IOTA Dipole Magnets Design Mini-Review Minutes

Fermilab 6/12/2013, compiled by A.Valishev

Present:
For the design team: Alexander Didenko, Sergei Nagaitsev, Alexander Valishev
Invited experts: Kermit Carlson, Bruce Hanna, Vladimir Kashikhin, Jerry Leibfritz, Daniel Wolff.

The design team presented current design of 30-degree and 60-degree dipole magnets for IOTA ring. Vendor (Milhous Co.) will manufacture 5 magnets of each type following the drawings by Fermilab.

Reviewer comments

I. Magnetic design

a. The presented design does not include pole chamfers, which may affect the field quality (desired better than 1E-3 in 48 mm dia. aperture) at different values of magnetic field.
b. The bounding box in the model was set too small – may affect field value but should be acceptable for field quality.
c. It was suggested to make a provision in the design for attaching custom-shaped shims to pole faces to correct for magnet-to-magnet differences and higher order multipole errors.
d. Need better understanding of manufacturing tolerances and their effect on field quality.

Action items: V.Kashikhin will re-run the model with modified mesh and check for possible inconsistencies.

II. Mechanical design

a. The Aluminum spacers between the poles of the C-type magnet seem too small in size for the anticipated load. Consider increasing the width of these spacers.
b. The coil supporting brackets are attached to the yoke by two small bolts, which take the shear stress. The normal practice is to weld brackets to the yoke.
c. Consider using Belleville washers to make sure the studs holding down core halves are reliably connected.
d. Consider placing spacers (G-10 or similar material) between the upper and lower coils to prevent them from relative movement.
e. Drawings must be checked by Fermilab's experts for conformance with the lab standards.

Action items: A.Didenko will consider the possible ways to implement these proposals. The drawings will be transferred to AD's S.Wesseln.

III. Coil design

a. Consider straightening the inside part of the coil rather than making it curved to follow the pole radius. This does not affect the field quality but simplifies manufacturing. Caveat – possible interference with the ion pump port.
b. The proposed method of conductor insulation (0.002" thick polyimide adhesive back tape with 50% overlap) does not allow for epoxy to flow between the coil turns. It is recommended to add fiberglass tape wrapping for epoxy impregnation.
c. Epoxy type for coils impregnation must be specified.

d. Corrector coil current density is high for the proposed cooling. Consider increasing the wire size.
e. Improve insulation between the coil and iron core by placing G10 spacers.
f. Coil pancake splices are external. Check if the splicing insulation is sufficient. Check if splice water connections are adequate.

Action items: A. Didenko will contact TD's magnet experts (A. Makarov) for advice on coil insulation, epoxy specification.

IV. Quality Assurance

Pre-fabrication

a. Steel 1010 must meet the chemical composition specs.
b. Copper bus must not have internal splices. The only allowed splices are external coil pancake connections.
c. Copper bus must be deburred prior to applying the insulating polyamide tape.

Post-fabrication

d. Prior to magnet assembly: Steel yoke and pole shape dimensional tolerances, coil pressure test, AC current (ringing) test to detect inner shorts.
e. After magnet assembly: gap measurements must be within tolerances. Corrector hi-potting test while yoke and main coil are grounded. Main coil hi-potting test while yoke and corrector coil are grounded.
f.

Action items: A.Valishev and S. Nagaitsev will draft a QA spec. document for vendor and have it reviewed by TD experts.