Fermilab

TS-SSC 92-045
3/31/92

To: R.Bossert, J.Carson, R.Jensen, F.Markley, P.Schmidt

From: Jim Strait

Subject: Additional cable-pair insulation breakdown tests

For completeness of the current round of cable-pair insulation breakdown tests and to facilitate comparison of these results with other tests and with known magnet preformance, we (Pam) should run a set of cables with with the standard fiberglass-epoxy insulation system. Listed below are the combinations of insulations that have been or will be tested along with priorities, the magnets in which they are used, and the current test status. Note that I have put the fiberglass-epoxy insulation at the highest priority among those systems which have not been done or are not currently being prepared. Also, the results listed in the "Status/Results" column should not be used to draw conclusions about the relative merits of the different systems; a complete report with discussion of the results will be prepared and circulated when all the data have been taken.

| Inner Wrap film | over-lap | adhes. | Outer Wrap film | over-lap | adhes | magnets | Status/Results |
|---|---|---|---|---|---|---|---|
| 1 H | 50% | - | LT | butt | 2290 | [a] | 45-55 kpsi breakdown |
| 2 NP | 50% | - | NP | butt | 2xCR | [b] | 30-60 kpsi breakdown |
| 5 H | 50% | - | LT | butt | 2x2290 | [c] | waiting for LT-film |
| 3 NP | 66% | CR | - | - | - | [d] | cable being insulated |
| 6 H | 50% | - | LT | 50% | 2290 | [a] | 40-55 kpsi breakdown |
| 7 NP | 50% | - | NP | 50% | 2xCR | [b] | 50-60 kpsi breakdown |
| 8 H | 50% | - | LT | 50% | 2x2290 | [c] | waiting for LT-film |
| 9 NP | 50% | CR | NP | 50% | CR | [d] | |
| - NP | 50% | - | NP | 50% | CR | none | 50-75 kpsi breakdown |
| 4 H | 50% | - | Glass | butt | epoxy | [e] | |

H = DuPont H-film Kapton
LT = DuPont LT-film Kapton
NP = Allied Signal NP-film Apical

2290 = 3M 2290 epoxy on one side
2x2290 = 3M 2290 epoxy on both sides
CR = cryorad on one side
2xCR = cryorad on both sides

Magnets
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[a] DSA330,332, DCA320,321
[b] DSA334 DCA322,323
[c] DSA333
[d] DSA331
[e] Tevatron, HERA, ASST, etc.

cc: R.Crockett, S.Delchamps, W.Koska, E.G.Pewitt, M.Wake

TS-SSC 92-046

Wayne Koska
March 31, 1992

# DCA319 Production Summary

DCA319 is the ninth SSC 50 mm aperture collider dipole magnet to be built and tested at Fermilab. Its assembly followed the baseline as stated in the 50 mm Collider Dipole Magnet Requirements and Specifications Book[1] (the Yellow Book). This report will summarize the production history of DCA319 and note any major discrepancies from the baseline design, however it is not a complete discussion of all "Discrepancy Reports". A number of references will be made to DCA319's Specific Data Summary Traveler (SDST) and to the Fermilab Advanced Magnet R&D group's technical note series.

Winding of the coils for DCA319 began on September 11, 1991. The inner coils used were designated 15M-50-1019, and 15M-50-1029, and the outer coils were designated 15M-50-2020 and 15M-50-2021. Coil 15M-50-1020 was originally to be installed in this magnet, but developed a turn to turn short and could not be used. Two metal chips were discovered on the exterior of coil 15M-50-1029 during sizing. They were removed and the coil insulation was repaired with electrical varnish. The averages of the azimuthal measurements, taken in three inch sections along the length of the inner coils, were 8.5 and 9.1 mils relative to the steel master block, with standard deviations of 1.2 and 1.0 mils. Azimuthal measurements of the outer coils resulted in averages of -1.6 (2020) and -4.5 mils (2021) with standard deviations of 1.2 and 1.1 mils. Coil 15M-50-2021 was sized with the automatic coil sizing robot, which systematically measures about 3 to 3.5 mils smaller than the semi-automatic method used on coil 15M-50-2020. The longitudinal distribution of the azimuthal size variations is reproducible from coil to coil, as can be seen in the plots in the SDST. These azimuthal sizes provided adequate final (pre-cold test) prestresses in the desired ranges (8-12 kpsi for the inner coils and 6-10 kpsi for the outer coils). The SDST should be consulted for details. Apparently one of the radial measurements of the coil size has been made in the wrong position for these and possibly all previous coils. It is a measurement of minor importance, and DR 464 may be consulted for details.

The collaring of magnet DCA319 on 12/9/91 went smoothly. A prestress history plot can be found in the SDST, along with a memo indicating the position of the 2 collar gauge packs relative to the maximum and minimum of the summed azimuthal size of the inner coils. The collar gauges indicate that the maximum inner (outer) coil stresses were about 17 kpsi (15 kpsi) and the final stresses after collaring were in the range of 9-13 kpsi (6-10 kpsi). The usual inner coil prestress loss of 2-3 kpsi after collaring can be seen. This may be due to creep of the kapton insulation. Measurements of the collared coil diameter show little variation along the length of the magnet, implying that there is not a large axial position dependence of the prestress.

Prior to end can assembly it was discovered that the key extensions were incorrectly cut. Assembly of the magnet was allowed to proceed, since the resulting small gap between the collars and end can should not affect the performance of the magnet. Both the lead end and return end cans were installed with 8 mils of kapton shim[2]. An assessment of end clamp installation data can be found in reference 3.

During the yoking procedure the beam tube was bent. It was bent back into shape and the electrical integrity of the magnet and the diameter of the tube were verified.

The stainless steel magnet shell was welded between January 8 and January 13, 1992. The yoke packs on DCA319 were configured with 4 approximately 12 foot long packs, with 99% packing factor, sandwiched between monolithic packs. The ends of the shell were in an out-of-round condition after the shell welding procedure and the end plates were machined to fit.

A plot of the measured end forces can be found in the SDST. The final force was approximately 3300 pounds.

Several problems were encountered during the cryostating of DCA319. The 20K and 80K shields were distorted due to the component parts being out of shape. This could have resulted in a thermal short. Aluminum tabs were welded onto the shields to maintain the proper alignment. The usual out of tolerance conditions of various tube positions were found. The discrepancy reports or the traveler should be consulted for details. This problem is being addressed by the engineering group. The radius at the end dome to single phase tube transition is less than the requested radius of 8 mm, however this specification was not received before the parts had arrived. This is not considered to be of consequence to the performance of the magnet.

Assembly of the magnet was completed and DCA319 was shipped to the Fermilab Magnet Test Facility on February 25, 1992. It was successfully tested beginning March 4, 1992.

In summary, DCA319 had no major assembly anomalies which would affect its mechanical performance.

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1 50 mm Collider Dipole Magnet Requirements and Specifications, E.G. Pewitt ed., 8-16-91.

2 Delchamps, S. DCA319: Extra Kapton for End Clamp Test, TS-SSC 91-232, 12-3-91
Delchamps, S. DCA319 End Clamp Test Before Collaring, TS-SSC 91-235, 12-3-91

3 Delchamps, S. End Clamp Deflections for DCA311-DCA319, TS-SSC 92-013, 1-29-92.