



TS-SSC 91-184
9/24/91
J. Strait

DCA313 Shell Gauge Data During Welding Operation

Attached are shell strain gauge data taken during the welding of DCA313. The gauges are at the same locations as on DCA312 and the same analysis and plots are shown here as for 312[1]. The data are displayed in Table I. The gauge at 36 degrees near the lead end failed when the press was closed and it is not included in the table. The compensating gauge towards the return end (C2) failed during the welding process; its data are included in the table but not in the plots.

Figure 1 plots the data sequentially and Figure 2 shows the strain changes versus press load before welding. There were apparently no data taken after the upper press platen was lowered onto the magnet but before the hydraulic cylinders were energized. Otherwise the data follow the same pattern as DCA312: bending effects drive some gauges positive and others negative as the press closes, strains increase as the shell is welded, and then redistribute themselves slightly as the press is opened. Figure 3 shows the strain change from the press closure versus the angle from the weld. The pattern of bending effects is qualitatively the same as in DCA312. Figure 4 is a plot of the strain change due to welding. As in DCA312, there is a large change in the gauges at 17, 28 and 36 degrees, relatively little change at 61 degrees, and a somewhat larger change at 90 degrees. The change when the press is opened is plotted in Figure 5. As in DCA312 the stress redistributes slightly from the shell parting plane towards 90 degrees.

The effect of welding is a combination of azimuthal tension and further bending as the shell is pulled into better conformance with the yoke. Figure 6 shows crude attempts at correcting for the bending by subtracting from the raw strain change a multiple of the bending observed as the press is closed. Plotted there are the average of the two gauges versus angle from the weld, and this average corrected by subtracting 1 and 1.5 times the change with press closure. The case of a 1.5 times the press closure change yields a smooth distribution over the 17-36 degree gauges (which does not prove that this correction is correct). As with DCA312 the apparent strain change due to shell tension near the weld is on the order of 1500 microstrain, corresponding to a stress of 45 kpsi.

However, the corrected strain changes at 60 and 90 degrees are still quite small and, as with DCA312, a smooth distribution cannot be obtained by this simple correction procedure. It is quite possible that there really is a large loss of stress between the 36 and 61 degree measurements because the shell could be binding on the yoke pack pick-up features near 45 degrees[2]. This does not, however, explain how there can be a substantially larger strain change at 90 degrees than at 61 degrees. The gauges have already been mounted

on the shell for DCA314, but it is planned to change the locations of the gauges on DCA315 to try to understand this pattern.

REFERENCES

- [1] J. Strait, DCA312 Shell Gauge Data During Welding Operation, TS-SSC 91-179, 9/13/91.
- [2] This was pointed out to me by Eric Haggard.

Distribution:

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Table I

DCA313 50mm Long Magnet Pre-weld Instrumentation Data Files
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 CALCULATED STRAIN READINGS

Force	-A1-	-A2-	-A3-	-A4-	-A5-	-A6-	-A7-	-A8-	-A9-	-A10-	-C1-	-C2-
P (hydr)	17° (L)	28° (L)	61° (L)	90° (L)	17° (R)	28° (R)	36° (R)	61° (R)	90° (R)	90° (R)	-C1-	-C2-
0	0	0	0	0	0	0	0	0	0	0	0	0
0	2	-3	2	2	2	2	7	2	7	7	2	2
1000	200	445	55	55	141	295	-116	109	82	82	-20	-3
2000	224	561	10	10	160	357	-139	112	149	149	-11	0
3000	223	555	-1	-1	165	362	-129	111	154	154	-6	10
4000	243	622	-14	-14	173	397	-137	114	189	189	2	8
5000	237	648	-25	-25	179	424	-137	114	216	216	2	8
6000	243	670	-35	-35	179	440	-126	125	253	253	-3	8
7000	234	693	-50	-50	184	463	-114	132	293	293	-1	9
8000	227	713	-60	-60	180	472	-100	141	323	323	2	13
9000	223	688	4	4	180	452	-114	127	309	309	-1	9
10000	1209	1833	43	43	768	1668	404	289	603	603	11	3
12000	1213	1837	35	35	754	1660	398	288	595	595	9	-4
14000	1211	1835	45	45	764	1670	406	292	605	605	13	6
16000	1792	2719	80	80	1791	2381	905	368	800	800	12	1643
18000	2081	3191	96	96	2127	2746	1129	385	864	864	5	-20
20000	2104	3230	90	90	2153	2784	1155	384	886	886	10	1676
22000	2111	3237	97	97	2160	2797	1172	401	900	900	22	1689
24000	2108	3234	104	104	2162	2798	1164	398	900	900	24	1691
26000	2095	3216	129	129	2160	2792	1157	428	920	920	22	1694
28000	2058	3174	258	258	2150	2770	1146	487	984	984	22	1689
30000	2056	3172	266	266	2148	2768	1144	491	983	983	22	1692

Strain change due to press closure
 Angle 17 28 36
 Lead End 1881 2542 1269
 turn End 1973 2332 1269
 Average 1927 2437 1269
 *Closure 1722 1845 1369
 1619 1548 1419

Strain change due to welding
 Angle 17 28 36
 Lead End 1881 2542 1269
 turn End 1973 2332 1269
 Average 1927 2437 1269
 *Closure 1722 1845 1369
 1619 1548 1419

Strain change due to press opening
 Angle 17 28 36
 Lead End 1881 2542 1269
 turn End 1973 2332 1269
 Average 1927 2437 1269
 *Closure 1722 1845 1369
 1619 1548 1419

Weld - 1*closure
 Weld - 1.5*closure

1st root 9/18/91 7:50:41
 2nd root 9/18/91 7:53:27
 1st filler 9/19/91 7:24:0E
 2nd filler 9/19/91 13:07:41

DCA312 Shell Guages: Histories during shell welding

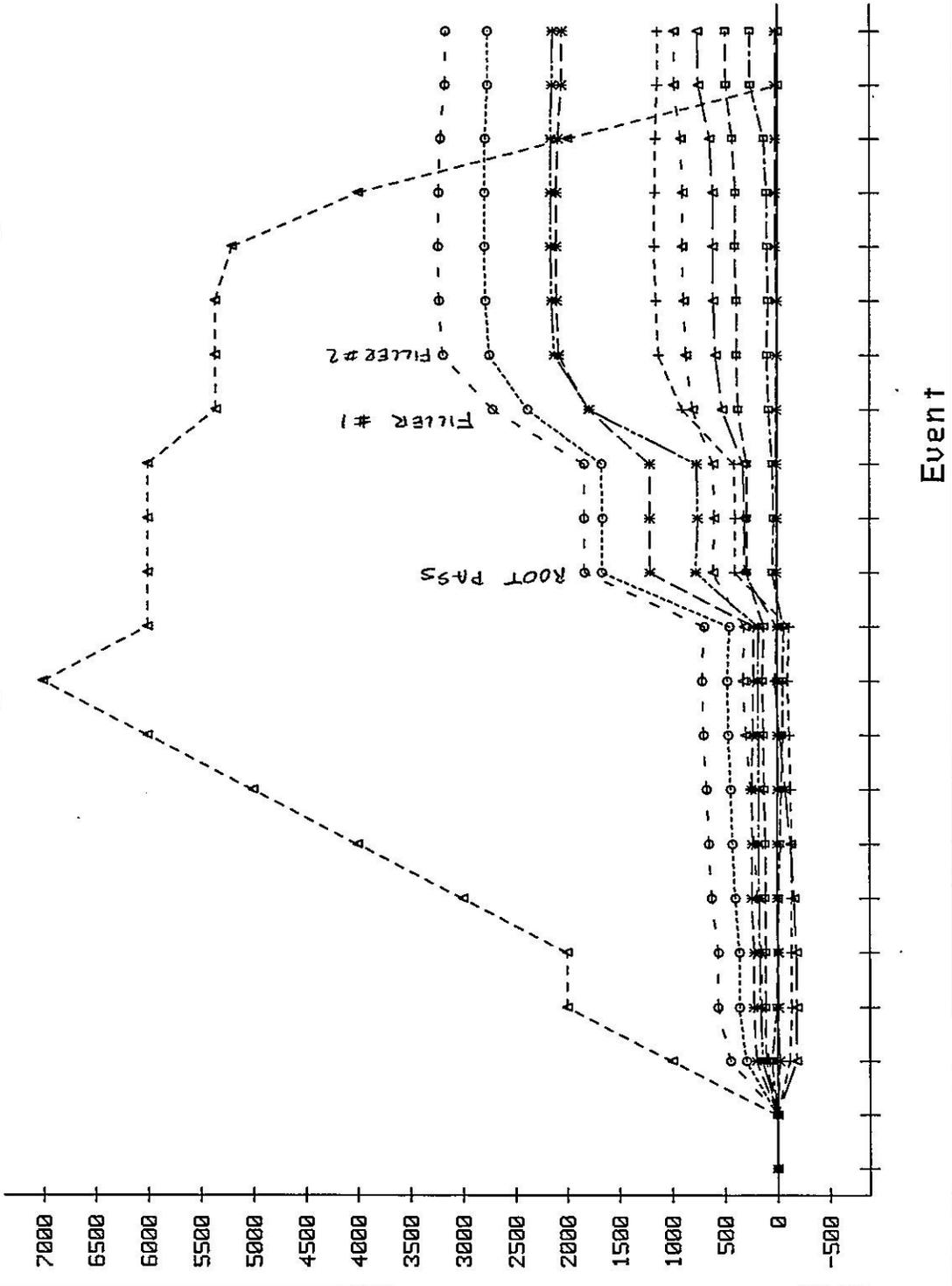
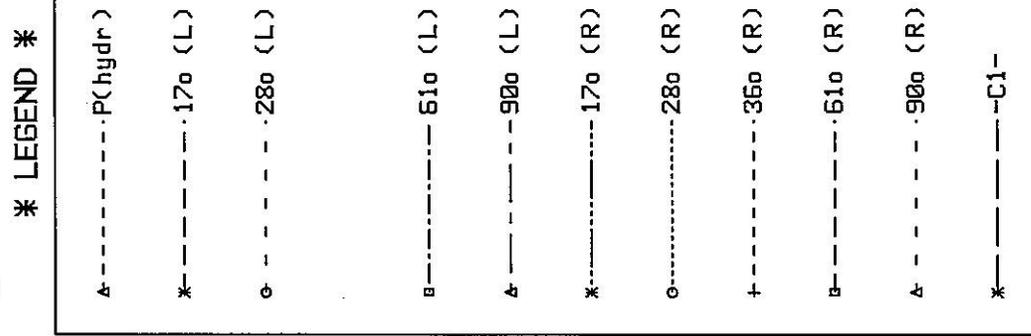


Figure 1

DCA312 Shell Guages: Change during press closure

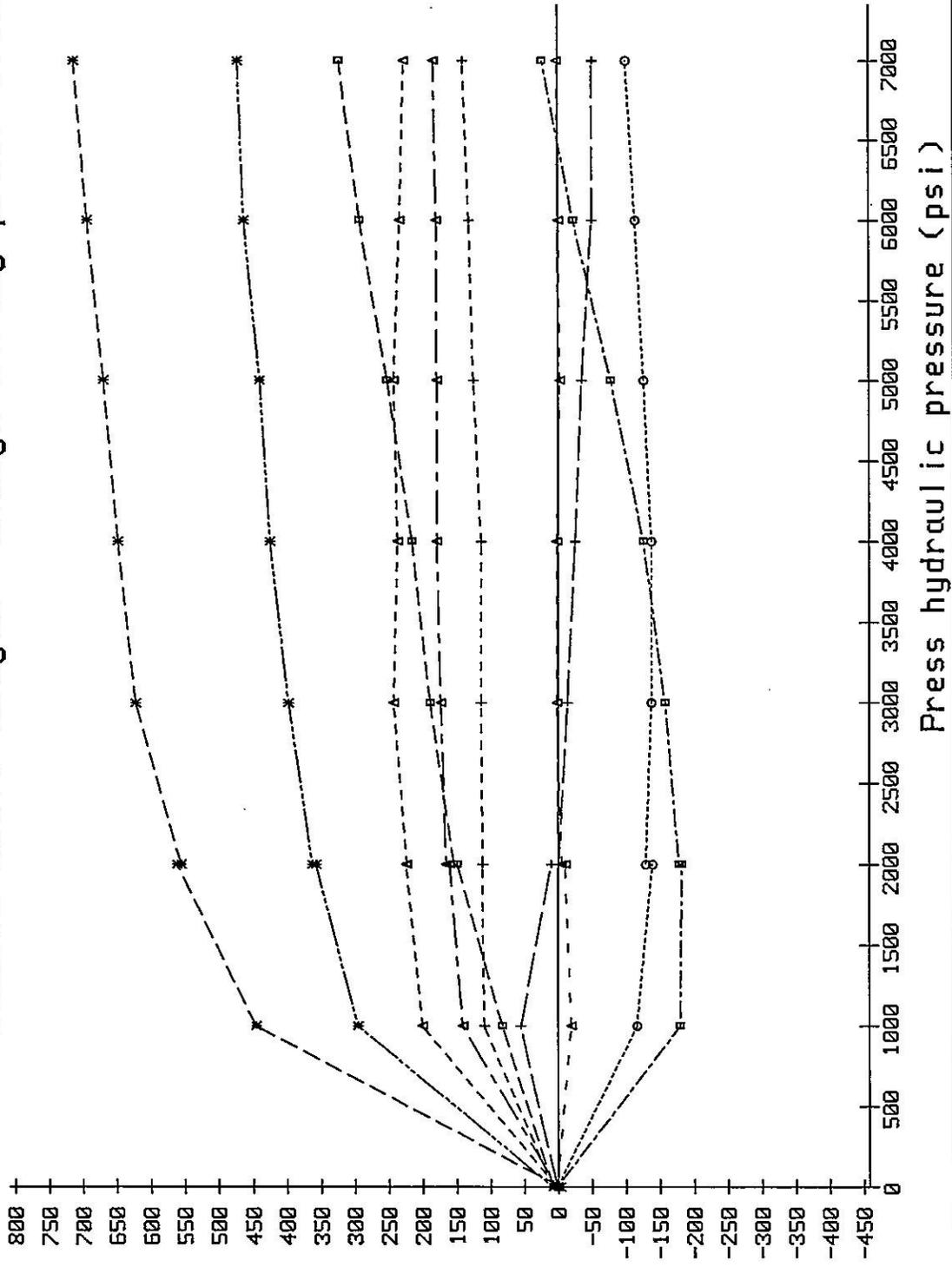


Figure 2

DCA312 Shell Guages: Change due to press closure

* LEGEND *

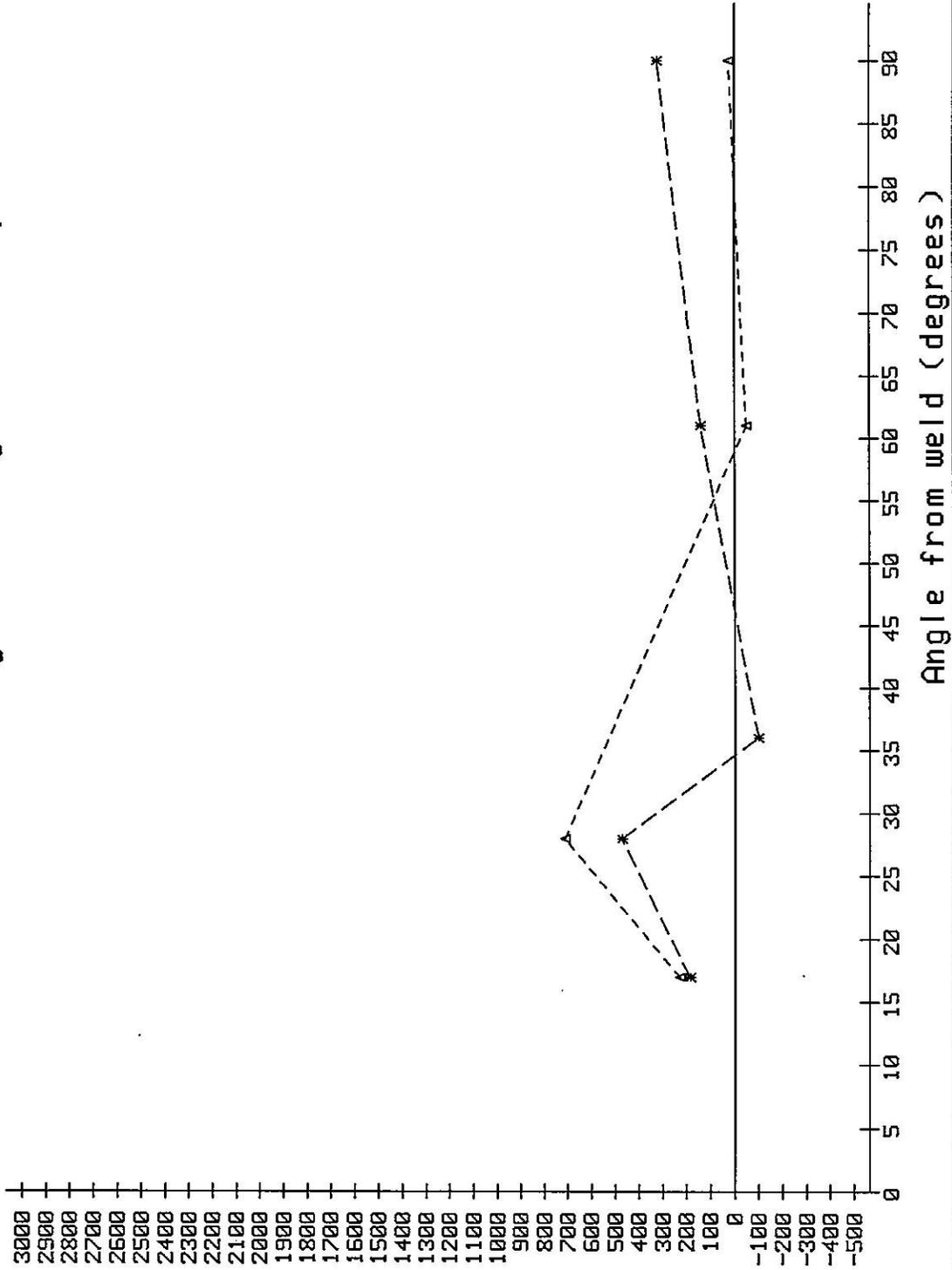
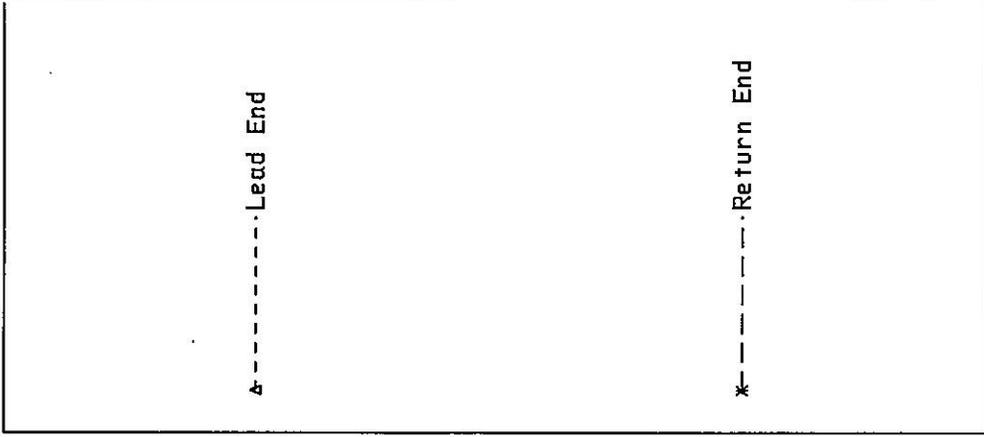
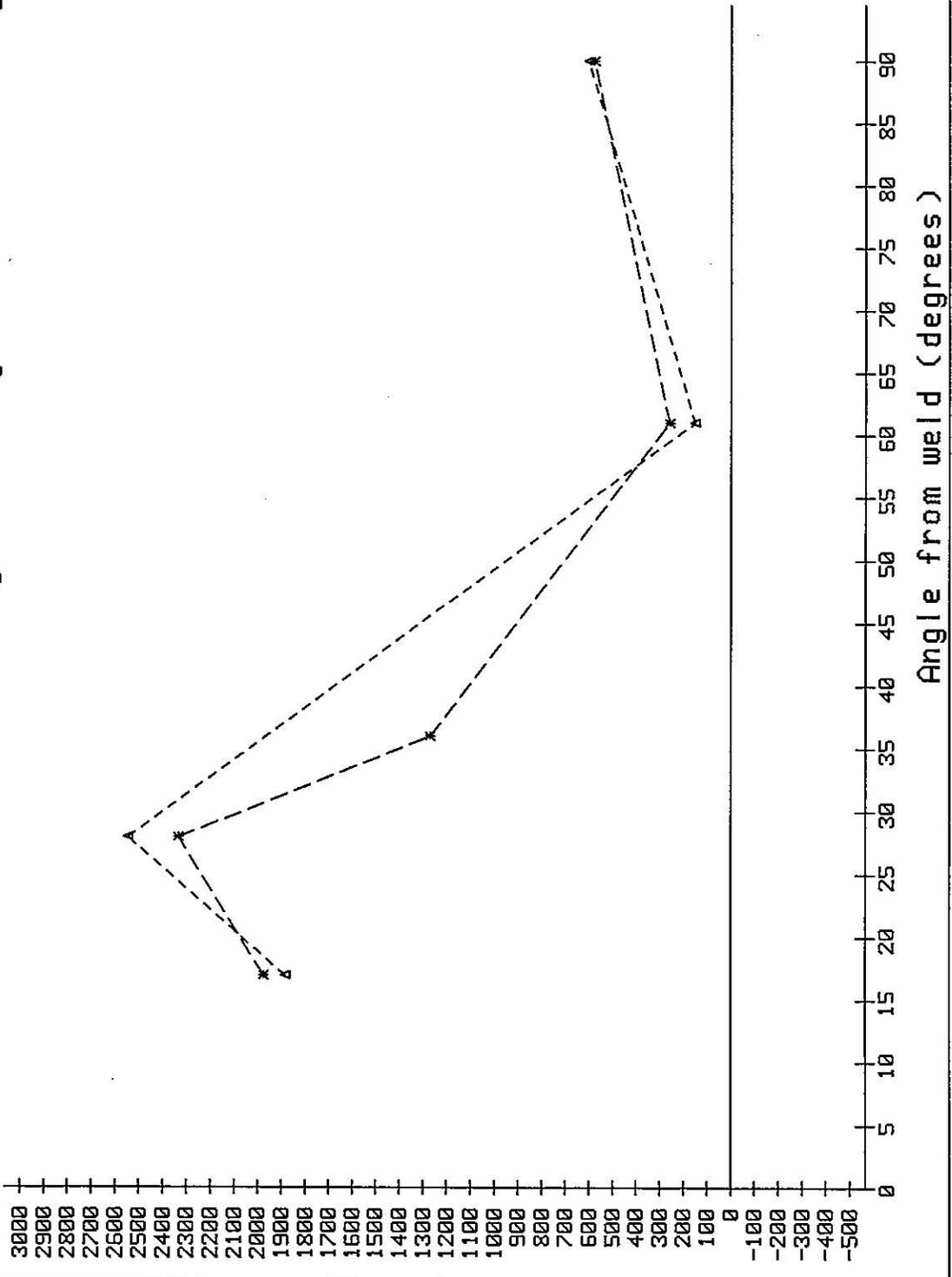


Figure 3

DCA312 Shell Guages: Change due to welding



* LEGEND *

A-----Lead End

*-----Return End

Figure 4

DCA312 Shell Gages: Change due to press opening

* LEGEND *

Lead End
 Return End

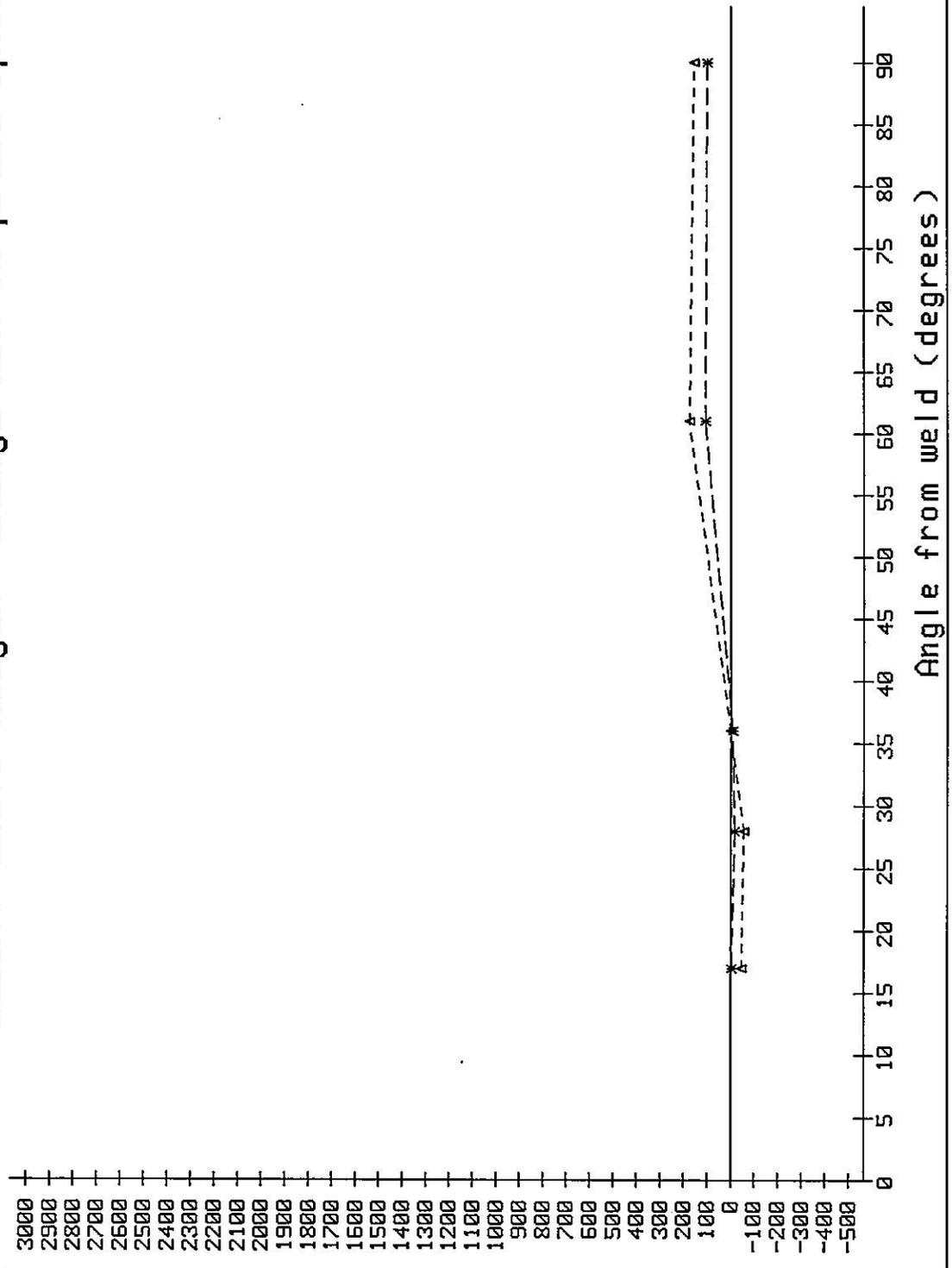


Figure 5

DCA312 Shell Gauges: Change due to welding

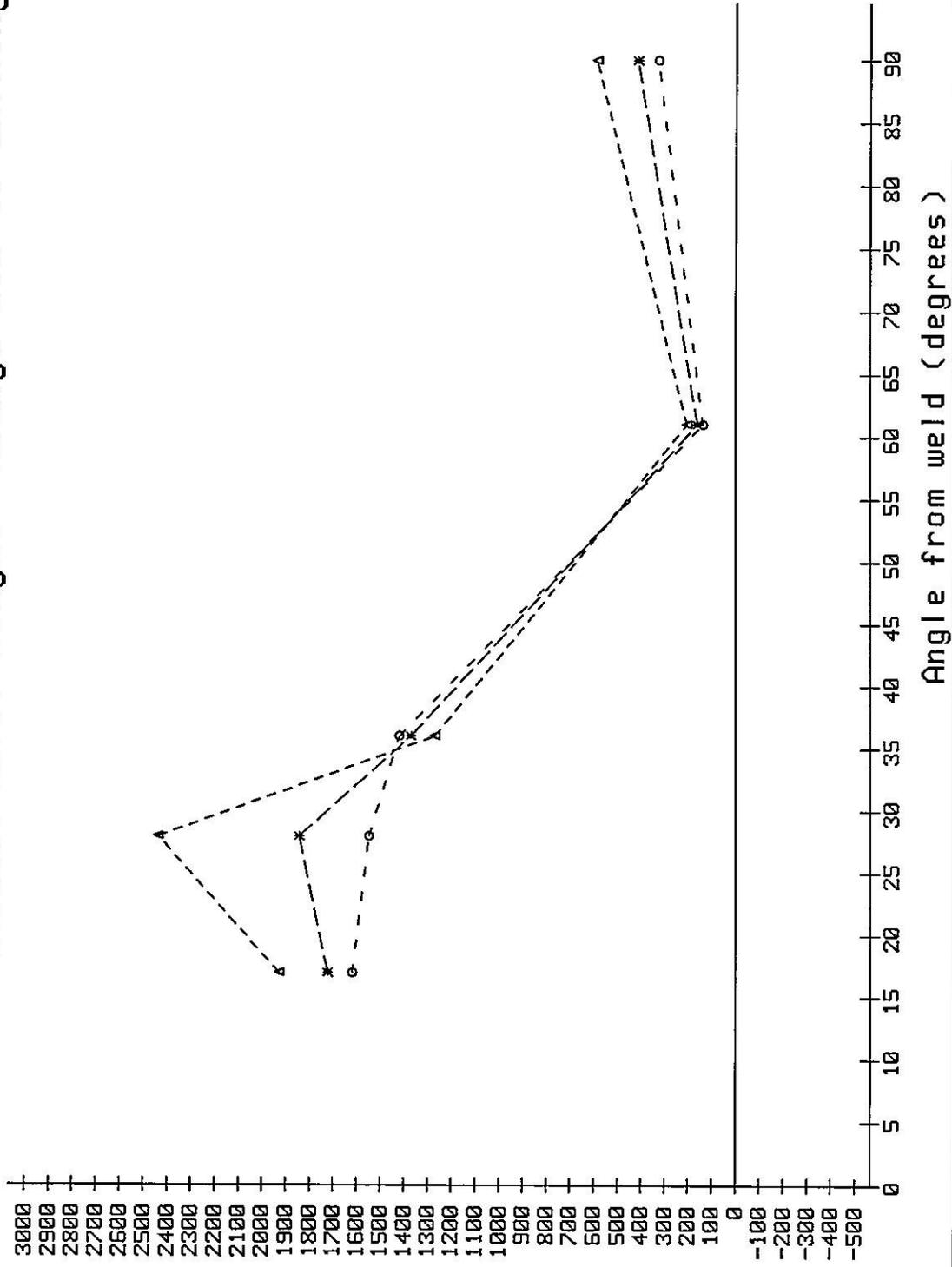


Figure 6