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The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

MetHyInfra

Metering cryogenic fluids/liquefied gases

20IND11

Menne Schakel on behalf of all MetHyInfra LH_2 partners

PTB Physikalisch-Technische Bundesanstalt Braunschweig und Berlin
University of Ljubljana Faculty of Mechanical Engineering
VSL National Metrology Institute
RISE Research Institutes of Sweden
DNV
CESAME-exadébit SA

MetHyInfra project: develop traceability for LH_2 flows

https://www.methyinfra.ptb.de/

LNG calibration facility

- Traceable to mass
- Water and LNG calibration of LH_2 flow meter
- Qmax LH2: 5000 kg/h

Intercomparison

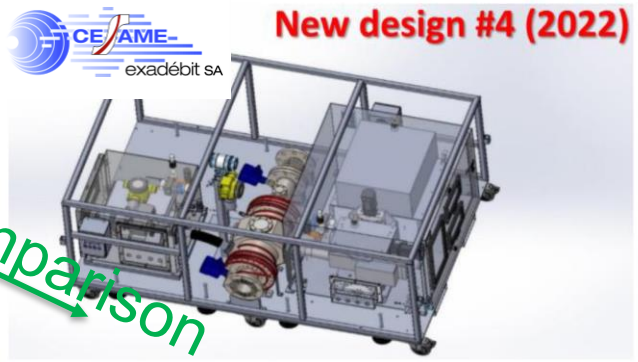


Figure 7: LDV standard for traceable cryogenic measurement (design and built by Cesame®)

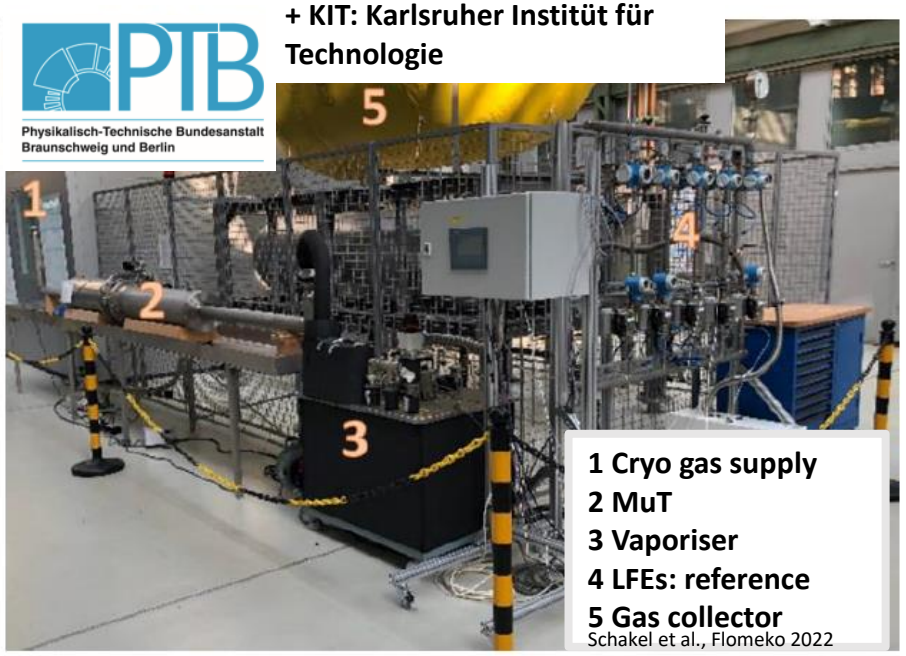
Schakel et al., Flomeko 2022

LDV standard for traceable cryogenic flow measurement: in-situ LNG and LH_2 traceability at industrial flow rates

- Traceable to length
- Laser Doppler Velocimetry
- Qmax LH2: 5000 kg/h

+ KIT: Karlsruher Institüt für Technologie

PTB
Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin



1 Cryo gas supply
2 MuT
3 Vaporiser
4 LFEs: reference
5 Gas collector

Schakel et al., Flomeko 2022

Figure 8: Picture of the vaporisation test rig

Vaporisation test rig: cryogenic gas traceability up to 4 kg/h

- Traceable to mass
- Novel method: traceability to LFE's in gas phase
- Qmax LH2: 4 kg/h

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- Calibration facilities for cryogenic fluids/liquefied gases are scarce
- Cryogenic fluids/liquified gases are growing in importance: LNG, LOHC, NH3, MEOH, LCO2
- Process conditions are very variable in terms of p, T, phase, composition, explosion characteristics, toxicity, required material compatibility
- Yet flow meters are approved that measure in a wide range of variable conditions
- Experience has shown that

  (I) Accuracy claims from basic calibrations for application under process conditions can be met. Accuracy claims can potentially even be improved

  (II) Unforeseen effects are identified by calibrating a flow meter with a (cryogenic/liquified gas) standard under process conditions

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- Error with basic calibration not necessarily the same than on process conditions
  - Can be within stated accuracy limit. The cryogenic/liquified gas standard supports proving the meter's accuracy claim
  - For accuracy-critical cases, measurement error at process conditions is preferably known

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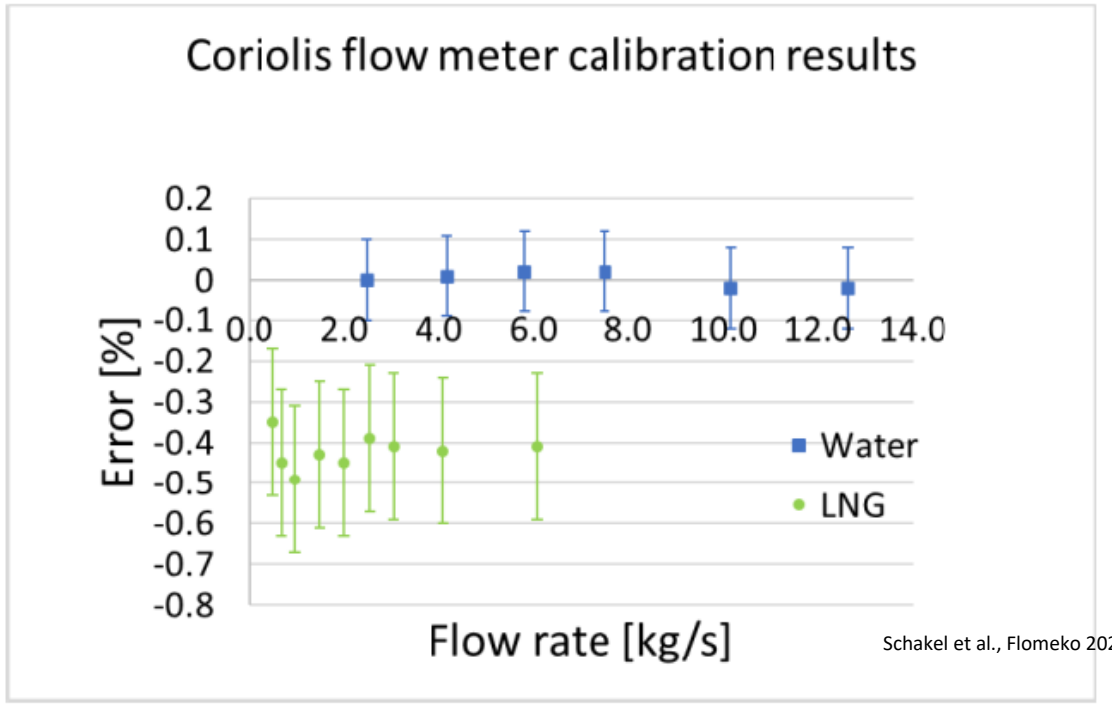
- Example from MetHyInfra. Water calibration and LNG calibration.



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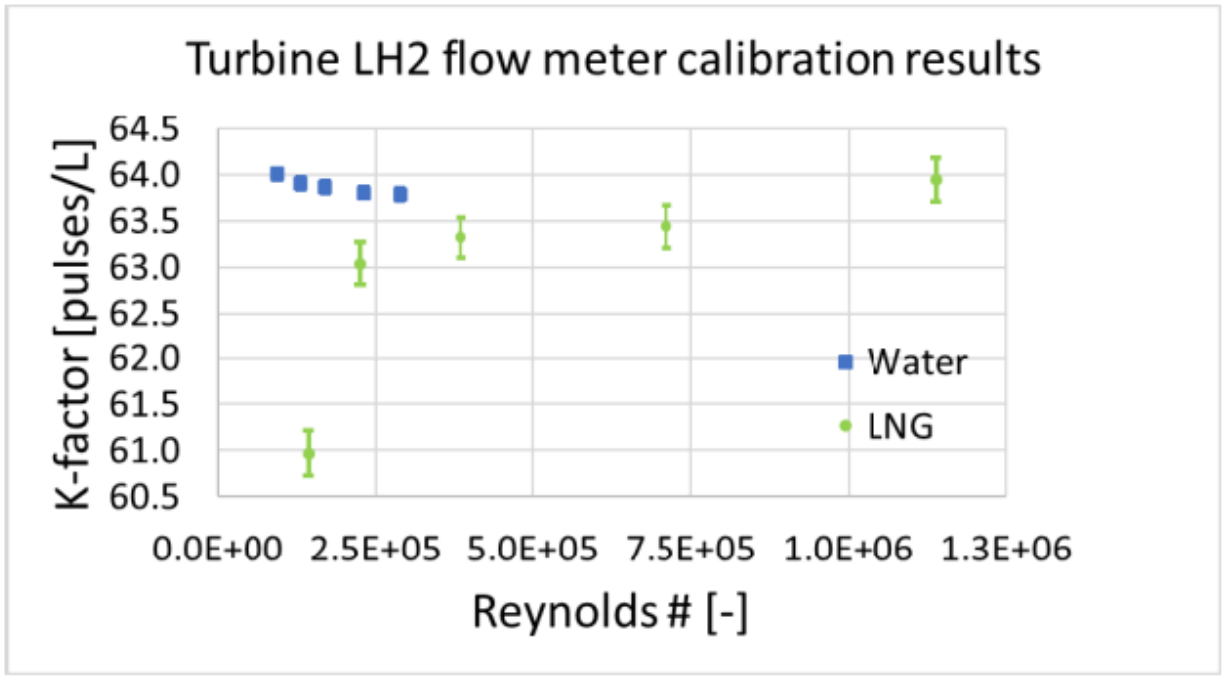

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internal

external

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