Twinning Project "Strengthening the capacities of the Bureau of Metrology for internal market integration"
Twinning ref. MK 12 IPA EC 01 16 TWL

A Project funded by the European Union and Implemented and led by CMI

MEASURING SYSTEMS FOR LIQUIDS OTHER THAN WATER IN PRACTICE

Republic of Macedonia, Skopje, 21.6.2017

TWINNING

This Project is funded by the European Union

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DEFINITION OF MEASURING SYSTEMS

A meter by itself is not a measuring system.

The smallest possible measuring system shall include:

- **A meter**
- **A transfer point**
- **A hydraulic path with particular characteristics**

DEFINITION OF MEASURING SYSTEMS

For correct operation of a measuring system, it is often necessary to add:

- **A gas elimination device**
- **A filter**
- **A pump**
- **A correction devices**

ELIMINATION OF AIR GASES - MID

Any percentage of air or gas not easily detectable in the liquid shall not lead to a variation of error greater than:

- **0,5 % for liquids other than potable liquids and for liquids of a viscosity not exceeding 1 mPa.s, or**
- **1 % for potable liquids and for liquids of a viscosity exceeding 1 mPa.s.**

However, the allowed variation shall never be smaller than 1 % of MMQ. This value applies in the case of air or gas pockets.

ELIMINATION OF AIR GASES - OIML

Measuring systems shall incorporate a gas elimination device for the proper elimination of any air or undissolved gases which may be contained in the liquid before it enters the meter. In the case that neither air intake nor gas release will occur in the liquid upstream of the meter, a gas elimination device is not required.

Since the effectiveness of gas elimination devices decreases as the viscosity of the liquids increases, these devices are not required for measuring liquids with a dynamic viscosity of more than 20 mPa·s at 20 °C.

In this case, it is necessary to make provisions to prevent entry of air. The pump shall be so arranged that the inlet pressure is always greater than the atmospheric pressure.

ELIMINATION OF AIR OR GASES - OIML

The gas elimination device shall be suitable for the supply conditions and be arranged in such a way that the effect due to the influence of the air or gases on the measuring result does not exceed:

- **1 % of the quantity measured for milk, beer, other foaming potable liquids, and for liquids of a viscosity exceeding 1 mPa·s (at 20 °C); or**
- **0.5 % of the quantity measured for all other liquids.**

However, it is not necessary for this effect to be less than 1 % of the minimum measured quantity.

ELIMINATION OF AIR OR GASES

Question regarding a problem with Coriolis mass flow meters when there is an air content inside the measured liquid.

- **Such situation disagrees with requirements of MID and OIML R 117 mentioned above.**

METROLOGICAL COMPONENTS OF MEASURING SYSTEMS

- Flowmeter (or flow sensor)
- Calculating device
- Associated measuring devices
  - Thermometers or temperature sensors
  - Pressure transducers
  - Oscillation densitometers

VERIFICATION OF MEASURING SYSTEMS

- The verification of measuring system can be performed in one or more stages.
- For example some associated devices can be tested in laboratory (first stage) and then there is performed a testing of the whole measuring system (second stage).
- One stage verification procedure takes place mainly when measuring system contains only flowmeter or flowmeter and calculating unit as metrological components (typically fuel dispensers).

TESTING OF FLOW METERS

- Testing in laboratory

- Testing in a place of installation separately
- (e.g. Flowmeters on pipelines using small volume prover)

- Testing in a place of installation together with testing of whole system
- (e.g. Flowmeters at filling stations of road tankers)

TESTING OF CALCULATING DEVICES

- Testing of used analog inputs (RTD, 4-20 mA) in laboratory or in place of installation (this testing is not performed when the associated measuring device and calculating device is tested together as one measuring chain).

- In case that there is not a clear evidence that the settings of calculating unit was not changed it is necessary to check this settings (e.g. Constants of associated devices; calculation and correction tables; checking of calculations etc.). This checking take place in the last stage of verification.

TESTING OF ASSOCIATED DEVICES

- In laboratory
- In a place of installation
  - Per partes
    (e.g. Testing of temperature sensor and testing of temperature input on calculating device)
  - Complete chain
    e.g. Testing of temperature sensor and calculating device together)

ROAD TANKERS FOR CRYOGENIC LIQUIDS

Measured quantity: ***mass***

Metrological components:

- ***calculating device***
- ***flow meter***
- ***temperature sensor***

Verification procedure:

direct comparison with master meter; testing of thermometer as complete metrological chain together

Equipment:

master meter for cryogenic liquids with thermometer

ROAD TANKERS FOR LPG

Measured quantity: ***mass or volume at actual conditions***

Metrological components:

- ***calculating device***
- ***flow meter***

Verification procedure:

direct comparison with master meter

Equipment: ***master meter for LPG***

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ROAD TANKERS FOR LIQUID FUELS

Measured quantity: ***volume at reference temperature***

Metrological components:

- ***calculating device***
- ***flow meter***
- ***temperature sensor***

Verification procedure: ***verification of temperature sensor and then verification of whole measuring system***

Equipment: ***set of vessels or master meter, temperature calirator***

The verification is mostly performed by authorized metrological bodies in CR

ROAD TANKERS FOR AdBlue

Measured quantity: ***volume at actual conditions***

Metrological components:

- ***calculating device***
- ***flow meter***

Verification procedure: ***direct comparison with standard vessel***

Equipment: ***volumetric standard 500 L***

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ROAD TANKERS FOR MILK

Measured quantity: ***volume at actual conditions***

Metrological components:

- ***calculating device***
- ***flow meter***

Verification procedure:

direct comparison with standard vessel

Equipment: ***volumetric standards 300 L and 1000 L***

FILLING STATIONS FOR ROAD TANKERS

Measured quantity: ***volume at reference conditions***

Metrological components:

- ***calculating device***
- ***flow meter***
- ***temperature sensor***

Verification procedure: ***verification of temperature sensor in laboratory + testing of the temperature input on calculating device or testing of the whole chain of temperature measurement and then verification of the whole measuring system using master meter or volumetric standard***

Equipment: ***master meter or set of vessels with temperature compensation; temperature calibrator; equipment for input signals simulation***

MEASURING SYSTEMS ON PIPELINES

Measured quantity: ***mass or volume at reference conditions***

Metrological components:

- ***calculating device***
- ***flow meter***
- ***(temperature sensor)***
- ***(pressure sensor)***
- ***(density meter)***

MEASURING SYSTEMS ON PIPELINES

Verification procedure:

- ***Testing of all associated devices in laboratory***
- ***Testing of used analog inputs of calculating device***
- ***Verification of flow meter in laboratory (eventually in place of installation using e.g. Small volume prover)***
- ***Verification of the complete system in a place of installation***

MEASURING SYSTEMS ON PIPELINES

Border station on crude oil pipeline Družba from Slovak Republic.

Instrumentation

- **3x mass flowmeter E+H Promass 83F DN150**
- **3x Pressure transducer Cerabar S for pressure compensation**
- **Flow computer FloBoss S600 as display and printing unit**

BORDER STATION ON CRUDE OIL PIPELINE DRUŽBA

Verification procedure:

- Pressure transducers are tested in CMI's laboratory
- Flow meters are tested in accredited calibration laboratory
- In the place of installation is performed checking of flowmeters settings and setting of „zero" flow rate and sealing of the system

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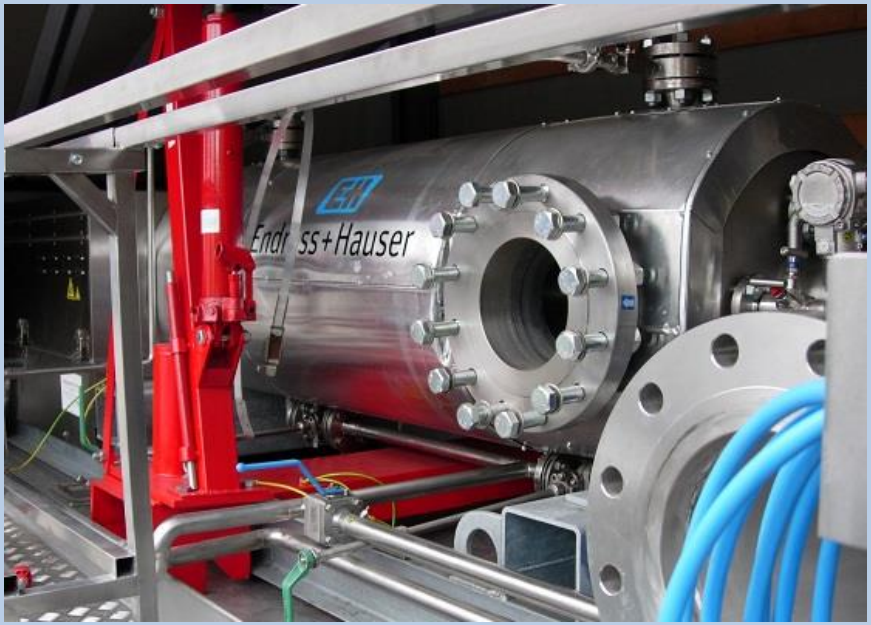
MEASURING SYSTEMS ON PIPELINES



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SEALING OF THE MEASURING SYSTEMS

Question regarding the sealing of filters on road tankers.

- **The sealing has to be done in accordance with type examination certificate of the measuring system .**
- **It is possible for owner of road tanker (or custom officers) to put some kind sealing to other parts of the road tanker to prevent manipulation with product.**

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Thank you for your attention!