DESIGN AND MANUFACTURING OF JT-60SA VACUUM VESSEL

K. Masaki[1], Y. K. Shibama[1], S. Sakurai[1], M. Katayama[1], A. Sakasai[1]

[1]*Japan Atomic Energy Agency, Naka, Ibaraki-ken, 311-0193 Japan*

Corresponding author: masaki.kei@jaea.go.jp

JT-60 is planned to be upgraded to JT-60SA tokamak machine with fully superconducting coils. The JT-60SA is a project of the JA-EU satellite tokamak program under both Broader Approach program and Japanese domestic program. The JT-60SA tokamak comprises the following main components: vacuum vessel (VV), thermal shield (TS), 18 toroidal field coils (TFC), 6 equiliblium field coils (EF), center solenoid (CS) and cryostat.

VV has a D-shape poloidal cross section and a toroial configuration with 10-degree segmented facets (36 cornered shape) in toroidal direction. The outer diameter and the height are 9.95 m and 6.6 m, respectively. The material is 316L stainless steel with low cobalt content of <0.05wt%. The VV is composed of 18 port sections with 9 legs having leaf-springs to absorbe thermal dispalcement at baking operation. 73 ports are arranged for plasma heating, diagnostics, in-vessel water cooling pipes, etc. Each port is connected to cryostat by bellows, and insulated from the cryostat at the connections.

The VV has a double wall structure composed of inner/outer shells and ribs to ensure high rigidity at operational load and high toroidal one-turn resistance of ~16 μΩ simultaneously. The double wall thicknesses are 194 mm at inboard and 242 mm at outboard. Inner/outer shells and ribs have 18-mm and 22-mm thicknesses, respectively. In the double wall, boric-acid water of ~50°C (0.3MPa:gauge pressure) circulates at plasma operation to reduce nuclear heating of the superconducting coils. At the baking of 200°C to obtain ultrahigh vacuum of ~10^{-6} Pa, nitrogen gas (0.19MPa: gauge pressure) circulates in the double wall segmeted by ribs as circulation channels. Orifice seizes for the circualtion are optimezed to obtaine appropriate flow rate in each channel.

Manufacturing of the actual VV has started in December 2009 after fundamental welding R&D [1] and a trial manufacturing of upper half of 20-degree sector. In this paper, the design of JT-60SA vacuum vessel and its interface structure between VV and other components, especially cryostat, are described. Furthermore, the present status of the actual VV manufacturing and the resutls of the trial manufacturing are also presented.

[1] S. Asano, et al., “Fundamental welding R&D results for manufacturing vacuum vessel of JT-60SA”, in this conference