FABRICATION STATUS OF THE PEFP DTL II*

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Abstract

The DTL II as a main part of the PEFP proton linac is under development. Following the DTL I which accelerates the proton beam up to 20 MeV, DTL II increases the proton energy from 20 MeV to 100 MeV. The DTL II consists of 7 tanks and each tank is composed of 3 sections whose length is about 2.2 m. The tank is made of seamless carbon steel and inside surface is electroplated with copper. Each drift tube contains an electroquadrupole magnet which is made of hollow conductor and iron yoke with epoxy molding. The status of development and test results of the fabricated parts are reported in this paper.

INTRODUCTION

Proton Engineering Frontier Project (PEFP) proton linac is 100 MeV accelerator which is composed of an injector, 3 MeV RFQ, 20 MeV DTL I and 100 MeV DTL II [1-4]. An accelerating section up to 20 MeV DTL I is completed and installed in KAERI site and 100 MeV DTL II is under development. The 100 MeV DTL II consists of 7 tanks and each tank is an assembly of 3 sections. Main parameters of 100 MeV DTL II are shown in Table 1.

DTL II FABRICATION

Tank Assembly

The length of each DTL II tank is about 6.8 m. For easy fabrication, the tank is divided in 3 sections. Each section is made of seamless carbon steel with copper plating.

Three sections are combined into one tank by using bolting method. We used a C-seal and O-ring at the interface between sections for RF sealing and vacuum sealing respectively. Fig.1 shows the C-seal and O-ring installed at the interface. Total weight of combined tank is about 5 tons. Fig. 2 shows the combined DTL tank during assembly.

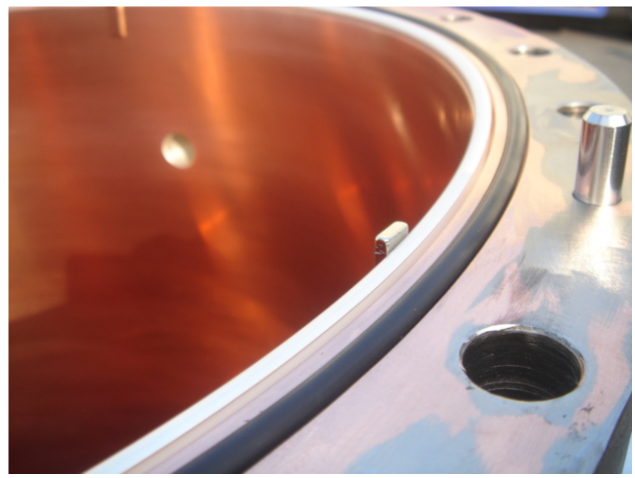

Figure 1: C-seal and O-ring for RF and vacuum sealing.

Drift Tube and Electroquadrupole Magnet

Each tank of DTL II contains drift tubes (DT). The stem of DT is a triaxial structure [5]. Outer stem is made of OFHC and middle and inner stem are stainless steel. Each part of DT is assembled by using brazing and electron beam welding method as shown in Fig. 3.

Table 1: Main parameters of DTL II

	DTL101	DTL102	DTL103	DTL104	DTL105	DTL106	DTL107
Cell number	34	28	25	23	21	20	19
Energy [MeV]	33.1	45.3	57.1	69.1	80.4	91.7	102.6
Length [mm]	6737.97	6707.26	6791.74	6877.06	6777.65	6869.92	6880.20
E0 [MV/m]	2.58	2.58	2.58	2.58	2.58	2.58	2.58
H at wall [A/m]	3402.9	3429.2	3442.3	3393.3	3403.0	3370.5	3377.7
Stored energy [J]	15.8	15.9	16.2	16.1	16.0	16.0	16.1
Beam power [kW]	257.4	241.3	231.2	235.5	222.2	222.5	214.2
Cu power [kW]	807.3	798.0	808.9	791.3	785.9	782.2	789.4

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Figure 2: 3-section combined into one tank assembly.

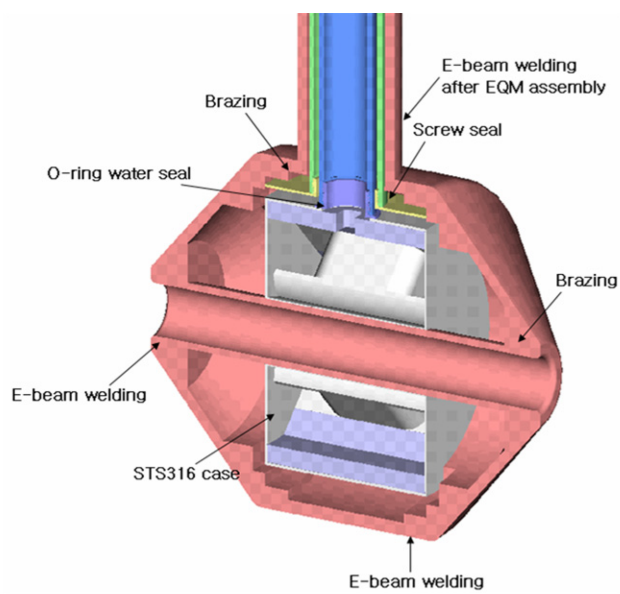

Figure 3: Structure of drift tube.

Each DT includes an electroquadrupole magnet. To prevent the epoxy molded magnet from wetting, we wrapped the magnet with stainless steel jacket. Before installing the DT into the tank, we measured the field gradient of each electroquadrupole magnet by using a rotating coil method [6]. A rotating coil measurement system is composed of a rotating coil, a motor to rotate the coil, a rotary encoder and data acquisition system as shown in Fig. 4. Measurement results for DTL102 are summarized in Fig. 5. During the measurement, the coil excitation current was 400 A and measured GL was about 17.2 kG with standard deviation of 0.56 %.

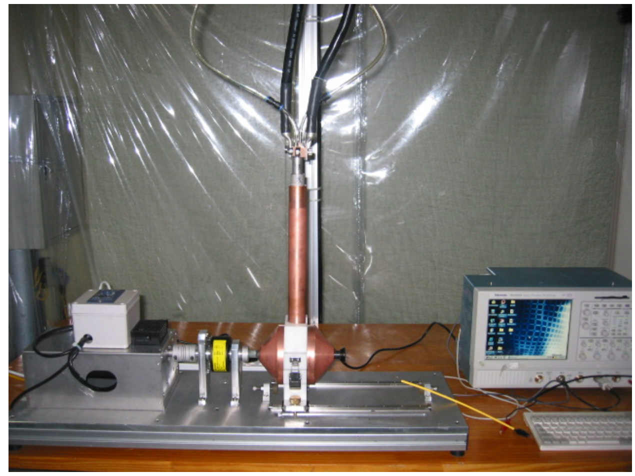

Figure 4: Rotating coil measurement system setup.

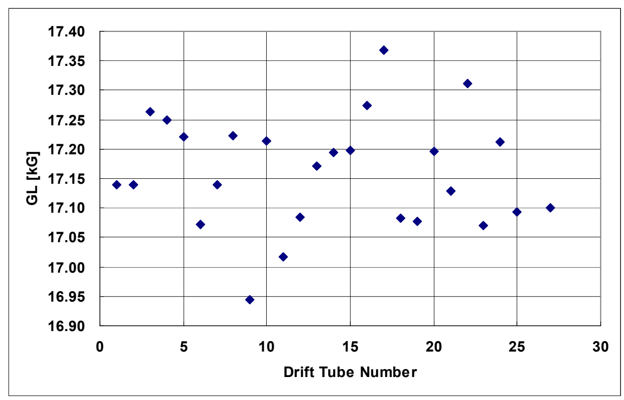

Figure 5: Measured GL for DTL102 electroquadrupole.

DRIFT TUBE ALIGNMENT

We have performed the DT alignment for DTL102 by using two laser trackers. The alignment scheme is shown in Fig. 6. By using two laser trackers, the position of DT can be monitored and adjusted in real time. Alignment tolerance is ±50 um in transverse direction and ±100 um in longitudinal direction at the center of electroquadrupole magnet installed in the DT. The final alignment results are summarized in Fig. 7.

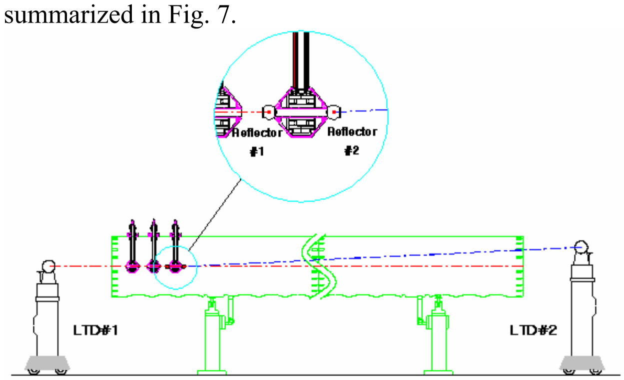

Figure 6: Alignment scheme by using two laser trackers.

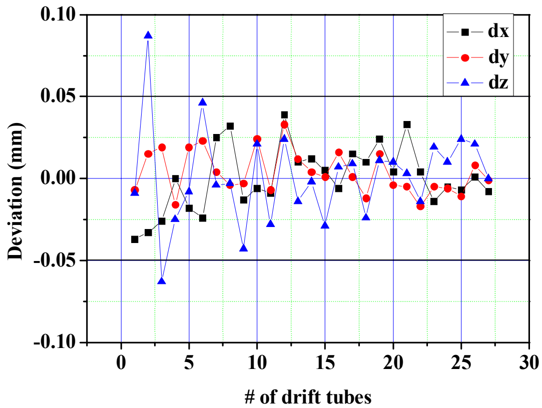

Figure 7: Alignment result for DTL102.

FIELD FLATNESS TUNING

After installing the DT in the tank, we have performed the field flatness tuning by using the slug tuners [7]. Each tank has 12 slug tuners and the tuning range is designed to be ±1 MHz. The field flatness requirement is ±2%. To measure the field profile, we used a bead pull method. The field flatness tuning setup is shown in Fig. 8. To minimize the temperature drift effect, the tuning was performed with constant temperature condition which was made by using SCR controlled heating cables around the tank and ambient temperature control. Tank temperature was maintained within ±0.2 ˚C. The field flatness tuning result is summarized in Fig. 9.

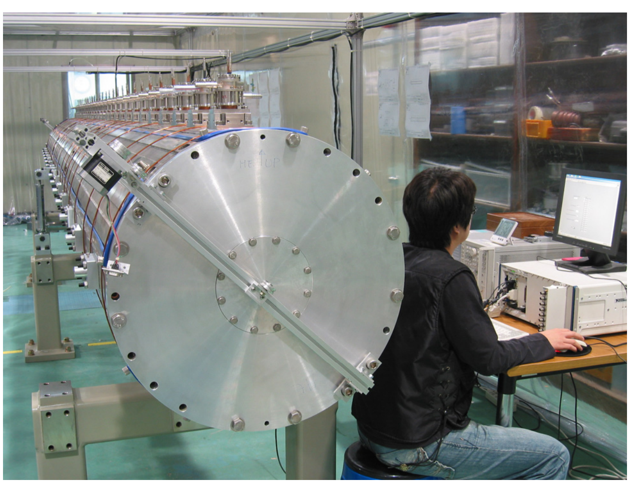

Figure 8: Field flatness tuning setup.

CONCLUSION

Fabrication of DTL II is undergoing. Three tanks were already fabricated and the alignment of drift tubes was performed for one tank. The electroquadrupoles in the drift tubes were measured by using a rotating coil method to check the field gradient. Field flatness tuning was performed after DT installation. The rest four tanks of DTL II will be fabricated in near future.

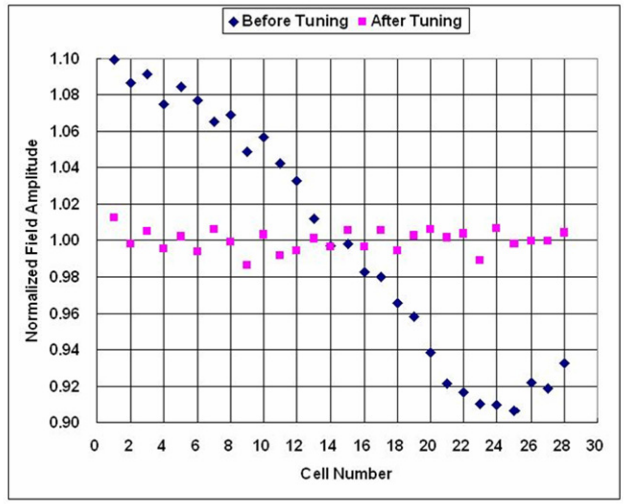

Figure 9: Field flatness tuning results for DTL102.

REFERENCES

[1] J. H. Jang, Y. S. Cho, H. J. Kwon, K. Y. Kim and Y. H. Kim, "Beam Dynamics Design of the PEFP 100 MeV Linac", HB2006, Tsukuba, p. 99 (2006)

[2] H. J. Kwon, Y. S. Cho, H. S. Kim, J. H. Jang, Y. H. Kim, K. T. Seol, I. S. Hong and Y. G. Song, "Test Results of the PEFP 20-MeV Proton Accelerator", LINAC'06, Knoxville, p. 133 (2006)

[3] J. H. Jang, Y. S. Cho, H. J. Kwon, K. Y. Kim and Y. H. Kim, "Design of the PEFP 100-MeV Linac", LINAC'06, Knoxville, p. 130 (2006)

[4] M. Y. Park, H. J. Kwon, Y. H. Kim, J. H. Jang and Y. S. Cho, "DTL Fabrication Status of PEFP Linac", APAC'04, Gyeongju, p. 735 (2004)

[5] Y. H. Kim, J. H. Jang and Y. S. Cho, "Design and Fabrication of the PEFP DTL II", PAC'07, Albuquerque, p. 1553 (2007)

[6] Jack Tanabe, "Iron Dominated Electromagnets Design, Fabrication, Assembly and Measurements", SLAC-R-754, (2005)

[7] M. Y. Park, Y. S. Cho, H. S. Kim, H. J. Kwon, K. T. Seol and Y. G. Song, "Tuning of 20MeV PEFP DTL", PAC'05, Knoxville, p. 1598 (2005)