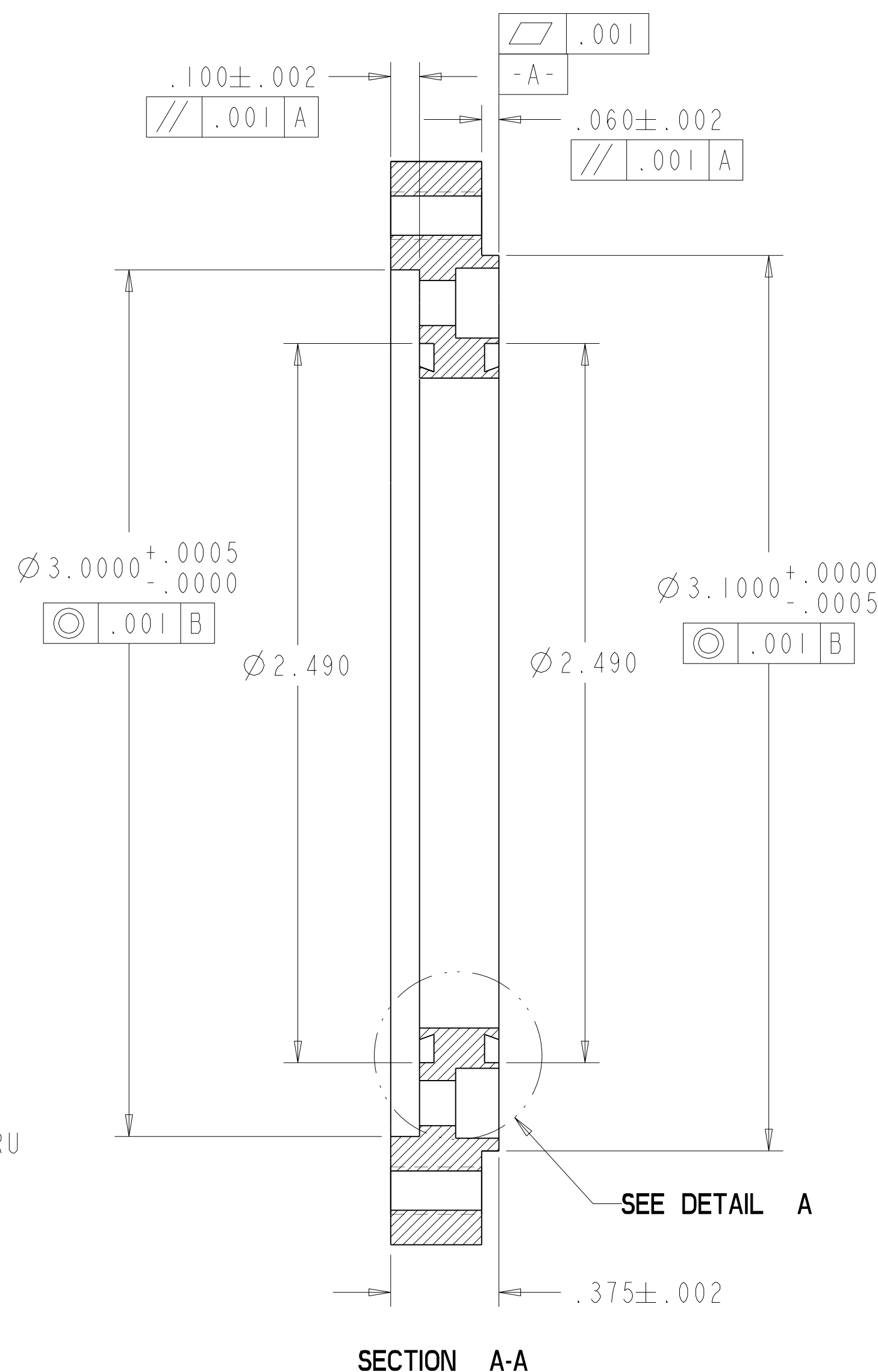
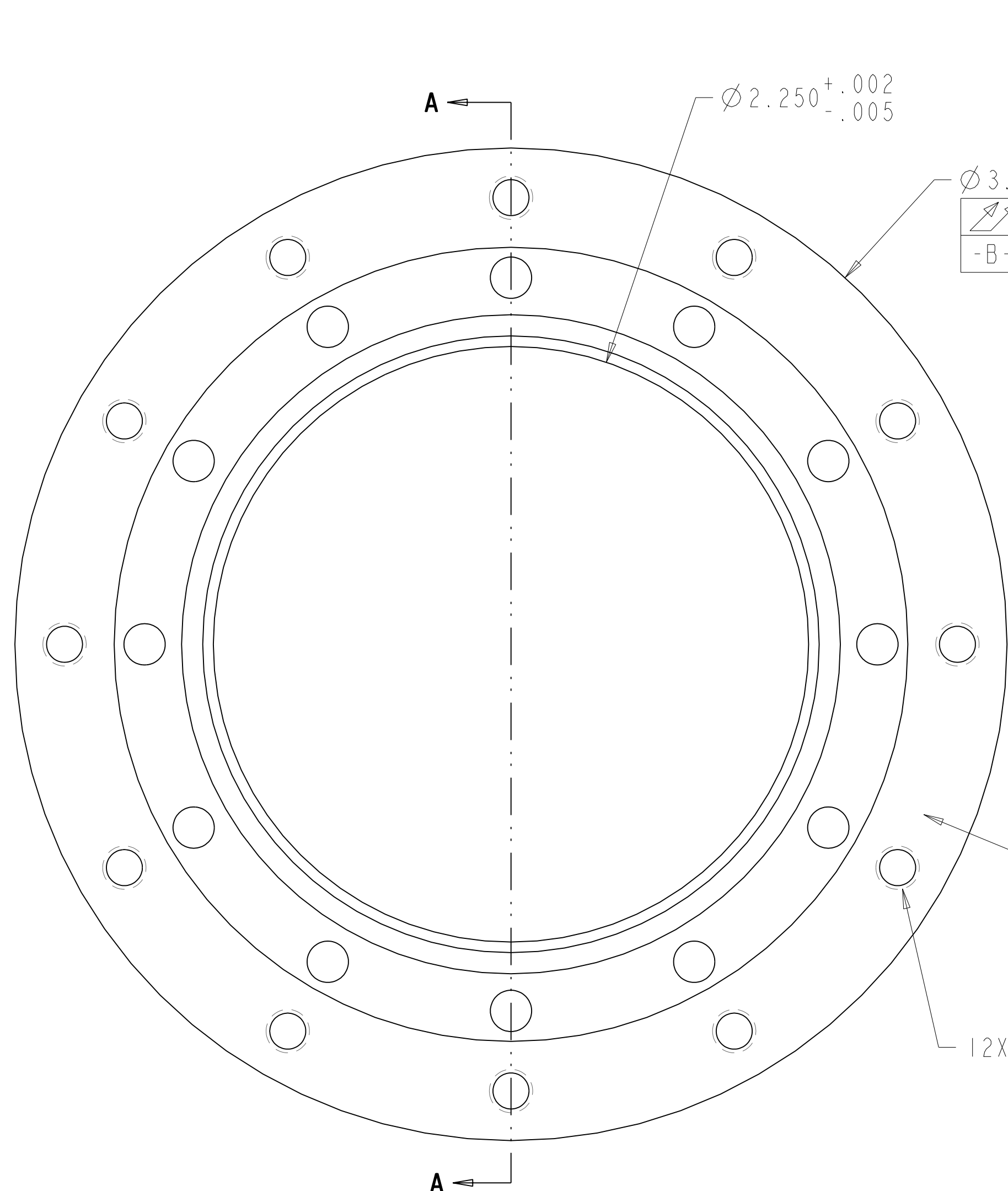
QTY RECD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO
	AAA11-501262	MOTOR SPOOL FLANGE 2	SST 304	3
	AAA11-501261	MOTOR SPOOL TUBE	SST 304	2
	AAA11-501260	MOTOR SPOOL FLANGE 1	SST 304	1

THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY	
		WEIGHT(lbs):	8.064	LAWRENCE LIVERMORE NATIONAL SECURITY-LLC	
		APPROVALS	DATE	TITLE	
		ORIGINATOR BROOKSBYI	11/22/10	MOTOR SPOOL WELDMENT	
		DRAWN BROOKSBYI	2/16/11	SIZE	CAGE CODE
		CHECKED KILLINGSWORTH2	2/28/11	D	14067
		APPROVED PIGGOTT1	3/1/11	DWG NO	AAA11-501263-AA
			DRAWING LEVEL 2	SCALE:	NONE
				SHEET 1 OF 1	

UNCLASSIFIED

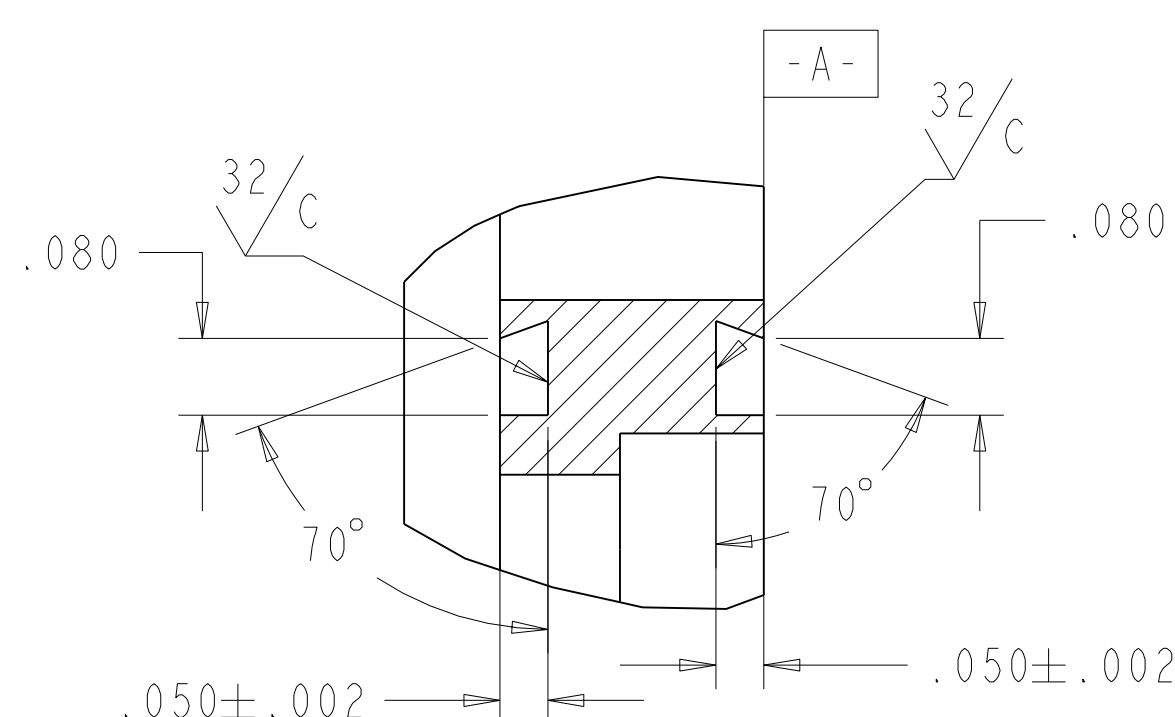
UNCLASSIFIED

ZONE		REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA		INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



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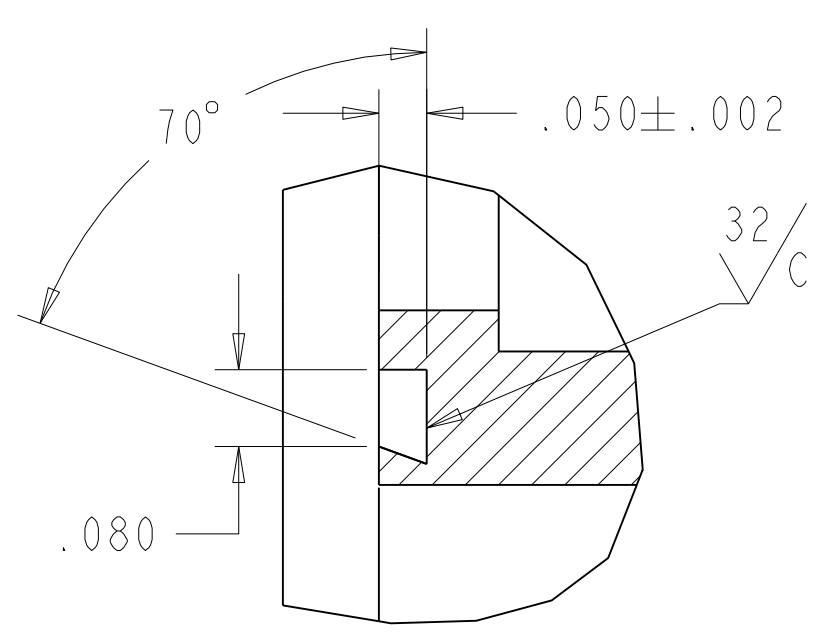
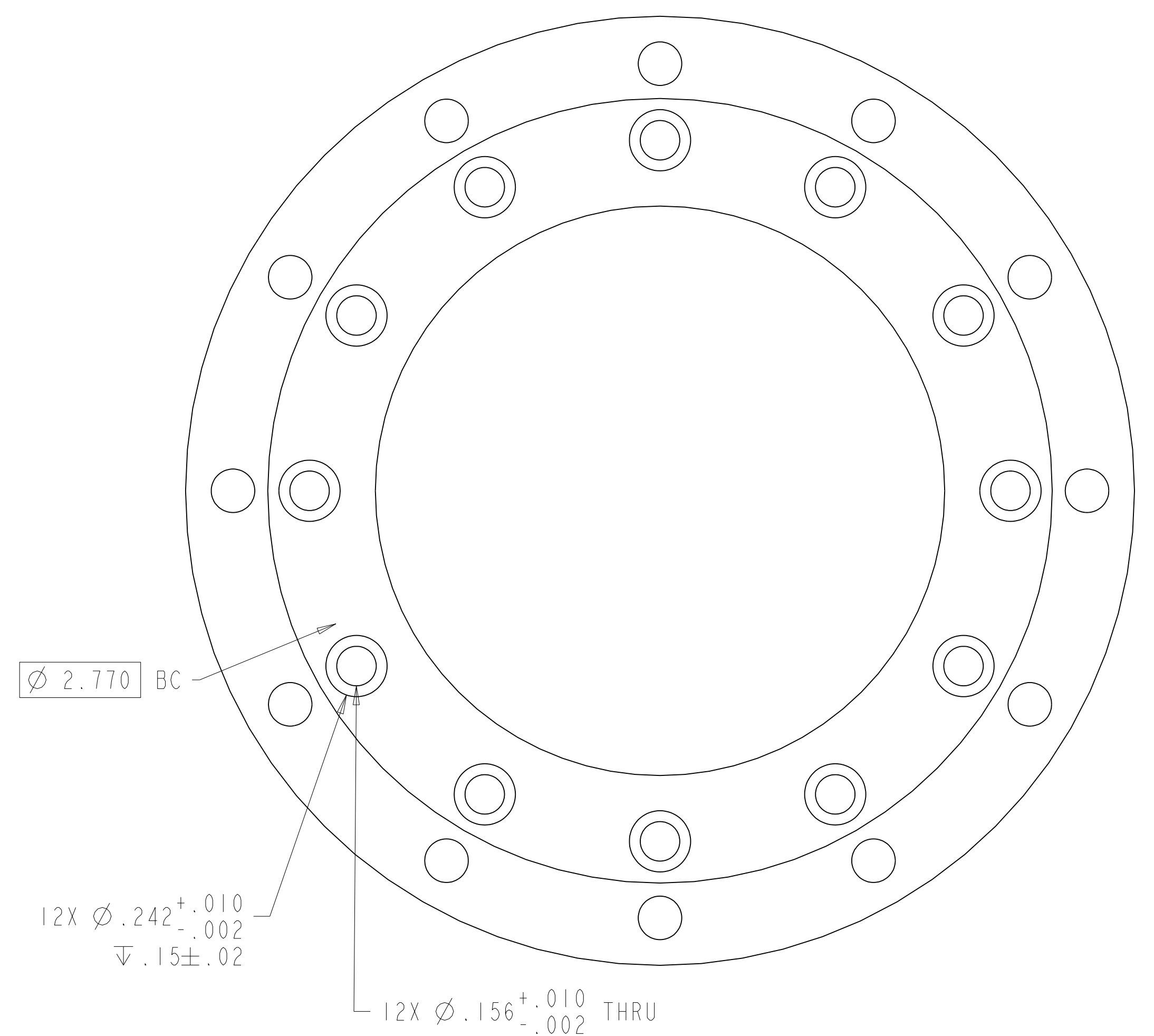
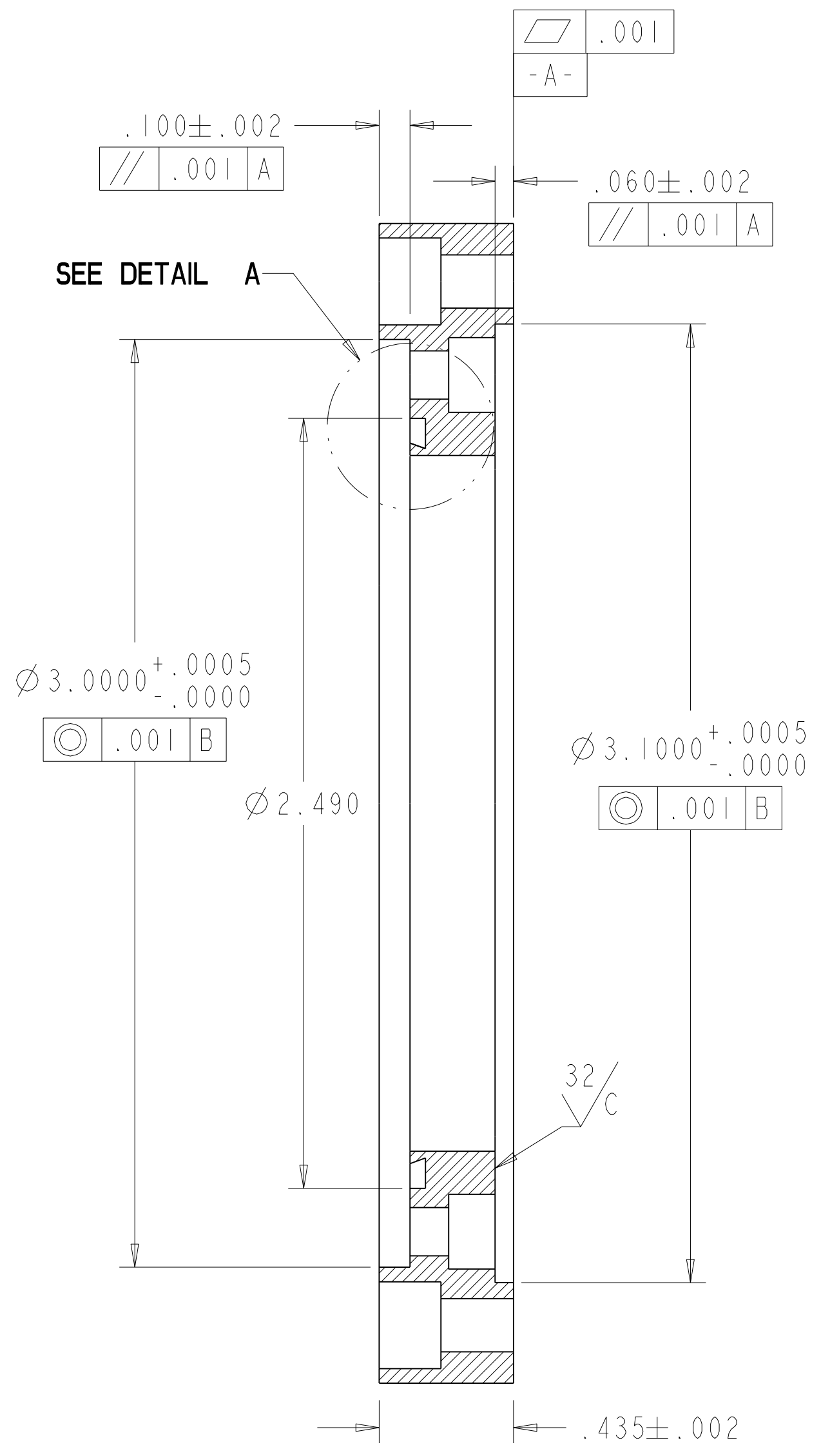
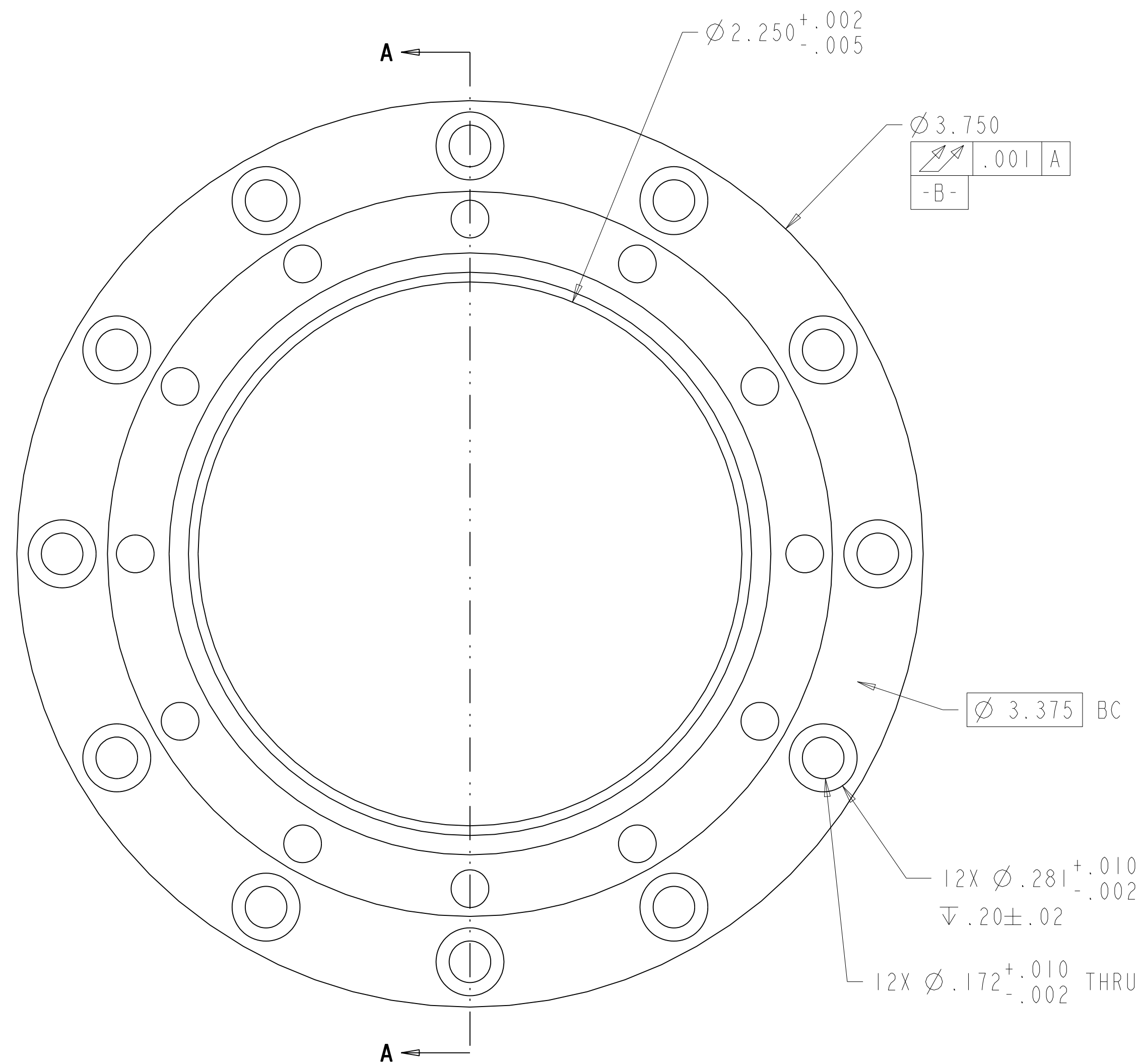
DETAIL A
SCALE 5.000

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			SST	304	I
QTY RECD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL		MATERIAL SPECIFICATION	ITEM NO
		PARTS LIST			
THIRD ANGLE PROJECTION		WEIGHT(lbs): 0.543		LAWRENCE LIVERMORE NATIONAL LABORATORY	
APPROVALS		DATE		TITLE	
ORIGINATOR BROOKSBYI		11/22/10		SHAFT FLANGE 3	
DRAWN BROOKSBYI		2/16/11		SIZE CAGE CODE DWG NO REV	
CHECKED KILLINGSWORTH2		2/28/11		D 14067 AAA11-501264-AA	
APPROVED PIGGOTTI		3/1/11		SCALE: NONE SHEET 1 OF 1	
		DRAWING LEVEL 2			

UNCLASSIFIED

ZONE		REV	DESCRIPTION	DWN	CHK	APVD	DATE
AA	INITIAL RELEASE			BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



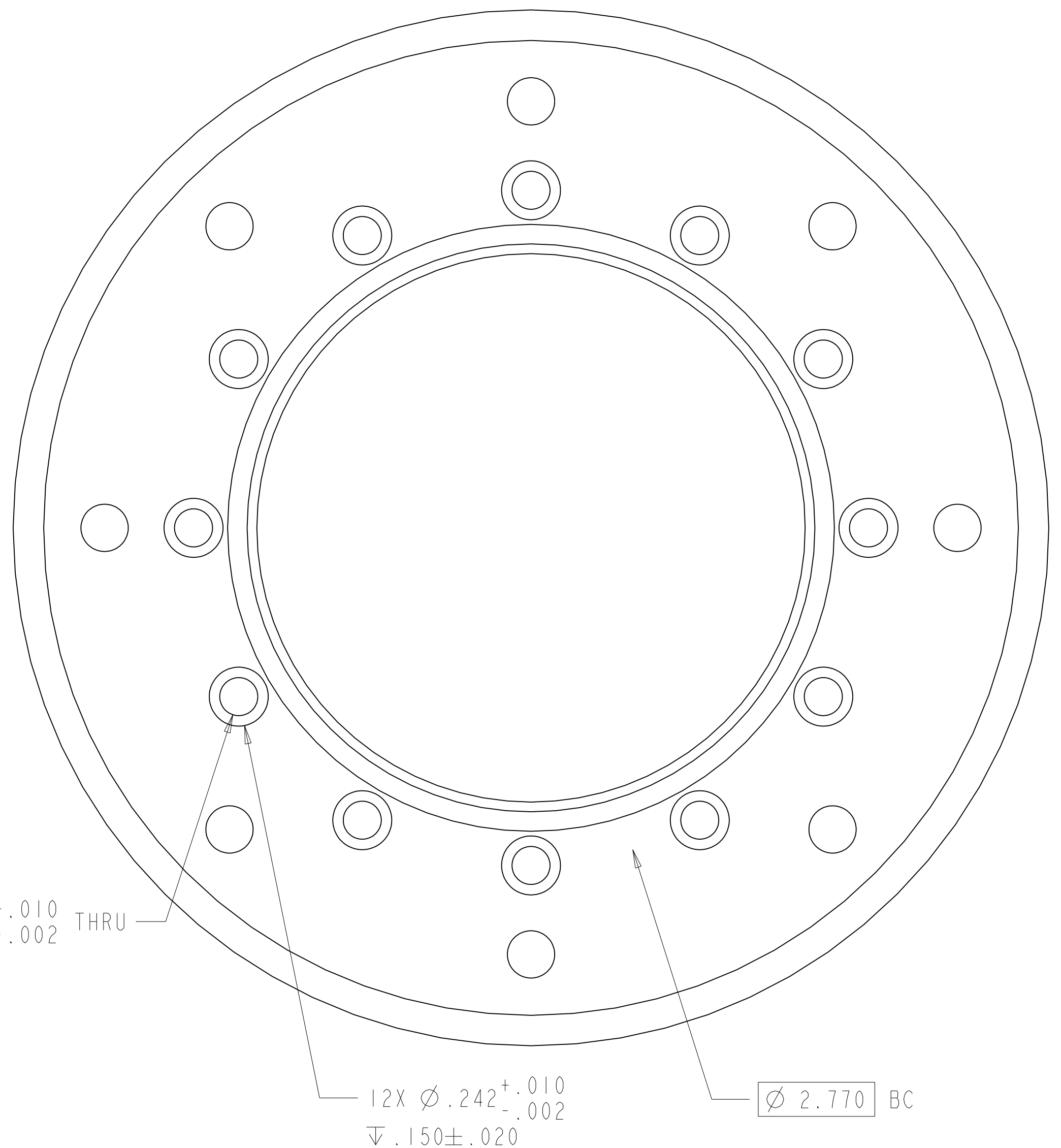
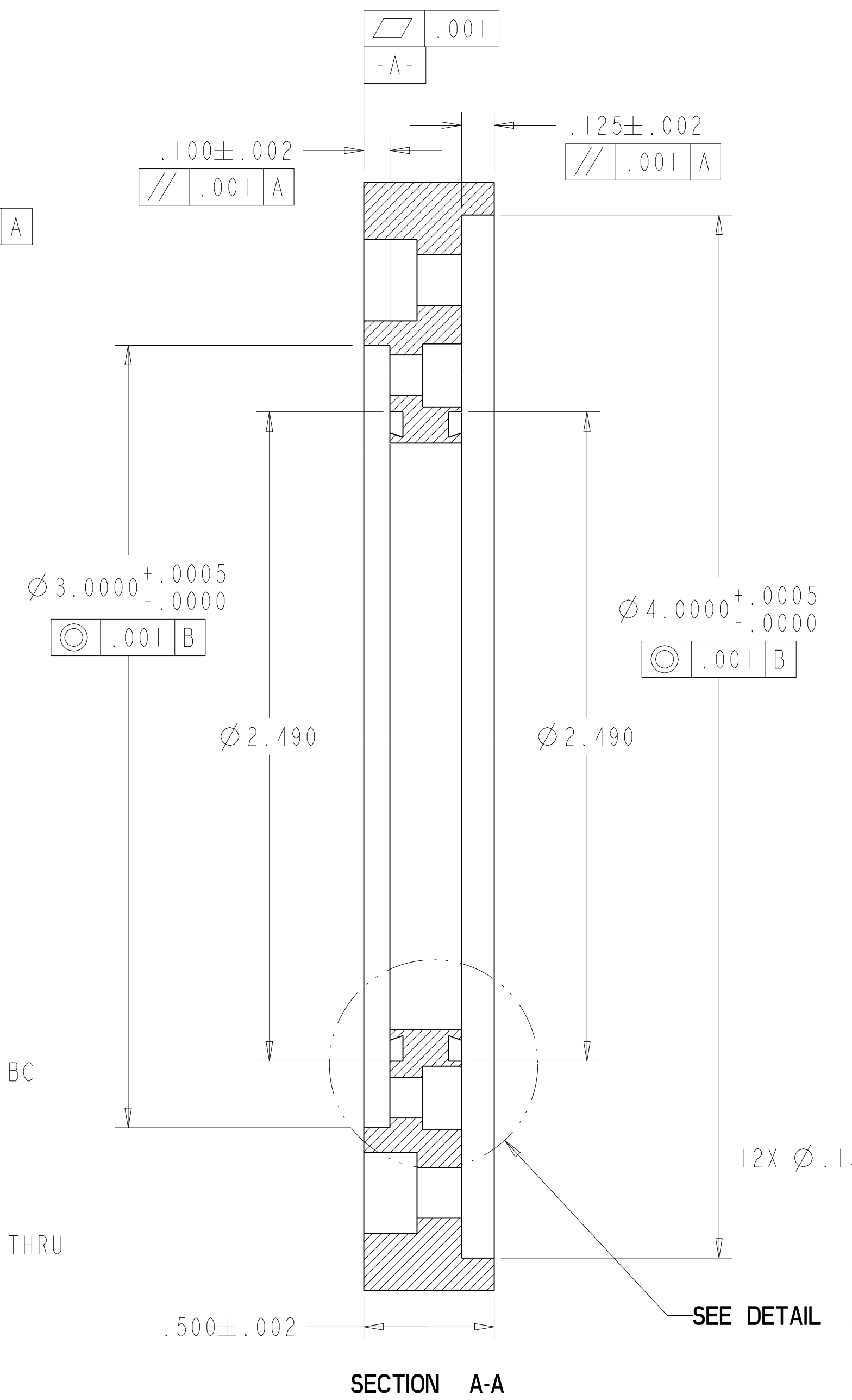
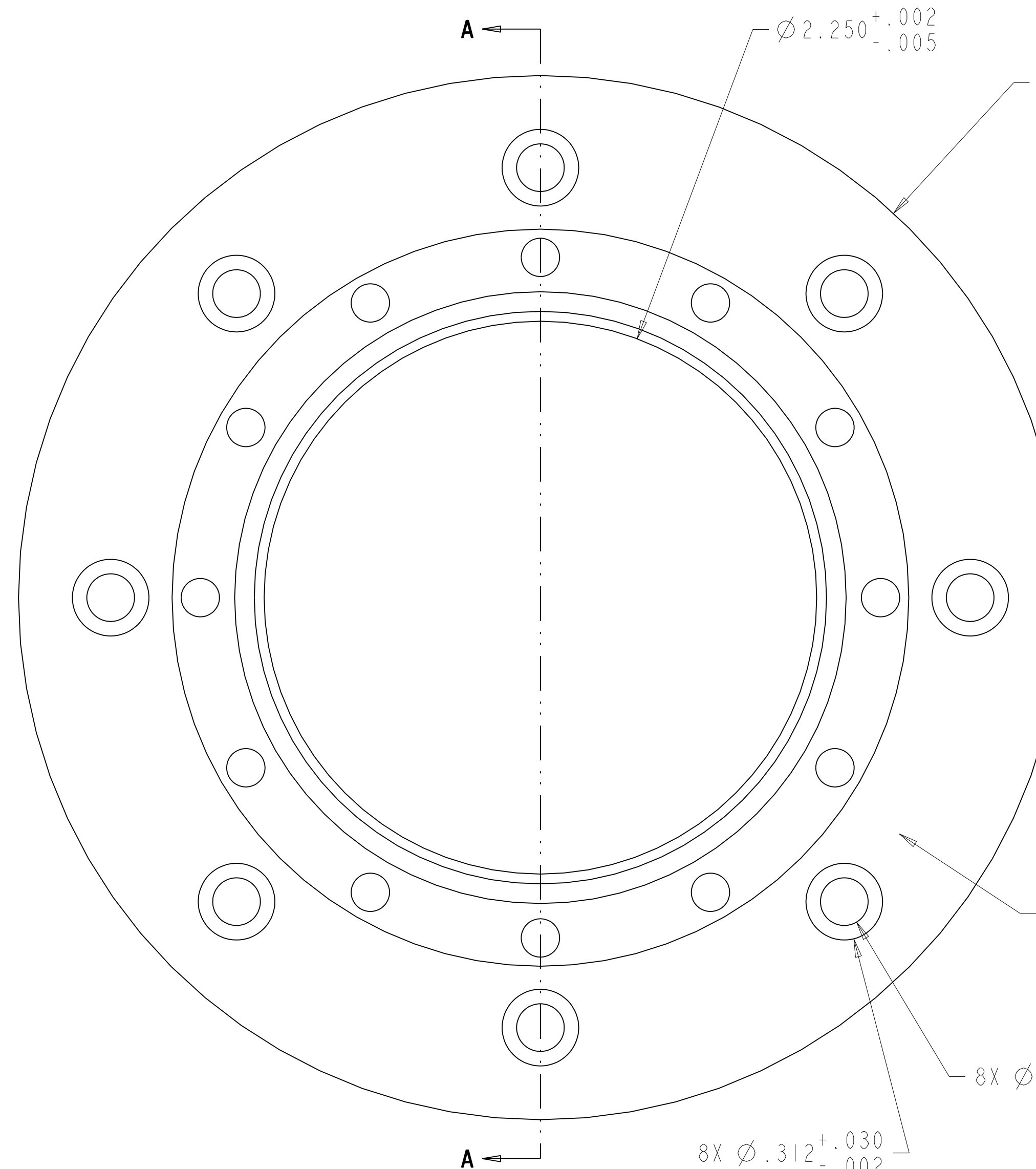
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SCALE 5.000

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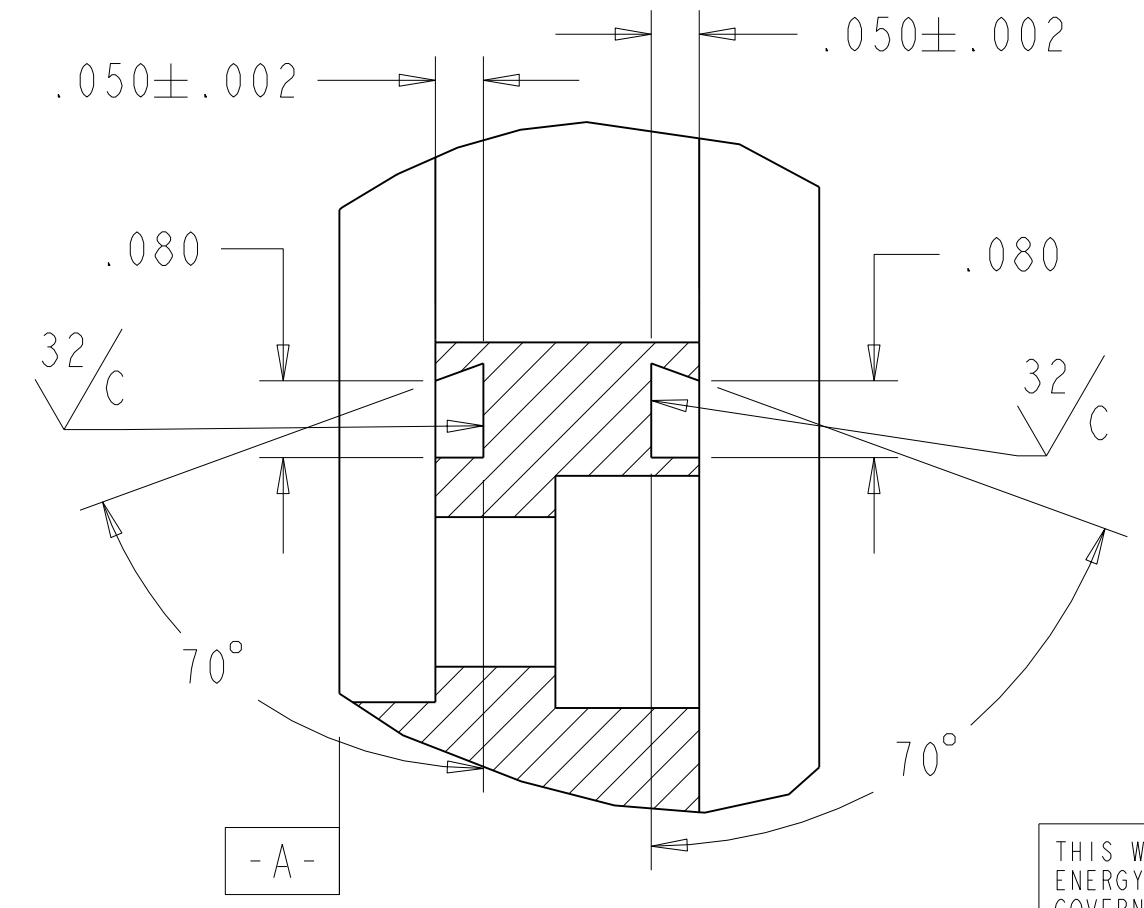
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		SST		304	I
QTY RECD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL		MATERIAL SPECIFICATION	ITEM NO
PARTS LIST					
THIRD ANGLE PROJECTION		WEIGHT(lbs): 0.627		LAWRENCE LIVERMORE NATIONAL LABORATORY	
APPROVALS		DATE		TITLE	
ORIGINATOR: BROOKSBYI		11/22/10		SHAFT FLANGE 4	
DRAWN: BROOKSBYI		2/16/11		SIZE CAGE CODE DWG NO REV	
CHECKED: KILLINGSWORTH2		2/28/11		D 14067 AAA11-501265-AA	
APPROVED: PIGGOTTI		3/1/11		SCALE: NONE SHEET 1 OF 1	
		DRAWING LEVEL 2			

REVISIONS						
ZONE	REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



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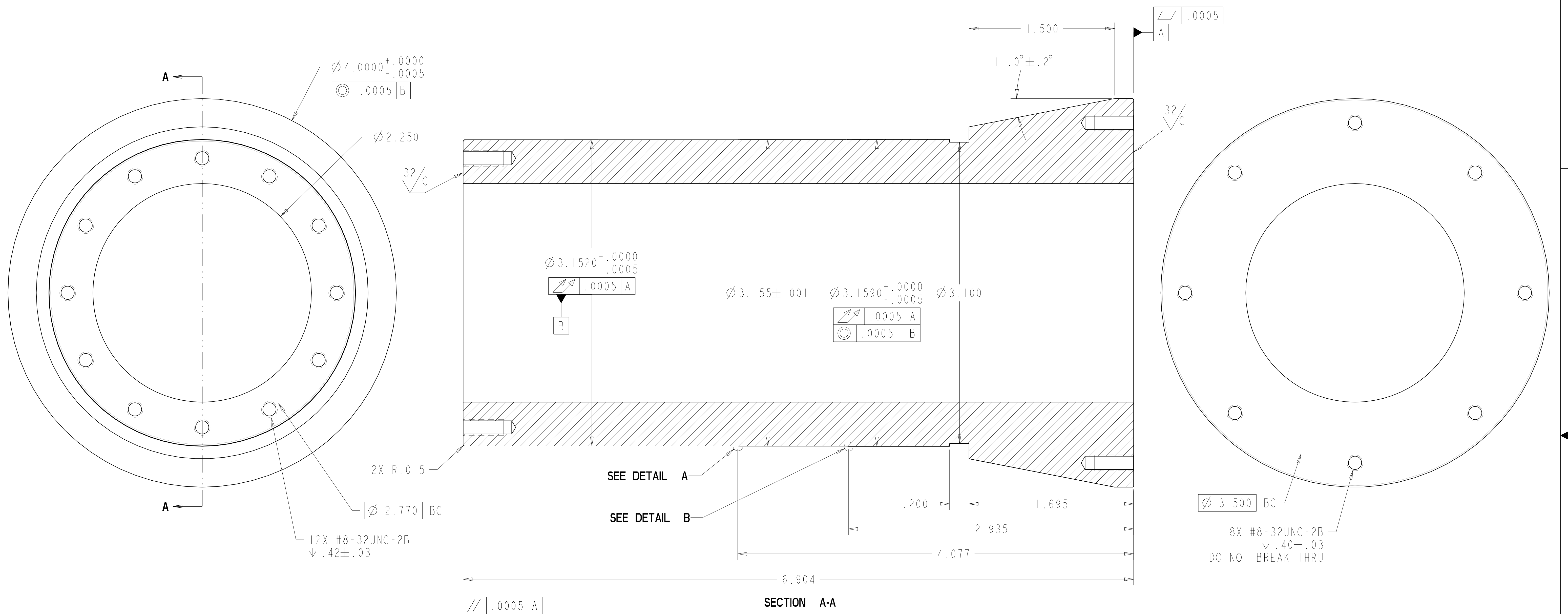


DETAIL A
SCALE 5.000

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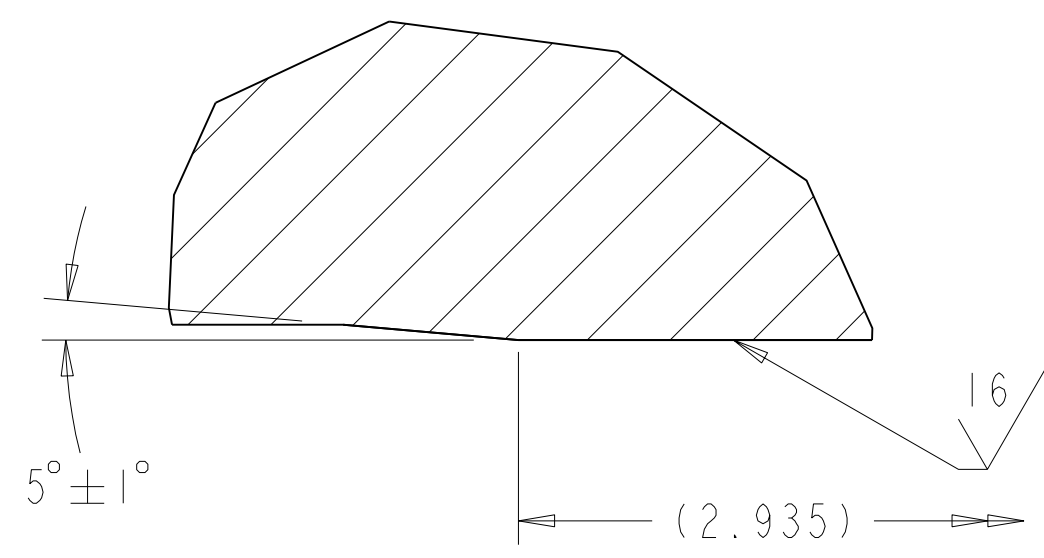
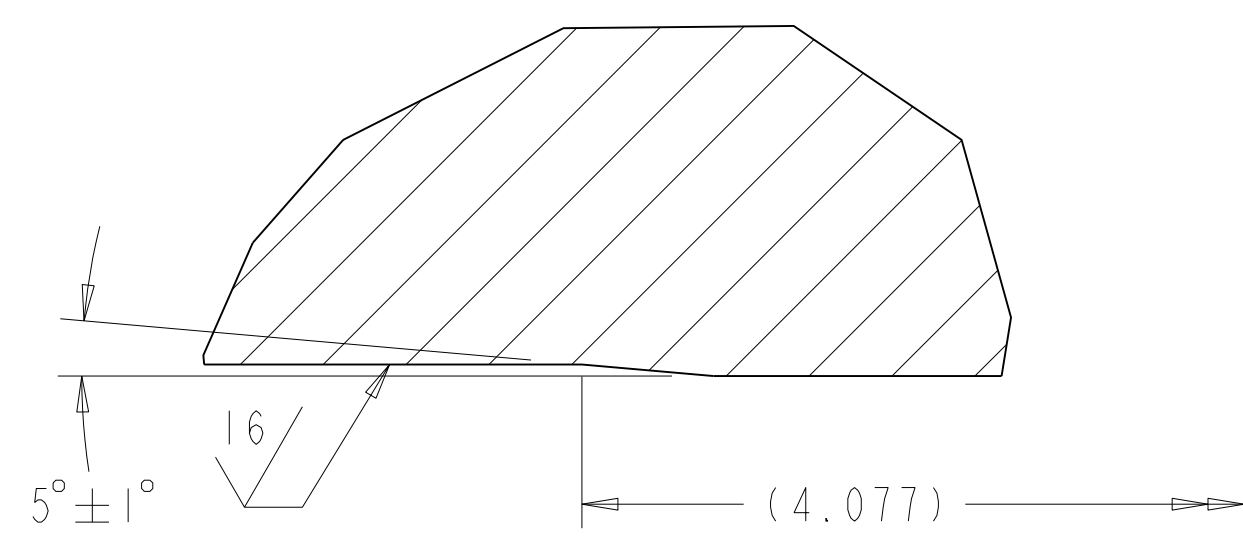
QTY REOD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	SST	304	I
PARTS LIST					
THIRD ANGLE PROJECTION			LAWRENCE LIVERMORE NATIONAL LABORATORY		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:			LAWRENCE LIVERMORE NATIONAL SECURITY-LLC		
DECIMALS ± 0.005			ANGLES ± 0.5		
WEIGHT (lbs): 0.966			DATE: 11/22/10		
APPROVALS			DATE: 2/16/11		
CHECKED: KILLINGSWORTH2			DATE: 3/1/11		
APPROVED: PIGGOTTI			DRAWING LEVEL: 2		
TITLE: SHAFT FLANGE 5			REV: AA		
SIZE: D			CAGE CODE: AAA11-501266		
SCALE: NONE			SHEET 1 OF 1		

ZONE		REV	DESCRIPTION	REVISIONS			
AA	INITIAL RELEASE			DWN	CHK	APVD	DATE
				BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



NOTES, UNLESS OTHERWISE SPECIFIED:

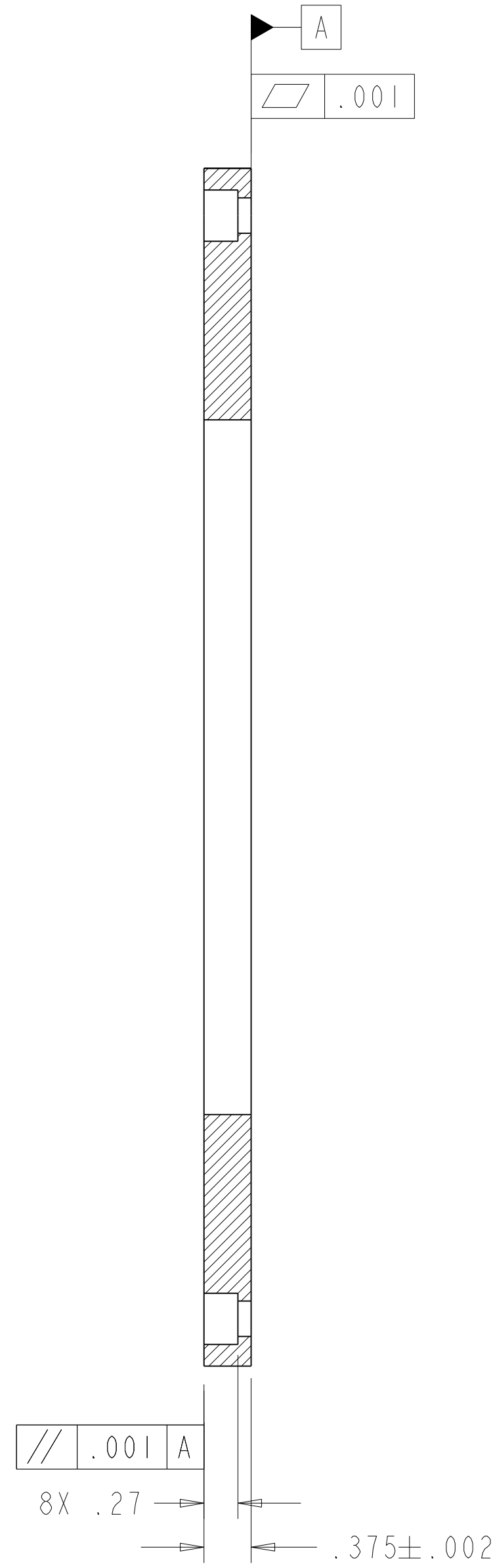
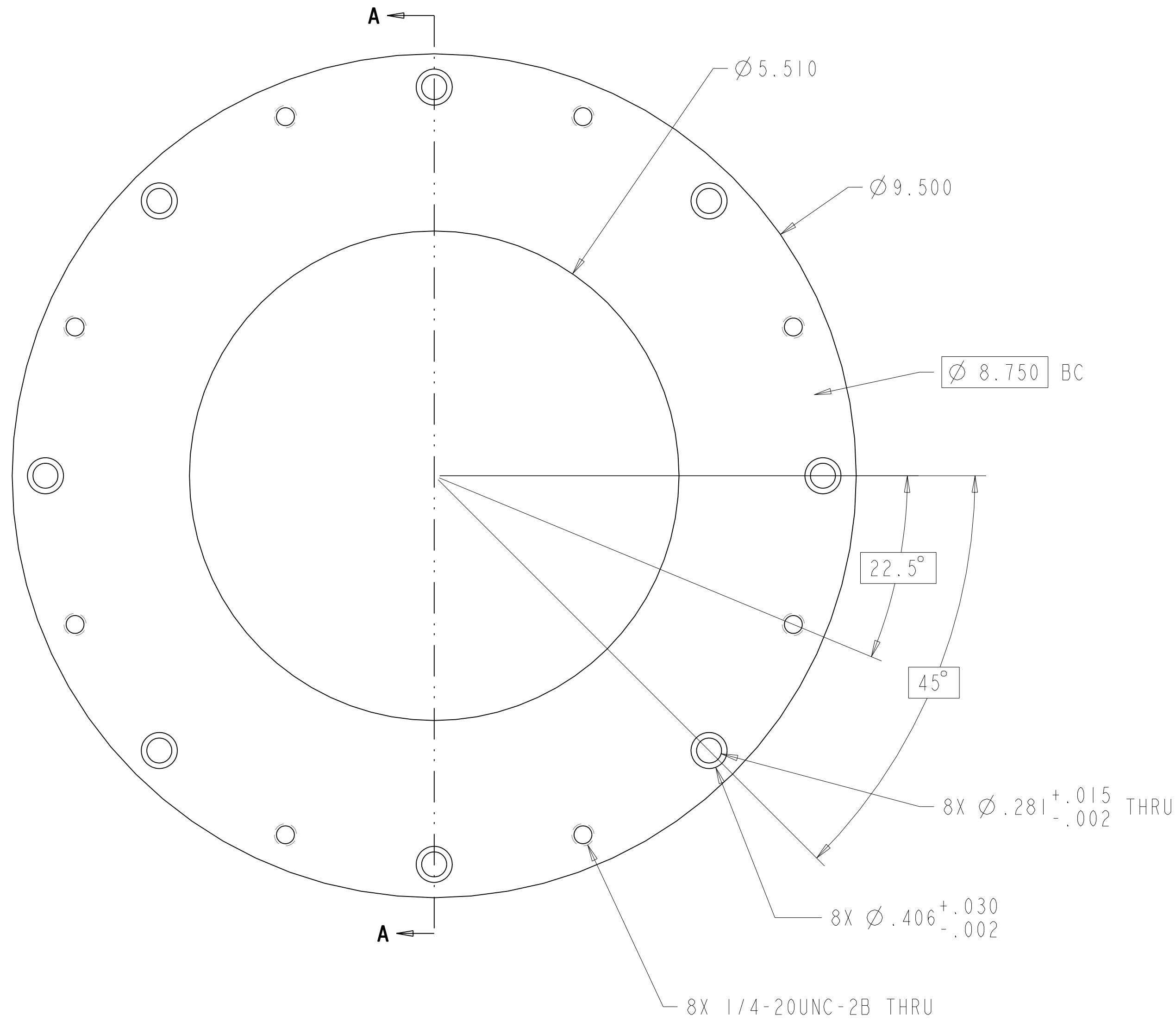
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- REMOVE ALL BURRS AND BREAK SHARP EDGES [.010 MAX] CHAMFER OR RADIUS.
- ALL MACHINED SURFACES WILL BE 62 FINISH OR BETTER. NO PITS, DENTS, SCRATCHES, ETC. PERMITTED.
- PART WILL BE FREE OF ALL FOREIGN MATERIALS, LOOSE SCALE, CHIPS, GREASE AND OIL.
- PROTECT FROM DAMAGE THRU-OUT ALL PHASES OF MACHINING, SHIPPING AND HANDLING.



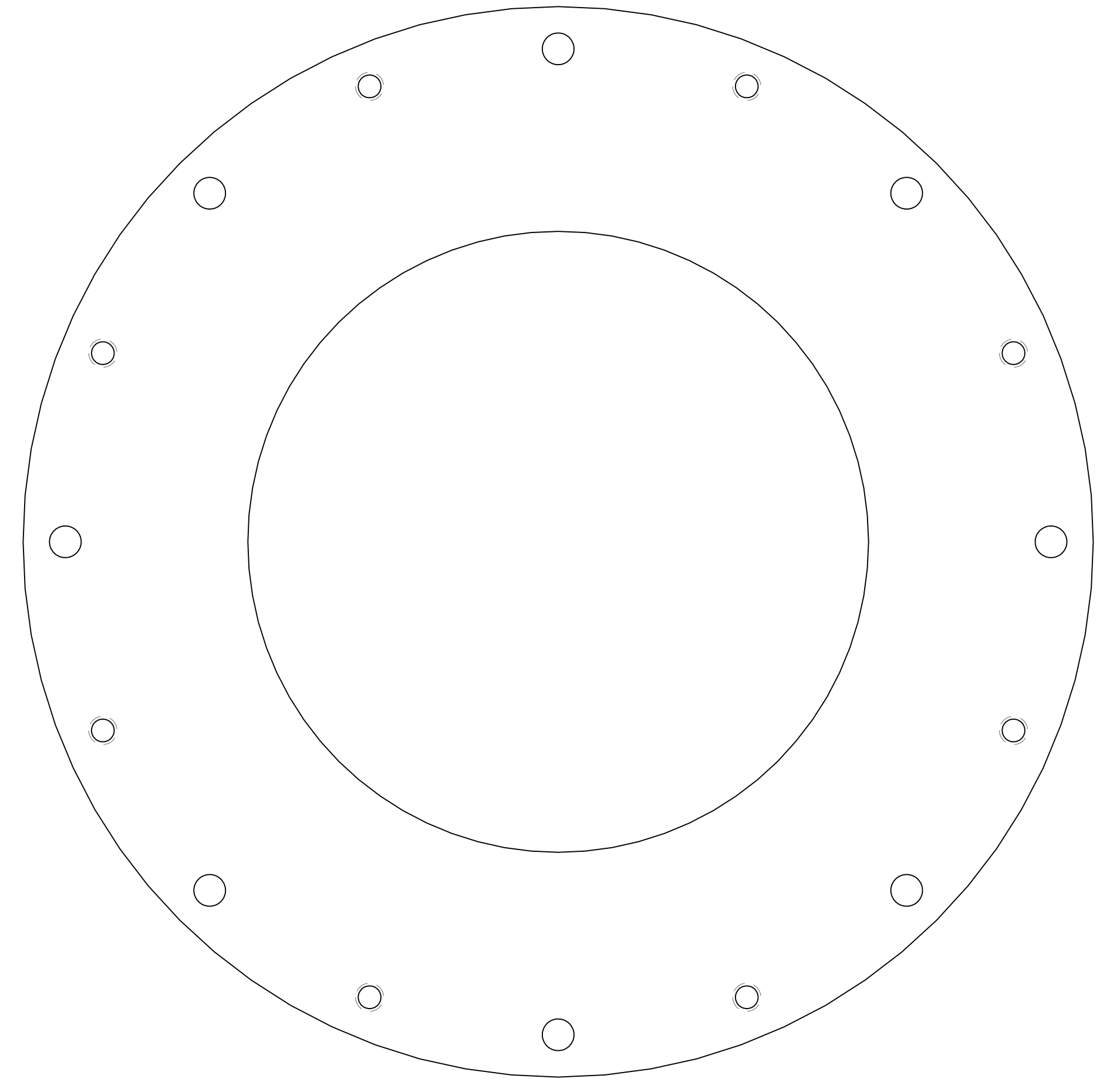
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QTY RECD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	SST	416	I
PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY LAWRENCE LIVERMORE NATIONAL SECURITY-LLC			
THIRD ANGLE PROJECTION		WEIGHT(lbs):	9.075		
APPROVALS		DATE	11/22/10		
ORIGINATOR BROOKSBYI		DATE	2/16/11		
DRAWN BROOKSBYI		DATE	2/28/11		
CHECKED KILLINGSWORTH2		DATE	3/1/11		
APPROVED PIGGOTTI		DRAWING LEVEL	2		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:		DECIMALS	± 0.005		
		ANGLES	± 0.5		
TITLE		SIZE	CAGE CODE	DWG NO	REV
SHAFT - MOTOR		D	14067	AAA11-501267-AA	
SCALE:		NONE		SHEET 1 OF 1	

ZONE		REV	DESCRIPTION	REVISIONS			
	AA		INITIAL RELEASE	DWN	CHK	APVD	DATE
				BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



SECTION A-A



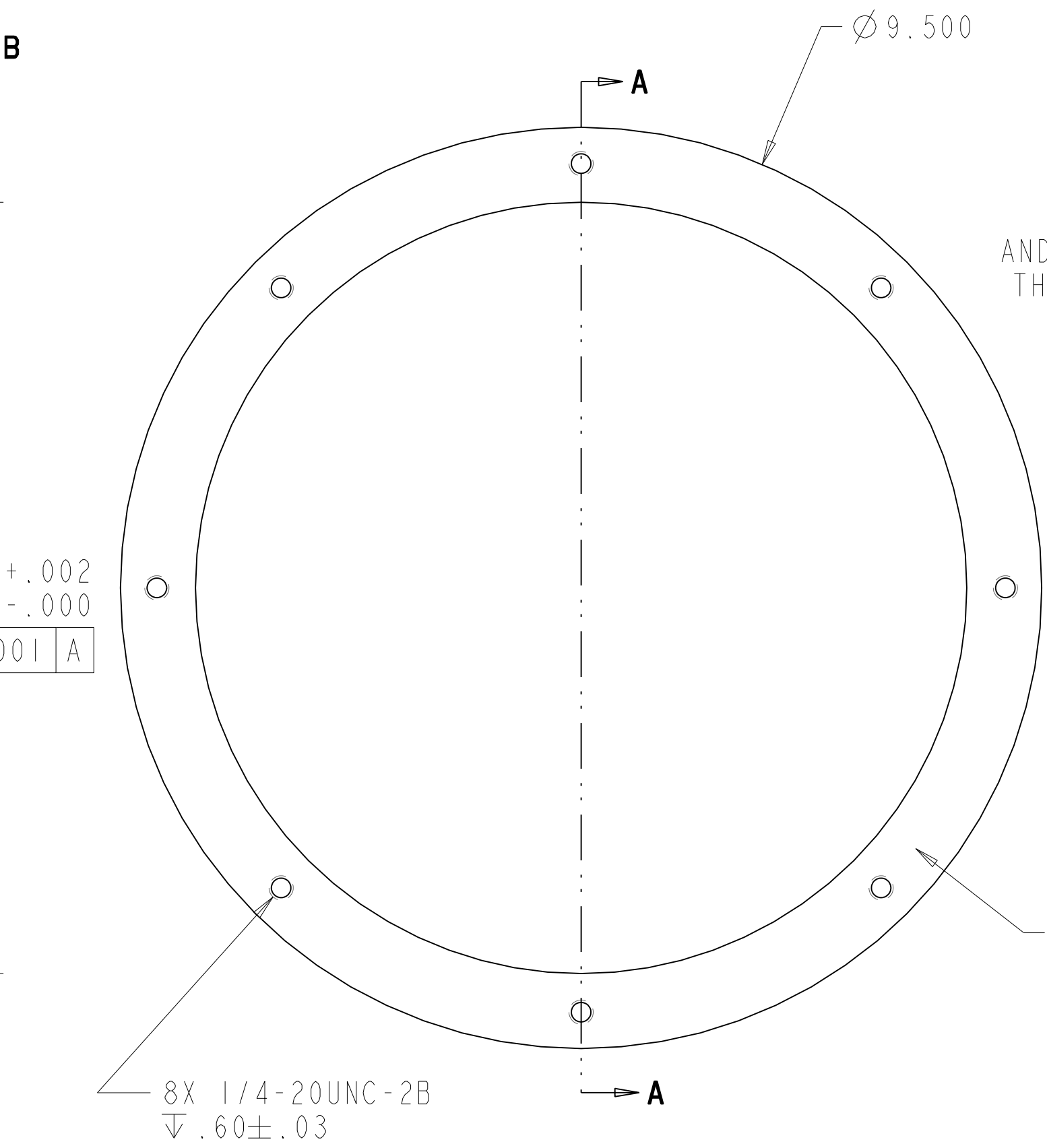
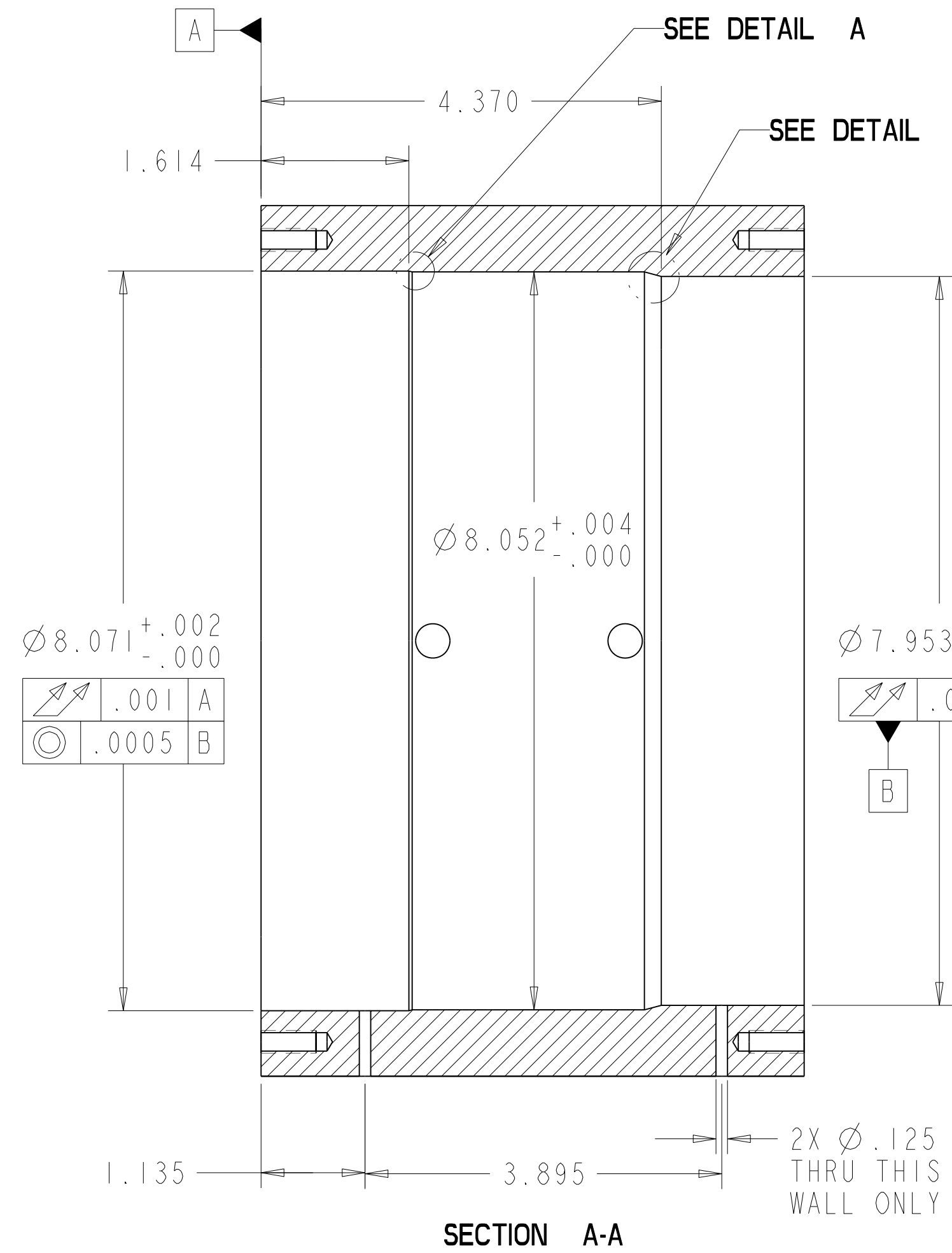
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QTY REQD		PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	ALUM	6061-T6	1
MATERIAL SPECIFICATION		ITEM NO		PARTS LIST		
THIRD ANGLE PROJECTION		WEIGHT(lbs): 1.687		LAWRENCE LIVERMORE NATIONAL LABORATORY		
APPROVALS		DATE		LAWRENCE LIVERMORE NATIONAL SECURITY-LLC		
ORIGINATOR BROOKSBYI		11/22/10		TITLE		
DRAWN BROOKSBYI		2/16/11		MOTOR CASE FLANGE 1		
CHECKED KILLINGSWORTH2		2/28/11		SIZE	CAGE CODE	DWG NO
APPROVED PIGGOTTI		3/1/11		D	14067	AAA11-501268-AA
DRAWING LEVEL 2		SCALE: NONE		SHEET 1 OF 1		

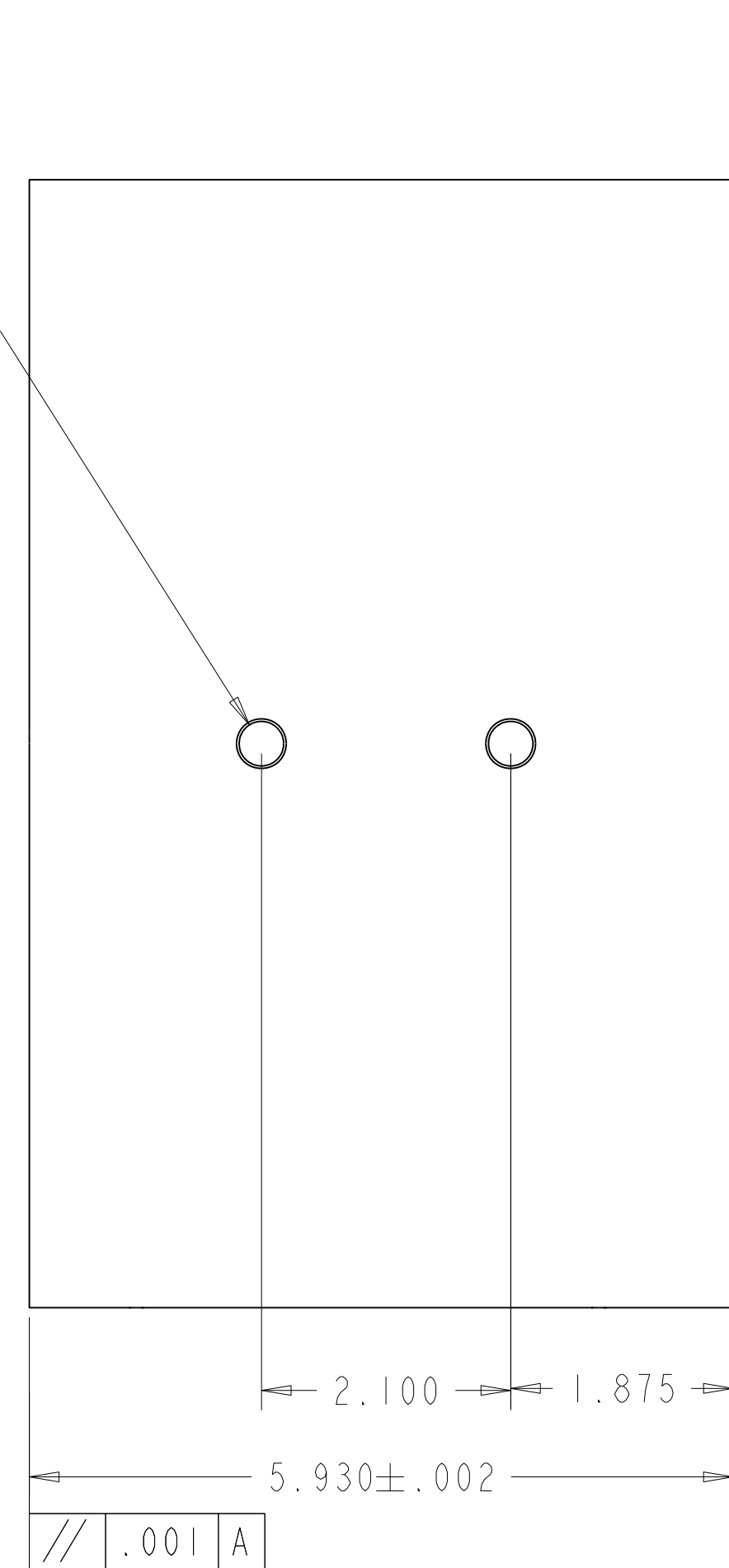
ZONE		REV	DESCRIPTION	REVISIONS			
		AA	INITIAL RELEASE	DWN	CHK	APVD	DATE
		AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTT1	3-1-11



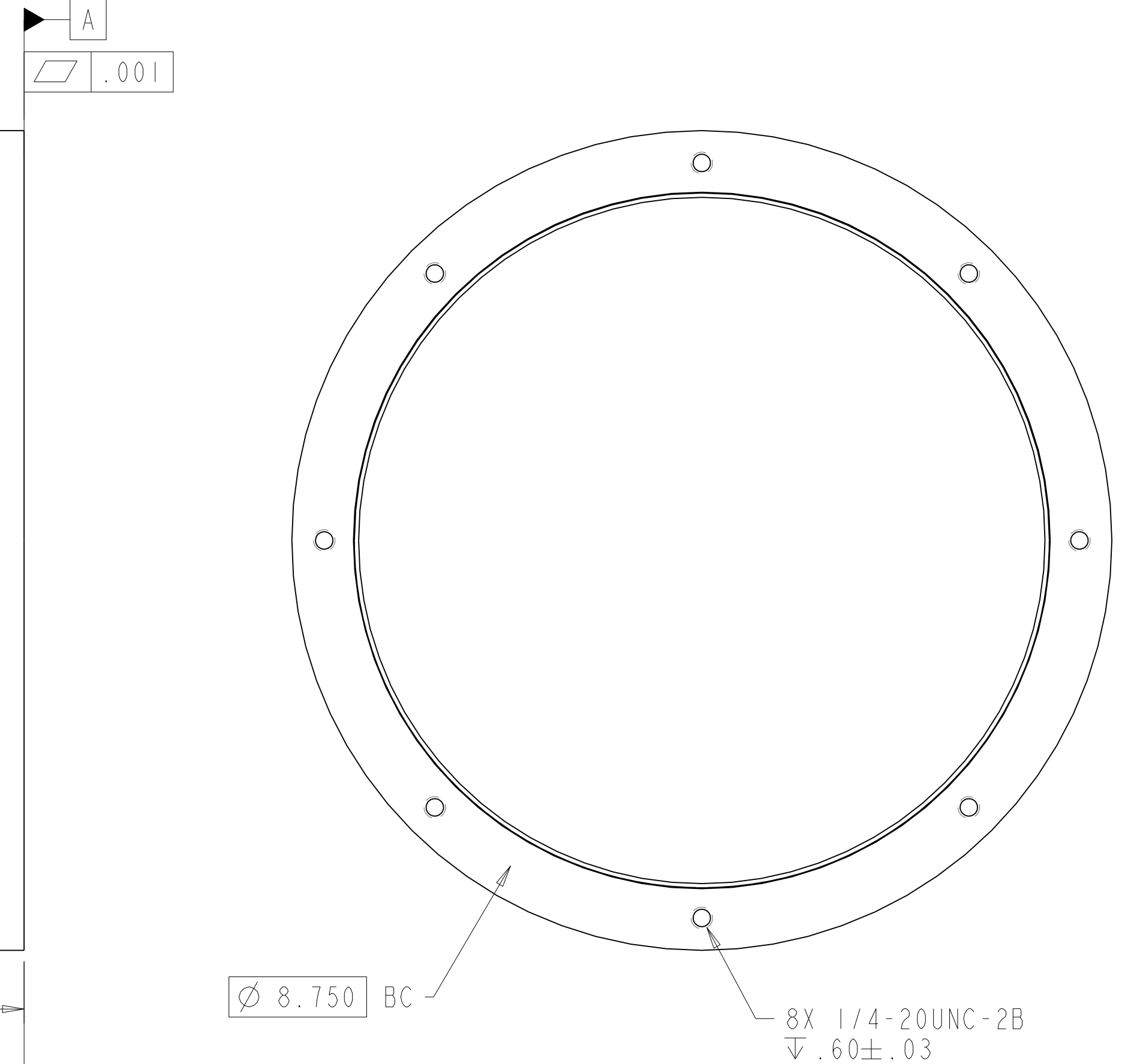
2X 1/4" NPT
AND Ø .375 THRU
THIS WALL ONLY

Ø 8.750 BC

8X 1/4-20UNC-2B
▽.60±.03



DETAIL A
SCALE 10.000



DETAIL B
SCALE 10.000

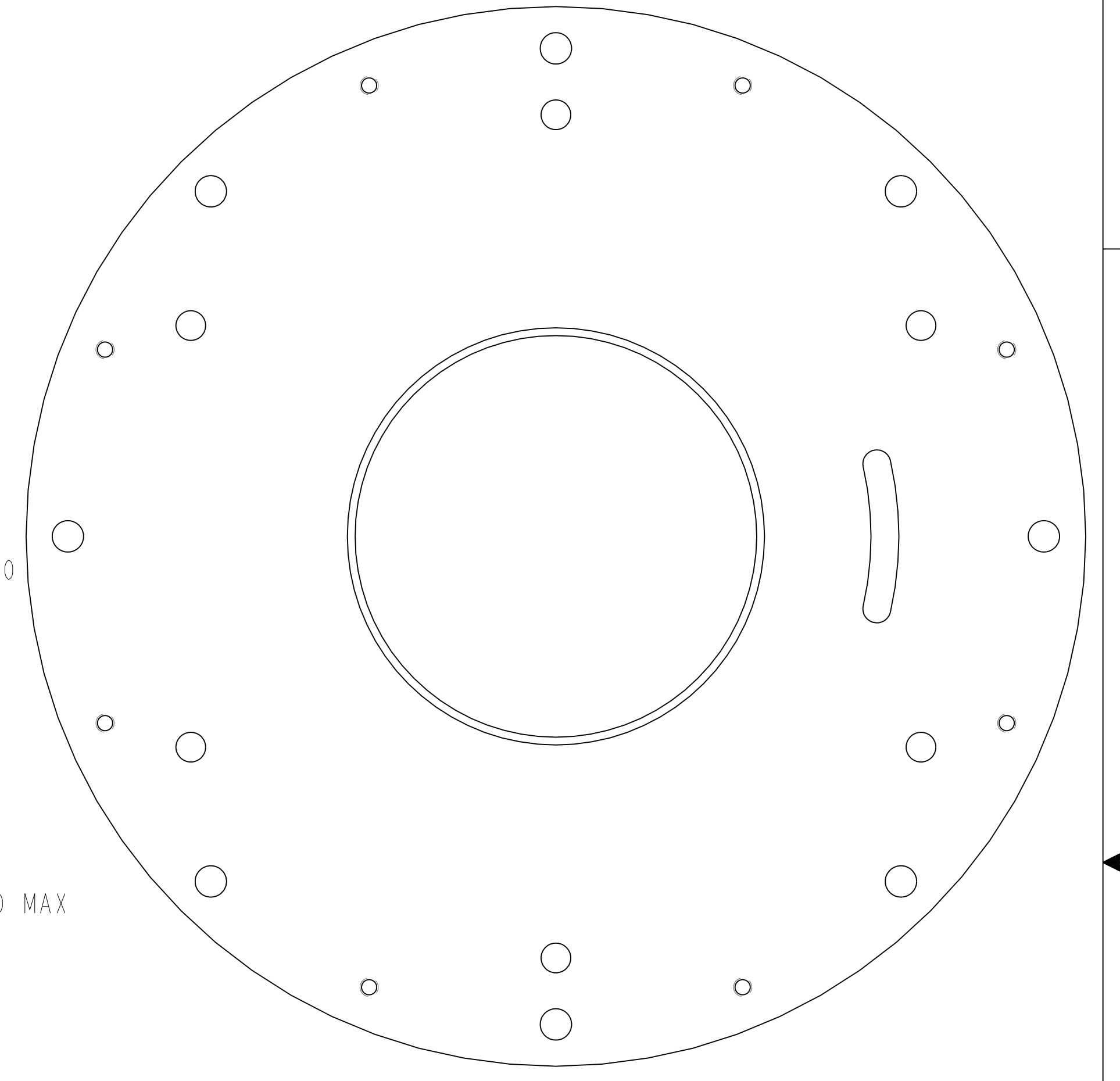
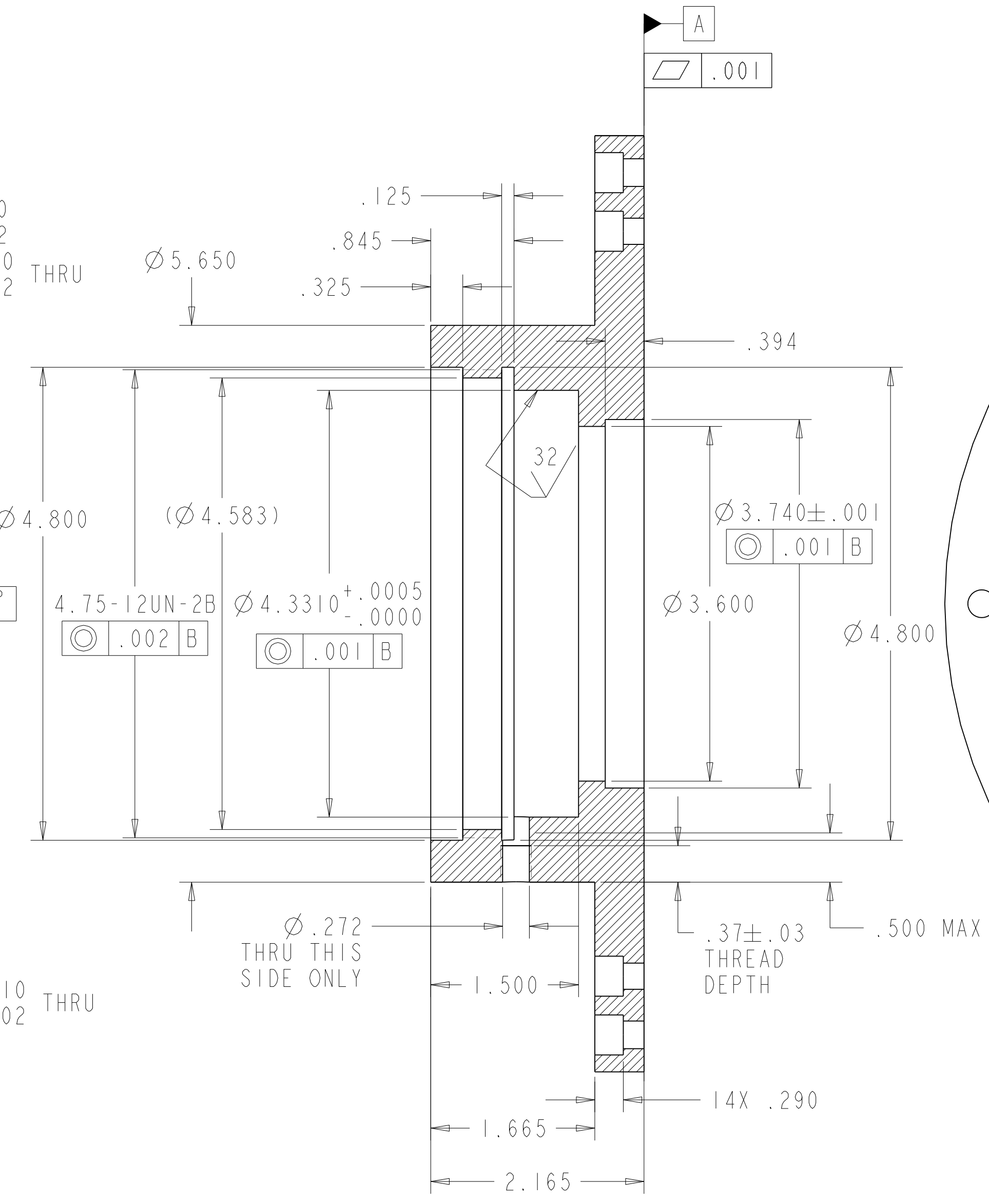
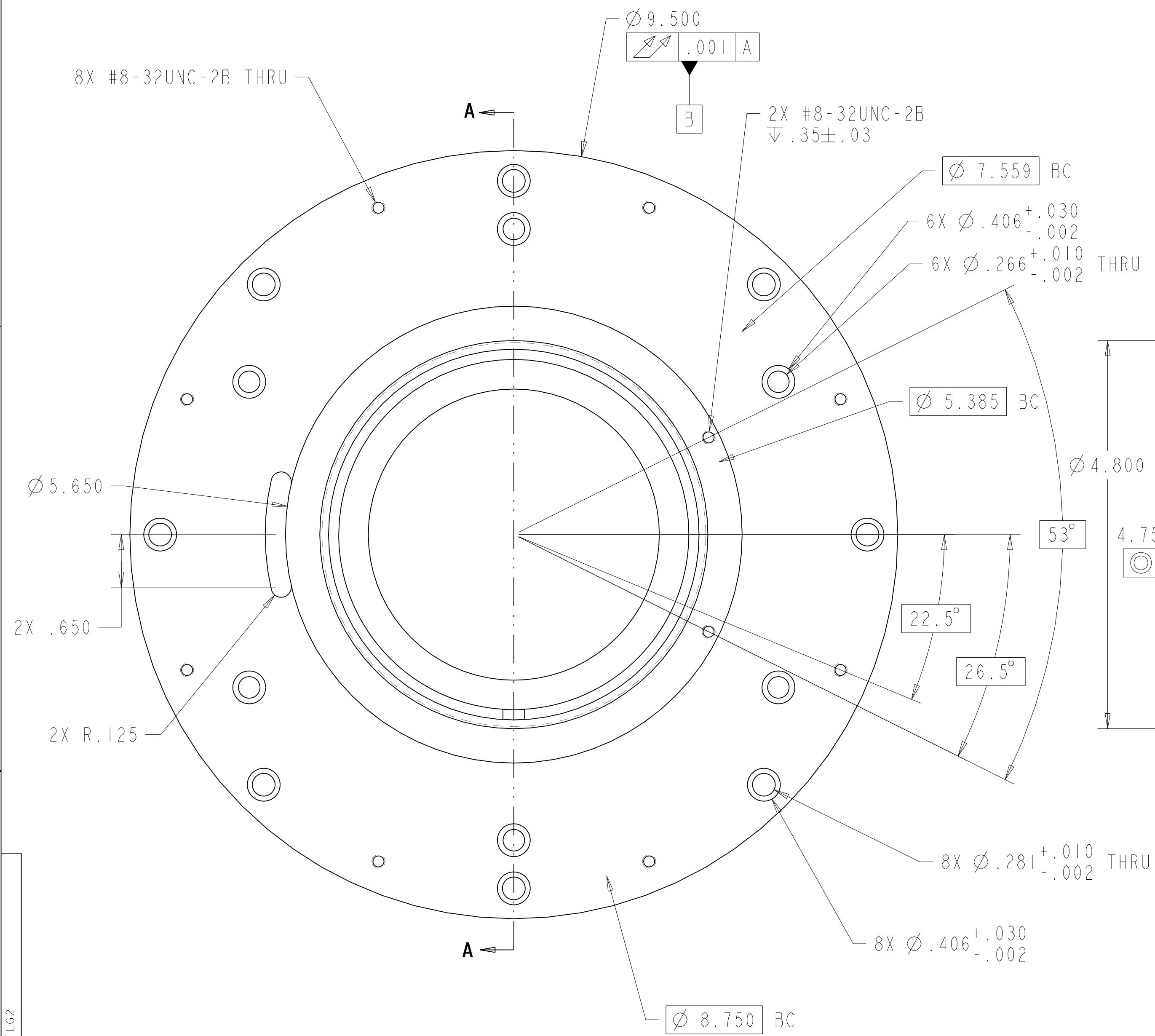
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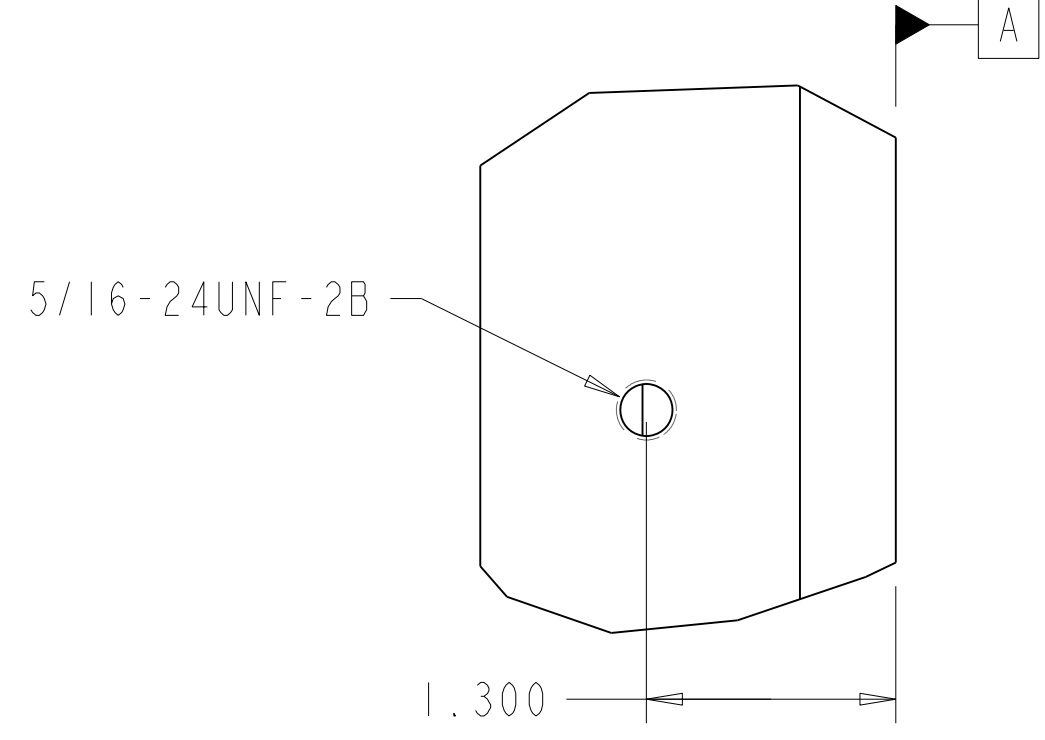
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QTY RECD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO
			ALUM 6061-T6	1
PARTS LIST				
THIRD ANGLE PROJECTION		LAWRENCE LIVERMORE NATIONAL LABORATORY ©LAWRENCE LIVERMORE NATIONAL SECURITY-LLC		
WEIGHT(lbs): 11.707		TITLE		
APPROVALS		DATE		
ORIGINATOR BROOKSBYI		11/22/10		
DRAWN BROOKSBYI		2/16/11		
CHECKED KILLINGSWORTH2		2/28/11		
APPROVED PIGGOTT1		3/1/11		
DECIMALS ± 0.005		ANGLES ± 0.5		DRAWING LEVEL 2
SIZE D	CAGE CODE 14067	DWG NO AAA11-501269-AA	REV	
SCALE: NONE		SHEET 1 OF 1		

		REVISIONS				
ZONE	REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11
	AB	CHANGED 4.75-8UN TO 4.75-12UN	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	5-4-11



SECTION A-A



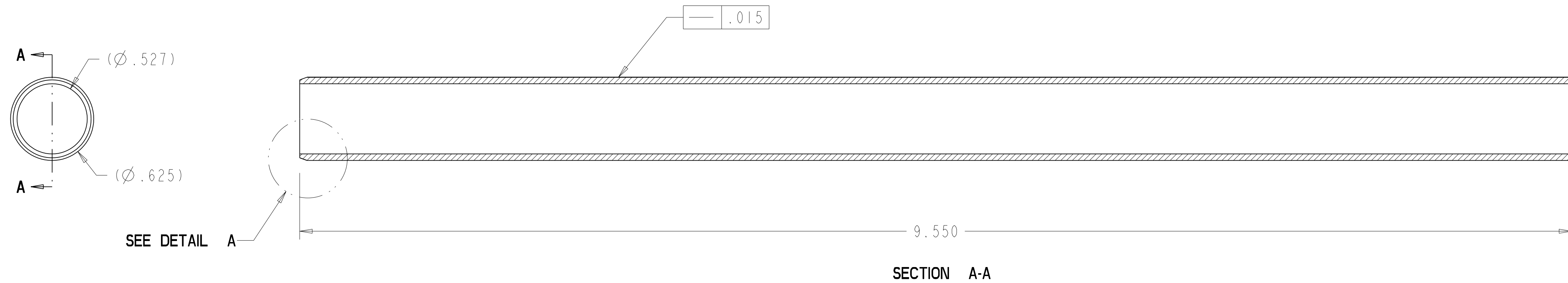
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		ALUM		6061-T6		I	
QTY REOD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL			MATERIAL SPECIFICATION	ITEM NO	
PARTS LIST							
THIRD ANGLE PROJECTION		WEIGHT(lbs): 4.390		LAWRENCE LIVERMORE NATIONAL LABORATORY			
		APPROVALS	DATE	NATIONAL LABORATORY			
		BROOKSBYI	11/22/10	LAWRENCE LIVERMORE NATIONAL SECURITY-LLC			
		BROOKSBYI	2/16/11	TITLE			
		KILLINGSWORTH2	2/28/11	MOTOR CASE FLANGE 2			
		PIGGOTTI	3/1/11	SIZE	CAGE CODE	DWG NO	REV
			DRAWING LEVEL	D	14067	AAA11-501270-AB	
			2	SCALE:	NONE	SHEET 1 OF 1	

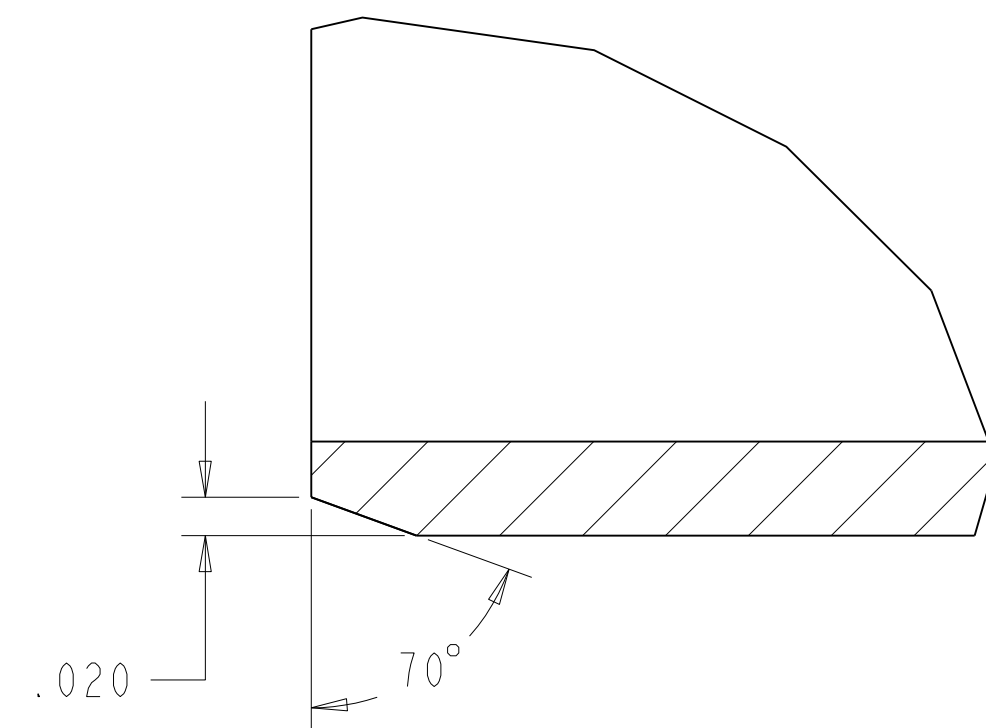
UNCLASSIFIED

ZONE		REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA		INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



SEE DETAIL A

SECTION A-A



DETAIL A
SCALE 10.000

NOTES, UNLESS OTHERWISE SPECIFIED:

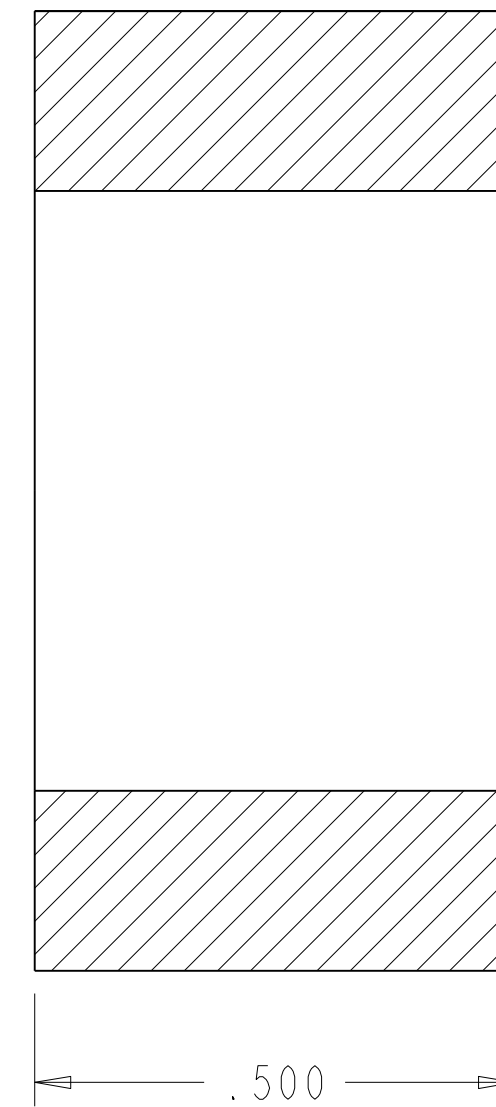
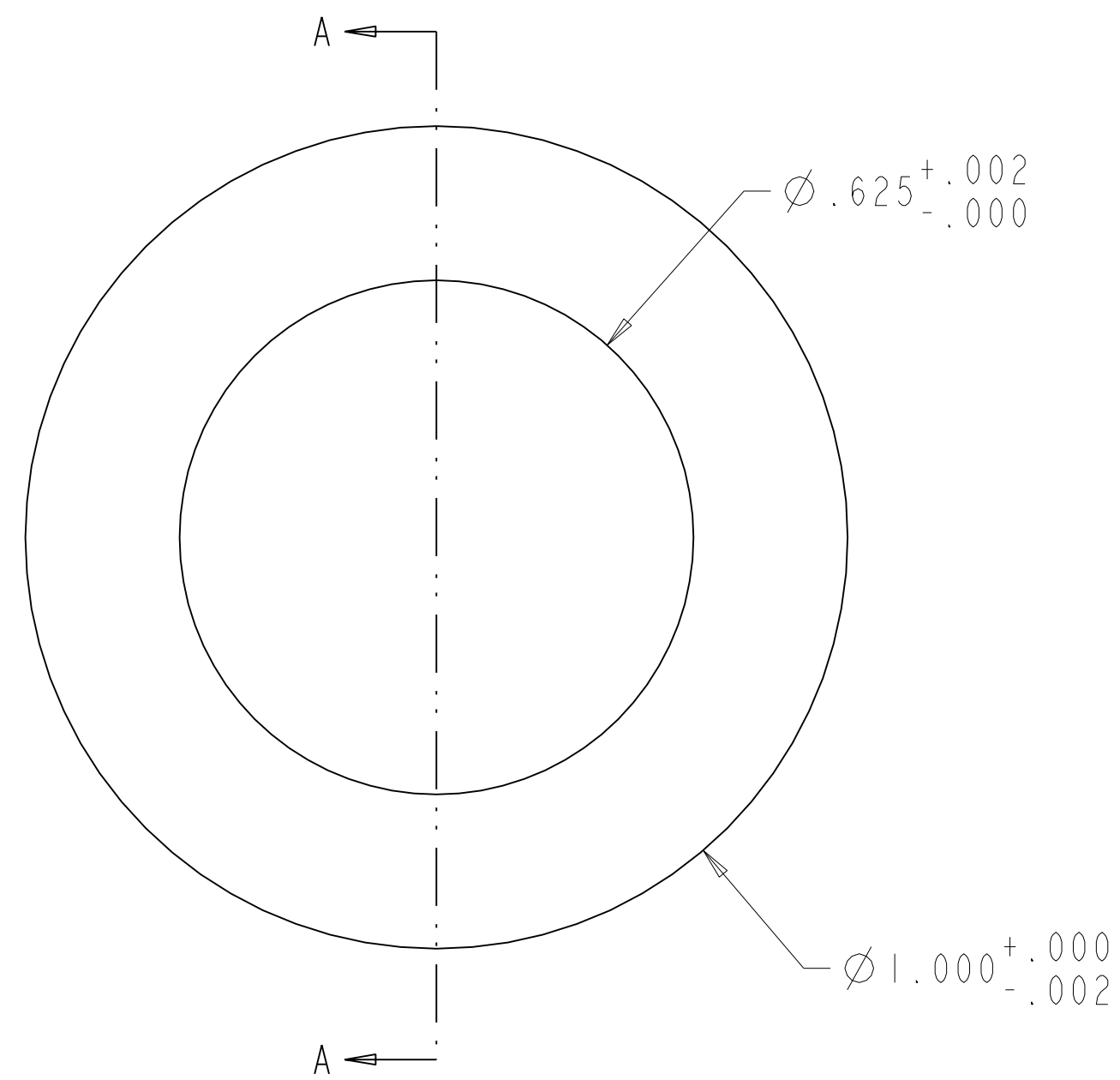
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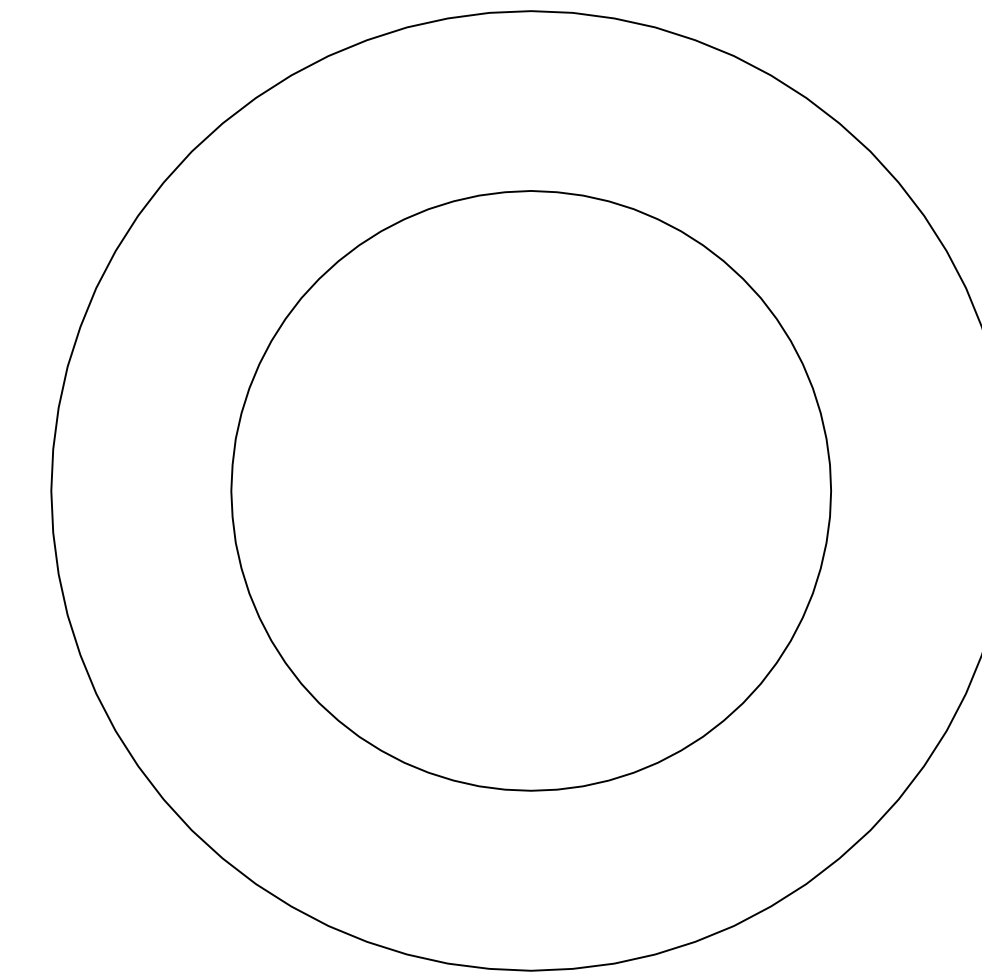
		TUBE, 0.6250D x 0.049W		SST	304	I
QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL		MATERIAL SPECIFICATION	ITEM NO	
PARTS LIST						
THIRD ANGLE PROJECTION		WEIGHT(lbs): 0.242		LAWRENCE LIVERMORE NATIONAL LABORATORY		
APPROVALS		DATE		TITLE		
ORIGINATOR BROOKSBYI		11/22/10		WATER UNION 355 INNER TUBE		
DRAWN BROOKSBYI		2/16/11		SIZE	CAGE CODE	DWG NO
CHECKED KILLINGSWORTH2		2/28/11		D	14067	AAA11-501271-AA
APPROVED PIGGOTTI		3/1/11		SCALE:	NONE	SHEET 1 OF 1
		DRAWING LEVEL 2				

UNCLASSIFIED

ZONE		REV	DESCRIPTION	REVISIONS			
		AA	INITIAL RELEASE	DWN	CHK	APVD	DATE
		AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



SECTION A-A



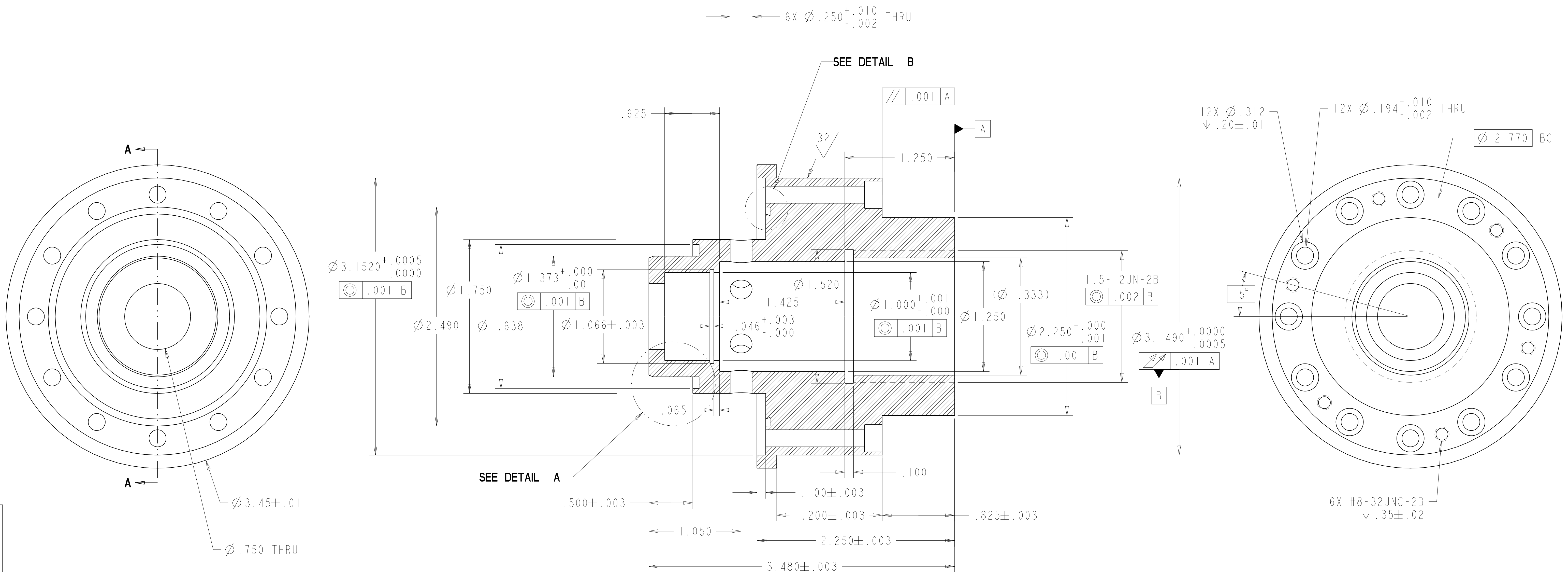
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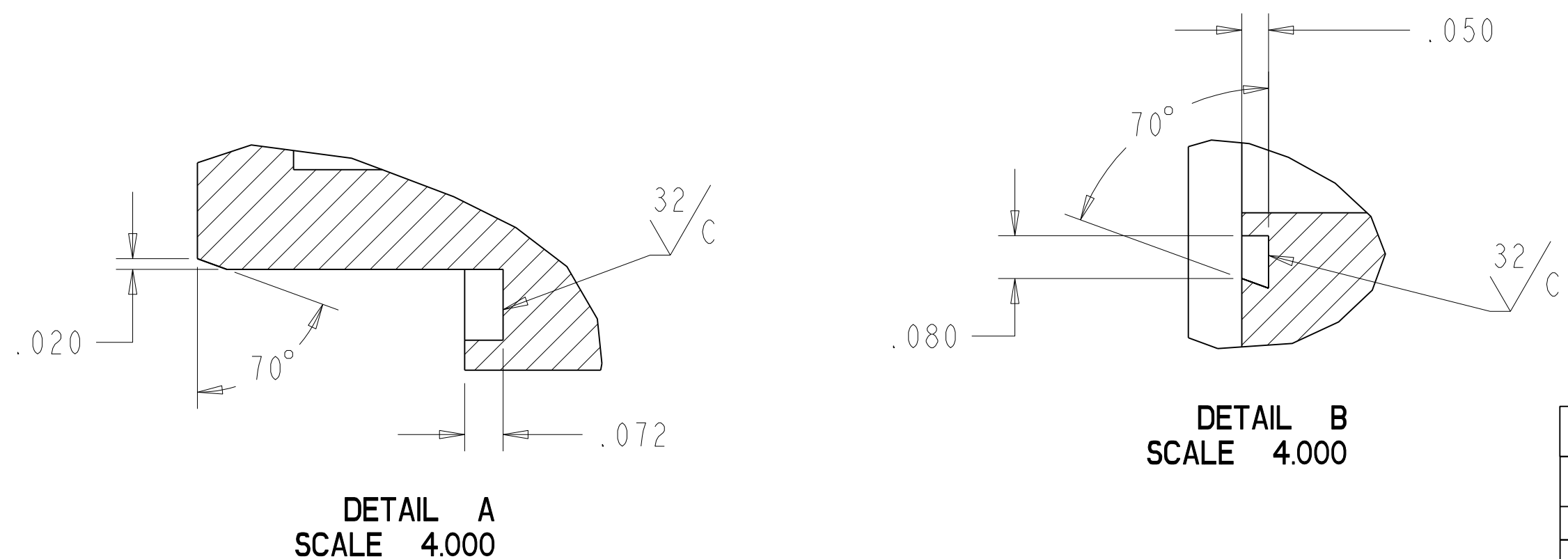
QTY REQD		PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	PTFE	I
				MATERIAL SPECIFICATION	ITEM NO
PARTS LIST					
THIRD ANGLE PROJECTION		WEIGHT(lbs): 0.010		LAWRENCE LIVERMORE NATIONAL LABORATORY	
APPROVALS		DATE	TITLE		
ORIGINATOR BROOKSBYI		11/22/10	WATER UNION PTFE BEARING		
DRAWN BROOKSBYI		2/16/11	SIZE	CAGE CODE	DWG NO
CHECKED KILLINGSWORTH2		2/28/11	D	14067	AAA11-501272-AA
APPROVED PIGGOTTI		3/1/11	SCALE:	NONE	SHEET 1 OF 1
		DRAWING LEVEL 2			

ZONE		REV	DESCRIPTION	REVISIONS			
AA		INITIAL RELEASE		DWN	CHK	APVD	DATE
				BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



NOTES, UNLESS OTHERWISE SPECIFIED:

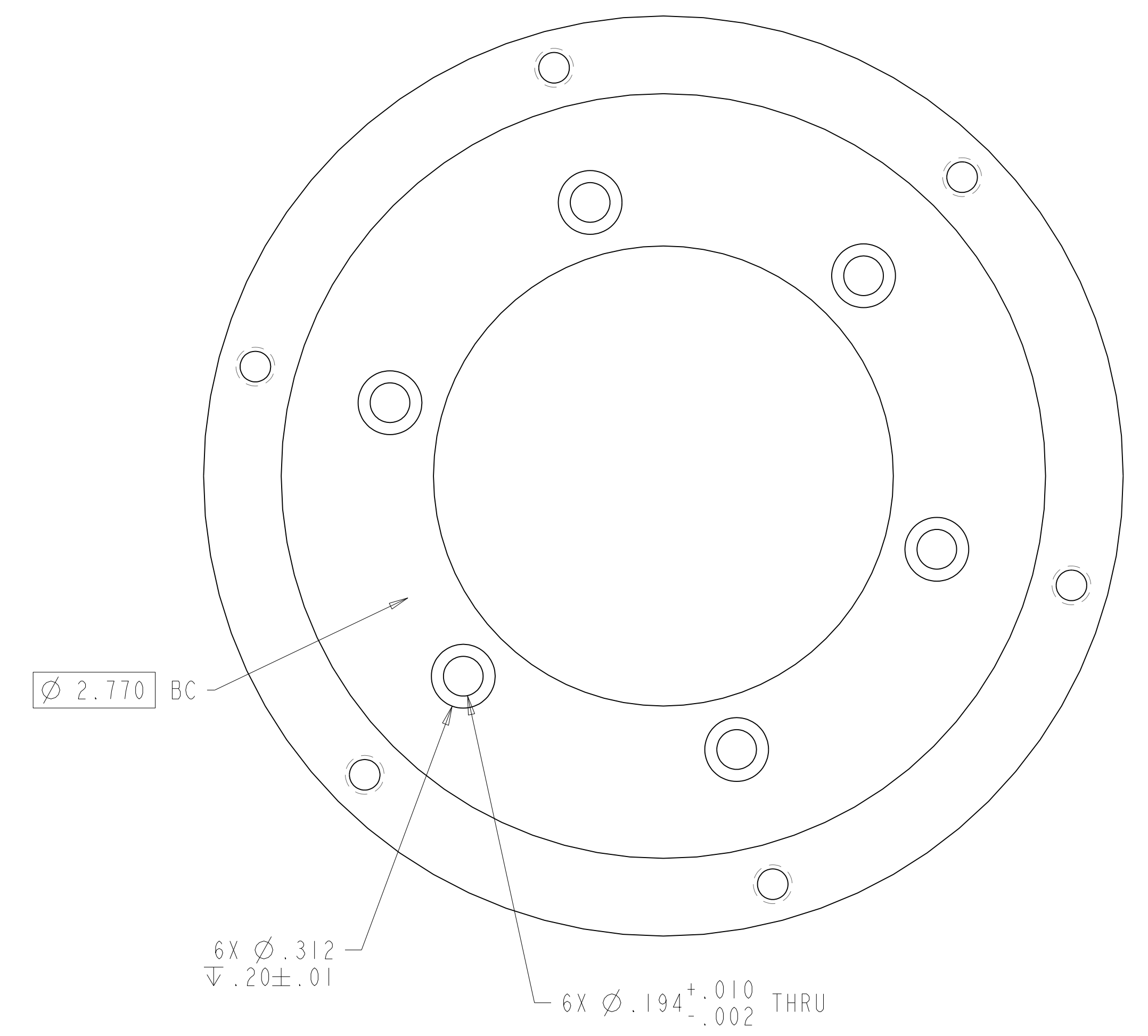
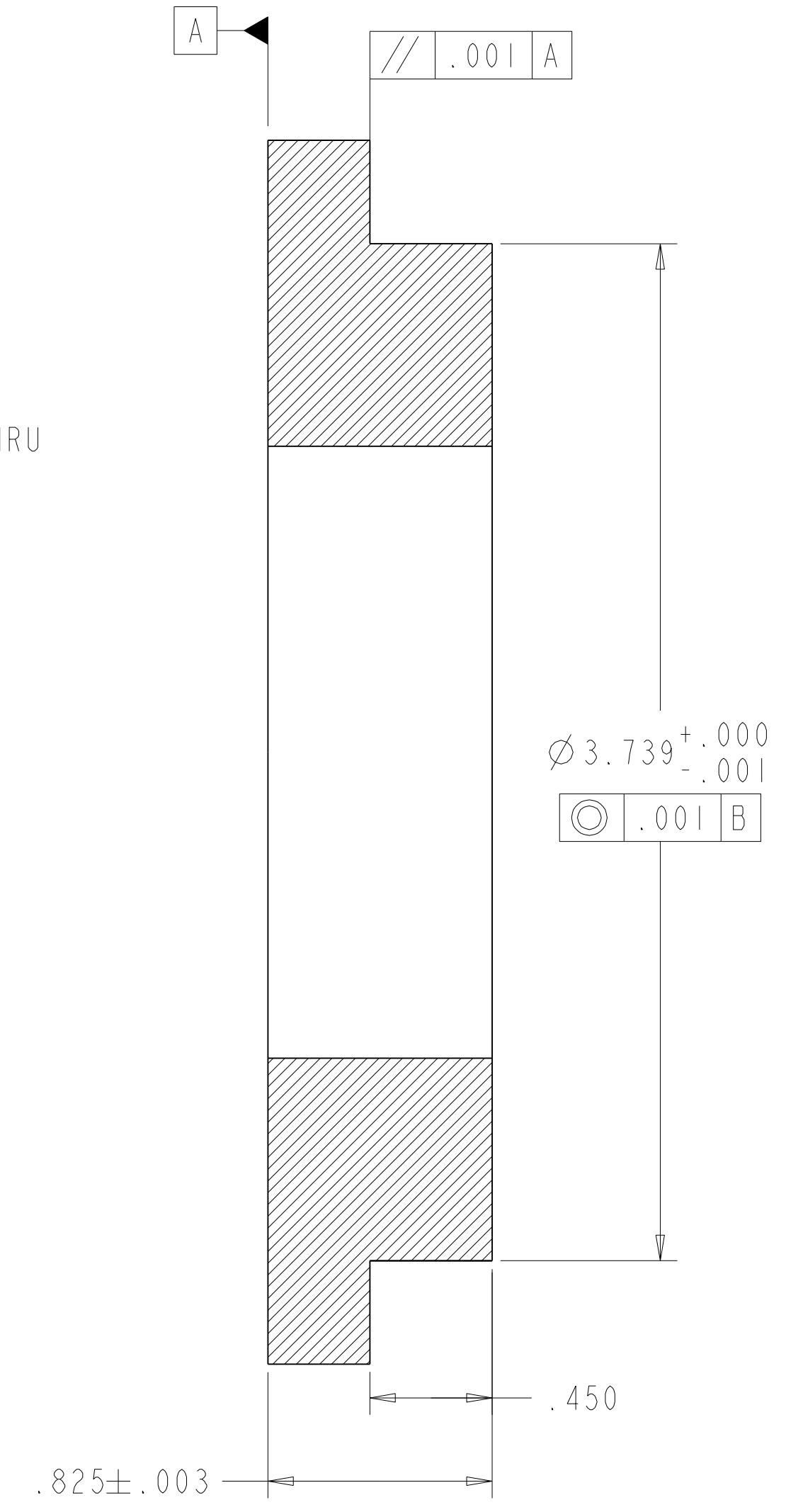
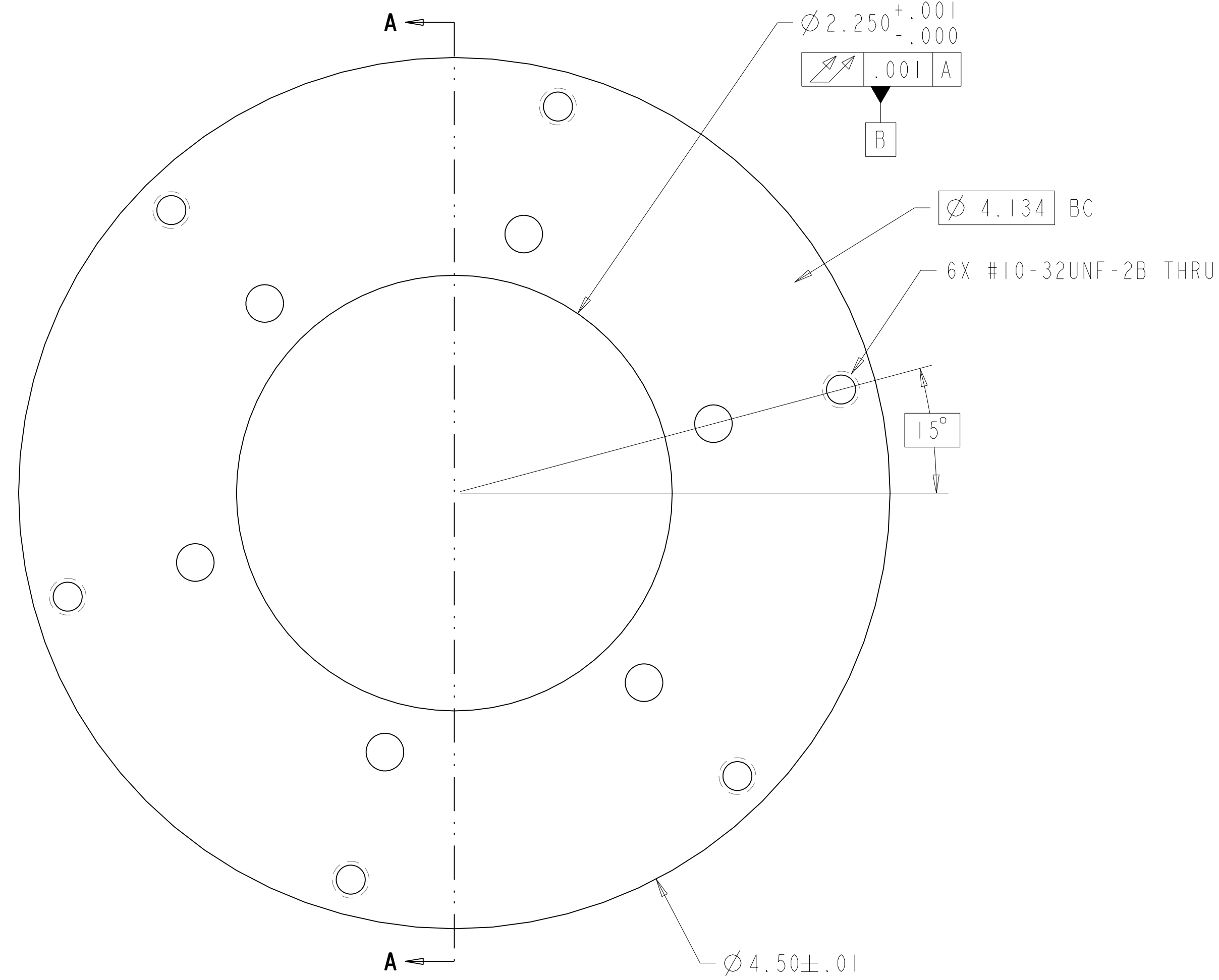
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QTY RECD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	SST	304	I
PARTS LIST					
THIRD ANGLE PROJECTION			LAWRENCE LIVERMORE NATIONAL LABORATORY		
WEIGHT(lbs): 3.373			NATIONAL LABORATORY		
APPROVALS			LAWRENCE LIVERMORE NATIONAL SECURITY-LLC		
DATE			TITLE		
ORIGINATOR: BROOKSBYI			SHAFT FLANGE 7		
DRAWN: BROOKSBYI			SIZE		
CHECKED: KILLINGSWORTH2			CAGE CODE		
APPROVED: PIGGOTTI			DWG NO		
DATE: 2/28/11			AAA11-501273-AA		
DRAWING LEVEL: 2			REV		
SCALE: NONE			SHEET 1 OF 1		

ZONE		REV	DESCRIPTION	REVISIONS			
DWN	CHK	APVD	DATE				
AA			INITIAL RELEASE	BROOKSBY1	KILLINGSWORTH2	PIGGOTT1	3-1-11



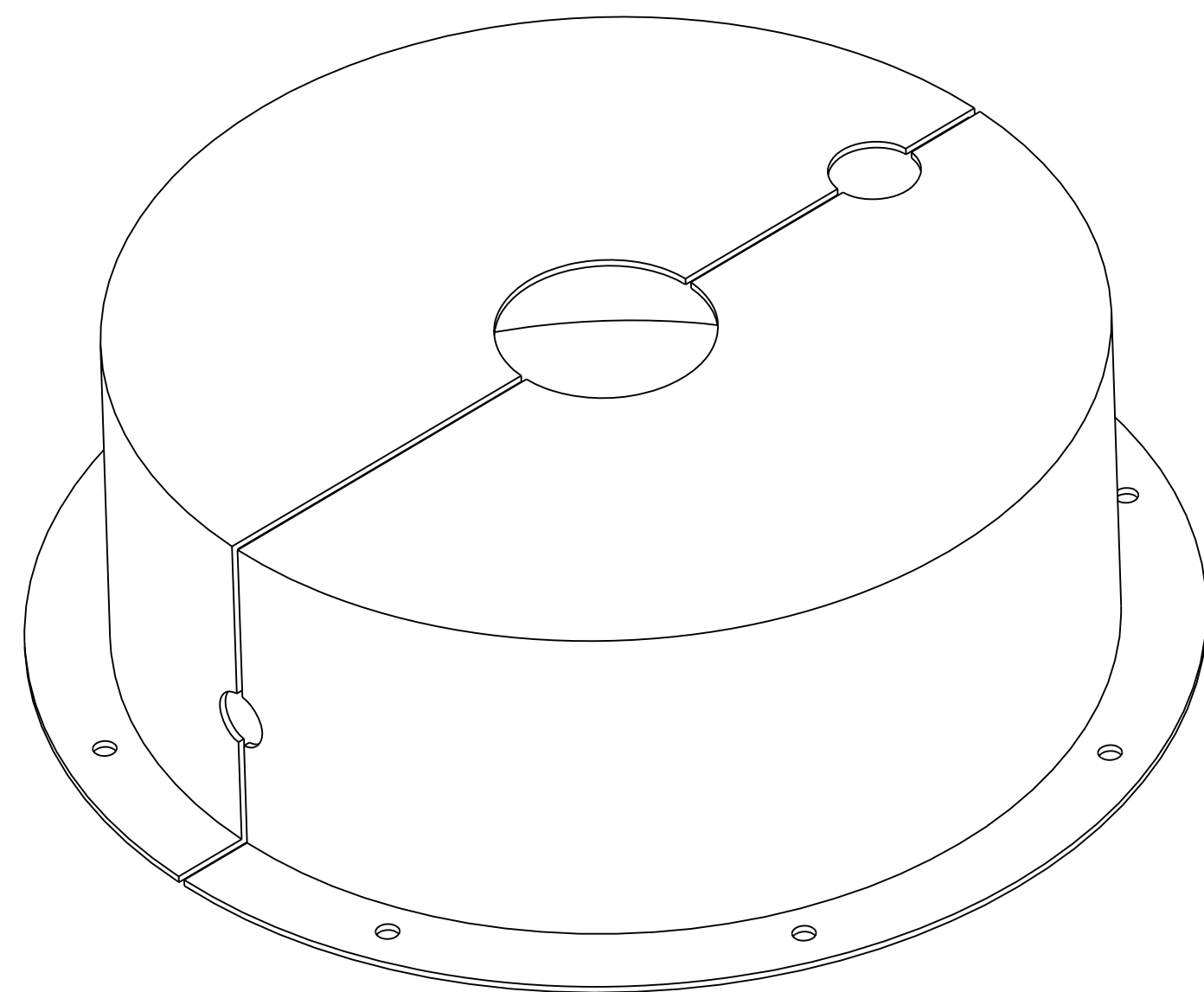
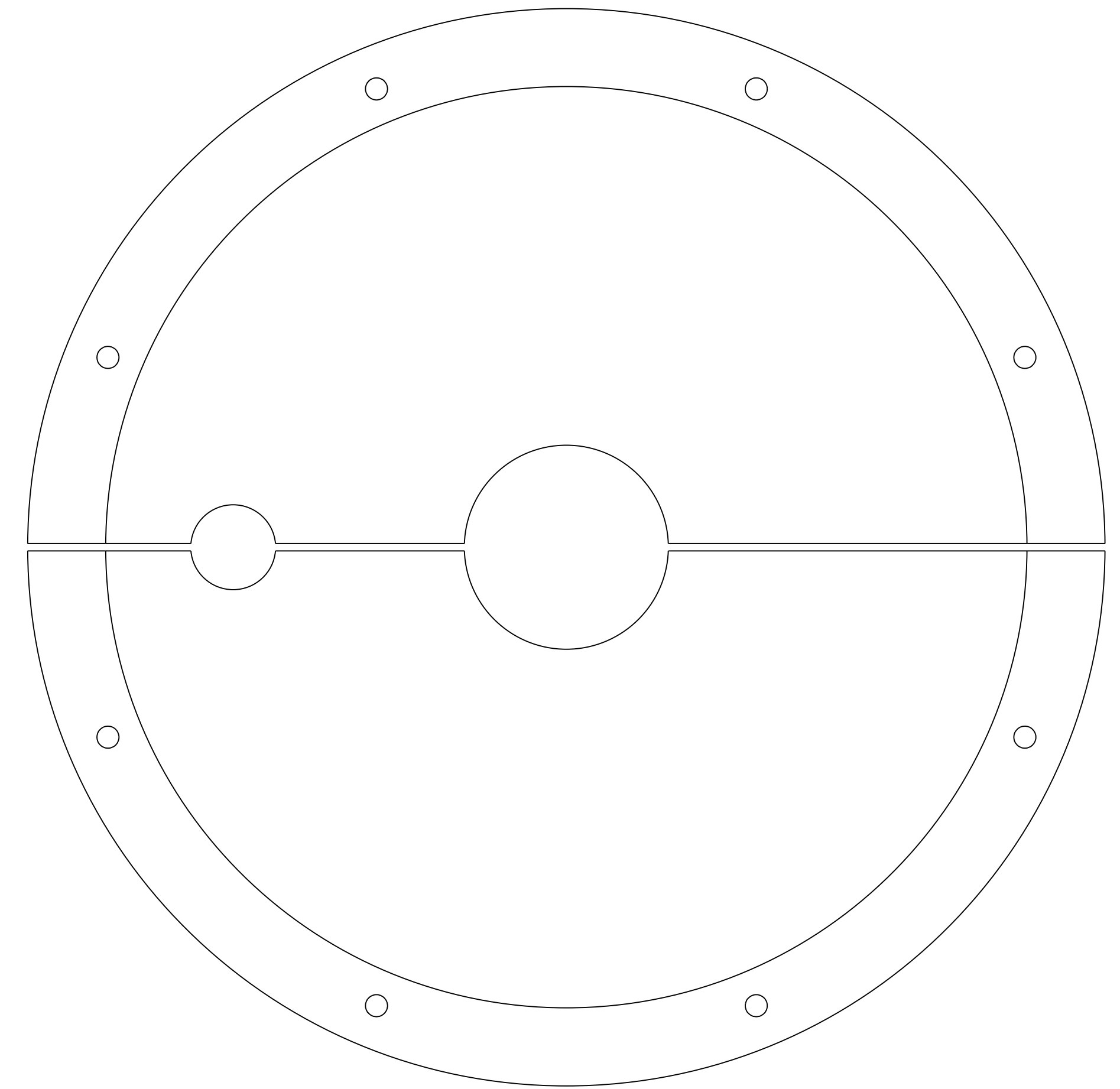
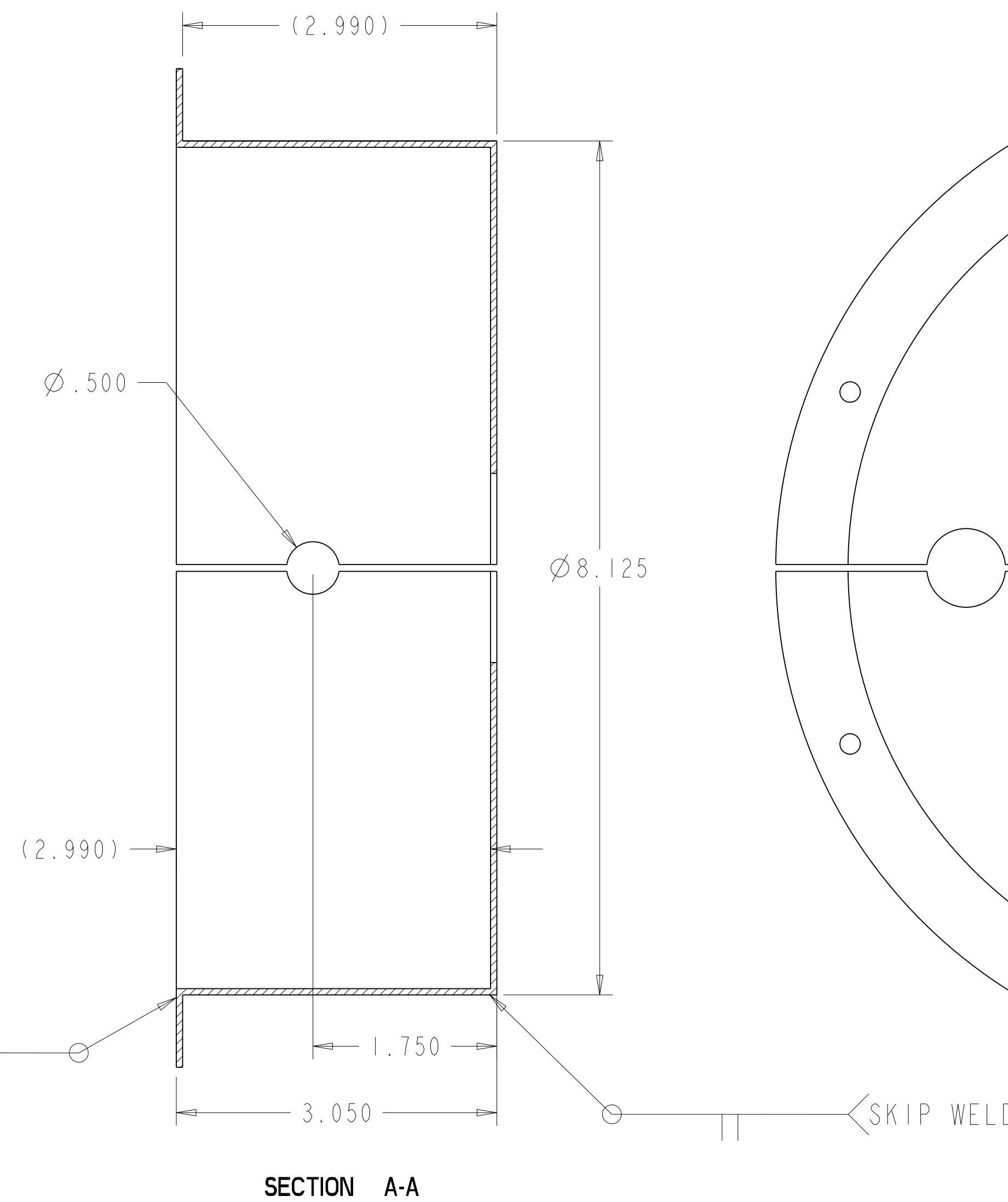
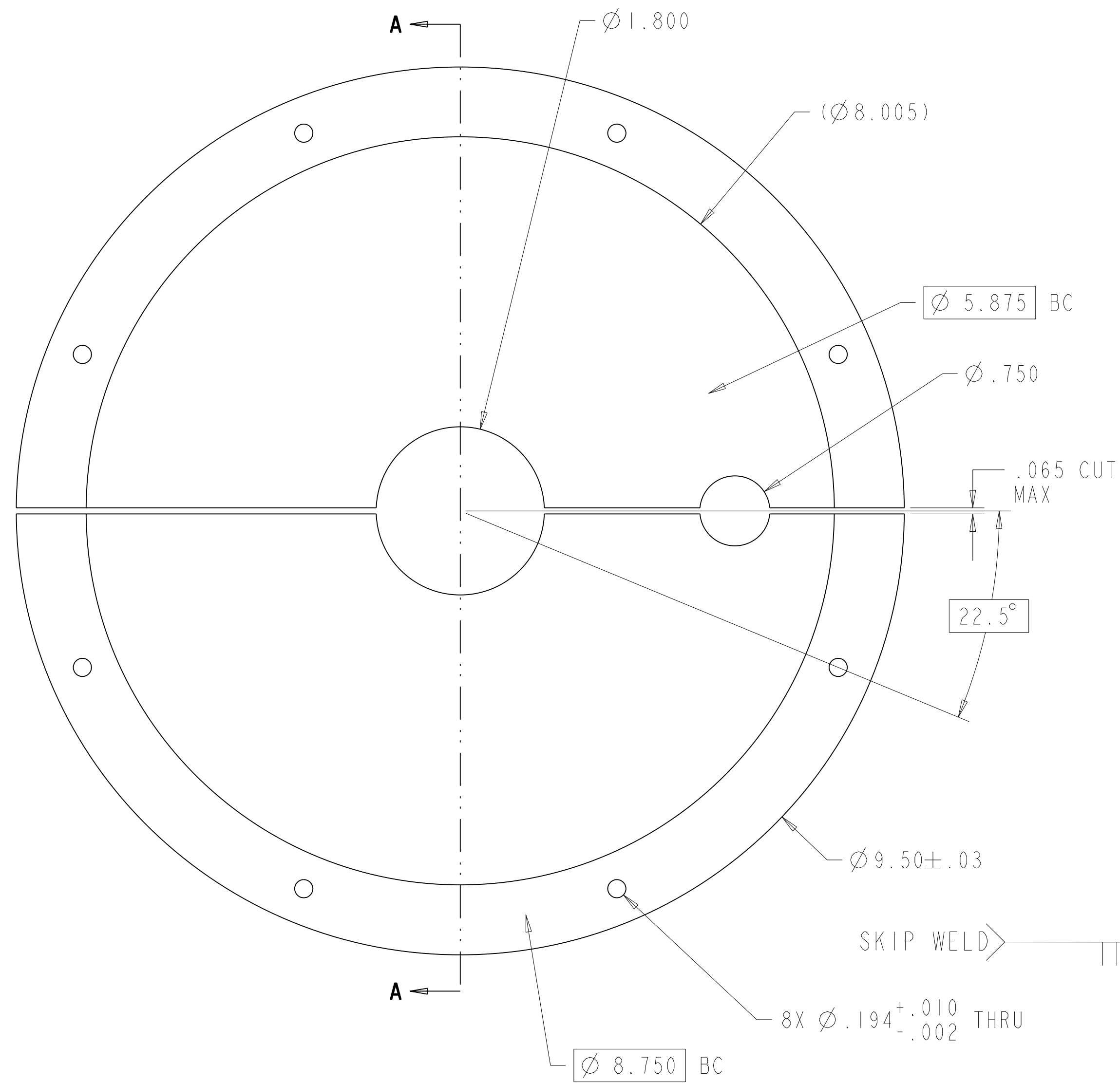
SECTION A-A

- NOTES, UNLESS OTHERWISE SPECIFIED:
- PART DIMENSIONS FROM CAD MODEL. IGES OR STEP FILE TO BE PROVIDED. CRITICAL DIMENSIONS WILL BE NOTED ON THIS DRAWING. ALL OTHERS WILL BE PER THE GENERAL TOLERANCES NOTED IN TITLE BLOCK, AND PER INDUSTRY STANDARDS AND TYPICAL MACHINE TOOL CAPABILITIES.
 - REMOVE ALL BURRS AND BREAK SHARP EDGES [.010 MAX] CHAMFER OR RADIUS.
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QTY RECD		PART OR IDENTIFYING NO		NOMENCLATURE OR DESCRIPTION/MATERIAL		ALUM	6061-T6	I
PARTS LIST								
THIRD ANGLE PROJECTION			WEIGHT(lbs): 0.724			LAWRENCE LIVERMORE NATIONAL LABORATORY		
APPROVALS			DATE			TITLE		
ORIGINATOR BROOKSBY1			11/22/10			ENCODER MOUNTING DISK		
DRAWN BROOKSBY1			2/16/11			SIZE CAGE CODE DWG NO REV		
CHECKED KILLINGSWORTH2			2/28/11			D 14067 AAA11-501274-AA		
APPROVED PIGGOTT1			3/1/11			SCALE: NONE SHEET 1 OF 1		
			DRAWING LEVEL 2					

ZONE		REV	DESCRIPTION	REVISIONS			
		AA	INITIAL RELEASE	DWN	CHK	APVD	DATE
		AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



NOTES, UNLESS OTHERWISE SPECIFIED:

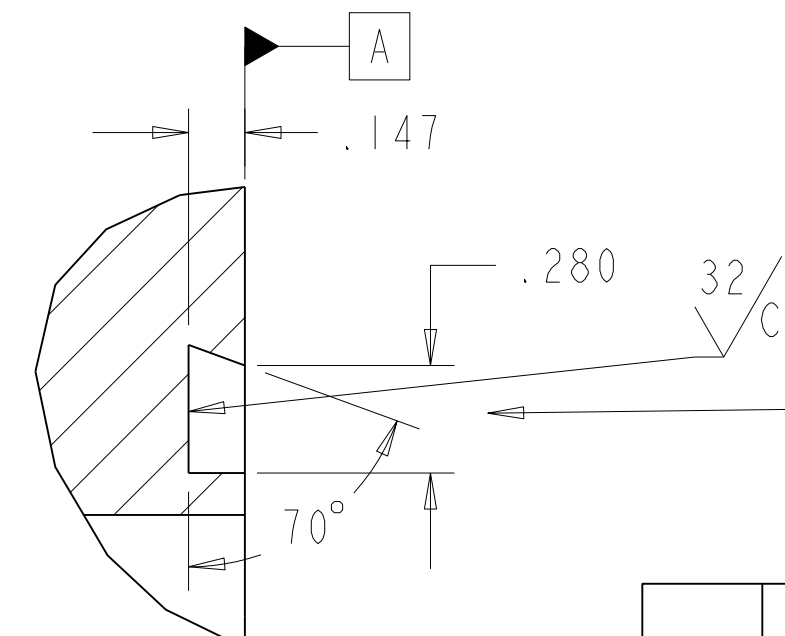
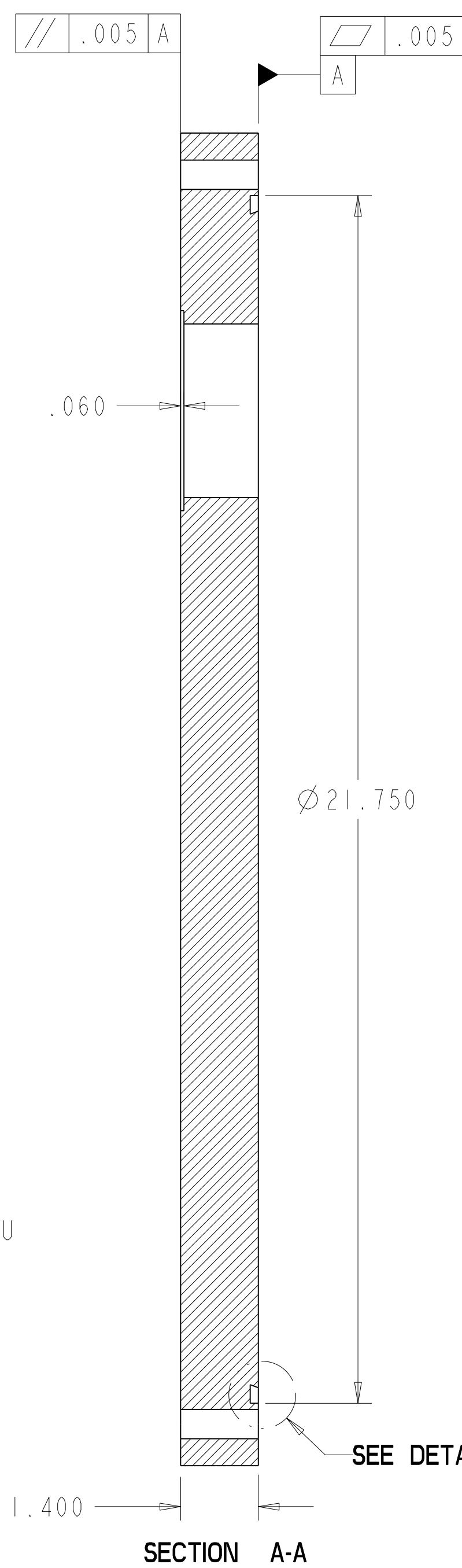
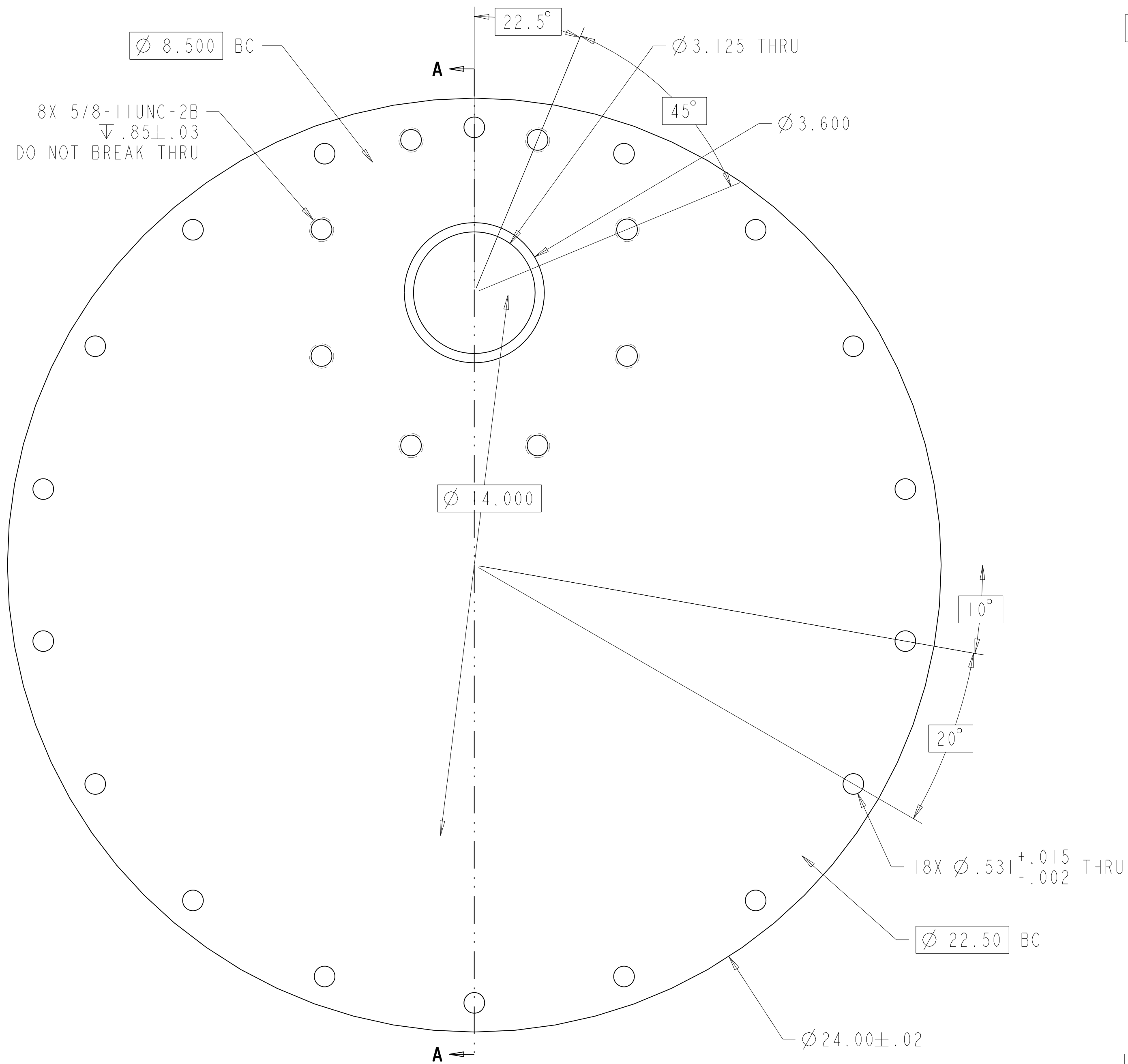
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QTY RECD		PART OR IDENTIFYING NO		SHEET, 16 GA, 0.06in THK		SST		304		I	
NOMENCLATURE OR DESCRIPTION/MATERIAL		PARTS LIST		MATERIAL SPECIFICATION		ITEM NO		WEIGHT(lbs):		2.444	
APPROVALS		DATE		TITLE		LAWRENCE LIVERMORE NATIONAL LABORATORY		LAWRENCE LIVERMORE NATIONAL SECURITY-LLC		A	
ORIGINATOR		DATE		MOTOR END COVER		SIZE		CAGE CODE		DWG NO	
DRAWN		DATE		REV		D		14067		AAA11-501275-AA	
CHECKED		DATE		SCALE:		NONE		SHEET		1 OF 1	
APPROVED		DRAWING LEVEL									
PIGGOTTI		2									

UNCLASSIFIED

ZONE		REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA		INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



DETAIL A
SCALE 2.000

(FOR O-RING
AS 568A-390
20.9551D x $\phi .210$)

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QTY	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO
		PLATE, 1.5in THK	ALUM 6061-T6	1

THIRD ANGLE PROJECTION		PARTS LIST	
		WEIGHT(lbs): 59.973	TITLE
		APPROVALS	DATE
		ORIGINATOR: BROOKSBYI	11/22/10
		DRAWN: BROOKSBYI	2/16/11
		CHECKED: KILLINGSWORTH2	2/28/11
		APPROVED: PIGGOTTI	3/1/11
		DRAWING LEVEL: 2	

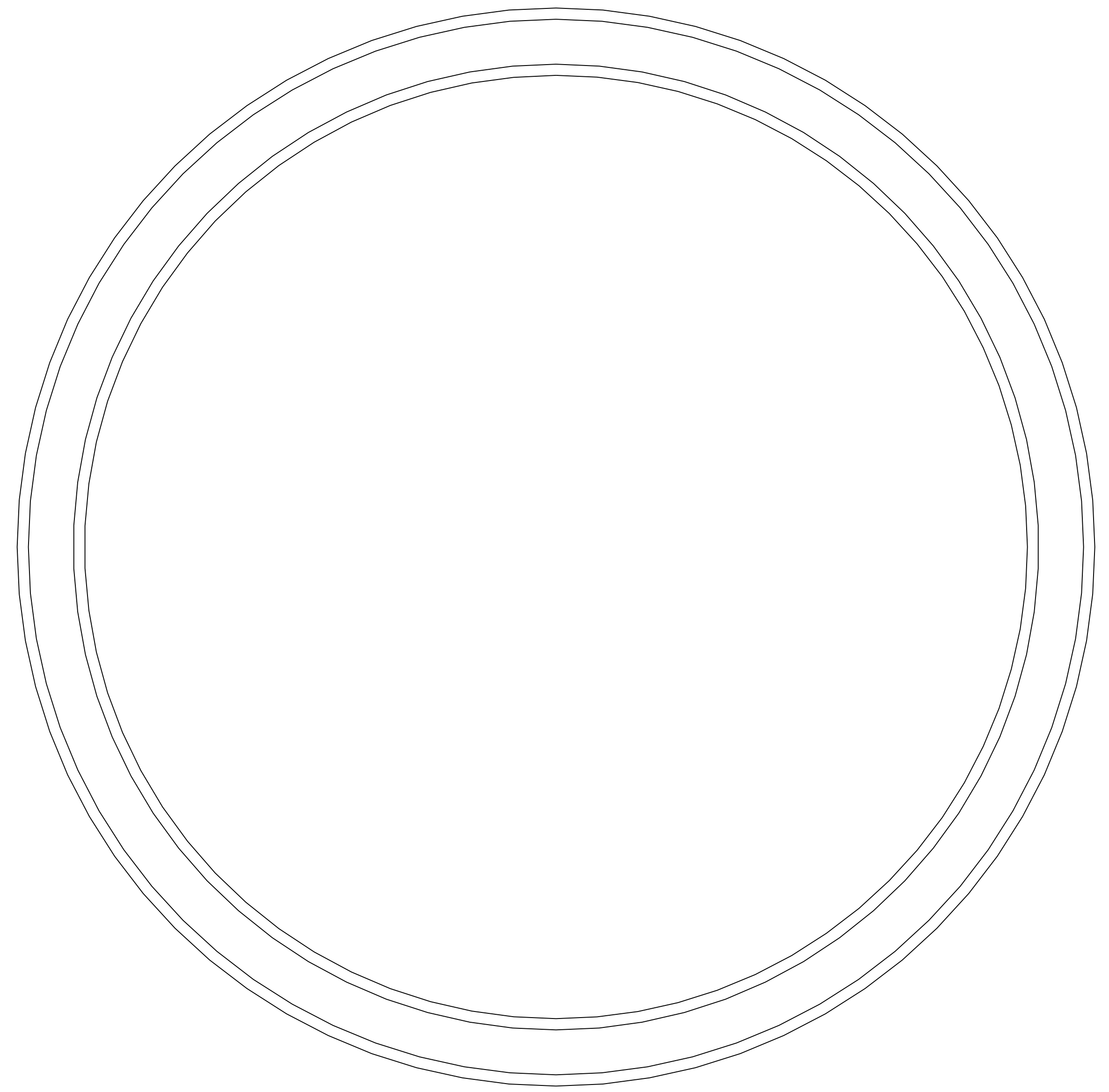
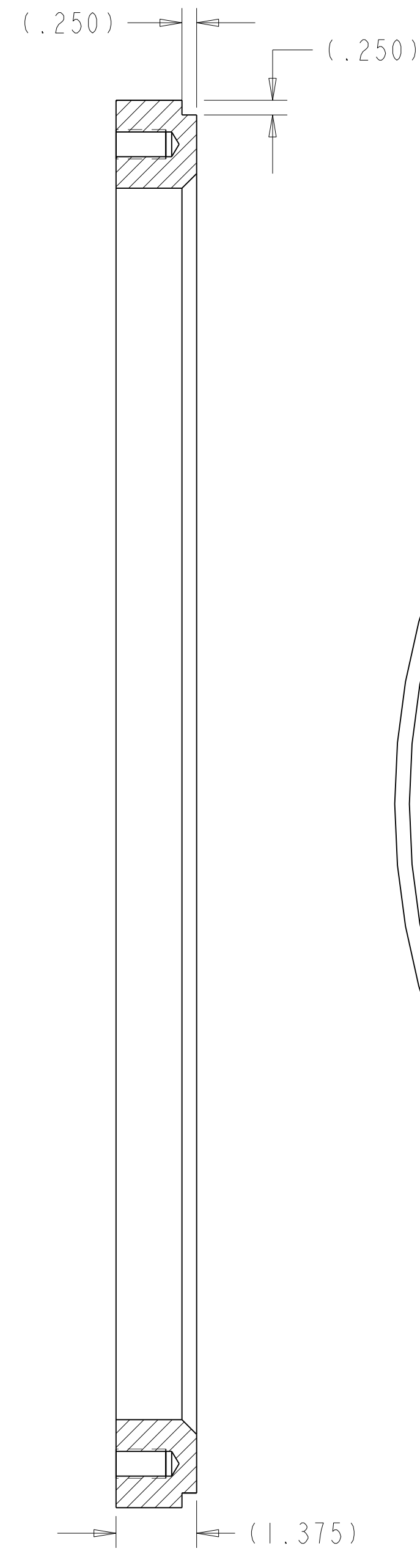
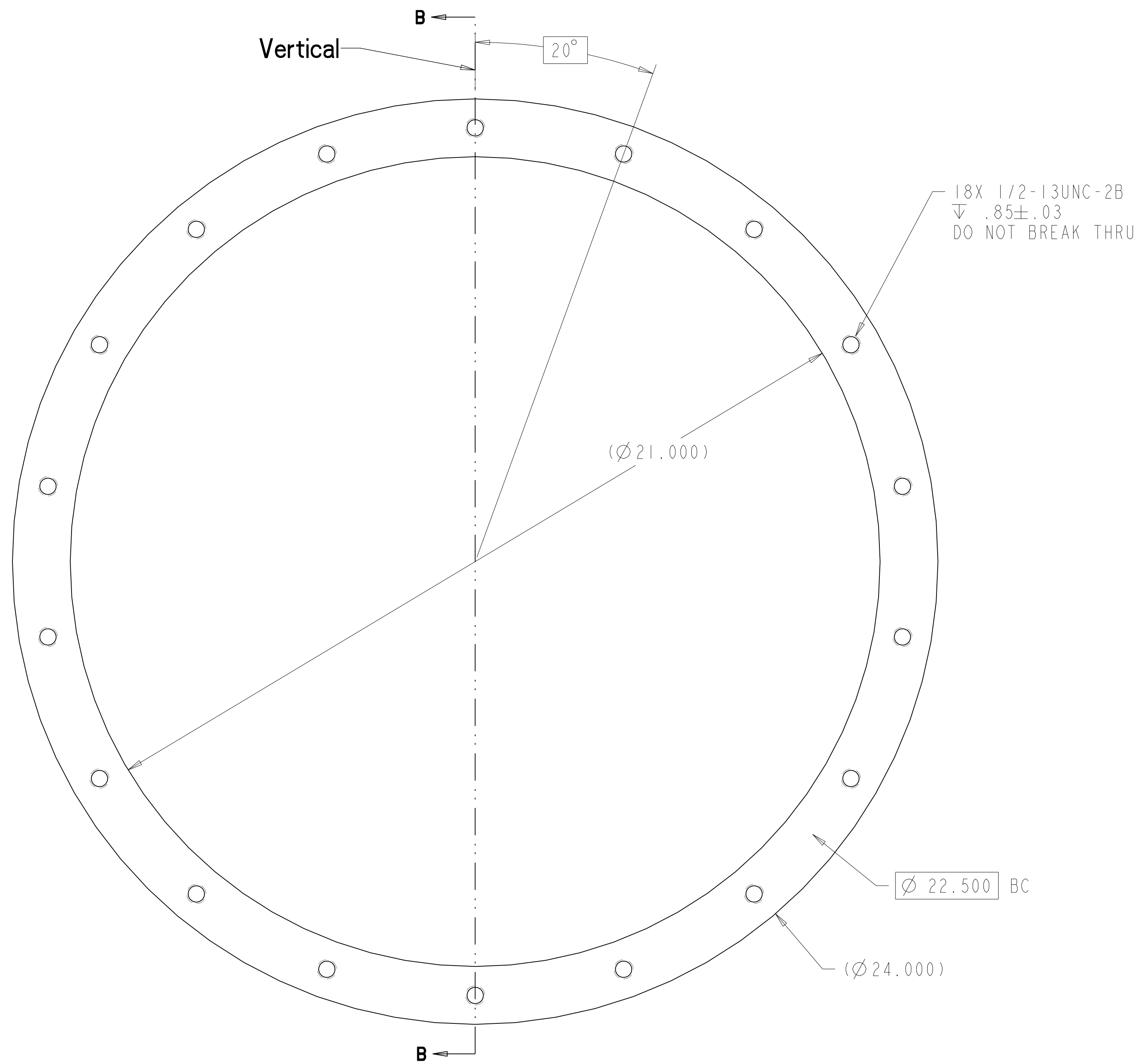
SIZE	CAGE CODE	DWG NO	REV
D	14067	AAA11-501276-AA	

SCALE: NONE SHEET 1 OF 1

UNCLASSIFIED

UNCLASSIFIED

ZONE		REV	DESCRIPTION	REVISIONS			
AA	INITIAL RELEASE	BROOKSBY1	KILLINGSWORTH2	PIGGOTT1	3-1-11	DATE	



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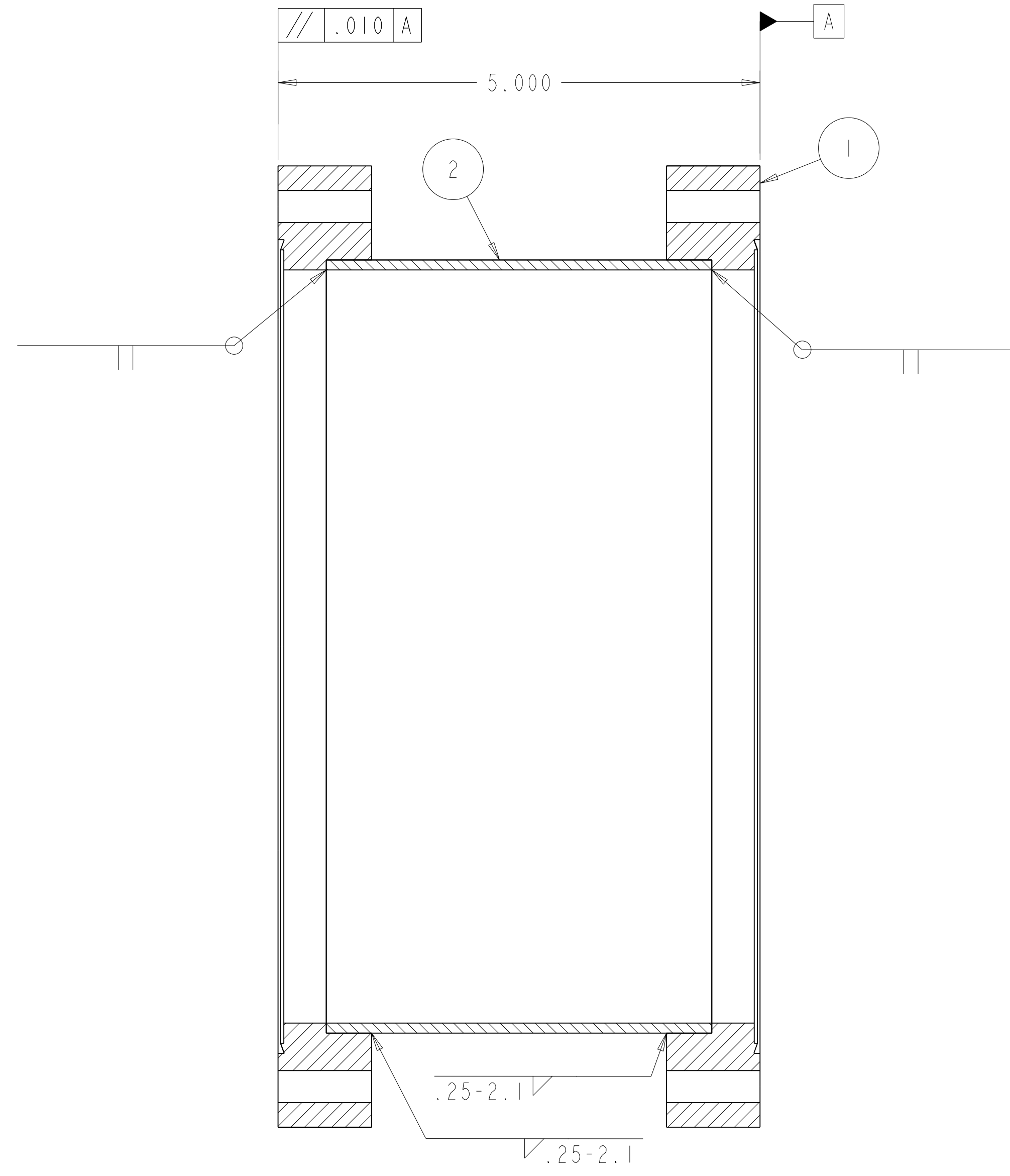
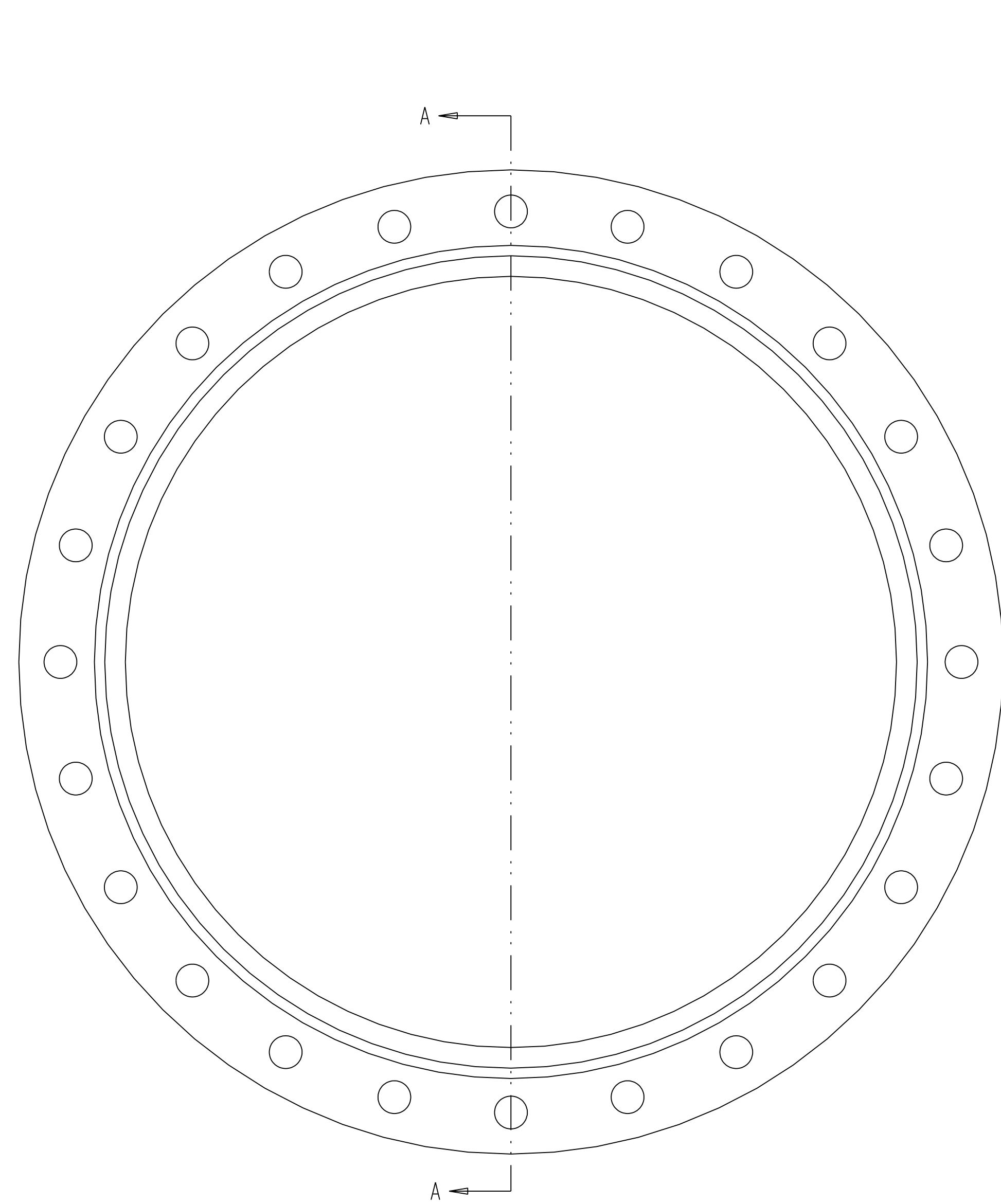
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QTY RECD		PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	SST	304	I
THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY LAWRENCE LIVERMORE NATIONAL SECURITY-LLC		
WEIGHT(lbs):		39.054		TITLE		
APPROVALS		DATE		VESEL PORT FLANGE IB		
ORIGINATOR BROOKSBY1		11/22/10		SIZE	CAGE CODE	DWG NO
DRAWN BROOKSBY1		2/16/11		D	14067	AAA11-501277-AA
CHECKED KILLINGSWORTH2		2/28/11		SCALE:	NONE	
APPROVED PIGGOTT1		3/1/11		SHEET 1 OF 1		
DECIMALS		ANGLES				
± 0.005		± 0.5				

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ZONE		REV	DESCRIPTION	REVISIONS			
		AA	INITIAL RELEASE	DWN	CHK	APVD	DATE
		AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3-1-11



SECTION A-A

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL	MATERIAL SPECIFICATION	ITEM NO
1		TUBE, 8in OD x 7.812in ID	SST 304	2
2	110033	10in CF FLANGE, MDC	SST 304	1

THIRD ANGLE PROJECTION		PARTS LIST		LAWRENCE LIVERMORE NATIONAL LABORATORY	
		WEIGHT(lbs):	17.581	LAWRENCE LIVERMORE NATIONAL SECURITY-LLC	
		APPROVALS	DATE	TITLE	
		ORIGINATOR	11/22/10	10in CF SPOOL	
		DRAWN	2/16/11	SIZE	CAGE CODE
		CHECKED	2/28/11	D	14067
		APPROVED	3/1/11	DWG NO	AAA11-501278-AA
		DRAWING LEVEL	2	SCALE:	NONE
				SHEET 1 OF 1	

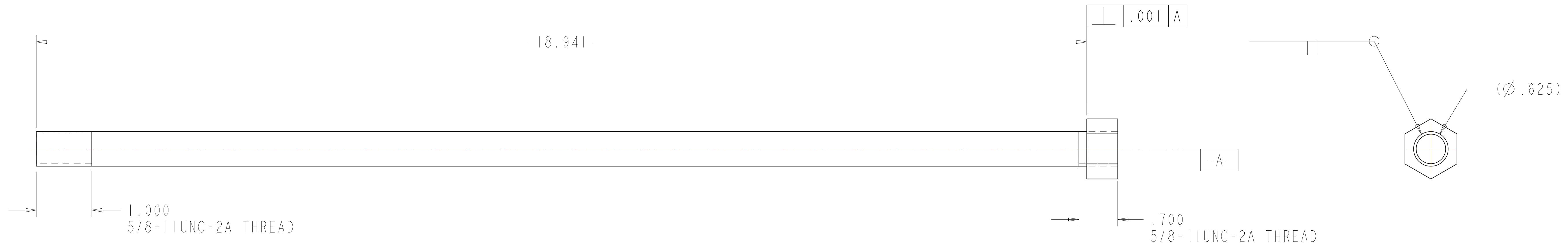
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MODEL: SPOOL_10IN_CF
DRAWING: SPOOL_10IN_CF

UNCLASSIFIED

REVISIONS						
ZONE	REV	DESCRIPTION	DWN	CHK	APVD	DATE
	AA	INITIAL RELEASE	BROOKSBYI	KILLINGSWORTH2	PIGGOTTI	3/1/11



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		SST		304	I
QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION/MATERIAL		MATERIAL SPECIFICATION	ITEM NO
PARTS LIST					
THIRD ANGLE PROJECTION		WEIGHT(lbs): 1.828		LAWRENCE LIVERMORE NATIONAL LABORATORY	
APPROVALS		DATE	TITLE		
ORIGINATOR BROOKSBYI		11/22/10	ROD ASSY WELDMNT		
DRAWN BROOKSBYI		2/16/11	LAWRENCE LIVERMORE NATIONAL SECURITY-LLC		
CHECKED KILLINGSWORTH2		2/28/11	SIZE CAGE CODE DWG NO REV		
APPROVED PIGGOTTI		3/1/11	D 14067	AAA11-501279 - AA	
DRAWING LEVEL 2		SCALE: NONE		SHEET 1 OF 1	

UNCLASSIFIED

PROJECT: THREADED-ROD-ASSY1 MODEL: THREADED-ROD-ASSY1