METROLOGY for HYDROGEN VEHICLES

Flow metering

Work Package 1

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EMPIR MetroHyVe SAB Workshop
24 January 2018, Delft

EMPIR EURAMET

This project has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme.

Project Team

METROLOGY for HYDROGEN VEHICLES

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Ha FUNDACION PARA EL DESARROLLO DE LAS NUEVAS TECNOLOGIAS DEL HIDRÓGENO EN ARAGÓN

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WP1 Flow metering, objectives

- To develop a metrological infrastructure for testing/calibrating flow meters used for hydrogen flow metering from refuelling stations, target accuracy of 1%
- Acquire technical data to revise standards
- Support laboratories by providing good practice guides describing calibration and validation of flow meters used at refuelling stations
- Provide input to improve metrological requirements from OIML R139-1

Workload divided over 5 tasks

WP1 Flow metering, tasks

Task 1.1: Obtain information about the station process design, operating conditions and current placement and details of the hydrogen flow meters in Hydrogen Refuelling Stations (HRS). Design of various HRS and uncertainty sources will be documented (anonymously) in a pubic report.

Task 1.2 and 1.3 : Performance testing of Coriolis flow meters (in kind contribution from manufacturers) with alternative safe fluids (nitrogen, air, water, oil) to study temperature and pressure dependence:

- Define test matrix and obtain Coriolis flow meters
- N_2 and air, 23 kg/m^3 @ 20 bar, 46 kg/m^3 @ 40 bar, similar to density of H_2 at 350 bar and 700 bar, flow range (0.05 – 2.0) kg/min, limited by pressure drop and speed of sound
- Temperature dependence with N_2 for flow rate < 1 kg/min
- Pressure dependence with water or oil up to 875 bar, pair of flow meters in series (high and low pressure part of the rig)

WP1 Flow metering, tasks

Task 1.4: Development of mobile gravimetric standards (Hydrogen Field Standards = HFS) to calibrate and verify HRS in the field. Publication of results in peer-reviewed journals and good practice guides

- 4 HFS to be developped (CESAME, METAS, VSL and JV)
- Validation of HFS
- Field testing with HFS at 350 bar and 700 bar
- Assessment of using substitute substances to hydrogen by comparison with results in the field
- Write good practice guide fo validating meters at HRSs and the type approval procedure

Task 1.5: Provide detailed uncertainty budgets for the various approaches

- Use of substitute substances in the laboratory for testing (gas and liquid)
- Gravimetric approach in the field
- Plan of dedicated testing facility to high pressure hydrogen (costs + uncertainty)

WP1 Flow metering, planning

METROLOGY for HYDROGEN VEHICLES

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Activities	Jun 17	Jul 17	Aug 17	Sep 17	Okt 17	Nov 17	Dez 17	Jan 18	Feb 18	Mrz 18	Apr 18	Mai 18	Jun 18	Jul 18	Aug 18	Sep 18	Okt 18	Nov 18	Dez 18	Jan 19	Feb 19	Mrz 19	Apr 19	Mai 19	Jun 19	Jul 19	Aug 19	Sep 19	Okt 19	Nov 19	Dez 19	Jan 20	Feb 20	Mrz 20	Apr 20	Mai 20
	WP1																																			
	Task 1.1, Identifying and assessing the uncertainty sources																																			
1.1.1	Questionnaire																																			
1.1.2					Report																															
1.1.3								Send report to OIMLR139																													
	Task 1.2, Investigate substitute substances, gas																																			
1.2.1	Test matrix																																			
1.2.2	Obtain CMF as in-kind																																			
1.2.3								Test measurements with CMF																													
1.2.4																				Peer-review paper																
	Task 1.3, Investigate pressure dependence																																			
1.3.1	Calibrations with CMF, RISE																																			
1.3.2	Calibrations with CMF, NEL																																			
1.3.3																										Peer-reviewed paper										
	Task 1.4, Development gravimetric standards																																			
1.4.1	Development of primary standards																																			
1.4.2														Inter-comparison																							
1.4.3																				Field testing 350 bar																
1.4.4																				Field testing 700 bar																
1.4.5																													Paper								
1.4.6																													Master meter								
1.4.7																													Comparison								
1.4.8																																Guide				
	Task 1.5, Uncertainty budgets																																			
1.5.1																				Unc. budget substitute																
1.5.2																				Unc- budget water																
1.5.3																				Unc. budget gravimetric																
1.5.4																				Unc. budget gravimetric																
1.5.5																										Report										
1.5.6																															Dedicated bench					

WP1 Flow metering, status

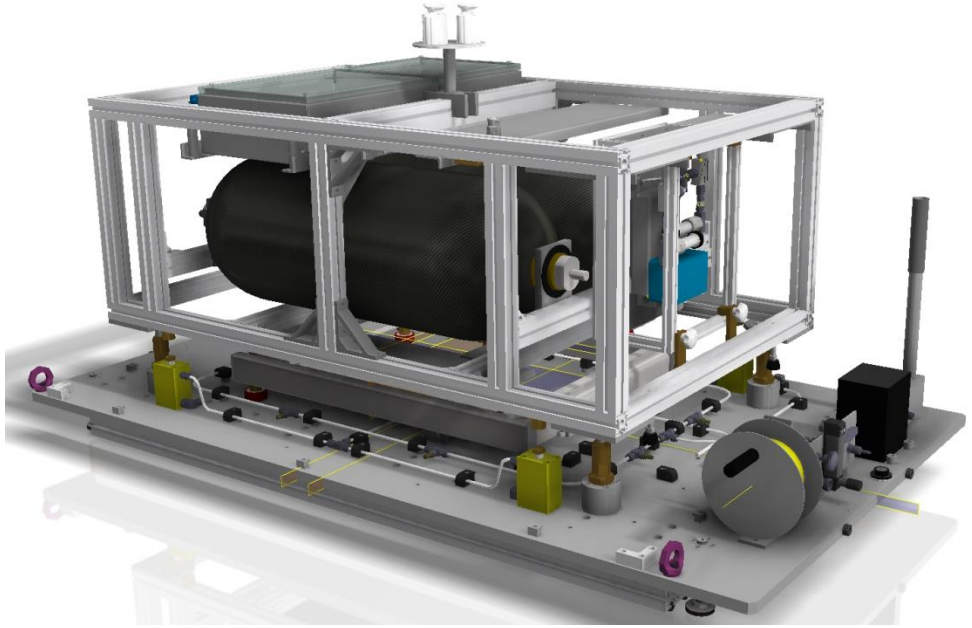
Task 1.1: Information has been collected, report to be available during Q1

Task 1.2 & 1.3:

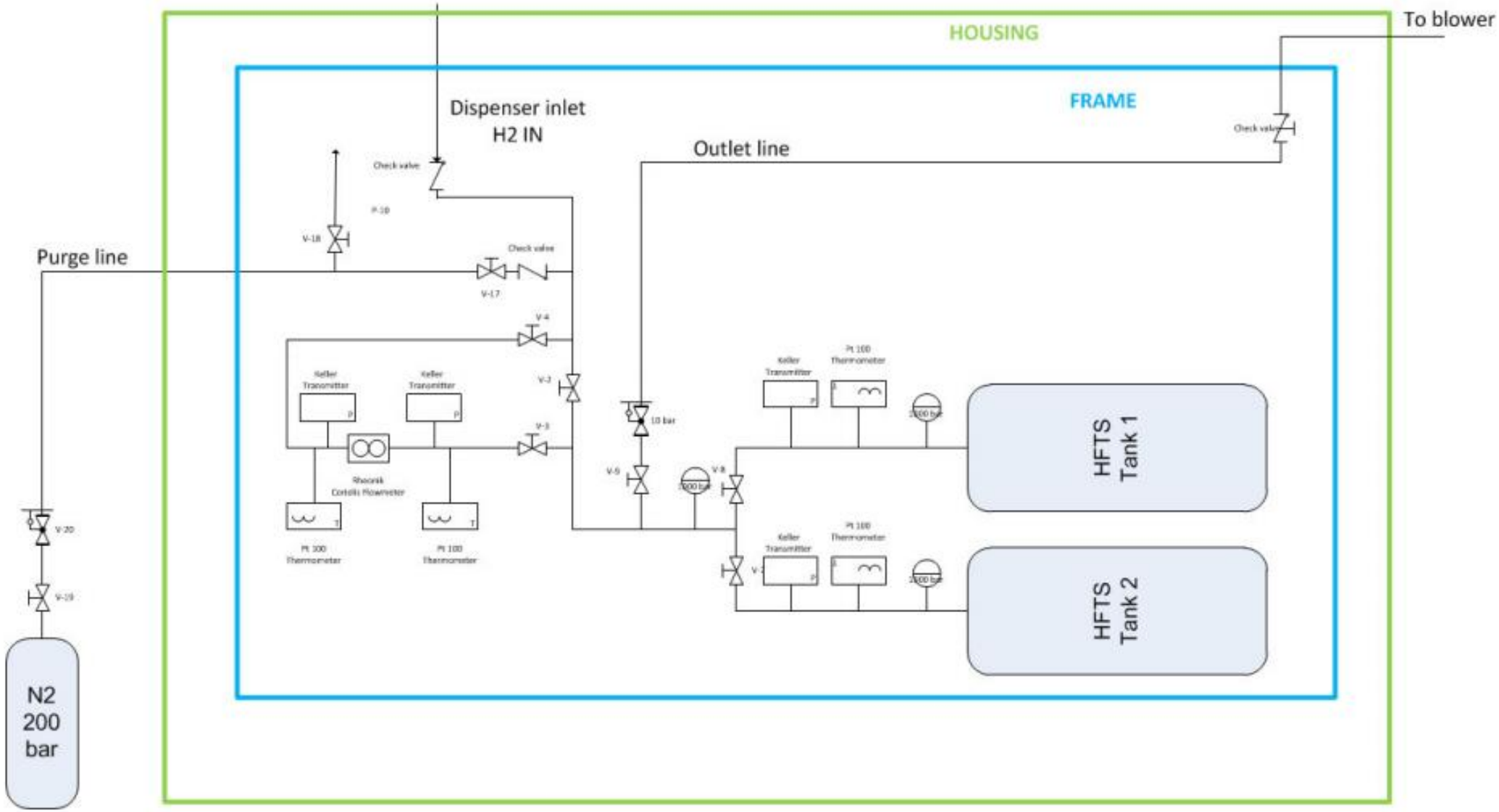
- 6 Coriolis flow meters expected in February 2018 as in kind contribution (Thank you)
- Testing schedule has been established, to be validated by all partners
- Measurements to start in February 2018

Task 1.4:

- Development of 3 HFS in progress, 1 already finished
- ATEX and pressure certifications are time consuming
- Delivery times are long



WP1 Flow metering, status



WP1 Flow metering, open questions

Tasks 1.2 & 1.3:

- Any results from similar experiments would be welcome

Task 1.4:

- Safety requirements from HRS operators for field testing? ATEX certification should cover this issue…
- List of suppliers for high pressure hydrogen equipment (pressure vessels, valves, pressure reducers, blower, …) and best practice

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THANK YOU