Fermilab

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FROM: Jim Strait

SUBJECT: DC0302 and DS0311 Collaring: Press Gap Data

The gap between the upper press platen and the lower tooling is measured at several points along the press when a collared coil is keyed in the collaring press. Data were recorded on the first keying attempt on DC0302 and on three attempts on DS0311; both magnets were keyed in the long press in ICB. Strain gage data have been previously presented for DC0302 [1] but the DS0311 data have not been formally published.

Gap data were recorded for DC0302 at the two ends and the middle of the magnet and at the two strain gage packs, which are located 1/3 and 2/3 of the way from the lead to the return end. Data for DS0311 was recorded at the two ends and the moddle of the magnet. DS0311 was collared near the end of the press corresponding to the lead end of a long coil. Figure 1 shows the average of all measurements for each pressing as a function of $P_{HYDRALIC}$. On the third attempt on DS0311 gaps larger than 15 mils were recorded only as ">15," so meaningful average can be computed only for $P_{HYDRALIC} \geq 4$ kpsi. On the first attempt on DC0302, the coil was partially keyed.[1] On the first attempt on DS0311 the keys were not inserted. Keys were inserted on the second attempt but the insertion was found to be incomplete; full insertion was achieved on the third attempt. I do not know

what press shims were used or how much pressure was applied to the side hydraulic cylinders. A 12 mil shim was used between the upper tooling and the press platten on the first attempt on DC0302.

Figure 2 shows the press gap as a function of position along the coil for DC0302 for three pressures. At each position the average of the gap on two sides is plotted. The gap varies by about 10 mils along the length of the coil. The press closes at essentially the same rate at all points.

The data in Figure 1 have a couple of notable features. First, the gaps in DS0311 are about 20 mils smaller than those in DC0302 despite the fact that the sum of the coil sizes plus pole shims (averaged over inner and outer coil) is identical within a mil. Although I do not know how the press was shimmed for DS0311, it is doubtful that shim differences can explain the gap differences.

Second, the rate of change of the gaps are rather similar and much larger than expected form the coil size measurements. As long as the press gaps are open and the collars have not been keyed, the press load is balanced by the coil stress at the mid-plane. The coil is load in a similar way as it is when the size measurements are made. One would expect naively that the gaps would close at a rate given by the measured coil "spring constants," summed over the upper and lower coils and averaged over the inner and outer coils. This sum and average gives for both magnets an expected slope of 0.9 mils/kpsi, where the pressure is the average of the inner and outer coil stresses at the mid-plane inferred from the press load. The slopes in Figure 2 are dramatically larger. For DC0302 for $3 \leq P_{HYDRAULIC} \leq 6$ kpsi ($6.7 \leq \sigma_{COIL} \leq 13.3$ kpsi) the fit slope is -2.8 mils per coil kpsi. For DS0311 for $1 \leq P_{HYDRAULIC} \leq 4$ kpsi ($2.2 \leq \sigma_{COIL} \leq 8.9$ kpsi) the slope is -3.2 mils per coil kpsi. It has been conjectured by Mike Winters and Dick Sims that the larger slope may result from the redistribution of the Kapton ground insulation into the rough surfaces of the collars and the coil. Since the ground insulation is absent when the coil sizes are measured, this effect would be absent in the size data. However, this redistribution is an inelastic

phenomenon, so the fact that the slopes are the same on the first and second compressions of DS0311 suggests that this may not be the dominant cause of the large slopes. It has been conjectured that the large slopes result from transverse bending of the press plattens. This could be checked by comparing these slopes with gap data taken on the Tevatron collaring press which presumably deflects in a different way. If a substantially different slope is observed, then press bending would be shown to be an important effect. This possibility could also be addressed with ANSYS calculations.

[1] J. Strait, Analysis of DC0302 Collaring Data, TS-SSC 90--71, 10/11/90.

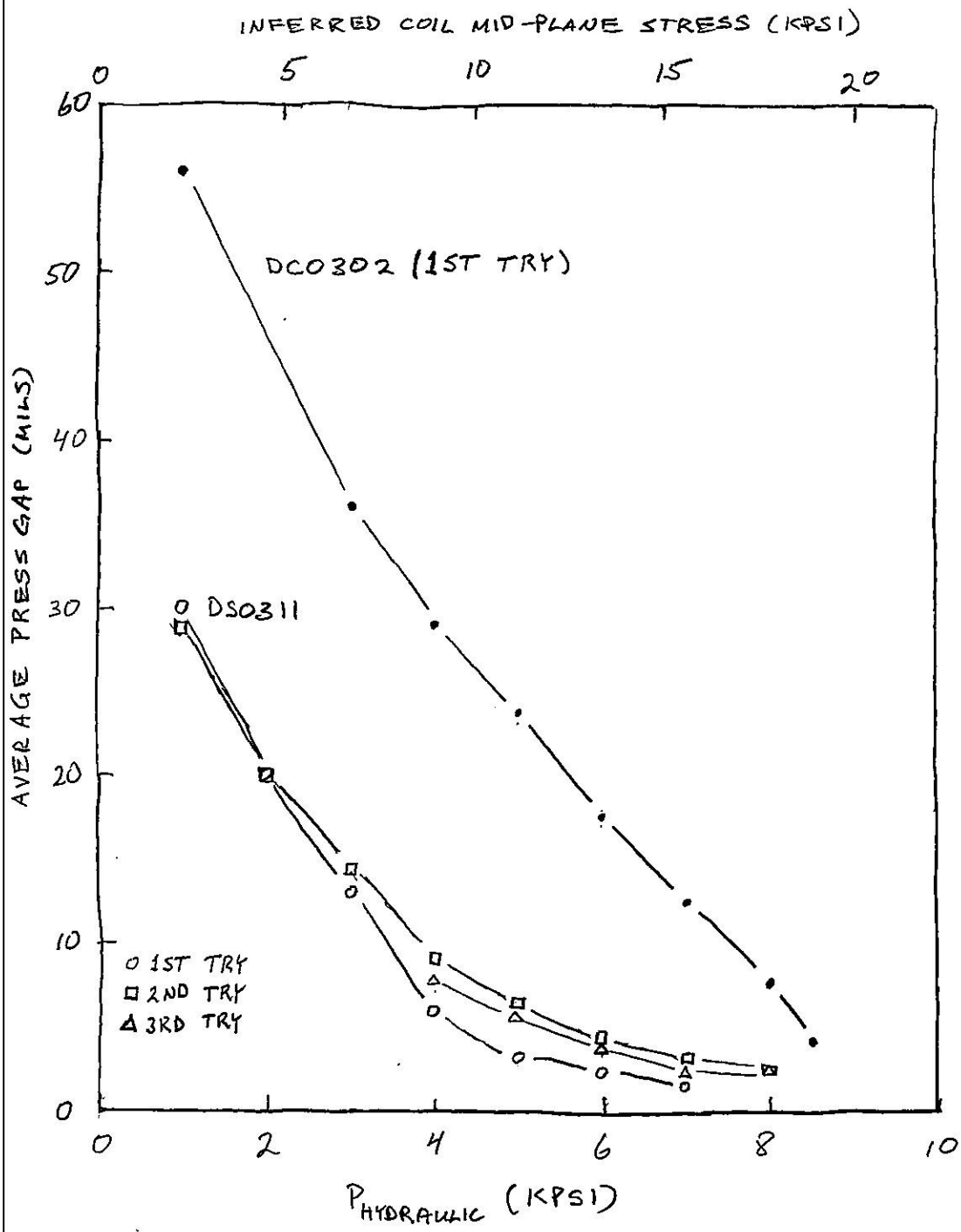
INFERRED COIL MID-PLANE STRESS (KPSI)
0
5
10
15
20
60
50
40
30
20
10
0
AVERAGE PRESS GAP (MILS)
DC0302 (1ST TRY)
DS0311
1ST TRY
2ND TRY
3RD TRY
0
2
4
6
8
10
P HYDRAULIC (KPSI)

Figure 1

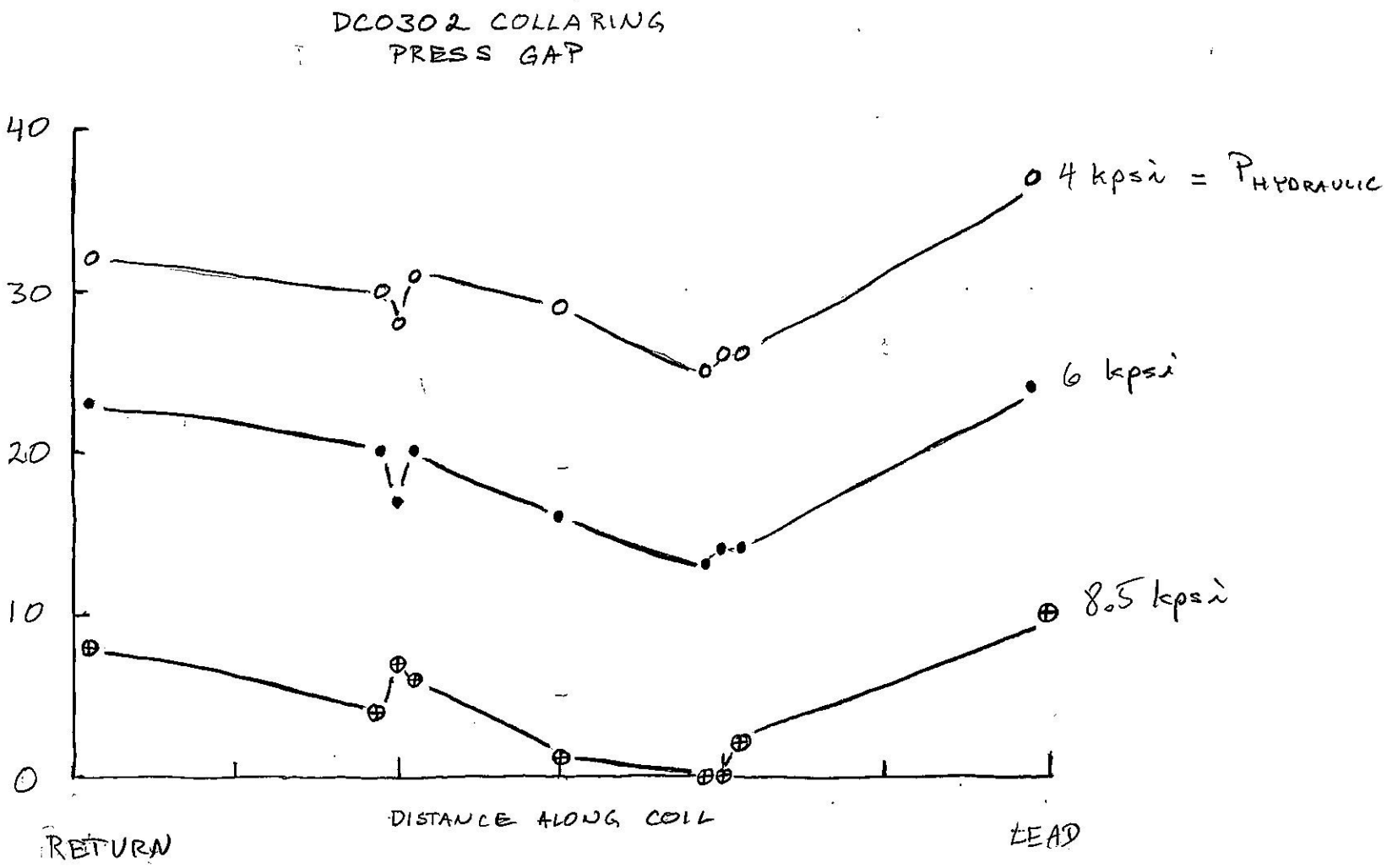
DC0302 COLLARING
PRESS GAP
40
30
20
10
0
4 kpsi = P HYDRAULIC
6 kpsi
8.5 kpsi
DISTANCE ALONG COIL
RETURN
LEAD

Figure 2