FABRICATION STATUS OF THE PEFP 20 MeV DTL*

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Abstract

The PEFP (Proton Engineering Frontier Project) 20 MeV DTL have been constructing in KAERI site. The fabrication of the first tank is finished and the DT installation is in the process. We choose the pool-type electromagnets as the focusing magnet and 50 DTs will be installed on first tank. We tested the winding schemes of copper coils on the iron core and measured the magnetic field saturation. In this paper, the results of the tank fabrication and quadrupole magnet test are presented.

INTRODUCTION

The front part of PEFP proton accelerator consists of 50 keV source, 3 MeV RFQ and 20 MeV DTL will be constructed and tested until the year 2005 [1-2]. In KAERI site, beam test of the DTL will be limited because of the lack of radiation shielding. We are scheduled to start the tuning of 1st DTL from the September this year.

DTL TANK

Fabrication

The fabrication of PEFP DTL tanks is in progress [2-3]. The main parameters are listed in below.

Table 1. PEFP DTL parameters

Parameters	Value
In/out energy	3 / 20 MeV
Current	0 ~ 20 mA
Duty	24 %
No. of tank	4
Tank diameter	54.4 cm
Tank length	4.43/4.65/4.76/4.78 m
Power	225/225/224/221 kW
DT diameter	13 cm
Bore radius	0.7 cm
DT face angle	10 degree
Stem diameter	2.6 cm
No. of cells	51/39/33/29

The fabrication of 1st tank is completed as shown in figure 2. The ambient temperature during the machining was 10 ℃, so we compensated the size to designed temperature 40 ℃. The cooling of the tank is achieved through the 20 water channel machined in tank wall. The total flow rate is 10 L/sec and the maximum temperature rise was calculated as 1.7 degree. The inner surface is copper plated using PR method in 100 μm thickness. We polished mechanically the surface after PR plating in order to satisfy the Ra 0.3 μm roughness. And then electro polishing and chromate treatment procedures are performed (in figure 1). The quality factor and outgassing rate of plating surface were measured by means of fabricating the small plating sample.

Every component such as slug tuner, post coupler and end wall will be fabricated with OFHC copper and jointed to the tank. The grilled adaptor for vacuum port will be fabricated independently and bolted to the tank. They have respective cooling channels and will be modified gradually according to the results of tuning.

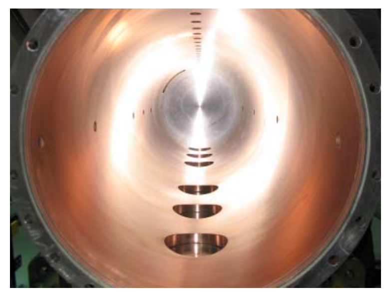

Figure 1. Plated inside of tank.

Figure 2. Installed DTL tank 1.

Installation

Every joint has metal C-seal and viton o-ring as RF and vacuum sealing scheme in DTL tank. We designed the stem, post coupler and pick up to have same seal groove geometry. We completed the vacuum tightness test in this joint and confirmed the contact between C-seal and stem. We designed the stem holder to align the drift tubes within ±50 μm error range. It divided into 3 parts and the M6 bolts are installed to adjust the DTs in 3 directionally.

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For post coupler, the radial movement and rotation functions will be added. It will take about a month to install the 50 DTs in tank, so we are planning to build the temporary tent in lab to prevent the contamination during the install. To align the drift tube, the laser tracker system will be used.

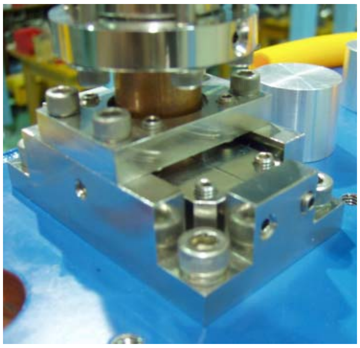

Figure 3. Stem mounting holder

DRIFT TUBE AND EQM

Drift tube

We are fabricating the 50 drift tubes with the pool-type EQMs inside. PEFP DT divided by 6 pieces as shown in figure 4 and the thickness of every part is over 3 mm. The joints are e-beam welded together, but the joint between outer shell of DT and stem (2 and 6 in figure) is brazed to guarantee the straightness of stem. We installed the iron core with designed alignment error through 2 pin holes and fixed using 2 bolt taps. In figure 7, the installed EQM inside drift tube and the completed drift tube.

The calculations of deformation and strength intensity of DT carried out using ANSYS code. The results satisfied to the allowable designed value. We fabricated the test sample as shown in figure 7 and tested the vacuum leak tightness at welded joints as under 1E-10 mbar L/sec. Also the endurance test of coolant was performed under coolant pressure difference 2 atm and flow rate 20 L/min.

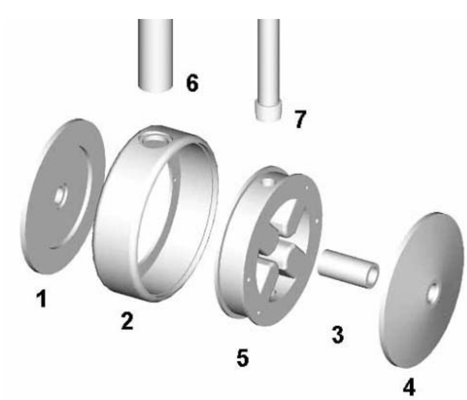

Figure 4. Parted view of drift tube

Quadrupole Magnet

The electro quadrupole magnet was designed using Poisson Superfish code and the parameters are listed in table 2. We fabricated the core using one iron bulk and nickel plated to prevent the corrosion by the cooling water.

The cooling water channel having 23 mm × 3 mm size is machined around the outside of the core(refer to figure 4). The coolant rotated in this channel is cool down the coils and then come out through the inner tube of the stem (in figure 5).

Table 2. PEFP EQM parameters

Parameters	Value
GL	20 kG/cm.cm (17.5 + 10% margin)
Effective length	3.4 cm (measured)
Good field diameter	14 mm (0.5%)
Multipole	<1% at r<7 cm <0.1% at r<3.5 cm
External diameter	110 mm
Bore diameter	20 mm
Pole length	25 mm
NI for 20 kG	2200 AT
Conductor	3 mm * 2 mm
# of turns	9

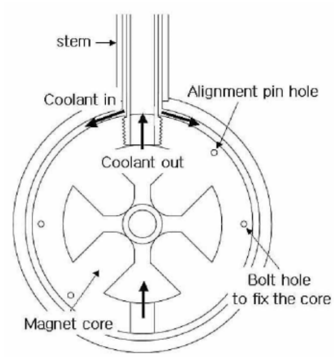

Figure 5. The cooling scheme of the DT

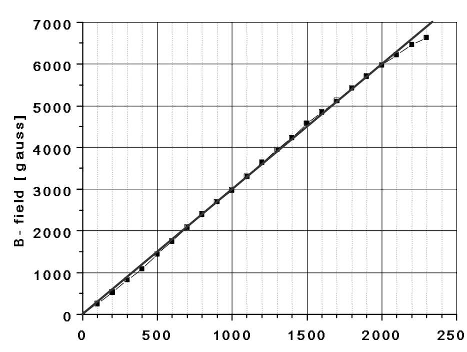

Figure 6. Measurement of the magnetic saturation

We wound the copper wire 9.5 turns on respective iron core poles continuously and measured the magnetic saturation and effective length using the gauss meter and hole probe. The effective length was measured as 3.4 cm and adaptable to the beam dynamics designation value 3.5 cm. Saturation started above the total current 2200 AT. This result satisfies the designed GL of 17.5 kG/cm.cm in which the effective length is 3.4 cm. And it can be obtained the 20 kG/cm.cm by reducing the coolant hole diameter.

Figure 7. Assembled EQM in DT and fabrication completed DT

CONCLUSION

The 4 tanks of the PEFP 20 MeV DTL are fabricating and the several tests for the drift tube installation were completed. And proto type DT and quadrupole magnet was fabricated and tested. We verified the performance suitable to the designed value. We're completing the designation of components such as slug tuner, end wall, post coupler and vacuum grill adaptor. Simultaneously we preparing for tuning, and will start the tuning immediately after the completion of drift tube installation.

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