HEAT METER LABORATORY OF ENERGETIKA LJUBLJANA D.O.O.

Technical characteristics and calibration capabilities of testing facilities

Test rig is owned by:
Energetika Ljubljana d.o.o., Verovškova 62, 1000 Ljubljana, Slovenija;
Contact: Igor Poljak DI, +386 1 5889-570; +386 1 5889-575;
igor.poljak@energetika-lj.si;

Number of persons employed in the lab: 5
Approximate number of calibrations in the lab per year: calibration ca.30; verification 8000
Average time elapsed between submission of meter and completion of documentation: 10 days
Accessibility:

- for any customers.

Meters for which application:

- cold water meters (potable water): yes
- hot water meters: yes
- heat meters: yes

Main purpose of testing facility:

- for scientific investigations (traceability measurements, type approval, endurance tests, influences of flow profile, of static/dynamic pressure, of mechanical vibrations, of climatic influences, test of the installation components e.g. valves, diverters, etc): yes
- for calibrations (special / common): yes
- for verifications (initial / subsequent): yes

ACCREDITATION: **SIST EN ISO/IEC 17020 AND SIST EN ISO/IEC 17025.**

In laboratory are 4 **testing devices**:

- **Volukal** in fig. 1. for testing and calibration of flow sensors of heat meters and cold and hot water meters.

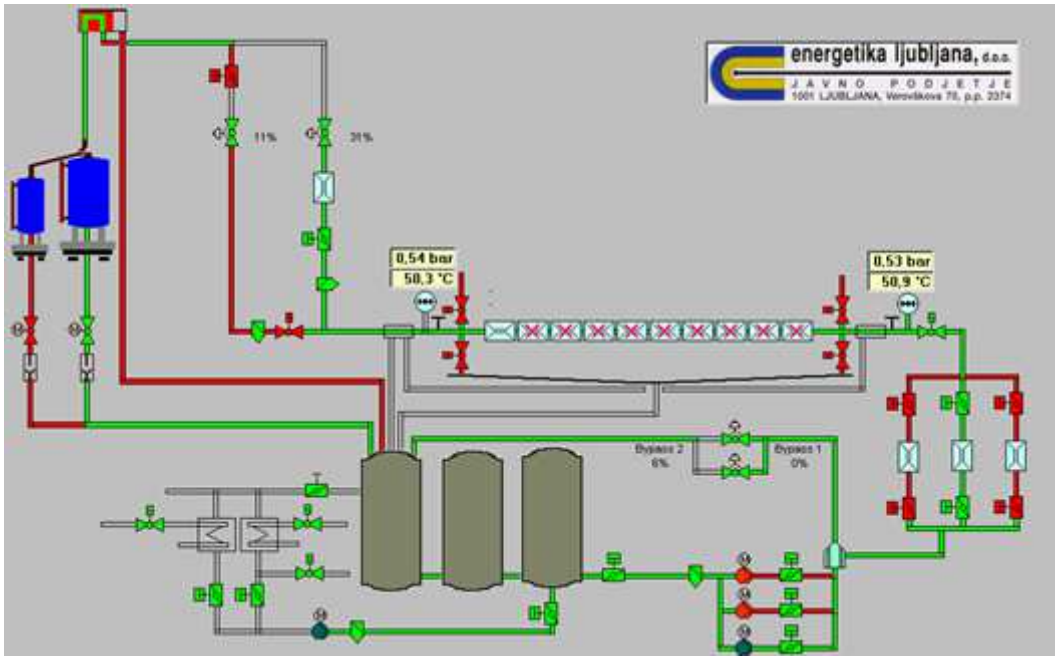

Fig. 1: Basic circuit diagram of the test facility for flow sensors and water meters

Characteristics of testing facilities and calibration capabilities

- Flow range / nominal pipe size: 6 l/h …..180 000 l/h ; DN 150
- Pressure range / pressure settable yes/no: ≤ 5 bar / settable yes
- Temperature range / temperature settable yes/no: 20°C ≤ t ≤ 75°C / settable yes
- Liquid (water from supply, distilled/deionised water, treated water e.g. with additives or with glycol, conductivity µS/cm): water mix from district heating net

(demineralisated water) and drinking water in water tanks, conductivitiy nearly 150 µS/cm at 50°C.

- Measured quantities
  - Volume flow: - yes
  - Volume: yes
  - Mass: yes
- Mode of measurement
  - flying start/stop: yes
  - standing start/stop: yes
- standards
  - gravimetric (e.g. balances, Coriolis meters): balances
  - volumetric (e.g. standard capacity tanks, master meters, piston/ball provers): master meters (electromagnetic meters-MID)
- In the case of conversion mass→volume resp. volume→mass: density calculation/density standard: density calculated by H.Bettin, F Spieweck: Die Dichte des Wassers als Funktion der Temperatur nach Einführung der ITS 90, PTB – Mitteilungen Nr. 3/1990.
- traceability of standards, calibration intervals: to national standards, one calibration per year
- stability of flow rate, temperature and pressure: < 0,2% ; 0,5 K; 0,2 bar
- mode of operation:
  - supply tanks (upper level/ground level/ basement) and their capacities: basement (7 m^3)
  - pumps and their power: centrifugal pumps, 50 kW

- Types of flow sensors under test (PD-meters, Coriolis-meters, US-meters, etc.): any
- Restriction to special interfaces between flow sensors under test and testing facility yes/no/which ones (e.g. only pulse output): interfaces for the most common flow sensors present, NOWA.

- measurement uncertainty of testing facilities/procedures in use – BMC (P =95 %):

  6 l/h ≤ q ≤ 20 l/h ; (3 – 20 l) ≤ 0,3 %

  20 l/h < q ≤ 100 l/h ; (20 – 60 l) ≤ 0,3 %

  100 l/h ≤ q ≤ 180 m^3/h ; (60 – 3000 l) ≤ 0,2 %

The testing rig is shown in Fig 1. and consists of three storage tanks with a total volume of ca. 7 m^3 for the warm water mode up to 75 °C.

For the calibration of cold water meters is possibility to cooling the water with cooling agregate or with network water through the heat exchanger.

Primary measuring for the test volume are weighing instruments working according to the principle of electromagnetic force compensation. They determine the reference volume and does the measurement deviation with regard to density and buoyancy.

The weighing instruments as well as the temperature sensors installed in the test facility are calibrated regular time intervals.

The calibration procedure for water meters can be carried out by different methods.

In the "Flying mode" the flow will be built up to the value by which the water meters will be tested later. The water is deflected back to the storage tank immediately. Having reached stationary conditions which are characterised by constant flow and constant temperature conditions the water is deflected to the preselected weighing instrument in a certain period of time. After reaching the chosen testing volume the water is deflected again past the weighing instruments into the storage tanks.

In the "Start-stop mode" the flow is rising fast from zero to the reference value and the water is deflected on one of the two weighing instruments. After reaching the reference value the flow is also reduced quickly to zero.

Well as in "Flying mode" as in "Start-stop mode" weighing instruments are generally used as measuring standards. But it is also possible to use master meters as measuring standards in all modes. As a rule, the testing is done in "Flying mode" by means of a weighing instrument. The measuring procedure is controlled by the meter(s) to be tested themselves by triggering a start pulse for the comparison measurement with the master meter. The pulse rate of the master meter is very high usually leading to a high resolution of the comparison measurement.

At each testing point, the measuring deviation of the master meter is determined by the weighing instrument. On the whole the determination of the measuring deviation of the meter to be tested depends on the calibration of the weighing instrument used, the accuracy of the determination of density and buoyancy as well.

- **Termokal** in fig. 2. for testing and calibration of platinum temperature sensors of heat meters.

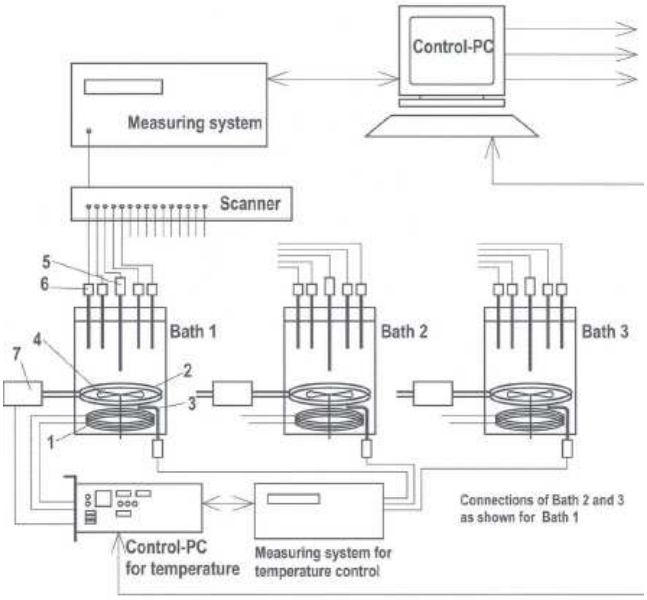

Fig. 2: TERMOKAL - Test plant for temperature-sensors

Specifications:

- Temperature range: 0°C to 200°C
- Temperature-unformity in the calibration zone: better than ±5mK over 15 min.
- BMC (k=2): better than 0,05°C

The test plant Termokal developed by the AUSTRIAN RESEARCH CENTERS SEIBERSDORF is a calibration plant for platinum resistance thermometers. Up to 36 thermo-meters of all common nominal values from 25 to 1000 Ohm can be calibrated simultaniously in the temperature range between 0 °C to 200 °C. The selection of sensors to best fitted pairs also is supported.

The Termokal-plant consists of:

- 3 + 1 precision calibration baths
- a measuring system
- software for control of the plant

Calibration bath:

The calibration baths are of cylindrical design, made of stain-less steel. A mixing wheel, arranged at the bottom of the bath, ensures a constant flow and a uniform temperature distribution. The temperature of the bath is controlled by integrated cooling (not in use)- and heating-coils.

The geometrical design of the baths was developed, optimized and tested by the AUSTRIAN RESEARCH CENTERS SEIBERSDORF over many years, to ensure optimum flow as well as highest temperature distribution stability (spatial and temporal).

Measuring system

The resistance of the sensors to be tested is measured by comparing the voltage drop at the specimen and at a high precision reference resistance with injected current. Disturbances are eliminated resp. compensated by opti-mum choice of materials and measuring technology.

The measuring system consists of high resolution digital voltmeter, scanner, current source and reference sensors for the temperature of the bath.

- **Kompukal** in fig. 3. for testing and calibration of calculators of heat meters.

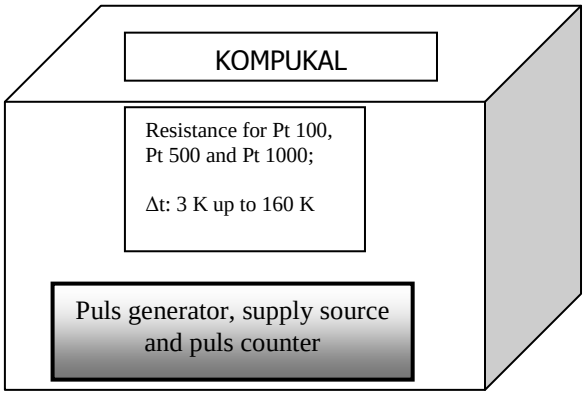

Fig 3: Kompukal: testing device for heat meter calculators.

Testing device Kompukal is simulator for temperature difference and volume pulses for calibration and control of heat meters calculators.

Specification:

- Resistances for simulation for temperature differences for Pt 100, Pt 500, and Pt 1000;
- Δt: 3 K ..... 160 K
- BMC (k=2): ± 0,05(for Δt 50 to 160K) up to 0,42(Δt 3K).

Since 2009 we have special test equipment for compact heat meters and cooling meters for DN 15 to DN 32 mm.

Energetika Ljubljana is one of the members of **EMATEM** - European Metrology Association for Thermal Energy Measurement.