Testing Inspection and (re)Certification of Hydrogen Refuelling Stations in N. Europe

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H2IL TRANSPORT CONFERENCE

Add value.
Inspire trust.

TÜV SÜD at a glance

15,000+
technical experts

150+
years of safety, security & sustainability

1,000+
locations worldwide

26,000+
TÜV SÜD employees

€2.9
billion in annual revenue

100 %
independent & impartial

TÜV SÜD global experts are committed to helping you manage risks and access global markets through a comprehensive portfolio of technical solutions

Our expertise

Testing and product certification

Auditing and system certification

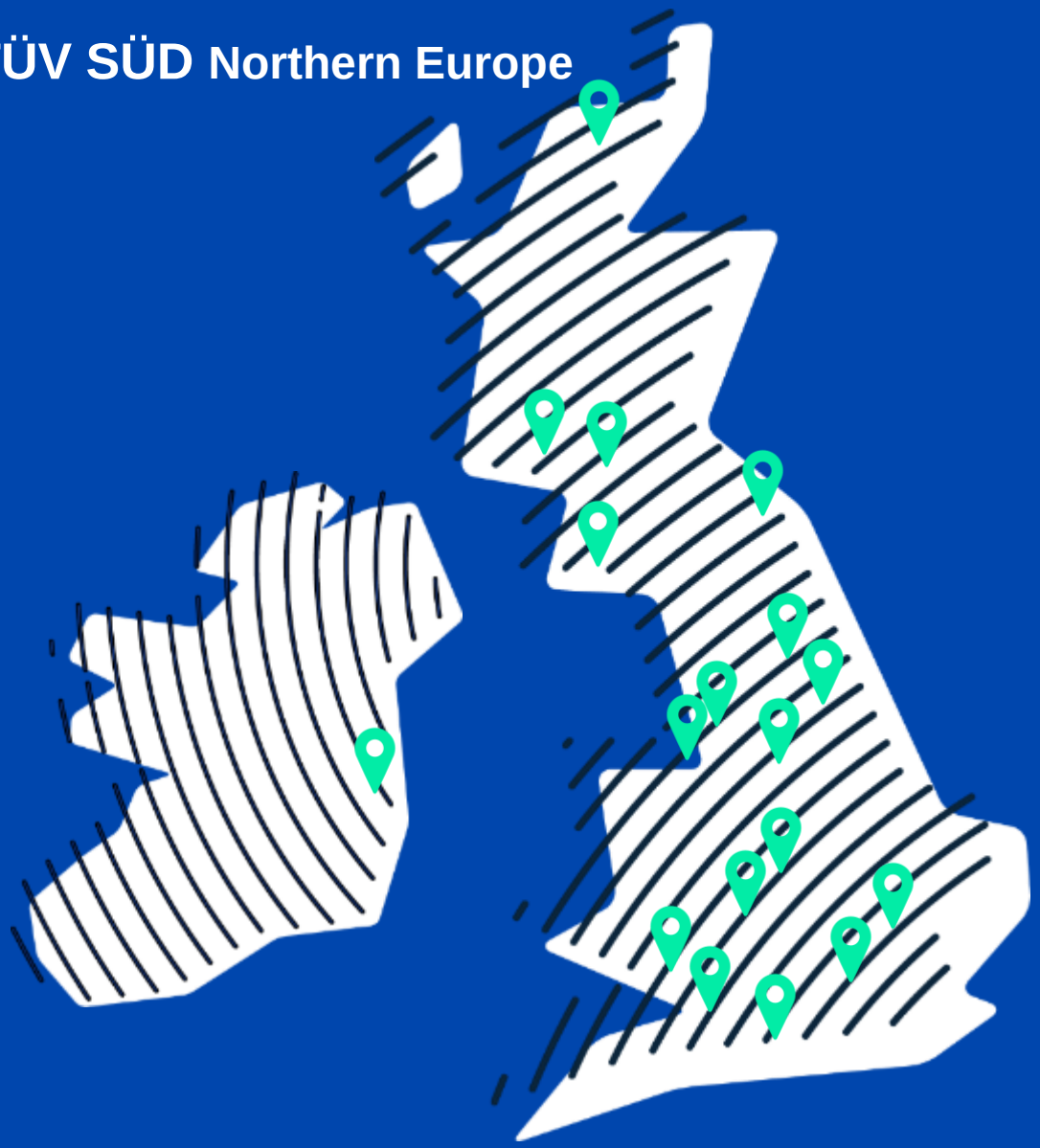
Inspection

Advisory and training

Verification and validation

A strong presence across UK & Nordics

TÜV SÜD Northern Europe



600+
TÜV SÜD
employees

21
locations

£80
million in
annual revenue

100%
independent
& impartial

TÜV SÜD extensive experience in Electrolysers

Ensuring safety and efficiency along the H_2 value chain

GREEN PRODUCTION
(Electrolysis plant and Power2Gas)

TRANSMISSION, DISTRIBUTION & STORAGE
(Pipeline, tank)

CONSUMPTION

Stationary applications

Mobile applications

Feasibility & management

Engineering

Construction & Commissioning

Operation

Staff training

Technical advisory and Global Market Access for electrolyser system

Process Safety, HAZOP & certification concept

Global Supply Chain requirements management

Material & component compatibility as certification body (H2 Readiness Certification)

Electrolysis plant safety
- Approval with authorities
- conformity assessment (e.g. CE)
- accredited expert services for plant
- assembly commissioning

Pressure Equipment Directive PED 2014/68/EU Certification

ELY stack and system certification
(e.g. CE, ISO 22734)

TS = Technical Service; CB = Certification Body

TÜV SÜD Northern Europe-Hydrogen Industry Services

Electrolyser /Fuel Cell Certification

Process- Plant Safety HAZOP –
Pressure Equipment (re) Inspections

Hydrogen Refueler
Dispensed Accuracy

Material

Component

System

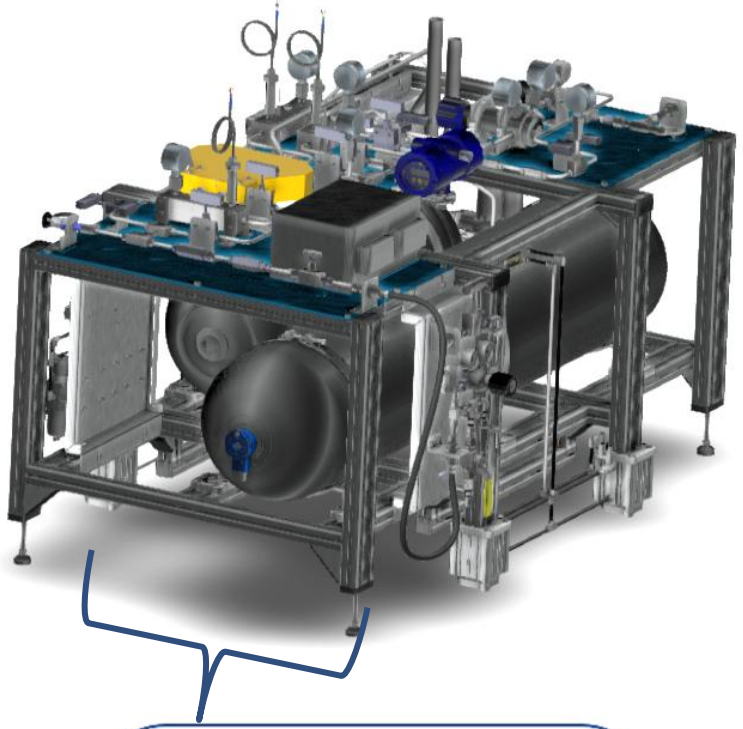
Material/Component/System
Compatibility with H_2

H2 Ready Certificate :
Level 1- Concept, Level 2-Project
Level 3- Transition (NG-H2)

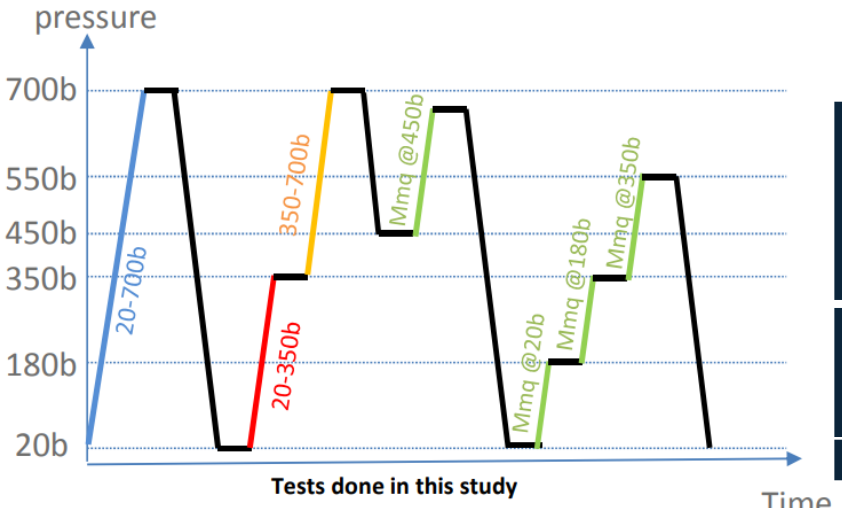
Technical Due Diligence

Hydrogen Field Test Standard (HFTS)

Gravimetric system – To measure Dispensed Quantity- **TÜV SÜD NEL ©**



- Gravimetric system with a hydrogen capacity similar to light duty FCEVs
- Mass of hydrogen collected = **1 kg** to **6 kg**
- Capability to verify H70 dispensers filling hydrogen to **700 bar**
- **OIML R139** regulations require the following tests to be done **3** times, *(time consuming)*



*MMQ= Minimum Measurable Quantity = 1kg

Accuracy Class	MPE for meter [in % of the measured quantity value]	MPE for complete system [% of the measured quantity value]	
		At type evaluation, initial or subsequent verification	In-service inspection under rated operating conditions
Class 4	2	4	5

*MPE= Maximum Permissible Accuracy

METTLER-TOLEDO PBK989-CC300 scale.
High Resolution ~ 0.0001g

Definitions of Errors during filling – basic analysis

Depending on the HRS design the most probable error comes from not including in the dispenser reading:

- **DEAD VOLUME:** *A dead volume is created when there is a large time lapse between one fuelling cycle to the other as a result of depressurization between the two fills.*

  This is measured by the dispenser flowmeter, but the customer DOES NOT actually receive this amount, and hence needs to be removed from the final amount paid by the customer.

- **VENTED GAS MASS:** *A vented gas mass is created just after the filling is completed and before the nozzle is disconnected and the filling hose is depressurised.*

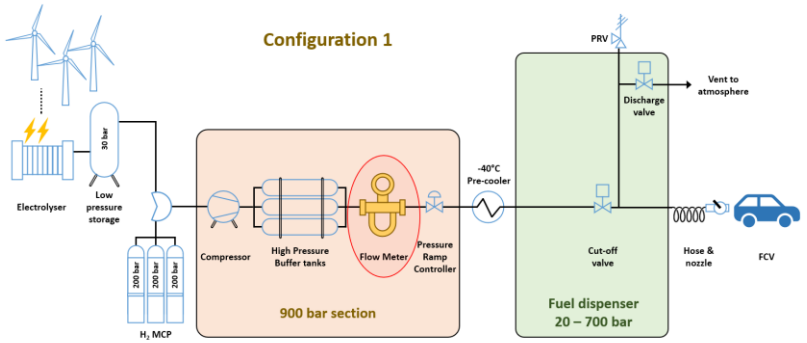
  This amount should be subtracted from the dispenser reading and may easily be responsible of carrying about **5 g** error. *OIML R139 2018 Annex B specifies the methods for calculating the vented quantity.*

All of the above + poor maintenance and calibration of flow meters can easily cause the customers to pay for the fuel they didn't receive.

Position of the Flow Meter and its effects

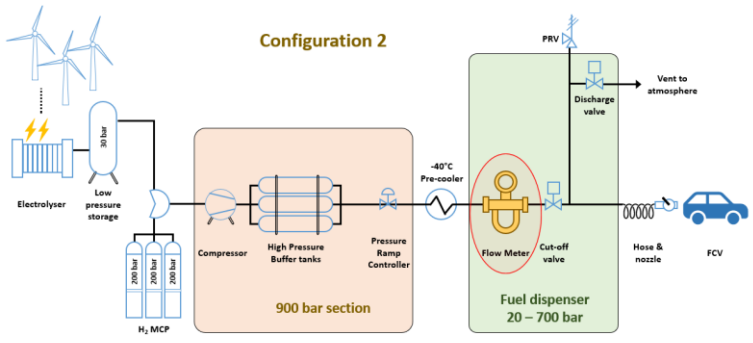
Pros and cons for each configuration

UK HRS



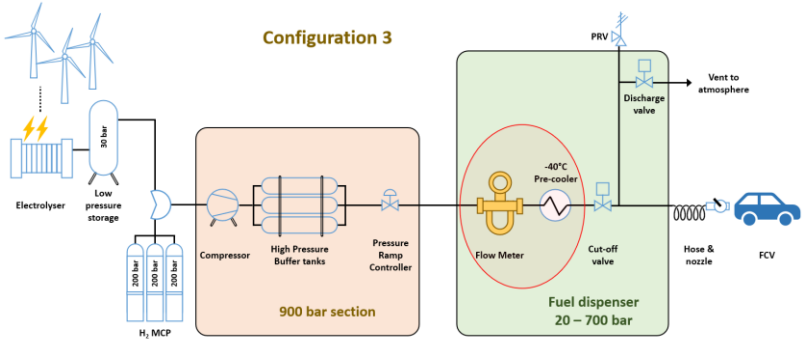
Meter at 900 bar section before pre-cooler

- **Pro:** relatively **constant** near ambient **temperature**
- **Con:** significant **'dead volume'** containing gas measured by flow meter but not delivered to the FCEV



Meter at dispenser after pre-cooler

- **Pro:** **'dead volume'** minimised
- **Con:** large **change** hydrogen gas **temperature** from initial ambient to -40 °C

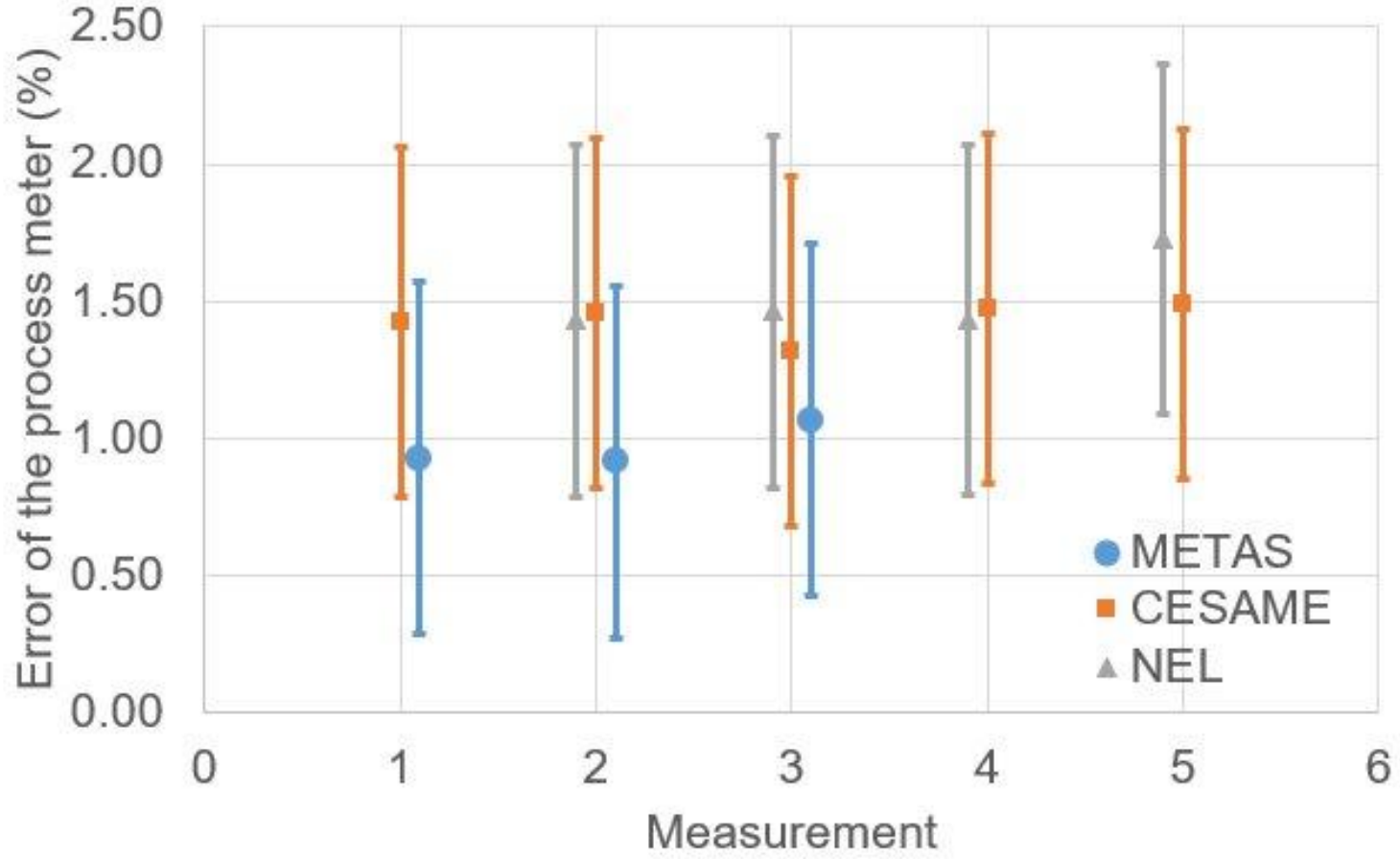


Meter at dispenser but before pre-cooler

- **Pro:** relatively constant near ambient **temperature** whilst reducing the '**dead volume**'
- **Con:** Could be **expensive** for large stations with multiple dispensers

Test Results at a Hydrogen Refuelling Station in Europe

The test results were processed in accordance with OIML R139 standard which accounts for vented quantity and dead volume upstream the dispenser

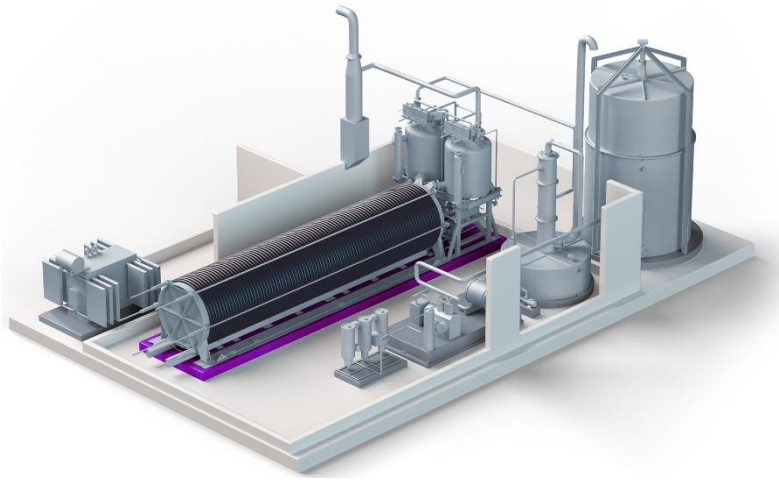


- The results confirmed that the station is well within the **accuracy limit of Class 4 (in service)** operation
- TÜV SÜD NEL© **HFTS** is **performing well** and matches with the results of other ***CESAME(France), METAS (Switzerland)***

(Re) Certification of HRS Equipment

- **MEGC/ TYPE IV CYLINDERS:**
  Are being decommissioned after (**15000**- **20,000** pressure cycles), by larger companies.
- On average HRS ~ **6-7yrs**
- We believe that by pro-active maintenance regimes and periodic inspections we can extend their lifetime to
  Re-Certify Pressure equipment at HRS and extend the lifetime **~10yrs**

- **Electrolysers (ALK/PEM)**:
  Water Purification System / Gas Dryer-Separators overtime start producing degraded H_2
  Loss of Quality (Purity) and **Quantity** of H_2
- These systems need to be proactively maintained and like any other pressure equipment and their **lifetime extended.**

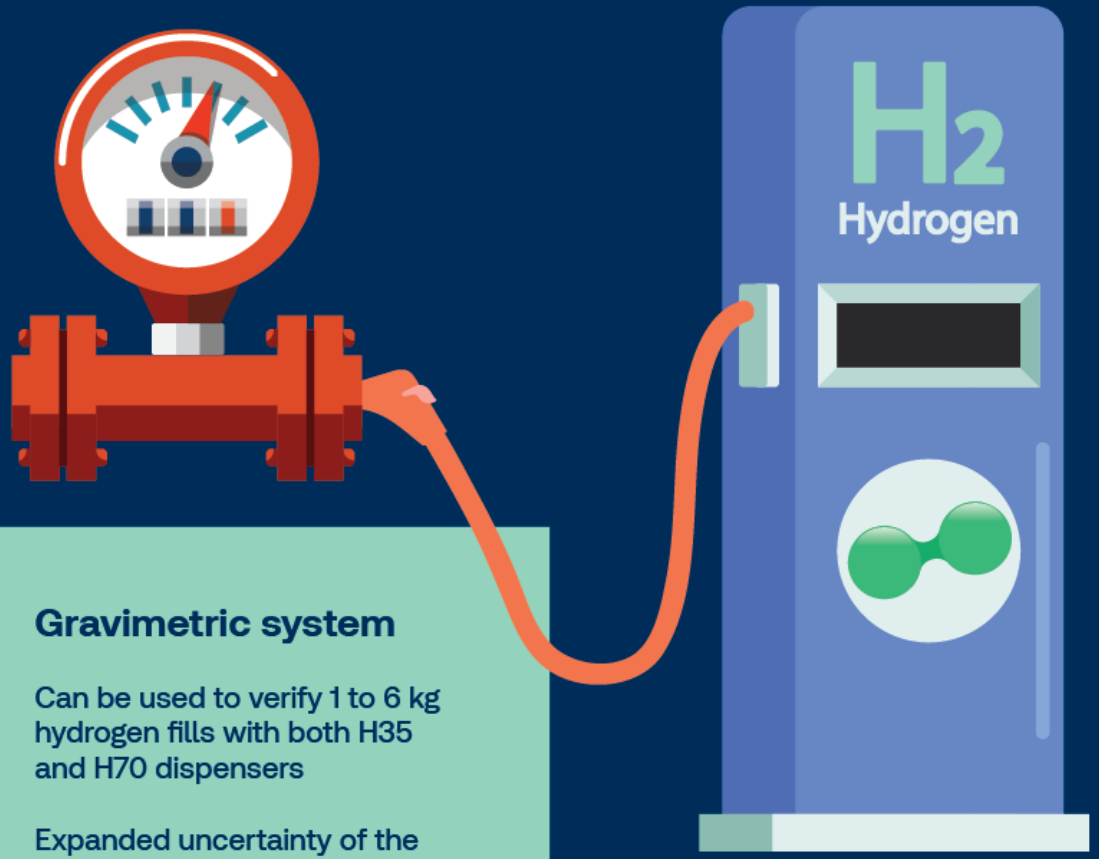


TUV SUD Ltd. is providing PED, Process Safety Services to **Re-Certify** HRS

Conclusions & Way Forward

- The **HRS dispenser accuracy** results for LD HFTS by TUV SUD on a European HRS fit well with the ones conducted by other partners and are well within the **acceptable limits for a Class 4 (in- service)** accuracy.
- The results for UK based test stations are highly dependent on the configuration and how well the communication channel is with the manufacturers.
- Advise HRS to contact their original manufacturers early so that **dead/vented volumes** can be accommodated when calculating final dispenser accuracy.
- Be **proactive** in communication. Involve the Government/Funding body **from start** when talking to UK HRS accuracy calculations
- **Pro-active Maintenance** and **Periodic Inspections** of Pressurised Systems (MEGS, Electrolysers) and Purification/Drying/Gas Separation Systems via **TUV SUD Ltd.** will **(re) certify HRS** equipment and **extend the life** of existing and new build stations.

Mobile primary standard facility for testing hydrogen refuelling stations dispensed quantities



Gravimetric system

Can be used to verify 1 to 6 kg hydrogen fills with both H35 and H70 dispensers

Expanded uncertainty of the associated test method as per Part 2 of OIML R 139

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Thank you

Department for Science, Innovation & Technology

Office for Product Safety & Standards

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