



# FLOMEKO2019

18<sup>th</sup> International Flow Measurement Conference

Portugal | Lisbon | LNEC | 26-28 june 2019

## PROGRAMME



Instituto Português da  Qualidade



LABORATÓRIO NACIONAL  
DE ENGENHARIA CIVIL







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## Michael Reader-Harris – IMEKO TC9



Dear all,

Welcome to FLOMEKO. The first IMEKO Conference on Flow Measurement - FLOMEKO - took place in 1978 in the Netherlands. The 11th, from 12 to 14 May 2003 returned to the same place, Groningen, 25 years later. But FLOMEKO is very international, conferences have also taken place in Africa (South Africa), America (Brazil), Asia (China, Japan, Korea, Taiwan), Australia, and Europe (France, Germany, Hungary, Sweden, UK). This is the 18th FLOMEKO.

FLOMEKO covers not only the measurement of the quantity of flowing fluids, but also calibrations and calibration facilities, traceability and quality control, uncertainty, instrumentation, numerical simulation, flow visualisation, flow conditioning, practical experience with existing measuring methods, specific metering principles, wet-gas and multiphase flow measurement and other topics.

FLOMEKO provides a wonderful opportunity to meet fellow flow metrologists.

It is particularly delightful to come to Portugal, to enjoy its history, warmth and welcome. I hope that many of you will take the opportunity to explore Lisbon, to go a little further afield, to Sintra, for example, and maybe to travel to the Algarve or to the Douro Valley.

Best wishes,

Michael

Dr Michael Reader-Harris,

Chairman IMEKO TC9



## Álvaro Ribeiro – FLOMEKO2019



Dear Colleagues,

FLOMEKO is an event of IMEKO TC9 very special for many people around the world who, since 1978, have found in this community a space for sharing, dialogue and development of applied knowledge in industry, research, teaching and resource management.

For the entities that organize this event for the first time in Portugal, it is an honor but also a challenge, to try to establish bridges between stakeholders, to involve different areas of interest, to join partners and to promote synergies for the future. A grateful message should be addressed to the sponsors and entities that have supported this initiative, to the committees, speakers and participants who make it a success and the team that make it happen.

We hope that, as in previous events, FLOMEKO 2019 will be a major contribution to the innovation and creativity that promote scientific and technological development in this context of flow, helping to consolidate key foundations for the organizations and companies that apply this knowledge in the day-to-day activities impacting on technological, political, social, economic and environmental domains.

In the social context Lisbon is a welcoming city, with immense light, friendliness and diversified cultural and social opportunities, so we hope that you can enjoy what Portugal has to offer you and that you have lasting memories and a desire to return.

Welcome to the FLOMEKO2019 experience and Welcome to Lisboa!

Álvaro Ribeiro

Chairperson of FLOMEKO2019



## Erik Smits



For over 26 years Erik Smits has travelled around the world to work on metering systems and flow meter calibration facilities of customers of VSL. Erik started his career at NMI-VSL in the hydrocarbon and water flow meter calibration facilities next to the liquid volume laboratory as a calibration and verification engineer. Many of the flow meters he calibrated needed a second stage verification in their metering system on location of operation. Through the years Erik developed his skills as a metrologist being responsible for the Dutch National Reference Standards for liquid flow and volume.

Erik was the project manager for modernizing the hydrocarbon facilities and the construction of the water flow calibration facility of VSL. VSL's water flow calibration facility has one of the lowest measurement uncertainties in the world. His experience in this type of work gives him the basis to take up new challenges around the world and to advise operators and manufacturers of flow meters and calibration facilities. Traceability to the SI through VSL has been provided around the world for all kinds of instruments including pipe provers. Erik started the program "VSL CMC Certified" to review calibration facilities for measurement uncertainties.

After 24 years Erik was asked to step up and be one of the managers for the Calibration and Reference Materials department at VSL. From June 1st, 2019 he has been the Manager of Flow Metrology leading a team of about 15 flow scientists and metrologists. Erik is a member of Euramet TC-Flow, Working Group for Fluid Flow of BIPM, EuReGa and Convenor for ISO/TC 28/WG 20 working on a standard for LNG flow measurement. Erik also provides technical expertise to several accrediting bodies during audits of companies that are accredited, or are seeking accreditation, according to ISO/IEC17025.

Keynote:

How do we provide and maintain flow measurement traceability for the fluids of the future?



## José Pedro Salema



José Pedro Salema is the Chief Executive Officer of EDIA – the public company that manages the Alqueva project – since 2013. Before this he was the co-founder and managing partner of AGROGESTÃO - a consultancy firm focused on farm management software tools and training services.

He is a certified trainer with extensive experience in lecturing at college level. He has an Agronomic Engineering degree from Lisbon's University, a Master's degree in Management and a MBA in E-Business from the Portuguese Catholic University.

Keynote:

Water flow measurement in the Alqueva multipurpose project



## Vania Silverio



Vania Silverio is currently involved in scientifically innovative and challenging R&D projects combining nanotechnology with simulation tools for the design, fabrication, integration and test of microfluidic devices and sensors (INESC-MN, [www.inesc-mn.pt](http://www.inesc-mn.pt)). Additionally, she is engaged on the definition of ISO Standards and Processes for Microfluidics [CEN/TC-332/WG7; ISO/TC48/WG3].

She is author of more than 35 research publications in the areas of fluid dynamics at the microscale and microfluidics device fabrication. She combines her research with advanced training, teaching and theses supervision at the Master and PhD level at Instituto Superior Técnico, ULisboa (<http://tecnico.ulisboa.pt>), where she is an Invited Assistant Professor (Microfluidics course; Micro and Nanofabrication Techniques course).

Silverio is regular Peer Reviewer of several Scientific Journals and is currently involved in the organization of 3 International Meetings on Micro and Nanotechnology. She is member of the International Microfluidics Association, of the IEEE Society USA, of the Portuguese Physical Society and of the European Physical Society. She holds a PhD degree in Mechanical Engineering (Technico, ULisboa) and a Licenciatura degree in Technological Chemistry (5 years, FCUL, ULisboa).

Keynote:

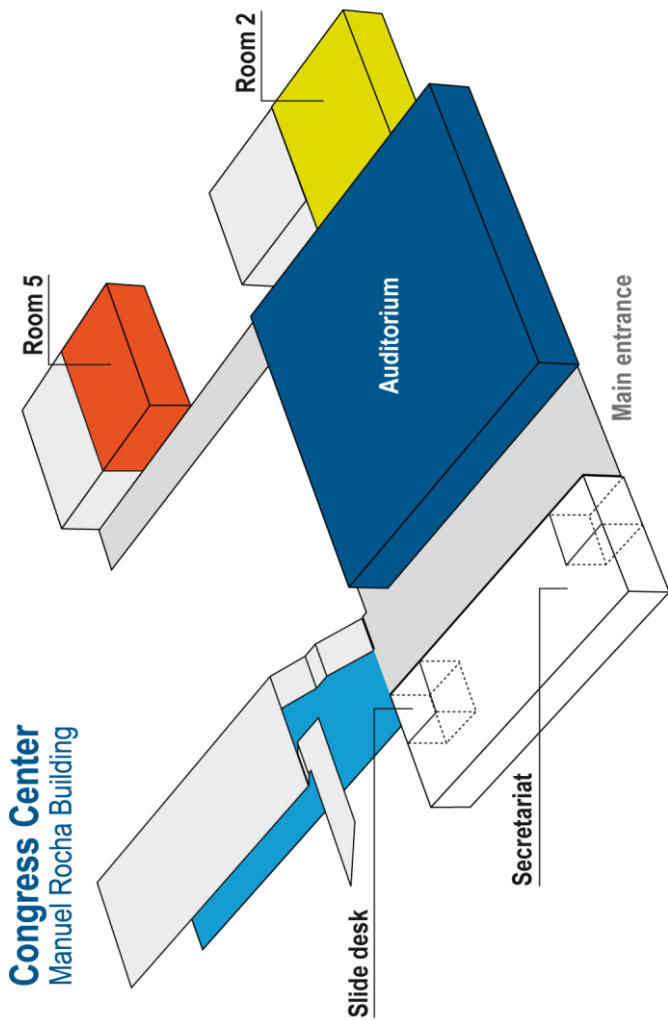
Microfluidics: the science and technology for miniaturized laboratories on-chip





# OVERALL SCHEDULE

Date & Time/Planned Activity	Location	
<b>Monday – 24 June 2019</b>		
9:00 – 16:00	WGFF meeting	IPQ
17:00 – 18:00	Welcome Reception at the City Hall	CML
<b>Tuesday – 25 June 2019</b>		
9:00 – 16:00	WGFF meeting	IPQ
18:00 – 19:00	Get Together	LNEC
19:00 – 20:00	Registration	
<b>Wednesday – 26 June 2019</b>		
8:00 – 9:00	Registration	
9:00 – 11:00	Opening Ceremony+Keynote speaker – Erik Smits	
11:00 – 11:30	networking@coffee	
11:30 – 13:00	Conference Sessions & Presentations	LNEC
13:00 – 14:00	networking@lunch	
14:00 – 15:30	Conference Sessions & Presentations	
15:30 – 16:00	networking@coffee	
16:00 – 17:30	Conference Sessions & Presentations	
<b>Thursday – 27 June 2019</b>		
9:00 – 10:00	Keynote speaker – José Pedro Salema Group photo (Main Entrance)	
10:00 – 11:00	Poster Session	
11:00 – 11:30	networking@coffee	LNEC
11:30 – 13:00	Conference Sessions & Presentations	
13:15 – 13:45	IMEKO TC9 members meeting	
13:00 – 14:00	networking@lunch	
14:00 – 15:30	Conference Sessions & Presentations	
16:00 – 19:00	<i>"Discover Lisboa with us"</i>	
19:30 – 23:00	Conference Gala Dinner	
<b>Friday – 28 June 2019</b>		
9:00 – 10:00	Keynote speaker – Vania Silverio	
10:00 – 11:00	Conference Sessions & Presentations	
11:00 – 11:30	networking@coffee	
11:30 – 13:00	Conference Sessions & Presentations	LNEC
13:00 – 14:00	networking@lunch	
14:00 – 15:30	Poster Session	
15:00 – 15:30	networking@coffee	
15:30 – 17:00	Conference Sessions & Presentations	
17:00 – 17:30	Closing ceremony	





Time	Tuesday 25 June		
18:00 – 20:00	Get-Together Party		
19:00 – 20:00	REGISTRATION		
Time	Wednesday 26 June		
08:00 – 09:30	REGISTRATION		
09:30 – 10:00	OPENING CEREMONY		
10:00 – 11:00	PLENARY SESSION KEYNOTE SPEAKER – ERIK SMITS		
11:00 – 11:30	networking@coffee		
11:30 – 13:00	AUDITORIUM S1.1 Liquid Flow Standards	ROOM 5 S2.9 Coriolis Meter Technology	ROOM 2 S3.12 CFD and Simulation
13:00 – 14:00	networking@lunch		
14:00 – 15:30	AUDITORIUM S4.1 Gas Flow	ROOM 5 S5.5 Flow Standards	ROOM 2 S6.8 Uncertainty Determination
15:30 – 16:00	networking@coffee		
16:00 – 17:30	AUDITORIUM S7.10 Microflow	ROOM 5 S8.9 Flow Metering Technology	ROOM 2 S9.6 Critical Flow Venturi Nozzels



Time	Thursday 27 June		
9:00 – 10:00	PLENARY SESSION KEYNOTE SPEAKER – JOSÉ PEDRO SALEMA		
10:00 – 11:00	POSTER SESSION 1		
11:00 – 11:30	networking@coffee		
11:30 – 13:00	AUDITORIUM S10.5 Flow Standards	ROOM 5 S11.1 Wet Gas	ROOM 2 S12.2 Air Speed
13:00 – 14:00	networking@lunch		
14:00 - 15:30	AUDITORIUM S13.5 Flow Standards	ROOM 5 S14.1 Multiphase Flow	ROOM 2 S15.9 Flow Metering Technology
16:00 – 19:00	"DISCOVER LISBOA WITH US"		
19:30 – 23:00	CONFERENCE GALA DINNER		



Time	Friday 28 June		
9:00 – 10:00	PLENARY SESSION KEYNOTE SPEAKER – VANIA SILVERIO		
10:00 – 11:00	AUDITORIUM S16.1 Uncertainty and Traceability	ROOM 5 S17.5 Flow Performance Studies	ROOM 2 S18.7/8 Legal Metrology
11:00 – 11:30	networking@coffee		
11:30 – 13:10	AUDITORIUM S19.9 Flow Metering Technology	ROOM 5 S20.8 Intercomparisons	ROOM 2 S21.10/11 Microflow
13:10 – 14:00	networking@lunch		
14:00 – 15:00	POSTER SESSION 2		
15:00 – 15:30	networking@coffee		
15:30 – 17:10	AUDITORIUM S22.1/12 Liquid Flow	ROOM 5 S23.5 Gas Standards	ROOM 2 S24.2 Natural Gas
17:10 – 17:30	CLOSING CEREMONY		



## THEMES

- 1 - Liquid, gas & multi-phase flows
- 2 - Air speed, volume
- 3 - Fluid properties
- 4 - Hydrocarbon flows, e.g.: LNG, CNG and so forth
- 5 - Primary standards, new calibration and inter-comparison facilities
- 6 - Critical Flow Venturi Nozzles
- 7 - Legal Metrology in Flow Measurement
- 8 - Analysis and assessment of uncertainties
- 9 - Development and performance of flow metering technology
- 10 - Micro-flow technology
- 11 - New applications in healthcare, saving energy and protecting the environment
- 12 - Computer-modelling applications



# SESSIONS

**Wednesday, 11:30 to 13:00 – Auditorium**

## Oral session S1.1

## Liquid Flow Standards

Chairperson: Miroslava Benkova

- 11:30 1002 SWITZERLAND  
**LIQUID PROPERTIES EFFECTS ON CORIOLIS AND THERMAL MASS FLOW METERS AT VERY LOW FLOW RATES**  
*Hugo Bissig, Martin Tschannen, Marc de Huu*
- 11:50 1060 CHINA  
**EXPERIMENTAL ANALYSIS OF INFLUENCING FACTORS ON FLOW STABILITY OF WATER FLOW FACILITIES**  
*Tao Meng, Chao Xing, Bo Wu, Chi Wang, Huichao Shi, Xiao Peng Li*
- 12:10 1043 BRAZIL  
**PITOMETRY AS A VALIDATION TOOL FOR WATER FLOW MEASUREMENT IN LARGE DIAMETER PIPELINES**  
*Kazuto Kawakita, Nilson Taira, Valmir Ruiz*
- 12:30 1063 DENMARK  
**NOVEL CALIBRATION FACILITY FOR WATER FLOW WITH LARGE TEMPERATURE SPAN**  
*Anders Niemann*



**Wednesday, 11:30 to 13:00 – Room 5**

**Oral session S2.9**

**Coriolis Meter Technology**

Chairperson: Oliver Büker

- 11:30 1003 GERMANY**  
**FROM DISTURBANCE TO MEASUREMENT: APPLICATION OF CORIOLIS METER FOR PATTERN IDENTIFICATION OF GAS BUBBLES**  
*Hao Zhu, Alfred Rieder, Wolfgang Drahm, Yaoying Lin, Andreas Guettler, Michael Wiesmann, Josef Hubensteiner*
- 11:50 1053 UNITED STATES**  
**BEST PRACTICES FOR PROVING CORIOLIS METERS**  
*Marc Buttler*
- 12:10 1100 UNITED KINGDOM**  
**STRUCTURAL CONDITION MONITORING OF CORIOLIS FLOWMETERS THROUGH STIFFNESS MEASUREMENT**  
*Jingqiong Zhang, Tao Wang, Yong Yan*
- 12:30 1046 SWEDEN**  
**INVESTIGATIONS ON PRESSURE DEPENDENCE OF CORIOLIS MASS FLOW METERS USED AT HYDROGEN REFUELLING STATIONS**  
*Oliver Büker, Krister Stolt*





**Wednesday, 11:30 to 13:00 – Room 2**

**Oral session S3.12**

**CFD and Simulation**

Chairperson: Jan Gersl

- 11:30 1065 FRANCE**  
**NUMERICAL AND EXPERIMENTAL INVESTIGATIONS ON CYLINDRICAL CRITICAL FLOW VENTURI NOZZLE (CFVN)**  
*Marc Antoine Lambert, Rémy Maury, Jean Christophe Valiere, Eric Foucault, Guillaume Lehnasch, Bodo Mickan, Ernst Von Lavante*
- 11:50 1045 GERMANY**  
**MODELING OF THE FLOW COMPARATOR AS CALIBRATION DEVICE FOR HIGH PRESSURE NATURAL GAS FLOW METERING IN MODELICA**  
*Sukhwinder Singh, Gerhard Schmitz, Bodo Mickan*
- 12:10 1036 CHINA**  
**NUMERICAL STUDY ON TOP-HAT FLOW FIELD FOR GAS FLOW MEASUREMENT UNDER LOWER PRESSURE**  
*Han Zhang*
- 12:30 1052 UNITED STATES**  
**AUGMENTED INTELLIGENCE APPLIED TO NATURAL GAS ULTRASONIC MEASUREMENT**  
*James Ed Hanks*



**Wednesday, 14:00 to 15:30 – Auditorium**

**Oral session S4.1**

**Gas Flow**

Chairperson: Michael Reader-Harris

**14:00 1025 UNITED STATES**  
**TEST GAS PERFORMANCE OF CORIOLIS METERS: LABORATORY AND THE**  
**FIELD EVALUATION OF A NEW METHOD**

*Justin Hollingsworth, David Morett*

**14:20 1024 UNITED KINGDOM**  
**ORIFICE PLATE PRESSURE LOSS RATIO: THEORETICAL WORK IN**  
**COMPRESSIBLE FLOW AND EXPERIMENTAL WORK IN CO<sub>2</sub>**

*Michael Reader-Harris, David Addison, Ketan Mistry, Julian Barnett*

**14:40 1054 JAPAN**  
**REDEFINITION OF STANDARD EQUATION FOR DISCHARGE COEFFICIENT**  
**OF THROAT-TAPPED FLOW NOZZLE**

*Noriyuki Furuichi*

**15:00 1038 UKRAINE**  
**A METHOD FOR MAINTAINING ACCURACY OF ULTRASONIC GAS FLOW**  
**METERS CALIBRATED ON AIR AT ATMOSPHERIC PRESSURE WHEN**  
**MEASURING NATURAL GAS AT HIGH PRESSURE**

*Volodymyr Naumenko, Andrii Stetsenko*



**Wednesday, 14:00 to 15:30 – Room 5**

## Oral session S5.5

## Flow Standards

Chairperson: Marc de Huu

- 14:00 1015 SWITZERLAND  
**DESIGN OF GRAVIMETRIC PRIMARY STANDARDS FOR FIELD TESTING OF HYDROGEN REFUELLING STATIONS**  
*Marc De Huu, Hugo Bissig, Martin Tschannen*
- 14:20 1079 SLOVENIA  
**EFFECTS OF INCLINATION OF A CLEARANCE-SEALED PISTON PROVER ON THE LEAKAGE FLOW RATE**  
*Gregor Bobovnik, Joze Kutin*
- 14:40 1090 CHINA  
**SIMULATION STUDY ON MEASUREMENT METHOD OF FLOW LUCTUATION SIGNAL BASED ON CHAOTIC OSCILLATOR**  
*Huichao Shi, Tao Meng*
- 15:00 1149 TAIWAN  
**ESTABLISHMENT AND VERIFICATION OF MERCURY-SEALED PISTON PROVER FOR PRIMARY STANDARD**  
*Ying-Chun Lin, Win-Tin Lin, Chun-Lin Chiang*



**Wednesday, 14:00 to 15:30 – Room 2**

**Oral session S6.8**

**Uncertainty Determination**

Chairperson: Álvaro Ribeiro

- 14:00 1058 SOUTH KOREA  
**UNCERTAINTY EVALUATION OF STACK FLOWRATE MEASUREMENT WITH S-TYPE PITOT TUBE BY USING MONTE CARLO METHOD**  
*Doan Trang Nguyen, Woong Kang, Yong-Moon Choi*
- 14:20 1094 CZECH REPUBLIC  
**UNCERTAINTY OF SO<sub>2</sub> MEASUREMENTS IN DRYERS DUE TO WATER DROPLET AND WATER FILM CONDENSATION**  
*Stanislav Knotek*
- 14:40 1128 PORTUGAL  
**UNCERTAINTY EVALUATION OF TOTALIZATION OF FLOW AND VOLUME MEASUREMENTS IN WATER SUPPLY NETWORKS**  
*Álvaro Ribeiro, Dália Loureiro, Maria do Céu Almeida, Maurice Cox, João Alves e Sousa, Maria Silva, Luís Martins, Rita Brito, Ana Catarina Soares*
- 15:00 1107 PORTUGAL  
**DEFORMATIONS AND VOLUME CHANGES DUE TO MOISTURE VARIATIONS IN HERITAGE BUILDINGS - USE OF NDT TECHNIQUES**  
*José Dias, Luís Matias, Maria Henriques*



## Wednesday, 16:00 to 17:30 – Auditorium

### Oral session S7.10

Microflow

Chairperson: Elsa Batista

- 16:00 1147 PORTUGAL  
**NEW EMPIR PROJECT - METROLOGY FOR DRUG DELIVERY**  
*Elsa Batista*
- 16:20 1144 NETHERLANDS  
**A CALIBRATED PHYSICAL FLOW STANDARD FOR MEDICAL PERFUSION IMAGING**  
*Gertjan Kok, Nikola Pelevic, Xenios Milidonis, Muhammad Sohaid Nazir, Myles Capstick, Sita Drost, Christian Poelma, Tobias Schaeffter, Amedeo Chiribiri*
- 16:40 1040 FRANCE  
**DEVELOPMENT OF AN OPTICAL MEASUREMENT METHOD FOR “SAMPLED” MICRO-VOLUMES AND NANO-FLOW RATES**  
*Florestan Ogheard, Philippe Cassette*
- 17:00 1132 UNITED STATES  
**REPRODUCIBILITY OF LIQUID MICRO-FLOW MEASUREMENTS**  
*John Wright*



**Wednesday, 16:00 to 17:30 – Room 5**

**Oral session S8.9**

**Flow Metering Technology**

Chairperson: Woong Kang

- 16:00 1152 UNITED KINGDOM  
**MEASUREMENT OF WATER VOLUME FRACTION IN OIL-WATER UPWARD FLOW BY USING MICROWAVE CYLINDRICAL RESONANT CAVITY**  
*Chao Yuan, Georgios Dimitrakis, Buddhika Hewakandamby*
- 16:20 1007 JAPAN  
**FLOW MEASUREMENT TURN DOWN ANALYSIS FOR DP FLOW METER USING MULTIPLE MULTIVARIABLE TRANSMITTERS**  
*Akio Ito, Hiromasa Takiguchi, Aya Morokata, Vince Cisar*
- 16:40 1156 PORTUGAL  
**FLOW4LINK - THE FLOW IN THE HAND**  
*Duarte Silva, Maurício Sampaio, Carlos Milagres, Vítor Ferreira Alves*
- 17:00 1116 PORTUGAL  
**AN UNCERTAINTIES SIMULATION MODEL APPLIED TO AN AUTOMATED LAMINAR FLOWMETER**  
*A. Pedro, Teresa Morgado, H. Navas*



Welcome at inotech – Perfection in precision ...

26 years of inotech – 26 years of continuous development in innovative energy supply products

In the last, now almost 27 years the inotech Meter Calibration Systems GmbH has evolved into a leading manufacturer of test equipment for gas meters, testing facilities and calibration facilities and has a reputation as an expert and reliable partner for meter manufacturers and independent test centers throughout the entire world. In the last few years we have also established ourselves in the field of water meter and heat meter test equipment and this has also effectively extended our product portfolio. Millions of different types of meters are calibrated with our test equipment every year.

Test equipment is our core business. Every day we combine our know-how with our customers demands to improve our products constantly. Our customer requirements in the focus of all our product developments and production and are always state of the art development.

The current inotech developments are focused on the new PS 8 software generation that transfers the test equipment of single systems into a network of testing systems. Consequently, the PS 8 version is particularly interesting for all test centers with multiple testing units. Of course, considerable attention is paid to the world of smart meters and the testability of these new meters is given priority.

Come and talk to us and we will be happy to introduce you to the new generation of developments.

As our company is owner-led, we have flat hierarchies and rapid decision-making processes and we can respond flexibly to the demands of the market. This flexibility is our strength and makes us a reliable partner for our customers. Due to the changing meter market towards the Smart Meter, the continuous further development and adaptation in close coordination with our customers is a basic precondition for successful products. These are the challenges we set ourselves and we constantly work towards being even better.



Energoflow AG operates to meet the requirements of a constantly evolving industry and always seeks the best ways to incorporate its state-of-the art, competitive products and services on-line as well as implements advanced innovative solutions to accomplish the goals and provide excellent performance on a global basis.

We strive to provide state-of-the-art, cost effective turnkey technical solutions to our valued clients throughout the globe for gas and liquid measurement and monitoring and in related fields across a wide range of industries and applications. Our gas meters and flow meters are reliable, accurate and capable of functioning as satisfactorily in the harshest process and ambient conditions.

And we use the principle of the 3 E's for achieving this: Experience, Expertise & Efficiency !





# UBERTONE

UBERTONE is specialized in the design and manufacturing of high resolution velocity and acoustic turbidity profilers for scientific applications and OEM acoustic based instruments for industries. Ubertone's devices allow to measure instantaneous velocity profiles, as well as echo amplitude and acoustic turbidity profiles. The company provides two families of products: one component velocity profilers (known as UVP) and two components velocity profilers (known as ADVP). Ubertone offers solutions for various applications such as detailed flow visualization, turbulence and sediment transport studies, opaque liquids characterization, with instruments that can be used in open channel flows (sewage networks, wastewater treatment plants, physical models, small rivers...) as well as in closed-conduit flows (pipes, experimental setups...).

Read more: <http://ubertone.com/>

Come visit our stand!



The Laboratory of Metrology of REN Gasodutos, is composed of a Fixed Laboratory (located in Pombal) and a Mobile Unit. Since 2015, its activity has been accredited in accordance with NP EN ISO / IEC 17025, and is mainly focused on the calibration of the gas metering and instrumentation systems that make up the National Natural Gas System (SNGN)

The services provided by the Metrology Laboratory and its capabilities are:

- Calibration of Gas Volumetric Counters (Turbines, Rotary Pistons) with air at atmospheric pressure, for flows between 10 - 2500 m<sup>3</sup>/h;
- Calibration of Gas Volume Conversion Electronic Devices;
- Calibration of pressure measuring elements for pressures between 0 and 200 bar;
- Calibration of temperature measuring elements between -20 °C and 100 °C;

The Metrology Laboratory of REN Gasodutos has the most advanced technical means and a highly specialized and experienced team, thus enabling us to present ourselves as a national reference in the natural gas sector.

EPAL is a reference company in the water sector, nationally and internationally, that for more than 150 years produces, transports and distributes water for consumption.

The supply system of EPAL serves more than 2.9 million inhabitants, is developed between the bay of Castelo do Bode and the city of Lisbon, along more than 2000 km. It replenishes a set of management entities on the north bank of the river Tagus and in Lisbon is responsible for the home supply to more than 350 thousand direct customers.

To guarantee the production and distribution of water with quality and in quantity, it has Water Treatment Stations and accredited Laboratories equipped with the highest technology.

Because innovation is a company's goal, over time there are several services and products related to the water cycle and the efficiency of the systems that the company has been developing and marketing.

Since 2015, within the scope of the restructuring of the water sector, EPAL has been delegated management of the multi-municipal system Águas do Vale do Tejo, whose activity includes water supply and wastewater sanitation services to the municipalities of Beiras and Alentejo.

EPAL and Águas do Vale do Tejo cover 33% of the national territory, serve 87 municipalities and 3.5 million inhabitants.



In business for more than 100 years, our company is recognized by a profound knowledge in mechanical water meters production.

Janz has a leading role in the water measurement sector worldwide being state-of-the-art in industry developments and meeting demanding production standard.

We offer all the necessary certifications that enable us to offer a wide range of solutions and, above all, to satisfy and exceed our customers expectations.

For more information, please visit our website: [www.janz.pt](http://www.janz.pt)



**Wednesday, 16:00 to 17:30 – Room 2**

**Oral session S9.6**

**Critical Flow Venturi Nozzles**

Chairperson: Bodo Mickan

15:30 1047 GERMANY  
**DISCHARGE COEFFICIENTS OF CFVN PREDICTED FOR HIGH REYNOLDS  
NUMBERS BASED ON CALIBRATION WITH ATMOSPHERIC AIR**  
*Bodo Mickan*

15:50 1087 UNITED STATES  
**THE EFFECTS OF INLET CURVATURE ON DISCHARGE COEFFICIENT FOR  
CRITICAL FLOW VENTURIS AT LOW REYNOLDS NUMBERS**  
*Bradford Sims, Robert Mckee, Jesse Brandt*



Thursday, 10:00 to 11:00 – Congress Center hall

## Poster session

1049 CHINA  
**STUDY ON HUMIDITY QUANTITY TRACEABILITY METHOD AND ITS EFFECT ON SONIC NOZZLE GAS FLOW**

*Shun-li Wang, Xiao-Yu Li, Hao Li*

1121 CHINA  
**CAPACITY ANALYSIS OF ULTRASONIC TRANSIT TIME FOR SOUND SPEED CALIBRATED WATER LEVEL**

*Yuan Liu, Heming Hu, Chi Wang*

1123 RUSSIAN FEDERATION  
**MEASUREMENT UNCERTAINTIES ESTIMATION INTRODUCED BY THE DIVERTER INTO THE BUDGET OF STANDARD UNCERTAINTIES**

*Alexey Shchelchkov*

1131 CHINA  
**STUDY ON DATA COLLECTION METHODS OF NATURAL GAS FLOW VERIFICATION**

*Zheng Bo*

1019 CHINA  
**DIAGNOSIS METHOD OF VORTEX FLOWMETER BASED ON IOT**

*Yu Gu, Chao Feng, HanSheng Ye*

1133 UNITED STATES  
**AUTOMATED SUBSTITUTION WEIGHING APPARATUS FOR LIQUID VOLUME MEASUREMENT**

*John Wright*

1026 CHINA  
**THE BILATERAL COMPARISON BETWEEN NIM AND PTB FOR SMALL GAS FLOW**

*Chunhui Li, Bodo Mickan, Shan Gao*

1027 CHINA  
**THE HIGH PRESSURE SONIC NOZZLE GAS FLOW STANDARD FACILITY IN NIM**

*Chunhui Li, Bodo Mickan, Lishui Cui*



1032 CHINA  
**NUMERICAL SIMULATION AND EXPERIMENT OF BUTTERFLY VALVE FLOW  
FIELD IN VARIABLE HEAD FLOW STANDARD FACILITY**

*Yuming Shen, Feng Lu, Jin Ming Zhang*

1041 CHINA  
**DEVELOPMENT AND UNCERTAINTY EVALUATION OF GAS FLOW  
STANDARD DEVICE WITH ADJUSTABLE WORKING TEMPERATURE**

*Chaojian Tao, Youyi Pan, Yong Wang*

1069 SOUTH KOREA  
**THE INTER-COMPARISON OF AIR SPEED FROM 2 M/S TO 40 M/S BY AMCA  
PITOT STATIC TUBES**

*Yong-Moon Choi, Yoshiya Terao*

1081 SLOVENIA  
**PVTT PRIMARY FLOW STANDARD FOR SMALL GAS FLOW RATES**

*Gregor Bobovnik, Joze Kutin, Urban Primožic*

1088 CHINA  
**ANALYSIS OF THE EFFECT OF PRESSURE AND TEMPERATURE ON THE  
MEASUREMENT ERROR OF GAS TURBINE FLOWMETER AND RESEARCH  
ON THE TESTING METHOD**

*Jun Mu*

1136 LITHUANIA  
**REPRODUCTION OF AIR VELOCITY IN THE ENTRANCE REGION OF THE  
PIPE**

*Agne Bertasiene, Nerijus Pedisius*



**Thursday, 11:30 to 13:00 – Auditorium**

**Oral session S10.5**

**Flow Standards**

Chairperson: Seok Hwan Lee

**11:30 1029 FRANCE**  
**EDF R&D NEW TEST BENCH FOR LIQUID INDUSTRIAL FLOW METERS CALIBRATION**

*Emmanuel Thibert, José Veau, Sylvain Blairon, Eric Nanteau, Didier Boldo*

**11:50 1004 CHINA**  
**MOLTEN SALT FLOW CALIBRATION FACILITY BY DYNAMIC WEIGHING METHOD BASE ON ARGON PRESSURE BALANCE PRINCIPLE**

*Chao Chen*

**12:10 1064 FRANCE**  
**HYDROGEN REFUELLING STATION CALIBRATION WITH A TRACEABLE GRAVIMETRIC STANDARD**

*Rémy Maury, Christophe Auclercq, Matthias Schrade, Harm Tido*

**12:30 1057 SOUTH KOREA**  
**MEASUREMENT OF HYDROCARBON LIQUID FLOW RATE USING A VOLUMETRIC AND GRAVIMETRIC METHOD: COMPARISON BETWEEN KRISS AND PTB HYDROCARBON STANDARD SYSTEMS**

*Seok Hwan Lee, Marcus Link, Byung Ro Yoon, Enrico Frahm*





Thursday, 11:30 to 13:00 – Room 5

Oral session S11.1

Wet Gas

Chairperson: Anders Niemann

- 11:30 1084 UNITED KINGDOM  
**VERTICALLY INSTALLED VENTURI TUBES FOR WET-GAS FLOW MEASUREMENT: POSSIBLE IMPROVEMENTS TO ISO/TR 11583 TO EXTEND ITS RANGE OF APPLICABILITY**  
*Emmelyn Graham, Michael Reader-Harris*
- 11:50 1044 CHINA  
**STUDY ON APPLICATION OF WET GAS METERING TECHNOLOGY IN SHALE GAS MEASUREMENT**  
*Qiang Zhang, Dingfa Liu*
- 12:10 1114 UNITED STATES  
**A HYBRID WET GAS METER DESIGN FOR MARGINAL FIELDS**  
*Richard Steven, Eric Sanford, Kim Lewis, Koichi Igarashi*
- 12:30 1129 UNITED KINGDOM  
**PREDICTING THE OUTPUT ERROR OF A CORIOLIS FLOWMETER UNDER GAS-LIQUID TWO-PHASE CONDITIONS THROUGH ANALYTICAL MODELLING**  
*Yong Yan, Jinyu Liu, Tao Wang, Yong Yan, Xue Wang*



Thursday, 11:30 to 13:00 – Room 2

Oral session S12.2

Air Speed

Chairperson: Isabelle Care

- 11:30 1030 FRANCE  
**INVESTIGATION OF IN-LINE PRESSURE EFFECT ON PITOT TUBE MEASUREMENTS**  
*Isabelle Care*
- 11:50 1042 SOUTH KOREA  
**THE IMPACT OF GEOMETRIC PARAMETERS OF A S-TYPE PITOT TUBE ON THE FLOW VELOCITY MEASUREMENT AT SMOKE-STACKS**  
*Woong Kang, Doan Trang Nguyen, Yong-Moon Choi*
- 12:10 1059 CZECH REPUBLIC  
**COMPARISON OF CALIBRATIONS OF WIND SPEED METERS WITH A LARGE BLOCKAGE EFFECT**  
*Jan Gersl*
- 12:30 1066 GERMANY  
**BISTATIC WIND LIDAR SYSTEM FOR TRACEABLE WIND VECTOR MEASUREMENTS WITH HIGH SPATIAL AND TEMPORAL RESOLUTION**  
*Stefan Oertel, Michael Eggert, Christian Gutsmuths, Paul Wilhelm, Harald Muller, Helmut Tobben*



**Thursday, 14:00 to 15:30 – Auditorium**

**Oral session S13.5**

**Flow Standards**

Chairperson: John Wright

- 14:00 1028 CHINA  
**THE HIGH PRESSURE CLOSE LOOP GAS FLOW STANDARD FACILITY IN NIM**  
*Chunhui Li, Chi Wang, Ming Xu, Wecan Yan*
- 14:20 1157 SOUTH KOREA  
**A NEW GRAVIMETRIC PRIMARY STANDARD FOR NATURAL GAS FLOW MEASUREMENT AT KOGAS**  
*Young-Cheol Ha*
- 14:40 1125 GERMANY  
**PERFORMANCE OF THE LDA VOLUMETRIC FLOW RATE STANDARD UNDER SEVERLY DISTURBED FLOW CONDITIONS**  
*Felix Heitmann, Jonas Steinbock, Markus Juling*
- 15:00 1010 NETHERLANDS  
**IMPROVEMENTS TO THE PRIMARY LNG MASS FLOW STANDARD**  
*Menne Schakel, Mijndert Van Der Beek, Ilko Rahneberg, Jan Schleichert, Thomas Froehlich, Tobias Einkenel, Norbert Rogge*



**Thursday, 14:00 to 15:30 – Room 5**

**Oral session S14.1**

**Multiphase Flow**

Chairperson: Corinna Kroner

- 14:00 1104 **FRANCE**  
**TURBULENCE MEASUREMENTS WITH A NEW TWO COMPONENTS  
ULTRASONIC PROFILER**  
*Marie Burckbuchler, Helder Guta, Guillaume Fromant, Stéphane Fischer,  
Damien Dufour*
- 14:20 1033 **CHINA**  
**ON TWO-PHASE FLOW MODELS FOR CORIOLIS FLOWMETERS**  
*Xiao Zhang*
- 14:40 1017 **IRAN**  
**MASS LOADING MEASUREMENT IN GAS-SOLID TWO-PHASE FLOW BASED  
ON VORTEX SHEDDING PRINCIPLES**  
*S.H. Hashemabadi, Mansoor Shirvani, H. Farahzadi*
- 15:00 1070 **GERMANY**  
**NUMERICAL SIMULATION, VALIDATION, AND ANALYSIS OF TWO-PHASE  
SLUG FLOW IN LARGE HORIZONTAL PIPES**  
*Sonja Schmelter, Marc Olbrich, Ellen Schmeyer, Markus Bar*



Thursday, 14:00 to 15:30 – Room 2

Oral session S15.9

Flow Metering Technology

Chairperson: Noriyuki Furuichi

- 14:00 1118 GERMANY  
**ULTRASONIC FLOWMETER FOR FLOW RATES BELOW 100 L/H**  
*Rainer Kramer; Toralf Dietz*
- 14:20 1113 UNITED STATES  
**A HYBRID WET GAS METER DESIGN FOR MARGINAL FIELDS**  
*Richard Steven*
- 14:40 1142 JAPAN  
**EXPERIMENTAL STUDY ON FLOW RATE MEASUREMENT DOWNSTREAM OF AN ELBOW PIPE USING THE CLAMP-ON ULTRASONIC FLOWMETER**  
*Sanehiro Wada, Noriyuki Furuichi, Hiroyuki Hamada, Tatsuya Akama, Tomoo Yamaguchi, Shinji Suzuki*
- 15:00 1068 ITALY  
**A NOVEL CALIBRATION OF THE LARGE PISTON PROVER AT INRIM**  
*Aline Piccato, Fabio Bertiglia, Marco Bisi, Gaetano La Piana, Pier Giorgio Spazzini*



**Friday, 10:00 to 11:00 – Auditorium**

**Oral session S16.1**

**Uncertainty and Traceability**

Chairperson: Luis Martins

10:00 1071 **BRAZIL**

**UNCERTAINTY ANALYSIS FOR MULTIPHASE FLOW: A CASE STUDY FOR HORIZONTAL AIR-WATER FLOW EXPERIMENTS**

*Felipe Da Silva, Marcelo Souza De Castro*

10:20 1127 **PORTUGAL**

**CALCULATION OF THE FLOW-RATE MEASUREMENT UNCERTAINTY BY MEANS OF PITOT TUBES USING THE MONTE CARLO METHOD**

*Luis Martins, Álvaro Ribeiro, João Alves e Sousa*

10:40 1075 **GERMANY**

**COMBINING THREE INDEPENDENT TRACEABILITY CHAINS FOR HIGH-PRESSURE GAS FLOW IN GERMANY**

*Jos Van Der Grinten, Bodo Mickan*



**Friday, 10:00 to 11:00 – Room 5**

**Oral session S17.5**

**Flow Performance Studies**

Chairperson: Pier Giorgio Spazzini

- 10:00 1016 INDIA  
**EFFECT OF BOUNDARY LAYER THICKNESS ON THE PERFORMANCE OF V-CONE FLOWMETER USING CFD**  
*Sheikh Nasiruddin, Sidhnath Singh, Srinivas Veeravalli, Shriram Hegde*
- 10:20 1140 CHINA  
**RESEARCH ON PERFORMANCE OF STACK ULTRASONIC FLOWMETERS**  
*Liang Zhang, Chi Wang, Jieyun Fang, Yang Yang*
- 10:40 1076 SOUTH AFRICA  
**FLOW INSTABILITY EVALUATION AT THE NMISA GAS FLOW LABORATORY**  
*Deona Jonker, Mpilo Dlamini, Mathapelo Molefe*



**Friday, 10:00 to 11:00 – Room 2**

**Oral session S18.7/8**

**Legal Metrology**

Chairperson: Bulent Unsal

**10:00 1117 TURKEY**

**INITIAL RESULTS ON THE FLOW DYNAMICS OF HOUSEHOLD WATER CONSUMPTION**

*Bulent Unsal*

**10:20 1082 SLOVENIA**

**LIQUID LEVEL DETECTION IN STANDARD CAPACITY MEASURES WITH COMPUTER VISION**

*Gregor Bobovnik, Joze Kutin, Tim Music*

**10:40 1150 UNITED KINGDOM**

**OIL-WATER FLOW MEASUREMENT FOR CUSTODY TRANSFER APPLICATIONS**

*Wes Maru, S. Lakshmanan, N. Singh, A. Thomas*





## Friday, 11:30 to 13:10 – Auditorium

### Oral session S19.9

### Flow Metering Technology

Chairperson: Marc Macdonald

- 11:30 1072 GERMANY  
**IDENTIFICATION OF COHERENT STRUCTURES IN HORIZONTAL SLUG FLOW**  
*Marc Olbrich, Ellen Schmeyer, Markus Bar, Moritz Sieber, Kilian Oberleithner, Sonja Schmelter*
- 11:50 1080 NETHERLANDS  
**BALANCING COSTS AND RISK IN METERING; TECHNOLOGY QUALIFICATION OF FLOW SYSTEMS TO CONTROL FIELD ROBUSTNESS**  
*Henk Riezebos*
- 12:10 1037 CHINA  
**PITOT TUBE BASED ON MEAN SQUARE ERROR ALGORITHM FOR GAS-LIQUID MIXED PHASE FLOW GAS FLOW MEASUREMENT**  
*Zhongjun Han, Yu Gu, Han Sheng Ye*
- 12:30 1050 UNITED KINGDOM  
**AIR AND NITROGEN TESTING OF CORIOLIS FLOW METERS DESIGNED FOR HYDROGEN REFUELLING STATIONS**  
*Marc MacDonald, Marc De Huu, Rémy Maury, Woong Kang*
- 12:50 1077 GERMANY  
**CAVITATING HERSCHEL VENTURI TUBE TEST RIG**  
*Heiko Warnecke, Corinna Kroner, Daniel Schumann, Jens Tranckner*



**Friday, 11:30 to 13:10 – Room 5**

**Oral session S20.8**

**Intercomparisons**

Chairperson: Chunhui Li

- 11:30 1126 **RUSSIAN FEDERATION**  
**LOW-PRESSURE GAS FLOW STANDARD IN RUSSIAN FEDERATION:  
PRINCIPLES, CALIBRATION TECHNIQUES, INTERCOMPARISONS**  
*Ilya Isaev*
- 11:50 1139 **BRAZIL**  
**COMPARISON OF DIFFERENT METHODS FOR CALIBRATION OF COLE  
TYPE PITOT TUBES**  
*Luri Baldaconi da Silva Bispo, Luciana Pacifico, Nilson Taira, Paulo Jabardo,  
Wellington Oliveira*
- 12:10 1145 **NETHERLANDS**  
**RESULTS FROM AN INTERCOMPARISON BETWEEN MULTIPHASE FLOW  
TEST FACILITIES**  
*Gertjan Kok, Dennis Van Putten, Lev Zakharov*
- 12:30 1013 **BRAZIL**  
**BILATERAL COMPARISON IN THE CALIBRATION OF ATMOSPHERIC TANK  
PROVERS BY VOLUMETRIC AND GRAVIMETRIC METHODS**  
*Kazuto Kawakita, Valmir Ruiz, Cezar Augusto Gonçalves, Marcos Teruya,  
William Escaletti Dos Anjos*
- 12:50 1135 **DENMARK**  
**PRIMARY PISTON PROVER INTERCOMPARISON BETWEEN PTB, VSL AND  
FORCE TECHNOLOGY**  
*Arnthor Gunnarsson, Jos Van Der Grinten, Mijndert Van Der Beek, Bodo  
Mickan*



## Friday, 11:30 to 13:10 – Room 2

### Oral session S21.10/11

### Microflow

Chairperson: Hugo Bissig

- 11:30 1099 CZECH REPUBLIC  
**NEW PRIMARY MICROFLOW STANDARD WITH PISTON PROVER**  
*Miroslava Benkova*
- 11:50 1103 JAPAN  
**PRIMARY STANDARD FOR LIQUID HYDROCARBON AT LOW FLOW RATES USING LIGHT OIL, KEROSENE AND INDUSTRIAL GASOLINE**  
*Kar-Hooi Cheong, Ryouji Doihara, Noriyuki Furuichi, Takashi Shimada, Yoshiya Terao*
- 12:10 1001 SWITZERLAND  
**TRACEABILITY OF PULSED FLOW RATES CONSISTING OF CONSTANT DELIVERED VOLUMES AT GIVEN TIME INTERVAL**  
*Hugo Bissig, Martin Tschannen, Marc de Huu*
- 12:30 1056 SOUTH KOREA  
**DEVELOPMENT OF CLAMP-ON TYPE THERMAL MASS FLOW METER USING NEAR INFRARED ABSORPTION METHOD FOR MICRO FLOW APPLICATIONS**  
*Seok Hwan Lee, Seongchong Park, Woong Kang*
- 12:50 1000 CHINA  
**DESIGN OF A CALIBRATION SYSTEM FOR MINIATURE CARBON DIOXIDE SENSORS**  
*Mengna Li*



**Friday, 14:00 to 15:00 – Congress Center hall**

**Poster session**

**1009** **NETHERLANDS**  
**LNG MID-SCALE LOOP FLOW METERING; PRELIMINARY TEST RESULTS**  
*Menne Schakel*

**1035** **CHINA**  
**THE THEORETIC ANALYSE FOR THE DISCHARGE COEFFICIENT OF SONIC NOZZLES WITH LAMINAR BOUNDARY LAYER**  
*Peijuan Cao*

**1153** **SLOVENIA**  
**FUEL DISPENSERS IN SLOVENIA - BETWEEN COMPLIANCE AND FAIRNESS**  
*Gasper Vindisar, Dusanka Skrbic, Boris Simsic*

**1112** **PORTUGAL**  
**PERFORMANCE STUDY IN FUEL DISPENSERS IN THE FIELD OF VOLUME MEASUREMENTS**  
*Elsa Batista*

**1048** **NETHERLANDS**  
**CYCLONIC STACK FLOW MEASUREMENT UNCERTAINTIES AND IMPACT ON ANNUALISED MASS EMISSION MEASUREMENTS**  
*Menne Schakel, Marcel Workamp, Jan Gersl*

**1115** **PORTUGAL**  
**STATISTICAL QUALITY CONTROL METHOD FOR AUTOMATED WATER FLOW MEASUREMENTS IN CONCRETE DAM FOUNDATION DRAINAGE SYSTEMS**  
*Luís Martins, Juan Mata, António Tavares de Castro, Álvaro Ribeiro*

**1022** **ROMANIA**  
**A METHOD OF FLOW MEASUREMENT BASED ON A REACTION FORCE. REACTION FLOWMETERS**  
*Horia Mihai Motit*

**1078** **CHINA**  
**EXPERIMENTAL INVESTIGATION TO MEASURE THE NATURAL GAS FLOW BY LASER DOPPLER ANEMOMETER**  
*Huiyu Chen*



- 1086** **CHINA**  
**CRITICAL FLOW CHARACTERISTICS OF SPINDLE FLOWMETER**  
*Xiao Ming*
- 1134** **BRAZIL**  
**METHODOLOGY FOR CALIBRATION OF CORIOLIS USING DIFFERENTIAL PRESSURE**  
*Paulo Ferreira, Paulo Couto, Carlos Nunes, Jailton Damasceno, Mila Avelino, Jackson Oliveira, Luciano Batista*
- 1092** **UNITED STATES**  
**CALIBRATION OF MICROFLUIDIC FLOW METERS**  
*Liji Huang, Xiaochuan Feng*
- 1101** **JAPAN**  
**DEVELOPMENT OF SMALL WEIGHING SYSTEM FOR LIQUID MICRO-FLOW**  
*Ryouji Doihara, Kar-Hooi Cheong, Takashi Shimada, Noriyuki Furuichi*
- 1146** **BRAZIL**  
**DISCUSSION ON THE CALIBRATION PROCEDURE IN THE MASS-VOLUME FLOW RATE**  
*Mila Rosendahl Avelino, Leandro Sampaio, Ana Beatriz Silva, José Gabriel Siqueira, Amsterdam de Jesus Mendoça, José Maurício Gouveia*
- 1012** **UNITED STATES**  
**GAS CYLINDER METER WITH CLOUD DATA MANAGEMENT**  
*Liji Huang, Wenhong Deng*
- 1141** **CHINA**  
**INTERLABORATORY COMPARISON OF S-TYPE PITOT TUBE AND THREE-DIMENSIONAL PITOT TUBES FOR STACK FLOWRATE MEASUREMENT**  
*Liang Zhang, Iosif Shinder, Woong Kang, Aaron Johnson, Chi Wang, Michael Moldover*
- 1034** **CHINA**  
**2D AND 3D NUMERICAL SIMULATION RESULTS OF VORTEX FLOWMETER UNDER NONIDEAL INSTALLATION CONDITIONS**  
*Wen-Lin Chen, Jun Mu*
- 1098** **CZECH REPUBLIC**  
**INFLUENCE OF DISTURBING PART ON MEASUREMENT OF LDV PACKAGE SYSTEM**  
*Jan Sluse*



## Friday, 15:30 to 17:10 – Auditorium

### Oral session S22.1/12

### Liquid Flow

Chairperson: Florestan Oghard

- 15:30 1097 UNITED KINGDOM  
**CO-CURRENT LIQUID-LIQUID FLOW PATTERN DETERMINATION THROUGH  
MAGNETIC INDUCTION TOMOGRAPHY**  
*Yessica Arellano-Prieto, Andy Hunt, Olivier Haas, Hafiz Ahmed, Lu Ma*
- 15:50 1095 PORTUGAL  
**FACTORS INFLUENCING THE QUALITY FLOW MEASUREMENTS IN  
DRINKING WATER SYSTEMS - LESSONS LEARNED**  
*Maria Silva, Dália Loureiro, Álvaro Ribeiro, Conceição Amado*
- 16:10 1085 NETHERLANDS  
**ASSESSMENT OF ALLOCATION SYSTEMS: COMBINING DATA VALIDATION**  
*Henk Riezebos, Dennis Van Putten*
- 16:30 1091 CHINA  
**PERFORMANCE OF A WATER VELOCITY CALIBRATION FACILITY**  
*Heming Hu*
- 16:50 1151 JAPAN  
**PROBLEMS TO NOTE WHEN USING THE NOZZLE TO NOZZLE TEST  
METHOD**  
*Shinichi Nakao*



**Friday, 15:30 to 17:10 – Room 5**

**Oral session S23.5**

**Gas Standards**

Chairperson: Khaled Chahine

- 15:30 1119 AUSTRALIA  
**ESTABLISHMENT OF AN ULTRA-HIGH-ACCURACY 670L PVTT GAS FLOW  
PRIMARY STANDARD AT NMIA**  
*Khaled Chahine*
- 15:50 1031 CHINA  
**NUMERICAL SIMULATION AND EXPERIMENT OF GAS MASS IN PVTT  
CONTAINER BY ISOTHERMAL BOUNDARY CONDITION**  
*Yu Ming Shen, Ruo Xuan Liu, Ming Zheng Zhu*
- 16:10 1110 CHINA  
**MODEL STUDY ON THE VOLUME VALUE OF THE GAS DISCHARGED BY  
HIGH PRECISION BELL PROVER**  
*Jing-Fang Xing*
- 16:30 1154 JAPAN  
**EFFECTS OF STEP IN CFVN ON PREMATURE UNCHOKING PHENOMENA**  
*Naiki Takegawa, Masahiro Ishibashi, Toshihiro Morioka*
- 16:50 1011 UNITED STATES  
**GAS FLOW METER WITH THERMAL TIME-OF-FLIGHT TECHNOLOGY**  
*Liji Huang*



**Friday, 15:30 to 17:10 – Room 2**

**Oral session S24.2**

**Natural Gas**

Chairperson: Remy Maury

**15:30 1102 CHINA**  
**THE TECHNICAL STATUS AND PROSPECT OF NATURAL GAS FLOW TRACEABILITY SYSTEM IN CHINA**

*Jiqin Duan*

**15:50 1155 CHINA**  
**APPLICATION AND UNCERTAINTY ANALYSIS OF A NEW BALANCE USED IN NATURAL GAS PRIMARY STANDARD UP TO 60BAR**

*Jia Ren, Jiqin Duan, Yang Dong*

**16:10 1138 UNITED STATES**  
**NON-NULLING MEASUREMENTS OF FLUE GAS FLOWS IN A COAL-FIRED POWER PLANT STACK**

*Aaron Johnson*

**16:30 1023 UKRAINE**  
**EXAMINATION OF HYDROGEN INFLUENCE ON PHYSICAL PROPERTIES OF NATURAL GAS AND METROLOGICAL CHARACTERISTICS OF ITS METERING SYSTEMS**

*Volodymyr Naumenko, Andrii Stetsenko*

**16:50 1006 CHINA**  
**THE INFLUENCE OF THE FRINGE NON-UNIFORMITY ON THE CALIBRATION OF LDA**

*Lishui Cui*







inotech Meter Calibration Systems GmbH



**UBERTONE**

**REN** 

The logo for REN features the word "REN" in a bold, dark blue, sans-serif font. To the right of the text is a stylized symbol consisting of two overlapping triangles, one green and one blue.

 **JANZ**

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