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M1Or2C-03: Tensile Properties and Fracture Toughness of New Stainless-Steel Plate at Cryogenic Temperatures

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The Joint Special Design Team for a fusion demonstration reactor (DEMO) was organized in 2015 to enhance Japan's DEMO design activity and coordinate relevant research and development (R&D) toward DEMO. The fundamental concept of DEMO and its key components were already reported with main arguments on the design strategy [1]. Development of cryogenic materials with higher strength for toroidal field coils is one of major challenges on the magnet in this activity. The requirement to 0.2% proof stress of the material is over 1200 MPa at 4.2 K. HRX19TM comprises of its own unique materials with the optimized chemical composition and production process to further increase strength and improve hydrogen embrittlement resistance in a component range of ASME standard XM-19 (22%Cr-13%Ni-5%Mn-2%Mo-Nb, V) [2]. In the previous work, cryogenic mechanical properties of XM-19 were investigated and the 0.2% proof stress of this steel exceeded 1200 MPa at 4.2 K in several conditions [3]. Therefore, HRX19TM could also be a candidate material to achieve higher yield strength at cryogenic temperatures.
In this research, tensile properties and fracture toughness of a 30 mm-thickness plate of HRX19TM were investigated at 4.2 K. The results will be presented with microstructural and fractographical information and compared with the data of the steels reported in the literature.

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[3] McRae DM, et al., Fatigue and fracture of three austenitic stainless steels at cryogenic temperatures, IOP Conf. Series: Materials Science and Engineering 279 (2017) 012001 doi:10.1088/1757-899X/279/1/012001

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