TS-SSC 92-075 *
July 10, 1992
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DCA321 Production Report

DCA321 is the second full length SSC collider dipole magnet built at Fermilab with all-kapton coil insulation. It is built essentially according to the specifications in "50 mm Collider Dipole Magnet Requirements and Specifications," Baseline Issue, August 16, 1991 ("The Yellow Book"). However, the inner coil insulation system used in this magnet consists of a butt wrap layer of 1 mil kapton LT film over a 50% overlap layer of 1 mil kapton H film. The outer coils have a 50% overlap layer of 1 mil kapton LT film over a 50% overlap layer of 1 mil kapton H film. The inner and outer coil LT film layers have epoxy only on one side of the film. Brass shims were attached to the inner and outer coil wedges to compensate for the change in the insulation thickness from the baseline ASST design. The inner coil thin and thick wedges had 15 mil and 30 mil shims added respectively. The outer coil wedges had 10 mil shims added.

Coil Fabrication

Some scratch damage to the coil insulation was detected during coil fabrication. The damage was repaired by applying varnish to the affected areas (DR 477, 456, 414a, and 400). The coils used in this magnet are given in the following table. All coils passed the electrical checks with no failures.

Magnet	coil number		cable	insulation	shim
DCA321	upper outer	2024	4-S-30	2H+2LT one side	+5
	lower outer	2025	4-S-30	2H+2LT one side	+5
	upper inner	1023	3-S-25	2H+buttLT one side	+0
	lower inner	1024	3-S-25	2H+buttLT one side	+0

The average inner coil sizes were close to the target value. The outer coils were somewhat under size, and 5 mil pole shims were introduced to compensate. The preload pressures after collar keying were close to the design value.

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Field Components

The predicted "normal" field components are shown in the following table. For the yoked harmonics, the yoke iron permeability is taken to be infinite.

Pole	w/o iron	w/ iron bn
0	0.7948946	1.0472381
1	0.0000000	0.0000000
2	-0.9275075	2.5480890
3	0.0000000	0.0000000
4	0.5779247	0.4057957
5	0.0000000	0.0000000
6	0.0330854	0.0250856
7	0.0000000	0.0000000
8	0.0872760	0.0662492
9	0.0000000	0.0000000
10	0.0231962	0.0176068

The coil size distributions showed an anomaly near the return end. We might therefore expect to see a large skew sextupole (a2) in this region.

Assembly

Voltage tap 18C of the lower inner coil was lost during yoke assembly (DR 488). Some measurements during cryostat assembly were out of tolerance (DR 525, 523, 519). One of the quench protection heater strips shorted to ground during end clamp installation. The reason this occurred was that the kapton wrap around the quench heater was cut flush with the end clamp insulator instead of continuing around the corner of the insulator to the point where the heater strip is soldered to a 14 AWG wire. Additional kapton insulation was applied at the position (DR 497). Much of the collar strain gauge pack data was lost during yoking. This was because the signal cables were out of the groove near the end of the magnet, causing them to be pinched between the yoke iron and the collar packs. The yoke iron was removed and re-installed with the collar strain gauge signal cables in the proper position.

Magnet		coil	cable	insulation	shim	wedge
DSA330	UP-out	235	4-I-40	2H+2LT one side	+5	
(Spalding)	LW-out	236	4-I-58	2H+2LT one side	+5	
	UP-in	135	3-S-26	2H+butLT one side	+0	(1)
	LW-in	136	3-S-26	2H+butLT one side	+0	(1)
DSA331	UP-out	240	4-I-58	2NP one side+2NP one side	+0	
	LW-out	239	4-I-56	2NP one side+2NP one side	+0	
	UP-in	140	3-S-26	3NP one side	+0	
	LW-in	139	3-S-26	3NP one side	(+5)	(2)
DSA332	UP-out	237	4-I-58	2H+2LT one side	+10	
	LW-out	238	4-I-58	2H+2LT one side	+10	
	UP-in	137	3-I-66	2H+butLT one side	+0	
	LW-in	138	3-S-26	2H+butLT one side	+0	
DSA 333	UP-out	242	4-I-58	2H+2LT both side	+4	
(torlon)	LW-out	243	4-I-51	2H+2LT both side	+4	
	UP-in	143	3-I-66	2H+butLT both side	+2	
	LW-in	144	3-I-66	2NP+butLT both side	+2	
DSA 334	UP-out		4-O-25	2NP+2NP both side		
(cryorad)	LW-out		4-O-25	2NP+2NP both side		
	UP-in		3-I-66	2NP+butNP both side		
	LW-in		3-I-66	2NP+butNP both side		
DCA 320	UP-out	2022	4-S-29	2H+2LT one side	+5	
	LW-out	2023	4-S-29	2H+2LT one side	+5	
	UP-in	1021	3-I-66	2H+butLT one side	+0	
	LW-in	1022	3-I-68	2H+butLT one side	+0	
DCA 321	UP-out	2024	4-S-30	2H+2LT one side	+5	
	LW-out	2025	4-S-30	2H+2LT one side	+5	
	UP-in	1023	3-S-25	2H+butLT one side	+0	
	LW-in	1024	3-S-25	2H+butLT one side	+0	
DCA 322	UP-out	2026	4-S-31	2NP+2NP both side	+0	
	LW-out	2027	4-S-31	2NP+2NP both side	+0	
	UP-in	1025	3-S-35	2NP+butNP both side	+0	
	LW-in	1026	3-S-36	2NP+butNP both side	+0	
DCA 323	UP-out	2028	4-S-32	2NP+2NP both side	+0	
	LW-out	2029	4-S-32	2NP+2NP both side	+0	
	UP-in	1027	3-S-40	2NP+butNP both side	+0	
	LW-in	1028	3-S-46	2NP+butNP both side	+0	

(1) Two 15 mil shims in large wedge. Had difficulty

(2) 15 mil shim in large wedge could have been used insted of 30 mil one. The pole shim of 5 mil was used only in the quadrant 4.

- Standard wedges have 15 mil brass shim in small inner wedges, 30 mil shim in large inner wedges and 10 mil shim in outer wedges to compensate the cable thickness change.