

# The Shape of the Upper Half of the Acrylic Vessel Prior to Hanging it on Ropes

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## 1 Summary

This report presents the results of the survey of the upper half of the acrylic vessel. The surveying was done before the vessel was hung on the ropes. The vessel was found to be spherical within  $\pm 0.23''$ , with an inner radius of  $236.38''$ . The bottom of the vessel was horizontal within  $\pm 0.04''$ , and was circular within  $+0.13''$  and  $-0.18''$ , with a circular radius of  $234.15''$  on the inside.

## 2 Description of the Surveying

There were generally three targets on each panel (at the lower left, middle and upper right areas). Two extra targets were placed on the rope groove panels (at the upper left and lower right areas) to increase the sensitivity of the search for twisting of these panels after the vessel had been raised. The five targets on each 101 panel were placed on the flat, raised surface. A target was also placed on the bottom edge of every 102 panel.

The surveying was done in two parts: the 101-106 panels were shot on Nov 28, and the 108-110 and 102 bottoms were shot on Dec 16. The center and north targets could not be shot on Nov 28, so that data by itself cannot easily be compared with that from the other dataset. Hence, on Dec 15, the center and north targets were shot, along with the middle target on each 101 panel. The results from that measurement were used to transform the Nov 28 data to a common reference frame (the GRAVITY CENTER frame) which has its origin at the mark in the center of the platform (originally used to define the position of the vertical axis of symmetry of the PSUP), the z axis runs vertically, and the x axis runs in the vertical plane containing the center and north target locations. In addition to this frame, a SPHERE CENTER frame with its origin at the center of the best-fit sphere to the whole vessel (excluding the 101 targets) and with the axes parallel to those in the GRAVITY CENTER frame was used when presenting the spherical radius for each point.

For reference, the coordinates of the targets in the SPHERE CENTER and GRAVITY CENTER frames are tabulated in the Appendices to this report.

## 3 The Bottom of the Vessel

As surveyed on Dec 16, the average height of the points on the bottom edge of the panels was  $59.093''$  in the GRAVITY CENTER frame, and the variation in the heights was about

$\pm 0.040''$ . These points were fit using Erik Saettler's 'avfit' program. The results are presented in the table below, as well as in Figures 1 to 4. From the table, we see that the fitted center is within  $0.05''$  of the nominal location, and the circular radius ( $234.150''$ ) is  $0.035''$  under the nominal value of  $234.185''$ . The radii vary between  $+0.13''$  and  $-0.18''$ . From the fit to the heights, we see that there is a  $\pm 0.016''$  tilt to the vessel, and that the remainder of the  $\pm 0.040''$  variation in the heights is due to the 'elliptical' deformation of the bottom.

Radius fit: Input: "102b16gcf.txt"

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A(1) = 234.1503
A(2) = 0.0101
A(3) = 0.0446
A(4) = -0.0282
A(5) = -0.0771
RMS Residual = 0.1239
Shape analysis: Nominal center: 0.0000 0.0000 91.5914
circle mean radius: 234.150299 mean spherical radius: 236.394824
Center x = 0.0101 , y = 0.0446 z = 59.0929
Elipse: bulge = 0.1643 , major axis angle = 161.2 grads

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Height fit:

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A(1) = -32.4980
A(2) = 0.0078
A(3) = -0.0139
A(4) = -0.0222
A(5) = 0.0062
RMS Residual = 0.0134
Height analysis: Nominal center: 0.0000 0.0000 91.5914
mean height: -32.498035
variation amplitude = 0.0159 , High point angle = 167.2 grads
2nd harmonic amp = 0.0230 , High point angle = 8.6 grads

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Grads	radius	radfit	z	zfit	rad-sphere	Event Name
-180.2	234.1683	234.0828	-32.4575	-32.4656	236.4127	102-09B
-138.3	233.9394	234.0347	-32.5032	-32.4989	236.1859	102-05B
-99.3	234.2439	234.1142	-32.5382	-32.5283	236.4875	102-08B
-60.5	234.0998	234.2319	-32.5115	-32.5255	236.3448	102-01B
-20.8	234.3208	234.2586	-32.4993	-32.4998	236.5637	102-03B
17.4	234.2154	234.1800	-32.5023	-32.4871	236.4593	102-07B
58.3	234.0296	234.1037	-32.4882	-32.5000	236.2753	102-06B
97.1	234.1490	234.1272	-32.5090	-32.5123	236.3936	102-04B
140.0	234.2654	234.1968	-32.5075	-32.4963	236.5089	102-02B
175.4	234.0851	234.1869	-32.4680	-32.4707	236.3303	102-10B

AV Height by Azimuthal Angle

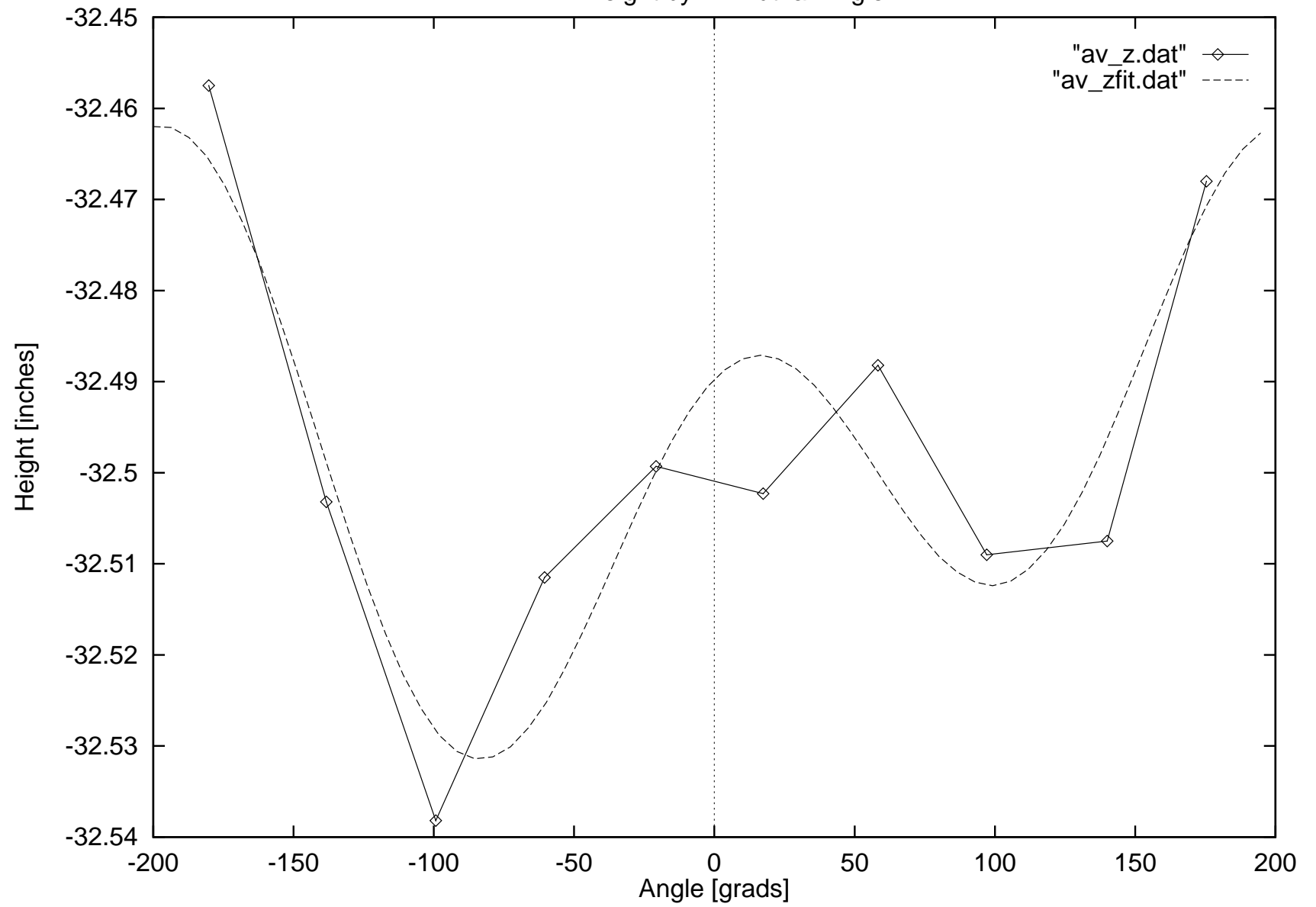


Figure 1: Heights of the 102 bottoms.  
3

AV Radius by Azimuthal Angle

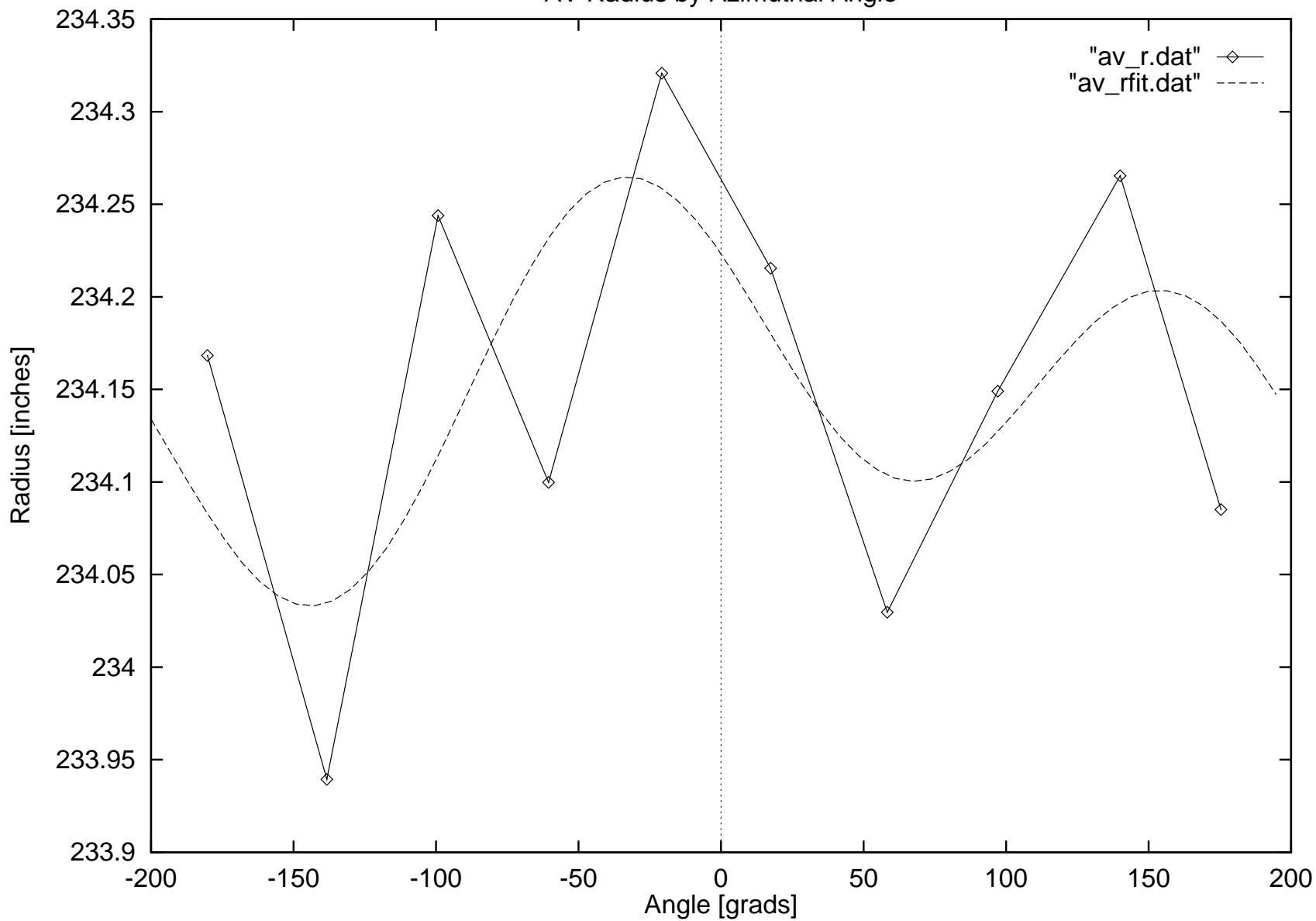


Figure 2: Circular radius of the 102 Bottoms.  
4

AV Spherical Radius by Azimuthal Angle

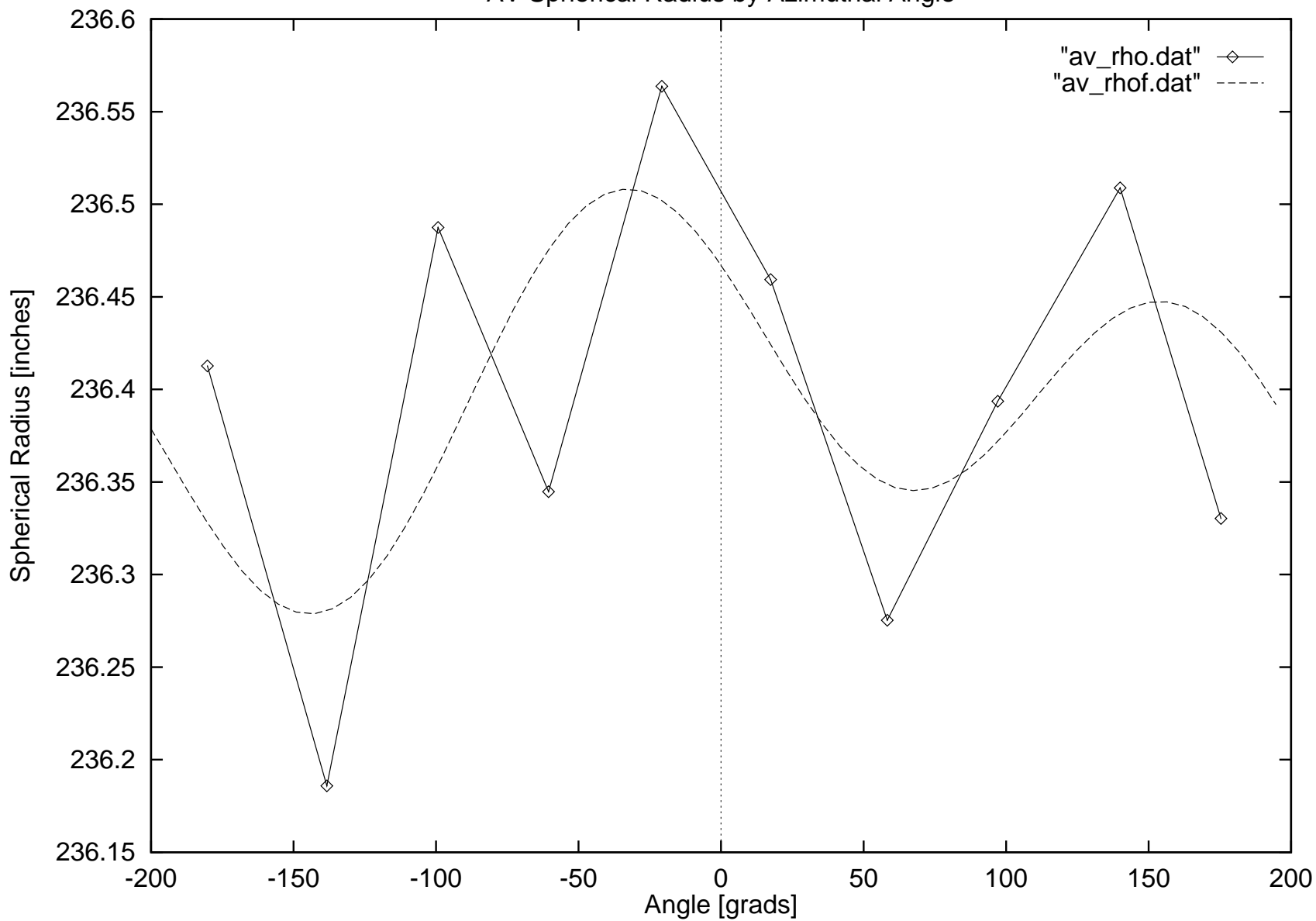
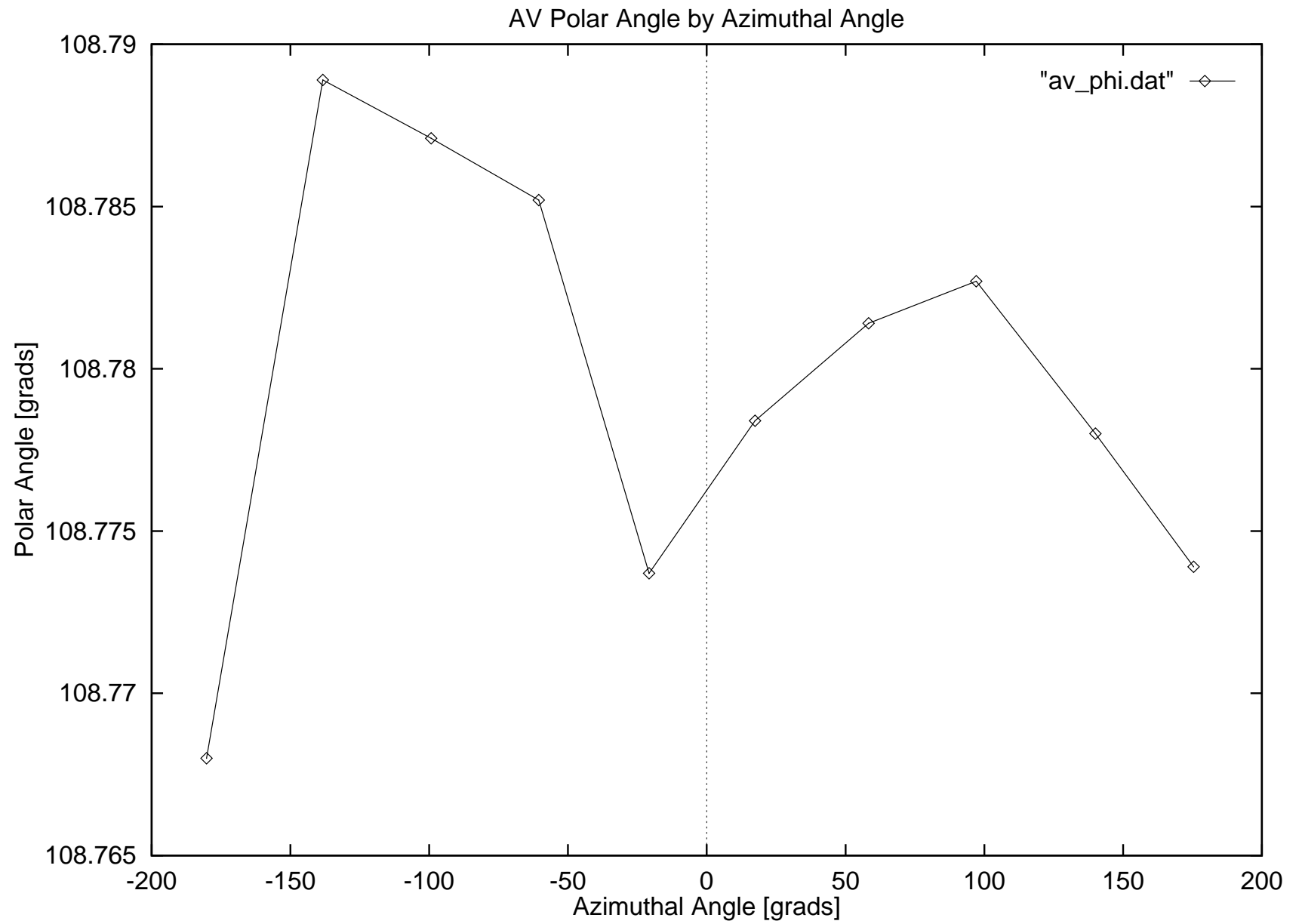


Figure 3: Spherical radius of the 102 Bottoms.  
5

Figure 4: Polar angle of the 102 Bottoms.  
6



## 4 Building the GRAVITY CENTER frame for the Nov 28 data

Due to improper placement of the theodolites, the targets defining North and the nominal axis of symmetry of the vessel could not be sighted during the Nov 28 survey job. These two targets usually define the GRAVITY CENTER frame. Since they weren't sighted, the frame had to be built in a different manner. The center, north, and the middle target on each 101 panel were shot in a separate job on Dec 15. The GRAVITY CENTER frame was built as usual in that job, and the coordinates of the targets on the 101 panels were obtained. Then, in the Nov 28 job, the 'GRAVITY CENTER' frame that best reproduced five of these target coordinates was built. Between the two jobs, the coordinates of the five targets varied by 0.030" on average, with a standard deviation of 0.014". This difference is comparable to that encountered between jobs where the frames were built in the normal fashion. Hence, the GRAVITY CENTER frame was used in both the Nov 28 and Dec 16 jobs to combine the data from both halves of the vessel survey.

## 5 Sphericity of the Vessel

Before combining the data acquired on Nov 28 and Dec 16, each dataset was fitted separately to check for consistency between the two sets of measurements. The results are given in the GRAVITY CENTER frame of each job.

A spherical fit to the data for the 102-106 panels gives:

$$\begin{aligned} \text{vessel center (x,y,z)} &= (0.034, 0.028, 91.522) \\ \text{radius} &= 236.390 \\ \text{maximum deviations} &= +0.186, -0.194 \end{aligned}$$

A spherical fit to the data for the 108-110 panels plus the bottoms of the 102 panels gives:

$$\begin{aligned} \text{vessel center (x,y,z)} &= (0.062, 0.003, 91.560) \\ \text{radius} &= 236.375 \\ \text{maximum deviations} &= +0.201, -0.227 \end{aligned}$$

The fitted centers differ by about 0.050" between the two datasets, and the fitted radii differ by 0.015". So, the results from the two sets of data are consistent. A fit to the combined datasets gives:

$$\begin{aligned} \text{vessel center (x,y,z)} &= (0.042, 0.020, 91.550) \\ \text{radius} &= 236.383 \\ \text{maximum deviations} &= +0.200, -0.233 \end{aligned}$$

The nominal height of the vessel center is calculated by adding the nominal inside half-height of the 102 panels (32.498") to the average height of the bottom of the 102 panels (59.093") to give 91.591". Based on this, the best-fit sphere center deviates from the nominal position by 0.06". The best-fit radius of 236.383" is smaller than the nominal value of 236.43" by 0.05". The maximum deviation in the radius is -0.23", which is well below the design tolerance of 0.5". A plot of the deviations from the best-fit value is shown in Figure 5.

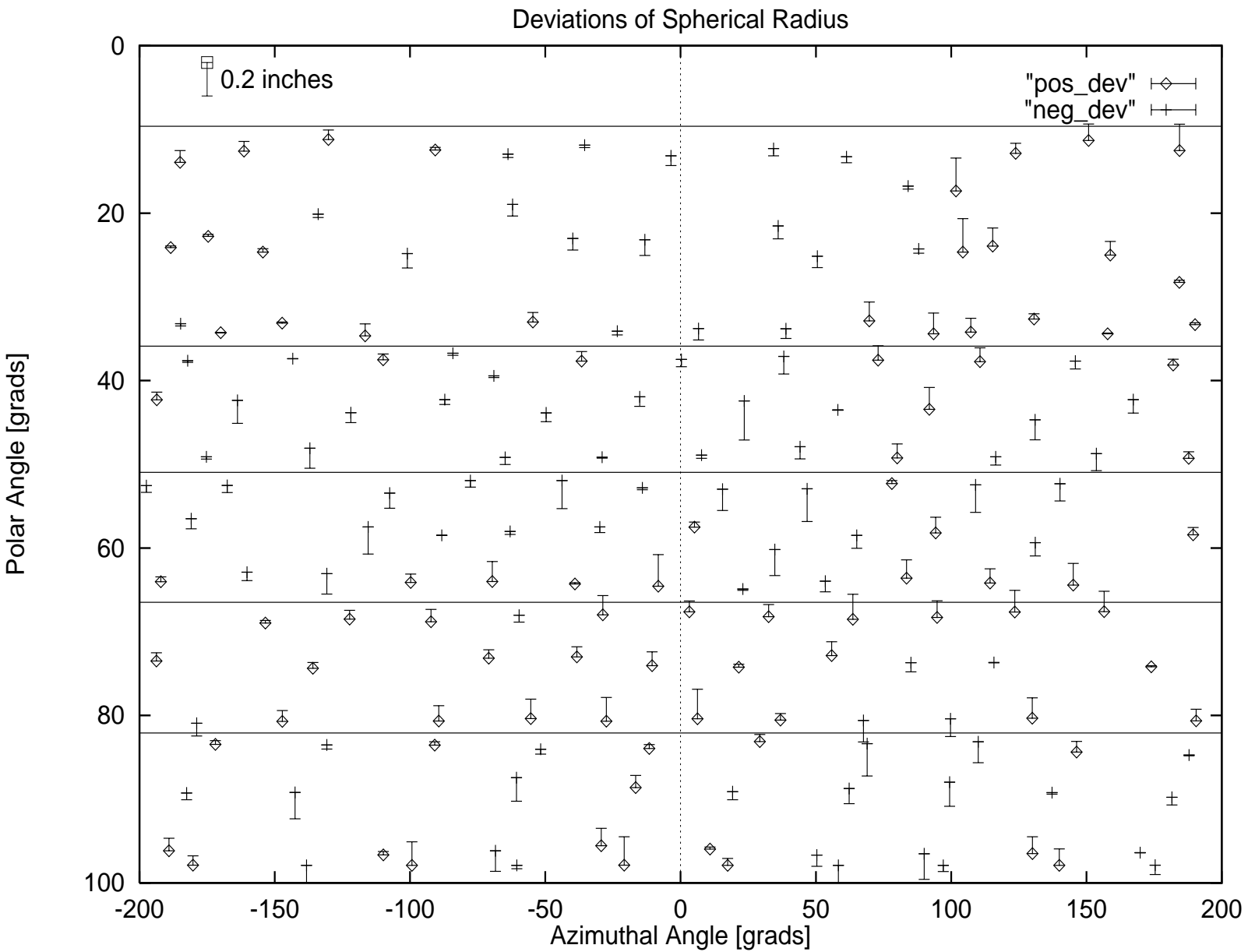


Figure 5: Deviations of the spherical radius from the best-fit value. Positive deviations are shown with diamonds, and negative ones with crosses. (The horizontal lines roughly show the locations of the horizontal bonds.)



## 6 Conclusions

Prior to hanging it on ropes, the upper half of the acrylic vessel was seen to be spherical, with a radius of  $236.38 \pm 0.23''$ . This is  $0.05''$  under the nominal radius of  $236.43''$ . As all of the panels are thicker than the nominal value of  $2.17''$ , the slightly smaller radius is not undesirable. The variation in radii of  $\pm 0.23''$  is well under the design tolerance of  $\pm 0.5''$ . The variation in the height of the bottom of the 102 panels was  $\pm 0.040''$ . A fit to these heights indicates that there was a slight tilt to the vessel of  $\pm 0.016''$ , and that the rest of the variation was due to an 'elliptical' distortion in the bottom row of panels.

# 7 Appendix A

## Measure EVENT SUMMARY

Job Name: DOME-NOV28  
Date: 97/03/24  
Operator: robk

### Job Comments:

Survey of 101/102/104/106 panels taken on Nov 28, 1996.  
The sphere center was got from a fit to the entire vessel (ie. including the data taken on Dec 16, 1996).

The first set of coords are in the SPHERE CENTER frame, and the second are in the GRAVITY CENTER frame.

### JOB SUMMARY

VALUES SHOWN IN: R Hand Inch Grads

Event No.	CS No.	COORDINATES			POINTING ERROR	APEX ANGLE	EVENT NAME
		X	Y	Z			
	Polar	236.2300	109.9825	107.2295			
9	5	231.8289	36.6529	-26.7690	0.0007		102-04-LL
	Polar	243.5273	109.9719	82.8589			
9	4	231.8790	36.6211	64.7808	0.0007		102-04-LL
	Polar	236.2388	100.5663	97.7398			
10	5	236.0806	2.0999	8.3856	0.0011		102-04-M
	Polar	256.4084	100.5571	74.5125			
10	4	236.1231	2.0662	99.9343	0.0011		102-04-M
	Polar	236.2578	89.9938	92.3708			
11	5	231.6719	-36.7163	28.2453	0.0007		102-04-UR
	Polar	263.4168	89.9863	69.9446			
11	4	231.7057	-36.7496	119.7929	0.0007		102-04-UR
	Polar	235.0380	86.2756	105.9590			
12	5	228.5922	-50.0584	-21.9682	0.0012	56.09	101-04-LL
	Polar	244.1691	86.2691	81.6038			
12	4	228.6227	-50.0896	69.5791	0.0012	40.72	101-04-LL

	Polar	235.1093	73.8526	106.1556			
13	5	214.5490	-93.4341	-22.6978	0.0009		101-04-LR
	Polar	243.9578	73.8479	81.7862			
13	4	214.5697	-93.4620	68.8483	0.0009		101-04-LR
	Polar	235.0299	80.5322	98.9386			
14	5	224.0949	-70.7472	3.9185	0.0009	50.57	101-04-M
	Polar	253.6796	80.5264	75.4377			
14	4	224.1209	-70.7781	95.4652	0.0009	34.39	101-04-M
	Polar	234.9158	86.3121	93.9559			
15	5	228.4732	-49.8950	22.2695	0.0000	53.28	101-04-UL
	Polar	260.1174	86.3053	71.1686			
15	4	228.5040	-49.9273	113.8168	0.0000	40.77	101-04-UL
	Polar	235.0441	74.2557	93.8094			
16	5	215.0651	-92.0433	22.8202	0.0006		101-04-UR
	Polar	260.4212	74.2506	71.0553			
16	4	215.0864	-92.0726	114.3664	0.0006		101-04-UR
	Polar	236.4829	70.0060	107.2090			
17	5	209.3683	-106.6537	-26.7218	0.0012		102-02-LL
	Polar	243.7731	70.0017	82.8649			
17	4	209.3860	-106.6803	64.8240	0.0012		102-02-LL
	Polar	236.3741	62.7069	99.1202			
18	5	196.9448	-130.6706	3.2665	0.0009		102-02-M
	Polar	254.6814	62.7032	75.7155			
18	4	196.9572	-130.6953	94.8116	0.0009		102-02-M
	Polar	236.4465	53.6798	93.7354			
19	5	175.7182	-156.4941	23.2299	0.0003	30.98	102-02-UR
	Polar	261.8190	53.6769	71.1110			
19	4	175.7249	-156.5146	114.7744	0.0003	12.29	102-02-UR
	Polar	235.0188	46.4311	105.9903			
20	5	155.9181	-174.4585	-22.0817	0.0003		101-02-LL
	Polar	244.0842	46.4289	81.6289			
20	4	155.9205	-174.4731	69.4624	0.0003		101-02-LL
	Polar	235.0198	34.0286	106.2025			
21	5	119.1580	-201.2785	-22.8613	0.0012		101-02-LR
	Polar	243.7838	34.0269	81.8181			
21	4	119.1543	-201.2848	68.6822	0.0012		101-02-LR

	Polar	235.1084	40.2225	99.8610			
22	5	138.8568	-189.7221	0.5134	0.0007	32.57	101-02-M
	Polar	252.4961	40.2204	76.2419			
22	4	138.8558	-189.7335	92.0572	0.0007	9.06	101-02-M
	Polar	235.1424	46.4168	93.7366			
23	5	155.8963	-174.5131	23.0972	0.0006		101-02-UL
	Polar	260.5907	46.4144	71.0007			
23	4	155.8989	-174.5291	114.6413	0.0006		101-02-UL
	Polar	235.0896	33.9581	93.7209			
24	5	118.9562	-201.4463	23.1498	0.0009		010-02-UR
	Polar	260.5532	33.9562	70.9821			
24	4	118.9527	-201.4539	114.6933	0.0009		010-02-UR
	Polar	236.3823	30.1339	107.1017			
25	5	107.0884	-209.0842	-26.3147	0.0012	34.80	102-10-LL
	Polar	243.8016	30.1322	82.7573			
25	4	107.0829	-209.0877	65.2287	0.0012	13.76	102-10-LL
	Polar	236.3378	18.4065	99.7554			
26	5	67.3833	-226.5264	0.9081	0.0005		102-10-M
	Polar	253.7687	18.4044	76.2608			
26	4	67.3740	-226.5217	92.4512	0.0005		102-10-M
	Polar	236.3782	12.0564	94.1287			
27	5	44.3096	-231.1654	21.7695	0.0015		102-10-UR
	Polar	261.2188	12.0542	71.4356			
27	4	44.2994	-231.1560	113.3126	0.0015		102-10-UR
	Polar	235.0456	6.6392	106.3485			
28	5	24.3467	-232.6072	-23.4005	0.0007	26.36	101-05-LL
	Polar	243.5872	6.6367	81.9499			
28	4	24.3358	-232.5920	68.1427	0.0007	0.00	101-05-LL
	Polar	235.1114	-5.9867	105.9329			
29	5	-21.9813	-233.0569	-21.8792	0.0018	24.03	101-05-LR
	Polar	244.2137	-5.9903	81.5840			
29	4	-21.9922	-233.0313	69.6643	0.0018	0.00	101-05-LR
	Polar	235.2146	0.1374	99.7765			
30	5	0.5076	-235.2126	0.8259	0.0004	25.72	101-05-M
	Polar	252.6814	0.1344	76.1758			
30	4	0.4964	-235.1927	92.3692	0.0004	0.00	101-05-M

	Polar	235.1459	6.3975	93.8170		
31	5	23.4793	-232.8570	22.8019	0.0003	101-05-UL
	Polar	260.4639	6.3950	71.0662		
31	4	23.4687	-232.8430	114.3451	0.0003	101-05-UL
	Polar	235.1565	-5.5764	93.9190		
32	5	-20.4780	-233.1871	22.4279	0.0019	101-05-UR
	Polar	260.3349	-5.5798	71.1525		
32	4	-20.4887	-233.1631	113.9713	0.0019	101-05-UR
	Polar	236.4569	-10.8604	106.8337		
33	5	-39.9118	-231.6832	-25.3335	0.0009	102-09-LL
	Polar	244.2148	-10.8646	82.5216		
33	4	-39.9224	-231.6534	66.2101	0.0009	102-09-LL
	Polar	236.3420	-17.4433	99.1703		
34	5	-63.9447	-227.5063	3.0802	0.0006	102-09-M
	Polar	254.5335	-17.4483	75.7512		
34	4	-63.9542	-227.4719	94.6241	0.0006	102-09-M
	Polar	236.4049	-28.0222	92.7269		
35	5	-100.0742	-212.4763	26.9494	0.0006	102-09-UR
	Polar	263.0308	-28.0285	70.2495		
35	4	-100.0801	-212.4344	118.4939	0.0006	102-09-UR
	Polar	235.0713	-33.7475	106.0344		
36	5	-118.3239	-201.8984	-22.2485	0.0014	101-09-LL
	Polar	244.0230	-33.7549	81.6694		
36	4	-118.3278	-201.8509	69.2964	0.0014	101-09-LL
	Polar	235.1154	-45.7469	106.0917		
37	5	-154.0740	-176.1698	-22.4636	0.0003	101-09-LR
	Polar	243.9811	-45.7564	81.7244		
37	4	-154.0720	-176.1143	69.0822	0.0003	101-09-LR
	Polar	235.3017	-39.6909	98.4508		
38	5	-137.3404	-190.9758	5.7255	0.0008	101-09-M
	Polar	254.5125	-39.6992	75.0344		
38	4	-137.3416	-190.9248	97.2708	0.0008	101-09-M
	Polar	235.1360	-33.7410	93.8208		
39	5	-118.3100	-201.9219	22.7873	0.0012	101-09-UL
	Polar	260.4299	-33.7482	71.0656		
39	4	-118.3136	-201.8757	114.3321	0.0012	101-09-UL

	Polar	235.1148	-45.9779	93.7202			
40	5	-154.6675	-175.5585	23.1548	0.0006		101-09-UL
	Polar	260.5365	-45.9872	70.9781			
40	4	-154.6652	-175.5041	114.7007	0.0006		101-09-UL
	Polar	236.2252	-57.5150	99.1068			
41	5	-185.5279	-146.1874	3.3141	0.0015	18.44	102-05-M
	Polar	254.4966	-57.5267	75.6837			
41	4	-185.5190	-146.1255	94.8609	0.0015	0.00	102-05-M
	Polar	236.3580	-69.2277	92.7984			
42	5	-207.9418	-109.1489	26.6804	0.0002	46.04	102-05-UR
	Polar	262.8869	-69.2415	70.3040			
42	4	-207.9244	-109.0826	118.2284	0.0002	46.04	102-05-UR
	Polar	234.9486	-73.7090	106.1260			
43	5	-214.2008	-93.8578	-22.5734	0.0003	36.45	101-08-LL
	Polar	243.7766	-73.7240	81.7378			
43	4	-214.1802	-93.7887	68.9751	0.0003	32.43	101-08-LL
	Polar	235.0118	-85.7737	106.0356			
44	5	-228.1392	-51.8472	-22.2473	0.0001		101-08-LR
	Polar	243.9615	-85.7911	81.6629			
44	4	-228.1090	-51.7748	69.3025	0.0001		101-08-LR
	Polar	235.2054	-79.6569	98.4327			
45	5	-223.2310	-73.8646	5.7898	0.0009	51.21	101-08-M
	Polar	254.4430	-79.6728	75.0087			
45	4	-223.2057	-73.7942	97.3389	0.0009	51.21	101-08-M
	Polar	235.0540	-73.2945	93.4793			
46	5	-213.5491	-95.2342	24.0337	0.0010		101-08-UL
	Polar	260.7880	-73.3091	70.7684			
46	4	-213.5286	-95.1665	115.5822	0.0010		101-08-UL
	Polar	235.0289	-86.2068	93.6300			
47	5	-228.3859	-50.2719	23.4777	0.0006	53.40	101-08-UR
	Polar	260.5715	-86.2239	70.8933			
47	4	-228.3551	-50.2008	115.0275	0.0006	53.40	101-08-UR
	Polar	236.4020	-90.1047	107.3935			
48	5	-231.9787	-36.3507	-27.3932	0.0004		102-08-LL
	Polar	243.3736	-90.1230	83.0170			
48	4	-231.9451	-36.2774	64.1570	0.0004		102-08-LL

	Polar	236.4027	-109.0900	92.8244			
49	5	-232.5121	33.4266	26.5893	0.0003		102-08-UR
	Polar	262.9037	-109.1112	70.3295			
49	4	-232.4624	33.4985	118.1416	0.0003		102-08-UR
	Polar	234.9770	-113.7409	105.9526			
50	5	-228.5220	50.1053	-21.9391	0.0016		101-01-LL
	Polar	244.0530	-113.7633	81.5854			
50	4	-228.4688	50.1776	69.6136	0.0016		101-01-LL
	Polar	235.0404	-126.0642	106.1854			
51	5	-214.5982	93.1220	-22.8006	0.0005		101-01-LR
	Polar	243.7971	-126.0883	81.7998			
51	4	-214.5353	93.1913	68.7533	0.0005		101-01-LR
	Polar	235.0888	-119.3146	99.2641			
52	5	-224.3369	70.2305	2.7175	0.0002		101-01-M
	Polar	253.2396	-119.3376	75.7167			
52	4	-224.2790	70.3012	94.2707	0.0002		101-01-M
	Polar	235.0048	-113.6911	93.8341			
53	5	-228.5151	49.9163	22.7257	0.0009	58.45	101-01-UL
	Polar	260.2942	-113.7131	71.0640			
53	4	-228.4617	49.9874	114.2784	0.0009	58.45	101-01-UL
	Polar	235.0276	-125.9137	93.7653			
54	5	-214.7898	92.6024	22.9804	0.0007		101-01-UR
	Polar	260.4102	-125.9375	71.0083			
54	4	-214.7267	92.6704	114.5343	0.0007		101-01-UR
	Polar	236.2601	-131.5701	106.8535			
55	5	-206.5971	111.7678	-25.3854	0.0015		102-01-LL
	Polar	244.0084	-131.5949	82.5176			
55	4	-206.5300	111.8354	66.1689	0.0015		102-01-LL
	Polar	236.2417	-139.3114	97.1345			
56	5	-192.4192	136.6454	10.6299	0.0008		102-01-M
	Polar	257.1538	-139.3367	73.9847			
56	4	-192.3462	136.7087	102.1849	0.0008		102-01-M
	Polar	236.3530	-148.2842	93.3704			
57	5	-170.6405	161.6816	24.5687	0.0001	16.72	102-01-UR
	Polar	262.1752	-148.3102	70.7881			
57	4	-170.5618	161.7395	116.1243	0.0001	0.00	102-01-UR

	Polar	235.0520	-153.7623	105.9491			
58	5	-155.4188	174.9668	-21.9331	0.0001	55.85	101-03-LL
	Polar	244.1515	-153.7890	81.5905			
58	4	-155.3373	175.0227	69.6228	0.0001	55.85	101-03-LL
	Polar	235.1421	-166.0639	106.2494			
59	5	-118.9186	201.5417	-23.0459	0.0009		101-03-LR
	Polar	243.8294	-166.0910	81.8683			
59	4	-118.8311	201.5893	68.5105	0.0009		101-03-LR
	Polar	235.0475	-159.2596	98.4975			
60	5	-140.3204	188.4854	5.5468	0.0016		101-03-M
	Polar	254.2465	-159.2864	75.0523			
60	4	-140.2357	188.5371	97.1030	0.0016		101-03-M
	Polar	235.0301	-153.6409	93.8782			
61	5	-155.6975	174.6087	22.5659	0.0014	55.11	101-03-UL
	Polar	260.2832	-153.6674	71.1054			
61	4	-155.6158	174.6634	114.1218	0.0014	55.11	101-03-UL
	Polar	235.0566	-165.9083	93.8015			
62	5	-119.3768	201.1931	22.8502	0.0015		101-03-UR
	Polar	260.4152	-165.9352	71.0436			
62	4	-119.2891	201.2394	114.4066	0.0015		101-03-UR
	Polar	236.4853	-170.6378	106.1635			
63	5	-104.7527	210.7833	-22.8597	0.0005		102-03-LL
	Polar	245.1978	-170.6649	81.9219			
63	4	-104.6631	210.8277	68.6969	0.0005		102-03-LL
	Polar	236.4557	-183.3848	98.4629			
64	5	-60.9968	228.3814	5.7087	0.0017		102-03-M
	Polar	255.6232	-183.4115	75.1501			
64	4	-60.9031	228.4151	97.2655	0.0017		102-03-M
	Polar	236.4052	-188.3777	93.2615			
65	5	-42.6794	231.1754	24.9765	0.0002	39.56	012-03-UR
	Polar	262.3909	-188.4042	70.7032			
65	4	-42.5849	231.2044	116.5334	0.0002	39.56	012-03-UR
	Polar	235.2820	-193.5743	106.0735			
66	5	-23.6001	233.0201	-22.4122	0.0014	19.11	101-10-LL
	Polar	244.2211	-193.6006	81.7259			
66	4	-23.5055	233.0461	69.1446	0.0014	2.30	101-10-LL



	Polar	235.1005	194.3275	105.9631			
67	5	20.8289	233.1413	-21.9893	0.0007	22.03	101-10-LR
	Polar	244.2124	194.3022	81.6103			
67	4	20.9236	233.1573	69.5673	0.0007	9.01	101-10-LR
	Polar	235.2666	199.3101	97.2622			
68	5	2.5472	235.0352	10.1148	0.0002	28.49	101-10-M
	Polar	256.1145	199.2844	74.0119			
68	4	2.6425	235.0544	101.6715	0.0002	9.65	101-10-M
	Polar	235.1203	-193.4462	93.7269			
69	5	-24.0451	232.7409	23.1308	0.0005		101-10-UL
	Polar	260.5892	-193.4725	70.9880			
69	4	-23.9502	232.7657	114.6876	0.0005		101-10-UL
	Polar	235.0939	194.3249	93.9127			
70	5	20.8338	233.0908	22.4453	0.0007		101-10-UR
	Polar	260.3317	194.2996	71.1438			
70	4	20.9287	233.1054	114.0018	0.0007		101-10-UR
	Polar	236.3948	189.1336	106.6253			
71	5	39.9370	231.6991	-24.5570	0.0022	24.48	102-07-LL
	Polar	244.5022	189.1090	82.3291			
71	4	40.0313	231.7108	66.9994	0.0022	14.61	102-07-LL
	Polar	236.3347	180.7844	99.0126			
72	5	70.2479	225.6233	3.6653	0.0007		102-07-M
	Polar	254.7992	180.7608	75.6170			
72	4	70.3410	225.6273	95.2214	0.0007		102-07-M
	Polar	236.4257	170.7466	92.3645			
73	5	104.1040	210.3788	28.2886	0.0007		102-07-UR
	Polar	263.5837	170.7242	69.9513			
73	4	104.1938	210.3745	119.8440	0.0007		102-07-UR
	Polar	235.0759	166.3153	106.0478			
74	5	118.1246	202.0149	-22.2982	0.0013		101-07-LL
	Polar	244.0865	166.2939	81.6850			
74	4	118.2122	202.0089	69.2570	0.0013		101-07-LL
	Polar	234.9359	153.7222	106.2662			
75	5	155.3778	174.6986	-23.0874	0.0017		101-07-LR
	Polar	243.6592	153.7030	81.8672			
75	4	155.4592	174.6841	68.4667	0.0017		101-07-LR

	Polar	235.2131	160.1972	98.1571		
76	5	137.6069	190.6389	6.8080	0.0010	101-07-M
	Polar	254.8984	160.1767	74.7789		
76	4	137.6921	190.6275	98.3627	0.0010	101-07-M
	Polar	235.1014	166.4655	93.7199		
77	5	117.6189	202.2432	23.1547	0.0006	101-07-UL
	Polar	260.6004	166.4438	70.9833		
77	4	117.7068	202.2359	114.7098	0.0006	101-07-UL
	Polar	234.9946	154.0821	93.9495		
78	5	154.4769	175.6758	22.3006	0.0010	101-07-UR
	Polar	260.2073	154.0626	71.1690		
78	4	154.5588	175.6602	113.8548	0.0010	101-07-UR
	Polar	236.3166	149.6770	107.4250		
79	5	166.8057	165.1217	-27.4995	0.0011	59.19 102-06-LL
	Polar	243.3374	149.6586	83.0423		
79	4	166.8849	165.1048	64.0543	0.0011	55.52 102-06-LL
	Polar	236.2915	137.6963	98.5704		
80	5	196.0140	131.8485	5.3056	0.0008	102-06-M
	Polar	255.3601	137.6800	75.2329		
80	4	196.0859	131.8240	96.8583	0.0008	102-06-M
	Polar	236.1889	131.0852	92.6163		
81	5	207.1861	110.0548	27.3324	0.0003	102-06-UR
	Polar	263.0463	131.0701	70.1455		
81	4	207.2532	110.0271	118.8844	0.0003	102-06-UR
	Polar	234.9022	126.4048	106.1523		
82	5	213.9819	94.2181	-22.6658	0.0006	101-06-LL
	Polar	243.7876	126.3909	81.7630		
82	4	214.0451	94.1904	68.8857	0.0006	101-06-LL
	Polar	234.8760	114.0579	106.3599		
83	5	228.0301	51.1887	-23.4252	0.0008	101-06-LR
	Polar	243.4753	114.0465	81.9462		
83	4	228.0835	51.1578	68.1250	0.0008	101-06-LR
	Polar	234.8819	120.5592	98.8419		
84	5	222.7030	74.5294	4.2726	0.0009	101-06-M
	Polar	253.6830	120.5462	75.3410		
84	4	222.7619	74.4988	95.8235	0.0009	101-06-M

	Polar	234.8162	126.4101	93.9009			
85	5	213.9130	94.2090	22.4621	0.0012		101-06-UL
	Polar	260.1055	126.3959	71.1136			
85	4	213.9764	94.1800	114.0136	0.0012		101-06-UL
	Polar	234.8294	114.1375	93.8191			
86	5	227.9840	51.4778	22.7638	0.0010		101-06-UR
	Polar	260.2221	114.1257	71.0457			
86	4	228.0378	51.4455	114.3140	0.0010		101-06-UR
	Polar	236.2760	100.2362	89.3134			
87	5	232.9532	0.8645	39.4766	0.0010		104-01-LL
	Polar	267.3111	100.2269	67.3877			
87	4	232.9956	0.8306	131.0253	0.0010		104-01-LL
	Polar	236.3803	84.1765	81.8548			
88	5	219.8723	-55.8044	66.4654	0.0014		104-01-M
	Polar	276.4825	84.1699	61.2716			
88	4	219.9021	-55.8361	158.0125	0.0014		104-01-M
	Polar	236.5117	76.5049	75.1483			
89	5	203.9915	-78.9001	90.0000	0.0009	32.42	104-01-UR
	Polar	284.2737	76.4997	55.9000			
89	4	204.0161	-78.9289	181.5466	0.0009	35.83	104-01-UR
	Polar	236.5050	70.0622	89.2523			
90	5	207.8348	-105.6416	39.7386	0.0019		104-09-LL
	Polar	267.5903	70.0576	67.3543			
90	4	207.8531	-105.6698	131.2844	0.0019		104-09-LL
	Polar	236.5041	43.4979	75.0970			
91	5	138.0328	-169.5581	90.1733	0.0007	14.46	104-09-UR
	Polar	284.3064	43.4963	55.8563			
91	4	138.0369	-169.5719	181.7176	0.0007	22.94	104-09-UR
	Polar	236.3900	26.0283	82.4288			
92	5	90.4211	-208.6966	64.4203	0.0005	32.13	104-11-M
	Polar	275.7808	26.0268	61.7339			
92	4	90.4162	-208.6989	155.9638	0.0005	0.00	104-11-M
	Polar	236.4520	9.4815	89.5943			
93	5	34.6183	-230.7177	38.4768	0.0012		104-10-LL
	Polar	267.0739	9.4792	67.6305			
93	4	34.6082	-230.7067	130.0200	0.0012		104-10-LL

	Polar	236.4317	-6.2833	81.6634			
94	5	-22.3377	-225.5887	67.1619	0.0002	24.55	104-10-M
	Polar	276.7068	-6.2864	61.1131			
94	4	-22.3464	-225.5655	158.7056	0.0002	0.00	104-10-M
	Polar	236.3064	-21.1456	89.9167			
95	5	-76.0902	-220.5942	37.2716	0.0020	20.04	104-12-LL
	Polar	266.5150	-21.1508	67.8851			
95	4	-76.0980	-220.5580	128.8158	0.0020	20.04	104-12-LL
	Polar	236.3972	-46.4898	76.6162			
96	5	-147.1734	-164.3684	84.8922	0.0017		104-12-UR
	Polar	282.4698	-46.4985	57.0502			
96	4	-147.1681	-164.3175	176.4383	0.0017		104-12-UR
	Polar	236.4462	-52.7904	89.6602			
97	5	-172.0633	-157.6044	38.2343	0.0011	18.96	104-07-LL
	Polar	266.9597	-52.8008	67.6806			
97	4	-172.0568	-157.5466	129.7807	0.0011	0.00	104-07-LL
	Polar	236.4174	-64.0744	82.6309			
98	5	-192.3728	-121.7684	63.7052	0.0020	18.22	104-07-M
	Polar	275.5314	-64.0868	61.8935			
98	4	-192.3580	-121.7066	155.2528	0.0020	0.00	104-07-M
	Polar	236.4341	-77.6263	76.0943			
99	5	-206.5147	-75.7223	86.7116	0.0012	50.47	104-07-UR
	Polar	283.0880	-77.6412	56.6356			
99	4	-206.4894	-75.6580	178.2606	0.0012	50.47	104-07-UR
	Polar	236.4557	-107.7445	76.4508			
100	5	-218.8325	26.7532	85.4863	0.0009	56.48	104-08-UR
	Polar	282.7160	-107.7655	56.9214			
100	4	-218.7840	26.8203	177.0383	0.0009	56.48	104-08-UR
	Polar	236.4741	-110.5836	89.6287			
101	5	-230.1258	38.6140	38.3542	0.0000	57.59	104-08-LR
	Polar	267.0331	-110.6050	67.6560			
101	4	-230.0749	38.6850	129.9066	0.0000	57.59	104-08-LR
	Polar	236.4330	-129.0589	81.2966			
102	5	-203.1336	99.7474	68.4671	0.0004		104-13-M
	Polar	277.1389	-129.0832	60.8131			
102	4	-203.0686	99.8115	160.0211	0.0004		104-13-M

	Polar	236.3414	-140.3320	75.5884			
103	5	-176.6442	129.7523	88.4219	0.0021	56.23	104-13-UR
	Polar	283.5841	-140.3578	56.2289			
103	4	-176.5723	129.8098	179.9766	0.0021	56.23	104-13-UR
	Polar	236.4987	-144.6387	89.2961			
104	5	-178.1557	150.4189	39.5769	0.0006		104-06-LL
	Polar	267.4913	-144.6645	67.3826			
104	4	-178.0794	150.4781	131.1322	0.0006		104-06-LL
	Polar	236.4431	-161.6433	81.1196			
105	5	-128.1446	186.3051	69.0993	0.0014		104-06-M
	Polar	277.3746	-161.6704	60.6730			
105	4	-128.0600	186.3522	160.6553	0.0014		104-06-M
	Polar	236.4969	-171.2453	75.5217			
106	5	-95.6881	197.2439	88.7098	0.0002	17.58	104-06-UR
	Polar	283.8238	-171.2730	56.1890			
106	4	-95.6009	197.2831	180.2660	0.0002	0.00	104-06-UR
	Polar	236.5237	-172.5553	89.6429			
107	5	-97.5313	212.0458	38.3103	0.0011	17.61	104-06-LR
	Polar	267.0973	-172.5823	67.6754			
107	4	-97.4410	212.0868	129.8669	0.0011	0.00	104-06-LR
	Polar	236.4646	-189.4318	82.2827			
108	5	-37.5706	224.2406	64.9625	0.0008		104-04-M
	Polar	276.0410	-189.4588	61.6197			
108	4	-37.4775	224.2672	156.5192	0.0008		104-04-M
	Polar	236.4477	196.8032	75.1446			
109	5	10.9751	218.3786	89.9882	0.0011		104-04-UR
	Polar	284.2122	196.7767	55.8892			
109	4	11.0670	218.3935	181.5444	0.0011		104-04-UR
	Polar	236.5579	193.7971	89.3154			
110	5	22.6891	232.1279	39.5160	0.0004	37.22	104-03-LL
	Polar	267.5609	193.7718	67.4082			
110	4	22.7839	232.1416	131.0725	0.0004	18.37	104-03-LL
	Polar	236.4002	178.5155	82.4667			
111	5	75.3241	214.6589	64.2876	0.0004	50.35	104-03-UR
	Polar	275.7779	178.4916	61.7672			
111	4	75.4150	214.6600	155.8433	0.0004	32.37	104-03-UR

	Polar	236.4555	167.4982	75.7744			
112	5	107.2779	191.5455	87.8236	0.0004	59.20	104-03-UR
	Polar	283.5325	167.4755	56.3929			
112	4	107.3637	191.5387	179.3785	0.0004	41.14	104-03-UR
	Polar	236.4214	163.0943	89.4935			
113	5	127.7483	195.1071	38.8412	0.0005	57.47	104-02-LL
	Polar	267.2222	163.0730	67.5476			
113	4	127.8347	195.0971	130.3960	0.0005	43.65	104-02-LL
	Polar	236.4645	144.1754	80.9328			
114	5	173.6904	144.4973	69.7685	0.0003	68.75	104-02-M
	Polar	277.6553	144.1573	60.5312			
114	4	173.7655	144.4760	161.3217	0.0003	53.81	104-02-M
	Polar	236.5317	136.3635	76.1174			
115	5	185.1448	118.9848	86.6676	0.0017		104-02-UR
	Polar	283.2282	136.3467	56.6728			
115	4	185.2142	118.9604	178.2199	0.0017		104-02-UR
	Polar	236.2551	132.4551	89.5596			
116	5	203.4461	113.7470	38.5717	0.0016		104-05-LL
	Polar	266.9876	132.4396	67.5907			
116	4	203.5141	113.7198	130.1238	0.0016		104-05-LL
	Polar	236.3277	114.8899	81.8758			
117	5	220.6393	52.5673	66.3760	0.0015		104-05-M
	Polar	276.4169	114.8777	61.2853			
117	4	220.6936	52.5355	157.9262	0.0015		104-05-M
	Polar	236.4818	105.2226	75.8781			
118	5	218.9692	18.0040	87.4757	0.0003		104-05-UR
	Polar	283.4446	105.2123	56.4793			
118	4	219.0157	17.9719	179.0250	0.0003		104-05-UR
	Polar	236.4918	116.5027	70.6550			
119	5	204.7325	54.2930	105.1914	0.0017		106-03-LL
	Polar	289.1190	116.4899	52.3536			
119	4	204.7874	54.2637	196.7419	0.0017		106-03-LL
	Polar	236.4768	105.7148	64.6671			
120	5	200.1716	18.0175	124.6114	0.0009		106-03-M
	Polar	295.1888	105.7044	47.6913			
120	4	200.2183	17.9886	216.1608	0.0009		106-03-M

	Polar	236.2191	90.9843	58.2929			
121	5	185.4386	-26.4385	143.9200	0.0018		106-03-UR
	Polar	300.9099	90.9773	42.7867			
121	4	185.4754	-26.4646	235.4682	0.0018		106-03-UR
	Polar	236.4674	85.6266	71.2992			
122	5	207.4391	-47.6472	103.0321	0.0015		106-08-LL
	Polar	288.4068	85.6200	52.8571			
122	4	207.4709	-47.6771	194.5796	0.0015		106-08-LL
	Polar	236.3034	68.9575	65.9550			
123	5	179.6160	-95.2553	120.4318	0.0014	18.05	106-08-M
	Polar	293.7386	68.9539	48.6763			
123	4	179.6371	-95.2794	211.9781	0.0014	34.45	106-08-M
	Polar	236.2794	59.8022	58.1272			
124	5	150.9329	-110.3774	144.4440	0.0024	11.17	106-08-UR
	Polar	301.1056	59.8007	42.6614			
124	4	150.9507	-110.3957	235.9900	0.0024	33.56	106-08-UR
	Polar	236.5122	54.9011	71.5790			
125	5	162.0036	-138.7999	102.1149	0.0031	8.55	106-09-M
	Polar	288.1385	54.8988	53.0779			
125	4	162.0148	-138.8195	193.6600	0.0031	27.03	106-09-M
	Polar	236.4263	10.5740	64.9022			
126	5	33.2977	-198.6250	123.8418	0.0004	46.32	106-11-M
	Polar	294.8695	10.5738	47.8625			
126	4	33.2954	-198.6160	215.3859	0.0004	46.32	106-11-M
	Polar	236.3423	-2.5104	58.3778			
127	5	-7.3958	-187.4575	143.7452	0.0019	45.35	106-11-UR
	Polar	300.9148	-2.5105	42.8486			
127	4	-7.3954	-187.4399	235.2898	0.0019	45.35	106-11-UR
	Polar	236.4124	-7.8824	71.1458			
128	5	-26.2491	-210.9155	103.5205	0.0015	38.56	106-12-LL
	Polar	288.4703	-7.8848	52.7248			
128	4	-26.2543	-210.8925	195.0646	0.0015	38.56	106-12-LL
	Polar	236.3218	-19.0773	62.7748			
129	5	-58.1719	-188.2774	130.4441	0.0017		106-12-M
	Polar	296.8171	-19.0801	46.2126			
129	4	-58.1718	-188.2479	221.9890	0.0017		106-12-M

	Polar	236.3408	-32.4067	58.3696			
130	5	-91.4175	-163.8001	143.7684	0.0016	43.63	106-12-UR
	Polar	300.9109	-32.4111	42.8393			
130	4	-91.4118	-163.7635	235.3142	0.0016	43.63	106-12-UR
	Polar	236.3328	-39.7239	69.8834			
131	5	-122.9174	-170.7333	107.6784	0.0022		106-07-LL
	Polar	289.7112	-39.7309	51.7272			
131	4	-122.9135	-170.6886	199.2242	0.0022		106-07-LL
	Polar	236.2603	-69.2602	70.0620			
132	5	-186.5345	-97.7909	107.0548	0.0022		106-13-LL
	Polar	289.4514	-69.2732	51.8611			
132	4	-186.5141	-97.7317	198.6030	0.0022		106-13-LL
	Polar	236.2204	-84.5189	63.8590			
133	5	-193.3068	-47.9566	127.0146	0.0026	52.79	106-13-M
	Polar	295.6681	-84.5352	47.0387			
133	4	-193.2749	-47.8964	218.5643	0.0026	52.79	106-13-M
	Polar	236.2911	-92.4731	59.3659			
134	5	-188.4458	-22.3847	140.7856	0.0008		106-13-UR
	Polar	299.9601	-92.4912	43.5946			
134	4	-188.4081	-22.3261	232.3360	0.0008		106-13-UR
	Polar	236.4316	-100.2614	71.2261			
135	5	-212.6884	0.8734	103.2608	0.0010		106-06-LL
	Polar	288.3934	-100.2810	52.7849			
135	4	-212.6457	0.9386	194.8120	0.0010		106-06-LL
	Polar	236.3817	-111.6904	64.9865			
136	5	-198.1342	36.7983	123.5519	0.0001	56.17	106-06-M
	Polar	294.7292	-111.7124	47.9193			
136	4	-198.0831	36.8596	215.1041	0.0001	56.17	106-06-M
	Polar	236.3434	-122.3114	57.7252			
137	5	-174.8071	63.9020	145.6613	0.0007		106-06-UR
	Polar	301.4939	-122.3359	42.3477			
137	4	-174.7498	63.9574	237.2141	0.0007		106-06-UR
	Polar	236.5019	-130.3879	71.1165			
138	5	-188.8144	97.6596	103.6575	0.0002	56.68	106-01-LL
	Polar	288.5880	-130.4127	52.7047			
138	4	-188.7497	97.7194	195.2113	0.0002	56.68	106-01-LL



	Polar	236.3643	-136.9611	64.4592			
139	5	-167.6277	109.9642	125.2074	0.0001	55.97	106-01-M
	Polar	295.2390	-136.9873	47.5124			
139	4	-167.5601	110.0185	216.7615	0.0001	55.97	106-01-M
	Polar	236.2151	-156.1590	57.7272			
140	5	-118.2181	143.6301	145.5762	0.0007	53.78	106-01-UR
	Polar	301.3813	-156.1882	42.3458			
140	4	-118.1427	143.6727	237.1310	0.0007	53.78	106-01-UR
	Polar	236.3901	-160.9161	71.4350			
141	5	-122.7002	174.0965	102.5444	0.0005		106-10-LL
	Polar	288.1584	-160.9439	52.9504			
141	4	-122.6182	174.1413	194.1001	0.0005		106-10-LL
	Polar	236.3481	-170.1077	63.8581			
142	5	-90.1674	177.7058	127.0862	0.0010		106-10-M
	Polar	295.8240	-170.1366	47.0508			
142	4	-90.0845	177.7426	218.6418	0.0010		106-10-M
	Polar	236.3722	-185.8856	58.6933			
143	5	-41.4146	183.7274	142.8316	0.0004		106-10-UR
	Polar	300.6835	-185.9153	43.0932			
143	4	-41.3302	183.7527	234.3871	0.0004		106-10-UR
	Polar	236.5707	-191.7077	71.7259			
144	5	-27.7463	211.8103	101.6477	0.0011		106-02-LL
	Polar	288.0384	-191.7354	53.1938			
144	4	-27.6558	211.8337	193.2039	0.0011		106-02-LL
	Polar	236.4135	194.8771	63.9032			
145	5	16.0299	198.7724	126.9800	0.0006		106-02-M
	Polar	295.8600	194.8495	47.0932			
145	4	16.1177	198.7851	218.5356	0.0006		106-02-M
	Polar	236.2549	184.5354	58.8616			
146	5	45.3700	183.0828	142.2626	0.0022	55.09	106-02-UR
	Polar	300.4299	184.5082	43.2188			
146	4	45.4543	183.0884	233.8176	0.0022	35.84	106-02-UR
	Polar	236.3753	177.0152	72.1178			
147	5	75.6188	200.2636	100.2477	0.0009	55.29	106-05-LL
	Polar	287.4463	176.9907	53.4929			
147	4	75.7067	200.2636	191.8030	0.0009	36.14	106-05-LL

	Polar	236.2276	165.2018	66.8693			
148	5	106.5337	175.0907	117.4619	0.0001	61.62	106-05-M
	Polar	292.7609	165.1788	49.3810			
148	4	106.6160	175.0832	209.0163	0.0001	42.74	106-05-M
	Polar	236.1875	153.2799	58.8155			
149	5	126.2244	139.9500	142.3586	0.0020		106-05-UR
	Polar	300.4141	153.2584	43.1828			
149	4	126.2989	139.9373	233.9118	0.0020		106-05-UR
	Polar	236.3193	146.5198	71.0665			
150	5	158.1190	141.7118	103.7445	0.0019	67.98	106-04-LL
	Polar	288.5192	146.5007	52.6649			
150	4	158.1937	141.6931	195.2977	0.0019	50.80	106-04-LL
	Polar	236.3058	134.9463	64.9906			
151	5	171.8663	105.1204	123.4992	0.0024		106-04-M
	Polar	294.7092	134.9293	47.9313			
151	4	171.9328	105.0980	215.0513	0.0024		106-04-M
	Polar	236.4004	121.9212	58.1186			
152	5	176.0820	63.1473	144.5431	0.0034		106-04-UR
	Polar	301.2472	121.9070	42.6638			
152	4	176.1391	63.1233	236.0939	0.0034		106-04-UR

# 8 Appendix B

## Measure EVENT SUMMARY

Job Name: DOME-DEC16-B  
Date: 97/03/24  
Operator: robk

### Job Comments:

Survey of 108/110 and 102 bottoms taken on Dec 16, 1996.  
The sphere center was got from a fit to the entire vessel (ie. including the data taken on Nov 28, 1996).

The first set of coords are in the SPHERE CENTER frame, and the second are in the GRAVITY CENTER frame.

### JOB SUMMARY

VALUES SHOWN IN: R Hand Inch Grads

Event No.	CS No.	COORDINATES			POINTING ERROR	APEX ANGLE	EVENT NAME
		X	Y	Z			
	Polar	236.4669	119.9833	54.7165			
11	8	170.3726	55.3080	154.3723	0.0012		108-11-LL
	Polar	304.2698	119.9854	40.0843			
11	3	170.4146	55.3280	245.9223	0.0012		108-11-LL
	Polar	236.5134	108.0977	48.2523			
12	8	161.2732	20.6249	171.7678	0.0015		108-11M
	Polar	309.4916	108.1033	35.2227			
12	3	161.3152	20.6449	263.3178	0.0015		108-11M
	Polar	236.4652	89.3458	41.9361			
13	8	142.7214	-24.1108	186.9895	0.0032		108-11UR
	Polar	313.9204	89.3575	30.5166			
13	3	142.7634	-24.0908	278.5395	0.0032		108-11UR
	Polar	236.3333	83.5334	54.5664			
14	8	172.7165	-45.6981	154.7065	0.0036		108-03LL
	Polar	304.2602	83.5441	39.9627			
14	3	172.7585	-45.6781	246.2565	0.0036		108-03LL

	Polar	236.2640	68.9688	49.6582		
15	8	146.8123	-77.8253	167.9584	0.0047	108-03M
	Polar	308.1631	68.9831	36.2622		
15	3	146.8543	-77.8053	259.5084	0.0047	108-03M
	Polar	236.3365	54.1061	41.8704		
16	8	108.5290	-95.3601	187.0370	0.0035	108-03UR (114)
	Polar	313.8282	54.1250	30.4596		
16	3	108.5710	-95.3401	278.5870	0.0035	108-03UR (114)
	Polar	236.2805	46.3522	54.1294		
17	8	118.1534	-132.5334	155.8947	0.0032	108-04LL
	Polar	304.5633	46.3682	39.6259		
17	3	118.1954	-132.5134	247.4447	0.0032	108-04LL
	Polar	236.3027	32.7267	46.9794		
18	8	78.1734	-138.4303	174.8284	0.0021	108-04M (134)
	Polar	310.2136	32.7453	34.2553		
18	3	78.2154	-138.4102	266.3784	0.0021	108-04M (134)
	Polar	236.4167	17.9355	42.3826		
19	8	40.5966	-140.2647	185.9316	0.0017	108-04UR
	Polar	313.5540	17.9555	30.8376		
19	3	40.6386	-140.2447	277.4816	0.0017	108-04UR
	Polar	236.4217	12.2282	54.7612		
20	8	34.2094	-175.9037	154.2168	0.0019	108-07LL (115)
	Polar	304.1538	12.2442	40.1063		
20	3	34.2514	-175.8837	245.7668	0.0019	108-07LL (115)
	Polar	236.4283	-6.4251	47.0034		
21	8	-16.0328	-158.3189	174.8611	0.0009	108-07M
	Polar	310.3049	-6.4092	34.2736		
21	3	-15.9908	-158.2990	266.4111	0.0009	108-07M
	Polar	236.3727	-17.8209	41.8093		
22	8	-39.8723	-138.6969	187.2043	0.0016	108-07UR
	Polar	313.8816	-17.8055	30.4068		
22	3	-39.8303	-138.6769	278.7542	0.0016	108-07UR
	Polar	236.3695	-24.7348	54.5648		
23	8	-67.6907	-165.3652	154.7348	0.0013	108-01LL
	Polar	304.2558	-24.7236	39.9513		
23	3	-67.6487	-165.3452	246.2848	0.0013	108-01LL

	Polar	236.2446	-36.1928	47.0725		
24	8	-85.7074	-134.1533	174.5526	0.0012	108-01M
	Polar	310.0660	-36.1830	34.3150		
24	3	-85.6654	-134.1333	266.1026	0.0012	108-01M
	Polar	236.3813	-56.6534	41.5463		
25	8	-111.5366	-90.3591	187.8056	0.0014	108-01UR
	Polar	314.0569	-56.6486	30.2097		
25	3	-111.4946	-90.3391	279.3556	0.0014	108-01UR
	Polar	236.2624	-62.9661	53.4138		
26	8	-146.8643	-96.5838	157.8682	0.0009	108-02LL
	Polar	305.1079	-62.9638	39.0746		
26	3	-146.8223	-96.5638	249.4182	0.0009	108-02LL
	Polar	236.3233	-78.0999	48.7114		
27	8	-154.0990	-55.2060	170.4538	0.0012	108-02M
	Polar	308.9094	-78.1017	35.5424		
27	3	-154.0570	-55.1860	262.0038	0.0012	108-02M
	Polar	236.4172	-90.0588	41.6862		
28	8	-142.2272	-22.3919	187.5183	0.0007	108-02UR
	Polar	314.0004	-90.0647	30.3147		
28	3	-142.1853	-22.3719	279.0683	0.0007	108-02UR
	Polar	236.3539	-112.8459	46.9792		
29	8	-155.7858	31.8686	174.8666	0.0008	108-05M
	Polar	310.2432	-112.8571	34.2502		
29	3	-155.7438	31.8886	266.4167	0.0008	108-05M
	Polar	236.3727	-130.9790	43.8247		
30	8	-132.7361	70.2241	182.5425	0.0011	108-05UR
	Polar	312.5199	-130.9948	31.9029		
30	3	-132.6941	70.2441	274.0925	0.0011	108-05UR
	Polar	236.3392	-135.1590	54.6388		
31	8	-152.2523	93.8242	154.5072	0.0015	108-06LL
	Polar	304.1691	-135.1729	40.0074		
31	3	-152.2103	93.8442	246.0572	0.0015	108-06LL
	Polar	236.3293	-150.3033	48.7282		
32	8	-115.2276	116.3308	170.4150	0.0011	108-06M
	Polar	308.9189	-150.3204	35.5607		
32	3	-115.1856	116.3508	261.9650	0.0011	108-06M

	Polar	236.4393	-163.4241	41.8655		
33	8	-78.5385	121.3168	187.1296	0.0013	108-06UR
	Polar	313.9214	-163.4444	30.4553		
33	3	-78.4965	121.3368	278.6796	0.0013	108-06UR
	Polar	236.3767	-171.0044	54.6134		
34	8	-78.6529	160.5788	154.6030	0.0011	108-08LL
	Polar	304.2416	-171.0210	39.9942		
34	3	-78.6109	160.5988	246.1530	0.0011	108-08LL
	Polar	236.3248	-184.8979	46.5959		
35	8	-37.1159	153.5138	175.7991	0.0033	108-08M
	Polar	310.5199	-184.9162	33.9712		
35	3	-37.0739	153.5338	267.3491	0.0033	108-08M
	Polar	236.3394	199.6858	41.6392		
36	8	0.7096	143.7916	187.5628	0.0039	108-08UR
	Polar	313.9845	199.6673	30.2888		
36	3	0.7516	143.8116	279.1128	0.0039	108-08UR
	Polar	236.3627	192.2573	54.3349		
37	8	21.6098	176.8024	155.3746	0.0036	108-09LL
	Polar	304.4777	192.2432	39.7872		
37	3	21.6518	176.8224	246.9246	0.0036	108-09LL
	Polar	236.1499	176.4813	47.1523		
38	8	57.5385	148.5985	174.2831	0.0050	108--09M
	Polar	309.9519	176.4686	34.3836		
38	3	57.5805	148.6185	265.8331	0.0050	108--09M
	Polar	236.2783	161.8723	41.2440		
39	8	80.3834	117.7719	188.4030	0.0010	108-09UR
	Polar	314.1924	161.8619	29.9975		
39	3	80.4254	117.7919	279.9531	0.0010	108-09UR
	Polar	236.3103	155.8393	53.2339		
40	8	112.1229	134.8390	158.3964	0.0007	108-10LL
	Polar	305.3541	155.8323	38.9561		
40	3	112.1649	134.8590	249.9464	0.0007	108-10LL
	Polar	236.3803	141.8845	48.3410		
41	8	128.7660	99.5074	171.4446	0.0009	108-10M
	Polar	309.2950	141.8806	35.2837		
41	3	128.8080	99.5274	262.9946	0.0009	108-10M

	Polar	236.4684	126.9941	41.7282			
42	8	131.3697	59.3011	187.4639	0.0013		108-10UR
	Polar	314.0649	126.9945	30.3641			
42	3	131.4117	59.3211	279.0139	0.0013		108-10UR
	Polar	233.3404	65.2804	109.6200			
44	8	197.2172	-119.6631	-35.1263	0.0009		SB5-A-R
	Polar	237.5064	65.2912	84.7300			
44	3	197.2592	-119.6431	56.4237	0.0009		SB5-A-R
	Polar	236.4656	92.7304	38.0159			
45	8	132.0962	-15.1501	195.5429	0.0039		110-05 SLICE
	Polar	316.4044	92.7422	27.6188			
45	3	132.1382	-15.1301	287.0929	0.0039		110-05 SLICE
	Polar	236.5820	95.6623	27.3965			
46	8	98.4690	-6.7198	215.0110	0.0018		110-05 SLICE M
	Polar	322.0698	95.6770	19.8366			
46	3	98.5110	-6.6998	306.5610	0.0018		110-05 SLICE M
	Polar	236.5790	98.2240	19.2698			
47	8	70.4940	-1.9671	225.8237	0.0009		110-05 SLICE T
	Polar	325.1233	98.2431	13.9277			
47	3	70.5360	-1.9471	317.3737	0.0009		110-05 SLICE T
	Polar	236.4136	69.4052	36.2814			
48	8	113.1089	-58.9694	199.0487	0.0017	67.66	110-01B
	Polar	317.3732	69.4238	26.3374			
48	3	113.1509	-58.9494	290.5987	0.0017	56.72	110-01B
	Polar	236.4900	84.6242	26.5916			
49	8	93.1498	-22.9457	216.1577	0.0017	69.11	110-01M
	Polar	322.3264	84.6437	19.2467			
49	3	93.1918	-22.9257	307.7077	0.0017	56.48	110-01M
	Polar	236.4433	76.1573	14.2991			
50	8	49.0117	-19.2652	230.5041	0.0021		110-01T
	Polar	326.3365	76.1983	10.3248			
50	3	49.0537	-19.2452	322.0541	0.0021		110-01T
	Polar	236.3867	42.1295	38.2417			
51	8	82.1053	-105.4061	195.0050	0.0025		110-04B
	Polar	316.1775	42.1511	27.7773			
51	3	82.1473	-105.3861	286.5550	0.0025		110-04B

	Polar	236.4640	41.2061	27.7961		
52	8	60.2979	-79.7702	214.2805	0.0019	110-04M
	Polar	321.7659	41.2351	20.1194		
52	3	60.3399	-79.7502	305.8305	0.0019	110-04M
	Polar	236.4816	49.2339	12.5902		
53	8	32.4571	-33.2478	231.8721	0.0019	110-04T
	Polar	326.7447	49.2942	9.0866		
53	3	32.4991	-33.2278	323.4221	0.0019	110-04T
	Polar	236.3937	9.8668	37.0148		
54	8	20.0418	-128.2753	197.5494	0.0013	109-11B
	Polar	316.9089	9.8887	26.8691		
54	3	20.0838	-128.2553	289.0994	0.0013	109-11B
	Polar	236.3959	15.6600	31.4072		
55	8	27.2615	-108.5807	208.2067	0.0011	109-11M
	Polar	319.9766	15.6859	22.7530		
55	3	27.3035	-108.5607	299.7567	0.0011	109-11M
	Polar	236.5399	15.6087	13.9254		
56	8	12.4592	-49.7940	230.9035	0.0020	109-11T
	Polar	326.5119	15.6653	10.0478		
56	3	12.5012	-49.7740	322.4536	0.0020	109-11T
	Polar	236.3693	-15.2330	36.8963		
57	8	-30.6801	-125.7621	197.7703	0.0025	109-05B
	Polar	316.9479	-15.2153	26.7781		
57	3	-30.6381	-125.7421	289.3203	0.0025	109-05B
	Polar	236.3923	-11.5294	26.8080		
58	8	-17.4043	-95.0483	215.7412	0.0015	109-05M
	Polar	322.1175	-11.5046	19.3903		
58	3	-17.3623	-95.0283	307.2912	0.0015	109-05M
	Polar	236.4522	-14.9804	15.4771		
59	8	-13.2708	-55.3516	229.4989	0.0023	109-05T
	Polar	326.0505	-14.9399	11.1652		
59	3	-13.2288	-55.3316	321.0489	0.0023	109-05T
	Polar	236.3828	-30.0448	38.0982		
60	8	-60.5407	-118.6113	195.3024	0.0009	110-09SLICE B
	Polar	316.2409	-30.0313	27.6628		
60	3	-60.4987	-118.5913	286.8524	0.0009	110-09SLICE B



	Polar	236.3952	-25.3569	25.3143			
61	8	-35.5052	-84.3759	217.9514	0.0025	35.66	110-09SLICE M
	Polar	322.7455	-25.3354	18.3009			
61	3	-35.4632	-84.3559	309.5014	0.0025	35.66	110-09SLICE M
	Polar	236.3888	-52.7242	36.8271			
62	8	-95.2163	-87.3973	197.9273	0.0006		110-07 B
	Polar	317.0017	-52.7174	26.7249			
62	3	-95.1743	-87.3773	289.4773	0.0006		110-07 B
	Polar	236.4028	-45.6194	27.4026			
63	8	-64.7907	-74.3824	214.8388	0.0029		110-07M
	Polar	321.8637	-45.6074	19.8212			
63	3	-64.7487	-74.3624	306.3888	0.0029		110-07M
	Polar	236.4398	-38.6496	13.9874			
64	8	-29.3987	-42.3234	230.7558	0.0028		110-07T
	Polar	326.3930	-38.6210	10.0854			
64	3	-29.3567	-42.3034	322.3058	0.0028		110-07T
	Polar	236.4531	-83.4066	38.5075			
65	8	-129.9196	-34.6516	194.5000	0.0003		110-10B
	Polar	316.0571	-83.4107	27.9655			
65	3	-129.8776	-34.6316	286.0500	0.0003		110-10B
	Polar	236.3615	-66.0605	22.3544			
66	8	-70.0187	-41.3192	221.9389	0.0017		110-10M
	Polar	323.8482	-66.0573	16.1456			
66	3	-69.9767	-41.2992	313.4889	0.0017		110-10M
	Polar	236.4390	-69.8217	12.4478			
67	8	-40.8715	-20.9694	231.9336	0.0016		110-10T
	Polar	326.7224	-69.8198	8.9714			
67	3	-40.8295	-20.9494	323.4836	0.0016		110-10T
	Polar	236.3698	-115.8129	40.8057			
68	8	-137.0056	34.7483	189.4537	0.0006		110-11B
	Polar	314.5329	-115.8263	29.6626			
68	3	-136.9636	34.7683	281.0037	0.0006		110-11B
	Polar	236.2966	-99.0006	27.5898			
69	8	-99.2182	-1.5577	214.4515	0.0008		110-11M
	Polar	321.6756	-99.0130	19.9552			
69	3	-99.1762	-1.5377	306.0015	0.0008		110-11M

Polar	236.3972	-109.3068	13.8389		
70 8	-50.4405	7.4269	230.8338	0.0018	110-11T
Polar	326.3844	-109.3391	9.9779		
70 3	-50.3985	7.4469	322.3838	0.0018	110-11T
Polar	236.4389	-145.4101	36.6618		
71 8	-97.3681	84.2510	198.3042	0.0012	110-06B
Polar	317.1584	-145.4312	26.6096		
71 3	-97.3261	84.2710	289.8542	0.0012	110-06B
Polar	236.3129	-137.9005	21.0710		
72 8	-63.5831	43.0659	223.4867	0.0012	110-06M
Polar	324.2560	-137.9338	15.2172		
72 3	-63.5411	43.0859	315.0367	0.0012	110-06M
Polar	236.3618	-136.1726	14.3956		
73 8	-44.6663	28.5162	230.3447	0.0009	110-06T
Polar	326.2236	-136.2200	10.3826		
73 3	-44.6243	28.5362	321.8947	0.0009	110-06T
Polar	236.3603	-176.6216	37.8918		
74 8	-47.5792	123.6859	195.7146	0.0021	110-12B
Polar	316.3604	-176.6438	27.5173		
74 3	-47.5372	123.7059	287.2646	0.0021	110-12B
Polar	236.3129	-160.1316	25.5865		
75 8	-54.1805	74.8982	217.4822	0.0017	110-12M
Polar	322.5595	-160.1631	18.5023		
75 3	-54.1385	74.9182	309.0322	0.0017	110-12M
Polar	236.3668	-164.5558	13.1881		
76 8	-25.6903	41.2735	231.3131	0.0015	110-12-T
Polar	326.5021	-164.6163	9.5135		
76 3	-25.6483	41.2935	322.8632	0.0015	110-12-T
Polar	236.3148	193.3927	37.5518		
77 8	13.6183	130.7419	196.3817	0.0046	110-02B
Polar	316.5280	193.3734	27.2690		
77 3	13.6603	130.7619	287.9317	0.0046	110-02B
Polar	236.2877	-186.8154	25.7455		
78 8	-19.1177	90.9867	217.2275	0.0025	110-02M
Polar	322.4743	-186.8464	18.6211		
78 3	-19.0757	91.0067	308.7775	0.0025	110-02M

	Polar	236.3243	-196.4548	14.6101		
79	8	-2.9922	53.6770	230.1283	0.0010	110-02T
	Polar	326.1426	-196.5058	10.5455		
79	3	-2.9502	53.6970	321.6783	0.0010	110-02T
	Polar	236.3244	161.0460	37.5733		
80	8	75.5474	107.6585	196.3453	0.0014	110-13B
	Polar	316.5314	161.0350	27.2881		
80	3	75.5894	107.6785	287.8953	0.0014	110-13B
	Polar	236.3059	163.9377	23.9198		
81	8	46.5349	73.1689	219.8211	0.0017	15.71 110-13M
	Polar	323.2305	163.9195	17.2985		
81	3	46.5769	73.1889	311.3711	0.0017	0.00 110-13M
	Polar	236.3388	165.6527	13.6431		
82	8	25.8210	43.1222	230.9324	0.0011	110-13T
	Polar	326.3817	165.6201	9.8506		
82	3	25.8630	43.1422	322.4824	0.0011	110-13T
	Polar	236.4957	130.2897	36.5341		
83	8	114.1311	58.8084	198.6098	0.0014	110-05B
	Polar	317.3153	130.2889	26.5293		
83	3	114.1731	58.8284	290.1598	0.0014	110-05B
	Polar	236.3140	149.4843	27.9404		
84	8	71.5785	70.4283	213.9175	0.0018	110-05M
	Polar	321.5631	149.4747	20.2276		
84	3	71.6205	70.4482	305.4675	0.0018	110-05M
	Polar	236.3475	138.6870	14.7477		
85	8	44.5483	30.9829	230.0340	0.0023	110-05T
	Polar	326.1376	138.6781	10.6507		
85	3	44.5903	31.0029	321.5840	0.0023	110-05T
	Polar	236.5068	106.4999	38.2366		
86	8	132.9665	13.6233	195.1148	0.0021	110-09B
	Polar	316.3133	106.5074	27.7837		
86	3	133.0085	13.6433	286.6648	0.0021	110-09B
	Polar	236.3570	112.0115	26.9734		
87	8	95.4497	18.2258	215.4572	0.0027	110-09M
	Polar	322.0326	112.0192	19.5237		
87	3	95.4917	18.2458	307.0071	0.0027	110-09M

	Polar	236.3648	115.8779	18.6418		
88	8	66.1173	16.8409	226.3034	0.0033	110-09T
	Polar	325.1032	115.8863	13.4698		
88	3	66.1593	16.8609	317.8534	0.0033	110-09T
	Polar	236.3454	102.9400	108.7732		
89	8	233.8551	10.8073	-32.4676	0.0020	55.67 102-04B
	Polar	241.4867	102.9449	84.2646		
89	3	233.8971	10.8273	59.0824	0.0020	55.67 102-04B
	Polar	236.4811	60.0379	108.7677		
90	8	189.5876	-137.5710	-32.4661	0.0012	102-02B
	Polar	241.6001	60.0490	84.2718		
90	3	189.6297	-137.5510	59.0839	0.0012	102-02B
	Polar	236.3272	24.6262	108.7628		
91	8	88.3117	-216.7951	-32.4266	0.0032	102-10B
	Polar	241.4402	24.6388	84.2504		
91	3	88.3537	-216.7751	59.1234	0.0032	102-10B
	Polar	236.4386	-19.7922	108.7557		
92	8	-71.6461	-222.9781	-32.4161	0.0046	102-09B
	Polar	241.5249	-19.7830	84.2532		
92	3	-71.6041	-222.9581	59.1339	0.0046	102-09B
	Polar	236.2258	-61.7469	108.7761		
93	8	-192.9998	-132.2873	-32.4618	0.0014	102-05B
	Polar	241.2856	-61.7449	84.2497		
93	3	-192.9577	-132.2673	59.0882	0.0014	102-05B
	Polar	236.5232	-100.6964	108.7745		
94	8	-234.2661	2.5627	-32.4968	0.0026	102-08B
	Polar	241.5675	-100.7020	84.2780		
94	3	-234.2241	2.5827	59.0532	0.0026	102-08B
	Polar	236.3614	-139.4898	108.7733		
95	8	-190.5043	136.0901	-32.4701	0.0027	102-01
	Polar	241.4380	-139.5008	84.2621		
95	3	-190.4623	136.1101	59.0799	0.0027	102-01
	Polar	236.5527	-179.1728	108.7628		
96	8	-75.2969	221.8874	-32.4579	0.0021	102-03B
	Polar	241.6569	-179.1853	84.2733		
96	3	-75.2549	221.9074	59.0921	0.0021	102-03B

Polar	236.4233	182.6136	108.7685		
97 8	63.1649	225.5049	-32.4609	0.0022	102-07B
Polar	241.5536	182.6040	84.2673		
97 3	63.2069	225.5249	59.0891	0.0022	102-07B
Polar	236.2245	141.6807	108.7721		
98 8	185.6017	142.4824	-32.4468	0.0015	102-06B
Polar	241.3788	141.6781	84.2518		
98 3	185.6437	142.5024	59.1032	0.0015	102-06B

# 9 Appendix C

## Measure EVENT SUMMARY

Job Name: DOME-DEC15-A  
Date: 97/03/24  
Operator: robk

### Job Comments:

Coords of center targets on the 101 panels. The coordinates marked with a '\*' were used to transform the Nov 28 1996 data as the CENTER and NORTH targets could not be shot on that day.

The first coords are in the GRAVITY CENTER frame, and the second are in the DEFAULT frame (and aren't of much interest here).

### JOB SUMMARY

VALUES SHOWN IN: R Hand Inch Grads

Event No.	CS No.	COORDINATES			POINTING ERROR	APEX ANGLE	EVENT NAME
		X	Y	Z			
* 11	3	224.1435	-70.7890	95.4641	0.0008		101-04M
11	1	236.4072	93.9931	15.0733	0.0008		101-04M
12	3	138.8771	-189.7667	92.0612	0.0005		101-02M
12	1	311.3001	-31.7729	11.6704	0.0005		101-02M
* 13	3	0.4961	-235.2243	92.3719	0.0015		101-05M
13	1	297.5580	-176.7793	11.9812	0.0015		101-05M
14	3	-137.3575	-190.9471	97.2693	0.0008		101-09M
14	1	201.7966	-285.3788	16.8785	0.0008		101-09M
* 15	3	-223.2150	-73.8016	97.3349	0.0004		101-08M
15	1	60.0765	-317.1592	16.9441	0.0004		101-08M
16	3	-224.3074	70.3106	94.2648	0.0000		101--01M
16	1	-72.4210	-260.4677	13.8740	0.0000		101--01M
* 17	3	-140.2666	188.5706	97.1066	0.0007		101-03M

17	1	-147.1468	-136.1121	16.7159	0.0007	101-03M
18	3	2.6387	235.1161	101.6728	0.0013	101-10M
18	1	-132.5905	13.4757	21.2821	0.0013	101-10M
* 19	3	137.7100	190.6439	98.3615	0.0009	101-07M
19	1	-37.7643	119.4475	17.9707	0.0009	101-07M
20	3	222.7947	74.5033	95.8187	0.0007	101-06M
20	1	102.7255	150.9220	15.4280	0.0007	101-06M