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Commissioning of temperature sensors for the XFEL AMTF

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Demaco was awarded with the contract for the design, manufacturing and installation of the Accelerator Module Test Facility (AMTF) for XFEL at DESY, Hamburg.

The scope consisted of a Sub-cooler Box XASB, a Valve Box XAVB and all interconnecting multiple Helium Transfer Lines. The instrumentation was part of the responsibility and based on the specifications of DESY. For Temperature measurement suitable thermo sensors of resistive type had to be installed at the locations where the lowest temperature could drop below 40 K.

Calibration of the thermo sensors has been held on a certified calibration set-up based on International Temperature Scale 1990 (ITS-90). The number of calibration points are adequate to the required accuracy of the thermo sensor. The low temperature thermo sensors are calibrated between 300 K down to 4 K.

Specification of thermo sensors:

Nominal resistance at 300 K: $40 \leq R \leq 1100 \text{ Ohms}$.

Temperature coefficient: Negative.

Self-heating effect: $\leq 2 \text{ mK}$ for temperature range 1.6 - 5 K.

Dimensionless sensitivity $|(T/R) \cdot (dR/dT)| \geq 0.15$.

Accuracy dT/T (calibration and fitting): better than $\pm 0.5 \%$ for the whole T - range.

Thermal cycles before calibration: ≥ 25 times in the range from 80 K to 300 K.

Long term stability δ after 150 thermal cycles from 300 to 80 K, and after 5 years: $-0.5 \% \leq \delta \leq 0.5 \%$ for the whole T - range.

Temperature shift β caused by gamma radiation of $1 \times 10^6 \text{ Gy}$ total dose: $-0.5 \% \leq \beta \leq 0.5 \%$ for the whole T - range.

Electrical insulation resistance: $> 3000 \text{ M}\Omega$.

Physical size: less than 10mm long and 3mm diameter.

The specification of the temperature sensors has been tested, validated and accepted by the customer.

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