



Effect of Reduced Press Load on Shell Tension

To investigate the true requirements for the yoking press, the practice short magnet DSA327 was yoked using a modified procedure[1] which specified that the shell be welded at about 1/3 the load used on previous short and long magnets. As in the normal procedure the press was initially closed to a load of about 13000 lbs/in (3500 psi in the hydraulic system) to measure the response of the coil stresses to loads applied to the collars through the yoke. The press was then opened and then closed again to a load of 2900 lbs/in (hydraulic system $P = 1000$ psi) for welding. For comparison the load normally used is 10400 lbs/in (2800 psi) for short magnets and 12200 lbs/in (6000 psi) for long magnets[2].

The histories of the average inner and outer coil stress data are shown in Table I and Figure 1, including the two collaring assemblies earlier this year. The load increase and decrease with press closing and opening can be seen. As is normal, the outer coil is largely unaffected. (The small discontinuity in the down ramp data for the inner coil probably results from readout problems. In the same data sets several of the outer coil compensating gauges showed large changes in resistance which resulted in large changes in apparent strain and stress. These were "fixed" by using the "unaffected" compensating gauges for these measurements. No obvious problems can be seen in the inner coil data, but the data corresponding to "event numbers" 46-49 are suspect.) A large increase in inner coil load, to a value comparable to that at peak press load, is observed with shell welding. (I suspect that the reported press hydraulic pressure of 0 at event number 55 is an error and that the press was in fact closed at this point.)

The press hydraulic pressure was converted to a load per unit length as before[3]. The coil stress as a function of press load before welding is shown in Figure 2. The dashed horizontal lines show the final coil stresses after welding. The applied press load during welding is indicated also. The final inner coil stress corresponds to that with a press load of about 12000 lbs/in, which corresponds to a shell stress at the weld of about 30 kpsi. This is the same as observed in other magnets welded at higher press load[3]. The data from DSA324 are shown in Figure 3 for comparison. Despite the greater than a factor of 3 difference in the press load during welding, the deduced final shell tension is essentially identical.

The conclusion is that at least from the standpoint of achieving adequate azimuthal stress in the shell, the press load applied during welding can be much less than we have been using. I would caution, however, that with a lower load applied the yoke gap will be open before shell welding, both for vertically split and for horizontally split yoke magnets. This may lead to a less well defined magnet geometry with consequent adverse consequences for field quality. This issue is not addressed by this test.

REFERENCES

- [1] J. Strait, DSA327 shell welding experiment procedure, TS-SSC 91-181, 9/18/91
- [2] The intent was to have the long and short magnet press loads be the same, but "small" correction factors for the load to overcome the short press springs and the weight of the long press upper platen were ignored in writing the procedures. See [3] for a discussion of these corrections.
- [3] J. Strait, Estimated shell tension from coil stress data, TS-SSC 91-182, 9/20/91.

Distribution

R. Bossert
J. Carson
S. Delchamps
A. Devred
C. Goodzeit
M. Gordon
N. Hassan
W. Koska
M. Lamm
M. Packer
E.G. Pewitt
R. Riecken
H. Trenham
M. Wake
R. Williams

Table I

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|-----|------------|----------|-----------|--------------------|------------|----------------|-------|---|---|---|----------------------------|--|-------------|----------|
| 340 | | | | Hydraulic Pressure | | Average Stress | | | | | | | | |
| 341 | Seq Number | Date | Time | Vertical | Horizontal | Inner | Outer | | | | pump psi to contact magnet | | | 300 |
| 342 | 1 | 05/07/91 | 0.3298611 | 0 | 0 | -133 | 7 | | | | | | (collaring) | (yoking) |
| 343 | 2 | 05/07/91 | 0.3520833 | 780 | 0 | 219 | 1421 | | | | | MPa / psi | 0.0069046 | |
| 344 | 3 | 05/07/91 | 0.3590278 | 2000 | 0 | 1744 | 4054 | | | | | (N/mm) / (lbs./in.) | 0.1754 | |
| 345 | 4 | 05/07/91 | 0.3618056 | 4000 | 0 | 5596 | 9436 | | | | | Vertical press load (lbs./in) / pump psi | 5.909 | 4.167 |
| 346 | 5 | 05/07/91 | 0.3645833 | 6000 | 0 | 10249 | 15746 | | | | | Horizontal press load (lbs./in) / pump psi | 1.000 | |
| 347 | 6 | 05/07/91 | 0.36875 | 7000 | 0 | 12481 | 18982 | | | | | | | |
| 348 | 7 | 05/07/91 | 0.3715278 | 8000 | 0 | 14045 | 21093 | | | | | | | |
| 349 | 8 | 05/07/91 | 0.3756944 | 8500 | 0 | 14165 | 21509 | | | | | | | |
| 350 | 9 | 05/07/91 | 0.3944444 | 8356 | 65 | 13865 | 21372 | | | | | | | |
| 351 | 10 | 05/07/91 | 0.3972222 | 8352 | 200 | 13967 | 21516 | | | | | | | |
| 352 | 11 | 05/07/91 | 0.4 | 8348 | 400 | 14102 | 21693 | | | | | | | |
| 353 | 12 | 05/07/91 | 0.4034722 | 8344 | 600 | 14170 | 21786 | | | | | | | |
| 354 | 13 | 05/07/91 | 0.40625 | 8344 | 800 | 14212 | 21845 | | | | | | | |
| 355 | 14 | 05/07/91 | 0.4104167 | 4000 | 788 | 12871 | 19393 | | | | | | | |
| 356 | 15 | 05/07/91 | 0.4138889 | 4132 | 0 | 12662 | 19224 | | | | | | | |
| 357 | 16 | 05/07/91 | 0.4166667 | 0 | 0 | 9817 | 14335 | | | | | | | |
| 358 | 17 | 05/07/91 | 0.4194444 | 0 | 0 | 9755 | 14245 | | | | | | | |
| 359 | 18 | 05/07/91 | 0.4208333 | 0 | 0 | 9739 | 14224 | | | | | | | |
| 360 | | | | | | | | | | | | | | |
| 361 | 20 | 06/11/91 | 0.5708681 | 0 | 0 | -124 | 75 | | | | | | | |
| 362 | 21 | 06/11/91 | 13:44:4 | 800 | 0 | 478 | 1881 | | | | | | | |
| 363 | 22 | 06/11/91 | 13:45:3 | 2000 | 0 | 2022 | 4733 | | | | | | | |
| 364 | 23 | 06/11/91 | 13:48:2 | 4000 | 0 | 5505 | 10092 | | | | | | | |
| 365 | 24 | 06/11/91 | 13:53:1 | 6000 | 0 | 9780 | 16168 | | | | | | | |
| 366 | 25 | 06/11/91 | 13:56:5 | 7000 | 0 | 11918 | 19281 | | | | | | | |
| 367 | 26 | 06/11/91 | 14:04:4 | 8000 | 0 | 12963 | 20914 | | | | | | | |
| 368 | 27 | 06/11/91 | 14:18:2 | 8500 | 0 | 13023 | 21210 | | | | | | | |
| 369 | 28 | 06/11/91 | 14:56:1 | 8389 | 65 | 12832 | 21154 | | | | | | | |
| 370 | 29 | 06/11/91 | 15:00:1 | 8387 | 200 | 12899 | 21233 | | | | | | | |
| 371 | 30 | 06/11/91 | 15:02:4 | 8386 | 400 | 12952 | 21301 | | | | | | | |
| 372 | 31 | 06/11/91 | 15:04:5 | 8386 | 600 | 13002 | 21355 | | | | | | | |
| 373 | 32 | 06/11/91 | 15:09:1 | 4000 | 594 | 11621 | 18799 | | | | | | | |
| 374 | 33 | 06/11/91 | 15:12:4 | 4119 | 0 | 11478 | 18683 | | | | | | | |
| 375 | 34 | 06/11/91 | 15:16:1 | 0 | 0 | 8796 | 13880 | | | | | | | |
| 376 | 35 | 06/11/91 | 15:29:5 | 0 | 0 | 8763 | 13823 | | | | | | | |
| 377 | 36 | 06/11/91 | 15:30:5 | 0 | 0 | 8762 | 13819 | | | | | | | |
| 378 | | | | Yoking | lbs/in | | | | | | | | | |
| 379 | 38 | 09/26/91 | 09:06:4 | 0 | 0 | 6595 | 12452 | | | | | | | |
| 380 | 39 | 09/26/91 | 09:07:5 | 800 | 2083 | 7220 | 12564 | | | | | | | |
| 381 | 40 | 09/26/91 | 09:08:4 | 1000 | 2917 | 7435 | 12596 | | | | | | | |
| 382 | 41 | 09/26/91 | 09:09:0 | 1500 | 5000 | 7930 | 12732 | | | | | | | |
| 383 | 42 | 09/26/91 | 09:09:4 | 2000 | 7083 | 8403 | 12862 | | | | | | | |
| 384 | 43 | 09/26/91 | 09:10:0 | 2500 | 9167 | 8765 | 12927 | | | | | | | |
| 385 | 44 | 09/26/91 | 09:10:4 | 3000 | 11250 | 8963 | 12938 | | | | | | | |
| 386 | 45 | 09/26/91 | 09:11:1 | 3500 | 13333 | 9151 | 12924 | | | | | | | |
| 387 | 46 | 09/26/91 | 09:12:0 | 3000 | 11250 | 8511 | 12899 | | | | | | | |
| 388 | 47 | 09/26/91 | 09:12:5 | 2500 | 9167 | 7822 | 12903 | | | | | | | |
| 389 | 48 | 09/26/91 | 09:13:3 | 2000 | 7083 | 8019 | 12778 | | | | | | | |
| 390 | 49 | 09/26/91 | 09:14:3 | 1500 | 5000 | 7514 | 12662 | | | | | | | |
| 391 | 50 | 09/26/91 | 09:15:1 | 1000 | 2917 | 7036 | 12498 | | | | | | | |
| 392 | 51 | 09/26/91 | 09:15:4 | 800 | 2083 | 6916 | 12472 | | | | | | | |
| 393 | 52 | 09/26/91 | 09:16:1 | 0 | 0 | 6410 | 12198 | | | | | | | |
| 394 | 53 | 09/26/91 | 09:17:2 | 1000 | 2917 | 7246 | 12351 | | | | | | | |
| 395 | 54 | 09/26/91 | 10:13:1 | 1000 | 2917 | 7500 | 12457 | | | | | | | |
| 396 | 55 | 09/26/91 | 10:52:0 | 0 | 0 | 8493 | 12763 | | | | | | | |
| 397 | 56 | 09/26/91 | 13:12:2 | 1000 | 2917 | 8903 | 12893 | | | | | | | |
| 398 | 57 | 09/26/91 | 14:24:3 | 1000 | 2917 | 9261 | 13027 | | | | | | | |
| 399 | 58 | 09/26/91 | 14:29:2 | 1000 | 2917 | 9292 | 13023 | | | | | | | |
| 400 | 59 | 09/26/91 | 14:29:5 | 0 | 0 | 9010 | 13027 | | | | | | | |

DSA327 Chart

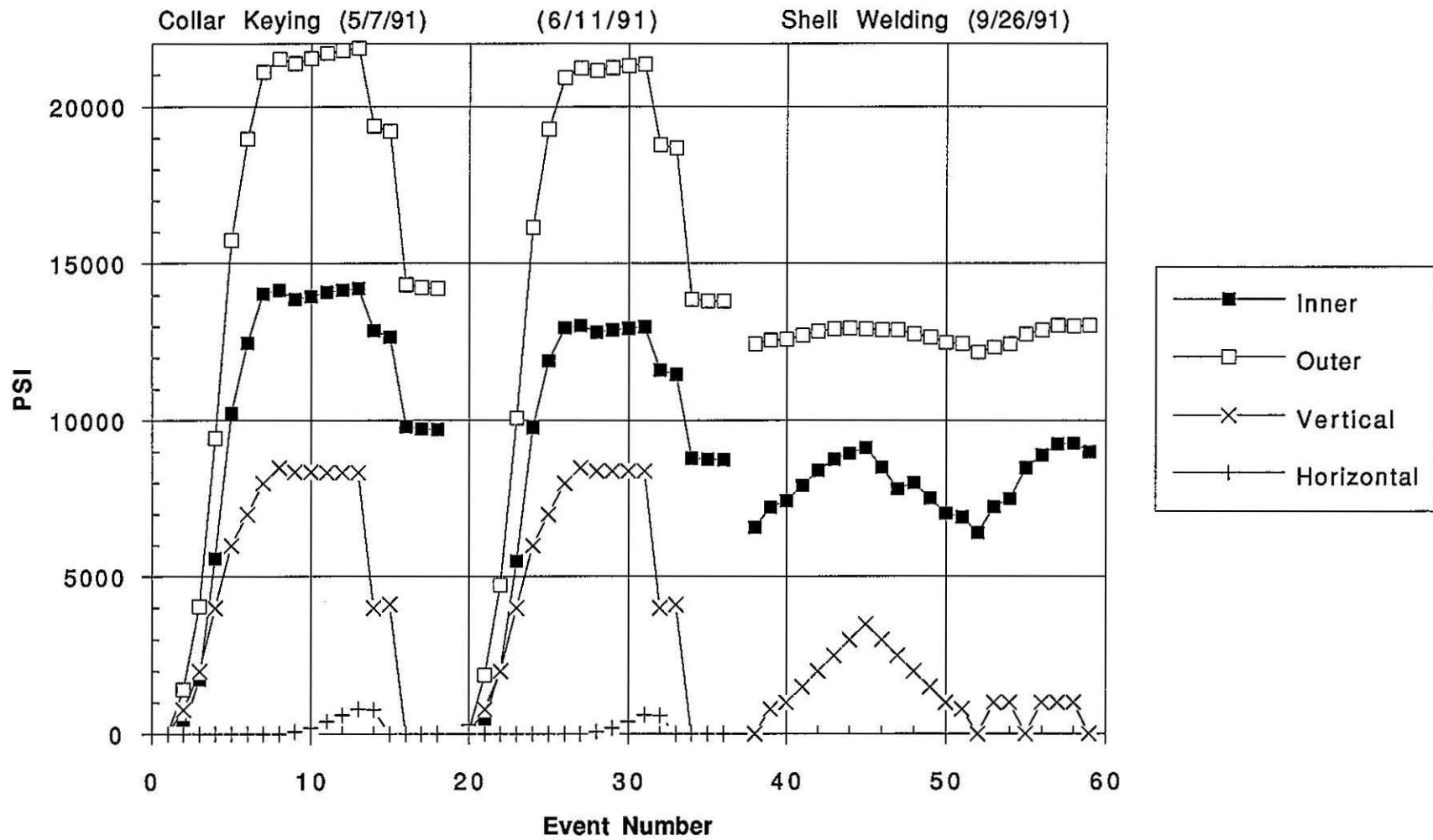


Figure 1

DSA327 Yoking

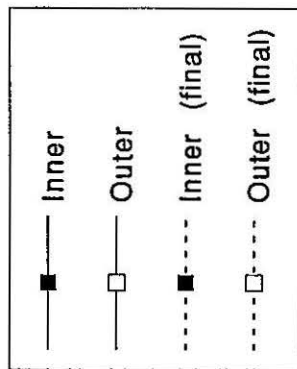
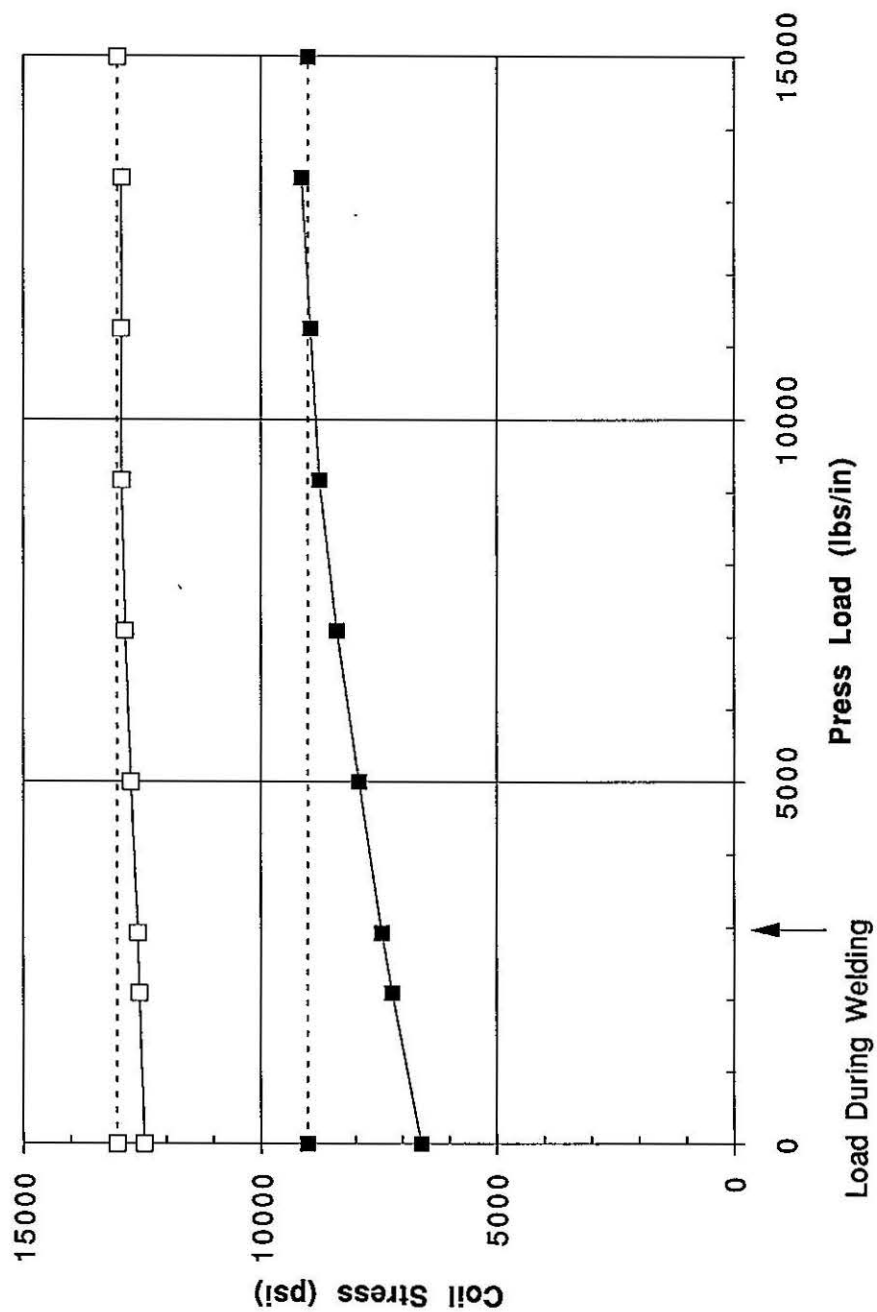


Figure 2

DSA324 Yoking

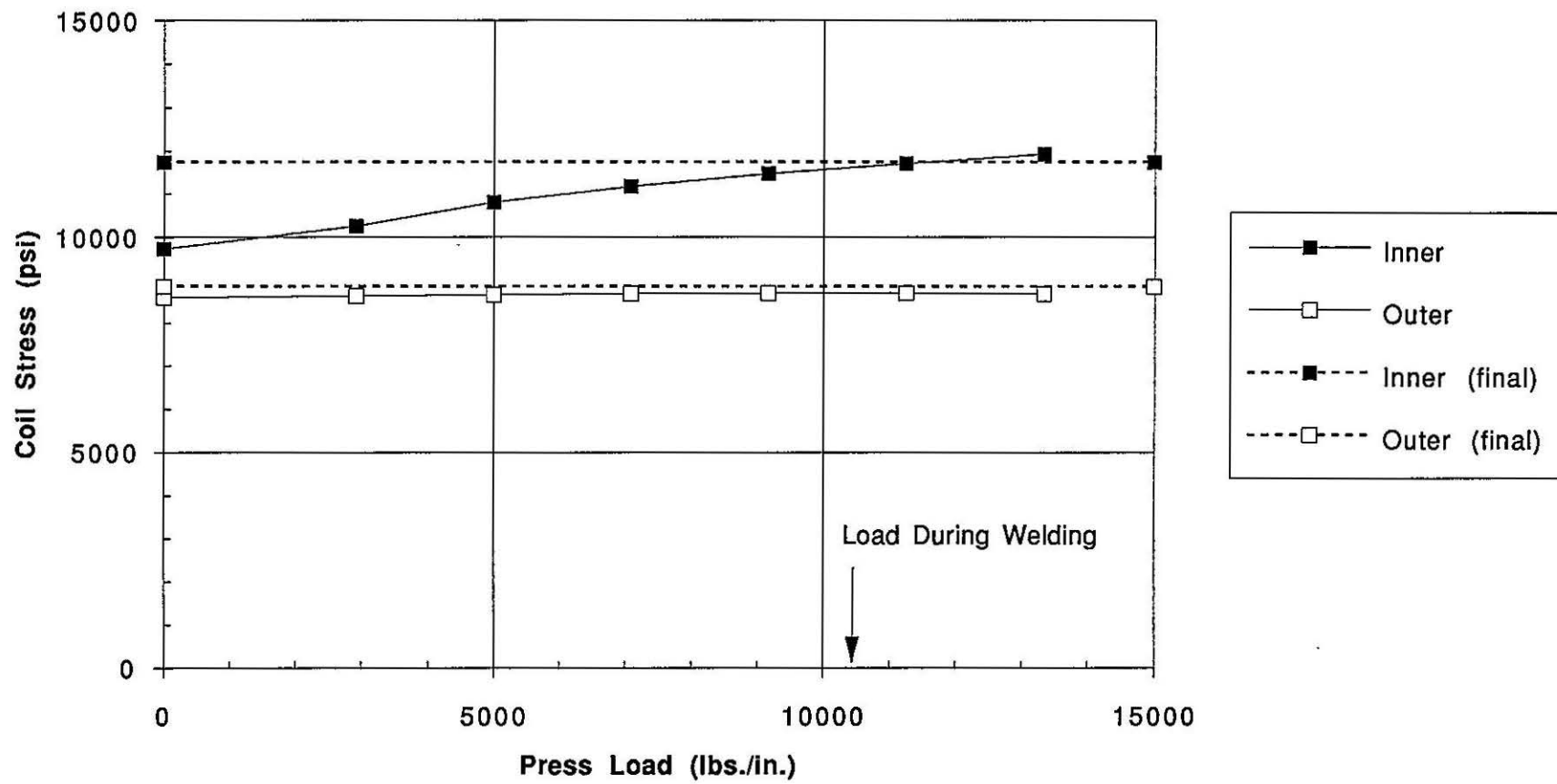


Figure 3

