



H2 calibration

HAN CAMPUS 30 JANUARI 2026

Agenda



1

Introduction

Arjan

2

New Primary standard for low flow

Dorus

3

Loop calibration H₂

Dorus

4

CEM use for fuel cell

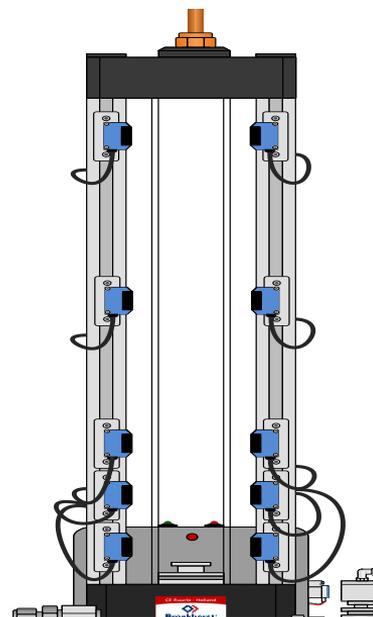
Arjan

5

Q&A

All

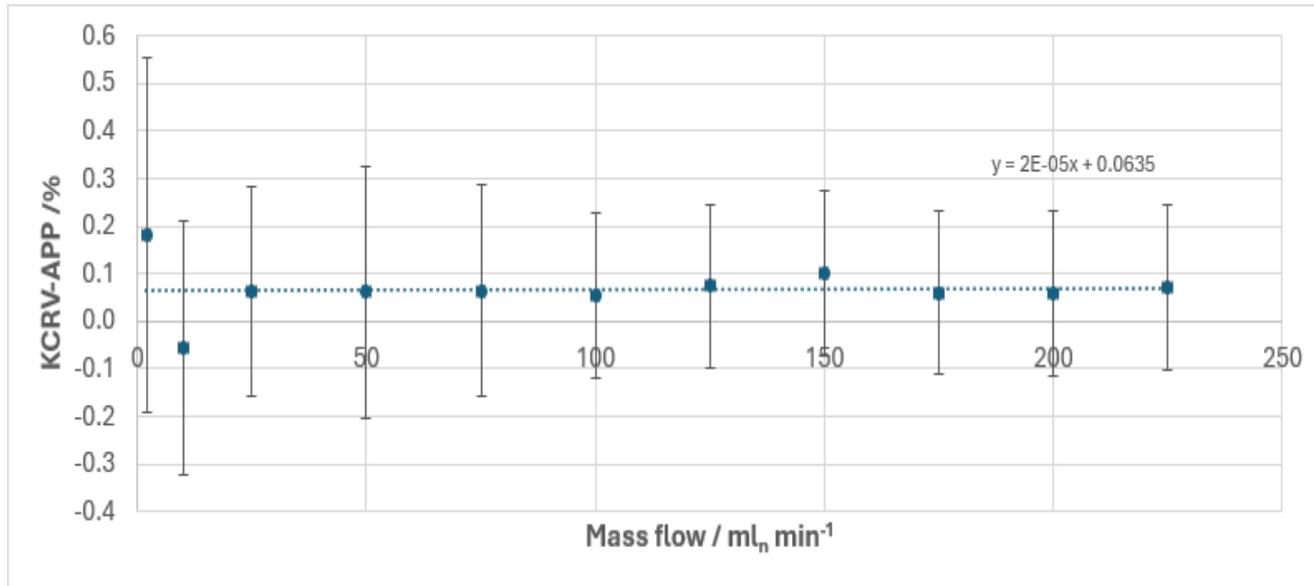
Future landscape of Bronkhorst standards



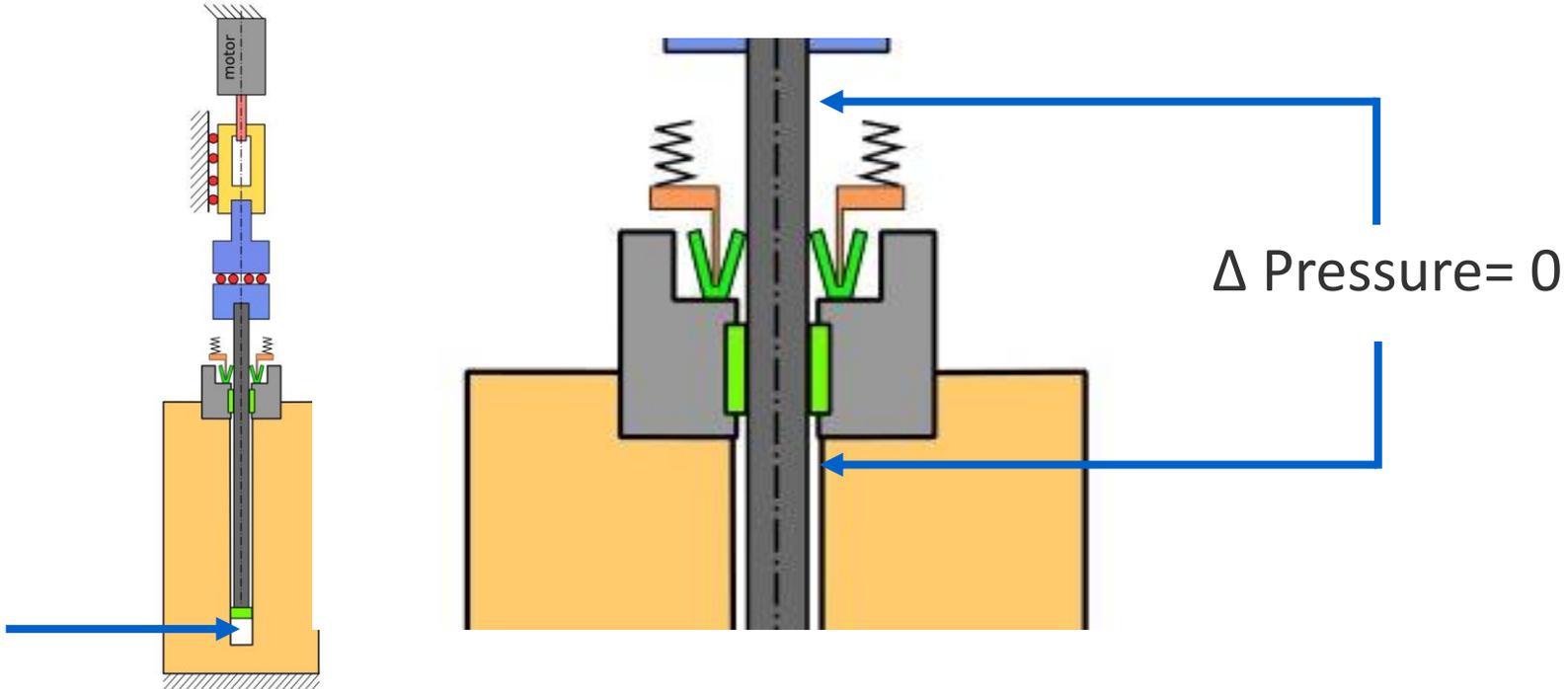
- > Away from mercury
- > Improve uncertainty
- > Own the primary standard
- > Become Designated Institute

Primary standard

Calibration at METAS (Swiss National Metrology Institute)



Future landscape of Bronkhorst standards



Loop Calibration System



Why a Loop Calibration System?

- > Increased interest in high-flow instruments
- > Benefits
 - ◆ Gas is circulated: virtually no waste of gas
 - ◆ Cost savings for expensive gasses like He
 - ◆ Cost savings on energy usage
 - ◆ Green: virtually no exhaust of greenhouse gases
 - ◆ Higher accuracy than conversion



Why a Loop Calibration System for Hydrogen?

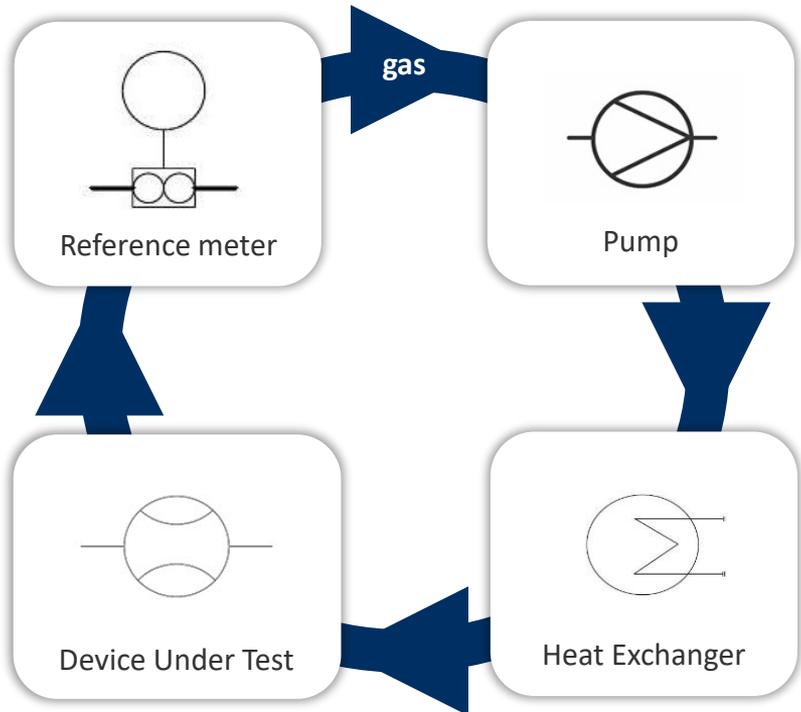
- Company decision focus on the Renewable Energy focus market and in particular the Hydrogen economy
- Increased accuracy is demanded by Fuel Cell and Electrolyser customers for high flow of Hydrogen

- Hydrogen has become the 3rd most used gas by our customers



What is a Loop Calibration System?

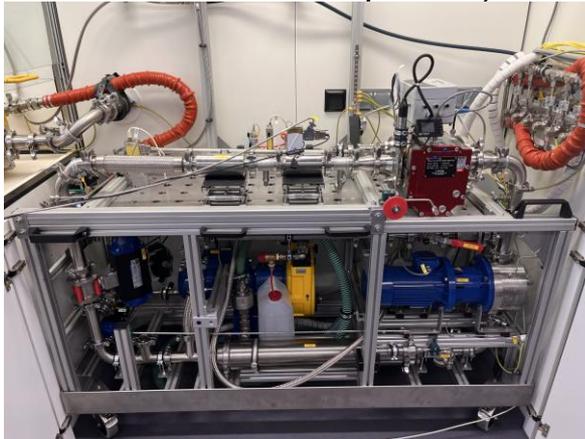
- A system to calibrate and adjust gasflow meters, while circulating and re-using the fluid.
- Loop calibration is especially efficient for high flow of fluids.



Explanation of Loop Calibration System



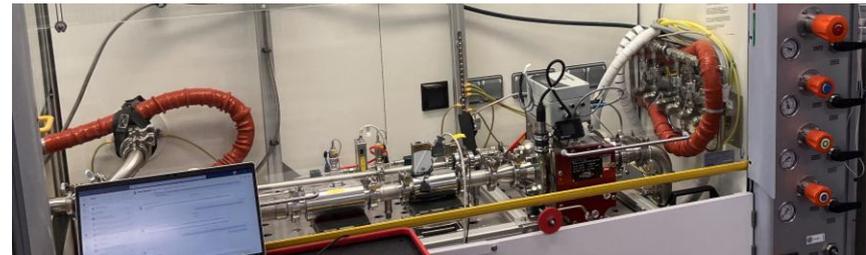
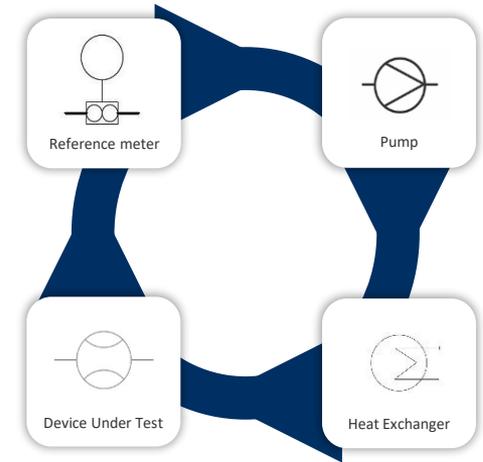
- In the Real Gas Calibration Centre (RCC)
- Possibilities
 - ◆ Gases: H_2 ; CH_4 ; Ar; CO_2 ; C_3H_8 ; He
 - ◆ Pressure: max. 10 bar(g)
 - ◆ Flow: max. 3300 l/min H_2



Explanation Loop Calibration System

> System

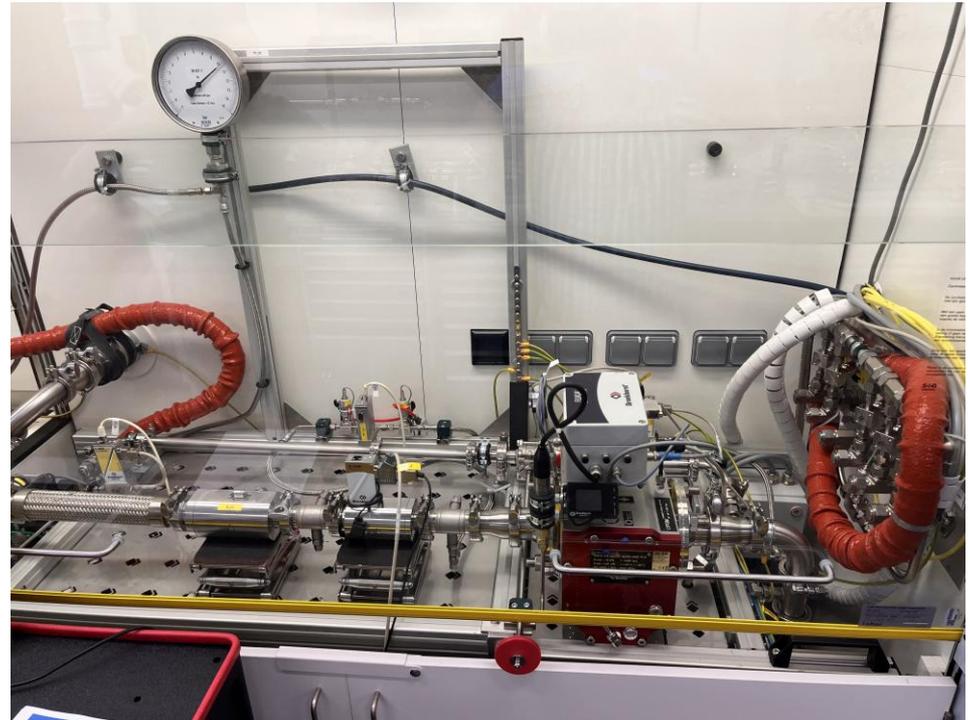
- ◆ Manual machine control by expert personnel
 - Limited number of calibrations possible
- ◆ Nitrogen purging to avoid explosive mixture
- ◆ Vacuum pumping to obtain pure gas content



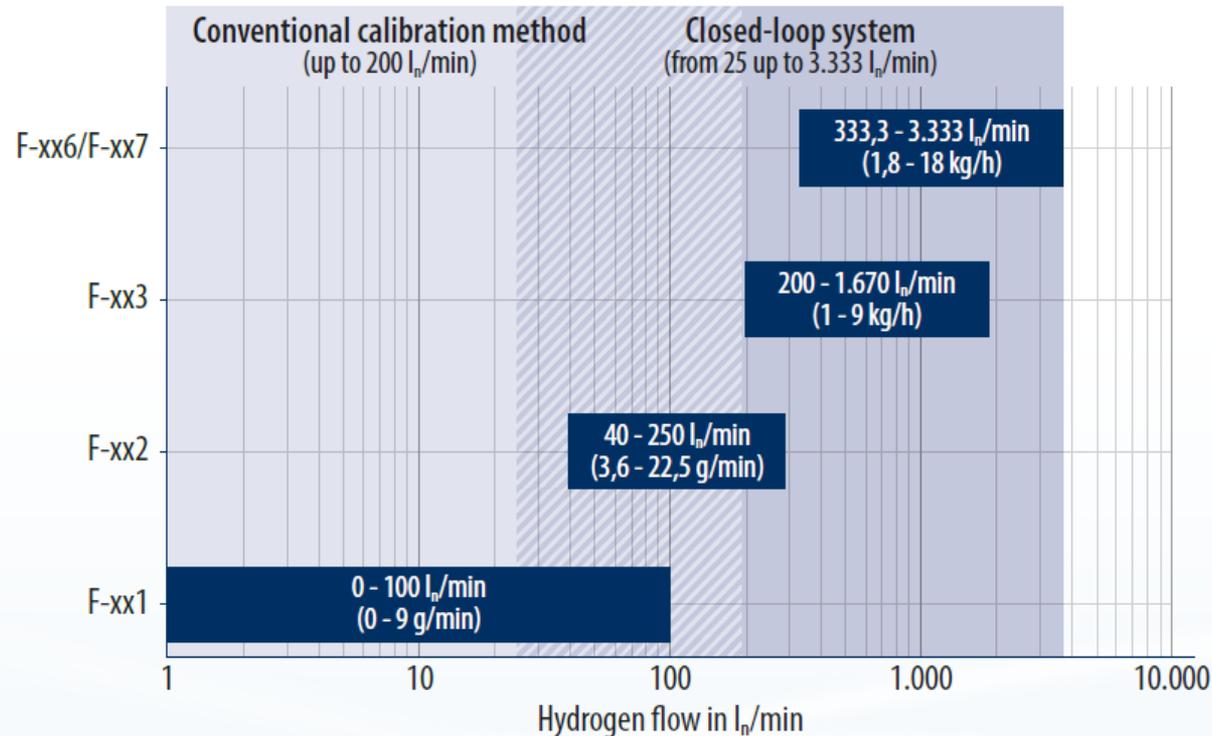
What can be calibrated

➤ Device Under Test

- ◆ F-xx2
- ◆ F-xx3
- ◆ F-xx6A
- ◆ MASS-STREAM



H2 capabilities



CEM Controlled Evaporation Mixing

Vapour flow - Fuel Cells and Electrolyzers

> Topics

- > Why Vapor control
- > Bubbler versus CEM evaporator
- > Configuration
- > Test setup system HAN

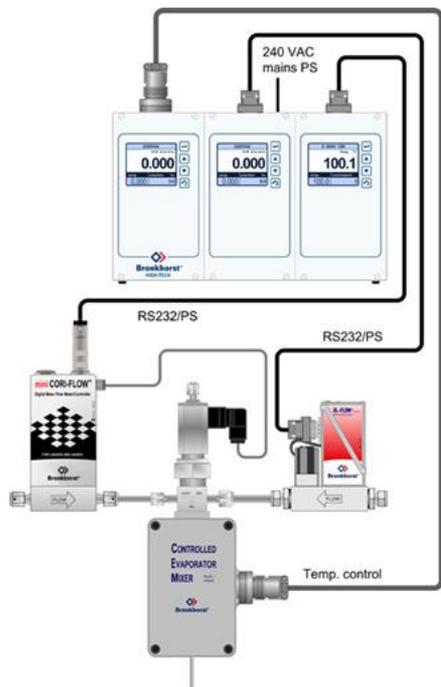


Why Vapor Control

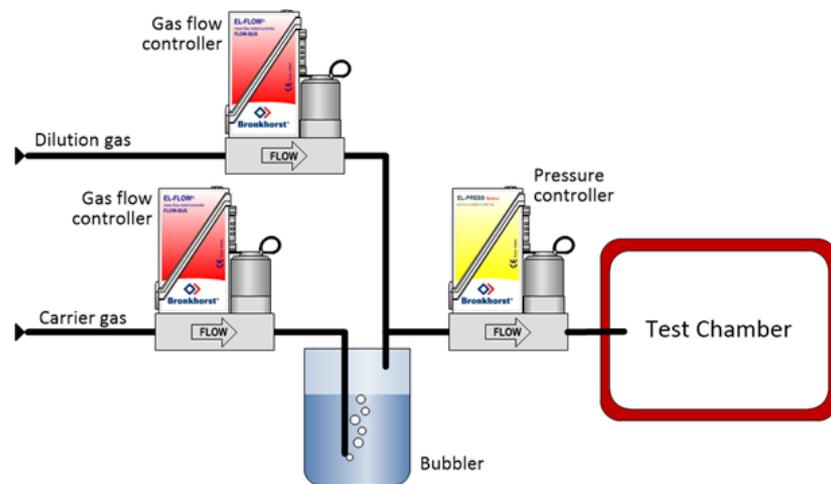
- Create test conditions in relation to Fuel cells and "Electrolyzers"
- Testing proton conductivity
- Testing membrane from drying out or flooding
- Determines efficiency, stability, and safety
- Is essential to understand the durability of the installations

Bubbler versus CEM Evaporator

CEM System



Bubbler

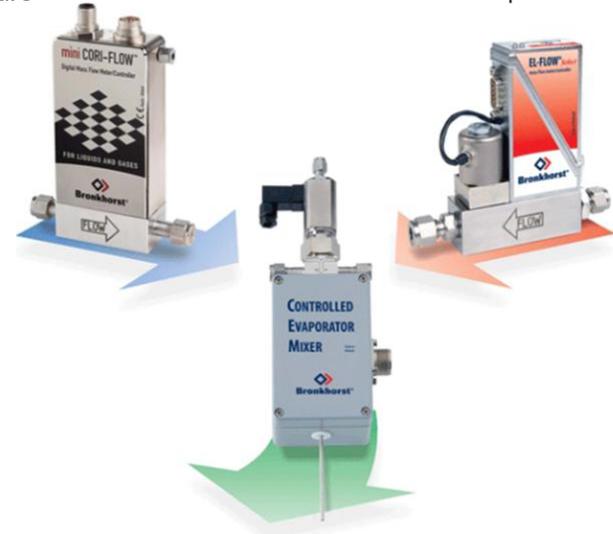


Configuration



Liquid:

- Flow rate
- Supply pressure (min/max.)
- Temperature



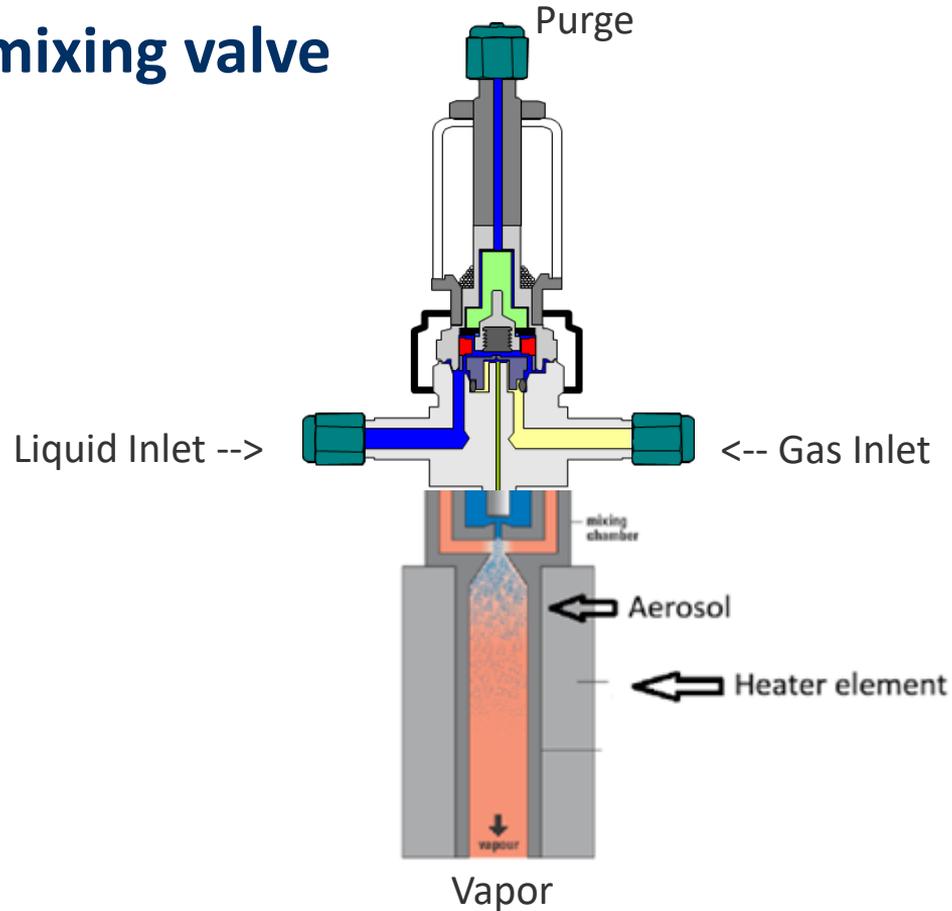
Carrier gas:

- Flow rate
- Supply pressure (min/max.)
- Temperature

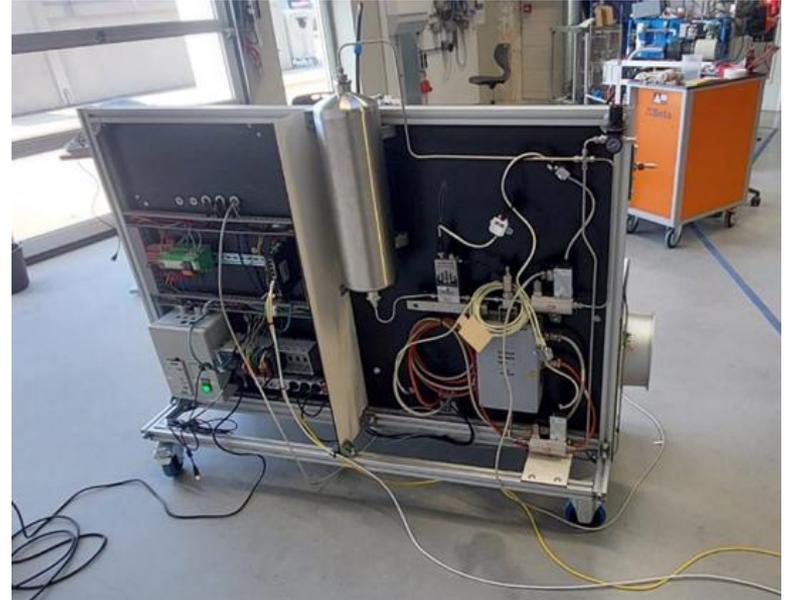
Customer process:

- Temperature (process and ambient)
- Pressure
- Vapour flow rate
- Vapour composition (%RH; mix-flow; molmass concentration; ppm)

Configuration, mixing valve



Test setup system HAN H2 Lab



Questions?

