



EMATEM

European Metrology Association
for Thermal Energy Measurement

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The Water-Monopropylene Glycol Mixtures Flow Rate Measurement



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Chapter describing:

- Introduction, question of cooling application for thermal energy meters, selected meters for testing**
- Hydraulic circuit, equipment for measurement**
- Results, presentation of measured values for particular types of meters**
- Conclusion, discussion of the results**

1. Introduction



Motivation:

Cooling systems certification and standardization.

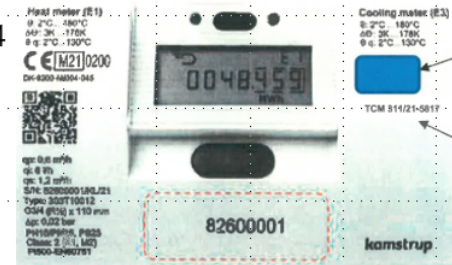
Effect of correct parametrization of liquid (SW).

Standards:

Directive 2014/32/EU (MID), Annex MI-004

EN 1434:2022

Cooling?

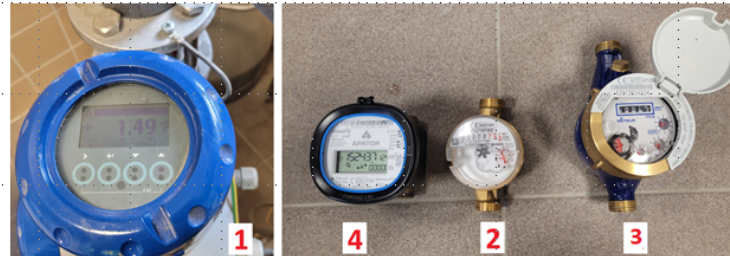


Monopropylene glycol

- glycol concentrations in water were chosen as follows: (0, 10, 30, 50) wt. %, which were corresponding to freezing points of (0, -3, -14, -34) °C

Selected flow meters

- Single-jet, dry dial flow meter (water meter)
- Multi-jet, wet dial flow meter (water meter)
- Ultrasonic flow (water meter)
- Electromagnetic flow meter

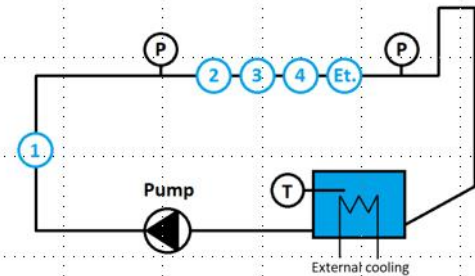


2. Hydraulic circuit

Hydraulic circuit:



Mass flow meter MM CMF050 / 5700R,
Flow rates: (500, 1000, 1500) L/h, 5 repeating.



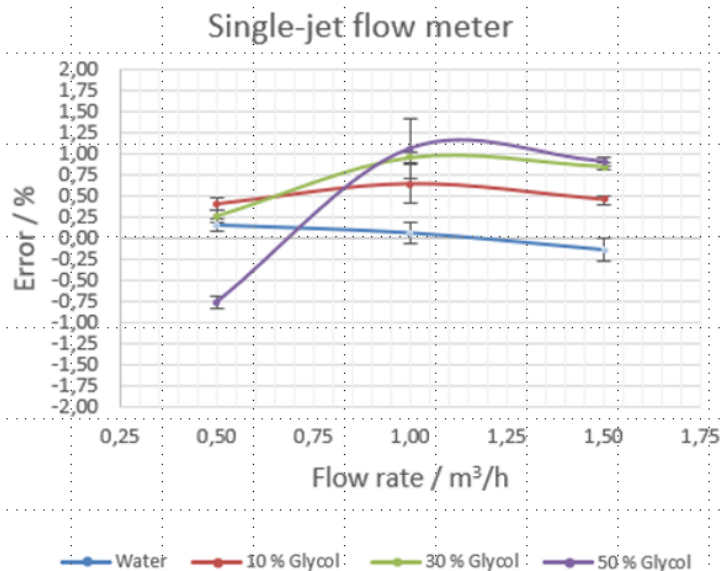
P - pressure sensor
T - temperature sensor

1 - electromagnetic flow meter
2 - single-jet flow meter
3 - multi-jet flow meter
4 - ultrasonic flow meter
Et. - reference mass flow meter

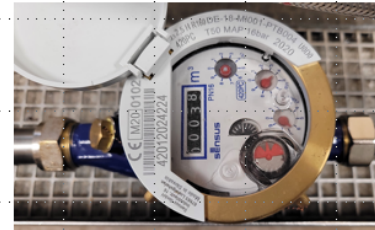
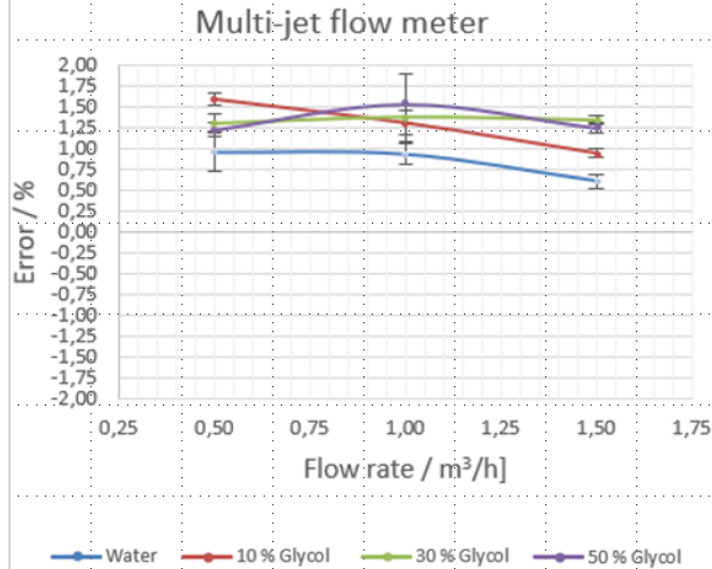


3. Results

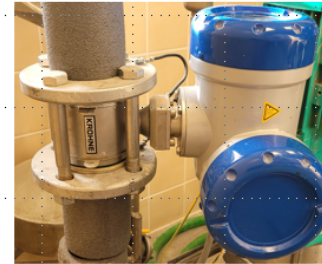
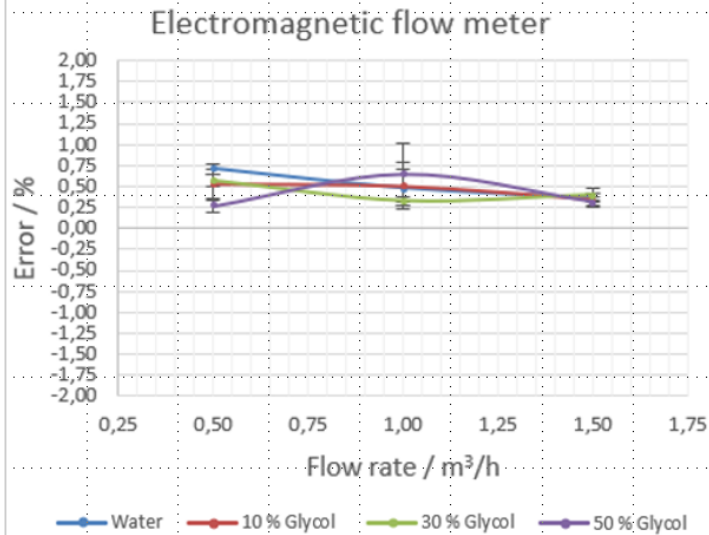
Single-jet flow meter



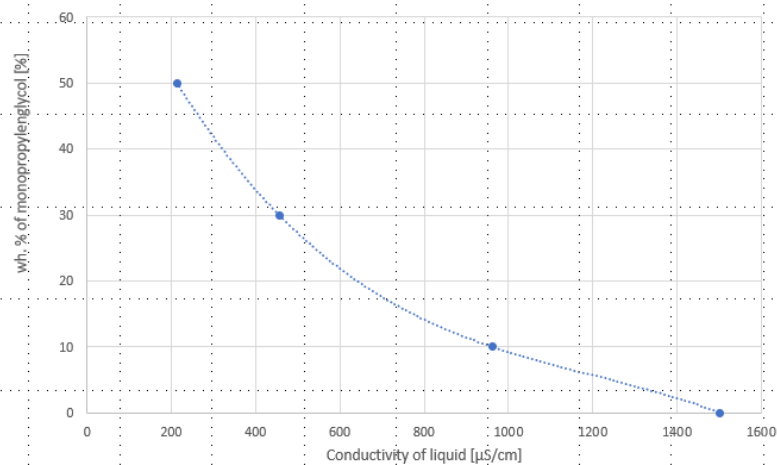
Multi-jet flow meter



Electromagnetic flow meter

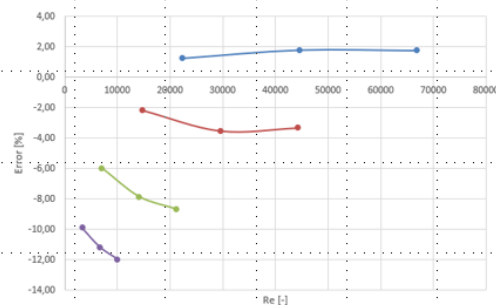
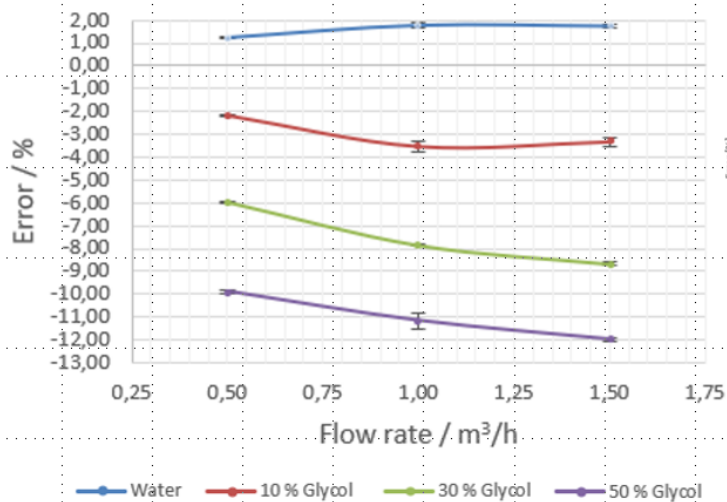


Electrical conductivity of tested liquid

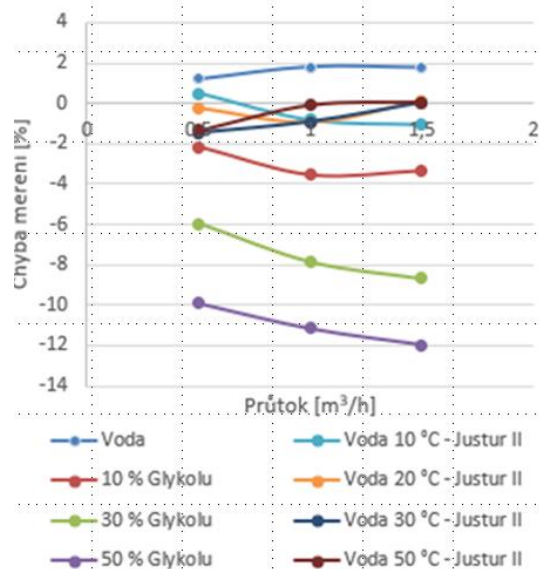


Ultrasonic flow meter

Ultrasonic flow meter



Measured results comparison – testing water, glycol and retesting at metrological testbench JUSTUR



4. Conclusion

Conclusion:

a)

Single-jet, multi-jet and electromagnetic flow sensor (errors and uncertainties are in approx. range 0.1 % up to 1,6 %), below MPE limits according to the standard:
EN 1434-1:2022 for thermal energy meters and the standard
EN ISO 4064-1:2017 (2024) for water meters.

Comparing - error curves of flow sensors for water, with results for all water-glycol mixtures, a significant error limit is fulfilled (1 % declination).

b)

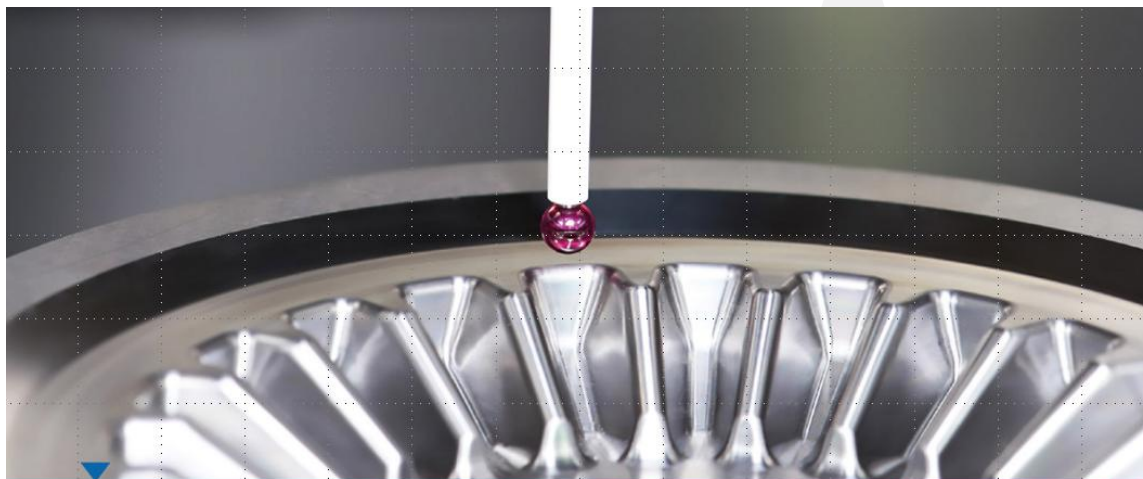
Ultrasonic flow meter

- with increasing wt.% of glycol errors over MPE, meter measure less than real.
- results out of MPE
- meter was not damaged during testing

The reasons can be as follows

- Different speed of sound for water and glycol mixtures.
- Different viscosity for water and glycol mixtures.
- Different flow profile for water and glycol mixtures (Reynolds number effect).
- ~~The meter damage during the measurement.~~
- Tested ultrasonic flow meter was adjusted for water measurement only.

Meter adjustment was discussed with manufacturer – confirmed unique adjustment for drinkable water.



THANK YOU FOR YOUR ATTENTION



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