

## A unique laboratory in gas flow rate measurement for manufacturers and users

In addition to the possession and development of the national references for gas flow measurement (sonic nozzles under a critical regime) within the framework of a laboratory associated with the LNE (LNE-LADG), the CESAME EXADEBIT laboratory offers to its customers more than 25 years expertise and an experience in the field of gas flowrate and particularly pressure testing.



High pressure tanks 200 bar



Meter repairing workshop

### Services Offered

- Calibration of all types of flowmeters
- Testing and certification of equipment used for gas transmission and distribution (valves, regulators, safety valves)
- Statutory metrology testing for gas flowmeters
- Research and development in gas metering systems (sonic nozzles, gas flowmeters)

### Registrations and accreditations

- BIPM-LNE (National Measurement Institute associated to LNE)
- Accredited by COFRAC (calibration and testing) in compliance with ISO 17025
- Periodical verification of gas flowmeters (DRIRE, in compliance with 17020) and repairer statutory approved (legal metrology : LNE-CIM with ISO 9001 standard)



Safety valve test Bench

### Parameters

- Flow rate :  $4 \cdot 10^{-4}$  to 30 kg/s  
1 à 80 000 m<sup>3</sup>/h (normal conditions)
- pressure : 1 to 45 bar (depending on flow rate)
- uncertainties : 0.2 to 0.25 %  
depending on flow rate

### Partners

Gas companies; manufacturers and users of gas meters; aeronautic, mechanical and chemical industries; Euramet, BIPM; LNE; PTB; VSL

**CESAME - EXADEBIT**  
Christophe WINDENBERGER

**43 route de l'Aérodrome**  
**86036 Poitiers Cedex**

**Tel. : (33) 5.49.37.91.26**

**Fax : (33) 5.49.52.85.76**

**E-Mail : cesame@univ-poitiers.fr**



For the **benefits** of **suppliers shippers customers** of natural Gas

An extensive **cooperation** between three European National Metrology Institutes (NMI, PTB and LNE), holding high pressure facilities, leads to the definition of a **universal unit for gas cubic meter** called :

**The International Harmonised cubic meter of Natural Gas**

Best and unique reference value

Lowest uncertainty

Highest level of confidence between the actors of gas trade

Long term stability

Fair and reliable Trading

### Miscellaneous

CESAME-EXADEBIT is also one of the participants in the EUROPEAN HARMONISED CUBIC METER OF NATURAL GAS realised by 3 independent metrology laboratories : PTB-Pigsar in Germany, VSL in Netherlands and LNE-LADG in France.

# The LNE – LADG uses critical flow venturi nozzles for the high pressure gas metering



View and principle of a critical flow venturi nozzle

$$Q_m = A f(\gamma) P_o / (rT_o)^{0,5} \text{ (perfect gas)}$$

$$Q_m = A C C^* P_o / (rT_o)^{0,5} \text{ (real gas)}$$

A : cross section of the nozzle,  
 P<sub>o</sub>, T<sub>o</sub> : absolute stagnation pressure and temperature of the gas,  
 γ : isentropic coefficient,  
 C\* : critical flow function (ISO 9300),  
 C : discharge coefficient (ISO 9300),  
 r : ratio of the Universal gas constant on the molar mass.

## Short chain of traceability



Mass, time

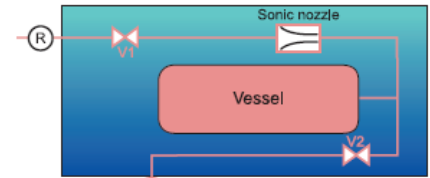
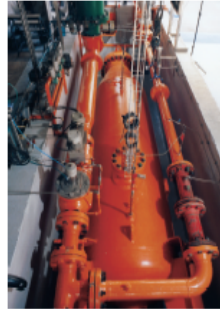
Primary standards

P, V, T, time method

Working standards

Sonic nozzles

Calibration of all type of flow meters



View and principle of the primary nozzle calibration bench "pisc"

Possibilities  
 7 to 55 bars  
 9 to 10.000 m<sup>3</sup>/h  
 0,19 % (2F)



High pressure flow test benches using sonic nozzles as reference

Possibilities  
 1 to 40 bars  
 9 to 80.000 m<sup>3</sup>/h  
 0,2 to 0,24 % (2F)

## Experience on sonic nozzles used flow standards (at high pressure)

- Close to the concept of a flow standard (kg/s).
- Very stable, highly repeatable.
- Not affected by downstream conditions.
- Unaffected by flow disturbances.
- Independent of the gas composition.
- Low uncertainty (< 0,2%).

