DSA324 TEST PLAN

TS-SSC 91- 138
T. Jaffery
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Test Objectives

DSA324 is the third 50 mm model SSC dipole magnet to be tested in Lab2. For most part the test plan for this magnet is similar to previous standard test procedures for short R&D magnets tested in Lab2. Few additional tests will also be performed which are being added to this test plan. Test objectives for magnet DSA324 are to make the standard quench, strain gage and harmonics measurements through two thermal cycles . Magnetic field measurements will be made both with the standard magnetometer and with the partially completed HAL2 system. All standard magnetometer tests will be done with probe #11, and Periodic field study will be done using Rawson Lush Fieldmeter. Heater studies will be done during second thermal cycle.

The instrumentation on magnet DSA324 is identical to that of magnet DSA323 except the location of its shell strain gages is 180 degrees rotated with respect to the yoke parting plane. DSA324 has inner and outer collar, bullet, end clamp and skin tension (on the shell of the magnet) gages. Since the cold calibration (Ro) is not available for end clamp and skin gages therefore they will be calibrated at 4.3 K in Lab2.

Distribution:
- S. Delchamps
- S. Gourlay
- J. Strait
- M. Wake

THERMAL CYCLE I

1) Cool to 4.35 K monitoring all thermometers and strain gages at 10 minute logging intervals.

2) Protect magnet with a 30 mohm dump resistor. Delay dump firing 50 msec after quench detection, but phase back power supply promptly. Evacuate the warm bore tube.

3) Check safety circuit balances:

Set data logger sampling frequencies and pre-quench windows:
all the data loggers at 1 kHz and 50% pre-quench

a) sawtooth ramps between 100 A and 200 A at 50 A/sec.

b) manual trip at 1000 A.

4) Set data logger sampling frequencies and pre-quench windows:

a) data loggers 1 and 2: 2 kHz and 25% pre-quench.

b) data loggers 3 and 4: 5 kHz and 50% pre-quench.

STRAIN GAGE AND QUENCH TESTING

5) **Bring magnet to 4.35 K (860 Torr or 16.5 psia.)** Ramp rate = 16 A /sec.

a) Take strain gage runs, one file per current loop, using the sequences of currents below. Take data at all currents on the way up, and for the currents marked "*" on the way down. For high currents runs the Power Leads flow rate must be >275 SCFH.

Run 1: 0*, 2200, 3100*, 3800, 4400*, 4900, 5400*, 5800 A,

Run 2: 0*, 2200, 3100*, 3800, 4400*, 4900, 5400*, 5800, 6200 A

Run 3: 0*, 2200, 3100*, 3800, 4400*, 4900, 5400*, 5800, 6200*, 6600 A

Run 4: 0*, 2200, 3100*, 3800, 4400*, 4900, 5400*, 5800, 6200*, 6600 , 7000 A

Run 5: 0*, 2200, 3100*, 3800, 4400*, 4900, 5400*, 5800, 6200*, 6600, 7000*, 7400 A

Run 6: 0*, 2200, 3100*, 3800, 4400*, 4900, 5400*, 5800, 6200*, 6600, 7000*, 7400 A, 8100 A

Note: Runs 5 and/or 6 may lead to first spontaneous quench .

6) With ramp rate = 16 A/sec, train the magnet until 4 plateau quenches have occurred. Do not do more than 15 quenches. The predicted short sample limit currents (inner coil) as a function of temperature are:

7) Take a strain gage run to $I_{plateau}$ - 100 A.

8) **RAMP RATE** dependence studies at 4.35 K.

a) Ramp to quench at 16, 25, 50, 75, 100, 150, 200, 225, 250, 300 A/sec.

b) Ramp to 6500 A at 16 A/sec, then ramp down from 6500 A to 4000 A at 100, 200, 300, and 400 A/sec.

9) This can be done at 4.2 K or 4.35 K.
DSA323 during its testing had displayed some unusual quenching on the downramp after exceeding 7kA one or more times without quenching. This part has been added to see any down ramp quenching like it was seen on DSA323. Do 6-8 sawtooth ramps from 0 - (Iq - 200)A with 180 sec dwell time at the peak current (flattop) to observe any down ramp quenches.

4.2K STUDIES

10) Bring the magnet to 4.2K. Keep the bore tube evacuated and establish plateau I_{quench}.

b) Bring the warm bore tube to room temperature, and establish the flow of room temperature purge gas. Quench the magnet twice, or to plateau current if any training is observed, to establish I_{quench} under these conditions.

Rawson Lush 789 Fieldmeter

11) Transfer Function Measurement

Insert the Rawson Lush 789 Fieldmeter into the bore tube and zero the meter. Ramp the magnet to 500 A and measure the current with HP3457A DVM and field on the probe meter.
Ramp the magnet at 1000 amps interval up to 6500 A or (Iq - 200 A) and take I and field measurement at each interval .

12) Periodic Field Measurement See run plan in appendix

HARMONICS MEASUREMENTS

13) Bring the warm bore tube to room temperature, insert probe #11, and establish the flow of room temperature purge gas. Quench the magnet twice, or to plateau current if any training is observed, to establish I_{quench} under these conditions.

14) Measure harmonics at **4.2 K.**

a) Power the magnet with 200 A. Locate the ends of the magnet relative to the tape measure on the probe mounting fixture by moving the probe vertically and identifying the points at which the dipole field is 1/2 its central value. Define the magnet center to be half way between the two end points.

b) Ramp the magnet to quench at 16 A/sec.

c) Position the probe 9 inches below (towards return end, away from the gage pack) the center of the magnet and measure the harmonics as a function of current. Do one sawtooth cycle at 16 A/sec from 0 to 6500 A or I_{quench} - 200 A, whichever is higher. Record data every 6 seconds (approximately every 100 A) starting from 0 A.

d) Ramp the magnet to quench at 16 A/sec.

e) Ramp the magnet at 12 A/sec to 6500 A or I_{quench} - 200 A, whichever is lower, hold at flattop for 2 minutes, ramp down at -12 A/sec to 110 A, hold for 2 minutes, ramp at 6 A/sec to 5000 A. (If I_{quench} < 5500 A, the final ramp should be to I_{quench} - 500 A.).

f) Measure harmonics as a function of position at 5000 A (or I_{quench} - 500 A.) Take data at the following positions relative to the center of the magnet (positive is towards the lead end, i.e. up.) z = -24", -22", -20", -18", -16", -14", -12", -10", -8", -6", -4", -2", 0", 2", 4", 6", 8", 10", 12", 14", 16", 18", 20",22", 24".

g) Ramp the magnet to 5500 A (or I_{quench} -200 A), then back to 5000 A (or I_{quench} -500 A.) Measure harmonics as a function of position at z = -24", -22", -20", -18", -16", -14", -12", -10", -8", -6", -4", -2", 0", 2", 4", 6", 8", 10", 12", 14", 16", 18", 20",22", 24".

h) Position the probe 9 inches below (towards return end, away from the gage pack) the center of the magnet and measure the harmonics as a function of current. Ramp the magnet from 5000 A down to 110 A, then to I_{quench} - 200 A, back to 110 A, then to 1000 A, all at 16 A/sec. Record data every 6 seconds (approximately every 100 A) starting from 500 A on the first down ramp until 1000 A on the second up ramp.

i) **HAL2 Harmonics:** Ramp the magnet to quench at 16 A/sec. Repeat steps e) and f) with the HAL2 System instead of the magnetometer.

FURTHER STRAIN GAGE STUDIES

Remove the harmonic probe and evacuate the warm bore.

14) **Take the magnet to 3.8 K.** Using 16 A/sec ramp rate, quench the magnet at 3.8 K until 3 quenches have occurred on plateau or a total of 10 quenches have been taken, whichever comes first.

15) Take a strain gage run at 3.8K to I_{quench} - 100 A.

THERMAL CYCLE II

16) **Warm the magnet to within 10 K of the pretest temperature** (the dewar temperature before it was cooled down the first time.) Record the strain gages and thermometers at 10 minute intervals during the thermal cycle.

17) a) Repeat steps 2 - 7, 9 and steps 13 - 14e-i from the first thermal cycle.

b) If time permits repeat steps 11 and 12.

HEATER STUDIES

18) These Studies are described in the appendix of this plan.

16) AC LOSS MEASUREMENT
See attached appendix.

19) **Warm to room temperature.** Monitor all strain gages and thermometers at 10 minute logging intervals until T > 100 K, then at 30 minute intervals. Continue to monitor until the magnet is within 5 K of its pretest temperature.