Design of double-walled bellow cooling pipes for silicone oil used for the DSSC Detector project @ European XFEL.

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DSSC Detector introduction

- DSSC (DEPMOS Sensor with Signal Compression)
- non-linear gain (DEPFET Sensor)
- with 1-4e-9 A/m² signal current

The picture above shows the complete DSSC-Detector with vacuum vessel, Actuation and Feedthrough flanges. Motion stages completed with cooling-block and electronics.

This is a development project for the XFEL led by the MPG's Laser Science (CFEL), Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany.

Inner parts of DSSC

- Silicone fluid has an operation temperature by +60°C
- Coolant flow is through a outer shell (cooling-block)
- bellow is used to move the electronics in the in-vacuum detector head
- non-linear gain DEPFET Sensor
- DSSC (DEPMOS Sensor with Signal Compression)

Cooling-block with included electronics

- the aim is to achieve -30°C Sensor Temperature at every point of surface
- Silicone fluid has an operation temperature by +60°C
- shows sealing in the in-vacuum detector head
- cooling-blocks are welded to connectors in copper-blocks

Requirements to cooling pipes

- sufficient cross-section for cooling performance,
- enough flow of silicone fluid
- Stainless-steel (weldable / vacuum compatible)
- liquid safe enclosed
- no force to connection points at the copper-blocks
- reliability about many years of user operation

Cooling Pipe Test with moving

- Cooling pipes mounted on middle size bellow called "zero-position"
- movement from zero to 7 mm in each direction
- fluid temperature -40°C
- cycle ~ 15 s
- movements rotary: circle / cross
- Duration 24 h

Movement of quadrants

- Quadrants move ±7 mm in each direction by medium-hole-position
- Cooling pipes are in fixed position at the back midfringe of the vessel
- Cooling pipes are welded to connectors in copper-blocks
- this means that the pipes itself catch this movement without being force into the connection points in the cooling block

From CAD-Model to real parts

- shows a CAD test for bellow at (front)
- test for silicone oil (welding)
- Outer to cooling-block (welded)
- Inner bellow
- Outer bellow
- sealing washer
- The complete double walled cooling pipe (Prototype)

Summary

- Test result is very good
- no problems with feasibility
- Cooling performance should be tested with final copper-block

We will use this part at DSSC Detector Project

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