R & D of the Fabrication Technology for ITER Magnet Supports

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Abstract. The R&D of the manufacture related technology for ITER magnet supports is one of the tasks for construction. 316LN as the main raw material has been developed tested. The material shows excellent mechanical property at room temperature, 77K and 4.2K. An alternative design for toroidal field support (TFS) manufacture without welding was carried out, the structure analysis shows that no stress concentration and buckling in the present design during ITER operation. However, the further engineering test of the structure stability under various load combinations is also scheduled. For cooling pipe, brazing connection to attach the cooling pipe to support-plates is suggested. Several kinds brazing filler as candidates, including Sn-Pb, Ag-based and Cu-based alloy has been developed. The tensile strength of brazed solder is up to 400MPa at 77K for Ag-based and Cu-based fillers. In PF3-4 support system, Ion implantation was utilized to modify the surface condition of the strut dowel due to its non-boundary modification of the microstructure as well as the formation of hard alloys on the surface. It is clear that the wear resistance was improved obviously after ion implantation vie increase the surface hardness and reduce the wearing. For CC support, the plasma spray insulation coating was developed and introduced.

1, Introduction
Magnet supports is one of the key components to sustain all the magnet coils of ITER, including toroidal field (TF) coils, PF coils and correction coils (CC). The components in this system endure several large forces, such as dead weight of coils, thermal load during coil cooling down from room temperature to 4K, electromagnetic forces (TF coil operation, plasma burning, plasma disruptions (DIS) and vertical displacement events (VDE)), and seismic loads if they occur [1,2]. China signed the procurement arrangement with ITER international organization (IO) and promised to manufacture all the magnet supports for ITER construction. Therefore, the manufacturing-related R&D is a key step for the final components. In this report, we introduce our recent progress for the R&D work towards the ITER construction.

2, Material R&D
316LN austenitic stainless steel has been recommended in ITER structure components due to its excellent corrosion and fatigue resistance, high strength at low temperature and low creep rate. It is estimated that more than 2000 tons of various types of 316LN stainless steel are needed for all the magnet supports, including hot-rolled plate, forged blocks, and pipes. Until to now, both hot-rolled plate and forged block were developed. The chemical composition of the steels is similar with that of the steel developed by JAEA for TF case manufacturing[3]. The mechanical test results of these materials are summarized in Table 1. The plate and the forged block showed high strength and good elongation at both room