Results of the BETS Survey of the CC Cryostat

Engineering Note #3740.214-EN-127

This Engineering Note presents results of dimensional surveys of the CC Cryostat. The surveys were performed by members of the Fermilab Alignment Group using a computerized optical system known as BETS. The coordinate system used is described on page 1 of the note. Locations of the support bosses in the inner vessel are given on pages 2 and 3. The bosses control the position of the module array within the cryostat. Locations of the center cylinders (bores) and bypass tubes in both vessels are given on pages 2 and 4 through 6. Elevations and locations of the nozzles on top of the cryostat are given on page 9. Measurements of the stack-up heights of the support stanchions are given on page 13. Raw BETS data are included in Appendix A of the Note.

This engineering note contains 18 pages and Appendix A contains 39 pages.

Issued: January 7, 1988

Originator: Richard D. Luther *RDC*

CC CRYOSTAT SURVEY DATA

COORDINATE SYSTEM

- +X $\Rightarrow$ EAST TO WEST
- +Y $\Rightarrow$ VERTICALLY UPWARD
- +Z $\Rightarrow$ SOUTH TO NORTH

ORIGIN: ON THE CENTERLINE OF THE VACUUM VESSEL INNER CYLINDER, MIDWAY BETWEEN THE SUPPORT STANCHIONS, THE ORIENTATION OF THE SYSTEM (ROTATION ABOUT THE Z-AXIS) IS DEFINED BY THE LOCATION OF THE MAIN RING BYPASS TUBE.

PLAN VIEW

ELEV. LOOKING SOUTH

LOOKING NORTH

PLAN VIEW

SURVEY DATA

(CONVERTED TO COORD. SYSTEM
SHOWN ON PREV. PAGE.)

<u>LOCATION (1)</u>	<u>X</u>	<u>Y</u>	<u>Z</u>	<u>Ref (2)</u>
BYPASS PIPE -				
SOUTH END	12.979	81.331	-55.037	2L
NORTH END	NO DATA			
THEO	12.98	81.46	—	
BORE -				
SOUTH END -	0	0	-48.466	21
NORTH END	0	0	47.419	21
			L _{THEO} = 103.328"	
SUPPORT BOSSES				
NE	-72.923	-65.668	27.251	77
SE	-72.768	-65.591	-27.628	↓ NE BOSS IS WITHIN .019" OF PLANE DEFINED BY THE OTHER 3 BOSSES.
NW	73.346	-65.222	27.647	
SW	73.646	-65.164	-27.263	
THEORETICALS	± 73.344	-65.625	± 27.500	
INNER VESSEL -				
BYPASS PIPE -				
SOUTH END	12.821	81.751	-53.084	41
NORTH END	12.926	81.475	53.661	42
(THEO.)	12.980	81.960	—	
BORE -				
SOUTH END	0.534	0.279	-46.474	41
(THEO.)	0	0	-51.734	
NORTH END	0.790	0.223	46.463	42
(THEO.)	0	0	+51.734	

(1) SEE DIAGRAMS IN APP. A

(2) REFERS TO PAGES IN SURVEYOR'S
LOGBOOK. CONTAINED IN APP. A.

ENGINEERING NOTE

SECTION

PROJECT

SERIAL-CATEGORY

PAGE

SUBJECT

SUPPORT BOSS LOCATIONS - CC CRYOSTAT

NAME

ED LUTWY

DATE

11/17/81

REVISION DATE

(Ref: B.E.S. Survey; Eng. Note 3740.214-EN-127)

LEGEND

PLAN VIEW

SURVEY RESULTS

BOSSSES

	<u>P_{ACT}</u>	<u>Q₄</u>
NW	73.346, 65.222, 27.647	-60.972
SW	73.646, 65.164, -27.263	-60.914
NE	-72.923, 65.668, 27.251	-61.418
SE	-72.768, 65.591, -27.628	-61.341
	THEO'S	
	± 73.344, -65.625, ± 27.5	-61.375

ESTIMATE MAX EXTENT OF P.V.
BORE (FOR INT. W/MODULES).
RLEC INSP DATA
INDICATES MAX INSIDE
CIRCUM. OF PV HEAD
IS 64.398 (6309-B). THE
WALL THICKNESS IS 0.625"
& the back up varies 0.375"

Extent = $\frac{64.398 + 0.625 + 0.375 + 1.790}{2}$
= 33.989

Use 34"

SUBJECT

CC SURVEY DATA
SOUTH END-LOOKING NORTH

NAME

Rick Luther

DATE

1/5/88

REVISION DATE

SURVEY DATA

INNER CYLINDERS (BORES) AND
BYPASS TUBES

SOUTH END-LOOKING NORTH

SUBJECT

CC SURVEY DATA
NORTH END - LOOKING NORTH

NAME

RICK LUTHER

DATE

1/5/98

REVISION DATE

SURVEY DATA

INNER CYLINDERS (BORES) AND
BYPASS TUBES

NORTH END - LOOKING NORTH

DETERMINE THE AMOUNT OF ROTATION OF THE VESSEL (ABOUT ITS N/S $\hat{z}$) REQUIRED TO CENTER THE COORDINATE SYSTEM ON THE SUPPORT BOSS X-COORDINATES, RATHER THAN THE BYPASS TUBE.

THE AVG X-COORD. OF THE BOSSES IS:

$$\begin{array}{r} .002 \\ .300 \\ .421 \\ + .576 \\ \hline 1.299/4 = 0.325" = \Delta x \end{array}$$

USING THE SW BOSS
($x_0 = 73.646$)

$$x_2 = 73.646 - 0.325 = 73.321$$

$$R_1 = (65.164^2 + 73.646^2)^{\frac{1}{2}} = 98.3366"$$

$$y_2 = (98.3366^2 - 73.321^2)^{\frac{1}{2}} = 65.529"$$

$$\Delta y = 65.529 - 65.164 = .365"$$

$$\Delta A = [365^2 + 325^2]^{\frac{1}{2}} = 0.489"$$

$$R_{\text{BYPASS}} = [81.331^2 + 12.979^2]^{\frac{1}{2}} = 82.360"$$

$$\Delta_{\text{BYPASS}} = \frac{82.360 \times .489}{98.3366} = 0.410" *$$

$$\alpha_1 = \tan^{-1} \frac{73.646}{65.164} = 0.846 \text{ RAD} = 48.497^\circ$$

$$\alpha_2 = \tan^{-1} \frac{73.321}{65.529} = 0.841 \text{ RAD} = 48.213^\circ$$

$$\Delta \alpha = 0.285^\circ = .005 \text{ RAD}$$

$$\alpha_{\text{BYPASS}} = \tan^{-1} \frac{12.979}{81.331} = 0.15825 \text{ RAD}$$

$$\Delta x_{\text{BYPASS}} = 0.410 \cos(.15825 - .005) = .405$$

$$\Delta y_{\text{BYPASS}} = 0.410 \sin(.15825 - .005) = .064$$

$$x'_{\text{BYPASS}} = 12.979 + .405 = 13.384"$$

$$y'_{\text{BYPASS}} = 81.331 - .064 = 81.267"$$

To make correction by rotating heads at reinstallation.

Outer (Vacc.) HD.

$$\Delta = \frac{204}{2} \times .005 = 0.510"$$

* RADIAL CLEARANCE (THEO.) BETWEEN BERTH PIPE & V.U. TUBE IS $(1\frac{1}{2} - 6) \div 2 = 0.625$. ROTATING THE VESSEL W/O CORRECTING HEADS OR TUBE LOCATIONS IS INADEQUATE.

LIFT LUGS

<u>LOCATION</u>	<u>X</u>	<u>Y</u>	<u>Z</u>	<u>Ref.</u>
NEAR	-44.212	99.328	35.272	25
NWEAR	43.695	99.848	35.247	25
SEAR	-44.096	99.473	-34.476	23
SWEAR	43.576	99.722	-34.505	23

USE TO LAYOUT VESSEL $\pm 107"$ LIMIT ON TOP OF VESSEL FOR PIPING FITUP. SEE FOLLOWING PAGE FOR SUMMARY OF LOCATIONS & ELEVATIONS OF NOZZLES.

JD, CW, MC
12-5-87
BK D.O., TS-1

HORZ. DISTANCES TO NOZZLES, PIPE SUPPORTS,
AND REF. BARS LOCATED ON TOP OF VESSEL.

ACCURACY IS $\pm .100"$

NOTE: ALL MEASUREMENTS ARE FROM
A LINE DEFINED BY EXISTING
PUNCH MARKS ON TOP OF VESSEL.

NORTH

(Ref. APP. A)

RCR
12/1/87

Correction of the location of the bosses would require that the Costat vessels be rotated on their bases by .005 radians. To do this, the stanchions on the east side of the vessel would be raised $3/8"$ & those on the west would be lowered by $3/8"$. To correct the resulting misalignment of the main ring bypass tubes, the heads would have to be rotated approximately $1/2"$ (at the OD's) when reinstalled. This could cause problems with weld gaps, etc. because the heads would be re-fit with a changed orientation. A more feasible alternative would be to relocate the tube main ring plates on the heads. This would require extensive handling of the heads, surveying in an awkward position, and possibly enlarging of the head cut outs. Additionally, rotation of the vessels could cause problems with instrumentation and piping layouts, since surveys of the nozzles indicate that they are basically located correctly (no rotation of the pattern of nozzles).

OVER ALL LENGTHS OF VESSELS

LOCATION		X	Y	Z	Ref			
OUTER VESSEL								
S1M	TOP	1.246	38.974	-59.935	23	LENGTH		
N1M		2.382	40.089	60.169	25	120.104	These are not at head tangent points. OAL measured by tape to be 120 ⁵ / ₈ ".	
S3M	BOT	-1.620	-43.822	-60.100	23	119.828		
N3M		.749	-40.669	59.728	25			
S2M	EAST	-38.691	-1.246	-59.704	23	119.426		
N2M		-38.702	-1.393	59.722	25			
S4M	WEST	39.481	-.381	-60.128	23	119.940		
N4M		38.930	-1.167	59.812	25			
S10	TOP	-6.206	92.425	-50.188	22			
N10		-.781	90.253	51.536	25			
S30	BOT	-1.399	-87.994	-52.702	23			
N30		-.032	-91.255	51.585	26			
S20	EAST	-89.256	2.730	-51.480	23			
N20		-90.455	-3.571	50.878	25			
S40	WEST	86.225	-1.683	-53.193	23			
N40		81.552	-1.611	55.562	25			
S1I		.642	30.076	-47.230	23			
N1I		-.453	30.128	45.630	22			
INNER VESSEL -								
S1	TOP	.521	48.673	-58.465	41	117.070		Determined visually to be @ Head Tangent points. Actual Radius to tangents = 51 ³ / ₄ " Close. Theo OAL = 117 ¹ / ₄ - 1/4
N1		1.06	49.173	58.605	42			
S3	BOT	1.059	-45.853	-58.120	41	116.988		
N3		.496	-46.822	58.868	42			
S2	EAST	-44.704	1.489	-58.364	41	116.834		
N2		-48.235	.415	58.470	42			
S4	WEST	47.350	2.274	-58.187	41	116.922		
N4		46.267	.182	58.735	42			

RDL 11/13/87

MEASURE DISTANCE FROM BOTTOM OF STANCHION TO TARGETS & BALLS:

	<u>h"</u>	<u>Y (Survey)</u>	<u>COUNTER BORE ELEV.</u> ($Y - h + 7116$)
SW TGT	20/64	-81907	-83.470 vs -83.557 $\Rightarrow .09"$
NW TGT	23/64	-82128	-83.737 vs -83.799 $\Rightarrow .06"$
SE TGT	169/64	-82484	-83.984
SEETGT	158/64	-82559	-84.028
NE TGT	158/64	-82522	-83.991
NEETGT	158/64	-82598	-84.067
			-84.029 vs 84.066 $\Rightarrow .04"$
SW BALL	6 7/16	-77.557	-83.557
NW BALL	6 8/16	-77.736	-83.799
SE BALL		-77.916	-83.979
NE BALL		-78.003	-84.066

USE TGT MEASUREMENTS:

THIS CORNER
OF THE CARRIAGE
NEEDS TO BE
~0.25" HIGHER
THAN THE OTHER 3.

< NEED TO SURVEY CARRIAGE >

J.D.CW, MC
12-2-87
BK D, O, 75-1

SUMMARY OF BOSS TO LEB DIFFERENCES FROM P. 94, 95, 96 THIS BOOK

13

LOCATION	DIFFERENCE	"GAP" (= THEO - MEASURED)
N.E. BOSS	18.913"	0.100"
NW BOSS	18.918"	0.105
SE BOSS	18.892"	0.079
SW BOSS	18.848"	0.035

Results indicate that 1, 2, or 3 of the stanchions may not be completely compressed. Since the presence of gaps in the stanchions will complicate the assembly of the modules, a method of determining and eliminating any gaps will be developed. Since both North end stacks appear to have gaps, it is suspected that the forces exerted by the bellows on top of the vessel are sufficient to move the vessel when the heads are removed. (Note: The stanchions were tight when installed. The weight of the heads is approximately 2/3 of the total wt of the cryostat.)

C.R. 87
12-3-87
ED

Find Stiffness of 6 convolution bellows, 12" ϕ :

$$\delta = \frac{Pl^3}{12EI} \quad ; \quad \frac{P}{\delta} = \frac{12EI}{l^3} = \frac{C}{l^3}$$

PARAMETER DATA (Attached)

12" ϕ , 4 convol. $\frac{P}{\delta} = 18386 \frac{\#}{in} = \frac{C}{4^3}$

$$C = 1.177 \times 10^6$$

12" ϕ , 8 conv. $\frac{P}{\delta} = 2298 \frac{\#}{in} = \frac{C}{8^3}$

$$C = 1.177 \times 10^6$$

See plot
on following
page

$\therefore$ for 12" ϕ 6 conv.

$$\frac{P}{\delta} = \frac{C}{l^3} = \frac{1.177 \times 10^6}{6^3} = 5449 \frac{\#}{in}$$

8" ϕ , 7 convolutions

8" ϕ , 4 conv

$$\frac{P}{\delta} = 26872 \frac{\#}{in} = \frac{C}{4^3} ; C = 1.720 \times 10^6$$

8 conv. $\frac{P}{\delta} = 3359 = \frac{C}{8^3} ; C = 1.720 \times 10^6$

7 conv. $\frac{P}{\delta} = \frac{1.720 \times 10^6}{7^3} = 5015 \frac{\#}{in}$

find cylinder weight:

$$W = \pi (194)(.625)(75)(.290 \frac{\#}{\text{in}^3})$$

$$= 8285 \#$$

Find force F at top sufficient to lift cylinder:

$$F = \frac{8300(27\frac{1}{2})}{157} = \underline{\underline{1454 \#}}$$

$$\Sigma \text{ Spring Const} = (5450 \times 4) + (5015 \times 2) + 1572$$

$$= 33400 \text{ lb/in}$$

$$\delta_{\text{top}} = \frac{1454 \#}{33400 \#/\text{in}} = .044" \text{ very small.}$$

$$\delta_{\text{STANCHION}} = \delta_{\text{TOP}} \left(\frac{54}{157} \right) = .044 \left(\frac{54}{157} \right) = .015"$$

$\therefore$ It appears possible that preload of bellows may be sufficient to lift vessel.

SYSTEM	NG GIMBAL			NH HINGE			NT TIE ROD			NS See Note 6 17 SINGLE UNRESTRAINED EXPANSION JOINT Pressure Thrust equals 151.2 sq. in. times Pressure							
	BANDED BELLOWS BB Style "S" Only			WELD END WW			FLANGE FF			VAN STONE FLANGE VV 16 Con Maximum			VAN STONE/WELD END VW 20 Con Maximum			FLANGE/WELD END FW
ENDS	TEMPERATURE DEG F	CONVOLUTIONS	NON-CONCURRENT MOVEMENTS			SPRING RATE			OVERALL LENGTH AND WEIGHT								
			AXIAL INCH	LATERAL INCH	ANGULAR DEGREE	AXIAL WORKING LBS/INCH	LATERAL WORKING LBS/INCH	ANGULAR WORKING IN LBS/DEG	ADD TO THE LENGTH BELOW								
PRESSURE PSI			REFER TO NOTES 1 & 4						O.A.L. and weights below are for Style S.								
									For "G", "H" and "T" weights, refer to page 40.								
									BB		WW		FF/VV		FW/VW		
									O.A.L.	WT.	O.A.L.	WT.	O.A.L.	WT.	O.A.L.	WT.	
50	-20 to 800	4	1.34	.11	7.8	563	18386	236	6	6	9 1/2	40	7 7/8	133	8 1/16	65	
		8	2.68	.45	10	282	2298	118	9 1/2	9	13	43	11 3/8	137	12 3/16	68	
		12	4.17	1.05	10	188	681	79	13	13	16 1/2	47	14 7/8	140	15 1/16	72	
		16	4.48	1.50	10	275	562	116	16 1/2	16	20	50	18 3/8	144	19 3/16	75	
		20	5.89	2.47	10	220	288	92	20	20	23 1/2	54	21 7/8	147	22 1/16	79	
150	-20 to 800	4	.82	.07	5.9	1904	62255	800	6	9	9 1/2	43	7 7/8	136	8 1/16	90	
		8	1.64	.28	10	952	7782	400	9 1/2	15	13	49	11 3/8	141	12 3/16	95	
		12	2.46	.62	10	635	2306	269	13	20	16 1/2	54	14 7/8	146	15 1/16	100	
		16	2.38	.80	10	1130	2313	475	16 1/2	26	20	59	18 3/8	153	19 3/16	106	
		20	3.25	1.36	10	904	1184	380	20	31	23 1/2	65	21 7/8	158	22 1/16	112	
300	-20 to 800	4	.48	.04	4	8841	290089	3713	6	20	9 1/2	54	9 1/4	242	9 3/8	148	
		8	.95	.16	8	4420	36261	1856	9 1/2	29	13	63	12 3/4	251	12 7/8	157	
		12	1.43	.36	10	2947	10744	1238	13	37	16 1/2	71	16 1/4	259	16 3/8	165	
		16	1.90	.64	10	2210	4533	928	16 1/2	45	20	79	19 3/4	267	19 7/8	173	
		20	2.42	1.01	10	1768	2321	743	20	53	23 1/2	87	23 1/4	275	23 3/8	183	
LINER	To Specify Liners Add L suffix to part number and advise Pathway of specific movements to properly size liner. On combination ends specify flow direction. For Van Stone liner add 1/8" to O.A.L.			MATERIALS	BELLOWS: ASTM A 240-T304. To specify alternate bellows material, add suffix to part number. Refer to page 37. FLANGES: For low pressure systems see pages 35 and 36A for Pathway Standard Angle Flanges and Plate Flanges. ASTM A181/A105 50 lb. Series: 150 lb. ANSI B 16.5 R.F.S.O. 150 lb. Series: 150 lb. ANSI B 16.5 R.F.S.O. 300 lb. Series: 300 lb. ANSI B 16.5 R.F.S.O. PIPE: ASTM A53/A106 50 lb. Series: 0.375" Wall 150 lb. Series: 0.375" Wall 300 lb. Series: 0.375" Wall BANDS: Carbon Steel LINERS: ASTM A 240-T304 COVERS: Carbon Steel TIE RODS, GIMBALS, HINGES: Carbon Steel			NOTES	1. Rated cycle life is 5000 cycles for any one movement tabulated. 2. To combine axial, lateral, or angular movements refer to page 39. 3. To obtain greater movements or cycle life refer to page 38. 4. Maximum axial extension movement is 50% of tabulated axial value. 5. Maximum test pressure: 1 1/2 x rated working pressure. 6. Pressure thrust load is applied to adjacent pipe anchors or equipment when single unrestrained joints are used. 7. If the expansion joint has flanged ends, refer to page 36 for the maximum temperature rating.								
	COVER	To Specify Covers Add C suffix to part number															

PART NUMBER EXAMPLE

12 NG FF 150 12 L — —

FLEXWELLES

NG

GIMBAL

NH

HINGE

NT

TIE ROD

NS

See Note 6

SINGLE UNRESTRAINED EXPANSION JOINT
Pressure Thrust equals 67.2 sq. in. times Pressure

BANDED BELLOWS

BB

Style "S" Only

WELD END

WW

FLANGE

FF

VAN STONE FLANGE

VV

16 Con Maximum

VAN STONE/WELD END

VW

20 Con Maximum

FLANGE/WELD END

FW

PRESSURE PSIG	TEMPERATURE DEG F	CONVOLUTIONS	NON-CONCURRENT MOVEMENTS			SPRING RATE			OVERALL LENGTH AND WEIGHT							
			AXIAL	LATERAL	ANGULAR	AXIAL	LATERAL	ANGULAR	ADD TO THE LENGTH BELOW							
			INCH	INCH	DEGREE	WORKING LBS/INCH	WORKING LBS/INCH	WORKING IN LBS/DEG	O.A.L. and weights below are for Style S.	Style "G" FW-VW 6 in. WW 8 in.	Style "H" FW-VW 6 in. WW 8 in.	Style "T" FW-VW 4 in. WW 6 in.	For "G", "H" and "T" weights, refer to page 40.			
			REFER TO NOTES 1 & 4						BB		WW		FF/VV		FW/VW	
									O.A.L.	WT.	O.A.L.	WT.	O.A.L.	WT.	O.A.L.	WT.
50	-20 to 800	4	.59	.05	8	945	26872	176	5	3	8½	23	6	62	7¼	30
		8	1.18	.21	10	472	3359	88	7½	4	11	24	8½	63	9¼	31
		12	1.79	.48	10	315	995	59	10	5	13½	25	11	64	12¼	33
		16	2.64	.95	10	236	420	44	12½	5	16	26	13½	65	14¼	34
		20	2.35	1.06	10	448	511	84	15	6	18½	27	16	65	17¼	35
		24	2.91	1.57	10	374	296	70	17½	7	21	28	18½	66	19¼	35
150	-20 to 800	4	.44	.04	5	2241	63850	418	5	3	8½	24	6	63	7¼	44
		8	.87	.16	10	1121	7981	209	7½	5	11	25	8½	64	9¼	45
		12	1.31	.35	10	747	2365	139	10	6	13½	26	11	66	12¼	46
		16	1.77	.64	10	560	998	105	12½	7	16	28	13½	67	14¼	47
		20	1.77	.79	10	877	1000	164	15	9	18½	29	16	68	17¼	48
		24	2.21	1.19	10	730	579	136	17½	10	21	30	18½	69	19¼	50
300	-20 to 800	4	.25	.02	4	12053	344662	2250	5	9	8½	29	7¾	121	7½/16	75
		8	.50	.09	7	6026	43083	1125	7½	12	11	32	9¾	124	10¾/16	78
		12	.75	.20	10	4018	12765	750	10	14	13½	35	12¾	126	12½/16	81
		16	1.00	.36	10	3013	5385	562	12½	17	16	37	14¾	129	15¾/16	84
		20	1.25	.56	10	2411	2757	450	15	20	18½	40	17¾	132	17½/16	87
		24	1.49	.80	10	2009	1596	375	17½	23	21	43	19¾	135	20¾/16	89

LINER

To Specify Liners Add **L** suffix to part number and advise Pathway of specific movements to properly size liner. On combination ends specify flow direction. For Van Stone liner add 1/8" to O.A.L.

MATERIALS

BELLOWS: ASTM A 240-T304. To specify alternate bellows material, add suffix to part number. Refer to page 37.
FLANGES: For low pressure systems see pages 35 and 36A for Pathway Standard Angle Flanges and Plate Flanges.
ASTM A181/A105
 50 lb. Series: 150 lb. ANSI B 16.5 R.F.S.O.
 150 lb. Series: 150 lb. ANSI B 16.5 R.F.S.O.
 300 lb. Series: 300 lb. ANSI B 16.5 R.F.S.O.
PIPE: ASTM A53/A106
 50 lb. Series: 0.322" Wall
 150 lb. Series: 0.322" Wall
 300 lb. Series: 0.322" Wall
BANDS: Carbon Steel
LINERS: ASTM A 240-T304
COVERS: Carbon Steel
TIE RODS, GIMBALS, HINGES: Carbon Steel

NOTES

1. Rated cycle life is 5000 cycles for any one movement tabulated.
2. To combine axial, lateral, or angular movements refer to page 39.
3. To obtain greater movements or cycle life refer to page 38.
4. Maximum axial extension movement is 50% of tabulated axial value.
5. Maximum test pressure: 1½ x rated working pressure.
6. Pressure thrust load is applied to adjacent pipe anchors or equipment when single unrestrained joints are used.
7. If the expansion joint has flanged ends, refer to page 36 for the maximum temperature rating.

PART NUMBER EXAMPLE

8 NT FF 150 8 L C M6

FLEXWATERS

APPENDIX A

*Selected pages from the
Surveyor's Data log Book
(39 PAGES)*

A-10139
7

JD, CW
10-12-87
BK D0 25-1

D.O. DETECTOR END CAP REFERENCE
LOCATION OF POINTS SURVEYED
SEE RETS FILE FOR COORDINATES
P 10-26 THIS BK

EAST SIDE LOOKING WEST

SOUTH SIDE LOOKING NORTH

○ = PUNCH MARK IN STEEL
□ = FOIL TGT
⊙ = TOOLING BALL

JD, CW
10-09-87
BK DO 75-1

IT WAS DECIDED BY RICK LUTHER TO
REFERENCE THE O.O. DETECTOR CORE
USING THE ϕ OF THE INSIDE CYLINDER
AS THE HORIZ + VERT ϕ . THE IDEAL
OFFSET POSITION FROM THIS ϕ OF THE MAIN RING
BEAM PIPE IS TO BE USED FOR ROTATION
WHICH IS 12.98" SOUTH OF ϕ . SEE P10-26

3790.214-ME-21325

LOOKING NORTH

SET UP MICROMETERS IN CENTER OF DONUTS TO
DEFINE ϕ AND ORIENTATE OFF OF WITH BE.T.S.
ON JOB FILE O.O. DETECTOR END CAP REFERENCE.
P10-26 THIS BK.

MICROMETER READINGS

SOUTH END

0°	498"	495"
45°	553"	555"
90°	326"	355"
135°	480"	503"
180°	484"	485"
225°	398"	376"
270°	418"	381"
315°	272"	270"

NORTH END

0°	482"
45°	350"
90°	260"
135°	460"
180°	480"
225°	465"
270°	260"
315°	470"

ALSO 4 SOUTH SIDE LOOKING NORTH

JO CW
10-12-87
BK DO 75-1

D.O. DETECTOR END CAP REFERENCE
LOCATION OF POINTS SURVEYED
SEE BETS 406 FOR COORDINATES
P 10-26 THIS BK

JD,
JO-13-87
BK 00,75-1

SUMMARY OF TOOLING BALL AND
FOIL TARGET COORDINATES OF THE
DO DETECTOR CORE FROM 7-26
THIS BK.

NOTE: THERE WILL BE A $-48.466''$ Z CORECTION
ON THESE COORDINATES SO THAT EVERYTHING
IS RELATIVE TO A X,Y,Z $\pm$ OF CORE.
Z $\pm$ IS DETERMINED BY THE MID POINT
BETWEEN THE SUPPORT NOZZLES AS PER
PRINT # 3740-214-ME-223235 SHT 1

NW BALL
-X $-81.114''$
Y $-77.736''$
Z $28.205''$

NE BALL
-X $80.804''$
Y $-78.003''$
Z $27.476''$

SW BALL
-X $-81.478''$
Y $-77.556''$
Z $-27.232''$

SE BALL
-X $80.594''$
Y $-77.916''$
Z $-28.203''$

SW TGT
-X $-73.516''$
Y $-81.907''$
Z $-34.229''$

SE TGT
-X $72.777''$
Y $-82.484''$
Z $-34.534''$

NW TGT
-X $-73.202''$
Y $-82.128''$
Z $34.531''$

NE TGT
-X $72.778''$
Y $-82.522''$
Z $34.230''$

NEE TGT
-X $79.713''$
Y $-82.598''$
Z $27.395''$

SEE TGT
-X $79.534''$
Y $-82.559''$
Z $-27.864''$

J.D. RS.

11-05-87

BK DOTS-1

LAB A - D.O. CENTRAL DETECTOR

SURVEY OF ARGON VESSEL SUPPORT BOSSES
 SEE BETS FILE [D-O CENTRAL DET. INNER SUPPORT]
 P78-81 THIS BK.

PLAN VIEW

NOTE: ALL COORDINATES ARE RELATIVE TO
 ORIENTATION SHOWN ON p.8 THIS BK.
 Z = HEIGHT DIFF. FROM CENTER

FRONT VIEW OF BOSS

JK
 11-6-81
 ED

26

A-6

JORS
11-5-87
BK 00, 75-1
PLANE ANALYSIS FOR BOSSES
SURVEYED ON P. 77 THIS BOOK

11/05/87
10:12

FERMILAB SURVEY/ALIGNMENT
ANALYSIS - PLANES

Page 1

JOB FILE: D-0 CENTRAL DET. INNER SUPPORT SURVEY
OPERATORS: JAMES DAHLBERG, RICH SMITH
LOCATION: LAB A
MEASUREMENT UNITS: Inches
COMMENTS:

RMS FIT 0.0112 Inches
WORST FIT 0.0112 Inches WORST FIT POINT NEBOSS

POINT	FIT	POINT	FIT	POINT	FIT
SWBOSS	0.0112	NWBOSS	0.0112	NEBOSS	0.0112
SEBOSS	0.0112				

END OF PLANES ANALYSIS - D-0 CENTRAL DET. INNER SUPPORT SURVEY

JD, CW

10-23-87

BX 0-0, 75-1

D-O DETECTOR (INSIDE) END CAP SURVEY

SUMMARY OF SURVEY POINTS REFERENCED
DURING BETS JOB FILE (SAME AS TITLE ABOVE)SOUTH SIDE (INSIDE) END CAP
LOOKING NORTH COORDINATES OF SURVEY POINTS ABOVE, RELATIVE
TO ORIENTATION USED ON p. 8 THIS BOOK.

OVERPASS PIPE	-X	-12.821"	S 1	-X	-.521"
	Y	81.751"		Y	48.673"
	Z	-53.084"		Z	-58.465"
CENTER BORE	-X	-.534"	S 2	-X	44.704"
	Y	0.279"		Y	1.489"
	Z	-46.474"		Z	-58.364"
			S 3	-X	-1.059
				Y	-45.853
				Z	-58.120"
			S 4	-X	-47.350"
				Y	2.274"
				Z	-58.187"

JD. GW

D-O DETECTOR (INSIDE) END CAP SURVEY

10-23-87

BK D-0.75-1

SUMMARY OF SURVEY POINTS REFERENCED
DURING BETS JOB FILE (SAME AS TITLE ABOVE) COORDINATES OF SURVEY POINTS ABOVE RELATIVE TO
ORIENTATION USED ON P. 8 THIS BOOK.

OVERPASS PIPE -X -12.926"
Y 81.475"
Z 53.661"

N 2 -X 48.235
Y 0.415
Z 58.470

CENTER BORE -X -0.790"
Y 0.223"
Z 46.463

N 3 -X -1.496
Y -46.822"
Z 58.868"

N 1 -X 1.060"
Y 49.173
Z 58.605

N 4 -X -46.267"
Y 0.182
Z 58.735

10/22/87
21:38

FERMILAB SURVEY/ALIGNMENT
J O B R E C A P R E P O R T

Page 1

JOB FILE: D-0 DETECTOR INSIDE END CAP REFERENCE
OPERATORS: CHARLES WILSON, JIM DAHLBERG
LOCATION: NWB-LAB A
MEASUREMENT UNITS: Inches
COMMENTS: REFERENCE INNER END CAPS AFTER OUTER END
CAPS WERE REMOVED.

***** CALIBRATION RECORD *****

CALIBRATION NAME: TCS01
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/21/87 - 19:07
CALIBRATION BAR LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: .3
THEODOLITE BASELINE LENGTH: 182.1924 Inches
THEODOLITE HEIGHT DIFFERENCE: -27.2382 Inches

***** ORIENT USING KNOWN VALUED POINTS *****

ORIENTATION NAME: SOUTH
REFERENCE POINT VALUES: Manually Entered
ORIENTATION LOGGED: 10/21/87 - 19:27

* * * REFERENCE POINT VALUES * * *

PT NAME	-X	Z	Y
SW-TGT	-73.5160	-34.2290	-81.9070
SE-TGT	72.7770	-34.5340	-82.4840
NEBALL	80.8040	27.4760	-78.0030

* * * POINT FIT DATA * * *

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
SW-TGT	0.0115	SE-TGT	0.0357	NEBALL	0.0302

RMS POINT FIT: 0.0278 Inches

10/22/87
21:38

FERMILAB SURVEY/ALIGNMENT
J O B R E C A P R E P O R T

Page 2

JOB FILE: D-0 DETECTOR INSIDE END CAP REFERENCE (cont'd)

***** ORIENT USING KNOWN VALUED POINTS (cont'd) *****

* * * CALCULATED ROTATIONS AND TRANSLATIONS RELATIVE TO THE TCS * * *

-X ROTATION: 0.1756 Degrees
Z ROTATION: -0.1075 Degrees
Y ROTATION: -4.3381 Degrees
-X TRANSLATION: 76.0149 Inches
Z TRANSLATION: -224.0317 Inches
Y TRANSLATION: -35.9079 Inches

***** CALIBRATION RECORD *****

CALIBRATION NAME: TCS02
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/22/87 - 18:37
CALIBRATION BAR LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: 2.1
THEODOLITE BASELINE LENGTH: 109.5960 Inches
THEODOLITE HEIGHT DIFFERENCE: 3.4948 Inches

***** CALIBRATION RECORD *****

CALIBRATION NAME: TCS03
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/22/87 - 18:42
CALIBRATION BAR LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: .9
THEODOLITE BASELINE LENGTH: 109.5960 Inches
THEODOLITE HEIGHT DIFFERENCE: 3.4955 Inches

***** ORIENT USING KNOWN VALUED POINTS *****

10/22/87
21:38

FERMILAB SURVEY/ALIGNMENT
J O B R E C A P R E P O R T

Page 3

JOB FILE: D-0 DETECTOR INSIDE END CAP REFERENCE (cont'd)

***** ORIENT USING KNOWN VALUED POINTS (cont'd) *****

ORIENTATION NAME: NORTH
REFERENCE POINT VALUES: Manually Entered
ORIENTATION LOGGED: 10/22/87 - 19:03

* * * REFERENCE POINT VALUES * * *

PT NAME	-X	Z	Y
SEBALL	80.5940	-28.2030	-77.9160
NETGT	72.7780	34.2300	-82.5220
NWTGT	-73.2020	34.5310	-82.1280

* * * POINT FIT DATA * * *

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
SEBALL	0.0268	NETGT	0.0209	NWTGT	0.0071

RMS POINT FIT: 0.0200 Inches

* * * CALCULATED ROTATIONS AND TRANSLATIONS RELATIVE TO THE TCS * * *

-X ROTATION: -0.2338 Degrees
Z ROTATION: 0.0340 Degrees
Y ROTATION: -167.5826 Degrees
-X TRANSLATION: 189.4485 Inches
Z TRANSLATION: 171.3551 Inches
Y TRANSLATION: -64.6710 Inches

***** POINT DATA *****

PT NAME	-X	Z	Y	DISTANCE	AXES	DATE
ORIENT	DOUBT	DOUBT	DOUBT	CLOSURE	TEMP	TIME

** THE NEXT 3 POINTS WERE USED TO CREATE THE SOUTH ORIENTATION **

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: SW-TGT

000001	-73.5205	-34.2396	-81.9078	0.0000	--Z-Y	10/21/87
SOUTH	0.0016	0.0017	0.0008	0.0030	70 F	19:15

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: SE-TGT

10/22/87
21:38

FERMILAB SURVEY/ALIGNMENT
J O B R E C A P R E P O R T

Page 4

JOB FILE: D-0 DETECTOR INSIDE END CAP REFERENCE (cont'd)

***** POINT DATA (cont'd) *****

PT NAME ORIENT	-X DOUBT	Z DOUBT	Y DOUBT	DISTANCE CLOSURE	D AXES TEMP	DATE TIME
000002	72.7593	-34.5031	-82.4817	146.2812	--Z-Y	10/21/87
SOUTH	0.0003	0.0009	0.0005	0.0009	70 F	19:24

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: NEBALL

000003	80.8263	27.4556	-78.0046	62.6419	--Z-Y	10/21/87
SOUTH	0.0004	0.0013	0.0006	0.0017	70 F	19:22

***** END OF POINTS USED TO CREATE THE SOUTH ORIENTATION *****

SHOT ON SPIDER MIC IN CENTER BORE(SOUTH END 5 INCHES IN)

S-TGT	-0.5344	-46.4739	0.2794	134.9574	--Z-Y	10/21/87
SOUTH	0.0006	0.0012	0.0007	0.0004	70 F	20:27

MAIN RING OVERPASS PIPE

MRPIPE	-12.8208	-53.0842	81.7505	82.6571	--Z-Y	10/21/87
SOUTH	0.0007	0.0012	0.0012	0.0085	70 F	20:37

SHOOT TANGENT POINTS OF SOUTH END CAP (PUNCHES S1-S4)

S1	-0.5212	-58.4648	46.6727	35.6983	--Z-Y	10/21/87
SOUTH	0.0006	0.0011	0.0009	0.0050	70 F	21:11

S2	44.7037	-58.3636	1.4886	65.3578	--Z-Y	10/21/87
SOUTH	0.0003	0.0009	0.0006	0.0018	70 F	21:12

S3	-1.0589	-58.1201	-45.8534	65.8448	--Z-Y	10/21/87
SOUTH	0.0006	0.0011	0.0004	0.0040	70 F	21:13

S4	-47.3502	-58.1668	2.2738	66.7766	--Z-Y	10/21/87
SOUTH	0.0011	0.0015	0.0008	0.0006	70 F	21:16

PUTTING A PUNCH MARK ON THE INSIDE OF THE CENTER BORE (SOUTH END TOP)

S-BORE	0.0026	-47.7394	32.5950	57.1910	--Z-Y	10/21/87
SOUTH	0.0006	0.0012	0.0009	0.0001	70 F	21:37

CLOSE ON SE-TGT

CLOSE	72.7588	-34.5110	-82.4803	136.7874	--Z-Y	10/21/87
SOUTH	0.0002	0.0009	0.0005	0.0002	70 F	21:40

10/22/87
21:38

FERMILAB SURVEY/ALIGNMENT
J O B R E C A P R E P O R T

Page 5

JOB FILE: D-0 DETECTOR INSIDE END CAP REFERENCE (cont'd)

***** POINT DATA (cont'd) *****

PT NAME	-X	Z	Y	DISTANCE	D AXES	DATE
ORIENT	DOUBT	DOUBT	DOUBT	CLOSURE	TEMP	TIME

** THE NEXT 3 POINTS WERE USED TO CREATE THE NORTH ORIENTATION **

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: SEBALL

000004	80.5756	-28.1836	-77.9174	0.0000	--Z-Y	10/22/87
NORTH	0.0004	0.0015	0.0005	0.0023	70 F	18:52

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: NETGT

000005	72.7951	34.2180	-82.5211	115.2377	--Z-Y	10/22/87
NORTH	0.0003	0.0008	0.0004	0.0009	70 F	18:58

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: NWTGT

000006	-73.1999	34.5242	-82.1275	145.9958	--Z-Y	10/22/87
NORTH	0.0015	0.0020	0.0006	0.0006	70 F	19:01

***** END OF POINTS USED TO CREATE THE NORTH ORIENTATION *****

SHOT ON SPIDER MIC IN CENTER BORE (NORTH END 5 INCHES IN)

N-TGT	-0.0750	46.4629	0.2231	110.7737	--Z-Y	10/22/87
NORTH	0.0003	0.0010	0.0008	0.0019	70 F	19:09

MAIN RING OVERPASS PIPE

PIPEMR	-12.9260	53.6608	81.4749	82.5755	--Z-Y	10/22/87
NORTH	0.0013	0.0010	0.0015	0.0059	70 F	19:17

NOTE: OVERPASS PIPE WELDS WERE CUT PRIOR TO THIS SHOT

SHOOT TANGENT POINTS ON NORTH END CAP (PUNCHES N1-N4)

N1	1.0603	58.6049	49.1727	35.5457	--Z-Y	10/22/87
NORTH	0.0008	0.0009	0.0011	0.0006	70 F	20:57

N2	48.2352	58.4700	0.4149	57.8440	--Z-Y	10/22/87
NORTH	0.0004	0.0007	0.0006	0.0012	70 F	20:59

N3	-0.4955	58.8684	-46.8219	67.8687	--Z-Y	10/22/87
NORTH	0.0008	0.0009	0.0004	0.0020	70 F	21:01

N4	-46.2673	58.7351	0.1819	65.6082	--Z-Y	10/22/87
NORTH	0.0015	0.0012	0.0009	0.0074	70 F	21:03

A-14

10/22/87
21:38

FERMILAB SURVEY/ALIGNMENT
J O B R E C A P R E P O R T

Page 6

JOB FILE: D-0 DETECTOR INSIDE END CAP REFERENCE (cont'd)

***** POINT DATA (cont'd) *****

PT NAME	-X	Z	Y	DISTANCE	D AXES	DATE
ORIENT	DOUBT	DOUBT	DOUBT	CLOSURE	TEMP	TIME

CLOSE ON NE-TGT

*CLOSE	72.7974	34.2190	-82.5225	147.0288	--Z-Y	10/22/87
NORTH	0.0004	0.0008	0.0004	0.0019	70 F	21:06

***** END OF RECAP FOR JOB FILE D-0 DETECTOR INSIDE END CAP REFERENCE *****

OK 8075-1

10

A-15

OK

10/10/87
22:29

FERMILAB SURVEY/ALIGNMENT
JOB RECAP REPORT

Page 10

JOB FILE: D-0 DETECTOR END CAP REFERENCE
OPERATORS: JAMES DAHLBERG
LOCATION: LAB A
MEASUREMENT UNITS: Inches
COMMENTS:

.....
..... CALIBRATION RECORD
.....

CALIBRATION NAME: TCS01
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/08/87 - 21:09
CALIBRATION BAR LENGTH: 114.9995 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: .8
THEODOLITE BASELINE LENGTH: 110.6605 Inches
THEODOLITE HEIGHT DIFFERENCE: 2.4594 Inches

.....
..... ORIENT USING KNOWN VALUED POINTS
.....

ORIENTATION NAME: TEST 1
REFERENCE POINT VALUES: Manually Entered
ORIENTATION LOGGED: 10/08/87 - 21:53

*** REFERENCE POINT VALUES ***

PT NAME	-X	Z	Y
S MRCL	-12.9800	-5.3053	81.4600
S TGT	0.0000	0.0000	0.0000
N TGT	0.0000	95.8945	0.0000

*** POINT FIT DATA ***

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
S MRCL	0.4914	S TGT	0.2326	N TGT	0.4549

RMS POINT FIT: 0.4317 Inches

10/10/87
22:29FERMILAB SURVEY ALIGNMENT
JOB RECORD REPORT

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JOB FILE: D-0 DETECTOR END CAP REFERENCE cont'd

.....
 ORIENT USING KNOWN VALUED POINTS -cont'd

*** CALCULATED ROTATIONS AND TRANSLATIONS RELATIVE TO THE TCS ***

-X ROTATION: 0.5620 Degrees
 Z ROTATION: -0.1928 Degrees
 Y ROTATION: -5.2038 Degrees
 -X TRANSLATION: -64.1332 Inches
 Z TRANSLATION: -176.6139 Inches
 Y TRANSLATION: -19.3335 Inches

.....
 ORIENT USING KNOWN VALUED POINTS

ORIENTATION NAME: TEST 2
 REFERENCE POINT VALUES: Manually Entered
 ORIENTATION LOGGED: 10/06/87 - 22:05

*** REFERENCE POINT VALUES ***

PT NAME	-X	Z	Y
N TGT	0.0000	95.8945	0.0000
S TGT	0.0000	0.0000	0.0000
S MRCL	-12.9800	-5.8957	91.4600

*** POINT FIT DATA ***

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
N TGT	0.2231	S TGT	0.1866	S MRCL	0.2385

RMS POINT FIT: 0.2185 Inches

*** CALCULATED ROTATIONS AND TRANSLATIONS RELATIVE TO THE TCS ***

-X ROTATION: 0.3945 Degrees
 Z ROTATION: -0.1768 Degrees
 Y ROTATION: -5.2309 Degrees
 -X TRANSLATION: -64.0370 Inches
 Z TRANSLATION: -176.7028 Inches
 Y TRANSLATION: -19.9428 Inches

.....
 ORIENT USING KNOWN VALUED POINTS

BK 00, 75-1

A-17

EX

10/10/87
22:29FERMILAB SURVEY/ALIGNMENT
JOB RECAP REPORT12
Page 1

JOB FILE: D-2 DETECTOR END CAP REFERENCE (cont'd)

.....
 ORIENT USING KNOWN VALUED POINTS (cont'd)

ORIENTATION NAME: TEST 2
 REFERENCE POINT VALUES: Manually Entered
 ORIENTATION LOGGED: 10/08/87 - 22:18

* * * REFERENCE POINT VALUES * * *

PT NAME	-X	Z	Y
S MRCL	-12.9800	-5.8857	81.2866
S TGT	0.0000	0.0000	0.0000
N TGT	0.0000	95.8945	0.0000

* * * POINT FIT DATA * * *

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
S MRCL	0.2995	S TGT	0.1520	N TGT	0.2507

RMS POINT FIT: 0.2420 Inches

* * * CALCULATED ROTATIONS AND TRANSLATIONS RELATIVE TO THE TCS * * *

-X ROTATION: 0.3647 Degrees
 Z ROTATION: -0.1550 Degrees
 Y ROTATION: -5.2361 Degrees
 -X TRANSLATION: -64.0027 Inches
 Z TRANSLATION: -176.6800 Inches
 Y TRANSLATION: -20.1346 Inches

.....
 ORIENT USING KNOWN VALUED POINTS

ORIENTATION NAME: TEST 4
 REFERENCE POINT VALUES: Manually Entered
 ORIENTATION LOGGED: 10/08/87 - 22:30

* * * REFERENCE POINT VALUES * * *

PT NAME	-X	Z	Y
N TGT	0.0000	95.8945	0.0000
S TGT	0.0000	0.0000	0.0000
S MRCL	-12.9800	-6.4860	81.2866

EX 00, 75-1

A-18

10/10/87
00:09

FERMILAB SURVEY/ALIGNMENT
JOB RECAP REPORT

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JOB FILE: D-0 DETECTOR END CAP REFERENCE (cont'd)

.....
..... ORIENT USING KNOWN VALUED POINTS (cont'd)
.....

... POINT FIT DATA ...

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
N TGT	0.0271	S TGT	0.0234	S MRCL	0.0490

RMS POINT FIT: 0.0350 Inches

... CALCULATED ROTATIONS AND TRANSLATIONS RELATIVE TO THE TCS ...

-X ROTATION: 0.2022 Degrees
Z ROTATION: -0.1414 Degrees
Y ROTATION: -5.2627 Degrees
-X TRANSLATION: -63.9088 Inches
Z TRANSLATION: -176.7658 Inches
Y TRANSLATION: -20.7194 Inches

.....
..... ORIENT USING KNOWN VALUED POINTS
.....

ORIENTATION NAME: TEST 5
REFERENCE POINT VALUES: Manually Entered
ORIENTATION LOGGED: 10/08/87 - 22:40

... REFERENCE POINT VALUES ...

PT NAME	-X	Z	Y
S MRCL	-12.9800	-6.5860	81.3370
S TGT	0.0000	0.0000	0.0000
N TGT	0.0000	95.8945	0.0000

... POINT FIT DATA ...

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
S MRCL	0.0165	S TGT	0.0099	N TGT	0.0159

RMS POINT FIT: 0.0144 Inches

BK 00, 75-1

A-19

10/10/87
22:29

FERMILAB SURVEY ALIGNMENT
JOB RECAP REPORT

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JOB FILE: D-0 DETECTOR END CAP REFERENCE (cont'd)

.....
ORIENT USING KNOWN VALUED POINTS (cont'd)
.....

*** CALCULATED ROTATIONS AND TRANSLATIONS RELATIVE TO THE TCE ***

-X ROTATION: 0.1844 Degrees
Z ROTATION: -0.1449 Degrees
Y ROTATION: -9.0659 Degrees
-X TRANSLATION: -63.9013 Inches
Z TRANSLATION: -176.7902 Inches
Y TRANSLATION: -20.7593 Inches

.....
CALIBRATION RECORD
.....

CALIBRATION NAME: TCS02
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/09/87 - 17:38
CALIBRATION BAR LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: 12
THEODOLITE BASELINE LENGTH: 107.0774 Inches
THEODOLITE HEIGHT DIFFERENCE: 0.1176 Inches

.....
ORIENT USING KNOWN VALUED POINTS
.....

ORIENTATION NAME: S CAP
REFERENCE POINT VALUES FROM JOB FILE: D-0 DETECTOR END CAP REFERENCE
ORIENTATION LOGGED: 10/09/87 - 17:58

*** REFERENCE POINT VALUES ***

PT NAME	-7	2	Y
SWLEG	-73.8048	14.7563	-78.0422
SELEG	72.7766	13.9320	-82.4836
N11	0.4526	94.0956	30.1279

*** POINT FIT DATA ***

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
SWLEG	0.0099	SELEG	0.0150	N11	0.0245

BK 00 75-1

A-20

10/10/87
22:29

FERMILAB SURVEY ALIGNMENT
JOB RECAP REPORT

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Page 3

JOB FILE: D-0 DETECTOR END CAP REFERENCE (cont'd)

.....
..... ORIENT USING KNOWN VALUED POINTS (cont'd)
.....

* * * POINT FIT DATA (cont'd) * * *

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
---------	-----	---------	-----	---------	-----

RMS POINT FIT: 0.0178 Inches

* * * CALCULATED ROTATIONS AND TRANSLATIONS RELATIVE TO THE TCS * * *

-X ROTATION: 0.1507 Degrees
Z ROTATION: -0.1555 Degrees
Y ROTATION: -9.1795 Degrees
-X TRANSLATION: -61.8034 Inches
Z TRANSLATION: -181.2955 Inches
Y TRANSLATION: -18.4831 Inches

.....
..... CALIBRATION RECORD
.....

CALIBRATION NAME: TCS03
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/09/87 - 22:40
CALIBRATION BAR LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: 2.2
THEODOLITE BASELINE LENGTH: 144.2450 Inches
THEODOLITE HEIGHT DIFFERENCE: 4.6026 Inches

.....
..... CALIBRATION RECORD
.....

CALIBRATION NAME: TCS04
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/09/87 - 22:46
CALIBRATION BAR LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: 1.9
THEODOLITE BASELINE LENGTH: 144.2448 Inches
THEODOLITE HEIGHT DIFFERENCE: 4.6045 Inches

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JOB FILE: D-0 DETECTOR END CAP REFERENCE (cont'd.)

.....
..... CALIBRATION RECORD
.....

CALIBRATION NAME: TC505
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/09/87 - 22:57
CALIBRATION BAF LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: 1.4
THEODOLITE BASELINE LENGTH: 144.2456 Inches
THEODOLITE HEIGHT DIFFERENCE: 4.6046 Inches

.....
..... CALIBRATION RECORD
.....

CALIBRATION NAME: TC505
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/09/87 - 23:21
CALIBRATION BAF LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: 2.4
THEODOLITE BASELINE LENGTH: 144.2473 Inches
THEODOLITE HEIGHT DIFFERENCE: 4.6039 Inches

.....
..... CALIBRATION RECORD
.....

CALIBRATION NAME: TC507
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/09/87 - 23:26
CALIBRATION BAF LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: 1.7
THEODOLITE BASELINE LENGTH: 144.2460 Inches
THEODOLITE HEIGHT DIFFERENCE: 4.6040 Inches

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JOB FILE: D-0 DETECTOR END CAP REFERENCE cont'd

.....
..... CALIBRATION RECORD
.....

CALIBRATION NAME: TC508
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/10/87 - 17:42
CALIBRATION BAR LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: .5
THEODOLITE BASELINE LENGTH: 117.0645 Inches
THEODOLITE HEIGHT DIFFERENCE: -3.8050 Inches

.....
..... CALIBRATION RECORD
.....

CALIBRATION NAME: TC509
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/10/87 - 18:02
CALIBRATION BAR LENGTH: 114.9999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: .5
THEODOLITE BASELINE LENGTH: 117.0865 Inches
THEODOLITE HEIGHT DIFFERENCE: -3.8073 Inches

.....
..... ORIENT USING KNOWN VALUED POINTS
.....

ORIENTATION NAME: N CAP
REFERENCE POINT VALUES FROM JOB FILE: D-0 DETECTOR END CAP REFERENCE
ORIENTATION LOGGED: 10/10/87 - 18:26

* * * REFERENCE POINT VALUES * * *

PT NAME	-X	Z	Y
N11	0.4526	54.0958	30.1279
S11	-0.6419	1.2359	30.0756
TP-004	42.9763	54.8376	-126.5525
TP-007	-294.3960	-91.5997	-10.7593

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JOB FILE: D-0 DETECTOR END CAP REFERENCE (cont'd)

***** ORIENT USING KNOWN VALUED POINTS (cont'd) *****

*** POINT FIT DATA ***

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
N10	0.0037	S10	0.0153	TF-004	0.0155
TF-007	0.0253				

RMS POINT FIT: 0.0170 Inches

*** CALCULATED ROTATIONS AND TRANSLATIONS RELATIVE TO THE TCS ***

X ROTATION: -0.2037 Degrees
Z ROTATION: 0.1055 Degrees
Y ROTATION: -174.9740 Degrees
X TRANSLATION: 52.8751 Inches
Z TRANSLATION: 255.7517 Inches
Y TRANSLATION: -31.7070 Inches

***** CALIBRATION RECORD *****

CALIBRATION NAME: TCS10
CALIBRATION TYPE: New Calibration
CALIBRATION LOGGED: 10/10/87 - 22:58
CALIBRATION BAR LENGTH: 114.6999 Inches
REVERSE AND PLUNGE?: N
OF SHOTS: 1

CALIBRATION INDEX: 13
THEODOLITE BASELINE LENGTH: 104.2191 Inches
THEODOLITE HEIGHT DIFFERENCE: -1.4910 Inches

***** ORIENT USING KNOWN VALUED POINTS *****

ORIENTATION NAME: EAST
REFERENCE POINT VALUES FROM JOB FILE: D-0 DETECTOR END CAP REFERENCE
ORIENTATION LOGGED: 10/10/87 - 22:07

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JOB FILE: C-0 DETECTOR END CAP REFERENCE (cont'd)

.....
 ORIENT USING KNOWN VALUED POINTS (cont'd)

* * * REFERENCE POINT VALUES * * *

PT NAME	X	Y	Z
TP-001	-22.4648	-127.0374	88.2239
TP-002	90.0248	-101.1894	-88.1870
TP-004	40.9783	54.6575	-108.5525

* * * POINT FIT DATA * * *

PT NAME	FIT	PT NAME	FIT	PT NAME	FIT
TP-001	0.0272	TP-002	0.0115	TP-004	2.2158

RMS POINT FIT: 2.0194 inches

* * * CALCULATED ROTATIONS AND TRANSLATIONS RELATIVE TO THE TOS * * *

-X ROTATION: -2.0205 Degrees
 Z ROTATION: -2.3844 Degrees
 Y ROTATION: -120.0902 Degrees
 -X TRANSLATION: 254.4118 inches
 Z TRANSLATION: 10.8817 inches
 Y TRANSLATION: -41.2919 inches

.....
 POINT DATA

PT NAME	-X	Z	Y	DISTANCE	D AXES	DATE
ORIENT	DOUBT	DOUBT	DOUBT	CLOSURE	TEMP	TIME

DIST BETWEEN TWO SPIDER MICS NEEDED FOR FUTURE ORIENTATION

S MIC	79.8058	170.1015	21.5033	0.0002	--Z-Y	10/28/87
TOS01	0.0002	0.0009	0.0004	0.0002	SS F	21:15
N MIC	86.6032	265.5910	21.8515	85.2945	--Z-Y	10/28/87
TOS01	0.0004	0.0021	0.0005	0.0002	SS F	21:16
MRPIPE	66.0730	164.5210	102.7699	131.4452	--Z-Y	10/28/87
TOS01	0.0003	0.0009	0.0008	0.0027	SS F	21:21

** THE NEXT 3 POINTS WERE USED TO CREATE THE TEST ' ORIENTATION **

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT #S: S MRCL

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JOB FILE: C-R DETECTOR END CAP REFERENCE (cont'd)

***** POINT DATA (cont'd) *****

PT NAME	X	Y	Z	DISTANCE	D AXES	DATE
ORIENT	DOUBT	DOUBT	DOUBT	CLOSURE	TEMP	TIME
000001	-13.0046	-5.0001	61.6146	0.0000	--Z--	0 08 87
TEST 1	0.0003	0.0009	0.0006	0.0016	66 F	21:50

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: 1 TGT

000002	-0.0371	0.0351	0.0326	60.6070	--Z--	0 08 87
TEST 1	0.0003	0.0009	0.0004	0.0007	66 F	21:51

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: 1 TGT

000003	0.0517	95.1050	-0.3670	95.6500	--Z--	0 08 87
TEST 1	0.0004	0.0001	0.0006	0.0005	66 F	21:52

***** END OF POINTS USED TO CREATE THE TEST 1 ORIENTATION *****

** THE NEXT 3 POINTS WERE USED TO CREATE THE TEST 2 ORIENTATION **

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: 1 TGT

000004	0.0310	95.0050	-0.1947	0.0000	--Z--	10/08/87
TEST 2	0.0004	0.0001	0.0006	0.0012	66 F	22:00

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: 1 TGT

000005	-0.0028	0.1176	0.1431	95.6500	--Z--	0 08 87
TEST 2	0.0003	0.0009	0.0004	0.0012	66 F	22:02

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: 1 MRCL

000006	-10.9560	-5.1265	61.5115	60.6313	--Z--	10/08/87
TEST 2	0.0003	0.0009	0.0006	0.0013	66 F	22:04

***** END OF POINTS USED TO CREATE THE TEST 2 ORIENTATION *****

** THE NEXT 3 POINTS WERE USED TO CREATE THE TEST 3 ORIENTATION **

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: 1 MRCL

000007	-13.0029	-5.1576	61.4300	0.0000	--Z--	10/08/87
TEST 3	0.0003	0.0009	0.0006	0.0000	66 F	22:15

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: 1 TGT

000008	-0.0111	0.1345	0.0595	60.6306	--Z--	10/08/87
TEST 3	0.0003	0.0009	0.0004	0.0004	66 F	22:16

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JOB FILE: CH0 DETECTOR END CAP REFERENCE POINTS

.....
..... POINT DATA (cont'd)
.....

PT NAME	X	Y	DISTANCE	AXES	DATE
ORIENT	DOUBT	DOUBT	CLOSURE	TEMP	TIME

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: N TEST

000009	0.0343	95.2015	-0.2134	95.8874	--Z-Y 10/08/87
TEST 3	0.0004	0.0001	0.0005	0.0001	58 F 22:17

***** END OF POINTS USED TO CREATE THE TEST 3 ORIENTATION *****

** THE NEXT 3 POINTS WERE USED TO CREATE THE TEST 4 ORIENTATION **

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: N TEST

000010	0.0038	95.9251	-0.0242	0.0000	--Z-Y 10/08/87
TEST 4	0.0004	0.0001	0.0005	0.0001	58 F 22:07

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: S TEST

000011	0.0020	0.2194	-0.0132	95.8657	--Z-Y 10/08/87
TEST 4	0.0003	0.0005	0.0004	0.0007	58 F 22:08

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: S MPL

000012	-12.8862	-6.5175	81.3227	80.8281	--Z-Y 10/08/87
TEST 4	0.0003	0.0005	0.0005	0.0036	58 F 22:09

***** END OF POINTS USED TO CREATE THE TEST 4 ORIENTATION *****

** THE NEXT 3 POINTS WERE USED TO CREATE THE TEST 5 ORIENTATION **

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: S MPL

000013	-12.9791	-6.5725	81.3312	0.0000	--Z-Y 10/08/87
TEST 5	0.0003	0.0005	0.0005	0.0035	58 F 22:36

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: S TEST

000014	0.0011	-0.0056	-0.0072	82.6287	--Z-Y 10/08/87
TEST 5	0.0003	0.0009	0.0004	0.0022	58 F 22:39

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: N TEST

000015	-0.0022	95.8854	0.0128	95.8922	--Z-Y 10/08/87
TEST 5	0.0004	0.0001	0.0005	0.0012	58 F 22:40

***** END OF POINTS USED TO CREATE THE TEST 5 ORIENTATION *****

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JOB FILE: C-0 DETECTOR END CAP REFERENCE

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JOB FILE: C-0 DETECTOR END CAP REFERENCE (cont'd)

.....
..... POINT DATA (cont'd)
.....

PT NAME ORIENT	X DOUBT	Y DOUBT	Z DOUBT	DISTANCE CLOSEURE	DATE TEMP	DATE TIME
SWAYL	-73.8248	14.7583	-78.0421	134.8155	--2--	10/08/87
TEST S	0.0002	0.0012	0.0007	0.0027	68 F	23:34
SELEG	72.7766	13.5320	-82.4836	148.8810	--2--	10/08/87
TEST S	0.0005	0.0012	0.0006	0.0027	68 F	23:37
SAC	81.0019	-11.7219	92.4253	187.6241	--2--	10/08/87
TEST S	0.0002	0.0009	0.0029	0.0050	68 F	23:42
N11	0.4526	94.0956	30.1279	114.4335	--2--	10/08/87
TEST S	0.0002	0.0021	0.0008	0.0029	68 F	23:46
N11GT	0.4073	95.3540	30.1157	113.8891	--2--	10/08/87
TEST S	0.0002	0.0021	0.0008	0.0029	68 F	23:48

.. THE NEXT 3 POINTS WERE USED TO CREATE THE S CAP ORIENTATION ..

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: SELEG

000016	-73.7595	14.7514	-78.0451	0.0222	--2--	10/09/87
S CAP	0.0202	0.0012	0.0007	0.0025	68 F	17:47

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: SELEG

000017	72.7753	13.5328	-82.4954	148.8447	--2--	10/09/87
S CAP	0.0007	0.0013	0.0008	0.0017	68 F	17:48

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: N11

000018	0.4487	94.1099	30.1475	98.8216	--2--	10/09/87
S CAP	0.0004	0.0022	0.0006	0.0023	68 F	17:52

..... END OF POINTS USED TO CREATE THE S CAP ORIENTATION

SE R01	95.1780	12.9144	-51.5613	149.1357	--2--	10/09/87
S CAP	0.0006	0.0016	0.0006	0.0027	68 F	18:16
SE R02	105.5015	30.0574	-82.2960	38.5526	--2--	10/09/87
S CAP	0.0010	0.0019	0.0009	0.0017	68 F	18:19
SE R03	93.7411	-7.1646	-63.8030	40.7575	--2--	10/09/87
S CAP	0.0007	0.0012	0.0006	0.0024	68 F	18:24
SE R04	105.6507	23.3007	-54.4100	34.7676	--2--	10/09/87
S CAP	0.0025	0.0018	0.0010	0.0042	68 F	18:27

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JOB FILE: D-2 DETECTOR END CAP REFERENCE CONT'D

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.....
..... POINT DATA (cont'd)
.....

PT NAME ORIENT	X COORD	Y COORD	Z COORD	DISTANCE CLOSURE	D AXES TEMP	DATE TIME
(SEBALL S CAP	82.5544 0.0005	20.2504 0.0015	-77.9156 0.0005	30.3959 0.0011	--Z-Y 66 F	10/09/87 19:35
000018 SPHFN1	82.5539	20.2742	-77.9155			10/09/87 19:37
(SULEB(-) S CAP	-73.5183 0.0001	14.2373 0.0013	-81.5088 0.0007	0.0000 0.0001	--Z-Y 66 F	10/09/87 19:40
S1M S CAP	-11.2455 0.0001	-11.4592 0.0005	38.9736 0.0005	143.1639 0.0037	--Z-Y 66 F	10/09/87 19:44
S2M S CAP	38.6508 0.0002	-11.2377 0.0012	-11.2458 0.0004	56.6794 0.0045	--Z-Y 66 F	10/09/87 19:46
S2O S CAP	69.2559 0.0005	-3.0136 0.0013	2.7300 0.0005	51.3837 0.0065	--Z-Y 66 F	10/09/87 19:46
S3M S CAP	1.5155 0.0001	-11.5344 0.0005	-43.6003 0.0004	99.6072 0.0001	--Z-Y 66 F	10/09/87 19:52
S3O S CAP	1.3867 0.0001	-4.2355 0.0012	-87.3944 0.0007	44.7952 0.0016	--Z-Y 66 F	10/09/87 19:54
S4M S CAP	-39.4505 0.0001	-11.6515 0.0005	-0.3803 0.0004	95.5664 0.0040	--Z-Y 66 F	10/09/87 19:55
S4O S CAP	-85.2254 0.0001	-4.7072 0.0011	-1.6829 0.0004	47.2744 0.0004	--Z-Y 66 F	10/09/87 20:01
[SW EAP S CAP	-43.5752 0.0001	13.3514 0.0012	99.7223 0.0011	111.5851 0.0026	--Z-Y 66 F	10/09/87 20:04
[SE EAP S CAP	44.2552 0.0003	13.9902 0.0012	99.4729 0.0012	87.6726 0.0015	--Z-Y 66 F	10/09/87 20:06
S1I S CAP	-0.5419 0.0001	1.2359 0.0012	30.0758 0.0005	83.5471 0.0027	--Z-Y 66 F	10/09/87 20:10
S1 TGT S CAP	-0.5412 0.0001	2.5181 0.0012	30.0942 0.0005	1.3640 0.0003	--Z-Y 66 F	10/09/87 20:13
[SWBALL S CAP	-81.4752 0.0001	21.2340 0.0014	-77.5555 0.0007	135.9637 0.0009	--Z-Y 66 F	10/09/87 20:30

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JOB FILE: D-R DETECTOR END CAP REFERENCE

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JOB FILE: D-R DETECTOR END CAP REFERENCE

POINT DATA

PT NAME	X	Y	Z	DISTANCE	D AXES	DATE
ORIENT	DOUBT	DOUBT	DOUBT	CLOSURE	TEMP	TIME
TP-001	-22.4848	-257.3574	68.3035	254.8102	--Z--	10/09/87
S CAP	0.0001	0.0005	0.0005	0.0022	68 F	21:12
TP-002	90.0245	-22.1694	-89.1872	335.4552	--Z--	10/09/87
S CAP	0.0005	0.0010	0.0005	0.0021	68 F	21:00
TP-003	361.6475	-46.7111	-27.3762	379.8032	--Z--	10/09/87
S CAP	0.0257	0.0269	0.0011	0.0012	68 F	21:24
TP-004	40.9762	54.8378	-126.5525	245.4422	--Z--	10/09/87
S CAP	0.0023	0.0018	0.0012	0.0013	68 F	21:25
TP-005	255.0753	379.7116	-6.6922	402.8453	--Z--	10/09/87
S CAP	0.0092	0.0116	0.0012	0.0011	68 F	21:32
TP-006	-261.8376	166.8182	-5.0862	628.3409	--Z--	10/09/87
S CAP	0.0016	0.0057	0.0006	0.0011	68 F	21:34
TP-007	-294.3960	-91.5957	-10.7992	260.5035	--Z--	10/09/87
S CAP	0.0045	0.0035	0.0005	0.0027	68 F	21:37
TP-008	-86.7525	-19.3119	-82.7122	221.4235	--Z--	10/09/87
S CAP	0.0001	0.0010	0.0007	0.0005	68 F	21:42

CLOSEOUT ON TARGET SEAX.

CLOSE	-73.8040	14.7532	-78.0517	26.2987	--Z--	10/09/87
S CAP	0.0001	0.0013	0.0007	0.0002	68 F	21:48

.. THE NEXT 4 POINTS WERE USED TO CREATE THE N CAP ORIENTATION ..

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: N11

000020	2.4418	54.0731	30.1244	0.0000	--Z--	10/10/87
N CAP	0.0003	0.0005	0.0005	0.0025	68 F	18:07

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: S11

000021	-0.6405	1.2501	30.0616	52.8254	--Z--	10/10/87
N CAP	0.0004	0.0020	0.0005	0.0016	68 F	18:10

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: TP-004

000022	40.9884	54.6447	-125.5595	144.4761	--Z--	10/10/87
N CAP	0.0004	0.0014	0.0010	0.0022	68 F	18:15

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10/12/87
22:29

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JOB FILE: D-2 DETECTOR END CAP REFERENCE (cont'd)

.....
..... POINT DATA (cont'd)
.....

PT NAME	X	Y	Z	DISTANCE	D AXES	DATE
ORIENT	DOUBT	DOUBT	DOUBT	CLOSURE	TEMP	TIME

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: TP-007

000003	-294.3987	-81.5993	-13.7943	308.5083	--Z-Y	10/10/87
N CAP	0.0038	0.0059	0.0010	0.0028	68 F	18:19

***** END OF POINTS USED TO CREATE THE N CAP ORIENTATION *****

NWBALL	-81.1140	76.6712	-77.7356	279.7955	--Z-Y	10/10/87
N CAP	0.0004	0.0012	0.0006	0.0019	68 F	18:34
NW TST	-73.2021	82.9966	-82.1075	11.0407	--Z-Y	10/10/87
N CAP	0.0004	0.0011	0.0005	0.0022	68 F	18:36
NEBALL	50.8043	75.9416	-76.2028	154.2231	--Z-Y	10/10/87
N CAP	0.0007	0.0012	0.0007	0.0046	68 F	18:39
NE TST	70.7777	82.5955	-82.5223	11.4222	--Z-Y	10/10/87
N CAP	0.0005	0.0011	0.0007	0.0014	68 F	18:41
N1M	-12.3924	106.6346	40.0667	146.1347	--Z-Y	10/10/87
N CAP	0.0004	0.0005	0.0005	0.0020	68 F	19:47
N2M	35.7202	105.1676	-1.3926	58.3852	--Z-Y	10/10/87
N CAP	0.0003	0.0008	0.0004	0.0002	68 F	19:50
N4M	-35.9301	106.2794	-0.1673	77.6419	--Z-Y	10/10/87
N CAP	0.0004	0.0005	0.0004	0.0025	68 F	19:53
N4C	-21.5516	104.0293	41.5111	42.8573	--Z-Y	10/10/87
N CAP	0.0004	0.0010	0.0005	0.0024	68 F	19:57
NW EAP	-42.5945	83.7124	95.6484	110.1811	--Z-Y	10/10/87
N CAP	0.0004	0.0010	0.0011	0.0023	68 F	20:16
NE EAP	44.0119	93.7377	95.3277	87.9090	--Z-Y	10/10/87
N CAP	0.0004	0.0011	0.0012	0.0051	68 F	20:18
N1Q	0.7810	100.0020	92.2530	47.2559	--Z-Y	10/10/87
N CAP	0.0004	0.0008	0.0010	0.0020	68 F	20:21
N2Q	50.4553	95.3441	-3.5706	129.7876	--Z-Y	10/10/87
N CAP	0.0007	0.0011	0.0005	0.0049	68 F	20:26
N3M	-0.7494	106.1935	-40.6692	98.8579	--Z-Y	10/10/87
N CAP	0.0004	0.0008	0.0003	0.0015	68 F	20:29

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22:09

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JOB FILE: D-2 DETECTOR END CAP REFERENCE

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JOB FILE: D-2 DETECTOR END CAP REFERENCE

***** POINT DATA *****

PT NAME ORIENT	X DOUSE	Y DOUSE	Z DOUSE	DISTANCE CLOSURE	D AXES TEMP	DATE TIME
NIC	0.0318	-00.0511	-91.2548	91.2405	--2--	10/10/87
N CAP	0.0004	0.0005	0.0005	0.0001	68 F	22:30

** THE NEXT 3 POINTS WERE USED TO CREATE THE EAST ORIENTATION **

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: TP-001

000024	-20.4712	-297.3608	55.3168	0.0002	--2--	10/10/87
EAST	0.0008	0.0008	0.0003	0.0004	68 F	22:00

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: TP-002

000025	50.0283	-22.1600	-89.1908	235.5379	--2--	10/10/87
EAST	0.0003	0.0005	0.0005	0.0015	68 F	22:00

REFERENCE VALUE POINT NAME FOR THE FOLLOWING POINT WAS: TP-004

000026	42.9788	54.3513	-126.5500	97.6767	--2--	10/10/87
EAST	0.0005	0.0011	0.0005	0.0036	68 F	22:04

***** END OF POINTS USED TO CREATE THE EAST ORIENTATION *****

SEET67	79.5339	20.6002	-62.5591	68.6735	--2--	10/10/87
EAST	0.0008	0.0001	0.0005	0.0010	68 F	22:13

NEET67	79.7132	79.5612	-82.5975	55.2591	--2--	10/10/87
EAST	0.0005	0.0002	0.0005	0.0012	68 F	22:14

CHECK EAST SIDE TOOL BALLS FROM DIFF ORIENTATION

BALLNE	80.7599	75.9277	-75.0004	4.7240	--2--	10/10/87
EAST	0.0009	0.0002	0.0005	0.0010	68 F	22:22

BALLSE	50.5949	20.2701	-77.9159	55.6591	--2--	10/10/87
EAST	0.0005	0.0002	0.0004	0.0005	68 F	22:26

***** END OF RECAP FOR JOB FILE D-2 DETECTOR END CAP REFERENCE *****

30, CW, MC CONTINUED FROM p 94 THIS BOOK
 12-2-87
 BK D.O., 75-1 WEST SIDE

STATION	R S			H I	F S			HEIGHT	REMARKS
	STA	SCALE	RIC		STA	SCALE	RIC		
E.M. ON FLOOR WEST TABLE		42"	.151"	142.151				100.000"	RANDOM HEIGHT FROM 95 THIS BK TOP OF TABLE
A					3"	1.6	.024	137.527"	"
B					3"	1.6	.050	137.501"	"
C					3"	1.6	.045	137.506"	"
D					3"	1.8	.030	137.321"	"
E					3"	1.6	.009	137.542"	"
F					3"	1.7	.057	137.394"	"
S.W. LEG									BOT. OF STAIN. STEEL
A					(0.2)	.100		142.251"	"
B					(0.1)	.083		142.168"	142.221 "
C					(0.1)	.006		142.245"	513 "
TOOLING BALL					(5")	(1.6)	.075	148.676"	
N.W. LEG									
A					(0.2)	.065		142.286"	"
B					(0.1)	.972		142.179"	142.251 "
C					(0.1)	.009		142.251"	"
TOOLING BALL					(5")	(1.7)	.094	148.757"	
E.M. ON FLOOR		42"	.153"					99.998"	CLOSE OUT

NORTH
 PLAN VIEW

CK
 12-3-87
 ED

96

A-34

TD, CW, MC
12-2-87
BK D.975-1

CONTINUED FROM P. 95 THIS BK.

HEIGHT OF BOSSES

STATION	B.S.			H I	F S			HEIGHT	REMARKS
	STK	SCALE	MIC		STK	SCALE	MIC		
B.M. ON FLOOR		65"	.194	165.194				100.000	RANDOM H.S. FROM P. 95 THIS BK
N.E. BOSS					3"	1.0	.089	161.105	
N.W. BOSS					3"	1.0	.037	161.157	
S.E. BOSS					3"	1.2	.066	160.928	
S.W. BOSS					3"	1.1	.025	161.069	
EAST TABLE P.A.					28"	.030		137.164	CHECK
WEST TABLE P.T.F.					27.5"	.307		137.397	CHECK
B.M. ON FLOOR		65"	.193					100.001	CLOSE OUT

MEASURE TO THIS SURFACE

CK
12-3-87
ED

4-35 OT

J.D. CW, MC

12-2-87

BK D, 0.75-1.

SUMMARY OF BOSS TO LEG DIFFERENCES
FROM P. 94, 95, 96 THIS BOOK

LOCATION	DIFFERENCE	GAP (= THEO - MEASURED)
N.E. BOSS	18.913"	0.100"
N.W. BOSS	18.918"	0.105
S.E. BOSS	18.892"	0.079
S.W. BOSS	18.898"	0.035

C.K.
12-3-87
ED

98

A-36

D, LW, MC
12-3-87
BK D.O., 75-1

MEASURE THE NOZZLES ON TOP OF THE CENTER
VESSEL RELATIVE TO A COMMON HORIZ PLANE
SURVEY DONE IN LABA.
SEE P. 99 THIS BL FOR LOCATION OF POINTS SURVEYED

STATION	BS		HI	FS			HEIGHT	REMARKS
	SCALE	MIC		STK	SCALE	MIC		
BM ON VESSEL	13.7	.078	113.778"				100.000"	STAINLESS RIM (RANDOM HEIGHT)
N 1								
NE .233 LOW				15"	12.4	.001	86.377"	THREADED HOLE FLANGE
NW .109 LOW				15"	12.3	.063	86.415"	"
SE .354 HI				15"	12.6	.010	86.168"	"
SW .232 LOW				15"	12.1	.018	86.660"	"
N 2								
NW .309 LOW				—	19.5	.063	94.215"	SESS " "
SE .101 LOW				—	19.4	.079	94.299"	" "
N 3 .540 LOW				—	12.3	.013	101.465"	(NORTHSIDE) TOP FLANGE
N 4				3"	8.8	.006	101.972"	HIGHEST POINT
N 6				3"	7.8	.070	102.908"	HIGHEST POINT
N 11 .23 HI				—	17.0	.039	96.739"	THREADED HOLE FLANGE
N 13				3"	18.9	.090	91.788"	TOP OF FLANGE
REF. BARS								
NE				3"	6.9	.018	103.860"	≈ 107" ABOVE E
NW				3"	7.0	.004	103.774"	"
SE				3"	7.1	.028	103.650"	"
SW				3"	7.2	.052	103.526"	"
NW PIPE SUPP.								
1.5" Ø				2"	10.9	.004	100.874"	BOT. OF I.D.
3.75" Ø				2"	11.9	.013	99.865"	"
7.00" Ø				2"	14.8	.071	96.907"	"
SW PIPE SUPP.								
1.5" Ø				2"	11.2	.049	100.529"	BOT. OF I.D.
3.75" Ø				2"	12.1	.068	99.610"	"
7.0" Ø				2"	14.9	.080	96.798"	"
BM ON VESSEL				—	13.7	.075	100.003"	CLOSE OUT

JD. LOCATION OF NOZZLES SURVEYED ON
12-4-87 P. 98 THIS BOOK
BIC 00,75-1

NORTH

JD, CW, MC HORIZ. DISTANCES TO NOZZLES, PIPE SUPPORTS,
 12-5-87 AND REF. BARS LOCATED ON TOP OF VESSEL.
 BK D.O., 75-1 ACCURACY IS $\pm .100"$

NOTE: ALL MEASUREMENTS ARE FROM
 A LINE DEFINED BY EXISTING
 PUNCH MARKS ON TOP OF VESSEL.

NORTH

4-34-1 101

JO
12-5-87
BK 00,75-1

SCRATCH NOTES FOR P.100 THIS BK

RDC 11/20/87

BARS ARE 1.5"

AS BUILT NOZZLE
LOCATIONS

1.5 1.75
3.75 1.875
7.00 3.5

MEASURED BY: