



Ultrasonic Clamp-On Flow Meter Testing

Carried out for
Micronics Ltd

By Colin Judd

10 July 2015



Ultrasonic Clamp-On Flow Meter Testing

Carried out for:

Micronics Ltd
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High Wycombe
Bucks
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Contract: **Report 58933/1**

Date: **10 July 2015**

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SUMMARY

Micronics Ltd commissioned BSRIA to carry out a series of tests on a Micronics Ltd U1000 Ultrasonic clamp-on flow meter to verify the accuracy of the instrument against an in-line reference instrument. Testing was carried out over a range of water flow rates using multiple pipe sizes and materials. Testing was carried out in accordance with the method defined in Section 7 of this report.

This technical report details the test method and results obtained, and is based on an evaluation of a sample of the above mentioned product.

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1 INTRODUCTION

This report details the result of a series of comparative tests carried out on a Micronics Ltd U1000 ultrasonic clamp-on flow meter against an in-line electromagnetic reference instrument in order to verify the accuracy of the instrument. Testing was carried out at Micronics Ltd facility located in Loudwater, High Wycombe on 08 October 2014 and 02 June 2015. The testing carried out on 02 June 2015 only involved the 6" uPVC pipe. All information and data given in this report concerning the 6" uPVC pipe relates only to the test carried out on 02 June 2015. All other information and data relates to the tests carried out on 08 October 2014.

The test rig and the Micronics Ltd U1000 ultrasonic clamp on flow meter were commissioned and operated by Tony Cane of Micronics Ltd. BSRIA provided additional instrumentation to record the ambient air temperature, tank temperature, pipe surface temperature and the mA output of both the Micronics Ltd U1000 ultrasonic clamp on flow meter and the in line electromagnetic reference flow meter. The witness testing was carried out by Tom Garrigan on 08 October 2014 and Colin Judd on 02 June 2015 of BSRIA Ltd.

2 TEST ITEM

The unit tested was a Micronics Ltd U1000 ultrasonic clamp on flow meter, as shown in Figure 1. The Micronics Ltd U1000 ultrasonic clamp on flow meter consisted of a mountable transducer set and a detachable head assembly, which together as one complete unit were installed on to the surface of the pipe. The instrument displayed the flow rate in l/s, and had a 4-20mA output, which was logged to a laptop via an Agilent data acquisition switch unit supplied by BSRIA.

Two variants of the Micronics Ltd U1000 ultrasonic clamp-on flow meter were tested, which were as follows:

- Software version 05.01.xxx with 42 degree PEEK sensors for use on pipes with an inside diameter between 20 and 110 mm.
- Software version 10.01.xxx with 24 degree ABS sensors for use on pipes with an inside diameter of 110 to 220mm.

The claimed accuracy of the Micronics Ltd U1000 ultrasonic clamp-on flow meter was $\pm 3\%$ of the flow reading for velocities greater than 0.3m/s.

Figure 1 Micronics Ltd ultrasonic clamp on flow meter



3 OBJECTIVES

The objective of the tests was to verify the accuracy of the Micronics Ltd U1000 clamp-on flow meter against an in-line electromagnetic reference flow meter. Testing was to be done using multiple pipe materials and sizes over a range of flow rates within the capability of the test rig and within the range of the reference instruments.

4 TEST RIG INFORMATION

The rig used for testing was located at Micronics Ltd facility in High Wycombe, UK. The test rig was a closed loop system, which comprised of a fresh water tank (10,000 Litres), two inverter driven pumps and a series of pipes connected by manifolds and valves. In line electromagnetic flow meters were installed in each of the flow lines in order to measure the water flow rate.

Water was drawn from the fresh water tank by the inverter driven pump/s and supplied water to a four branch manifold, where each branch could be isolated using the isolating valves as shown in Figure 2.

Table 1 shows the nominal size and material of each of the flow lines tested.

Table 1 Test rig flow lines

Nominal Pipe Size	Material
2"	uPVC
2"	Mild Steel
4"	uPVC
4"	Mild Steel
6"	uPVC
6"	Mild Steel

Figure 2 Micronics Ltd Test Rig



5 INSTRUMENTATION

Table 2 and Table 3 show the instrumentation used during the testing of the Micronics Ltd U1000 ultrasonic clamp-on flow meter.

Table 2 Instrumentation used on 08 October 2014

Instrument	Manufacturer	Range	Units	I.D.	Calibration Due
DN50 Electromagnetic Flow Meter ¹	Kröhne	0 – 8.33	l/s	N/A	16-09-2014
DN100 Electromagnetic Flow Meter ¹	Kröhne	0 – 33.3	l/s	N/A	16-09-2014
DN150 Electromagnetic Flow Meter ¹	Kröhne	0 – 45.0	l/s	N/A	16-09-2014
Platinum Resistance Thermometers ²	Anville Sensors	5 - 45	°C	Card 1 PRT 01 Card 1 PRT 02 Card 1 PRT 03	27-08-2015
Ultrasonic Thickness Gauge ²	Dakota	1.0 – 20.0	mm	1020 202162	18-06-2015
Digital Vernier Caliper ²	Mitutoyo	0 - 150	mm	385	25-04-2016
Vernier Caliper ²	Mitutoyo	0 - 600	mm	185	25-11-2017

¹ Micronics Ltd instrumentation. See appendix A for calibration certificates.

² BSRIA Ltd instrumentation. See appendix A for calibration certificates.

Table 3 Instrumentation used on 02 June 2015

Instrument	Manufacturer	Range	Units	I.D.	Calibration Due
Platinum Resistance Thermometers ²	Anville Sensors	5 - 45	°C	Card 1 PRT 01 Card 1 PRT 02	07-05-2016
Ultrasonic Thickness Gauge ²	Dakota	1.0 – 20.0	mm	1020 202162	21-04-2016
Vernier Caliper ²	Mitutoyo	0 - 600	mm	185	25-11-2017
DN150 Electromagnetic Flow Meter ¹	Kröhne	0 – 45.0	l/s	N/A	02-10-2015

¹ Micronics Ltd instrumentation. See appendix A for calibration certificates.

² BSRIA Ltd instrumentation. See appendix A for calibration certificates.

6 PRE-TEST CHECKS

The outside diameter of each pipe size and each material was measured using a set of Vernier callipers prior to testing, as shown in Table 3. The thickness of each pipe size and each material was measured using an ultrasonic thickness gauge at four different positions, and the average values are shown in Table 4.

Table 4 BSRIA measured pipe dimensions

Nominal Pipe Size/Material	Measured Outside Diameter (mm)	Measured Thickness (mm)	Calculated Internal Diameter (mm)
2" uPVC	60.38	4.44	51.51
2" Mild Steel	60.37	3.91	52.56
4" uPVC	114.50	7.72	99.06
4" Mild Steel	114.50	4.19	106.12
6" uPVC	168.30	9.19	149.92
6" Mild Steel	165.00	4.36	156.28

Table 5 shows the dimensions of each pipe size and each material as measured by Micronics Ltd.

Table 5 Micronics Ltd measured pipe dimensions

Nominal Pipe Size/Material	Measured Outside Diameter (mm)	Measured Thickness (mm)	Calculated Internal Diameter (mm)
2" uPVC	60.4	4.1	52.2
2" Mild Steel	60.4	4.0	52.4
4" uPVC	114.3	8.0	98.3
4" Mild Steel	114.3	4.37	105.6
6" uPVC	168.3	9.0	150.0
6" Mild Steel	164.0	5.0	154.0*

*The internal diameter value input into the Micronics Ltd U1000 ultrasonic clamp on flow meter by Tony Cane of Micronics Ltd prior to testing the 6" mild steel pipe was 155.5mm.

Checks were also carried out on the medium (fluid) to be used during testing using a refractometer, which indicated a freezing point of 0°C. This check confirmed the application fluid in the test rig was water, and as a result a density value of 1kg/m³ was used throughout the duration of testing.

It is not possible to provide an uncertainty for the complete data logging system, due to the lack of information provided in the calibration certificates for the Kröhne reference flow meters. Whilst the uncertainty of the calibrating instrument is provided in each of the Kröhne reference flow meter calibration certificates, there is no uncertainty given for the overall calibration.

The uncertainty of the Agilent data acquisition switch unit was ±0.1% of the reading +0.01% of the range, which was set to 1A.

7 METHODOLOGY

7.1 INSTALLATION OF MICRONICS LTD U1000

The Micronics Ltd U1000 ultrasonic clamp-on flow meter was installed on to each of the pipe sizes and materials by Tony Cane of Micronics Ltd during the testing. Following installation of the flow meter, Tony Cane of Micronics Ltd entered the relevant parameters in to the unit including the internal diameter of the pipe samples being tested, as shown in Table 4.

7.2 TEST SETUP

Calibrated Platinum Resistance Thermometers (PRTs) connected to an Agilent data acquisition switch unit supplied by BSRIA that in turn displayed live data via a laptop were used to measure the ambient air temperature, the tank water temperature and the relevant pipe surface temperature throughout the duration of testing.

The 4-20mA outputs of both the Micronics Ltd U1000 ultrasonic clamp on flow meter and the in line reference electromagnetic flow meter were wired into the Agilent data acquisition switch unit supplied by BSRIA that in turn displayed live mA and flow rate readings to a laptop. Prior to each test commencing the mA output and the screen reading of each instrument was checked to ensure 'zero' flow was being displayed.

Manual readings were taken from the screen of both the Micronics Ltd U1000 ultrasonic clamp on flow meter and the in line reference electromagnetic flow meter during testing, which were consistent with the data logged via the laptop.

7.3 TEST METHOD

The test rig was operated by Tony Cane of Micronics Ltd. Each pipe size and each material was tested at five flow rates within the flow range of both the Micronics U1000 Ltd ultrasonic clamp on flow meter and the in line electromagnetic flow meter.

A stabilisation period of two minutes per set value, with an additional five minutes following stabilisation for data collection was given for each pipe size and each material. Data was logged at thirty second intervals during both the stabilisation and the data collection periods.

The ambient temperature of the water remained within tolerances ($18^{\circ}\text{C} \pm 3^{\circ}\text{C}$) throughout the duration of the testing. The ambient temperature of the room remained within the tolerances ($20^{\circ}\text{C} \pm 3^{\circ}\text{C}$) throughout the duration of the testing.

8 RESULTS

Table 6 details the configuration of the flow ranges set for the Micronics Ltd U1000 ultrasonic clamp-on flow meter and the software version and sensor type used for each pipe size tested. Details of the flow ranges set for the Kröhne DN50, Kröhne DN100 and Kröhne DN150 in-line reference flow meters for each pipe size tested are also included.

Table 6 Instrument configuration

Nominal Pipe Size	U1000		Kröhne Reference Flow Meter	
	Flow range	Software and version sensor type	Size	Flow range
-	l/s	-	-	l/s
2"	0-8.0	05.01.xxx with 42 degree PEEK sensors	DN50	0-8.33
4"	0-34.0	05.01.xxx with 42 degree PEEK sensors	DN100	0-33.3
6" Steel	0-45.5	10.01.xxx with 24 degree ABS sensors	DN150	0-45.0
6" uPVC*	0-35.3	10.01.xxx with 24 degree ABS sensors	DN150	0-45.0

*Test carried out on 02 June 2015

Table 7, Table 8, Table 9, Table 10, Table 11 and Table 12 show the results of the verification tests carried out on the Micronics Ltd U1000 ultrasonic clamp-on flow meter for each pipe size and material.

Table 7 2" uPVC Test Results

Tank Temperature (°C)	Pipe Surface Temperature (°C)	Ambient Air Temperature (°C)	U1000 Output (mA)	Kröhne DN50 Output (mA)	U1000 Flow Rate (l/s)	Kröhne DN50 Flow Rate (l/s)	Difference (l/s) – U1000 v Kröhne DN50 (%)
16.8	17.2	18.6	6.573	6.447	1.286	1.274	0.97%
16.8	17.2	18.5	9.017	8.802	2.507	2.500	0.32%
16.8	17.2	18.6	11.447	11.095	3.724	3.694	0.81%
16.8	17.2	18.8	16.063	15.583	6.031	6.031	0.01%
16.9	17.3	18.8	19.243	18.638	7.622	7.621	0.01%

Table 8 2" Mild Steel Test Results

Tank Temperature (°C)	Pipe Surface Temperature (°C)	Ambient Air Temperature (°C)	U1000 Output (mA)	Kröhne DN50 Output (mA)	U1000 Flow Rate (l/s)	Kröhne DN50 Flow Rate (l/s)	Difference (l/s) – U1000 v Kröhne DN50 (%)
18.1	18.2	19.3	6.901	6.826	1.450	1.471	-1.42%
18.1	18.2	19.4	9.996	9.814	2.998	3.027	-0.96%
18.1	18.2	19.3	13.129	12.855	4.565	4.610	-0.98%
18.1	18.2	19.5	15.978	15.579	5.989	6.028	-0.66%
18.1	18.3	19.5	19.050	18.516	7.525	7.558	-0.43%

Table 9 4" uPVC Test Results

Tank Temperature (°C)	Pipe Surface Temperature (°C)	Ambient Air Temperature (°C)	U1000 Output (mA)	Kröhne DN100 Output (mA)	U1000 Flow Rate (l/s)	Kröhne DN100 Flow Rate (l/s)	Difference (l/s) – U1000 v Kröhne DN100 (%)
16.9	17.6	19.0	6.848	6.966	6.052	6.173	-1.97%
16.9	17.4	19.0	9.899	10.085	12.535	12.666	-1.03%
16.9	17.4	19.1	12.548	12.789	18.165	18.292	-0.69%
17.0	17.4	19.2	16.116	16.522	25.746	26.061	-1.21%
17.1	17.5	19.3	19.702	20.198	33.367	33.713	-1.03%

Table 10 4" Mild Steel Test Results

Tank Temperature (°C)	Pipe Surface Temperature (°C)	Ambient Air Temperature (°C)	U1000 Output (mA)	Kröhne DN100 Output (mA)	U1000 Flow Rate (l/s)	Kröhne DN100 Flow Rate (l/s)	Difference (l/s) – U1000 v Kröhne DN100 (%)
17.8	17.9	19.7	6.890	6.938	6.141	6.116	0.40%
17.8	17.9	19.7	9.681	9.725	12.072	11.915	1.32%
17.9	18.0	19.8	12.724	12.734	18.539	18.178	1.99%
17.9	18.0	19.7	15.985	15.975	25.469	24.925	2.18%
18.0	18.1	19.7	19.574	19.511	33.095	32.283	2.51%

Table 11 6" uPVC Test Results

Tank Temperature (°C)	Pipe Surface Temperature (°C)	Ambient Air Temperature (°C)	U1000 Output (mA)	Kröhne DN150 Output (mA)	U1000 Flow Rate (l/s)	Kröhne DN150 Flow Rate (l/s)	Difference (l/s) – U1000 v Kröhne DN150 (%)
17.1	-	17.1	6.313	6.233	5.117	4.931	3.79%*
17.1	-	17.3	9.503	9.402	12.165	11.929	1.98%
17.1	-	18.1	12.704	12.469	19.212	18.702	2.73%
17.1	-	18.4	15.820	15.505	26.118	25.409	2.79%
17.2	-	18.4	19.039	18.702	33.210	32.464	2.30%

*The calculated velocity was below the measurement threshold for this size of pipe
Test carried out on 02 June 2015

Table 12 6" Mild Steel Test Results

Tank Temperature (°C)	Pipe Surface Temperature (°C)	Ambient Air Temperature (°C)	U1000 Output (mA)	Kröhne DN150 Output (mA)	U1000 Flow Rate (l/s)	Kröhne DN150 Flow Rate (l/s)	Difference (l/s) – U1000 v Kröhne DN150 (%)
17.2	17.3	19.4	5.812	5.857	5.153	5.224	-1.36%
17.2	17.3	19.5	9.347	9.545	15.206	15.594	-2.49%
17.3	17.3	19.5	12.851	13.141	25.170	25.710	-2.10%
17.4	17.5	19.5	16.176	16.651	34.628	35.580	-2.68%
17.7	17.8	19.7	19.445	20.095	43.922	45.267	-2.97%

9 CONCLUSIONS

9.1 2" UPVC TEST

The difference between the in-line electromagnetic reference flow meter and the Micronics Ltd U1000 was within the claimed specification ($\pm 3\%$) of the ultrasonic clamp on flow meter across the range of flow rates tested on the 2" uPVC pipe.

9.2 2" MILD STEEL TEST

The difference between the in-line electromagnetic reference flow meter and the Micronics Ltd U1000 was within the claimed specification ($\pm 3\%$) of the ultrasonic clamp on flow meter across the range of flow rates tested on the 2" mild steel pipe.

9.3 4" UPVC TEST

The difference between the in-line electromagnetic reference flow meter and the Micronics Ltd U1000 was within the claimed specification ($\pm 3\%$) of the ultrasonic clamp on flow meter across the range of flow rates tested on the 4" uPVC pipe.

9.4 4" MILD STEEL TEST

The difference between the in-line electromagnetic reference flow meter and the Micronics Ltd U1000 was within the claimed specification ($\pm 3\%$) of the ultrasonic clamp on flow meter across the range of flow rates tested on the 4" mild steel pipe.

9.5 6" UPVC TEST

The calculated velocity at the lowest flow rate on the 6" uPVC pipe was less than 0.3m/s which is outside the claimed measurement range of the instrument. The difference between the in-line electromagnetic reference flow meter and the Micronics Ltd U1000 was greater than the claimed specification ($\pm 3\%$) of the ultrasonic clamp on flow meter at the lowest flow reading on the 6" uPVC pipe.

The difference between the in-line electromagnetic reference flow meter and the Micronics Ltd U1000 was within the claimed specification ($\pm 3\%$) of the ultrasonic clamp on flow meter at all other flow readings on the 6" uPVC pipe.

9.6 6" MILD STEEL TEST

The calculated velocity at the lowest flow rate on the 6" mild steel pipe was less than 0.3m/s which is outside the claimed measurement range of the instrument. The difference between the in-line electromagnetic reference flow meter and the Micronics Ltd U1000 was within the claimed specification ($\pm 3\%$) of the ultrasonic clamp on flow meter at the lowest flow reading on the 6" mild steel pipe.

The difference between the in-line electromagnetic reference flow meter and the Micronics Ltd U1000 was within the claimed specification ($\pm 3\%$) of the ultrasonic clamp on flow meter at the second, third, fourth and fifth flow readings on the 6" mild steel pipe.

APPENDIX: A INSTRUMENT CALIBRATION CERTIFICATES

Figure 3 Kröhne DN50 Calibration Certificate


KROHNE		
Calibration Certificate - Kalibrierzertifikat - Certificat d'étalonnage DIN 55 350-18-4.2.2		
Customer / Kunde / Client	:	Micronics Ltd
Customer Order / Bestellnummer / Commande Client	:	20243
Product / Produkt / Produit	:	
Type / Typ / Type	:	OPTIFLUX 5000 DN 50 mm/ 2 inch
Sales Order / VK-Auftrag / Commande de vente	:	551000193 10 1
Serial Number / Seriennummer / Numéro de série	:	A08 17075
Tag Number / Tagnummer / Repère	:	
Calibration Method / Kalibriermethode / Méthode d'étalonnage		
The flow sensor has been calibrated against a piston-prover. The calibration certificate of this prover registers the traceability to national standards, which establishes the physical units of measurements according to the International System of Units (SI).		
Die Prüfung des Durchflussmessgeräts erfolgt im Vergleich zu einem Piston-Prover. Die Kalibrierung des Provers ist rückführbar auf Nationale Standards. Die physikalischen Einheiten sind nach dem SI-System definiert.		
Le capteur de mesure a été étalonné avec un piston étalon. Le certificat d'étalonnage de cet étalon prouve la traçabilité aux étalons nationaux qui utilisent des unités de mesures physiques selon le Système International (SI).		
Test Equipment Data / Kalibrierstanddaten / Données du banc d'étalonnage		
Serial Number / Seriennummer / Numéro de série	:	PST A10
Calibration fluid / Kalibrierflüssigkeit / Fluide d'étalonnage	:	Water / Wasser / Eau
Uncertainty / Unsicherheit / Incertitude	:	0.02 %
Calibration Results / Kalibrier Resultats / Résultats d'étalonnage		
Flow Rate Durchflussmenge Débit (%)	Set Flow rate Gewählte Durchfluss Débit réglé (m3/h)	Deviation Abweichung Ecart (%)
107.15	22.7220	-0.04
23.51	4.9855	+0.06
Calibration Data / Kalibrierdaten / Données d'étalonnage		
GK : 0.0000	GKh :	L1 : 0.0000000
GKI : 3.6260	GK070 : 0.0000	L2 : 0.0000000
		L3 : 0.0000000
Date / Datum / Date : 2013-09-19	Signature / Unterschrift / Signature :	
		
KROHNE Altimeter, Kerkeplaat 12, 3313 LC Dordrecht, Nederland, Tel.:+31 (0)78 6306 300, Fax.:+31 (0)78 6306 390, www.KROHNE.com		

Figure 4 Kröhne DN100 Calibration Certificate



WINPRINT 8.5.1376
068407 R1

CALIBRATION CERTIFICATE

Mm03.

Nr.: A00R41140

Primary head:

Type	: IFS4000F	
DN	: 100 mm/4 inch	
Flanges	: DIN2633 PN16	
Test pressure	: 24 Bar	
Liner	: PFA	
Electrode constr.	: S.A.constr.	PC/PCL/PCH value: ---/4.6233/---
Electrode material	: Hastelloy C	
Iso class	: H	Field frequency: 1/6 of line frequency
Protection class	: IP67	

*The primary head has been calibrated against a piston-prover.
The calibration certificate of this prover documents the traceability to national standards, which realize the physical units of measurement according to the International System of Units (SI).
Uncertainty of the piston-prover is 0.02%.*

*The calibration fluid water, has a conductivity of about 300 uS/cm and a temperature of 21°C.
According to DIN 1944 an inlet section of 5D and an outlet section of 3D, measured from the electrode/sensor axis, with undisturbed flow is recommended.
The calibrations were carried out with an inlet section-length of 10-15D.*

THE CALIBRATIONS:

Cal. measuring range (= 100%): 84.820 m3/h

<u>Range in %</u>	<u>Deviation in %</u>
102.31	+0.00
48.06	+0.00

Dordrecht, 2013-09-16

Figure 5 Kröhne DN150 Calibration Certificate



WINPRINT 8.5.1376
005907 R1

CALIBRATION CERTIFICATE

Nr.: A00R41186

MM04

Primary head:

Type	: IFS4000K	
DN	: 150 mm/6 inch	
Flanges	: DIN2633 PN16	
Test pressure	: 24 Bar	
Liner	: PFA	
Electrode constr.	: Standard	PC/PCL/PCH value: ---/5.6134/---
Electrode material	: Hastelloy C	
Iso class	: H	Field frequency: 1/6 of line frequency
Protection class	: IP67	

*The primary head has been calibrated against a piston-prover.
 The calibration certificate of this prover documents the traceability to national standards, which realize the physical units of measurement according to the International System of Units (SI).
 Uncertainty of the piston-prover is 0.02%.*

*The calibration fluid water, has a conductivity of about 300 uS/cm and a temperature of 21°C.
 According to DIN 1944 an inlet section of 5D and an outlet section of 3D, measured from the electrode/sensor axis, with undisturbed flow is recommended.
 The calibrations were carried out with an inlet section-length of 10-15D.*

THE CALIBRATIONS:

Cal. measuring range (= 100%): 127.230 m³/h

Range in %	Deviation in %
102.14	-0.07
48.07	+0.07

Dordrecht, 2013-09-16



 KROHNE altometer, Kerkeplaat 12, 3313 LC Dordrecht, Nederland, Tel.: +31 (0)78 630 6 300, Fax: +31 (0)78 630 6 390. www.KROHNE.com

Figure 6 Kröhne DN150 Calibration Certificate

MMS



Calibration Certificate – Kalibrierzertifikat – Certificat d'étalonnage
DIN 55 350-18-4.2.2

Customer / Kunde / Client **Micronics filtration Ltd**
 Customer Order / Bestellnummer / Commande Client **1250142**
 Product / Produkt / Produit
 Typ / Type / Type **IFM4080K**
 Sales Order / VK-Auftrag / Commande de vente **197009452**
 Serial Number / Seriennummer / Numéro de série **A96R13005**
 Tag Number / Tagnummer / Repère

Calibration Method / Calibration Method / Méthode d'étalonnage

The flow sensor has been calibrated against a piston-prover. The calibration certificate of this prover documents the traceability to national standards, which realize the physical units of measurements according to the International System of Units (SI).

Die Prüfung des Durchflussmessgeräts erfolgt im Vergleich zu einem Piston-Prover. Die Kalibrierung des Provers ist rückführbar auf Nationale Standards. Die physikalischen Einheiten sind nach dem SI-System definiert.

Le capteur de mesure a été étalonné avec un piston étalon. Le certificat d'étalonnage de cet étalon prouve la traçabilité aux étalons nationaux qui utilisent des unités de mesures physiques selon le Système International (SI).

Test Equipment Data / Kalibrierstanddaten / Données du banc d'étalonnage

Serial Number / Seriennummer / Numéro de série **A12**
 Calibration fluid / Kalibrierflüssigkeit / Fluide d'étalonnage **Water / Wasser / Eau**
 Uncertainty / Unsicherheit / Incertitude **0.02%**
 Calibration measuring range **127,200 m3/h**

Calibration Results / Kalibrier Resultats / Résultats d'étalonnage

Flow Rate Durchflussmenge Débit (%)	Set Flow rate Gewählte Durchfluss Débit réglé m3/h	Deviation Abweichung Ecart (%)
92,87	118,1306	-0,03
61,95	78,8004	-0,10
30,95	39,3684	0,21

Calibration Data / Kalibrierdaten / Données d'étalonnage

GK: 2,7321 GK_h :
 GKl:-- GK_w :

Date / Datum / Date : 2014-10-02

Signature / Unterschrift / Signature :

KROHNE allometer, Kerkeplaat 12, 3313 LC Dordrecht, Nederland, Tel.: +31 (0)78 630 6 300, Fax: +31 (0)78 630 6 390. www.KROHNE.com

Figure 7 Platinum Resistance Thermometer Calibration Sheet



CALIBRATION SHEET

Manufacturer : Anville	Instrument: PRTs 01, 02, 03, 04, 05, 06
-------------------------------	--

Variable: Dry bulb temperature (°C)
--

Probe Name	ASL Ref probe	Probe	slope	intercept	Corrected value
Agilent 34970 MY44005660 Card 1 PRT 01	5.01	5.07	1.00	-0.06	5.01
	14.96	15.05			14.96
	24.98	25.09			24.99
	34.95	35.07			34.96
	44.96	45.09			44.96
Agilent 34970 MY44005660 Card 1 PRT 02	5.01	5.12	1.00	-0.10	5.01
	14.96	15.08			14.96
	24.98	25.11			24.99
	34.95	35.09			34.96
	44.96	45.10			44.95
Agilent 34970 MY44005660 Card 1 PRT 03	5.01	5.02	1.00	-0.01	5.01
	14.96	14.99			14.97
	24.98	25.02			24.99
	34.95	35.00			34.96
	44.96	45.01			44.96
Agilent 34970 MY44005660 Card 1 PRT 04	5.01	5.02	1.00	-0.01	5.01
	14.96	14.99			14.96
	24.98	25.03			24.99
	34.95	35.01			34.96
	44.96	45.02			44.95
Agilent 34970 MY44005660 Card 1 PRT 05	5.01	5.12	1.00	-0.10	5.01
	14.96	15.09			14.97
	24.98	25.13			24.98
	34.95	35.11			34.96
	44.96	45.13			44.96
Agilent 34970 MY44005660 Card 1 PRT 06	5.01	5.04	1.00	-0.03	5.01
	14.96	15.02			14.97
	24.98	25.06			24.99
	34.95	35.04			34.96
	44.96	45.06			44.96
Engineer : Colin Judd				Date: 27 August 2014	

Figure 8 Ultrasonic Thickness Gauge Calibration Certificate

<h2 style="margin: 0;">CERTIFICATE OF CALIBRATION</h2>		Certificate Number STD62946MW
Issued By BSRIA Instrument Solutions Date of Issue 23 April 2014		Page 1 of 2 Pages
<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">  <p>BSRIA Instrument Solutions</p> <p style="font-size: small;">Old Bracknell Lane West, Bracknell, Berkshire, RG12 7AH, United Kingdom T: +44 (0) 1344 459314 F: +44 (0) 1344 465556 E: info@bis.fm W: www.bis.fm</p> </div> <div style="text-align: center;">  <p style="font-size: x-small;">BSRIA Quality Approved D M Winslade</p> </div> <div style="text-align: right;"> <p>Approved Signatory</p> </div> </div>		
Customer : BSRIA Instrument Solutions Old Bracknell Lane West, Bracknell Berkshire RG12 7AH		
Date Received : 31 January 2013		
Instrument -	System ID : 202162 Description : Ultrasonic Thickness Gauge Manufacturer : Dakota Model Number : MX-2 Serial Number : 15848 Procedure Version : 31F4V1	Job Number : H22521-1 Ref. Number : 202162 Last Certificate Number : STD62691AL Last Calibration Date : 11/04/2014
Environmental Conditions		
Temperature : 20°C +/- 4°C Relative Humidity : 50% +/- 20%		Mains Voltage : 240V +/- 10V Mains Frequency : 50Hz +/- 1Hz
Comments		
Instrument allowed to stabilise prior to reading.		
1020		
Traceability Information		
Instrument description Calibration Step Wedge Block	Serial number N075037	Certificate number 86277
	Cal. Date 31/03/2014	Cal. Period 52
Calibrated By : M. Winslade 		Date of Calibration : 23 April 2014
This certificate provides traceability of measurement to recognised National Standards, and to the units of measurement realised at the National Physical Laboratory or other recognised National Standards laboratories. Copyright of this certificate is owned by the issuing laboratory and may not be reproduced except with the prior written approval of the issuing laboratory. This certificate complies with the requirements of BS EN ISO 10012:2003.		

CERTIFICATE OF CALIBRATION

Certificate Number
STD62946MW

Page 2 of 2 Pages

Test Title	Tolerance	Applied Value	Reading	% Of Spec.
CONTENTS				
Main Handset	---	---	Pass	
Ultrasonic Probe	---	---	Pass	
Ultrasonic Couplant	---	---	Pass	
Comm"s Lead	---	---	Pass	
Software, CD	---	---	Pass	
Plastic Carry Case	---	---	Pass	
Manual	---	---	Pass	
Certificate	---	---	Pass	

INSPECTION RESULTS, SETUP AND ZERO CHECK

Main Handset	---	---	Pass	
Probe / Lead set	---	---	Pass	
Probe Clean	---	---	Pass	
Comm"s Lead set	---	---	Pass	
Back Light	---	---	Pass	
Battery Status	---	---	Pass	
Zero Check	---	---	Pass	
Setup Complete	---	---	Pass	

*The above instrument has been setup with the following user defined materials
 User Material 1 = Copper; Sound Velocity 4674 m/s
 User Material 2 = Iron; Sound Velocity 5893 m/s*

CALIBRATION RESULTS

Thickness	0.10mm	1.0mm	1.00mm	0%
	0.100mm	2.0mm	1.97mm	30%
	0.100mm	3.0mm	2.98mm	20%
	0.100mm	4.0mm	3.99mm	10%
	0.100mm	5.0mm	4.99mm	10%
	0.100mm	6.0mm	5.98mm	20%
	0.100mm	7.0mm	6.95mm	50%
	0.100mm	8.0mm	7.94mm	60%
	0.100mm	20.0mm	19.98mm	20%

Calibration Block Material Used was Steel.

----- END OF DATA -----

Uncertainties

ZZ/CTF/03 ±0.1mm upto 8mm, ±0.15mm above. (Mild Steel).

Figure 9 Ultrasonic Thickness Gauge Calibration Certificate

CERTIFICATE OF CALIBRATION	
Issued By BSRIA Instrument Solutions	Certificate Number STD71545
Date of Issue 21 April 2015	Page 1 of 2 Pages



Instrument Solutions

Old Bracknell Lane West, Bracknell,
Berkshire, RG12 7AH, United Kingdom
T: +44 (0) 1344 459314 F: +44 (0) 1344 465556
E: info@bis.fm W: www.bis.fm



Approved Signatory

Customer : BSRIA Instrument Solutions
Old Bracknell Lane West, Bracknell
Berkshire RG12 7AH

Date Received : 31 January 2013

Instrument -	System ID :	202162	Job Number :	H22521-1
	Description :	Ultrasonic Thickness Gauge	Ref. Number :	202162
	Manufacturer :	Dakota		
	Model Number :	MX-2		
	Serial Number :	15848	Last Certificate Number :	STD70625
	Procedure Version :	31F4V1	Last Calibration Date :	10/03/2015

Environmental Conditions

Temperature :	20°C +/- 4°C	Mains Voltage :	240V +/- 10V
Relative Humidity :	50% +/- 20%	Mains Frequency :	50Hz +/- 1Hz

Comments

Instrument allowed to stabilise prior to reading.

1020

Traceability Information

<i>Instrument description</i>	<i>Serial number</i>	<i>Certificate number</i>	<i>Cal. Date</i>	<i>Cal. Period</i>
Calibration Step Wedge Block	N075037	93170	27/03/2015	52

Calibrated By : A. Lennard

Date of Calibration : 21 April 2015

This certificate provides traceability of measurement to recognised National Standards, and to the units of measurement realised at the National Physical Laboratory or other recognised National Standards laboratories.
Copyright of this certificate is owned by the issuing laboratory and may not be reproduced except with the prior written approval of the issuing laboratory.
This certificate complies with the requirements of BS EN ISO 10012:2003.

CERTIFICATE OF CALIBRATION

Certificate Number
STD71545

Page 2 of 2 Pages

Test Title	Tolerance	Applied Value	Reading	% Of Spec.
CONTENTS				
Main Handset	---	---	Pass	
Ultrasonic Probe	---	---	Pass	
Ultrasonic Couplant	---	---	Pass	
Comm's Lead	---	---	Pass	
Software, CD	---	---	Pass	
Plastic Carry Case	---	---	Pass	
Manual	---	---	Pass	
Certificate	---	---	Pass	
INSPECTION RESULTS, SETUP AND ZERO CHECK				
Main Handset	---	---	Pass	
Probe / Lead set	---	---	Pass	
Probe Clean	---	---	Pass	
Comm's Lead set	---	---	Pass	
Back Light	---	---	Pass	
Battery Status	---	---	Pass	
Zero Check	---	---	Pass	
Setup Complete	---	---	Pass	
<i>The above instrument has been setup with the following user defined materials</i>				
<i>User Material 1 = Copper; Sound Velocity 4674 m/s</i>				
<i>User Material 2 = Iron; Sound Velocity 5893 m/s</i>				
CALIBRATION RESULTS				
Thickness	0.10mm	1.0mm	1.01mm	10%
	0.100mm	2.0mm	2.04mm	40%
	0.100mm	3.0mm	2.99mm	10%
	0.100mm	4.0mm	3.99mm	10%
	0.100mm	5.0mm	4.98mm	20%
	0.100mm	6.0mm	6.03mm	30%
	0.100mm	7.0mm	7.03mm	30%
	0.100mm	8.0mm	7.98mm	20%
	0.100mm	20.0mm	20.04mm	40%

Calibration Block Material Used was Steel.

----- END OF DATA -----

Uncertainties

ZZ/CTF/03 ±0.1mm upto 8mm, ±0.15mm above. (Mild Steel).

Figure 10 Digital Vernier Calliper (0-150mm) Calibration Certificate

CERTIFICATE OF CALIBRATION
 ISSUED BY **Calmet Laboratory Services**
 A division of Lazgill Ltd
 11b Upper Teddington Road, Hampton Wick, Kingston, Surrey KT1 4DL
 Telephone: 020 8977 8455 Facsimile: 020 8614 8048
 DATE OF ISSUE **24 April 2014** CERTIFICATE NUMBER **CN196302**



Page 1 of 1

BSRIA Limited
 Old Bracknell Lane West
 BRACKNELL
 Berks
 RG12 7AH

Approved signatory

Geoff Herbert
 Technical Manager

Your reference 31473

Our reference WI024037-001

Item	0-150mm DIGITAL CALIPER
Manufacturer	MITUTOYO
Serial number	385
Date received	17 April 2014
Date calibrated	23 April 2014
Laboratory environment	Temperature :20 °C ± 2 °C
Additional information	Adjustments were not performed. Final measurement was performed after a minimum of 24 hours stabilisation in the laboratory. The uncertainty limits quoted refer to the measured values only, with no account being taken of the instrument's ability to maintain its calibration. This laboratory is accredited in accordance with the recognised international standard ISO/IEC 17025:2005.
Equipment used	RS002,ME014,ME171,RS630 AND RS011.

Calibration results

Calibration Method

Vernier Caliper The gauge has been examined and calibrated to the tolerances specified in BS:887:2008 Superseded, Withdrawn where applicable and checked in comparison to reference standards, length standards, by direct measurement, to Calmet Procedure 4

	Tolerance	Result
Fixed Jaw Squareness	0.008 mm	0.005 mm
Flatness of external measuring faces	0.005 mm	0.001 mm
Parallelism of external measuring faces	0.008 mm	0.004 mm
Parallelism of internal measuring faces-Low range	0.010 mm	<0.010 mm
Parallelism of internal measuring faces-High range	0.010 mm	<0.010 mm
Co Planar Relationship of Jaws	0.050 mm	0.032 mm
Accuracy of Scale Reading - Metric 0-150mm	± 0.020 mm	-0.010 mm
Accuracy of Scale Reading - Imperial 0-6in	± 0.001 in	±0.0005 in
Depth Gauge Check 50mm / 2.00in	N/A	50.00

Notes : The measurements (excluding uncertainty) marked thus * were found to be out of tolerance.

Notes : Traceable to National Standards via specified Equipment
 Uncertainty of measurement: ±10 +(30 x length in M) µm

Dimensions are measured in millimetres or Inches as indicated.

Except where stated otherwise, the reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

Figure 11 Vernier Calliper (0-600mm) Calibration Certificate

CERTIFICATE OF CALIBRATION	
ISSUED BY Calmet Laboratory Services	
A division of Lazgill Ltd 11b Upper Teddington Road, Hampton Wick, Kingston, Surrey KT1 4DL Telephone: 020 8977 8455 Facsimile: 020 8614 8048	
DATE OF ISSUE 25 November 2014	CERTIFICATE NUMBER CN205237



Page 1 of 1

Approved signatory

Geoff Herbert
 Technical Manager

BSRIA Limited
 Old Bracknell Lane West
 BRACKNELL
 Berks
 RG12 7AH

Your reference Michelle Kinch

Our reference WI025212-001

Item	0-600mm Vernier Caliper
Manufacturer	MITUTOYO
Serial number	185
Date received	12 November 2014
Date calibrated	25 November 2014
Laboratory environment	Temperature :20 °C ± 2 °C
Additional information	Adjustments were not performed. Final measurement was performed after a minimum of 24 hours stabilisation in the laboratory. The uncertainty limits quoted refer to the measured values only, with no account being taken of the instrument's ability to maintain its calibration. This laboratory is accredited in accordance with the recognised international standard ISO/IEC 17025:2005.
Equipment used	RS002 Metric Gauge Blocks Calibrated 27/9/2012. RS216 Length Bars

Calibration results**Calibration Method**

Vernier Caliper The gauge has been examined and calibrated to the tolerances specified in BS:887:2008 Superseded, Withdrawn where applicable and checked in comparison to reference standards, length standards, by direct measurement, to Calmet Procedure 4

	Tolerance	Result
Fixed Jaw Squareness	0.024 mm	0.009 mm
Flatness of external measuring faces.	0.005 mm	0.0010 mm
Parallelism of external measuring faces.	0.008 mm	0.004 mm
Parallelism of internal measuring faces.	0.010 mm	<0.010 mm
Co Planar Relationship of Jaws.	0.050 mm	0.026 mm
Accuracy of Scale Reading - Metric 0-300mm	± 0.020 mm	<0.020 mm
Accuracy of Scale Reading -Metric 300-600mm	± 0.040 mm	<0.020 mm
Accuracy of Scale Reading - Imperial 0-12in	± 0.001 in	<0.001 in
Accuracy of Scale Reading - Imperial 12-24in	± 0.0015 in	<0.001 in
Combined width of Jaws	±0.013 mm	12.712 mm

Notes : The measurements (excluding uncertainty) marked thus * were found to be out of tolerance.
 Uncertainty of measurement : ± 0.030mm

Dimensions are measured in millimetres or Inches as indicated.

Except where stated otherwise, the reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.