

Experience gained during Manufacture and Testing of the W7-X Supersconducting Magnets

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The W7-X basic device is presently being assembled at the Greifswald branch of IPP. The specific field configurations of this helical advanced stellarator are realised by a symmetric arrangement of 50 non-planar and 20 planar superconducting coils. In order to sustain the large electromagnetic forces and moments, all coils are bolted to a massive coil support structure and supported against each other by inter-coil support elements. Cooling of superconductor and the casing is provided by supercritical helium. For all coils the same cable-in-conduit conductor is used. This conductor is formed by a NbTi cable which is co-extruded in an aluminium jacket.

Low-resistive electrical joints connect the conductor layers within a winding package and potential break provide electrical insulation of the helium pipes. After insulation and vacuum pressure impregnation, the winding packages are embedded in stainless steel casings, which are then finish-machined and equipped with cooling pipes. During a rapid shut-down of the magnet system the windings may experience voltages up to several kilovolts. High voltage tests under degraded vacuum conditions (Paschen tests) provide a sensitive method to detect weak points in the electrical insulation.

Manufacture of the magnets is in a well advanced stage. All winding packages are completed, many of them are integrated in the casings and several coils have already been delivered for cold testing. These tests are performed in a cryogenic test facility at CEA Saclay. Tests at nominal operating conditions and quench tests confirmed the electric layout and the specified margin.

Design changes have been implemented during fabrication due to more detailed structural analyses. Some manufacturing processes had to be modified and re-qualified to allow repair of weaknesses defects found during tests.

The presentation will give an overview of the production status of the superconducting coils, the experiences gained during fabrication of the superconductor, the winding packages, the steel casings and during assembly, as well as of the results of the cryogenic tests.