MODIFICATION OF AA-SEPTUM VACUUM CHAMBER

M. Zanolli

The AA short-term improvement programme[1] foresees the replacement of the septum vacuum chamber to have better beam acceptance at injection.

The original design lets the beam just pass by at the downstream end of SMH1 with the theoretical beam characteristics then available.

Later calculations[2] with revised AA-parameters show that a larger kick for injection is required to clear this point ($\Delta r \simeq 5$ mm) and that there would be a further restriction on the other side of the chamber at the upstream end of SM1.

A design study was made and it is proposed to cut-off the symmetrically positionned arms upstream and downstream of the main part of the vacuum chamber, and to replace them by a slightly different arrangement (Fig. 1).

In this way a space of 2.5 mm is gained on either side of the septum magnet (2 mm due to tube displacement and 0.5 mm due to a reduction of wall-thickness) with none or perhaps negligible septum magnet modifications (Fig. 2), thereby reducing the required extra kicker voltage.

Although of less importance, the vertical aperture will also be increased up to the limit of the space available.

Drawing A-43-5006-4 shows the cross-section of the built-in vacuum chamber arms, while drawing A-43-5032-4 shows the proposed ones.

Strength calculations[3] indicate that the new section will withstand the loadings.

Fig. 3 illustrates the positions of the nodal points considered and the deflection of the rectangular tube, while Tables 1 to 3 give the values of deflection, stresses and moments respectively at these points.

Two identical sub-assemblies (tubes, flanges and cover) will be prepared and vacuum-tested after controlling, cleaning and vacuum-firing.

During the shut-down in winter 1982 the septum vacuum chamber will be taken out of the ring, both ends accurately machined-off and the remaining part cleaned. Then the two sub-assemblies will be accurately positionned and welded into place. Cleaning of the whole chamber or only partially, if necessary, and final vacuum tests will conclude the operation.

After installation in the ring more care has to be taken when mounting the septum magnet around it.

It is believed that this proposal represents the best and most economical solution with the actual septum magnets.

Fabrication within the restricted time schedule should cause no problems. Manufacture could start in September. The new rectangular tubes are already available.

References

1) E.J.N. Wilson handed out a note under the heading "Consolidation Hardware 1982/1983" at a meeting on 19.1.1982.

2) B. Autin, A. Poncet and R. Sherwood have since calculated again and independently the beam position and its profile under different conditions.

3) H. Stucki made these calculations with the SAFE-SHELL program.

Distribution

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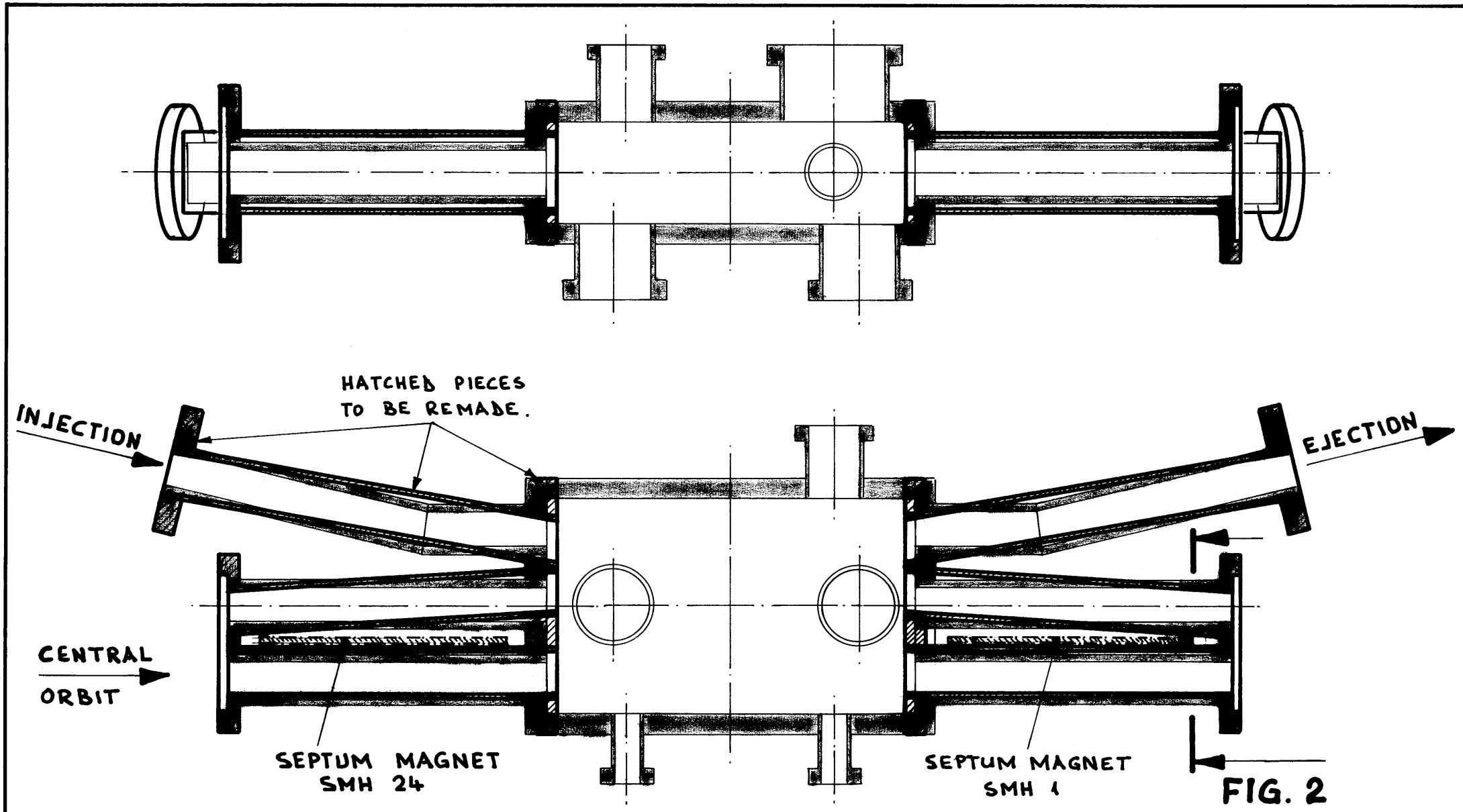


FIG. 2

FIG. 1: MODIFICATION OF SEPTUM VACUUM CHAMBER

PROPOSAL

9.8.82 Ü.Z.

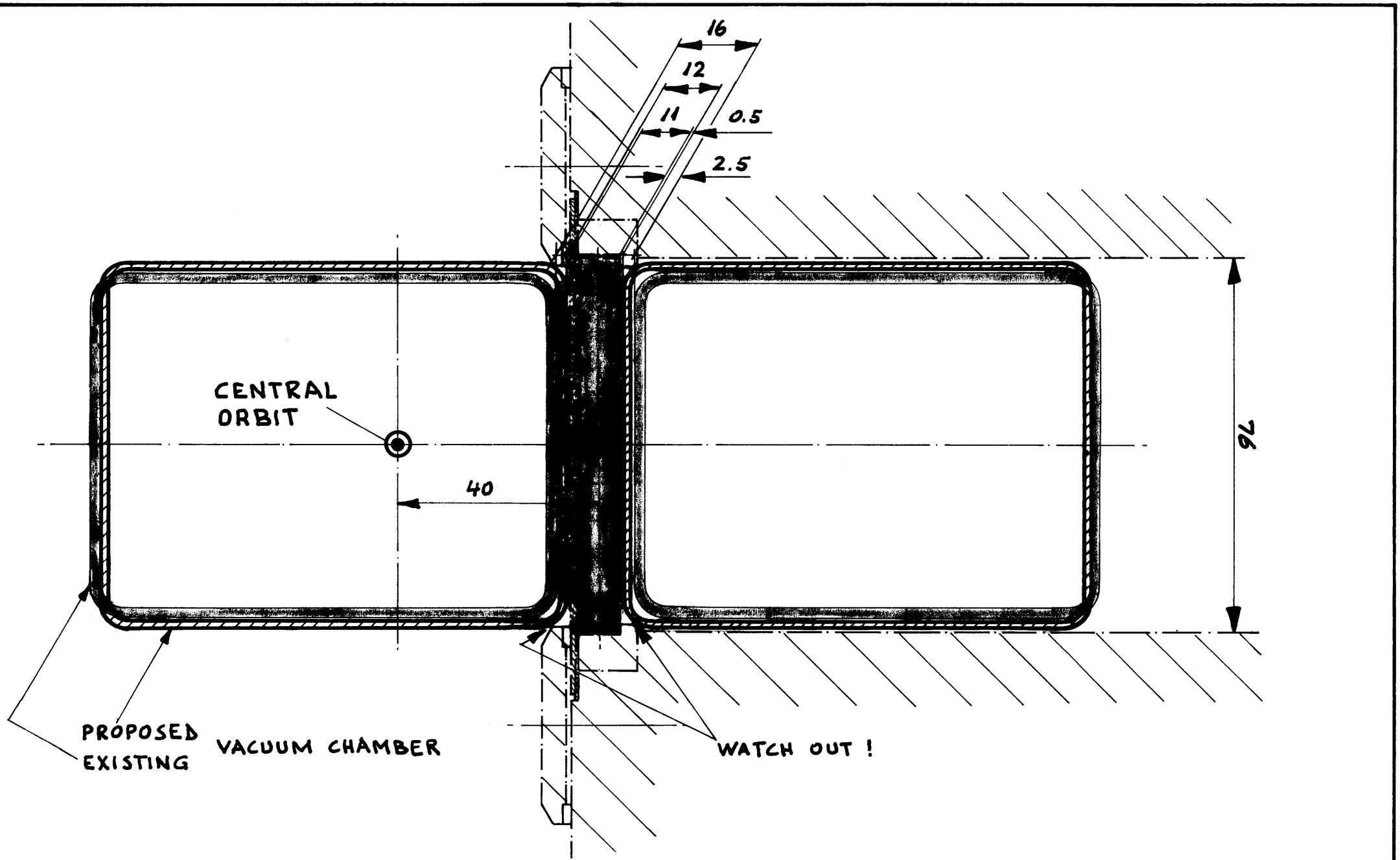
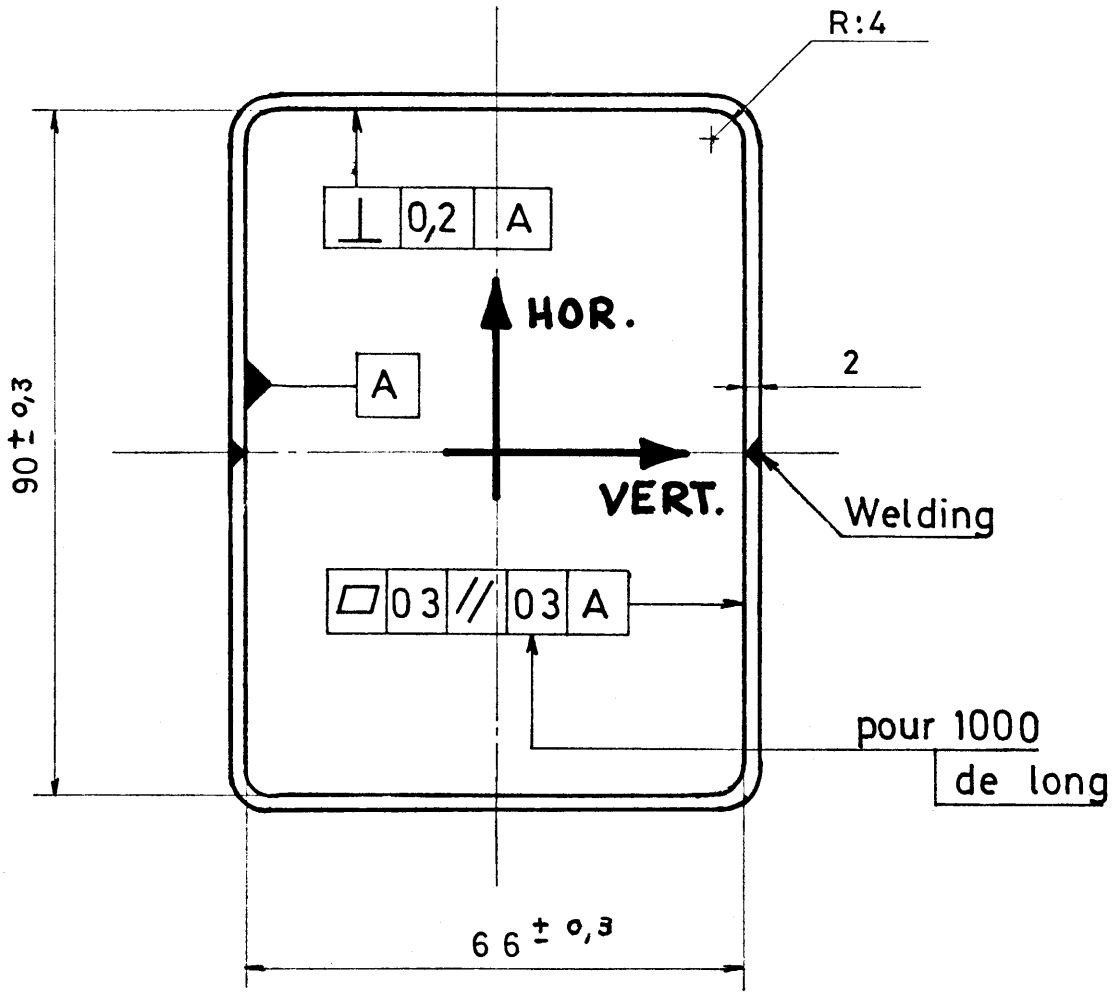


FIG. 2: VACUUM CHAMBERS IN SEPTUM MAGNET

10.8.82 Th. 2.

Modifications:.....



First angle projection
Projection européenne

Ensemble Assembly A-43-5005-0	S/ensemble S/assembly A-43-5007-0	Nom-Name		Date	Issue
A A Vacuum Chamber	Echelle Scale	Dessiné	REGAT	5-4-78	
Vacuum for Septum Rectangular Tube	1:1	Contrôlé			
					A
					B
					C

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ISR

A-43-5006-4

INDICE	DATE	NOM	MODIFICATION

DIMENSION	> 1	> 30	> 120	> 400	> 1000	> 2000
USINAGE	±0,2	±0,3	±0,5	±0,8	±1,2	±2
MÉCANO-SOUDURE	±0,5	±0,8	±1	±2	±3	±4

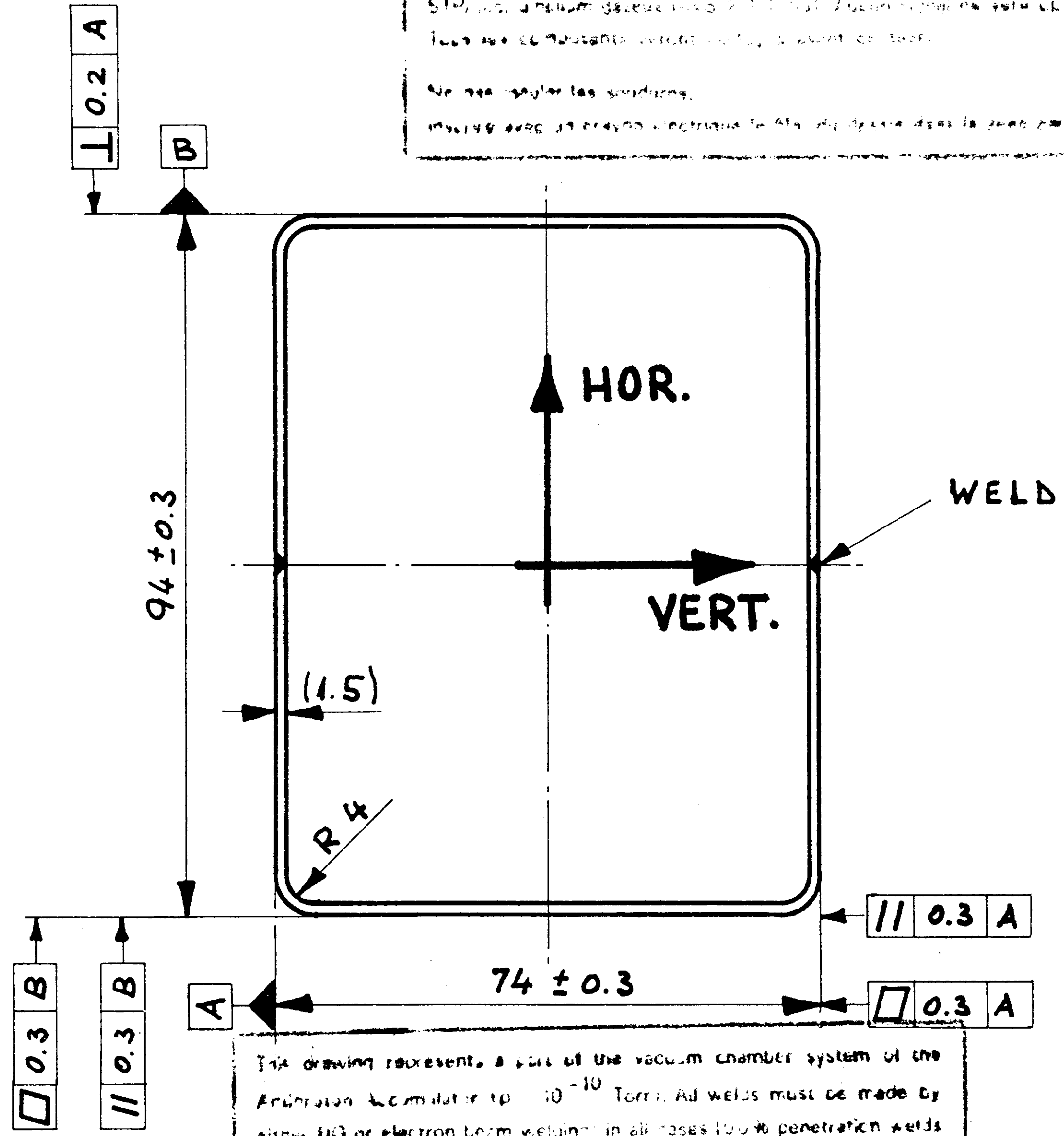
TOLÉRANCES GÉNÉRALES

DESSIN, RUGOSITÉ, TOLÉRANCES SELON NORMES ISO

Ce dessin représente une partie de l'enceinte à vide [illegible] de l'Accumulateur d'Antiprotons [illegible] 10^{-10} Torr. Les soudures seront [illegible] [illegible] 100% de pénétration [illegible] à l'aide d'un détecteur [illegible] 10^{-10} cm^3 STP [illegible] Aucune [illegible] observé. Tous les composants [illegible] avant [illegible].

Ne pas meuler les soudures.

Inscrire avec un crayon électrique le No. du dessin dans la zone ombrée.



This drawing represents a part of the vacuum chamber system of the Antiproton Accumulator (p ≤ 10^{-10} Torr). All welds must be made by either TIG or electron beam welding; in all cases 100% penetration welds are necessary. All assembled parts must be leak checked with a spectrometer having a detection limit of [illegible] Std cm^3/sec. of helium gas (AVS 2. 1. 1963). No leak should be detected. All parts must be cleaned before leak checking.

Do not grind the welds.

Inscribe drawing No. shaded area with an electric pencil.

NOMBRE PAR UNITÉ	DESCRIPTION	POS.	MATIÈRE	COTES BRUTES	FOURNISSEURS No SCEM
2	SHEET 1.5 THICK		ST.ST. 316 LN	166 × 1300	44.59.32.515.8

ENSEMBLE	S. ENSEMBLE	NOM	DATE

AA - VACUUM SYSTEM

RECTANGULAR TUBE FOR SEPTUM VACUUM CHAM.

ÉCHELLE SCALE		NOM	DATE
1:1	DESSINÉ	Zanoli	7.6.82
	CONTRÔLÉ		
	REMPLACE		
	REMPLACÉ PAR		
	RÉDUCTION		

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A.43.5032.4 INDICE

Projection européenne
First angle projection

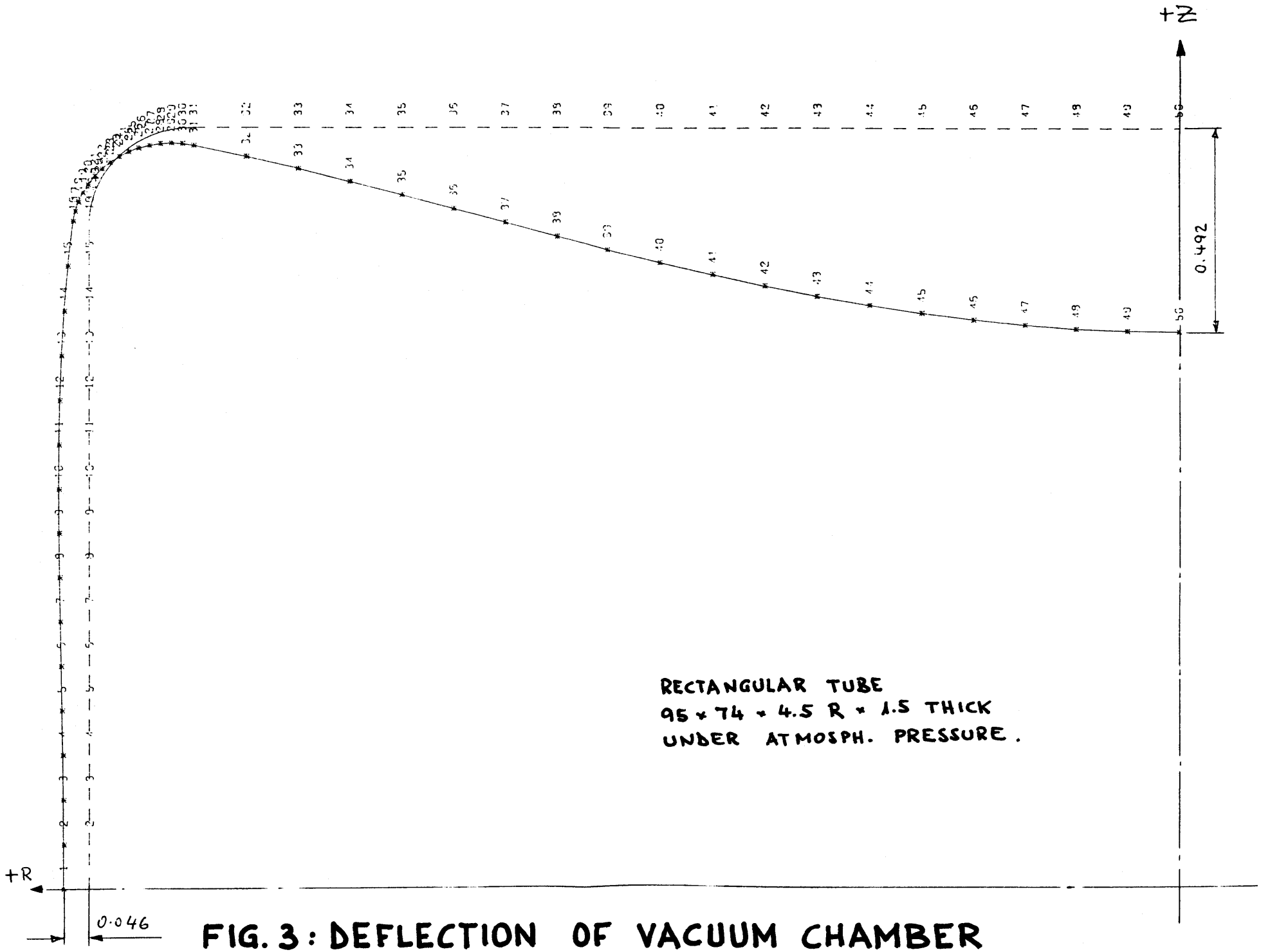

FIG. 3: DEFLECTION OF VACUUM CHAMBER

NODAL POINT	R-DISPLACEMENT	Z-DISPLACEMENT	ROTATION	LOADING CONDITION 1
1	.54285859E-01	0.	0.	
2	.54532466E-01	-.30550800E-04	.22626551E-03	
3	.55254459E-01	-.61101568E-04	.43607611E-03	
4	.56398361E-01	-.91652275E-04	.61297686E-03	
5	.57875040E-01	-.12220290E-03	.74051286E-03	
6	.59559713E-01	-.15275341E-03	.80222918E-03	
7	.61291946E-01	-.18330382E-03	.78167091E-03	
8	.62875649E-01	-.21385412E-03	.66238312E-03	
9	.64079084E-01	-.24440432E-03	.42791090E-03	
10	.64634857E-01	-.27495447E-03	.61799329E-04	
11	.64239924E-01	-.30550461E-03	-.45240652E-03	
12	.62555588E-01	-.33605481E-03	-.11311616E-02	
13	.59207499E-01	-.36660518E-03	-.19909207E-02	
14	.53785655E-01	-.39715583E-03	-.30481389E-02	
15	.45844403E-01	-.42770691E-03	-.43192710E-02	
16	.34902437E-01	-.45825860E-03	-.58207720E-02	
17	.32085137E-01	-.61257322E-03	-.61783279E-02	
18	.29130900E-01	-.10871785E-02	-.65458701E-02	
19	.26073486E-01	-.19130912E-02	-.69216593E-02	
20	.22952552E-01	-.31177036E-02	-.73038664E-02	
21	.19813243E-01	-.47236951E-02	-.76905920E-02	
22	.16705569E-01	-.67480045E-02	-.80798874E-02	
23	.13683605E-01	-.92008907E-02	-.84697758E-02	
24	.10804501E-01	-.12085127E-01	-.88582739E-02	
25	.81273485E-02	-.15395355E-01	-.92434135E-02	
26	.57119218E-02	-.19117635E-01	-.96232635E-02	
27	.36173337E-02	-.23229199E-01	-.99959500E-02	
28	.19006429E-02	-.27698449E-01	-.10359678E-01	
29	.61545688E-03	-.32485172E-01	-.10712749E-01	
30	-.18942981E-03	-.37541007E-01	-.11053584E-01	
31	-.47138009E-03	-.42810124E-01	-.11380734E-01	
32	-.44657056E-03	-.69508904E-01	-.12721425E-01	
33	-.42176104E-03	-.98820447E-01	-.13747574E-01	
34	-.39695152E-03	-.13006876E+00	-.14476655E-01	
35	-.37214201E-03	-.16261648E+00	-.14926142E-01	
36	-.34733250E-03	-.19586488E+00	-.15113510E-01	
37	-.32252300E-03	-.22925384E+00	-.15056235E-01	
38	-.29771351E-03	-.26226190E+00	-.14771790E-01	
39	-.27290402E-03	-.29440619E+00	-.14277650E-01	
40	-.24809454E-03	-.32524250E+00	-.13591290E-01	
41	-.22328506E-03	-.35436524E+00	-.12730185E-01	
42	-.19847558E-03	-.38140743E+00	-.11711809E-01	
43	-.17366612E-03	-.40604075E+00	-.10553636E-01	
44	-.14885665E-03	-.42797548E+00	-.92731421E-02	
45	-.12404720E-03	-.44696055E+00	-.78878010E-02	
46	-.99237748E-04	-.46278349E+00	-.64150874E-02	
47	-.74428303E-04	-.47527048E+00	-.48724760E-02	
48	-.49618863E-04	-.48428633E+00	-.32774412E-02	
49	-.24809429E-04	-.48973447E+00	-.16474577E-02	
50	0.	-.49155695E+00	0.	

TABLE 1: DEFLECTION VALUES

LOADING CONDITION 1

ELEMENT	MERIDIONAL STRESS	HOOP STRESS	MERIDIONAL BENDING	HOOP BENDING	SHEAR STRESS	EQUIVALENT STRESS
1	-.3099	-.0931	1.7214	.5164	-.0072	1.8054
2	-.3099	-.0931	1.5962	.4789	-.0217	1.6942
3	-.3099	-.0931	1.3458	.4037	-.0361	1.4716
4	-.3099	-.0931	.9703	.2911	-.0506	1.1378
5	-.3099	-.0931	.4695	.1409	-.0650	.6928
6	-.3099	-.0931	-.1564	-.0469	-.0794	.4145
7	-.3099	-.0931	-.9075	-.2723	-.0939	1.0821
8	-.3099	-.0931	-1.7838	-.5351	-.1083	1.8609
9	-.3099	-.0931	-2.7853	-.8356	-.1228	2.7511
10	-.3099	-.0931	-3.9120	-1.1736	-.1372	3.7525
11	-.3099	-.0931	-5.1638	-1.5491	-.1517	4.8651
12	-.3099	-.0931	-6.5409	-1.9623	-.1661	6.0891
13	-.3099	-.0931	-8.0431	-2.4129	-.1806	7.4243
14	-.3099	-.0931	-9.6705	-2.9011	-.1950	8.8708
15	-.3099	-.0931	-11.4231	-3.4269	-.2094	10.4285
16	-.3208	-.0963	-12.5304	-3.7591	-.2017	11.4224
17	-.3403	-.1022	-12.8804	-3.8641	-.1703	11.7508
18	-.3564	-.1070	-13.1694	-3.9508	-.1370	12.0219
19	-.3689	-.1107	-13.3943	-4.0183	-.1021	12.2330
20	-.3777	-.1134	-13.5526	-4.0658	-.0662	12.3815
21	-.3827	-.1149	-13.6427	-4.0928	-.0295	12.4660
22	-.3839	-.1152	-13.6635	-4.0991	.0074	12.4855
23	-.3812	-.1144	-13.6148	-4.0844	.0443	12.4398
24	-.3746	-.1124	-13.4971	-4.0491	.0808	12.3294
25	-.3643	-.1093	-13.3117	-3.9935	.1163	12.1555
26	-.3503	-.1051	-13.0607	-3.9182	.1506	11.9199
27	-.3329	-.0999	-12.7467	-3.8240	.1832	11.6254
28	-.3121	-.0936	-12.3733	-3.7120	.2138	11.2750
29	-.2882	-.0865	-11.9444	-3.5833	.2421	10.8726
30	-.2616	-.0785	-11.4648	-3.4395	.2677	10.4226
31	-.2467	-.0740	-9.9973	-2.9992	.2726	9.1050
32	-.2467	-.0740	-7.6518	-2.2956	.2579	7.0203
33	-.2467	-.0740	-5.4366	-1.6310	.2432	5.0514
34	-.2467	-.0740	-3.3518	-1.0055	.2284	3.1983
35	-.2467	-.0740	-1.3972	-.4192	.2137	1.4611
36	-.2467	-.0740	.4271	.1281	.1989	.5989
37	-.2467	-.0740	2.1211	.6363	.1842	2.1045
38	-.2467	-.0740	3.6847	1.1054	.1695	3.4943
39	-.2467	-.0740	5.1181	1.5354	.1547	4.7683
40	-.2467	-.0740	6.4211	1.9263	.1400	5.9265
41	-.2467	-.0740	7.5939	2.2781	.1253	6.9688
42	-.2467	-.0740	8.6363	2.5909	.1105	7.8953
43	-.2467	-.0740	9.5484	2.8645	.0958	8.7061
44	-.2467	-.0740	10.3302	3.0991	.0811	9.4010
45	-.2467	-.0740	10.9818	3.2945	.0663	9.9801
46	-.2467	-.0740	11.5030	3.4509	.0516	10.4433
47	-.2467	-.0740	11.8939	3.5682	.0368	10.7908
48	-.2467	-.0740	12.1545	3.6463	.0221	11.0224
49	-.2467	-.0740	12.2848	3.6854	.0074	11.1382

TABLE 2: STRESSES OF VACUUM CHAMBER

LOADING CONDITION 1

ELEMENT	MERIDIONAL FORCE	HOOP FORCE	MERIDIONAL MOMENT	HOOP MOMENT	SHEAR
1	-.4649	-.1396	.6455	.1937	-.0108
2	-.4649	-.1396	.5986	.1796	-.0325
3	-.4649	-.1396	.5047	.1514	-.0542
4	-.4649	-.1396	.3638	.1092	-.0758
5	-.4649	-.1396	.1761	.0528	-.0975
6	-.4649	-.1397	-.0587	-.0176	-.1192
7	-.4649	-.1397	-.3403	-.1021	-.1408
8	-.4649	-.1397	-.6689	-.2007	-.1625
9	-.4649	-.1397	-1.0445	-.3133	-.1842
10	-.4649	-.1397	-1.4670	-.4401	-.2058
11	-.4649	-.1397	-1.9364	-.5809	-.2275
12	-.4649	-.1397	-2.4528	-.7358	-.2492
13	-.4649	-.1396	-3.0162	-.9048	-.2708
14	-.4649	-.1396	-3.6264	-1.0879	-.2925
15	-.4649	-.1396	-4.2837	-1.2851	-.3142
16	-.4813	-.1445	-4.6989	-1.4097	-.3026
17	-.5105	-.1532	-4.8301	-1.4490	-.2554
18	-.5346	-.1605	-4.9385	-1.4816	-.2054
19	-.5533	-.1661	-5.0229	-1.5069	-.1532
20	-.5666	-.1700	-5.0822	-1.5247	-.0993
21	-.5741	-.1723	-5.1160	-1.5348	-.0443
22	-.5758	-.1728	-5.1238	-1.5371	.0112
23	-.5717	-.1716	-5.1055	-1.5317	.0665
24	-.5619	-.1686	-5.0614	-1.5184	.1211
25	-.5464	-.1640	-4.9919	-1.4976	.1744
26	-.5255	-.1577	-4.8977	-1.4693	.2258
27	-.4993	-.1498	-4.7800	-1.4340	.2748
28	-.4681	-.1404	-4.6400	-1.3920	.3207
29	-.4324	-.1297	-4.4792	-1.3438	.3631
30	-.3923	-.1177	-4.2993	-1.2898	.4016
31	-.3700	-.1110	-3.7490	-1.1247	.4089
32	-.3700	-.1110	-2.8694	-.8608	.3868
33	-.3700	-.1110	-2.0387	-.6116	.3647
34	-.3700	-.1110	-1.2569	-.3771	.3426
35	-.3700	-.1110	-.5239	-.1572	.3205
36	-.3700	-.1110	.1602	.0480	.2984
37	-.3700	-.1110	.7954	.2386	.2763
38	-.3700	-.1110	1.3818	.4145	.2542
39	-.3700	-.1110	1.9193	.5758	.2321
40	-.3700	-.1110	2.4079	.7224	.2100
41	-.3700	-.1110	2.8477	.8543	.1879
42	-.3700	-.1110	3.2386	.9716	.1658
43	-.3700	-.1110	3.5807	1.0742	.1437
44	-.3700	-.1110	3.8738	1.1621	.1216
45	-.3700	-.1110	4.1182	1.2354	.0995
46	-.3700	-.1110	4.3136	1.2941	.0774
47	-.3700	-.1110	4.4602	1.3381	.0553
48	-.3700	-.1110	4.5579	1.3674	.0332
49	-.3700	-.1110	4.6068	1.3820	.0111

TABLE 3: MOMENT VALUES OF VACUUM CHAMBER