



Jefferson Lab Alignment Group

Data Transmittal

TO: D.Kashy

DATE: 04 Nov 2015

FROM: Chris Gould

Checked: SH/KT

: B1681

DETAILS:

M:\align\DATA\Inspection\HallB\Torus12G\151103A

Below are the results of the Torus magnet survey from the week of November 2nd, 2015.
The coordinate system was established using a best fit transformation to the coil fiducials.
Additionally, a plane and circle were formed to the found data. Values are in mm.

Upstream Points Found				Ideals			Deltas			plane fit results	Planar Error	Radial Error
Coil	x	y	z	x	y	z	x	y	z			
A	0.36	3207.40	-506.46	0.04	3207.24	-507.04	0.32	0.16	0.58	AUS	0.49	0.29
B	-2777.15	1603.98	-507.38	-2777.63	1603.47	-506.82	0.48	0.51	-0.56	BUS	-0.45	-0.18
C	-2778.13	-1602.31	-506.78	-2777.30	-1604.17	-506.91	-0.83	1.86	0.13	CUS	-0.03	-0.10
D	0.63	-3207.27	-506.16	0.77	-3207.36	-507.04	-0.14	0.09	0.88	DUS	0.46	0.27
E	2777.07	-1603.38	-507.07	2777.59	-1603.67	-507.00	-0.52	0.29	-0.07	EUS	-0.42	-0.16
F	2776.99	1603.72	-506.88	2777.63	1603.66	-507.05	-0.64	0.06	0.17	FUS	-0.06	-0.11
Downstream Points Found				Ideals			Deltas			plane fit results	Planar Error	Radial Error
Coil	x	y	z	x	y	z	x	y	z			
A	0.84	4213.61	878.51	-0.03	4213.08	878.24	0.87	0.53	0.27	ADS	0.70	0.05
B	-3649.68	2105.88	877.27	-3648.27	2106.44	878.14	-1.41	-0.56	-0.87	BDS	-0.60	0.02
C	-3648.09	-2107.87	878.01	-3648.72	-2106.07	878.17	0.63	-1.80	-0.16	CDS	-0.07	-0.09
D	0.51	-4213.11	878.86	-0.50	-4212.87	878.31	1.01	-0.24	0.55	DDS	0.62	0.10
E	3648.38	-2106.61	877.69	3648.57	-2106.38	878.22	-0.19	-0.23	-0.53	EDS	-0.51	-0.04
F	3649.05	2105.98	877.82	3648.62	2106.64	878.22	0.42	-0.66	-0.40	FDS	-0.15	-0.04

Using the lines formed from the found tooling balls to the found hub line, the adjacent angles were calculated for each cryostat in the upstream and downstream positions.
The ideal angles should be 60°.

UPSTREAM		DOWNSTREAM	
	DEGREES		DEGREES
CA TO CB	60.01718	CA TO CB	60.03971
CB TO CC	59.98158	CB TO CC	60.00424
CC TO CD	60.01467	CC TO CD	59.97385
CD TO CE	59.96828	CD TO CE	59.97709
CE TO CF	60.00935	CE TO CF	59.99345
CF TO CA	60.00894	CF TO CA	60.01165
SUM	360		359.99999

Hub locations relative to various coordinate systems. Origin is the coil case design zero point (ref. dwg. B00000-04-01-1101).

	Relative to Best Fit				Relative to straight ahead beam				CEBAF System [meters]		
	X	Y	Z		X	Y	Z		X	Y	Z
HUB_US	0.00	1.23	450.02		-1.28	-5.39	460.31		-80.59872	103.34987	-401.64883
HUB_DS	-0.30	0.96	2500.13		-0.59	0.81	2510.48		-80.59941	103.35607	-403.69900

Planes were measured to the outside edge of the Oops and are relative to the Hub Line. The Y and Z values should be considered as approximates.

OOPS	X	Y	Z
S1 OOPS	250.77	1.96	776.53
S4 OOPS	-252.05	3.66	776.59

The following values are for the seven main supports. The coordinates given are to the centroids of the measured planes taken at the ends of the threaded rods.

	X	Y	Z
COILB_Z_SUP	-3467.17	1983.75	-336.84
COILD_Z_SUP	-0.07	-3995.60	-334.60
COILF_Z_SUP	3464.00	1997.36	-336.46
S1_DS_Y_SUP	3797.14	530.17	926.97
S1_US_Y_SUP	2931.18	529.61	-459.93
S4_DS_Y_SUP	-3802.00	528.35	928.15
S4_US_Y_SUP	-2930.88	528.66	-462.53

The upstream and downstream edges of the connector plates were measured as well as points along the outside surface in order to construct the planes. The edge points do not define the extents only points along the edge. For each of the sectors, the coordinate system was rotated to the S1 position to give a true yaw and roll angle.

CONNECTORS	X	Y	Z			Yaw	Roll
S1 PLANE CENTER	208.33	-1.00	1389.93	Proj. Ang.	Ry from Z	Rz from X	
Point on Normal	1265.11	-13.58	1390.60	(deg)	89.9636°	-0.6818°	
S1D EDGE1	207.80	26.77	2535.42				
S1D EDGE2	207.51	-20.05	2535.12				
S1P1	207.36	-38.66	2511.59				
S1P2	207.73	39.23	2521.10				
S1P3	208.47	36.14	1914.51				
S1P4	207.61	-36.37	1910.43				
S1P5	208.66	-36.07	726.91				
S1P6	209.79	30.94	712.53				
S1P7	209.11	33.48	407.41				
S1P8	207.94	-36.71	414.97				

S1U EDGE1	209.19	23.88	400.72			
S1U EDGE2	208.08	-28.31	400.32			
					Yaw	Roll
S2 PLANE CENTER	96.45	182.93	1203.13	Proj. Ang.	Ry from Z	Rz from X
Point on Normal	617.92	1098.87	1202.28	(deg)	90.0462°	0.3458°
S2D EDGE1	81.41	192.51	2531.55			
S2D EDGE2	129.33	165.76	2531.65			
S2P1	136.20	159.13	412.12			
S2P2	74.30	195.19	413.78			
S2P3	69.90	197.57	659.81			
S2P4	90.59	185.85	694.63			
S2P5	137.46	161.21	2520.07			
S2P6	70.23	198.67	2518.36			
S2U EDGE1	80.50	191.74	400.95			
S2U EDGE2	127.93	164.21	401.04			
					Yaw	Roll
S3 PLANE CENTER	-99.87	182.24	1127.03	Proj. Ang.	Ry from Z	Rz from X
Point on Normal	-652.46	1081.29	1126.29	(deg)	90.0403°	1.5765°
S3D EDGE1	-124.65	168.49	2531.43			
S3D EDGE2	-78.25	196.34	2531.08			
S3P1	-130.01	165.30	2524.35			
S3P2	-90.97	188.54	2521.07			
S3P3	-79.81	194.90	414.57			
S3P4	-137.95	158.14	418.97			
S3P5	-73.01	198.16	692.92			
S3P6	-114.29	172.52	599.64			
S3P7	-73.04	198.11	717.68			
S3U EDGE1	-130.99	163.14	401.11			
S3U EDGE2	-86.16	191.14	400.59			
					Yaw	Roll
S4 PLANE CENTER	-209.46	2.92	1438.12	Proj. Ang.	Ry from Z	Rz from X
Point on Normal	-1268.64	9.98	1439.58	(deg)	89.9213°	-0.3823°
S4D EDGE1	-208.26	26.92	2534.64			
S4D EDGE2	-208.62	-25.53	2534.78			
S4P1	-208.49	-24.95	2528.69			
S4P2	-208.23	38.12	2520.58			
S4P3	-207.92	28.16	2150.03			
S4P4	-208.28	-38.52	2118.14			
S4P5	-211.51	-25.13	411.86			
S4P6	-210.82	33.42	411.11			
S4P7	-209.87	35.09	680.48			
S4P8	-210.60	-22.86	684.11			
S4 EDGE1	-211.35	22.49	401.76			
S4 EDGE2	-211.54	-25.05	401.23			

						Yaw	Roll
S5 PLANE CENTER	-103.30	-180.32	1322.93		Proj. Ang.	Ry from Z	Rz from X
Point on Normal	-619.73	-1105.64	1322.39		(deg)	90.0295°	0.8339°
S5D EDGE1	-123.65	-170.23	2532.45				
S5D EDGE2	-83.78	-192.79	2532.62				
S5P1	-133.34	-163.18	412.29				
S5P2	-70.20	-197.83	418.51				
S5P3	-81.50	-192.56	688.02				
S5P4	-136.07	-162.88	679.78				
S5P5	-66.46	-202.65	2530.21				
S5P6	-122.13	-170.97	2522.07				
S5P7	-134.23	-161.78	1667.47				
S5P8	-82.49	-190.71	1665.11				
S5U EDGE1	-80.44	-192.29	401.68				
S5U EDGE2	-120.89	-170.28	401.95				
						Yaw	Roll
S6 PLANE CENTER	105.37	-178.75	1472.48		Proj. Ang.	Ry from Z	Rz from X
Point on Normal	633.38	-1093.94	1471.32		(deg)	90.0628°	0.0176°
S6D EDGE1	124.84	-168.70	2532.39				
S6D EDGE2	79.54	-194.13	2532.33				
S6P1	70.20	-198.41	410.82				
S6P2	138.06	-158.03	408.28				
S6P3	136.21	-159.40	776.30				
S6P4	82.04	-191.54	773.81				
S6P5	137.35	-161.76	2521.32				
S6P6	69.89	-199.70	2519.94				
S6P7	72.30	-198.64	2188.25				
S6P8	136.89	-162.47	2181.13				
S6U EDGE1	121.80	-167.64	401.20				
S6U EDGE2	82.32	-191.20	401.32				

Planes were measured on the upstream faces of the upstream and downstream cold beam boxes. For each of sectors, the coordinate system was rotated to the S1 position to give a true pitch and yaw angle.

US COLD BEAM BOX	X	Y	Z			Pitch	Yaw
S1 PLANE CENTER	2654.21	171.97	-594.69		Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	2668.58	172.07	-2055.65		(deg)	-89.9960°	179.4361°
S1UVJP1	2784.43	-1457.47	-594.32				
S1UVJP2	2519.39	-1308.64	-597.07				
S1UVJP3	2778.35	-68.67	-592.33				
S1UVJP4	2546.42	-73.85	-594.15				
S1UVJP5	2514.35	727.76	-595.16				
S1UVJP6	2786.18	746.15	-593.05				
S1UVJP7	2512.96	1345.85	-597.40				

S1UVJP8	2791.56	1464.59	-594.05			
					Pitch	Yaw
S2 PLANE CENTER	1356.31	2279.34	-594.13	Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	1357.60	2282.47	-2061.54	(deg)	-89.9827°	179.8691°
S2UVJP1	2409.68	1536.60	-595.93			
S2UVJP2	2665.84	1684.10	-595.33			
S2UVJP3	1785.00	1874.03	-592.85			
S2UVJP4	1954.55	2079.31	-593.78			
S2UVJP5	842.64	2418.08	-593.31			
S2UVJP6	970.60	2652.95	-592.21			
S2UVJP7	101.25	2843.88	-595.75			
S2UVJP8	120.91	3145.78	-593.89			
					Pitch	Yaw
S3 PLANE CENTER	-1347.01	2286.48	-596.95	Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	-1344.68	2283.16	-2086.40	(deg)	-90.0136°	-179.8444°
S3UVJP1	-2699.39	1654.09	-598.18			
S3UVJP2	-2448.03	1505.79	-597.64			
S3UVJP3	-1844.95	2148.15	-596.96			
S3UVJP4	-1766.08	1884.78	-596.27			
S3UVJP5	-933.74	2666.17	-595.98			
S3UVJP6	-853.35	2410.74	-595.71			
S3UVJP7	-115.89	3137.15	-597.89			
S3UVJP8	-114.65	2885.00	-596.96			
					Pitch	Yaw
S4 PLANE CENTER	-2654.40	-8.02	-595.29	Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	-2667.64	-6.97	-2090.61	(deg)	-90.0399°	179.4928°
S4UVJP1	-2785.43	-1515.24	-596.73			
S4UVJP2	-2530.93	-1365.35	-597.84			
S4UVJP3	-2779.53	-619.56	-593.70			
S4UVJP4	-2520.09	-611.02	-595.43			
S4UVJP5	-2780.89	623.04	-592.76			
S4UVJP6	-2516.68	615.12	-595.42			
S4UVJP7	-2782.32	1475.52	-593.25			
S4UVJP8	-2539.33	1333.37	-597.18			
					Pitch	Yaw
S5 PLANE CENTER	-1269.19	-2326.06	-594.93	Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	-1270.10	-2328.13	-2069.94	(deg)	-89.9903°	179.9125°
S5UVJP1	-102.00	-3127.07	-594.92			
S5UVJP2	-79.66	-2871.62	-594.91			
S5UVJP3	-911.39	-2690.91	-595.10			
S5UVJP4	-848.04	-2417.71	-594.23			
S5UVJP5	-1521.59	-2023.78	-594.63			
S5UVJP6	-1627.06	-2275.95	-594.71			
S5UVJP7	-2391.94	-1523.03	-596.69			

S5UVJP8	-2671.81	-1678.39	-594.24			
					Pitch	Yaw
S6 PLANE CENTER	1705.70	-2081.20	-595.04	Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	1706.80	-2083.82	-1687.53	(deg)	-90.0185°	179.8524°
S6UVJP1	2707.63	-1655.25	-595.61			
S6UVJP2	2471.91	-1518.00	-595.54			
S6UVJP3	1814.62	-2180.89	-594.09			
S6UVJP4	1721.08	-1911.60	-595.10			
S6UVJP5	823.36	-2714.29	-594.48			
S6UVJP6	695.57	-2507.17	-595.42			
DS COLD BEAM BOX	X	Y	Z		Pitch	Yaw
S1 PLANE CENTER	3504.47	-1436.16	778.38	Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	3508.02	-1434.48	214.23	(deg)	-89.8296°	179.6391°
S1_DVJP1	3621.32	-1998.97	777.88			
S1_DVJP2	3392.51	-1865.41	775.93			
S1_DVJP3	3623.22	-983.67	780.06			
S1_DVJP4	3380.82	-896.58	779.65			
					Pitch	Yaw
S3 PLANE CENTER	-3473.40	2153.97	778.17	Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	-3473.79	2154.34	721.75	(deg)	-89.8470°	179.4769°
S3_DS_USVJP1	-3516.67	2155.78	778.46			
S3_DS_USVJP2	-3440.20	2087.43	777.51			
S3_DS_USVJP3	-3488.84	2189.23	778.53			
S3_DS_USVJP4	-3447.91	2183.43	778.17			
					Pitch	Yaw
S4 PLANE CENTER	-3491.62	6.25	778.27	Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	-3480.07	5.65	-849.60	(deg)	-89.9789°	-179.5933°
S4_DVJP1	-3487.54	1684.26	777.16			
S4_DVJP2	-3486.63	1341.29	778.82			
S4_DVJP3	-3371.49	1324.27	778.83			
S4_DVJP4	-3373.74	1589.02	777.95			
S4_DVJP5	-3610.51	-1553.95	777.77			
S4_DVJP6	-3638.99	-1376.96	777.66			
S4_DVJP7	-3477.79	-1386.36	779.17			
S4_DVJP8	-3486.32	-1571.57	778.81			
					Pitch	Yaw
S5 PLANE CENTER	-1822.38	-3047.69	776.82	Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	-1819.82	-3043.50	-1210.72	(deg)	-89.9965°	-179.8585°
S5_DVJP1	-3472.28	-2149.38	776.72			
S5_DVJP2	-3420.19	-2183.87	777.10			
S5_DVJP3	-3416.96	-2091.33	776.17			
S5_DVJP4	-3489.80	-2131.45	776.54			
S5_DVJP5	-82.23	-4178.32	776.21			

S5_DVJP6	-82.90	-3867.56	777.50			
S5_DVJP7	-305.59	-3749.82	777.30			
S5_DVJP8	-309.06	-4029.77	777.01			
					Pitch	Yaw
S6 PLANE CENTER	1783.01	-3133.70	777.47	Proj. Ang.	Rx from Y	Ry from Z
Point on Normal	1786.56	-3142.67	-1195.10	(deg)	-90.0410°	179.7227°
S6_DVJP1	3486.55	-2190.69	776.15			
S6_DVJP2	3460.69	-2146.14	775.67			
S6_DVJP3	3424.52	-2208.64	776.42			
S6_DVJP4	3455.49	-2239.08	776.62			
S6_DVJP5	136.51	-4023.59	778.24			
S6_DVJP6	134.71	-4161.07	779.20			
S6_DVJP7	81.58	-4182.31	779.21			
S6_DVJP8	84.03	-3918.07	778.21			

Lines were constructed at the intersection of the coil and upstream face of the cold box. The begin and end points were constructed by taking the ideal point and projecting them at right angles to the line created by the intersection of the coil plane and the cold box plane. Naming is "Sector_Coil_US/DS".

	Measured			Ideals(model)			Deltas		
Line	X	Y	Z	X	Y	Z	X	Y	Z
S2_CA_US									
Begin (mm)	62.5	3219.1	-593.3	61.3	3219.1	-596.9	1.2	0.0	3.6
End (mm)	62.0	2852.5	-594.0	61.3	2852.5	-596.9	0.7	0.0	2.9
S3_CA_US									
Begin (mm)	-97.3	3199.6	-597.0	-95.0	3199.6	-596.9	-2.3	0.0	-0.1
End (mm)	-96.0	2833.0	-596.2	-95.0	2833.0	-596.9	-0.9	0.0	0.7
S3_CB_US									
Begin (mm)	-2755.3	1665.7	-597.8	-2757.2	1662.6	-596.9	1.8	3.1	-0.9
End (mm)	-2439.9	1479.0	-596.9	-2439.7	1479.3	-596.9	-0.2	-0.3	0.0
S4_CB_US									
Begin (mm)	-2818.0	1518.2	-592.8	-2818.4	1517.5	-596.9	0.4	0.7	4.1
End (mm)	-2501.6	1333.0	-595.7	-2500.9	1334.2	-596.9	-0.7	-1.2	1.2
S4_CC_US									
Begin (mm)	-2818.7	-1556.1	-594.9	-2818.5	-1556.5	-596.9	-0.2	0.4	2.0
End (mm)	-2502.6	-1370.4	-597.6	-2501.0	-1373.1	-596.9	-1.6	2.7	-0.7
S5_CC_US									
Begin (mm)	-2721.3	-1685.6	-594.9	-2723.4	-1682.1	-596.9	2.1	-3.5	2.0
End (mm)	-2405.8	-1499.0	-595.4	-2405.9	-1498.8	-596.9	0.1	-0.2	1.5
S5_CD_US									
Begin (mm)	-58.0	-3219.0	-594.4	-61.3	-3219.1	-596.9	3.3	0.0	2.5
End (mm)	-62.0	-2852.5	-594.9	-61.3	-2852.5	-596.9	-0.7	0.0	2.0
S6_CD_US									

Begin (mm)	104.5	-3199.4	-594.0		95.0	-3199.6	-596.9	9.4	0.2	2.9
End (mm)	98.5	-2832.9	-594.9		95.0	-2833.0	-596.9	3.5	0.1	2.0
S6_CE_US										
Begin (mm)	2757.2	-1662.6	-595.0		2757.2	-1662.6	-596.9	0.0	0.0	1.9
End (mm)	2440.5	-1477.8	-595.7		2439.7	-1479.3	-596.9	0.9	1.5	1.2
S1_CE_US										
Begin (mm)	2820.3	-1514.1	-593.2		2818.4	-1517.5	-596.9	1.9	3.4	3.7
End (mm)	2502.0	-1332.3	-596.3		2500.9	-1334.2	-596.9	1.1	1.9	0.6
S1_CF_US										
Begin (mm)	2819.3	1555.0	-593.0		2818.5	1556.5	-596.9	0.8	-1.5	3.9
End (mm)	2502.6	1370.3	-596.1		2501.0	1373.1	-596.9	1.6	-2.8	0.8
S2_CF_US										
Begin (mm)	2723.0	1682.8	-594.2		2723.4	1682.1	-596.9	-0.4	0.7	2.7
End (mm)	2407.1	1496.8	-594.9		2405.9	1498.8	-596.9	1.2	-2.0	2.0
S3_CB_DS										
Begin (mm)	-3303.2	1966.0	775.8		-3297.8	1974.8	778.9	-5.4	-8.8	-3.1
End (mm)	-3616.7	2155.8	779.2		-3615.3	2158.1	778.9	-1.4	-2.4	0.3
S4_CB_DS										
Begin (mm)	-3680.8	2044.6	776.2		-3676.6	2051.9	778.9	-4.2	-7.3	-2.7
End (mm)	-3362.7	1862.3	778.5		-3359.1	1868.6	778.9	-3.6	-6.3	-0.4
S4_CC_DS										
Begin (mm)	-3360.8	-1865.7	779.9		-3359.1	-1868.5	778.9	-1.7	2.9	1.0
End (mm)	-3675.6	-2053.5	777.7		-3676.6	-2051.9	778.9	1.0	-1.6	-1.2
S5_CC_DS										
Begin (mm)	-3612.8	-2162.6	776.4		-3615.3	-2158.1	778.9	2.6	-4.5	-2.5
End (mm)	-3294.4	-1980.7	777.2		-3297.8	-1974.8	778.9	3.4	-5.9	-1.7
S5_CD_DS										
Begin (mm)	-64.2	-3843.4	777.4		-61.4	-3843.4	778.9	-2.9	0.0	-1.5
End (mm)	-63.4	-4210.0	776.6		-61.4	-4210.0	778.9	-2.0	0.0	-2.3
S6_CD_DS										
Begin (mm)	62.5	-4210.0	779.3		61.3	-4210.0	778.9	1.2	0.0	0.4
End (mm)	66.7	-3843.5	777.6		61.3	-3843.4	778.9	5.4	-0.1	-1.3
S6_CE_DS										
Begin (mm)	3295.1	-1979.6	774.9		3297.8	-1974.8	778.9	-2.7	-4.7	-4.0
End (mm)	3614.1	-2160.2	776.3		3615.3	-2158.1	778.9	-1.1	-2.0	-2.6
S1_CE_DS										
Begin (mm)	3676.3	-2052.5	777.6		3676.6	-2051.9	778.9	-0.3	-0.6	-1.2
End (mm)	3359.7	-1867.6	776.2		3359.1	-1868.6	778.9	0.6	1.0	-2.7