Modular Coil Assembly and Interface Design Issues

3/22/07

Objectives

- Review chits and open issues from recent modular coil design reviews:
  - Bolted joint design, Feb-22
  - Coil instrumentation, Jan-24

- Other modular coil and interface issues:
  - Bladders
  - Bushings
  - Insulation
  - Clamps

- Prioritize needs for field period assembly start

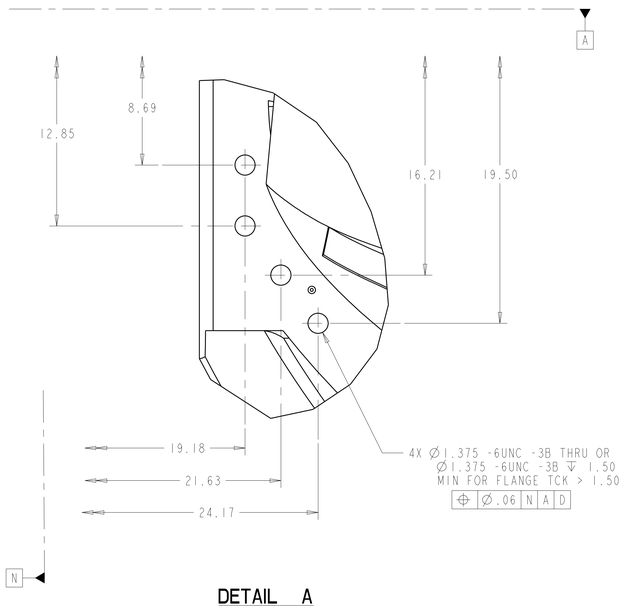
Bolted joint design – open issues

- Shear loads with added inboard bolts
- Shim design, incl inboard shims
- Joint assembly and tightening

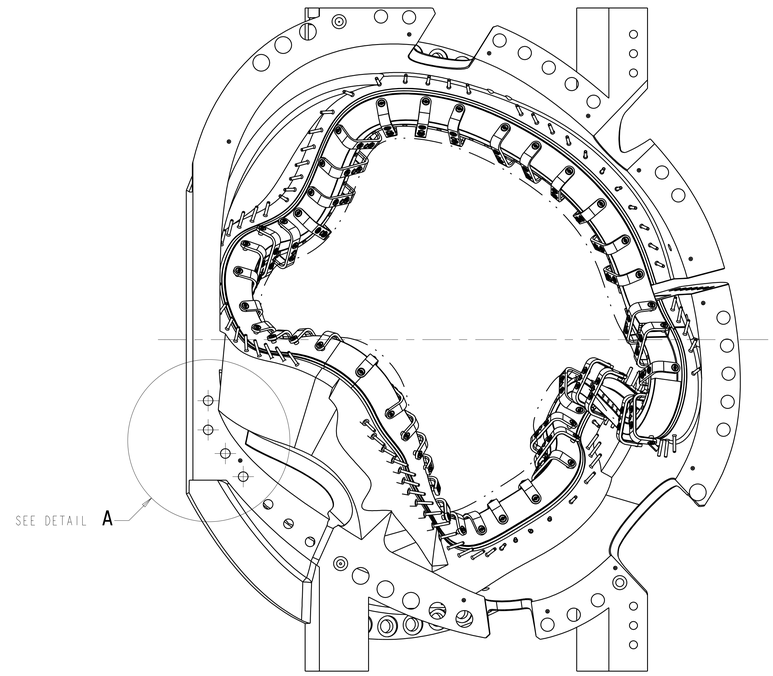
NEXT ASS'Y: FINAL ASS'Y:

NOTES

1. DRAWING PREPARED IN ACCORDANCE WITH ASME Y14.100-2004.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS ARE IN INCHES



DETAIL A
SCALE 0.250



TYPE C WINDING FORM VIEW AT DATUM D
MAY BE PART ONLY OR PARTIALLY ASSEMBLIED
SCALE 0.12

REFERENCE MODEL FOR THIS DRAWING IS SE141-116

P THIS DRAWING PRODUCED ON PRO-ENGINEER

REV	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
0	ORIGINAL ISSUE	GM	03/07									

REVISION OR ISSUE PURPOSE — REVISION APPROVAL

SCALE NOTED

TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONS
XX DECIMALS ±.01
XXX DECIMALS ±.005
ANGLES ±0°15'
BREAK SHARP EDGES .06 MAX
FINISH 125 UNLESS OTHERWISE SPECIFIED

DRAWING APPROVALS		DATE
DES	D WILLIAMSON	03/07
DRW	G MCGINNIS	03/07
CHK		
SECT	:	:
DEPT	:	:
PE	:	:
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGEL	03/07
	:	:
	:	:

UT-BATTELLE
Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under
U.S. GOVERNMENT contract DE-AC05-000R22725
UT-BATTELLE, LLC. Oak Ridge, Tennessee

PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT

TYPE C WINDING FORM MODIFIED TO ADD INNER HOLES

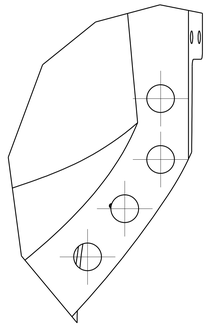
VERSION NO.	PLANT	BLDG	FL	SHT	OF	TYPE	CLASS
0	ORNL	5700	3	1	1	S	U

RELEASE LEVEL: SE141-146 REV 0

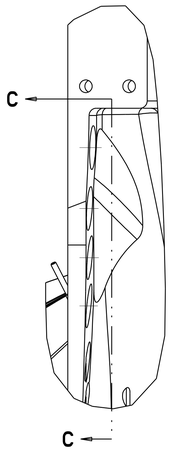
SE141-146

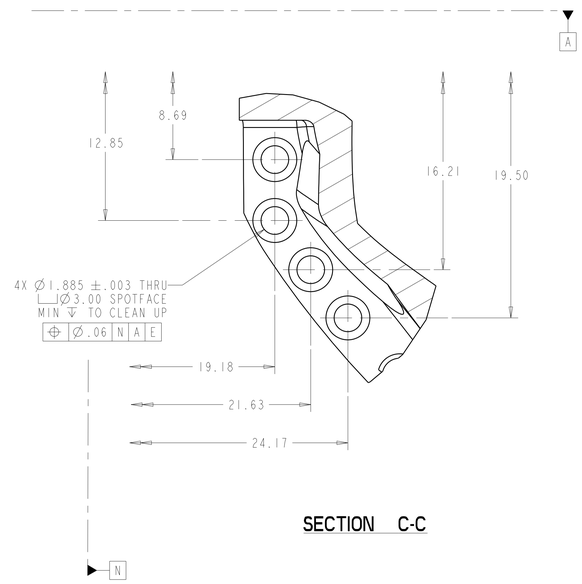
NOTES

1. DRAWING PREPARED IN ACCORDANCE WITH ASME Y14.100-2004.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS ARE IN INCHES

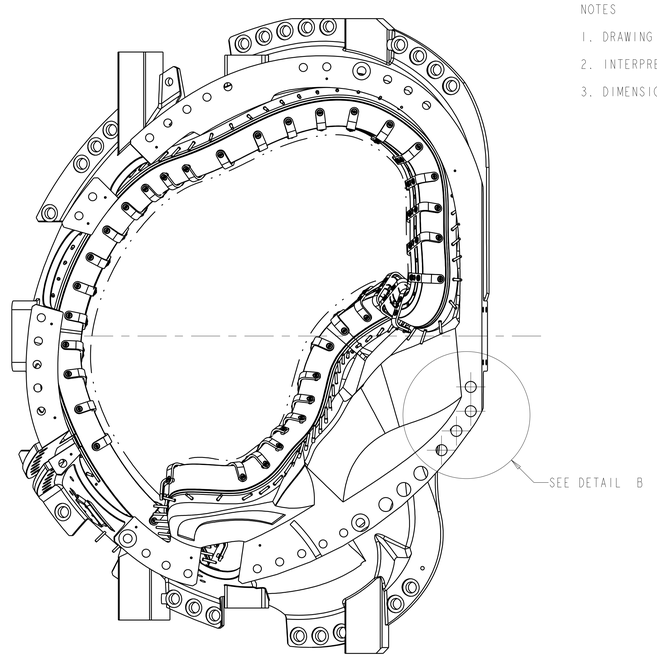


DETAIL B
SCALE 0.250

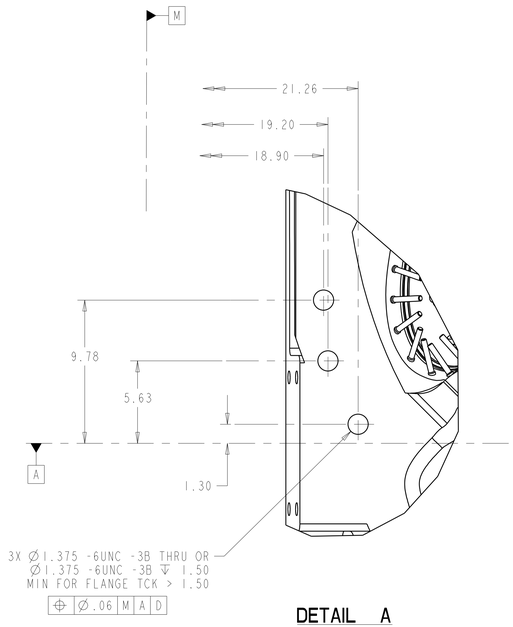




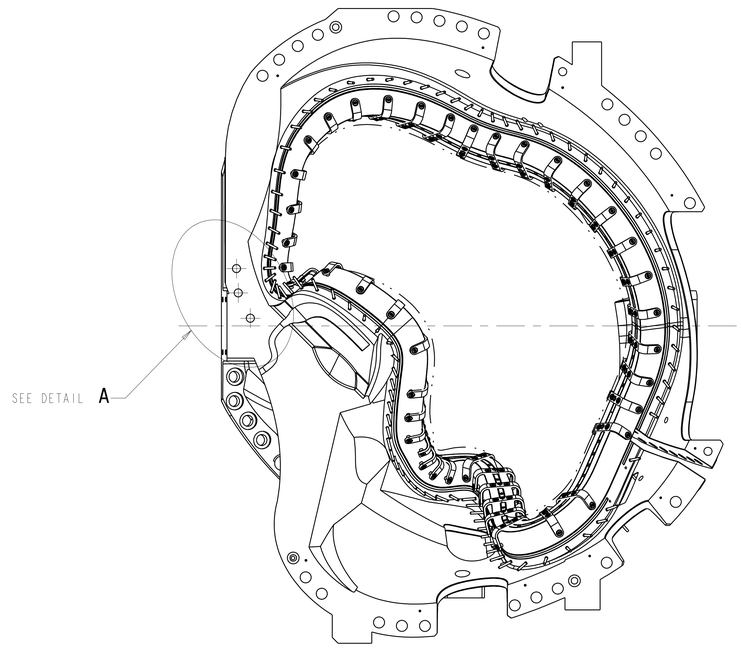
SECTION C-C



TYPE B WINDING FORM VIEW AT DATUM E
MAY BE PART ONLY OR PARTIALLY ASSEMBLIED
SCALE 0.10



DETAIL A
SCALE 0.250



TYPE B WINDING FORM VIEW AT DATUM D
MAY BE PART ONLY OR PARTIALLY ASSEMBLIED
SCALE 0.10

REFERENCE MODEL FOR THIS DRAWING IS SE141-115

P THIS DRAWING PRODUCED ON PRO-ENGINEER

REV.	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
0	ORIGINAL ISSUE	GM	03/07									

REVISION OR ISSUE PURPOSE — REVISION APPROVAL

SCALE NOTED

TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONS .
XX DECIMALS ±.01
XXX DECIMALS ±.005
ANGLES ±0°15'
BREAK SHARP EDGES .06 MAX
FINISH .125 UNLESS OTHERWISE SPECIFIED

DRAWING APPROVALS		DATE
DES	D WILLIAMSON	03/07
DRW	G MCGINNIS	03/07
CHK		
SECT	:	:
DEPT	:	:
PE	:	:
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGEL	03/07
	:	:
	:	:

UT-BATTELLE — Oak Ridge National Laboratory, managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-000R22725 UT-BATTELLE, LLC. Oak Ridge, Tennessee

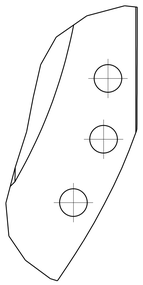
PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT

TYPE B WINDING FORM MODIFIED TO ADD INNER HOLES

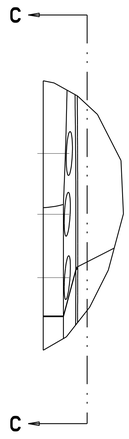
VERSION NO.	PLANT	BLDG	FL	SHT	OF	TYPE	CLASS
0	ORNL	5700	3	1	1	S	U

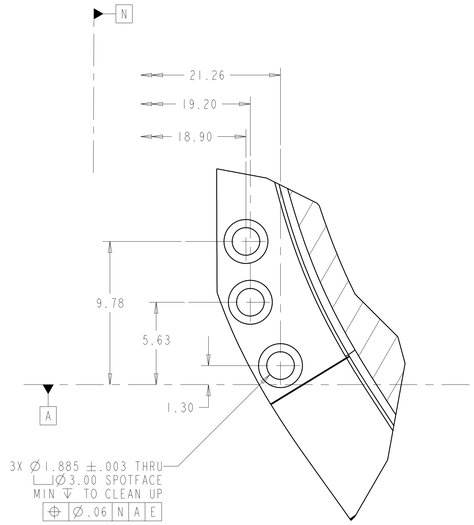
RELEASE LEVEL: SE141-145 — REV 0

SE141-145



DETAIL D
SCALE 0.250

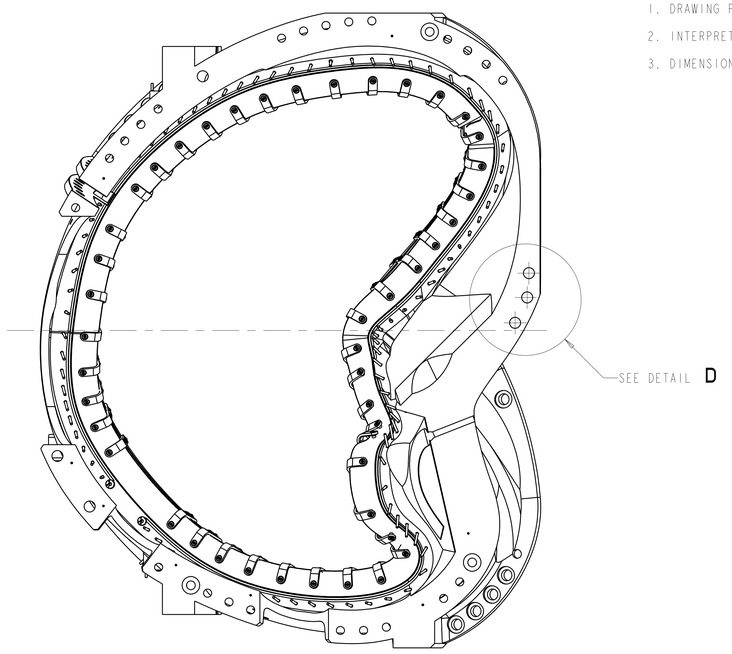




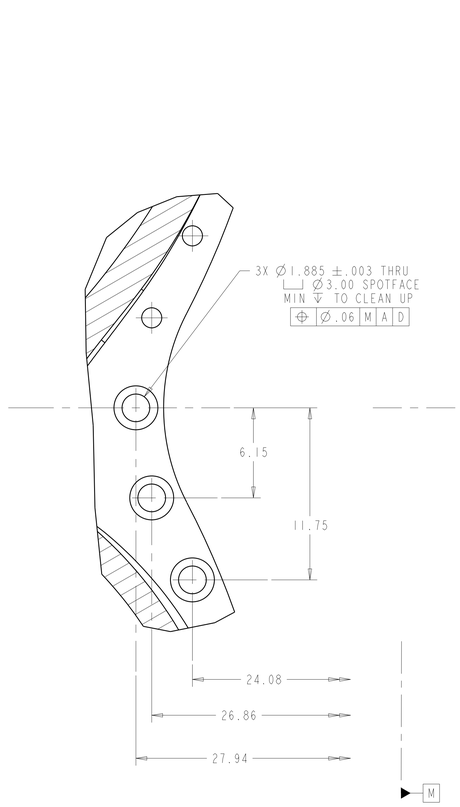
SECTION C-C

NOTES

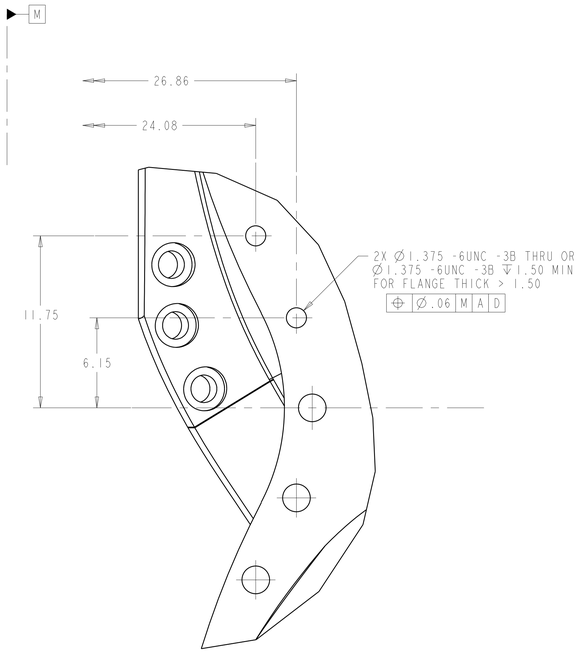
1. DRAWING PREPARED IN ACCORDANCE WITH ASME Y14.100-2004.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS ARE IN INCHES



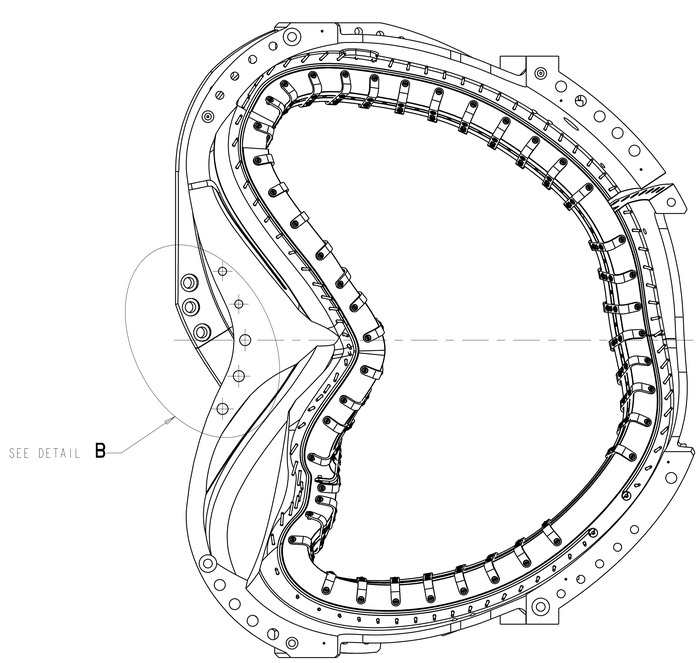
TYPE A WINDING FORM VIEW AT DATUM E
MAY BE PART ONLY OR PARTIALLY ASSEMBLIED
SCALE 0.10



SECTION A-A



DETAIL B
SCALE 0.250



TYPE A WINDING FORM VIEW AT DATUM D
MAY BE PART ONLY OR PARTIALLY ASSEMBLIED
SCALE 0.10

REFERENCE MODEL FOR THIS DRAWING IS SE141-114

P THIS DRAWING PRODUCED ON PRO-ENGINEER

REV	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
0	ORIGINAL ISSUE	GM	03/07									

REVISION OR ISSUE PURPOSE — REVISION APPROVAL

SCALE NOTED

TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONS	
XX DECIMALS	±.01
XXX DECIMALS	±.005
ANGLES	±0°15'
BREAK SHARP EDGES	.06 MAX
FINISH	125 UNLESS OTHERWISE SPECIFIED

DRAWING APPROVALS		DATE
DES	D WILLIAMSON	03/07
DRW	G MCGINNIS	03/07
CHK		
SECT	:	:
DEPT	:	:
PE	:	:
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGEL	03/07
	:	:
	:	:

UT-BATTELLE

Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under
U.S. GOVERNMENT contract DE-AC05-00OR22725
UT-BATTELLE, LLC. Oak Ridge, Tennessee

PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT

TYPE A WINDING FORM
MODIFIED TO ADD INNER HOLES

VERSION NO.	PLANT	BLDG	FL	SHT	OF	TYPE	CLASS
0	ORNL	5700	3	1	1	S	U

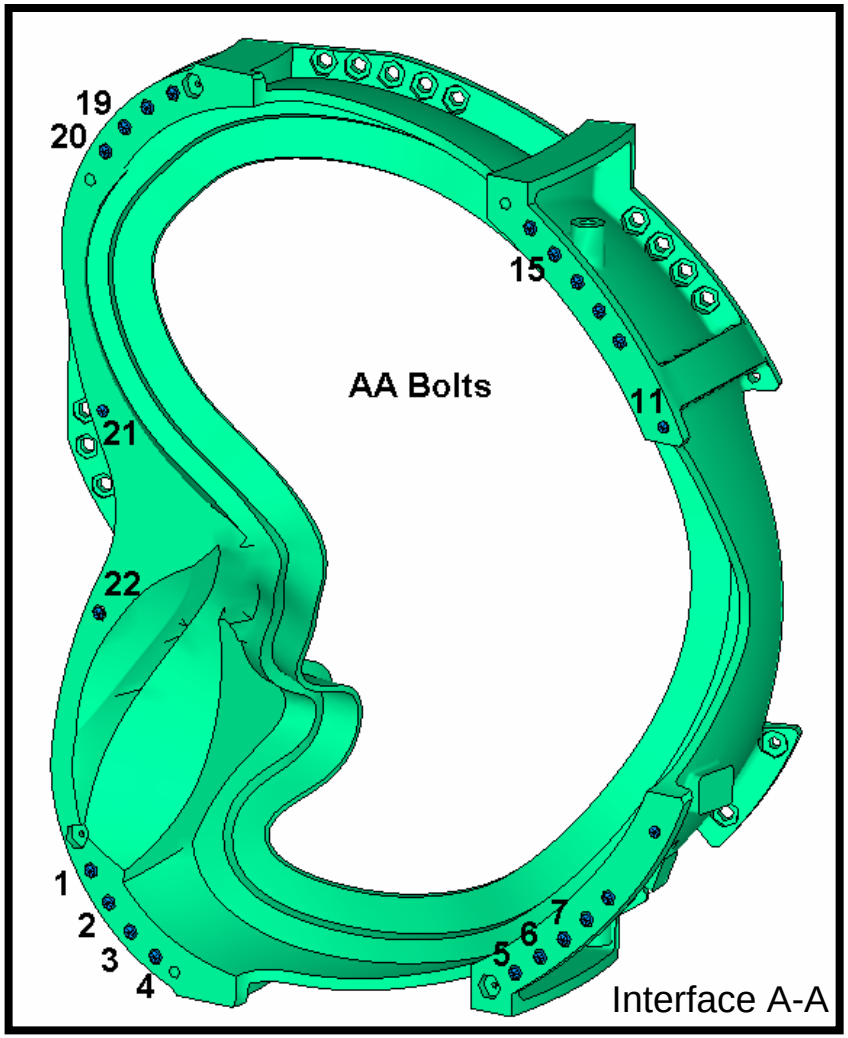
RELEASE LEVEL: SE141-144 REV 0

SE141-144

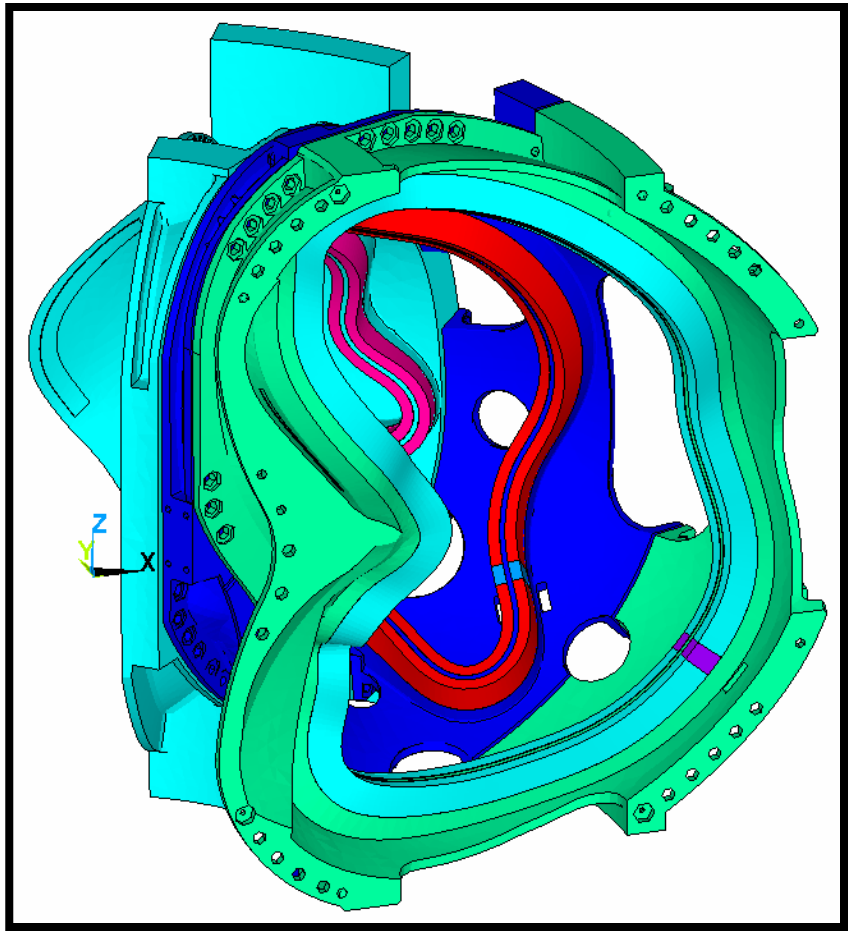
Global w/ Bolts (3)

- Load step difference (preload/EM) used to determine alternating bolt load
- Results preliminary, but suggest alternating load is ~8% of preload

Bolt No.	Tension (kip)	LS Diff (kip)	Shear (kip)
1	76.5	-5.9	7.5
2	78.4	-3.4	4.8
3	79.1	-2.0	3.2
4	78.7	-1.7	2.8
5	83.6	0.7	5.2
6	81.2	0.4	3.1
7	80.8	0.3	3.0
8	81.0	0.0	3.4
9	82.7	-0.1	4.6
10	60.0	-0.4	0.6
11	60.0	-0.4	0.6
12	82.7	-0.1	4.6
13	81.0	0.1	3.4
14	80.9	0.3	3.0
15	81.2	0.5	3.1
16	83.7	0.8	5.2
17	78.6	-1.8	2.7
18	79.0	-2.1	3.0
19	78.2	-3.6	4.5
20	76.1	-6.3	7.0
21	78.2	-1.3	46.7
22	78.2	-0.8	46.9



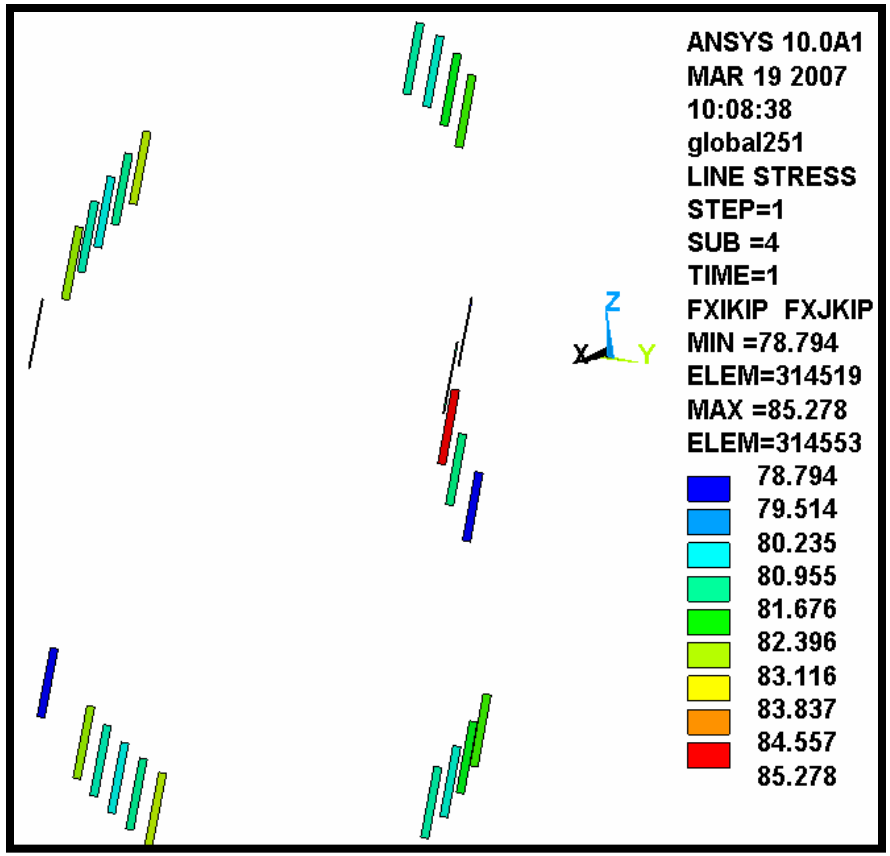
Model Revised to Include (5) A-A Inboard Bolts



Global Model Results, A-A

- Various Contour Plots of A-A Flange Results:
  - Bolt Preload [k-lb or kip]
  - Bolt Shear Force Range [k-lb or kip] produced by EM Load cycle. Non-zero value indicates that the joint is not completely isolated with preload & design-basis friction estimation (μ=0.3).
  - Slippage produced by initial EM Load cycle (~0.3 mm at inboard leg).
  - Incremental Position Shift Following EM ON-Off Cycle

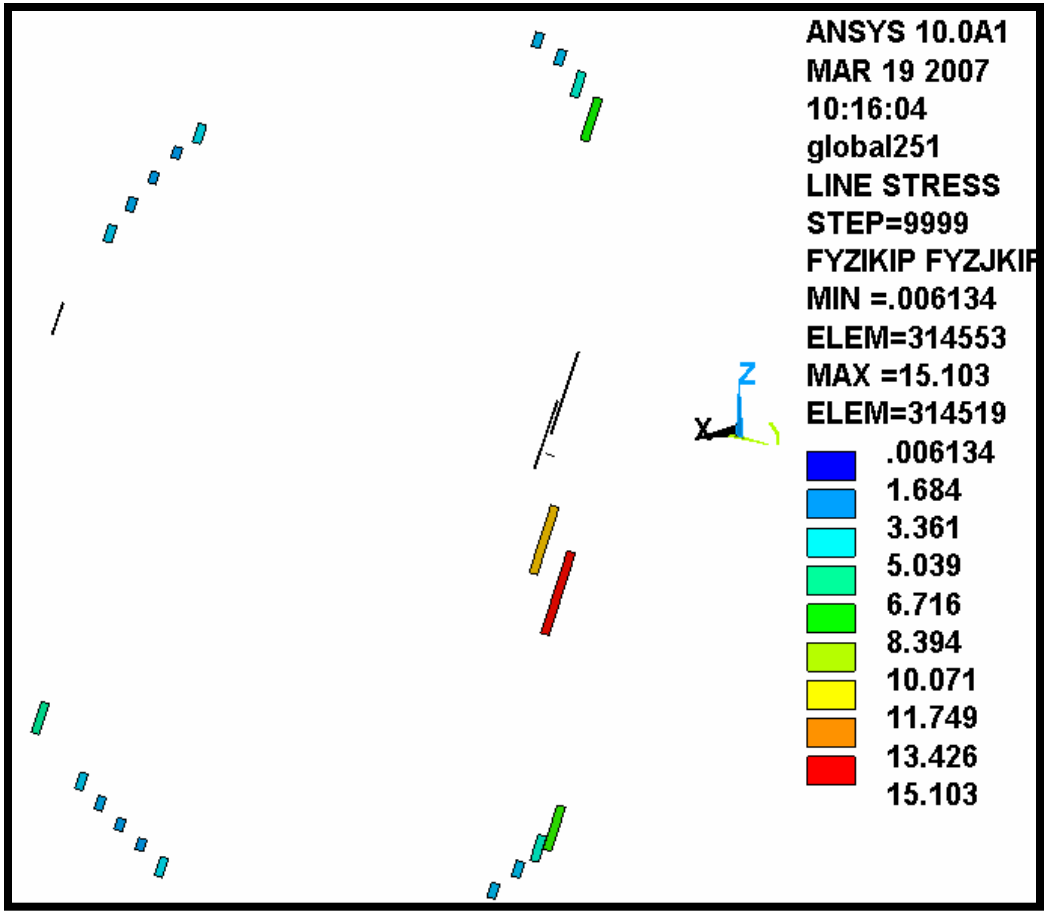
Preload [kip] in A-A Flange Bolts (79 min.<81 Average<85 max.)



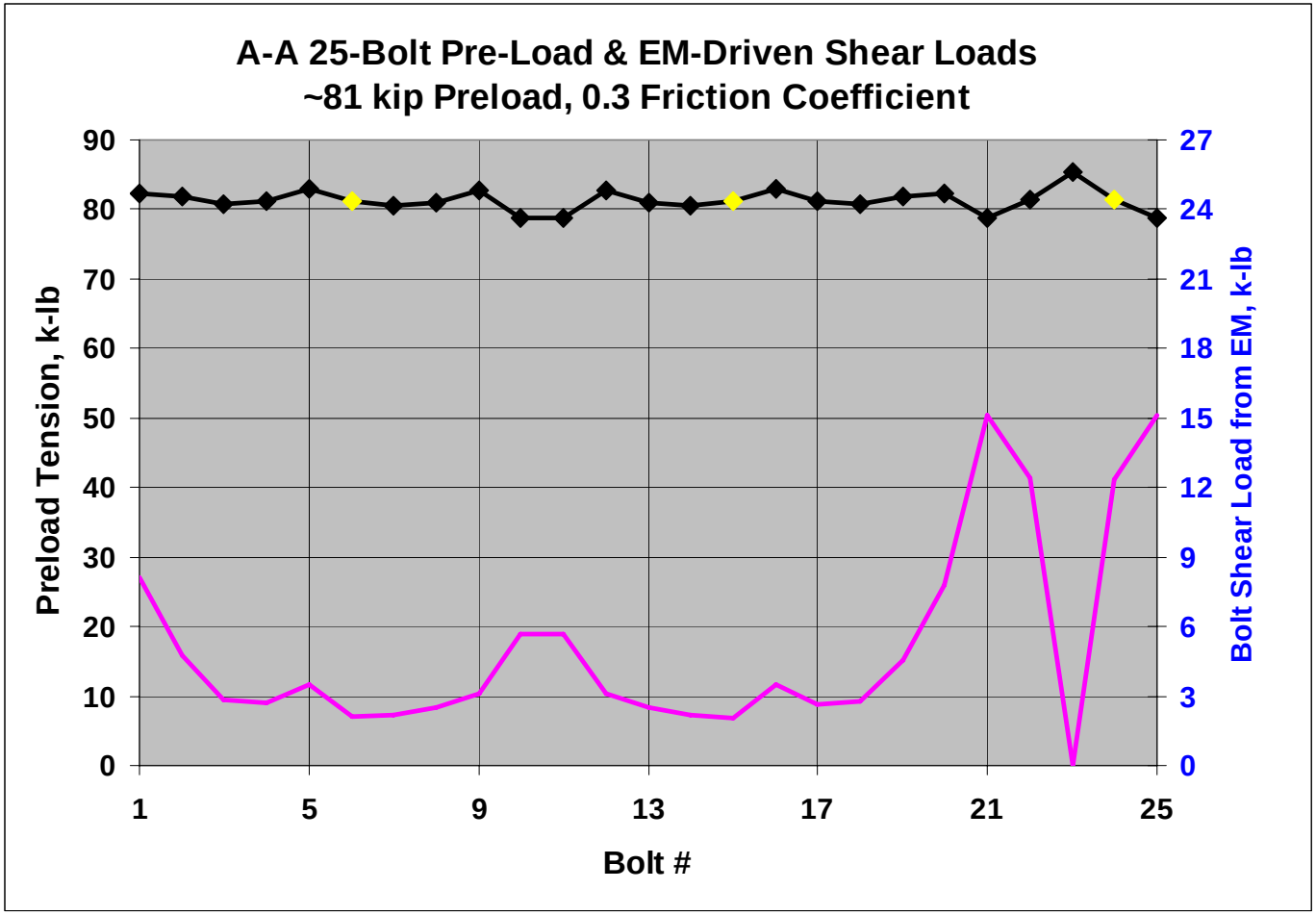
Average Preload 4% higher than 78 kip goal. All below 86 kip limit.

Shear Force Range in A-A Flange Bolts from EM Loads (μ=0.3, 81 kip Preload)

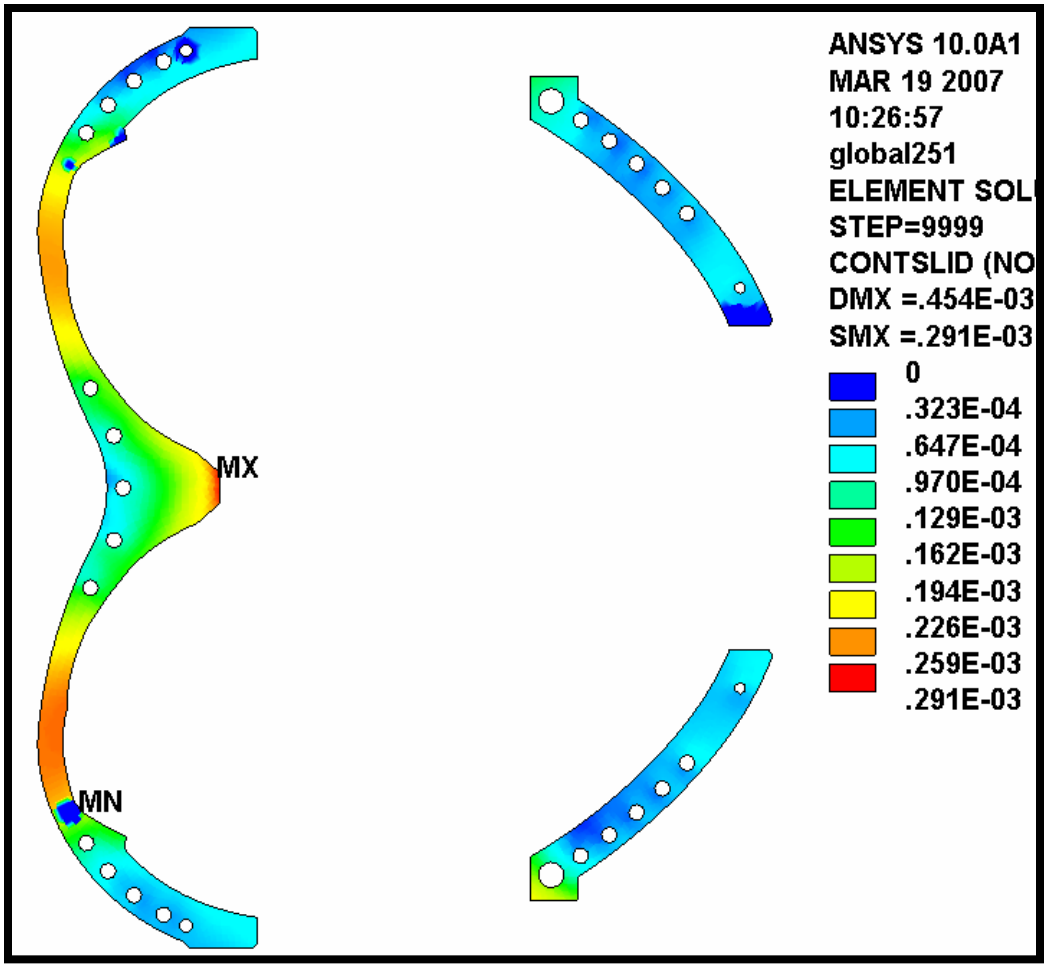
- The addition of (5) Inboard A-A bolts is not sufficient to isolate them from significant shear loads:
- Four of the five inboard bolts carry shear loads of 12-15 kip.



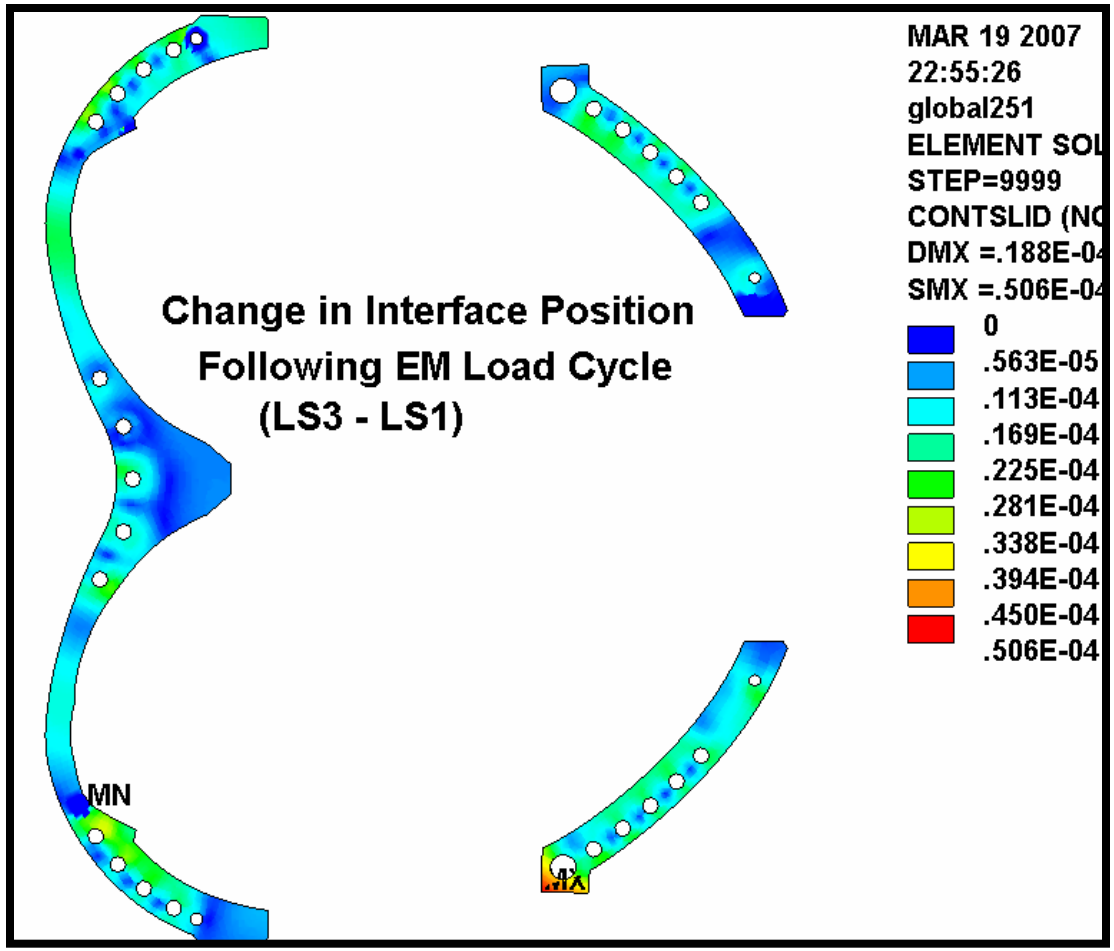
A-A Bolt Preload & EM-Driven Shear Load Range



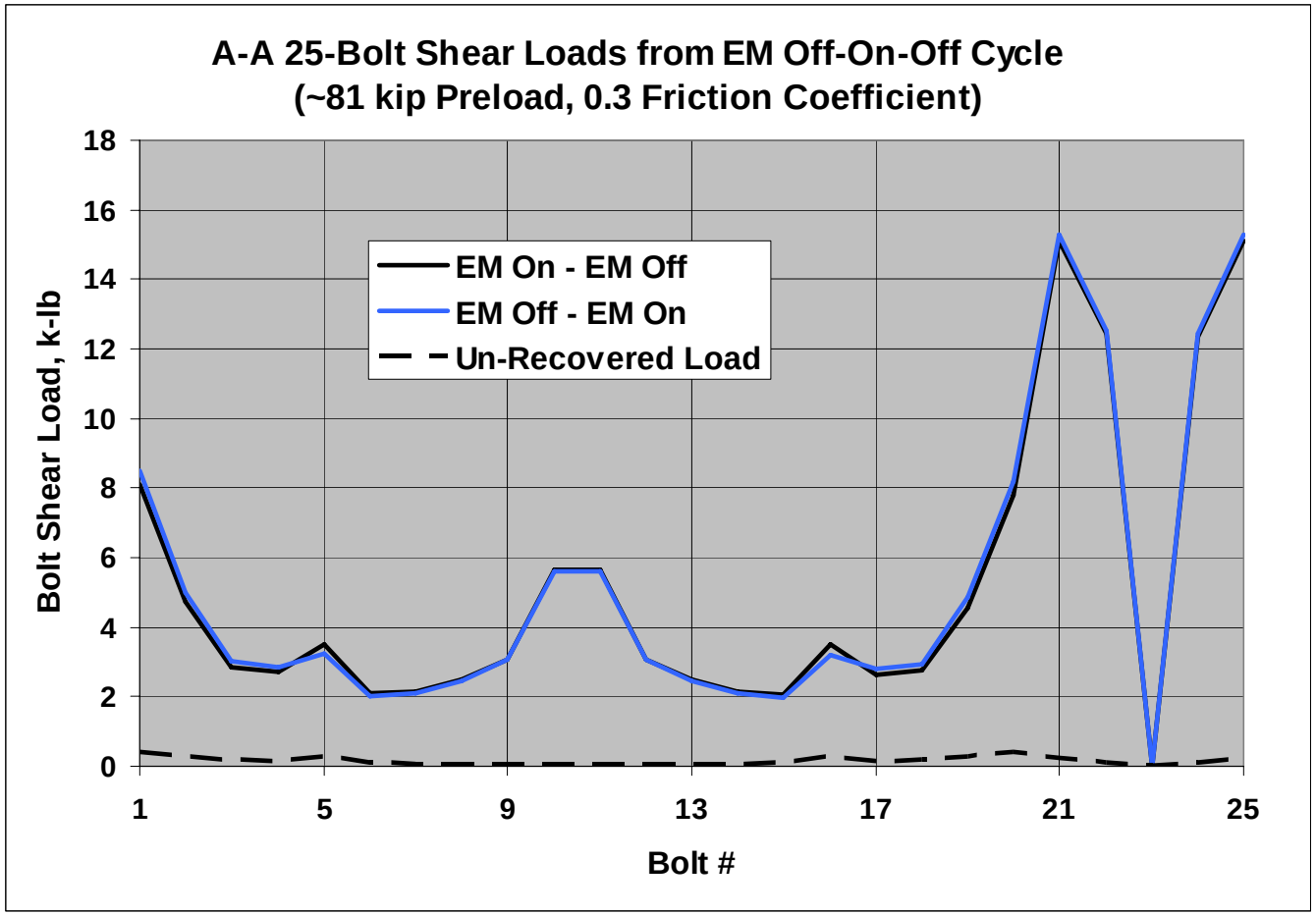
Contact Slippage [m] at A-A Flange From EM Loading (μ=0.3, 81 kip Preload)



Incremental Position Shift Following EM ON-Off Cycle



Bolt Shear Load Range History & Un-Recovered from EM Cycle



Observations: Revised A-A

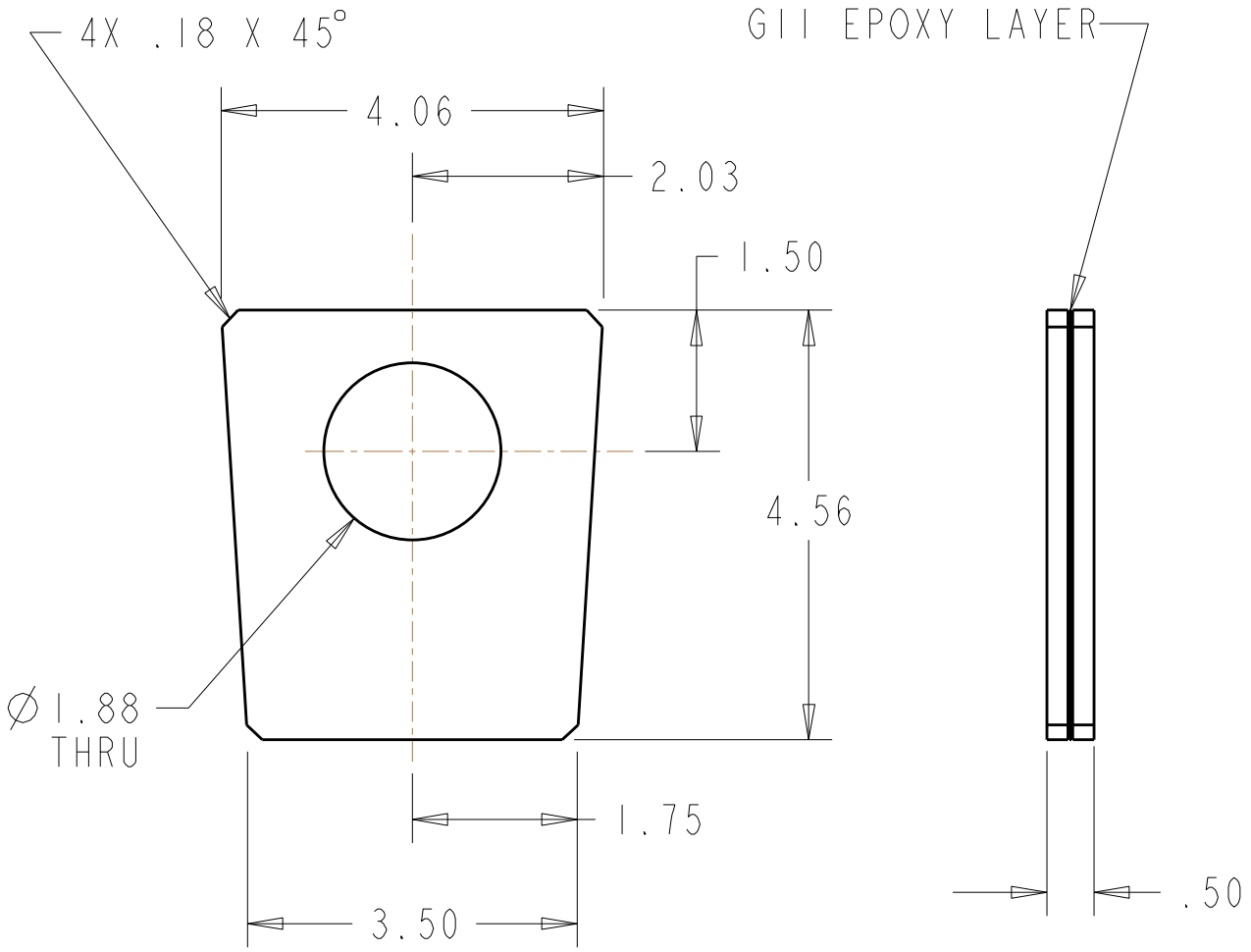
- (25) A-A bolts with 81 kip average preload cannot produce a no-slip interface.
- (4) of the (5) Inboard Leg bolts carry shear loads of 12.5 to 15 kip when EM loads are applied.
- The shear load in all of the bolts return to pre-EM load levels when EM forces are released.
- This implies that bolts will likely be exposed to a high number of bending stress cycles.
- There is a tiny (0-2 mil) incremental position change from the EM load cycle.

Future Work

- A more thorough analysis of the interface still requires a traditional contact analysis where flange separation can occur.

Shim requirements

- Resist loads
- Maintain geometry
- Isolate electrically
- Capable of dissassembly
- Minimal fab/inst cost

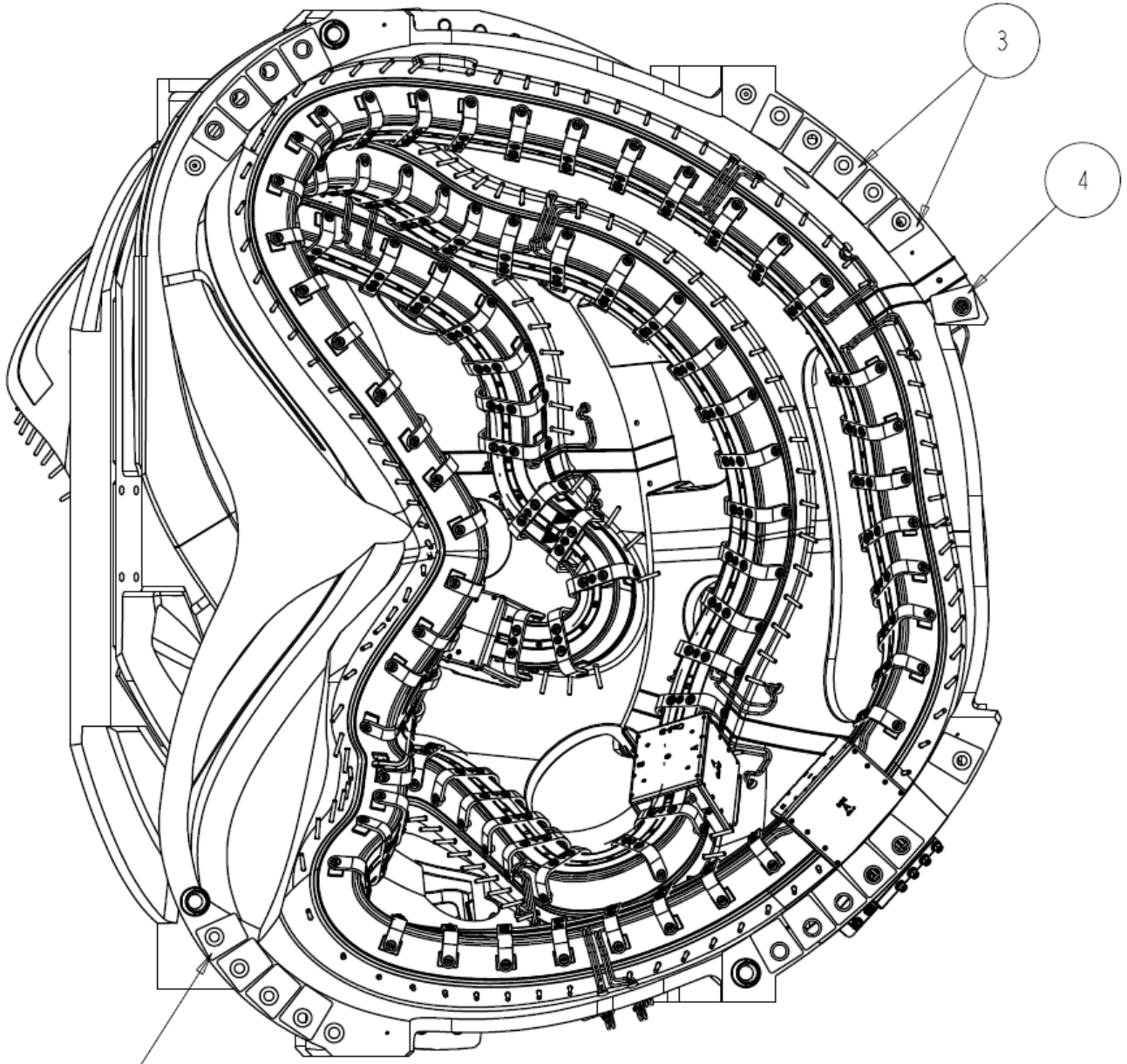


NOTE: ALL DIMENSIONS SHOWN ARE PRELIMINARY

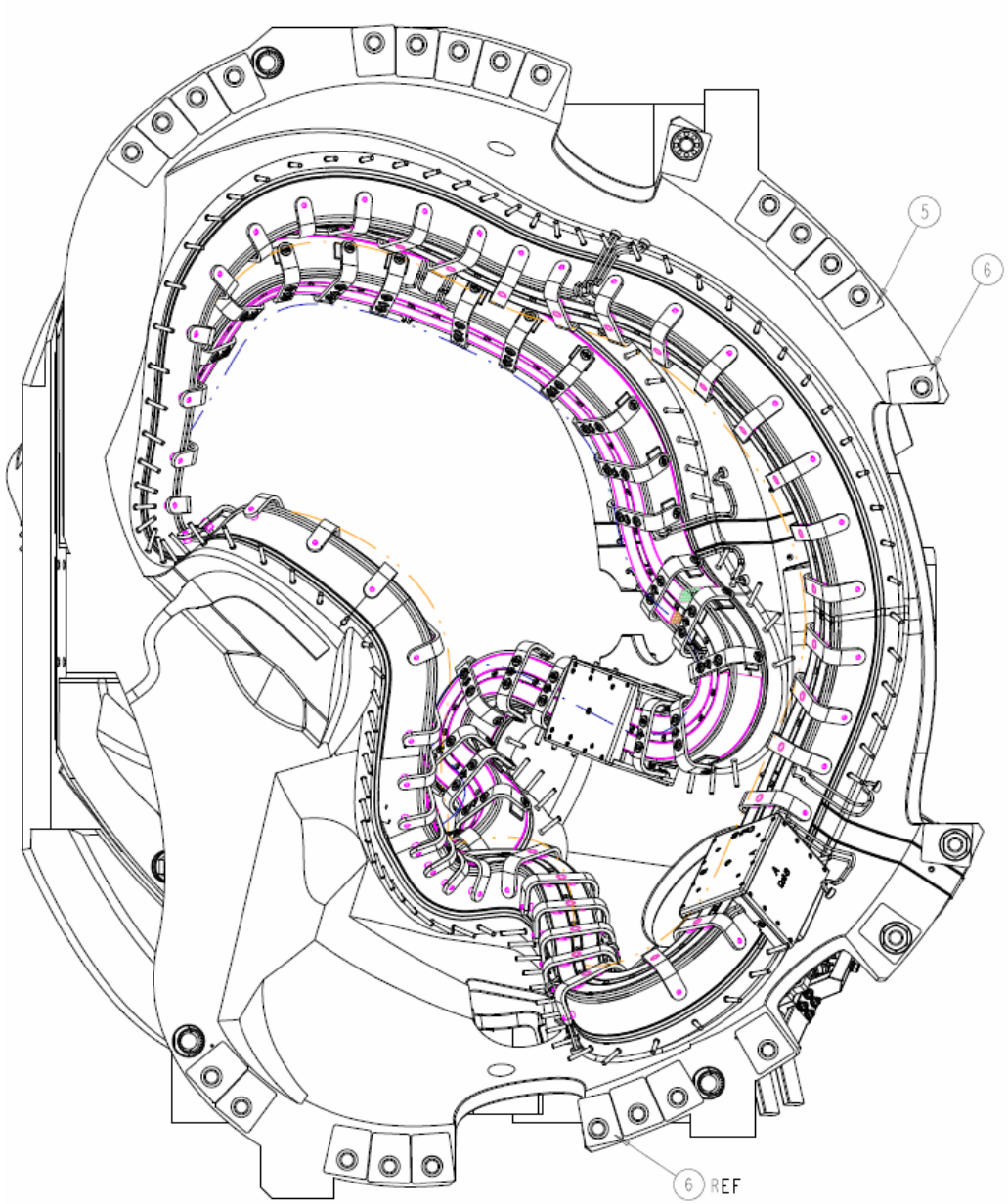
APPROXIMATE QUANTITY = 500

MATERIAL	316 SST	SOURCE	BID / PREFERRED
SPEC	NA	VENDOR	COMPANY ADDRESS PHONE
HEAT TREAT	NA		
COATING	NA		
UNITS	INCHES		

DATA SHEET	FILENAME	TITLE / DESCRIPTION				
UT-BATTELLE Oak Ridge National Laboratory	DS140-040	SINGLE PLACE SHIM PLATE				
	PREPARED BY	CHECKED BY	APPROVED BY	ISSUE DATE	VER	REV
	G MCGINNIS		D WILLIAMSON	01/16/07	1	0

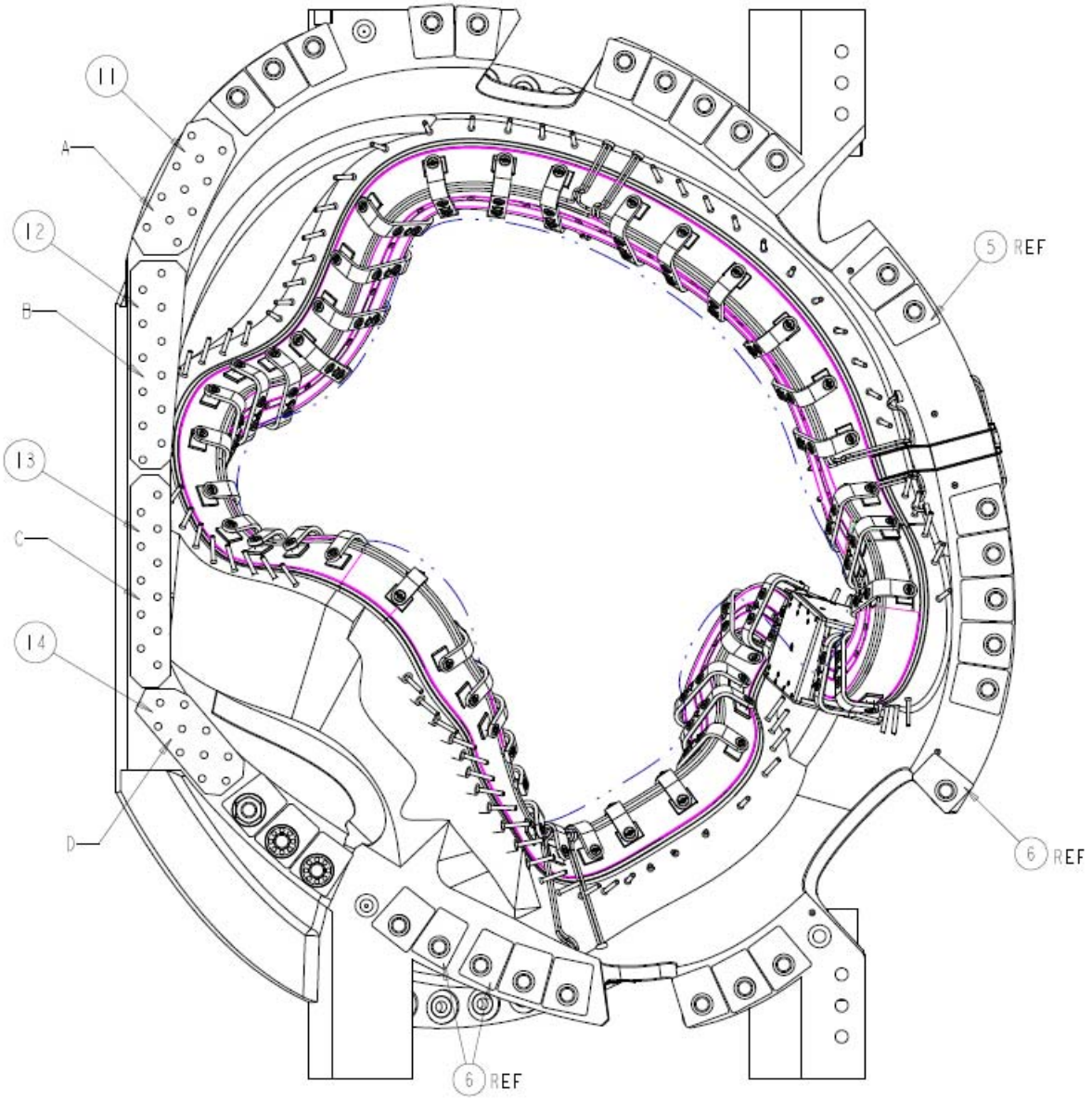


BOLTED JOINT SHIM LAYOUT - AA



VIEW C-C A-B SHIM-SHEAR PLATES

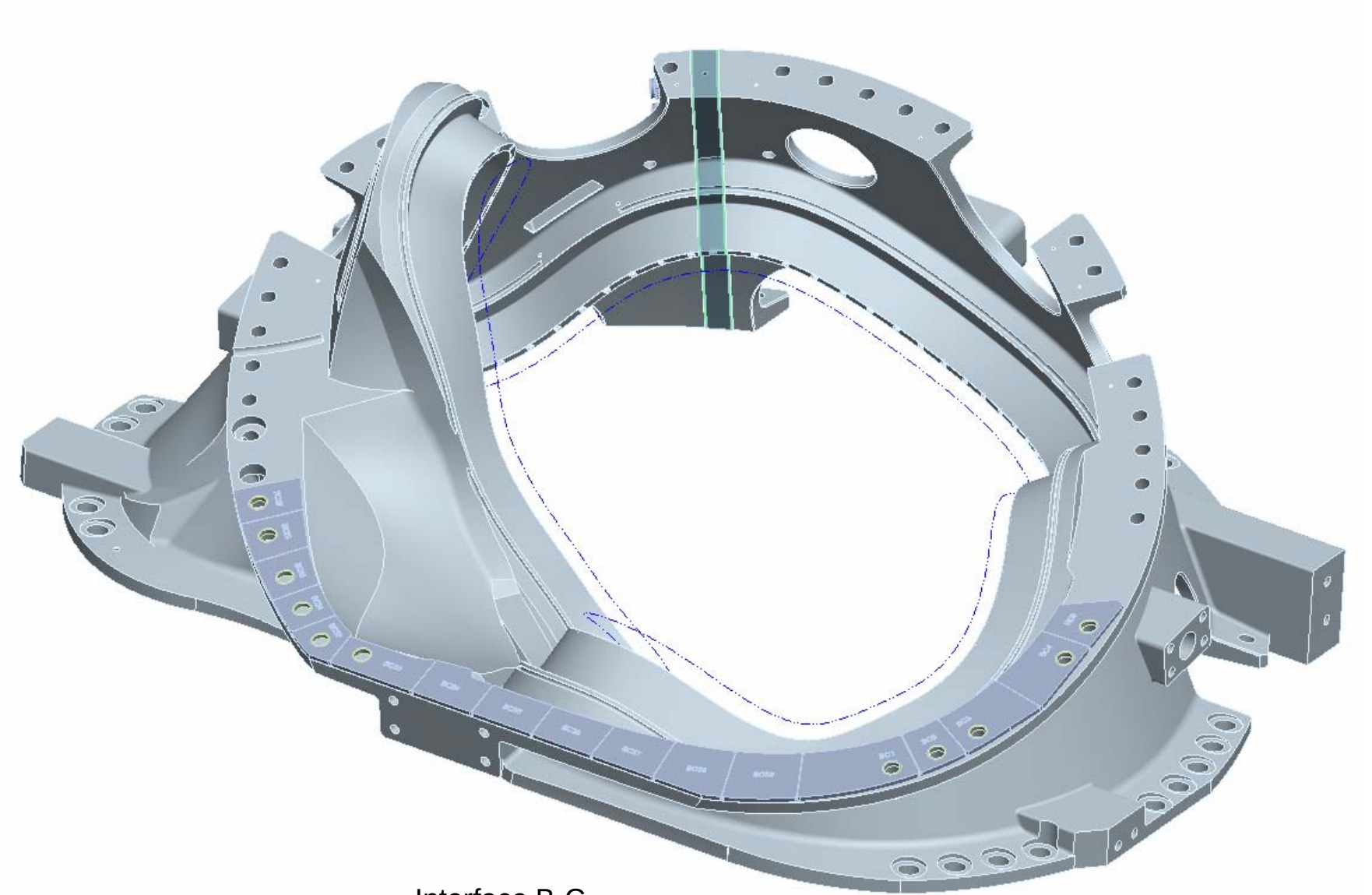
SCALE .12



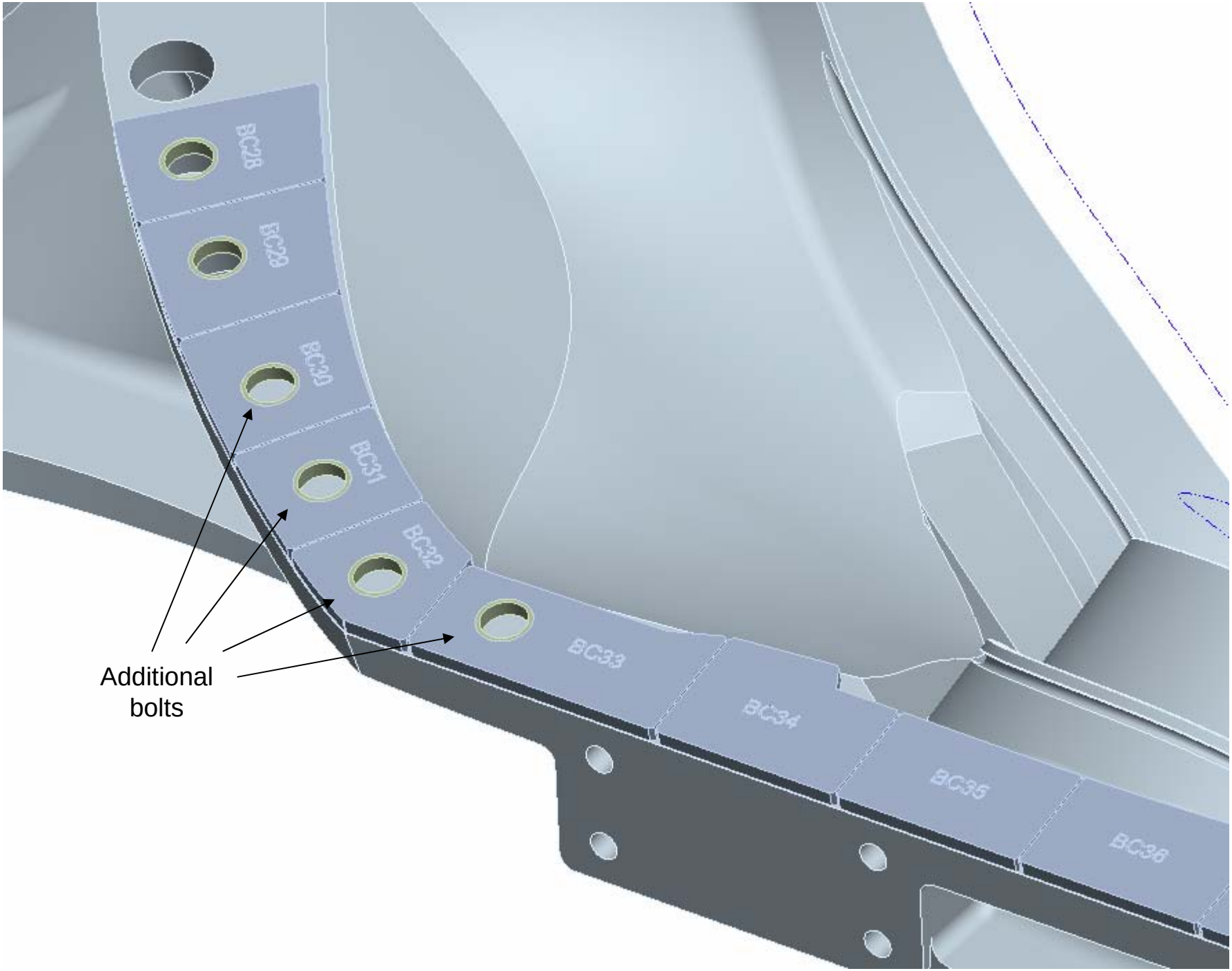
VIEW D-D B-C SHIM-SHEAR PLATES

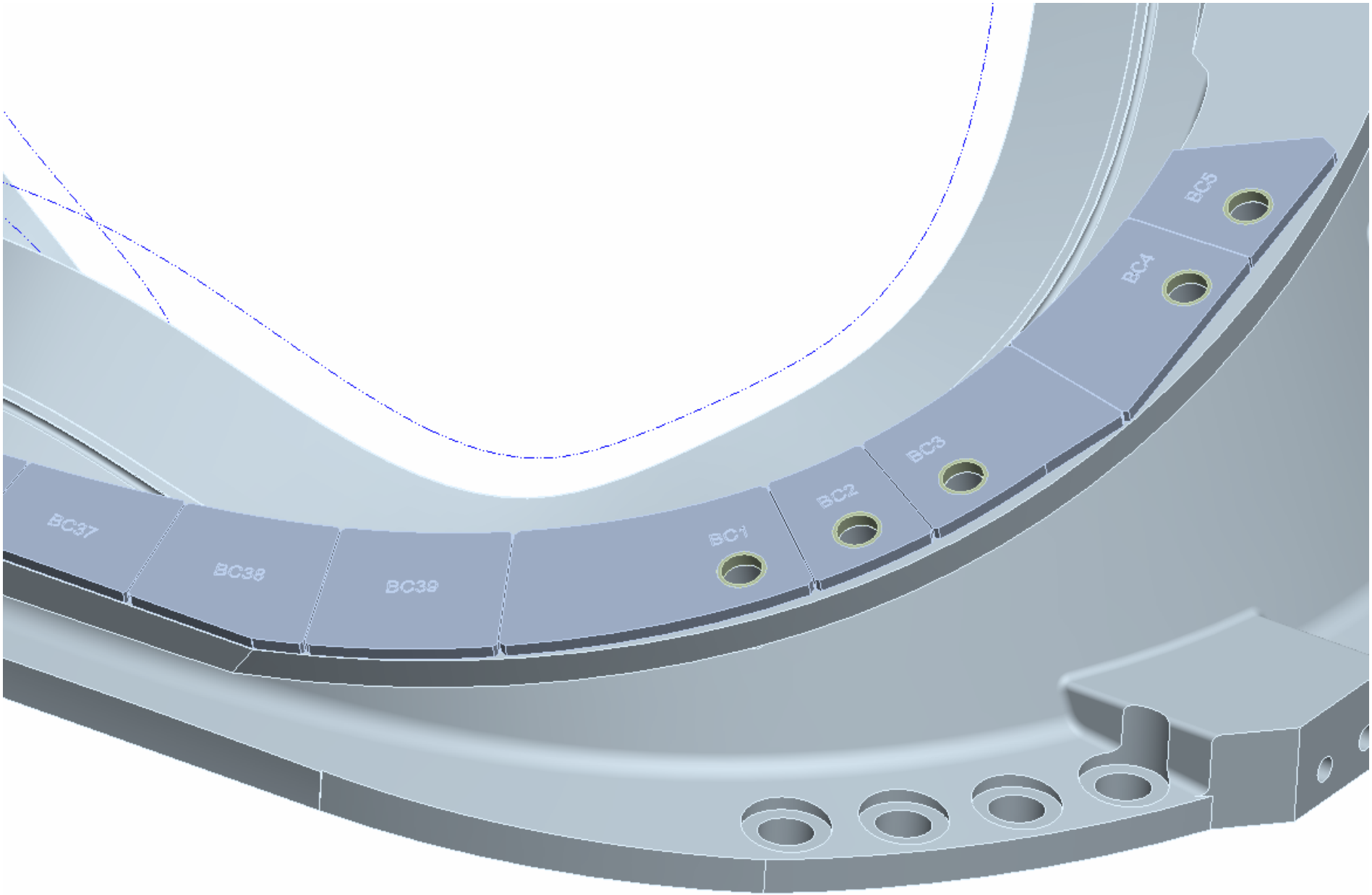
SCALE .12

Individual Shims w/ Custom Shape



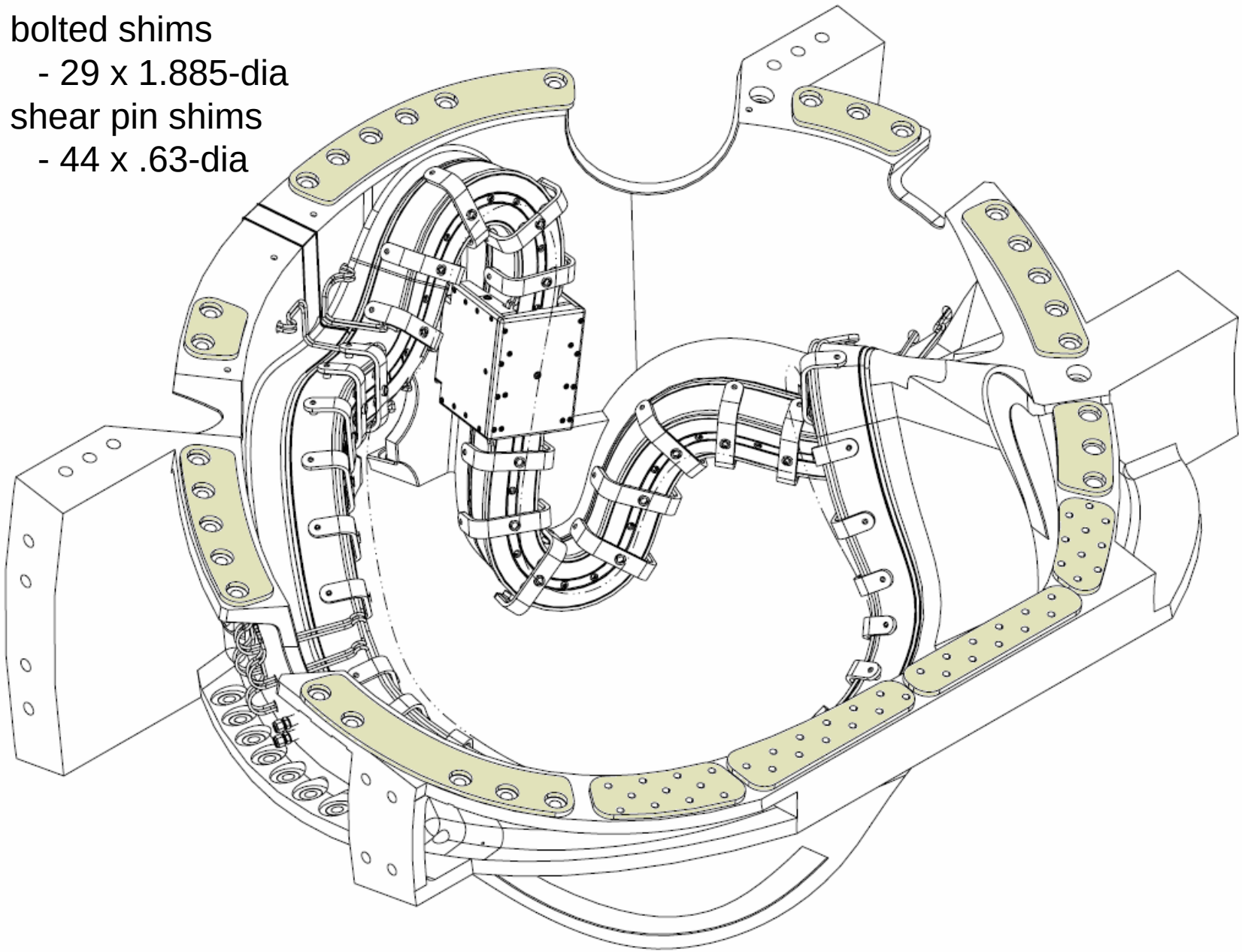
Interface B-C


BC28
BC29
BC30
BC31
BC32
BC33
BC34
BC35
BC36
Additional
bolts

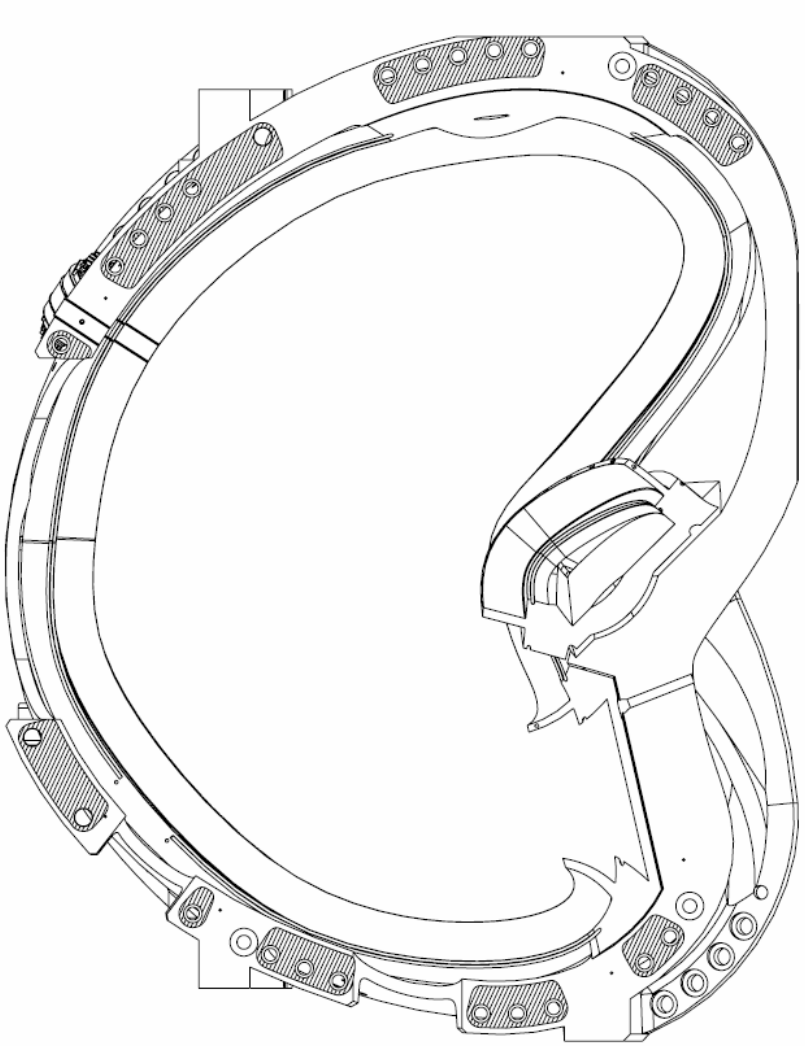

BC37
BC38
BC39
BC1
BC2
BC3
BC4
BC5

COIL-C TO –B INTERFACE

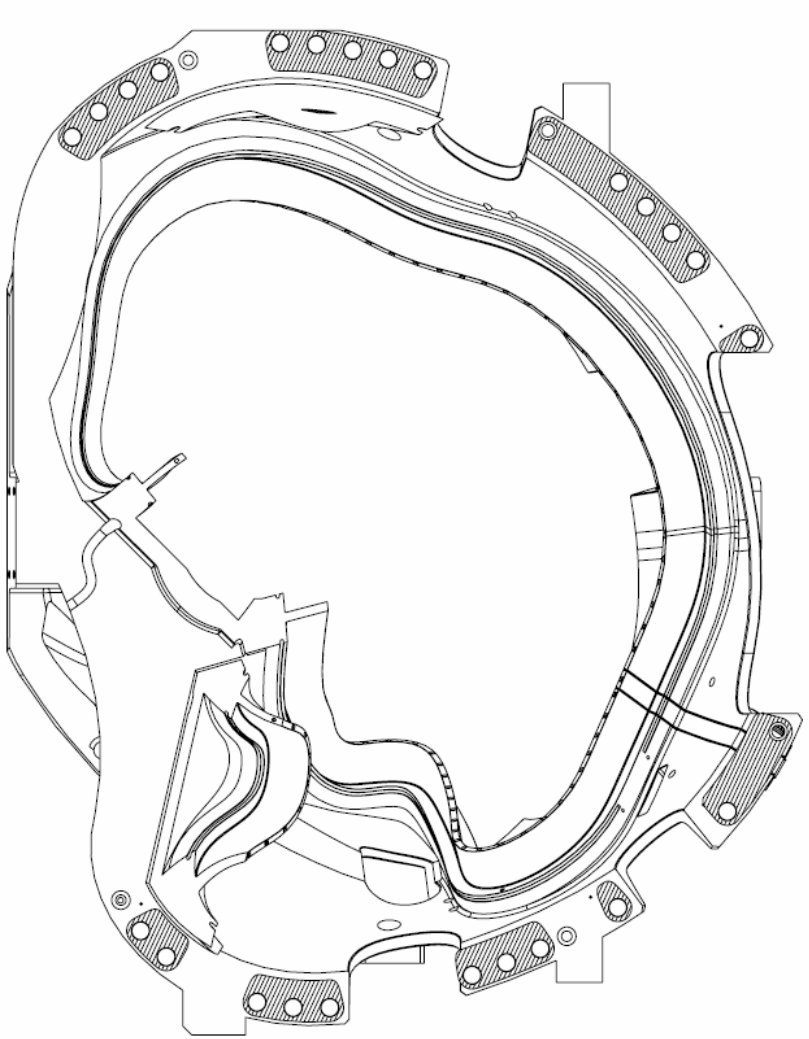
- 7 bolted shims
  - 29 x 1.885-dia
- 4 shear pin shims
  - 44 x .63-dia



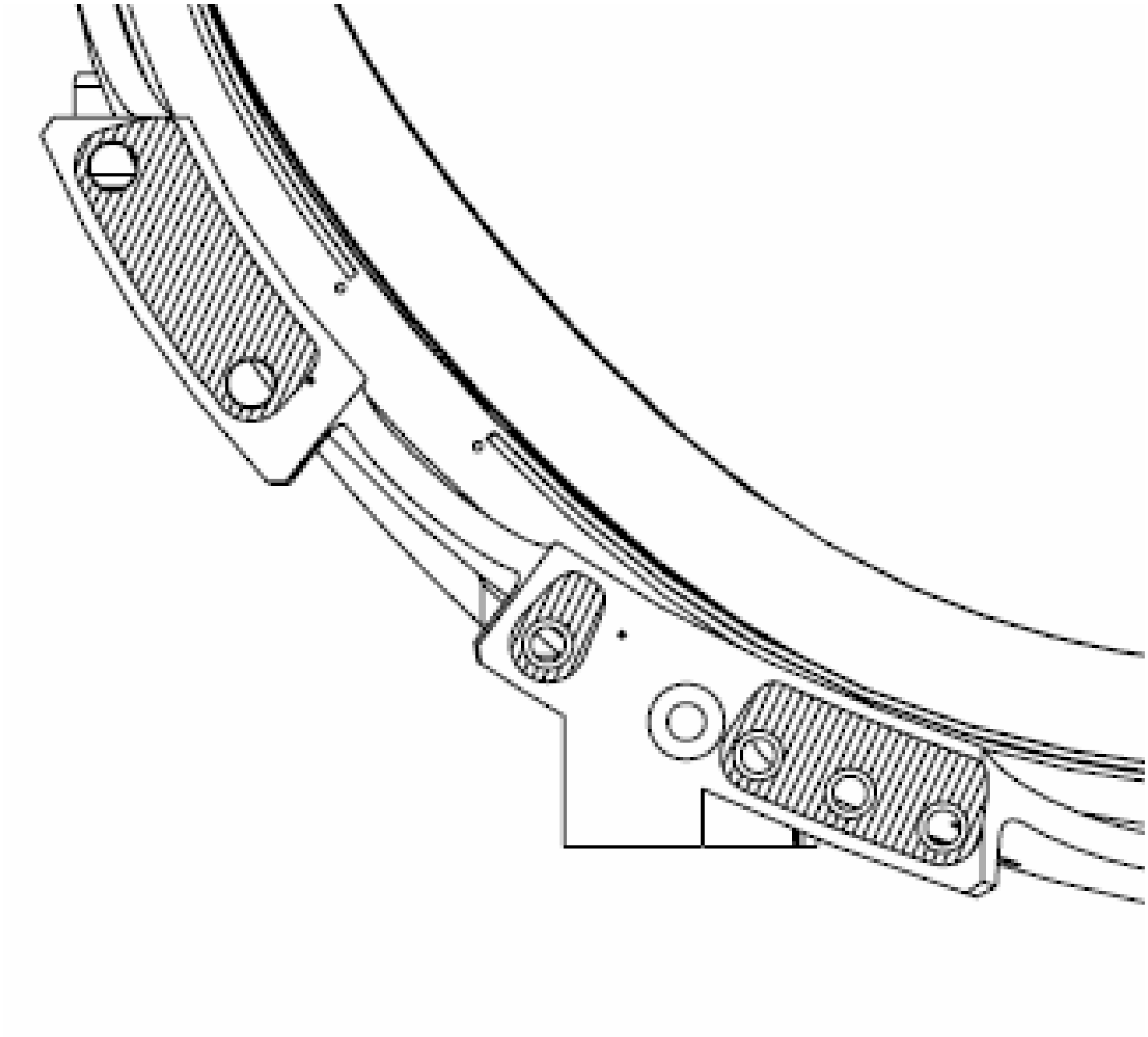
COIL TO COIL INTERFACE A-B



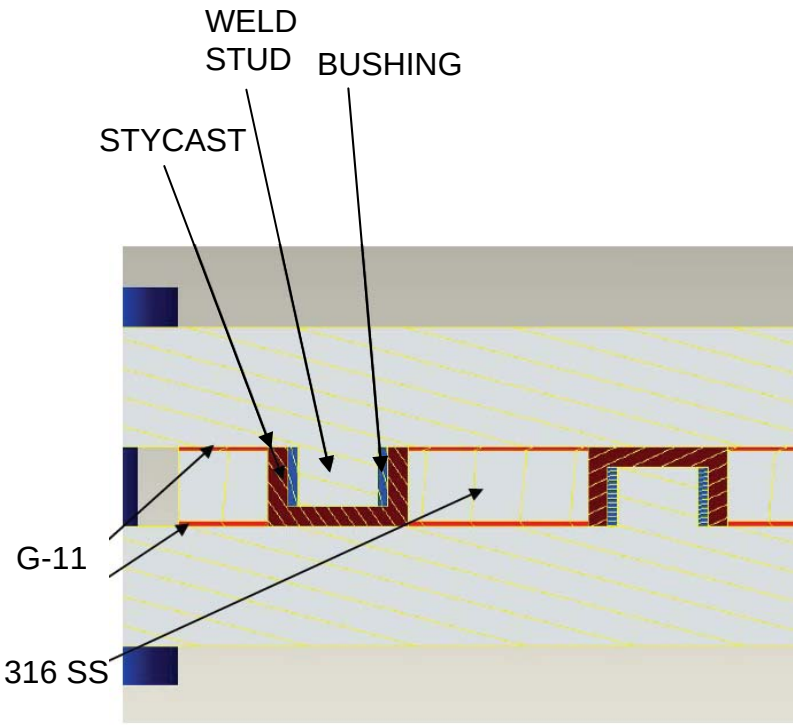
TYPE-A



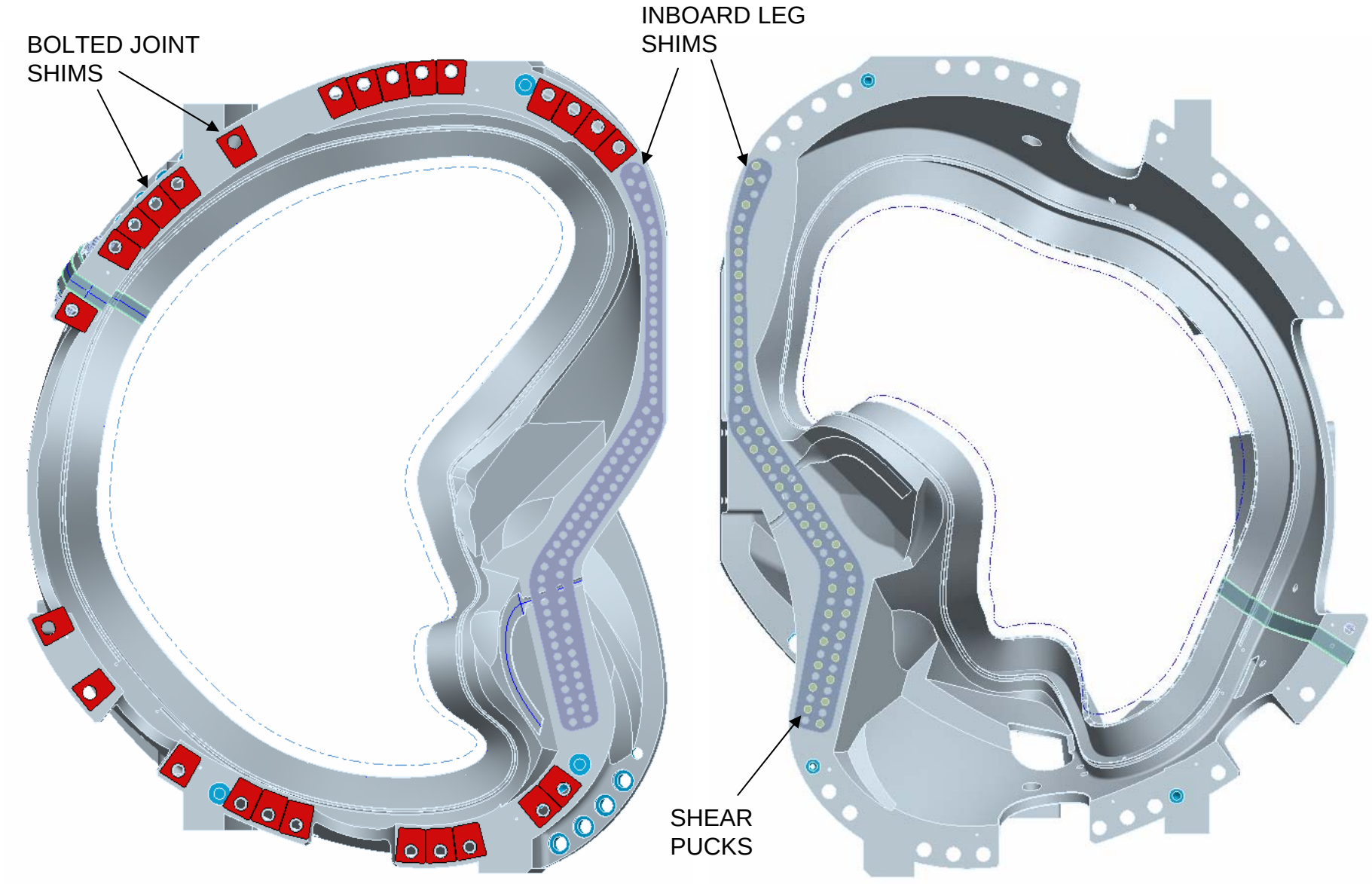
TYPE-B

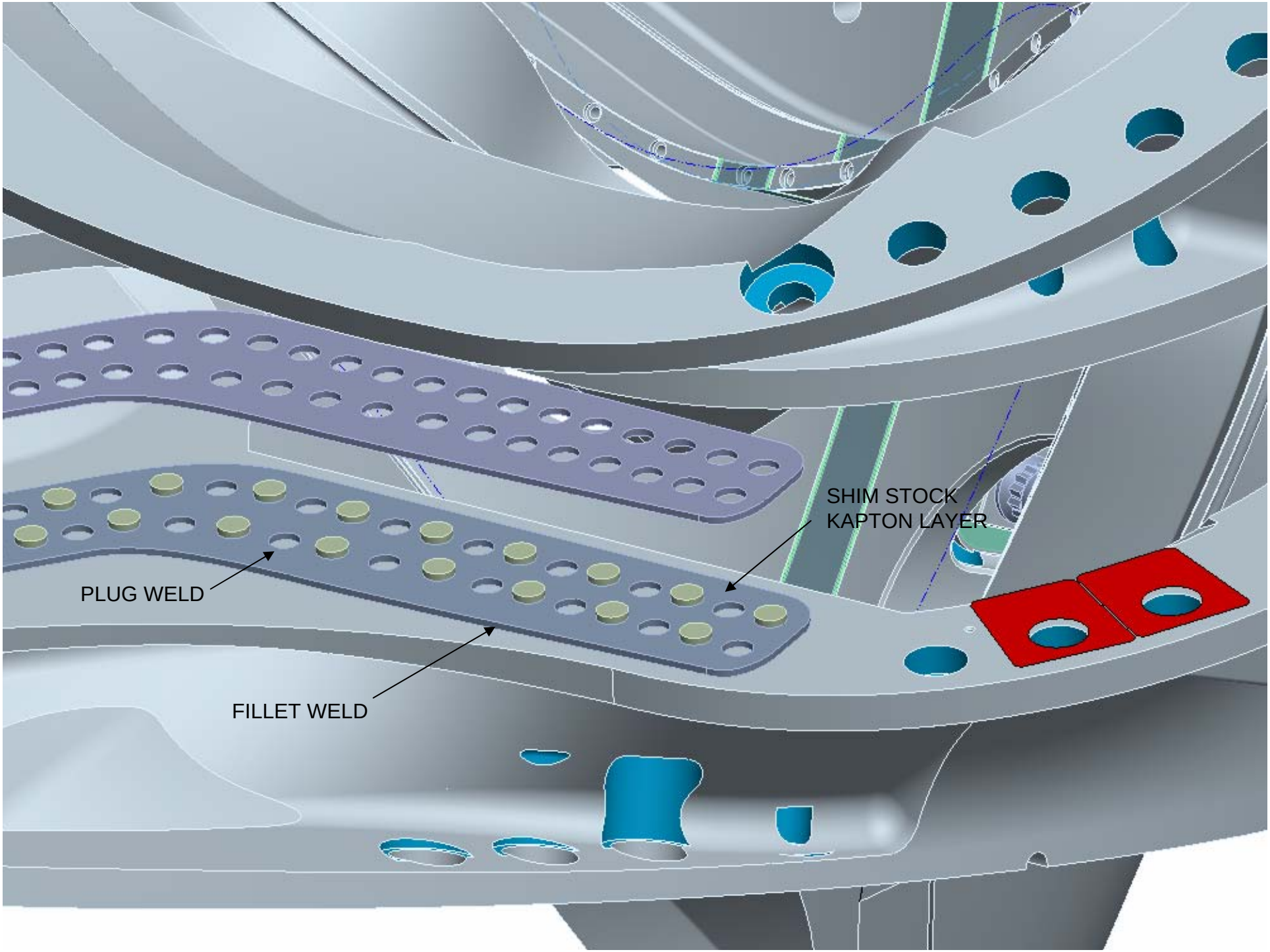


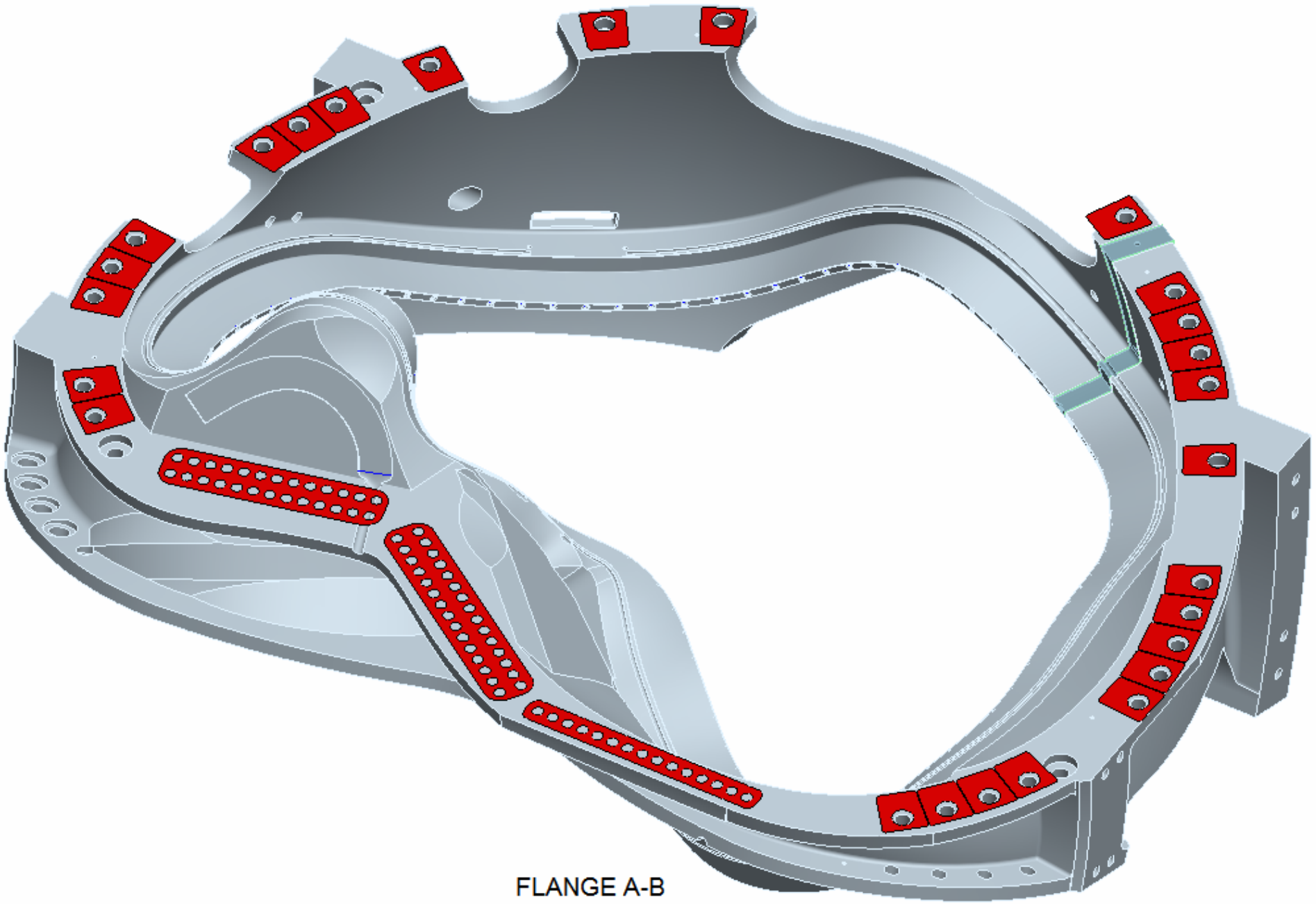
INBOARD LEG CONCEPT – SHEAR PINS



INBOARD LEG CONCEPT – SHEAR PUCKS

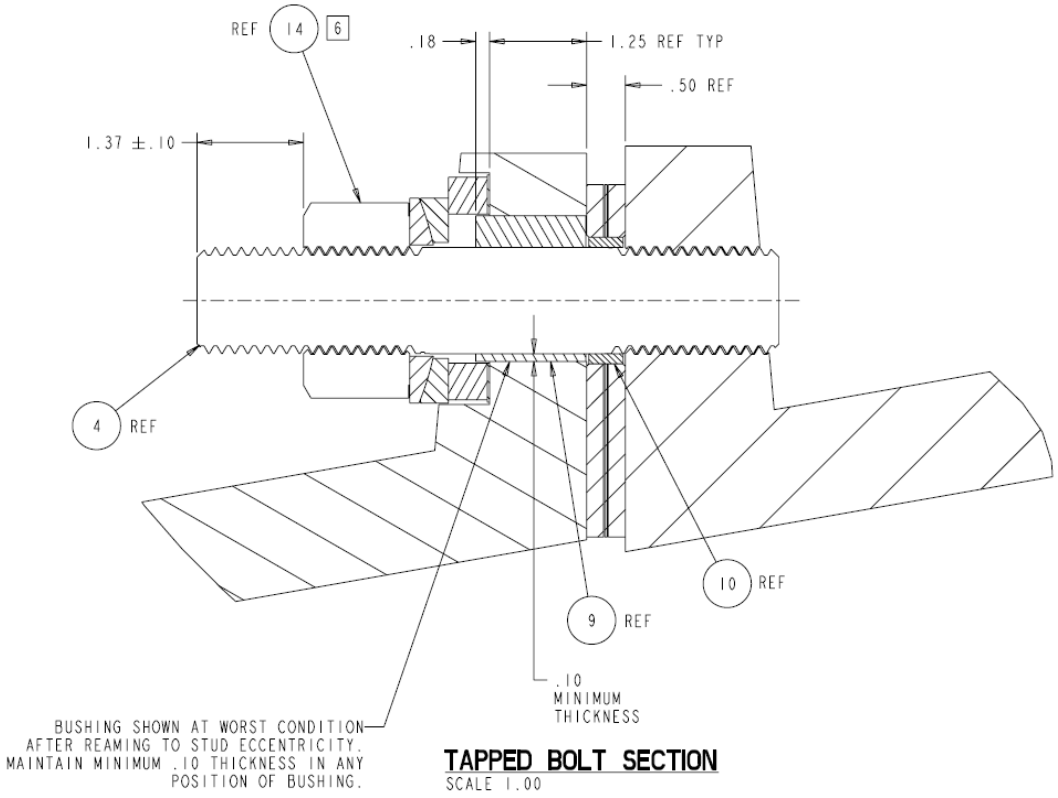



SHIM STOCK
KAPTON LAYER
PLUG WELD
FILLET WELD

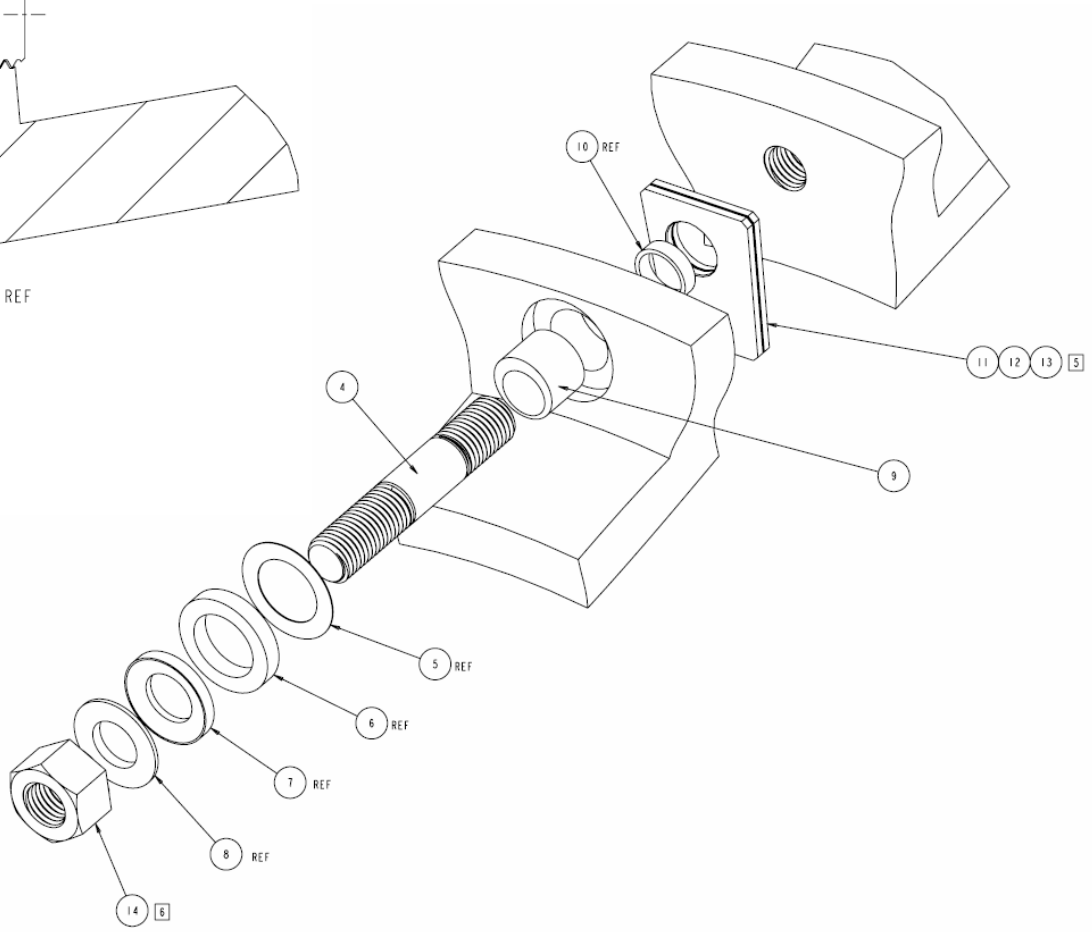


FLANGE A-B

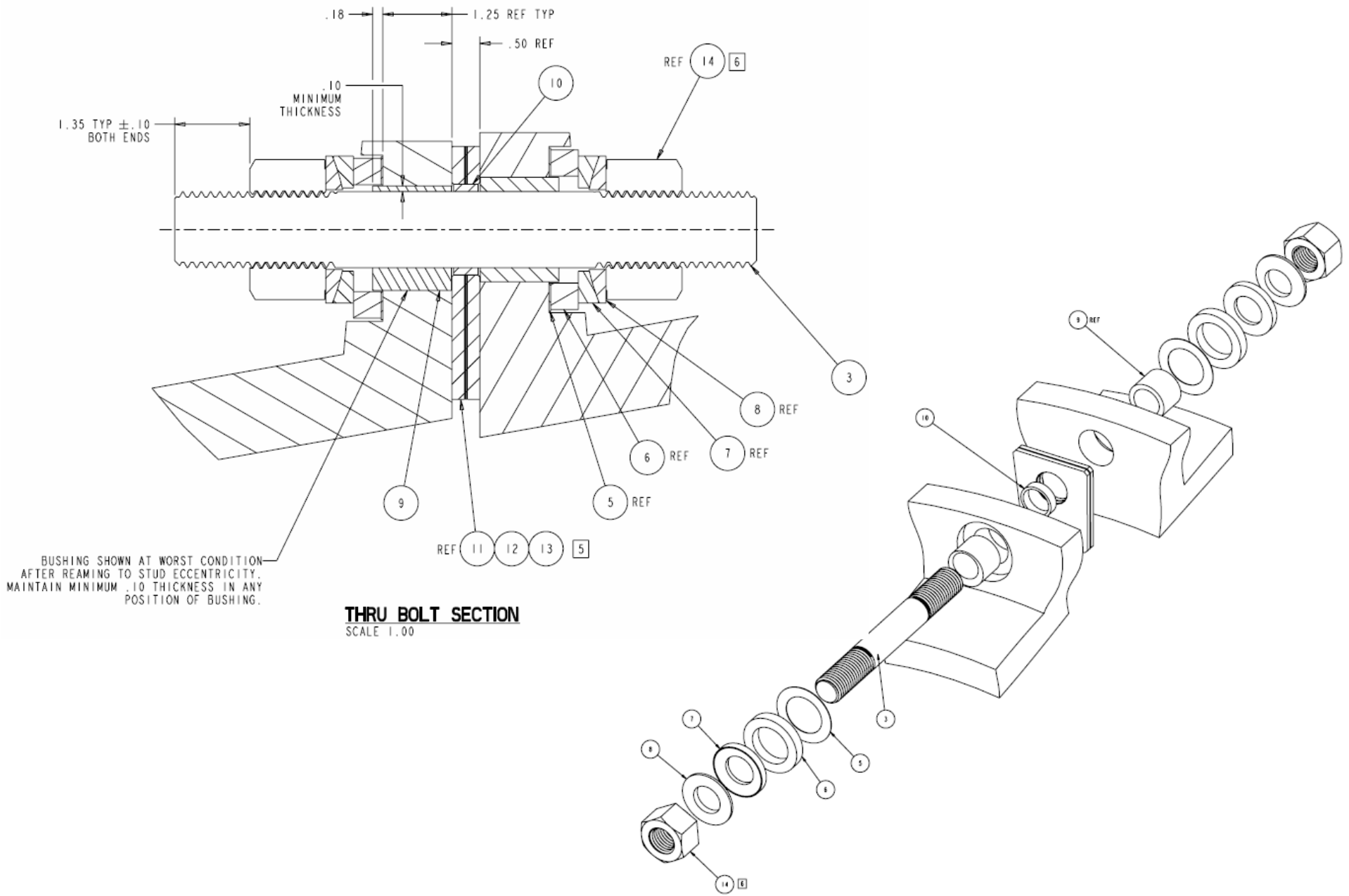
Tapped Hole



TAPPED BOLT SECTION
SCALE 1.00

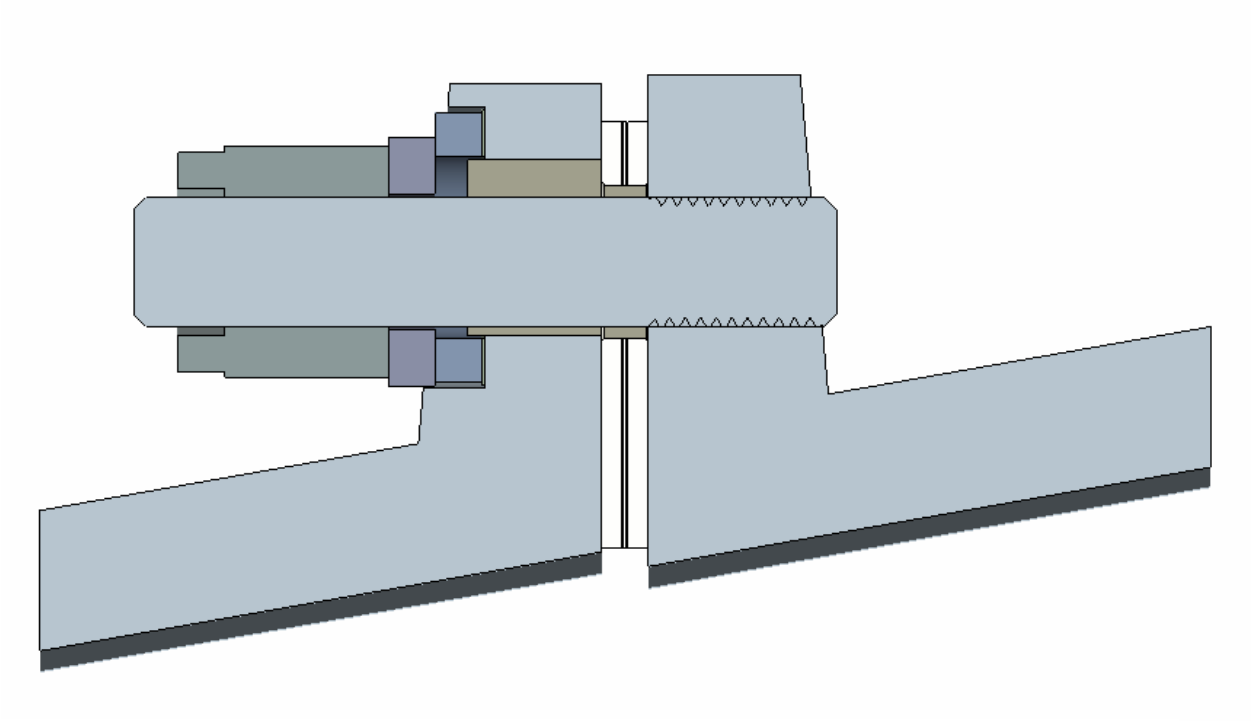


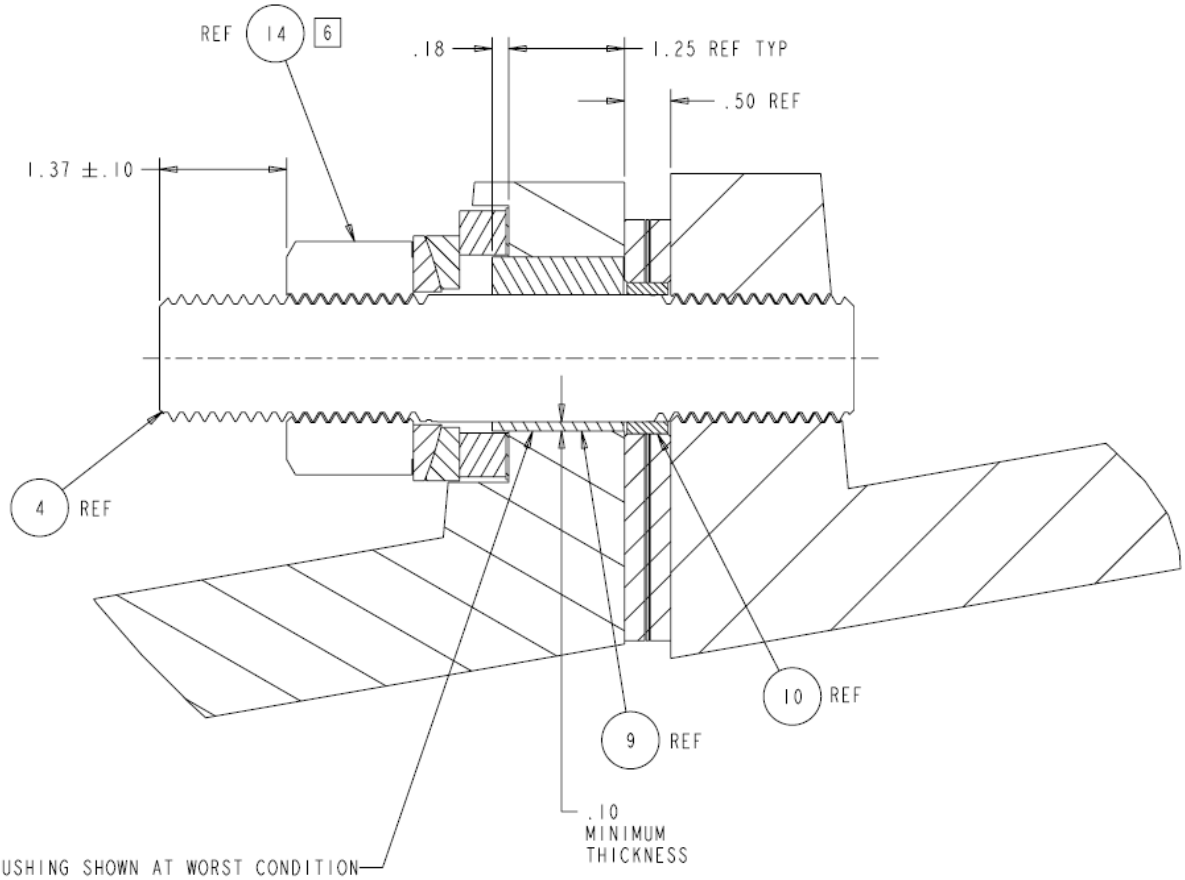
Through Hole



Inventory of Tapped/Through Holes

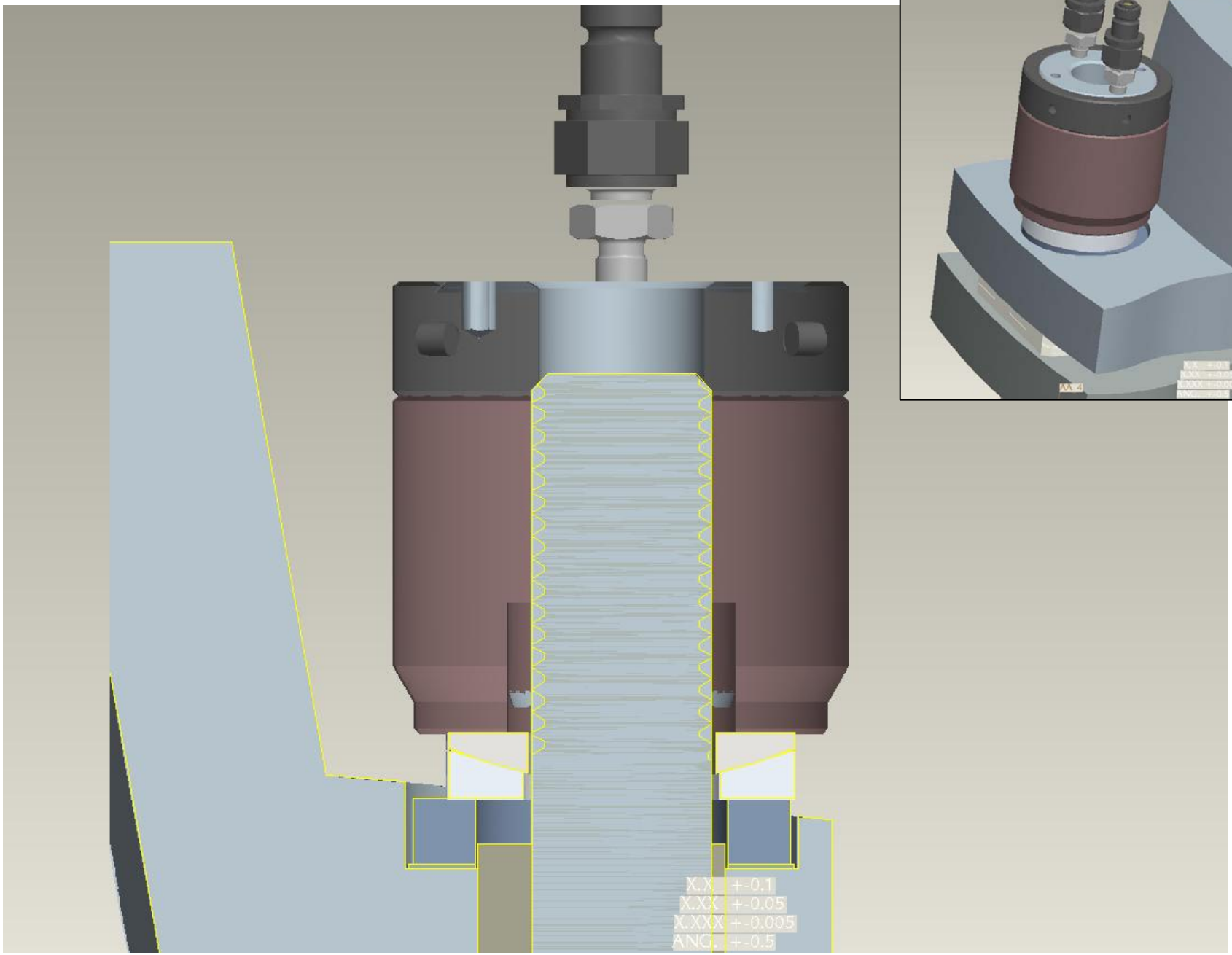
No.	Interface	Typ	No. Tapped Holes	Total Tapped	No. Thru Holes	Total Thru	Total Fasteners
1	A-B	5	25	125	1	5	
2	A1-B	1	7	7	19	19	
3	B-C	6	29	174	0	0	
4	A-A	2	20	40	0	0	
5	A1-A	1	6	6	14	14	
6	C-C	3	8	24	24	72	
	Total	18		376		110	486





BUSHING SHOWN AT WORST CONDITION AFTER REAMING TO STUD ECCENTRICITY. MAINTAIN MINIMUM .10 THICKNESS IN ANY POSITION OF BUSHING.

TAPPED BOLT SECTION
SCALE 1.00


X.X +-0.1
X.XX +-0.05
X.XXX +-0.005
ANG. +-0.5

APPROVED FOR PRODUCTION

DATE 17-Mar-06 SIG GM
HYDRATIGHT SWEENEY LTD

ALL DIMENSIONS IN MILLIMETERS UNLESS STATED

IF IN DOUBT ASK

THIRD ANGLE PROJECTION

WEIGHT (kg)
3.63

TECHNICAL DATA

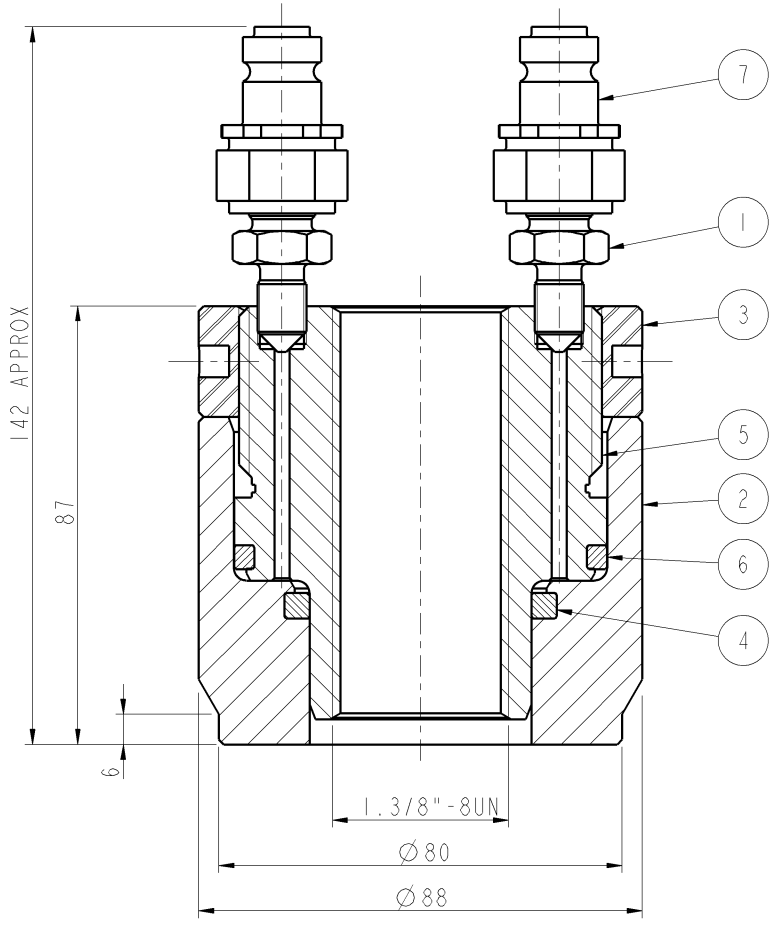
HYDRAULIC PRESSURE AREA = 2780 mm² (4.31 in²)

MAX WORKING PRESSURE = 150 MPa (21750 psi)

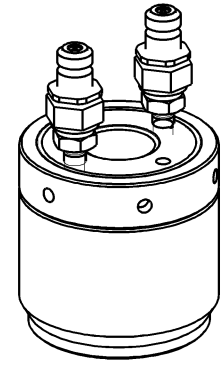
MAX LOAD CAPACITY = 417.0 kN (41.8 tonf)

MAX RAM STROKE = 15 mm (0.59 in)

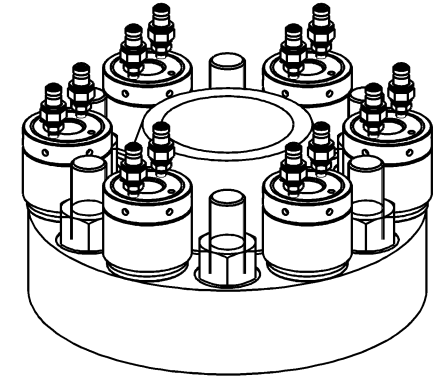
MINIMUM STUD PROTRUSION REQUIRED ABOVE JOINT FACE = 92 mm (3.62 in)



SECTION A-A



SCALE 0.450



SCALE 0.200

ITEM	DESCRIPTION	QTY	MATL	ITEM NUMBER
7	QUICK DISCONNECT NIPPLE	2	STEEL	QDCJN1161500
6	OUTER SEAL SET	1	H-ECOPUR	K02-HTS0740-ON
5	INSERT	1	STEEL	HNIC6167002D
4	INNER SEAL SET	1	H-ECOPUR	S02-HTS0440-ON
3	COLLAR	1	STEEL	HNIC6167003D
2	BODY	1	STEEL	HNIC6167001D
1	ADAPTOR 1/4"BSP x 1/8"BSP	2	ST.ST.	ADMMBCAC2275

A3 COMPUTER ORIGINAL

ALTERATIONS

DRAWN: GM

DATE: 23-FEB-2006

SALES ORDER No.: SA680621

CHECKED: MH

SALES QUOTE No.: QA571916

SCALE: 1.00 : 1

LIMITS U.S.O.: -

MATERIAL: -

SURFACE FINISH: -

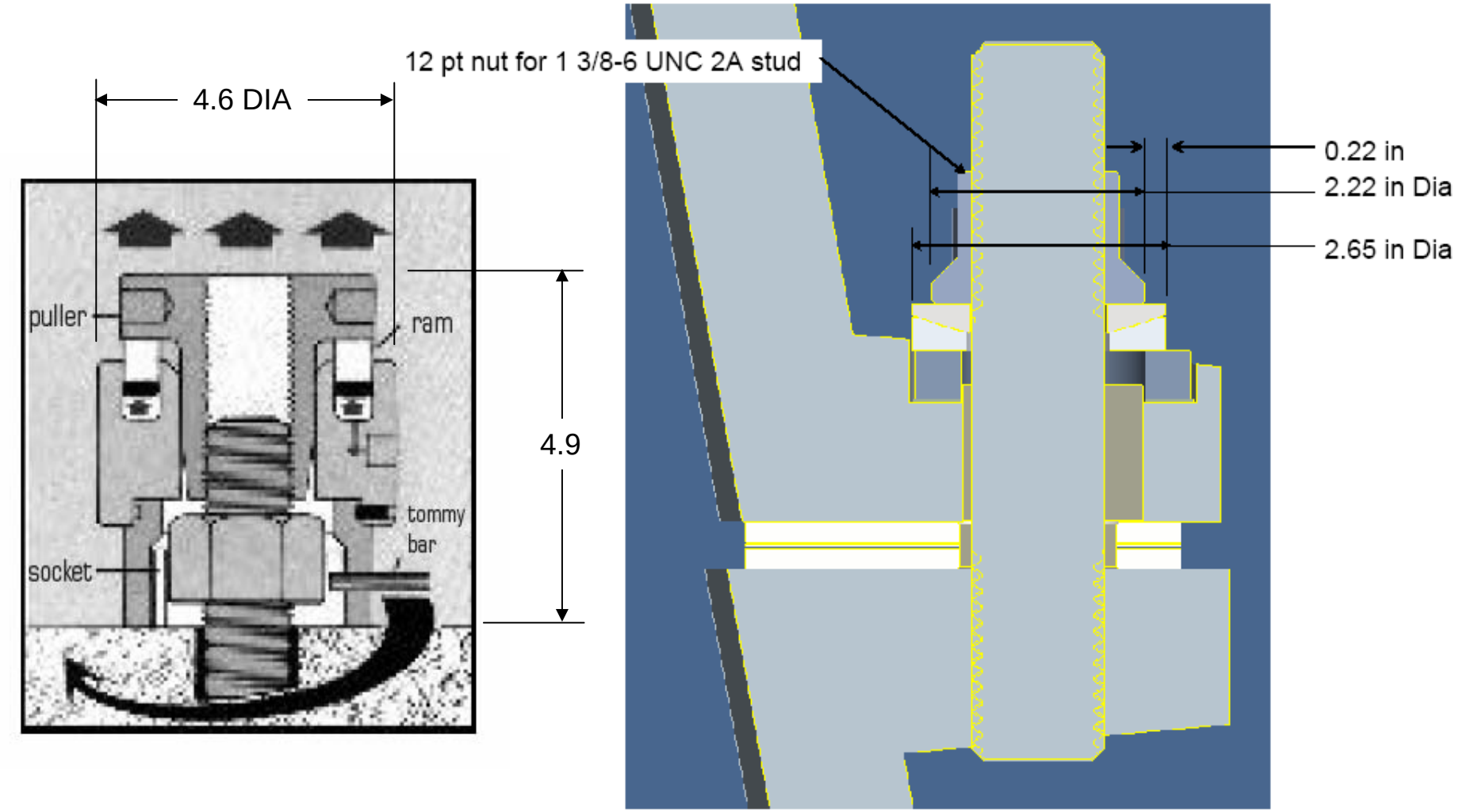
HEAT TREATMENT: -

hydratight

TITLE: 1.3/8"-8UN TOP COLLAR HYDRAULIC NUT

DRAWING No.: HNIC6167000D

ISSUE: A

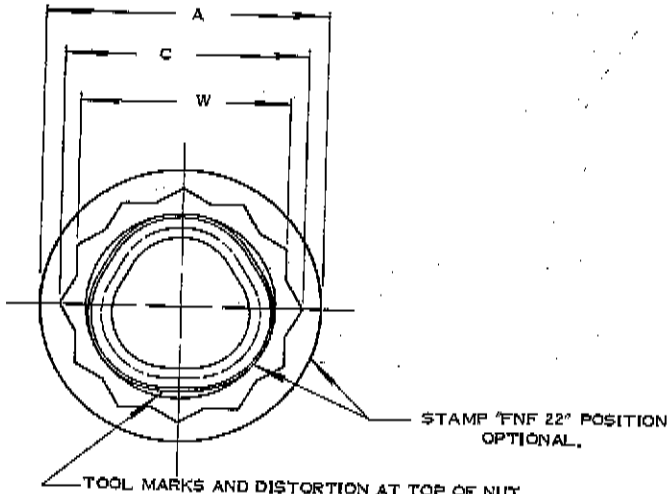

12 pt nut for 1 3/8-6 UNC 2A stud
4.6 DIA
puller
ram
tommy
bar
socket
4.9
0.22 in
2.22 in Dia
2.65 in Dia

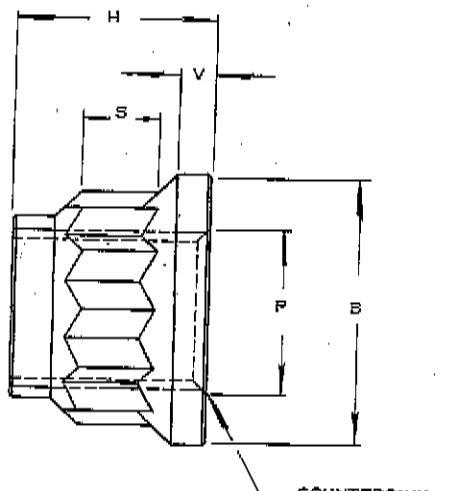
SPS TECHNOLOGIES

SHEET 1 OF 2

DRAWING NUMBER SPS-N-59680

REVISION (3) REVISED AND REDRAWN 10/21/64 (4) 8-8-66 (5) 4-24-67 (6) 7-9-68 (7) 10-27-75





*

DASH NO.	(1) THREAD SIZE	A MAX.	B MIN.	C MIN.	H MAX.	P MAX.	S MIN.	V MIN.	W MAX.	W MIN.	(2) X	(3) Y	AXIAL STRENGTH LBS. MIN.	WEIGHT MAXIMUM LBS./100
-1032	.190-32NS-3B	.350	.287	.277	.230	.220	.080	.015	.251	.243	.002	.002	4,980	.25
-428	.250-28NS-3B	.438	.398	.347	.300	.280	.100	.020	.313	.305	.002	.002	8,890	.47
-524	.312-24NS-3B	.531	.491	.419	.385	.343	.120	.035	.376	.367	.002	.002	14,100	.84
-624	.375-24NS-3B	.649	.609	.481	.455	.405	.152	.060	.439	.430	.002	.002	20,900	1.43
-720	.437-20NS-3B	.750	.705	.631	.520	.473	.168	.075	.564	.553	.003	.003	28,300	2.47
-820	.500-20NS-3B	.828	.783	.703	.600	.535	.190	.095	.627	.616	.003	.003	37,800	3.51
-918	.562-18NS-3B	.938	.893	.775	.680	.597	.230	.095	.690	.679	.003	.003	47,900	4.83
-1018	.625-18NS-3B	1.050	1.005	.845	.740	.660	.250	.095	.752	.741	.004	.003	59,900	6.23
-1216	.750-16NS-3B	1.230	1.185	1.059	.900	.785	.310	.120	.940	.928	.004	.003	86,900	11.06
-1414	.875-14NS-3B	1.438	1.393	1.200	1.060	.910	.350	.145	1.064	1.052	.005	.004	119,000	16.97
-1612	1.000-12NS-3B	1.625	1.580	1.344	1.210	1.035	.400	.170	1.190	1.178	.006	.004	155,000	24.72
-1812	1.125-12NS-3B	1.875	1.825	1.557	1.370	1.160	.450	.170	1.377	1.364	.006	.005	198,000	36.24
-2012	1.250-12NS-3B	2.125	2.075	1.699	1.510	1.285	.500	.210	1.502	1.489	.007	.006	247,000	50.90
-2212	1.375-12NS-3B	2.313	2.263	1.842	1.670	1.410	.550	.250	1.627	1.614	.008	.006	W 301,000	63.43
-2412	1.500-12NS-3B	2.500	2.450	1.985	1.820	1.535	.600	.290	1.752	1.739	.009	.007	361,000	79.69

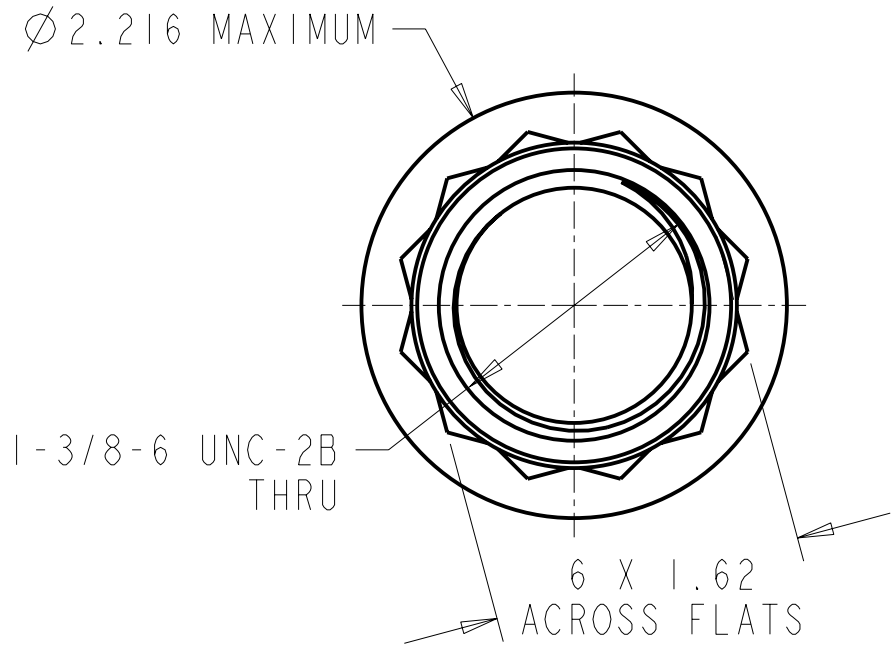
(1) THREADS: BEFORE LUBRICATION PER SPS-N-222.
(2) BEARING SQUARENESS: BEARING SURFACE TO BE SQUARE WITH PITCH DIAMETER WITHIN "X" T.I.R. WHEN CHECKED AT A POINT MIDWAY BETWEEN THE O.D. AND I.D. OF THE BEARING SURFACE.
(3) BEARING FLATNESS: BEARING SURFACE TO BE FLAT TO CONCAVE WITHIN "Y" T.I.R. WHEN CHECKED IN ACCORDANCE WITH SPS-G-1013.

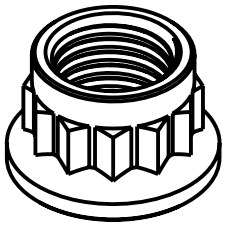
MATERIAL: ALLOY STEEL PER AMS 6485 OR EQUIVALENT.
HARDNESS: ROCKWELL C 45 MAXIMUM.
PLATING: FNF 22-CADMIUM PLATE PER SPECIFICATION QQ-P-416, TYPE II, CLASS 3, PLUS CARBOWAX.
FNF 22 M- CADMIUM PLATE PER SPECIFICATION QQ-P-416 (TYPE AND CLASS TO BE AT MANUFACTURER'S OPTION), PLUS MOLYBDENUM DISULFIDE DRY FILM LUBRICANT. NUTS MUST MEET QQ-P-416, TYPE II, SALT SPRAY REQUIREMENTS.
FNF 22 C - CADMIUM PLATE PER SPECIFICATION QQ-P-416, TYPE II, CLASS 3, PLUS CETYL ALCOHOL.
COLOR: WHEN SPECIFIED, NUT TO BE COLORED YELLOW. COLORING MAY BE INCOMPLETE. NO COLORING PERMISSIBLE ON THREADS OR BEARING SURFACE.
LUBRICANT: MOLYBDENUM DISULFIDE DRY FILM LUBRICANT AND MIL-N-25027.
NON-DRY LUBRICANT: UNLESS OTHERWISE SPECIFIED PARTS SHALL BE SUPPLIED WITH A NON DRY LUBRICANT (CARBOWAX OR CETYL ALCOHOL) SOLUBLE IN THE CLEANER SPECIFIED IN MIL-N-25027.
LOCKING TORQUE PER SPECIFICATION SPS-N-222.
BREAK SHARP CORNERS.
DIMENSIONS IN INCHES UNLESS SPECIFIED OTHERWISE.
DIMENSIONS TO BE MET PRIOR TO LUBRICANT.
SURFACE TEXTURE: USAS B46.1 UNLESS OTHERWISE SPECIFIED THE SURFACE TEXTURE SHALL NOT EXCEED 125 MICROINCHES.
PERFORMANCE: SEE PROCUREMENT SPECIFICATION.
DESIGN AND USAGE LIMITATIONS: THESE NUTS ARE DESIGNED TO DEVELOP THE TENSILE STRENGTH OF BOLTS AND SCREWS WITH AN ULTIMATE TENSILE STRENGTH OF 220 KSI BASED ON A CROSS SECTIONAL AREA AT THE BASIC PITCH DIAMETER OF THE THREAD. THESE NUTS ARE DESIGNED TO BE USED ON EXTERNAL THREADS CONFORMING TO MIL-S-8879 WITHIN THE LIMITATIONS OF MS 33538.
PART NUMBER: SPS PART NUMBER CONSISTS OF "FNF 22" PLUS APPLICABLE DASH NUMBER. ADD LETTER "M" TO "FNF 22" FOR NUT LUBRICATED WITH MOLYBDENUM DISULFIDE, ADD LETTER "C" FOR CETYL ALCOHOL LUBRICATION. NO LETTER DESIGNATES NUT LUBRICATED WITH CARBOWAX. ADD LETTER "Y" TO DASH NUMBER FOR NUT COLORED YELLOW.

TOLERANCES ± ——— AND ——— UNLESS OTHERWISE NOTED * INDICATES LATEST CHANGE STANDARD

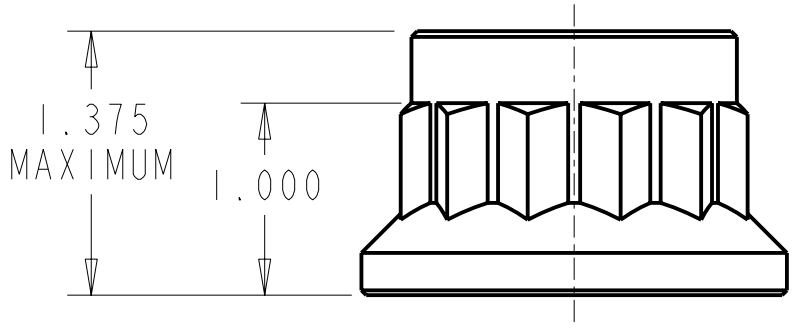
STANDARDS AND SPECIFICATIONS	TITLE	DRAWN BY W.A.B. DATE 12/7/62
SPS-N-222	NUT, FLEXLOC, DOUBLE HEXAGON, SELF-LOCKING, ALLOY STEEL 450°F, 220 KSI, FLANGED, HI-LIFE	APPROVED DATE 12/7/62
FED. IDENT. CODE NO. 56878		PART NUMBER FNF 22
CUSTODIAN: JENKINTOWN, PA.		

1002





SCALE 0.500



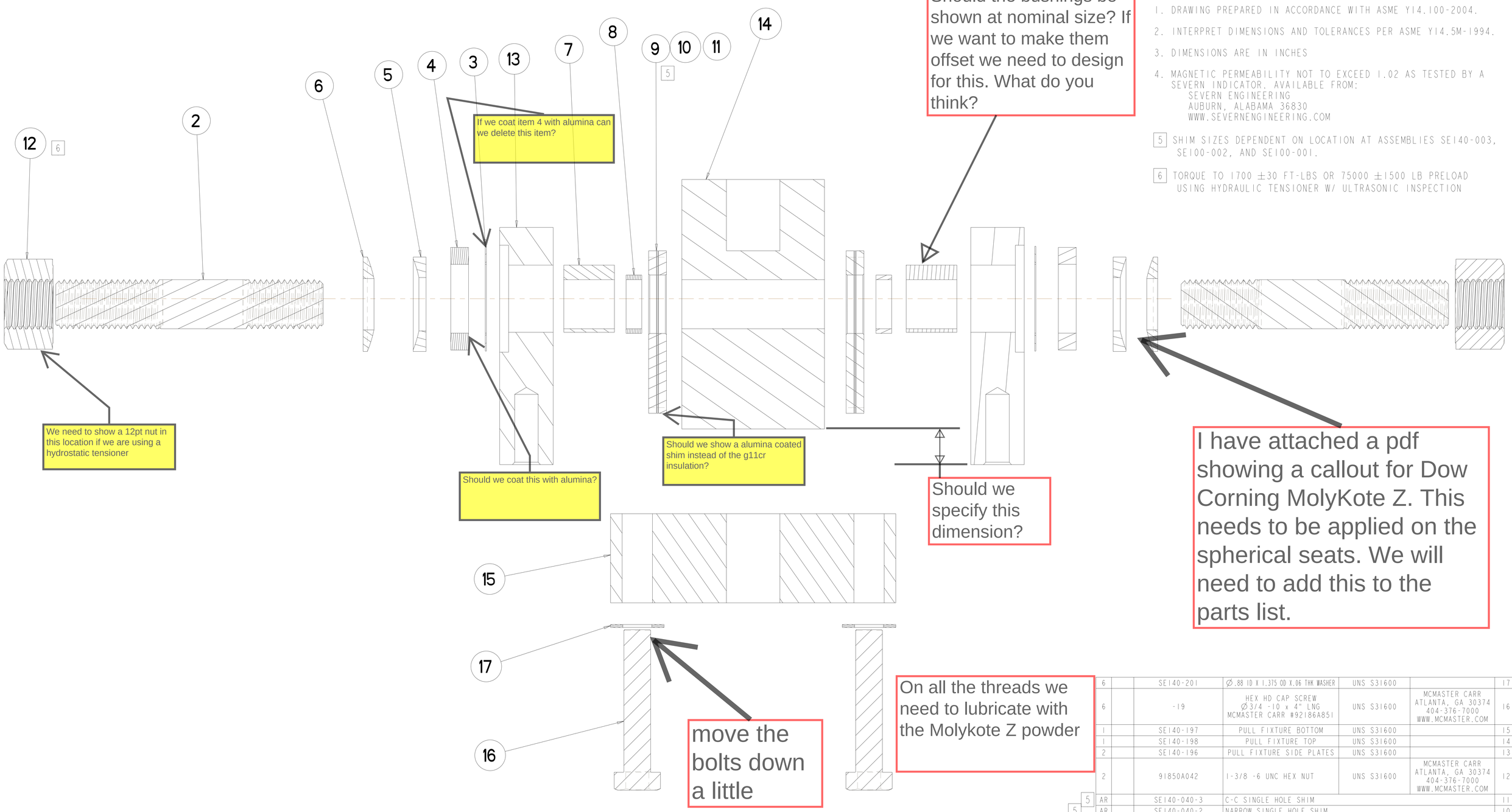
TOLERANCE = ±.010 AND ±2°

⚠ MATERIAL CHANGED

MATERIAL	UNS S66286	SOURCE	BID / PREFERRED
SPEC	ASTM A453 GRADE 660B	VENDOR	SUGGESTED VENDOR: PCC SPS Fastener Division 301 HIGHLAND AVENUE JENKINTOWN, PA 19046 PHONE: 215-572-3000
HEAT TREAT	NA		
COATING	SILVER PLATE PER AMS 2410		
UNITS	INCHES		
LUBRICANT			

DATA SHEET

FILENAME	TITLE / DESCRIPTION				
DS141-060	NUT, 12PT HEX 1.375-6UNC-2B				
PREPARED BY	**CHECKED BY**	**APPROVED BY**	**ISSUE DATE**	**VER**	**REV**
MT BROWN	M COLE	D WILLIAMSON	6/24/04	1	1



NOTES

1. DRAWING PREPARED IN ACCORDANCE WITH ASME Y14.100-2004.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS ARE IN INCHES
4. MAGNETIC PERMEABILITY NOT TO EXCEED 1.02 AS TESTED BY A SEVERN INDICATOR. AVAILABLE FROM:
   SEVERN ENGINEERING
   AUBURN, ALABAMA 36830
   WWW.SEVERNENGINEERING.COM

[5] SHIM SIZES DEPENDENT ON LOCATION AT ASSEMBLIES SE140-003, SE100-002, AND SE100-001.

[6] TORQUE TO 1700 ±30 FT-LBS OR 75000 ±1500 LB PRELOAD USING HYDRAULIC TENSIONER W/ ULTRASONIC INSPECTION

1

EXPLODED SECTION VIEW

6		SE140-201	Ø.88 ID X 1.375 OD X.06 THK WASHER	UNS S31600		17
6		-19	HEX HD CAP SCREW Ø3/4 -10 x 4" LNG MCMASTER CARR #92186A851	UNS S31600	MCMASTER CARR ATLANTA, GA 30374 404-376-7000 WWW.MCMASTER.COM	16
1		SE140-197	PULL FIXTURE BOTTOM	UNS S31600		15
1		SE140-198	PULL FIXTURE TOP	UNS S31600		14
2		SE140-196	PULL FIXTURE SIDE PLATES	UNS S31600		13
2		91850A042	1-3/8 -6 UNC HEX NUT	UNS S31600	MCMASTER CARR ATLANTA, GA 30374 404-376-7000 WWW.MCMASTER.COM	12
[5] AR		SE140-040-3	C-C SINGLE HOLE SHIM			11
[5] AR		SE140-040-2	NARROW SINGLE HOLE SHIM			10
[5] AR		SE140-040-1	SINGLE HOLE SHIM			9
1		SE140-195-2	BUSHING			8
2		SE140-195-1	BUSHING			7
2		SE140-194-2	MALE SPHERICAL WASHER			6
2		SE140-194-1	FEMALE SPHERICAL WASHER			5
2		SE140-193	FLAT WASHER			4
2		SE140-192	INSULATING WASHER			3
2		SE140-191-2	1-3/8" X 7.50LG STUD			2
		-1	MCWF FLANGE PULL TEST ASSEMBLY			1
CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION		FIND NO

NEXT ASSEMBLY — PARTS LIST

SE140-199 B

REV	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
0	ORIGINAL ISSUE	GM	02/07									

REVISION OR ISSUE PURPOSE — REVISION APPROVAL

SCALE NOTED

TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS :
XX DECIMALS ±.01
XXX DECIMALS ±.005
ANGLES ±0°15'
BREAK SHARP EDGES .06 MAX
FINISH .125 UNLESS OTHERWISE SPECIFIED

DRAWING APPROVALS		DATE
DES	K FREUDENBERG	02/07
DRW	G LOVETT	02/07
CHK	M COLE	02/07
SECT	:	:
DEPT	:	:
PE	D WILLIAMSON	02/07
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGEL	02/07
	:	:
	:	:

UT-BATTELLE — Oak Ridge National Laboratory, managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725 UT-BATTELLE, LLC. Oak Ridge, Tennessee

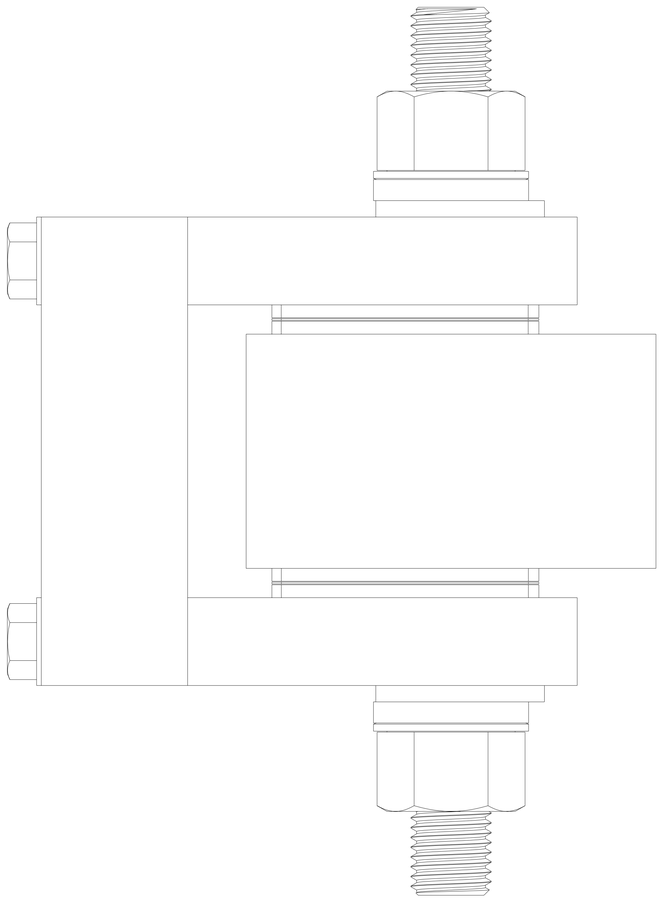
PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT

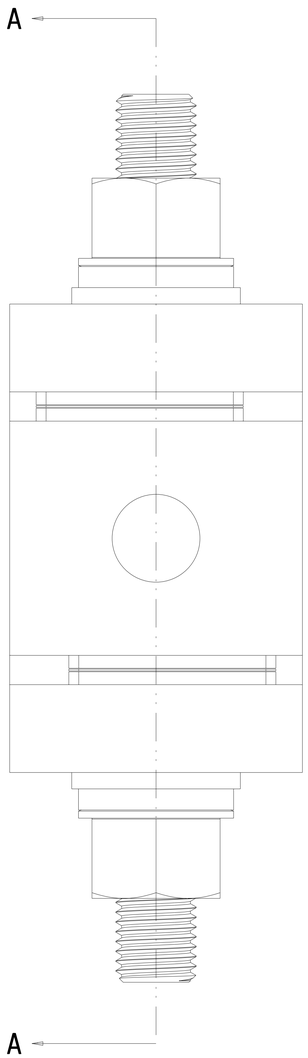
MCWF FLANGE PULL SHEAR TEST ASSEMBLY

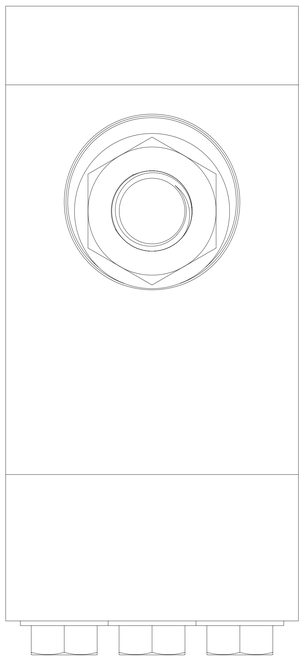
VERSION NO.	PLANT	BLDG	FL	SHT	OF	TYPE	CLASS
12+	ORNL	5700	3	1	3	A	U

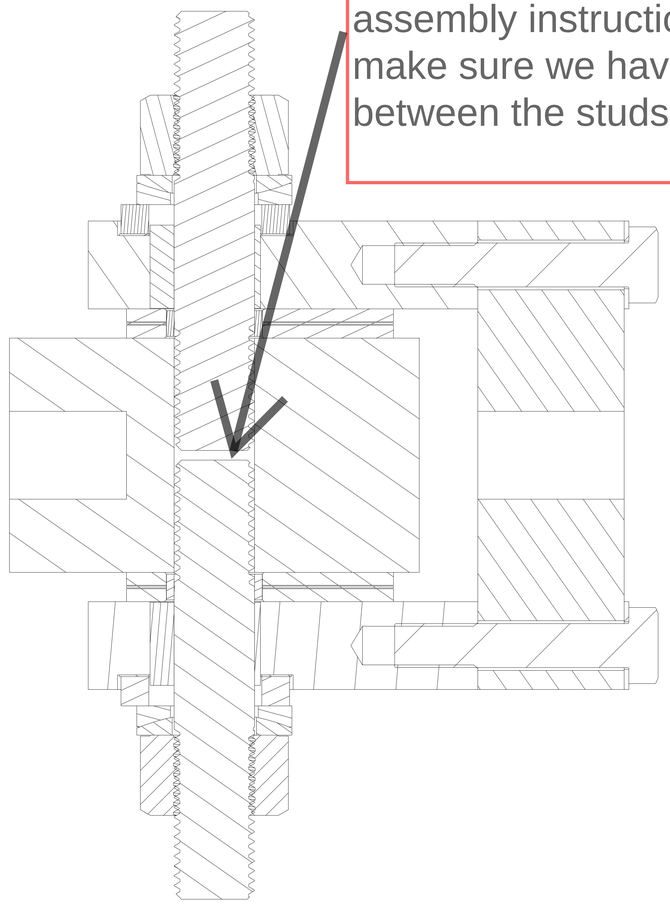
RELEASE LEVEL: WIP — SE140-199 — REV: 0

P THIS DRAWING PRODUCED ON PRO-ENGINEER









We need a note or some assembly instructions that make sure we have a gap between the studs.

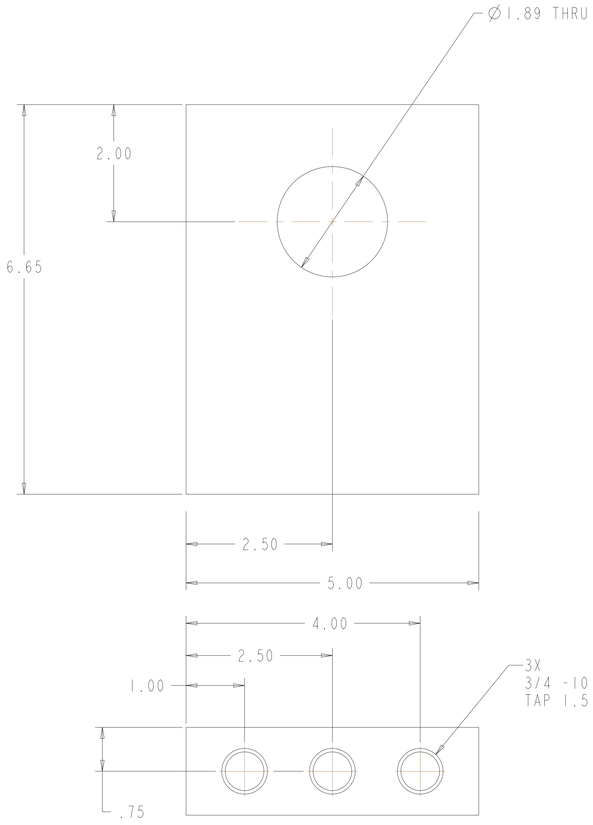
SECTION A-A

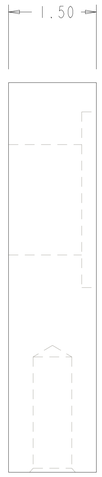
SCALE 1.000

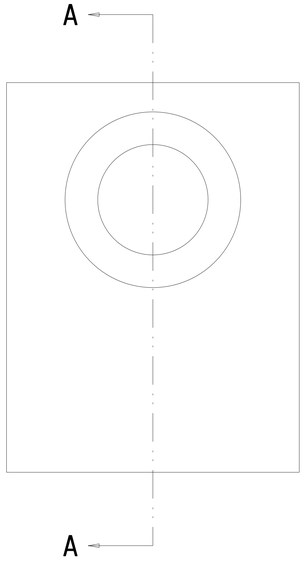
We need to show some overall dimensions on this dwg. and some center lines for the screws?

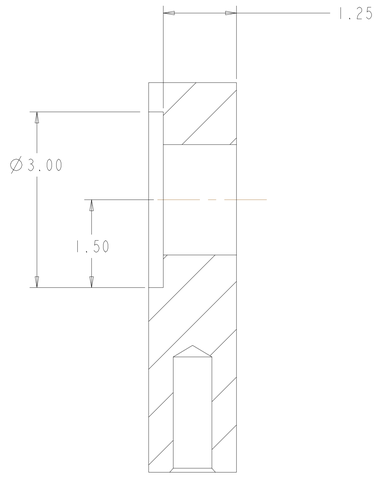
UT-BATTELLE	Oak Ridge National Laboratory managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725 UT-BATTELLE, LLC. Oak Ridge, Tennessee						
PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT							
MCWF FLANGE PULL SHEAR TEST ASSEMBLY							
VERSION NO. 12+	PLANT ORNL	BLDG 5700	FL 3	SHT 2	OF 3	TYPE A	CLASS U
RELEASE LEVEL WIP	SE140-199						REV 0

SE140-199

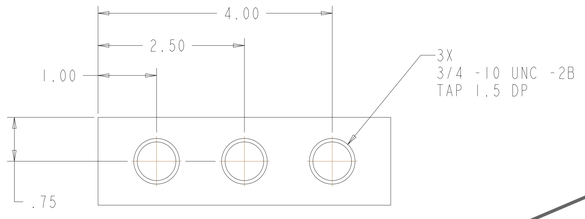








SECTION A-A

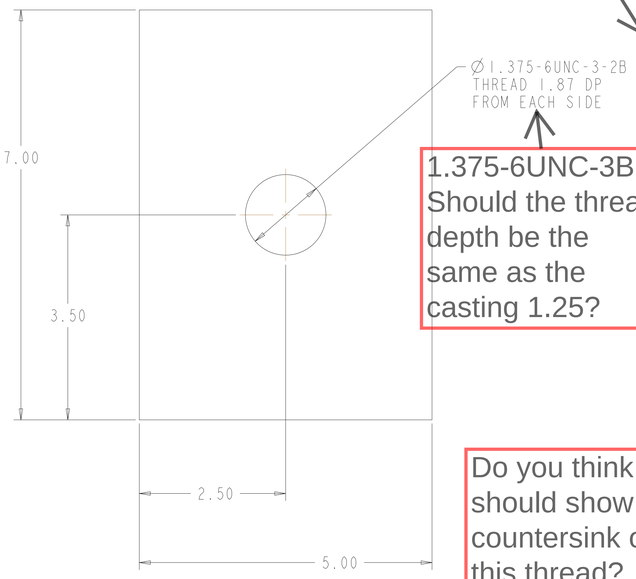


13

What do you think about matching the surface finish to match what we see on the flange? Should we require a 125 surface roughness?

Do you think this and the opposite side should have a countersink so that the first thread will not impact the surface?

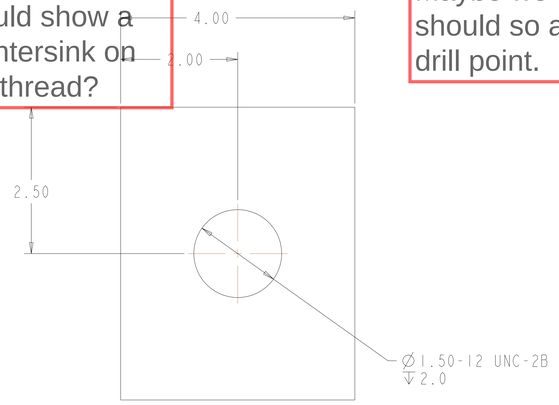
Do we need to call out a flatness on this face and a parallelism on the opposite face



1.375-6UNC-3B
Should the thread depth be the same as the casting 1.25?

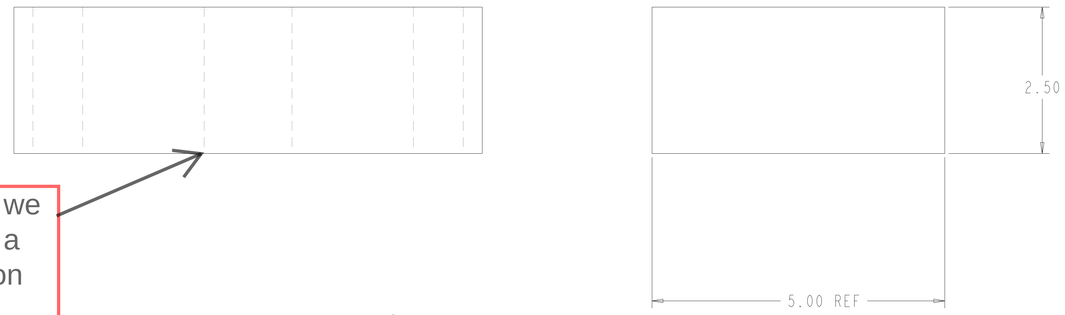
This is shown as a flat bottom. Don't you think they will drill this? Maybe we should so a drill point.

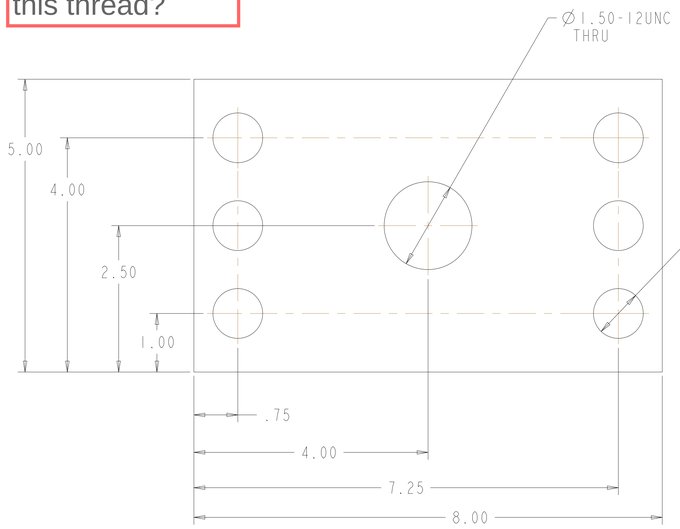
Do you think we should show a countersink on this thread?



14

Do you think we should show a countersink on this thread?





15

This seems like a pretty big hole. What do you think of using the std normal fit for a cap screw which is .781

UT-BATTELLE	Oak Ridge National Laboratory managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725 UT-BATTELLE, LLC Oak Ridge, Tennessee						
PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT							
MCWF FLANGE PULL SHEAR TEST ASSEMBLY							
VERSION NO. 12+	PLANT ORNL	BLDG 5700	FL 3	SHT 3 OF 3	TYPE A	CLASS U	
RELEASE LEVEL WIP	SE140-199					REV 0	

SE140-199

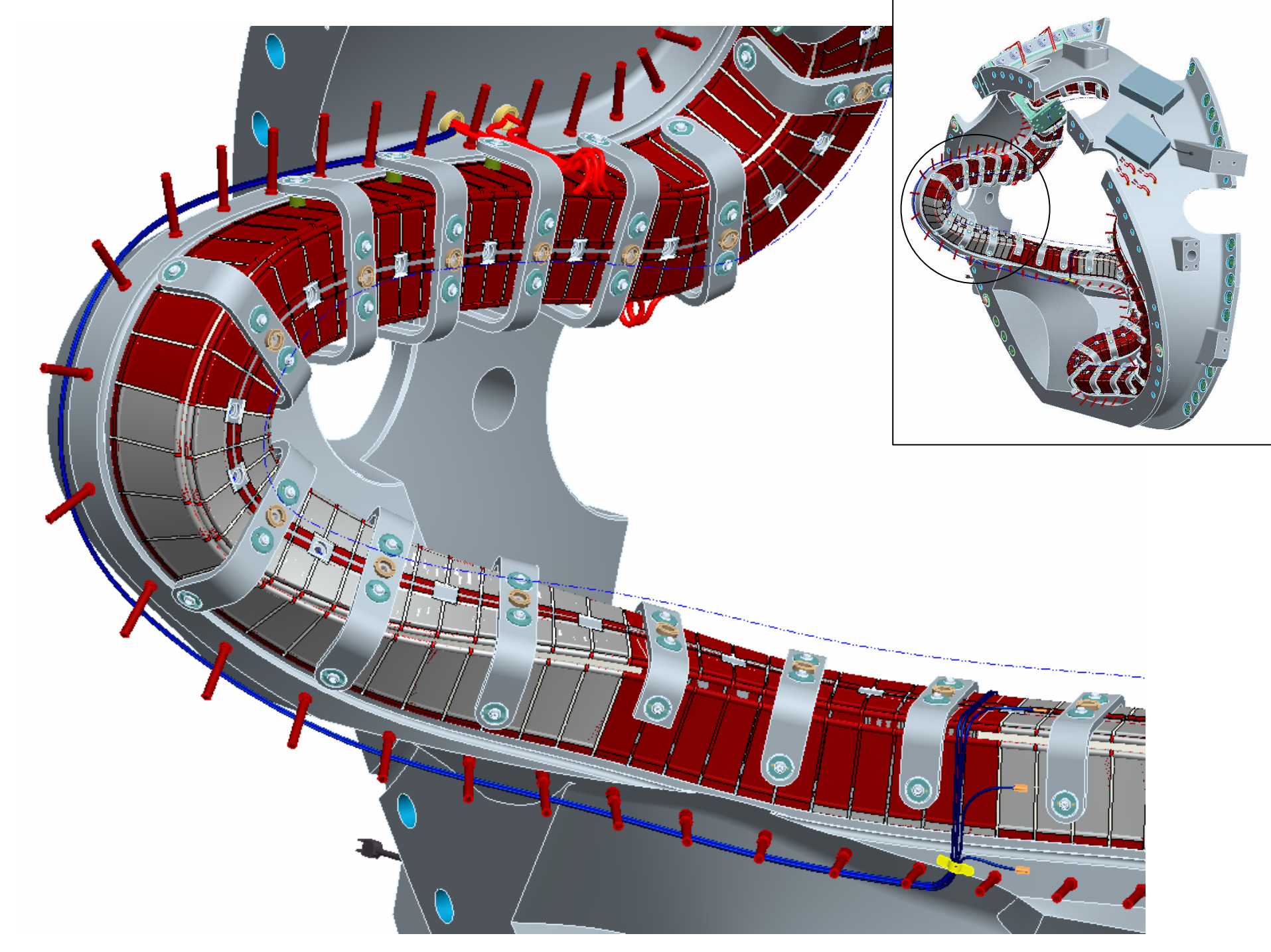
Design Review/QA Audit [Cog Engr/RLM/Chair]	Rvw Date	#	Chit/Audit Finding [Originator]	Review Board Recommendation	Project Disposition
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	1	Consider a "Plan B" for the possible condition of inadequate fit-up which might require additional machining of the shims. [Reiersen]	Concur	1. Worst case fitups are being analyzed. May preclude using constant thickness shims everywhere. (Brooks) 2. Production prototype (A1:A2) will determine whether contoured shims are required. If so, use of a high friction foil or a spray application of alumina can be done post-machining.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	2	Identify if any of the existing holes need to be worked on. [Cole]	Concur	Holes should be examined and cataloged as to whether any re-work is required. Bushing OD could be determined at the same time.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	3	What are tolerance requirement for the half-period assembly? Need to consciously define. Needs more attention. [Cole]	Concur	Requirements for positioning the coil current centers will be provided in the Station 2 assembly specification. (Cole) Input to be provided by Brooks.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	4	Establish criteria for adequate fit-up of the shims [Cole]	Concur	1. FEA analysis indicates that maximum deflections will be on the order of 1 mil (Fan) 2. Joint tension tests will measure deflections upon tensioning the bolts (Gettelfinger) 3. Approach to finalize fit-up criteria is TBD
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	5	Do ultrasonic testing during tension test. [Cole]	Concur	UT will be performed during tension test
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	6	Measure μ at LN temperature with Stellalloy. Since Stellalloy seems stronger at LN temperature than standard stainless and since the failure seems to be destruction of the SS surface the maximum μ may be higher with Stellalloy. [Zarnstorff]	Concur	Stellalloy and SS316LN have very comparable strength properties. There are no plans to machine Stellalloy test pieces out of the prototype casting for friction tests.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	7	I recall Gettelfinger getting μ ~ 0.7 in one of his tests at very high clamping shims to increase pressure (~ 7000 PSI?). Consider understanding shims to increase pressure to obtain this high μ.	Concur - Friction testing should be performed over an appropriate range of pressures.	Friction testing will be performed over a representative range of pressures.
Modular Coil Interface Hardware PDR	2/22/2007	8	Tabulate deflection and bolt shear loads	Concur - Need to resolve	The overloading of the bushings

			pressure to obtain this high pr		
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	8	Tabulate deflection and bolt shear loads in case without additional inner leg bolts with ~ no friction on inner leg region. Consider if this is a more attractive solution than added bolt design. [Zarnstorff]	Concur - Need to resolve	The overloading of the bushings on the A-A flange will be resolved by adding additional bolts.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	9	Shims must protrude beyond flange or have a handle for insertion and positioning. [Viola]	Concur - Also beneficial for reducing peak stresses in shims.	A handling feature for the shims will be added.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	10	Eliminate spherical washers! Unnecessarily costly and potential loss of preload. [Viola]	Concur -Consider	1. Loss of preload will be tested in bolt tension tests with spherical washers and flat washers. Test will also provide cost data. 2. Design solution may be to use only where necessary to save cost. Spherical washers are needed where stud is not normal to spotface.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	11	The concern is do we have a pre fit-up of the MC before the diamond coated shims are installed? [Brown]	Concur - If needed to be determined by prototyping.	The assembly sequence will be worked out on the production protoype (A1:A2)
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	12	Make as many similar parts as possible i.e. all shims have same shape. [Viola]	Concur	Plan is to minimize the number of different parts
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	13	In place of planned " welded threaded hole adapters" use A286 nuts and washers. Use box wrench to resist rotation during tightening operations. [Heitzenroeder]	Concur	A1 adapters to replace through holes with tapped holes will be replaced with standard nuts
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	14	Expedite completion of coil-to-coil assembly prototyping to resolve issues that cannot be otherwise addressed. [Reiersen]	Concur	Daily meetings are being held at 3:45 to review daily progress and make plans for the following day.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	15	Need to establish acceptable fit up requirements for the shim. Also, determine where the preferred contact area is [Reiersen]	Concur	1. See Chit 4 re fit-up criteria. 2. Good fit-up around the stud is seen as important to provide a good load path for the bolt preload. The impact of not having good fit-up in the shell region will be investigated.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	16	Need to finalize shim area. Fit up favors a smaller area. Shear is the glass epoxy favors a larger area. [Reiersen]	Concur	See chits 12 and 15.
Modular Coil Interface Hardware PDR	2/22/2007	17	Load washer may have to be modified to	Concur	Interface with hydraulic

			[illegible]		
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	17	Load washer may have to be modified to accommodate hydraulic tensioners. [Reiersen]	Concur	Interface with hydraulic tensioners will be investigated.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	18	Resolve issue of what the stress allowables should be in the G-11 bushing. [Reiersen]	Concur	Stress allowaqbles will be reviewed and set per the NCSX Structural and Cryogenic Design Criteria.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	19	Send analysis results to Fan for checking. [Reiersen]	Concur	Analyses will be documented and provided for proejct review.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	20	Finalize location of bolts to resolve peak bushing stress concerns especially on A-A [Reiersen]	Concur	Adding more bolts on A-A will be investigated for reducing peak bushing stresses.
Modular Coil Interface Hardware PDR Williamson/Nelson/Reiersen	2/22/2007	21	Confirm that single shear test setup is OK. If not, consider setting it up a a double shear test. [Reiersen]	Concur	Double shear setup is being considered.

Coil instrumentation – open issues

- Fiber optic gage calibration
- Length of leads



COMPONENT	CABLE LENGTHS
A-Coil Plug-in TC #1	65"
A-Coil Plug-in TC #2	48"
A-Coil Surface Mount TC (dual)	12"
A-Coil Strain Set near Hole 64	192"
A-Coil Strain Set near Hole 44	90"
B-Coil Plug-in TC #1	60"
B-Coil Plug-in TC #2	30"
B-Coil Surface Mount TC (dual)	60"
B-Coil Strain Set near Hole 64	120"
C-Coil Plug-in TC #1	54"
C-Coil Plug-in TC #2	42"
C-Coil Surface Mount TC (dual)	12"
C-Coil Strain Set near Hole 68	96"
C-Coil Strain Set near Hole 46	112"

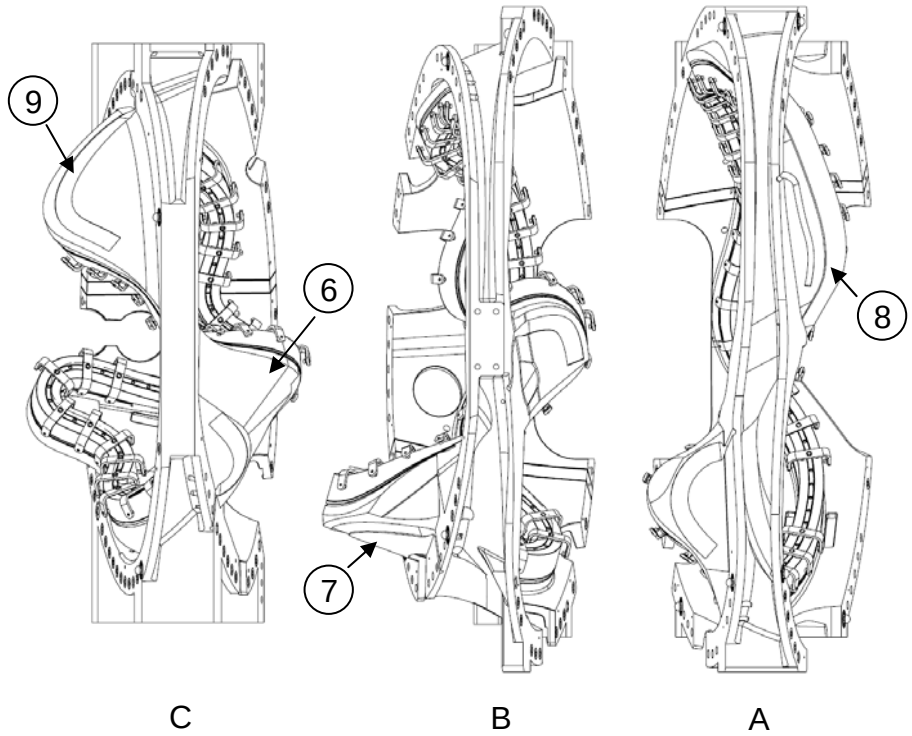
Design Review/QA Audit [Cog Engr/RLM/Chair]	Rvw Date	#	Chit/Audit Finding [Originator]
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	1	Strain gages on steel will be fairly each to interpret but gages on the composite conductor and chill plates may yield readings that are not so easy to interpret due to the uncertainty of the material. [Brooks]
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	2	Perform accuracy measurement on FBG sensors. [Dong]
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	3	Assume that installation and electronics costs are in WBS1 as they are not in WBS 5. [Gettelfinger]
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	4	Consider monitoring the coolant tube inlet and outlet temperatures. Useful diagnostic for monitoring will cooldown. [Reiersen]
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	5	Monitor coil resistance to infer coil temperature. Reduce number of TC's. 600 looks to be an excessive number fold into coil protection. [Reiersen]
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	6	Verify that problems with displacement gage were due to condensation could be done at PPPL. Also consider installing on machine. [Reiersen]
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	7	Investigate the calibration of FBG's so they have the same issues as Fabry Perot gages. [Reiersen]
Modular Coil Strain Gage FDR Willamson/Nelson/Reiersen	1/24/2007	8	We need to use calibrated gages if they are used to validate the structures models. Require the use of weldable gages. [Reiersen]

Bladder – open issues

- Drawing of standard shape
- Prototyping – AB, BC, or CC

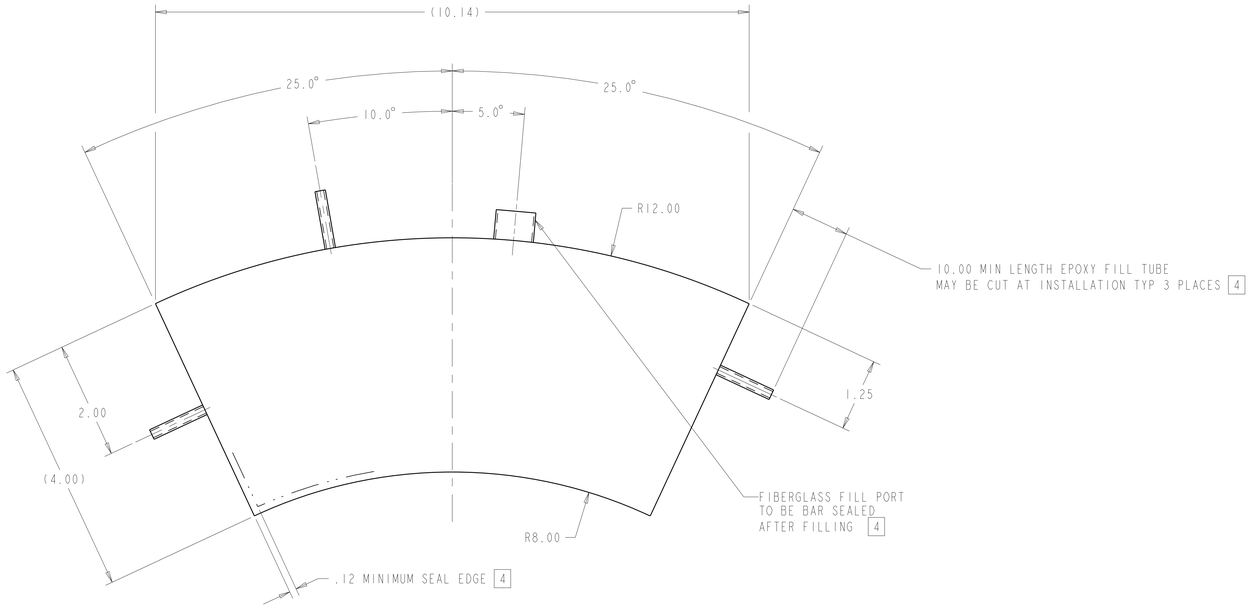
Inventory of wing surfaces:

No.	Coil Type	Interface	Location	Area (in2)
1	A	A-B	outboard	84
2	B	A-B	inboard	233
3	A	A-B	inboard	211
4	B	B-C	outboard	10
5	B	B-C	inboard	~0
6	C	B-C	inboard	433
7	B	B-C	inboard	293
8	A	A-A	inboard	301
9	C	C-C	inboard	408
10	C	C-C	outboard	131

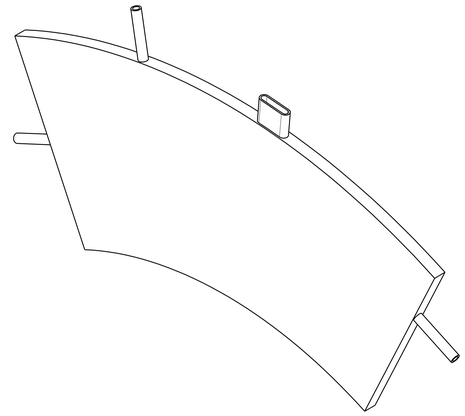


NOTES

1. DRAWING PREPARED IN ACCORDANCE WITH ASME Y14.100-2004.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS ARE IN INCHES
4. BAG TO BE FABRICATED FROM 5 MIL THICK CLEAR FEP SHEET CONTINUOUSLY SEALED AROUND EDGE. FILL PORTS TO BE BONDED IN PLACE USING A MANUFACTURER APPROVED ADHESIVE.



-1 WING SUPPORT BLADDER
SCALE 1.000



ISOMETRIC VIEW
SCALE 1.00

SEE SHEET 2 FOR APPROXIMATE WING LOCATIONS

AR	AR		-1	WING SUPPORT BLADDER	TEFLON FEP 4	ASTM D-882 (MECHANICAL)	1
SE140-050	SE140-003	CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION	FIND NO
		NEXT ASSEMBLY		PARTS LIST			

SE140-050
B

REV	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
0	ORIGINAL ISSUE	GM	03/07									

REVISION OR ISSUE PURPOSE — REVISION APPROVAL

SCALE NOTED
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS :
XX DECIMALS ±.01
XXX DECIMALS ±.005
ANGLES ±0°15'
BREAK SHARP EDGES .06 MAX
FINISH .125 UNLESS OTHERWISE SPECIFIED

DRAWING APPROVALS	DATE
DES D WILLIAMSON	03/07
DRW G MCGINNIS	03/07
CHK	
SECT :	:
DEPT :	:
PE :	:
CR :	:
PJ :	:
REQ :	:
PPPL DRFT J SIEGEL	03/07
:	:
:	:

UT-BATTELLE
Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-000R22725
UT-BATTELLE, LLC Oak Ridge, Tennessee

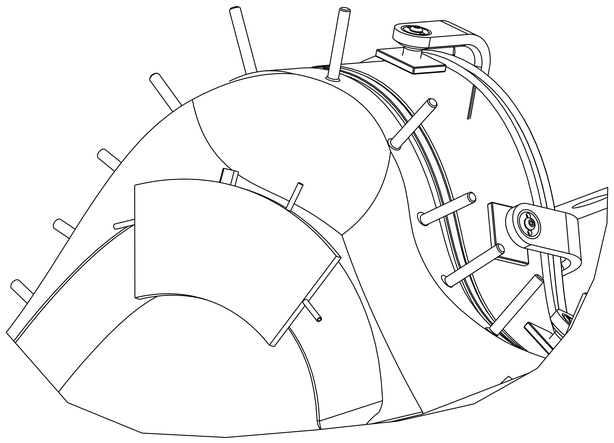
PROJECT NAME
NATIONAL COMPACT STELLARATOR EXPERIMENT

WING SUPPORT BLADDER

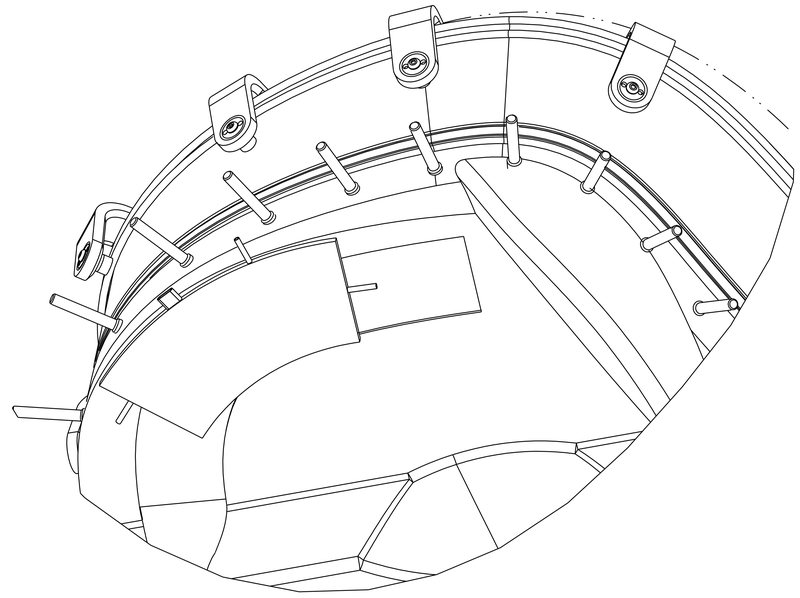
VERSION NO.	PLANT	BLDG	FL	SHT	OF	TYPE	CLASS
0+	ORNL	5700	3	1	2	S	U

RELEASE LEVEL: WIP
SE140-050
REV 0

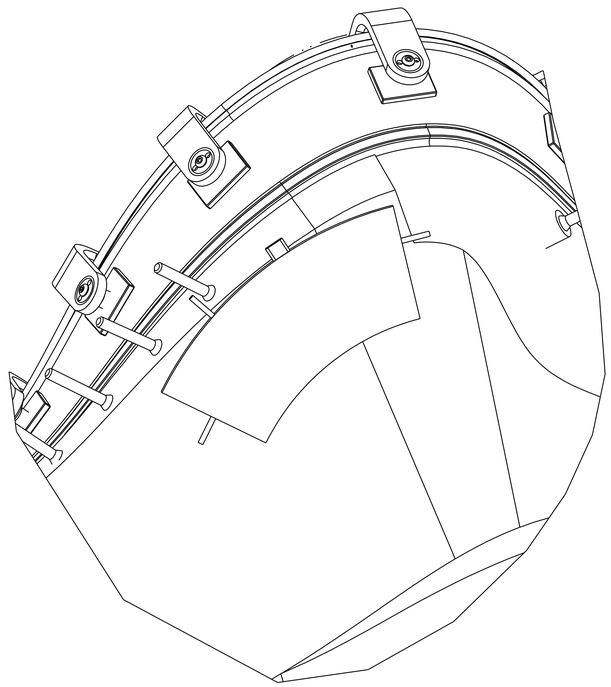
P THIS DRAWING PRODUCED ON PRO-ENGINEER



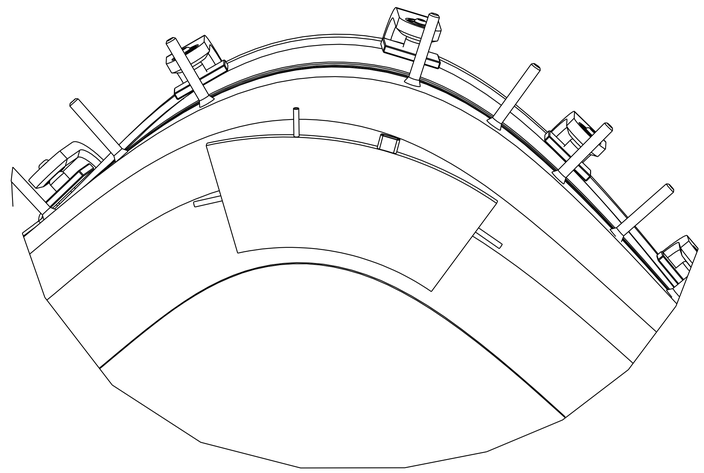
WING BLADDER BETWEEN A-B
A COIL -REF NUMBER 3
SCALE .50



WING BLADDER BETWEEN A-B
B COIL -REF NUMBER 2
SCALE .50



WING BLADDER BETWEEN B-C
C COIL REF NUMBER 6
SCALE .50



WING BLADDER BETWEEN C-C
C COIL REF NUMBER 9
SCALE .50

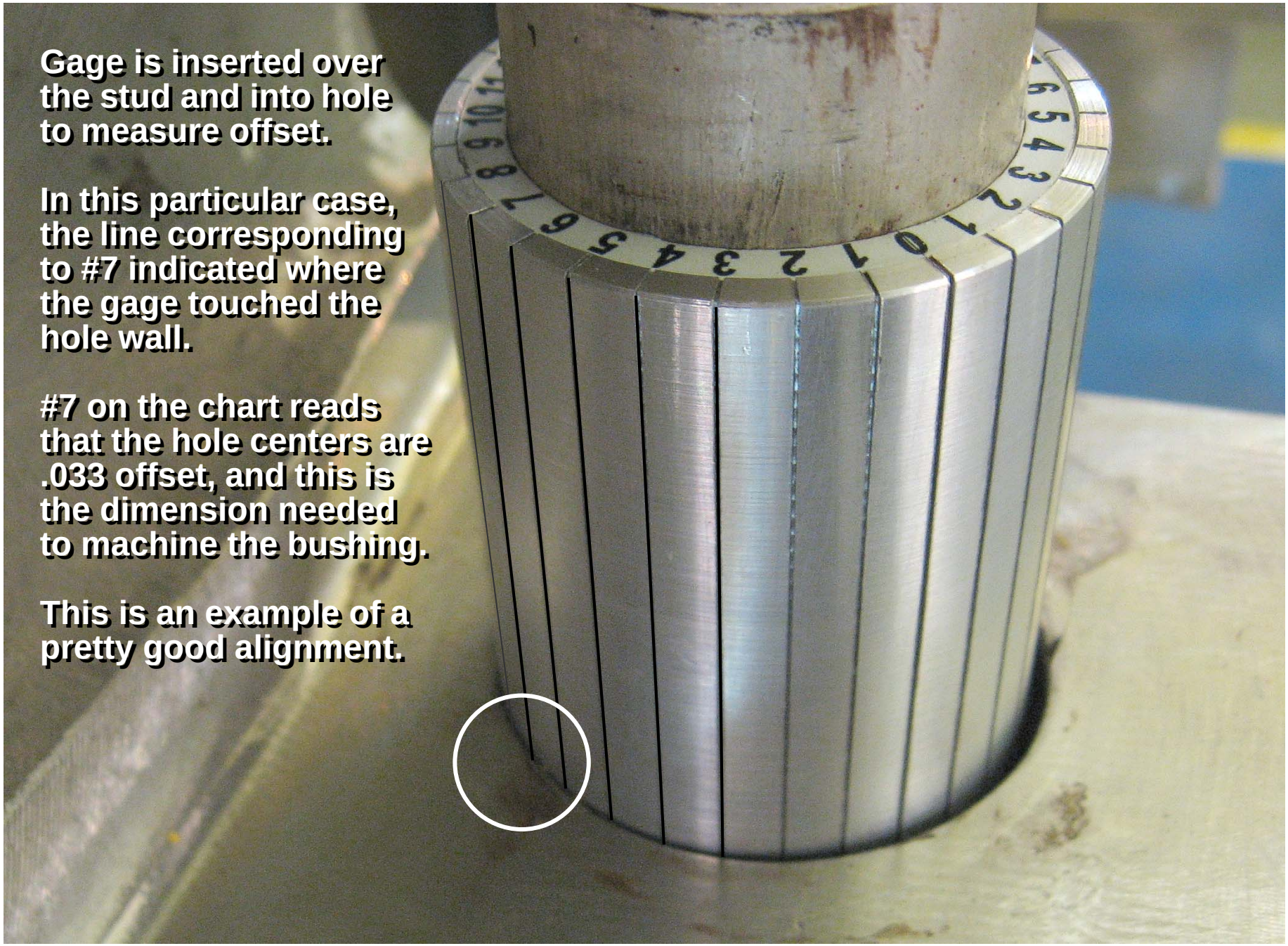
UT-BATTELLE	Oak Ridge National Laboratory managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-000R22725 UT-BATTELLE, LLC. Oak Ridge, Tennessee						
PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT							
WING SUPPORT BLADDER							
VERSION NO. 0+	PLANT ORNL	BLDG 5700	FL 3	SHT 2 OF 2	TYPE S	CLASS U	
RELEASE LEVEL WIP	SE140-050					REV 0	

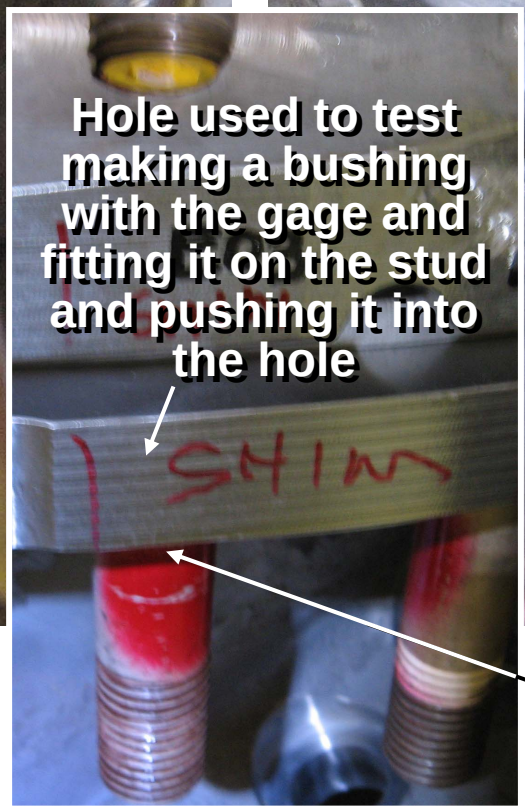
SE140-050

IH6-021	Procure materials for 1st FPA	05MAR07	21	02APR07	02APR07		
Bladder Tests							
1421-3002	Test plan,Setup test fixt.Order matl	01JAN07A	5	31JAN07A	19JAN07		
1421-3004	Rvw struct analyses.Verify perf of Teflon bladde	01FEB07*	5	07FEB07	26JAN07		
1421-3006	Perform Tests to develop epoxy filling techniq	29JAN07A	13*	14FEB07	02FEB07		
1421-3019	Determ if "one size fits all"&bladder dwgs	22JAN07A	18*	14FEB07	02FEB07		
1421-3011	Test 1/2" bag with CTD, Stycast 2850	29JAN07A	1	31JAN07A	06FEB07		
1421-3012	Fill &Test Teflon bladder to determine properti	29JAN07A	14*	15FEB07	15MAR07		
1421-3016	Procure/fab prototype bladder for C-C installati	16FEB07	15	08MAR07	05APR07		
1421-3021	Conduct FDR of bladder design	16MAR07	1	16MAR07	13APR07		
1421-3023	Resolve FDR issues, release proc dwgs for fab	19MAR07	5	23MAR07	20APR07		
1421-3025	Procure bladders for first FPA (2 ea)	26MAR07	20	20APR07	18MAY07		
1421-3028	Bladders available for FPA		0	20APR07	18MAY07		
IH2-030.01	Finalize Requirements	01DEC06A	31*	22JAN07A	22JAN07A	0701	
IH2-030.02	Procure Samples	01DEC06A	15*	22DEC06A	22DEC06A	0701	
IH2-030.03	Epoxy Fill Equipment	01DEC06A	15*	22DEC06A	22DEC06A	0701	
Bushing Test							

Bushings – open issues

- Drawing for “perfect” bushing


Gage is inserted over the stud and into hole to measure offset.
In this particular case, the line corresponding to #7 indicated where the gage touched the hole wall.
#7 on the chart reads that the hole centers are .033 offset, and this is the dimension needed to machine the bushing.
This is an example of a pretty good alignment.

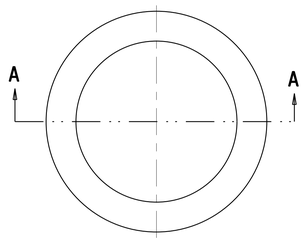


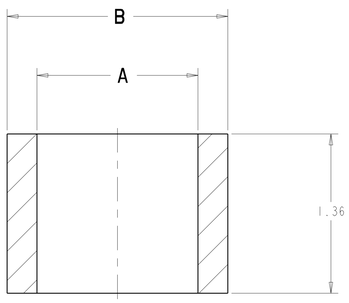
A flashlight and a mirror were used to read the gage from underneath the flange

NEXT ASS'Y: | FINAL ASS'Y:

NOTES

1. DRAWING PREPARED IN ACCORDANCE WITH ASME Y14.100-2004.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS ARE IN INCHES

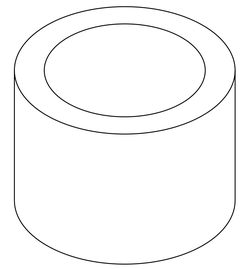




SECTION A-A

-1 BUSHING
SCALE 2.000

PART NO	DIM A	DIM B
-12	Ø1.375	Ø1.905
-11	Ø1.375	Ø1.903
-10	Ø1.375	Ø1.901
-9	Ø1.375	Ø1.889
-8	Ø1.375	Ø1.887
-7	Ø1.375	Ø1.885
-6	Ø1.000	Ø1.905
-5	Ø1.000	Ø1.903
-4	Ø1.000	Ø1.901
-3	Ø1.000	Ø1.889
-2	Ø1.000	Ø1.887
-1	Ø1.000	Ø1.885



ISOMETRIC VIEW
SCALE 2.00

SE140-195	CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION	FIND NO
		-12	BUSHING	GAROLITE	G-11	1
		-11				
		-10				
		-9				
		-8				
		-7				
		-6				
		-5				
		-4				
		-3				
		-2				
		-1				
	AR					

NEXT ASSEMBLY

PARTS LIST

SE140-195

P THIS DRAWING PRODUCED ON PRO-ENGINEER

REV	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
0	ORIGINAL ISSUE	GM	11/06									

REVISION OR ISSUE PURPOSE | REVISION APPROVAL

SCALE NOTED
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS
XX DECIMALS ±.01
XXX DECIMALS ±.005
ANGLES ±0°15'
BREAK SHARP EDGES .06 MAX
FINISH 125 UNLESS OTHERWISE SPECIFIED

DRAWING APPROVALS		DATE
DES	D WILLIAMSON	11/06
DRW	G MCGINNIS	11/06
CHK		
SECT	:	:
DEPT	:	:
PE	:	:
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGEL	11/06
	:	:
	:	:

UT-BATTELLE
Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725
UT-BATTELLE, LLC. Oak Ridge, Tennessee

PRINCETON PLASMA PHYSICS LABORATORY

NATIONAL COMPACT STELLARATOR EXPERIMENT

BUSHING

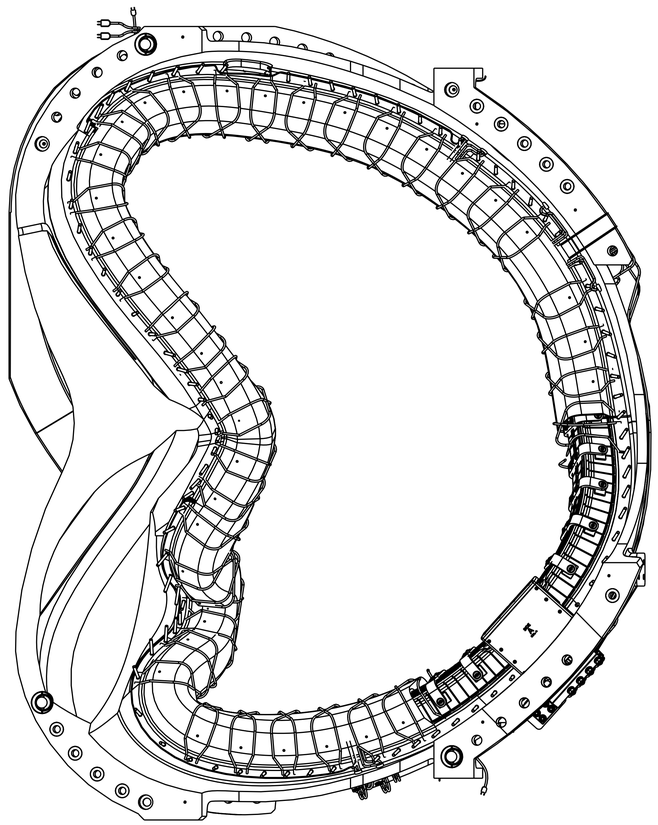
VERSION NO.	PLANT	BLDG	FL	SHT	OF	TYPE	CLASS
0	ORNL	5700	3	1	1	S	U

RELEASE LEVEL | SE140-195 | REV 0

Bushing Test						
1421-3094	Schemes for tight fit bushing Prepare sketches.	*01JAN07A*	*5*	*08JAN07A*	**26JAN07**	
1421-3096	Procure bushing materials for tests. Fabricate	*09JAN07A*	*15*	*15JAN07A*	**16FEB07**	
1421-3099	Procure tools&materials required f/ bushing assy	*16JAN07A*	*15*	*22JAN07A*	**16FEB07**	
1421-3102	Trial bushing installations on a production coil	*23JAN07A*	*10*	*31JAN07A*	**02MAR07**	
1421-3104	Doc. test results. Select bushing config. Peer r	*08MAR07*	*5*	*14MAR07*	**09MAR07**	
1421-3106	Proc bushing matls for assy operations. Fab bush	*15MAR07*	*30*	*25APR07*	**20APR07**	
1421-3109	Bushings available for FPA operations		*0*	*25APR07*	**20APR07**	

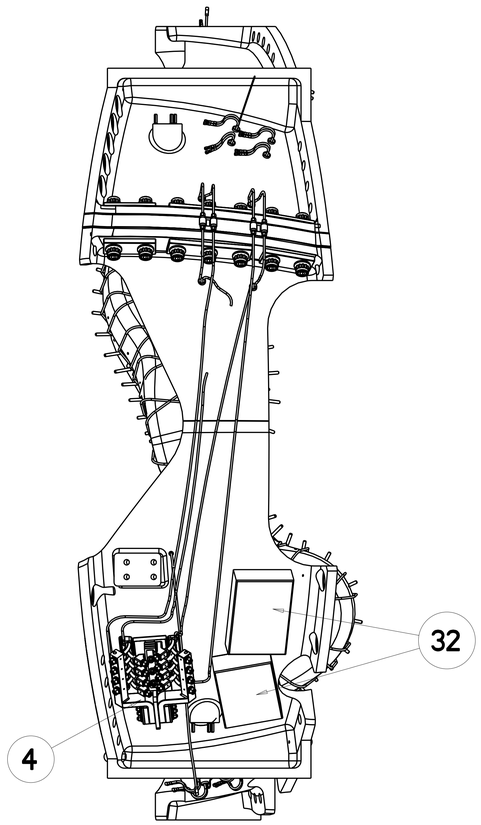
Thermal insulation – open issues

- Prototyping
- Callout on drawing

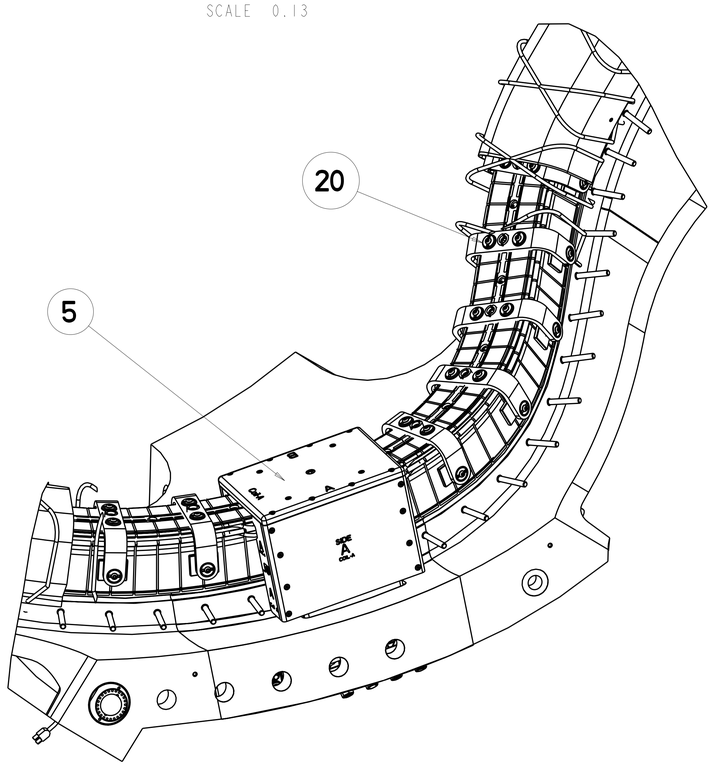


1

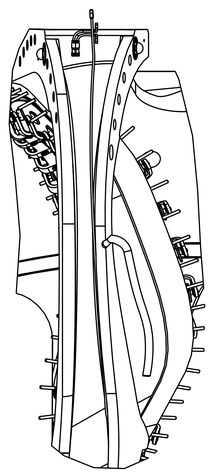
SCALE 0.13



SCALE 0.130



SCALE 0.25



NOTES:
1. DRAWING PREPARED IN ACCORDANCE WITH ASME Y14.100-2000.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y14.5M
3. DIMENSIONS ARE IN INCHES
4. DIMENSIONS APPLY AT ROOM TEMPERATURE. OPERATING TEMP 80 K.
5. LEADS AREA SHALL BE COVERED OR SPRAYED WITH AN INSULATING MATERIAL TO PREVENT DEBRIS FROM CAUSING AN ELECTRICAL SHORT DURING OPERATION.
6. OPTIONAL BLANKET INSULATION ASSEMBLY, F/N 18, NOT SHOWN. SEE DRAWING SE122-009 FOR INSTALLATION.
7. SEE LATEST REVISION OF PROCEDURE D-NCSX-MCF-001 FOR ADDITIONAL REQUIREMENTS.
8. WELDING SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF PPPL PROCEDURE NO. ENG-037. VISUAL WELD INSPECTION SHALL BE PERFORMED IN ACCORDANCE WITH THE ACCEPTANCE CRITERIA OF AWS D1.6.
9. VENDOR INFORMATION: TRULY TUBULAR FITTING CORP
PO BOX 1160
MT VERNON, NY 10550
914-664-8686 OR WWW.TRULYTUBULAR.COM
10. VENDOR INFORMATION: FISO FIBER OPTICS
500 ST. JEAN BAPTISTE AVE SUITE 195
QUEBEC QC, G2E 5R CANADA
418-688-8065 OR WWW.FISO.COM
11. VENDOR INFORMATION: OMEGA ENGINEERING CORP
ONE OMEGA DRIVE
STAMFORD, CT 06907
800-848-4286 OR WWW.OMEGA.COM
12. SOME PARTS IN THIS ASSEMBLY ARE GRAPHIC REPRESENTATIONS OF ACTUAL PARTS/ASSEMBLIES. PART IDENTIFICATION NUMBERS REFER TO ACTUAL PARTS. FOR FULL MODELED ASSEMBLY SEE SE140-102-
13. TYPE "A" COIL: REMOVE NOTED STUDS AFTER CLAMP AND INSULATION BLANKETS ARE ASSEMBLED (POST VPI).

	2		-34	WASHER		SS 316L	
	4		-33	3/8 - 16UNC HEX NUT		SS 316L	
	12		SE142C-014	LINED INSULATING SLEEVE			33
	2		SE142C-015	3"X8"X12" FLUX LOOP BOX			32
10	AR		SE142C-013	FISO FIBER OPTIC STRAIN SENSOR			31
	2		SS-810-1-8	BLEED VALVE			30
11	2		TEMP-THERMOCOUPLER1	THERMO COUPLER			29
	6		SE185I-170	BALL ALIGNMENT ASSEMBLY			28
	13		SE141-204	FLANGE BUSHINGS			27
				TRULY TUBULAR FITTING		BRAZETYTE	26
	AR		SE142C-011	TUBE CLAMP			25
	2		SE142A-025	POL BR CONNECTOR ASSEMBLY			24
	2		90FF-4	TRULY TUBULAR 1/4 ELBOW		BRAZETYTE	23
9	2		10FF-4	TRULY TUBULAR 1/4 UNION		BRAZETYTE	22
6	AR		SE122-009	WINDING FORM INSULATION ASSY			21
	AR		SE142A-010	CLAMP ASSEMBLY			20
	AR		SE142A-248	SIDE B COOLING TUBES			19
	1		SE142A-246-4	SIDE "B" CHILL PLATES (SIDE)			18
	1		SE142A-246-3	SIDE "B" UPPER CHILL PLATES (TOP)			17
	AR		SE142A-243	SIDE "B" GROUNDWRAP			16
	1		SE142A-241	SIDE "B" WINDING ASSEMBLY			15
	1		SE142A-244-4	SIDE "B" LOWER CLADDING (BASE)			14
	1		SE142A-244-3	SIDE "B" UPPER CLADDING (SEPTUM)			13
	AR		SE142A-258	SIDE A COOLING TUBES			12
	1		SE142A-256-4	SIDE A LOWER CHILL PLATES (SIDE)			11
	1		SE142A-256-3	SIDE A UPPER CHILL PLATES (TOP)			10
	AR		SE142A-253	SIDE-A WP GROUNDWRAP			9
	1		SE142A-251	SIDE "A" WINDINGS ASSEMBLY			8
	1		SE142A-254-4	SIDE "A" LOWER CLADDING (BASE)			7
	1		SE142A-254-3	SIDE "A" UPPER CLADDING (SEPTUM)			6
	1		SE142A-080	TYPE "A" LEADS ASSEMBLY			5
	1		SE142C-050	TYPE "A" TERMINAL ASSEMBLY			4
			SE141-121	STUDS (SEE SHT 2)			3
	1		SE141-101	MOD COIL WINDING FORM ASSEMBLY TYPE-A			2
	1		-1	MCWF-TYPE A ASM			1
SE140-003	CAGE CODE		PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION	FIND NO
	SE140-101		NEXT ASSEMBLY	PARTS LIST			

SE140-101

P THIS DRAWING PRODUCED ON PRO-ENGINEER

REV.	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
	REVISION OR ISSUE PURPOSE	REVISION APPROVAL										

SCALE NOTED
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS
XX DECIMALS ±.01
XXX DECIMALS ±.005
ANGLES ±0°15'
BREAK SHARP EDGES .06 MAX
FINISH 125 UNLESS OTHERWISE SPECIFIED

DES	D WILLIAMSON	07-06
DRW	G LOVETT	07-06
CHK	M COLE	08-06
SECT	:	:
DEPT	:	:
PE	D WILLIAMSON	8-06
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGLE	08-06
	:	:
	:	:
	DRAWING APPROVALS	DATE

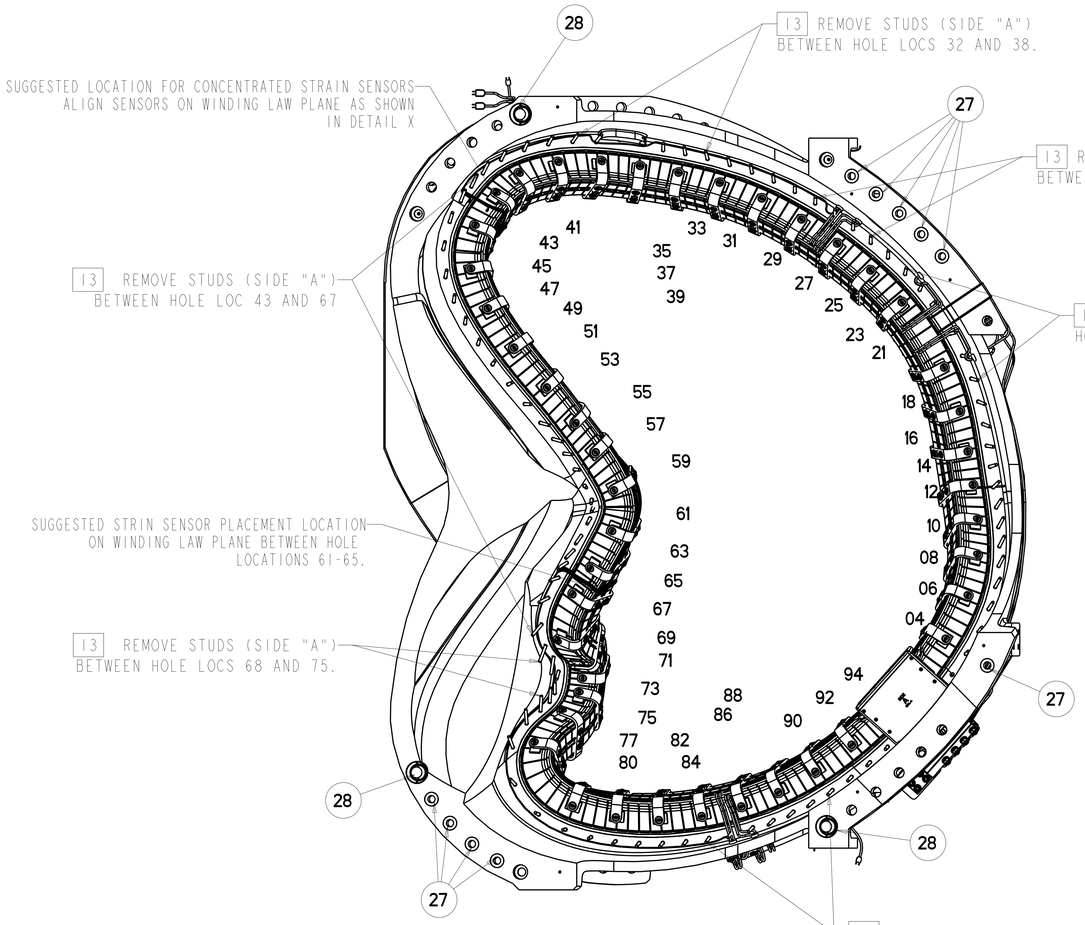
UT-BATTELLE
Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725
UT-BATTELLE, LLC. Oak Ridge, Tennessee
operated by

NATIONAL COMPACT STELLARATOR EXPERIMENT

MCWF TYPE "A"
FULL COIL ASSEMBLY

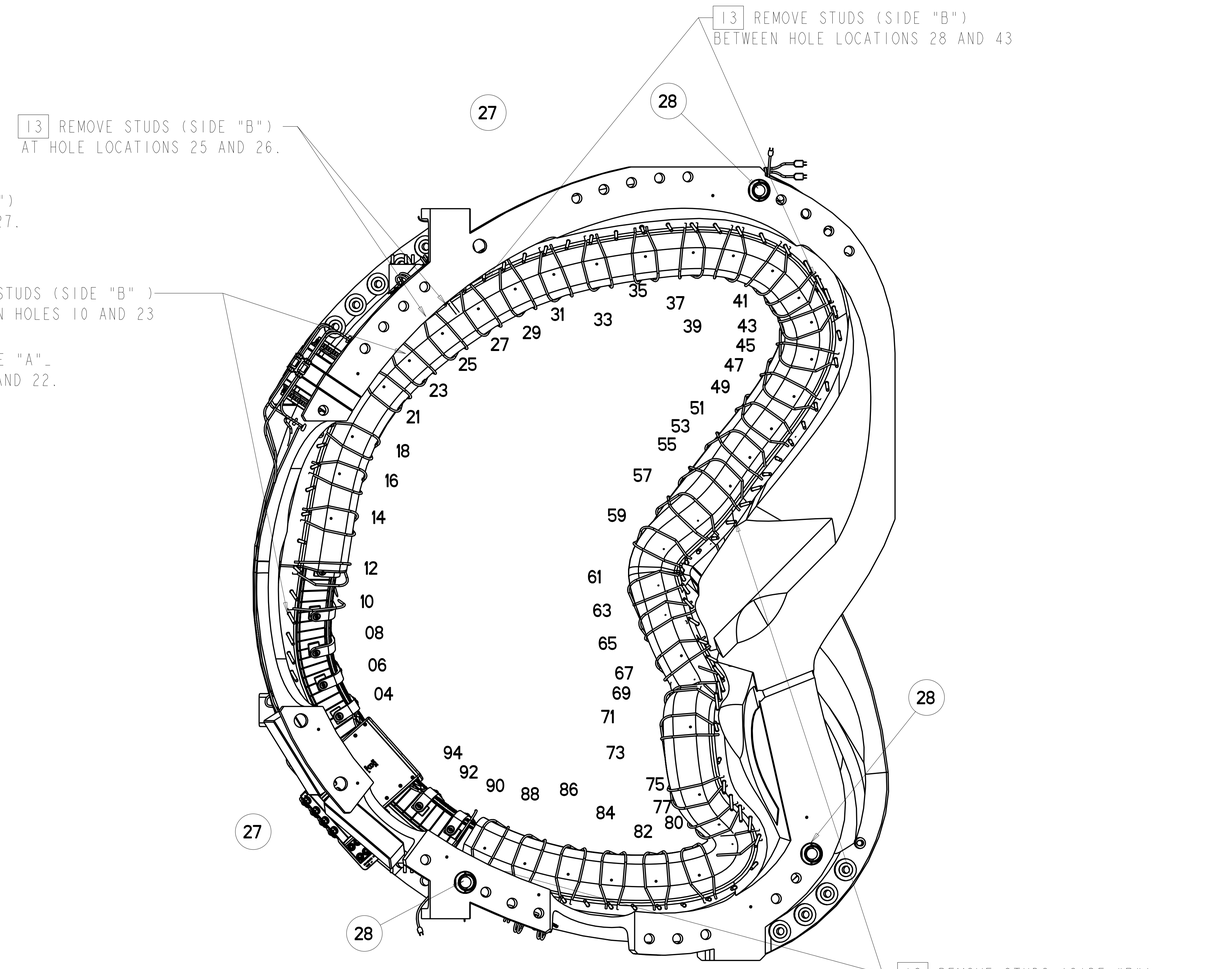
VERSION NO.	PLANT	BLDG	FL	SHT OF	TYPE	CLASS
25	X-10	5700	3	1 2	S	U

RELEASE LEVEL: WIP
SE140-101
REV 0



SIDE "A" VIEW

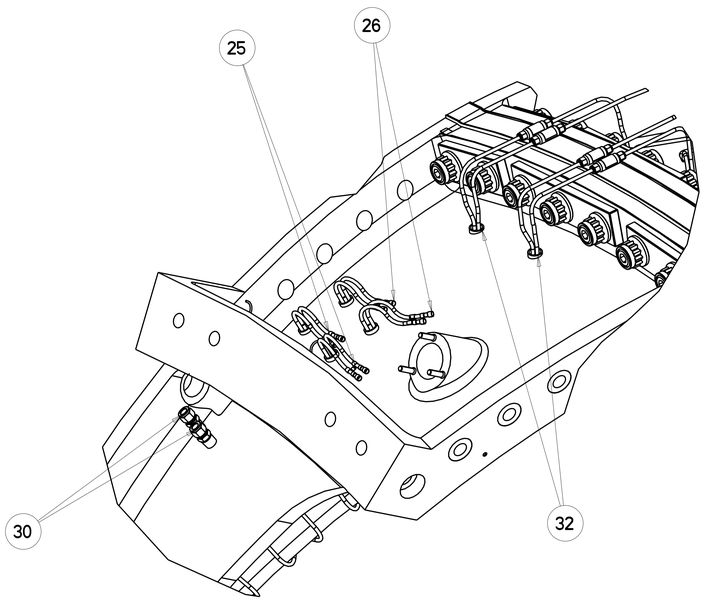
SCALE 0.125



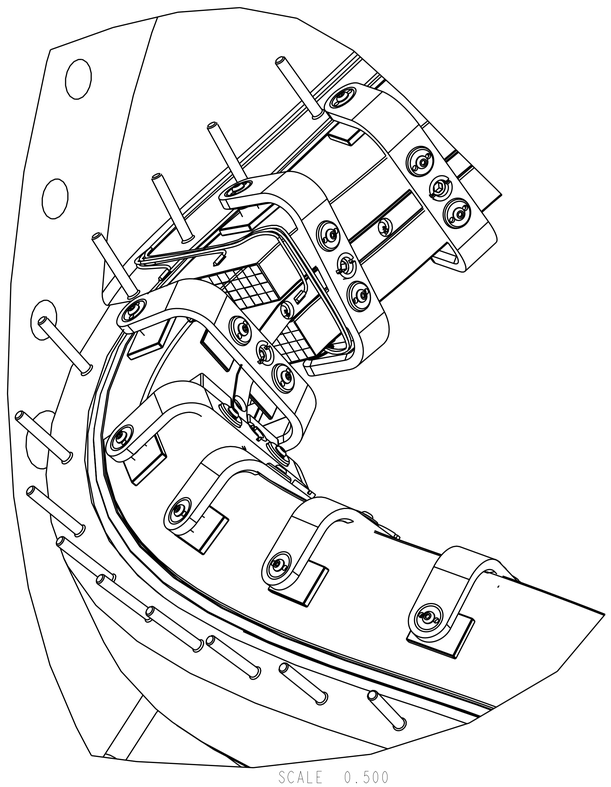
SIDE "B" VIEW

SCALE 0.125

CLAMP / HOLE NUMBER LOCATIONS

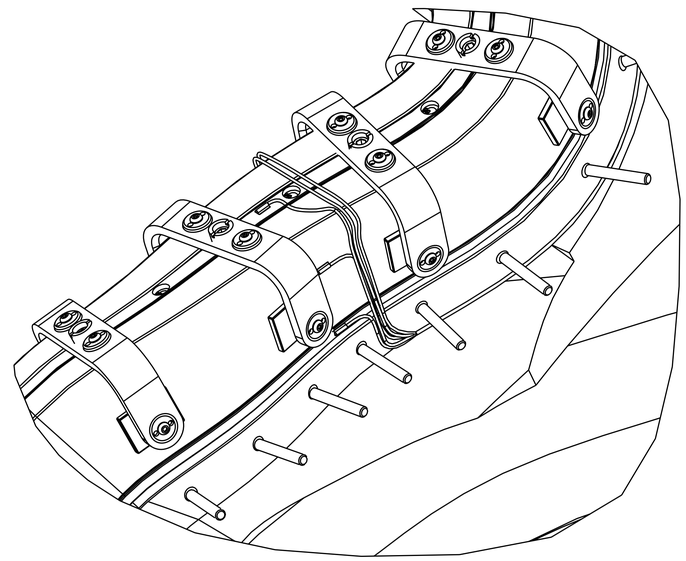


SCALE 0.250



SCALE 0.500

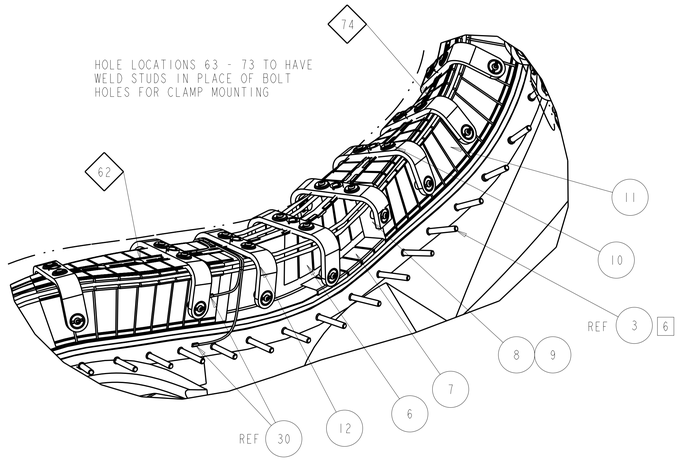
CLAMP / HOLE NUMBER LOCATIONS



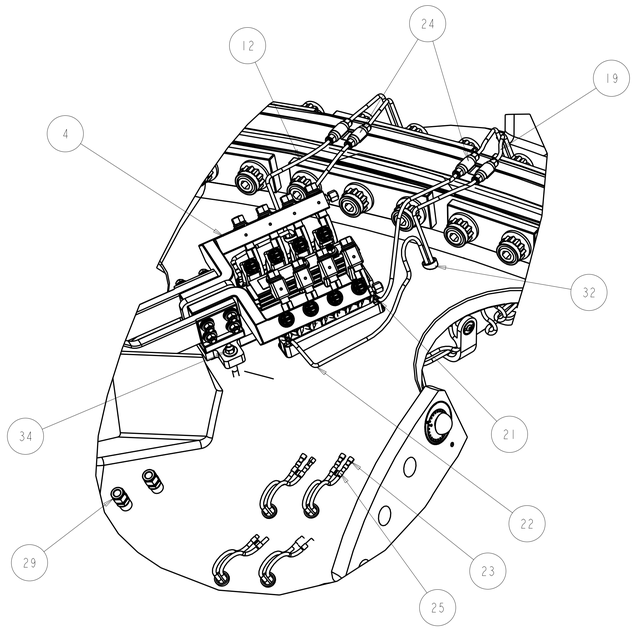
SCALE 0.500

SE140-101

UT-BATTELLE	Oak Ridge National Laboratory managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725 UT-BATTELLE, LLC. Oak Ridge, Tennessee						
PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT							
MCWF TYPE "A" FULL COIL ASSEMBLY							
VERSION NO: 48	PLANT X-10	BLDG 5700	FL 3	SHT OF 2 2		TYPE S	CLASS U
RELEASE LEVEL WIP	SE140-101						REV 0



CUT-AWAY VIEW SHOWING WINDING INSTALLATION SEQUENCE (SIDE A)
SCALE 0.250



TUBING AT POLOIDAL BREAK
SCALE 0.250

-1 MCWF TYPE-B ASM
SCALE 0.125

NOTES:
1. DRAWING PREPARED IN ACCORDANCE WITH ASME Y14.100-2000.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y14.5M
3. DIMENSIONS ARE IN INCHES
4. DIMENSIONS APPLY AT ROOM TEMPERATURE. OPERATING TEMP 80 K.
5. LEADS AREA SHALL BE COVERED OR SPRAYED WITH AN INSULATING MATERIAL TO PREVENT DEBRIS FROM CAUSING AN ELECTRICAL SHORT DURING OPERATION.
6. OPTIONAL BLANKET INSULATION ASSEMBLY, F/N 18, NOT SHOWN. SEE DRAWING SE122-009 FOR INSTALLATION.
7. SEE LATEST REVISION OF PROCEDURE D-NCSX-MCF-001 FOR ADDITIONAL REQUIREMENTS.
8. WELDING SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF PPPL PROCEDURE NO. ENG-037. VISUAL WELD INSPECTION SHALL BE PERFORMED IN ACCORDANCE WITH THE ACCEPTANCE CRITERIA OF AWS D1.6.
9. VENDOR INFORMATION: TRULY TUBULAR FITTING CORP
PO BOX 1160
MT VERNON, NY 10550
914-664-8686 OR WWW.TRULYTUBULAR.COM
10. VENDOR INFORMATION: FISO FIBER OPTICS
500 ST. JEAN BAPTISTE AVE SUITE 195
QUEBEC QC, G2E 5R CANADA
418-688-8065 OR WWW.FISO.COM
11. VENDOR INFORMATION: OMEGA ENGINEERING CORP
ONE OMEGA DRIVE
STAMFORD, CT 06907
800-848-4286 OR WWW.OMEGA.COM
12. SOME PARTS IN THIS ASSEMBLY ARE GRAPHIC REPRESENTATIONS OF ACTUAL PARTS/ASSEMBLIES. PART IDENTIFICATION NUMBERS REFER TO ACTUAL PARTS. FOR FULL MODELED ASSEMBLY SEE SE140-102-
13. TYPE "B" COIL: REMOVE NOTED STUDS AFTER CLAMP AND INSULATION BLANKETS ARE ASSEMBLED (POST VPI).

	4		3/8 -16 UNC	HEX NUT	316 SST	ASTM B18.2.2	34
	AR		SE142B-030	WIRE CLAMP			33
10	12		SE142C-014	INSULATING SLEEVE			32
	2		SE142C-015	3" X 8" X 12" FLUX LOOP BOX			31
	5		FOS-N-BA-C1-F1-M2-R3-ST	STRAIN SENSOR			30
	2		SS-810-1-8	BLEED VALVE			29
11	2		NCSX-PRL-003	THERMOCOUPLE		INCONEL 718	28
	6		SE1851-170	BALL ALIGNMENT ASSEMBLY			27
	13		SE141-204	FLANGE BUSHINGS			26
	AR		SE142C-011	TUBE CLAMP			25
	2		SE142B-020	POL BR CONNECTOR ASSEMBLY			24
	16		5FF-5-4	1/4" X 5/16" REDUCER UNION		BRAZETYTE	23
9	2		90FF-4	1/4" ELBOW		BRAZETYTE	22
	2		10FF-4	1/4" UNION		BRAZETYTE	21
	AR		SE142B-010	CLAMP ASSEMBLY			20
			SE142B-248	SIDE "B" COOLING TUBES			19
	1		SE142A-246-4	SIDE "B" CHILL PLATES (SIDE)			18
	1		SE142A-246-3	SIDE "B" UPPER CHILL PLATES (TOP)			17
	AR		SE142A-243	SIDE "B" GROUNDWRAP			16
	1		SE142A-241	SIDE "B" WINDING ASSEMBLY			15
	1		SE142A-244-4	SIDE "B" LOWER CLADDING (BASE)			14
	1		SE142B-244-3	SIDE "B" UPPER CLADDING (SEPTUM)			13
	AR		SE142B-258	SIDE A COOLING TUBES			12
	1		SE142B-256-4	SIDE A LOWER CHILL PLATES (SIDE)			11
	1		SE142B-256-3	SIDE A UPPER CHILL PLATES (TOP)			10
	AR		SE142B-253	SIDE-A WP GROUNDWRAP			9
	1		SE142B-251	SIDE "A" WINDINGS ASSEMBLY			8
	1		SE142B-254-4	SIDE "A" LOWER CLADDING (BASE)			7
	1		SE142B-254-3	SIDE "A" UPPER CLADDING (SEPTUM)			6
	1		SE142B-080	TYPE "B" LEADS ASSEMBLY			5
	1		SE142B-050	TYPE "B" TERMINAL ASSEMBLY			4
6	1		SE142B-STUDS	STUDS			3
	1		SE141-102	MOD COIL WINDING FORM ASSEMBLY TYPE-B			2
	AR	X	-1	MCWF-TYPE "B" ASM			1
SE140-003	-	CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION	FIND NO
		NEXT ASSEMBLY		PARTS LIST			

SE140-102
B

REV	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
0	ORIGINAL ISSUE	GM	11/06									

REVISION OR ISSUE PURPOSE — REVISION APPROVAL

SCALE NOTED
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS
XX DECIMALS ±.01
XXX DECIMALS ±.005
ANGLES ±0°15'
BREAK SHARP EDGES .06 MAX
FINISH .125 UNLESS OTHERWISE SPECIFIED

DRAWING APPROVALS		DATE
DES	D WILLIAMSON	11/06
DRW	G LOVETT	11/06
CHK	M COLE	11/06
SECT	:	:
DEPT	:	:
PE	D WILLIAMSON	11/06
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGLE	11/06
	:	:
	:	:

UT-BATTELLE
Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725
UT-BATTELLE, LLC. Oak Ridge, Tennessee

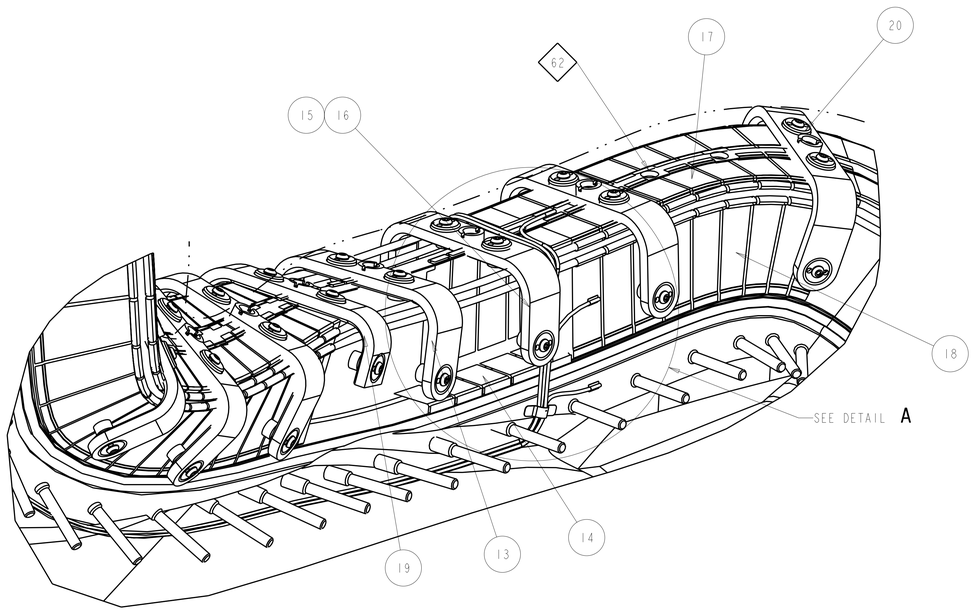
PRINCETON PLASMA PHYSICS LABORATORY
NATIONAL COMPACT STELLARATOR EXPERIMENT

MCWF TYPE "B"
FULL COIL ASSEMBLY

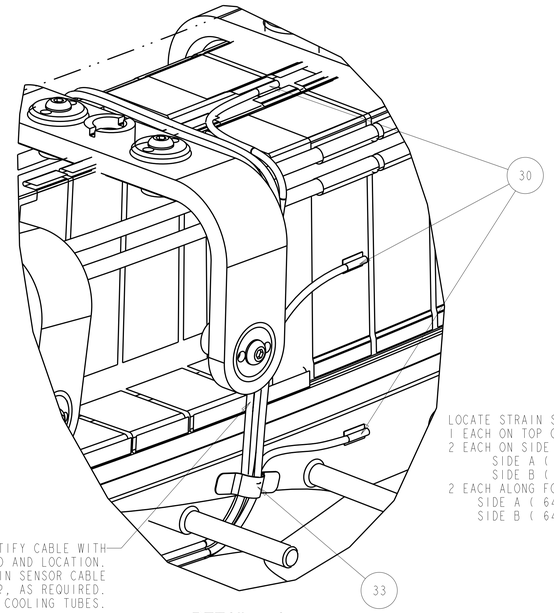
VERSION NO.	PLANT	BLDG	FL	SHT OF	TYPE	CLASS
16	X-10	5700	3	1 2	S	U

RELEASE LEVEL: WIP
SE140-102
REV 0

P THIS DRAWING PRODUCED ON PRO-ENGINEER



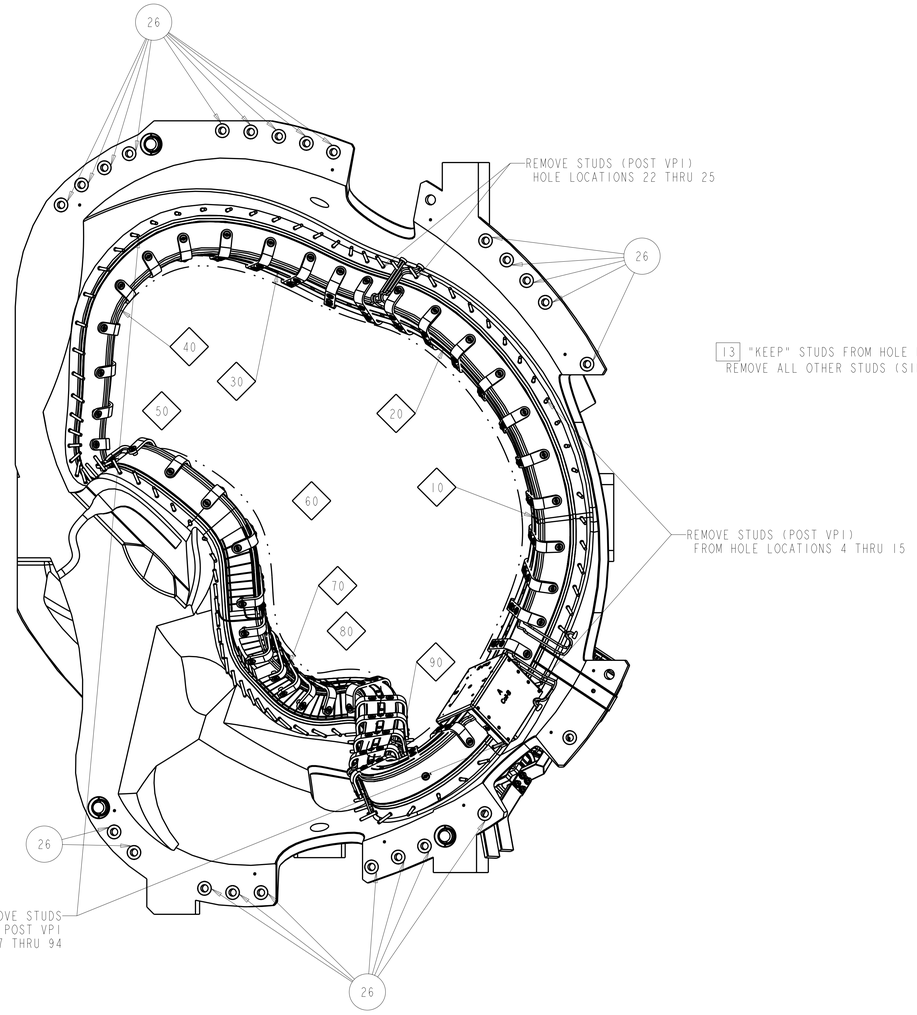
CUT-AWAY VIEW SHOWING WINDING INSTALLATION SEQUENCE (SIDE B)
SCALE 0.500



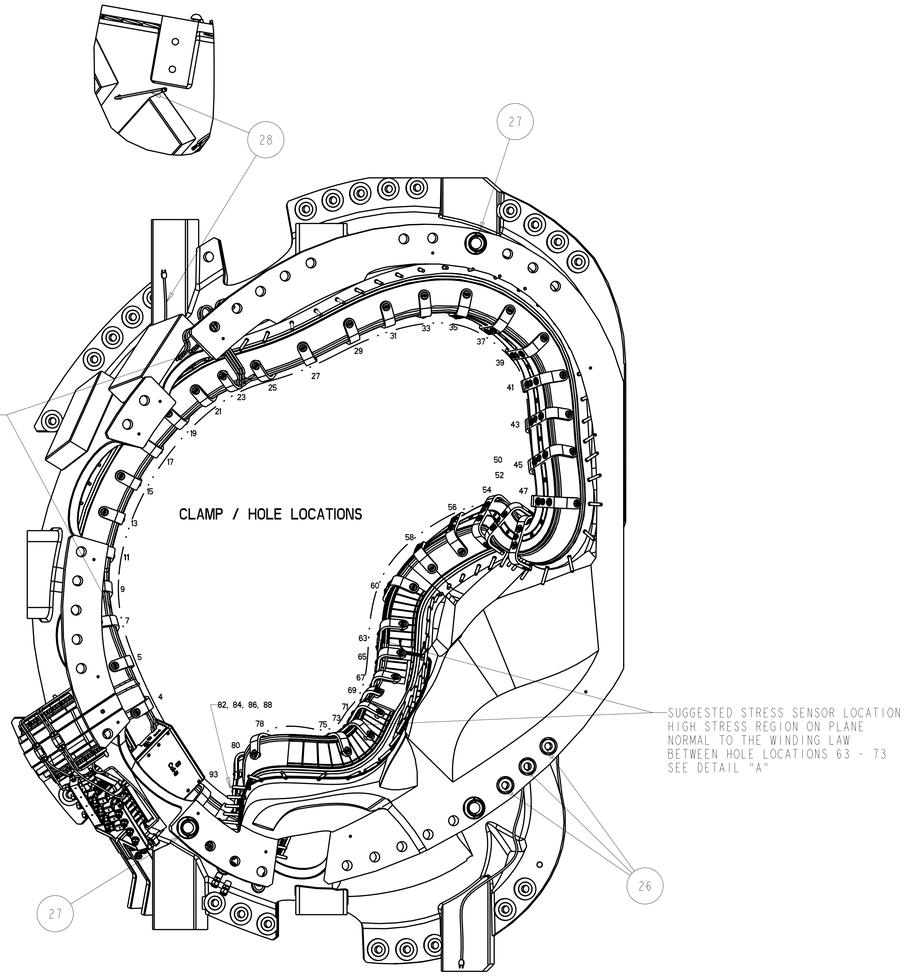
LOCATE STRAIN SENSORS AND LABLE AS SHOWN
1 EACH ON TOP OF TEE (64 T-TOP)
2 EACH ON SIDE OF CHILL PLATES
SIDE A (64-B-A)
SIDE B (64-B-B)
2 EACH ALONG FORM BELOW VPI GROOVE
SIDE A (64-V-A)
SIDE B (64-V-B)

COLOR CODE OR IDENTIFY CABLE WITH HOLE NUMBER ASSOCIATED AND LOCATION. BUNDLE FIBER OPTIC STRAIN SENSOR CABLE AND SECURE WITH CLAMP, F/N ??, AS REQUIRED. EXIT COIL WITH COOLING TUBES.

DETAIL A
SCALE 1.000



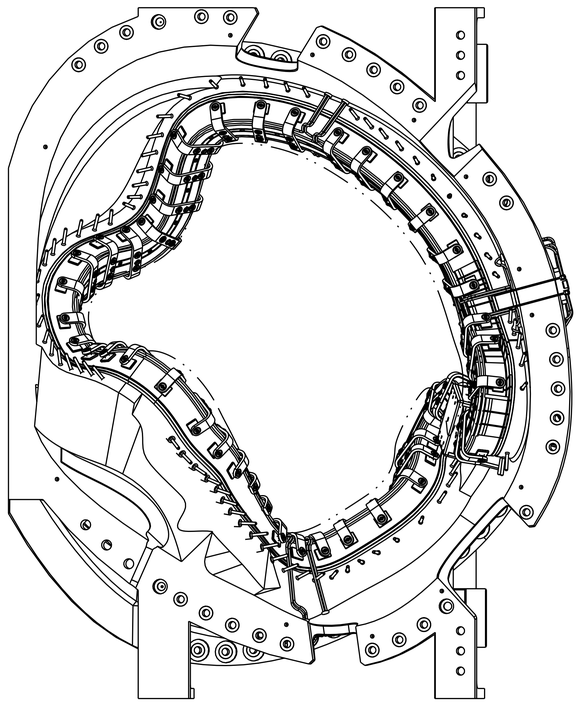
SIDE "A" VIEW



SIDE "B" VIEW

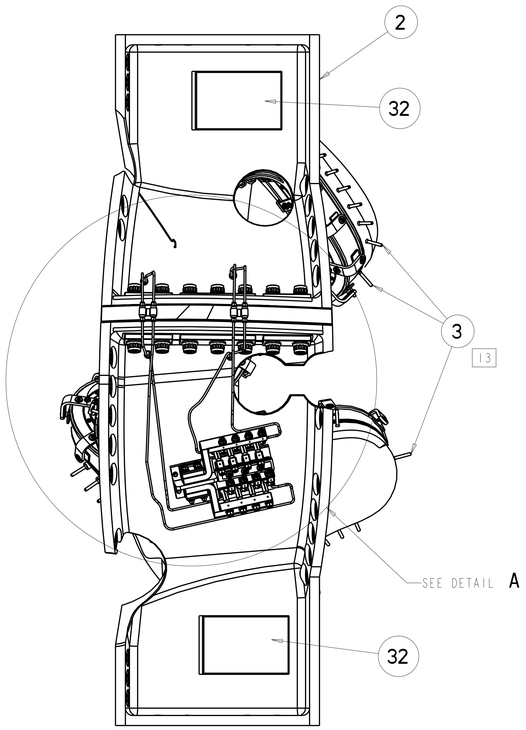
UT-BATTELLE	Oak Ridge National Laboratory managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725 UT-BATTELLE, LLC. Oak Ridge, Tennessee						
PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT							
MCWF TYPE "B" FULL COIL ASSEMBLY							
VERSION NO. 16	PLANT X-10	BLDG 5700	FL 3	SHT 2 OF 2	TYPE S	CLASS U	
RELEASE LEVEL WIP	SE140-102					REV 0	

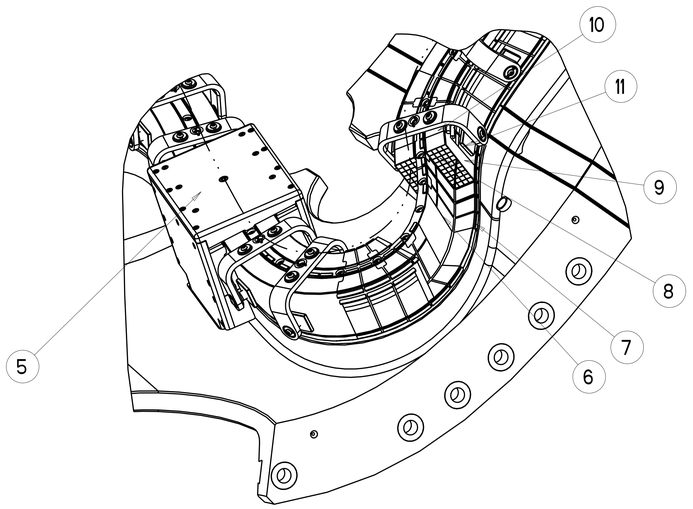
SE140-102



1 TYPE-C MODULAR COIL ASSEMBLY

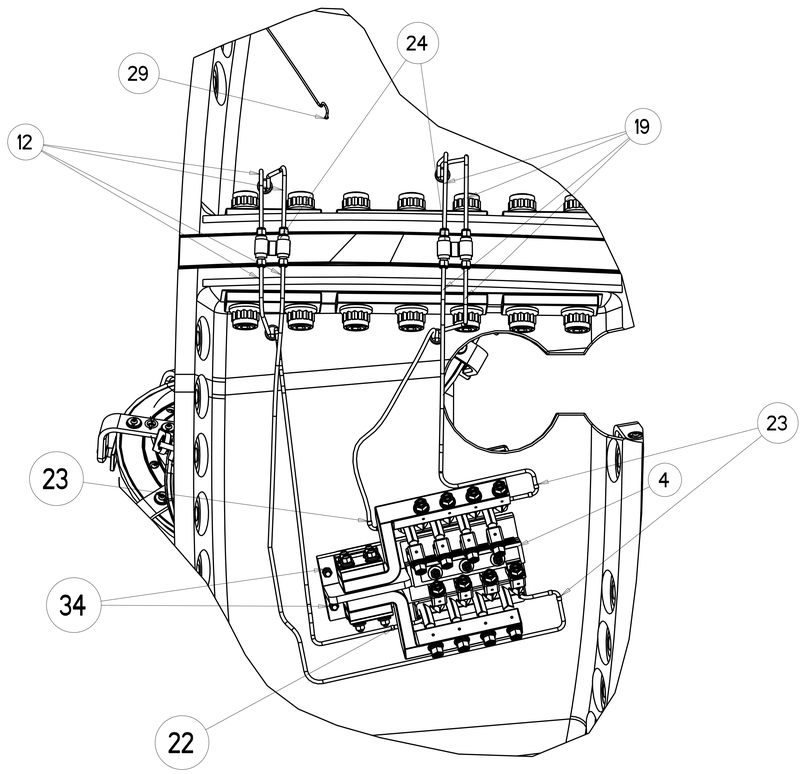
SCALE: 0.125





CUT-AWAY VIEW SHOWING WINDING INSTALLATION SEQUENCE (SIDE "A")

SCALE 0.25



DETAIL A

SCALE 0.250

NOTES:
1. DRAWING PREPARED IN ACCORDANCE WITH ASME Y14.100-2000.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y14.5M
3. DIMENSIONS ARE IN INCHES
4. DIMENSIONS APPLY AT ROOM TEMPERATURE. OPERATING TEMP 80 K.
5. LEADS AREA SHALL BE COVERED OR SPRAYED WITH AN INSULATING MATERIAL TO PREVENT DEBRIS FROM CAUSING AN ELECTRICAL SHORT DURING OPERATION.
6. OPTIONAL BLANKET INSULATION ASSEMBLY, F/N 18, NOT SHOWN. SEE DRAWING SE122-009 FOR INSTALLATION.
7. SEE LATEST REVISION OF PROCEDURE D-NCSX-MCF-001 FOR ADDITIONAL REQUIREMENTS.
8. WELDING SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS OF PPPL PROCEDURE NO. ENG-037. VISUAL WELD INSPECTION SHALL BE PERFORMED IN ACCORDANCE WITH THE ACCEPTANCE CRITERIA OF AWS D1.6.
9. VENDOR INFORMATION: TRULY TUBULAR FITTING CORP, PO BOX 1160, MT VERNON, NY 10550, 914-664-8686 OR WWW.TRULYTUBULAR.COM
10. VENDOR INFORMATION: FISO FIBER OPTICS, 500 ST. JEAN BAPTISTE AVE SUITE 195, QUEBEC QC, G2E 5R CANADA, 418-688-8065 OR WWW.FISO.COM
11. VENDOR INFORMATION: OMEGA ENGINEERING CORP, ONE OMEGA DRIVE, STAMFORD, CT 06907, 800-848-4286 OR WWW.OMEGA.COM
12. SOME PARTS IN THIS ASSEMBLY ARE GRAPHIC REPRESENTATIONS OF ACTUAL PARTS/ASSEMBLIES. PART IDENTIFICATION NUMBERS REFER TO ACTUAL PARTS. FOR FULL MODELED ASSEMBLY SEE SE140-102-
13. TYPE "C" COIL: REMOVE ALL STUDS AFTER CLAMP AND INSULATION BLANKETS ARE ASSEMBLED (POST VPI).

	4		-34	3/8-16 UNC HEX NUT		STAINLESS	34
	12		SE142C-014	INSULATING SLEEVE		NEMA GRADE G-11CR	33
	2		SE142C-015	3"x8"x12" FLUX LOOP BOX			32
10	AR		SE142C-013	FIBER OPTIC STRAIN GAGE			31
	2		SS-810-1-8	BLEED VALVE			30
11	2		SE142C-016	THERMO COUPLER		INCONEL 718	29
	6		SE1851-170	BALL ALIGNMENT ASSEMBLY			28
	13		SE141-204	FLANGE BUSHINGS			27
	16		5FF-5-4	TRULY TUBULAR BRAZETYTE		BRAZETYTE	26
	AR		SE142C-011	TUBE CLAMP			25
	2		SE142C-020	POL BR CONNECTOR ASSEMBLY			24
9	3		90FF-4	TRULY TUBULAR 1/4 ELBOW		BRAZETYTE	23
9	2		10FF-4	TRULY TUBULAR 1/4 UNION		BRAZETYTE	22
6	AR		SE122-009	WINDING FORM INSULATION ASSY			21
	AR		SE142C-010	CLAMP ASSEMBLY			20
12	AR		SE142C-248	SIDE B COOLING TUBES			19
	1		SE142C-488	SIDE "B" CHILL PLATES (SIDE)			18
	1		SE142C-486	SIDE "B" UPPER CHILL PLATES (TOP)			17
	AR		SE142C-243	SIDE "B" GROUNDWRAP			16
	1		SE142C-241	SIDE "B" WINDING ASSEMBLY			15
	1		SE142C-484	SIDE "B" LOWER CLADDING (BASE)			14
	1		SE142C-482	SIDE "B" UPPER CLADDING (SEPTUM)			13
	AR		SE142C-258	SIDE A COOLING TUBES			12
	1		SE142C-388	SIDE A LOWER CHILL PLATES (SIDE)			11
	1		SE142C-386	SIDE A UPPER CHILL PLATES (TOP)			10
	AR		SE142C-253	SIDE-A WP GROUNDWRAP			9
	1		SE142C-251	SIDE "A" WINDINGS ASSEMBLY			8
	1		SE142C-384	SIDE "A" LOWER CLADDING (BASE)			7
12	1		SE142C-382	SIDE "A" UPPER CLADDING (SEPTUM)			6
	1		SE142C-080_2	TYPE "C" LEADS ASSEMBLY			5
	1		SE142C-050	TYPE "C" TERMINAL ASSEMBLY			4
13			TEMP_060831A	STUDS (SEE NOTE 13)			3
	1		SE141-103	MOD COIL WINDING FORM ASSEMBLY TYPE-A			2
	1		-1	MCWF-TYPE C ASM			1
SE140-003	101-10413	CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION	FIND NO
		NEXT ASSEMBLY		PARTS LIST			

SE140-103 B

P THIS DRAWING PRODUCED ON PRO-ENGINEER

REV	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
	REVISION OR ISSUE PURPOSE	REVISION APPROVAL										

SCALE NOTED

TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONS
XX DECIMALS ±.01
XXX DECIMALS ±.005
ANGLES ±0°15'
BREAK SHARP EDGES .06 MAX
FINISH 125 UNLESS OTHERWISE SPECIFIED

DES	D WILLIAMSON	10-06
DRW	G LOVETT	10-06
CHK	MIKE COLE	11-06
SECT	:	:
DEPT	:	:
PE	:	:
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGLE	11-06
	:	:
	:	:
	DRAWING APPROVALS	DATE

UT-BATTELLE
Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725
UT-BATTELLE, LLC. Oak Ridge, Tennessee

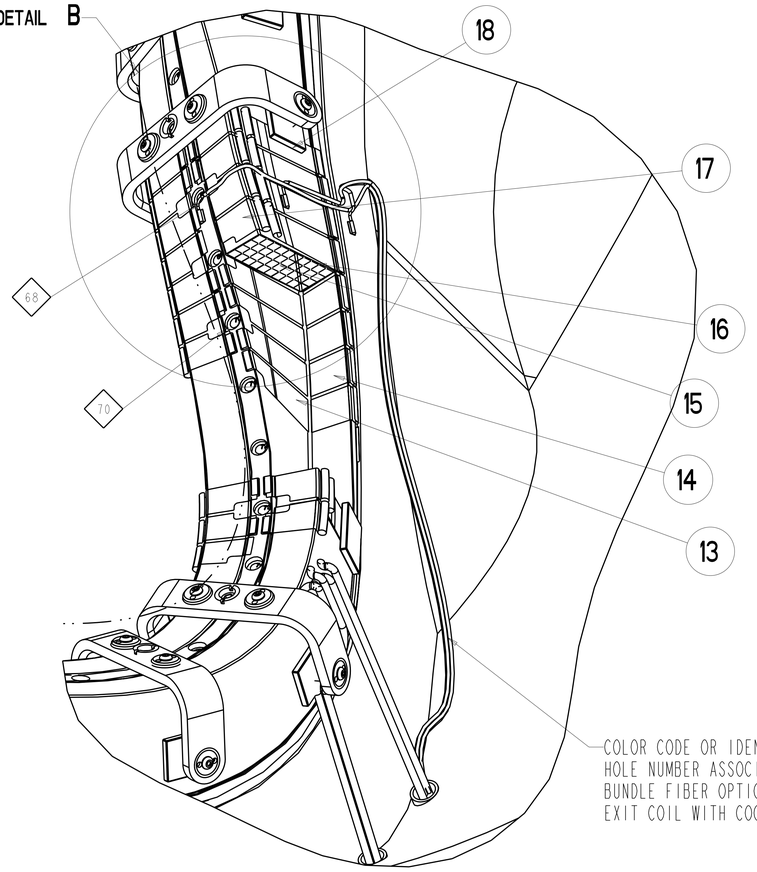
NATIONAL COMPACT STELLARATOR EXPERIMENT

TYPE "C" MCWF
FINAL COIL ASSEMBLY

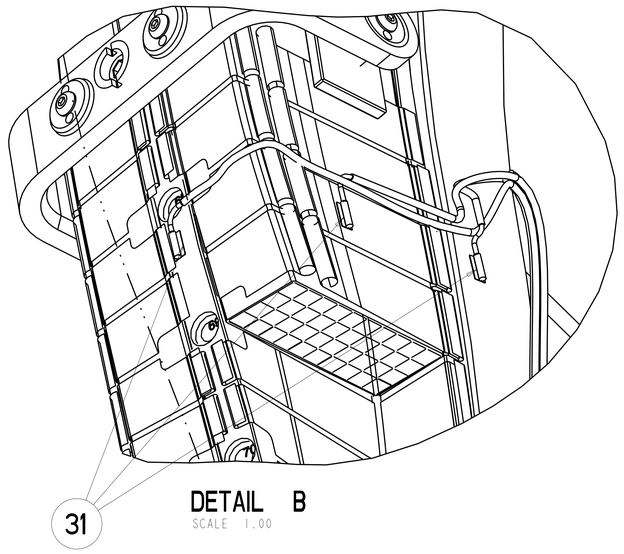
VERSION NO.	PLANT	BLDG	FL	SHT OF	TYPE	CLASS
24	X-10	5700	3	1 2	S	U

RELEASE LEVEL: WIP

SE140-103 REV 0

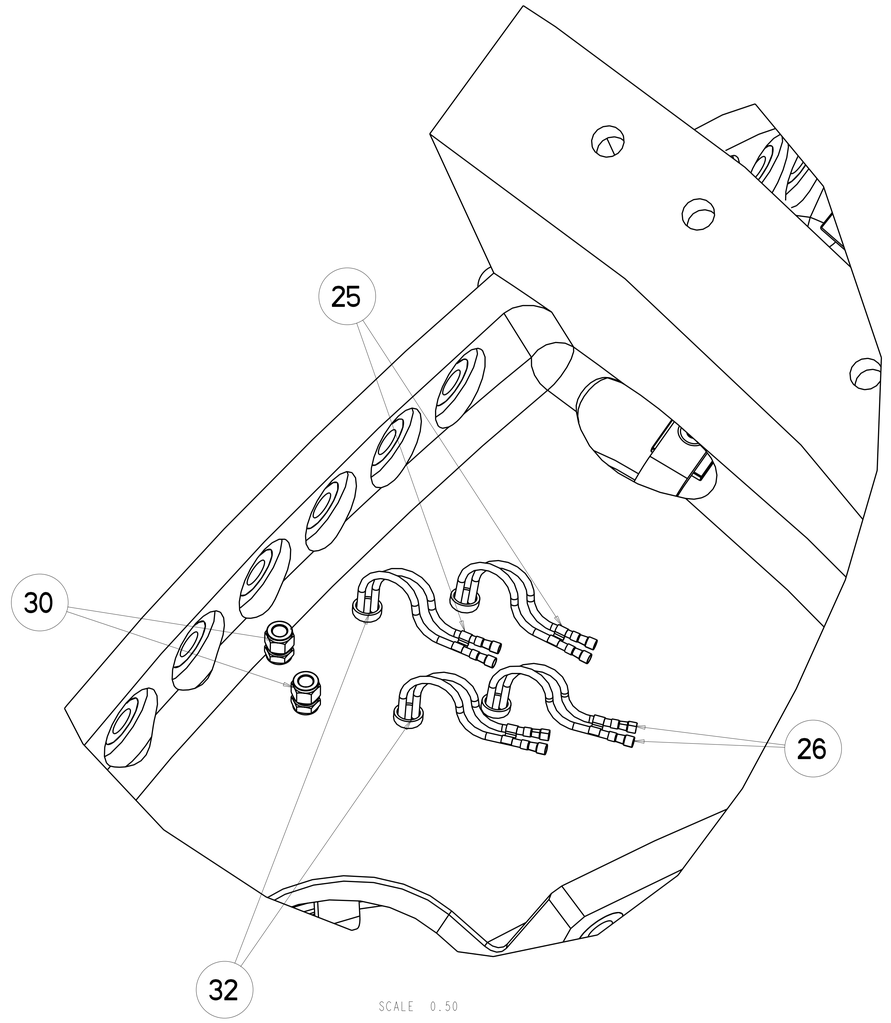


COLOR CODE OR IDENTIFY EACH CABLE WITH HOLE NUMBER ASSOCIATED AND LOCATION BUNDLE FIBER OPTIC STRAIN SENSOR CABLE EXIT COIL WITH COOLING TUBES.



DETAIL B
SCALE 1.00

LOCATE STRAIN SENSORS AND LABEL AS SHOWN
1 EACH ON TOP OF TEE (ie 68-T-TOP)
2 EACH ON SIDE CHILL PLATE
ie (SIDE A) 68-C-A AND (SIDE B) 68-C-B
2 EACH ALONG FORM BELOW VPI GROOVE
ie (SIDE A) 68-V-A AND (SIDE B) 68-V-B

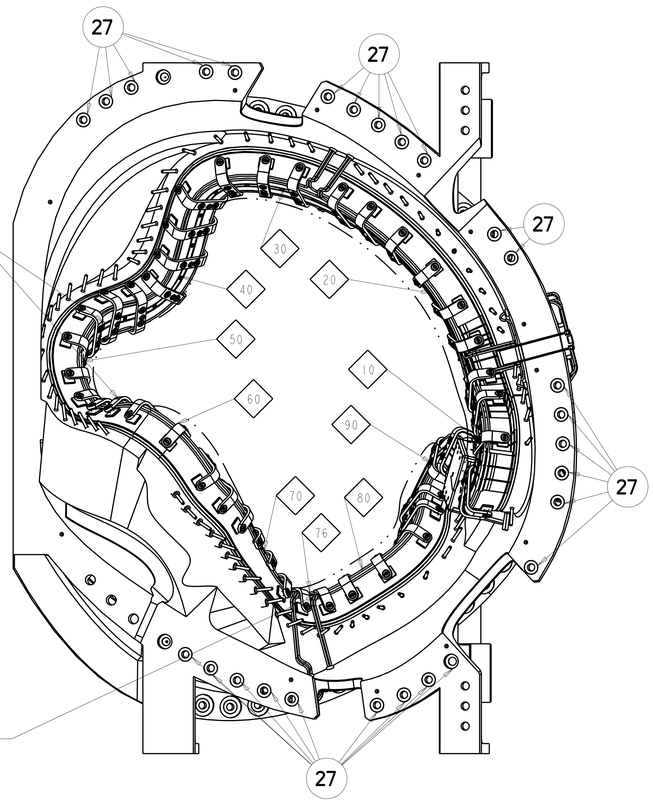


SCALE 0.50

CUT-AWAY VIEW SHOWING WINDING ASSEMBLY SEQUENCE (SIDE "B")

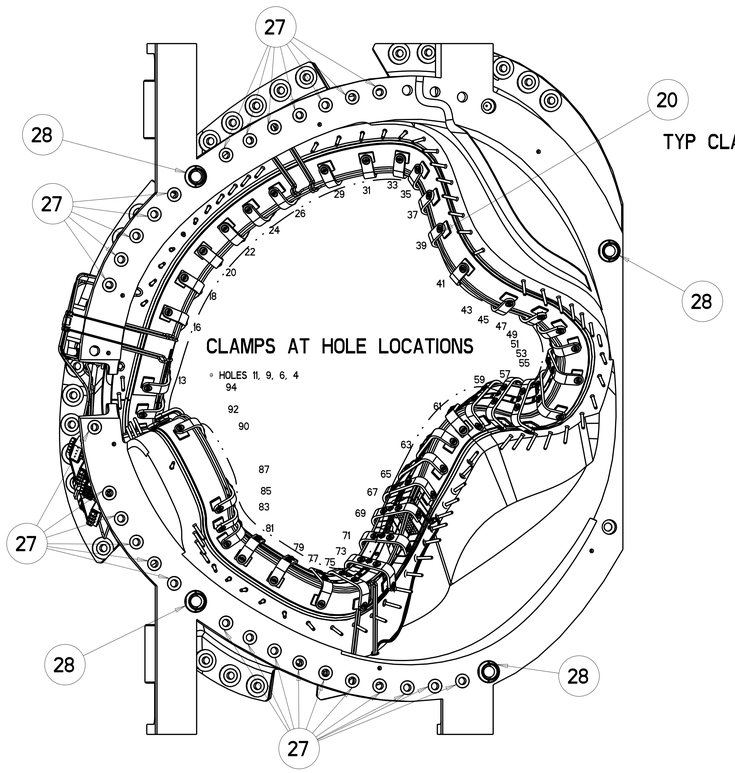
SCALE 0.500

SUGGESTED STRESS SENSOR LOCATION
HIGH STRESS REGION ON PLANE
NORMAL TO THE WINDING LAW
BETWEEN HOLE NUMBER 45-54
SEE DETAIL "B"



SUGGESTED STRESS SENSOR LOCATION
HIGH STRESS REGION ON PLANE
NORMAL TO THE WINDING LAW
BETWEEN HOLE NUMBER 67-76
SEE DETAIL "B"

SIDE "A" VIEW



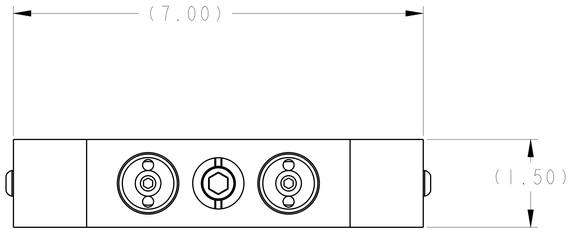
SIDE "B" VIEW

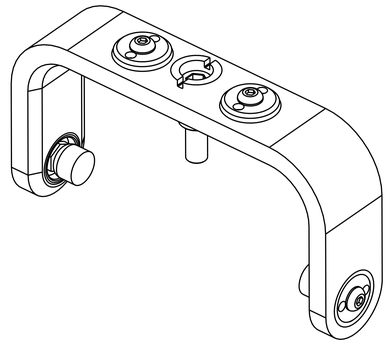
UT-BATTELLE	Oak Ridge National Laboratory managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725 UT-BATTELLE, LLC. Oak Ridge, Tennessee						
PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT							
TYPE "C" MCWF FINAL COIL ASSEMBLY							
VERSION NO. 29	PLANT X-10	BLDG 5700	FL 3	SHT OF 2 2	TYPE S	CLASS U	
RELEASE LEVEL WIP	SE140-103					REV 0	

SE140-103

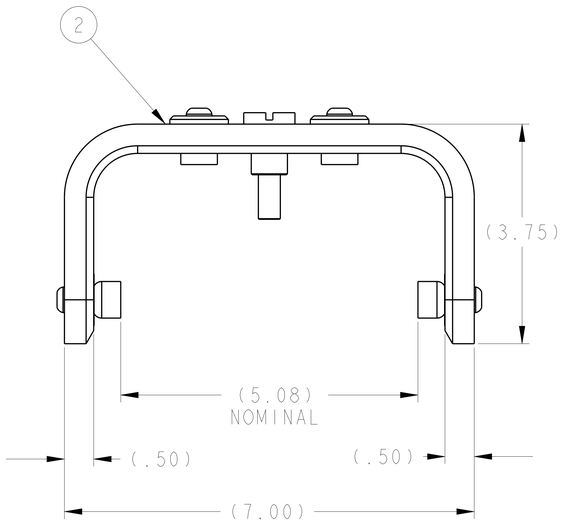
Clamps – open issues

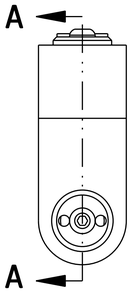
- Clamps to remove or modify

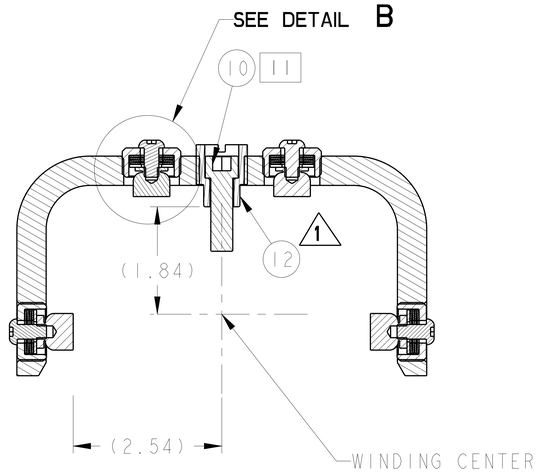




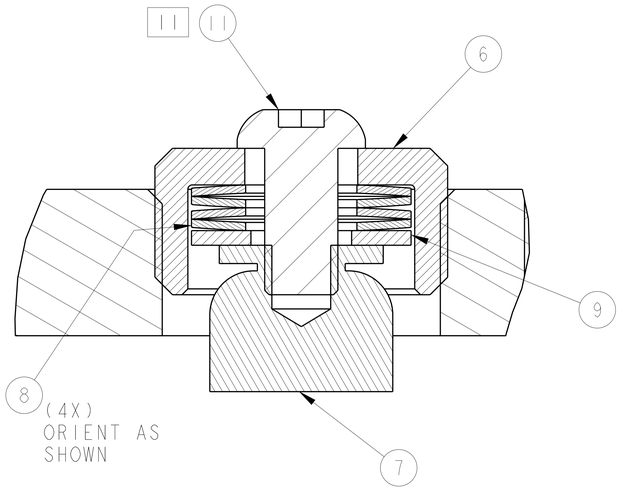
1 CLAMP ASSEMBLY
SCALE 1.0







SECTION A-A



1 DETAIL B
SCALE 5.0
TYP 2 PLCS
ROTATE 90° 2 PLCS

NOTES:

1. DRAWING PREPARED IN ACCORDANCEWITH ASME Y14.100-2000.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1994.
3. DIMENSIONS ARE IN INCHES
4. DIMENSIONS APPLY AT ROOM TEMPERATURE. OPERATING TEMP 80 K
5. GEOMETRY IS DEFINED IN PRO ENGINEER CAD MODELS/FILES
6. DRAWING AND MODELS COMBINED DEFINE FINISHED MACHINED PART
7. MAGNETIC PERMABILITY SHALL NOT EXCEED 1.02 AS TESTED BY A SEVERN-TYPE INDICATOR. AVAILABLE FROM

   SEVERN ENGINEERING COMPANY
   555 OLD STAGE ROAD SUITE 14
   AUBURN, ALABAMA 36830

8. SOLON MANUFACTURING CO. — CAGE CODE: 5L934
   7 ISLAND AVENUE — PHONE: 207-474-6213
   SKOWHEGAN, ME 04976-1102 — FAX: 207-474-7320

9. VLIER — CAGE CODE: 01226
   40 GUEST ST. — PHONE: 800-821-1090
   BRIGHTON, MA 02135 — FAX: 800-457-2020

10. MCMASTER-CARR SUPPLY — CAGE CODE: 39428
    600 COUNTY LINE RD — PHONE: 630-833-0300
    ELMHURST, IL 60126-2081

11. SILVER PLATE PER AMS 2410J.
    PLATING THICKNESS .0002 TO .0005 INCH

12. ITEM 6 USES SPANNER WRENCH, 5981A1 FROM MCMASTER CARR OR EQUAL.

1 13. DELETED NOTE 13 AT REVISION 1.

1	10	1		SE142C-294	BUSHING, SPACER			12
1	10	4		98164A211	BUTTONHEAD CAP SCREW, 1/4-20 UNC X .50 LG, 5/32 HEX DRIVE	UNS S31600		11
1	10	1		92185A626	SOCKET HD CAP SCREW, 3/8-16 UNC X 1.25 LG	UNS S31600		10
	10	4		90107A030	WASHER, FLAT, .75 OD X .344 ID X .050 THK	UNS S31600		9
	8	16		61240718	WASHER, BELLEVILLE, 3/8 ID X 3/4 OD X.040 THK X .056 FREE HT	INCONEL 718		8
	9	4		SSP300	CLAMP SWIVEL, 1/4-20 UNC X 5/16 LG THD, PAD DIA 5/8, OA LENGTH 5/8	SS, UNS S31600		7
		4		SE142C-275	KEEPER, SCREW, SET			6
		2		SE142C-274	WASHER, SPHERICAL, CONCAVE			5
		2		SE142C-273	WASHER, SPHERICAL, CONVEX			4
		0		SE142C-272	BUSHING, SPACER			3
		1		SE142C-271	BAR, CLAMP			2
	7	AR	X	-1	CLAMP ASSEMBLY			1
SE140-103		-1	CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION	FIND NO
			NEXT ASSEMBLY		PARTS LIST			

SE142C-270

REV	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	DEO	DATE	ORNL	DOE	DATE
1	REVISE PART AND DRAWING PER ECN 5220	GLL	1-06	MJC			DEW					

REVISION OR ISSUE PURPOSE — REVISION APPROVAL

SCALE NOTED

TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONS
XX DECIMALS ±.01
XXX DECIMALS ±.005
ANGLES ±0°15'
BREAK SHARP EDGES .06 MAX
FINISH 125 UNLESS OTHERWISE SPECIFIED

DRAWING APPROVALS		DATE
DES	D WILLIAMSON	1-27-05
DRW	GARY LOVETT	1-27-05
CHK	TOM HARGROVE	8-26-05
SECT	:	:
DEPT	:	:
PE	D WILLIAMSON	8-26-05
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGEL	8-26-05
	:	:
	:	:

UT-BATTELLE
Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725
UT-BATTELLE, LLC. Oak Ridge, Tennessee

PROJECT NAME: NATIONAL COMPACT STELLARATOR EXPERIMENT

CLAMP ASSEMBLY

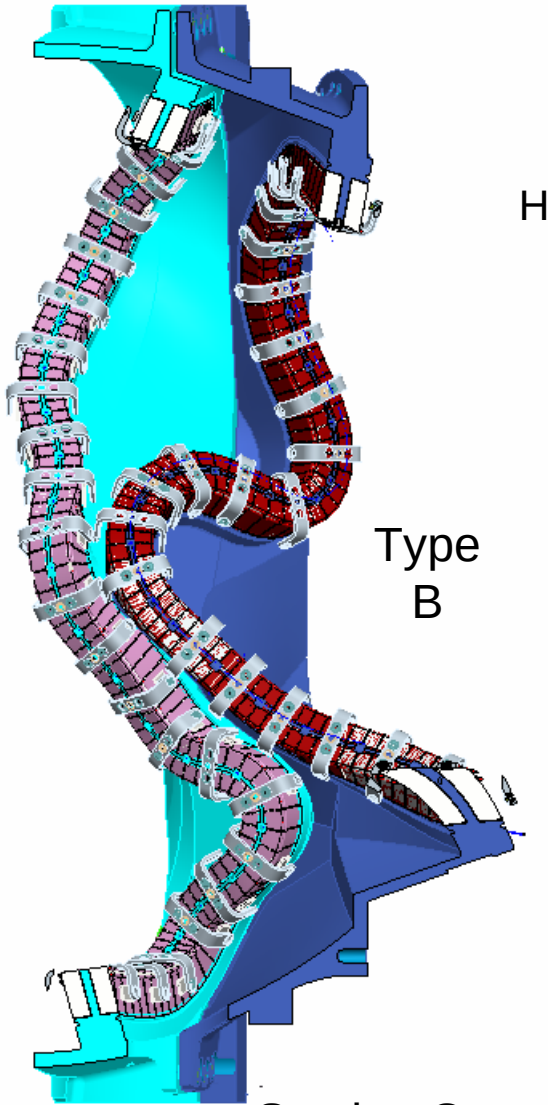
VERSION NO.	PLANT	BLDG	FL	SHT	OF	TYPE	CLASS
10	X-10	5700	3	1	1	S	U

RELEASE LEVEL: WIP — SE142C-270 — REV 1

P THIS DRAWING PRODUCED ON PRO-ENGINEER

Top

A-to-B Fit-up

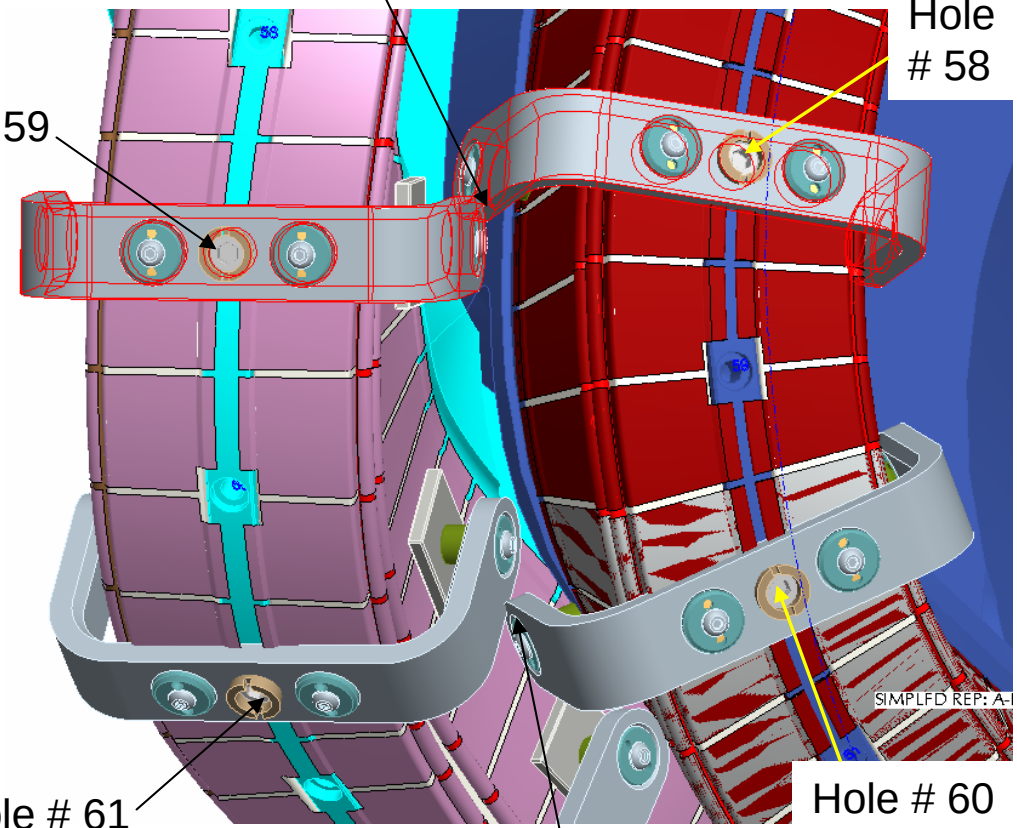


Section Cut
Looking Inboard

0.162” clearance

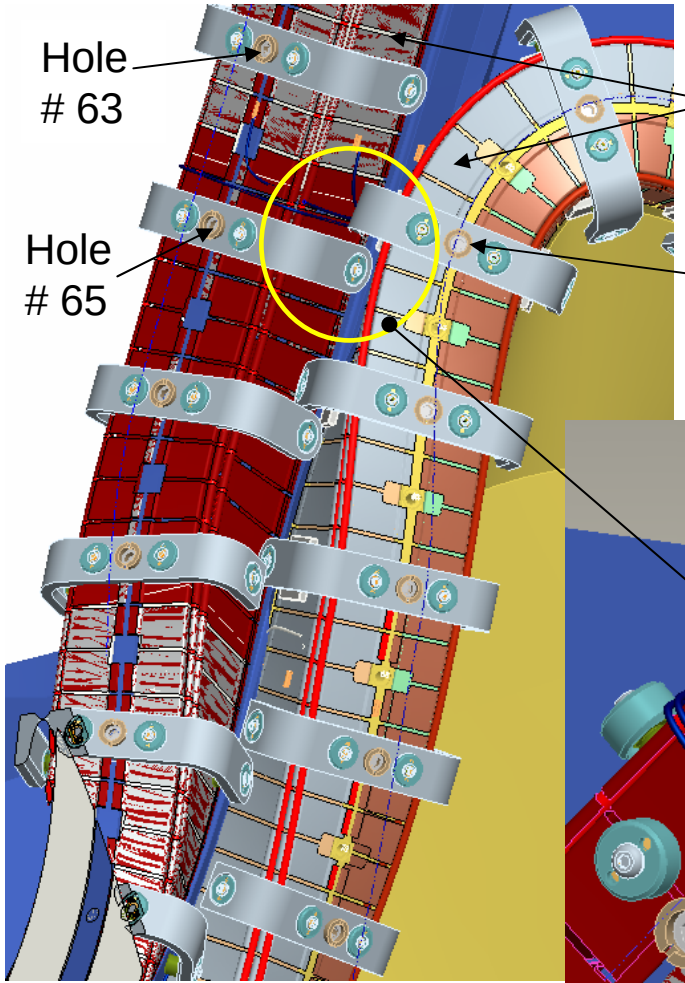
Type-A

Type-B



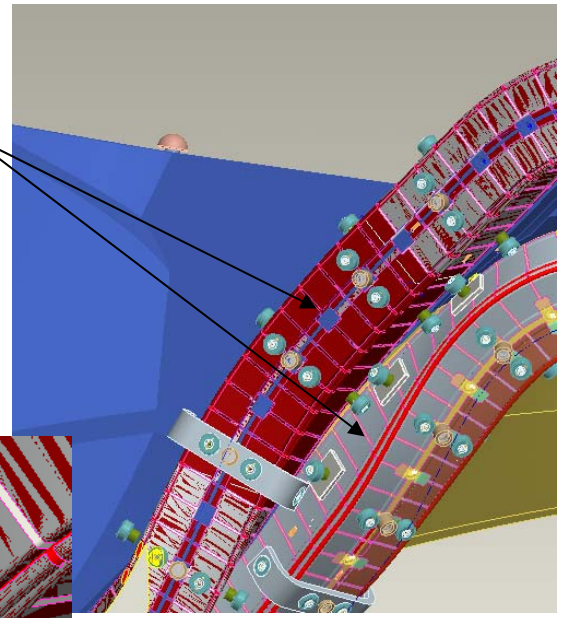
These clamps have an interference

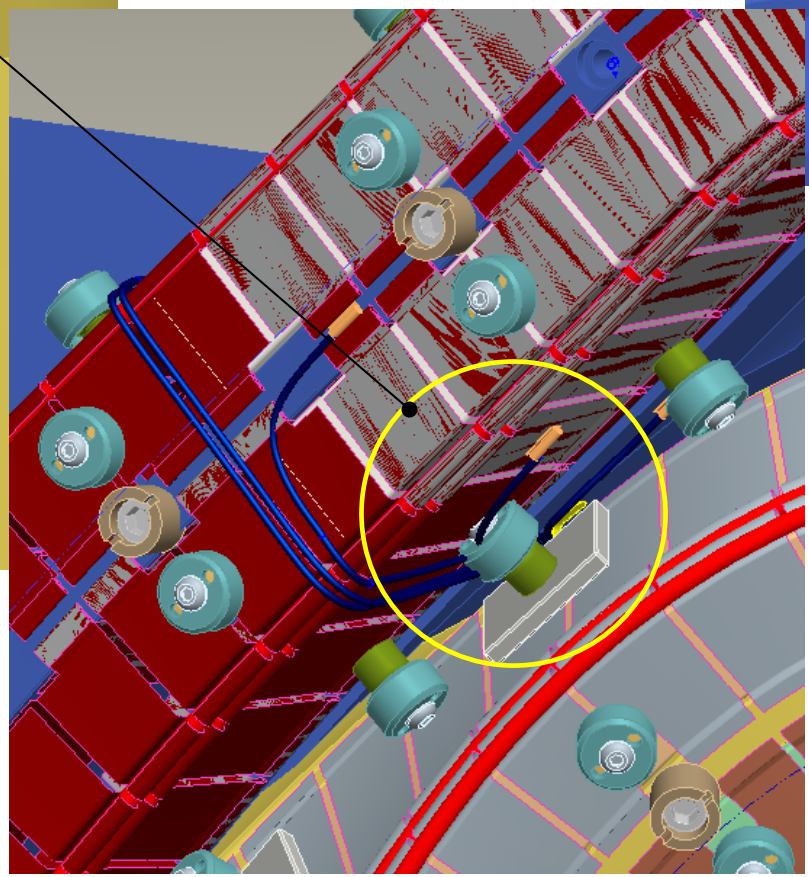
Clamps on A and B where there is interference or close contact is indicated. Clamp measured needed.



Ignoring the clamps their appears to be no winding interferences.

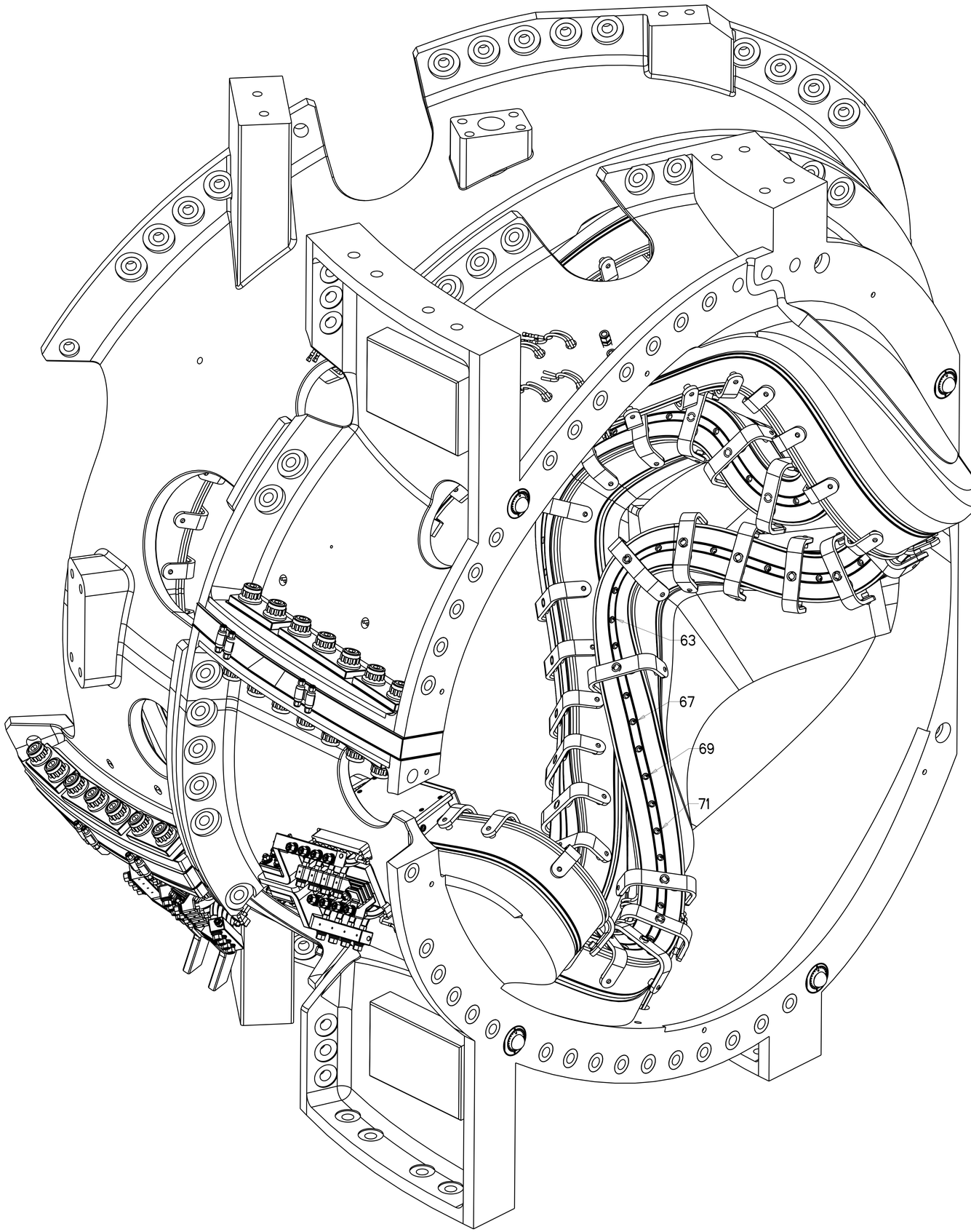
Hole 61…I think!



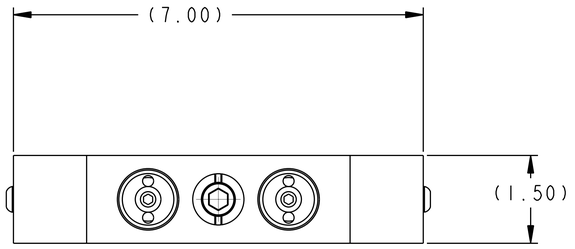


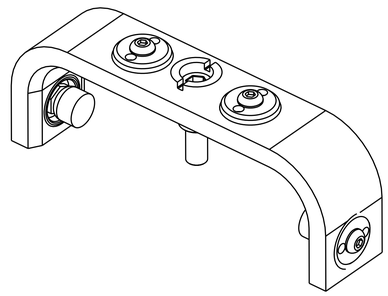
Type-C Clamp 61 and clamp hardware interferes with the Type-B winding and local cable.

B-to-C Fit-up



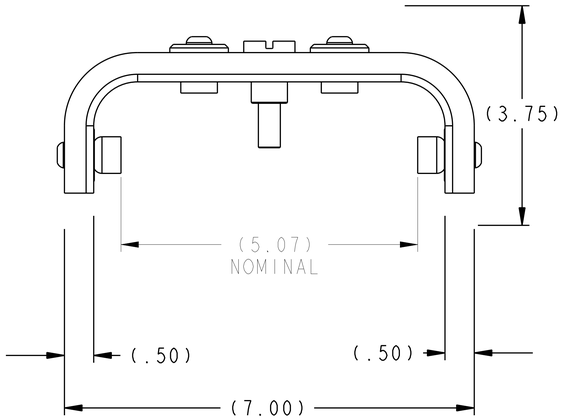
TYPE-C CLAMPS TO BE REMOVED

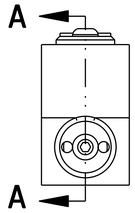


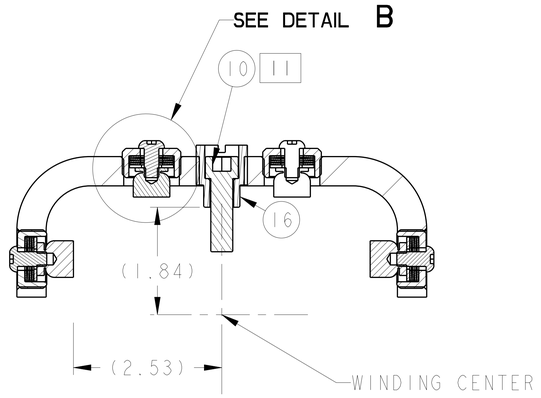


1 CLAMP ASSEMBLY
SCALE 1.0

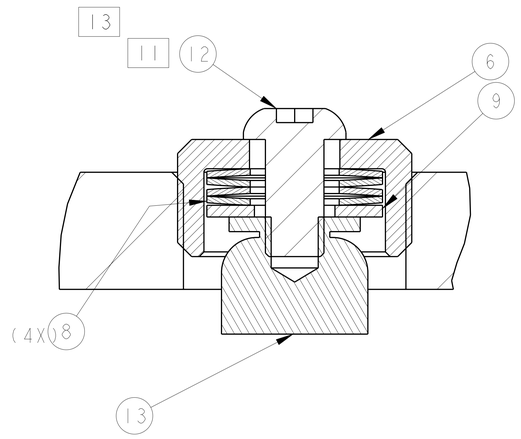
2







SECTION A-A



DETAIL B
SCALE 4.0

NOTES:

1. DRAWING PREPARED IN ACCORDANCEWITH ASME Y14.100-2000.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1994.
3. DIMENSIONS ARE IN INCHES
4. DIMENSIONS APPLY AT ROOM TEMPERATURE. OPERATING TEMP 80 K
5. GEOMETRY IS DEFINED IN PRO ENGINEER CAD MODELS/FILES
6. DRAWING AND MODELS COMBINED DEFINE FINISHED MACHINED PART
7. MAGNETIC PERMABILITY SHALL NOT EXCEED 1.02 AS TESTED BY A SEVERN-TYPE INDICATOR. AVAILABLE FROM

   SEVERN ENGINEERING COMPANY
   555 OLD STAGE ROAD SUITE 14
   AUBURN, ALABAMA 36830

8. SOLON MANUFACTURING CO. — CAGE CODE: 5L934
   7 ISLAND AVENUE — PHONE: 207-474-6213
   SKOWHEGAN, ME 04976-1102 — FAX: 207-474-7320

9. VLIER — CAGE CODE: 01226
   40 GUEST ST. — PHONE: 800-821-1090
   BRIGHTON, MA 02135 — FAX: 800-457-2020

10. MCMASTER-CARR SUPPLY — CAGE CODE: 39428
    600 COUNTY LINE RD — PHONE: 630-833-0300
    ELMHURST, IL 60126-2081

11. SILVER PLATE PER AMS 2410J.
    PLATING THICKNESS .0002 TO .0005 INCH

12. ITEM 6 USES SPANNER WRENCH, 5981A1 FROM MCMASTER CARR OR EQUAL.

	1		SE142C-294	BUSHING, SPACER			16
	2		-15	SPACER 1.5 X 2.0 X .25 THK	NEMA GRADE G11CR		15
	2		-14	SPACER 1.5 X 2.0 X .125 THK	NEMA GRADE G11CR		14
9	2		SSP300	CLAMP SWIVEL, 1/4-20 UNC X 5/16 LG THD, PAD DIA 5/8, OA LENGTH	UNS S31600		13
11 10	4		98164A211	BUTTONHEAD CAP SCREW, 1/4-20 UNC X .50 LG, 5/32 HEX DRIVE	UNS S31600		12
11 10	2		97345A601	BOLT, SOC HEAD, 5/16-18 UNC, .375 OD X 3/8" LG SHLDR , 3/8 HEX DRIVE	UNS S31600		11
11 10	1		92185A626	SOCKET HD CAP SCREW, 3/8-16 UNC X 1.25 LG	UNS S31600		10
10	4		90107A030	WASHER, FLAT, .75 OD X .344 ID X .050 THK	UNS S31600		9
8	16		61240718	WASHER, BELLEVILLE, 3/8 ID X 3/4 OD X.040 THK X .056 FREE HT	INCONEL 718		8
9	2		SSP300	CLAMP SWIVEL, 1/4-20 UNC X 5/16 LG THD, PAD DIA 5/8, OA LENGTH 5/8	SS, UNS S31600		7
	4		SE142C-275	KEEPER, SCREW, SET			6
	2		SE142C-274	WASHER, SPHERICAL, CONCAVE			5
	2		SE142C-273	WASHER, SPHERICAL, CONVEX			4
	0		SE142C-272	BUSHING, SPACER			3
	1		SE142C-271	BAR, CLAMP			2
7	AR	X	-1	CLAMP ASSEMBLY			1
SE140-103	-1	CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION	FIND NO
		NEXT ASSEMBLY		PARTS LIST			

SE142C-303

P THIS DRAWING PRODUCED ON PRO-ENGINEER

REV	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
	REVISION OR ISSUE PURPOSE	REVISION APPROVAL										

SCALE NOTED
TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONS
XX DECIMALS ±.01
XXX DECIMALS ±.005
ANGLES ±0°15'
BREAK SHARP EDGES .06 MAX
FINISH 125 UNLESS OTHERWISE SPECIFIED

DES	D WILLIAMSON	1-27-05
DRW	GARY LOVETT	1-27-05
CHK	TOM HARGROVE	8-26-05
SECT	:	:
DEPT	:	:
PE	:D WILLIAMSON	8-26-05
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGEL	8-26-05
	:	:
	:	:
DRAWING APPROVALS		DATE

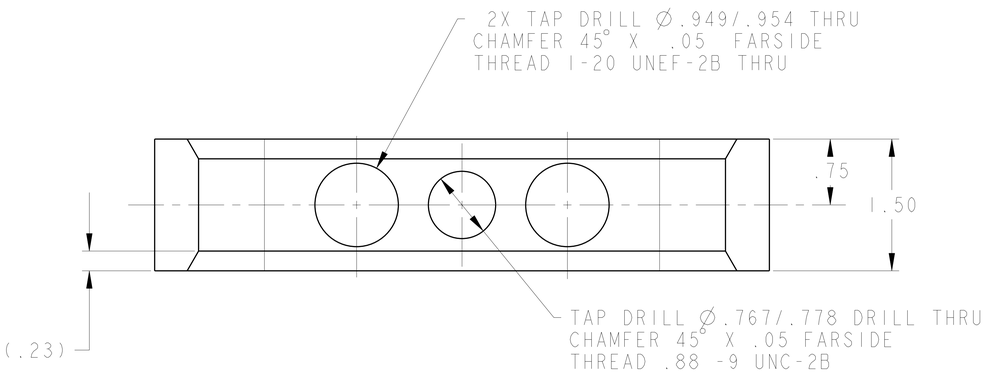
UT-BATTELLE
Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725
UT-BATTELLE, LLC. Oak Ridge, Tennessee

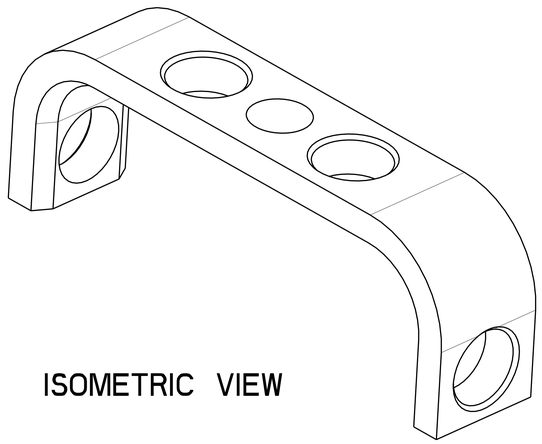
NATIONAL COMPACT STELLARATOR EXPERIMENT

CLAMP ASSEMBLY
MODIFIED

VERSION NO.	PLANT	BLDG	FL	SHT	OF	TYPE	CLASS
1	X-10	5700	3	1	1	S	U

RELEASE LEVEL: WIP
SE142C-303
REV 0



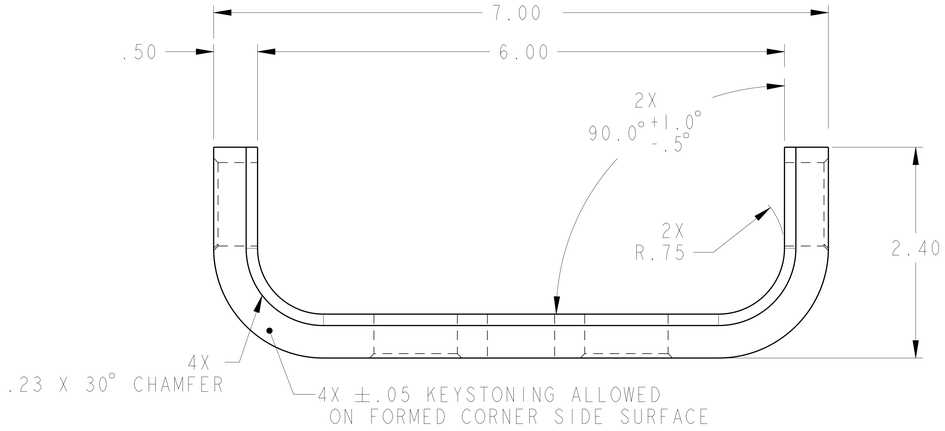


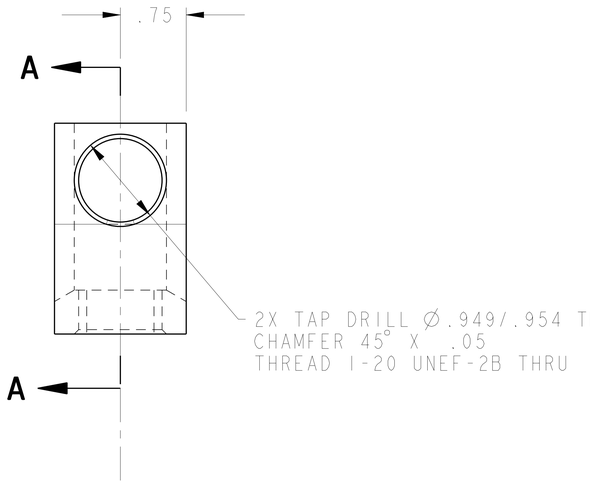
ISOMETRIC VIEW

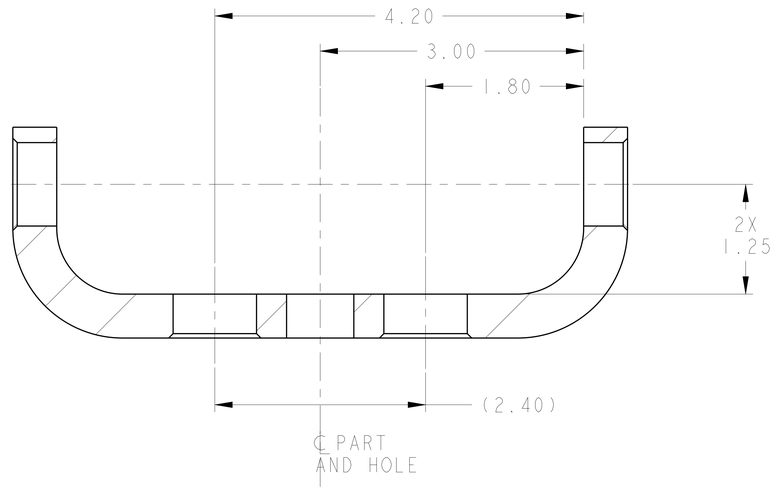
NOTES:

1. DRAWING PREPARED IN ACCORDANCEWITH ASME Y14.100.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y14.5M
3. DIMENSIONS ARE IN INCHES
4. DIMENSIONS APPLY AT ROOM TEMPERATURE. OPERATING TEMP 80 K
5. GEOMETRY IS DEFINED IN PRO ENGINEER CAD MODELS/FILES
6. DRAWING AND MODELS COMBINED DEFINE FINISHED MACHINED PART
7. MAGNETIC PERMABILITY SHALL NOT EXCEED 1.02 AS TESTED BY A SEVERN-TYPE INDICATOR. AVAILABLE FROM

   SEVERN ENGINEERING COMPANY
   555 OLD STAGE ROAD SUITE 14
   AUBURN, ALABAMA 36830







SECTION **A-A**

(1) BAR, CLAMP-MODIFIED

7	AR	X		-1	BAR, CLAMP-MODIFIED	UNS S31600			1
SE142C-270	-1		CAGE CODE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL	SPECIFICATION		FIND NO
			← NEXT ASSEMBLY	PARTS LIST					

SE142C-302

P THIS DRAWING PRODUCED ON PRO-ENGINEER

REV	DESCRIPTION	BY	DATE	CHK	DEPT	DATE	PE	REQ	DATE	ORNL	DOE	DATE
	REVISION OR ISSUE PURPOSE	REVISION APPROVAL										

SCALE 1.50

TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONS	'
XX DECIMALS	±.01
XXX DECIMALS	±.005
ANGLES	±0°15'
BREAK SHARP EDGES	.06 MAX
FINISH	125 UNLESS OTHERWISE SPECIFIED

DRAWING APPROVALS		DATE
DES	PJ FOGARTY	1-03-05
DRW	GARY LOVETT	1-03-05
CHK	TOM HARGROVE	8-26-05
SECT	:	:
DEPT	:	:
PE	D WILLIAMSON	8-26-05
CR	:	:
PJ	:	:
REQ	:	:
PPPL DRFT	J SIEGEL	8-26-05
	:	:
	:	:

UT-BATTELLE

Oak Ridge National Laboratory
managed for the DEPARTMENT OF ENERGY under U.S. GOVERNMENT contract DE-AC05-00OR22725
UT-BATTELLE, LLC. Oak Ridge, Tennessee

PROJECT NAME
NATIONAL COMPACT STELLARATOR EXPERIMENT

BAR, CLAMP SHORT

VERSION NO.	PLANT	BLDG	FL	SHT	OF	TYPE	CLASS
3	X-10	5700	3	1	1	S	U

RELEASE LEVEL		REV
WIP	SE142C-302	0