

Measurements to be made on the ACOL quadrupoles

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Definitions

$$a) \quad \Delta G/G_o \equiv \left(\left(\frac{d}{dx} \int B_y dz \right)_x - \left(\frac{d}{dx} \int B_y dz \right)_o \right) / \left(\frac{d}{dx} \int B_y dz \right)_o$$

$$b) \quad G_o \equiv \left(\frac{d}{dx} \int B_y dz \right)_{x=0}$$

$$c) \quad K \equiv G_o / B\rho$$

$$d) \quad K' \equiv \frac{d^2}{dx^2} \int B_y dz$$

Objectives

1. To shim the magnets so that
 - a) the average G_o of each family agrees with the theoretical value of that family to 1 in 10^3 .
 - b) within a family, of which there are seven, the values of G_o agree to better than 1 in 10^3 .
 - c) G versus x (horizontal displacement) is uniform to 1 in 10^3 for the QN's.
 - d) $(\Delta G/G_o - K'x/K)$ is ~ 1 in 10^3 for the QW's.
2. To estimate the range of adjustment possible for in situ shimming.
3. To ensure that reversing current polarity results in equal and opposite gradient integrals.

Measurements on the first QN (19 Turns per coil)

4. G_o versus I (magnetization curve) after cycling the magnet to $I = I_{max}$.
5. G versus x at three current levels, corresponding to the three QN families.
6. Adjust pole shims to obtain the correct magnetic length for each family.

7. Use washers to ensure that the $\Delta G/G_0$ tolerance can be met for each family.
8. Choosing appropriate current levels, measure the effects of standard washer packs at each position on $\Delta G/G_0$ vs x and y (if possible).
9. Find the magnetic centre by measuring $\int Bdz$, and translate to target positions.
10. Check G_0 and magnetic centre with current reversed.
11. Measure G_0 and $\Delta G/G_0$ versus x in the presence of ferrite injection magnet.
12. Compensate for the ferrite using washers.
13. Measure $\frac{dB}{dx}$ at the magnet centre.

Measurements on the production QN's

14. G_0 versus I .
15. G versus x at the current corresponding to the quadrupole's family.
16. Adjust the length and $\Delta G/G_0$ as appropriate.
17. Find the magnetic centre and affix target.

Measurements on the first QW's (QFW8)

18. G_0 versus I .
19. G versus x, y (if possible) at I (nominal) and I (nominal) $\pm 1\%$. It may be best to use a harmonic coil for G versus y .
20. Adjust shims to obtain the correct magnetic length.
21. If necessary machine the shims to vary K'/K , and use washers to obtain the required $(\Delta G/G_0 - K'x/K)$ tolerance.
22. Find the magnetic centre and affix target.
23. Measure the effects of standard washer packs at each position on $\Delta G/G_0$ versus x, y .
24. Measure $\frac{dB}{dx}$ at the magnet centre.
25. Check G_0 and the magnetic centre with the current reversed.

Measurements on the production QW's

- 26. See 18.
- 27. G versus x at I(nominal).
- 28. See 20.
- 29. See 21.
- 30. See 22.
- 31. See 25.

Measurements on the first QWSS (QDW)

- 32. See 18.
- 33. G versus x,y at the three appropriate currents.
- 34. Adjust shims to obtain the correct magnetic length for each family.
- 35. If necessary machine the shims to vary $K'x/K$ and use washers to obtain the required $(\Delta G/G_0 - K'x/K)$ tolerance for each family.
- 36. See 22.
- 37. See 23.
- 38. See 24.
- 39. See 25.

Measurements on the production QWSS's

- 40. See 18.
- 41. See 27.
- 42. See 20.
- 43. See 21.
- 44. See 22.
- 45. See 25.