

20IND13

Sustainable
advanced
flow meter
calibration
for the
transport
sector



Realisation and measurement of dynamic flow changes

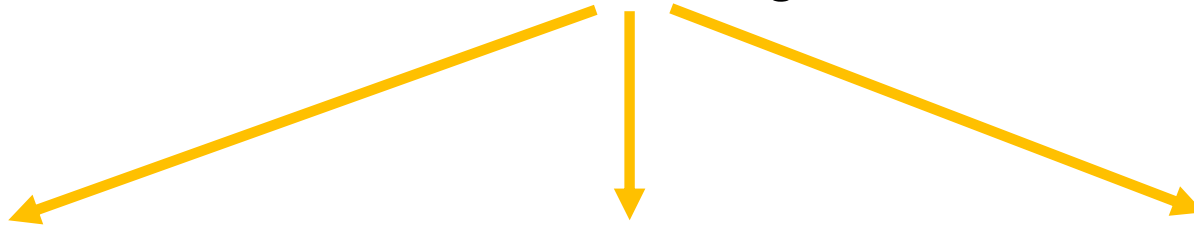
Heiko Warnecke

SAFEST Webinar, February 20th, 2023

- The measurement behavior of flow meters under dynamic loads and at low flow rates is not well known
- No capabilities for calibrations under dynamic flow conditions available
- Is the measurement accuracy of a flow meter given?

- Therefore:
 - Derivation of the **Input** to be realised on the test rigs
 - Setup of **Infrastructure** to generate traceable profiles
 - **Evaluation** of the metrological infrastructure, processes and profile realisations

flow measurement necessary in three different orders of magnitude:



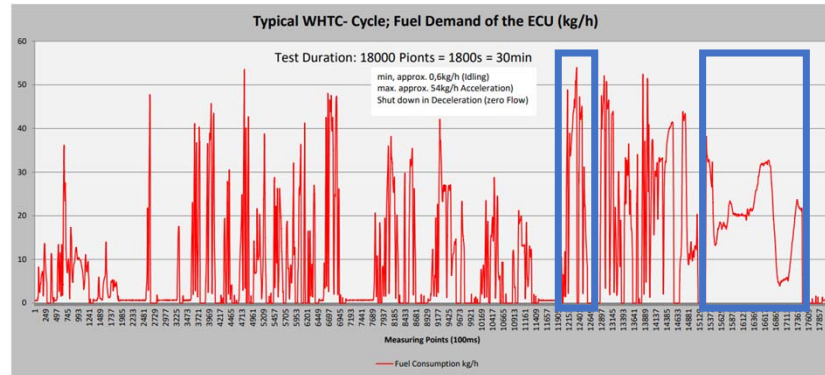
~ 5 l/h



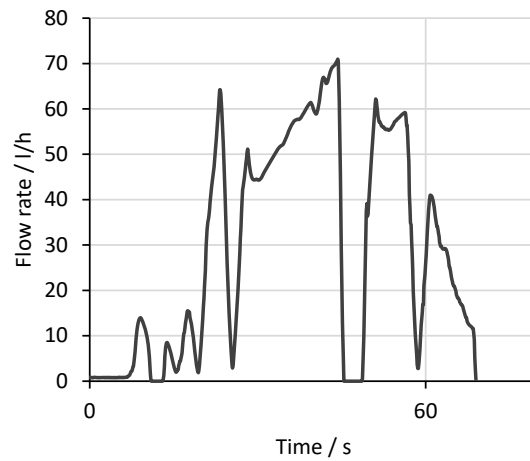
~ 50 l/h



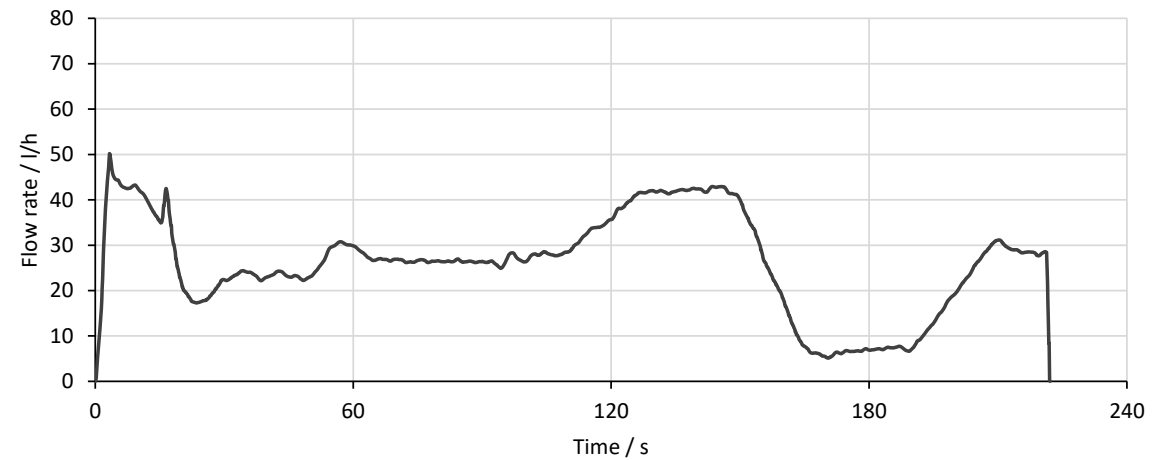
~ 500 l/h



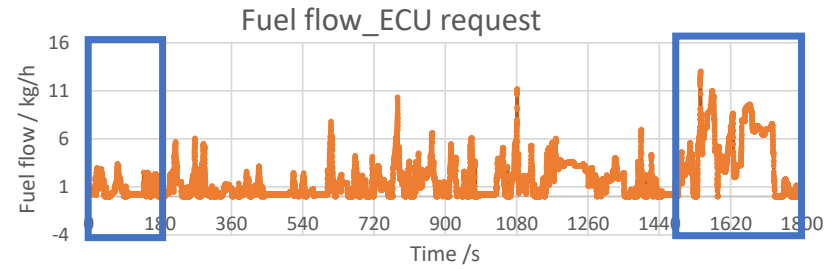
Truck profile 1



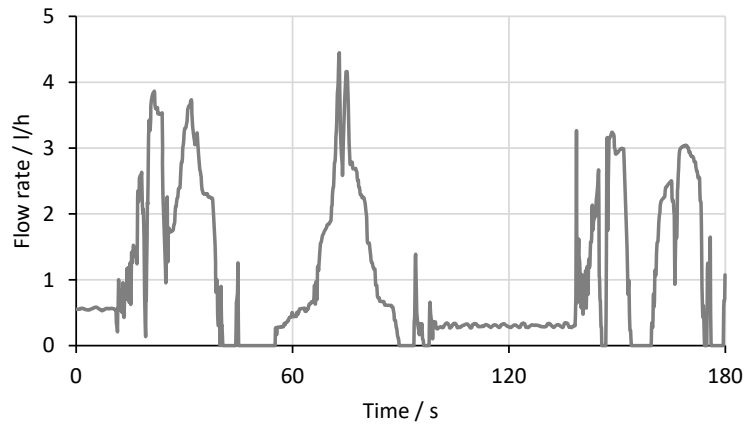
Truck profile 2



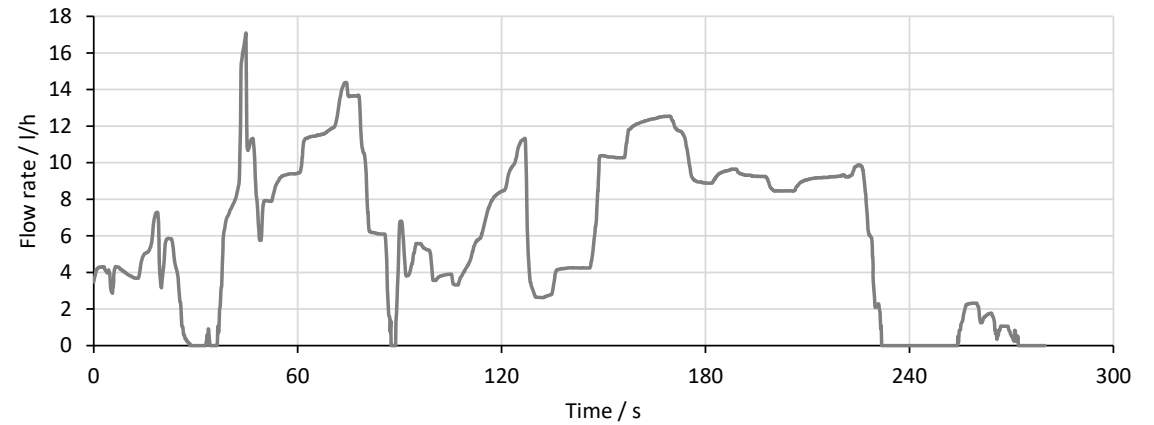
Input passenger car profile



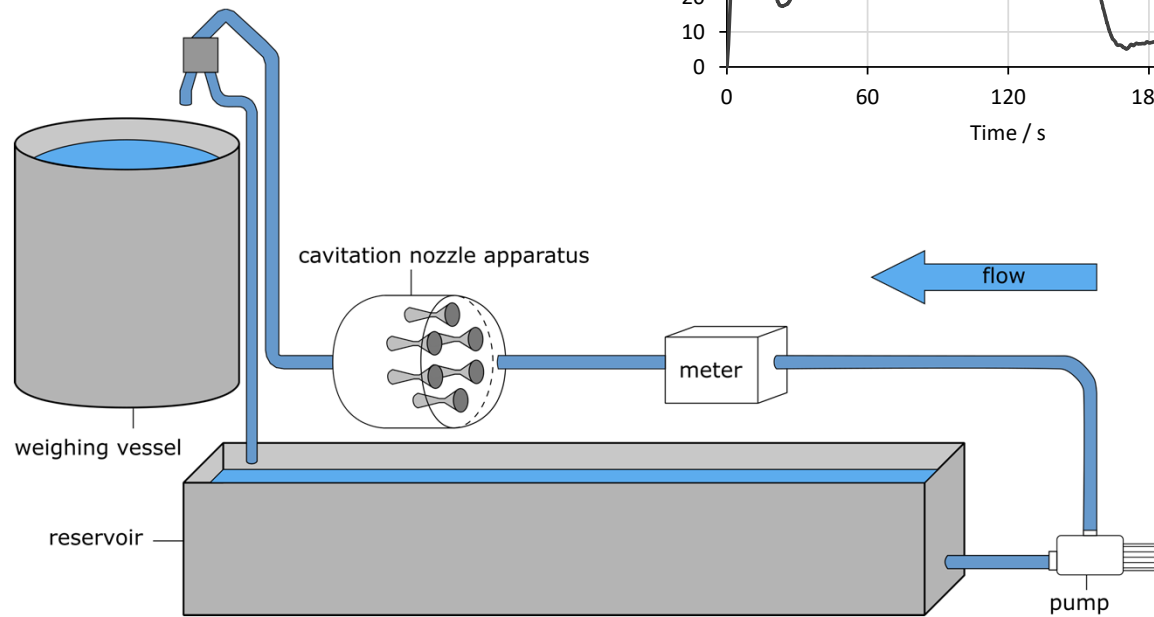
Passenger car 1



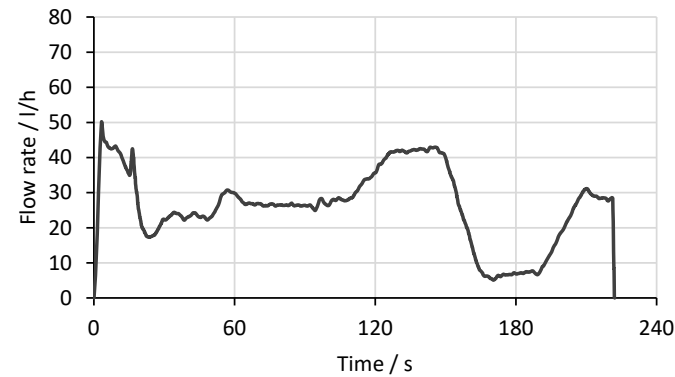
Passenger car 2



Example: test rig PTB

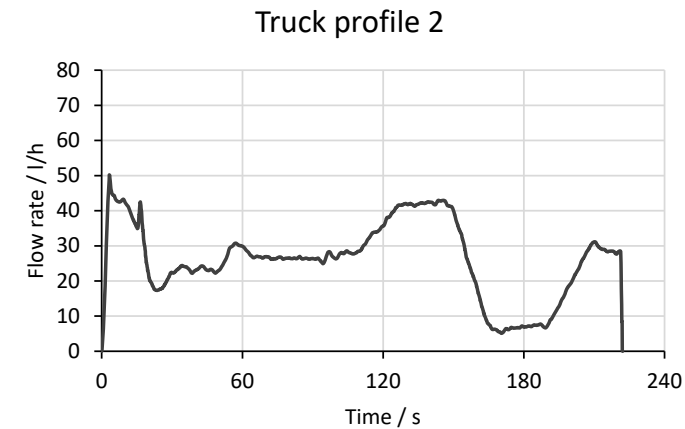


Truck profile 2

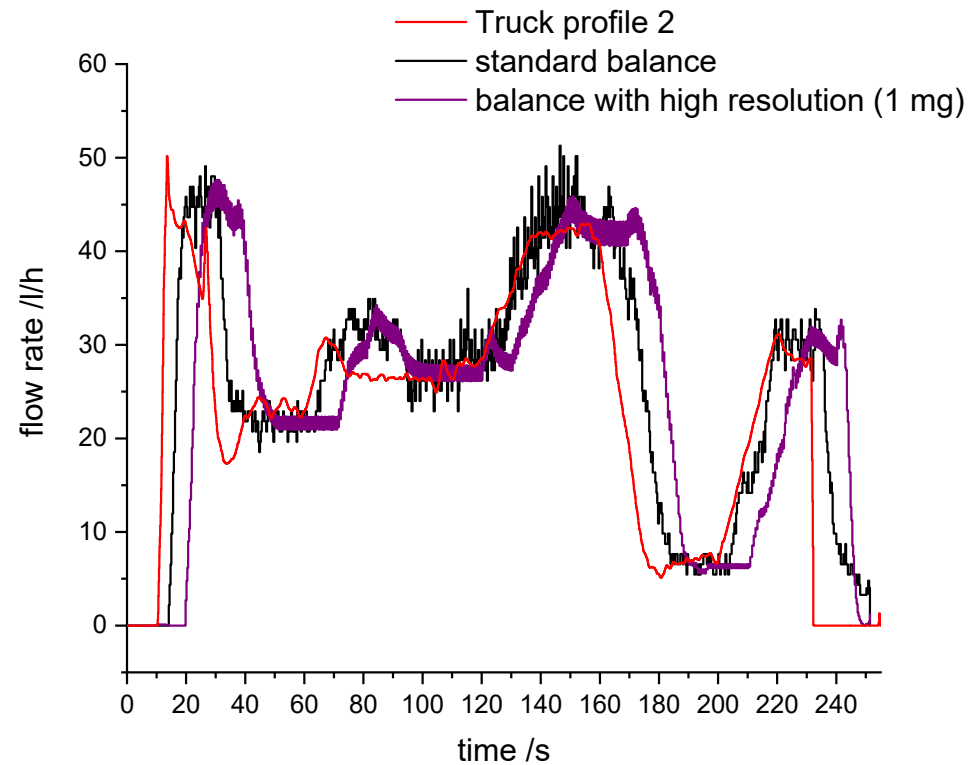


=> Traceability ensured

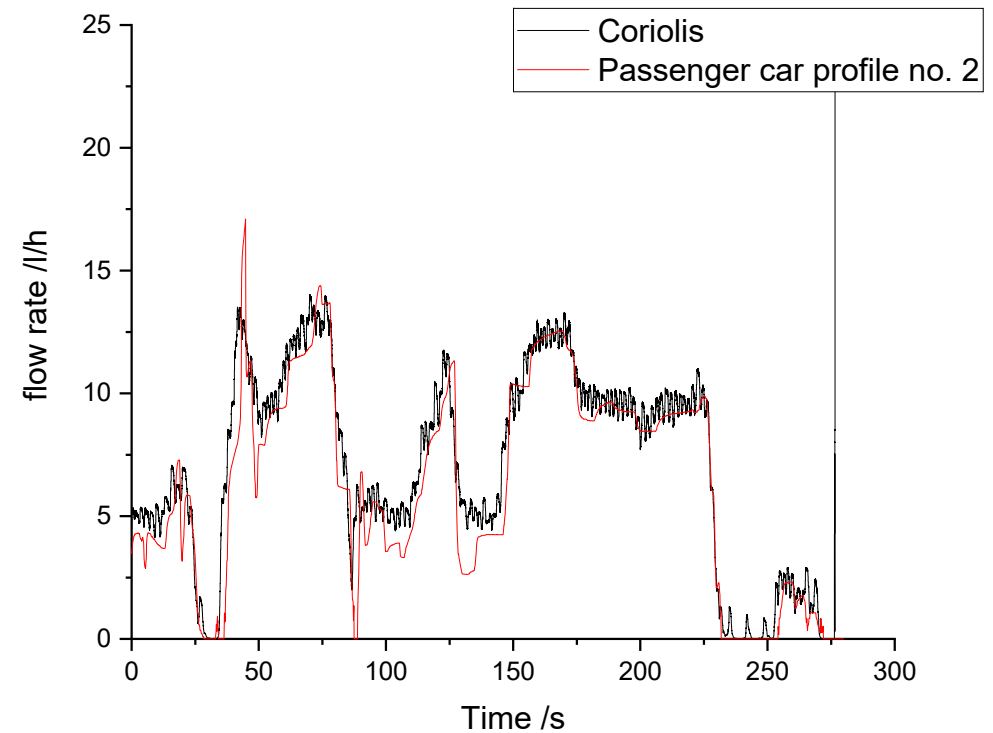
- Issues to be addressed:
 - Synchronisation between meter and reference signals
 - Validation procedure
 - High resolution data
 - Suitable flow meter
- >
- Literature study
 - Step response investigations



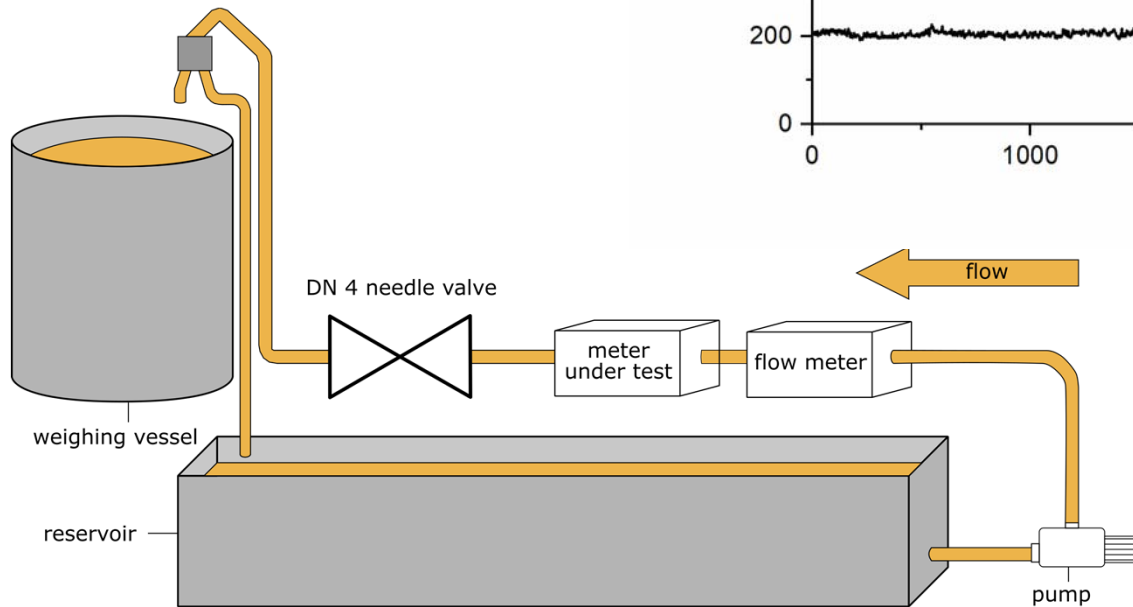
- Results with water
- Good agreement between specification and measurements of the gravimetric references



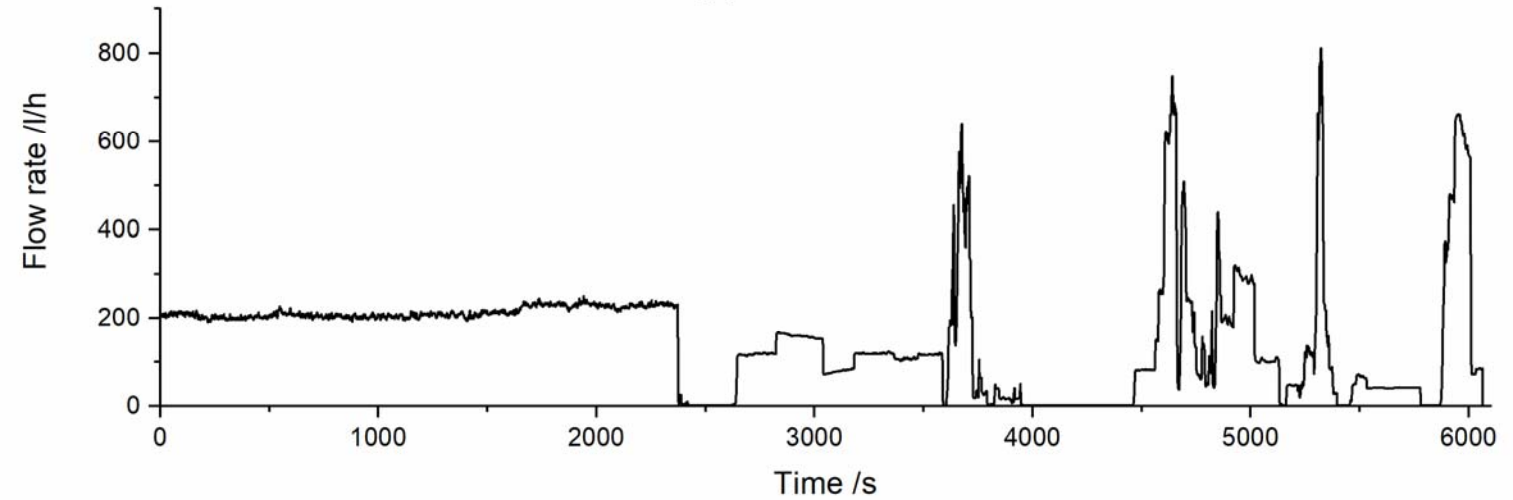
- Good general agreement between specification and measurement



Example: test rig PTB

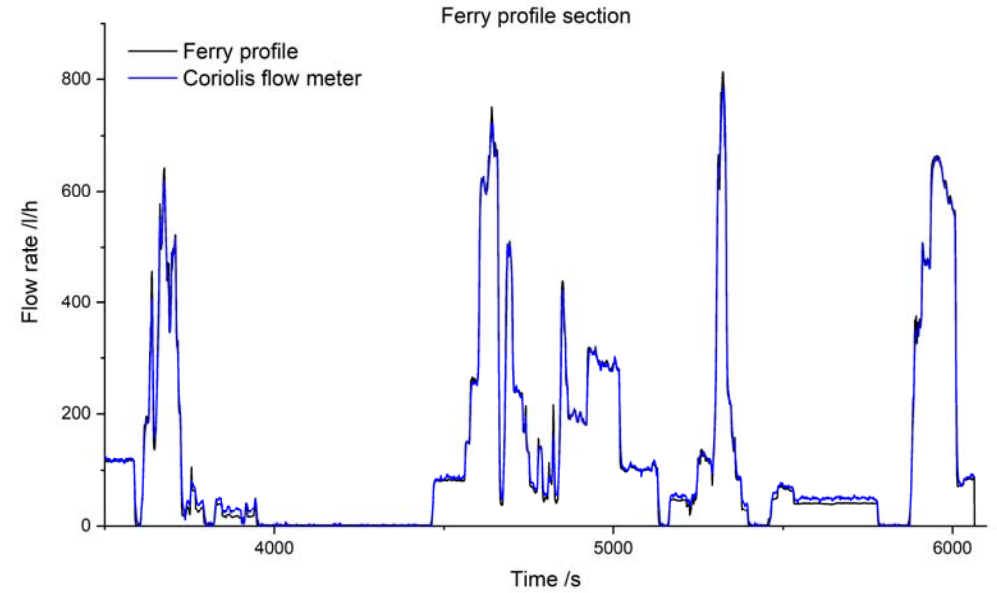
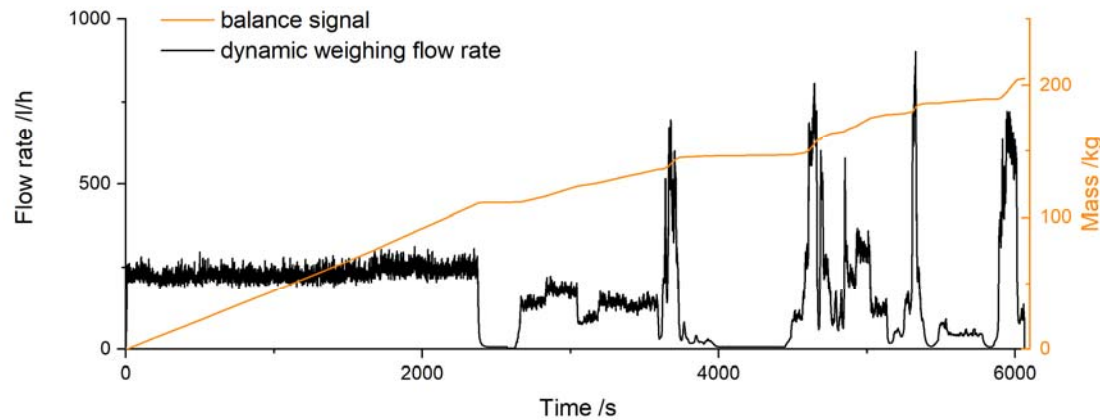


Ferry profile



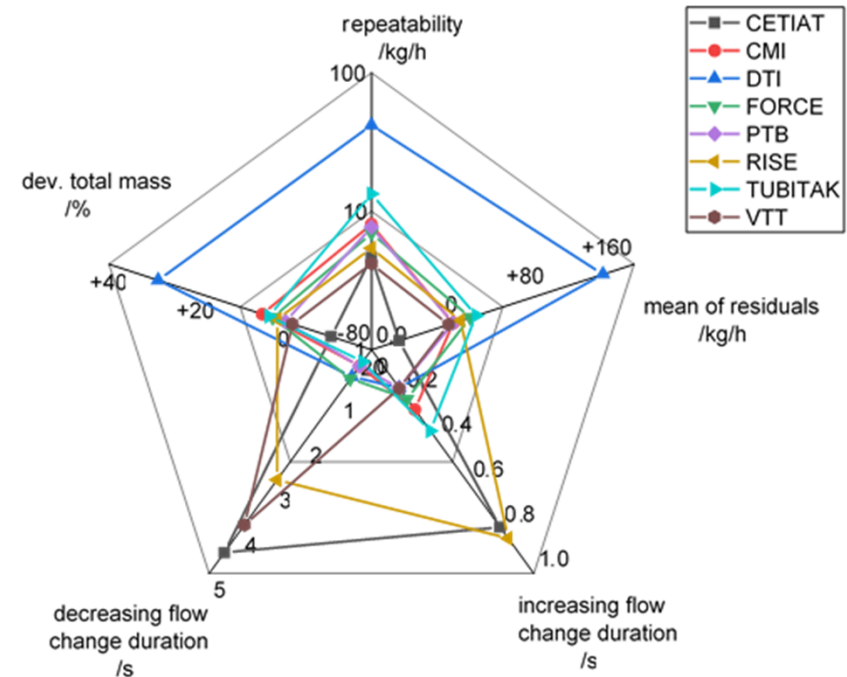
Validation with different methods:

- Dynamic weighing
- Coriolis flow meter
- ...

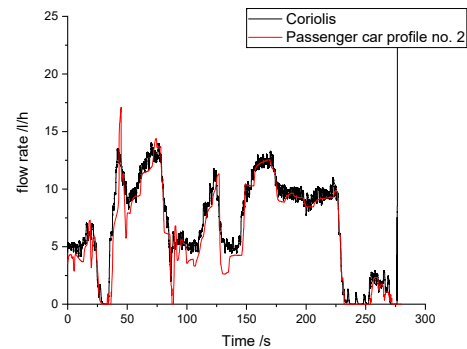
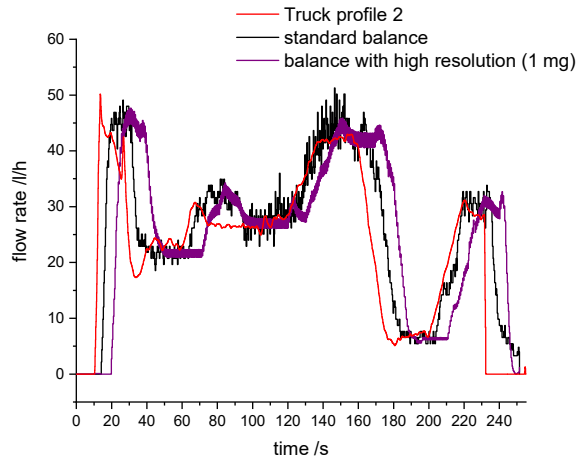


Additional criteria for evaluation necessary due to dynamic loads:

- Mean value of the standard deviations
- Mean value of the residuals
- Response time for flow changes
- Deviation of the measured total mass



- Dynamic profiles available according to which a flow meter can be tested
- Infrastructure in development to realise profiles with different technologies
- Additional criteria needed and specified for evaluation



- Temperature effects?
- Optimisation of profile realisation for flow rates < 1 l/h
- Regular assessment by applying evaluation criteria

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*Supporting
the future*

Acknowledgement

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<https://www.ptb.de/empir2021/safest/the-project/>