Hydrogen Readiness Of The Gas Infrastructure
Manufacturer Perspective

Farecogaz, April 2022

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Hydrogen Readiness Of Gas Infrastructure

AGENDA

- Farecogaz - Introduction
- Hydrogen mission statement & activities
- Hydrogen readiness – baseline & general statements
- Equipment overview & hydrogen readiness
- What about 100% hydrogen?
- Hydrogen – manufacturer declaration

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Farecogaz – Introduction

Farecogaz – Who we are

Association of European Manufacturers of gas meters, gas pressure regulators & associated safety devices and gas stations

18 Members across Europe covering multiple disciplines along the gas value chain

Farecogaz - Our Members

APATOR
DIEHL Metering
EMERSON
FLONIDAN
FMG Flow Meter Group
MESURA A Cavagna Group Company
Pietro Fiorentini
gAvilar Always in control!
GMT GmbH
Honeywell
Itron
Landis+Gyr
VALVITALIA GROUP
MeteRSit
RMG
Sagemcom
SICK Sensor Intelligence.
kromschroeder

Farecogaz – Structure & Organisation

President – Carsten Lorenz
Vice President – Paul Ladage
Harald Petermann – General Secretary

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Farecogaz – Hydrogen Mission Statement

Farecogaz mission & members activities regarding hydrogen readiness:

Hydrogen Mission Statement:

– Farecogaz members supporting the industry efforts to b er blends, up to 100%

General activities:

– Gas network component investigations to understand the im o ensure costumers safety

Main topics for components H2 readiness:

– Rubber

– Metal

– Gaskets (Tightness)

– Metering - Technology readiness

– ATEX compatibility

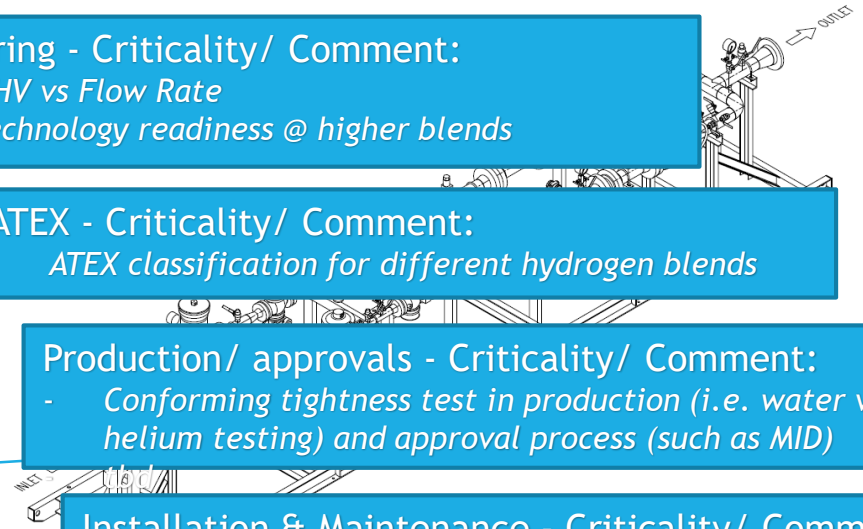
– Production/ approval procedures

– Installation/ Maintenance & De-commissioning procedures

Rubber - Criticality/ Comment:
- *Aging, permeability over time*
- *Critical for tightness and safety*

Metals - Criticality/ Comment:
- *Hydrogen embrittlement @ high pressure*
- *Critical for tightness and safety*

Metering - Criticality/ Comment:
- *HHV vs Flow Rate*
- *Technology readiness @ higher blends*



ATEX - Criticality/ Comment:
- *ATEX classification for different hydrogen blends*

Production/ approvals - Criticality/ Comment:
- *Conforming tightness test in production (i.e. water vs helium testing) and approval process (such as MID)*

Installation & Maintenance - Criticality/ Comment:
- *In field tightness test, Training, …*

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Hydrogen Readiness – Baseline

- **Products for gas measurement & regulation typically covered by European Standards such as:**
  - Pressure Equipment Directive (PED)
  - Measurement Instrument Directive (MID)
  - Equipment for Explosive Atmospheres Directive (ATEX)

- **General requirements for the products – especially those for metrology and performance – are specified in harmonized standards**
  - These standards need to be adapted for hydrogen – work in progress

- **Conformity assessment required before placing into market**
  - For Hydrogen manufacturers declare conformity in manufacturer declarations

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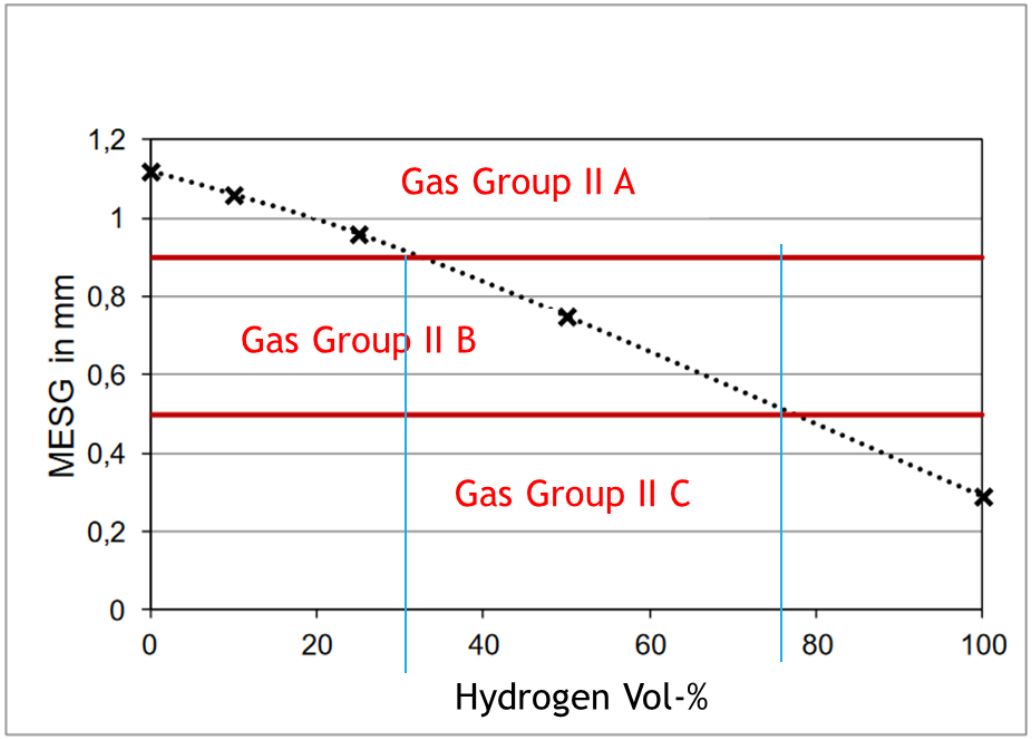
Hydrogen Readiness – Baseline

ATEX classification for gas infrastructure components in natural gas/ hydrogen mixtures



- **Group IIA** for ≤ 25% hydrogen
- **Group IIB** for > 25% hydrogen
- **Group IIC** for ≥ 75% hydrogen

I.e. ATEX marking for a residential Ultrasonic gas meter suitable for natural gas and hydrogen up to 100%

II 3G Ex ic IIC T3 Gc

Source:
EN 60079-20-1; 5.2.4, 5.2.1
Abschlussbericht zum Forschungsvorhaben 2539, Bundesanstalt für Materialforschung und -prüfung

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Hydrogen Readiness – General Statements

- **No uniform trend for H2 blending yet.**
  - Utility requests for components to operate in H2 blends of 10%, 20% and 100% (feasibility)
- **Many pilot projects started/ ongoing – small scale**
- **Harmonized standards for conformity assessment to be adapted (Meters & Regulators)**
  - Considering long-term experience and endurance results
- **NewGasMet-Project investigates on impact of renewable gases on standards that are used to demonstrate the conformity of gas meters to the European Measuring Instruments Directive (MID)**
  - **Recommendations expected in Q4 2022 on**
    - EN 12480 - Rotary Gas Meters
    - EN 12261 – Turbine Gas Meters
    - EN 1359 – Diaphragm Gas Meters
    - EN 14236 – Ultrasonic Gas meters
    - prEn 17526 – Thermal Mass Gas Meters
    - CEN/ TC 237 & OIML R137

Hydrogen Readiness – General Statements

- Standards for Gas pressure regulators:
  - EN 334 - 11/2019 - Gas pressure regulators up to 100bar - Update work started 01/2021
  - EN14382 - 11/2019 – Safety devices up to 100bar - Update work started 01/2021
  - ISO 23555-1 bis -3 Update after EN 334/EN 14382 readiness
- Main Working items (Ad Hoc Groups):
  - Leakage test specification
  - Material suitability Metal/Non-Metal

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Hydrogen Readiness – General Statements

- Fundamentals in Europa:
  - CEN Hydrogen – H2NG Initiative:

    GERG Study mirrored in CEN TC234/WG13:

    „To develop a detailed understanding of the state of the art relating to hydrogen injection in the gas networks based on international information sources” e. g.:
  - Priority 1: Safety: Classification of Leaks, integrity management, Gas tightness
  - Priority 7: Network equipment: Impact of H2 addition on equipment and material on network

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Hydrogen Readiness – Infrastructure Component Overview

		[%]→	2	5	10	20	25	30	40	50	60	70	80	90	100
TS	Pipeline (steel, > 16 bar)	10%													
TS	Compressors	5%													
ST	Storage (cavern)	100%													
ST	Storage (porous)														
ST	Dryer	5%													
TS/DS	Valves	10%													
TS/DS	Process gas chromatographs														
TS/DS	Volume converters	10%													
TS/DS	Volume measurement	10%													
DS	Pipeline (plastics, < 16 bar)	100%													
DS	Pipeline (steel, < 16 bar)	25%													
DS	House installation	30%													
U	Gas engines	10%													
U	Gas cooker	10%													
U	Atmospheric gas burner	10%													
U	Condensing boiler	10%													
U	CNG-vehicles	2%													
U	Gas turbines	1%													
U	Feedstock														

- Possible without adjustment as per current knowledge.
- Modifications maybe needed.
- Conflicting references, further R&D/ clarification required.
- Significant modifications/ replacement required.
- Not feasible.

TS – Transmission System

ST – Storage

DS – Distribution System

U – Utilization

Source: THE LIMITATIONS OF HYDROGEN BLENDING IN THE EUROPEAN GAS GRID, table 1, Fraunhofer Institute, January 2022
https://www.iee.fraunhofer.de/content/dam/iee/energiesystemtechnik/en/documents/Studies-Reports/FINAL_FraunhoferIEE_ShortStudy_H2_Blending_EU_ECF_Jan22.pdf

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Hydrogen Readiness – Selected Components

Product Group	Application		Hydrogen Impact								
			≤ 10%*			≤ 30%*			100%*		
			Safety	Function	Normative	Safety	Function	Normative	Safety	Function	Normative
Diaphragm Gas Meters	residential	low pressure			work in progress			work in progress			work in progress
Ultrasonic Gas Meters	residential										
Thermal Mass Gas Meters	residential										
Rotary Gas Meters	industrial	medium/ high pressure									
Turbine Gas Meters	industrial										
Ultrasonic Gas Meters	industrial										
Low/ mid Pressure Regulators	residential	low pressure									
High Pressure Regulators	industrial	high pressure									

Can operate without any restrictions related to safety, function/ performance.

No restrictions expected related to safety, function/ performance. Long term/ endurance test for confirmation

Need further investigations and likely modifications.

**Generally it is recommend to check manufacturer H2 declarations or directly consult the manufacturer before using components in H2 blends.*

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What about 100% Hydrogen?

Replacing natural gas with Hydrogen – Fluid property implications for gas meters

- Volume flow rates of gas meters will need to increase to transport the same amount of energy
- Installed base of gas meters potentially would run over-ranged in high/ 100% H2 blends
- Metrological performance of installed gas meters in high H2 blends to be confirmed
- Standards to be modified for pattern approval and initial/ in-service calibration (tightness, endurance, metrological)

Property	Hydrogen	Methane
Heating Value (massic)	39,39 kwh/kg	13,9 kwh/kg
Heating Value (volumic)	3 kwh/m³	10 kwh/m³
Heat Conductivity	0,186 W/m K	0,00341 W/m K
Density (0°)	0,0899 kg/m³	0,72 kg/m³
Sonic Speed	1284 m/s	430 m/s

H2 flow rate implications @ Qmax		
Meter Type	**Natural Gas**	**100% Hydrogen**
G4 (i.e. DGM)	6 m³/h	20 m³/h
G10 (i.e. DGM)	16 m³/h	50 m³/h
…	…	…
G250 (i.e. Rotary)	400 m³/h	1202 m³/h
G400 (i.e. Rotary)	650 m³/h	1952 m³/h

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Regulator & Safety devices in use with Hydrogen

Replacing natural gas with Hydrogen – Fluid property implications for gas pressure regulators

- The transported energy content decreases as the proportion of hydrogen increases, since hydrogen has a volume-related calorific value that is three times lower than that of natural gas.

- Balancing the energetic performance of a gas pressure regulator, the transported performance decreases slightly with increasing hydrogen content.

Regulator & Safety devices in use with Hydrogen

Replacing natural gas with Hydrogen – Fluid property implications for gas pressure regulators

- Flow capacity increase of the specific regulator with increasing H2 ratio
- Flow velocity increase
- Sound emission increase
- Reduced flow capacity of an existing GPRS
- Review of station sizing
- Negative Joule-Thomson-Coefficient leading to a slight temperature increase at 100% H2

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Manufacturer Declaration For Hydrogen Readiness

- **Actually, many manufacturers already published declarations for H2 readiness on their websites**
- **For the moment these declarations are in manufacturer specific format**
- **Farecogaz is about to standardize the manufacturer declaration and using a common standard across the industry – centrally stored on Farecogaz website**
- **Manufacturers can confirm the suitability of products concerning MID, PED, ATEX,…**

Manufacturer declaration
Herstellererklärung

Betreffend Erdgas-Geräte bei Betrieb
- mit Erdgasen nach DVGW G 260/262 mit Wasserstoffbeimischungen oder
- mit reinem Wasserstoff

Concerning of Natural Gas (NG) devices when operated
- ***with Natural Gas and admixture of hydrogen or***
- ***pure hydrogen***

Name des Ausstellers: *Issuer's name:*	**Manufacturer A**
Anschrift des Ausstellers: *Issuer's adress:*	….
Gegenstand der Erklärung: *Object of the declaration:*	**Pressure regulator with shut off device**
Typenbezeichnung: *Type designation:*	.....
Erklärungs-Nummer und Revision: *Declaration-no. and Revision:*	.....

The devices specified above comply to the following requirements

For operation when the hydrogen content in Natural Gas is ≤ 10 Mol-%

Maximum admissible band width of hydrogen content in Natural Gas	[Vol. -%]	**0-10%**
Performance data *(flow range, control parameters, accuracy, repeatability, etc.) are as for operation with Natural Gas without Hydrogen content:* *If "No": refer to "Additional Information".*		
Limits of Operating Pressure / Operating Temperature *for pressure resistance are as for operation with Natural Gas without Hydrogen content.* *If "No": refer to "Additional Information".*		
Safe-guarding of ***chemical resistance*** *by use of suitable materials for wetted parts acc. to Pressure Equipment Directive 2014/68/EU (PED)*		
Gas tightness *of the device was tested at a test pressure of 1,1 times the max operating pressure, applying* • ☐ *Air* • ☐ *Nitrogen* • ☐ *a gas mixture including a minimum of 10 vol-% H_2 or >99% H_2* • ☐ *a gas mixture including a minimum of 10 vol-% He or >99% He* • ☒ *other method, refer to "Additional Information"* *Tick where applicable.*		
The standard configuration of the device is approved for use in potentially explosive atmospheres ***acc. to ATEX-Directive*** *2014/34/EU minimum for explosion group (minimum):* • ☐ *IIA* • ☐ *IIB* • ☐ *IIB+H2* • ☐ *IIC* • ☐ *Approval(s) for higher gas group(s) available, refer to "Additional Information".* *Tick where applicable.* *Note: The suitability of the device for use in gas mixtures with up to 10 vol-% Hydrogen content has to be verified by a risk assessment performed by the operating company.*		
Suitability of the device for the ***use in commercial transactions*** *acc.to the Measuring Instruments Directive 2014/32 / EU (MID) in conjunction with the Technical Guideline TR-G 19 of the Physikalisch-Technische Bundesanstalt.*		

Thank You !

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