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## **Cryogenic thermometry for refrigerant distribution system of JT-60SA**

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JT-60SA is a fully superconducting fusion experimental device involving Japan and Europe. The cryoplant supplies supercritical or gaseous helium to superconducting coils through valve boxes (VBs) or coil terminal boxes (CTBs). There are 89 temperature measurement points at 4 K in VBs and CTBs. Resistance temperature sensors will be installed on cryogen pipes in vacuum.

Two type of sensors and two installation methods were experimentally evaluated in terms of accuracy and manufacturability. The sensor in the well method is installed in a narrow stainless steel capillary which is inserted into a cryogen pipe. This method is relatively conventional and accurate measurement, but technical inspections have to be imposed because of machining and welding pipes. The sensor in the saddle method is installed in a copper block which is attached on a cryogen pipe by silver brazing. This method is easy to make and not necessary to conduct specific inspections, but relatively inaccurate measurement because of less thermal contact between the sensor and fluid.

Two sensors installed on the pipe by each method have been examined at same time and compared with one reference sensor directly immersed in liquid helium in the pipe. The temperature of helium changes in the range of 3.34-5.06 K as an experimental parameter. The measured temperature difference between attached one and reference one has been within about 30 mK even by the saddle method. It is satisfied the accuracy requirement within 0.1 K.

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