FABRICATION AND TEST OF THE DRIFT TUBES FOR PEFP 20MEV DTL*

Y.H. Kim#, H.J. Kwon, M.Y, Park, and Y.S. Cho, PEFP, KAERI, DaeJeon, Korea

Abstract

Drift tubes of PEFP 20MeV DTL contain electro-quadrupole magnet composed of commercial enamel wire cooled with water coolant. Those were fabricated through the process of brazing, assembling, electron-beam welding, and post-machining. During the e-beam welding, temperature increase was kept under 50 degree to protect the EQM wire from thermal damage. We performed several tests such as vacuum leak test, hydraulic test, and electrical test. EQM properties such as effective length, magnetic saturation, and offset between magnetic center and geometric center of DT were measured and recorded also.

INTRODUCTION

20MeV 350MHz DTL is under construction in KAERI site as the first stage of the PEFP(Proton Engineering Frontier Project) of which final goal is to develop 1GeV, 20mA proton accelerator. After physical design of PEFP DT(Drift Tube)[1], detailed design of DT was done to acquire the space for EQM(Electro-Quadrupole Magnet) in the limitations of vacuum and structural requirements.[2]

FABRICATION OF DRIFT TUBES

Drift tubes of PEFP 20MeV DTL contain electro-quadrupole magnet composed of commercial enamel wire cooled with water. So, we established the fabrication process, considering the protection of EQM from the damage which can be occurred in the fabrication process.

Drift tube fabrication process

As shown in figure 1, drift tube was designed keeping all the dimensions constant except L to increase machinability and cost. And then some parts shown in figure 1 were brazed to assure perpendicularity before assembling the EQM

EQM was fabricated using one bulk core and commercial copper wire which were wound continuously without any joint. It has 9 turns per one pole and there was not any solenoid component as shown in figure 2. Fabricated EQM was assembled to drift tube using two alignment pins and two bolts to assure the magnet alignment tolerance as shown in figure 3

- After assembling all remained parts, we welded two points shown in figure 4 using e-beam welding. Electron beam voltage and current was as follows, so temperature increase of the drift tube during e-

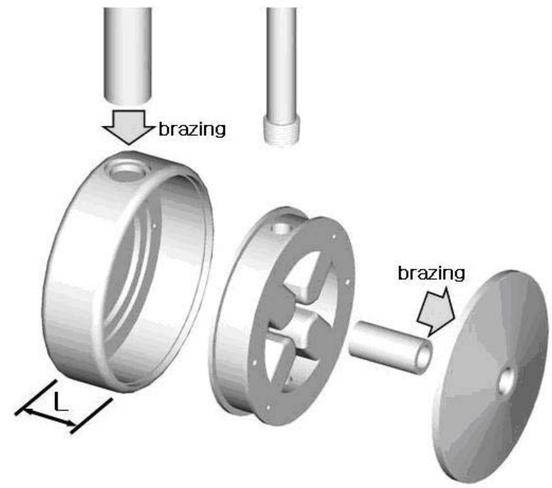

Figure 1: Parts of drift tube


Figure 2: EQM winding


Figure 3: EQM assembled to drift tube

* This work is supported by the 21C Frontier R&D program in the Ministry of Science and Technology of the Korean government.
# yhkim72@kaeri.re.kr

beam welding was kept under 50 degree.

- electron beam voltage : 60kV
- electron beam current : 65mA for inner welding point and 75mA for outer welding poing
- welding depth : over 2.5mm for inner welding point and over 3.5mm for outer welding point shown in figure 4

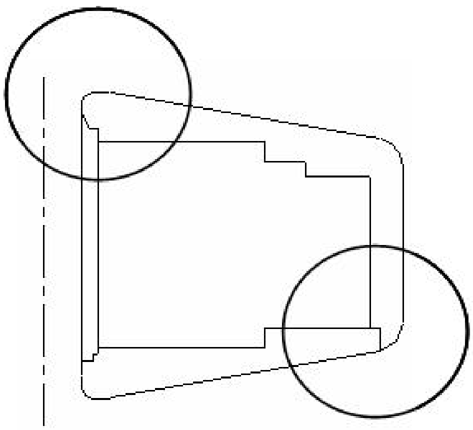

Figure 4 : Welding points for drift tube fabrication

As the final process, we machined the drift tube to remove the welding seam and re-adjust the dimension of the drift tube distorted by e-beam welding. Figure 5 shows the finally fabricated drift tube.

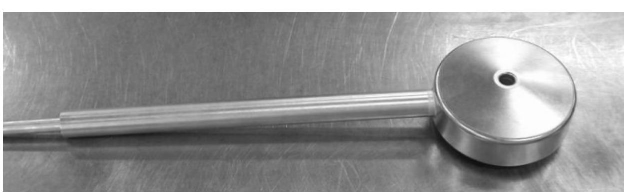

Figure 5: Finally fabricated drift tube

TESTS OF THE DRIFT TUBES

Vacuum leak test

We test the vacuum stability of the fabricated drift tube using He leak detector and He leak rate was $1*10^{-9}$ torrL/sec for all the drift tubes.

EQM Insulation test

Insulation resistance between EQM and drift tube was measured using Mega-Ohm tester in the stats that inside of the drift tube was filled with water. And it showed over 20kOhm with the applied voltage of 250Vwhich is about 8 times larger than operating voltage of 30V.

Hydraulic test

In the hydraulic test, coolant flow rate was 20SLM under pressure difference of 2atm between inlet and outlet of the drift tube. In that case, expected coolant temperature increase is 1.5 degree for designed power dissipation of 2kW which is the sum of magnet power dissipation of 1kW and RF power of 1kW dissipated on the drift tube surface.

Magnetic center measurement

For magnetic center measurement, we used hall sensor whose active area is 0.5 mm * 1.0 mm and xyz-stage as shown in figure 6. The geometric center and magnetic center of the drift tube was aligned well within the limitations of the Vernier-calipers resolution of 50µm.

EQM power feeding test

We performed the EQM power feeding test at the operating condition as shown in figure 7. Introduced current for EQM was 250A, coolant flow rate was 15SLM and no additional cooling system for current joint. The Maximum temperature of the current joint was under 60°C and no extraordinary problem was observed in the temperature change of the drift tube surface and EQM insulation resistance level.

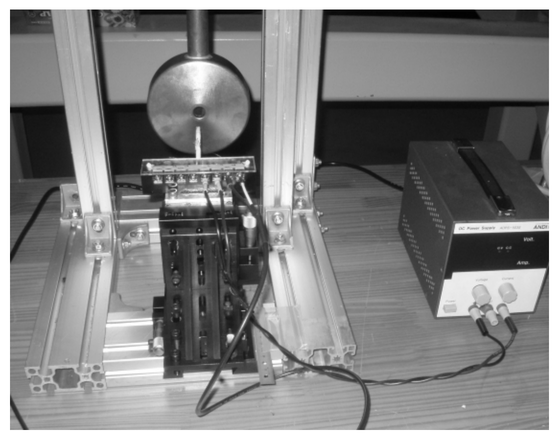

Figure 6: Test setup for magnetic center measurement

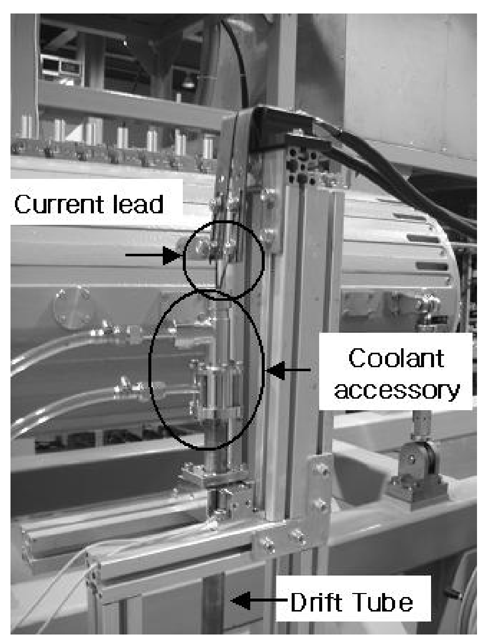

Figure 7: Test setup for EQM power feeding test

 0-7803-8859-3/05/$20.00 ©2005 IEEE

SUMMARY

- We fabricated the drift tubes for PEFP 20MeV DTL through brazing, e-beam welding, and post-machining process. During the process, EQM was protected from the thermal damage induced from all the fabrication process.
- We perform the vacuum leak test, EQM insulation test, hydraulic test, magnetic center measurement, and EQM power feeding test. From all the tests, it was verified that fabricated drift tube satisfied the requirements for PEFP DTL.

REFERENCES

[1] Y.S. Cho, et al, DESIGN OF 20MEV DTL FOR PEFP, Proceedings of the 2003 Particle Accelerator Conference, p1219
[2] Y.H. Kim, 2004 Asian Particle Accelerator Conference Proceeding.