Fermilab

TS-SSC-91- 139

DCA311 turn to turn short location [1]

Masayoshi Wake
Fermilab,TS/Mag.R&D
July 10, 1991

The first Fermilab long 50mm magnet DCA311 developed a turn to turn short in the upper outer coil during the end collet installation. For the determination of the short location, an aluminum clamp[2] of width 40mm was used. It reproduced a short when the clamping was made at 1 inch from the saddle edge. Measurement of the potentials in the coil with 1 A DC current was made as shown in Fig.1 to determine the location of the short.

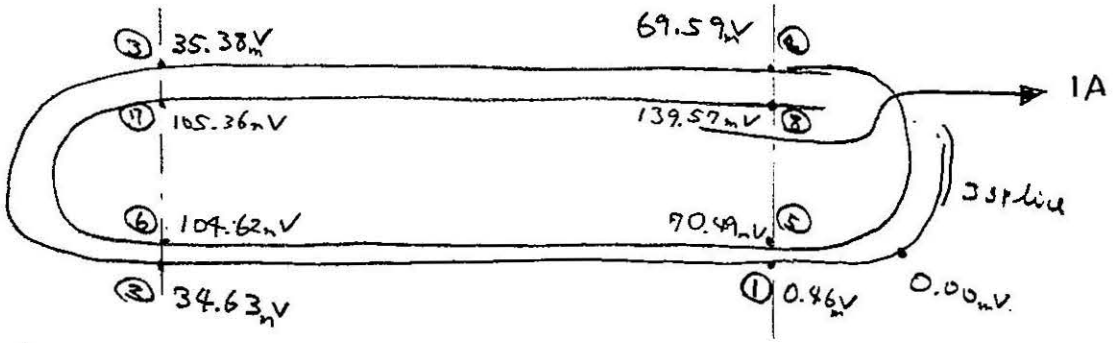
Potential map in the coil obtained by this measurement is shown in Fig.2. Electric length of the streight part has a good consistency but the electric length of the end part obtained by the potential measurement has a significant discrepancy with the geometrical length as shown in Table1. This may be caused by the inaccuacy of the voltage readings. Short location can be determined as shown in Fig.3. The short is located in the ramp-splice side but the position which is calculated was off from the clamp. The cable looked much more compressed in the ramp splice side than the J-splice side.

Another measurement using 10 A currnt was carried out to have more accuracy in the location of the short. Fig4 and Table 2 shows the measurement method and result. Three voltages with and without pressure on the clamp can give the location of the short. It was determined at 37% position in the 40mm width of the clamp. The short was not observed when we moved the clamp by half inch toward the magnet center. This is another proof for the short location.

[1]Distribution: R.Bossert, J.Carson, S.Delchamps, I.Gonczy, S.Gourlay, W.Koska, M.Kuchnir, M.Lamm, G.Pewitt, P.Sanger, J.Strait

[2]S.Delchamps initiated this measurement

w/o short



w/ short

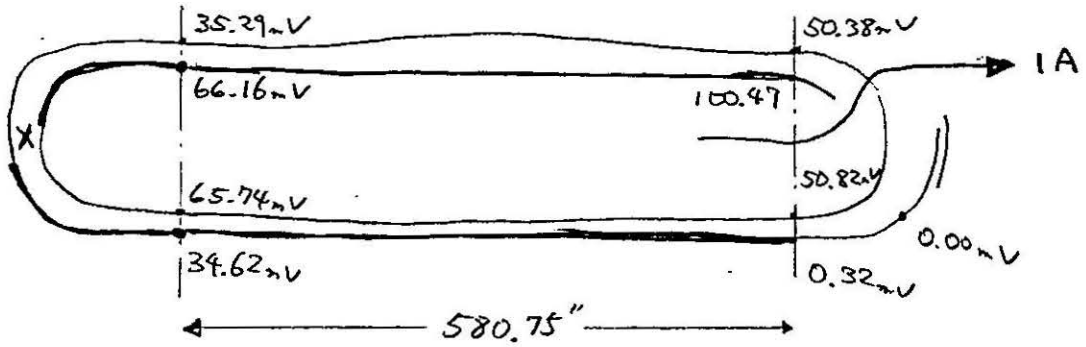


Fig. 1

Measured Potentials.

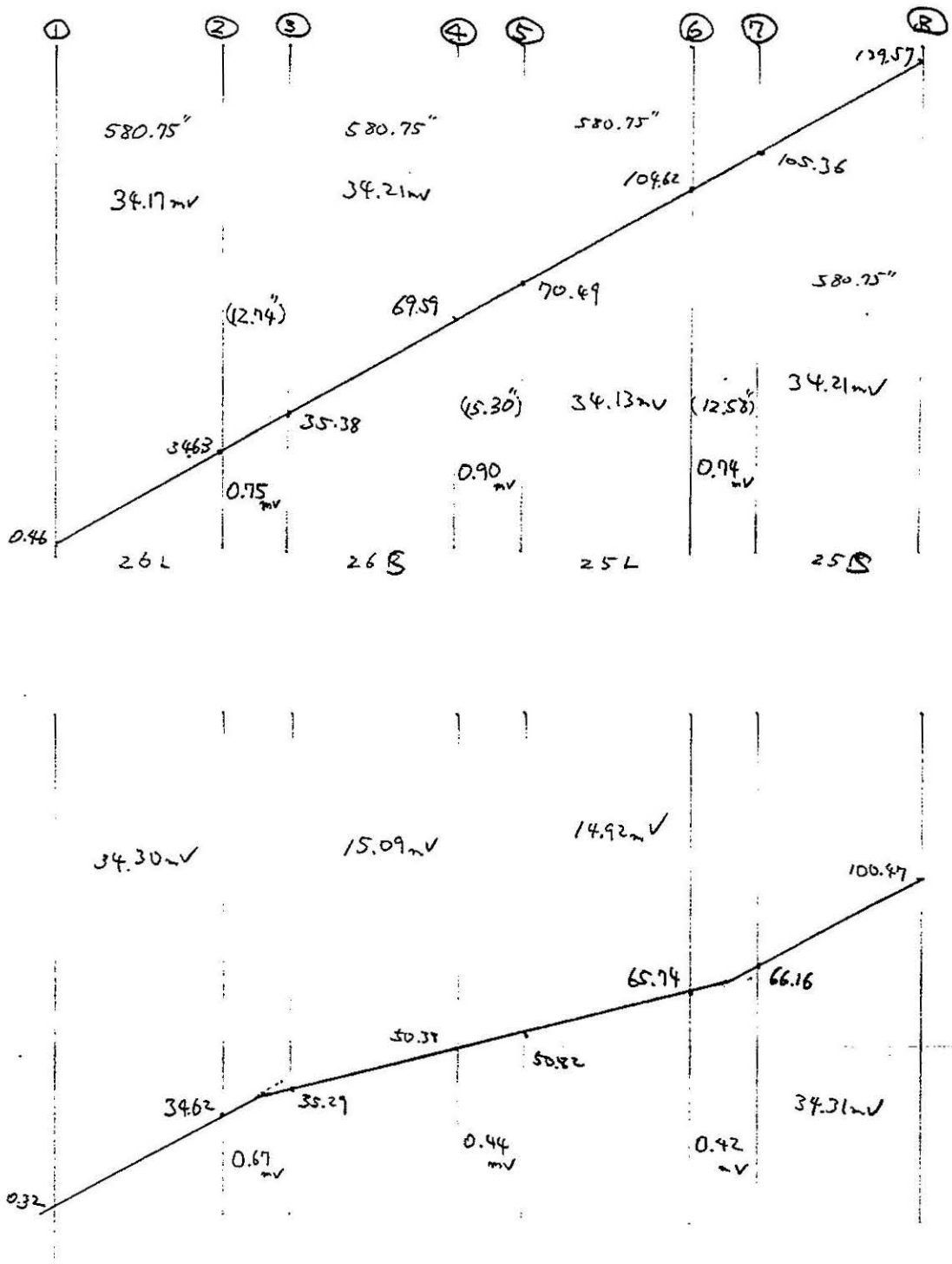


Fig 2

Potential Map

Electric length at straight part

	w/o short	w/ short	geometric
26 J$	34.17 mV	34.30 mV	580.75"
26 R$	34.21	—	
25 J$	34.13	—	
25 R$	34.21	34.31 mV	

* consistent within 0.4% accuracy

Electric length at End Part

	electric	geometric
26 return	0.75mV = 12.74"	14.25"
25 lead	0.90mV ≃ 15.30"	15.50"
25 return	0.74mV = 12.58"	14.25"

* better believe in electric length.
too large discrepancies.

Current Sharing

	conduction	shorts	
③–④	0.441	0.559	0.4397 cond.
④–⑤	0.489	0.511	0.5602 shorts.
⑤–⑥	0.437	0.563	
③–⑥	0.440	0.560	

Table 1.

$$x + 0.44.(1-x) = \frac{0.67}{0.75} = 0.893$$

$$0.56\,x = 0.893 - 0.44$$

$$x = 0.810 \qquad 0.310 \times 12.74'' = 3.95''$$

$$(1-x) + 0.44\,x = \frac{0.42}{0.74} = 0.568$$

$$0.56\,x = 0.771 \qquad 0.291 \times 12.74'' = 3.45''$$

$$\boxed{x = 3.7'' \pm 0.5''}$$

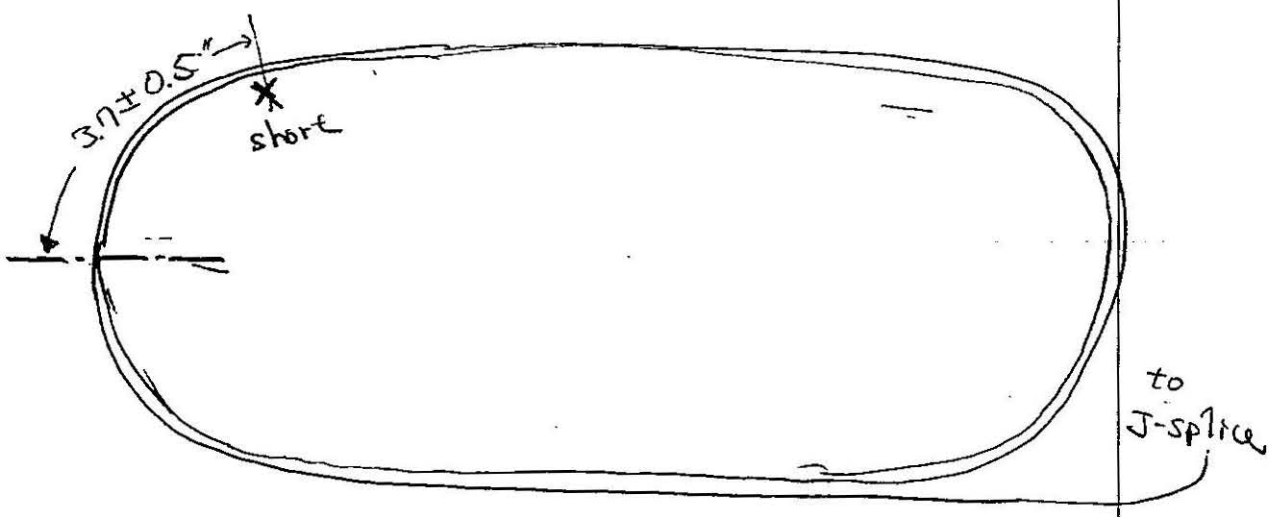
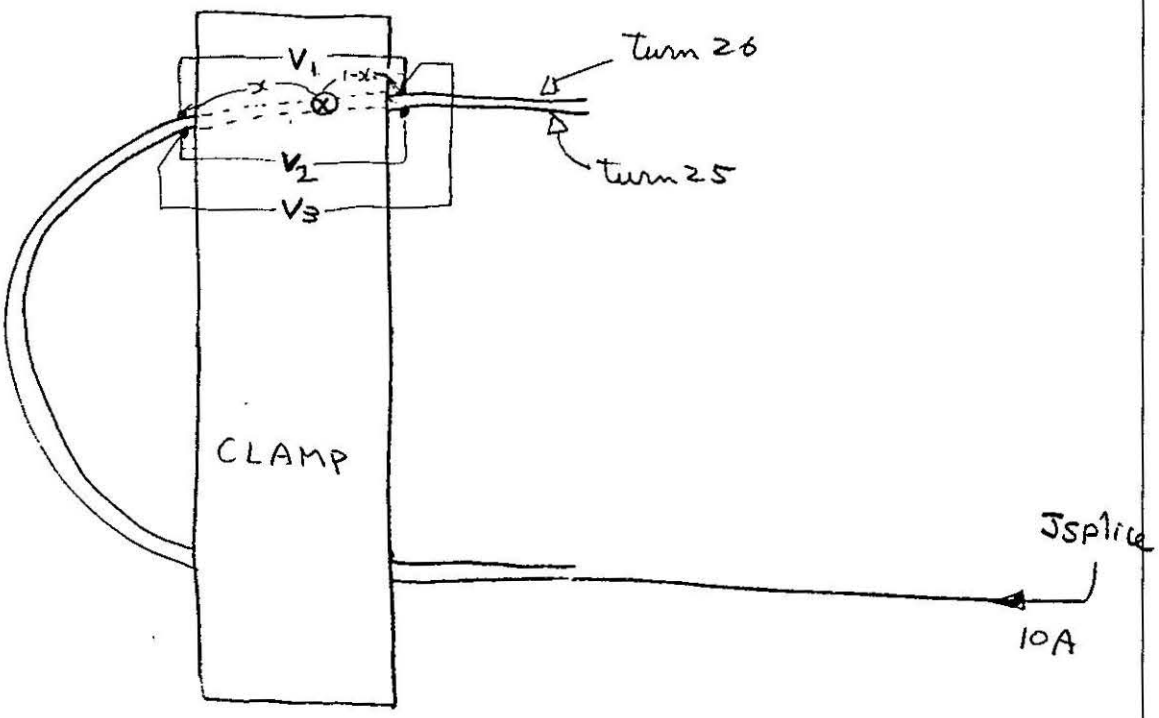


Fig. 3
Estimated Location of Short



	V_1	V_2	V_3
① w/ short	0.5	0.7	113.2 110.0
② w/o short	1.0	1.0	495
ratio ①/②	β_1 0.5	β_2 0.7	α 0.222

$$x = \frac{\beta_1 - \alpha}{1-\alpha} = 0.357$$

$$x = \frac{1-\beta_2}{1-\alpha} = 0.386$$

→ 37% position from the outer edge of the clamp

Fig 4 / Table 2

Further Localization