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Flow Test at Factory for ITER Thermal Shield

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Thermal Shield (TS) is to be installed between vacuum vessel/cryostat and superconducting magnet in ITER tokamak. The TS plays a role in minimizing thermal radiation load onto the magnet. The TS has to be cooled by flowing 80 K helium gas inside cooling pipes welded on the TS surface. The helium coolant is supplied from the cryoplant via manifold pipes and distributed to all TS segments. Flow through each TS segment should be fully characterized to accurately predict the flow distribution in TS flow network for ensuring reliable operation of the TS.

This paper describes how the manufactured TS segments are validated by factory flow test. Instead of applying cryogenic helium flow in the test, high pressure and room temperature nitrogen gas passes through the cooling pipe on TS segment. Equivalent test flow rate is determined by matching test Reynolds number with that of actual operating condition of TS based on similarity principle. Flow rate is controlled by a thermal mass flow controller and pressure drop between the inlet and the outlet of the pipe routing is measured by a differential pressure gauge. Test results are compared with calculated ones by incompressible pipe flow analysis to check the validity of pipe and elbow loss coefficients for the real manufactured TS segments. Orifice elements are to be connected to several TS segments for mass flow balancing of the TS flow network. The orifices are also tested separately by the flow test apparatus. Correlation for the orifice loss coefficient is derived from the test results.

Eligible for student paper award?

No

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