

# **FINAL DESIGN AND MANUFACTURING OF THE CRYOLEGS TO W7-X-SUPERCONDUCTING COIL MAGNET AND SUPPORT SYSTEM**

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One of the most complicated task during assembly of the W7-X is the installation of the superconductive coil system. The coils are supported by a circular support structure, the coil support structure (CSS). The entire magnet system is enclosed between the outer vessel and plasma vessel in ultra high vacuum at 4K.

The CSS carries all 70 coils. The CSS is designed as closed ring made of 5 modules (10 half modules). The supporting of the CSS takes place via 10 cryolegs acting on the machine base (MB).

The cryolegs are static highly loaded components. These legs are transfer elements between the cold parts embedded in the cryostat (outer vessel) and the machine-base at ambient temperature. The cryolegs take over five substantial tasks:

- Transmission of high vertical and horizontal forces (max  $F_v = 1000$  kN, max  $F_h = 156$  kN)
- Thermal insulator between the cold parts (CSS / coil system) embedded in the cryostat and the components working at ambient temperature (cryoleg components connected to the machine base)
- Compensation of different thermal expansions between the CSS at 4K and the machine base at ambient temperature
- Compensation of building and assembly tolerances between the CSS and the outer vessel
- Vertical and horizontal adjustment of the CSS on the machine-base

All components of the cryolegs, except the insulator socket, are made of stainless steel 1.4429 316LN (yield point  $R_p 0,2: > 900$  MPa with 4 K, elongation at fracture:  $> 25$  %, Young's modulus :  $> 190$  GPa at 4 K, cobalt content  $< 2000$  ppm).

Due to its high mechanical requirements of the insulator tube a separate R&D is necessary for the development, building and test prototypes and the following manufacturing of the real parts. In parallel the operability of the bearing components is to be proven by specified test.

The design of the cryolegs is described in the present paper together with their calculations and technical characteristics. Additionally the investigations for the employment of the insulator tube and the test of endurance of the cryoleg bearings are presented.