Fermilab

SDC SOLENOID DESIGN NOTE #201

TITLE: Comparison of Parameters of Detector Solenoids

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Several years ago I gathered information on the presently operating detector solenoids. I thought it might still be useful and should be recorded someplace. In the process of retyping the information, I added material on the SDC detector solenoid, the SDC prototype, and the upgrade solenoid for D0. I have included as many references as I could easily find, mostly papers from the Applied Superconductivity Conference, the Cryogenic Engineering Conference, and the Magnet Technology Conference. I have copies of the references in a notebook in my office.

Table 1. General Parameters

Magnet	Field (T)	Energy (MJ)	Thkns (X_0)	Mass (tonnes)	Energy/mass (kJ/kg)	Ref.
CDF	1.5	30	0.86	5.6	5.4	1, 2
Topaz	1.2	19.5	0.70	4.5	4.3	2, 3
Venus	0.75	11.7	0.52	4.3	2.7	2, 4, 5
Cleo II	1.5	25	2.5	7.0	3.6	2, 6
Aleph	1.5	136	1.7	25	5.4	2, 7
Delphi	1.2	109	4.0	25	4.3	2, 8
H1	1.2	120	1.2	25	4.8	2, 9
Zeus	1.8	10.5	0.9	1.9	5.5	10, 11
SDC	2.0	146	1.2	20	7.3	12, 13
SDC--PT	1.5	48	1.2	4.5	10.7	13
D0	2.0	5.6	0.871	1.46	3.8	14

References

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8. R.Q. Apsey et al, Design of a 5.5 metre diameter superconducting solenoid for the Delphi particle physics experiment at LEP, *IEEE Trans. on Magnetics* MAG-21:490 (1985).
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Table 2. RRR of Aluminum-stabilized Conductors in Zero Field

Magnet	Design	Measured
CDF	≥1000 (1) 4500 typo? (3)	1885 (2), coil, overall conductor 2000 (4); coil, Al portion only
Topaz	2500 (3)	2500 (5)
Venus	≥1000 (3)	1800 (6)
Amy	>1000 (3)	>3500 (8); conductor, Al portion only
Aleph	500-1000 (3)	2000 (9); conductor
Delphi/H1	>500 (3, 10)	750-1575 (11); conductor
Cleo II	>500 (3)	1000 (12); conductor
Zeus	1000 (13)	>1400 (14); conductor
SDC	500, Al only (15)	
D0	1000 (16)	

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Table 3. Aspect Ratio of Conductors

Magnet	Conductor Dimensions (mm x mm)	Aspect Ratio	Supplier	Ref.
CDF	3.89 x 20	5.14	Hitachi	1
Topaz	3.6 x 18	5.00	Furakawa	1
Venus	6.6 x 10	1.52	Mitsubishi	1,2
Aleph	3.6 x 35	9.72	Vacuumschmelze	1,3
Delphi/H1	4.5 x 24	5.33	Brown Boveri	1,4
Cleo II	4.89 & 5.1 x 16	3.27 & 3.14	Vacuumschmelze ?	5
Zeus	4.3 & 5.56 x 15	3.49 & 2.70	Europa Metalli-LMI	6
SDC	4.37 x 43.8	10.0	Furakawa	7
D0	3.82 & 5.125 x 15	3.93 & 2.93	----------	8

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Table 4. Conductor Winding Strain

Magnet	Conductor Height (mm)	Coil Inner Radius Warm (mm)	Height/Radius (%)
CDF	20	1483	1.35
Topaz	18	1441	1.25
Venus	10	1000	1.00
Aleph	35	~2650	1.32
Delphi/H1	24	~2800	0.86
Cleo II	16	~1700	0.94
Zeus	15	925	1.62
SDC	43.8	1818	2.41
D0	15	612	2.45

Table 5. Superconductor Joint Resistance at Zero Field and 4.2 K

Magnet	Current (kA)	Test joint length (m)	Test joint resis. (nΩ)	Magnet joint length (m)	Magnet joint resis. (nΩ)	Number of joints in coil	Ref.
CDF	5	0.2	2.5	0.4+	0.7+	9	1,2
Topaz	3.65	?	?	?	?	3	
Venus	4.1	0.1	2.8	?	0.8	8	3
Aleph	5	?	?	0.2	1.5	~15	4
Delphi	5	?	?	15	>0.1	?	5
Zeus	5	?	?	2	0.5	4	6
SDC	8	?	1	?	?	~8	7
D0	4.825	?	?	0.4	0.4	4	8

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Table 6. Maximum Discharge Voltage

Magnet	Fast Dump Resistor (mΩ)	Max. Current (kA)	Max. Terminal Voltage (V)	Center Tapped to Ground?
CDF	74	5	370	Yes
Topaz	100	3.65	365	No
Venus	100	4	400	No
Cleo II	?	3.3	?	?
Aleph	120	5	600	?
Delphi	150	5	750	Yes
H1	136	5.5	750	Yes?
Zeus	63	4.987	314	Yes
SDC	50-100	8	400-800	?
D0	48	4.825	232	Yes