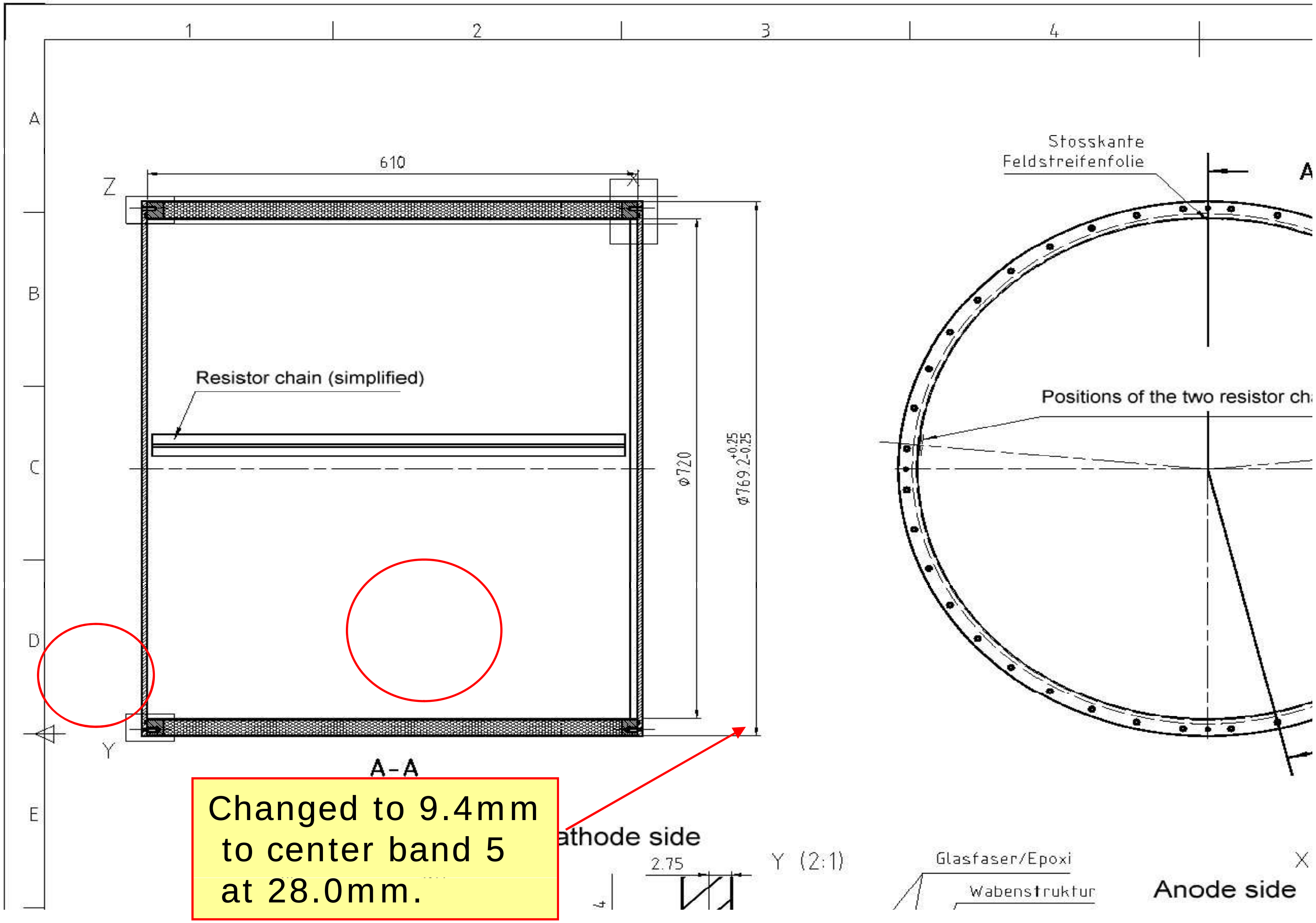
Discussion for the LP endplate

D. P. Peterson Cornell University, Laboratory for Accelerator-based ScienceS and Education

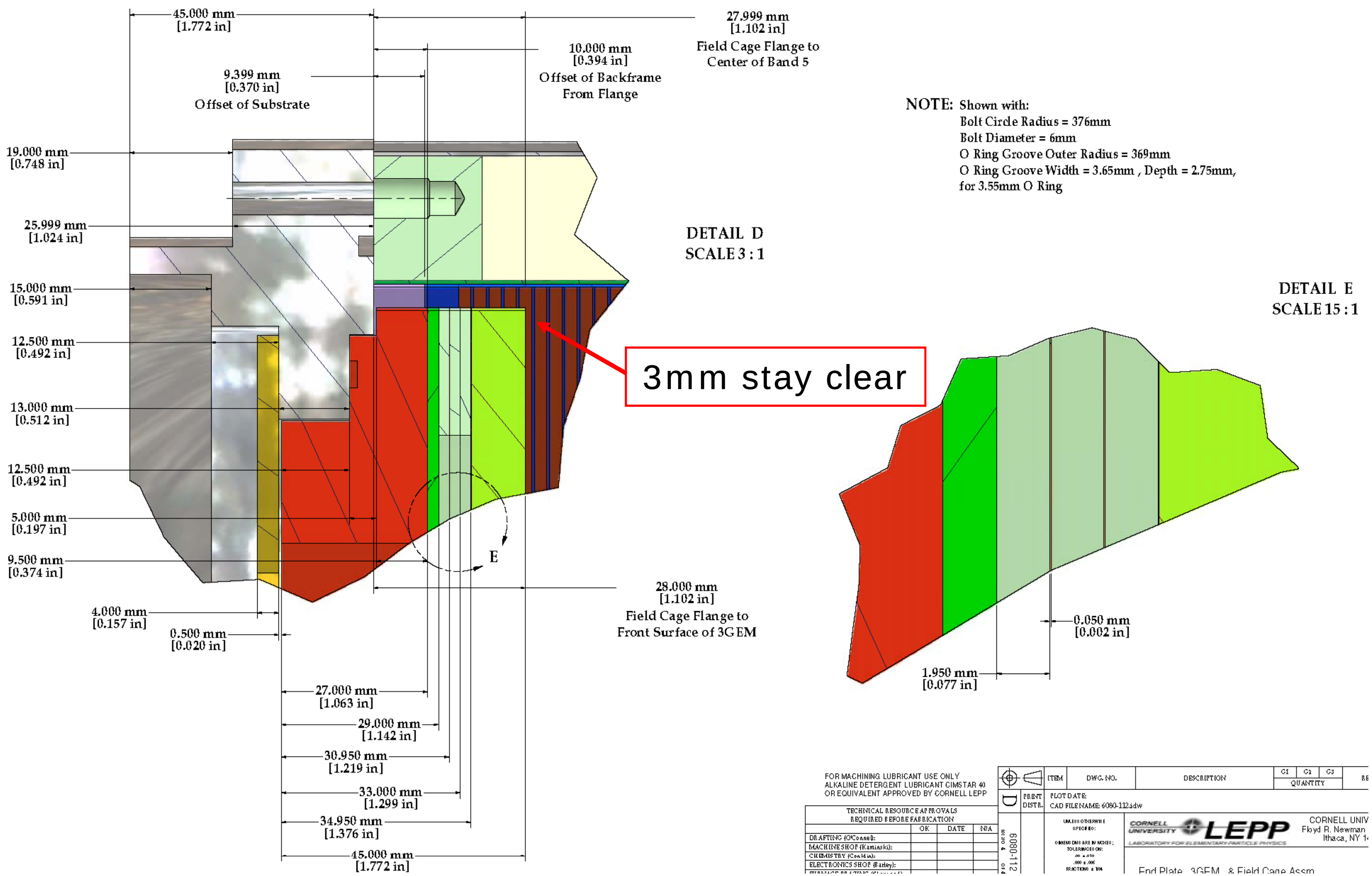
See also: http://w4.lns.cornell.edu/~dpp/linear_collider/LargePrototype.html

This project is supported by
the US National Science Foundation (LEPP cooperative agreement)
and an LCDRD consortium grant

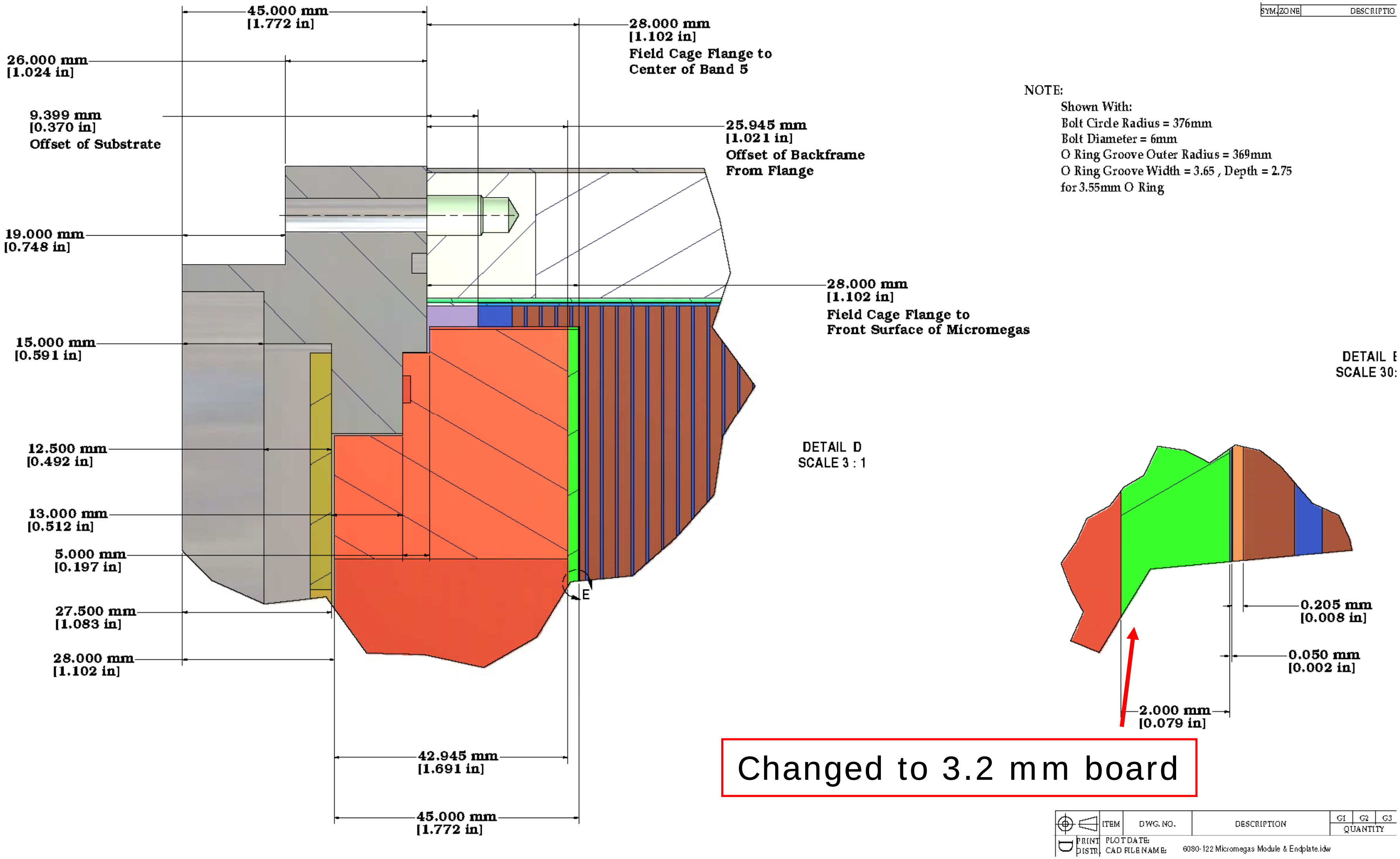
Drawing from DESY 2007-08-09, 2007-09-18



Endplate/band geometry (3GEM+G) 2007-10-21



Endplate/band geometry (3GEM=G) 2007-10-21



Changed to 3.2 mm board

Endplate Drawings, 2007-10-20

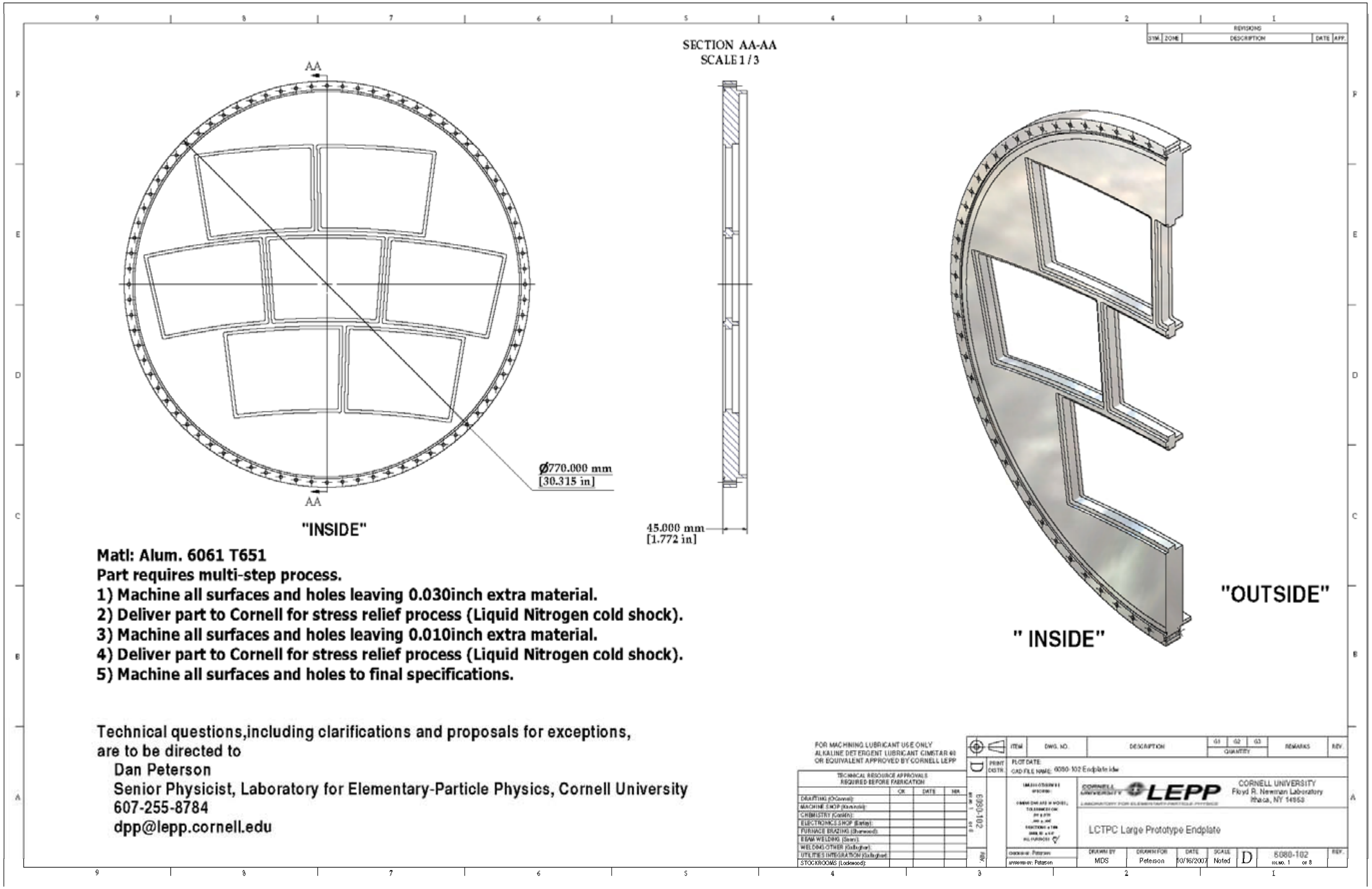
Endplates drawings were prepared for
sending to vendors and preliminary quotes 2007-10-19.

Missing:

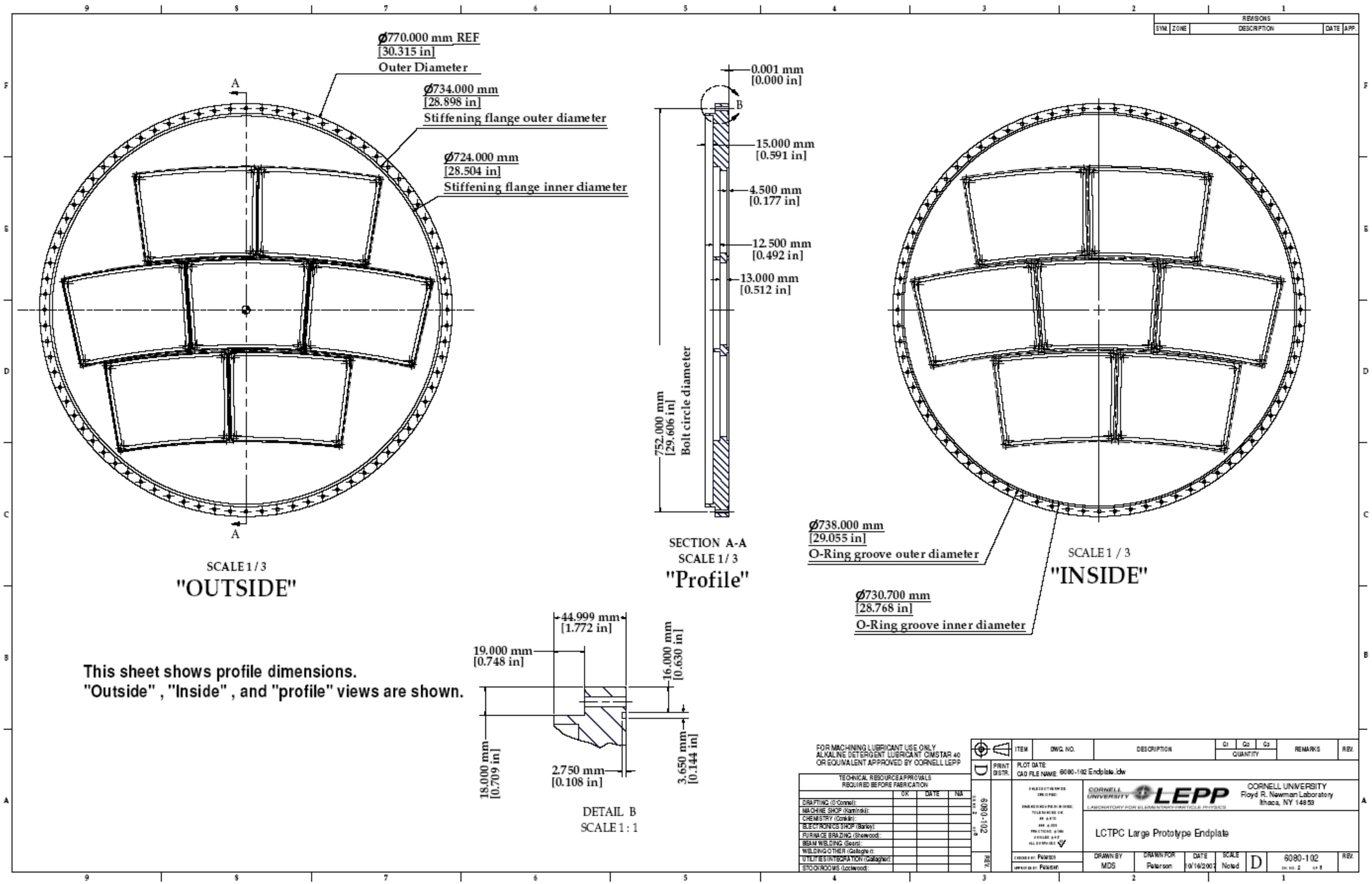
- gas holes
- skirt holes
- fun holes

The missing items will not significantly affect
evaluation by potential vendors.

Endplate Drawings, 2007-10-20



Endplate Drawings, 2007-10-20

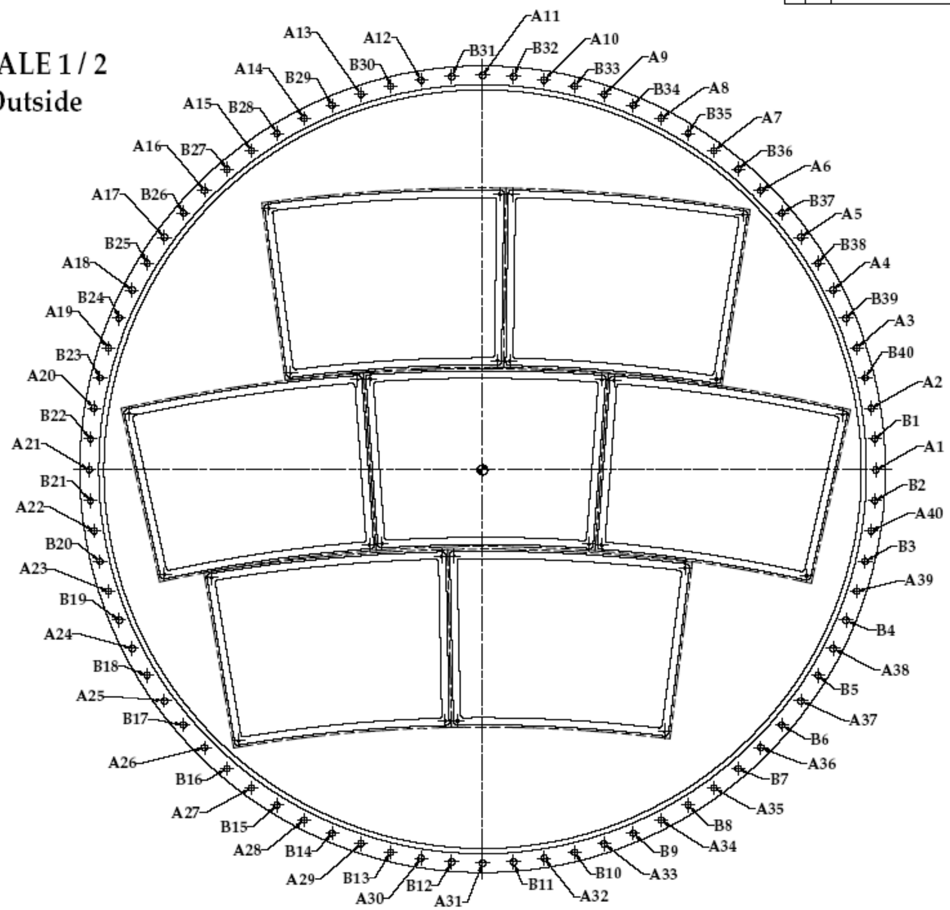


Endplate Drawings, 2007-10-20

THRU HOLES			
HOLE	XDIM	YDIM	DESCRIPTION
A31	0.000	-376.000	Ø6.100 mm THRU
A30	-58.819	-371.371	Ø6.100 mm THRU
A32	58.819	-371.371	Ø6.100 mm THRU
A29	-116.190	-357.597	Ø6.100 mm THRU
A33	116.190	-357.597	Ø6.100 mm THRU
A28	-170.700	-335.018	Ø6.100 mm THRU
A34	170.700	-335.018	Ø6.100 mm THRU
A27	-221.007	-304.190	Ø6.100 mm THRU
A35	221.007	-304.190	Ø6.100 mm THRU
A26	-265.872	-265.872	Ø6.100 mm THRU
A36	265.872	-265.872	Ø6.100 mm THRU
A25	-304.190	-221.007	Ø6.100 mm THRU
A37	304.190	-221.007	Ø6.100 mm THRU
A24	-335.018	-170.700	Ø6.100 mm THRU
A38	335.018	-170.700	Ø6.100 mm THRU
A23	-357.597	-116.190	Ø6.100 mm THRU
A39	357.597	-116.190	Ø6.100 mm THRU
A22	-371.371	-58.819	Ø6.100 mm THRU
A40	371.371	-58.819	Ø6.100 mm THRU
A21	-376.000	0.000	Ø6.100 mm THRU
A1	376.000	0.000	Ø6.100 mm THRU
A20	-371.371	58.819	Ø6.100 mm THRU
A2	371.371	58.819	Ø6.100 mm THRU
A19	-357.597	116.190	Ø6.100 mm THRU
A3	357.597	116.190	Ø6.100 mm THRU
A18	-335.018	170.700	Ø6.100 mm THRU
A4	335.018	170.700	Ø6.100 mm THRU
A17	-304.190	221.007	Ø6.100 mm THRU
A5	304.190	221.007	Ø6.100 mm THRU
A16	-265.872	265.872	Ø6.100 mm THRU
A6	265.872	265.872	Ø6.100 mm THRU
A15	-221.007	304.190	Ø6.100 mm THRU
A7	221.007	304.190	Ø6.100 mm THRU
A14	-170.700	335.018	Ø6.100 mm THRU
A8	170.700	335.018	Ø6.100 mm THRU
A13	-116.190	357.597	Ø6.100 mm THRU
A9	116.190	357.597	Ø6.100 mm THRU
A12	-58.819	371.371	Ø6.100 mm THRU
A10	58.819	371.371	Ø6.100 mm THRU
A11	0.000	376.000	Ø6.100 mm THRU

DOWEL HOLE LOCATIONS			
HOLE	XDIM	YDIM	DESCRIPTION
B1	374.841	29.501	Ø6.000 mm THRU
B2	374.841	-29.501	Ø6.000 mm THRU
B3	365.611	-87.775	Ø6.000 mm THRU
B4	347.379	-143.889	Ø6.000 mm THRU
B5	320.593	-196.459	Ø6.000 mm THRU
B6	285.913	-244.192	Ø6.000 mm THRU
B7	244.192	-285.913	Ø6.000 mm THRU
B8	196.459	-320.593	Ø6.000 mm THRU
B9	143.889	-347.379	Ø6.000 mm THRU
B10	87.775	-365.611	Ø6.000 mm THRU
B11	29.501	-374.841	Ø6.000 mm THRU
B12	-29.501	-374.841	Ø6.000 mm THRU
B13	-87.775	-365.611	Ø6.000 mm THRU
B14	-143.889	-347.379	Ø6.000 mm THRU
B15	-196.459	-320.593	Ø6.000 mm THRU
B16	-244.192	-285.913	Ø6.000 mm THRU
B17	-285.913	-244.192	Ø6.000 mm THRU
B18	-320.593	-196.459	Ø6.000 mm THRU
B19	-347.379	-143.889	Ø6.000 mm THRU
B20	-365.611	-87.775	Ø6.000 mm THRU
B21	-374.841	-29.501	Ø6.000 mm THRU
B22	-374.841	29.501	Ø6.000 mm THRU
B23	-365.611	87.775	Ø6.000 mm THRU
B24	-347.379	143.889	Ø6.000 mm THRU
B25	-320.593	196.459	Ø6.000 mm THRU
B26	-285.913	244.192	Ø6.000 mm THRU
B27	-244.192	285.913	Ø6.000 mm THRU
B28	-196.459	320.593	Ø6.000 mm THRU
B29	-143.889	347.379	Ø6.000 mm THRU
B30	-87.775	365.611	Ø6.000 mm THRU
B31	-29.501	374.841	Ø6.000 mm THRU
B32	29.501	374.841	Ø6.000 mm THRU
B33	87.775	365.611	Ø6.000 mm THRU
B34	143.889	347.379	Ø6.000 mm THRU
B35	196.459	320.593	Ø6.000 mm THRU
B36	244.192	285.913	Ø6.000 mm THRU
B37	285.913	244.192	Ø6.000 mm THRU
B38	320.593	196.459	Ø6.000 mm THRU
B39	347.379	143.889	Ø6.000 mm THRU
B40	365.611	87.775	Ø6.000 mm THRU
41	0.000	0.000	Value

SCALE 1 / 2
Outside



Specification for holes in the flange area.

Dowel holes 'B' have tolerance +/- 0.002 inch,
within a frame defind by
the hole locations B1, B11, B21, B31.

FOR MACHINING LUBRICANT USE ONLY
ALKALINE DETERGENT LUBRICANT CIMSTAR 40
OR EQUIVALENT APPROVED BY CORNELL LEPP

TECHNICAL RESOURCE APPROVALS REQUIRED BEFORE FABRICATION	OK	DATE	NA
DRAFTING (O'Connell):			
MACHINE SHOP (Kaminski):			
CHEMISTRY (Conklin):			
ELECTRONICS SHOP (Barley):			
FURNACE BRAZING (Sherwood):			
BEAM WELDING (Sears):			
WELDING OTHER (Callaghan):			
UTILITIES INTEGRATION (Callagher):			
STOCKROOMS (Lockwood):			

ITEM | DWG. NO. | DESCRIPTION | QUANTITY | REMARKS | REV.

PLOT DATE:
CAD FILE NAME: 6080-102 Endplate.idw

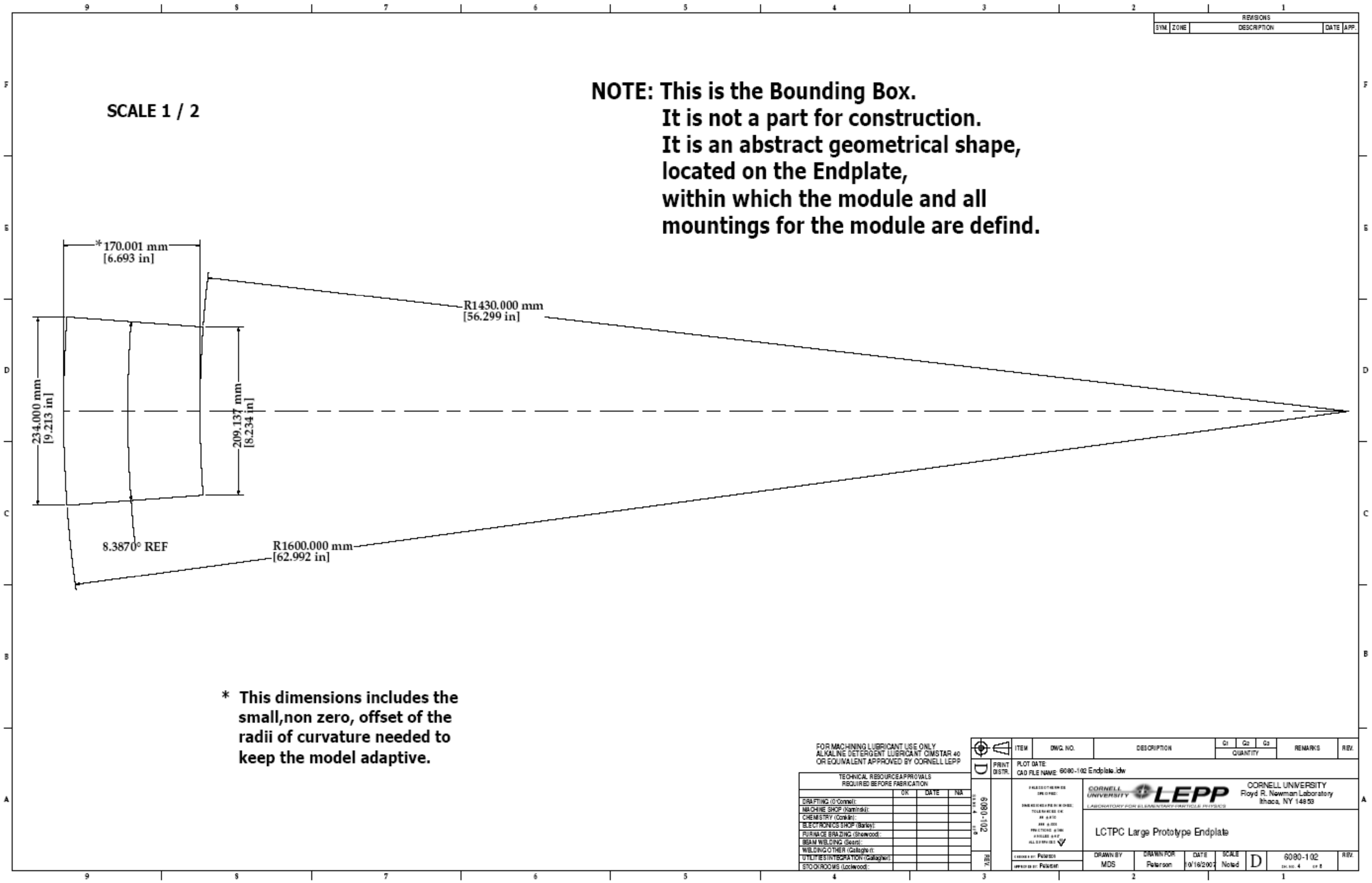
CORNELL UNIVERSITY
Floyd R. Newman Laboratory
Ithaca, NY 14853

LCTPC Large Prototype Endplate

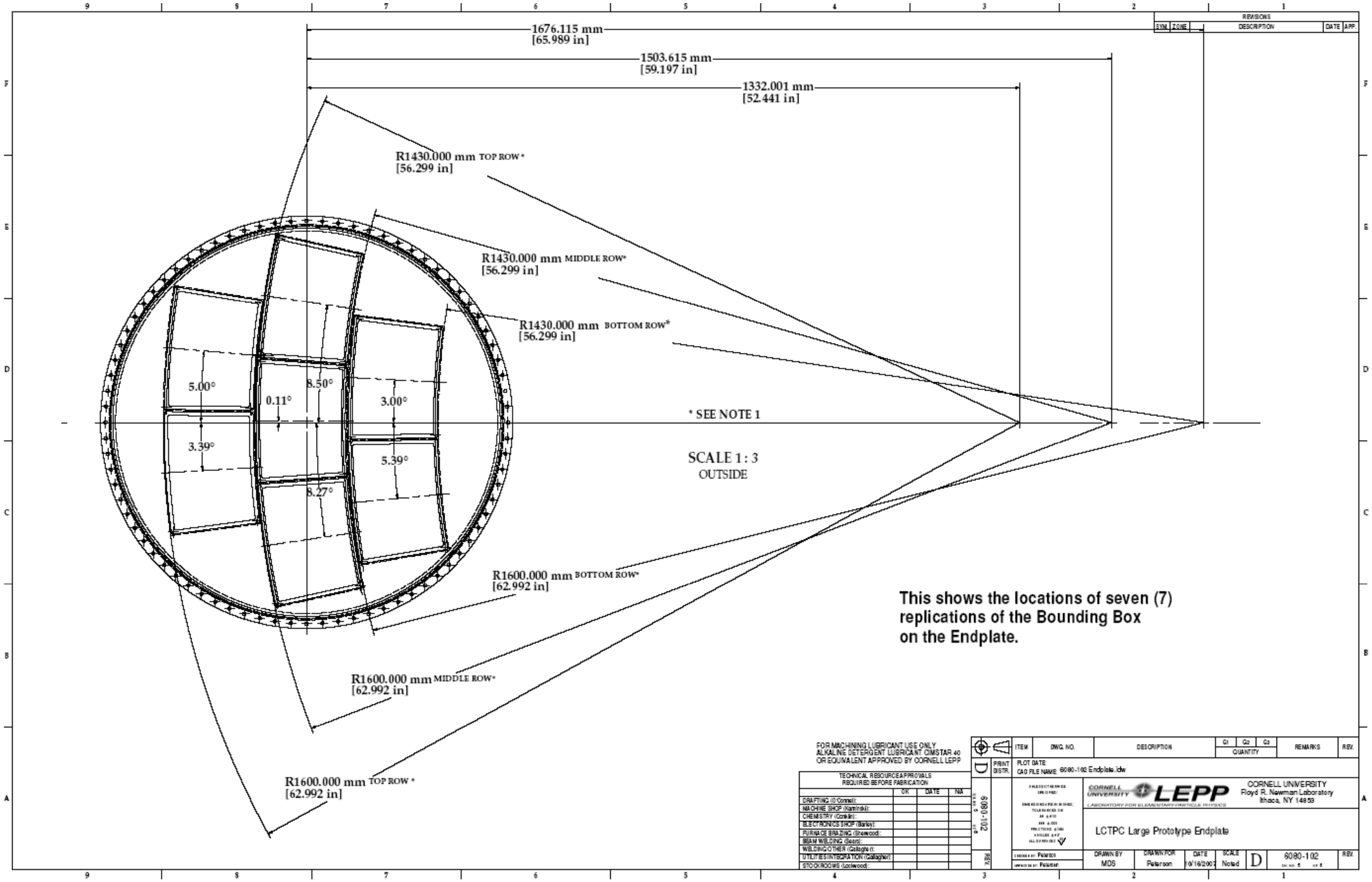
CHECKED BY: Peterson
APPROVED BY: Peterson

DRAWN BY	DRAWN FOR	DATE	SCALE			REV.
MDS	Peterson	10/16/2007	NOTED	D	6080-102	

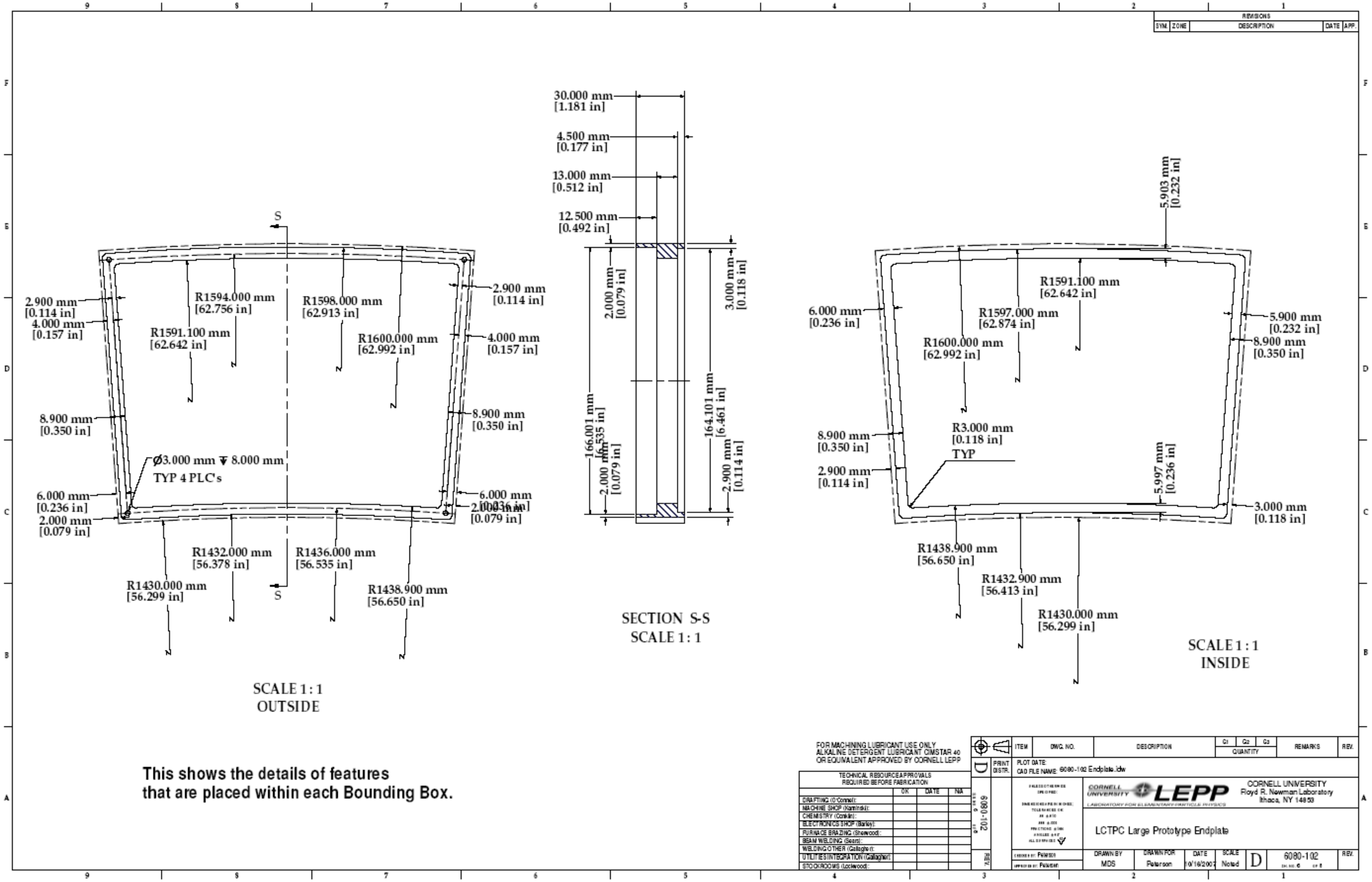
Endplate Drawings, 2007-10-20



Endplate Drawings, 2007-10-20



Endplate Drawings, 2007-10-20

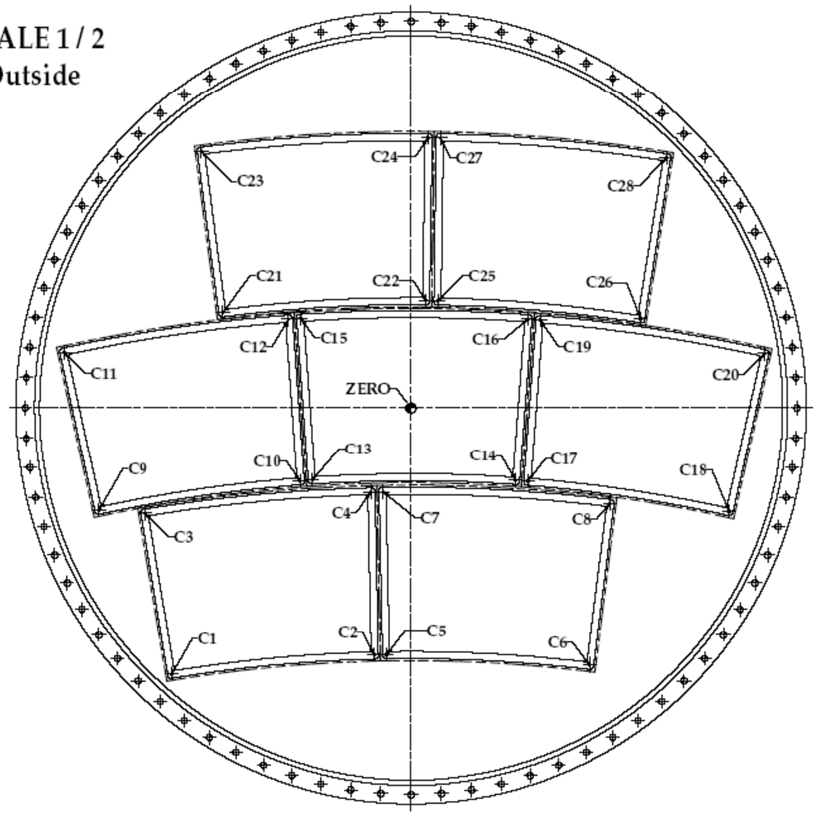


This shows the details of features
that are placed within each Bounding Box.

Endplate Drawings, 2007-10-20

DOWEL HOLE LOCATIONS			
HOLE	XDIM	YDIM	DESCRIPTION
C1	-233.079	-259.158	⌀2.000 mm ∓ 8.000 mm
C2	-35.909	-240.565	⌀2.000 mm ∓ 8.000 mm
C3	-259.376	-103.359	⌀2.000 mm ∓ 8.000 mm
C4	-39.200	-82.597	⌀2.000 mm ∓ 8.000 mm
C5	-23.911	-240.315	⌀2.000 mm ∓ 8.000 mm
C6	173.862	-250.680	⌀2.000 mm ∓ 8.000 mm
C7	-27.202	-82.347	⌀2.000 mm ∓ 8.000 mm
C8	193.647	-93.921	⌀2.000 mm ∓ 8.000 mm
C9	-304.150	-100.196	⌀2.000 mm ∓ 8.000 mm
C10	-108.166	-71.696	⌀2.000 mm ∓ 8.000 mm
C11	-338.261	54.081	⌀2.000 mm ∓ 8.000 mm
C12	-119.410	85.906	⌀2.000 mm ∓ 8.000 mm
C13	-96.197	-70.842	⌀2.000 mm ∓ 8.000 mm
C14	101.848	-71.232	⌀2.000 mm ∓ 8.000 mm
C15	-107.440	86.760	⌀2.000 mm ∓ 8.000 mm
C16	113.713	86.324	⌀2.000 mm ∓ 8.000 mm
C17	113.814	-72.133	⌀2.000 mm ∓ 8.000 mm
C18	309.684	-101.406	⌀2.000 mm ∓ 8.000 mm
C19	125.679	85.423	⌀2.000 mm ∓ 8.000 mm
C20	344.403	52.734	⌀2.000 mm ∓ 8.000 mm
C21	-183.486	92.228	⌀2.000 mm ∓ 8.000 mm
C22	14.213	103.929	⌀2.000 mm ∓ 8.000 mm
C23	-204.330	248.850	⌀2.000 mm ∓ 8.000 mm
C24	16.437	261.915	⌀2.000 mm ∓ 8.000 mm
C25	26.212	103.760	⌀2.000 mm ∓ 8.000 mm
C26	223.497	86.460	⌀2.000 mm ∓ 8.000 mm
C27	28.436	261.746	⌀2.000 mm ∓ 8.000 mm
C28	248.747	242.472	⌀2.000 mm ∓ 8.000 mm
ZERO	0.000	0.000	Value

SCALE 1 / 2
Outside



This sheet shows dowel holes that are defined within the Bounding Box. Global locations are shown here for reference and certification measurements.

Dowel hole locations and cut-out features have tolerance +/- 0.001 inch within the Bounding Box.
Dowel hole locations have tolerance +/- 0.002 within a frame defind by holes B1, B11, B21, B31.

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TECHNICAL RESOURCE APPROVALS REQUIRED BEFORE FABRICATION	OK	DATE	N/A
DRAFTING (O'Connell):			
MACHINE SHOP (Kaminski):			
CHEMISTRY (Conklin):			
ELECTRONICS SHOP (Barley):			
FURNACE BRAZING (Sherwood):			
BEAM WELDING (Sears):			
WELDING OTHER (Gallagher):			
UTILITIES INTEGRATION (Gallagher):			
STOCKROOMS (Lockwood):			

ITEM	DWG. NO.	DESCRIPTION	Q1	Q2	Q3	REMARKS	REV.
			QUANTITY				

D
PRINT DISTR.
PLOT DATE:
CAD FILE NAME: 6080-102 Endplate.idw

6080-102
REV.

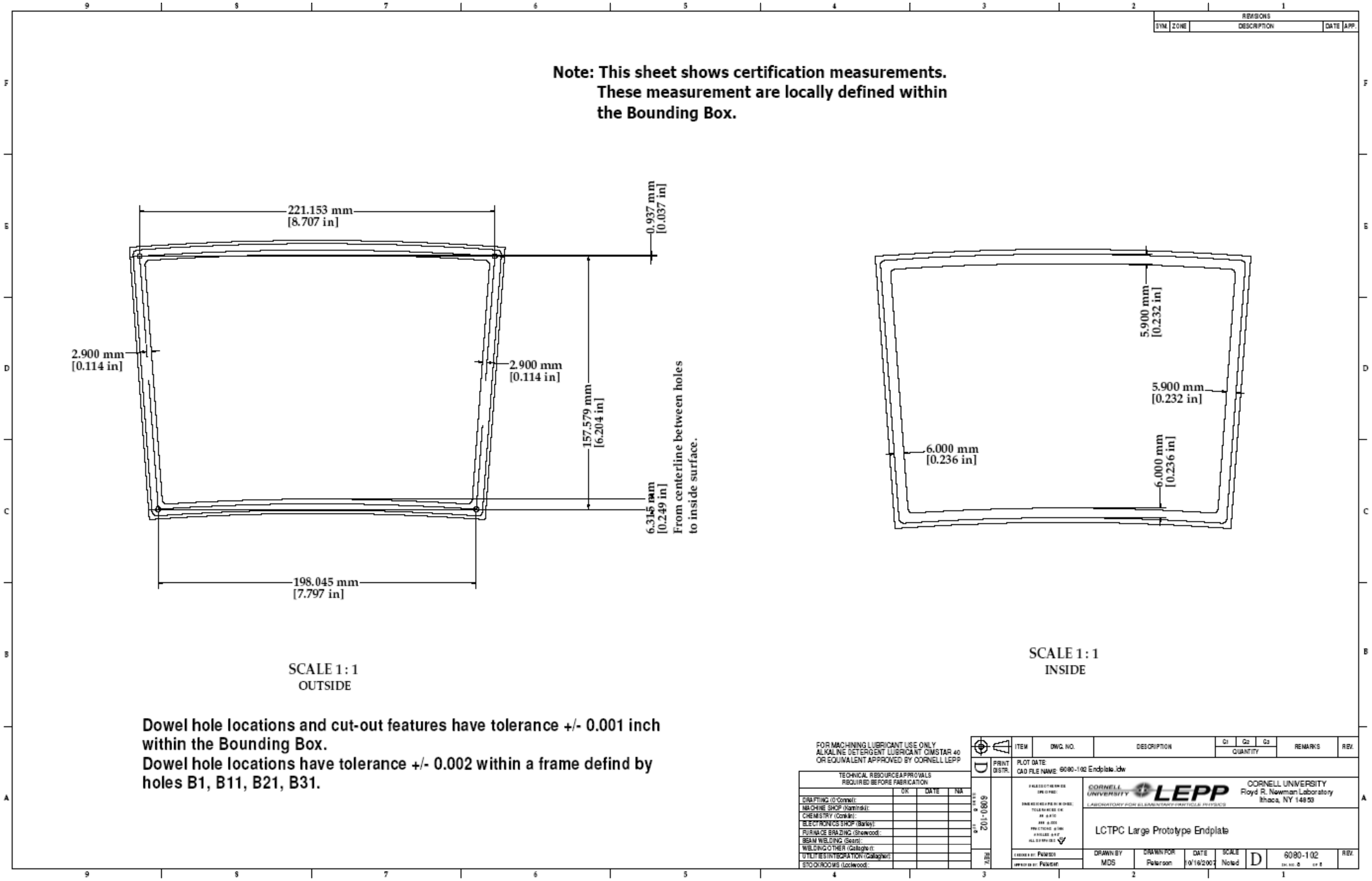
CHECKED BY: Peterson
APPROVED BY: Peterson

CORNELL UNIVERSITY LEPP
LABORATORY FOR ELEMENTARY-PARTICLE PHYSICS
CORNELL UNIVERSITY
Floyd R. Newman Laboratory
Ithaca, NY 14853

LCTPC Large Prototype Endplate

DRAWN BY	DRAWN FOR	DATE	SCALE			REV.
MDS	Peterson	10/16/2007	NOTED	D	6080-102	

Endplate Drawings, 2007-10-20



Endplate Drawings, 2007-10-20

While the endplate drawings are being sent to outside vendors,
a series of module back-frames will be made in the Cornell shop.

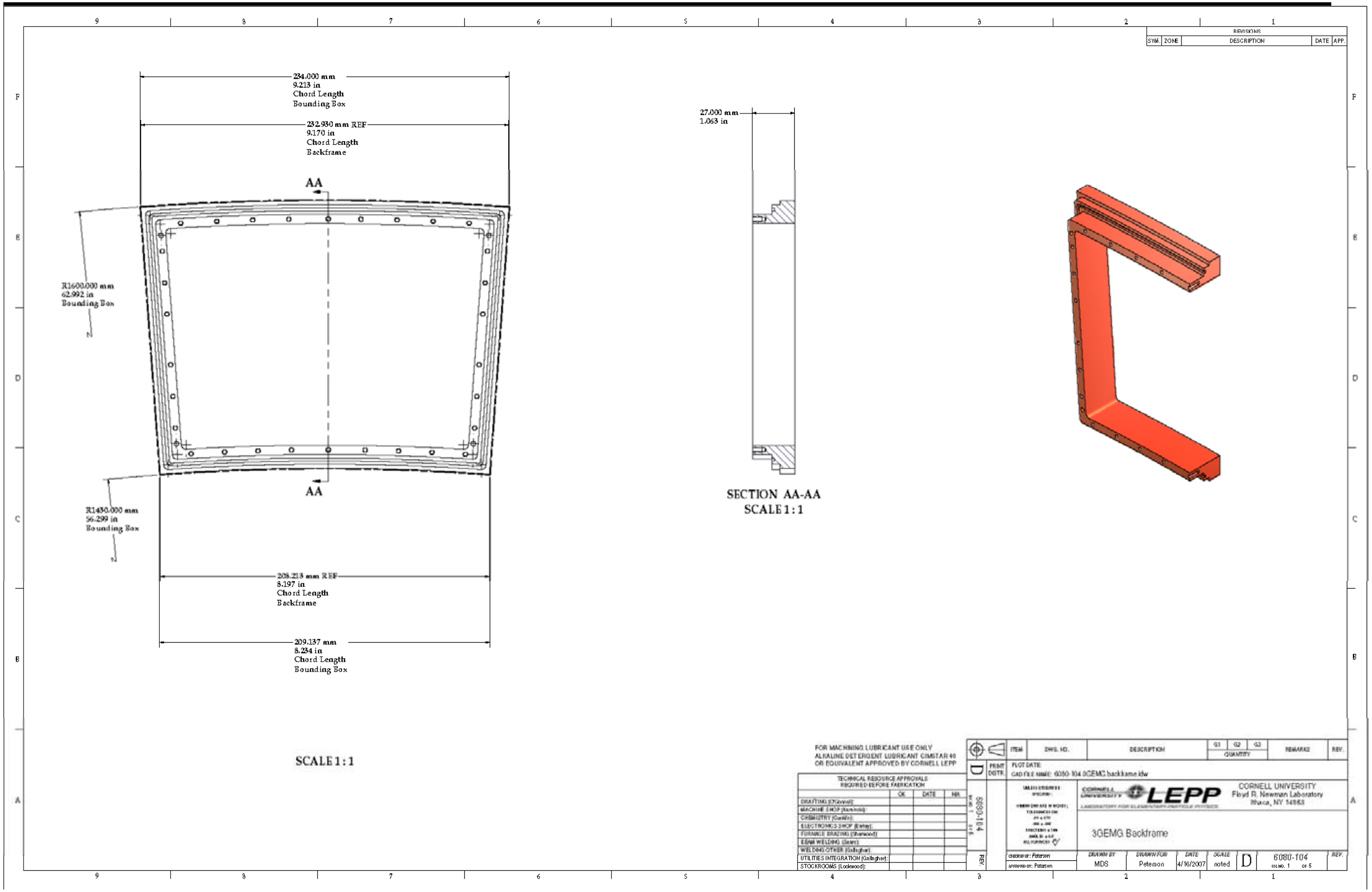
a total of 4 back-frames,

2 for Micromegas, pad board 3.2mm,

2 for GEM
I need up-to-date information on the need of GEM.
Currently I planned for 18mm of material:
2mm pad board, 3x 2mm GEM, 10mm Gate.
In the absence of firm numbers, I am producing back-frames for 8mm material.
(They can be re-machined, but they may warp.)

This will be the full process:
- 75μm oversize
- liquid N_2 stress relief
- 25μm oversize
- liquid N_2 stress relief
- final cut

Endplate Drawings, 2007-10-20



Stress relief test piece

This shows the first in a series of "stress relief test pieces".

This has been cut with a center opening of 30cm wide. The "mullions" are the same size as proposed in the endplate drawing: 18mm at the widest width, 14mm in depth.

This is the first baseline part, with no stress relief.

It has been fully measured on a CMM. The mullion position is distorted upward by 500μm (0.020inch).

The part was revised to have the strengthening section as shown in the current endplate.

Stress relief test piece

A close-up of the part shown in the previous slide.

Machining a Stress Relief Test Piece, 2007-05-25

Motivation:

A position tolerance of <25μm is needed for the modules to decouple the calibration of the magnetic field from the position calibration of the modules.

I am trying to provide, at delivery, <25μm position tolerance of the mullions. The endplate will then be evaluated after some service time to determine the ability to maintain this tolerance.

The program:

6 plates are being made to the revised drawing. A multi-step production is used:

1) machine to 1000 μm oversize
2) machine to 750 μm oversize,
3) stress relief
4) machine to 250 μm oversize,
5) stress relief
6) machine to drawing dimensions

Stress relief processes:
2 plates - (3)heat to 325F, (5)heat to 650F
2 plates - rapid cooling to liquid N_2
2 plates - ultrasonic cleaner, 6 hours

Coordinate Measuring machine (CMM), 2007-05-25

CMM, 2007-05-25, Z measurements

Example of measurement after the 2nd machining.

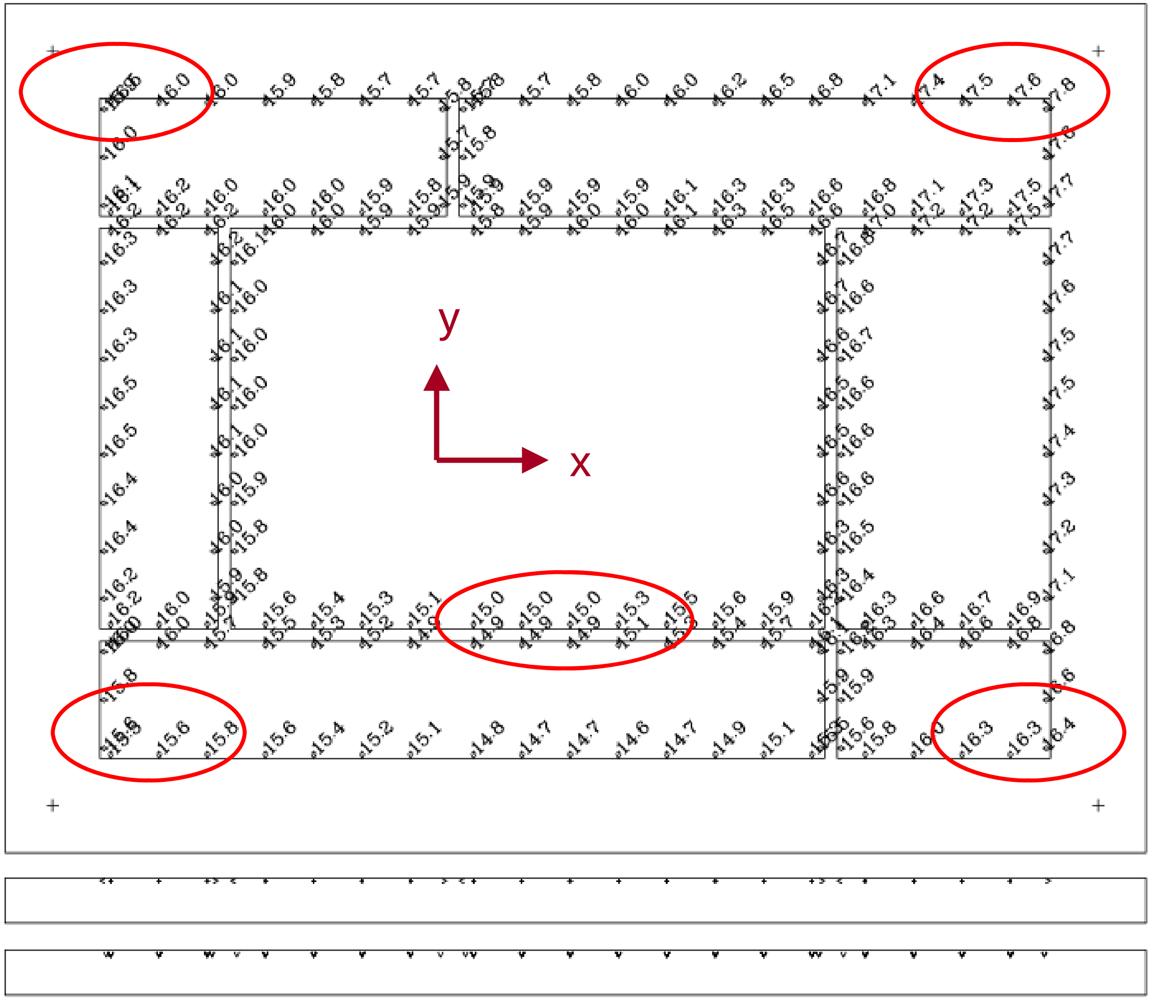
Units are milli-inch.
0.001 inch = 25.5 μm

This is the Z view.

There is a 30 μm bowing in z-x .

There is a twist about x from left to right of 25 μm.

/home/dpp/BulkDisk/StressReliefCmm/read3/Plate3.txt
3 machine 2
z



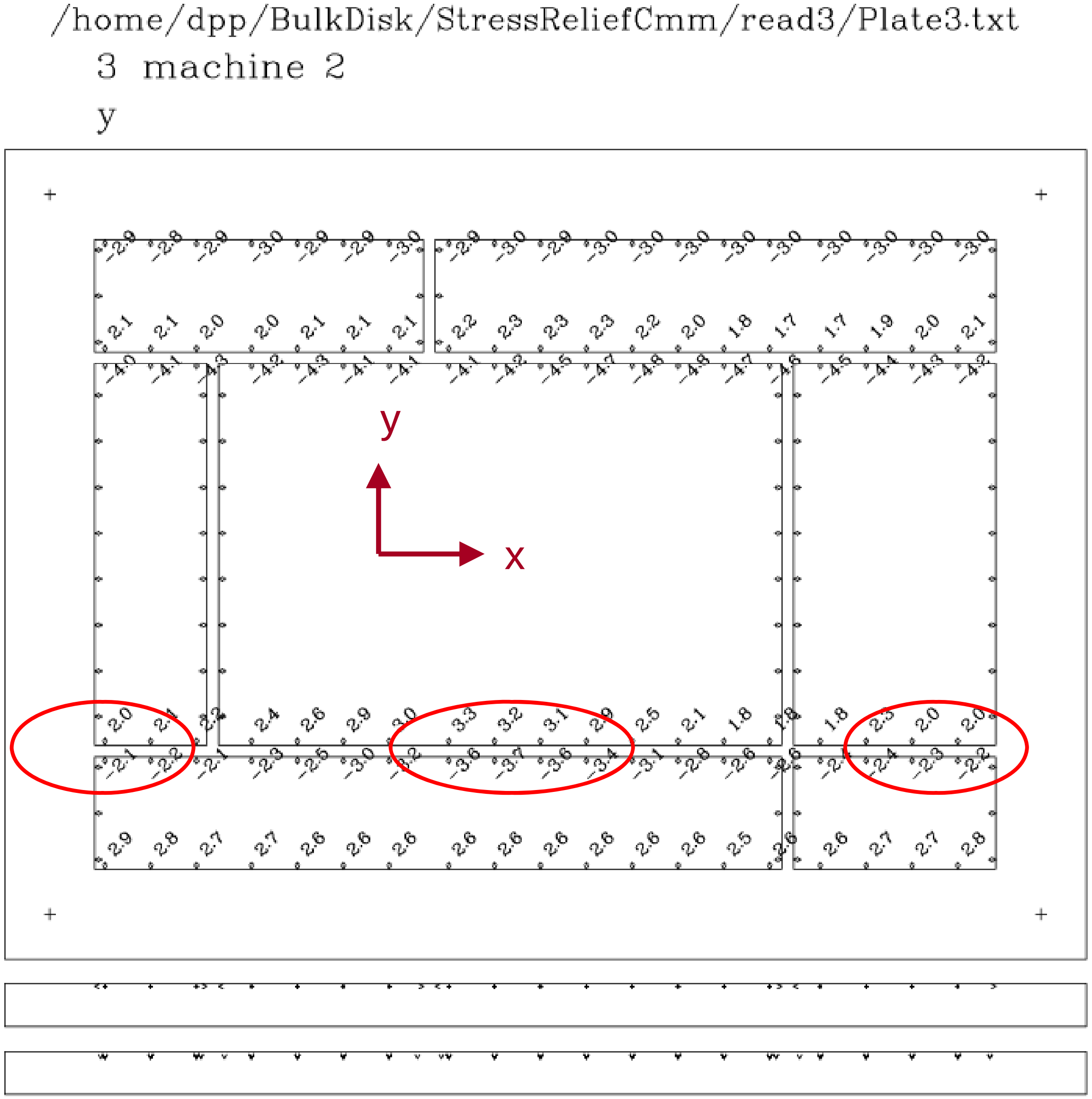
CMM, 2007-05-25, y measurements

Example of measurement after the 2nd machining.

Units are milli-inch.
0.001 inch = 25.5 μm

This is the y view.

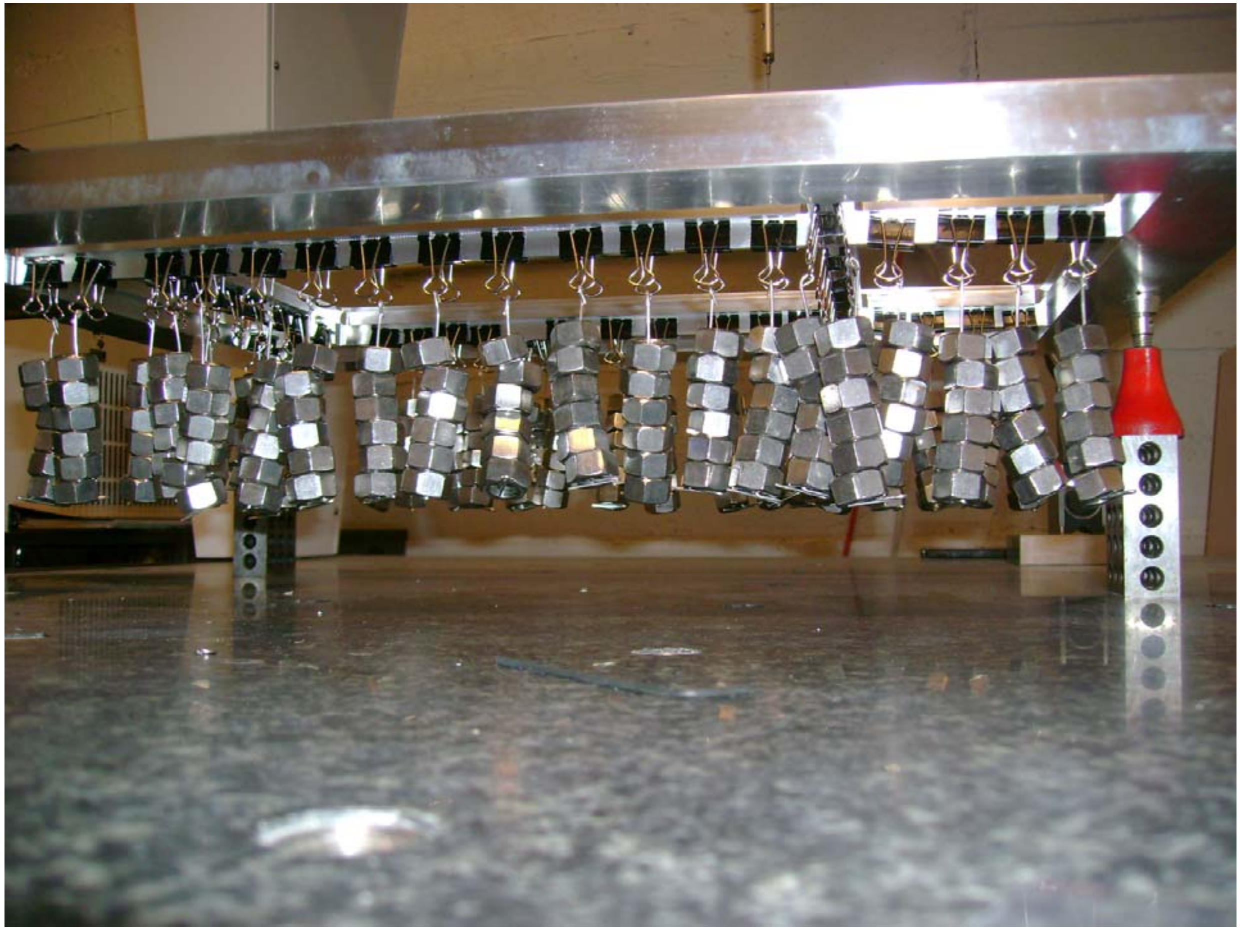
There is a 30 μm bowing in y of the indicated mullion.



Endplate loading 2007-08-17

A test piece was loaded with 5 kg, 2.6millibar

The center of the longest span deflected by 7 μm.



Gas Seal test, 2007-08-21

Test of the o-ring seal.

It can be mounted either way.

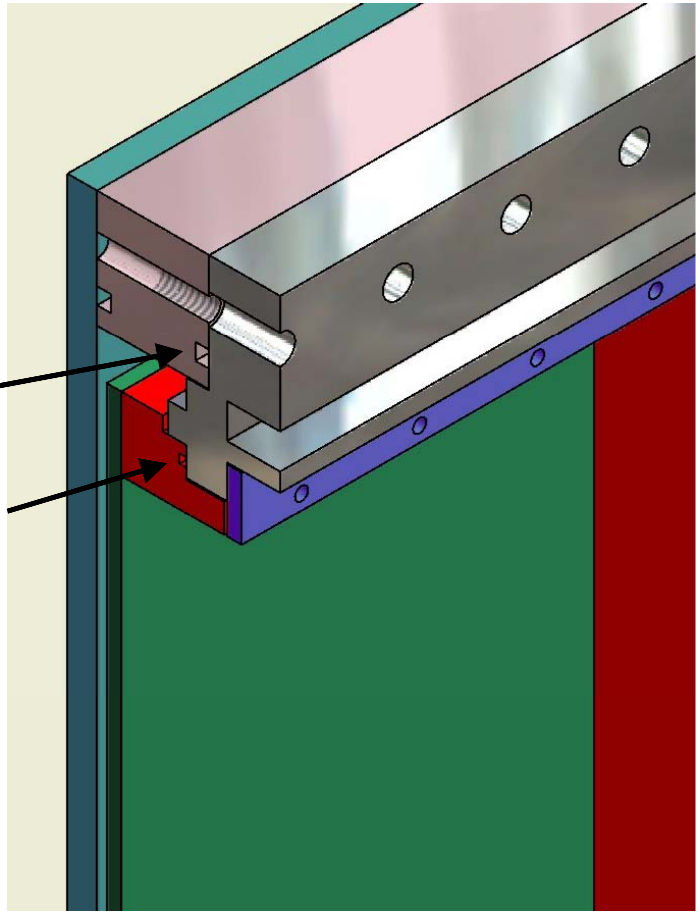
- model of mullion
- back-frame
- clamping bracket

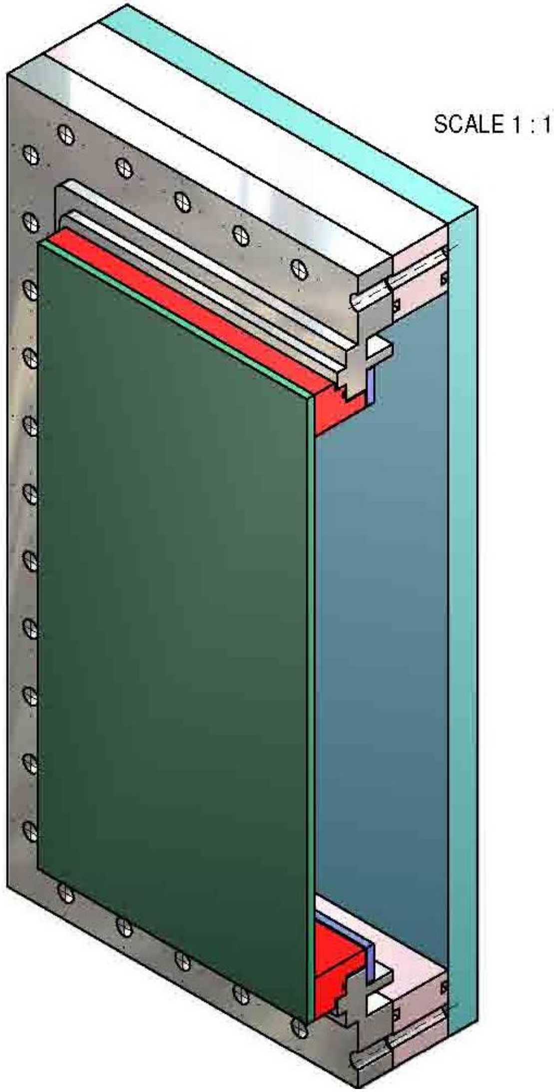
2007-08-21

improved box seal

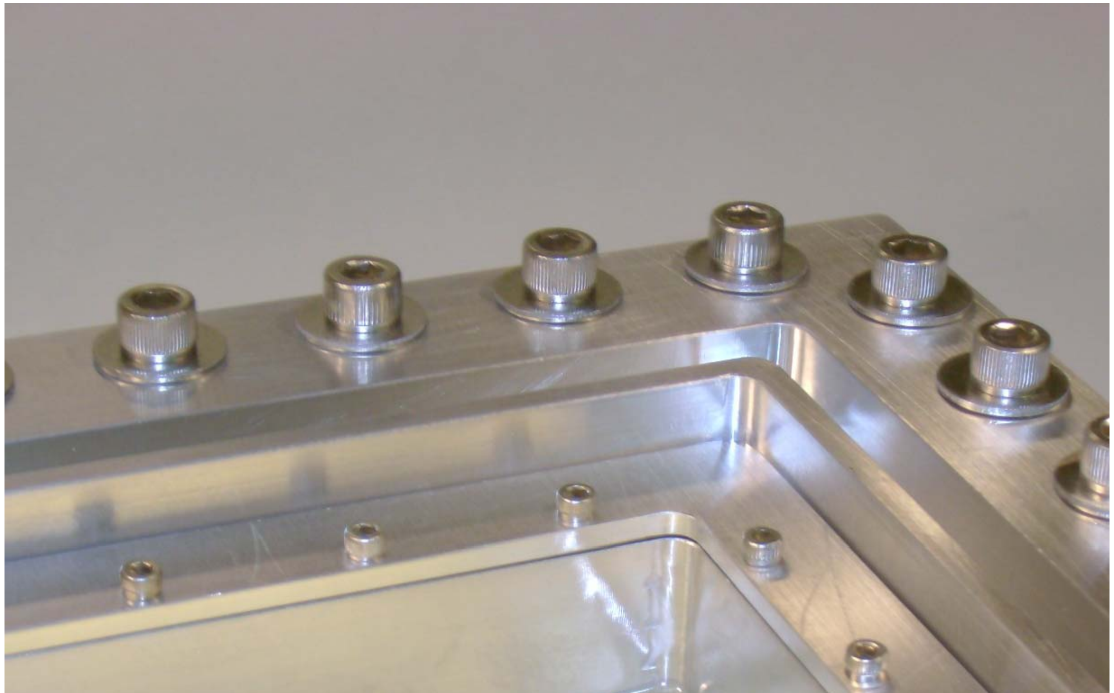
improved module seal

test of blank plate





Gas Seal test, 2007-08-21



After 1 week, pressure changed from
20.1 inch water (~40 millibar) to 13 inch water

Calculate: leak rate through module seal = 0.13 cc/hour

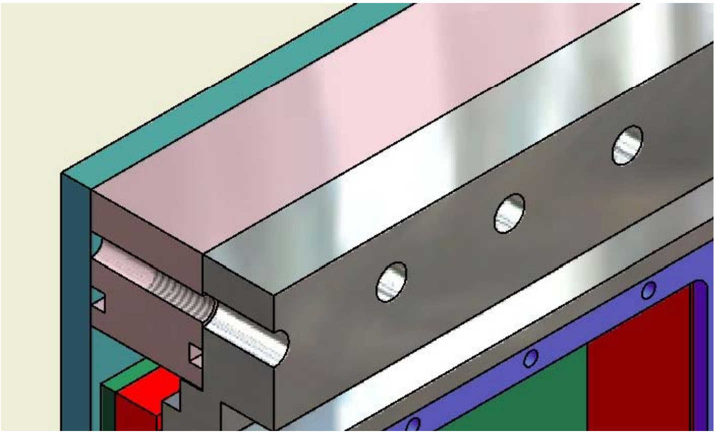
(After another 8 weeks, the pressure has dropped
to ~ 8 inch water, a much lower leak rate.
The seal does not require pressure.)

decisions

Bolt size: (I propose 8mm, DESY proposes 5mm)

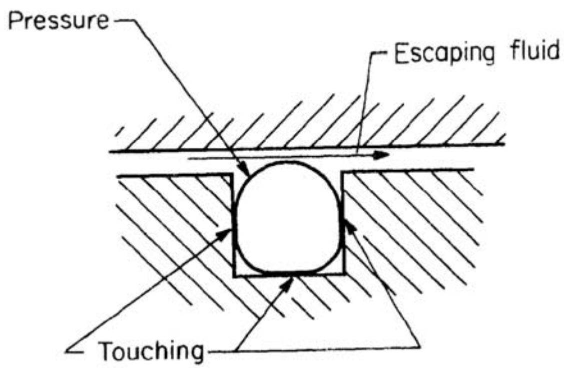
The proposed self tapping insert will require more
a larger insert hole, limiting mounting screws to 5mm.

I have ordered parts, as used in the gas seal test,
with (5mm x 0.8mm) and (6mm x1mm) threads.
Tests of torque to make the seal will follow.



decisions

O-rings



Figu
row

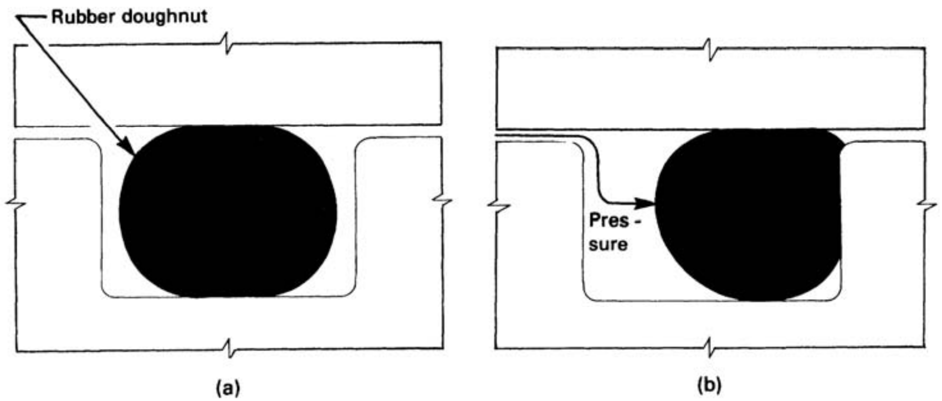


Figure 1.1 How an O ring works. (*a*) As installed. (*b*) Under pressure. (*From* The Parker O-Ring Handbook, *courtesy of Parker Seal Group.*)

4 surface contact

2 surface contact

schedule

I will know more about the schedule after first discussions with vendors.