

20IND06 PROMETH2O

Metrology for trace water in ultra-pure process gases

Welcome & Opening of the meeting

Delft, 2-3 November 2022

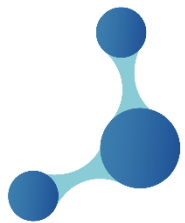
EMPIR



EURAMET

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

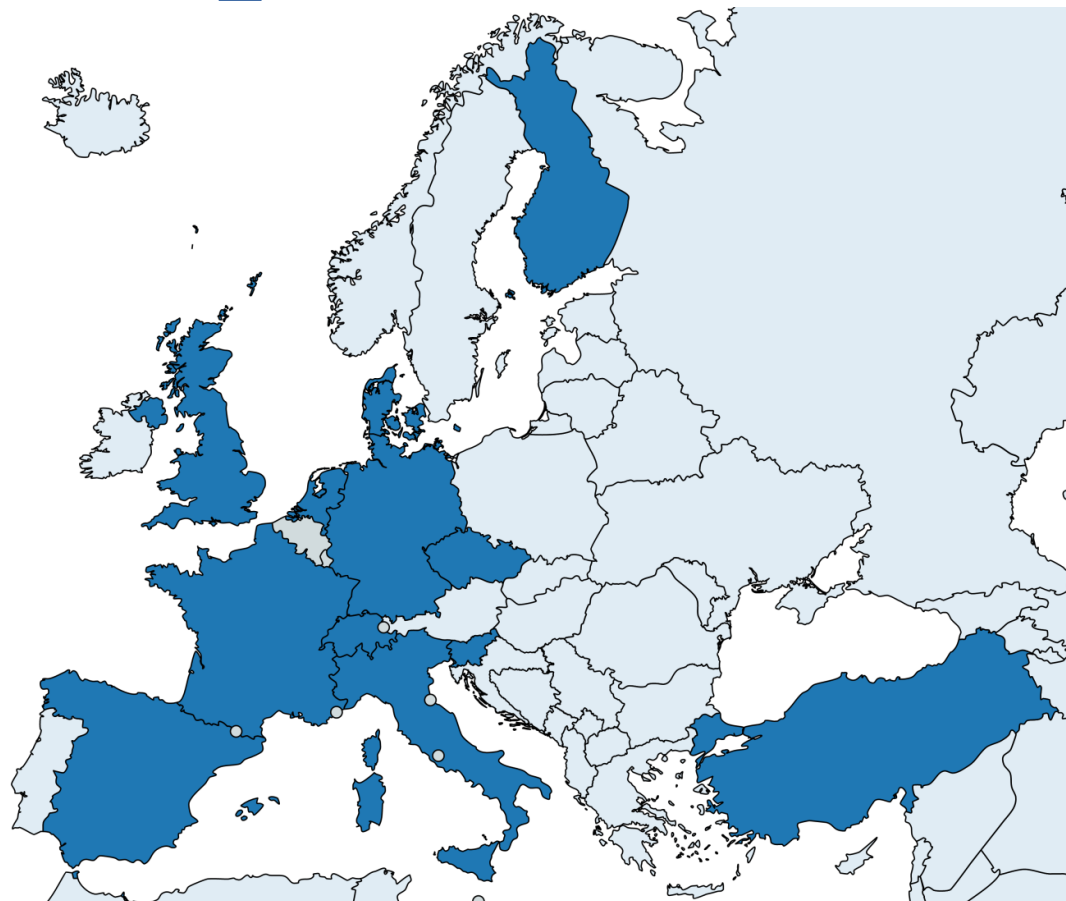
2 nd of November 2022	
12:30	0. Registration; coffee/tea
13:00	1. Opening of the meeting and introduction of attendees
13:30	2. WP1: Improved trace water measurement methods and techniques (Led by WP1 leader) <i>Active partners: DTU, INRIM, MBW, PTB, Qrometric, SUN, TUBITAK</i>
13:30 – 14:00	Report on Task 1.1: Development and improvement of optical analysers
14:00 – 14:30	Report on Task 1.2: Validation of the measurement methods and techniques
14:30 – 15:00	Discussion and planning of M18-to-M27 activities
15:00-15:30	Coffee/tea
15:30	3. WP2: Provision of robust traceability to trace water measurements in real humid gas mixtures (Led by WP2 leader) <i>Active partners: INRIM, CEM, CETIAT, CMI, CNAM, INTA MBW, PTB, UL, UNICAS, UVa, VSL, VTT</i>
15:30 – 16:00	Report on Task 2.1: Development of primary humidity standards for trace water vapour in an increased range of gas matrices
16:00 – 16:30	Report on Task 2.2: Measurement of the enhancement factor in selected humid gas mixtures
16:30 – 17:00	Discussion and planning of M18-to-M27 activities
17:00	End of the day
19:00	Project Dinner



3rd of November 2022

9:00	4. WP3 Demonstration at industrial test beds and facilitation of end-user uptake (Led by WP3 leader) <i>Active partners: VSL, DTU, INRIM, MBW, Nippon Gases, Qrometric, UL, Vaisala</i>
9:00 – 9:15	Report on Task 3.1: Inventory of stakeholder needs and protocols for the demonstrations at the test beds
9:15 – 9:45	Discussion and planning of M18-to-M27 activities
9:45	5. WP4: Creating Impact (Led by WP4 leader) <i>Active partners: All</i>
9:45 – 10:00	Report from the Steering Board (SAB)
10:00 – 10:20	Report on Task 4.1: Knowledge transfer (Liaison with standard bodies and committees; conference
10:20 – 10:45	Report on Task 4.3: Uptake and exploitation
10:45-11:00	Coffee/tea
11:00	6. Project management (Led by project coordinator) <i>Active partners: All</i>
11:00 – 11:15	M18 project reporting and deadlines. Mid-term Review
11:15 – 11:45	Risk management, delays, amendments to the protocol
11:45 – 12:00	Update of the Data Management Plan
12:00 – 12:15	Next project meeting (M27)
12:15 – 12:30	Summary of the meeting and AOB
12:30	7. Closing of the meeting
12:30	Lunch
13:30–14:30	Laboratory tour (Chemistry and Temperature & Humidity)

- Introduction of attendees (in presence and remotely connected)



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19 partners from 12 countries – 242 person-months

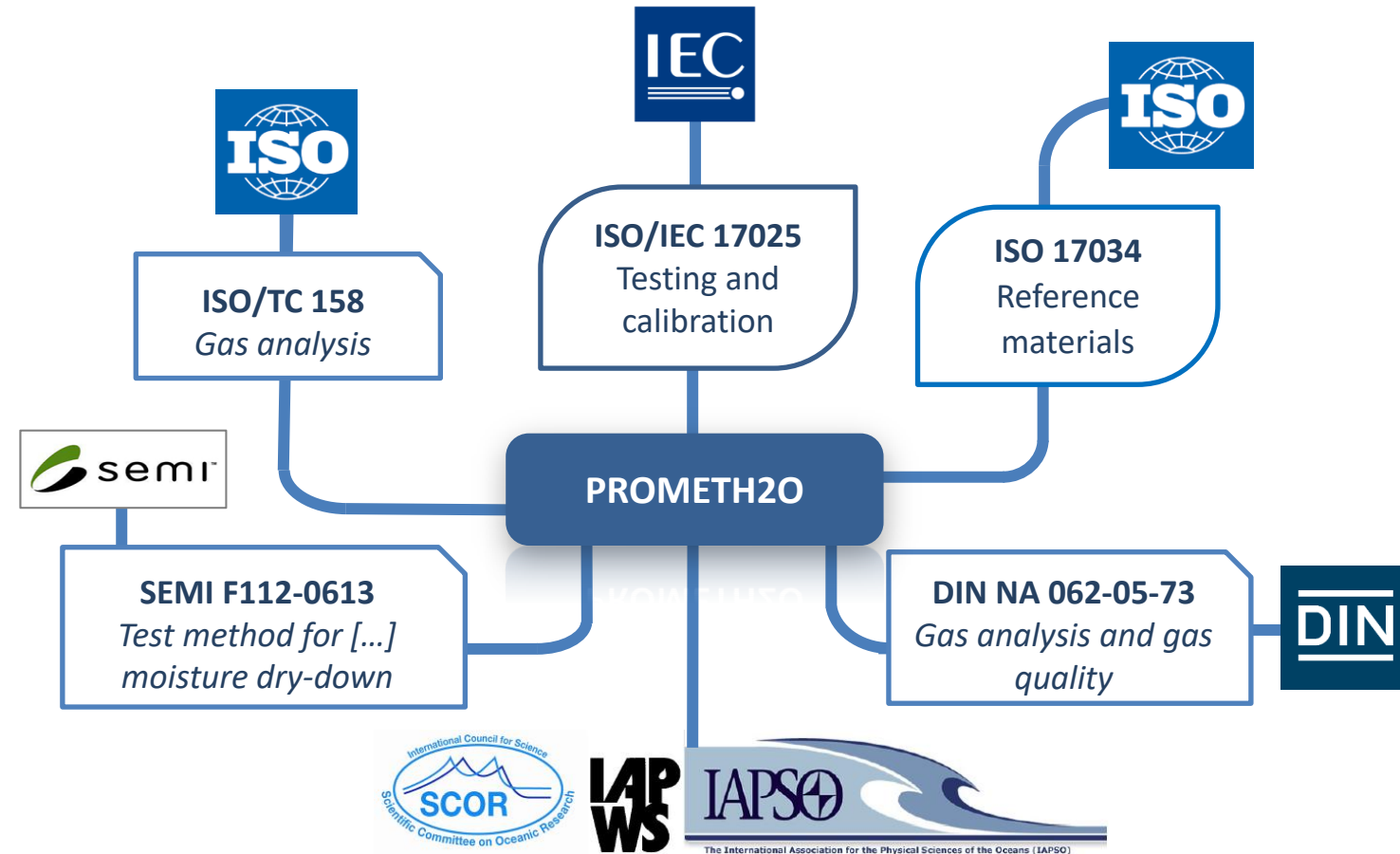
- ✓ **New measurement methods** in the amount fraction range between 5 ppm and 5 ppb with relative standard uncertainty between 3 % and 8 %.
- ✓ **New primary standards** for trace water vapour in N_2 , Ar and H_2 down to 5 ppb (or $-105\text{ }^{\circ}\text{C}$ frost point temperature) at pressures up to 1 MPa.
- ✓ **New data** and correlation equations of water vapour enhancement in N_2 , Ar and H_2 in the temperature range from $-30\text{ }^{\circ}\text{C}$ to $-90\text{ }^{\circ}\text{C}$ and pressures up to 1 MPa.
- **Two demonstrations** in industrial environments with real-time measurements and on-site calibrations.
- ✓ **A toolkit of metrological solutions** for robust measurement traceability in the production of ultra-pure process gases.



Relevant objective (Activity delivering the deliverable)	Deliverable number	Deliverable description	Deliverable type	Partners (Lead in bold)	Delivery date
1 (A1.2.7)	D1	Report and recommendations on measurement methods and techniques for trace water measurements in industrial environments in the amount fraction range between 5 parts in 10^6 (5 ppm) and 5 parts in 10^9 (5 ppb) (-65 °C and -105 °C frost point) with relative standard uncertainty between 3 % and 8 %, from upper to lower range, respectively	Report	DTU, SUN, MBW, INRIM, TUBITAK, Qrometric	Nov 2023 (M30)
5 (A1.3.3)	D2	Report on the “Recommendation of transfer standards for a future CIPM comparison in the frost-point temperature range -65 °C to -105 °C (5 ppm to 5 ppb)	Report	INRIM, PTB, TUBITAK, DTU	May 2024 (M36)
2 (A2.1.7)	D3	Report on the development of primary trace water vapour standards describing the range, the estimated uncertainty and the gas species in which reference values can be generated with a target fraction range from 5 ppm to 5 ppb (-65 °C to -105 °C) with relative standard uncertainty less than 3 % to 8 % in selected gas matrices at pressures up to 1 MPa	Report	INRIM, VTT, CMI, INTA, UL, PTB, MBW, VSL, CETIAT	Nov 2023 (M30)
3 (A2.3.4)	D4	User guide related with the software tool(s) of a web-based application to estimate the enhancement factor and uncertainty in water vapour in N_2 , Ar and H_2 in the temperature range between -30 °C and -90 °C and pressure range from 0.1 MPa to above 1 MPa	User guide	UNICAS, VTT	Nov 2023 (M30)

Relevant objective (Activity delivering the deliverable)	Deliverable number	Deliverable description	Deliverable type	Partners (Lead in bold)	Delivery date
3 (A2.3.5)	D5	Report on the development and validation of correlation equations for the enhancement of water vapour in N ₂ , Ar and H ₂ in the temperature range from -30 °C to -90 °C and at pressures from 0.1 MPa to above 1 MPa	Report	VTT, CNAM, CETIAT, CMI, VSL, UL, INTA, CEM, UVa, UNICAS	Jan 2024 (M32)
4 (A3.2.6)	D6	Report on a) the delivery of a tested toolkit of metrological solutions at an equipment developer to provide measurement traceability in the field with a target of improved trace water measurement methods between 5 ppm and 5 ppb and b) discussion with stakeholder needs on the compliance and lessons learned	Report	Qrometric, UL, MBW, INRIM, Vaisala, VSL	Feb 2024 (M33)
4 (A3.3.4)	D7	Report on assessing the production quality of bulk and specialty gases at a specialty gas company facility to demonstrate improved trace water measurement methods between 5 ppm and 5 ppb in an industrially relevant facility	Report	Nippon Gases, INRIM, VSL, DTU, Vaisala	May 2024 (M36)
5	D8	Evidence of contributions to or influence on new or improved international guides, recommendations and standards with a focus on, e.g., the following committees: ISO/TC 158 WG3; SEMI, Gases Global Technical Committee; DIN NA 062-05-73 AA; CIPM CCT WG-Hu; CIPM CCQM GAWG; IAPWS WG TPWS; JCS; EURAMET TC-T; EURAMET TC-MC SCGA. Examples of early uptake of project outputs by end-users.	Reporting documents	CETIAT, all partners	May 2024 (M36)
n/a	D9	Delivery of all technical and financial reporting documents as required by EURAMET	Reporting documents	INRIM, all partners	May 2024 (M36 + 60 days)

- **Extended-range primary standards** and measurement traceability for trace water in UHP gases.
- **Integration of metrology infrastructure** in Europe and leadership of European NMIs in this developing field.
- **Underpinning of metrology** of trace water for reference gases (e.g. N₂, H₂, Ar).
- **Better knowledge** of measurement techniques and of real humid gas mixtures.
- A **CIPM comparison** enabled in the trace water range.



Standards Committee / Technical Committee / Working Group	Partners involved	Likely area of impact / activities undertaken by partners related to standard / committee
ISO/TC 158 Analysis of gases WG3 Gravimetric methods	VSL, CEM	VSL and CEM will disseminate to ISO/TC 158/WG3 the outputs of the project in order to update ISO 19229: 2019 'Gas analysis - Purity analysis and the treatment of purity data' with the project results that are metrological traceable.
SEMI, Gases Global Technical Committee.	CETIAT	CETIAT will liaise with SEMI Gases Global Technical Committee to disseminate the outputs of the project from WP2 and contribute to a future update of SEMI F112-0613 - Test Method for Determination of Moisture Dry-Down Characteristics of Surface-Mounted and Conventional Gas Delivery Systems by Cavity Ring Down Spectroscopy (CRDS).
DIN NA 062-05-73 AA, Standards Committee Materials Testing on "Gas analysis and gas quality"	PTB	PTB will disseminate to the DIN NA 062-05-73 AA committee the outputs of the project from WP2 to contribute to the discussion on gas supplier industry.
CIPM CCT WG-Hu CCT Working Group for Humidity	INRIM, CETIAT, INTA, PTB, VTT	INRIM, CETIAT, INTA, PTB, and VTT will disseminate to CIPM CCT WG-Hu the outputs of the project from WP1 to contribute on the consultations for the protocol for CIPM inter-comparison.
CIPM CCQM GAWG CCQM Working Group on Gas Analysis	PTB	PTB will disseminate to CIPM CCQM GAWG the outputs of the project from WP1 and WP2 to contribute on the consultations for the protocol for CIPM CCT inter-comparison and liaise with such committee.
IAPWS WG TPWS Working Group Thermophysical Properties of Water and Steam	INRIM, PTB, VTT	INRIM, PTB, and VTT will disseminate to IAPWS WG TPWS the outputs of the project from WP2 to contribute on the consultation on non-ideal humid gas mixtures and water vapour enhancement data and correlation.
JCS	INRIM, PTB, VTT	INRIM, PTB, and VTT will disseminate to JCS the outputs of the project from WP2 to contribute on the consultation on non-ideal humid gas mixtures and water vapour enhancement data and correlation equations.
EURAMET TC-T	INRIM, CETIAT, INTA, PTB, VTT	INRIM, CETIAT, INTA, PTB, and VTT will disseminate to EURAMET TC-T the outputs of the project from WP1 and WP2 to inform the metrology community..
EURAMET TC-MC SCGA	PTB	PTB will disseminate WP1 and WP2 output to EURAMET SCGA and will liaise with this gas metrology committee.

A **Steering Board** made of, at least, 6 key stakeholders (i.e. gas and equipment manufacturers, industry, standards developing organisations, international scientific associations) will be established.



21 organisations have joined the SB so far!

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International Organisations	
CIPM CCT WG-Hu	Stephanie Bell *
IAPWS	Karsten Meier
JCS	Olaf Hellmuth
KRISS	Byung Il Choi
NMIJ	Hisashi Abe
ISO/TC 158 WG3	Adriaan van der Veen
CIPM CCQM GAWG	Paul Brewer
UNI CIG	Paola Comotti
ACCREDIA	Rosalba Mugno

Instrument Manufacturers	
Ball Wave	Yusuke Tsukahara
Meeco	Rutger Oudwater
Li-Cor	Graham Leggett
Baker Hughes	Gerard McKeogh
PST/Rotronic	Richard Gee
EffecTech Ltd	Paul Holland

Gas Producers	
Air Liquide	Jean-Luc Blanc
Air Liquide	Antonio Carreira
BOC	Kevin D. Cleaver
SOL	Riccardo Nava
SIAD	Pierluigi Bissolotti
SAPIO	Pierluigi Radaelli
FHa	Laura Abadía Albás

*** The SB is chaired by Stephanie Bell**