

Calibration Certificate

Number 13566/2015
Date 2015-02-23

Applicant Name: LLC SPA Turbulentnost-DON
Order no. K5 0003

Meter under test Description: Ultrasonic meter
Manufacturer: SPA Turbulentnost-DON
Type: Turbo Flow
Serial number: 50089 - forward
Nominal size: 12"
Range of flowrate: 200...6500 m³/h
Year of manufacture: 2013
Nominal diameter of meter: 300 mm
Nominal diameter of flange: 300 mm
Nominal flange pressure: ANSI 600 # RTJ

Date of test 2015-02-23

Results The results of the calibration are presented on page 3.

Test procedure PTB-Prüfregeln Band 30, Messgeräte für Gas, Hochdruckprüfung von Gaszählern
Physikalisch-Technische Bundesanstalt, Braunschweig und Berlin, 2003

Test facility *pigsar* represents the National Standard of the Federal Republic of Germany for the unit of volume for high pressure natural gas under supervision of PTB. *pigsar* disseminates the harmonised values for the unit of volume for high pressure gas flow measurements of the Federal Republic of Germany, France and The Netherlands. *pigsar* is accredited according to EN ISO 17025.

Traceability The presented results of the calibration are based on the unified Dutch-French-German reference values for the unit of volume for high-pressure gas flow measurements. On June-02-1999, PTB (Physikalisch-Technische Bundesanstalt) and VSL (formerly NMI-VSL, Netherlands Measurement Institute - Van Swinden Laboratorium) and later on May-04-2004 LNE (The Laboratoire national de métrologie et d'essais) have joined the harmonization (unification) procedure and the use of these reference values, see page 2.

Dorsten, 2015-02-23



The presented results of the calibration are based on the harmonized Dutch-French-German reference values for the unit of Volume for High Pressure Natural Gas flow measurements. In Paris, on 2004-May-4, PTB (Physikalisch-Technische Bundesanstalt), VSL (Van Swinden Laboratorium) and LNE (The Laboratoire national de métrologie et d'essais) have agreed on the harmonization and the use of these reference values.



The Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig and Berlin is the national institute for science and technology and the highest technical authority of the Federal Republic of Germany for the field of metrology and certain sectors of safety engineering. The PTB comes under the auspices of the Federal Ministry of Economics. It meets the requirements for calibration and testing laboratories as defined in the EN ISO/IEC 17025.

It is the fundamental task of the PTB to realize and maintain the legal units in compliance with the International System of Units (SI) and to disseminate them, above all within the framework of legal and industrial metrology. The PTB thus is on top of the metrological hierarchy in Germany.

This certificate is consistent with the Calibration and Measurement Capabilities (CMCs) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures (CIPM). Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see <http://www.bipm.org>).



Dutch
Metrology
Institute

VSL is the National Metrology Institute of The Netherlands and is part of the Holland Metrology Group (formerly known as NMi Group). VSL is appointed by the Dutch Government as the national institute for developing and maintaining the national measurement standards.

VSL makes an important contribution towards the reliability, quality and innovation of products and processes, both in business and society at large and provides a direct link to international accepted measurement standards in order to achieve traceability for measurement results of companies, laboratories and organisations.

VSL is accredited by RvA (Raad voor Accreditatie, "Board of Accreditation") to perform calibrations conform ISO17025 and is accredited to perform initial verification services for and on behalf of NMi Certin B.V.



The Laboratoire national de métrologie et d'essais (LNE) is the company designated by the French government as responsible of policy in terms of metrology in replacement of BNM (Bureau National de Métrologie) since January 2005.

The LNE is also designated by the French government as the Legal Metrology Service to perform type approvals and verifications. Thus, it is the fundamental task of the LNE to realize, develop and maintain the national primary standards and to insure the traceability of industries and users to the S.I units by the realization of specific instrumentation and calibration benches.

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Applicant LLC SPA Turbulentnost-DON

Meter under Test
 Type Ultrasonic meter Turbo Flow
 Manufacturer SPA Turbulentnost-DON
 Serial number 50089 - forward
 Nominal Size 12"
 Year of manufacture 2013

Test Conditions
 Test medium Natural gas
 Pressure, absolute 50,9 bar
 Gas Temperature 16 °C
 Gas density (p, T) 43,3 kg/m³
 Dyn. viscosity (p, T) 1,28E-5 Pa s
 CO₂ 1,4 mole %
 H₂ 0,0 mole %
 Calorific value,s 10,33 kWh/m³
 Density,normal 0,8263 kg/m³
 Normal conditions (273,15 K; 101,325 kPa)

Results	Qi / Qmax	Qi (m³/h)	Reynoldsnnumber	Deviation (%)		U _{tot} (%)	U _{meter} (%)
				as found	as left		
	0,03	209,38	0,83 *10 ⁶	1,10	0,00	0,88	0,88
	0,06	402,21	1,62 *10 ⁶	0,94	0,00	0,38	0,36
	0,12	809,46	3,25 *10 ⁶	0,77	0,00	0,21	0,16
	0,25	1609,15	6,43 *10 ⁶	0,81	0,00	0,20	0,14
	0,37	2414,41	9,60 *10 ⁶	0,72	0,00	0,21	0,16
	0,62	4008,99	16,06 *10 ⁶	0,54	0,00	0,14	0,03
	0,99	6438,51	25,44 *10 ⁶	0,65	0,00	0,18	0,11
verification	0,03	201,01	0,81 *10 ⁶		-0,39	0,32	0,29
	0,15	951,64	3,79 *10 ⁶		0,00	0,40	0,38
	0,40	2601,25	10,40 *10 ⁶		-0,06	0,25	0,21

Weighted mean error, with continuous and linear decrease of weighing factor between 0,7 Qmax and Qmax: 0,67 % (as found)
 0,00% (as left)

The deviation is defined as: $Deviation = \frac{(Indicated\ Value - Reference\ Value)}{(Reference\ Value)} \cdot 100\%$

where the reference volume refers to the conditions at the meter under test. The reported values of this deviation are the arithmetical means of *n* single repeat measurements at each flow-rate.

The reported total uncertainty is defined as: $U_{tot} = \sqrt{U_{harmonized}^2 + U_{meter}^2}$

where *U_{harmonized}* is the expanded uncertainty of the harmonized reference value, stated as the standard uncertainty of measurement multiplied by the coverage factor *k*=2, and *U_{meter}* is the expanded standard uncertainty of the meter under test, determined on the base of *n* repeats at each flow-rate, multiplied by Student-t-factor (*n*) / *n*^{0,5}, with a probability of 95%.

Remarks Security marks are applied

The meter was adjusted by multipoint linearisation algorithm over the calibrated range of the meter.

Tested in Dorsten at pigsar, on 2015-02-23 Schiffmann

Error Curve

Type of meter: Ultrasonic meter	Customer: LLC SPA Turbulentnost-DON	DN: 300	p (abs): 51 bar	HF: 900,000 pulses / m ³
Meter no: 50089	Manufacturer: SPA Turbulentnost-DON	Size: 12"	Qmax: 6500 m ³ /h	-
Date: 2015-02-23	Gear 1: -		Qmin: 200 m ³ /h	-
Inspector: Schiffmann	Gear 2: -		-	-

