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MetForTC

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Fakultet strojarstva i brodogradnje

EMPIR JRP 18RPT03 MetForTC

WORKSHOP
Temperature measurement by thermocouples

Dual-Type Thermometer

Faculty of Mechanical Engineering and Naval Architecture, Laboratory for Process Measurement (FSB-LPM), East building, Blue room, Ivana Lučića 5,

Zagreb, Croatia, 27 February, 2020

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Why do we want to determine the TC drift in-situ?

- Many processes are controlled by TCs.
- Their (extensive and expensive) regulation equipment is geared to certain type of TCs.
- Some processes last a long time (sometimes for days or weeks) and cannot be stopped.
- This means that TC cannot be removed from the process for calibration because the process cannot be stopped.
- The unknown TC drift can cause deviations from the required temperature(s) and cause serious damage (annealing of turbine parts, annealing of aluminum parts, power-plants, turbines, continous casting, farmaceutical products, etc.)

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For cases where we cannot remove the controlling TC from the process and where we must determine it's drift, we are developing Dual-Type thermometer.

This is not to be confused with thermometers with two sensors of the same type, where one is used for regulation and the other for display. This is very common in industry.

Here, the idea is to combine two different types of thermometers in a single sheath:

- One is the usual TC (required)
- The other is thermometer with much (order of magnitude) smaller drift than the TC in question.

The possible combinations depend on the type of TC required,

Base type TC can be paired with:

- PRT – t < 400°C
- SPRT – t < 660°C
- Noble-Type TC for t> 660°C
- Pyrometer with optical fibers (where only fibers are inserted)
- Optical pyrometers
- One-shot TC-s
- Any other type of suitable thermometer

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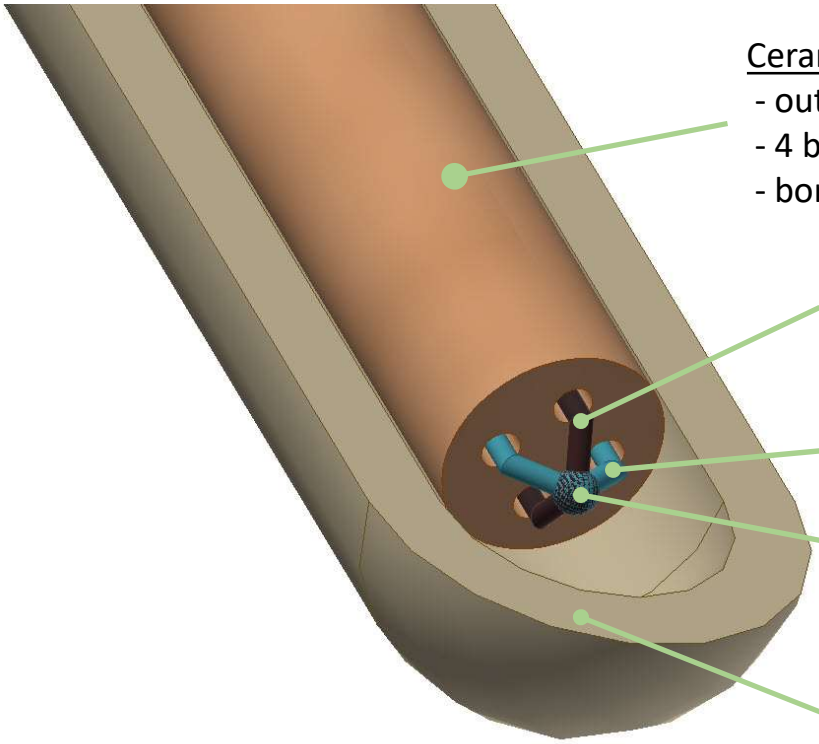
Noble type TC can be paired with:

- PRT – t < 400°C
- SPRT – t < 660°C
- Periodically inserted noble-Type TC for t> 660°C
- Pyrometer with optical fibers (where only fibers are inserted)
- Optical pyrometers
- One-shot noble TC-s
- Any other type of suitable thermometer

The second thermometer can be:

- Permanently placed in the sheat with TC for continous monitoring of drift
- Periodically inserted to check the drift

Dual type thermometer, 2 TCs – design V1



Ceramic insulator:
- outer diameter: 3 mm
- 4 bores
- bores diameters: 0.53 mm

Thermocouple wires, TC1:
- diameter: 0.3 mm

Thermocouple wires, TC2:
- diameter: 0.3 mm

Junction

Ceramic sheath:
- closed bottom
- outer diameter: 6 mm
- inner diameter: 4 mm

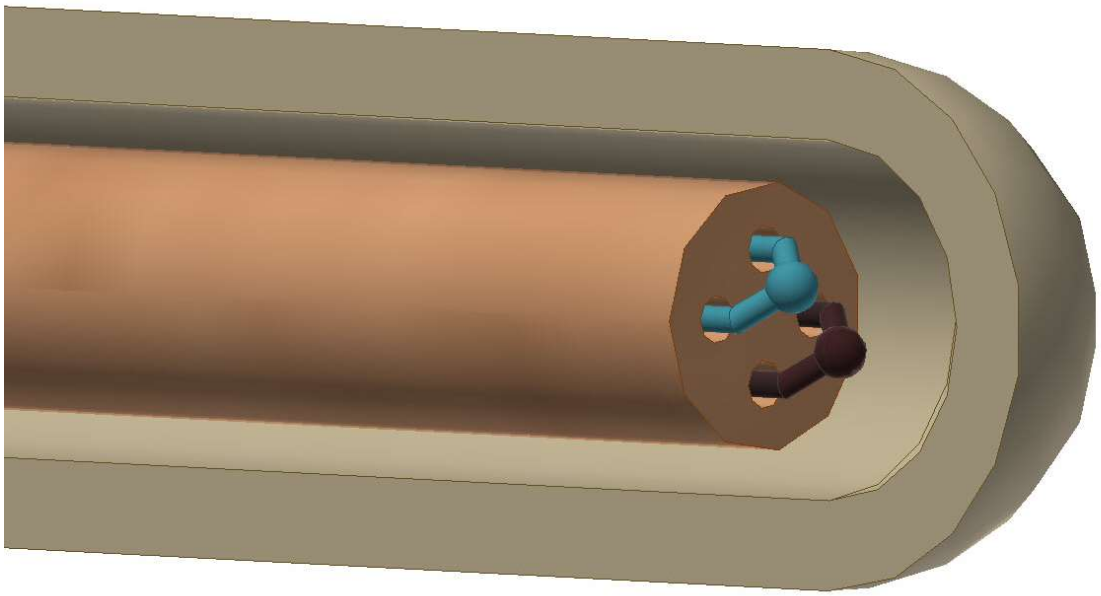
Dual type thermometer, 2 TCs – design V2

Ceramic insulator:
- outer diameter: 3 mm
- 4 bores
- bores diameters: 0.53 mm

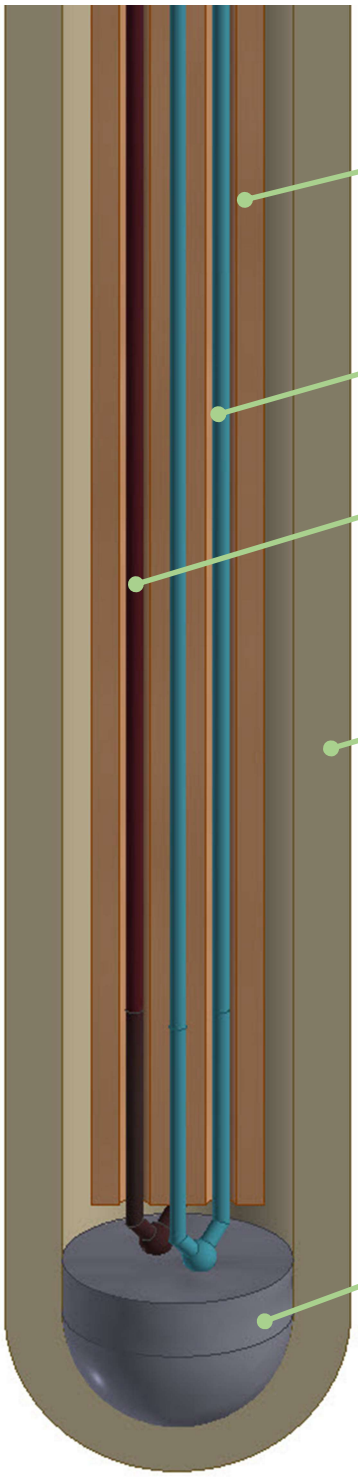
Thermocouple wires, TC1:
- diameter: 0.3 mm

Thermocouple wires, TC2:
- diameter: 0.3 mm

Ceramic sheath:
- closed bottom
- outer diameter: 6 mm
- inner diameter: 4 mm



Dual type thermometer, 2TCs – design V2.1
(same as V2, with metal cylinder at the bottom)



Ceramic insulator:
- outer diameter: 3 mm
- 4 bores
- bores diameters: 0.53 mm

Thermocouple wires, TC1:
- diameter: 0.3 mm

Thermocouple wires, TC2:
- diameter: 0.3 mm

Ceramic sheath:
- closed bottom
- outer diameter: 6 mm
- inner diameter: 4 mm

Metal cylinder:
- for achieving an electrical contact between two TC junctions

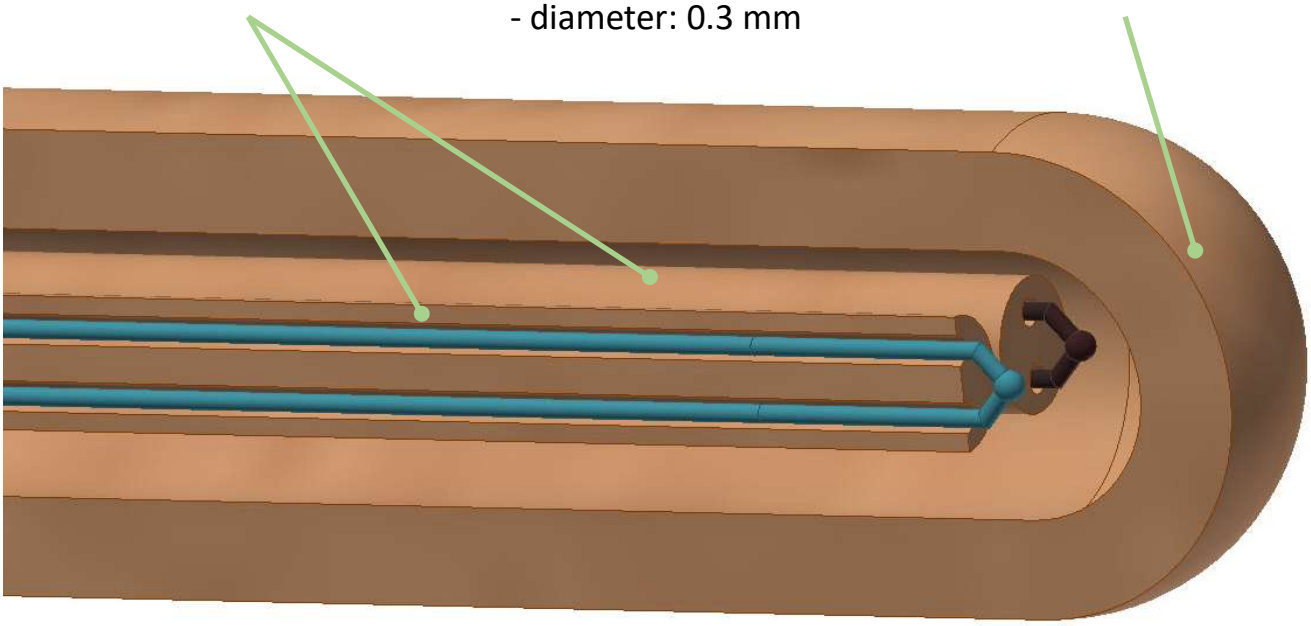
Dual type thermometer, 2 TCs – design V3

Ceramic insulators (2 pieces):
- outer diameter: 2.2 mm
- 2 bores
- bores diameters: 0.5 mm

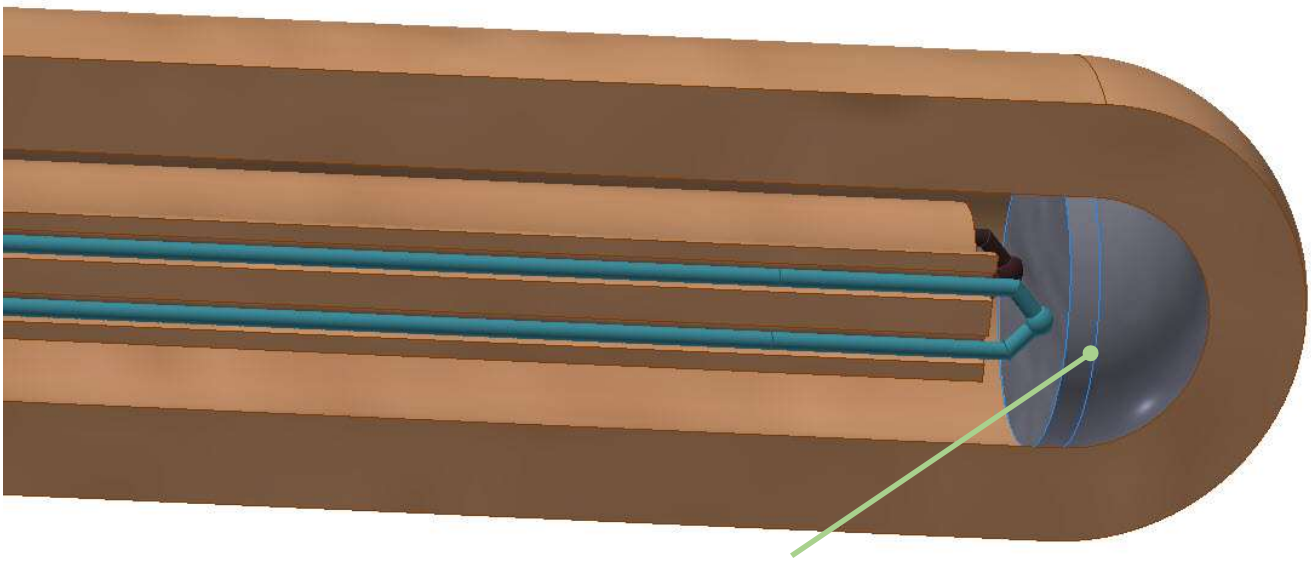
Thermocouple wires, TC1:
- diameter: 0.3 mm

Thermocouple wires, TC2:
- diameter: 0.3 mm

Ceramic sheath:
- closed bottom
- outer diameter: 8 mm
- inner diameter: 5 mm

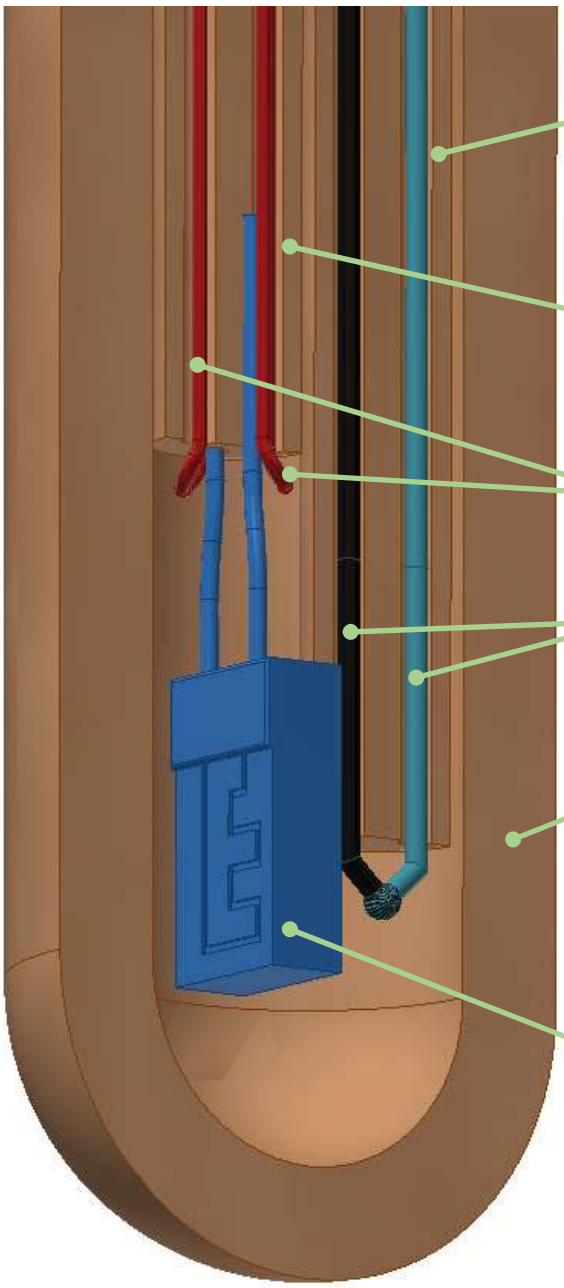


Dual type thermometer, 2 TCs – design V3.1 (same as V3, with metal cylinder at the bottom)



Metal cylinder:
- for achieving an electrical contact between two TC junctions

Dual type thermometer, TC and PRT – design V4 (thin film PRT sensor)



Ceramic insulator (TC):
- outer diameter: 2.2 mm
- 2 bores
- bore diameters: 0.5 mm

Ceramic insulator (PRT):
- outer diameter: 2.2 mm
- 4 bores
- bore diameters: 0.5 mm

4 wires, PRT:
- diameter: 0.2 mm

Thermocouple wires, TC:
- diameter: 0.3 mm

Ceramic sheath:
- closed bottom
- outer diameter: 8 mm
- inner diameter: 5 mm

PRT sensor:
- thin film
- L: 4.1 mm
- H: 1.2 mm
- W: 2.2 mm

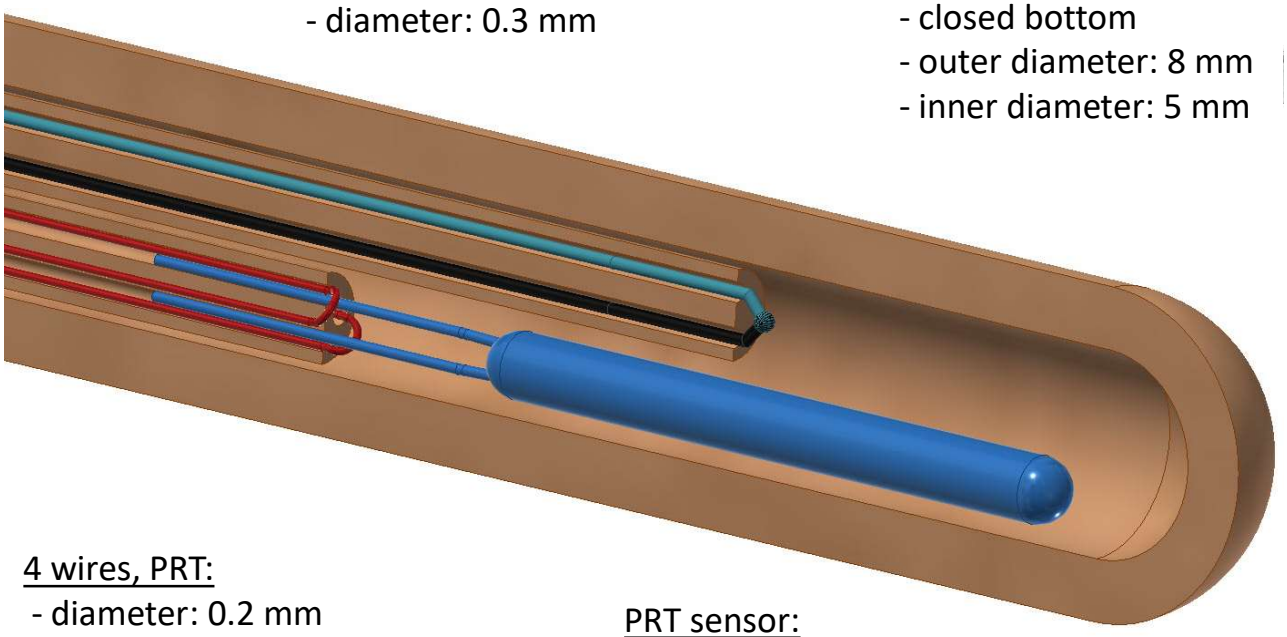
Dual type thermometer, TC and PRT – design V5 (wirewound PRT sensor)

Ceramic insulator (TC):
- outer diameter: 2.2 mm
- 2 bores
- bore diameters: 0.5 mm

Ceramic insulator (PRT):
- outer diameter: 2.2 mm
- 4 bores
- bore diameters: 0.5 mm

Thermocouple wires, TC:
- diameter: 0.3 mm

Ceramic sheath:
- closed bottom
- outer diameter: 8 mm
- inner diameter: 5 mm



4 wires, PRT:
- diameter: 0.2 mm

PRT sensor:
- wirewound
- L: 15 mm
- D: 1.5 mm
- TCR=3916 ppm/K

Dual type thermometer HEAD, for V1, V2 and V2.1