

Takahata, K., Iwamoto, A., Morisaki, T., Yamamoto, J., Motojima, O.

Poloidal coil system of the Large Helical Device consists of three pairs of circular solenoids. One of Outer Vertical (OV) coils has been finished in April of 1996, and three coils, IV, IS and OV, have then been installed into a lower part of the LHD supporting shell. Another OV coil is planning to be completed till the end of 1996. Main parameters of the OV coils are listed in Table I. Top view is also shown in Fig. 1. The coil has a center diameter of 11.1 m, and weighs about 45 tons. It becomes the largest forced-flow type superconducting coil.

Conductor of the OV coil is Nb-Ti cable-in-conduit type with 486 strands and a 3.5 mm thick conduit. The surface of strands is uncoated, which affects heat transfer to helium and current redistribution. Pure gas helium was enclosed into the conductor to avoid oxidation of the strand surface during fabrication. A void fraction, which is one of the most important parameters, was optimized to be 0.38 from the viewpoint of a strand movement and an inter-strand coupling loss.

A coil consists of eight double-pancakes. Each double-pancake with two layers and 9 turns/layer has about 630 m long conductor. The molded pancakes kept tolerances of ± 3 mm for the inner diameters (± 2 mm for an average), ± 5 mm for the outer diameter (± 2 mm for an average) and ± 1 mm for the height. The tolerances correspond to extreme accuracy of less than 5×10^{-4} for the diameter. Figure 2 shows average manufacturing errors of the double-pancakes for the OV coils. The lower coil consists of #1~#8, and the upper consists of #9~#16. The figure indicates that all errors were acceptable.

The pancakes were, then, stacked and molded. As for the electric joints between pancakes, a superconducting joint technique was applied in the same way as the IV and IS coils. The ground insulation of 4 mm thickness was wound around the molded coil. Finally, the coil was covered with ten fan-shaped PC sleeves.

Table I. Main Parameters of the OV coil

Cooling type	Forced-flow
Center diameter	11.1 m
Height	0.54 m
Total weight	45 tons
Number of pancakes	16
Number of turns	$9 \times 16 = 144$
Operating current	31.3 kA
Maximum field	5.0 T
Stored energy	251 MJ

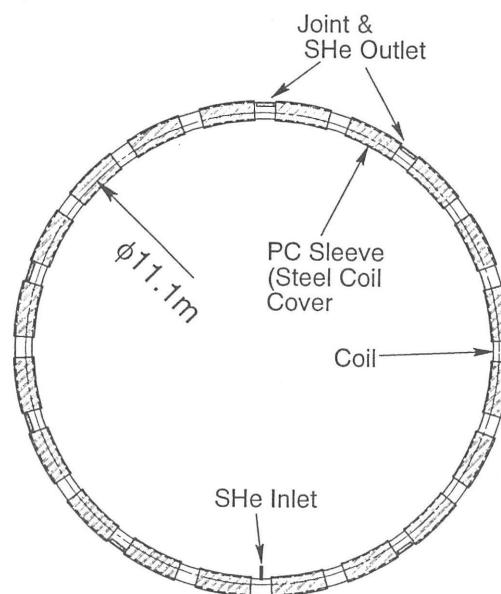


Fig. 1. Top View of the OV coil

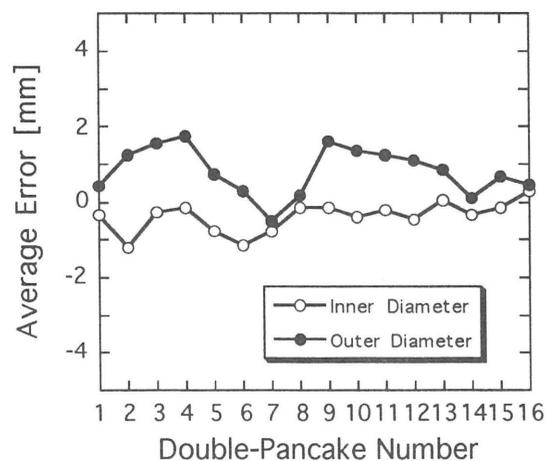


Fig. 2. Average manufacturing errors of the double-pancakes for the OV coils