

PRELOAD EXPERIMENTS ON WENDELSTEIN 7-X ATTACHMENT SYSTEM OF THE SUPERCONDUCTING COILS

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The attachment system of Wendelstein 7-X (W7-X) superconducting coils has to withstand the deadweight and the electromagnetic loads of the coils which result to sizeable coil deformations during operation.

After a design review in 2003 the attachment system has been modified to cope with loads and deformations larger than previously predicted, considering the W7-X goal of testing plasma scenarios at 3 Tesla.

The attachment system joins the coil casing extension blocks to similar blocks on the main coil support structure using a stud connection. The studs are threaded on one side inside the coil blocks and are preloaded on the other side with a nut acting on the support structure block through a long cylindrical sleeve. The sleeves are used to increase the elasticity of the attachment, allowing larger coil deformations. The system will operate at 4 K.

The fastener system was improved in order to achieve a high preload, having a limited space for the fitting elements (e.g., tensioners, washers, studs) and a preloading test campaign has been carried out to assess the behaviour of the system.

INCONEL 718 has been used for the stud, the sleeve and the washers. Their detailed design was optimised during the tests. A special tensioner, namely the superbolt™, has been used; its performances have been improved with respect to the standard design by a factor 2.5 in terms of preload and maximum size.

With the new developed high strength tensioner, a full scale mock-up of a single fastener assembly with a M30 stud has been built and tested.

The stresses and the elongation of the assembly have been measured at different preloading up to 570 kN. After that the preload has stabilized (a certain relaxation occurs due to the weaker material (cast steel) of the extension blocks), the assembly has been thermal cycled three times, between room temperature and 77 K and the behaviour of the preload has been measured.

The paper describes the tests and the instrumentation used and summarizes the results obtained.