

## ITER Toroidal Field Model Coil



MAGNETS  
FOR FUSION



MAGNETS FOR HIGH  
ENERGY PHYSICS



MAGNETS FOR  
MEDICAL  
APPLICATIONS



SYSTEMS  
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The main objective of the ITER TF Model Coil was to demonstrate the industrial feasibility of the ITER TF Coils and to assess their operating margins. The coil was manufactured by the European AGAN Consortium and delivered in 1999. The scope of supply of ASG (then acting as the "Magnet Division" of Ansaldo) consisted in winding the Double Pancakes (DP) composing the TFMC coil, in developing the Full Size Joint Samples and the "Incoloy Program". The TFMC was composed of five Double Pancakes wound in a "racetrack" configuration. Each DP was obtained by jointing two individual layers of conductor, and it measured about 2.6 m in width and 3.6 m in length. The overall coil was composed of 98 turns in total, and could generate a magnetic field up to 7.4 T (8.5 T with LCT coil) with an operating current of 70 KA.

The conductor was a Nb<sub>3</sub>Sn Cable-In-Conduit with a central cooling channel. It was jacketed in a thin SS 316 LN seamless tube, and cooled by forced-flow of supercritical helium. The winding was carried out by the Wind-React-Insulate-Transfer process: the conductor was wound in a mould to form one layer of the DP, reacted and thus transferred inside a stainless steel Radial Plate. The covers of the grooves of the RP, themselves made of stainless steel, were sealed by laser welding, with a welding strategy that allowed to obtain the total flatness of the DP within 1 mm.

The test method used for the verification of the quality of the welds in the body of the groove covers was that of the eddy currents. Each DP was then impregnated using a unique VPI process during which both the ground and the turn insulations of the DP module were finalized.

The DP inner joints were then obtained by soldering two termination boxes (made by explosion bonding Cu-OFHC – stainless steel plate) into which the conductor ends of the layers composing the pancakes were blocked.



*TFMC single pancake winding*



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**DP4 ready for heat treatment.**  
*Superconducting samples of ENEA and FZK in front of top pancake. Incoloy mould frame under the top pancake*



**TFMC turn insulation**



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**TIG welding of channel covers**



**Starting of ground insulation process**



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**Pancake assembly line**



**Dummy DP impregnated: cleaning after impregnation**



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