Fermilab MTF

Doc Number: MTF-99-0047
Version:
Category: Report

Summary of Magnetic Measurements on IQC002-0

H.D. Glass
Fermi National Accelerator Laboratory *
P.O. Box 500
Batavia, Illinois 60510

1 Introduction

This report summarizes measurements taken on Main Injector Quadrupole IQC002-0. The test plan (MTF-94-0043) called for measurements to be taken with the VAX harmonics system, CHISOX, and some additional tests. The CHISOX measurements were taken for R&D purposes and are not discussed here. The additional tests called for in item 4 of the test plan were deferred until a more acceptable magnet came along. Thus, the only results reported here are the VAX harmonics.

2 Probe setup

The probe used was the Morgan probe with ID#21 (radius = 0.034517 m). The probe was placed at three different positions in the magnet:

Body: probe centered in magnet; in this position the probe measured body harmonics only. Data were entered with $z \approx 98''$ and with meas_procedure = "IQC-02."

Lead end: probe placed so that the active area extended from the magnet center to beyond the lead end of the magnet. The recorded z position was $\approx 50''$.

*Operated by the Universities Research Association under contract with the U. S. Department of Energy

Other end: probe placed so that the active area extended from the magnet center to beyond the non-lead end of the magnet. The recorded z-position was $\approx 144''$.

Two sets of "Lead end" and "Other end" data were taken. The first set (meas_procedure = "IQC-03") included reference runs (integrated strengths) and a complete set of harmonics at the same currents as were done in the body measurements. The second set (meas_procedure = "IQC-04") contained reference runs only.

The data were collected into a collection of "goodfiles" which were subsequently transferred to Sybase, where they reside on the "MTF-PRACTICE" data server in the "vaxdata" virtual database. The data can be examined by querying on magnet_id = "IQC002" or by using the available Sybase reports. The output of some of these reports is found in files on machine mdtf14 in directory /home/mdtf14/glass/miquads/iqc002.

3 Body harmonics

Figures 1–3 show the body field harmonics. The most significant result is the normal octupole (b_4) measurement, which is about -3.8 units at 1000 A and rises to ~ -3.0 units at 3000 A. The design specification calls for $b_4 = +2 \pm 1$ units at 2900 A.

4 Full-length harmonics

Figures 4–6 and Table 1 show the full-length harmonics, obtained by combining the Lead End and Other End measurements. The octupole appears to be helped by including the magnet ends: at 1000 A it is -2.3 units, and at 3000 A it is -1.4 units. These values are still outside the acceptable range.

5 Integrated gradient strength

The mean body field was obtained by averaging the reference Q1 amplitude when it was placed in the central "body" position in the magnet. The results are shown in Figure 7 and Table 2.

The total integrated strength was obtained by summing the strengths of the Lead End and Other End positions. On examining the first set of Lead

End data, it was determined that the survey had been done incorrectly, in that the effective magnetic length appeared to be about 1.0 inch too short. The probe was resurveyed on the Lead End after data were taken on the Other End, and this second data set was better. Two Other End data sets were taken, both with consistent results. The error in the total strength was calculated from the standard deviation of the two Other End data sets. Table 2 lists the integrated strengths and their estimated errors. These data are also displayed in Figures 8 and 9.

The effective length is obtained by dividing the integrated strength by the mean body field. The results are shown in Figure 10. Except for currents below 1000 A, the effective length is constant and is about 1.2 cm shorter than the steel length.

6 List of Figures

7 List of Tables

8 Survey

Both the length of the probe and the length of the magnet were surveyed as part of this test. These lengths are:

- length of probe (Q1 coil) = 94.371"
- length of magnet = 99.911"

Appended to this report is found a copy of the surveyor's summary of the surveyed lengths of the coils on Probe #21 and the length of the magnet.