Final report

CCM.FF-K1.2015

Water flow: 30 m³/h … 200 m³/h

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1 Introduction and purpose

The purpose of Key Comparison KC1 for water flow measurement (CCM.FF-K1.2015) was to support and prove the Calibration and Measurement Capabilities (CMC) of the participating National Metrology Institutes and Designated institutes as part of CIPM MRA.

The CMC-values of participating laboratories (Table 1) was evaluated by establishing a “Key Comparison Reference Value” (*KCRV*) and the Degree of Equivalence (E_N) between laboratories and KCRV.

In former versions, this comparison was labeled as CCM.FF-K1.2011. The official KCDB identifier was updated to **CCM.FF-K1.2015** (http://kcdb.bipm.org).

The basic subject of the calibrations was to determine the **meter *K*-factor** of the transfer flowmeters.

Depending on the operating principle of the used flowmeters, following meter-*K*-factors were the subject of measurements and had to be determined during calibrations:

Meter #1:

Turbine flowmeter - volume-related frequency output:

K_V (pulses/unit volume)

Meter #2:

Coriolis flowmeter:

a) mass-related frequency output:

K_m (pulses/unit mass)

b) volume-related frequency output:

K_V (pulses/unit volume)

Notes:

- As discussed during meeting of WGFF / Lisbon 2019, within this report the Coriolis_mass output was analyzed as the main meter for calibration results. Coriolis_volume output was not considered for evaluation of CMC values, because this output was not an independent measurand compared to Coriolis_Mass. Both values were based on the same flow meter instrument, linked with an internal value conversion.
- NEL declared to withdraw from key comparison CCM.FF-K1.2015. The communication to pilot laboratory is attached on page 99.

Acknowledgements

We would like to thank all participants of the comparison for their support. This round robin would not be possible without all your help, discussions und organization. Our acknowledgements include all participated staff of the laboratories - scientists, technicians and administration.

Special thanks go to Sejong Chun from KRISS for supporting the Draft by additional analysis on Reynolds number in Section 10.4., as well to Tao Meng from NIM for data and analysis on turbine meter hysteresis in Section 6.7.

2 Participants and measurement schedule

Participant list and measurement schedule are presented in Table 1. After three years of preparation the comparison started officially in December 2015.

Table 1: Participant list and measurement periods of standard calibration program (day #1 until day #3 of Table 4) (* pilot laboratory). Additional calibrations at pilot laboratory are listed in Table 6 and Table 7.

NMI/DI	Country	RMO	Contact	Calibration period
PTB*	Germany	EURAMET	enrico.frahm@ptb.de	02.12. - 04.12.2015
NEL	UK	EURAMET	Chris.Mills@tuvsud.com	15.12. - 17.12.2015
VSL	Netherlands	EURAMET	fsmits@vsl.nl	13.01. - 15.01.2016
RISE	Sweden	EURAMET	Oliver.Buker@ri.se	24.02. – 26.02.2016
PTB*	Germany	EURAMET	enrico.frahm@ptb.de	13.04. – 15.04.2016
UME	Turkey	EURAMET	basak.akselli@tubitak.gov.tr	26.05. – 28.05.2016
PTB*	Germany	EURAMET	enrico.frahm@ptb.de	19.07. – 27.07.2016
NIST	USA	SIM/Noramet	Iosif.Shinder@nist.gov	28.09 – 29.09.2016
CENAM	Mexico	SIM/Noramet	rarias@cenam.mx	21.02. – 22.02.2017
PTB*	Germany	EURAMET	enrico.frahm@ptb.de	24.04. – 26.04.2017
ITRI	Chinese Taipei	APMP	ctyang@itri.org.tw	27.06. – 29.06.2017
NIM	P.R. China	APMP	mengt@nim.ac.cn	29.08. – 31.08.2017
PTB*	Germany	EURAMET	enrico.frahm@ptb.de	24.10. – 06.11.2017
NMIJ/AIST	Japan	APMP	furuichi.noriyuki@aist.go.jp	05.12. – 07.12.2017
KRISS	Korea	APMP	sjchun@kriss.re.kr	24.01. – 02.02.2018
PTB*	Germany	EURAMET	enrico.frahm@ptb.de	03.04. – 12.04.2018

3 Description of the transfer standard

3.1 Transfer meter setup

The transfer meter setup (Figure 1) consisted a turbine flowmeter (Figure 2) at the inflow and a Coriolis flowmeter (Figure 3) at the outflow. The technical details of the meters are listed in Table 2 and Table 3. For flow conditioning, tube bundles were installed before and after turbine meter. Beside the two transfer flowmeters, all additional items were provided by the pilot laboratory:

- Pipework for meter installation (Figure 4)
- Cables for connecting transfer meters and the auxiliary devices to electronic boxes
- Electronic boxes 1 and 2 (Figure 5).

To provide optimum reproducibility conditions, the flowmeters and the inter-connecting pipework were equipped with pin-in-hole alignment capabilities. All elements of pipework were manufactured in stainless steel.

In addition to the used flowmeters, auxiliary measurands for diagnostic purposes were included in the transfer meter setup:

- Water density (based on a signal delivered by the Coriolis flowmeter)
- Fluid temperature by temperature transmitter
- Fluid pressure by pressure transmitter
- Pressure drop across the turbine meter by differential pressure transmitter

A detailed description of the setup is given in the Technical Protocol of KC1 [1].

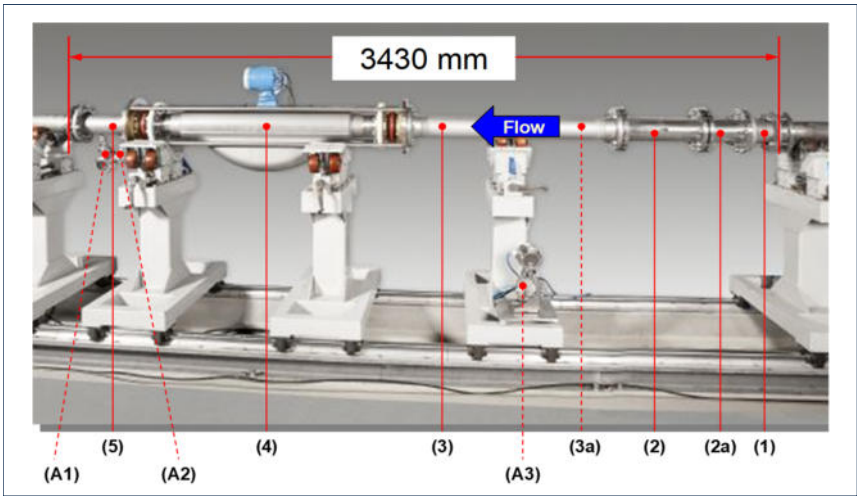


Figure 1: Transfer meter setup and pipework - Sample installation at pilot laboratory

(1) Inlet pipe section
(2) Turbine meter
(2a) Tube-bundle flow conditioner dedicated to the turbine
(3) Connecting pipe section with
(3a) Integrated tube-bundle flow conditioner
(4) Coriolis flowmeter
(5) Outlet pipe section

Auxiliary devices:

(A1) Pressure transmitter
(A2) Temperature transmitter
(A3) Differential pressure transmitter

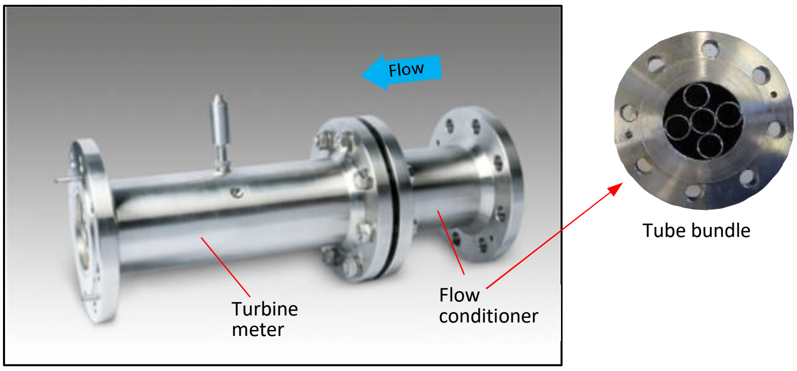


Figure 2: Transfer meter #1 - Turbine meter, DN100 mm

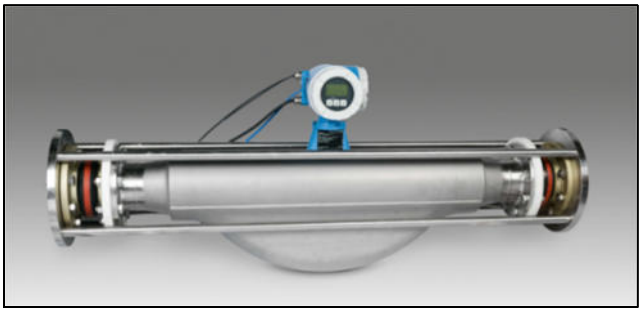


Figure 3: Transfer meter #2 - Coriolis flowmeter, DN100 mm

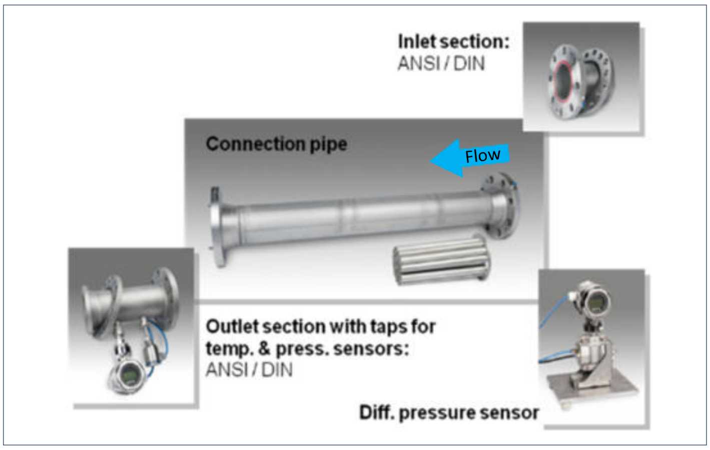


Figure 4: Transfer setup – pipework

Table 2: Transfer meter #1 - Turbine flowmeter (Figure 2)

Manufacturer:	KEM Küppers Elektromechanik GmbH	Germany
Type:	HM 100.71.FDB40-TS15-P	
Serial No.:	010995521	
Pipe size:	DN100	Nominal: 100 mm
Signal pick-up:	Type: VTE*/P-Ex Carrier-frequency pulse amplifier Serial No.: 02497623	Signal voltage: ca. 24 V
Output signal:	Frequency	(0 Hz) … 450 Hz (at 240 m³/h)
	Nominal meter *K*-factor: $K_{V,nom}$	**6.633 pulses/L**
Additional equipment:	Tube-bundle flow conditioner	Permanently installed at the inflow to meter
Special provision:	Pin-in-hole alignment	Steel pins located in precision holes on both ends

Table 3: Transfer meter #2 - Coriolis flowmeter (Figure 3)

Manufacturer:	ENDRESS + HAUSER	Switzerland
Type:	Proline Promass 83 F	
Serial No.:	D702C102000	
Pipe size:	DN100	Nominal: 100 mm
Signal output #1:	Mass-flowrate related: frequency	0 kHz … 10 kHz
	Nominal meter *K*-factor: $K_{m,nom}$	**100 pulses/kg**
Signal output #2:	Volume-flowrate related: frequency	0 kHz … 10 kHz
	Nominal meter *K*-factor: $K_{V,nom}$	**100 pulses/L**
Signal output #3:	Fluid density: current signal	4 mA … 20 mA
Communication line:	Reading parameters from flow meter	HART protocol (current output)
Special adoptions:	A cage-like meter extension in order to isolate the meter from external forces and torques	rubber damping elements included
Special provision:	Pin-in-hole alignment	Steel pins located in precision holes on both ends

3.2 Additional data logging - Electronic boxes 1 and 2

For the reported KC1 an additional datalogging system was designed. Beside standard impulse logging of the laboratory, an electronic device was provided by the pilot laboratory for a separate and independent data recording. Depending on electronical compatibility, the transfer setup and the auxiliary devices were connected by the laboratories, either to electronical box 1 or box 2.

Basically, electric pulses from transfer meters and additional process parameters, measured by the auxiliary devices (chapter 3.1), were logged by electronic box 1 (Figure 5a and Figure 6a). Also, power supply of the measurement instruments was provided by the box. The detailed use of electronic box 1 is described in the Technical Protocol of KC1 [1].

Due to the diverse conditions of the laboratories (e.g. electronical compatibility) it was necessary to provide an alternative junction device. For the scenario, if the use of electronic box 1 did not operate in the intended function (power supply of the transfer meters and data logging), electronic box 2 (Figure 5b and Figure 6b) had to be used. In that case, power supply of both flow meters and auto zero setting of Coriolis meter were provided by electronic box 2. A detailed description of the box is also given in the Technical Protocol [1].

Both boxes were developed as parallel working systems, which do not affect the standard pulse count recording of the laboratories. Tests at pilot laboratory verified the use of both boxes. Negative influences of the electronics or a significant deviation in pulse counting between the use of both boxes were not detected (Figure 7).

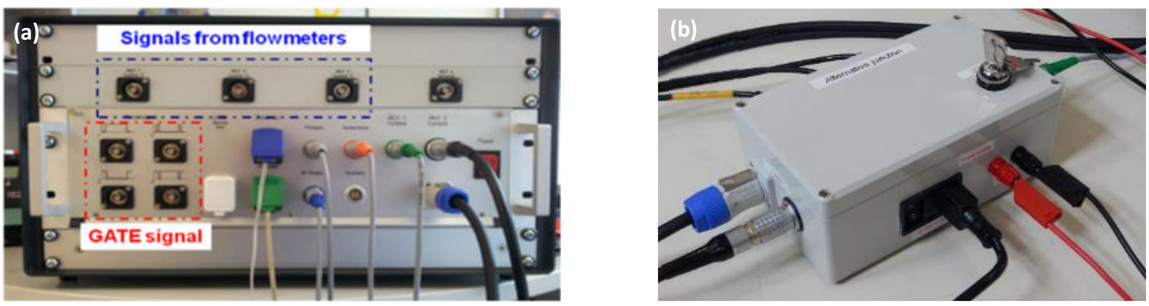
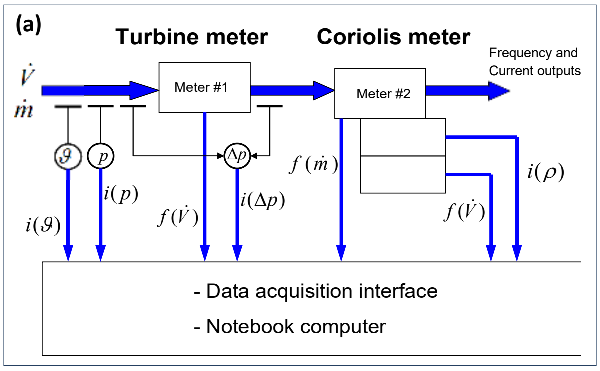


Figure 5: (a) Front side of electronic box 1
(b) Electronic box 2 (alternative junction) for power supply of both transfer meters and auto zero setting for Coriolis meter



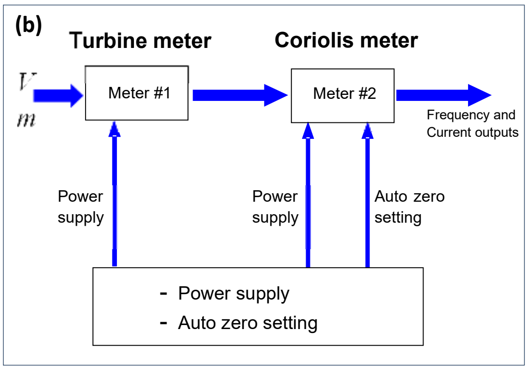
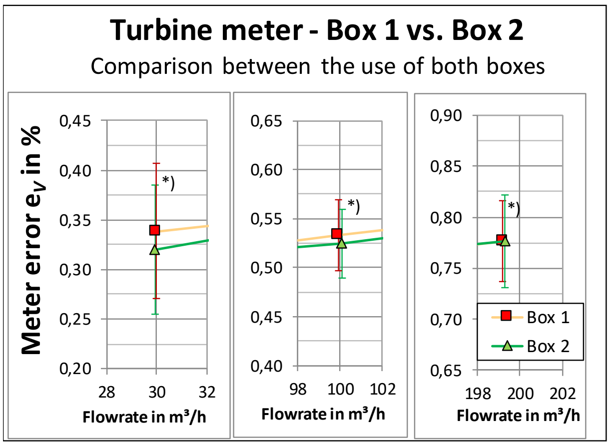


Figure 6: (a) Electronic Box 1 - Signal acquisition
(b) Electronic Box 2 - Power supply and function of auto zero setting



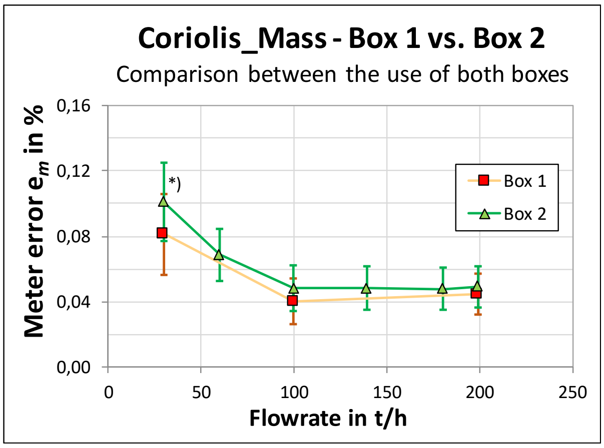


Figure 7: Meter error of repeated calibrations of turbine meter and Coriolis_Mass at pilot laboratory – Calibrations for using electronic box 1 and box 2 in 08/2016. *) are representing uncertainties $u_{x,i}$

4 Measurement program

4.1 Calibration program at participating laboratories

The objective of the measurement program was to verify the CMC entries of the participating laboratories. Therefore, it was necessary for all laboratories to calibrate the setup under comparable measurement conditions. All participants were asked to calibrate the transfer setup as far as possible under the following KC1 reference conditions.

<u>**KC1 reference conditions:**</u>

Fluid temperature: 20 °C

Line pressure: 3 bar (measured as positive back pressure after Coriolis meter)

Nominal flowrates: listed in Table 4

Setup: using the complete KC1 setup (Figure 1).

Table 4: Main tasks and flowrates of calibration days in participating laboratories as defined in [1]

Calibration day	Main task	Preparations before calibration	Auto zero setting at Coriolis meter		Repeated measure-ments	Nominal flowrate in m³/h	Post-processing
Day #1	Lab-to-lab reproducibility	Installation of transfer meters	yes		5	30, 60, 100, 140, 180, 200	Transfer package remains in calibration line
Day #2	Main calibration of KC1 and Day-to-day reproducibility	-	no		5	30, 60, 100, 140, 180, 200	Transfer package remains in calibration line
Day #3	Repeatability at selected flowrates	-	no		10	30, 100, 200	Transfer package is removed from calibration line

4.2 Methods used for calibration in participating laboratories

Each laboratory had to calibrate the setup by using their standard calibration method, which was subjected to the CMC entry (Table 5). Each laboratory provided the pilot laboratory with a description of the calibration procedure and an overview to the used calibration rig (Chapter 10.1.) All laboratories had an independent traceability in realization of their standards.

Table 5: Participating laboratories, calibration methods and CMC-values within the range of KC1 flowrates

NMI/DI	Country	Calibration method and reference	CMC Water CIPM MRA (k = 2)	
			U(Mass) in %	**U(Volume)** in %
NEL	United Kingdom	Gravimetric / flying-start-stop	0.100	0.100
VSL	The Netherlands	Gravimetric / standing-start-stop	0.030 (m ≤ 30 t/h) 0.015 (m > 30 t/h)	0.045
RISE	Sweden	Volumetric Prover/ flying-start-stop	0.080	0.060
UME	Turkey	Gravimetric / flying-start-stop	0.070	0.070
PTB	Germany	Gravimetric / flying-start-stop	0.020	0.020
NIST	USA	Gravimetric / flying-start-stop	0.030	0.030
CENAM	Mexico	Gravimetric / flying-start-stop	0.030	0.038
ITRI	Chinese Taipei	Gravimetric / flying-start-stop	0.040	0.040
NIM	P.R.O. China	Gravimetric / flying-start-stop	0.050	0.050
NMIJ/AIST	Japan	Gravimetric / flying-start-stop	0.042	0.042
KRISS	Korea	Gravimetric / flying-start-stop	0.060	0.060

4.3 Meter characterisation at pilot laboratory

The transfer setup was subjected to extensive characterisation measurements at pilot laboratory (Table 6 and Table 7). These calibrations were made under clearly defined conditions, which were basically derived from KC1 reference conditions (Chapter 4.1). The goal of the characterisation measurements was to analyze the impact of the following parameters to transfer meter setup: fluid temperature, line pressure, reproducibility and changing inflow conditions. The results aimed in a detailed knowledge about the transfer meter uncertainties u_{TS}.

During meter characterisation, the influences of different inflow conditions to meter setup were evaluated. In order to simulate a wide range of real inflow conditions, the setup was calibrated with several flow disturber (Figure 8) and changing inflow lengths (Figure 9). The calibrations were made under KC1 reference conditions, as listed in chapter 4.1.

Table 6: Extended calibration days at pilot laboratory

Calibration day	Main Task	Preparations before calibration	Auto zero setting at Coriolis meter	Repeated measure-ments	Nominal flow-rate in m³/h	Post-processing	Measurement periods at pilot laboratory
Day #4	Laboratory-internal reproducibility (I)	Installation of transfer meters	yes	5	30 60 100 140 180 200	Transfer package was removed from cali-bration line after each calibration day	25.07.2016 - 27.07.2016 02.11.2017 - 06.11.2017 09.04.2018 - 12.04.2018
Day #5	Laboratory-internal reproducibility (II)	Installation of transfer meters	yes				
Day #6	Day-to-day reproducibility (III)	-	no				

Table 7: Characterisation measurements at pilot laboratory

Task of calibrations	Nominal flowrate in m³/h	Temperature in °C	Line pressure in bar	Repeated measu-rements	Measurement periods at pilot laboratory
Temperature dependency	30, 60, 100, 140, 180	10, 15, 20, 25, 30	3	5	13.03.2013 - 02.04.2013
	30, 60, 100, 140, 180, 200	15, 20, 25	3	5	13.01.2015 - 19.01.2015
	30, 60, 100, 140, 180, 200	10, 20, 30	3	5	22.02.2019 - 01.03.2019
Pressure dependency	30, 60, 100, 140, 180	20	2, 3, 4	5	02.04.2013 - 04.04.2013
	30, 60, 100, 140, 180, 200	20	2, 3, 4	5	13.04.2018 - 18.04.2018
Inflow conditions	30, 100, 200	20	3	5	11.03.2019 – 29.03.2019

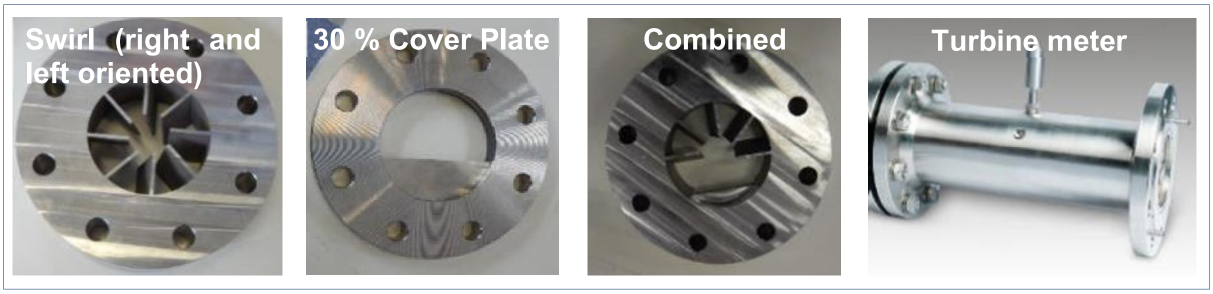


Figure 8: Used flow disturber for meter characterisation - inner pipe diameter: 100 mm

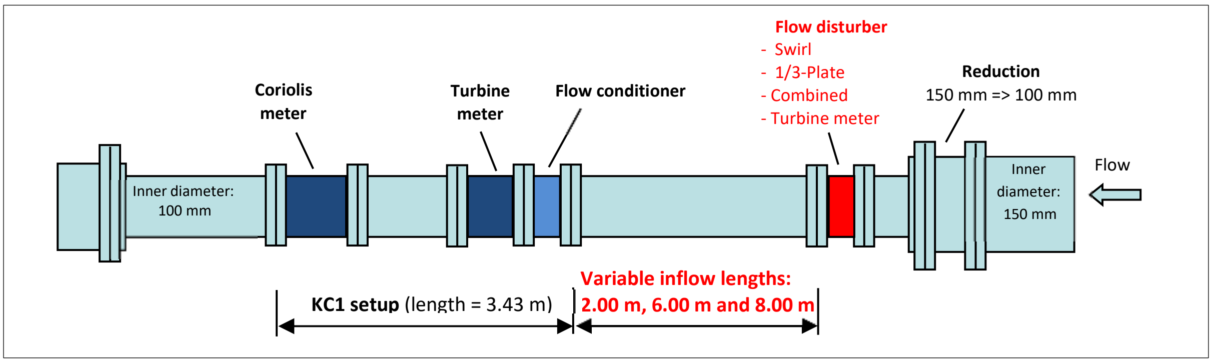


Figure 9: Calibration setup for meter characterisation – influences of different inflow lengths to transfer setup

5 Data calculation and evaluation criteria

5.1 Meter *K*-factor and temperature correction for final meter error x_i

According to the flowrates of Table 4, the meter *K*-factor was calculated for each calibration by using Equation (1) for turbine meter and, respectively, by Equation (2) for Coriolis meter.

$$K_{\mathrm{V}} = \frac{N}{(V_{\mathrm{ref}} \cdot 1000)} \quad \textbf{(1)}$$

$$K_{\mathrm{m}} = \frac{N}{m_{\mathrm{ref}}} \quad \textbf{(2)}$$

where K_V - *K*-factor of turbine meter (pulses/L)
K_m - *K*-factor of Coriolis meter (pulses/kg)
N - Counted number of pulses of the transfer meter (pulses)
V_{ref} - Volume, measured by the reference standard (m^3)
m_{ref} - Mass, measured by the reference standard (kg)

The relative measurement error *e* was calculated for each *K*-factor by:

$$e_{\mathrm{V}} = \frac{K_{\mathrm{V}} - K_{\mathrm{V,nom}}}{K_{\mathrm{V,nom}}} \cdot 100\ \% \quad \textbf{(3)}$$

$$e_{m} = \frac{K_{\mathrm{m}} - K_{\mathrm{m,nom}}}{K_{\mathrm{m,nom}}} \cdot 100\ \% \quad \textbf{(4)}$$

where e_V - Relative measurement error of turbine meter (%)
e_m - Relative measurement error of Coriolis meter (%)
$K_{V,nom}$ - Nominal *K*-factor of turbine meter (pulses/L)
$K_{m,nom}$ - Nominal *K*-factor of Coriolis mass (pulses/kg)

Both transfer meters were characterised by a systematic temperature dependency in meter error (Section 6.3). **All reported meter error of participating laboratories were corrected by applying Equation (22) until Equation (25) and Table 13**, to aim a temperature corrected meter error $e_{V,cor}$ for volume and $e_{m,cor}$ for mass.

For final evaluation of E_N, a mean meter error (x_i) was calculated separately for each laboratory, transfer meter and flowrate (Equation 5), **based on calibration results of day #1 and day #2** (Table 4).

$$x_i = \frac{\sum_{k=1}^{n} (e_{\mathrm{cor},k})}{n} \quad \textbf{(5)}$$

where x_i - Temperature corrected meter error for E_N-value evaluation
n - Number of measurements at calibrated test point
i - Laboratory index

5.2 Uncertainty $u_{x,i}$ of reported and temperature corrected value x_i

As described in [2], [3] and [4], the uncertainty of reported value x_i includes uncertainties introduced by the participant`s flow reference ($u_{base,i}$), by transfer meter (u_{TS}) and by repeatability of the reported value (Equation 6). The used input parameter of $u_{base,i}$ do represent the CMC values of Table 5 which were under evaluation during this comparison. Uncertainty calculations of u_{TS} were based on Equation (18), for Turbine meter, respectively for Coriolis meter, on Equation (19). Final values of u_{TS}

are presented in Table 8 and Table 9. The term $\frac{s}{\sqrt{n}}$ (Equation 6) represents the repeatability of measurements made in the participants laboratory [3], based on calibration results of day #1 and day #2 (Table 4).

$$u_{\mathrm{x},i} = \sqrt{u_{\mathrm{base},i}^2 + u_{\mathrm{comp}}^2} = \sqrt{u_{\mathrm{base},i}^2 + u_{\mathrm{TS}}^2 + \frac{s^2}{n}} \qquad \textbf{(6)}$$

where

$u_{x,i}$	- Uncertainty of reported and temperature corrected meter error (%)
$u_{\mathrm{base},i}$	- Uncertainty of laboratory refence, here it is equal to CMC_i (%)
u_{comp}	- Uncertainty of transfer meter measurements (%)
s	- Standard deviation of the mean of measurements at one flowrate point (%)
n	- Number of calibrations at one flowrate point (-)

All values of *u* are valid for *k* = 1.

5.3 Determination of Key Comparison reference value (KCRV) and it`s uncertainty

The Key Comparison reference value was calculated at each flowrate of Table 4, following the procedure A of [5]. All reported calibration results (day #1 and day #2) were used for the determination of KCRV and its uncertainty, because all participating laboratories declared their independent traceability chains to SI. The determination of KCRV included a consistency check according to [6].

The refence value *y* was calculated as weighted mean error of the participating laboratories, including standard uncertainties u(x_i) of the measurements as the weights:

$$y = \frac{\left(\frac{x_1}{u_{x,1}^2} + \frac{x_2}{u_{x,2}^2} + \ldots + \frac{x_i}{u_{x,i}^2}\right)}{\left(\frac{1}{u_{x,1}^2} + \frac{1}{u_{x,2}^2} + \ldots \frac{1}{u_{x,i}^2}\right)} \qquad \textbf{(7)}$$

where y - Reference value of the comparison (%)

The standard uncertainty u_y is given with:

$$\frac{1}{u_y^2} = \frac{1}{u_{x,1}^2} + \frac{1}{u_{x,2}^2} + \ldots + \frac{1}{u_{x,i}^2} \qquad \textbf{(8)}$$

where u_y - Standard uncertainty of y with k = 1 (%)

The expanded uncertainty of y was calculated with:

$$U(y) = 2 \cdot u_y \qquad \textbf{(9)}$$

where U(y) - Expanded uncertainty of *y* with k = 2 (%)

Based on [5] and [6], at each flow rate the chi-squared test was applied for a consistency check of the laboratory results. The chi-squared value was calculated with:

$$X_{\mathrm{obs}}^2 = \frac{(x_1 - y)^2}{u_{x,1}^2} + \frac{(x_2 - y)^2}{u_{x,2}^2} + \ldots + \frac{(x_i - y)^2}{u_{x,i}^2} \qquad \textbf{(10)}$$

where X_{obs}^2 - Observed chi-squared value

The degrees of freedom υ were estimated with:

$$\upsilon = n_i - 1 \qquad \textbf{(11)}$$

where n_i - number of evaluated laboratories

For data evaluation the CHIINV(0.05;v) function of MS Excel was used. The consistency check failed if CHIINV(0.05;v) gives values < than X^2_{obs}.

$$Pr\{X^2_\upsilon > X^2_{obs}\} < 0.05 \qquad \textbf{(12)}$$

where X^2_υ - Chi-squared test value

If consistency check of Equation (12) passed, *y* was accepted as the Key Comparison Reference value x_{KCRV} and $U(y)$ was accepted as the expanded uncertainty $U(x_{\text{KCRV}})$.

If the test of Equation (12) failed, the laboratory with highest value of $(x_i - y)^2 \,/\, u^2_{x,i}$ would excluded for the next evaluation round. New values of *y*, $U(y)$ and X^2_{obs} were calculated and the consistency check of Equation (12) was repeated.

5.4 Determination of differences „Lab to KCRV" as degree of equivalence (DoE)

Differences between laboratories results (x_i) and KCRV (x_{KCRV}) were calculated in accordance with Equation (13), separately for each flowmeter and flowrate. The results give the degree of equivalence (DoE) of each laboratory.

$$d_i = x_i - x_{\text{KCRV}} \qquad \textbf{(13)}$$

where d_i - Degree of equivalence (DoE) for each laboratory *i* in %

x_{KCRV} - Key Comparison Reference value in %

Based on differences d_i, the normalized Degree of Equivalence $E_{\text{N},i}$ was calculated for each laboratory and flowrate with:

$$E_{\text{N},i} = \left|\frac{d_i}{U(d_i)}\right| \qquad \textbf{(14)}$$

where $E_{\text{N},i}$ - Normalized Degree of Equivalence

The calculated differences of d_i are followed by specific uncertainties, which can be basically analyzed by a consideration of the general problem of the difference between two values x_1 and x_2. The pure propagation of the uncertainty (with k = 1) is given by Equation (15). Finally, the uncertainty of the difference is the quadratic sum of the uncertainties of u_1 and u_2 and subtracting twice the covariance between the two input values.

$$u^2_{x1-x2} = \left[\frac{\partial(x_1 - x_2)}{\partial x_1} \;\; \frac{\partial(x_1 - x_2)}{\partial x_1}\right] \begin{pmatrix} u_1^2 & cov \\ cov & u_2^2 \end{pmatrix} \begin{bmatrix} \dfrac{\partial(x_1 - x_2)}{\partial x_1} \\ \dfrac{\partial(x_1 - x_2)}{\partial x_1} \end{bmatrix} = u_1^2 + u_2^2 - 2 \cdot cov \qquad \textbf{(15)}$$

The value of covariance is identical to the value of measurement uncertainty related to KCRV for the independent participating labs which took part in the KCRV determination. Based on Equation (15), the extended uncertainty of d_i was calculated with Equation (16) for laboratories with contribution to the KCRV. Participating labs, which were excluded from the KCRV determination, do not have any interference. In that case the value of $U(d_i)$ would calculated according to equation (17).

$$U(d_i) = 2 \cdot \sqrt{u_{x,i}^2 + u_{KCRV}^2 - 2 \cdot u_{KCRV}^2} = 2 \cdot \sqrt{u_{x,i}^2 - u_{KCRV}^2} \quad \textbf{(16)}$$

$$U(d_i) = 2 \cdot \sqrt{u_{x,i}^2 + u_{KCRV}^2} \quad \textbf{(17)}$$

Note: An evaluation of "Lab to Lab differences" is not included in this report, because: "The 14th CCM meeting (February, 2013) agreed that pair wise degrees of equivalence should no longer be published in the KCDB. Information on pair-wise degrees of equivalence published in KC reports should be limited to the equations needed to calculate them, with the addition of any information on correlations that may be necessary to estimate them accurately." [14th CCM meeting in February 2013]

5.5 Evaluation of comparison data

For final data evaluation and decision table the following criteria were used - based on [3], [4] and [5]:

- **Chi-squared test**
  Data evaluation and consistency check, based on Equations (10) to Equations (12)

- The participant **passes the comparison if $E_{N,i} \leq$ 1.0 and $u_{comp}/u_{base,i} \leq$ 2**
  The results of participating laboratory *i* agrees within 95 % confidence level uncertainty expectations with the *KCRV* (k = 2).

- The participant passes the comparison at **"warning level" if 1.0 < $E_{N,i} \leq$ 1.2 and $u_{comp}/u_{base,i} \leq$ 2**

- The participant **fails the comparison if $E_{N,i} \leq$ 1.2 and $u_{comp}/u_{base,i} >$ 2**
  The results are inconclusive, because the transfer meter did not show sufficient low uncertainties to discern lab to *KCRV* below certain level. The transfer meter is not suitable for a confirmation of the declared CMC values.

- The participant **fails the comparison if $E_{N,i} >$ 1.2**
  The results do indicate that the agreement is outside of uncertainty expectations.

5.6 Alternative evaluation of the comparison data - based on Reynolds number

Especially for Turbine meter, comparison analysis based on Reynolds number are commonly practiced. For this report an additional data analysis was submitted by KRISS institute in January 2021. Procedure and results are presented in Appendix 10.4.

6 Laboratory conditions, transfer meter characteristics and meter uncertainties

In accordance to the WGFF recommendation for comparison calculations [3], the standard uncertainty u_{TS} of the transfer meter is the root-sum-of-squares (RSS) of several transfer meter characteristics. For this comparison the considered meter characteristics and input uncertainties of turbine meter are listed in Equation (18), for Coriolis meter in Equation (19). The final values of u_{TS} were calculated separately for each flowrate (Table 8 and Table 9).

Note: The uncertainties of u_{TS} are specified and valid for the presented comparison under the given measurement conditions. The values of u_{TS} may change if the setup or calibration conditions do deviate to this comparison.

$$Turbine\ meter: \quad u_{\mathrm{TS}} = \sqrt{u_{\mathrm{drift}}^2 + u_{\mathrm{reprod}}^2 + u_{\mathrm{temp}}^2 + u_{\mathrm{pres}}^2 + u_{\mathrm{flow}}^2 + u_{\mathrm{inflow}}^2 + u_{\mathrm{hyst}}^2} \qquad \textbf{(18)}$$

$$Coriolis_{Mass}: \quad u_{\mathrm{TS}} = \sqrt{u_{\mathrm{drift}}^2 + u_{\mathrm{reprod}}^2 + u_{\mathrm{temp}}^2 + u_{\mathrm{pres}}^2 + u_{\mathrm{flow}}^2} \qquad \textbf{(19)}$$

where
- u_{TS} - Uncertainty of transfer meter (%)
- u_{drift} - Uncertainty due to drift of transfer meter (%)
- u_{reprod} - Uncertainty due to reproducibility characteristics of transfer meter (%)
- u_{temp} - Uncertainty caused by temperature characteristics of transfer meter (%)
- u_{pres} - Uncertainty caused by pressure characteristics of transfer meter (%)
- u_{flow} - Uncertainty due to sensitivity of transfer meter to instable flow conditions (%)
- u_{inflow} - Uncertainty due to sensitivity of turbine meter to different inflow conditions (%)
- u_{hyst} - Uncertainty due to hysteresis effect (%)

All values of *u* are valid for *k* = 1.

Table 8: Final values of meter uncertainties u_{TS} for turbine meter (with *k* = 1)

	Meter uncertainty u_{TS}		**Input uncertainties for u_{TS}**						
Nominal flowrate in m³/h	**Turbine meter** considering u_{inflow} in %	**Turbine meter** without u_{inflow} in %	u_{drift} in %	u_{reprod} in %	u_{temp} in %	u_{pres} in %	u_{flow} in %	u_{inflow} in %	u_{hyst}
30	0.123	0.077	0.008	0.011	0.012	0.012	0.003	0.096	0.074
60	0.106	0.043	0.006	0.003	0.005	0.012	0.003	0.096	0.041
100	0.102	0.032	0.004	0.005	0.009	0.012	0.003	0.096	0.028
140	0.099	0.024	0.005	0.011	0.010	0.012	0.003	0.096	0.015
180	0.098	0.017	0.004	0.011	0.003	0.012	0.003	0.096	0.001
200	0.099	0.021	0.005	0.010	0.002	0.012	0.003	0.096	0.013

Table 9: Final values of meter uncertainties u_{TS} for Coriolis_Mass (with *k* = 1)

	Meter uncertainty u_{TS}	**Input uncertainties for u_{TS}**				
Nominal flowrate in t/h	**Coriolis_Mass** in %	u_{drift} in %	u_{reprod} in %	u_{temp} in %	u_{pres} in %	u_{flow} in %
30	0.022	0.012	0.011	0.013	0.006	0.001
60	0.012	0.006	0.005	0.007	0.006	0.001
100	0.010	0.005	0.004	0.005	0.006	0.001
140	0.009	0.004	0.003	0.004	0.006	0.001
180	0.008	0.004	0.002	0.002	0.006	0.001
200	0.007	0.004	0.002	0.001	0.006	0.001

6.1 Drift of transfer meter - uncertainty u_{drift}

The uncertainty due to meter drift u_{drift} was quantified by performing repeated calibrations at pilot laboratory (Table 1 and Table 6), using the reference standard as described in Figure 1. For each calibration period a mean value was calculated (Figure 10 and Figure 11). The final values of u_{drift} (Table 10) were calculated by using Equation (20), separately for each flowmeter and flowrate.

$$u_{drift} = \frac{Max\ (x_i) - Min\ (x_i)}{2 \cdot \sqrt{3}} \tag{20}$$

where u_{drift} - Uncertainty (k = 1) due to long term stability of transfer meter (%)

x_i - Averaged and temperature corrected meter error (%)

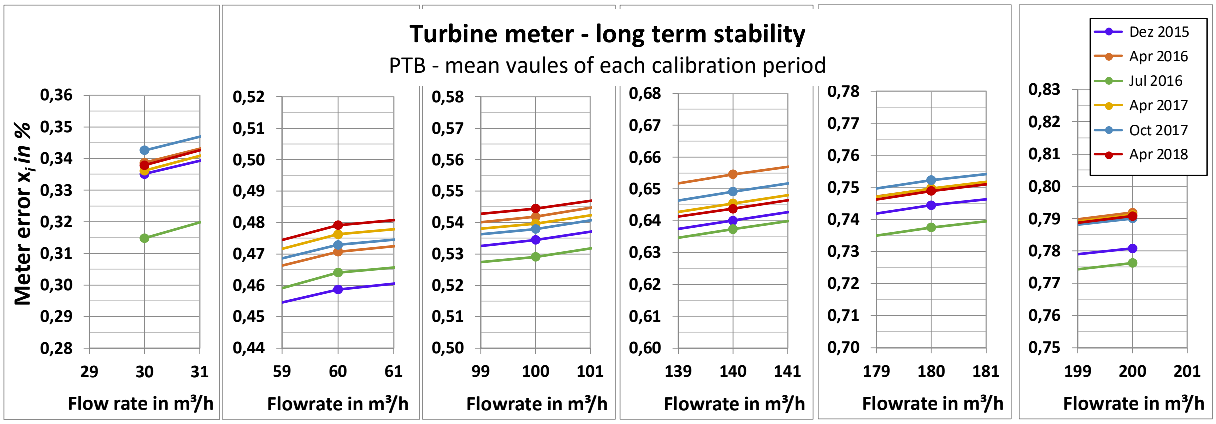


Figure 10: Long term stability of turbine meter - Mean values of temperature corrected meter error x_i for each calibration period, measured at PTB laboratory (day #1 until day# 3)

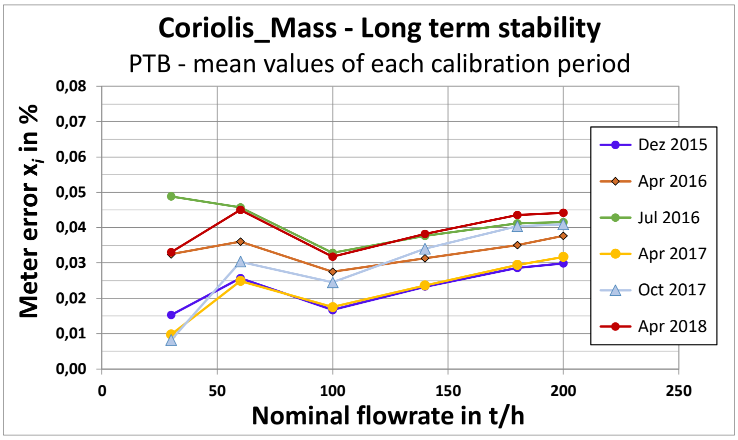


Figure 11: Long term stability of Coriolis_Mass - Mean values of temperature corrected meter error x_i for each calibration period, measured at PTB laboratory (day #1 until day# 3)

Table 10: Uncertainties u_{drift} caused by drift of meter error - turbine meter and Coriolis_Mass

	Nominal Flowrate					
k = 1	30 m³/h	60 m³/h	100 m³/h	140 m³/h	180 m³/h	200 m³/h
u_{drift} **Turbine meter in %**	0.008	0.006	0.004	0.005	0.004	0.005
u_{drift} **Coriolis_Mass in %**	0.012	0.006	0.005	0.004	0.004	0.004

6.2 Quantification of reproducibility - uncertainty u_{reprod}

The uncertainty due to reproducibility characteristics u_{reprod} of the transfer meter were estimated at pilot laboratory by calibrations on day #4 until day #6 (Table 6). For each period, a span of meter error $[max(x_i) - min\ (x_i)]$ was calculated (Figure 12). Because of non-normal distributed data, the uncertainty u_{reprod} was calculated separately for each flow rate by using maximum values of observed span (Equation 21). It was assumed that the final values of u_{reprod} (Table 11) did include the following sources of uncertainty: short term drift, setting of auto zero (at Coriolis meter) and reassembly of the transfer setup.

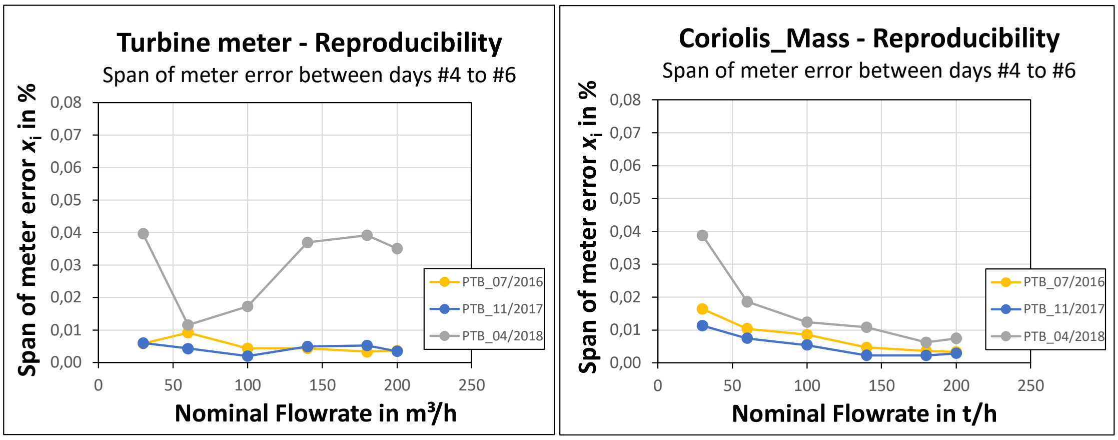


Figure 12: Results of reproducibility calibrations at pilot laboratory - Span of meter error (max - min) between calibration day #4 until day #6

$$u_{reprod} = \frac{max\ [max(x_i) - min\ (x_i)]}{2 \cdot \sqrt{3}} \qquad \textbf{(21)}$$

where u_{reprod} - Uncertainty (k = 1) due to reproducibility characteristics of transfer meter (%)

Table 11: Uncertainties u_{reprod} due to reproducibility characteristics of the transfer meters

	Nominal Flowrate					
k = 1	30 m³/h	60 m³/h	100 m³/h	140 m³/h	180 m³/h	200 m³/h
u_{reprod} **Turbine meter in %**	0.011	0.003	0.005	0.011	0.011	0.010
u_{reprod} **Coriolis_Mass in %**	0.011	0.005	0.004	0.003	0.002	0.002

6.3 Temperature dependency - uncertainty u_{temp}

Laboratory conditions

During calibrations in participating laboratories, the span of fluid temperature ranged between 10.95 °C and 30.10 °C. The maximum variation of fluid temperature within one participating lab, expressed as max(T_{fluid}) - min(T_{fluid}), was reported with 4.51 °C (Table 12, Figure 13).

Table 12: Fluid temperatures T_{fluid} (°C) in participating laboratories during calibrations

NMI	VSL	RISE	PTB 4	UME	NIST	CENAM	ITRI	NIM	NMIJ	KRISS
Max	18.16	20.26	20.27	17.30	24.55	25.22	30.10	27.22	14.44	11.78
Min	17.37	19.94	19.93	16.50	23.45	23.53	25.59	26.21	13.50	10.95
Max - Min	0.79	0.32	0.34	0.80	1.09	1.69	4.51	1.01	0.94	0.83
Mean	17.71	20.14	19.99	16.89	24.04	24.13	27.63	26.53	13.98	11.40

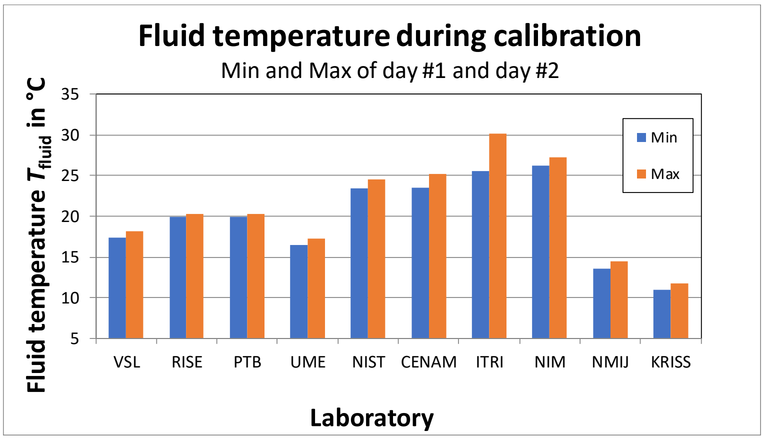


Figure 13: Fluid temperature T_{fluid} during calibrations in participating laboratories - Maximum and minimum of calibration on day #1 and day #2

Meter characteristics

The main temperature characterisation measurements were realised in pilot laboratory in 2013. The results were evaluated by calibrations in 2015 and 2019 (Table 7). The goal of characterisation measurements was to analyze meter error characteristics if the fluid temperature deviates from nominal temperature of 20 °C. Both meters showed a distinctive dependency of meter error due to changes in fluid temperature (Figure 14). The maximum range of +/-10 °C in fluid temperature T_{fluid} at participating laboratories (Figure 13), is followed by a maximum change in meter error for turbine meter with 0.055 %, respectively for Coriolis_Mass, with 0.077 %. This maximum amounts of meter error deviation would lead to a meter uncertainty u_{temp} (with k = 1) of 0.025 % for turbine meter and 0.033 % for Coriolis_Mass (Figure 17). Both high values of u_{temp} demonstrate the need of a temperature corrected meter error. The procedure of this correction was practiced as follows.

The correction is based on the relationship between a) deviation ΔT_{Fluid} (Equation 22) of current fluid temperature T_{Fluid} to nominal temperature T_{nom} and b) deviation Δe_{nom} (Equation 23) of meter error at current temperature conditions e to meter error e_{nom}, calibrated at nominal temperature. The relationship between ΔT and Δe_{nom} was analyzed separately for each transfer meter and flowrate by fitting a second-degree polynomial function using least squares fits (Figure 15). The resulting model parameter of Table (19) were used to calculate a correction value of meter error Δe_{cor} (Equation 24). Finally, the meter error e at current temperature conditions was corrected to meter error e_{cor} at nominal temperature conditions by applying Equation (25).

$$\Delta T_{fluid} = T_{fluid} - T_{nom} \quad \textbf{(22)}$$

where ΔT_{fluid} - Difference of current fluid temperature to nominal temperature of 20 °C (°C)
T_{fluid} - Current fluid temperature (°C)
T_{nom} - Nominal temperature of 20°C

$$\Delta e_{nom} = e - e_{nom} \quad \textbf{(23)}$$

where Δe_{nom} - Difference of meter error (%)
e - Meter error at current temperature conditions (%)
e_{nom} - Meter error at nominal temperature of 20 °C (%)

$$\Delta e_{cor} = a + b \cdot \Delta T_{fluid} + c \cdot \Delta T_{fluid}^2 \quad \textbf{(24)}$$

where Δe_{cor} - Correction value of meter error (%)
a, b, c - Parameter of fitted polynomial model (Table 13) (-)

$$e_{cor} = e - \Delta e_{cor} \quad \textbf{(25)}$$

where e_{cor} - Temperature corrected meter error (%)

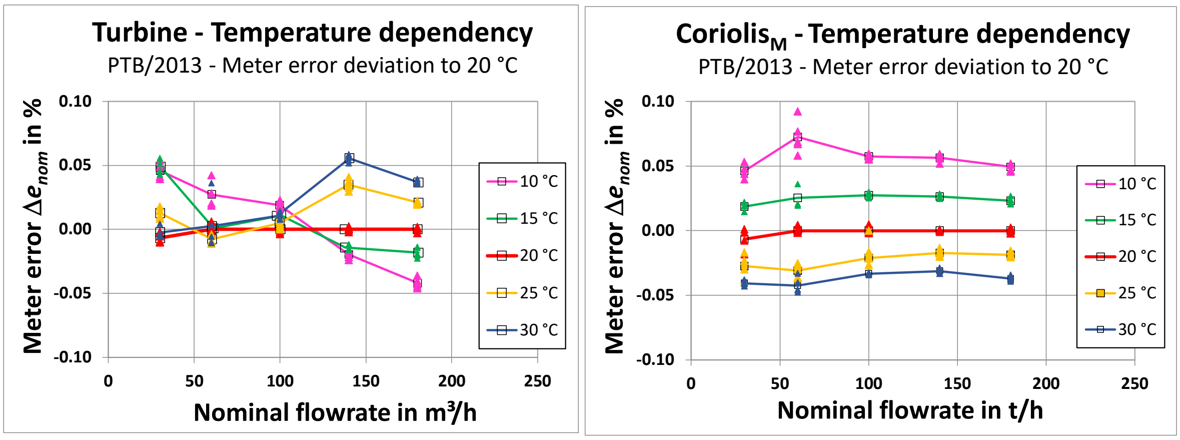


Figure 14: Temperature dependencies of turbine meter and Coriolis_Mass - Differences of meter error Δe_{nom}, expressed as results of Equation (23). All calibrations made at pilot laboratory/PTB in 2013.

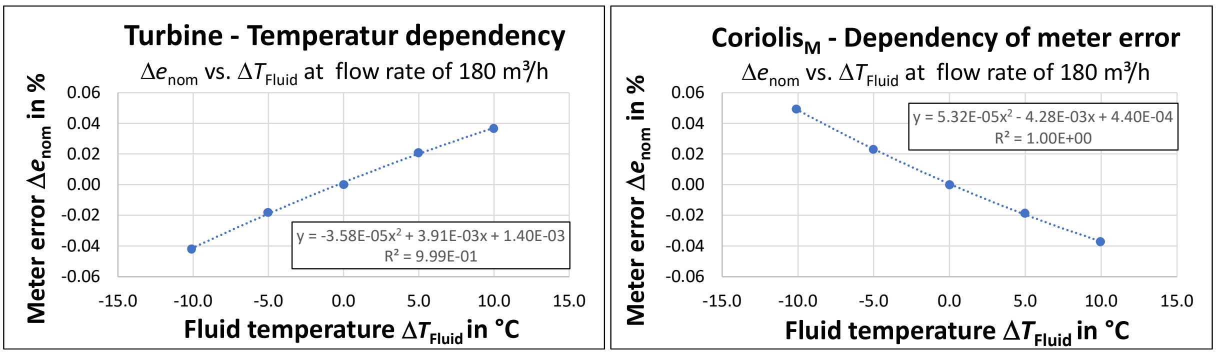


Figure 15: Temperature dependencies of Turbine meter and Coriolis_Mass - Example relationships between ΔT_{fluid} and Δe_{nom} at flowrate of 180 m³/h (Equation 22 and Equation 23) in order to estimate model parameters of Equation (24).

Table 13: Model Parameter for temperature dependent correction of meter error *e* by using Equation (13) until Equation (25). [(*)] Because no calibrations at 200 m³/h were made in 2013, parameter at flowrate of 200 m³/h were assumed to be equal to parameter at 180 m³/h.

	Turbine meter model parameter			**Coriolis_Mass model parameter**		
Nominal flowrate in m³/h	a	b	c	a	b	c
30	1.41E-02	-2.64E-03	1.09E-04	-6.69E-03	-4.38E-03	9.32E-05
60	-4.89E-03	-1.15E-03	1.89E-04	-4.44E-03	-5.71E-03	1.86E-04
100	2.89E-03	-4.52E-04	1.21E-04	-1.77E-05	-4.57E-03	1.18E-04
140	4.06E-03	3.97E-03	1.44E-04	9.29E-04	-4.36E-03	1.15E-04
180	1.40E-03	3.91E-03	-3.58E-05	4.40E-04	-4.28E-03	5.32E-05
200[(*)]	1.40E-03	3.91E-03	-3.58E-05	4.40E-04	-4.28E-03	5.32E-05

Meter uncertainty u_{temp}

The presented method was successfully applied during model evaluation by using the temperature characterisation measurements at pilot laboratory in 2015 and 2019 (Figure 17). Especially for Coriolis_Mass, a meter uncertainty reduction (u_{temp}) of up to 92 % was gained, if the meter error *e* was corrected by the described method. This clear improvement of u_{temp} over full flow scale can be explained by the distinctive temperature dependency of the Coriolis meter. Additionally, the low variations of u_{temp} between several evaluation years of 2013, 2015 and 2019 (Figure 17) underlines the long term stability of the investigated model parameters, presented in Table 13.
The calculation of u_{TS} itself is based on the following procedure and assumptions. The temperature range of reported laboratory data T_{fluid} does not exceed the investigated range of 20°C +/- 10 °C during characterisation measurements at pilot laboratory (Figure 13). As already discussed, within this range both meters showed a characteristic temperature sensitivity of meter error (Figure 14). The sensitivities of original meter error *e* and corrected meter error e_{cor} can also be expressed as specific model residuals $e_{residual}$ to mean values over all temperatures (Equation 26 and Figure 16). Maximum and minimum values of $e_{residual}$ were used to calculate u_{temp} with an assumption of a rectangular probability distribution (Equation 27).

The described procedure was practiced, separately for each flowrate and calibration period in 2013, 2015 and 2019. Based on corrected meter errors, the maximum uncertainties of the years 2013, 2015 and 2019 were used as final values for u_{temp} (Table 14).

For calculation of E_N values, all reported meter errors *(e_V and e_m)* of participating laboratories were corrected by the described method (Equation 22 until Equation 25).

$$e_{\mathrm{residual}} = e - e_{\mathrm{mean}} \qquad \textbf{(26)}$$

where $e_{residual}$ - Model residuals (%)
e_{mean} - Mean values of meter error at one flowrate over all temperatures (%)

$$u_{\mathrm{temp}} = \frac{max(e_{\mathrm{residual}}) - min(e_{\mathrm{residual}})}{2\sqrt{3}} \qquad \textbf{(27)}$$

where u_{temp} - Meter uncertainty caused by temperature effects (%)

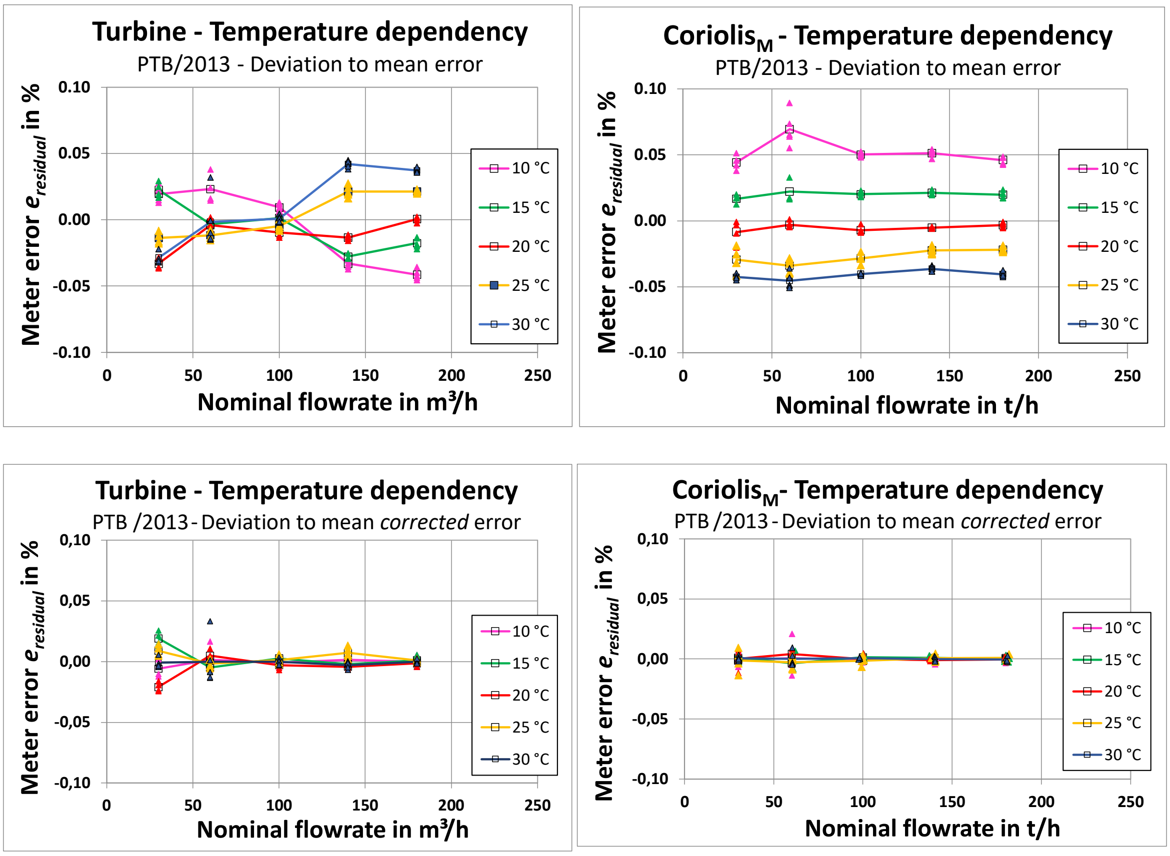


Figure 16: Temperature dependencies of Turbine meter and Coriolis_Mass - Residuals to mean values of Equation (26) for original meter error *e* and corrected meter error e_{cor}

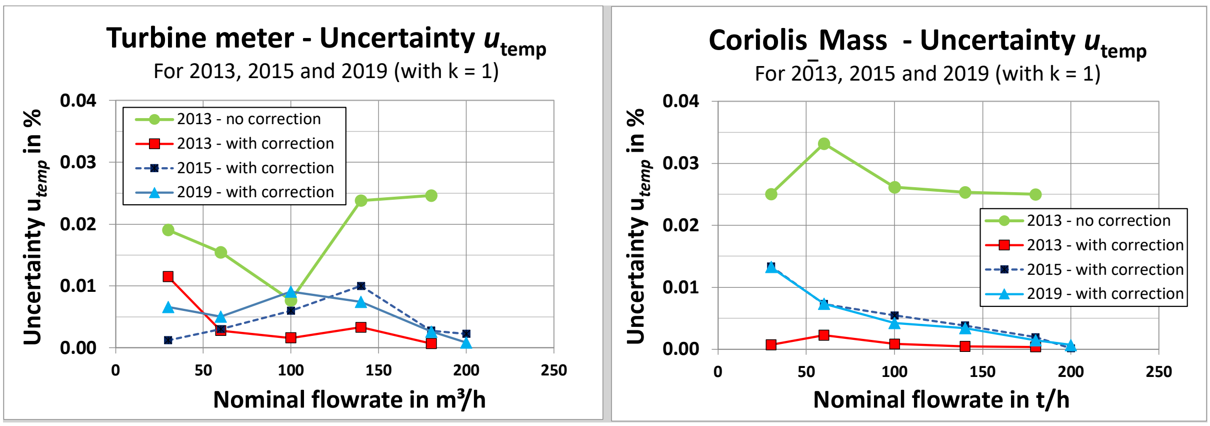


Figure 17: Meter uncertainties u_{temp} for turbine meter and Coriolis_Mass - based on **non corrected** meter error *e* for 2013, respectively, on **corrected** meter error e_{cor} for 2013, 2015 and 2019 by using Equation (22) until Equation (27).

Table 14: Final uncertainties of meter temperature sensitivity u_{temp}

Nominal flowrate	Uncertainty u_{temp} (k = 1)	
	Turbine meter	Coriolis_Mass
in m³/h	in %	in %
30	0.012	0.013
60	0.005	0.007
100	0.009	0.005
140	0.010	0.004
180	0.003	0.002
200	0.002	0.001

6.4 Pressure dependency - uncertainty u_{pres}

Laboratory conditions

The span of line pressure in participating laboratories p_{fluid} ranged between 0.33 bar and 3.29 bar (positive pressure after calibration setup), whereas 29 % of calibrations were made at line pressure between 2 bar and 1.5 bar and 11 % at line pressure < 1.5 bar (Figure 18).

Table 15: Line pressure p_{fluid} (bar) in participating laboratories during calibration

NMI	VSL	RISE	PTB 4	UME	NIST
Max	2.56	3.16	3.00	0.98	2.59
Min	1.65	2.98	2.99	0.33	1.64
Max - Min	0.91	0.18	0.01	0.65	0.95
Mean	2.05	3.07	3.00	0.56	1.98

NMI	CENAM	ITRI	NIM	NMIJ	KRISS
Max	3.00	4.47	2.30	2.36	2.83
Min	2.94	2.39	1.70	0.82	2.04
Max - Min	0.06	2.08	0.60	1.54	0.79
Mean	2.98	3.07	1.93	1.68	2.27

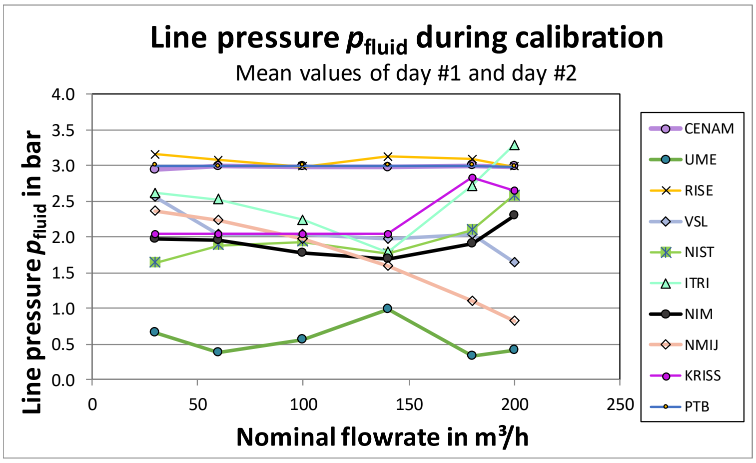


Figure 18: Line pressure during calibrations in participating laboratories - Mean values at each flowrate of calibration day #1 and day #2

Meter characteristics

Pressure dependencies of transfer meters were analyzed at pilot laboratory during characterisation measurements in 2013 and 2018 (Table 7). Due to technical restrictions, calibrations were only possible at line pressure between 2 bar and 4 bar. For data analysis, mean values over all pressure rates were calculated, separately for each calibration period and flowrate. Both meters showed a very low sensitivity to changes in line pressure (Figure 19 and Figure 20).

The deviations of meter error to mean values, expressed as residuals, were calculated separately for each calibration period. For a final analysis, these residuals were averaged over both calibration periods for each pressure rate (Figure 21). For pressure differences of +/- 1 bar, the sensitivity of meter error does not exceed +/- 0.02 % for turbine meter and +/- 0.01 % for Coriolis_mass.

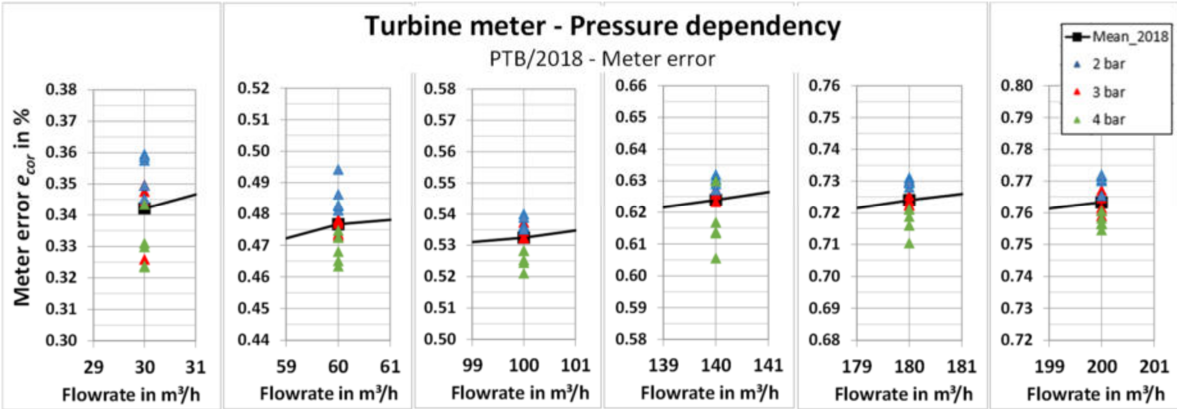


Figure 19: Pressure dependencies of turbine meter - Calibration results and mean values of characterization measurements at pilot laboratory in 2018

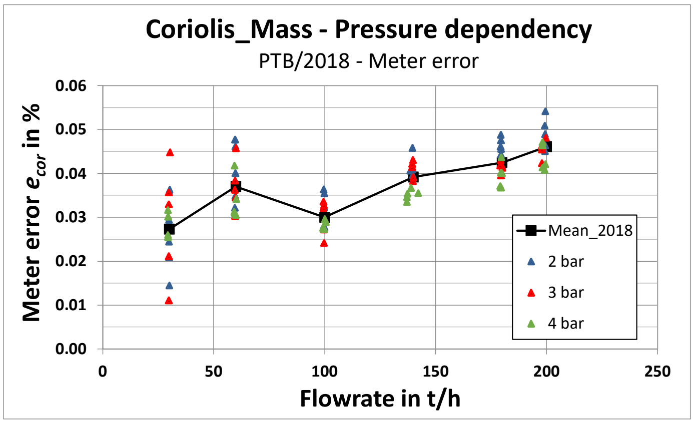


Figure 20: Pressure dependencies of Coriolis_Mass during characterisation measurements at pilot laboratory in 2018 - temperature corrected meter error and mean values

Meter uncertainty u_{pres}

For uncertainty calculation of u_{pres} it was assumed that the following conservative estimation of meter sensitivities do include the pressure range between 0.33 bar and 2 bar of reported data (Figure 18). The pressure sensitivities were treated as uncertainty contribution for turbine meter by u_{pres} = 0.020 % / $\sqrt{3}$ and for Coriolis by u_{pres} = 0.010 % / $\sqrt{3}$, based on a rectangular probability distribution.

The described method gave constant values for turbine meter (u_{pres} = 0.012 %) and Coriolis (u_{pres} = 0.006 %), which were used for full investigated flow scale. For final calculation of E_N values, no pressure corrections were made to the data submitted by participating laboratories.

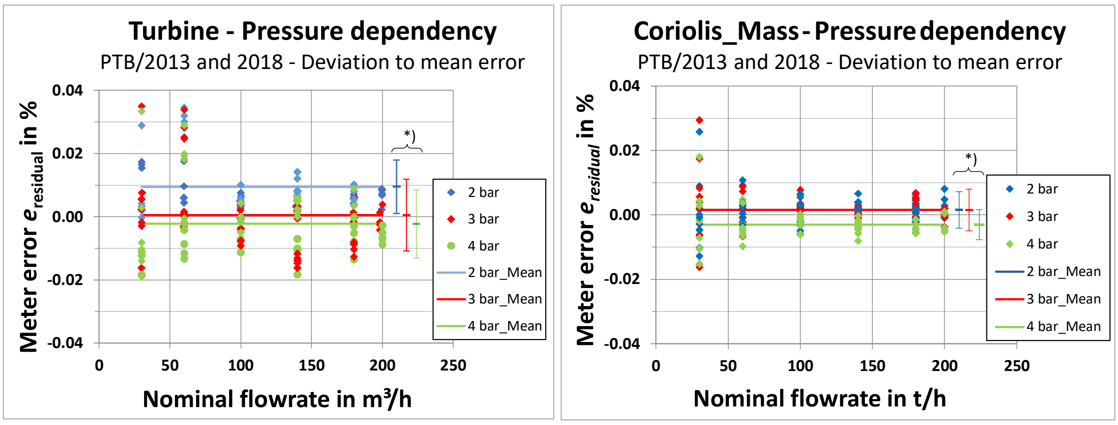


Figure 21: Pressure dependencies of turbine meter and Coriolis_Mass - residuals to mean values of temperature corrected meter error e_{cor}. *) represents the standard deviation of e_{cor} for each pressure rate

6.5 Dependency on flow stability - uncertainty u_{flow}

Laboratory conditions

For data analysis of flow stability, the deviations of reference flow between pilot laboratory and participating laboratories were used. The mean values of these differences did not exceed +/-3 % of flowrate at pilot laboratory (Figure 22).

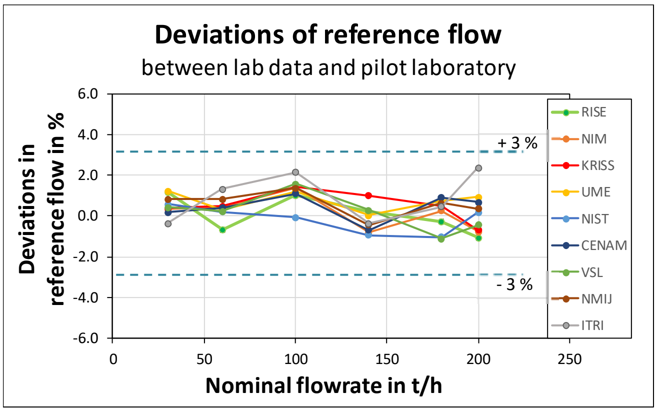


Figure 22: Flow stability $\dot{m}$ (t/h), expressed as deviations in reference flow between pilot laboratory (07/2015) and reported values of participating laboratories

Meter characteristics

For analyzing meter error sensitivity to changes in flowrate, calibration results at reference laboratory were evaluated. Between single calibration points, the meter error of a standard calibration (T_{fluid} = 20 °C, p_{fluid} = 3 bar) was linear interpolated. Within this model, the sensitivities of meter error were estimated by varying flowrates to maximum values of +/- 5.0 % with a resolution of 0.5 % (Figure 23). Based on the previously discussed maximum limits in flowrate stability of +/- 3 % (Figure 22), the turbine meter showed a maximum sensitivity in meter error of +/- 0.005 %. The Coriolis was much less sensitive, with values lower than +/- 0.001 % (Figure 23).

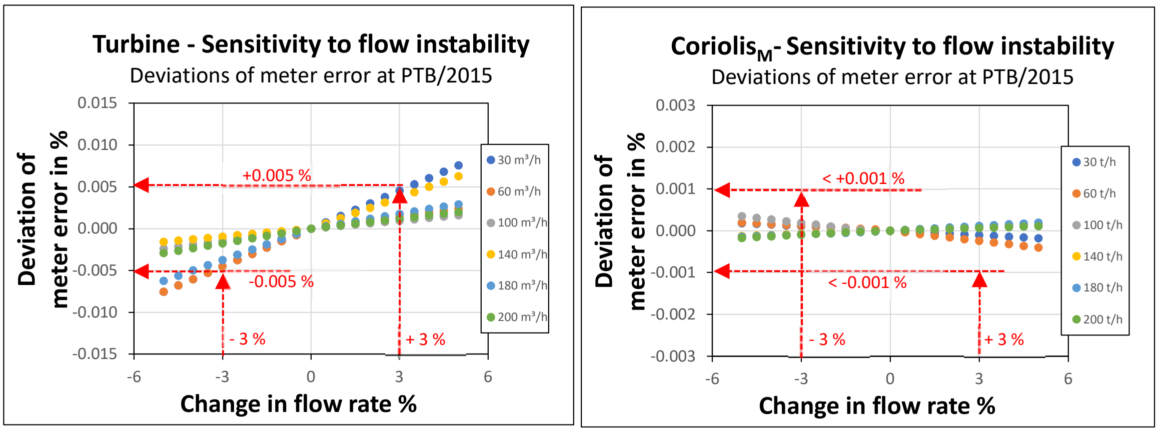


Figure 23: Sensitivity of transfer meters to flow instability - based on PTB data set 07/2015

Meter uncertainty u_{flow}

The estimated maximum values of flow meter sensitivity were used for calculation of u_{flow}. The flow stability sensitivities were treated as a rectangular uncertainty contribution, for turbine meter with u_{flow} = 0.005 % / $\sqrt{3}$ and for Coriolis by u_{flow} = 0.001 % / $\sqrt{3}$, based on a rectangular distribution. It was assumed, that the results for turbine meter (u_{flow} = 0.003 %) and Coriolis (u_{flow} = 0.001 %) are valid for full investigated flow scale. For final calculation of E_N values, no flow stability corrections were made to the data submitted by participating laboratories.

6.6 Dependency of inflow conditions to Turbine meter - uncertainty u_{inflow}

Laboratory conditions

The span of undisturbed inflow length in participating laboratories ranged between 3.0 m and 15.0 m. Typical fittings like valves, tube bundle or elbows were installed at the inflow of calibration line (Table 16).

Table 16: Reported inflow lengths of undisturbed flow and pipe installation at the inflow of calibration line in participating laboratories

NMI	VSL	RISE	PTB	UME	NIST
Undisturbed inflow length	9 m	5.7 m	8.5 m	15 m	15 m
Pipe installation before inflow	valve	90° elbow, flow conditioner	tube bundle, line reducer	valve	valve, elbow

NMI	CENAM	ITRI	NIM	NMIJ	KRISS
Undisturbed inflow length	8 m	3 m	3.3 m	7 m	8 m
Pipe installation before inflow	line reducer, valve	tube bundle, line reducer	filter	line reducer	header, valve, tube bundle

Turbine meter characteristics

For analyzing meter error sensitivity to different inflow conditions, additional calibrations at pilot laboratory were evaluated (Chapter 4.3). All used flow disturber showed a clear influence to the meter error of turbine meter. In comparison to calibrations without any flow disturber, the maximum observed shift of meter error (Figure 24) in positive direction was +0.167 % (disturber type: swirl right oriented, inflow length: 2 m), in negative direction -0.092 % (disturber type: 2nd turbine meter, inflow length: 4 m). For a maximum investigated inflow length of 8 m, the highest shift in meter error was observed with a right oriented swirl (+0.085 %).

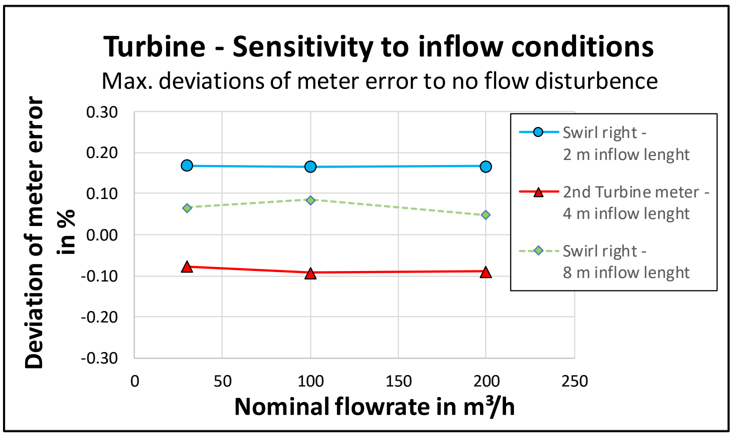


Figure 24: Maximum observed values of turbine meter sensitivity to different flow disturber and inflow length - based on PTB calibrations in 03/2019

Meter uncertainty u_{inflow}

The goal of this investigation was, to quantify the influence of different inflow conditions to calibration characteristics of the turbine meter. This research was necessary due to significant differences in turbine meter calibrations of participating laboratories. Whereas, the maximum span of Coriolis meter error between laboratories reached only 0.105 % (Figure 48), the results of turbine meter differed up to 0.395 % (Figure 26).
Such differences could not be explained by a standard estimation of meter uncertainties. Behind this background an additional uncertainty parameter (u_{inflow}) was introduced for the turbine meter.

With reference to the minimum reported inflow length of 3 m at participating laboratories (Table 16), the maximum observed meter error deviation at 2 m inflow length (Figure 24) was used for the estimation of turbine meter sensitivity u_{inflow}. The inflow sensitivity was treated as a rectangular uncertainty contribution with $u_{\text{inflow}} = 0.167\ \% / \sqrt{3} = 0.096\ \%$.

It was assumed, that the results of $u_{\text{inflow}} = 0.096\ \%$ are valid for full investigated flow scale. For final calculation of E_N values, no corrections for different inflow conditions were made to the submitted data of turbine meter.

6.7 Dependency of hysteresis effect - uncertainty u_{hyst}

Laboratory conditions

Depending on the working procedure of the participating laboratories, the transfer meter could be subjected to different warming up flowrates and periods. Within the technical protocol no specifications were given about warming up procedures before starting the standard calibration program of KC1.

Meter characteristics

For analyzing meter error sensitivities to hysteresis effect, calibration data of participating flow laboratory at NIM were used. During these tests, it was found that K_V of turbine meter drifted to smaller value after long time running at high flow rate (Test B of Table 17), but the value of K_V got back when the turbine was retested after zero flow rate for a while (Test A). At low flow rates between 30 m³/h and 100 m³/h, the drift reached values up to 0.128 %, which underlines the importance of this additional source of measurement uncertainty.

Table 17: Results of hysteresis effect calibrations under different types of warming up procedures (flow rates) - mean values of K_V and K_m were calibrated at flow laboratory of NIM in September 2017.

	Turbine meter			Coriolis_Mass		
Nominal flowrate in m³/h	**Test A**	**Test B**	**ΔK_V Test A / Test B**	**Test A**	**Test B**	**ΔK_m Test A / Test B**
	K_V in pulses/L	K_V in pulses/L	in %	K_m in pulses/kg	K_m in pulses/kg	in %
30	6.6505	6.6420	0.128	99.9981	99.9984	0.000
60	6.6596	6.6549	0.071	100.0045	99.9990	0.005
100	6.6659	6.6627	0.048	100.0133	100.0049	0.008
140	6.6725	6.6708	0.025	100.0110	100.0078	0.003
180	6.6777	6.6776	0.001	100.0107	100.0114	-0.001
200	6.6797	6.6812	-0.022	100.0128	100.0161	-0.003

Test A: After about 15min warming up at about 140 m³/h, with a test sequence **30 m³/h to 200 m³/h.**

Test B: After about 15min warming up at about 140 m³/h, with a test sequence **200 m³/h to 30 m³/h**.

Meter uncertainty u_{hyst}

For Coriolis meter, the differences ΔK_m of both testing modes (Table 17) were within the uncertainty ranges of u_{reprod} (Table 9) and were interpreted as negligible. But, there was an obviously change of K_V for Turbine meter, especially at low flow rates between 30 m³/h and 100 m³/h, by $\Delta K_V > 0.12\ \%$ (Table 17). Behind this background the additional uncertainty u_{hyst} for Turbine meter was introduced. Under the assumption of a rectangular distribution, the uncertainty u_{hyst} was estimated by using Equation (28). The results of u_{hyst} are presented in Table 18. For final calculation of E_N values, no correction for hysteresis effect were made to the data submitted by participating laboratories.

$$u_{\mathrm{hyst}} = \frac{\Delta K_{\mathrm{V}}}{\sqrt{3}} \tag{28}$$

where ΔK_V - Difference between testing modes A and B of Table 17 (%)

Table 18: Final uncertainties of turbine meter sensitivity to hysteresis effect u_{hyst}

Nominal flow rate	**Uncertainty** u_{hyst} (k = 1) **Turbine meter**
in m³/h	in %
30	0.074
60	0.041
100	0.028
140	0.015
180	0.001
200	0.013

7 Evaluation of comparison results

7.1 Ambient air temperature

Laboratory conditions

The span of air temperature in participating laboratories ranged between 18.24 °C and 32.31 °C. The maximum variation of air temperature within a participating lab, expressed as max(T_{air}) - min(T_{air}), was reported with 5.40 °C (Table 19, Figure 25).

Table 19: Air temperatures T_{air} (°C) in participating laboratories during calibrations on day#1 and day#2. *) only constant values were reported

NMI	VSL	RISE	PTB 4	UME *)	NIST	CENAM	ITRI	NIM	NMIJ	KRISS
Max	20.97		23.24	22.60	24.50	22.60	32.31	27.10	20.89	23.90
Min	20.36		22.34	22.60	23.90	19.57	31.22	23.70	18.24	18.50
Max - Min	0.61		0.90		0.60	3.03	1.09	3.40	2.65	5.40
Mean	20.54		23.06	22.60	24.02	20.98	31.45	23.70	19.66	18.57

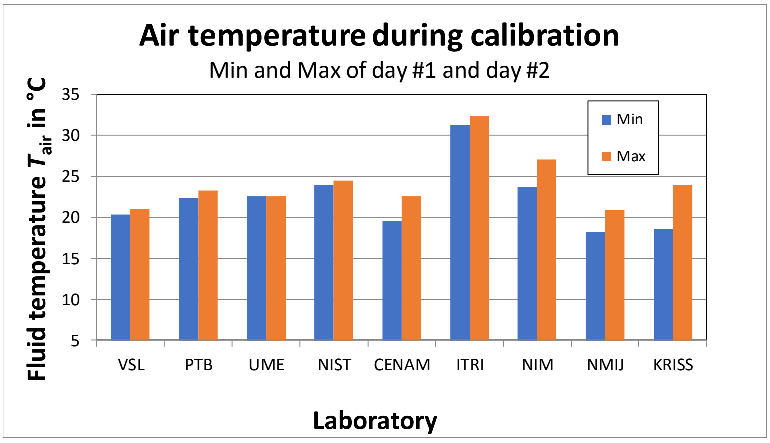


Figure 25: Air temperature T_{air} during calibrations in participating laboratories - maximum and minimum of calibration day #1 and day #2

7.2 Turbine transfer meter

7.2.1 Summarized results

Laboratory results

Table 20: Relative measurement error x_i (%) of turbine meter at participating laboratories - temperature corrected mean values of day #1 and day #2

Flowrate in m³/h	VSL	RISE	UME	PTB 4	NIST	CENAM	ITRI	NIM	NMIJ	KRISS
30	0.278	0.220	0.317	0.313		0.002	0.421	0.252	0.292	0.268
60	0.411	0.354	0.440	0.465		0.379	0.561	0.399	0.410	0.376
100	0.495	0.420	0.510	0.527		0.450	0.663	0.489	0.497	0.457
140	0.611	0.504	0.545	0.634		0.512	0.743	0.553	0.595	0.560
180	0.727	0.601	0.633	0.736		0.595	0.864	0.647	0.705	0.677
200	0.771	0.637	0.672	0.775		0.619	0.903	0.682	0.745	0.727

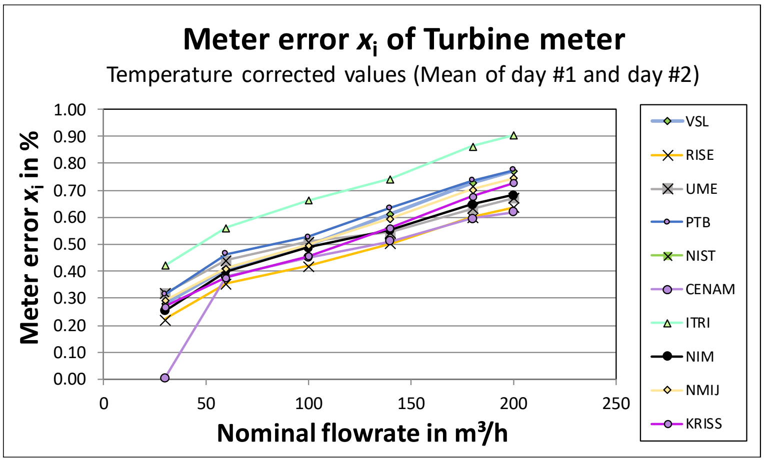


Figure 26: Relative measurement error x_i of turbine meter at participating laboratories - temperature corrected mean values of day #1 and day #2

KCRV, *U*(*KCRV*) and E_N-Value

The weighted mean y and its uncertainty $u(y)$ was calculated based on all laboratory data of calibration day #1 and day #2. The results of $\frac{(x_i - y)^2}{u^2(x_i)}$ and consistency check as well as the *KCRV* are summarized in Table 21 and Table 22.

Table 21: Results of $\frac{(x_i - y)^2}{u^2(x_i)}$ for each participating laboratory for turbine meter

Flowrate in m³/h	VSL	RISE	UME	PTB 4	NIST	CENAM	ITRI	NIM	NMIJ	KRISS
30	0.015	0.111	0.180	0.166		4.331	1.596	0.007	0.056	0.002
60	0.012	0.386	0.026	0.159		0.159	1.671	0.047	0.012	0.176
100	0.004	0.594	0.007	0.064		0.244	2.434	0.015	0.002	0.180
140	0.064	0.612	0.148	0.242		0.525	2.428	0.101	0.009	0.057
180	0.146	0.724	0.279	0.235		0.876	3.067	0.166	0.026	0.012
200	0.194	0.755	0.273	0.239		1.156	3.069	0.194	0.032	0.000

Table 22: Results of chi-squared test and *KCRV*-value for turbine meter

Flowrate	$\chi^2(\nu)$	χ^2_{obs}	Results of chi-squared test	*KCRV*	*U*(*KCRV*) (*k* = 2)
in m³/h				in %	in %
30	15.51	6.46	passed	0.263	0.084
60	15.51	2.65	passed	0.422	0.072
100	15.51	3.54	passed	0.502	0.070
140	15.51	4.19	passed	0.585	0.068
180	15.51	5.53	passed	0.688	0.067
200	15.51	5.91	passed	0.727	0.068

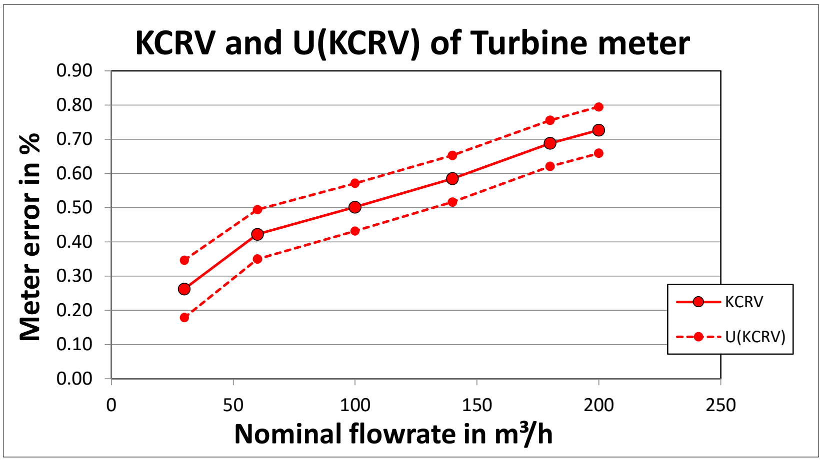


Figure 27: Key Comparison Reference value (KCRV) and its expanded uncertainty *U*(KCRV) for turbine meter, with k = 2

The degree of equivalence value E_N is a measure of result agreement of each participating laboratory to the KCRV. Expressed as the normalized differences of "lab to KCRV", the final E_N values of turbine meter are summarized in Table 23 and Figure 28. All results of participating laboratories confirmed to the consistency check of chi-squared test (Table 22). No extractions of laboratory results were made. All laboratories complied with the E_N criteria of < 1.2.

Table 23: Summary of E_N-values for turbine meter of each participating laboratory

Flowrate in m³/h	VSL	RISE	UME	PTB 4	NIST	CENAM	ITRI	NIM	NMIJ	KRISS
30	0.07	0.18	0.22	0.22		1.10	0.67	0.04	0.13	0.02
60	0.06	0.33	0.08	0.21		0.21	0.69	0.11	0.06	0.22
100	0.04	0.41	0.04	0.13		0.26	0.83	0.07	0.02	0.22
140	0.13	0.41	0.20	0.26		0.38	0.83	0.17	0.05	0.13
180	0.20	0.45	0.28	0.26		0.50	0.93	0.22	0.09	0.06
200	0.23	0.46	0.28	0.26		0.57	0.93	0.23	0.09	0.00

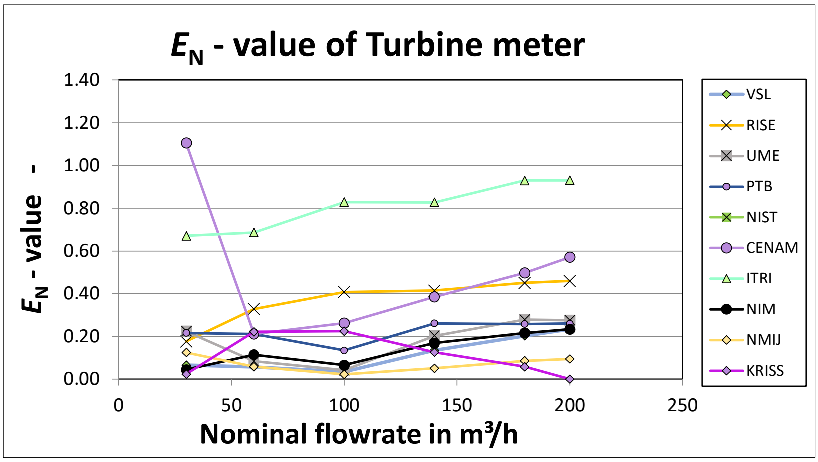


Figure 28: Summarized E_N-values of participating laboratories for turbine meter

Conclusive tests of comparison results $u_{comp}/u_{base,i}$

Based on [3], for a conclusive proof of participant results and an agreement with the *KCRV*, the comparison uncertainty ratio $u_{comp}/u_{base,i}$ should be < 2.

Results from all participating laboratories couldn`t comply with this limit (Table 24). For the purpose of KC1 the uncertainty u_{comp} of turbine meter was too high. A calibration of turbine meter gave for all laboratories inconclusive results. Finally, the meter was not suitable for a confirmation of the declared CMC values.

Table 24: Summarized results of conclusive proof $u_{comp}/u_{base,i}$ of each participating laboratory for turbine meter - * represents inconclusive data

Flowrate in m³/h	VSL	RISE	UME	PTB 4	NIST	CENAM	ITRI	NIM	NMIJ	KRISS
30	5.48 *	4.11 *	3.55 *	12.34 *		6.51 *	6.17 *	4.94 *	5.88 *	4.11 *
60	4.70 *	3.52 *	3.03 *	10.57 *		5.56 *	5.29 *	4.23 *	5.04 *	3.53 *
100	4.52 *	3.39 *	2.92 *	10.17 *		5.35 *	5.08 *	4.07 *	4.84 *	3.39 *
140	4.42 *	3.32 *	2.85 *	9.95 *		5.24 *	4.97 *	3.98 *	4.74 *	3.32 *
180	4.35 *	3.26 *	2.81 *	9.80 *		5.16 *	4.90 *	3.92 *	4.66 *	3.27 *
200	4.39 *	3.29 *	2.82 *	9.87 *		5.19 *	4.93 *	3.95 *	4.70 *	3.29 *

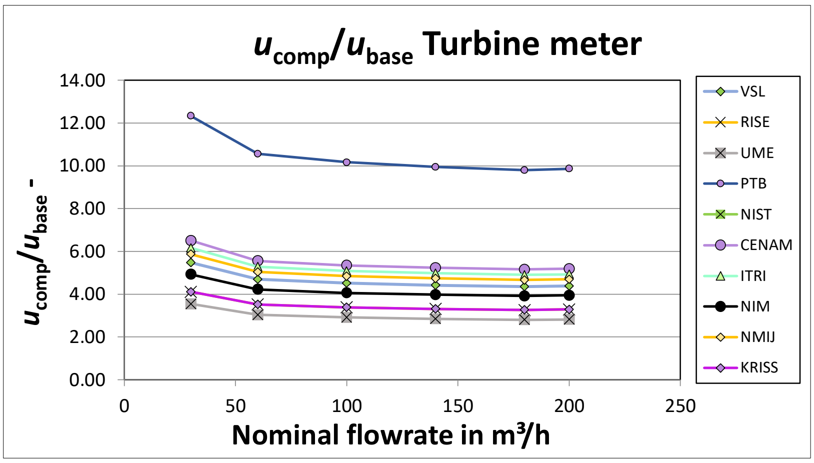


Figure 29: Summarized results of conclusive proof $u_{comp}/u_{base,i}$ of each participating laboratory for turbine meter

7.2.2 Final CMC-decision tables for participating laboratories

VSL - laboratory (Netherlands)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 25), because of inconclusive data - at all calibrated flowrates the ratio of u_{comp}/u_{base} was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

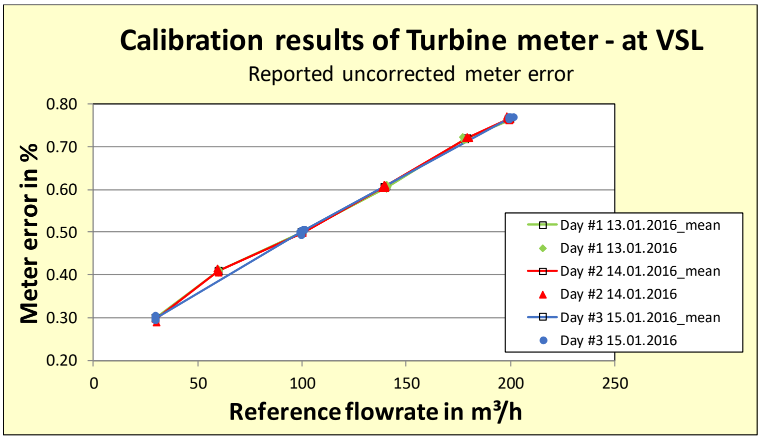


Figure 30: Calibration results of VSL laboratory for turbine meter - reported uncorrected meter error e_V

Table 25: Comparison decision table for VSL (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - * represents inconclusive data

	VSL / Netherlands						
Nominal flowrate	Relative measure-ment error	Expanded laboratory uncertainty	Expanded measurement uncertainty	Degree of equivalence	*Normalized degree of equivalence*	$u_{comp}/u_{base,i}$	CMC decision status
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in m³/h	in %	in %	in %	-	-	-	
30	0.278	0.045	0.251	0.016	0.07	5.48 *	inconclusive
60	0.411	0.045	0.216	-0.012	0.06	4.70 *	inconclusive
100	0.495	0.045	0.208	-0.007	0.04	4.52 *	inconclusive
140	0.611	0.045	0.204	0.026	0.13	4.42 *	inconclusive
180	0.727	0.045	0.201	0.038	0.20	4.35 *	inconclusive
200	0.771	0.045	0.202	0.045	0.23	4.39 *	inconclusive

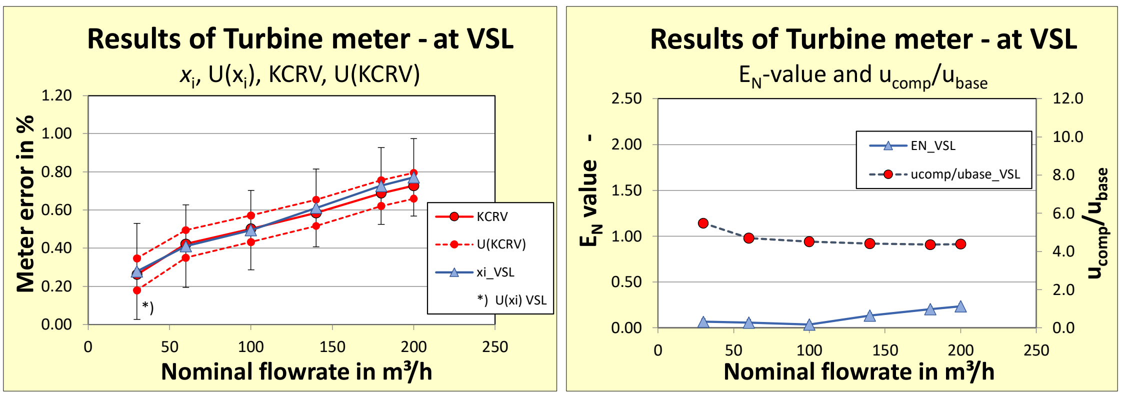


Figure 31: Comparison results of VSL laboratory for turbine meter

RISE - laboratory (Sweden)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 26), because of inconclusive data - at all calibrated flowrates the ratio of u_{comp}/u_{base} was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

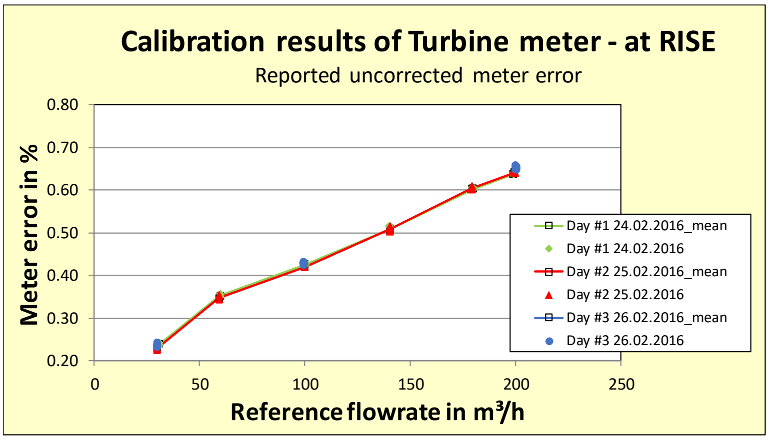
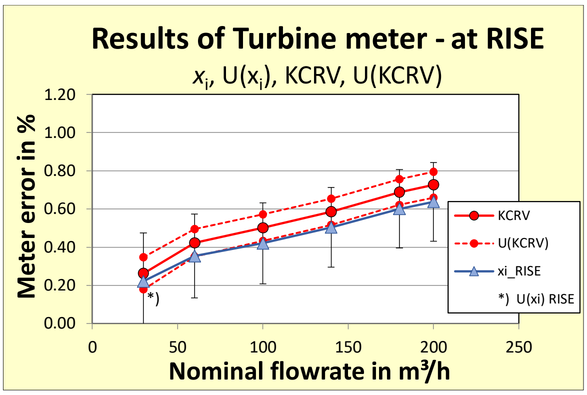


Figure 32: Calibration results of RISE laboratory for turbine meter - reported uncorrected meter error e_V

Table 26: Comparison decision table for RISE (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - * represents inconclusive data

	RISE / Sweden						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	u_{comp}/u_{base}	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in m³/h	in %	in %	in %	-	-	-	
30	0.220	0.060	0.254	-0.042	0.18	4.11 *	inconclusive
60	0.354	0.060	0.220	-0.068	0.33	3.52 *	inconclusive
100	0.420	0.060	0.212	-0.082	0.41	3.39 *	inconclusive
140	0.504	0.060	0.208	-0.081	0.41	3.32 *	inconclusive
180	0.601	0.060	0.205	-0.087	0.45	3.26 *	inconclusive
200	0.637	0.060	0.206	-0.090	0.46	3.29 *	inconclusive



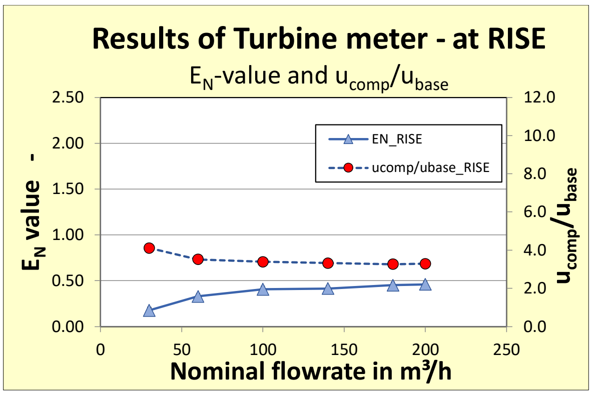


Figure 33: Comparison results of RISE laboratory for turbine meter

UME - laboratory (Turkey)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 27), because of inconclusive data - at all calibrated flowrates the ratio of u_{comp}/u_{base} was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

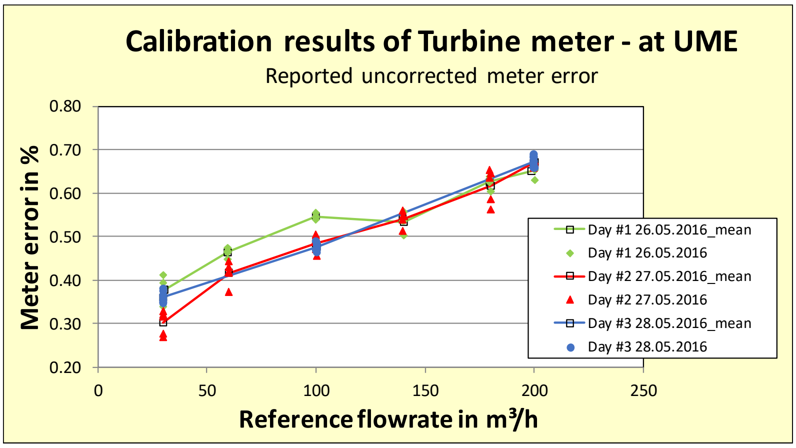


Figure 34: Calibration results of UME for turbine meter - reported uncorrected meter error e_V

Table 27: Comparison decision table for UME (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - * represents inconclusive data

	UME / Turkey						
Nominal flowrate	Relative measure-ment error	Expanded laboratory uncertainty	Expanded measurement uncertainty	Degree of equivalence	*Normalized degree of* equivalence	u_{comp}/u_{base}	CMC decision status
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in m³/h	in %	in %	in %	-	-	-	
30	0.317	0.070	0.258	0.055	0.22	3.55 *	inconclusive
60	0.440	0.070	0.223	0.018	0.08	3.03 *	inconclusive
100	0.510	0.070	0.216	0.009	0.04	2.92 *	inconclusive
140	0.545	0.070	0.211	-0.041	0.20	2.85 *	inconclusive
180	0.633	0.070	0.209	-0.055	0.28	2.81 *	inconclusive
200	0.672	0.070	0.210	-0.055	0.28	2.82 *	inconclusive

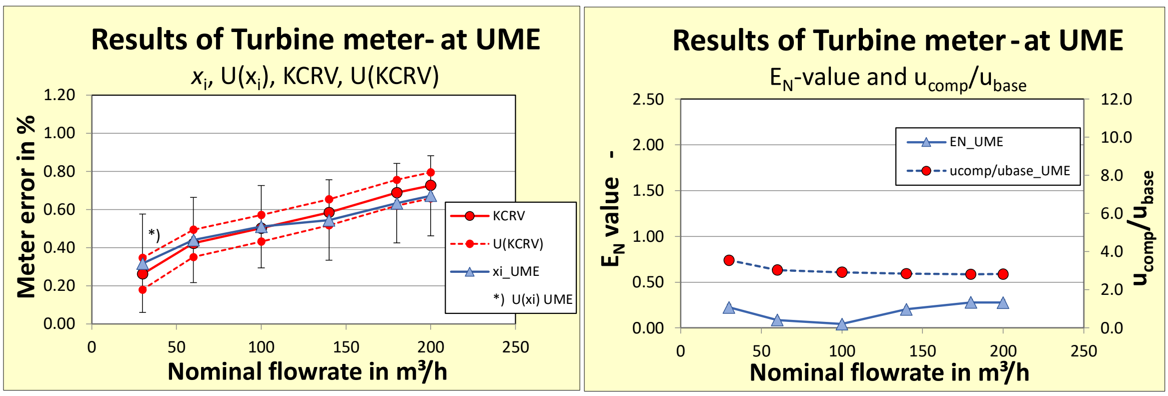


Figure 35: Comparison results of UME laboratory for turbine meter

PTB - laboratory (Germany)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 28), because of inconclusive data - at all calibrated flowrates the ratio of u_{comp}/u_{base} was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

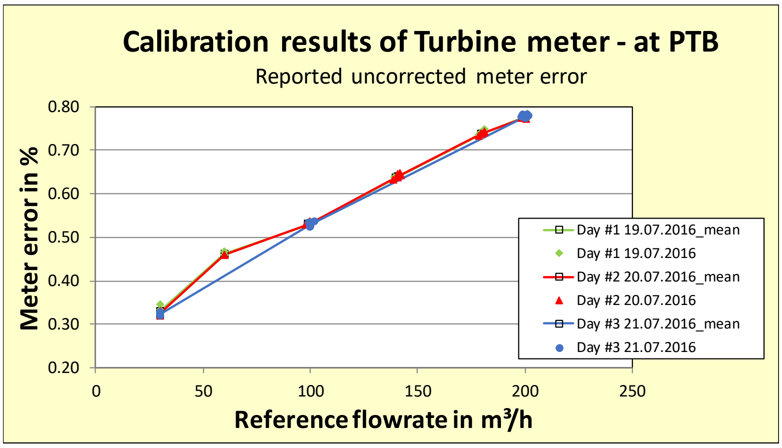
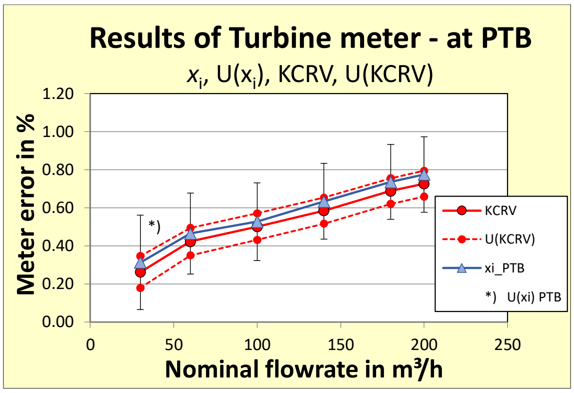


Figure 36: Calibration results of PTB for turbine meter - reported uncorrected meter error e_V

Table 28: Comparison decision table for PTB (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - * represents inconclusive data

	PTB / Germany						
Nominal flowrate	Relative measure-ment error	Expanded laboratory uncertainty	Expanded measurement uncertainty	Degree of equivalence	*Normalized degree of* equivalence	u_{comp}/u_{base}	CMC decision status
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in m³/h	in %	in %	in %	-	-	-	
30	0.313	0.020	0.248	0.050	0.22	12.34 *	inconclusive
60	0.465	0.020	0.212	0.042	0.21	10.57 *	inconclusive
100	0.527	0.020	0.204	0.026	0.13	10.17 *	inconclusive
140	0.634	0.020	0.200	0.049	0.26	9.95 *	inconclusive
180	0.736	0.020	0.197	0.048	0.26	9.80 *	inconclusive
200	0.775	0.020	0.198	0.048	0.26	9.87 *	inconclusive



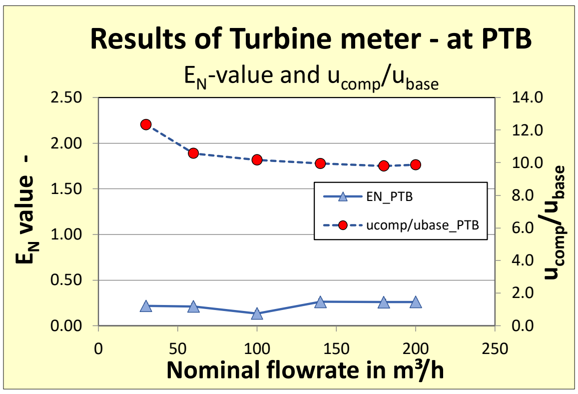


Figure 37: Comparison results of PTB laboratory for turbine meter

CENAM - laboratory (Mexico)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 29), because of inconclusive data - at all calibrated flowrates the ratio of u_{comp}/u_{base} was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

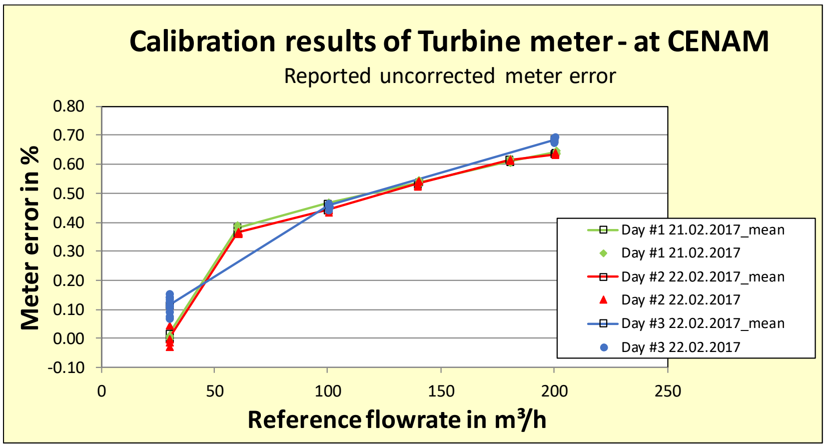


Figure 38: Calibration results of CENAM laboratory for turbine meter - reported uncorrected meter error e_V

Table 29: Comparison decision table for CENAM (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - * represents inconclusive data, ** represents data at warning level

	CENAM / Mexico						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	u_{comp}/u_{base}	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in m³/h	in %	in %	in %	-	-	-	
30	0.002	0.038	0.250	-0.260	1.10 **	6.51 *	inconclusive
60	0.379	0.038	0.215	-0.043	0.21	5.56 *	inconclusive
100	0.450	0.038	0.207	-0.051	0.26	5.35 *	inconclusive
140	0.512	0.038	0.203	-0.073	0.38	5.24 *	inconclusive
180	0.595	0.038	0.200	-0.093	0.50	5.16 *	inconclusive
200	0.619	0.038	0.201	-0.108	0.57	5.19 *	inconclusive

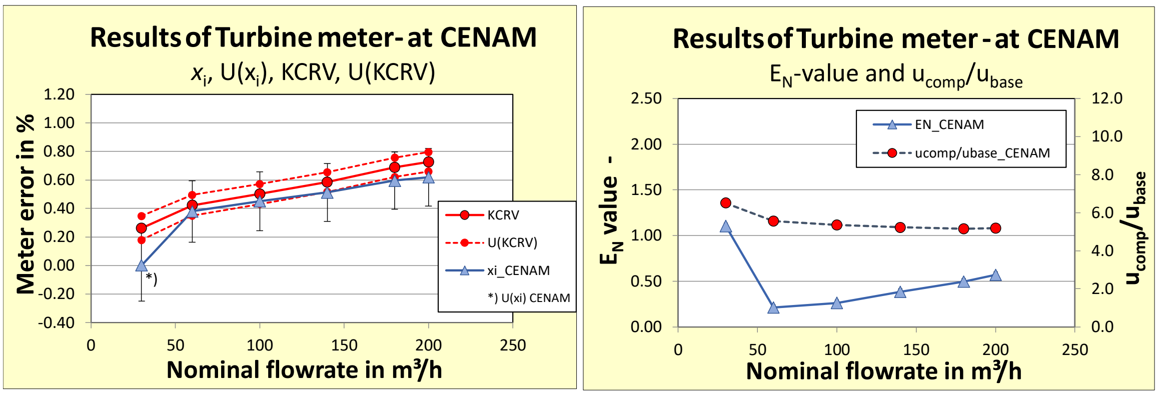


Figure 39: Comparison results of CENAM laboratory for turbine meter

ITRI - laboratory (Chinese Taipei)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 30), because of inconclusive data - at all calibrated flowrates the ratio of u_{comp}/u_{base} was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

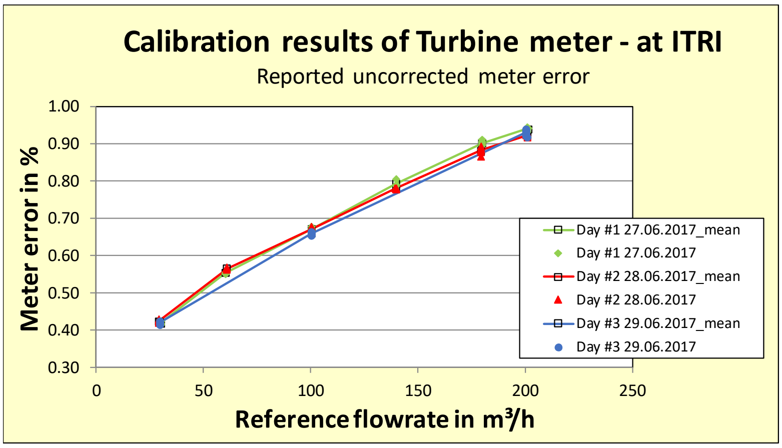


Figure 40: Calibration results of ITRI laboratory for turbine meter - reported uncorrected meter error e_V

Table 30: Comparison decision table for ITRI (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - * represents inconclusive data

	ITRI / Chinese Taipei						
Nominal flowrate	Relative measure-ment error	Expanded laboratory uncertainty	Expanded measurement uncertainty	Degree of equivalence	*Normalized degree of equivalence*	u_{comp}/u_{base}	CMC decision status
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in m³/h	in %	in %	in %	-	-	-	
30	0.421	0.040	0.250	0.158	0.67	6.17 *	inconclusive
60	0.561	0.040	0.215	0.139	0.69	5.29 *	inconclusive
100	0.663	0.040	0.207	0.162	0.83	5.08 *	inconclusive
140	0.743	0.040	0.203	0.158	0.83	4.97 *	inconclusive
180	0.864	0.040	0.200	0.175	0.93	4.90 *	inconclusive
200	0.903	0.040	0.201	0.176	0.93	4.93 *	inconclusive

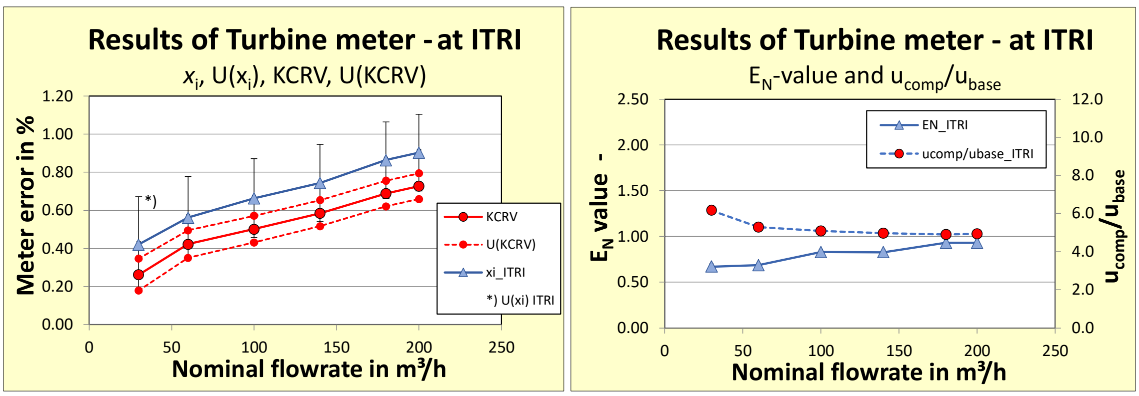


Figure 41: Comparison results of ITRI laboratory for turbine meter

NIM - laboratory (P.R. China)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 31), because of inconclusive data - at all calibrated flowrates the ratio of u_{comp}/u_{base} was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

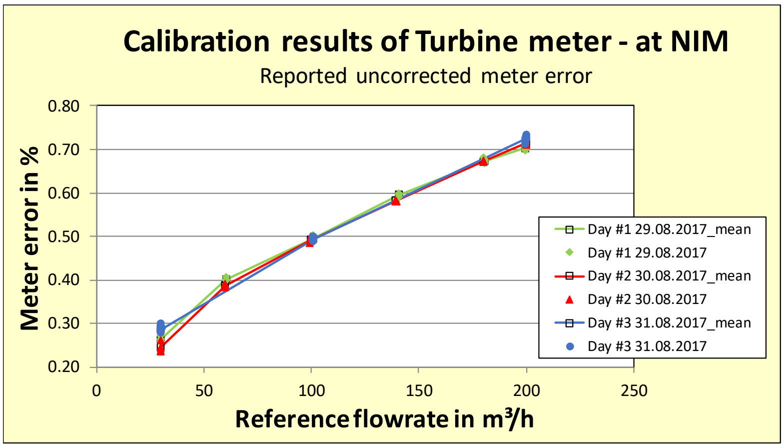
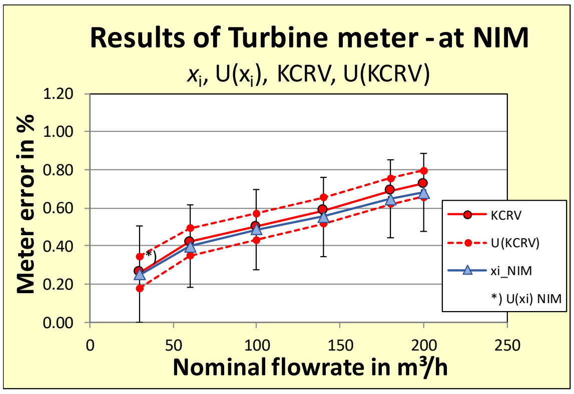


Figure 42: Calibration results of NIM laboratory for turbine meter - reported uncorrected meter error e_V

Table 31: Comparison decision table for NIM (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - * represents inconclusive data

	NIM / P.R. China						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	u_{comp}/u_{base}	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in m³/h	in %	in %	in %	-	-	-	
30	0.252	0.050	0.252	-0.011	0.04	4.94 *	inconclusive
60	0.399	0.050	0.217	-0.024	0.11	4.23 *	inconclusive
100	0.489	0.050	0.209	-0.013	0.07	4.07 *	inconclusive
140	0.553	0.050	0.205	-0.033	0.17	3.98 *	inconclusive
180	0.647	0.050	0.202	-0.041	0.22	3.92 *	inconclusive
200	0.682	0.050	0.204	-0.045	0.23	3.95 *	inconclusive



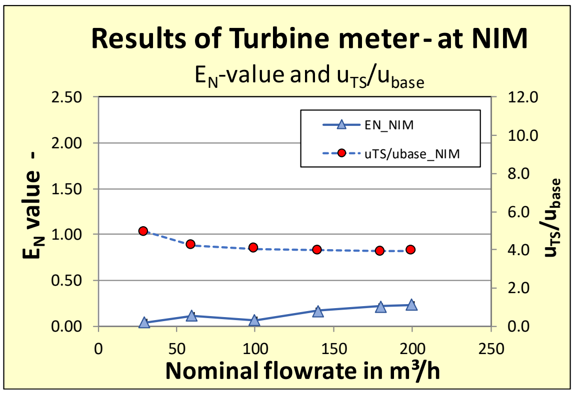


Figure 43: Comparison results of NIM laboratory for turbine meter

NMIJ - laboratory (Japan)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 32), because of inconclusive data - at all calibrated flowrates the ratio of u_{comp}/u_{base} was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

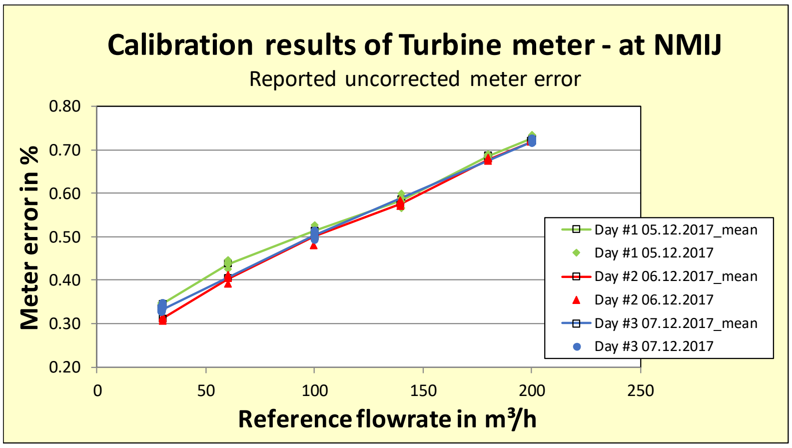


Figure 44: Calibration results of NMIJ for turbine meter - reported uncorrected meter error e_V

Table 32: Comparison decision table for NMIJ (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - * represents inconclusive data

	NMIJ / Japan						
Nominal flowrate	Relative measure-ment error	Expanded laboratory uncertainty	Expanded measurement uncertainty	Degree of equivalence	*Normalized degree of* equivalence	u_{comp}/u_{base}	CMC decision status
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in m³/h	in %	in %	in %	-	-	-	
30	0.292	0.042	0.250	0.030	0.13	5.88 *	inconclusive
60	0.410	0.042	0.216	-0.012	0.06	5.04 *	inconclusive
100	0.497	0.042	0.208	-0.004	0.02	4.84 *	inconclusive
140	0.595	0.042	0.203	0.010	0.05	4.74 *	inconclusive
180	0.705	0.042	0.200	0.016	0.09	4.66 *	inconclusive
200	0.745	0.042	0.202	0.018	0.09	4.70 *	inconclusive

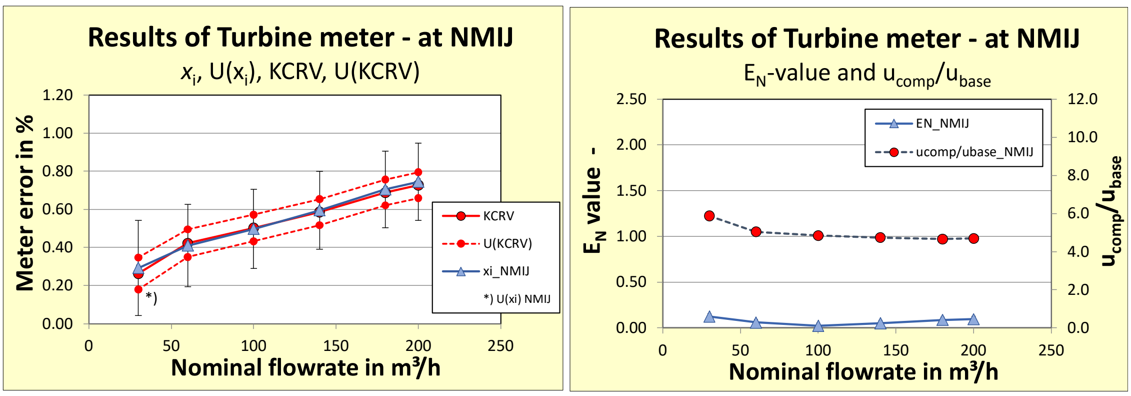


Figure 45: Comparison results of NMIJ laboratory for turbine meter

KRISS - laboratory (Korea)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 33), because of inconclusive data - at all calibrated flowrates the ratio of u_{comp}/u_{base} is > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

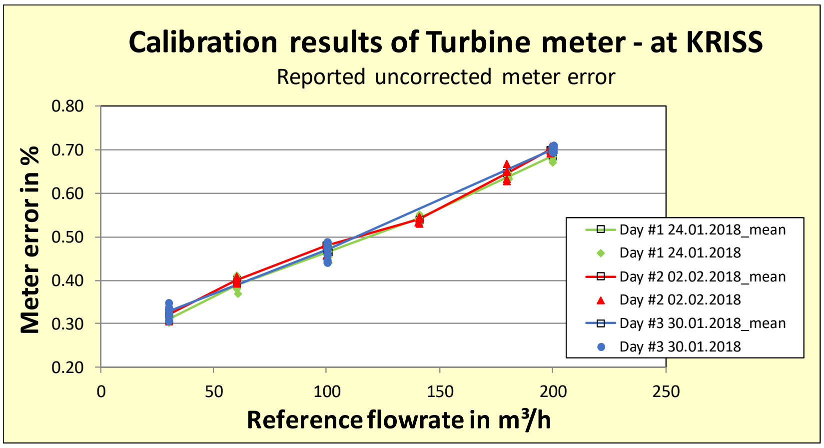
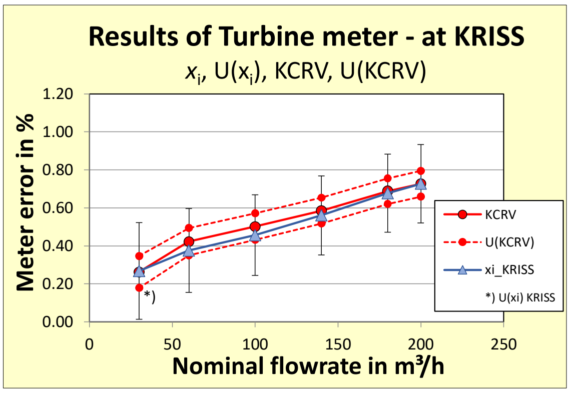


Figure 46: Comparison results of KRISS for turbine meter - reported uncorrected meter error e_V

Table 33: Comparison decision table for KRISS (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - * represents inconclusive data

	KRISS / Korea						
Nominal flowrate	Relative measure-ment error	Expanded laboratory uncertainty	Expanded measurement uncertainty	Degree of equivalence	*Normalized degree of* equivalence	u_{comp}/u_{base}	CMC decision status
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in m³/h	in %	in %	in %	-	-	-	
30	0.268	0.060	0.254	0.006	0.02	4.11 *	inconclusive
60	0.376	0.060	0.220	-0.046	0.22	3.53 *	inconclusive
100	0.457	0.060	0.212	-0.045	0.22	3.39 *	inconclusive
140	0.560	0.060	0.208	-0.025	0.13	3.32 *	inconclusive
180	0.677	0.060	0.205	-0.011	0.06	3.27 *	inconclusive
200	0.727	0.060	0.206	0.000	0.00	3.29 *	inconclusive



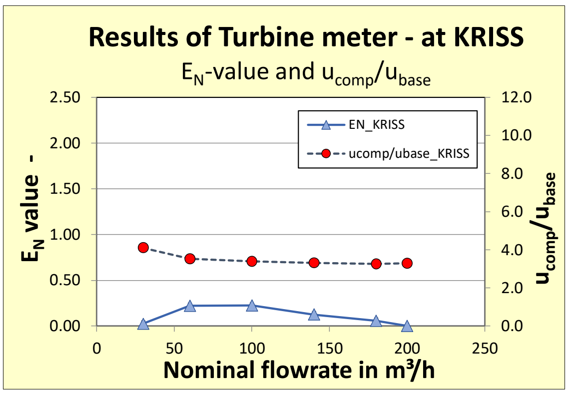


Figure 47: Comparison results of KRISS laboratory for turbine meter

7.3 Coriolis_Mass transfer meter

7.3.1 Summarized results

Laboratory results

Table 34: Relative measurement error x_i (%) of Coriolis_Mass at participating laboratories - temperature corrected mean values of day #1 and day #2

Flowrate in t/h	VSL	RISE	UME	PTB 4	NIST	CENAM	ITRI	NIM	NMIJ	KRISS
30	0.024	0.032	0.061	0.045	0.013	0.047	0.069	0.023	0.074	0.027
60	0.024	0.029	0.048	0.041	0.021	0.049	0.074	0.036	0.055	-0.002
100	0.023	0.020	0.039	0.032	0.014	0.045	0.079	0.037	0.058	-0.022
140	0.029	0.020	-0.015	0.034	0.017	0.030	0.073	0.034	0.060	-0.032
180	0.033	0.023	0.014	0.036	0.002	0.035	0.086	0.038	0.067	-0.017
200	0.037	0.022	-0.005	0.040	0.026	0.037	0.072	0.041	0.067	-0.005

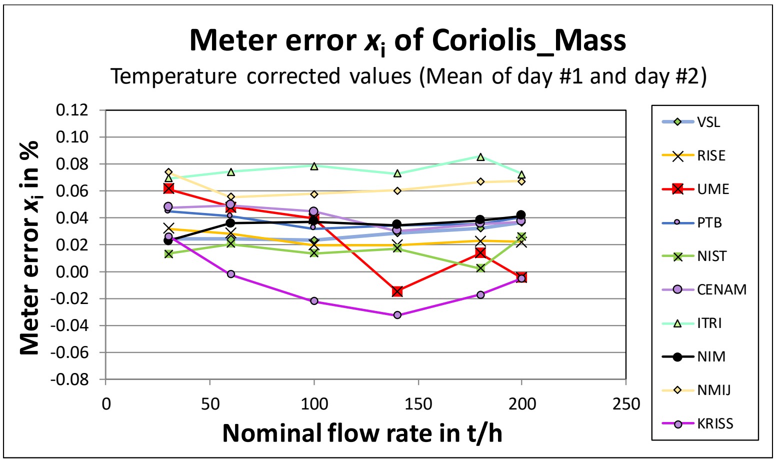


Figure 48: Relative measurement error x_i of Coriolis_Mass at participating laboratories - temperature corrected mean values of day #1 and day #2

KCRV, *U*(KCRV) and E_N-Value

The weighted mean *y* and its uncertainty *u*(*y*) was calculated based on all laboratory data of calibration day #1 and day #2. The results of $\frac{(x_i - y)^2}{u^2(x_i)}$ and consistency check as well as the *KCRV* are summarized in Table 35 and Table 36.

Table 35: Results of $\frac{(x_i - y)^2}{u^2(x_i)}$ for each participating laboratory for Coriolis_Mass

Flowrate in t/h	VSL	RISE	UME	PTB 4	NIST	CENAM	ITRI	NIM	NMIJ	KRISS
30	0.408	0.041	0.232	0.022	1.028	0.055	0.908	0.302	1.103	0.155
60	0.836	0.045	0.072	0.050	0.673	0.355	2.441	0.004	0.529	1.465
100	0.609	0.105	0.028	0.007	1.018	0.417	4.132	0.023	1.101	2.926
140	0.039	0.078	1.457	0.043	0.542	0.002	3.618	0.014	1.592	4.116
180	0.088	0.099	0.362	0.000	2.148	0.001	5.356	0.008	1.929	2.877
200	0.018	0.160	1.406	0.021	0.547	0.005	2.529	0.015	1.670	1.952

Table 36: Results of chi-squared test and *KCRV*-value for Coriolis_Mass transfer meter

Flowrate	$\chi^2(\nu)$	χ^2_{obs}	**Results of chi-squared test**	***KCRV***	***U*(*KCRV*)** (*k* = 2)
in t/h				in %	in %
30	16.92	4.25	**passed**	0.041	0.019
60	16.92	6.47	**passed**	0.038	0.014
100	16.92	10.37	**passed**	0.033	0.013
140	16.92	11.50	**passed**	0.031	0.012
180	16.92	12.87	**passed**	0.036	0.012
200	16.92	8.32	**passed**	0.038	0.011

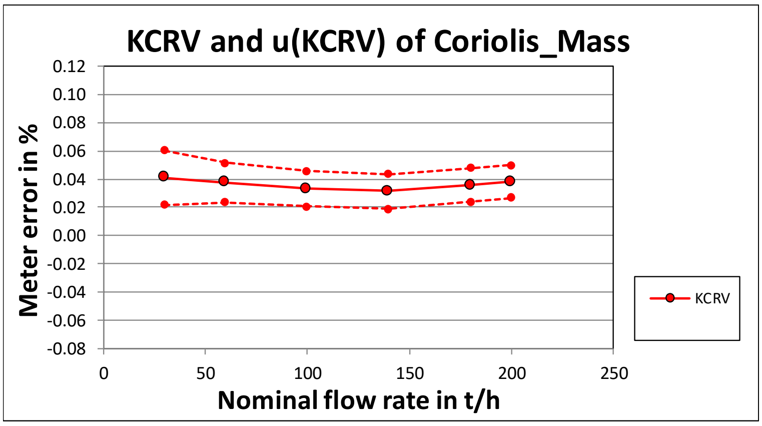


Figure 49: Key Comparison Reference value (*KCRV*) and its expanded uncertainty *U*(*KCRV*) for Coriolis_Mass, with *k* = 2

The degree of equivalence value E_N is a measure of result agreement of each participating laboratory to the *KCRV*. Expressed as the normalized differences of "lab to *KCRV*", the final E_N values are summarized in Table 37 and Figure 50. All results of participating laboratories confirmed to the consistency check of chi-squared test (Table 36). No extractions of laboratory results were made. All laboratories complied with the E_N criteria of < 1.2.

Table 37: Summary of E_N-values of participating laboratories for Coriolis_Mass transfer meter - * represents values at warning level

Flowrate in t/h	**VSL**	**RISE**	**UME**	**PTB 4**	**NIST**	**CENAM**	**ITRI**	**NIM**	**NMIJ**	**KRISS**
30	0.34	0.10	0.25	0.08	0.54	0.13	0.50	0.29	0.55	0.20
60	0.52	0.11	0.14	0.12	0.44	0.32	0.82	0.03	0.38	0.62
100	0.45	0.16	0.09	0.05	0.53	0.35	1.06 *	0.08	0.55	0.87
140	0.12	0.14	0.61	0.12	0.39	0.03	0.99	0.06	0.65	1.03 *
180	0.18	0.16	0.31	0.01	0.76	0.01	1.20 *	0.05	0.72	0.86
200	0.08	0.20	0.60	0.08	0.39	0.04	0.83	0.06	0.67	0.71

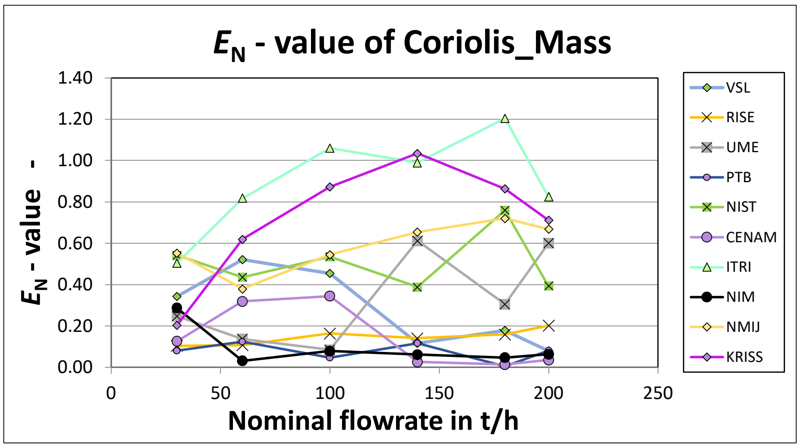


Figure 50: Summarized E_N-values of participating laboratories for Coriolis_Mass transfer meter

Conclusive tests of comparison results u_{comp}/u_{base}

Based on [3], for a conclusive proof of participant results and an agreement with the *KCRV*, the comparison uncertainty ratio u_{comp}/u_{base} should be < 2. The results for participating laboratories are summarized in Table 38 and Figure 51.

Beside one calibration, all results complied with this limit. For the final purpose of KC1 the uncertainties u_{comp} of Coriolis_Mass were sufficiently low enough. Finally, the meter was suitable for a confirmation of the declared CMC values.

Table 38: Summarized results of conclusive proof u_{comp}/u_{base} of participating laboratories for Coriolis_Mass transfer meter - * represents values with inconclusive data

NMI	VSL	RISE	UME	PTB 4	NIST	CENAM	ITRI	NIM	NMIJ	KRISS
Flowrate in t/h										
30	1.46	0.55	0.66	2.19 *	1.53	1.47	1.10	0.88	1.08	0.74
60	1.65	0.31	0.44	1.24	0.92	0.82	0.62	0.50	0.61	0.43
100	1.32	0.25	0.31	0.99	0.82	0.66	0.50	0.40	0.49	0.38
140	1.17	0.22	0.42	0.88	0.77	0.59	0.45	0.35	0.43	0.30
180	1.03	0.19	0.27	0.78	1.15	0.52	0.40	0.31	0.37	0.28
200	1.00	0.19	0.25	0.75	0.52	0.50	0.38	0.30	0.37	0.26

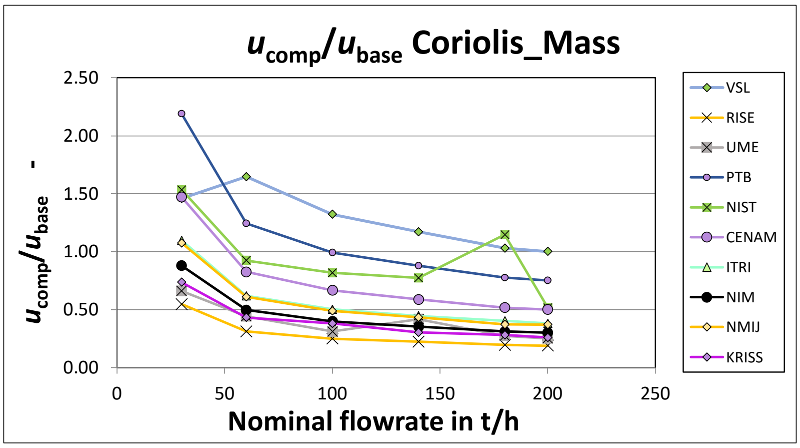


Figure 51: Summarized results of conclusive proof u_{comp}/u_{base} of participating laboratories for Coriolis_Mass transfer meter

7.3.2 Final CMC-decision tables for participating laboratories

VSL - laboratory (Netherlands)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 39).

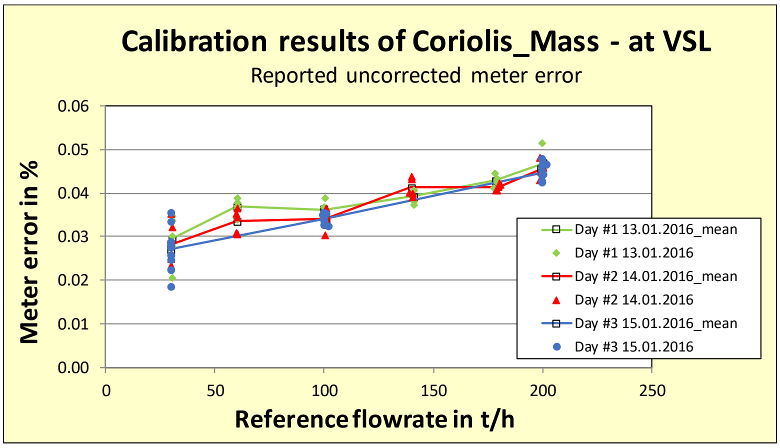


Figure 52: Calibration results of VSL for Coriolis_Mass transfer meter - reported uncorrected meter error e_m

Table 39: Comparison decision table for VSL (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2)

	VSL / Netherlands						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of equivalence***	**u_{comp}/u_{base}**	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in t/h	in %	in %	in %	-	-	-	
30	0.024	0.030	0.053	-0.017	0.34	1.46	acceptable
60	0.024	0.015	0.029	-0.013	0.52	1.65	acceptable
100	0.023	0.015	0.025	-0.010	0.45	1.32	acceptable
140	0.029	0.015	0.023	-0.002	0.12	1.17	acceptable
180	0.033	0.015	0.022	-0.003	0.18	1.03	acceptable
200	0.037	0.015	0.021	-0.001	0.08	1.00	acceptable

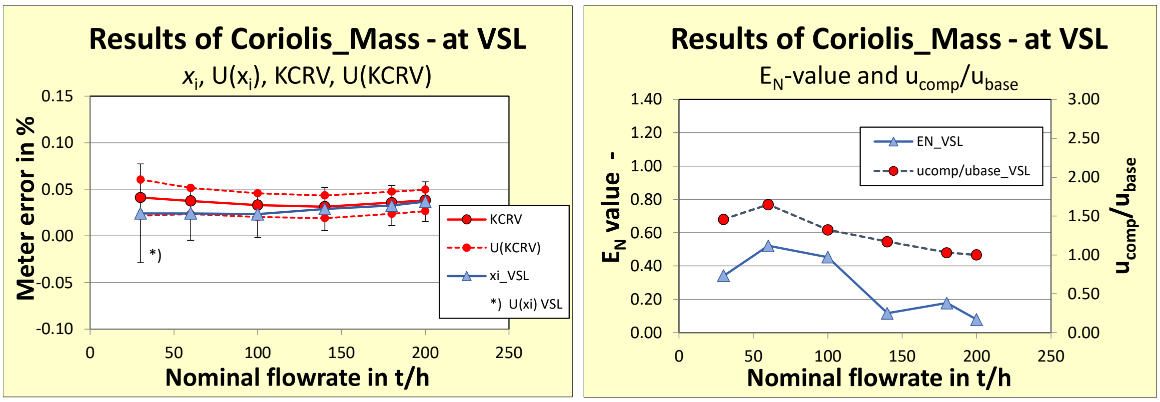


Figure 53: Comparison results of VSL laboratory for Coriolis_Mass transfer meter

RISE - laboratory (Sweden)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 40).

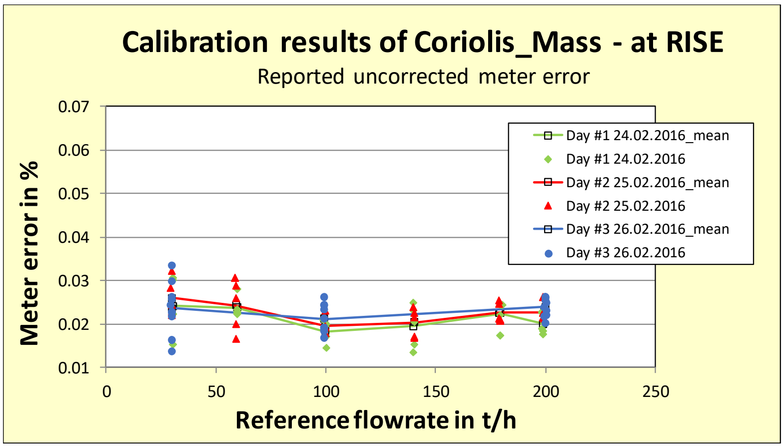


Figure 54: Calibration results of RISE for Coriolis_Mass transfer meter – reported uncorrected meter error e_m

Table 40: Comparison decision table for RISE laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2)

	RISE / Sweden						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	**u_{comp}/ u_{base}**	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in t/h	in %	in %	in %	-	-	-	
30	0.032	0.080	0.091	-0.009	0.10	0.55	acceptable
60	0.029	0.080	0.084	-0.009	0.11	0.31	acceptable
100	0.020	0.080	0.082	-0.013	0.16	0.25	acceptable
140	0.020	0.080	0.082	-0.011	0.14	0.22	acceptable
180	0.023	0.080	0.081	-0.013	0.16	0.19	acceptable
200	0.022	0.080	0.081	-0.016	0.20	0.19	acceptable

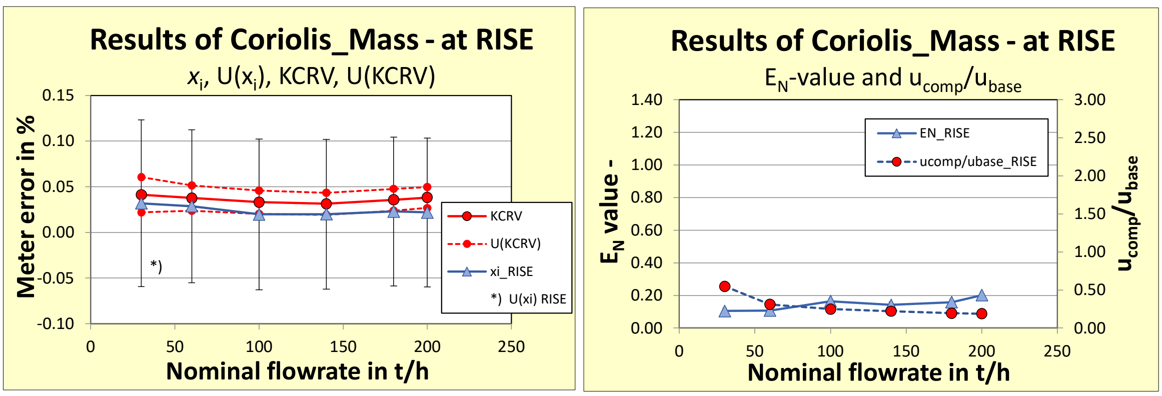


Figure 55: Comparison results of RISE laboratory for Coriolis_Mass transfer meter

UME - laboratory (Turkey)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 41).

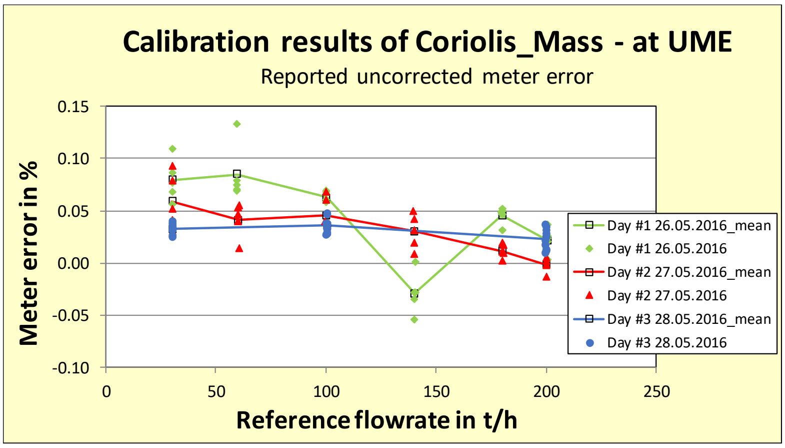


Figure 56: Calibration results of UME for Coriolis_Mass transfer meter – reported uncorrected meter error e_m

Table 41: Comparison decision table for UME laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2)

	UME / Turkey						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	**u_{comp}/ u_{base}**	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in t/h	in %	in %	in %	-	-	-	
30	0.061	0.070	0.084	0.020	0.25	0.66	acceptable
60	0.048	0.070	0.077	0.010	0.14	0.44	acceptable
100	0.039	0.070	0.073	0.006	0.09	0.31	acceptable
140	-0.015	0.070	0.076	-0.046	0.61	0.42	acceptable
180	0.014	0.070	0.073	-0.022	0.31	0.27	acceptable
200	-0.005	0.070	0.072	-0.043	0.60	0.25	acceptable

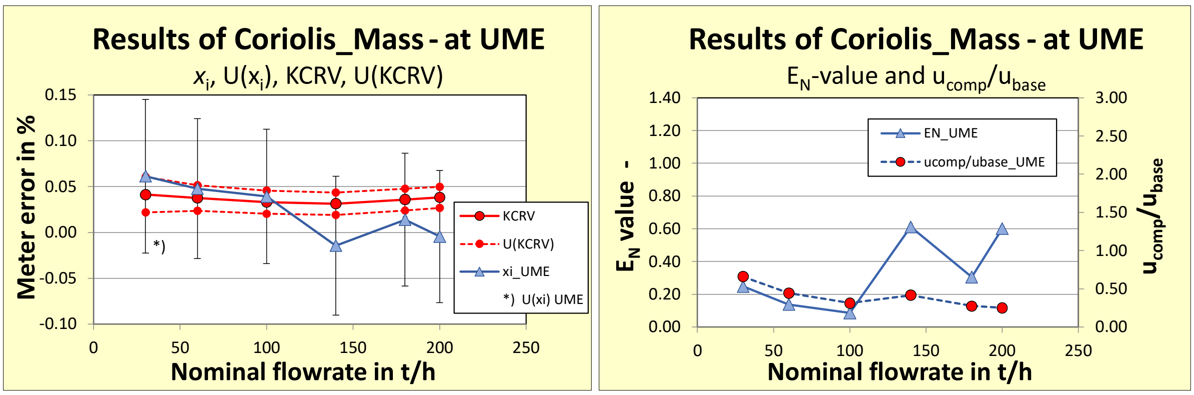


Figure 57: Comparison results of UME laboratory for Coriolis_Mass transfer meter

PTB - laboratory (Germany)

For mass calibration between flowrates of 60 t/h and 200 t/h this comparison supported the declared base uncertainties of the participant (Table 42). Only at the flowrate of 30 t/h the results were inconclusive - ratio of u_{comp}/u_{base} was > 2. The Coriolis meter was not suitable for a confirmation of the declared CMC value at this flowrate.

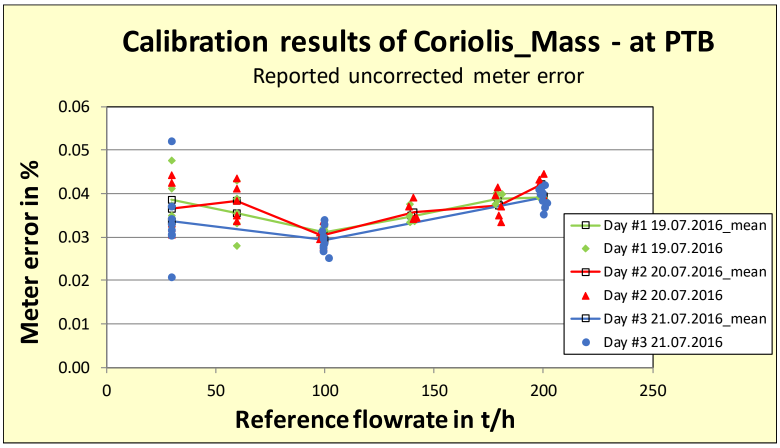


Figure 58: Calibration results of PTB for Coriolis_Mass transfer meter – reported uncorrected meter error e_m

Table 42: Comparison decision table for PTB laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2) - * represents inconclusive data

	PTB / Germany						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	u_{comp}/u_{base}	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in t/h	in %	in %	in %	-	-	-	
30	0.045	0.020	0.048	0.004	0.08	2.19 *	inconclusive
60	0.041	0.020	0.032	0.004	0.12	1.24	acceptable
100	0.032	0.020	0.028	-0.001	0.05	0.99	acceptable
140	0.034	0.020	0.027	0.003	0.12	0.88	acceptable
180	0.036	0.020	0.025	0.000	0.01	0.78	acceptable
200	0.040	0.020	0.025	0.002	0.08	0.75	acceptable

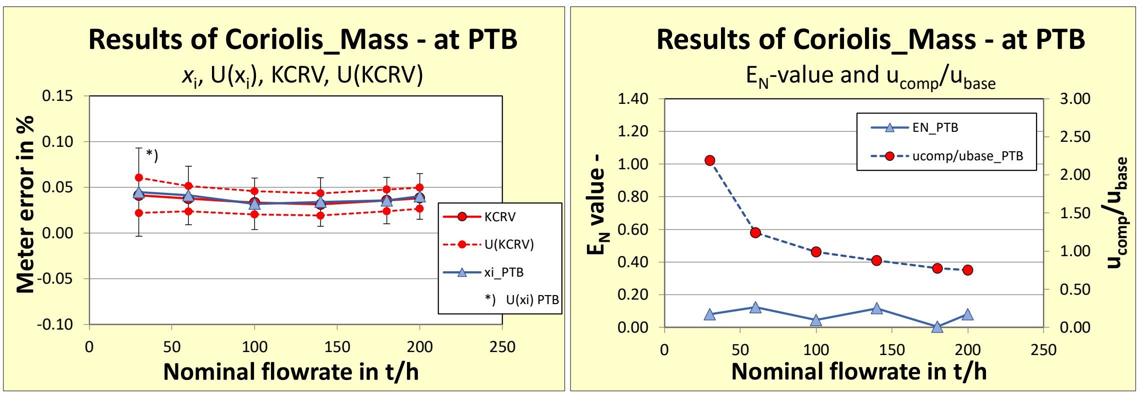


Figure 59: Comparison results of PTB laboratory for Coriolis_Mass transfer meter

NIST - laboratory (USA)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 43).

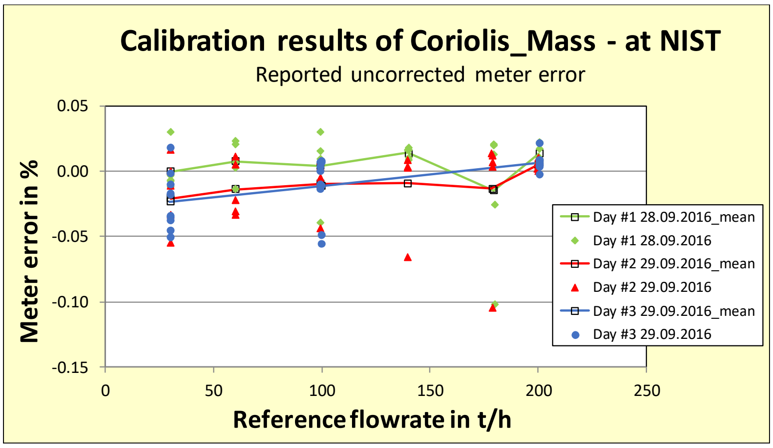


Figure 60: Comparison results of NIST for Coriolis_Mass transfer meter - reported uncorrected meter error e_m

Table 43: Comparison decision table for NIST laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2)

	NIST / USA						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	**u_{comp}/ u_{base}**	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in t/h	in %	in %	in %	-	-	-	
30	0.013	0.030	0.055	-0.028	0.54	1.53	acceptable
60	0.021	0.030	0.041	-0.017	0.44	0.92	acceptable
100	0.014	0.030	0.039	-0.020	0.53	0.82	acceptable
140	0.017	0.030	0.038	-0.014	0.39	0.77	acceptable
180	0.002	0.030	0.046	-0.033	0.76	1.15	acceptable
200	0.026	0.030	0.034	-0.012	0.39	0.52	acceptable

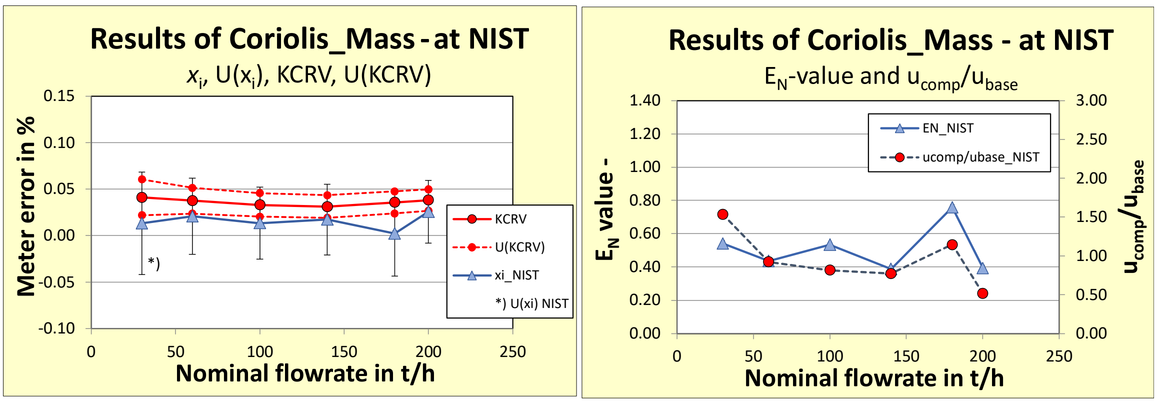


Figure 61: Comparison results of NIST laboratory for Coriolis_Mass transfer meter

CENAM - laboratory (Mexico)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 44).

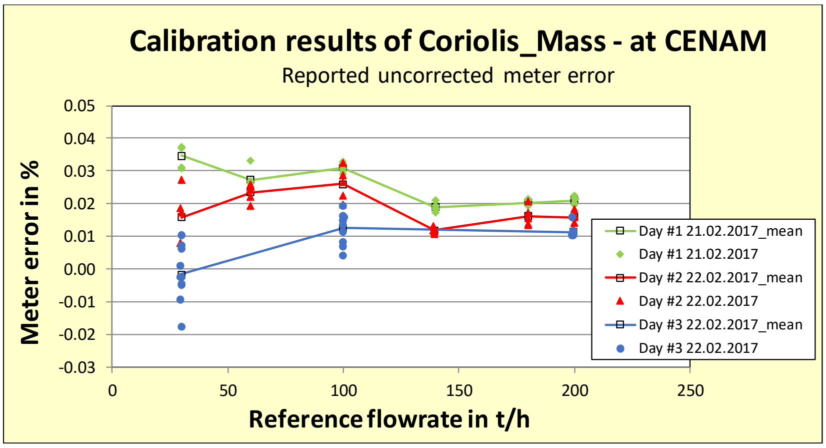
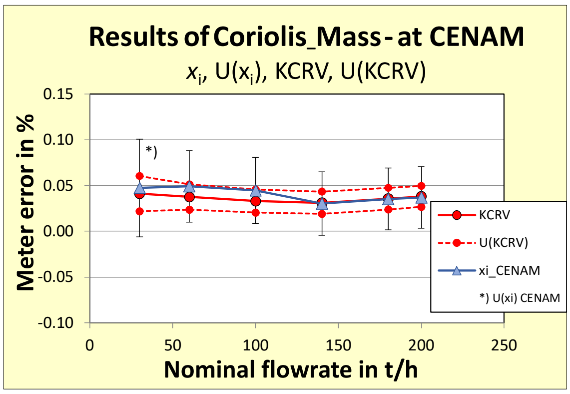


Figure 62: Comparison results of CENAM for Coriolis_Mass transfer meter - reported uncorrected meter error e_m

Table 44: Comparison decision table for CENAM laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2)

	CENAM / Mexico						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	u_{comp}/u_{base}	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in t/h	in %	in %	in %	-	-	-	
30	0.047	0.030	0.053	0.006	0.13	1.47	acceptable
60	0.049	0.030	0.039	0.012	0.32	0.82	acceptable
100	0.045	0.030	0.036	0.012	0.35	0.66	acceptable
140	0.030	0.030	0.035	-0.001	0.03	0.59	acceptable
180	0.035	0.030	0.034	0.000	0.01	0.52	acceptable
200	0.037	0.030	0.034	-0.001	0.04	0.50	acceptable



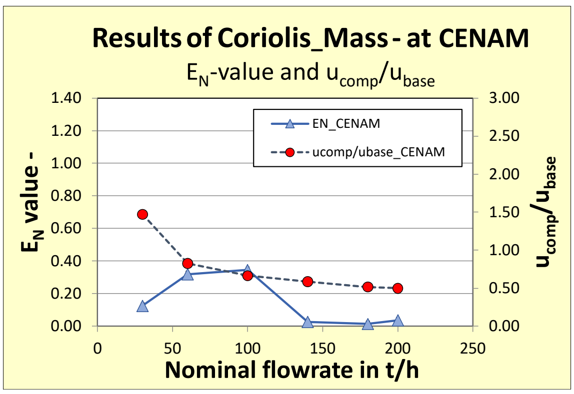


Figure 63: Comparison results of CENAM laboratory for Coriolis_Mass transfer meter

ITRI - laboratory (Chinese Taipei)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 45).

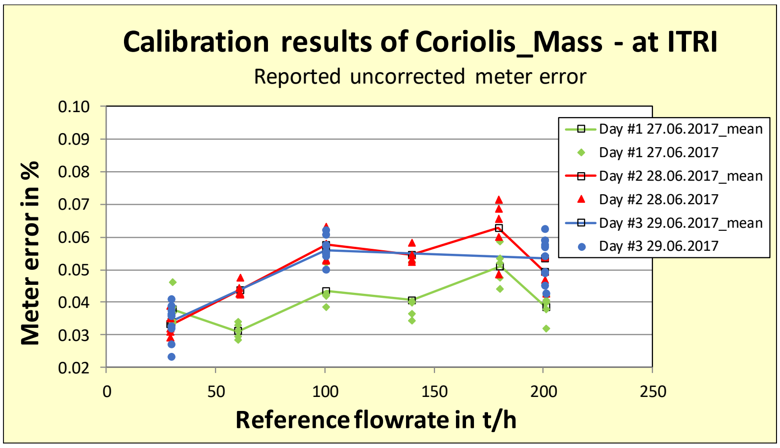


Figure 64: Comparison results of ITRI for Coriolis_Mass transfer meter - reported uncorrected meter error e_m

Table 45: Comparison decision table for ITRI laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2) - * represents E_N values at warning level

	ITRI / Chinese Taipei						
Nominal flowrate	Relative measure-ment error	Expanded laboratory uncertainty	Expanded measurement uncertainty	Degree of equivalence	*Normalized degree of* equivalence	u_{comp}/ u_{base}	CMC decision status
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in t/h	in %	in %	in %	-	-	-	
30	0.069	0.040	0.059	0.028	0.50	1.10	acceptable
60	0.074	0.040	0.047	0.037	0.82	0.62	acceptable
100	0.079	0.040	0.045	0.045	1.06 *	0.50	warning level
140	0.073	0.040	0.044	0.042	0.99	0.45	acceptable
180	0.086	0.040	0.043	0.050	1.20 *	0.40	warning level
200	0.072	0.040	0.043	0.034	0.83	0.38	acceptable

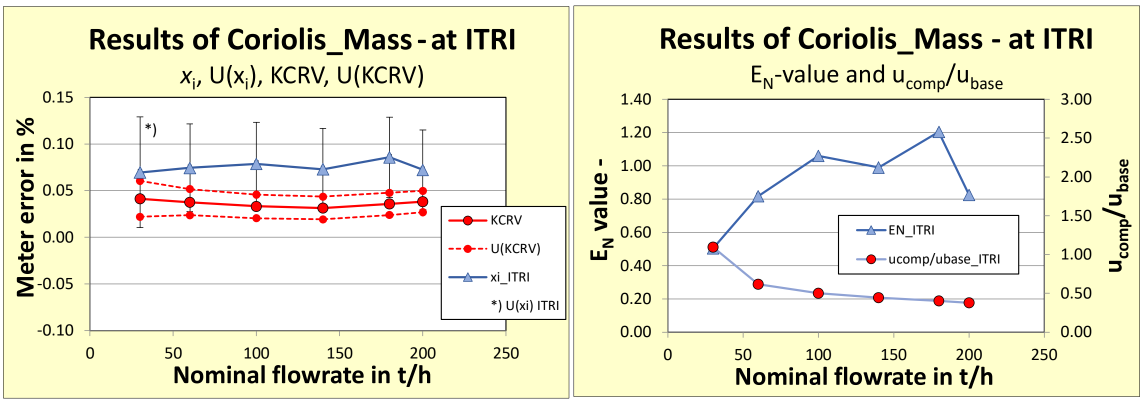


Figure 65: Comparison results of ITRI Chinese Taipei laboratory for Coriolis_Mass transfer meter

NIM - laboratory (P.R. China)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 46).

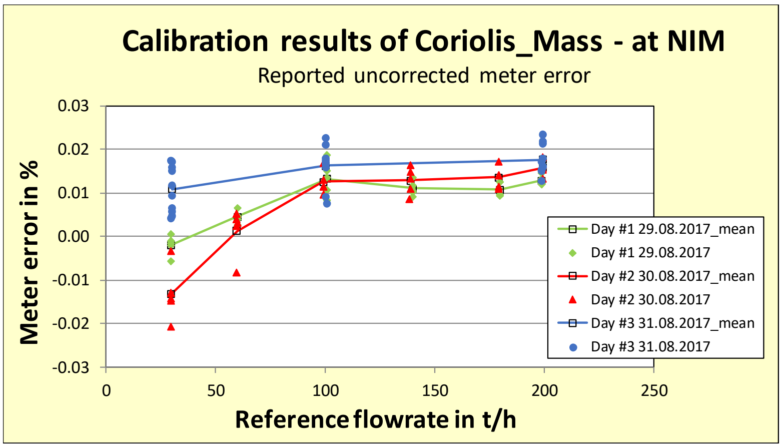


Figure 66: Calibration results of NIM for Coriolis_Mass transfer meter – reported uncorrected meter error e_m

Table 46: Comparison decision table for NIM laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2)

	NIM / P.R. China						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	**u_{comp}/ u_{base}**	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in t/h	in %	in %	in %	-	-	-	
30	0.023	0.050	0.067	-0.018	0.29	0.88	acceptable
60	0.036	0.050	0.056	-0.002	0.03	0.50	acceptable
100	0.037	0.050	0.054	0.004	0.08	0.40	acceptable
140	0.034	0.050	0.053	0.003	0.06	0.35	acceptable
180	0.038	0.050	0.052	0.002	0.05	0.31	acceptable
200	0.041	0.050	0.052	0.003	0.06	0.30	acceptable

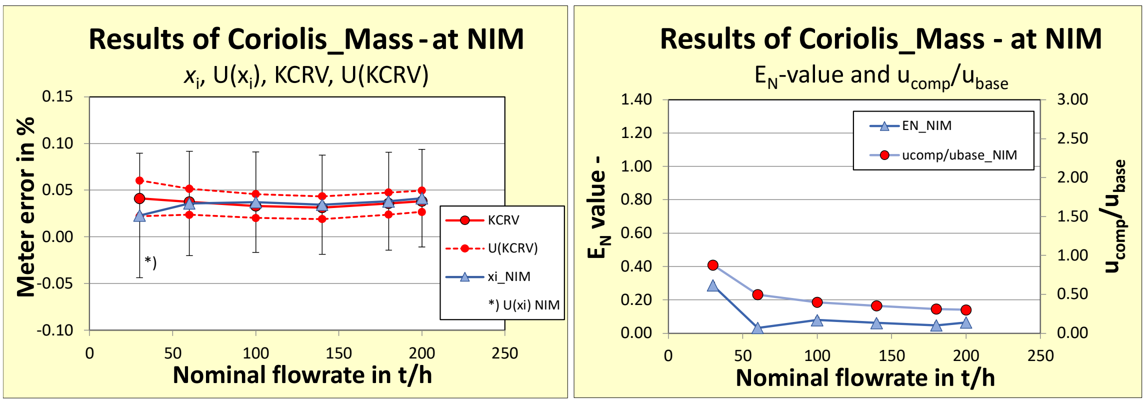


Figure 67: Comparison results of NIM/P.R. China laboratory for Coriolis_Mass transfer meter

NMIJ - laboratory (Japan)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 47).

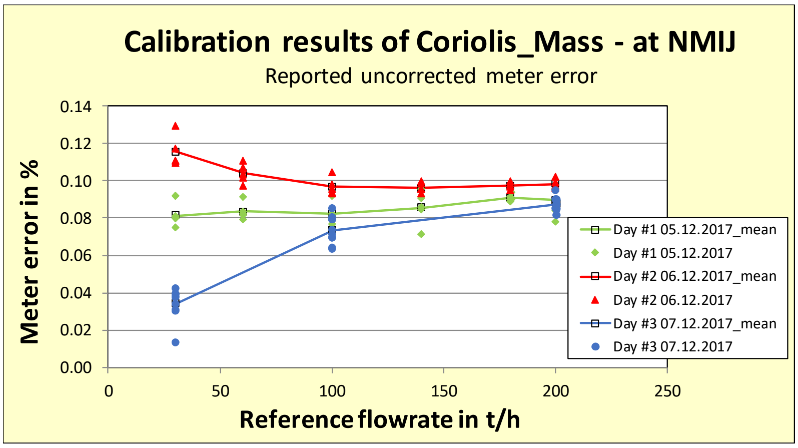


Figure 68: Comparison results of NMIJ for Coriolis_Mass transfer meter – reported uncorrected meter error e_m

Table 47: Comparison decision table for NMIJ laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2)

	NMIJ / Japan						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	**u_{comp}/ u_{base}**	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in t/h	in %	in %	in %	-	-	-	
30	0.074	0.042	0.062	0.032	0.55	1.08	acceptable
60	0.055	0.042	0.049	0.018	0.38	0.61	acceptable
100	0.058	0.042	0.047	0.025	0.55	0.49	acceptable
140	0.060	0.042	0.046	0.029	0.65	0.43	acceptable
180	0.067	0.042	0.045	0.031	0.72	0.37	acceptable
200	0.067	0.042	0.045	0.029	0.67	0.37	acceptable

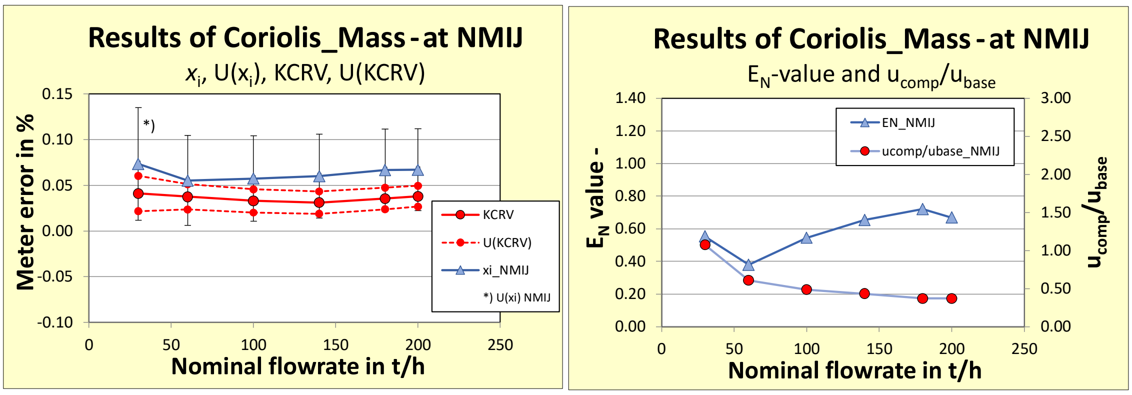


Figure 69: Comparison results of NMIJ/Japan laboratory for Coriolis_Mass transfer meter

KRISS-laboratory (Korea)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 48).

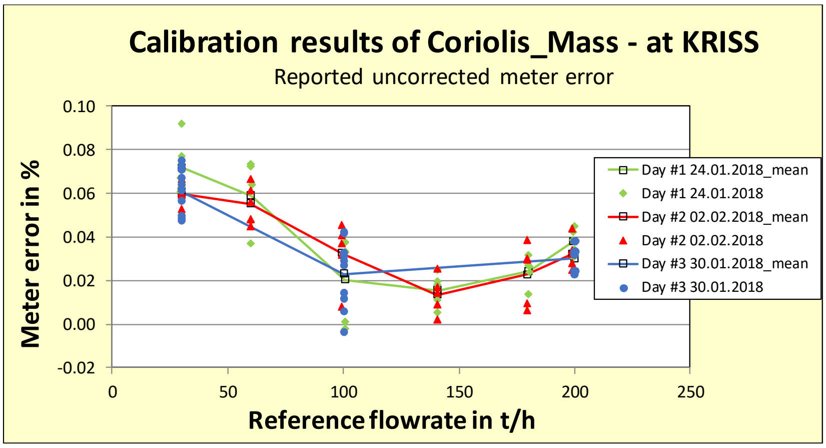
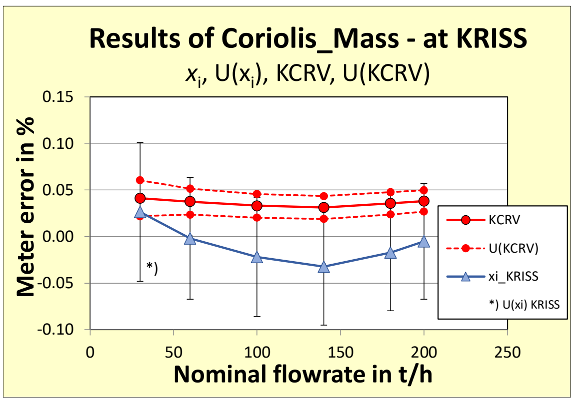


Figure 70: Comparison results of KRISS for Coriolis_Mass transfer meter - reported uncorrected meter error e_m

Table 48: Comparison decision table for KRISS laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2) - * represents E_N values at warning level

	KRISS / Korea						
Nominal flowrate	**Relative measure-ment error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of* equivalence**	u_{TS}/u_{base}	**CMC decision status**
	x_i	$U_{base,i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
in t/h	in %	in %	in %	-	-	-	
30	0.027	0.060	0.074	-0.015	0.20	0.74	acceptable
60	-0.002	0.060	0.065	-0.040	0.62	0.43	acceptable
100	-0.022	0.060	0.064	-0.055	0.87	0.38	acceptable
140	-0.032	0.060	0.063	-0.064	1.03 *	0.30	warning level
180	-0.017	0.060	0.062	-0.053	0.86	0.28	acceptable
200	-0.005	0.060	0.062	-0.043	0.71	0.26	acceptable



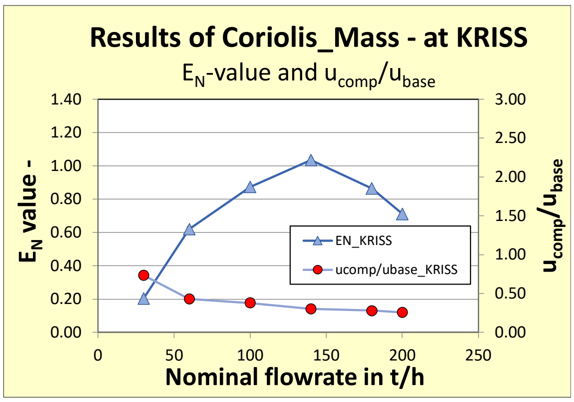


Figure 71: Comparison results of KRISS laboratory for Coriolis_Mass transfer meter

8 Nomenclature and unit symbols

Terms and abbreviations

APMP	Asia Pacific Metrology Programme
BIPM	Bureau International des Poids et Mesures
CCM	Consultative Committee for Mass and Related Quantities
CIPM	International Committee for Weights and Measures
CMC	Calibration and Measurement Capabilities
DI	Designated Institue
DN	Inner pipe diameter (mm)
DoE	Degree of Equivalence
EURAMET	The European Association of National Metrology Institutes
GUM	Guide to the Expression of Uncertainty in Measurement
FF	Fluid flow
KC1	Key comparison CCM.FF-K1.2015
KCRV	Key comparison reference value
MRA	(CIPM) Mutual Recognition Arrangement
NMI	National Metrology Institute
RMO	Regional Metrology Organisation
SIM	Interamerican Metrology System
TP	Technical Protocol
WGFF	(CCM) Working Group on Fluid Flow

Symbols and units

d_i	Degree of equivalence (DoE) for each laboratory *i* (%)
Δe_{nom}	Difference of meter error (%)
e	Meter error at current temperature conditions (%)
e_{cor}	Temperature corrected meter error (%)
Δe_{cor}	Correction value of meter error (%)
e_{mean}	Mean values of meter error at one flow rate over all temperatures (%)
$E_{\text{N},i}$	Normalized Degree of Equivalence (-)
e_{nom}	Meter error at nominal temperature of 20 °C (%)
e_{m}	Relative measurement error of Coriolis meter (%)
$e_{\text{m,cor}}$	Temperature corrected measurement error of Coriolis meter (%)
$e_{residual}$	Model residuals (%)
e_{V}	Relative measurement error of turbine meter (%)
$e_{\text{V,cor}}$	Temperature corrected measurement error of turbine meter (%)
i	Laboratory index
k	Coverage factor (-)
K_{m}	meter *K*-factor - mass-related output (Coriolis meter) (pulses/kg)
$K_{\text{m,nom}}$	Nominal *K*-factor of Coriolis mass (pulses/kg)
K_{V}	meter *K*-factor - volume-related output (turbine meter) (pulses/L)
ΔK_{V}	Difference in meter K-factor of turbine meter (%)

$K_{V,nom}$	Nominal *K*-factor of turbine meter (pulses/L)
m_{ref}	Mass, measured by the reference standard (kg)
n	Number of calibrations (-)
N	Counted number of pulses of the transfer meter (pulses)
n_i	number of evaluated laboratories (-)
p_{fluid}	Line pressure (bar)
s	Standard deviation of the mean of measurements at one flowrate point (%)
T_{air}	Air temperature (°C)
T_{fluid}	Current fluid temperature (°C)
ΔT_{fluid}	Difference of current fluid temperature to nominal temperature of 20 °C (°C)
T_{nom}	Nominal temperature of 20°C
$u_{base,i}$	Standard uncertainty of laboratory refence (%)
u_{comp}	Standard uncertainty of transfer meter measurements (%)
u_{TS}	Standard uncertainty of transfer meter (%)
u_{drift}	Standard uncertainty due to drift of transfer meter (%)
u_{reprod}	Standard uncertainty due to reproducibility characteristics of transfer meter (%)
u_{temp}	Standard uncertainty caused by temperature characteristics of transfer meter (%)
u_{pres}	Standard uncertainty caused by pressure characteristics of transfer meter (%)
u_{flow}	Standard uncertainty due to sensitivity of transfer meter to instable flow conditions (%)
u_{inflow}	Standard uncertainty due to sensitivity of turbine meter to different inflow conditions (%)
u_{hyst}	Standard uncertainty due to hysteresis effect (%)
$U(KCRV)$	Expanded uncertainty of Key comparison reference value (%)
u_y	Standard uncertainty of *y* (%)
U(y)	Expanded uncertainty of *y* (%)
$u_{x,i}$	Standard uncertainty of reported and temperature corrected meter error (%)
V_{ref}	Volume, measured by the reference standard (m^3)
y	Reference value of the comparison (%)
x_i	Temperature corrected meter error for E_N-value evaluation
x_{KCRV}	Key Comparison Reference value (%)

υ	Degrees of freedom
X^2_{obs}	Observed chi-squared value
X^2_{υ}	Chi-squerred test value

9 References

[1] *Technical Protocol for Key Comparison CCM.FF-K1.2015*. Draft 5/3. Unpublished. 23.01.2017

[2] GUM - *Guide to the Expression of Uncertainty in Measurement*, JCGM 100:2008.

[3] BIPM: *WGFF Guidelines for CMC Uncertainty and Calibration Report Uncertainty*. 21.10.2013, http://www.bipm.org/utils/en/pdf/ccm-wgff-guidelines.pdf

[4] WRIGHT, J. et al. (2016): *Transfer standard uncertainty can cause inconclusive inter-laboratory comparisons*. Metrologia 53 (2016) 1243 - 1258

[5] Cox M. G.: *Evaluation of key comparison data*, Metrologia 39 (2002) 589 - 595

[6] Cox M. G.: *The evaluation of key comparison data: determining the largest consistent subset*, Metrologia 44 (2007) 187 - 200

10 Appendices

10.1 Information about participating laboratories

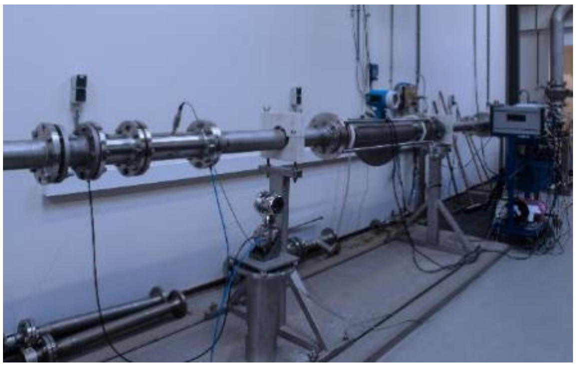
NMI/DI	Country	RMO	Contact	Address
NEL	UK	EURAMET	Christopher Mills Chris.Mills@ tuvsud.com	**TÜV SÜD National Engineering Laboratory** Scottish Enterprise Technology Park, East Kilbride Glasgow G75 0QF, United Kingdom
VSL	Netherlands	EURAMET	F. M. Smits fsmits@ vsl.nl	**VSL - Dutch Metrology Institute** Thijsseweg 11 2629 JA Delft, Netherlands
RISE	Sweden	EURAMET	Oliver Büker oliver.buker@ ri.se	**RISE - Research Institutes of Sweden** Measurement Science and Technology Brinellgatan 4 SE-504 62 Borås, Sweden
PTB	Germany	EURAMET	Enrico Frahm enrico.frahm@ ptb.de	**PTB - Physikalisch-Technische Bundesanstalt** Department 1.5 Liquid Flow Bundesallee 100 38116 Braunschweig, Germany
UME	Turkey	EURAMET	Başak Akselli basak.akselli@ tubitak.gov.tr	**UME - Ulusal Metroloji Enstitüsü, TUBITAK UME** Akiskanlar Laboratuvarlari Baris Mah. Dr. Zeki Acar cad. No: 1 41470 Gebze / Kocaeli, Turkey
NIST	USA	SIM/ Noramet	Iosif Shinder iosif.shinder@ nist.gov	**NIST - National Institute of Standards and Technology** 100 Bureau Dr Gaithersburg, MD 20899, USA
CENAM	Mexico	SIM/ Noramet	Roberto Arias Romero rarias@ cenam.mx	**CENAM - Centro Nacional de Metrología** km 4.5 carretera a los Cués, El Marqués, Qro. México, CP 76246
ITRI	Chinese Taipei	APMP	Cheng-Tsair Yang ctyang@ itri.org.tw	**ITRI - Industrial Technology Research Institute** Center for Measurement Standards Bldg. 16, No. 321, Sec. 2, Kuang-Fu Rd. Hsinchu, Chinese Taipei 30044
NIM	P.R. China	APMP	Tao Meng mengt@ nim.ac.cn	**NIM - National Institute of Metrology** Division of Thermometry and Material Evaluation No.18 Bei San Huan Dong Lu, Chaoyang District Beijing, 100029, P.R. China
NMIJ/AIST	Japan	APMP	Noriyuki Furuichi furuichi.noriyuki@ aist.go.jp	**NMIJ/AIST - National Institute of Advanced Industrial Science and Technology National Metrology Institute of Japan** Fluid Flow Division AIST Tsukuba Central 3, 1-1-1 Umezono Tsukuba 305-8563, Japan
KRISS	Korea	APMP	Sejong Chun sjchun@ kriss.re.kr	**KRISS - Korea Research Institute of Standards and Science** Thermometry and Fluid Flow Metrology Group Division of Physical Metrology 205A-dong 101-ho, Gajeong-ro 267, Yuseong-gu Daejeon 34113, South Korea

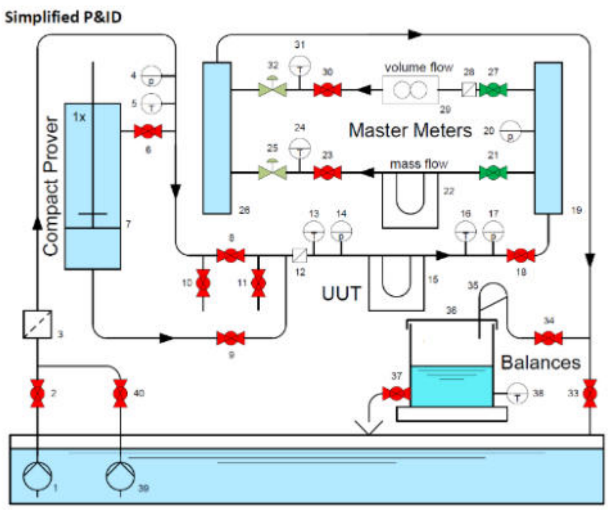
Characteristic information of primary standard used during KC	**Working procedure**

VSL – Netherlands

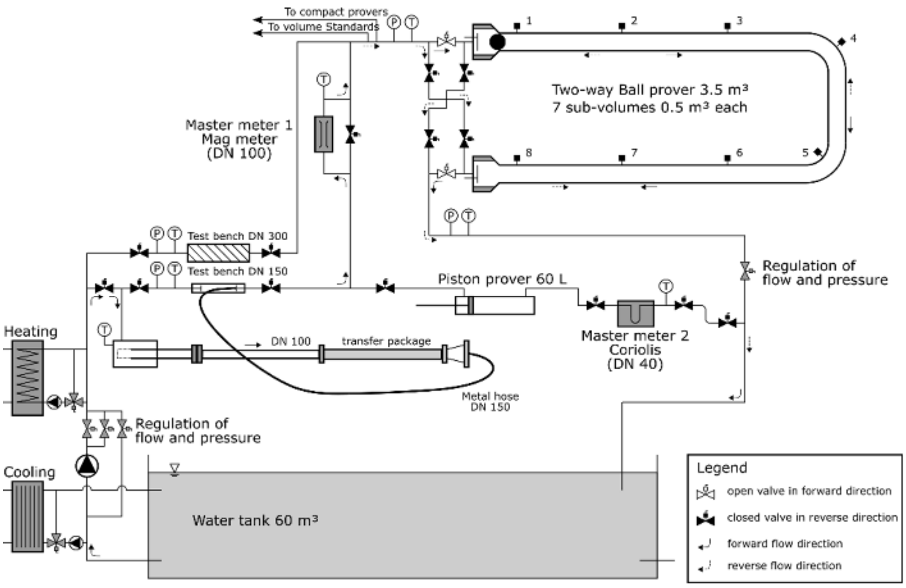
Range of flowrate	0.001 m³/h … 400 m³/h
Fluid temperature	Ambient 15 °C … 25 °C
Line pressure	1 bar(g) …. 5 bar(g)
Uncertainty (k = 2)	0.02% volume and mass for gravimetric and prover 0.04% master meter
Reference	Gravimetric, prover, master meters
Operating method	Dynamic for prover and master meter. Standing start-stop for gravimetric
Calibration line diameter	3 mm … 200 mm
Test fluid	water

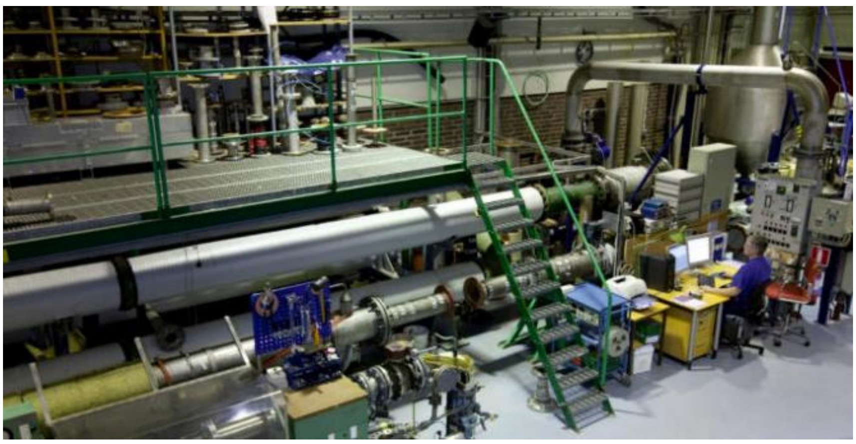
The VSL Water Flow facility (WF) represents the national standard of the Netherlands for the realization of the measurands volumetric and mass flow rate as well as the total volume and mass of flowing liquids (water). The gravimetric system utilized during the comparison has a standing start-stop method with five weighing scales and transfer points. Maximum loads of 10 t, 3.5 t, 600 kg, 70 kg and 6 kg. The dynamic system consists of a prover and seven master meters (three turbine meters and four Coriolis mass flow meters). For generating and stabilizing flow rates, the supply system consists of a 190 m³ storage tank, and two frequency-controlled pumps. The facility has two Meter Under Test sections at different locations in the facility. The maximum build in length is 9 meters. The fluid temperature is ambient with the concrete tank generating cooling from the surrounding soil to keep temperature stable during calibration runs.





<table>
<tr><th>Characteristic information of primary standard used during KC</th><th>Working procedure</th></tr>
<tr><td>
RISE – Sweden
<table>
<tr><td>Range of flowrate</td><td>6 m³/h to 720 m³/h</td></tr>
<tr><td>Fluid temperature</td><td>15 °C to 90 °C</td></tr>
<tr><td>Line pressure</td><td>up to 8 bar</td></tr>
<tr><td>Uncertainty (k = 2)</td><td>0.06% (volume flow)
0.08% (mass flow)</td></tr>
<tr><td>Reference</td><td>Ball prover 3.5 m³
Fixed volume standards with 1000 L or 3500 L
BCP 12” (20 L and 60 L)
BCP 24” (250 L)</td></tr>
<tr><td>Operating method</td><td>Direct pumping,
Flying- / standing-start-and-stop</td></tr>
<tr><td>Calibration line diameter</td><td>DN 40 (1 1/2”) to
DN 300 (12”)</td></tr>
<tr><td>Test fluid</td><td>water (and kerosene)</td></tr>
</table>
</td><td>VM4 represents one of the national primary standards of Sweden for the realization of the measurands volumetric and mass flow rate as well as the total volume and mass of water and kerosene. Traceability at low flow is realized by means of a compact piston prover with volumes of 20 L and 60 L and at high flow rates with a ball prover with a volume of 0.5 m³ to 3.5 m³. In addition, VM4 offers the possibility for direct calibration against two (fixed) volume standards of 1000 L and 3500 L. The flow is generated from a 60 m³ storage tank by means of frequency-controlled pumps. For the measurements a >50 D straight inlet section was provided upstream the transfer package. The fluid temperature (stability better ±0.2 K) is adjusted and controlled by a heating and cooling system.</td></tr>
</table>





Characteristic information of primary standard used during KC

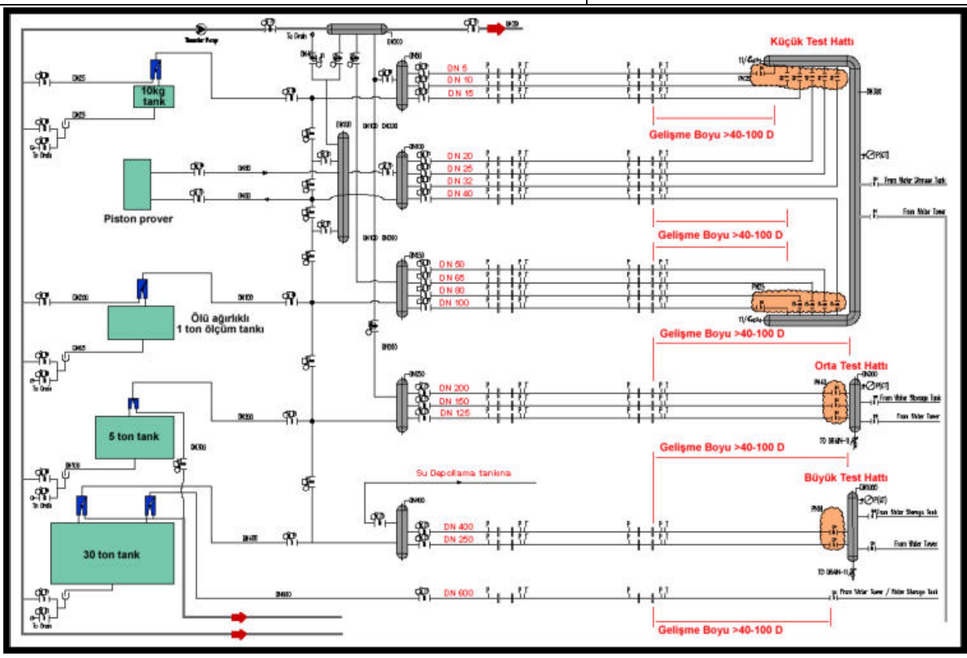
UME – Turkey

Range of flowrate	0.01 m³/h … 2,000 m³/h
Fluid temperature	10 °C … 35 °C
Line pressure	1 bar … 6 bar
Uncertainty (*k* = 2)	0.04 % volume, mass
Reference	gravimetric
Operating method	Direct pumping, constant head tank flying-/ standing-start-stop
Calibration line diameter	5 mm … 400 mm
Test fluid	water

Working procedure

The UME Water Flow Measurement Laboratory represents the national primary standard of Turkey for the realization of the measures volumetric and mass flow rate as well as the total volume and mass of flowing liquids (water).

The gravimetric reference consists of four independent diverter and balance systems with max. loads of 30 t, 5 t , 1 t and 10 kg. For generating and stabilizing flow rates, the supply system consists of a 300 m³ storage tank, of a frequency controlled pumping system, a constant head tank (50 m³,15 m³ and 5 m³, at a height of 35 m) and 16 calibration lines. For each diameter an upstream straight pipeline with a length of 50D and downstream of 20D is available.



Characteristic information of primary standard used during KC	Working procedure

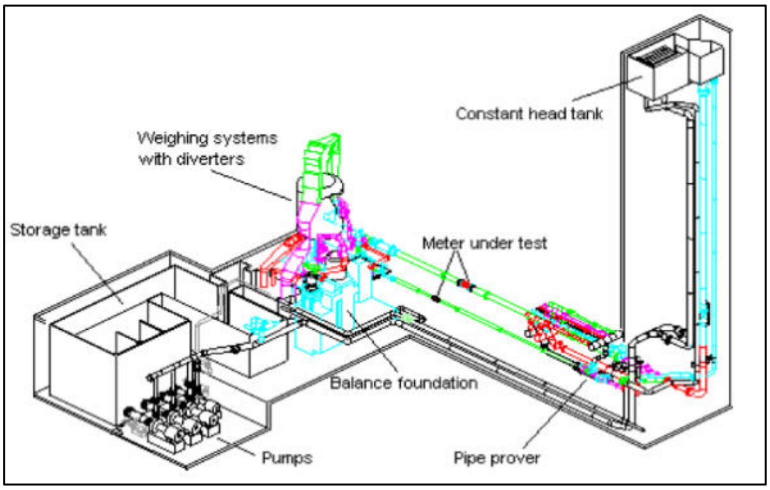
PTB – Germany

Range of flowrate	0.3 m³/h … 2,100 m³/h
Fluid temperature	10 °C … 35 °C
Line pressure	2 bar … 6 bar
Uncertainty (*k* = 2)	0.02 volume, mass
Reference	gravimetric
Operating method	Direct pumping , constant head tank flying-/ standing-start-stop
Calibration line diameter	25 mm … 400 mm
Test fluid	water

The PTB hydrodynamic test field (HDP) represents the national primary standard of Germany for the realization of the measurands volumetric and mass flow rate as well as the total volume and mass of flowing liquids (water).
The gravimetric reference consists of three independent diverter and balance systems with max. loads of 30 t, 3 t and 300 kg. For generating and stabilizing flow rates, the supply system consists of a 400 m³ storage tank, of a frequency controlled pumping system, a constant head tank (30 m³, at a height of 30 m) and two calibration lines. For each diameter an upstream straight pipeline with a length of 50D and downstream of 20D is available. The fluid temperature is adjusted and controlled by two separate heat exchanger systems.

Upstream view to calibration lines

3 t balance and diverter system



Principle drawing of the Hydrodynamic Test Field

Characteristic information of primary standard used during KC	Working procedure

NIST – USA

Range of flowrate	0.7 kg/s-65 kg/s
Fluid temperature	20˚C to 40˚C
Line pressure	300 kPa to 700 kPa
Uncertainty (*k* = 2)	0.033%
Reference	Gravimetric
Operating method	Static, Flying start and stop Gravimetric
Calibration line diameter	100 mm
Test fluid	Water

NIST Water Flow Measurement Standard (WFCF) has three parallel pipelines with diameters of 100, 200 and 400 mm and weighing system with capacity 3700 kg. Part of the WFCF which includes a 3700 kg collection tank and a 100 mm pipeline was used for key comparison. The WFCF uses two methods: (1) the static gravimetric method and an error-free uni-directional diverter with a collection/bypass unit to perform water flowmeter calibrations and (2) dynamic gravimetric method. Flow generation system comprised of storage tank, pumping system, and a flow control system which actuates the control valves. The flow generation system produces the water flow through the test section at the constant rate required for test point series necessary for a calibration.

Characteristic information of primary standard used during KC	**Working procedure**

CENAM – Mexico

Range of flow rate	(100... 12 000) kg/min
Fluid temperature	Ambient (not controlled) (15...27) °C
Line pressure	up to 10 bar
Uncertainty	$U(q_m)/\% = 0.030$ $U(q_v)/\% = 0.038$ $k = 2$
Reference	Gravimetric
Operating method	Flying start and stop
Calibration line diameter	100 mm 200 mm
Test fluid	Water

The Mexican Primary Measurement System for Water Flow is of the Static Weighing Design.

The gravimetric reference consists of two independent diverter and weighing systems; which maximum load capacities are 1500 kg and 10 000 kg, respectively.

Flow is controlled by means of frequency converter and throttling valves.

More than 100*D* upstream pipe length is available for calibrations.

No fluid temperature control available.

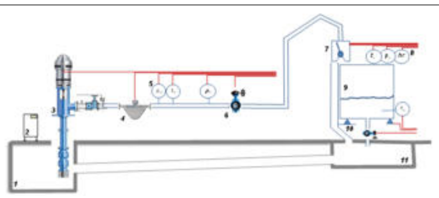
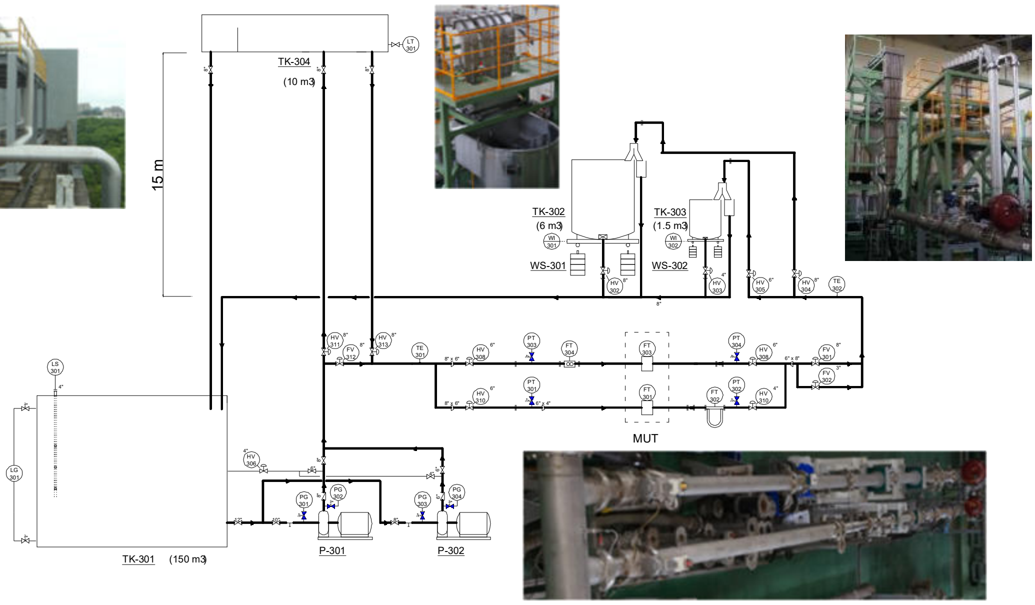


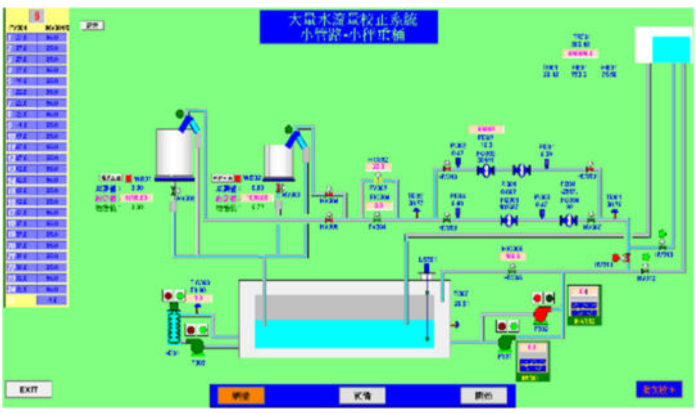
Fig. 1: Schematic diagram of CENAM water flow facility

Fig. 2: A view of the load cell at the 10 000 kg tank

Fig. 3: Front view of the static weighing system at CENAM Primary System for Water Flow

Characteristic information of primary standard used during KC	**Working procedure**
ITRI – Chinese Taipei <table><tr><td>Range of flowrate</td><td>1.8 m³/h to 480 m³/h</td></tr><tr><td>Fluid temperature</td><td>15 °C to 35 °C</td></tr><tr><td>Line pressure</td><td>40 kPa to 500 kPa</td></tr><tr><td>Uncertainty (k = 2)</td><td>U_{CMC,V} = 0.04 %</td></tr><tr><td>Reference</td><td>Weighing platform 6000 kg & 1500 kg</td></tr><tr><td>Operating method</td><td>Static weighing method with flying-start-and-finish Operating mode</td></tr><tr><td>Calibration line diameter</td><td>50 mm to 300 mm</td></tr><tr><td>Test fluid</td><td>Tap water</td></tr></table>	The primary standard adapts static weighing method with flying-start-and-finish mode to calibrate either quantity-type flowmeters or rate-type flowmeters. The water is pumped from the reservoir in the base room by a frequency controlled pump. Then the water flow directly through the meter under test, or flow to the constant head tank and the meter under test sequentially. The diverter is used to manipulate flow along the bypass loop or towards the weighing tank. When the predetermined flow quantity or the time interval for single test is achieved, the quantity of water accumulated in the tank is compared with that measured by the meter under test. Two weighing tanks are used as the references depending on the flow rate. Both quantity-type and rate-type flowmeters could be calibrated by the primary standard. The output of flowmeters could be volume, mass, volume flowrate, or mass flowrate.

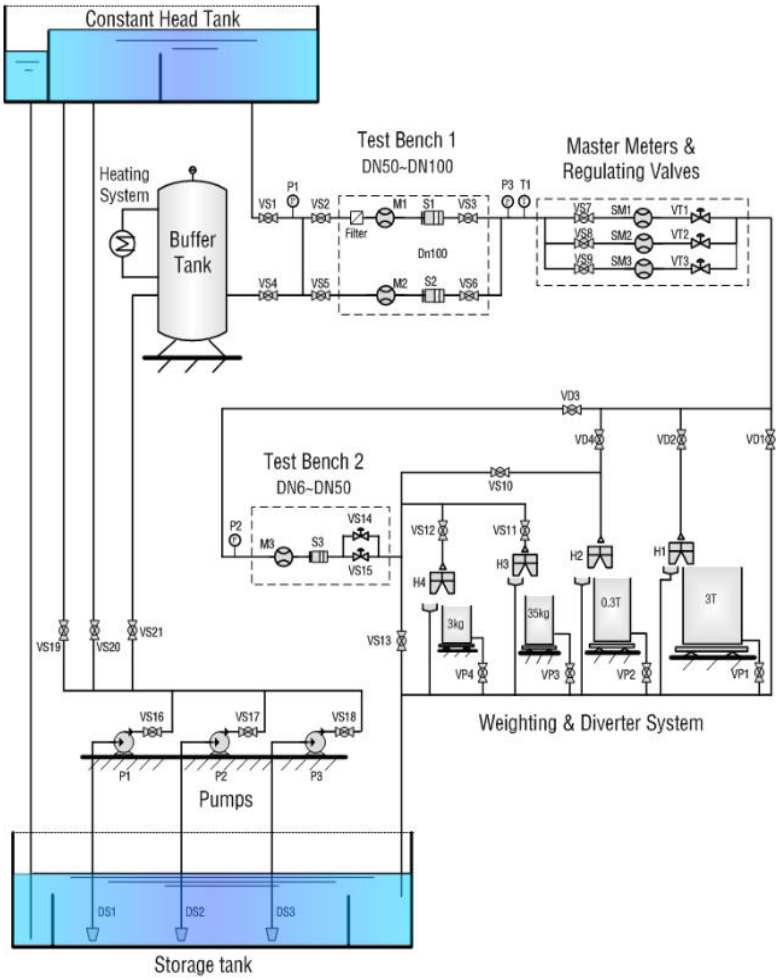




The water flow standard at ITRI

Characteristic information of primary standard used during KC	Working procedure
NIM – P.R. China	The cold-water flow facility of NIM is the Chinese national primary standard of water flow. It is a static gravimetric test facility. The gravimetric reference consists of four independent diverter-weighing systems with max. loads of 3t, 300 kg, 30kg and 3kg. For stabilizing flow rate, the supply system consists of three pumps, a head constant tank (about 18m high), a buffer tank and an underground water pool. Almost, the head constant tank is used when the flow below 160 m^3/h, and the buffer tank can be used for the full flow range.

Range of flowrate	10L/h … 200m^3/h
Fluid temperature	15°C … 35°C
Line pressure	1bar … 4bar
Uncertainty (k = 2)	0.05% mass, volume
Reference	gravimetric
Operating method	Direct pumping with buffer tank, constant head tank flying-start-stop
Calibration line diameter	DN6 … DN100
Test fluid	water



The water flow standard at NIM

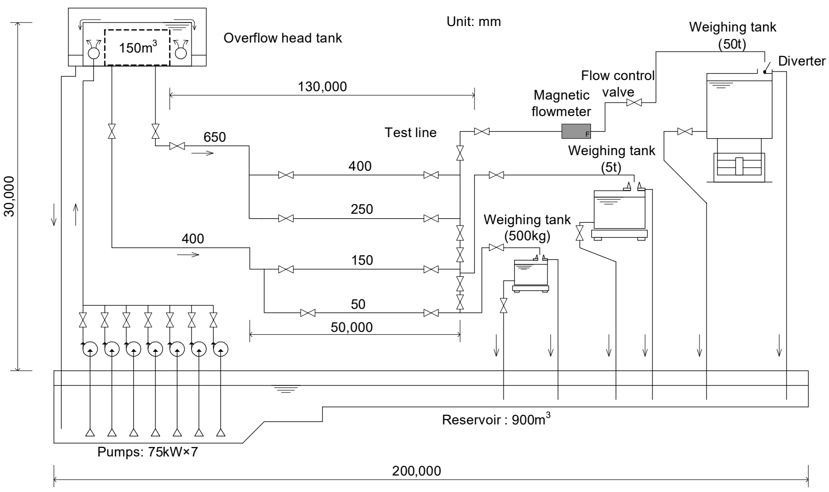
Characteristic information of primary standard used during KC

NMIJ/AIST – Japan

Range of flowrate	0.3 m^3/h – 3,000 m^3/h
Fluid temperature	Ambient (15 °C – 25 °C)
Line pressure	0.12 MPa – 0.24 MPa
Uncertainty (k = 2)	0.042% - 0.060% (mass, volume)
Reference	Gravimetric
Operating method	Overflow head tank, Weighing tank with double wing diverter
Calibration line diameter	25 mm - 400 mm
Test fluid	Water

Working procedure

The AIST water flow facility represents the national primary standard of Japan for the realization of the measurands volumetric and mass flow rate. The gravimetric reference consists of three independent diverter and balance systems with max. loads of 50 t, 5 t and 500 kg. For generating and stabilizing flow rates, the supply system consists of a 900 m³ storage tank, a overflow head tank (150 m³, at a height of 30 m) and four calibration lines. The straight pipe line lengths of each test line are 50 m. The fluid temperature is ambient but the stability of temperature is less than 1 °C during one day calibration.



Test line

The water flow standard at NMIJ

Weighing tank (5t)

Characteristic information of primary standard used during KC	Working procedure

KRISS – Korea

Range of flowrate	10 L/h … 2 000 m³/h
Fluid temperature	10 °C … 40 °C
Line pressure	3 bar (typically, at 230 kPa)
Uncertainty (*k* = 2)	0.06 % (previously, 0.08 %) Volume flow, Mass flow
Reference	Gravimetric
Operating method	Constant head tank, Direct pumping, Flying-start-and-finish (Standing-start-and-finish possible, but not used)
Calibration line diameter	10 mm … 400 mm
Test fluid	water

Working procedure

The water flow standard system at KRISS consists of a constant-level head tank, five weighing tanks, a reservoir, four pumps, six flow control units, six flow diverters, six weighbridges, ten test pipelines, and ten reference flow meters. The constant-level head tank is located at 20 m high from the ground level. Its height is 3 m. Thus, water pressure can be maintained at 230 kPa. The weight-bridges can collect water into the weighing tanks depending on the weighing capacity of 25 000 kg, 5 000, 1 000 kg, 100 kg, 64 kg and 6 kg. The straight pipelines have diameters from 10 mm to 400 mm. The biggest pipeline (400 mm) is directly connected from the head tank. A header is connected to the other pipelines (10 mm to 250 mm) to supply water from the head tank to the pipelines. The flow diverters are operated by the flying-start-and-finish method according to ISO 4185:1980.

The water flow standard system at KRISS

10.2 Detailed results of participating laboratories

VSL laboratory – Day#1

Data report VSL: Day#1

*Original data set

		Laboratory reference					Fluid			Ambient conditions		Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error		
												$K_{V,nom}$	6,6330	Pulses/ Liter	$K_{m,nom}$	100,0000	Pulses/ kg	$K_{V,nom}$	100,0000	Pulses/ Liter	T_{nom}	20	°C
																						Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
13.01.2016	30		30,072	30,092	2536,300	2,538	999,161	3,09	17,42	20,49	1,01	16888	6,6529	0,301	253718	100,0347	0,035	254072	100,0903	0,090	-2,580	0,279	0,029
13.01.2016	30		30,130	30,161	2521,140	2,523	999,159	3,08	17,43	20,60	1,01	16786	6,6525	0,294	252190	100,0302	0,030	252542	100,0855	0,086	-2,570	0,272	0,025
13.01.2016	30		30,088	30,109	2530,797	2,533	999,161	3,08	17,42	20,68	1,01	16852	6,6532	0,304	253165	100,0337	0,034	253518	100,0891	0,089	-2,580	0,283	0,028
13.01.2016	30		30,112	30,138	2532,295	2,534	999,154	3,08	17,46	20,73	1,01	16861	6,6528	0,298	253300	100,0278	0,028	253653	100,0825	0,082	-2,540	0,276	0,023
13.01.2016	30		30,103	30,124	2523,443	2,526	999,156	3,08	17,45	20,72	1,01	16803	6,6531	0,304	252396	100,0205	0,021	252749	100,0758	0,076	-2,550	0,282	0,015
13.01.2016	60		60,086	60,101	3036,274	3,039	999,121	2,00	17,39	20,65	1,01	20240	6,6602	0,410	303740	100,0371	0,037	304156	100,0861	0,086	-2,610	0,411	0,025
13.01.2016	60		60,048	60,096	3100,416	3,103	999,121	2,00	17,39	20,65	1,01	20667	6,6600	0,407	310155	100,0366	0,037	310580	100,0856	0,086	-2,610	0,408	0,025
13.01.2016	60		60,023	60,071	3032,271	3,035	999,118	2,01	17,41	20,69	1,01	20214	6,6604	0,413	303330	100,0339	0,034	303748	100,0834	0,083	-2,590	0,414	0,022
13.01.2016	60		60,016	60,067	3105,502	3,108	999,121	2,00	17,39	20,69	1,01	20701	6,6601	0,408	310668	100,0379	0,038	311095	100,0874	0,087	-2,610	0,408	0,026
13.01.2016	60		59,944	59,993	6052,239	6,058	999,125	2,01	17,37	20,69	1,01	40343	6,6600	0,407	605459	100,0388	0,039	606292	100,0888	0,089	-2,630	0,407	0,027
13.01.2016	100		99,738	99,817	3697,368	3,701	999,124	2,01	17,43	20,71	1,01	24667	6,6657	0,492	369873	100,0368	0,037	370374	100,0846	0,085	-2,570	0,487	0,024
13.01.2016	100		99,594	99,673	3633,739	3,637	999,122	2,01	17,44	20,73	1,01	24245	6,6663	0,503	363504	100,0358	0,036	363997	100,0835	0,084	-2,560	0,498	0,023
13.01.2016	100		99,974	100,050	3651,271	3,655	999,116	1,99	17,47	20,73	1,01	24361	6,6660	0,498	365252	100,0342	0,034	365750	100,0821	0,082	-2,530	0,493	0,022
13.01.2016	100		100,098	100,192	3746,850	3,750	999,122	1,99	17,44	20,74	1,01	24999	6,6661	0,500	374831	100,0390	0,039	375343	100,0876	0,088	-2,560	0,495	0,026
13.01.2016	100		100,096	100,180	7267,850	7,274	999,125	1,98	17,42	20,73	1,01	48491	6,6661	0,500	727045	100,0358	0,036	728037	100,0846	0,085	-2,580	0,495	0,023
13.01.2016	140		140,523	140,650	5164,560	5,169	999,096	2,00	17,66	20,75	1,01	34494	6,6729	0,602	516658	100,0391	0,039	517363	100,0851	0,085	-2,340	0,607	0,027
13.01.2016	140		140,695	140,827	5167,864	5,173	999,091	1,99	17,69	20,77	1,01	34520	6,6737	0,613	516997	100,0408	0,041	517704	100,0865	0,086	-2,310	0,617	0,029
13.01.2016	140		140,820	140,949	5358,806	5,364	999,098	1,99	17,65	20,79	1,01	35792	6,6731	0,604	536085	100,0382	0,038	536823	100,0855	0,086	-2,350	0,609	0,026
13.01.2016	140		141,075	141,190	5080,877	5,086	999,083	1,99	17,73	20,83	1,01	33937	6,6732	0,607	508277	100,0373	0,037	508979	100,0836	0,084	-2,270	0,611	0,026
13.01.2016	140		140,830	140,952	5182,836	5,188	999,078	1,99	17,76	20,85	1,01	34618	6,6732	0,606	518494	100,0406	0,041	519211	100,0866	0,087	-2,240	0,610	0,029
13.01.2016	180		178,755	178,918	6115,364	6,121	999,100	2,02	17,74	20,91	1,01	40892	6,6807	0,720	611797	100,0426	0,043	612607	100,0849	0,085	-2,260	0,727	0,032
13.01.2016	180		178,797	178,959	6468,675	6,475	999,079	2,02	17,85	20,95	1,01	43255	6,6807	0,719	647147	100,0432	0,043	648012	100,0847	0,085	-2,150	0,726	0,033
13.01.2016	180		179,306	179,461	6198,142	6,204	999,073	2,01	17,88	20,95	1,01	41446	6,6806	0,718	620077	100,0424	0,042	620911	100,0841	0,084	-2,120	0,725	0,033
13.01.2016	180		177,251	177,414	6336,038	6,342	999,063	2,05	17,94	20,95	1,01	42370	6,6809	0,722	633865	100,0412	0,041	634724	100,0830	0,083	-2,060	0,729	0,032
13.01.2016	180		177,901	178,074	6375,831	6,382	999,061	2,03	17,95	20,95	1,01	42633	6,6804	0,714	637868	100,0447	0,045	638735	100,0866	0,087	-2,050	0,721	0,035
13.01.2016	200		200,014	200,195	7286,324	7,293	999,074	1,64	17,84	20,95	1,01	48744	6,6836	0,763	728964	100,0455	0,046	729910	100,0826	0,083	-2,160	0,770	0,036
13.01.2016	200		200,190	200,381	7307,307	7,314	999,071	1,63	17,86	20,95	1,01	48885	6,6837	0,764	731054	100,0442	0,044	732001	100,0807	0,081	-2,140	0,771	0,034
13.01.2016	200		199,690	199,883	7301,441	7,308	999,071	1,66	17,86	20,93	1,01	48846	6,6837	0,764	730520	100,0515	0,051	731460	100,0872	0,087	-2,140	0,771	0,042
13.01.2016	200		199,800	199,989	7311,500	7,318	999,069	1,65	17,87	20,93	1,01	48914	6,6838	0,766	731483	100,0455	0,046	732432	100,0821	0,082	-2,130	0,773	0,036
13.01.2016	200		199,687	199,887	7236,737	7,243	999,067	1,66	17,88	20,91	1,01	48413	6,6837	0,764	724018	100,0476	0,048	724963	100,0847	0,085	-2,120	0,771	0,038

VSL laboratory – Day#2

Data report VSL: Day#2

Temperature correction of meter error: T_{nom} = 20 °C

												Turbine meter			Coriolis_Mass			Coriolis_Vol					
												$K_{V,nom}$	6,6330	Pulses/ Liter	$K_{m,nom}$	100,0000	Pulses/ kg	$K_{V,nom}$	100,0000	Pulses/ Liter			
		Laboratory reference					Fluid			Ambient conditions												Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
14.01.2016	30		29,972	29,997	2557,459	2,560	999,069	2,05	17,67	20,37	1,00	17031	6,6531	0,304	255810	100,0251	0,025	256183	100,0776	0,078	-2,330	0,283	0,021
14.01.2016	30		30,256	29,909	2524,129	2,527	999,058	2,05	17,73	20,38	1,00	16807	6,6523	0,290	252494	100,0321	0,032	252863	100,0839	0,084	-2,270	0,270	0,028
14.01.2016	30		29,904	29,928	2480,036	2,482	999,067	2,04	17,68	20,37	1,00	16515	6,6530	0,301	248091	100,0352	0,035	248452	100,0873	0,087	-2,320	0,280	0,031
14.01.2016	30		29,899	29,923	2509,708	2,512	999,065	2,05	17,69	20,43	1,00	16713	6,6531	0,303	251035	100,0256	0,026	251400	100,0774	0,077	-2,310	0,282	0,022
14.01.2016	30		29,901	29,928	3000,051	3,003	999,069	2,04	17,67	20,47	1,00	19977	6,6527	0,297	300075	100,0233	0,023	300512	100,0757	0,076	-2,330	0,276	0,019
14.01.2016	60		60,124	60,174	3043,011	3,046	999,080	2,08	17,64	20,44	1,00	20285	6,6600	0,407	304412	100,0365	0,036	304851	100,0886	0,089	-2,360	0,408	0,026
14.01.2016	60		60,128	60,176	3057,897	3,061	999,078	2,08	17,65	20,41	1,00	20385	6,6602	0,410	305895	100,0344	0,034	306337	100,0866	0,087	-2,350	0,411	0,024
14.01.2016	60		60,074	60,127	3042,010	3,045	999,076	2,08	17,66	20,39	1,00	20279	6,6602	0,409	304294	100,0306	0,031	304734	100,0827	0,083	-2,340	0,411	0,021
14.01.2016	60		59,792	59,845	3160,934	3,164	999,078	2,08	17,65	20,37	1,00	21072	6,6602	0,411	316205	100,0353	0,035	316665	100,0885	0,088	-2,350	0,412	0,025
14.01.2016	60		59,846	59,893	3494,231	3,497	999,076	2,09	17,66	20,36	1,00	23295	6,6605	0,415	349531	100,0309	0,031	350040	100,0840	0,084	-2,340	0,416	0,021
14.01.2016	100		100,516	100,602	3441,274	3,444	999,082	2,08	17,68	20,41	1,00	22961	6,6661	0,499	344232	100,0304	0,030	344725	100,0817	0,082	-2,320	0,495	0,019
14.01.2016	100		100,579	100,667	3531,718	3,535	999,082	2,07	17,68	20,42	1,00	23565	6,6663	0,501	353291	100,0337	0,034	353797	100,0851	0,085	-2,320	0,497	0,023
14.01.2016	100		100,712	100,795	3509,846	3,513	999,078	2,07	17,70	20,43	1,00	23419	6,6662	0,501	351113	100,0366	0,037	351619	100,0884	0,088	-2,300	0,496	0,025
14.01.2016	100		100,628	100,719	3548,386	3,552	999,080	2,07	17,69	20,41	1,00	23676	6,6662	0,500	354963	100,0351	0,035	355474	100,0869	0,087	-2,310	0,496	0,024
14.01.2016	100		100,683	100,773	6824,989	6,831	999,082	2,07	17,68	20,38	1,00	45538	6,6661	0,499	682734	100,0344	0,034	683719	100,0868	0,087	-2,320	0,495	0,023
14.01.2016	140		140,153	140,235	5110,309	5,115	999,069	1,95	17,79	20,63	1,00	34135	6,6734	0,609	511235	100,0399	0,040	511967	100,0899	0,090	-2,210	0,613	0,029
14.01.2016	140		140,000	140,139	5451,090	5,456	999,060	1,94	17,84	20,63	1,00	36410	6,6731	0,605	545348	100,0439	0,044	546129	100,0929	0,093	-2,160	0,609	0,033
14.01.2016	140		139,909	140,034	5198,838	5,204	999,063	1,93	17,82	20,67	1,00	34727	6,6735	0,611	520109	100,0433	0,043	520854	100,0928	0,093	-2,180	0,615	0,032
14.01.2016	140		140,306	140,440	5194,032	5,199	999,062	1,89	17,82	20,67	1,00	34694	6,6733	0,608	519607	100,0392	0,039	520350	100,0883	0,088	-2,180	0,612	0,028
14.01.2016	140		138,792	138,918	6992,647	6,999	999,067	1,99	17,81	20,67	1,00	46706	6,6731	0,604	699546	100,0402	0,040	700546	100,0898	0,090	-2,190	0,608	0,029
14.01.2016	180		180,034	180,198	6241,965	6,248	999,079	2,05	17,86	20,71	1,00	41740	6,6808	0,721	624461	100,0424	0,042	625321	100,0879	0,088	-2,140	0,728	0,033
14.01.2016	180		178,780	178,953	6538,768	6,545	999,053	2,06	18,00	20,75	1,00	43725	6,6807	0,719	654143	100,0407	0,041	655057	100,0856	0,086	-2,000	0,726	0,031
14.01.2016	180		178,669	178,833	6397,472	6,404	999,053	2,06	18,00	20,73	1,00	42781	6,6808	0,721	640007	100,0406	0,041	640898	100,0850	0,085	-2,000	0,728	0,031
14.01.2016	180		179,378	179,547	6338,962	6,345	999,058	2,04	17,97	20,73	1,00	42390	6,6809	0,722	634159	100,0415	0,041	635039	100,0859	0,086	-2,030	0,729	0,032
14.01.2016	180		180,581	180,752	6488,118	6,494	999,054	2,03	17,99	20,70	1,00	43387	6,6808	0,721	649084	100,0420	0,042	649986	100,0862	0,086	-2,010	0,728	0,033
14.01.2016	200		199,840	200,032	7244,443	7,251	999,052	1,65	17,96	20,81	1,00	48465	6,6836	0,763	724776	100,0458	0,046	725747	100,0849	0,085	-2,040	0,770	0,036
14.01.2016	200		199,541	199,742	7269,710	7,277	999,049	1,66	17,98	20,85	1,00	48634	6,6836	0,763	727303	100,0457	0,046	728281	100,0849	0,085	-2,020	0,769	0,036
14.01.2016	200		198,774	198,959	7457,346	7,465	999,036	1,63	18,04	20,81	1,00	49894	6,6841	0,771	746095	100,0483	0,048	747108	100,0876	0,088	-1,960	0,777	0,039
14.01.2016	200		198,692	198,883	7067,756	7,075	999,021	1,63	18,12	20,93	1,00	47286	6,6838	0,766	707079	100,0429	0,043	708047	100,0818	0,082	-1,880	0,772	0,034
14.01.2016	200		198,897	199,103	7136,376	7,143	999,014	1,64	18,16	20,97	1,00	47744	6,6836	0,763	713958	100,0449	0,045	714941	100,0839	0,084	-1,840	0,769	0,036

VSL laboratory – Day#3

Data report VSL: Day#3

												Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error		
												$K_{V,nom}$	6,6330	Pulses/ Liter	$K_{m,nom}$	100,0000	Pulses/ kg	$K_{V,nom}$	100,0000	Pulses/ Liter	T_{nom}	20	°C
		Laboratory reference					Fluid			Ambient conditions												Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
15.01.2016	30		29,928	29,954	2595,351	2,598	999,019	2,04	17,94	20,96	1,01	17284	6,6531	0,303	259622	100,0335	0,033	260003	100,0820	0,082	-2,060	0,283	0,031
15.01.2016	30		29,927	29,953	2495,063	2,498	999,014	2,04	17,97	21,06	1,01	16615	6,6526	0,295	249568	100,0247	0,025	249936	100,0734	0,073	-2,030	0,275	0,022
15.01.2016	30		29,897	29,923	2516,384	2,519	999,014	2,04	17,97	21,14	1,01	16758	6,6530	0,301	251685	100,0185	0,019	252056	100,0672	0,067	-2,030	0,281	0,016
15.01.2016	30		29,937	29,965	2510,612	2,513	999,010	2,04	17,99	21,24	1,01	16720	6,6531	0,304	251130	100,0274	0,027	251501	100,0760	0,076	-2,010	0,284	0,025
15.01.2016	30		29,921	29,948	2512,121	2,515	999,016	2,04	17,96	21,30	1,01	16729	6,6528	0,298	251277	100,0258	0,026	251649	100,0753	0,075	-2,040	0,278	0,023
15.01.2016	30		29,907	29,935	2521,980	2,524	999,017	2,04	17,95	21,28	1,01	16794	6,6525	0,294	252269	100,0282	0,028	252642	100,0776	0,078	-2,050	0,274	0,025
15.01.2016	30		29,913	29,939	2512,465	2,515	999,012	2,04	17,98	21,20	1,01	16732	6,6530	0,302	251319	100,0288	0,029	251692	100,0783	0,078	-2,020	0,282	0,026
15.01.2016	30		29,907	29,933	2499,311	2,502	999,016	2,04	17,96	21,20	1,01	16644	6,6529	0,300	249987	100,0224	0,022	250358	100,0722	0,072	-2,040	0,280	0,020
15.01.2016	30		29,949	29,978	2514,768	2,517	999,012	2,05	17,98	21,24	1,01	16747	6,6529	0,300	251566	100,0355	0,035	251930	100,0812	0,081	-2,020	0,280	0,033
15.01.2016	30		29,900	29,925	2734,043	2,737	999,014	2,04	17,97	21,26	1,01	18207	6,6528	0,299	273475	100,0258	0,026	273880	100,0752	0,075	-2,030	0,279	0,023
15.01.2016	100		99,158	99,244	3629,280	3,633	999,040	2,12	17,92	21,24	1,01	24217	6,6663	0,502	363055	100,0350	0,035	363576	100,0824	0,082	-2,080	0,497	0,025
15.01.2016	100		100,791	100,883	3657,710	3,661	999,034	2,06	17,94	21,22	1,01	24408	6,6666	0,506	365900	100,0353	0,035	366425	100,0820	0,082	-2,060	0,502	0,025
15.01.2016	100		99,672	99,768	3626,429	3,630	999,006	2,10	18,10	21,18	1,01	24197	6,6658	0,494	362765	100,0337	0,034	363295	100,0802	0,080	-1,900	0,490	0,025
15.01.2016	100		99,888	99,976	3645,089	3,649	999,036	2,10	17,94	21,18	1,01	24323	6,6664	0,503	364635	100,0346	0,035	365160	100,0820	0,082	-2,060	0,499	0,025
15.01.2016	100		99,938	100,027	3629,783	3,633	999,030	2,10	17,97	21,20	1,01	24220	6,6661	0,499	363097	100,0327	0,033	363620	100,0796	0,080	-2,030	0,495	0,023
15.01.2016	100		99,933	100,025	3679,423	3,683	999,035	2,09	17,94	21,20	1,01	24552	6,6663	0,503	368070	100,0347	0,035	368600	100,0821	0,082	-2,060	0,498	0,025
15.01.2016	100		99,991	100,077	3624,678	3,628	999,032	2,10	17,96	21,21	1,01	24186	6,6661	0,500	362595	100,0351	0,035	363117	100,0821	0,082	-2,040	0,495	0,025
15.01.2016	100		101,764	101,857	3741,633	3,745	999,033	2,03	17,94	21,20	1,01	24968	6,6666	0,506	374285	100,0325	0,033	374822	100,0791	0,079	-2,060	0,502	0,023
15.01.2016	100		100,029	100,124	3680,889	3,684	999,030	2,10	17,97	21,18	1,01	24561	6,6661	0,499	368209	100,0326	0,033	368739	100,0795	0,079	-2,030	0,495	0,023
15.01.2016	100		99,921	100,014	4109,826	4,114	999,035	2,10	17,94	21,15	1,01	27424	6,6664	0,503	411129	100,0356	0,036	411721	100,0830	0,083	-2,060	0,498	0,026
15.01.2016	200		201,730	201,921	7408,108	7,415	999,031	1,61	18,07	21,27	1,01	49564	6,6840	0,769	741156	100,0466	0,047	742135	100,0816	0,082	-1,930	0,775	0,038
15.01.2016	200		199,536	199,737	7355,665	7,363	999,037	1,64	18,04	21,25	1,01	49211	6,6838	0,765	735891	100,0441	0,044	736858	100,0791	0,079	-1,960	0,772	0,035
15.01.2016	200		199,558	199,756	7378,134	7,385	999,037	1,63	18,04	21,25	1,01	49361	6,6837	0,765	738128	100,0426	0,043	739099	100,0778	0,078	-1,960	0,771	0,034
15.01.2016	200		199,614	199,810	7468,670	7,476	999,035	1,64	18,05	21,27	1,01	49969	6,6840	0,769	747225	100,0479	0,048	748210	100,0832	0,083	-1,950	0,776	0,039
15.01.2016	200		199,521	199,720	7438,244	7,445	999,030	1,64	18,08	21,27	1,01	49765	6,6839	0,768	744141	100,0426	0,043	745122	100,0772	0,077	-1,920	0,774	0,034
15.01.2016	200		199,497	199,691	7412,267	7,419	999,026	1,64	18,10	21,31	1,01	49592	6,6840	0,769	741561	100,0451	0,045	742539	100,0795	0,079	-1,900	0,775	0,036
15.01.2016	200		199,415	199,617	7502,201	7,509	999,030	1,64	18,08	21,38	1,01	50192	6,6838	0,766	750568	100,0464	0,046	751558	100,0811	0,081	-1,920	0,772	0,038
15.01.2016	200		199,924	200,124	7465,366	7,473	999,029	1,63	18,08	21,46	1,01	49947	6,6840	0,769	746868	100,0444	0,044	747850	100,0787	0,079	-1,920	0,775	0,036
15.01.2016	200		199,606	199,799	7348,409	7,356	999,029	1,64	18,08	21,48	1,01	49164	6,6839	0,768	735155	100,0427	0,043	736122	100,0771	0,077	-1,920	0,774	0,034
15.01.2016	200		199,638	199,832	7475,130	7,483	999,009	1,64	18,19	21,48	1,01	50014	6,6841	0,770	747850	100,0451	0,045	748846	100,0791	0,079	-1,810	0,776	0,037

RISE Laboratory – Day#1

*Original data set

Data report RISE: Day#1

Temperature correction of meter error: T_{nom} = 20 °C

		Laboratory reference					Fluid			Ambient conditions		Turbine meter ($K_{V,nom}$ = 6,6330 Pulses/Liter)			Coriolis_Mass ($K_{m,nom}$ = 100,0000 Pulses/kg)			Coriolis_Vol ($K_{V,nom}$ = 100,0000 Pulses/Liter)				Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
24.02.2016	30	411,841	30,601	30,654	3500,717	3,507	998,255	3,24	20,15			23316,3046	6,6488	0,239	350122,3791	100,0152	0,015	350898,0236	100,0618	0,062	0,150	0,225	0,023
24.02.2016	30	411,255	30,652	30,705	3501,562	3,508	998,257	3,25	20,13			23321,0051	6,6485	0,234	350235,7949	100,0224	0,022	351012,2050	100,0694	0,069	0,130	0,220	0,030
24.02.2016	30	411,309	30,640	30,694	3500,719	3,507	998,258	3,27	20,13			23316,8322	6,6490	0,241	350176,9806	100,0305	0,031	350952,9053	100,0775	0,078	0,130	0,227	0,038
24.02.2016	30	411,211	30,655	30,709	3501,599	3,508	998,260	3,25	20,12			23321,6856	6,6487	0,237	350236,4744	100,0224	0,022	351011,1849	100,0692	0,069	0,120	0,223	0,030
24.02.2016	30	411,467	30,628	30,682	3500,693	3,507	998,261	3,24	20,12			23317,1134	6,6491	0,243	350176,7895	100,0302	0,030	350950,7558	100,0769	0,077	0,120	0,229	0,037
24.02.2016	60	211,255	59,656	59,759	3500,707	3,507	998,263	3,05	20,11			23341,7522	6,6562	0,350	350152,1691	100,0234	0,023	350921,6720	100,0691	0,069	0,110	0,355	0,028
24.02.2016	60	210,887	59,774	59,878	3501,568	3,508	998,264	3,03	20,10			23347,5243	6,6561	0,348	350236,3933	100,0225	0,022	351004,8957	100,0679	0,068	0,100	0,353	0,028
24.02.2016	60	210,897	59,757	59,861	3500,714	3,507	998,265	3,03	20,10			23342,6665	6,6564	0,353	350150,7223	100,0229	0,023	350917,4059	100,0679	0,068	0,100	0,358	0,028
24.02.2016	60	210,882	59,776	59,880	3501,590	3,508	998,266	3,03	20,09			23347,6564	6,6562	0,350	350236,0851	100,0222	0,022	351002,5282	100,0673	0,067	0,090	0,355	0,027
24.02.2016	60	210,941	59,759	59,863	3501,585	3,508	998,266	3,03	20,09			23343,3355	6,6566	0,356	350168,5879	100,0279	0,028	350935,4470	100,0731	0,073	0,090	0,361	0,033
24.02.2016	100	127,542	98,809	98,983	3500,645	3,507	998,249	3,03	20,18			23360,6198	6,6615	0,430	350138,0414	100,0209	0,021	350899,0227	100,0628	0,063	0,180	0,427	0,022
24.02.2016	100	125,799	100,203	100,379	3501,510	3,508	998,245	2,90	20,20			23364,7257	6,6611	0,424	350200,7141	100,0144	0,014	350962,4478	100,0561	0,056	0,200	0,421	0,015
24.02.2016	100	125,744	100,222	100,398	3500,629	3,507	998,241	2,89	20,22			23360,2575	6,6614	0,428	350131,9092	100,0200	0,020	350892,9860	100,0612	0,061	0,220	0,425	0,021
24.02.2016	100	125,650	100,321	100,498	3501,489	3,508	998,238	2,89	20,24			23365,4600	6,6613	0,427	350207,9503	100,0172	0,017	350970,3277	100,0582	0,058	0,240	0,424	0,018
24.02.2016	100	126,032	99,992	100,169	3500,602	3,507	998,234	2,88	20,25			23359,1003	6,6611	0,424	350127,4550	100,0194	0,019	350891,3679	100,0606	0,061	0,250	0,421	0,021
24.02.2016	140	90,024	139,986	140,234	3500,583	3,507	998,230	3,25	20,26			23379,9895	6,6671	0,514	350139,5403	100,0232	0,023	350891,0357	100,0604	0,060	0,260	0,509	0,023
24.02.2016	140	89,814	140,348	140,596	3501,444	3,508	998,231	3,24	20,26			23383,3250	6,6664	0,504	350199,8115	100,0154	0,015	350949,7038	100,0523	0,052	0,260	0,498	0,016
24.02.2016	140	89,904	140,173	140,422	3500,592	3,507	998,232	3,25	20,25			23380,1549	6,6671	0,514	350146,1627	100,0249	0,025	350896,1277	100,0619	0,062	0,250	0,509	0,025
24.02.2016	140	89,875	140,254	140,502	3501,485	3,508	998,233	3,24	20,25			23383,4380	6,6664	0,504	350194,1601	100,0136	0,014	350944,1345	100,0507	0,051	0,250	0,498	0,014
24.02.2016	140	89,781	140,366	140,614	3500,606	3,507	998,234	3,26	20,25			23379,4599	6,6669	0,511	350131,1097	100,0204	0,020	350881,3684	100,0577	0,058	0,250	0,506	0,021
24.02.2016	180	70,281	179,311	179,625	3500,591	3,507	998,248	3,15	20,18			23400,9418	6,6731	0,605	350145,9596	100,0244	0,024	350867,2287	100,0548	0,055	0,180	0,602	0,025
24.02.2016	180	69,893	180,352	180,669	3501,488	3,508	998,249	3,12	20,18			23406,4345	6,6730	0,603	350233,1209	100,0243	0,024	350951,4086	100,0539	0,054	0,180	0,601	0,025
24.02.2016	180	70,218	179,473	179,788	3500,613	3,507	998,248	3,14	20,18			23400,2580	6,6729	0,602	350137,9520	100,0221	0,022	350857,1119	100,0519	0,052	0,180	0,599	0,022
24.02.2016	180	70,079	179,873	180,190	3501,486	3,508	998,245	3,13	20,20			23406,0864	6,6729	0,602	350232,3740	100,0244	0,024	350952,5535	100,0542	0,054	0,200	0,599	0,025
24.02.2016	180	70,204	179,508	179,824	3500,605	3,507	998,244	3,13	20,19			23400,4000	6,6730	0,603	350120,9681	100,0175	0,017	350840,1720	100,0470	0,047	0,190	0,601	0,018
24.02.2016	200	63,419	198,710	199,060	3500,560	3,507	998,240	2,98	20,22			23408,2744	6,6752	0,636	350122,4383	100,0189	0,019	350826,1978	100,0436	0,044	0,220	0,634	0,019
24.02.2016	200	63,310	199,101	199,452	3501,412	3,508	998,240	2,96	20,22			23414,1665	6,6753	0,638	350207,7994	100,0185	0,019	350911,1092	100,0429	0,043	0,220	0,635	0,019
24.02.2016	200	63,454	198,601	198,950	3500,556	3,507	998,241	2,97	20,21			23408,0119	6,6752	0,636	350135,7886	100,0227	0,023	350838,5378	100,0471	0,047	0,210	0,634	0,023
24.02.2016	200	63,256	199,271	199,622	3501,420	3,508	998,242	2,96	20,21			23414,7509	6,6754	0,639	350205,4879	100,0177	0,018	350908,0791	100,0421	0,042	0,210	0,637	0,018
24.02.2016	200	63,423	198,698	199,048	3500,558	3,507	998,243	2,97	20,20			23408,8754	6,6754	0,639	350136,0209	100,0226	0,023	350839,7132	100,0475	0,047	0,200	0,637	0,023

RISE Laboratory – Day#2

Data report RISE: Day#2

*Original data set

Temperature correction of meter error: T_{nom} = 20 °C

		Laboratory reference					Fluid			Ambient conditions		Turbine meter ($K_{V,nom}$ = 0,0000 Pulses/Liter)			Coriolis_Mass ($K_{m,nom}$ = 63,2560 Pulses/kg)			Coriolis_Vol ($K_{V,nom}$ = 0,0000 Pulses/Liter)				Corrected meter error	
Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
25.02.2016	30	421,285	29,915	29,966	3500,808	3,507	998,298	3,07	19,94			23312,8653	6,6479	0,225	350166,9583	100,0245	0,025	350929,0297	100,0716	0,072	-0,060	0,210	0,031
25.02.2016	30	421,306	29,921	29,972	3501,685	3,508	998,297	3,06	19,94			23319,3153	6,6481	0,228	350247,6256	100,0227	0,023	351009,9749	100,0697	0,070	-0,060	0,213	0,029
25.02.2016	30	421,389	29,908	29,959	3500,830	3,507	998,296	3,06	19,95			23313,3276	6,6481	0,228	350193,5885	100,0323	0,032	350956,0029	100,0792	0,079	-0,050	0,213	0,039
25.02.2016	30	422,577	29,831	29,882	3501,684	3,508	998,295	3,06	19,95			23319,9590	6,6483	0,231	350266,8681	100,0283	0,028	351029,9425	100,0753	0,075	-0,050	0,216	0,035
25.02.2016	30	421,809	29,878	29,929	3500,804	3,507	998,294	3,06	19,97			23316,6542	6,6490	0,241	350157,2151	100,0221	0,022	350921,6138	100,0694	0,069	-0,030	0,227	0,029
25.02.2016	60	213,317	59,081	59,182	3500,816	3,507	998,295	3,11	19,95			23340,5920	6,6558	0,344	350186,7600	100,0305	0,031	350947,3464	100,0768	0,077	-0,050	0,349	0,035
25.02.2016	60	213,003	59,182	59,284	3501,663	3,508	998,296	3,11	19,95			23346,1226	6,6558	0,344	350225,5566	100,0166	0,017	350984,8525	100,0626	0,063	-0,050	0,349	0,021
25.02.2016	60	213,065	59,150	59,251	3500,800	3,507	998,297	3,12	19,94			23342,2508	6,6563	0,351	350171,3664	100,0259	0,026	350929,8705	100,0719	0,072	-0,060	0,356	0,030
25.02.2016	60	212,831	59,230	59,332	3501,673	3,508	998,296	3,11	19,96			23346,3144	6,6558	0,344	350237,1772	100,0199	0,020	350997,7648	100,0663	0,066	-0,040	0,349	0,024
25.02.2016	60	212,986	59,172	59,273	3500,780	3,507	998,292	3,12	19,97			23342,5805	6,6564	0,353	350180,1880	100,0289	0,029	350941,2756	100,0750	0,075	-0,030	0,358	0,033
25.02.2016	100	126,303	99,779	99,953	3500,677	3,507	998,262	3,06	20,11			23357,6458	6,6607	0,418	350135,9618	100,0192	0,019	350897,5584	100,0625	0,063	0,110	0,415	0,020
25.02.2016	100	126,001	100,044	100,218	3501,568	3,508	998,264	3,04	20,11			23363,7491	6,6608	0,419	350218,9532	100,0179	0,018	350979,8538	100,0611	0,061	0,110	0,416	0,018
25.02.2016	100	125,979	100,037	100,211	3500,704	3,507	998,262	3,05	20,12			23357,7172	6,6607	0,418	350131,3489	100,0179	0,018	350892,4955	100,0611	0,061	0,120	0,415	0,018
25.02.2016	100	126,105	99,961	100,135	3501,537	3,508	998,256	3,04	20,15			23363,4465	6,6607	0,418	350221,9546	100,0194	0,019	350985,1137	100,0625	0,063	0,150	0,415	0,020
25.02.2016	100	126,260	99,813	99,988	3500,664	3,507	998,257	3,04	20,13			23358,9200	6,6611	0,424	350147,6182	100,0230	0,023	350911,2232	100,0664	0,066	0,130	0,421	0,024
25.02.2016	140	89,938	140,123	140,367	3500,657	3,507	998,259	3,01	20,13			23379,7619	6,6671	0,514	350149,4038	100,0239	0,024	350897,3614	100,0631	0,063	0,130	0,510	0,024
25.02.2016	140	89,786	140,395	140,639	3501,534	3,508	998,261	3,00	20,12			23383,1341	6,6664	0,504	350212,7182	100,0169	0,017	350960,4633	100,0562	0,056	0,120	0,499	0,016
25.02.2016	140	89,818	140,311	140,555	3500,686	3,507	998,262	3,01	20,11			23379,0461	6,6668	0,510	350145,4211	100,0225	0,022	350892,1413	100,0616	0,062	0,110	0,505	0,022
25.02.2016	140	89,774	140,414	140,659	3501,545	3,508	998,264	3,00	20,11			23382,7985	6,6663	0,502	350214,6590	100,0172	0,017	350960,3187	100,0562	0,056	0,110	0,498	0,017
25.02.2016	140	89,770	140,386	140,630	3500,686	3,507	998,265	3,02	20,10			23379,2141	6,6669	0,511	350143,0614	100,0216	0,022	350889,9674	100,0610	0,061	0,100	0,507	0,021
25.02.2016	180	70,342	179,156	179,470	3500,617	3,507	998,255	3,06	20,16			23401,5258	6,6733	0,608	350148,3108	100,0246	0,025	350870,7644	100,0560	0,056	0,160	0,606	0,025
25.02.2016	180	70,268	179,390	179,705	3501,501	3,508	998,252	3,03	20,17			23407,2206	6,6733	0,608	350221,7801	100,0210	0,021	350945,6819	100,0525	0,052	0,170	0,606	0,021
25.02.2016	180	70,380	179,060	179,374	3500,619	3,507	998,248	3,05	20,19			23400,2168	6,6729	0,602	350134,9160	100,0213	0,021	350860,8581	100,0531	0,053	0,190	0,599	0,022
25.02.2016	180	70,296	179,318	179,633	3501,479	3,508	998,245	3,04	20,20			23405,6528	6,6728	0,600	350218,8974	100,0207	0,021	350944,3486	100,0520	0,052	0,200	0,598	0,021
25.02.2016	180	70,412	178,977	179,292	3500,591	3,507	998,244	3,04	20,20			23400,3187	6,6729	0,602	350147,5655	100,0253	0,025	350873,6305	100,0567	0,057	0,200	0,599	0,026
25.02.2016	200	63,254	199,229	199,580	3500,561	3,507	998,239	3,02	20,22			23409,1604	6,6755	0,641	350131,4753	100,0215	0,022	350845,5221	100,0490	0,049	0,220	0,638	0,022
25.02.2016	200	63,176	199,525	199,877	3501,446	3,508	998,241	2,99	20,22			23414,7321	6,6754	0,639	350222,4530	100,0225	0,022	350935,9317	100,0500	0,050	0,220	0,637	0,023
25.02.2016	200	63,311	199,049	199,400	3500,550	3,507	998,241	3,01	20,22			23409,8322	6,6757	0,644	350148,5050	100,0263	0,026	350862,5925	100,0539	0,054	0,220	0,641	0,027
25.02.2016	200	63,084	199,814	200,167	3501,414	3,508	998,240	3,00	20,22			23415,1102	6,6755	0,641	350217,8134	100,0212	0,021	350931,9620	100,0488	0,049	0,220	0,638	0,022
25.02.2016	200	63,256	199,223	199,574	3500,576	3,507	998,240	3,02	20,22			23409,4151	6,6756	0,642	350135,0125	100,0225	0,022	350848,8903	100,0500	0,050	0,220	0,640	0,023

RISE Laboratory – Day#3

Data report RISE: Day#3

*Original data set

Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Turbine meter: Pulse count	Turbine meter: K-factor	Turbine meter: Meter error	Coriolis_Mass: Pulse count	Coriolis_Mass: K-factor	Coriolis_Mass: Meter error	Coriolis_Vol: Pulse count	Coriolis_Vol: K-factor	Coriolis_Vol: Meter error	(T_{fluid} - T_{nom})	Corrected meter error: Turbine meter	Corrected meter error: Coriolis _Mass
			Laboratory reference				Fluid			Ambient conditions		$K_{V,nom}$	0,0000	Pulses/ Liter	$K_{m,nom}$	420,2800	Pulses/ kg	$K_{V,nom}$	0,0000	Pulses/ Liter	T_{nom} 20 °C		
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
26.02.2016	30	423,090	29,788	29,839	3500,788	3,507	998,287	3,01	19,98			23314,7827	6,6485	0,234	350162,7317	100,0243	0,024	350921,1228	100,0692	0,069	-0,020	0,220	0,031
26.02.2016	30	420,616	29,971	30,022	3501,698	3,508	998,292	3,05	19,98			23320,3072	6,6484	0,232	350214,9953	100,0138	0,014	350972,5976	100,0590	0,059	-0,020	0,218	0,020
26.02.2016	30	421,019	29,934	29,986	3500,773	3,507	998,289	3,05	19,98			23316,8547	6,6491	0,243	350155,1695	100,0219	0,022	350912,8339	100,0668	0,067	-0,020	0,229	0,029
26.02.2016	30	420,749	29,961	30,012	3501,684	3,508	998,288	3,05	19,99			23320,7100	6,6485	0,234	350222,6087	100,0163	0,016	350981,4889	100,0614	0,061	-0,010	0,220	0,023
26.02.2016	30	419,912	30,013	30,064	3500,806	3,507	998,301	3,06	19,90			23316,6599	6,6490	0,241	350199,5535	100,0336	0,034	350952,3451	100,0783	0,078	-0,100	0,227	0,040
26.02.2016	30	420,106	30,007	30,058	3501,724	3,508	998,320	3,06	19,81			23321,7422	6,6488	0,238	350253,8248	100,0225	0,022	351000,6354	100,0674	0,067	-0,190	0,224	0,028
26.02.2016	30	420,280	29,988	30,038	3500,932	3,507	998,336	3,06	19,74			23315,8456	6,6488	0,238	350183,6327	100,0261	0,026	350924,1280	100,0708	0,071	-0,260	0,223	0,032
26.02.2016	30	420,195	30,002	30,052	3501,835	3,508	998,347	3,05	19,69			23320,5824	6,6485	0,234	350287,3319	100,0298	0,030	351023,5879	100,0744	0,074	-0,310	0,219	0,035
26.02.2016	30	420,447	29,977	30,026	3500,992	3,507	998,352	3,06	19,68			23315,7090	6,6488	0,238	350186,6159	100,0256	0,026	350920,7242	100,0701	0,070	-0,320	0,223	0,031
26.02.2016	30	420,867	29,954	30,004	3501,894	3,508	998,358	3,07	19,65			23320,7553	6,6486	0,235	350265,8084	100,0227	0,023	350998,5842	100,0674	0,067	-0,350	0,220	0,028
26.02.2016	100	126,822	99,376	99,544	3500,837	3,507	998,310	3,13	19,89			23360,4493	6,6615	0,430	350150,5421	100,0192	0,019	350883,8481	100,0593	0,059	-0,110	0,427	0,019
26.02.2016	100	126,781	99,433	99,601	3501,712	3,508	998,308	3,13	19,90			23365,9474	6,6615	0,430	350235,2943	100,0187	0,019	350970,4023	100,0590	0,059	-0,100	0,427	0,018
26.02.2016	100	126,839	99,362	99,530	3500,820	3,507	998,309	3,13	19,89			23361,1531	6,6617	0,433	350174,8805	100,0263	0,026	350910,9023	100,0670	0,067	-0,110	0,430	0,026
26.02.2016	100	126,609	99,567	99,736	3501,688	3,508	998,307	3,13	19,90			23365,2787	6,6613	0,427	350255,1899	100,0244	0,024	350990,9507	100,0649	0,065	-0,100	0,424	0,024
26.02.2016	100	126,860	99,345	99,514	3500,807	3,507	998,308	3,14	19,90			23360,1295	6,6615	0,430	350156,8428	100,0212	0,021	350892,9729	100,0619	0,062	-0,100	0,427	0,021
26.02.2016	100	126,534	99,626	99,795	3501,681	3,508	998,304	3,12	19,92			23365,5333	6,6613	0,427	350232,8495	100,0183	0,018	350971,3551	100,0592	0,059	-0,080	0,424	0,018
26.02.2016	100	126,816	99,379	99,548	3500,798	3,507	998,303	3,13	19,92			23360,3002	6,6615	0,430	350163,1512	100,0234	0,023	350902,0507	100,0644	0,064	-0,080	0,427	0,023
26.02.2016	100	126,771	99,440	99,608	3501,690	3,508	998,303	3,13	19,92			23365,2645	6,6613	0,427	350235,7188	100,0192	0,019	350974,6881	100,0601	0,060	-0,080	0,424	0,019
26.02.2016	100	126,866	99,340	99,509	3500,804	3,507	998,304	3,12	19,91			23359,3673	6,6612	0,425	350166,3647	100,0243	0,024	350905,3236	100,0653	0,065	-0,090	0,422	0,024
26.02.2016	100	126,768	99,442	99,611	3501,691	3,508	998,306	3,13	19,91			23365,2274	6,6612	0,425	350228,5275	100,0169	0,017	350966,5906	100,0579	0,058	-0,090	0,422	0,017
26.02.2016	200	63,060	199,850	200,192	3500,702	3,507	998,289	3,07	19,98			23412,0261	6,6763	0,653	350160,2467	100,0255	0,025	350850,1424	100,0511	0,051	-0,020	0,651	0,025
26.02.2016	200	62,946	200,261	200,604	3501,560	3,508	998,289	3,05	20,00			23417,1712	6,6762	0,651	350248,4986	100,0259	0,026	350938,6131	100,0514	0,051	0,000	0,650	0,025
26.02.2016	200	63,015	199,991	200,335	3500,683	3,507	998,286	3,08	20,00			23411,8142	6,6763	0,653	350161,6675	100,0261	0,026	350852,1588	100,0516	0,052	0,000	0,651	0,026
26.02.2016	200	62,866	200,516	200,861	3501,573	3,508	998,285	3,06	20,01			23416,6917	6,6760	0,648	350233,9344	100,0220	0,022	350925,6218	100,0477	0,048	0,010	0,647	0,022
26.02.2016	200	63,120	199,661	200,004	3500,719	3,507	998,284	3,08	20,01			23410,6800	6,6760	0,648	350145,6042	100,0217	0,022	350837,4970	100,0474	0,047	0,010	0,647	0,021
26.02.2016	200	62,946	200,261	200,605	3501,560	3,508	998,284	3,06	20,01			23417,6251	6,6763	0,653	350227,3071	100,0202	0,020	350918,7076	100,0457	0,046	0,010	0,651	0,020
26.02.2016	200	63,086	199,766	200,110	3500,684	3,507	998,282	3,07	20,02			23411,0521	6,6761	0,650	350152,3950	100,0238	0,024	350844,3221	100,0493	0,049	0,020	0,648	0,023
26.02.2016	200	62,865	200,517	200,863	3501,528	3,508	998,280	3,05	20,03			23417,1363	6,6761	0,650	350235,7651	100,0230	0,023	350928,3829	100,0484	0,048	0,030	0,648	0,023
26.02.2016	200	63,044	199,900	200,245	3500,697	3,507	998,280	3,08	20,03			23412,8055	6,6766	0,657	350160,6672	100,0263	0,026	350852,7576	100,0517	0,052	0,030	0,656	0,026
26.02.2016	200	62,873	200,494	200,839	3501,565	3,508	998,279	3,05	20,04			23418,2973	6,6765	0,656	350242,4468	100,0249	0,025	350937,0813	100,0509	0,051	0,040	0,654	0,025

UME Laboratory – Day#1

Data report UME: Day#1

*Original data set

Turbine meter: $K_{V,nom}$ = 6,6330 Pulses/Liter — Coriolis_Mass: $K_{m,nom}$ = 100,0000 Pulses/kg — Coriolis_Vol: $K_{V,nom}$ = 100,0000 Pulses/Liter

Temperature correction of meter error: T_{nom} = 20 °C

		Laboratory reference					Fluid			Ambient conditions		Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error	Corrected meter error	
Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
26.05.2016	30	60,438	30,395	30,425	510,281	0,511	999,021	0,48	16,50	22,60	0,99	3402	6,6604	0,413	51084	100,1095	0,110	51165	100,1701	0,170	-3,500	0,388	0,100
26.05.2016	30	60,642	30,392	30,421	511,943	0,512	999,021	0,48	16,50	22,60	0,99	3412	6,6583	0,381	51229	100,0677	0,068	51310	100,1278	0,128	-3,500	0,356	0,058
26.05.2016	30	60,268	30,370	30,399	508,419	0,509	999,021	0,48	16,50	22,60	0,99	3389	6,6592	0,396	50886	100,0867	0,087	50966	100,1459	0,146	-3,500	0,371	0,077
26.05.2016	30	60,558	30,377	30,407	510,992	0,511	999,021	0,48	16,50	22,60	0,99	3405	6,6570	0,362	51128	100,0563	0,056	51209	100,1167	0,117	-3,500	0,337	0,047
26.05.2016	30	60,234	30,386	30,415	508,399	0,509	999,021	0,48	16,50	22,60	0,99	3387	6,6556	0,340	50879	100,0769	0,077	50959	100,1361	0,136	-3,500	0,316	0,067
26.05.2016	60	46,162	59,787	59,846	766,648	0,767	999,021	0,34	16,50	22,60	0,99	5114	6,6641	0,468	76767	100,1333	0,133	76880	100,1825	0,182	-3,500	0,467	0,115
26.05.2016	60	46,298	59,788	59,846	768,911	0,770	999,021	0,34	16,50	22,60	0,99	5129	6,6639	0,467	76945	100,0701	0,070	77064	100,1268	0,127	-3,500	0,465	0,052
26.05.2016	60	46,472	59,768	59,826	771,544	0,772	999,021	0,34	16,50	22,60	0,99	5147	6,6645	0,475	77212	100,0747	0,075	77331	100,1308	0,131	-3,500	0,474	0,057
26.05.2016	60	46,318	59,750	59,808	768,751	0,770	999,021	0,34	16,50	22,60	0,99	5127	6,6627	0,448	76928	100,0689	0,069	77047	100,1255	0,126	-3,500	0,447	0,051
26.05.2016	60	46,468	59,768	59,826	771,474	0,772	999,021	0,34	16,50	22,60	0,99	5146	6,6638	0,465	77208	100,0786	0,079	77326	100,1334	0,133	-3,500	0,463	0,061
26.05.2016	100	31,853	100,264	100,364	887,148	0,888	999,004	0,80	16,60	22,60	0,99	5923	6,6698	0,555	88775	100,0679	0,068	88910	100,1202	0,120	-3,400	0,549	0,051
26.05.2016	100	33,129	100,191	100,291	921,998	0,923	999,004	0,80	16,60	22,60	0,99	6155	6,6691	0,544	92254	100,0588	0,059	92394	100,1108	0,111	-3,400	0,538	0,042
26.05.2016	100	32,857	100,072	100,172	913,348	0,914	999,004	0,80	16,60	22,60	0,99	6097	6,6688	0,540	91398	100,0692	0,069	91537	100,1215	0,122	-3,400	0,534	0,052
26.05.2016	100	33,179	99,990	100,090	921,538	0,922	999,004	0,80	16,60	22,60	0,99	6152	6,6692	0,545	92207	100,0578	0,058	92346	100,1088	0,109	-3,400	0,539	0,041
26.05.2016	100	32,873	99,916	100,016	912,367	0,913	999,004	0,80	16,60	22,60	0,99	6091	6,6694	0,549	91292	100,0606	0,061	91431	100,1132	0,113	-3,400	0,543	0,044
26.05.2016	140	54,357	140,175	140,318	2116,548	2,119	998,987	1,70	16,70	22,60	0,99	14124	6,6664	0,503	211539	99,9453	-0,055	211859	99,9951	-0,005	-3,300	0,511	-0,071
26.05.2016	140	52,230	140,217	140,361	2034,327	2,036	998,970	1,70	16,80	22,60	0,99	13580	6,6686	0,536	203362	99,9652	-0,035	203670	100,0135	0,014	-3,200	0,543	-0,051
26.05.2016	140	111,707	140,125	140,270	4348,038	4,353	998,970	1,70	16,80	22,60	0,99	29025	6,6685	0,536	434680	99,9715	-0,028	435345	100,0213	0,021	-3,200	0,543	-0,045
26.05.2016	140	64,752	140,430	140,575	2525,854	2,528	998,970	1,70	16,80	22,60	0,99	16865	6,6701	0,559	252589	100,0014	0,001	252980	100,0531	0,053	-3,200	0,566	-0,015
26.05.2016	140	64,196	140,577	140,722	2506,805	2,509	998,970	1,70	16,80	22,60	0,99	16734	6,6686	0,536	250609	99,9715	-0,029	250997	100,0231	0,023	-3,200	0,543	-0,045
26.05.2016	180	50,997	180,007	180,184	2549,955	2,552	999,021	0,36	16,50	22,60	0,99	17033	6,6732	0,606	255075	100,0312	0,031	255393	100,0578	0,058	-3,500	0,619	0,015
26.05.2016	180	51,846	179,902	180,078	2590,902	2,593	999,021	0,36	16,50	22,60	0,99	17310	6,6745	0,626	259209	100,0459	0,046	259538	100,0748	0,075	-3,500	0,639	0,030
26.05.2016	180	51,237	179,855	180,031	2559,766	2,562	999,021	0,36	16,50	22,60	0,99	17104	6,6753	0,638	256109	100,0517	0,052	256434	100,0806	0,081	-3,500	0,651	0,036
26.05.2016	180	51,883	179,859	180,035	2592,103	2,595	999,021	0,36	16,50	22,60	0,99	17319	6,6749	0,632	259338	100,0493	0,049	259665	100,0773	0,077	-3,500	0,644	0,033
26.05.2016	180	51,728	179,768	179,944	2583,093	2,586	999,021	0,36	16,50	22,60	0,99	17258	6,6746	0,627	258436	100,0490	0,049	258765	100,0783	0,078	-3,500	0,640	0,033
26.05.2016	200	54,785	200,631	200,828	3053,238	3,056	999,021	0,45	16,50	22,60	0,99	20405	6,6765	0,656	305385	100,0200	0,020	305796	100,0566	0,057	-3,500	0,669	0,004
26.05.2016	200	55,806	200,438	200,635	3107,100	3,110	999,021	0,45	16,50	22,60	0,99	20766	6,6769	0,661	310823	100,0364	0,036	311242	100,0732	0,073	-3,500	0,674	0,020
26.05.2016	200	54,736	200,510	200,707	3048,632	3,052	999,021	0,45	16,50	22,60	0,99	20374	6,6765	0,655	304935	100,0236	0,024	305349	100,0613	0,061	-3,500	0,668	0,007
26.05.2016	200	55,128	200,601	200,798	3071,859	3,075	999,021	0,45	16,50	22,60	0,99	20524	6,6748	0,630	307196	100,0033	0,003	307613	100,0410	0,041	-3,500	0,642	-0,013
26.05.2016	200	54,806	200,511	200,707	3052,537	3,056	999,021	0,45	16,50	22,60	0,99	20400	6,6764	0,655	305331	100,0253	0,025	305748	100,0639	0,064	-3,500	0,667	0,009

UME Laboratory – Day#2

Data report UME: Day#2 | *Original data set

Turbine meter: $K_{V,nom}$ = 6,6330 Pulses/Liter; Coriolis_Mass: $K_{m,nom}$ = 100,0000 Pulses/kg; Coriolis_Vol: $K_{V,nom}$ = 100,0000 Pulses/Liter

Temperature correction of meter error: T_{nom} = 20 °C

Date	Nominal flowrate	Laboratory reference: Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Fluid: Water density	Line pressure	Water temp.	Ambient conditions: Air temp.	Air pressure	Turbine meter: Pulse count	K-factor	Meter error	Coriolis_Mass: Pulse count	K-factor	Meter error	Coriolis_Vol: Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Corrected meter error: Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
27.05.2016	30	88,105	30,159	30,192	738,091	0,739	998,883	0,86	17,30	22,60	0,99	4917	6,6543	0,322	73878	100,0933	0,093	74005	100,1534	0,153	-2,700	0,300	0,088
27.05.2016	30	90,844	30,157	30,191	760,997	0,762	998,883	0,86	17,30	22,60	0,99	5070	6,6549	0,330	76160	100,0792	0,079	76262	100,1013	0,101	-2,700	0,308	0,073
27.05.2016	30	89,451	30,192	30,226	750,194	0,751	998,883	0,86	17,30	22,60	0,99	4995	6,6508	0,269	75042	100,0301	0,030	75171	100,0901	0,090	-2,700	0,247	0,024
27.05.2016	30	93,491	30,185	30,219	783,908	0,785	998,883	0,86	17,30	22,60	0,99	5220	6,6515	0,279	78423	100,0410	0,041	78558	100,1013	0,101	-2,700	0,257	0,035
27.05.2016	30	92,710	30,195	30,229	777,601	0,778	998,883	0,86	17,30	22,60	0,99	5180	6,6541	0,318	77800	100,0513	0,051	77933	100,1104	0,110	-2,700	0,296	0,045
27.05.2016	60	73,646	60,317	60,384	1233,930	1,235	998,900	0,42	17,20	22,60	0,99	8230	6,6624	0,443	123461	100,0551	0,055	123671	100,1151	0,115	-2,800	0,444	0,042
27.05.2016	60	72,609	60,301	60,367	1216,209	1,218	998,900	0,42	17,20	22,60	0,99	8110	6,6609	0,421	121677	100,0461	0,046	121883	100,1053	0,105	-2,800	0,421	0,033
27.05.2016	60	73,234	60,322	60,389	1227,122	1,228	998,900	0,42	17,20	22,60	0,99	8179	6,6579	0,375	122729	100,0137	0,014	122936	100,0722	0,072	-2,800	0,375	0,001
27.05.2016	60	72,355	60,268	60,335	1211,304	1,213	998,900	0,42	17,20	22,60	0,99	8078	6,6615	0,430	121194	100,0525	0,053	121400	100,1124	0,112	-2,800	0,430	0,040
27.05.2016	60	72,623	60,254	60,321	1215,508	1,217	998,900	0,42	17,20	22,60	0,99	8105	6,6607	0,417	121599	100,0396	0,040	121805	100,0989	0,099	-2,800	0,417	0,027
27.05.2016	100	66,387	100,361	100,473	1850,744	1,853	998,883	0,33	17,30	22,60	0,99	12346	6,6634	0,458	185131	100,0306	0,031	185432	100,0813	0,081	-2,700	0,453	0,017
27.05.2016	100	66,811	100,178	100,290	1859,154	1,861	998,883	0,33	17,30	22,60	0,99	12404	6,6644	0,473	185970	100,0294	0,029	186282	100,0852	0,085	-2,700	0,468	0,016
27.05.2016	100	66,525	99,960	100,072	1847,178	1,849	998,883	0,33	17,30	22,60	0,99	12328	6,6665	0,505	184843	100,0678	0,068	185152	100,1231	0,123	-2,700	0,500	0,055
27.05.2016	100	64,806	99,809	99,921	1796,725	1,799	998,883	0,33	17,30	22,60	0,99	11991	6,6664	0,503	179782	100,0610	0,061	180083	100,1165	0,117	-2,700	0,498	0,048
27.05.2016	100	66,335	99,720	99,831	1837,478	1,840	998,883	0,33	17,30	22,60	0,99	12261	6,6653	0,487	183821	100,0398	0,040	184129	100,0955	0,095	-2,700	0,482	0,027
27.05.2016	140	63,042	140,267	140,422	2456,336	2,459	998,900	0,27	17,20	22,60	0,99	16400	6,6693	0,547	245681	100,0193	0,019	246083	100,0728	0,073	-2,800	0,553	0,005
27.05.2016	140	51,928	140,105	140,260	2020,945	2,023	998,900	0,27	17,20	22,60	0,99	13495	6,6702	0,561	202180	100,0423	0,042	202511	100,0959	0,096	-2,800	0,567	0,028
27.05.2016	140	53,216	140,067	140,221	2070,499	2,073	998,900	0,27	17,20	22,60	0,99	13823	6,6688	0,540	207114	100,0310	0,031	207452	100,0840	0,084	-2,800	0,546	0,017
27.05.2016	140	53,100	139,721	139,875	2060,888	2,063	998,900	0,27	17,20	22,60	0,99	13760	6,6694	0,549	206192	100,0501	0,050	206530	100,1039	0,104	-2,800	0,555	0,036
27.05.2016	140	52,914	139,886	140,040	2056,081	2,058	998,900	0,27	17,20	22,60	0,99	13723	6,6670	0,513	205625	100,0082	0,008	205960	100,0610	0,061	-2,800	0,519	-0,006
27.05.2016	180	51,399	180,493	180,688	2576,986	2,580	998,918	0,30	17,10	22,60	0,99	17212	6,6719	0,586	257723	100,0095	0,009	258129	100,0586	0,059	-2,900	0,597	-0,004
27.05.2016	180	50,871	180,404	180,600	2549,254	2,552	998,918	0,31	17,10	22,60	0,99	17023	6,6704	0,564	254970	100,0175	0,018	255369	100,0656	0,066	-2,900	0,574	0,004
27.05.2016	180	51,685	180,284	180,479	2588,299	2,591	998,918	0,31	17,10	22,60	0,99	17298	6,6759	0,647	258857	100,0105	0,010	259264	100,0593	0,059	-2,900	0,657	-0,003
27.05.2016	180	52,217	179,972	180,167	2610,425	2,613	998,918	0,30	17,10	22,60	0,99	17447	6,6764	0,654	261094	100,0197	0,020	261505	100,0688	0,069	-2,900	0,664	0,006
27.05.2016	180	51,095	179,916	180,111	2553,559	2,556	998,918	0,30	17,10	22,60	0,99	17064	6,6752	0,636	255360	100,0016	0,002	255762	100,0507	0,051	-2,900	0,647	-0,012
27.05.2016	200	56,409	200,305	200,526	3138,637	3,142	998,900	0,37	17,20	22,60	0,99	20981	6,6774	0,669	313860	99,9988	-0,001	314340	100,0416	0,042	-2,800	0,679	-0,014
27.05.2016	200	55,442	200,245	200,465	3083,873	3,087	998,900	0,37	17,20	22,60	0,99	20616	6,6777	0,675	308404	100,0054	0,005	308878	100,0490	0,049	-2,800	0,684	-0,007
27.05.2016	200	55,681	200,083	200,303	3094,686	3,098	998,900	0,37	17,20	22,60	0,99	20687	6,6773	0,668	309462	99,9979	-0,002	309937	100,0412	0,041	-2,800	0,678	-0,015
27.05.2016	200	55,799	200,061	200,278	3100,893	3,104	998,918	0,37	17,10	22,60	0,99	20726	6,6766	0,658	310048	99,9867	-0,013	310525	100,0322	0,032	-2,900	0,668	-0,027
27.05.2016	200	55,663	199,934	200,151	3091,382	3,095	998,918	0,37	17,10	22,60	0,99	20667	6,6781	0,680	309146	100,0025	0,003	309621	100,0478	0,048	-2,900	0,691	-0,011

UME Laboratory – Day#3

Data report UME: Day#3 — *Original data set

Turbine meter: $K_{V,nom}$ = 6,6330 Pulses/Liter; Coriolis_Mass: $K_{m,nom}$ = 100,0000 Pulses/kg; Coriolis_Vol: $K_{V,nom}$ = 100,0000 Pulses/Liter

Temperature correction of meter error: T_{nom} = 20 °C

Date	Nominal flowrate	Laboratory reference: Measu-rement time	Laboratory reference: Standard mass flowrate	Laboratory reference: Standard volume flowrate	Laboratory reference: Mass	Laboratory reference: Volume	Fluid: Water density	Fluid: Line pressure	Fluid: Water temp.	Ambient conditions: Air temp.	Ambient conditions: Air pressure	Turbine meter: Pulse count	Turbine meter: K-factor	Turbine meter: Meter error	Coriolis_Mass: Pulse count	Coriolis_Mass: K-factor	Coriolis_Mass: Meter error	Coriolis_Vol: Pulse count	Coriolis_Vol: K-factor	Coriolis_Vol: Meter error	(T_{fluid} - T_{nom})	Corrected meter error: Turbine meter	Corrected meter error: Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
28.05.2016	30	89,709	30,322	30,360	755,596	0,757	998,756	0,42	18,00	23,15	1,00	5036	6,6567	0,357	75583	100,0310	0,031	75719	100,0864	0,086	-2,000	0,337	0,029
28.05.2016	30	137,898	30,314	30,351	1161,165	1,163	998,756	0,41	18,00	23,15	1,00	7739	6,6566	0,355	116154	100,0323	0,032	116361	100,0859	0,086	-2,000	0,335	0,030
28.05.2016	30	89,893	30,295	30,332	756,474	0,757	998,774	0,41	17,90	23,15	1,00	5043	6,6583	0,381	75674	100,0351	0,035	75808	100,0895	0,089	-2,100	0,361	0,032
28.05.2016	30	87,935	30,293	30,331	739,962	0,741	998,756	0,41	18,00	23,15	1,00	4932	6,6569	0,361	74024	100,0376	0,038	74156	100,0913	0,091	-2,000	0,341	0,035
28.05.2016	30	89,603	30,301	30,338	754,172	0,755	998,756	0,41	18,00	23,15	1,00	5027	6,6573	0,366	75444	100,0355	0,035	75577	100,0872	0,087	-2,000	0,346	0,033
28.05.2016	30	87,239	30,304	30,341	734,351	0,735	998,756	0,41	18,00	23,15	1,00	4894	6,6561	0,348	73453	100,0244	0,024	73583	100,0768	0,077	-2,000	0,328	0,022
28.05.2016	30	88,757	30,308	30,346	747,242	0,748	998,756	0,41	18,00	23,15	1,00	4980	6,6562	0,350	74750	100,0346	0,035	74883	100,0879	0,088	-2,000	0,330	0,032
28.05.2016	30	90,177	30,299	30,336	758,952	0,760	998,756	0,41	18,00	23,15	1,00	5058	6,6562	0,349	75919	100,0314	0,031	76053	100,0833	0,083	-2,000	0,329	0,029
28.05.2016	30	89,013	30,298	30,336	749,145	0,750	998,756	0,41	18,00	23,15	1,00	4994	6,6580	0,377	74944	100,0394	0,039	75077	100,0923	0,092	-2,000	0,357	0,037
28.05.2016	30	91,745	30,282	30,319	771,723	0,773	998,756	0,41	18,00	23,15	1,00	5144	6,6573	0,367	77192	100,0256	0,026	77329	100,0785	0,078	-2,000	0,347	0,023
28.05.2016	100	73,601	100,195	100,320	2048,450	2,051	998,756	0,23	18,00	23,15	1,00	13671	6,6655	0,490	204923	100,0381	0,038	205277	100,0862	0,086	-2,000	0,486	0,028
28.05.2016	100	74,248	100,393	100,518	2070,557	2,073	998,756	0,22	18,00	23,15	1,00	13818	6,6653	0,486	207151	100,0460	0,046	207508	100,0938	0,094	-2,000	0,482	0,036
28.05.2016	100	71,607	100,348	100,471	1996,014	1,998	998,774	0,22	17,90	23,15	1,00	13319	6,6646	0,477	199665	100,0318	0,032	200008	100,0809	0,081	-2,100	0,472	0,022
28.05.2016	100	71,900	100,301	100,424	2003,220	2,006	998,774	0,22	17,90	23,15	1,00	13366	6,6641	0,469	200376	100,0270	0,027	200719	100,0754	0,075	-2,100	0,464	0,017
28.05.2016	100	72,567	100,386	100,510	2023,538	2,026	998,774	0,23	17,90	23,15	1,00	13502	6,6643	0,472	202413	100,0293	0,029	202759	100,0774	0,077	-2,100	0,467	0,019
28.05.2016	100	73,381	100,456	100,580	2047,649	2,050	998,774	0,23	17,90	23,15	1,00	13664	6,6648	0,480	204843	100,0381	0,038	205194	100,0867	0,087	-2,100	0,476	0,028
28.05.2016	100	72,489	100,544	100,669	2024,534	2,027	998,756	0,23	18,00	23,15	1,00	13508	6,6639	0,465	202511	100,0285	0,028	202856	100,0742	0,074	-2,000	0,461	0,019
28.05.2016	100	73,856	100,463	100,588	2061,064	2,064	998,756	0,23	18,00	23,15	1,00	13754	6,6650	0,482	206205	100,0478	0,048	206556	100,0935	0,093	-2,000	0,477	0,038
28.05.2016	100	73,028	100,384	100,509	2036,346	2,039	998,756	0,22	18,00	23,15	1,00	13588	6,6644	0,474	203710	100,0371	0,037	204057	100,0828	0,083	-2,000	0,470	0,027
28.05.2016	100	71,483	100,361	100,486	1992,813	1,995	998,756	0,22	18,00	23,15	1,00	13297	6,6642	0,470	199348	100,0335	0,033	199687	100,0789	0,079	-2,000	0,466	0,024
28.05.2016	200	54,857	200,012	200,261	3047,813	3,052	998,756	0,42	18,00	23,15	1,00	20381	6,6788	0,690	304887	100,0347	0,035	305366	100,0672	0,067	-2,000	0,697	0,025
28.05.2016	200	55,300	199,892	200,141	3070,530	3,074	998,756	0,42	18,00	23,15	1,00	20530	6,6778	0,676	307129	100,0247	0,025	307611	100,0571	0,057	-2,000	0,682	0,016
28.05.2016	200	55,368	199,795	200,044	3072,832	3,077	998,756	0,42	18,00	23,15	1,00	20545	6,6777	0,674	307396	100,0367	0,037	307828	100,0527	0,053	-2,000	0,680	0,027
28.05.2016	200	55,245	199,931	200,180	3068,135	3,072	998,756	0,42	18,00	23,15	1,00	20516	6,6785	0,686	306898	100,0275	0,028	307381	100,0603	0,060	-2,000	0,692	0,018
28.05.2016	200	55,779	199,871	200,124	3096,860	3,101	998,738	0,42	18,10	23,15	1,00	20708	6,6783	0,683	309782	100,0310	0,031	310269	100,0618	0,062	-1,900	0,690	0,022
28.05.2016	200	56,281	199,753	200,002	3122,882	3,127	998,756	0,42	18,00	23,15	1,00	20878	6,6772	0,666	312341	100,0169	0,017	312833	100,0498	0,050	-2,000	0,673	0,008
28.05.2016	200	55,547	199,847	200,100	3083,594	3,087	998,738	0,42	18,10	23,15	1,00	20617	6,6776	0,672	308427	100,0219	0,022	308914	100,0534	0,053	-1,900	0,678	0,013
28.05.2016	200	55,165	199,836	200,085	3062,230	3,066	998,756	0,42	18,00	23,15	1,00	20471	6,6767	0,659	306254	100,0101	0,010	306735	100,0426	0,043	-2,000	0,665	0,001
28.05.2016	200	55,334	200,188	200,437	3076,997	3,081	998,756	0,42	18,00	23,15	1,00	20570	6,6768	0,660	307737	100,0121	0,012	308223	100,0455	0,045	-2,000	0,667	0,003
28.05.2016	200	55,129	200,149	200,402	3065,033	3,069	998,738	0,42	18,10	23,15	1,00	20491	6,6770	0,663	306543	100,0130	0,013	307026	100,0441	0,044	-1,900	0,669	0,004

PTB Laboratory – Day#1

Data report PTB: Day#1

*Original data set

Turbine meter: $K_{V,nom}$ = 6,6330 Pulses/Liter; Coriolis_Mass: $K_{m,nom}$ = 100,0000 Pulses/kg; Coriolis_Vol: $K_{V,nom}$ = 100,0000 Pulses/Liter

Temperature correction of meter error: T_{nom} = 20 °C

Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Turbine meter Pulse count	Turbine meter K-factor	Turbine meter Meter error	Coriolis_Mass Pulse count	Coriolis_Mass K-factor	Coriolis_Mass Meter error	Coriolis_Vol Pulse count	Coriolis_Vol K-factor	Coriolis_Vol Meter error	(T_{fluid} - T_{nom})	Corrected meter error Turbine meter	Corrected meter error Coriolis_Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
19.07.2016	30	324,140	29,905	29,956	2692,653	2,697	998,325	3,00	20,27	23,13	1,01	17952	6,6559	0,345	269393	100,0474	0,047	269898	100,0670	0,067	0,265	0,331	0,055
19.07.2016	30	324,119	29,946	29,995	2696,089	2,701	998,355	2,99	20,12	23,12	1,01	17972	6,6550	0,331	269709	100,0371	0,037	270203	100,0555	0,055	0,123	0,318	0,044
19.07.2016	30	324,114	29,902	29,951	2692,163	2,697	998,363	3,01	20,08	23,10	1,01	17945	6,6547	0,328	269310	100,0348	0,035	269799	100,0524	0,052	0,082	0,314	0,042
19.07.2016	30	324,133	29,899	29,948	2692,011	2,696	998,365	3,00	20,08	23,07	1,01	17943	6,6544	0,322	269288	100,0323	0,032	269775	100,0493	0,049	0,076	0,308	0,039
19.07.2016	30	324,090	29,924	29,973	2693,953	2,698	998,367	3,00	20,07	23,07	1,01	17956	6,6544	0,323	269506	100,0411	0,041	269994	100,0585	0,059	0,066	0,309	0,048
19.07.2016	60	162,130	59,881	59,977	2696,795	2,701	998,391	3,00	19,95	23,08	1,01	18000	6,6638	0,465	269795	100,0428	0,043	270276	100,0599	0,060	-0,051	0,470	0,047
19.07.2016	60	162,117	59,846	59,942	2695,000	2,699	998,388	3,00	19,96	23,08	1,01	17988	6,6638	0,465	269595	100,0353	0,035	270076	100,0522	0,052	-0,038	0,470	0,039
19.07.2016	60	162,128	59,889	59,986	2697,150	2,701	998,393	3,00	19,94	23,08	1,01	18001	6,6634	0,458	269819	100,0386	0,039	270302	100,0566	0,057	-0,061	0,463	0,043
19.07.2016	60	162,109	59,830	59,926	2694,163	2,698	998,393	3,00	19,94	23,09	1,01	17981	6,6633	0,457	269491	100,0277	0,028	269975	100,0463	0,046	-0,060	0,462	0,032
19.07.2016	60	162,106	59,887	59,983	2696,662	2,701	998,392	3,00	19,94	23,09	1,01	17998	6,6634	0,459	269755	100,0329	0,033	270241	100,0520	0,052	-0,057	0,464	0,037
19.07.2016	100	97,338	99,653	99,814	2694,458	2,699	998,388	3,00	19,96	23,11	1,01	17995	6,6678	0,524	269531	100,0316	0,032	270011	100,0483	0,048	-0,038	0,521	0,031
19.07.2016	100	97,324	99,758	99,918	2696,890	2,701	998,392	3,00	19,94	23,13	1,01	18013	6,6684	0,534	269774	100,0315	0,032	270254	100,0484	0,048	-0,057	0,531	0,031
19.07.2016	100	97,324	99,719	99,879	2695,843	2,700	998,395	3,00	19,93	23,12	1,01	18005	6,6681	0,529	269658	100,0274	0,027	270139	100,0450	0,045	-0,072	0,526	0,027
19.07.2016	100	97,342	99,766	99,927	2697,621	2,702	998,390	3,00	19,96	23,10	1,01	18017	6,6681	0,529	269849	100,0322	0,032	270331	100,0495	0,050	-0,044	0,526	0,032
19.07.2016	100	97,322	99,659	99,819	2694,156	2,698	998,393	3,00	19,94	23,08	1,01	17995	6,6685	0,536	269502	100,0321	0,032	269984	100,0499	0,050	-0,059	0,533	0,032
19.07.2016	140	69,523	140,947	141,174	2721,967	2,726	998,394	2,98	19,94	23,08	1,01	18200	6,6756	0,642	272288	100,0335	0,034	272764	100,0475	0,047	-0,065	0,638	0,032
19.07.2016	140	69,522	139,309	139,533	2690,292	2,695	998,394	3,01	19,93	23,07	1,01	17987	6,6752	0,636	269122	100,0345	0,035	269593	100,0486	0,049	-0,066	0,632	0,033
19.07.2016	140	69,522	139,237	139,461	2688,897	2,693	998,392	3,01	19,94	23,07	1,01	17977	6,6749	0,632	268983	100,0347	0,035	269455	100,0492	0,049	-0,058	0,628	0,034
19.07.2016	140	69,543	139,235	139,460	2689,681	2,694	998,389	3,01	19,96	23,08	1,01	17983	6,6752	0,636	269069	100,0375	0,038	269542	100,0520	0,052	-0,043	0,632	0,036
19.07.2016	140	69,568	139,188	139,412	2689,733	2,694	998,394	3,01	19,94	23,08	1,01	17948	6,6621		269063	100,0334	0,033	269537	100,0486	0,049	-0,063	0,000	0,032
19.07.2016	180	54,127	178,369	178,656	2681,819	2,686	998,391	3,02	19,95	23,03	1,01	17948	6,6817	0,734	268282	100,0373	0,037	268738	100,0462	0,046	-0,053	0,733	0,037
19.07.2016	180	54,104	178,876	179,164	2688,296	2,693	998,392	3,01	19,94	23,06	1,01	17991	6,6816	0,732	268936	100,0396	0,040	269394	100,0488	0,049	-0,058	0,731	0,039
19.07.2016	180	54,105	178,793	179,081	2687,098	2,691	998,392	3,01	19,94	23,07	1,01	17984	6,6820	0,738	268817	100,0399	0,040	269276	100,0496	0,050	-0,058	0,737	0,039
19.07.2016	180	54,150	181,242	181,534	2726,170	2,731	998,392	2,97	19,94	23,07	1,01	18247	6,6825	0,746	272725	100,0396	0,040	273188	100,0483	0,048	-0,055	0,745	0,039
19.07.2016	180	54,105	179,358	179,648	2695,597	2,700	998,388	3,00	19,96	23,08	1,01	18040	6,6816	0,733	269663	100,0383	0,038	270123	100,0475	0,047	-0,038	0,732	0,038
19.07.2016	200	48,742	201,036	201,360	2721,898	2,726	998,390	2,97	19,95	23,06	1,01	18225	6,6849	0,783	272293	100,0379	0,038	272747	100,0434	0,043	-0,047	0,782	0,037
19.07.2016	200	48,699	200,222	200,546	2708,478	2,713	998,385	2,98	19,98	23,06	1,01	18134	6,6845	0,776	270960	100,0414	0,041	271412	100,0465	0,046	-0,023	0,775	0,041
19.07.2016	200	48,747	200,146	200,469	2710,127	2,715	998,389	2,99	19,96	23,07	1,01	18145	6,6845	0,776	271118	100,0389	0,039	271571	100,0445	0,045	-0,040	0,775	0,038
19.07.2016	200	48,727	198,156	198,476	2682,068	2,686	998,386	3,02	19,97	23,06	1,01	17957	6,6844	0,775	268311	100,0388	0,039	268763	100,0456	0,046	-0,027	0,774	0,038
19.07.2016	200	48,726	201,041	201,366	2721,086	2,725	998,386	2,97	19,97	23,08	1,01	18219	6,6847	0,779	272213	100,0384	0,038	272668	100,0439	0,044	-0,028	0,778	0,038

PTB Laboratory – Day#2

Data report PTB: Day#2

*Original data set

Temperature correction of meter error: T_{nom} = 20 °C

		Laboratory reference					Fluid			Ambient conditions		Turbine meter ($K_{V,nom}$ = 6,6330 Pulses/Liter)			Coriolis_Mass ($K_{m,nom}$ = 100,0000 Pulses/kg)			Coriolis_Vol ($K_{V,nom}$ = 100,0000 Pulses/Liter)				Corrected meter error	
Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis_Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
20.07.2016	30	324,135	29,906	29,956	2692,648	2,697	998,335	2,99	20,22	22,34	1,01	17949	6,6548	0,329	269379	100,0424	0,042	269898	100,0683	0,068	0,215	0,316	0,050
20.07.2016	30	324,111	29,918	29,967	2693,520	2,698	998,344	3,00	20,17	22,46	1,01	17954	6,6546	0,326	269471	100,0442	0,044	269978	100,0665	0,066	0,172	0,312	0,052
20.07.2016	30	324,111	29,917	29,966	2693,458	2,698	998,356	3,00	20,12	22,54	1,01	17953	6,6545	0,323	269428	100,0305	0,031	269928	100,0514	0,051	0,115	0,310	0,038
20.07.2016	30	324,107	29,954	30,003	2696,772	2,701	998,358	3,02	20,11	22,62	1,01	17975	6,6544	0,323	269766	100,0329	0,033	270263	100,0527	0,053	0,106	0,309	0,040
20.07.2016	30	324,132	29,896	29,945	2691,769	2,696	998,362	3,00	20,09	22,68	1,01	17941	6,6542	0,320	269263	100,0320	0,032	269759	100,0521	0,052	0,089	0,306	0,039
20.07.2016	60	162,106	59,852	59,950	2695,120	2,700	998,372	3,00	20,04	23,07	1,01	17988	6,6634	0,459	269606	100,0349	0,035	270111	100,0591	0,059	0,039	0,464	0,040
20.07.2016	60	162,148	59,860	59,958	2696,174	2,701	998,374	3,00	20,03	23,07	1,01	17995	6,6634	0,459	269728	100,0410	0,041	270228	100,0636	0,064	0,028	0,464	0,046
20.07.2016	60	162,109	59,858	59,955	2695,424	2,700	998,381	3,00	20,00	23,06	1,01	17990	6,6635	0,459	269645	100,0381	0,038	270142	100,0601	0,060	-0,001	0,464	0,042
20.07.2016	60	162,128	59,904	60,001	2697,824	2,702	998,383	3,00	19,99	23,05	1,01	18006	6,6635	0,459	269873	100,0336	0,034	270369	100,0553	0,055	-0,011	0,464	0,038
20.07.2016	60	162,130	59,884	59,981	2696,961	2,701	998,383	3,00	19,99	23,05	1,01	18000	6,6634	0,458	269813	100,0433	0,043	270308	100,0648	0,065	-0,011	0,463	0,048
20.07.2016	100	97,320	98,177	98,335	2654,030	2,658	998,387	3,01	19,97	23,06	1,01	17726	6,6681	0,530	265481	100,0294	0,029	265957	100,0471	0,047	-0,031	0,527	0,029
20.07.2016	100	97,343	97,796	97,954	2644,364	2,649	998,385	3,02	19,98	23,08	1,01	17661	6,6679	0,527	264518	100,0309	0,031	264993	100,0487	0,049	-0,024	0,524	0,031
20.07.2016	100	97,297	99,509	99,669	2689,406	2,694	998,388	3,00	19,96	23,08	1,01	17962	6,6680	0,528	269015	100,0277	0,028	269498	100,0457	0,046	-0,037	0,525	0,028
20.07.2016	100	97,342	99,621	99,782	2693,693	2,698	998,389	3,00	19,96	23,09	1,01	17991	6,6682	0,530	269452	100,0307	0,031	269936	100,0490	0,049	-0,044	0,527	0,031
20.07.2016	100	97,341	99,578	99,738	2692,480	2,697	998,387	3,00	19,97	23,10	1,01	17984	6,6686	0,536	269338	100,0334	0,033	269823	100,0519	0,052	-0,033	0,533	0,033
20.07.2016	140	69,543	138,568	138,791	2676,775	2,681	998,387	3,01	19,97	23,14	1,01	17896	6,6749	0,631	267776	100,0368	0,037	268248	100,0515	0,051	-0,033	0,627	0,036
20.07.2016	140	69,543	142,078	142,307	2744,582	2,749	998,390	2,97	19,95	23,15	1,01	18351	6,6755	0,641	274552	100,0342	0,034	275034	100,0484	0,048	-0,045	0,637	0,033
20.07.2016	140	69,561	141,808	142,037	2740,082	2,745	998,390	2,97	19,95	23,15	1,01	18322	6,6759	0,647	274102	100,0342	0,034	274581	100,0477	0,048	-0,048	0,643	0,033
20.07.2016	140	69,520	140,497	140,723	2713,151	2,718	998,391	2,99	19,95	23,15	1,01	18140	6,6752	0,636	271421	100,0390	0,039	271895	100,0525	0,053	-0,053	0,632	0,038
20.07.2016	140	69,541	140,536	140,763	2714,729	2,719	998,390	2,99	19,95	23,18	1,01	18152	6,6757	0,644	271565	100,0339	0,034	272039	100,0472	0,047	-0,046	0,640	0,033
20.07.2016	180	54,103	178,434	178,722	2681,611	2,686	998,390	3,01	19,95	23,18	1,01	17946	6,6815	0,731	268267	100,0395	0,040	268719	100,0468	0,047	-0,049	0,730	0,039
20.07.2016	180	54,148	179,943	180,234	2706,535	2,711	998,389	2,98	19,96	23,19	1,01	18114	6,6819	0,737	270748	100,0349	0,035	271204	100,0420	0,042	-0,042	0,736	0,034
20.07.2016	180	54,150	180,807	181,099	2719,629	2,724	998,391	2,97	19,95	23,20	1,01	18202	6,6821	0,740	272063	100,0368	0,037	272518	100,0429	0,043	-0,050	0,738	0,036
20.07.2016	180	54,104	180,807	181,099	2717,313	2,722	998,385	2,97	19,98	23,20	1,01	18187	6,6822	0,742	271822	100,0334	0,033	272278	100,0394	0,039	-0,023	0,740	0,033
20.07.2016	180	54,104	179,452	179,741	2696,953	2,701	998,388	3,00	19,96	23,21	1,01	18050	6,6820	0,738	269807	100,0414	0,041	270260	100,0479	0,048	-0,039	0,737	0,041
20.07.2016	200	48,679	199,025	199,346	2691,191	2,696	998,388	3,00	19,96	23,21	1,01	18019	6,6848	0,780	269234	100,0427	0,043	269675	100,0450	0,045	-0,036	0,779	0,042
20.07.2016	200	48,742	200,277	200,600	2711,615	2,716	998,386	2,99	19,97	23,23	1,01	18154	6,6841	0,770	271282	100,0444	0,044	271725	100,0461	0,046	-0,029	0,769	0,044
20.07.2016	200	48,724	200,401	200,724	2712,287	2,717	998,388	2,98	19,96	23,24	1,01	18160	6,6847	0,779	271335	100,0392	0,039	271778	100,0410	0,041	-0,036	0,778	0,039
20.07.2016	200	48,722	199,069	199,391	2694,159	2,699	998,387	3,01	19,97	23,24	1,01	18038	6,6844	0,775	269526	100,0409	0,041	269967	100,0429	0,043	-0,030	0,774	0,040
20.07.2016	200	48,699	198,361	198,682	2683,310	2,688	998,386	3,03	19,97	23,23	1,01	17965	6,6843	0,773	268447	100,0432	0,043	268887	100,0454	0,045	-0,026	0,772	0,043

PTB Laboratory – Day#3

Data report PTB: Day#3

*Original data set

												Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error		
												$K_{V,nom}$	6,6330	Pulses/ Liter	$K_{m,nom}$	100,0000	Pulses/ kg	$K_{V,nom}$	100,0000	Pulses/ Liter	T_{nom}	20	°C
		Laboratory reference					Fluid			Ambient conditions												Corrected meter error	
Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
21.07.2016	30	324,114	29,946	29,996	2696,096	2,701	998,346	2,99	20,16	23,68	1,00	17971	6,6545	0,325	269701	100,0339	0,034	270176	100,0444	0,044	0,164	0,311	0,041
21.07.2016	30	324,116	29,944	29,993	2695,916	2,700	998,355	3,00	20,12	23,65	1,00	17969	6,6543	0,321	269691	100,0369	0,037	270162	100,0467	0,047	0,124	0,307	0,044
21.07.2016	30	324,133	29,924	29,973	2694,281	2,699	998,358	3,00	20,11	23,63	1,00	17959	6,6547	0,327	269513	100,0315	0,032	269982	100,0411	0,041	0,106	0,313	0,039
21.07.2016	30	324,113	29,905	29,954	2692,350	2,697	998,360	3,01	20,10	23,64	1,00	17945	6,6543	0,320	269323	100,0327	0,033	269792	100,0426	0,043	0,097	0,307	0,040
21.07.2016	30	324,112	29,909	29,958	2692,743	2,697	998,362	3,00	20,09	23,64	1,00	17948	6,6544	0,323	269330	100,0207	0,021	269800	100,0311	0,031	0,088	0,309	0,028
21.07.2016	30	324,133	29,904	29,953	2692,469	2,697	998,364	3,00	20,08	23,63	1,00	17946	6,6544	0,322	269329	100,0305	0,030	269798	100,0408	0,041	0,077	0,308	0,038
21.07.2016	30	324,133	29,984	30,033	2699,686	2,704	998,367	2,99	20,06	23,63	1,00	17994	6,6543	0,322	270050	100,0301	0,030	270523	100,0417	0,042	0,063	0,308	0,037
21.07.2016	30	324,133	29,892	29,940	2691,344	2,696	998,369	3,00	20,05	23,62	1,00	17939	6,6546	0,325	269216	100,0303	0,030	269688	100,0423	0,042	0,053	0,311	0,037
21.07.2016	30	324,130	29,927	29,976	2694,523	2,699	998,369	2,99	20,06	23,62	1,00	17959	6,6541	0,319	269592	100,0518	0,052	270068	100,0650	0,065	0,055	0,305	0,059
21.07.2016	30	324,106	29,950	29,999	2696,394	2,701	998,369	3,00	20,05	23,61	1,00	17972	6,6543	0,322	269739	100,0369	0,037	270217	100,0507	0,051	0,055	0,308	0,044
21.07.2016	100	97,296	99,863	100,024	2698,977	2,703	998,389	3,00	19,96	23,63	1,00	18026	6,6681	0,529	269986	100,0327	0,033	270449	100,0429	0,043	-0,043	0,526	0,033
21.07.2016	100	97,319	99,718	99,879	2695,664	2,700	998,391	3,00	19,95	23,63	1,00	18003	6,6678	0,524	269647	100,0299	0,030	270108	100,0397	0,040	-0,051	0,521	0,030
21.07.2016	100	97,340	99,676	99,837	2695,134	2,699	998,388	3,00	19,96	23,63	1,00	18000	6,6679	0,527	269585	100,0266	0,027	270046	100,0362	0,036	-0,039	0,524	0,026
21.07.2016	100	97,316	99,659	99,820	2694,006	2,698	998,390	3,00	19,96	23,63	1,00	17993	6,6681	0,530	269480	100,0295	0,029	269943	100,0400	0,040	-0,044	0,527	0,029
21.07.2016	100	97,319	99,705	99,866	2695,322	2,700	998,390	3,00	19,95	23,62	1,00	18002	6,6682	0,531	269606	100,0274	0,027	270069	100,0378	0,038	-0,046	0,528	0,027
21.07.2016	100	97,297	99,778	99,939	2696,685	2,701	998,389	3,00	19,96	23,63	1,00	18011	6,6682	0,530	269745	100,0284	0,028	270209	100,0390	0,039	-0,041	0,527	0,028
21.07.2016	100	97,321	99,712	99,873	2695,588	2,700	998,390	3,00	19,96	23,61	1,00	18004	6,6683	0,532	269634	100,0279	0,028	270099	100,0390	0,039	-0,044	0,529	0,028
21.07.2016	100	97,318	99,964	100,126	2702,300	2,707	998,388	3,00	19,96	23,61	1,00	18048	6,6680	0,528	270321	100,0337	0,034	270789	100,0453	0,045	-0,036	0,525	0,034
21.07.2016	100	97,317	101,868	102,033	2753,762	2,758	998,389	2,98	19,96	23,61	1,00	18393	6,6685	0,535	275445	100,0250	0,025	275922	100,0368	0,037	-0,040	0,532	0,025
21.07.2016	100	97,340	99,204	99,364	2682,386	2,687	998,391	3,00	19,95	23,63	1,00	17916	6,6684	0,533	268322	100,0311	0,031	268787	100,0432	0,043	-0,050	0,530	0,031
21.07.2016	200	48,743	199,937	200,260	2707,077	2,711	998,389	2,99	19,96	23,60	1,00	18124	6,6843	0,773	270816	100,0400	0,040	271246	100,0374	0,037	-0,040	0,772	0,039
21.07.2016	200	48,724	200,044	200,367	2707,468	2,712	998,391	2,98	19,95	23,62	1,00	18127	6,6844	0,775	270854	100,0396	0,040	271283	100,0368	0,037	-0,051	0,774	0,039
21.07.2016	200	48,721	198,113	198,433	2681,161	2,685	998,390	3,02	19,95	23,62	1,00	17951	6,6845	0,776	268225	100,0406	0,041	268651	100,0382	0,038	-0,046	0,775	0,040
21.07.2016	200	48,724	201,006	201,331	2720,473	2,725	998,385	2,97	19,98	23,62	1,00	18215	6,6847	0,780	272147	100,0366	0,037	272579	100,0336	0,034	-0,022	0,778	0,036
21.07.2016	200	48,723	199,405	199,727	2698,757	2,703	998,385	3,00	19,98	23,63	1,00	18069	6,6845	0,776	269987	100,0412	0,041	270417	100,0388	0,039	-0,023	0,775	0,041
21.07.2016	200	48,720	199,994	200,317	2706,608	2,711	998,388	2,98	19,96	23,66	1,00	18122	6,6847	0,779	270764	100,0381	0,038	271196	100,0362	0,036	-0,038	0,778	0,038
21.07.2016	200	48,740	200,802	201,127	2718,662	2,723	998,383	2,96	19,99	23,63	1,00	18203	6,6847	0,780	271980	100,0419	0,042	272413	100,0391	0,039	-0,014	0,779	0,041
21.07.2016	200	48,724	200,166	200,490	2709,161	2,714	998,385	2,98	19,98	23,63	1,00	18138	6,6842	0,773	271011	100,0350	0,035	271443	100,0327	0,033	-0,023	0,771	0,034
21.07.2016	200	48,699	201,636	201,962	2727,660	2,732	998,388	2,96	19,96	23,63	1,00	18263	6,6847	0,779	272869	100,0378	0,038	273303	100,0353	0,035	-0,036	0,778	0,037
21.07.2016	200	48,722	198,626	198,947	2688,209	2,693	998,386	3,01	19,97	23,64	1,00	17999	6,6847	0,780	268928	100,0398	0,040	269358	100,0381	0,038	-0,028	0,779	0,039

NIST Laboratory – Day#1

Data report NIST: Day#1					*Original data set							Turbine meter			Coriolis_Mass				Coriolis_Vol				Temperature correction of meter error		
												$K_{V,nom}$	6,6330	Pulses/ Liter	$K_{m,nom}$	100,0000	Pulses/kg		$K_{V,nom}$	100,0000	Pulses/ Liter		T_{nom}	20	°C
		Laboratory reference					Fluid			Ambient conditions														Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter output frequency	Meter error	Pulse count	K-factor	Meter output frequency	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m		e_m	N	K_V		e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/ Liter]	[%]	[Pulses]	[Pulses/ kg]	[Hz]	[%]	[Pulses]	[Pulses/ Liter]	[Hz]	[%]	[°C]	[%]	[%]
28.09.2016	30	119,634	30,144	30,209	1001,721	1003,890	997,840	1,64	23,45	24,50	1,00					100,0298	837,5712	0,030		100,1329	840,2493	0,133	3,453		0,051
28.09.2016	30	119,641	30,152	30,217	1002,047	1004,223	997,834	1,64	23,48	24,40	1,00					99,9880	837,4418	-0,012		100,0204	839,5315	0,020	3,476		0,009
28.09.2016	30	119,643	30,181	30,247	1003,049	1005,241	997,819	1,64	23,54	24,20	1,00					99,9919	838,3007	-0,008		100,0302	840,4556	0,030	3,541		0,013
28.09.2016	30	119,632	30,132	30,198	1001,320	1003,515	997,813	1,65	23,56	24,30	1,00					99,9962	836,9682	-0,004		100,0255	839,0483	0,026	3,564		0,017
28.09.2016	30	119,634	30,055	30,121	998,763	1000,958	997,807	1,65	23,59	24,30	1,00					99,9934	834,7947	-0,007		100,0154	836,8132	0,015	3,587		0,015
28.09.2016	60	180,060	60,052	60,185	3003,620	3010,229	997,805	1,88	23,64	24,30	1,00					99,9860	1667,8901	-0,014		99,9866	1671,5690	-0,013	3,640		0,009
28.09.2016	60	180,057	60,071	60,204	3004,523	3011,148	997,800	1,88	23,66	24,30	1,00					100,0202	1668,9892	0,020		100,0418	1673,0297	0,042	3,663		0,043
28.09.2016	60	180,061	60,067	60,199	3004,348	3010,990	997,794	1,88	23,69	24,30	1,00					100,0024	1668,5565	0,002		100,0409	1672,8897	0,041	3,685		0,025
28.09.2016	60	180,048	60,049	60,182	3003,224	3009,880	997,789	1,88	23,71	24,30	1,00					100,0229	1668,3990	0,023		100,0429	1672,4297	0,043	3,707		0,046
28.09.2016	60	180,052	60,065	60,199	3004,127	3010,799	997,784	1,89	23,72	24,20	1,00					100,0067	1668,5929	0,007		100,0425	1672,8984	0,043	3,724		0,030
28.09.2016	100	108,764	99,234	99,455	2998,068	3004,745	997,778	1,93	23,75	24,30	1,00					99,9609	2755,4111	-0,039		99,9824	2762,1406	-0,018	3,754		-0,024
28.09.2016	100	108,767	99,261	99,483	2998,983	3005,671	997,775	1,93	23,77	24,30	1,00					100,0300	2758,0834	0,030		100,0386	2764,4716	0,039	3,766		0,046
28.09.2016	100	108,757	99,256	99,478	2998,579	3005,274	997,772	1,93	23,78	24,30	1,00					100,0092	2757,3775	0,009		100,0319	2764,1622	0,032	3,778		0,025
28.09.2016	100	108,768	99,233	99,455	2998,168	3004,873	997,769	1,93	23,79	24,30	1,00					100,0034	2756,5606	0,003		100,0232	2763,2726	0,023	3,794		0,019
28.09.2016	100	108,760	99,252	99,474	2998,520	3005,236	997,765	1,93	23,81	24,30	1,00					100,0157	2757,4294	0,016		100,0355	2764,1507	0,035	3,808		0,031
28.09.2016	140	77,358	139,714	140,031	3002,224	3009,030	997,738	1,51	23,84	24,30	1,00					100,0158	3881,5519	0,016		100,0218	3890,5853	0,022	3,843		0,030
28.09.2016	140	77,352	139,783	140,100	3003,447	3010,262	997,736	1,51	23,85	24,30	1,00					100,0164	3883,4922	0,016		100,0189	3892,4015	0,019	3,850		0,031
28.09.2016	140	77,357	139,786	140,104	3003,729	3010,552	997,733	1,51	23,86	24,30	1,00					100,0180	3883,6507	0,018		100,0255	3892,7661	0,026	3,858		0,032
28.09.2016	140	77,351	139,733	140,051	3002,360	3009,189	997,730	1,51	23,87	24,30	1,00					100,0089	3881,8218	0,009		100,0173	3890,9776	0,017	3,870		0,023
28.09.2016	140	77,354	139,729	140,048	3002,384	3009,223	997,727	1,51	23,89	24,30	1,00					100,0106	3881,7800	0,011		100,0242	3891,1544	0,024	3,886		0,025
28.09.2016	180	60,191	179,272	179,677	2997,398	3004,169	997,746	2,06	23,91	24,30	1,00					100,0203	4980,8000	0,020		100,0289	4992,4803	0,029	3,907		0,036
28.09.2016	180	60,178	179,307	179,713	2997,312	3004,091	997,743	2,06	23,92	24,30	1,00					100,0201	4981,7556	0,020		100,0242	4993,2293	0,024	3,917		0,036
28.09.2016	180	60,193	179,526	179,933	3001,725	3008,530	997,738	2,06	23,94	24,30	1,00					99,9747	4985,5679	-0,025		99,9772	4996,9944	-0,023	3,939		-0,010
28.09.2016	180	60,191	179,451	179,859	3000,369	3007,181	997,735	2,07	23,95	24,30	1,00					100,0129	4985,4010	0,013		100,0151	4996,8310	0,015	3,954		0,029
28.09.2016	180	60,200	179,649	180,057	3004,122	3010,954	997,731	2,07	23,97	24,30	1,00					99,8980	4985,1558	-0,102		99,9016	4996,6744	-0,098	3,970		-0,086
28.09.2016	200	54,005	200,097	200,549	3001,756	3008,526	997,750	2,69	24,01	24,40	1,00					100,0061	5558,5987	0,006		100,0229	5572,0684	0,023	4,006		0,022
28.09.2016	200	54,003	200,254	200,706	3003,952	3010,734	997,747	2,70	24,02	24,30	1,00					100,0225	5563,8487	0,022		100,0244	5576,5192	0,024	4,016		0,038
28.09.2016	200	54,021	200,192	200,645	3004,056	3010,849	997,744	2,69	24,03	24,40	1,00					100,0094	5561,4125	0,009		100,0107	5574,0626	0,011	4,029		0,025
28.09.2016	200	54,002	200,219	200,672	3003,414	3010,219	997,739	2,69	24,05	24,40	1,00					100,0172	5562,5804	0,017		100,0174	5575,1956	0,017	4,048		0,033
28.09.2016	200	54,009	200,061	200,515	3001,394	3008,204	997,736	2,70	24,06	24,40	1,00					100,0111	5557,8724	0,011		100,0155	5570,7279	0,015	4,063		0,027

NIST Laboratory – Day#2

Data report NIST: Day#2 — *Original data set

Turbine meter: $k_{nominal}$ 6,633 Pulses/Liter; Coriolis_Mass: $k_{nominal}$ 100,000 Pulses/kg; Coriolis_Vol: $k_{nominal}$ 100,000 Pulses/Liter

Temperature correction of meter error: T_{nom} 20 °C

		Laboratory reference					Fluid			Ambient conditions		Turbine meter			Coriolis_Mass				Coriolis_Vol				Temperature correction	Corrected meter error	
Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter output frequency	Meter error	Pulse count	K-factor	Meter output frequency	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m		e_m	N	K_V		e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[Hz]	[%]	[Pulses]	[Pulses/Liter]	[Hz]	[%]	[°C]	[%]	[%]
29.09.2016	30	120,154	30,099	30,167	1004,597	1006,858	997,755	1,62	23,80	24,10	1,00					100,1914	837,6938	0,000		100,1950	839,6089	0,000	3,804		0,022
29.09.2016	30	120,149	30,097	30,165	1004,485	1006,757	997,744	1,63	23,85	24,00	1,01					99,9891	835,9385	-0,011		100,0184	838,0746	0,018	3,846		0,011
29.09.2016	30	120,150	30,082	30,151	1003,995	1006,275	997,735	1,64	23,89	23,90	1,01					99,9453	835,1608	-0,055		99,9665	837,2347	-0,034	3,886		-0,032
29.09.2016	30	120,156	30,062	30,130	1003,354	1005,642	997,725	1,64	23,93	23,90	1,01					99,9669	834,7682	-0,033		99,9785	836,7685	-0,022	3,926		-0,011
29.09.2016	30	120,152	29,883	29,951	997,357	999,648	997,708	1,65	23,99	23,90	1,01					100,0164	830,2119	0,016		100,0004	831,9854	0,000	3,993		0,039
29.09.2016	60	179,908	59,903	60,042	2993,631	3000,558	997,691	1,88	24,10	24,00	1,01					100,0054	1664,0727	0,005		100,0181	1668,1355	0,018	4,102		0,030
29.09.2016	60	179,913	59,922	60,061	2994,634	3001,585	997,684	1,88	24,13	24,00	1,01					99,9665	1663,9319	-0,034		100,0021	1668,3881	0,002	4,129		-0,009
29.09.2016	60	179,945	59,915	60,054	2994,811	3001,781	997,678	1,89	24,15	24,00	1,01					99,9691	1663,7795	-0,031		99,9999	1668,1654	0,000	4,154		-0,006
29.09.2016	60	179,918	59,905	60,045	2993,872	3000,858	997,672	1,89	24,18	24,00	1,01					100,0113	1664,2107	0,011		100,0318	1668,4348	0,032	4,177		0,036
29.09.2016	60	179,938	59,932	60,072	2995,584	3002,590	997,667	1,89	24,20	24,00	1,01					99,9780	1664,4157	-0,022		99,9901	1668,5099	-0,010	4,201		0,003
29.09.2016	100	108,615	99,292	99,525	2995,713	3002,737	997,661	1,94	24,23	24,00	1,01					100,0031	2758,1907	0,003		100,0194	2765,1075	0,019	4,229		0,020
29.09.2016	100	108,610	99,321	99,554	2996,458	3003,495	997,657	1,94	24,24	24,00	1,01					99,9564	2757,7021	-0,044		99,9802	2764,8363	-0,020	4,242		-0,026
29.09.2016	100	108,604	99,332	99,566	2996,641	3003,689	997,654	1,94	24,26	24,00	1,01					100,0075	2759,4347	0,007		100,0217	2766,3180	0,022	4,258		0,025
29.09.2016	100	108,617	99,285	99,518	2995,558	3002,614	997,650	1,94	24,27	24,00	1,01					99,9948	2757,7625	-0,005		100,0240	2765,0668	0,024	4,273		0,012
29.09.2016	100	108,620	99,370	99,604	2998,206	3005,282	997,645	1,94	24,29	24,00	1,01					99,9896	2759,9791	-0,010		100,0028	2766,8595	0,003	4,289		0,007
29.09.2016	140	77,481	139,372	139,702	2999,648	3006,750	997,638	2,02	24,33	24,00	1,01					100,0036	3871,5792	0,004		100,0200	3881,3832	0,020	4,332		0,019
29.09.2016	140	77,488	139,483	139,813	3002,305	3009,423	997,635	2,02	24,34	24,00	1,01					99,9345	3871,9813	-0,065		99,9419	3881,4494	-0,058	4,345		-0,050
29.09.2016	140	77,480	139,424	139,755	3000,727	3007,850	997,632	2,02	24,36	24,00	1,01					100,0029	3872,9947	0,003		100,0317	3883,3085	0,032	4,356		0,019
29.09.2016	140	77,487	139,381	139,712	3000,059	3007,188	997,629	2,02	24,37	24,00	1,01					100,0032	3871,8208	0,003		100,0358	3882,2864	0,036	4,368		0,019
29.09.2016	140	77,487	139,431	139,763	3001,145	3008,286	997,626	2,02	24,38	24,10	1,01					100,0088	3873,4217	0,009		100,0309	3883,4985	0,031	4,379		0,025
29.09.2016	180	60,372	178,676	179,101	2996,397	3003,536	997,623	2,13	24,41	24,00	1,01					99,8958	4958,0436	-0,104		99,9104	4970,5832	-0,090	4,410		-0,087
29.09.2016	180	60,377	178,431	178,857	2992,558	2999,694	997,621	2,14	24,42	24,10	1,01					100,0137	4957,1014	0,014		100,0212	4969,2961	0,021	4,420		0,031
29.09.2016	180	60,375	178,518	178,944	2993,887	3001,035	997,618	2,13	24,43	24,10	1,01					100,0116	4959,4152	0,012		100,0149	4971,4175	0,015	4,430		0,029
29.09.2016	180	60,369	178,548	178,975	2994,121	3001,280	997,614	2,12	24,44	24,10	1,01					100,0036	4959,8498	0,004		100,0075	4971,9031	0,007	4,444		0,021
29.09.2016	180	60,390	178,534	178,961	2994,910	3002,081	997,611	2,13	24,46	24,10	1,01					100,0069	4959,6144	0,007		100,0161	4971,9453	0,016	4,457		0,025
29.09.2016	200	54,096	199,686	200,163	3000,618	3007,783	997,618	2,48	24,49	24,30	1,01					100,0041	5547,0608	0,004		99,9995	5560,0479	-0,001	4,493		0,022
29.09.2016	200	54,088	199,651	200,129	2999,660	3006,833	997,614	2,48	24,50	24,30	1,01					99,9998	5545,8561	0,000		100,0006	5559,1658	0,001	4,505		0,018
29.09.2016	200	54,077	199,626	200,104	2998,663	3005,844	997,611	2,47	24,52	24,20	1,01					100,0107	5545,7536	0,011		100,0289	5560,0491	0,029	4,519		0,028
29.09.2016	200	54,072	199,585	200,064	2997,767	3004,954	997,608	2,48	24,53	24,20	1,00					100,0059	5544,3571	0,006		100,0148	5558,1465	0,015	4,532		0,024
29.09.2016	200	54,089	199,466	199,945	2996,944	3004,139	997,605	2,49	24,55	24,20	1,00					100,0018	5540,8287	0,002		100,0116	5554,6738	0,012	4,545		0,020

NIST Laboratory – Day#3

Data report NIST: Day#3

*Original data set

Laboratory reference, Fluid, Ambient conditions:

Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]
29.09.2016	30	119,782	30,035	30,108	999,334	1001,762	997,576	1,92	24,57	24,30	1,01
29.09.2016	30	119,791	30,065	30,138	1000,404	1002,847	997,564	1,92	24,62	24,20	1,00
29.09.2016	30	119,776	30,058	30,132	1000,067	1002,519	997,554	1,92	24,66	24,20	1,00
29.09.2016	30	119,782	30,050	30,124	999,841	1002,312	997,535	1,92	24,73	24,20	1,01
29.09.2016	30	119,767	30,025	30,099	998,878	1001,354	997,527	1,92	24,76	24,20	1,00
29.09.2016	30	119,770	29,859	29,934	993,389	995,875	997,504	1,92	24,85	24,20	1,00
29.09.2016	30	119,812	30,059	30,134	1000,382	1002,893	997,496	1,92	24,88	24,20	1,00
29.09.2016	30	119,781	29,957	30,032	996,745	999,253	997,489	1,92	24,90	24,10	1,00
29.09.2016	30	119,781	29,980	30,055	997,495	1000,012	997,483	1,93	24,93	24,10	1,00
29.09.2016	30	119,781	29,950	30,025	996,496	999,017	997,476	1,93	24,96	24,10	1,01
29.09.2016	100	108,727	99,333	99,587	3000,060	3007,738	997,447	1,57	25,00	24,20	1,01
29.09.2016	100	108,710	99,373	99,627	3000,792	3008,481	997,444	1,57	25,01	24,30	1,01
29.09.2016	100	108,724	99,435	99,690	3003,026	3010,730	997,441	1,57	25,03	24,20	1,01
29.09.2016	100	108,719	99,461	99,716	3003,677	3011,390	997,439	1,57	25,03	24,30	1,00
29.09.2016	100	108,721	99,457	99,713	3003,637	3011,359	997,436	1,57	25,05	24,30	1,00
29.09.2016	100	108,708	99,496	99,752	3004,454	3012,189	997,432	1,57	25,06	24,30	1,00
29.09.2016	100	108,728	99,458	99,714	3003,839	3011,585	997,428	1,57	25,07	24,40	1,00
29.09.2016	100	108,716	99,541	99,798	3006,030	3013,792	997,425	1,57	25,09	24,30	1,00
29.09.2016	100	108,730	99,526	99,783	3005,949	3013,721	997,421	1,58	25,11	24,30	1,00
29.09.2016	100	108,716	99,641	99,899	3009,045	3016,837	997,417	1,57	25,12	24,40	1,00
29.09.2016	200	53,944	200,307	200,817	3001,510	3009,158	997,459	2,71	25,15	24,40	1,00
29.09.2016	200	53,904	200,288	200,798	2998,954	3006,592	997,459	2,72	25,15	24,40	1,00
29.09.2016	200	53,913	200,306	200,817	2999,735	3007,375	997,459	2,71	25,15	24,40	1,00
29.09.2016	200	53,898	200,435	200,946	3000,817	3008,465	997,458	2,71	25,15	24,30	1,00
29.09.2016	200	53,911	200,330	200,841	3000,013	3007,665	997,456	2,72	25,16	24,30	1,00
29.09.2016	200	53,884	200,220	200,732	2996,872	3004,537	997,449	2,71	25,19	24,30	1,00
29.09.2016	200	53,927	200,380	200,894	3001,613	3009,304	997,445	2,72	25,21	24,20	1,00
29.09.2016	200	53,906	200,324	200,838	2999,645	3007,343	997,440	2,72	25,23	24,20	1,00
29.09.2016	200	53,905	200,289	200,804	2999,058	3006,767	997,436	2,71	25,24	24,20	1,00
29.09.2016	200	53,881	200,366	200,882	2998,891	3006,611	997,432	2,72	25,25	24,30	1,01

Turbine meter ($k_{nominal}$ 6,633 Pulses/Liter), Coriolis_Mass ($k_{nominal}$ 100,000 Pulses/kg), Coriolis_Vol ($k_{nominal}$ 100,000 Pulses/Liter), Temperature correction of meter error (T_{nom} 20 °C), Corrected meter error:

Date	Nominal flowrate	Turbine Pulse count	Turbine K-factor	Turbine Meter error	Coriolis_Mass Pulse count	Coriolis_Mass K-factor	Coriolis_Mass Meter output frequency	Coriolis_Mass Meter error	Coriolis_Vol Pulse count	Coriolis_Vol K-factor	Coriolis_Vol Meter output frequency	Coriolis_Vol Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	N	K_V	e_V	N	K_m		e_m	N	K_V		e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[Hz]	[%]	[Pulses]	[Pulses/Liter]	[Hz]	[%]	[°C]	[%]	[%]
29.09.2016	30					100,0180	834,4432	0,018		100,0451	836,6972	0,045	4,568		0,043
29.09.2016	30					99,9620	834,8096	-0,038		99,9811	837,0080	-0,019	4,617		-0,013
29.09.2016	30					99,9981	834,9298	-0,002		100,0435	837,3566	0,043	4,657		0,023
29.09.2016	30					99,9829	834,5765	-0,017		100,0440	837,1500	0,044	4,729		0,008
29.09.2016	30					99,9648	833,7242	-0,035		100,0069	836,1435	0,007	4,758		-0,010
29.09.2016	30					99,9819	829,2664	-0,018		100,0063	831,5452	0,006	4,849		0,008
29.09.2016	30					99,9550	834,5845	-0,045		99,9503	836,6391	-0,050	4,878		-0,019
29.09.2016	30					99,9659	831,8522	-0,034		100,0078	834,2955	0,008	4,905		-0,008
29.09.2016	30					99,9494	832,3421	-0,051		99,9781	834,6819	-0,022	4,929		-0,025
29.09.2016	30					99,9901	831,8480	-0,010		100,0301	834,2866	0,030	4,959		0,016
29.09.2016	100					99,9861	2758,8685	-0,014		100,0066	2766,4970	0,007	5,001		0,006
29.09.2016	100					100,0036	2760,4546	0,004		100,0183	2767,9363	0,018	5,015		0,024
29.09.2016	100					99,9901	2761,7980	-0,010		100,0118	2769,4828	0,012	5,026		0,010
29.09.2016	100					100,0068	2762,9839	0,007		100,0282	2770,6708	0,028	5,035		0,027
29.09.2016	100					100,0068	2762,8971	0,007		100,0267	2770,5510	0,027	5,047		0,027
29.09.2016	100					99,9891	2763,4772	-0,011		100,0114	2771,2116	0,011	5,062		0,009
29.09.2016	100					100,0002	2762,7213	0,000		100,0082	2770,0691	0,008	5,074		0,020
29.09.2016	100					100,0079	2765,2513	0,008		100,0271	2772,9247	0,027	5,091		0,028
29.09.2016	100					99,9440	2763,0544	-0,056		99,9730	2771,0021	-0,027	5,105		-0,036
29.09.2016	100					99,9508	2766,4312	-0,049		99,9603	2773,8588	-0,040	5,122		-0,029
29.09.2016	200					100,0050	5564,3584	0,005		100,0117	5578,9079	0,012	5,149		0,025
29.09.2016	200					100,0047	5563,8110	0,005		100,0223	5578,9647	0,022	5,146		0,025
29.09.2016	200					100,0058	5564,3910	0,006		100,0159	5579,1270	0,016	5,147		0,026
29.09.2016	200					100,0085	5568,1056	0,009		100,0080	5582,2657	0,008	5,154		0,029
29.09.2016	200					100,0081	5565,1710	0,008		100,0105	5579,4953	0,010	5,163		0,028
29.09.2016	200					100,0216	5562,8750	0,022		100,0305	5577,5987	0,031	5,190		0,042
29.09.2016	200					100,0043	5566,3563	0,004		100,0108	5580,9796	0,011	5,211		0,025
29.09.2016	200					100,0073	5564,9712	0,007		100,0144	5579,6473	0,014	5,228		0,028
29.09.2016	200					100,0032	5563,7671	0,003		100,0238	5579,2180	0,024	5,237		0,024
29.09.2016	200					99,9971	5565,5653	-0,003		100,0021	5580,1690	0,002	5,254		0,018

CENAM Laboratory – Day#1

Data report CENAM: Day#1

*Original data set

Temperature correction of meter error: T_{nom} = 20 °C

Turbine meter: $K_{V,nom}$ = 6,6330 Pulses/Liter; Coriolis_Mass: $K_{m,nom}$ = 100,0000 Pulses/kg; Coriolis_Vol: $K_{V,nom}$ = 100,0000 Pulses/Liter

Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Turbine meter Pulse count	Turbine meter K-factor	Turbine meter Meter error	Coriolis_Mass Pulse count	Coriolis_Mass K-factor	Coriolis_Mass Meter error	Coriolis_Vol Pulse count	Coriolis_Vol K-factor	Coriolis_Vol Meter error	(T_{fluid} - T_{nom})	Corrected meter error Turbine meter	Corrected meter error Coriolis _Mass
	Laboratory reference						Fluid			Ambient conditions													
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
21.02.2017	30	180,123	30,051	30,108	1503,561	1,506	998,089	2,95	23,53	19,57	0,81	9992	6,6329	-0,002	150412	100,0372	0,037	150834	100,1261	0,126	3,530	-0,008	0,058
21.02.2017	30	180,123	30,009	30,067	1501,500	1,504	998,087	2,94	23,54	19,68	0,81	9979	6,6333	0,005	150197	100,0313	0,031	150618	100,1198	0,120	3,540	-0,002	0,052
21.02.2018	30	180,124	30,020	30,078	1502,040	1,505	998,082	2,94	23,56	19,77	0,81	9982	6,6329	-0,002	150260	100,0373	0,037	150679	100,1239	0,124	3,560	-0,008	0,058
21.02.2019	30	180,124	30,004	30,062	1501,228	1,504	998,080	2,95	23,57	19,88	0,81	9984	6,6378	0,072	150169	100,0307	0,031	150586	100,1159	0,116	3,570	0,066	0,052
21.02.2020	30	180,125	29,998	30,056	1500,937	1,504	998,080	2,95	23,57	20,02	0,81	9976	6,6337	0,011	150150	100,0375	0,037	150566	100,1220	0,122	3,570	0,005	0,059
21.02.2017	60	90,126	60,047	60,163	1503,264	1,506	998,074	2,99	23,60	20,28	0,81	10028	6,6580	0,376	150366	100,0264	0,026	150777	100,1066	0,107	3,600	0,383	0,049
21.02.2017	60	90,126	60,034	60,150	1502,963	1,506	998,072	2,99	23,61	20,35	0,81	10026	6,6580	0,376	150337	100,0271	0,027	150747	100,1065	0,106	3,610	0,383	0,050
21.02.2018	60	90,125	60,029	60,145	1502,823	1,506	998,075	3,00	23,60	20,38	0,81	10025	6,6579	0,376	150332	100,0331	0,033	150741	100,1121	0,112	3,600	0,383	0,056
21.02.2019	60	90,126	60,036	60,151	1502,983	1,506	998,074	2,99	23,60	20,40	0,81	10027	6,6586	0,385	150338	100,0264	0,026	150746	100,1047	0,105	3,600	0,392	0,049
21.02.2020	60	90,125	60,050	60,166	1503,343	1,506	998,072	3,00	23,61	20,44	0,81	10030	6,6589	0,391	150370	100,0238	0,024	150777	100,1012	0,101	3,610	0,398	0,046
21.02.2017	100	54,130	99,984	100,178	1503,376	1,506	998,062	2,98	23,65	20,57	0,81	10038	6,6640	0,468	150386	100,0322	0,032	150785	100,1032	0,103	3,650	0,465	0,047
21.02.2017	100	54,131	99,997	100,191	1503,586	1,507	998,062	2,99	23,65	20,63	0,81	10039	6,6638	0,464	150408	100,0329	0,033	150808	100,1045	0,105	3,650	0,461	0,048
21.02.2018	100	54,131	100,006	100,200	1503,715	1,507	998,059	2,98	23,66	20,70	0,81	10040	6,6638	0,465	150417	100,0302	0,030	150814	100,0996	0,100	3,660	0,462	0,045
21.02.2019	100	54,130	100,003	100,198	1503,665	1,507	998,057	2,98	23,67	20,80	0,81	10040	6,6640	0,468	150413	100,0309	0,031	150810	100,1001	0,100	3,670	0,465	0,046
21.02.2020	100	54,130	100,020	100,215	1503,925	1,507	998,054	2,98	23,68	20,83	0,81	10041	6,6635	0,460	150436	100,0289	0,029	150833	100,0978	0,098	3,680	0,458	0,044
21.02.2017	140	247,198	140,069	140,345	9617,988	9,637	998,032	2,98	23,77	21,47	0,81	64271	6,6692	0,546	961965	100,0173	0,017	964446	100,0779	0,078	3,770	0,525	0,031
21.02.2017	140	247,199	140,054	140,331	9616,986	9,636	998,027	2,98	23,79	21,52	0,81	64261	6,6688	0,540	961879	100,0188	0,019	964350	100,0779	0,078	3,790	0,519	0,033
21.02.2018	140	247,198	140,042	140,320	9616,187	9,635	998,023	2,98	23,81	21,56	0,81	64254	6,6686	0,537	961794	100,0182	0,018	964262	100,0766	0,077	3,810	0,516	0,032
21.02.2019	140	247,199	140,041	140,318	9616,083	9,635	998,020	2,98	23,82	21,62	0,81	64250	6,6683	0,532	961796	100,0195	0,020	964260	100,0772	0,077	3,820	0,511	0,034
21.02.2020	140	247,198	140,032	140,311	9615,475	9,635	998,015	2,98	23,84	21,74	0,81	64245	6,6682	0,530	961752	100,0213	0,021	964214	100,0783	0,078	3,840	0,509	0,035
21.02.2017	180	192,200	180,247	180,612	9623,188	9,643	997,979	3,00	23,99	22,00	0,81	64356	6,6741	0,619	962511	100,0200	0,020	964933	100,0690	0,069	3,990	0,603	0,036
21.02.2017	180	192,200	180,243	180,610	9622,985	9,643	997,969	3,00	24,03	22,10	0,81	64354	6,6739	0,617	962505	100,0215	0,021	964928	100,0696	0,070	4,030	0,601	0,037
21.02.2018	180	192,199	180,249	180,618	9623,284	9,643	997,961	3,00	24,06	22,15	0,81	64351	6,6734	0,609	962514	100,0193	0,019	964938	100,0668	0,067	4,060	0,592	0,035
21.02.2019	180	192,200	180,230	180,600	9622,280	9,642	997,951	2,99	24,10	22,21	0,81	64341	6,6730	0,603	962418	100,0197	0,020	964842	100,0662	0,066	4,100	0,586	0,036
21.02.2020	180	192,200	180,219	180,590	9621,675	9,641	997,944	2,99	24,13	22,27	0,81	64338	6,6730	0,603	962372	100,0213	0,021	964797	100,0671	0,067	4,130	0,587	0,038
21.02.2017	200	173,201	200,393	200,811	9641,197	9,661	997,919	2,99	24,23	22,34	0,81	64498	6,6759	0,647	964327	100,0215	0,022	966736	100,0627	0,063	4,230	0,630	0,038
21.02.2017	200	173,200	200,295	200,715	9636,391	9,657	997,906	2,98	24,28	22,39	0,81	64466	6,6758	0,646	963828	100,0196	0,020	966237	100,0596	0,060	4,280	0,628	0,037
21.02.2018	200	173,200	200,288	200,710	9636,093	9,656	997,899	2,99	24,31	22,41	0,81	64460	6,6754	0,639	963827	100,0226	0,023	966237	100,0620	0,062	4,310	0,621	0,040
21.02.2019	200	173,200	200,248	200,672	9634,187	9,655	997,889	2,99	24,35	22,42	0,81	64446	6,6752	0,636	963628	100,0217	0,022	966042	100,0606	0,061	4,350	0,618	0,039
21.02.2020	200	173,200	200,228	200,653	9633,189	9,654	997,881	2,99	24,38	22,42	0,81	64439	6,6751	0,635	963511	100,0199	0,020	965925	100,0581	0,058	4,380	0,617	0,037

CENAM Laboratory – Day#2

Data report CENAM: Day#2

*Original data set

Turbine meter: $K_{V,nom}$ = 6,6330 Pulses/Liter; Coriolis_Mass: $K_{m,nom}$ = 100,0000 Pulses/kg; Coriolis_Vol: $K_{V,nom}$ = 100,0000 Pulses/Liter

Temperature correction of meter error: T_{nom} = 20 °C

Date	Nominal flowrate	Measurement time	Standard mass flowrate (Laboratory reference)	Standard volume flowrate (Laboratory reference)	Mass (Laboratory reference)	Volume (Laboratory reference)	Water density (Fluid)	Line pressure (Fluid)	Water temp. (Fluid)	Air temp. (Ambient conditions)	Air pressure (Ambient conditions)	Pulse count (Turbine meter)	K-factor (Turbine meter)	Meter error (Turbine meter)	Pulse count (Coriolis_Mass)	K-factor (Coriolis_Mass)	Meter error (Coriolis_Mass)	Pulse count (Coriolis_Vol)	K-factor (Coriolis_Vol)	Meter error (Coriolis_Vol)	(T_{fluid} - T_{nom})	Turbine meter (Corrected meter error)	Coriolis _Mass (Corrected meter error)
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
22.02.2017	30	180,123	29,966	30,028	1499,341	1,502	997,957	2,94	24,07	19,99	0,81	9970	6,6360	0,045	149975	100,0273	0,027	150417	100,1171	0,117	4,070	0,040	0,050
22.02.2018	30	180,124	29,936	29,998	1497,840	1,501	997,951	2,94	24,09	20,06	0,81	9954	6,6320	-0,016	149810	100,0174	0,017	150251	100,1063	0,106	4,090	-0,021	0,040
22.02.2019	30	180,124	29,929	29,990	1497,459	1,501	997,950	2,95	24,10	20,14	0,81	9953	6,6330	-0,001	149758	100,0081	0,008	150198	100,0962	0,096	4,100	-0,006	0,031
22.02.2020	30	180,122	29,927	29,988	1497,349	1,500	997,947	2,94	24,11	20,21	0,81	9952	6,6328	-0,004	149763	100,0188	0,019	150202	100,1060	0,106	4,110	-0,009	0,042
22.02.2021	30	180,123	29,913	29,975	1496,688	1,500	997,945	2,95	24,12	20,27	0,81	9945	6,6310	-0,030	149681	100,0081	0,008	150120	100,0953	0,095	4,120	-0,035	0,031
22.02.2017	60	90,126	60,141	60,265	1505,637	1,509	997,944	2,99	24,13	20,40	0,81	10044	6,6572	0,365	150597	100,0221	0,022	151033	100,1054	0,105	4,130	0,371	0,047
22.02.2018	60	90,126	60,163	60,287	1506,167	1,509	997,939	2,99	24,15	20,46	0,81	10048	6,6575	0,369	150646	100,0194	0,019	151082	100,1021	0,102	4,150	0,376	0,044
22.02.2019	60	90,126	60,189	60,314	1506,837	1,510	997,939	2,99	24,15	20,51	0,81	10052	6,6572	0,364	150723	100,0261	0,026	151158	100,1080	0,108	4,150	0,371	0,051
22.02.2020	60	90,126	60,192	60,316	1506,897	1,510	997,936	2,98	24,16	20,53	0,81	10052	6,6569	0,360	150728	100,0254	0,025	151161	100,1057	0,106	4,160	0,367	0,050
22.02.2021	60	90,125	60,207	60,331	1507,267	1,510	997,939	2,99	24,15	20,58	0,81	10055	6,6573	0,366	150763	100,0241	0,024	151197	100,1053	0,105	4,150	0,372	0,049
22.02.2017	100	54,130	99,947	100,155	1502,811	1,506	997,924	2,99	24,21	20,70	0,81	10033	6,6623	0,442	150311	100,0199	0,020	150733	100,0924	0,092	4,210	0,438	0,037
22.02.2018	100	54,130	99,946	100,154	1502,801	1,506	997,924	2,99	24,21	20,74	0,81	10033	6,6623	0,442	150329	100,0325	0,033	150751	100,1051	0,105	4,210	0,439	0,050
22.02.2019	100	54,131	99,973	100,181	1503,231	1,506	997,924	2,99	24,21	20,80	0,81	10036	6,6624	0,444	150363	100,0266	0,027	150785	100,0990	0,099	4,210	0,440	0,044
22.02.2020	100	54,131	99,953	100,161	1502,930	1,506	997,921	2,99	24,22	20,81	0,81	10033	6,6617	0,433	150327	100,0226	0,023	150748	100,0942	0,094	4,220	0,430	0,040
22.02.2021	100	54,131	99,968	100,176	1503,150	1,506	997,921	2,99	24,22	20,86	0,81	10036	6,6628	0,449	150358	100,0286	0,029	150778	100,0995	0,099	4,220	0,446	0,046
22.02.2017	140	247,200	139,618	139,912	9587,094	9,607	997,898	2,97	24,31	21,33	0,81	64070	6,6689	0,541	958812	100,0107	0,011	961435	100,0735	0,073	4,310	0,517	0,026
22.02.2018	140	247,199	139,496	139,791	9578,681	9,599	997,893	2,97	24,33	21,44	0,81	64013	6,6688	0,539	957979	100,0116	0,012	960588	100,0727	0,073	4,330	0,515	0,027
22.02.2019	140	247,200	139,421	139,716	9573,572	9,594	997,891	2,98	24,34	21,52	0,81	63972	6,6681	0,528	957477	100,0125	0,013	960078	100,0727	0,073	4,340	0,504	0,028
22.02.2020	140	247,199	139,284	139,579	9564,159	9,584	997,886	2,99	24,36	21,61	0,81	63908	6,6679	0,526	956529	100,0118	0,012	959123	100,0711	0,071	4,360	0,502	0,028
22.02.2021	140	247,199	139,251	139,546	9561,853	9,582	997,881	2,99	24,38	21,68	0,81	63891	6,6677	0,523	956310	100,0130	0,013	958900	100,0714	0,071	4,380	0,499	0,029
22.02.2017	180	192,200	180,085	180,471	9614,502	9,635	997,857	3,00	24,48	21,80	0,81	64303	6,6738	0,615	961581	100,0136	0,014	964133	100,0641	0,064	4,480	0,597	0,031
22.02.2018	180	192,200	180,047	180,436	9612,500	9,633	997,846	3,00	24,52	21,87	0,81	64289	6,6737	0,613	961417	100,0174	0,017	963967	100,0667	0,067	4,520	0,595	0,035
22.02.2019	180	192,200	180,039	180,429	9612,096	9,633	997,839	3,00	24,55	21,92	0,81	64286	6,6736	0,612	961361	100,0158	0,016	963910	100,0642	0,064	4,550	0,593	0,034
22.02.2020	180	192,200	180,073	180,465	9613,894	9,635	997,829	3,00	24,59	21,99	0,81	64301	6,6738	0,615	961521	100,0137	0,014	964069	100,0610	0,061	4,590	0,597	0,032
22.02.2021	180	192,200	180,130	180,523	9616,897	9,638	997,821	2,99	24,62	22,01	0,81	64323	6,6740	0,618	961889	100,0207	0,021	964441	100,0675	0,068	4,620	0,599	0,039
22.02.2017	200	173,201	200,080	200,540	9626,077	9,648	997,703	3,00	25,08	22,53	0,81	64405	6,6753	0,638	962745	100,0143	0,014	965316	100,0510	0,051	5,080	0,618	0,034
22.02.2018	200	173,200	200,053	200,517	9624,779	9,647	997,689	2,98	25,13	22,52	0,81	64397	6,6753	0,638	962655	100,0184	0,018	965228	100,0540	0,054	5,130	0,617	0,039
22.02.2019	200	173,200	200,068	200,532	9625,477	9,648	997,684	2,98	25,15	22,54	0,81	64401	6,6752	0,636	962708	100,0166	0,017	965285	100,0522	0,052	5,150	0,615	0,037
22.02.2020	200	173,201	200,075	200,541	9625,876	9,648	997,677	2,98	25,18	22,58	0,81	64403	6,6751	0,634	962740	100,0158	0,016	965320	100,0508	0,051	5,180	0,614	0,036
22.02.2021	200	173,200	200,108	200,576	9627,378	9,650	997,666	2,98	25,22	22,60	0,81	64412	6,6749	0,631	962873	100,0140	0,014	965458	100,0485	0,048	5,220	0,611	0,034

CENAM Laboratory – Day#3

Data report CENAM: Day#3

*Original data set

Turbine meter: $K_{V,nom}$ = 6,6330 Pulses/Liter; Coriolis_Mass: $K_{m,nom}$ = 100,0000 Pulses/kg; Coriolis_Vol: $K_{V,nom}$ = 100,0000 Pulses/Liter

Temperature correction of meter error: T_{nom} = 20 °C

		Laboratory reference					Fluid			Ambient conditions		Turbine meter			Coriolis_Mass			Coriolis_Vol				Corrected meter error	
Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
22.02.2017	30	180,123	29,932	30,001	1497,639	1,501	997,726	2,94	24,98	21,46	0,81	9967	6,6400	0,106	149750	99,9907	-0,009	150196	100,0605	0,061	4,980	0,102	0,017
22.02.2018	30	180,124	29,905	29,973	1496,277	1,500	997,716	2,95	25,02	21,57	0,81	9960	6,6413	0,125	149624	99,9975	-0,002	150068	100,0652	0,065	5,020	0,122	0,024
22.02.2019	30	180,124	29,890	29,959	1495,537	1,499	997,716	2,95	25,02	21,64	0,81	9954	6,6406	0,115	149555	100,0009	0,001	149997	100,0674	0,067	5,020	0,111	0,027
22.02.2020	30	180,123	30,191	30,260	1510,583	1,514	997,711	2,94	25,04	21,76	0,81	10052	6,6392	0,093	151074	100,0104	0,010	151519	100,0754	0,075	5,040	0,089	0,037
22.02.2021	30	180,124	30,178	30,247	1509,951	1,513	997,716	2,94	25,02	21,86	0,81	10052	6,6420	0,135	150988	99,9953	-0,005	151433	100,0609	0,061	5,020	0,131	0,022
22.02.2022	30	180,124	30,157	30,226	1508,891	1,512	997,708	2,94	25,05	21,94	0,81	10047	6,6433	0,155	150900	100,0073	0,007	151343	100,0710	0,071	5,050	0,151	0,034
22.02.2023	30	180,123	30,142	30,212	1508,139	1,512	997,688	2,94	25,13	22,22	0,81	10041	6,6425	0,143	150810	99,9974	-0,003	151249	100,0566	0,057	5,130	0,139	0,024
22.02.2024	30	180,124	30,135	30,205	1507,768	1,511	997,687	2,94	25,13	22,24	0,81	10031	6,6375	0,068	150786	100,0061	0,006	151224	100,0646	0,065	5,130	0,064	0,033
22.02.2025	30	180,124	30,126	30,196	1507,328	1,511	997,687	2,93	25,13	22,26	0,81	10029	6,6381	0,077	150706	99,9822	-0,018	151143	100,0402	0,040	5,130	0,074	0,009
22.02.2026	30	180,123	30,125	30,194	1507,257	1,511	997,683	2,95	25,15	22,28	0,81	10035	6,6424	0,141	150719	99,9955	-0,004	151155	100,0524	0,052	5,150	0,138	0,022
22.02.2017	100	54,130	100,142	100,375	1505,758	1,509	997,681	2,98	25,16	22,33	0,81	10057	6,6635	0,460	150598	100,0148	0,015	151025	100,0658	0,066	5,160	0,457	0,035
22.02.2018	100	54,130	100,161	100,394	1506,037	1,510	997,678	2,97	25,17	22,37	0,81	10059	6,6636	0,461	150624	100,0135	0,013	151051	100,0641	0,064	5,170	0,458	0,034
22.02.2019	100	54,130	100,172	100,405	1506,187	1,510	997,678	2,97	25,17	22,40	0,81	10060	6,6636	0,461	150631	100,0082	0,008	151058	100,0588	0,059	5,170	0,458	0,029
22.02.2020	100	54,129	100,163	100,396	1506,047	1,510	997,679	2,98	25,17	22,42	0,81	10059	6,6636	0,461	150629	100,0161	0,016	151056	100,0668	0,067	5,170	0,457	0,037
22.02.2021	100	54,130	100,178	100,412	1506,287	1,510	997,676	2,98	25,18	22,41	0,81	10061	6,6638	0,465	150639	100,0068	0,007	151065	100,0566	0,057	5,180	0,461	0,027
22.02.2022	100	54,130	100,162	100,395	1506,037	1,510	997,679	2,97	25,17	22,39	0,81	10059	6,6636	0,462	150633	100,0195	0,019	151058	100,0688	0,069	5,170	0,458	0,040
22.02.2023	100	54,130	100,165	100,398	1506,077	1,510	997,674	2,98	25,19	22,40	0,81	10059	6,6634	0,458	150625	100,0115	0,011	151050	100,0603	0,060	5,190	0,455	0,032
22.02.2024	100	54,130	100,183	100,416	1506,357	1,510	997,676	2,97	25,18	22,42	0,81	10061	6,6635	0,460	150658	100,0148	0,015	151082	100,0632	0,063	5,180	0,456	0,035
22.02.2025	100	54,130	100,180	100,414	1506,316	1,510	997,676	2,97	25,18	22,45	0,81	10059	6,6624	0,443	150638	100,0042	0,004	151063	100,0533	0,053	5,180	0,439	0,025
22.02.2026	100	54,130	100,310	100,544	1508,267	1,512	997,673	2,97	25,19	22,46	0,81	10073	6,6630	0,452	150851	100,0161	0,016	151276	100,0645	0,064	5,190	0,448	0,037
22.02.2017	200	173,199	199,662	200,136	9605,941	9,629	997,634	3,02	25,35	22,60	0,81	64311	6,6791	0,695	960707	100,0118	0,012	963299	100,0443	0,044	5,350	0,673	0,033
22.02.2018	200	173,200	199,529	200,002	9599,529	9,622	997,631	3,02	25,36	22,64	0,81	64266	6,6788	0,691	960056	100,0107	0,011	962648	100,0432	0,043	5,360	0,670	0,032
22.02.2019	200	173,200	199,497	199,972	9598,025	9,621	997,626	3,02	25,38	22,68	0,81	64255	6,6787	0,689	959903	100,0105	0,010	962495	100,0425	0,042	5,380	0,668	0,032
22.02.2020	200	173,200	199,433	199,909	9594,923	9,618	997,616	3,02	25,42	22,72	0,81	64236	6,6788	0,691	959600	100,0112	0,011	962195	100,0426	0,043	5,420	0,669	0,032
22.02.2021	200	173,200	199,453	199,933	9595,922	9,619	997,603	3,02	25,47	22,74	0,81	64241	6,6786	0,687	959694	100,0106	0,011	962295	100,0412	0,041	5,470	0,665	0,032
22.02.2022	200	173,200	199,360	199,840	9591,416	9,615	997,597	3,02	25,49	22,77	0,81	64210	6,6784	0,685	959293	100,0158	0,016	961901	100,0467	0,047	5,490	0,663	0,037
22.02.2023	200	173,200	199,378	199,860	9592,318	9,615	997,589	3,02	25,52	22,78	0,81	64214	6,6782	0,681	959332	100,0104	0,010	961946	100,0412	0,041	5,520	0,659	0,032
22.02.2024	200	173,200	199,362	199,846	9591,517	9,615	997,579	3,02	25,56	22,81	0,80	64208	6,6780	0,679	959254	100,0107	0,011	961874	100,0410	0,041	5,560	0,657	0,032
22.02.2025	200	173,199	199,344	199,829	9590,616	9,614	997,571	3,02	25,59	22,83	0,80	64200	6,6778	0,675	959165	100,0108	0,011	961789	100,0408	0,041	5,590	0,653	0,033
22.02.2026	200	173,199	199,369	199,856	9591,817	9,615	997,561	3,03	25,63	22,82	0,80	64209	6,6778	0,676	959281	100,0104	0,010	961912	100,0401	0,040	5,630	0,653	0,032

ITRI Laboratory – Day#1

Data report ITRI: Day#1 — *Original data set

Temperature correction of meter error: T_{nom} = 20 °C

Turbine meter: $K_{V,nom}$ = 6,6330 Pulses/Liter; Coriolis_Mass: $K_{m,nom}$ = 100,0000 Pulses/kg; Coriolis_Vol: $K_{V,nom}$ = 100,0000 Pulses/Liter

		Laboratory reference					Fluid			Ambient conditions		Turbine meter			Coriolis_Mass			Coriolis_Vol				Corrected meter error	
Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
27.06.2017	30	658,479	30,195	30,311	5523,068	5,544	996,198	2,695	28,79	32,18	1,00	36930	6,6611	0,423	552562	100,0462	0,046	554510	100,0172	0,017	8,793	0,424	0,084
27.06.2017	30	658,504	30,190	30,303	5522,267	5,543	996,283	2,694	28,50	32,19	1,00	36919	6,6606	0,416	552439	100,0384	0,038	554349	100,0111	0,011	8,499	0,417	0,076
27.06.2017	30	658,442	30,187	30,298	5521,266	5,542	996,329	2,697	28,34	32,26	1,00	36911	6,6607	0,418	552330	100,0368	0,037	554198	100,0066	0,007	8,337	0,418	0,074
27.06.2017	30	658,500	30,186	30,296	5521,466	5,542	996,360	2,697	28,23	32,28	1,00	36911	6,6607	0,417	552333	100,0338	0,034	554178	100,0026	0,003	8,227	0,417	0,070
27.06.2017	30	658,600	30,182	30,291	5521,567	5,542	996,382	2,694	28,15	32,31	1,00	36911	6,6607	0,417	552345	100,0341	0,034	554172	100,0019	0,002	8,149	0,418	0,070
27.06.2017	60	330,840	60,257	60,509	5537,584	5,561	995,824	2,647	30,06	32,20	1,00	37089	6,6697	0,554	553940	100,0328	0,033	556103	100,0040	0,004	10,061	0,551	0,076
27.06.2017	60	330,837	60,242	60,495	5536,188	5,559	995,813	2,644	30,10	31,80	1,00	37079	6,6695	0,551	553781	100,0293	0,029	555957	100,0018	0,002	10,100	0,548	0,072
27.06.2017	60	330,676	60,266	60,517	5535,682	5,559	995,843	2,647	30,00	32,10	1,00	37076	6,6698	0,555	553757	100,0341	0,034	555916	100,0067	0,007	9,997	0,552	0,077
27.06.2017	60	330,736	60,261	60,496	5536,283	5,558	996,117	2,638	29,07	32,02	1,00	37070	6,6698	0,555	553785	100,0283	0,028	555783	99,9994	-0,001	9,072	0,555	0,069
27.06.2017	60	330,777	60,273	60,504	5537,990	5,559	996,177	2,635	28,86	31,93	1,00	37078	6,6696	0,552	553972	100,0312	0,031	555952	100,0050	0,005	8,864	0,552	0,072
27.06.2017	100	198,958	100,554	100,967	5557,212	5,580	995,906	2,530	29,79	31,88	1,00	37264	6,6781	0,679	556010	100,0520	0,052	558125	100,0214	0,021	9,787	0,669	0,085
27.06.2017	100	198,758	100,555	100,969	5551,700	5,575	995,899	2,537	29,81	32,15	1,00	37224	6,6775	0,671	555404	100,0421	0,042	557501	100,0081	0,008	9,810	0,660	0,076
27.06.2017	100	198,694	100,607	101,022	5552,801	5,576	995,895	2,541	29,82	32,10	1,00	37230	6,6772	0,666	555493	100,0383	0,038	557576	100,0013	0,001	9,824	0,656	0,072
27.06.2017	100	198,834	100,614	101,030	5557,106	5,580	995,891	2,545	29,84	32,15	1,00	37260	6,6774	0,669	555943	100,0418	0,042	558067	100,0114	0,011	9,837	0,659	0,075
27.06.2017	100	198,670	100,638	101,053	5553,803	5,577	995,887	2,537	29,85	32,10	1,00	37239	6,6776	0,672	555615	100,0423	0,042	557746	100,0130	0,013	9,850	0,662	0,076
27.06.2017	140	143,354	140,059	140,628	5577,234	5,600	995,957	2,396	29,62	31,78	1,00	37438	6,6855	0,792	557946	100,0399	0,040	559980	99,9987	-0,001	9,616	0,736	0,070
27.06.2017	140	143,097	140,079	140,649	5568,024	5,591	995,946	2,390	29,65	31,71	1,00	37382	6,6865	0,806	557094	100,0524	0,052	559150	100,0145	0,015	9,654	0,750	0,083
27.06.2017	140	143,153	140,082	140,653	5570,321	5,593	995,940	2,386	29,67	32,13	1,00	37391	6,6853	0,788	557235	100,0364	0,036	559303	100,0000	0,000	9,674	0,732	0,067
27.06.2017	140	143,303	139,978	140,549	5572,023	5,595	995,935	2,394	29,69	32,05	1,00	37404	6,6855	0,792	557427	100,0403	0,040	559514	100,0067	0,007	9,690	0,736	0,071
27.06.2017	140	143,320	139,979	140,551	5572,724	5,595	995,931	2,385	29,70	31,98	1,00	37408	6,6854	0,790	557464	100,0344	0,034	559603	100,0096	0,010	9,705	0,733	0,065
27.06.2017	180	111,633	180,293	181,017	5590,749	5,613	996,003	3,666	29,46	31,56	1,00	37568	6,6928	0,902	559366	100,0521	0,052	561298	99,9963	-0,004	9,461	0,867	0,087
27.06.2017	180	111,615	180,235	180,961	5588,046	5,611	995,989	3,667	29,51	31,65	1,00	37548	6,6924	0,895	559050	100,0439	0,044	561054	99,9998	0,000	9,509	0,860	0,079
27.06.2017	180	111,757	180,064	180,791	5589,848	5,612	995,980	3,667	29,54	31,52	1,00	37564	6,6930	0,905	559283	100,0533	0,053	561311	100,0124	0,012	9,540	0,869	0,089
27.06.2017	180	111,633	180,100	180,828	5584,743	5,607	995,972	3,661	29,57	31,64	1,00	37528	6,6927	0,900	558740	100,0476	0,048	560730	99,9995	-0,001	9,566	0,864	0,083
27.06.2017	180	111,777	180,013	180,742	5589,248	5,612	995,963	3,680	29,60	31,78	1,00	37563	6,6935	0,911	559251	100,0584	0,058	561262	100,0128	0,013	9,596	0,876	0,094
27.06.2017	200	99,977	201,425	202,222	5593,853	5,616	996,057	4,453	29,28	31,63	1,00	37598	6,6948	0,932	559564	100,0319	0,032	561328	99,9517	-0,048	9,276	0,897	0,067
27.06.2017	200	100,115	201,360	202,159	5599,760	5,622	996,049	4,471	29,30	31,64	1,00	37641	6,6953	0,940	560198	100,0397	0,040	561950	99,9560	-0,044	9,305	0,905	0,074
27.06.2017	200	100,054	201,490	202,290	5599,960	5,622	996,042	4,479	29,33	31,67	1,00	37643	6,6954	0,941	560231	100,0420	0,042	561932	99,9485	-0,051	9,330	0,906	0,077
27.06.2017	200	99,931	201,424	202,227	5591,250	5,614	996,031	4,458	29,37	31,68	1,00	37586	6,6956	0,944	559352	100,0406	0,041	561023	99,9412	-0,059	9,366	0,909	0,076
27.06.2017	200	99,914	201,473	202,278	5591,650	5,614	996,019	4,466	29,41	31,69	1,00	37589	6,6956	0,944	559376	100,0377	0,038	561188	99,9623	-0,038	9,406	0,909	0,073

ITRI Laboratory – Day#2

Data report ITRI: Day#2 — *Original data set

Temperature correction of meter error: T_{nom} = 20 °C

Turbine meter: $k_{nominal}$ = 6,633 Pulses/Liter; Coriolis_Mass: $k_{nominal}$ = 100,000 Pulses/kg; Coriolis_Vol: $k_{nominal}$ = 100,000 Pulses/Liter

		Laboratory reference					Fluid			Ambient conditions		Turbine meter			Coriolis_Mass			Coriolis_Vol				Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
28.06.2017	30	711,344	29,461	29,559	5821,325	5,841	996,694	2,699	27,02	31,22	1,00	38906	6,6613	0,426	582301	100,0290	0,029	584080	100,0029	0,003	7,023	0,425	0,062
28.06.2017	30	711,822	29,440	29,533	5821,024	5,839	996,838	2,702	26,49	31,24	1,00	38896	6,6609	0,420	582288	100,0319	0,032	583961	100,0020	0,002	6,492	0,418	0,063
28.06.2017	30	712,325	29,418	29,510	5820,924	5,839	996,880	2,696	26,33	31,31	1,00	38895	6,6611	0,423	582296	100,0350	0,035	583943	100,0049	0,005	6,333	0,422	0,066
28.06.2017	30	712,720	29,405	29,496	5821,625	5,840	996,914	2,694	26,21	31,32	1,00	38898	6,6610	0,422	582342	100,0308	0,031	583944	99,9964	-0,004	6,206	0,420	0,061
28.06.2017	30	713,021	29,394	29,484	5821,725	5,840	996,943	2,702	26,09	31,34	1,00	38900	6,6614	0,429	582399	100,0389	0,039	583995	100,0064	0,006	6,094	0,427	0,069
28.06.2017	60	344,079	61,070	61,252	5836,936	5,854	997,024	2,646	25,79	31,44	1,00	39052	6,6706	0,567	583940	100,0422	0,042	585483	100,0081	0,008	5,785	0,572	0,073
28.06.2017	60	344,277	61,049	61,233	5838,238	5,856	996,987	2,643	25,93	31,38	1,00	39061	6,6704	0,564	584073	100,0427	0,043	585625	100,0063	0,006	5,929	0,569	0,074
28.06.2017	60	344,018	61,062	61,247	5835,134	5,853	996,988	2,657	25,92	31,49	1,00	39041	6,6705	0,566	583761	100,0424	0,042	585322	100,0078	0,008	5,924	0,571	0,074
28.06.2017	60	343,973	61,070	61,254	5835,128	5,853	996,998	2,656	25,88	31,69	1,00	39042	6,6708	0,569	583789	100,0473	0,047	585336	100,0113	0,011	5,885	0,575	0,079
28.06.2017	60	344,275	61,049	61,232	5838,232	5,856	997,012	2,655	25,83	31,64	1,00	39060	6,6704	0,564	584081	100,0442	0,044	585631	100,0099	0,010	5,832	0,569	0,076
28.06.2017	100	209,437	100,594	100,895	5852,248	5,870	997,013	2,545	25,83	31,70	1,00	39198	6,6779	0,677	585593	100,0629	0,063	587107	100,0219	0,022	5,830	0,673	0,086
28.06.2017	100	209,376	100,644	100,947	5853,449	5,871	996,993	2,540	25,91	31,70	1,00	39201	6,6769	0,662	585653	100,0526	0,053	587190	100,0135	0,014	5,906	0,658	0,076
28.06.2017	100	209,358	100,642	100,945	5852,848	5,870	996,999	2,548	25,88	31,76	1,00	39201	6,6777	0,673	585646	100,0617	0,062	587193	100,0249	0,025	5,882	0,669	0,085
28.06.2017	100	209,455	100,609	100,910	5853,649	5,871	997,017	2,538	25,81	31,72	1,00	39203	6,6772	0,667	585703	100,0578	0,058	587251	100,0229	0,023	5,814	0,662	0,080
28.06.2017	100	209,422	100,642	100,942	5854,650	5,872	997,027	2,547	25,77	31,77	1,00	39210	6,6773	0,668	585776	100,0531	0,053	587354	100,0244	0,024	5,773	0,664	0,076
28.06.2017	140	151,233	139,835	140,252	5874,372	5,892	997,030	2,394	25,76	31,80	1,00	39385	6,6846	0,778	587745	100,0524	0,052	589227	100,0068	0,007	5,763	0,747	0,073
28.06.2017	140	151,075	139,817	140,232	5867,465	5,885	997,039	2,386	25,73	31,59	1,00	39339	6,6847	0,780	587057	100,0529	0,053	588546	100,0097	0,010	5,729	0,749	0,073
28.06.2017	140	151,101	139,850	140,264	5869,867	5,887	997,049	2,395	25,69	31,69	1,00	39354	6,6846	0,778	587306	100,0544	0,054	588875	100,0256	0,026	5,692	0,747	0,075
28.06.2017	140	151,094	139,814	140,227	5868,065	5,885	997,057	2,387	25,66	31,65	1,00	39343	6,6849	0,782	587126	100,0544	0,054	588585	100,0079	0,008	5,659	0,751	0,074
28.06.2017	140	151,334	139,773	140,184	5875,674	5,893	997,067	2,382	25,62	31,66	1,00	39394	6,6849	0,783	587909	100,0581	0,058	589375	100,0134	0,013	5,621	0,752	0,078
28.06.2017	180	118,000	179,765	180,297	5892,292	5,910	997,050	3,659	25,69	31,67	1,00	39539	6,6905	0,867	589515	100,0485	0,048	591069	100,0163	0,016	5,686	0,844	0,071
28.06.2017	180	117,953	179,555	180,085	5883,082	5,900	997,059	3,672	25,65	31,56	1,00	39481	6,6912	0,877	588660	100,0598	0,060	590065	100,0036	0,004	5,651	0,855	0,082
28.06.2017	180	117,840	179,731	180,260	5883,182	5,901	997,063	3,634	25,64	31,53	1,00	39488	6,6923	0,894	588738	100,0714	0,071	590255	100,0345	0,035	5,636	0,872	0,093
28.06.2017	180	117,978	179,572	180,100	5884,884	5,902	997,069	3,668	25,61	31,59	1,00	39496	6,6918	0,886	588891	100,0684	0,068	590365	100,0249	0,025	5,613	0,864	0,090
28.06.2017	180	118,097	179,428	179,954	5886,085	5,903	997,075	3,671	25,59	31,45	1,00	39504	6,6918	0,886	588993	100,0653	0,065	590478	100,0241	0,024	5,592	0,864	0,087
28.06.2017	200	105,636	200,843	201,435	5893,394	5,911	997,059	4,458	25,65	31,36	1,00	39568	6,6942	0,923	589629	100,0491	0,049	590756	99,9456	-0,054	5,650	0,901	0,071
28.06.2017	200	105,620	200,938	201,531	5895,296	5,913	997,056	4,457	25,66	31,55	1,00	39584	6,6947	0,931	589845	100,0535	0,054	591038	99,9608	-0,039	5,661	0,908	0,076
28.06.2017	200	105,540	200,957	201,550	5891,385	5,909	997,057	4,484	25,66	31,64	1,00	39554	6,6941	0,921	589413	100,0466	0,047	590554	99,9453	-0,055	5,659	0,899	0,069
28.06.2017	200	105,598	200,922	201,514	5893,588	5,911	997,058	4,465	25,66	31,65	1,00	39570	6,6943	0,925	589677	100,0540	0,054	590792	99,9483	-0,052	5,655	0,902	0,076
28.06.2017	200	105,540	201,104	201,697	5895,696	5,913	997,058	4,476	25,66	31,54	1,00	39582	6,6940	0,919	589820	100,0425	0,042	591047	99,9557	-0,044	5,655	0,897	0,065

ITRI Laboratory – Day#3

Data report ITRI: Day#3 — *Original data set

Temperature correction of meter error: T_{nom} = 20 °C

Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Turbine meter ($k_{nominal}$ 6,633 Pulses/Liter): Pulse count	Turbine meter: K-factor	Turbine meter: Meter error	Coriolis_Mass ($k_{nominal}$ 100,000 Pulses/kg): Pulse count	Coriolis_Mass: K-factor	Coriolis_Mass: Meter error	Coriolis_Vol ($k_{nominal}$ 100,000 Pulses/Liter): Pulse count	Coriolis_Vol: K-factor	Coriolis_Vol: Meter error	(T_{fluid} - T_{nom})	Corrected meter error: Turbine meter	Corrected meter error: Coriolis _Mass
	Laboratory reference						Fluid			Ambient conditions													
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
29.06.2017	30	668,017	29,763	29,861	5522,901	5,541	996,737	2,749	26,87	31,02	1,00	36906	6,6606	0,415	552470	100,0326	0,033	554103	100,0009	0,001	6,870	0,414	0,065
29.06.2017	30	668,563	29,731	29,829	5521,399	5,540	996,725	2,748	26,91	31,04	1,00	36898	6,6608	0,420	552269	100,0234	0,023	553908	99,9917	-0,008	6,913	0,419	0,056
29.06.2017	30	668,679	29,722	29,817	5520,699	5,538	996,824	2,746	26,55	31,01	1,00	36890	6,6609	0,421	552269	100,0361	0,036	553858	100,0053	0,005	6,547	0,419	0,067
29.06.2017	30	669,078	29,710	29,799	5521,700	5,538	997,004	2,742	25,87	31,04	1,00	36891	6,6611	0,423	552384	100,0388	0,039	553866	100,0066	0,007	5,870	0,421	0,068
29.06.2017	30	668,585	29,733	29,820	5521,995	5,538	997,092	2,754	25,53	31,19	1,00	36888	6,6608	0,419	552348	100,0269	0,027	553789	99,9963	-0,004	5,532	0,416	0,055
29.06.2017	30	668,581	29,736	29,820	5522,395	5,538	997,153	2,756	25,30	31,14	1,00	36890	6,6611	0,423	552437	100,0358	0,036	553837	100,0038	0,004	5,296	0,420	0,063
29.06.2017	30	668,420	29,741	29,825	5521,995	5,538	997,184	2,759	25,17	31,12	1,00	36887	6,6612	0,425	552426	100,0410	0,041	553803	100,0080	0,008	5,175	0,422	0,068
29.06.2017	30	668,776	29,727	29,810	5522,390	5,538	997,206	2,757	25,09	31,24	1,00	36886	6,6607	0,418	552415	100,0319	0,032	553779	99,9987	-0,001	5,089	0,414	0,058
29.06.2017	30	668,822	29,723	29,808	5522,089	5,538	997,168	2,750	25,24	31,25	1,00	36887	6,6610	0,422	552410	100,0364	0,036	553801	100,0043	0,004	5,239	0,419	0,064
29.06.2017	30	668,868	29,719	29,807	5521,683	5,538	997,045	2,747	25,71	31,52	1,00	36886	6,6605	0,414	552375	100,0374	0,037	553846	100,0074	0,007	5,715	0,412	0,066
29.06.2017	100	199,357	100,356	100,654	5557,423	5,574	997,039	2,527	25,74	31,33	1,00	37217	6,6770	0,663	556087	100,0620	0,062	557540	100,0264	0,026	5,736	0,659	0,084
29.06.2017	100	199,094	100,424	100,726	5553,825	5,571	997,002	2,523	25,88	31,18	1,00	37192	6,6766	0,657	555686	100,0547	0,055	557142	100,0160	0,016	5,879	0,652	0,077
29.06.2017	100	199,092	100,481	100,785	5556,928	5,574	996,982	2,528	25,95	31,20	1,00	37214	6,6767	0,658	556000	100,0553	0,055	557480	100,0189	0,019	5,953	0,654	0,078
29.06.2017	100	199,178	100,407	100,712	5555,226	5,572	996,974	2,523	25,99	31,20	1,00	37205	6,6770	0,664	555823	100,0541	0,054	557319	100,0197	0,020	5,986	0,659	0,077
29.06.2017	100	199,200	100,448	100,754	5558,130	5,575	996,966	2,517	26,01	31,04	1,00	37224	6,6769	0,662	556132	100,0574	0,057	557672	100,0301	0,030	6,014	0,657	0,081
29.06.2017	100	199,099	100,407	100,713	5553,024	5,570	996,959	2,524	26,04	31,12	1,00	37187	6,6763	0,653	555606	100,0547	0,055	557132	100,0243	0,024	6,042	0,649	0,078
29.06.2017	100	199,153	100,396	100,703	5553,925	5,571	996,951	2,516	26,07	31,22	1,00	37196	6,6768	0,661	555710	100,0572	0,057	557222	100,0235	0,024	6,070	0,656	0,081
29.06.2017	100	199,217	100,420	100,727	5557,023	5,574	996,944	2,525	26,10	31,28	1,00	37215	6,6765	0,655	555980	100,0500	0,050	557480	100,0133	0,013	6,099	0,651	0,073
29.06.2017	100	199,099	100,427	100,735	5554,120	5,571	996,936	2,522	26,13	31,38	1,00	37199	6,6770	0,664	555748	100,0605	0,061	557290	100,0307	0,031	6,129	0,659	0,084
29.06.2017	100	199,074	100,443	100,752	5554,320	5,571	996,928	2,519	26,16	31,38	1,00	37199	6,6767	0,659	555738	100,0551	0,055	557265	100,0219	0,022	6,156	0,655	0,079
29.06.2017	200	100,354	200,672	201,294	5593,964	5,611	996,910	4,453	26,23	31,26	1,00	37562	6,6940	0,919	559649	100,0452	0,045	560862	99,9521	-0,048	6,227	0,895	0,069
29.06.2017	200	100,418	200,670	201,294	5597,468	5,615	996,901	4,463	26,26	31,24	1,00	37589	6,6945	0,928	560068	100,0574	0,057	561328	99,9717	-0,028	6,260	0,903	0,082
29.06.2017	200	100,459	200,631	201,257	5598,669	5,616	996,890	4,464	26,30	31,28	1,00	37601	6,6952	0,937	560216	100,0623	0,062	561476	99,9755	-0,025	6,303	0,913	0,087
29.06.2017	200	100,357	200,630	201,259	5592,963	5,610	996,878	4,449	26,35	31,28	1,00	37559	6,6944	0,926	559572	100,0493	0,049	560797	99,9552	-0,045	6,348	0,901	0,074
29.06.2017	200	100,393	200,716	201,347	5597,368	5,615	996,868	4,458	26,38	31,34	1,00	37592	6,6950	0,934	560055	100,0568	0,057	561250	99,9563	-0,044	6,383	0,910	0,082
29.06.2017	200	100,356	200,643	201,278	5593,263	5,611	996,847	4,464	26,46	31,40	1,00	37567	6,6953	0,939	559629	100,0541	0,054	560855	99,9572	-0,043	6,461	0,914	0,079
29.06.2017	200	100,376	200,855	201,492	5600,271	5,618	996,837	4,466	26,50	31,38	1,00	37610	6,6945	0,927	560300	100,0487	0,049	561572	99,9587	-0,041	6,498	0,902	0,074
29.06.2017	200	100,219	200,788	201,428	5589,659	5,607	996,824	4,448	26,55	31,36	1,00	37541	6,6948	0,932	559294	100,0587	0,059	560491	99,9544	-0,046	6,546	0,907	0,084
29.06.2017	200	100,158	200,896	201,538	5589,259	5,607	996,815	4,452	26,58	31,21	1,00	37541	6,6952	0,938	559254	100,0587	0,059	560524	99,9665	-0,034	6,582	0,913	0,084
29.06.2017	200	105,540	201,104	201,697	5895,696	5,913	997,060	4,476	25,66	31,54	1,00	39582	6,6940	0,919	589820	100,0425	0,042	591047	99,9559	-0,044	5,655	0,897	0,065

NIM Laboratory – Day#1

Data report NIM: Day#1 | *Original data set

		Laboratory reference					Fluid			Ambient conditions		Turbine meter ($K_{V,nom}$ 6,6330 Pulses/Liter)			Coriolis_Mass ($K_{m,nom}$ 100,0000 Pulses/kg)			Coriolis_Vol ($K_{V,nom}$ 100,0000 Pulses/ Liter)			Temperature correction of meter error (T_{nom} 20 °C)	Corrected meter error	
Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
29.08.2017	30	239,113	30,023	30,112	1994,123	2,000	997,020	1,65	26,22	27,10	1,01	13300,81	6,6501	0,258	199409,4	99,9986	-0,001	200043,5	100,0176	0,018	6,220	0,256	0,029
29.08.2017	30	239,645	30,032	30,122	1999,177	2,005	997,020	1,65	26,22	27,10	1,01	13334,45	6,6501	0,258	199918,8	100,0005	0,001	200554,6	100,0197	0,020	6,220	0,256	0,031
29.08.2017	30	239,098	30,040	30,129	1995,124	2,001	997,020	1,65	26,22	27,10	1,01	13308,35	6,6506	0,265	199501,0	99,9943	-0,006	200135,5	100,0134	0,013	6,220	0,263	0,025
29.08.2017	30	239,881	30,033	30,123	2001,229	2,007	997,020	1,65	26,22	27,10	1,01	13349,82	6,6509	0,270	200119,1	99,9981	-0,002	200755,4	100,0171	0,017	6,220	0,268	0,028
29.08.2017	30	239,117	30,019	30,108	1993,872	2,000	997,018	1,65	26,23	27,10	1,01	13299,98	6,6505	0,264	199385,1	99,9989	-0,001	200019,1	100,0177	0,018	6,230	0,262	0,029
29.08.2017	60	119,040	60,208	60,388	1990,870	1,997	997,015	1,60	26,23	27,10	1,01	13298,24	6,6597	0,402	199095,9	100,0045	0,004	199724,8	100,0210	0,021	6,230	0,407	0,037
29.08.2017	60	119,869	60,235	60,415	2005,633	2,012	997,015	1,60	26,23	27,10	1,01	13396,64	6,6596	0,401	200568,8	100,0027	0,003	201201,9	100,0190	0,019	6,230	0,405	0,036
29.08.2017	60	119,608	60,209	60,390	2000,428	2,006	997,013	1,60	26,24	27,10	1,01	13362,59	6,6599	0,406	200056,1	100,0066	0,007	200687,6	100,0226	0,023	6,240	0,410	0,039
29.08.2017	60	119,662	60,206	60,387	2001,229	2,007	997,010	1,60	26,25	27,10	1,01	13366,89	6,6594	0,398	200132,5	100,0048	0,005	200765,2	100,0210	0,021	6,250	0,402	0,038
29.08.2017	60	119,104	60,194	60,374	1991,470	1,997	997,010	1,60	26,25	27,10	1,01	13301,80	6,6594	0,398	199155,1	100,0041	0,004	199784,2	100,0200	0,020	6,250	0,403	0,037
29.08.2017	100	79,774	100,921	101,226	2236,348	2,243	996,994	1,55	26,30	27,10	1,01	14952,00	6,6658	0,495	223665,1	100,0135	0,014	224366,7	100,0257	0,026	6,300	0,490	0,038
29.08.2017	100	79,635	100,909	101,214	2232,194	2,239	996,989	1,55	26,32	27,10	1,01	14923,27	6,6653	0,488	223243,3	100,0107	0,011	223944,9	100,0229	0,023	6,320	0,483	0,035
29.08.2017	100	79,541	100,911	101,216	2229,592	2,236	996,984	1,55	26,34	27,10	1,01	14907,31	6,6659	0,497	222977,8	100,0084	0,008	223680,0	100,0207	0,021	6,340	0,492	0,033
29.08.2017	100	79,213	100,910	101,216	2220,383	2,227	996,981	1,55	26,35	27,10	1,01	14846,64	6,6663	0,503	222071,8	100,0151	0,015	222771,5	100,0273	0,027	6,350	0,498	0,039
29.08.2017	100	79,509	100,842	101,148	2227,190	2,234	996,976	1,55	26,37	27,10	1,01	14891,14	6,6658	0,495	222760,7	100,0187	0,019	223463,0	100,0306	0,031	6,370	0,490	0,043
29.08.2017	140	59,381	140,328	140,755	2314,674	2,322	996,971	1,70	26,41	27,10	1,01	15492,15	6,6727	0,599	231498,6	100,0135	0,013	232221,1	100,0218	0,022	6,410	0,564	0,036
29.08.2017	140	59,616	140,365	140,792	2324,434	2,332	996,963	1,70	26,44	27,10	1,01	15557,02	6,6725	0,595	232467,6	100,0104	0,010	233194,3	100,0184	0,018	6,440	0,560	0,033
29.08.2017	140	59,539	140,294	140,723	2320,280	2,327	996,955	1,70	26,47	27,10	1,01	15529,80	6,6727	0,598	232051,8	100,0103	0,010	232779,8	100,0186	0,019	6,470	0,563	0,033
29.08.2017	140	59,682	140,307	140,736	2326,035	2,333	996,950	1,70	26,49	27,10	1,01	15567,11	6,6721	0,590	232624,7	100,0091	0,009	233356,4	100,0177	0,018	6,490	0,554	0,032
29.08.2017	140	59,620	140,271	140,701	2323,032	2,330	996,942	1,70	26,52	27,10	1,01	15547,46	6,6723	0,592	232330,4	100,0117	0,012	233062,1	100,0198	0,020	6,520	0,556	0,034
29.08.2017	180	44,418	179,901	180,456	2219,683	2,227	996,929	1,90	26,60	27,10	1,01	14869,19	6,6782	0,682	221989,1	100,0094	0,009	222677,4	100,0114	0,011	6,600	0,656	0,035
29.08.2017	180	44,184	180,026	180,583	2209,523	2,216	996,915	1,90	26,65	27,10	1,01	14800,44	6,6778	0,676	220972,8	100,0093	0,009	221660,6	100,0111	0,011	6,650	0,650	0,035
29.08.2017	180	44,515	180,042	180,603	2226,239	2,233	996,894	1,90	26,73	27,10	1,01	14912,37	6,6777	0,673	222651,9	100,0126	0,013	223350,8	100,0149	0,015	6,730	0,647	0,039
29.08.2017	180	44,281	179,955	180,518	2213,477	2,220	996,877	1,90	26,79	27,10	1,01	14826,66	6,6774	0,670	221375,5	100,0126	0,013	222072,8	100,0143	0,014	6,790	0,644	0,039
29.08.2017	180	44,830	180,008	180,574	2241,604	2,249	996,863	1,90	26,84	27,10	1,01	15015,20	6,6774	0,670	224182,2	100,0097	0,010	224891,9	100,0117	0,012	6,840	0,643	0,036
29.08.2017	200	44,754	199,109	199,737	2475,234	2,483	996,857	2,30	26,93	27,10	1,01	16587,17	6,6802	0,711	247553,5	100,0122	0,012	248332,9	100,0117	0,012	6,930	0,685	0,039
29.08.2017	200	44,583	199,218	199,850	2467,126	2,475	996,837	2,30	27,00	27,10	1,01	16532,53	6,6799	0,708	246748,7	100,0146	0,015	247529,9	100,0140	0,014	7,000	0,681	0,042
29.08.2017	200	44,367	199,195	199,831	2454,914	2,463	996,818	2,30	27,07	27,10	1,01	16449,51	6,6793	0,698	245520,6	100,0119	0,012	246302,1	100,0110	0,011	7,070	0,671	0,039
29.08.2017	200	44,634	199,214	199,855	2469,929	2,478	996,793	2,30	27,16	27,10	1,01	16551,24	6,6796	0,703	247026,0	100,0134	0,013	247819,2	100,0128	0,013	7,160	0,675	0,041
29.08.2017	200	44,206	199,157	199,801	2445,504	2,453	996,777	2,30	27,22	27,10	1,01	16387,29	6,6794	0,699	244579,8	100,0120	0,012	245369,8	100,0116	0,012	7,220	0,672	0,040

NIM Laboratory – Day#2

Data report NIM: Day#2 — *Original data set

												Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error		
												$K_{V,nom}$	6,6330	Pulses/ Liter	$K_{m,nom}$	100,0000	Pulses/ kg	$K_{V,nom}$	100,0000	Pulses/ Liter	T_{nom}	20	°C
		Laboratory reference					Fluid			Ambient conditions												Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
30.08.2017	30	239,870	30,043	30,132	2001,767	2,008	997,052	2,30	26,21	23,70	1,01	13351,63	6,6503	0,260	200148,4	99,9859	-0,014	200820,5	100,0259	0,026	6,210	0,258	0,016
30.08.2017	30	239,686	30,001	30,090	1997,463	2,003	997,036	2,30	26,27	23,70	1,01	13320,97	6,6492	0,244	199716,9	99,9853	-0,015	200395,0	100,0274	0,027	6,270	0,242	0,016
30.08.2017	30	239,613	29,991	30,080	1996,162	2,002	997,031	2,30	26,29	23,70	1,01	13312,60	6,6493	0,246	199574,8	99,9792	-0,021	200256,8	100,0230	0,023	6,290	0,244	0,010
30.08.2017	30	239,629	29,989	30,078	1996,162	2,002	997,028	2,30	26,30	23,70	1,01	13311,38	6,6487	0,236	199609,6	99,9967	-0,003	200292,9	100,0408	0,041	6,300	0,234	0,027
30.08.2017	30	239,878	29,979	30,069	1997,614	2,004	997,028	2,30	26,30	23,70	1,01	13321,41	6,6488	0,239	199735,7	99,9872	-0,013	200419,8	100,0314	0,031	6,300	0,237	0,018
30.08.2017	60	119,659	60,030	60,209	1995,311	2,001	997,031	2,30	26,29	23,70	1,01	13325,28	6,6585	0,384	199541,6	100,0052	0,005	200222,3	100,0484	0,048	6,290	0,389	0,038
30.08.2017	60	119,097	60,062	60,241	1987,004	1,993	997,031	2,30	26,29	23,70	1,01	13270,40	6,6588	0,388	198706,7	100,0032	0,003	199384,3	100,0462	0,046	6,290	0,393	0,036
30.08.2017	60	119,972	60,049	60,228	2001,167	2,007	997,031	2,30	26,29	23,70	1,01	13364,43	6,6585	0,384	200100,0	99,9917	-0,008	200782,0	100,0346	0,035	6,290	0,389	0,025
30.08.2017	60	119,660	60,036	60,215	1995,512	2,001	997,028	2,30	26,30	23,70	1,01	13327,29	6,6588	0,389	199558,8	100,0038	0,004	200238,2	100,0461	0,046	6,300	0,393	0,037
30.08.2017	60	119,880	60,020	60,199	1998,665	2,005	997,025	2,30	26,31	23,70	1,01	13348,70	6,6589	0,391	199871,1	100,0023	0,002	200552,8	100,0449	0,045	6,310	0,396	0,035
30.08.2017	100	74,349	99,452	99,751	2053,915	2,060	997,002	2,00	26,34	23,70	1,01	13731,86	6,6657	0,492	205411,5	100,0098	0,010	206105,7	100,0469	0,047	6,340	0,487	0,034
30.08.2017	100	74,912	99,411	99,711	2068,628	2,075	996,999	2,00	26,35	23,70	1,01	13831,42	6,6662	0,501	206886,6	100,0115	0,012	207586,1	100,0485	0,048	6,350	0,496	0,036
30.08.2017	100	74,882	99,376	99,676	2067,077	2,073	996,993	2,00	26,37	23,70	1,01	13819,92	6,6656	0,492	206731,3	100,0114	0,011	207429,9	100,0477	0,048	6,370	0,487	0,036
30.08.2017	100	74,351	99,415	99,715	2053,214	2,059	996,991	2,00	26,38	23,70	1,01	13726,98	6,6655	0,490	205356,0	100,0169	0,017	206050,5	100,0531	0,053	6,380	0,485	0,041
30.08.2017	100	74,089	99,365	99,665	2044,956	2,051	996,988	2,00	26,39	23,70	1,01	13671,06	6,6651	0,484	204522,3	100,0130	0,013	205214,8	100,0494	0,049	6,390	0,479	0,037
30.08.2017	140	59,039	139,150	139,575	2282,028	2,289	996,958	1,70	26,46	23,70	1,01	15271,08	6,6715	0,581	228240,2	100,0164	0,016	229004,2	100,0459	0,046	6,460	0,545	0,039
30.08.2017	140	59,820	139,038	139,464	2310,356	2,317	996,950	1,70	26,49	23,70	1,01	15461,16	6,6717	0,583	231060,6	100,0108	0,011	231836,7	100,0407	0,041	6,490	0,548	0,033
30.08.2017	140	59,929	139,040	139,467	2314,610	2,322	996,942	1,70	26,52	23,70	1,01	15489,31	6,6715	0,581	231495,4	100,0149	0,015	232274,1	100,0444	0,044	6,520	0,544	0,037
30.08.2017	140	59,178	138,981	139,408	2284,631	2,292	996,934	1,70	26,55	23,70	1,01	15289,28	6,6717	0,584	228493,2	100,0132	0,013	229262,8	100,0423	0,042	6,550	0,547	0,036
30.08.2017	140	59,975	138,851	139,279	2313,208	2,320	996,925	1,70	26,58	23,70	1,01	15480,34	6,6716	0,582	231340,9	100,0087	0,009	232122,3	100,0379	0,038	6,580	0,545	0,031
30.08.2017	180	44,693	179,564	180,120	2229,228	2,236	996,913	1,90	26,66	23,70	1,01	14931,73	6,6775	0,671	222954,2	100,0141	0,014	223694,3	100,0363	0,036	6,660	0,645	0,040
30.08.2017	180	44,880	179,660	180,219	2239,738	2,247	996,896	1,90	26,72	23,70	1,01	15002,47	6,6775	0,671	223999,7	100,0116	0,012	224746,9	100,0337	0,034	6,720	0,645	0,037
30.08.2017	180	44,193	179,533	180,094	2203,904	2,211	996,885	1,90	26,76	23,70	1,01	14763,19	6,6778	0,675	220428,1	100,0171	0,017	221166,5	100,0396	0,040	6,760	0,649	0,043
30.08.2017	180	44,381	179,527	180,091	2213,213	2,220	996,869	1,90	26,82	23,70	1,01	14825,21	6,6775	0,671	221345,7	100,0110	0,011	222089,9	100,0331	0,033	6,820	0,645	0,037
30.08.2017	180	44,099	179,479	180,045	2198,549	2,205	996,858	1,90	26,86	23,70	1,01	14727,48	6,6777	0,674	219885,8	100,0141	0,014	220627,8	100,0362	0,036	6,860	0,647	0,040
30.08.2017	200	44,037	199,531	200,162	2440,784	2,448	996,851	2,30	26,95	23,70	1,01	16357,89	6,6808	0,721	244116,7	100,0157	0,016	244933,9	100,0345	0,035	6,950	0,694	0,042
30.08.2017	200	44,241	199,534	200,168	2452,095	2,460	996,835	2,30	27,01	23,70	1,01	16432,73	6,6803	0,713	245254,1	100,0182	0,018	246079,4	100,0371	0,037	7,010	0,686	0,045
30.08.2017	200	44,414	199,429	200,065	2460,404	2,468	996,821	2,30	27,06	23,70	1,01	16488,52	6,6802	0,712	246080,7	100,0164	0,016	246912,0	100,0352	0,035	7,060	0,685	0,044
30.08.2017	200	44,150	199,409	200,048	2445,539	2,453	996,804	2,30	27,12	23,70	1,01	16389,80	6,6805	0,716	244591,4	100,0153	0,015	245421,8	100,0342	0,034	7,120	0,689	0,043
30.08.2017	200	44,028	199,407	200,050	2438,732	2,447	996,785	2,30	27,19	23,70	1,01	16343,74	6,6802	0,711	243905,5	100,0132	0,013	244737,4	100,0317	0,032	7,190	0,684	0,041

NIM Laboratory – Day#3

Data report NIM: Day#3 — *Original data set

Temperature correction of meter error: T_{nom} = 20 °C

Turbine meter: $K_{V,nom}$ = 6,6330 Pulses/Liter; Coriolis_Mass: $K_{m,nom}$ = 100,0000 Pulses/kg; Coriolis_Vol: $K_{V,nom}$ = 100,0000 Pulses/ Liter

		Laboratory reference					Fluid			Ambient conditions		Turbine meter			Coriolis_Mass			Coriolis_Vol					Corrected meter error	
Date	Nominal flowrate	Measurement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error		(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V		ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]		[°C]	[%]	[%]
31.08.2017	30	239,531	30,059	30,150	2000,017	2,006	996,982	2,30	26,47	23,40	1,01	13345,65	6,6526	0,296	200010,3	100,0043	0,004	200677,1	100,0349	0,035		6,470	0,294	0,035
31.08.2017	30	239,159	30,078	30,168	1998,165	2,004	997,009	2,30	26,37	23,40	1,01	13333,59	6,6530	0,301	199851,4	100,0175	0,017	200515,1	100,0495	0,049		6,370	0,299	0,048
31.08.2017	30	239,487	30,218	30,308	2010,226	2,016	997,028	2,30	26,30	23,40	1,01	13411,35	6,6517	0,282	201057,3	100,0173	0,017	201723,0	100,0502	0,050		6,300	0,281	0,048
31.08.2017	30	239,362	30,393	30,483	2020,785	2,027	997,031	2,30	26,29	23,40	1,01	13482,68	6,6522	0,289	202088,0	100,0047	0,005	202758,1	100,0384	0,038		6,290	0,287	0,035
31.08.2017	30	239,785	30,183	30,273	2010,426	2,016	997,025	2,30	26,31	23,40	1,01	13413,30	6,6520	0,287	201074,5	100,0159	0,016	201744,2	100,0505	0,050		6,310	0,285	0,047
31.08.2017	30	239,865	30,190	30,280	2011,527	2,018	997,023	2,30	26,32	23,40	1,01	13420,46	6,6519	0,285	201183,3	100,0152	0,015	201853,5	100,0496	0,050		6,320	0,283	0,046
31.08.2017	30	239,836	30,184	30,275	2010,926	2,017	997,020	2,30	26,33	23,40	1,01	13416,49	6,6519	0,285	201111,6	100,0094	0,009	201782,1	100,0438	0,044		6,330	0,283	0,040
31.08.2017	30	239,605	30,183	30,273	2008,875	2,015	997,020	2,30	26,33	23,40	1,01	13403,02	6,6520	0,287	200900,4	100,0064	0,006	201571,3	100,0414	0,041		6,330	0,285	0,037
31.08.2017	30	240,011	30,178	30,268	2011,927	2,018	997,017	2,30	26,34	23,40	1,01	13422,42	6,6515	0,279	201216,6	100,0119	0,012	201889,1	100,0468	0,047		6,340	0,278	0,043
31.08.2017	30	239,468	30,179	30,269	2007,473	2,013	997,017	2,30	26,34	23,40	1,01	13392,66	6,6515	0,279	200759,1	100,0059	0,006	201429,4	100,0405	0,040		6,340	0,277	0,037
31.08.2017	100	75,003	100,758	101,062	2099,207	2,106	996,997	1,90	26,35	23,40	1,01	14035,02	6,6658	0,494	209957,1	100,0173	0,017	210649,6	100,0458	0,046		6,350	0,489	0,042
31.08.2017	100	74,620	100,809	101,112	2089,548	2,096	996,997	1,90	26,35	23,40	1,01	13969,82	6,6655	0,490	208970,9	100,0077	0,008	209660,4	100,0363	0,036		6,350	0,485	0,032
31.08.2017	100	74,225	100,788	101,092	2078,038	2,084	996,991	1,90	26,37	23,40	1,01	13894,44	6,6662	0,501	207837,0	100,0160	0,016	208522,7	100,0441	0,044		6,370	0,496	0,040
31.08.2017	100	74,606	100,773	101,078	2088,397	2,095	996,989	1,90	26,38	23,40	1,01	13963,12	6,6659	0,496	208874,9	100,0169	0,017	209565,1	100,0452	0,045		6,380	0,491	0,041
31.08.2017	100	74,323	100,712	101,017	2079,239	2,086	996,983	1,90	26,40	23,40	1,01	13901,77	6,6658	0,495	207961,3	100,0180	0,018	208650,1	100,0465	0,047		6,400	0,490	0,042
31.08.2017	100	74,574	100,763	101,068	2087,296	2,094	996,980	1,90	26,41	23,40	1,01	13954,99	6,6655	0,490	208748,8	100,0092	0,009	209440,4	100,0376	0,038		6,410	0,485	0,034
31.08.2017	100	74,838	100,667	100,973	2092,701	2,099	996,975	1,90	26,43	23,40	1,01	13992,29	6,6660	0,498	209317,5	100,0226	0,023	210011,7	100,0508	0,051		6,430	0,493	0,047
31.08.2017	100	74,620	100,642	100,948	2086,095	2,092	996,972	1,90	26,44	23,40	1,01	13948,11	6,6660	0,497	208653,4	100,0210	0,021	209347,6	100,0500	0,050		6,440	0,492	0,046
31.08.2017	100	74,869	100,622	100,929	2092,651	2,099	996,967	1,90	26,46	23,40	1,01	13991,65	6,6658	0,495	209300,0	100,0167	0,017	209996,8	100,0453	0,045		6,460	0,490	0,041
31.08.2017	100	74,650	100,622	100,928	2086,495	2,093	996,964	1,90	26,47	23,40	1,01	13950,30	6,6657	0,493	208684,2	100,0166	0,017	209379,2	100,0451	0,045		6,470	0,488	0,041
31.08.2017	200	44,396	199,557	200,168	2460,955	2,468	996,950	2,30	26,59	23,40	1,01	16492,84	6,6814	0,729	246152,9	100,0233	0,023	246943,0	100,0383	0,038		6,590	0,704	0,049
31.08.2017	200	44,555	199,518	200,132	2469,314	2,477	996,931	2,30	26,66	23,40	1,01	16549,44	6,6815	0,731	246971,5	100,0163	0,016	247766,6	100,0303	0,030		6,660	0,705	0,042
31.08.2017	200	44,322	199,538	200,156	2456,651	2,464	996,914	2,30	26,72	23,40	1,01	16463,97	6,6811	0,725	245704,0	100,0158	0,016	246498,6	100,0297	0,030		6,720	0,699	0,042
31.08.2017	200	44,542	199,476	200,097	2468,062	2,476	996,898	2,30	26,78	23,40	1,01	16540,55	6,6810	0,724	246850,5	100,0179	0,018	247655,1	100,0327	0,033		6,780	0,698	0,044
31.08.2017	200	44,184	199,388	200,011	2447,142	2,455	996,884	2,30	26,83	23,40	1,01	16400,57	6,6810	0,724	244766,2	100,0213	0,021	245566,5	100,0356	0,036		6,830	0,698	0,048
31.08.2017	200	44,482	199,382	200,008	2463,608	2,471	996,870	2,30	26,88	23,40	1,01	16512,52	6,6816	0,733	246414,5	100,0218	0,022	247225,4	100,0369	0,037		6,880	0,706	0,048
31.08.2017	200	44,657	199,261	199,890	2471,766	2,480	996,854	2,30	26,94	23,40	1,01	16566,50	6,6812	0,727	247208,1	100,0127	0,013	248023,9	100,0271	0,027		6,940	0,700	0,039
31.08.2017	200	44,925	199,182	199,813	2485,630	2,494	996,840	2,30	26,99	23,40	1,01	16657,45	6,6803	0,713	248605,6	100,0171	0,017	249430,8	100,0320	0,032		6,990	0,687	0,044
31.08.2017	200	44,880	199,166	199,800	2482,928	2,491	996,824	2,30	27,05	23,40	1,01	16639,74	6,6804	0,714	248330,9	100,0154	0,015	249158,5	100,0299	0,030		7,050	0,687	0,042
31.08.2017	200	44,694	199,129	199,766	2472,167	2,480	996,810	2,30	27,10	23,40	1,01	16568,86	6,6808	0,720	247253,8	100,0150	0,015	248081,8	100,0298	0,030		7,100	0,693	0,042

NMIJ Laboratory – Day#1

Data report NMIJ: Day#1 — *Original data set

		Laboratory reference					Fluid			Ambient conditions		Turbine meter ($K_{V,nom}$ = 6,633 Pulses/Liter)			Coriolis_Mass ($K_{m,nom}$ = 100,000 Pulses/kg)			Coriolis_Vol ($K_{V,nom}$ = 100,000 Pulses/Liter)			Temperature correction of meter error (T_{nom} = 20 °C)	Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/ Liter]	[%]	[Pulses]	[Pulses/ kg]	[%]	[Pulses]	[Pulses/ Liter]	[%]	[°C]	[%]	[%]
05.12.2017	30	431,977	30,116	30,130	3613,773	3,615	999,561	2,36	13,76	20,68	1,00	24063	6,6558	0,343	361709	100,0918	0,092	362085	100,1519	0,152	-6,239	0,308	0,067
05.12.2017	30	430,625	30,204	30,218	3612,967	3,615	999,558	2,36	13,78	20,69	1,00	24058	6,6559	0,345	361588	100,0806	0,081	361964	100,1404	0,140	-6,216	0,310	0,056
05.12.2017	30	431,296	30,164	30,177	3613,764	3,615	999,557	2,36	13,79	20,71	1,00	24063	6,6558	0,343	361648	100,0751	0,075	362023	100,1346	0,135	-6,208	0,308	0,051
05.12.2017	30	431,504	30,140	30,154	3612,660	3,614	999,555	2,36	13,81	20,75	1,00	24056	6,6558	0,344	361555	100,0800	0,080	361931	100,1395	0,139	-6,191	0,310	0,056
05.12.2017	30	431,753	30,126	30,140	3613,057	3,615	999,553	2,36	13,82	20,82	1,00	24059	6,6559	0,346	361593	100,0795	0,080	361969	100,1388	0,139	-6,179	0,311	0,056
05.12.2017	60	216,298	60,281	60,309	3621,862	3,624	999,545	2,24	13,84	20,87	1,00	24137	6,6612	0,425	362473	100,0792	0,079	362844	100,1360	0,136	-6,164	0,416	0,041
05.12.2017	60	215,862	60,386	60,414	3620,860	3,623	999,540	2,24	13,87	20,86	1,00	24133	6,6619	0,436	362381	100,0815	0,081	362753	100,1382	0,138	-6,129	0,427	0,044
05.12.2017	60	215,830	60,420	60,448	3622,360	3,624	999,533	2,24	13,92	20,88	1,00	24144	6,6622	0,440	362534	100,0823	0,082	362908	100,1388	0,139	-6,078	0,431	0,045
05.12.2017	60	215,615	60,439	60,467	3619,856	3,622	999,527	2,24	13,97	20,89	1,00	24129	6,6626	0,446	362316	100,0913	0,091	362691	100,1475	0,147	-6,030	0,437	0,055
05.12.2017	60	215,681	60,455	60,484	3621,955	3,624	999,521	2,24	14,01	20,87	1,00	24141	6,6620	0,437	362498	100,0835	0,084	362875	100,1396	0,140	-5,986	0,428	0,047
05.12.2017	100	130,518	100,112	100,162	3629,563	3,631	999,500	1,97	14,07	20,88	1,00	24209	6,6666	0,507	363235	100,0768	0,077	363604	100,1284	0,128	-5,930	0,497	0,046
05.12.2017	100	130,362	100,204	100,255	3628,561	3,630	999,494	1,97	14,12	20,85	1,00	24207	6,6679	0,526	363189	100,0917	0,092	363560	100,1433	0,143	-5,885	0,516	0,061
05.12.2017	100	130,426	100,238	100,289	3631,564	3,633	999,489	1,97	14,15	20,82	1,00	24224	6,6670	0,513	363443	100,0789	0,079	363817	100,1307	0,131	-5,851	0,503	0,048
05.12.2017	100	130,435	100,220	100,272	3631,164	3,633	999,485	1,97	14,18	20,80	1,00	24222	6,6672	0,515	363415	100,0822	0,082	363790	100,1339	0,134	-5,823	0,505	0,052
05.12.2017	100	130,397	100,271	100,323	3631,963	3,634	999,482	1,97	14,20	20,77	1,00	24226	6,6668	0,509	363493	100,0817	0,082	363869	100,1333	0,133	-5,803	0,499	0,051
05.12.2017	140	93,728	140,047	140,122	3646,177	3,648	999,460	1,59	14,23	20,69	1,00	24335	6,6705	0,565	364877	100,0711	0,071	365241	100,1168	0,117	-5,771	0,580	0,041
05.12.2017	140	93,714	140,017	140,093	3644,875	3,647	999,457	1,59	14,25	20,64	1,00	24330	6,6715	0,580	364796	100,0846	0,085	365158	100,1296	0,130	-5,752	0,595	0,055
05.12.2017	140	93,738	139,981	140,057	3644,876	3,647	999,454	1,59	14,27	20,61	1,00	24332	6,6720	0,588	364799	100,0854	0,085	365163	100,1306	0,131	-5,732	0,602	0,056
05.12.2017	140	93,724	139,990	140,067	3644,575	3,647	999,452	1,59	14,29	20,59	1,00	24330	6,6720	0,588	364788	100,0907	0,091	365153	100,1359	0,136	-5,713	0,602	0,061
05.12.2017	140	93,712	140,012	140,090	3644,675	3,647	999,450	1,59	14,30	20,55	1,00	24333	6,6726	0,598	364815	100,0954	0,095	365183	100,1412	0,141	-5,701	0,612	0,066
05.12.2017	180	73,097	180,075	180,180	3656,387	3,659	999,422	1,10	14,33	20,41	1,00	24433	6,6784	0,685	365967	100,0898	0,090	366312	100,1263	0,126	-5,668	0,707	0,063
05.12.2017	180	73,001	180,016	180,120	3650,382	3,652	999,420	1,10	14,35	20,34	1,00	24392	6,6782	0,681	365366	100,0898	0,090	365711	100,1262	0,126	-5,654	0,703	0,063
05.12.2017	180	73,030	180,089	180,193	3653,286	3,655	999,419	1,10	14,36	20,30	1,00	24413	6,6786	0,687	365671	100,0937	0,094	366017	100,1302	0,130	-5,642	0,709	0,067
05.12.2017	180	73,054	179,993	180,098	3652,586	3,655	999,417	1,10	14,37	20,30	1,00	24408	6,6785	0,686	365582	100,0885	0,089	365925	100,1241	0,124	-5,632	0,708	0,062
05.12.2017	180	73,019	180,036	180,142	3651,687	3,654	999,415	1,10	14,38	20,29	1,00	24403	6,6788	0,690	365502	100,0913	0,091	365847	100,1272	0,127	-5,620	0,712	0,065
05.12.2017	200	65,850	200,081	200,202	3659,797	3,662	999,399	0,82	14,40	20,26	1,00	24467	6,6813	0,729	366329	100,0954	0,095	366660	100,1257	0,126	-5,599	0,750	0,069
05.12.2017	200	65,873	200,077	200,197	3661,000	3,663	999,398	0,82	14,41	20,22	1,00	24476	6,6816	0,732	366449	100,0953	0,095	366782	100,1260	0,126	-5,591	0,754	0,069
05.12.2017	200	65,894	200,193	200,314	3664,304	3,667	999,397	0,82	14,42	20,18	1,00	24495	6,6807	0,720	366738	100,0839	0,084	367071	100,1144	0,114	-5,579	0,741	0,058
05.12.2017	200	65,920	200,080	200,201	3663,706	3,666	999,395	0,82	14,43	20,13	1,00	24494	6,6815	0,732	366718	100,0948	0,095	367050	100,1249	0,125	-5,571	0,753	0,069
05.12.2017	200	65,888	200,144	200,265	3663,107	3,665	999,394	0,82	14,44	20,11	1,00	24486	6,6804	0,715	366597	100,0782	0,078	366932	100,1089	0,109	-5,562	0,737	0,052

NMIJ Laboratory – Day#2

Data report NMIJ: Day#2			*Original data set									Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error		
												$k_{nominal}$	6,633	Pulses/ Liter	$k_{nominal}$	100,000	Pulses/kg	$k_{nominal}$	100,000	Pulses/ Liter	T_{nom}	20	°C
		Laboratory reference					Fluid			Ambient conditions												Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/ Liter]	[%]	[Pulses]	[Pulses/ kg]	[%]	[Pulses]	[Pulses/ Liter]	[%]	[°C]	[%]	[%]
06.12.2017	30	431,487	30,147	30,159	3613,322	3,615	999,585	2,36	13,58	18,24	1,01	24053	6,6540	0,317	361727	100,1093	0,109	362142	100,1826	0,183	-6,417	0,281	0,084
06.12.2017	30	431,097	30,179	30,191	3613,915	3,615	999,596	2,36	13,50	18,62	1,01	24055	6,6535	0,309	361791	100,1105	0,111	362202	100,1838	0,184	-6,498	0,274	0,085
06.12.2017	30	431,028	30,191	30,203	3614,707	3,616	999,594	2,36	13,52	18,87	1,01	24061	6,6537	0,312	361871	100,1107	0,111	362282	100,1838	0,184	-6,483	0,277	0,085
06.12.2017	30	430,697	30,199	30,212	3612,997	3,614	999,593	2,36	13,53	19,23	1,01	24048	6,6533	0,305	361723	100,1172	0,117	362133	100,1898	0,190	-6,471	0,270	0,092
06.12.2017	30	430,632	30,205	30,217	3613,090	3,615	999,590	2,36	13,55	19,41	1,01	24050	6,6536	0,311	361776	100,1293	0,129	362185	100,2013	0,201	-6,449	0,275	0,104
06.12.2017	60	216,377	60,260	60,285	3621,893	3,623	999,580	2,24	13,58	19,55	1,01	24128	6,6589	0,391	362541	100,0971	0,097	362946	100,1668	0,167	-6,418	0,380	0,057
06.12.2017	60	216,127	60,311	60,337	3620,786	3,622	999,576	2,24	13,61	19,73	1,01	24124	6,6598	0,404	362452	100,1031	0,103	362857	100,1725	0,172	-6,389	0,394	0,064
06.12.2017	60	216,031	60,336	60,362	3620,682	3,622	999,573	2,24	13,64	19,84	1,01	24123	6,6597	0,403	362436	100,1016	0,102	362841	100,1706	0,171	-6,365	0,393	0,062
06.12.2017	60	215,938	60,352	60,378	3620,075	3,622	999,569	2,24	13,66	19,94	1,01	24121	6,6603	0,411	362395	100,1070	0,107	362800	100,1758	0,176	-6,341	0,401	0,068
06.12.2017	60	216,008	60,367	60,394	3622,172	3,624	999,567	2,24	13,68	20,12	1,01	24134	6,6600	0,407	362618	100,1106	0,111	363021	100,1785	0,178	-6,321	0,397	0,072
06.12.2017	100	130,442	100,074	100,120	3626,072	3,628	999,549	1,97	13,72	20,13	1,01	24178	6,6648	0,480	362953	100,0954	0,095	363345	100,1583	0,158	-6,284	0,469	0,062
06.12.2017	100	130,509	100,089	100,134	3628,471	3,630	999,545	1,97	13,74	19,94	1,01	24200	6,6664	0,504	363184	100,0928	0,093	363577	100,1556	0,156	-6,257	0,494	0,060
06.12.2017	100	130,513	100,097	100,143	3628,868	3,631	999,542	1,97	13,77	20,05	1,01	24204	6,6668	0,509	363265	100,1042	0,104	363657	100,1663	0,166	-6,232	0,499	0,071
06.12.2017	100	130,483	100,106	100,152	3628,365	3,630	999,539	1,97	13,79	20,35	1,01	24200	6,6666	0,507	363192	100,0980	0,098	363584	100,1598	0,160	-6,212	0,496	0,065
06.12.2017	100	130,451	100,142	100,188	3628,762	3,630	999,536	1,97	13,81	20,33	1,01	24202	6,6664	0,504	363215	100,0934	0,093	363608	100,1552	0,155	-6,189	0,493	0,061
06.12.2017	140	93,804	139,744	139,812	3641,269	3,643	999,512	1,59	13,86	20,11	1,01	24305	6,6716	0,582	364489	100,0994	0,099	364865	100,1538	0,154	-6,143	0,597	0,067
06.12.2017	140	93,893	139,753	139,822	3644,971	3,647	999,509	1,59	13,88	20,35	1,01	24329	6,6714	0,579	364855	100,0982	0,098	365231	100,1521	0,152	-6,122	0,594	0,066
06.12.2017	140	93,815	139,778	139,847	3642,566	3,644	999,506	1,59	13,90	20,47	1,01	24311	6,6708	0,571	364596	100,0932	0,093	364974	100,1475	0,147	-6,104	0,585	0,061
06.12.2017	140	93,802	139,743	139,812	3641,164	3,643	999,505	1,59	13,91	20,33	1,01	24303	6,6712	0,576	364463	100,0952	0,095	364841	100,1494	0,149	-6,091	0,591	0,063
06.12.2017	140	93,888	139,761	139,831	3644,964	3,647	999,502	1,59	13,93	20,17	1,01	24329	6,6714	0,578	364844	100,0954	0,095	365220	100,1486	0,149	-6,074	0,593	0,064
06.12.2017	180	73,115	179,883	179,978	3653,371	3,655	999,475	1,10	13,96	20,33	1,01	24410	6,6780	0,678	365702	100,0999	0,100	366056	100,1441	0,144	-6,039	0,702	0,072
06.12.2017	180	73,179	179,908	180,003	3657,073	3,659	999,472	1,10	13,98	20,42	1,01	24435	6,6780	0,679	366068	100,0986	0,099	366423	100,1428	0,143	-6,020	0,703	0,071
06.12.2017	180	73,205	179,956	180,051	3659,373	3,661	999,470	1,10	14,00	20,21	1,01	24449	6,6777	0,673	366284	100,0948	0,095	366639	100,1386	0,139	-6,003	0,697	0,067
06.12.2017	180	73,170	179,955	180,050	3657,570	3,660	999,467	1,10	14,01	20,07	1,01	24439	6,6782	0,681	366112	100,0971	0,097	366467	100,1408	0,141	-5,988	0,705	0,069
06.12.2017	180	73,198	179,933	180,030	3658,571	3,661	999,466	1,10	14,02	20,10	1,01	24445	6,6780	0,678	366211	100,0967	0,097	366565	100,1400	0,140	-5,976	0,702	0,069
06.12.2017	200	66,064	199,827	199,938	3667,077	3,669	999,448	0,82	14,06	20,27	1,01	24513	6,6809	0,723	367082	100,1021	0,102	367423	100,1398	0,140	-5,943	0,746	0,074
06.12.2017	200	66,050	199,843	199,954	3666,578	3,669	999,446	0,82	14,07	20,17	1,01	24509	6,6807	0,720	367015	100,0974	0,097	367357	100,1352	0,135	-5,929	0,743	0,070
06.12.2017	200	65,956	199,894	200,005	3662,273	3,664	999,444	0,82	14,09	20,10	1,01	24480	6,6807	0,718	366583	100,0971	0,097	366923	100,1342	0,134	-5,913	0,741	0,070
06.12.2017	200	65,981	199,868	199,980	3663,174	3,665	999,442	0,82	14,10	20,07	1,01	24487	6,6809	0,722	366681	100,0992	0,099	367021	100,1362	0,136	-5,899	0,745	0,072
06.12.2017	200	66,004	199,890	200,002	3664,876	3,667	999,440	0,82	14,12	20,32	1,01	24497	6,6805	0,716	366839	100,0959	0,096	367180	100,1328	0,133	-5,884	0,739	0,068

NMIJ Laboratory – Day#3

Data report NMIJ: Day#3 — *Original data set

Turbine meter: $k_{nominal}$ 6,633 Pulses/Liter; Coriolis_Mass: $k_{nominal}$ 100,000 Pulses/kg; Coriolis_Vol: $k_{nominal}$ 100,000 Pulses/Liter

Temperature correction of meter error: T_{nom} 20 °C

Date	Nominal flowrate	Laboratory reference: Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Fluid: Water density	Line pressure	Water temp.	Ambient conditions: Air temp.	Air pressure	Turbine meter: Pulse count	K-factor	Meter error	Coriolis_Mass: Pulse count	K-factor	Meter error	Coriolis_Vol: Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Corrected meter error: Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
07.12.2017	30	434,638	29,929	29,939	3613,461	3,615	999,668	2,36	13,03	16,97	1,02	24055	6,6548	0,329	361393	100,0130	0,013	361796	100,0913	0,091	-6,972	0,291	-0,015
07.12.2017	30	436,249	29,811	29,821	3612,554	3,614	999,671	2,36	13,01	17,34	1,02	24051	6,6554	0,338	361364	100,0301	0,030	361769	100,1092	0,109	-6,993	0,300	0,002
07.12.2017	30	430,901	30,183	30,193	3612,746	3,614	999,674	2,36	12,99	17,84	1,02	24053	6,6556	0,341	361385	100,0306	0,031	361790	100,1100	0,110	-7,015	0,303	0,002
07.12.2017	30	431,291	30,164	30,174	3613,738	3,615	999,669	2,36	13,02	18,45	1,02	24058	6,6552	0,334	361495	100,0335	0,034	361901	100,1127	0,113	-6,980	0,296	0,005
07.12.2017	30	431,381	30,147	30,157	3612,428	3,614	999,668	2,36	13,03	18,86	1,02	24052	6,6559	0,345	361384	100,0391	0,039	361790	100,1182	0,118	-6,972	0,308	0,011
07.12.2017	30	432,365	30,088	30,099	3613,667	3,615	999,640	2,36	13,25	20,30	1,02	24056	6,6546	0,325	361503	100,0377	0,038	361900	100,1115	0,112	-6,753	0,288	0,011
07.12.2017	30	432,353	30,084	30,095	3613,059	3,614	999,636	2,36	13,28	20,19	1,01	24053	6,6548	0,329	361448	100,0393	0,039	361845	100,1127	0,113	-6,720	0,292	0,012
07.12.2017	30	432,387	30,079	30,090	3612,753	3,614	999,632	2,36	13,31	19,88	1,01	24052	6,6551	0,333	361427	100,0420	0,042	361820	100,1139	0,114	-6,691	0,296	0,015
07.12.2017	30	432,435	30,077	30,088	3612,848	3,614	999,627	2,36	13,34	20,06	1,01	24051	6,6546	0,326	361419	100,0371	0,037	361812	100,1086	0,109	-6,656	0,289	0,011
07.12.2017	30	432,465	30,070	30,082	3612,343	3,614	999,623	2,36	13,38	20,07	1,01	24050	6,6552	0,335	361375	100,0389	0,039	361768	100,1100	0,110	-6,622	0,299	0,013
07.12.2017	100	130,513	100,132	100,173	3630,157	3,632	999,598	1,97	13,42	19,93	1,01	24208	6,6659	0,496	363267	100,0692	0,069	363644	100,1329	0,133	-6,578	0,485	0,034
07.12.2017	100	130,477	100,209	100,251	3631,957	3,633	999,586	1,97	13,51	20,11	1,01	24221	6,6661	0,499	363454	100,0711	0,071	363833	100,1340	0,134	-6,487	0,488	0,037
07.12.2017	100	130,484	100,182	100,224	3631,155	3,633	999,579	1,97	13,57	20,20	1,01	24216	6,6661	0,500	363368	100,0695	0,070	363751	100,1328	0,133	-6,430	0,489	0,035
07.12.2017	100	130,495	100,185	100,227	3631,553	3,633	999,573	1,97	13,61	20,07	1,01	24222	6,6670	0,513	363442	100,0789	0,079	363824	100,1414	0,141	-6,389	0,502	0,045
07.12.2017	100	130,335	100,233	100,276	3628,849	3,630	999,570	1,97	13,64	20,00	1,01	24199	6,6656	0,492	363117	100,0640	0,064	363499	100,1261	0,126	-6,364	0,481	0,030
07.12.2017	100	130,404	100,240	100,284	3631,050	3,633	999,566	1,97	13,66	20,29	1,01	24215	6,6660	0,497	363336	100,0636	0,064	363719	100,1256	0,126	-6,336	0,487	0,030
07.12.2017	100	130,468	100,224	100,268	3632,249	3,634	999,565	1,97	13,67	20,12	1,01	24227	6,6671	0,514	363535	100,0854	0,085	363918	100,1472	0,147	-6,325	0,503	0,052
07.12.2017	100	130,376	100,234	100,278	3630,046	3,632	999,561	1,97	13,70	19,98	1,01	24211	6,6667	0,508	363291	100,0789	0,079	363674	100,1404	0,140	-6,300	0,497	0,045
07.12.2017	100	130,383	100,235	100,279	3630,245	3,632	999,560	1,97	13,71	20,20	1,01	24213	6,6669	0,511	363315	100,0800	0,080	363697	100,1412	0,141	-6,293	0,500	0,047
07.12.2017	100	130,506	100,223	100,268	3633,247	3,635	999,558	1,97	13,73	20,21	1,01	24232	6,6666	0,506	363593	100,0738	0,074	363975	100,1347	0,135	-6,273	0,496	0,041
07.12.2017	200	65,858	200,136	200,237	3661,274	3,663	999,496	0,82	13,78	19,98	1,01	24473	6,6809	0,722	366438	100,0848	0,085	366770	100,1250	0,125	-6,217	0,747	0,056
07.12.2017	200	65,805	200,271	200,373	3660,773	3,663	999,492	0,82	13,81	19,89	1,01	24468	6,6804	0,715	366388	100,0849	0,085	366723	100,1255	0,125	-6,189	0,739	0,056
07.12.2017	200	65,769	200,242	200,344	3658,270	3,660	999,489	0,82	13,83	20,05	1,01	24452	6,6806	0,718	366137	100,0847	0,085	366473	100,1254	0,125	-6,168	0,742	0,056
07.12.2017	200	65,853	200,197	200,299	3662,074	3,664	999,487	0,82	13,85	20,30	1,01	24479	6,6810	0,724	366536	100,0897	0,090	366870	100,1295	0,130	-6,154	0,748	0,061
07.12.2017	200	65,878	200,207	200,311	3663,674	3,666	999,485	0,82	13,86	20,50	1,01	24490	6,6811	0,725	366714	100,0946	0,095	367048	100,1342	0,134	-6,139	0,749	0,066
07.12.2017	200	65,887	200,235	200,339	3664,674	3,667	999,482	0,81	13,88	20,54	1,01	24496	6,6809	0,722	366798	100,0902	0,090	367134	100,1300	0,130	-6,120	0,746	0,062
07.12.2017	200	65,910	200,264	200,368	3666,475	3,668	999,480	0,81	13,89	20,30	1,01	24508	6,6809	0,722	366966	100,0869	0,087	367302	100,1264	0,126	-6,106	0,746	0,058
07.12.2017	200	65,716	200,245	200,350	3655,364	3,657	999,479	0,82	13,91	20,03	1,01	24432	6,6804	0,714	365835	100,0817	0,082	366169	100,1208	0,121	-6,093	0,738	0,053
07.12.2017	200	65,801	200,260	200,365	3660,370	3,662	999,476	0,81	13,92	19,89	1,01	24466	6,6805	0,716	366364	100,0893	0,089	366698	100,1281	0,128	-6,076	0,740	0,061
07.12.2017	200	65,926	200,242	200,347	3666,977	3,669	999,475	0,81	13,93	19,79	1,01	24511	6,6807	0,720	367019	100,0876	0,088	367354	100,1264	0,126	-6,067	0,743	0,059

KRISS Laboratory – Day#1

Data report KRISS: Day#1					*Original data set							Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error		
												$K_{V,nom}$	6,633	Pulses/ Liter	$K_{m,nom}$	100,000	Pulses/ kg	$K_{V,nom}$	100,000	Pulses/ Liter	T_{nom}	20	°C
		Laboratory reference					Fluid			Ambient conditions												Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/ Liter]	[%]	[Pulses]	[Pulses/ kg]	[%]	[Pulses]	[Pulses/ Liter]	[%]	[°C]	[%]	[%]
24.01.2018	30	243,371	29,955	29,960	2025,018	2,025	999,818	2,04	10,95	18,70	1,02	13475	6,6530	0,302	202688	100,0919	0,092				-9,050	0,255	0,051
24.01.2018	30	243,552	29,960	29,966	2026,921	2,027	999,817	2,04	10,96	18,70	1,02	13489	6,6537	0,312	202819	100,0626	0,063				-9,040	0,265	0,022
24.01.2018	30	243,293	29,966	29,971	2025,119	2,026	999,812	2,04	11,01	18,60	1,02	13477	6,6537	0,312	202668	100,0771	0,077				-8,990	0,265	0,037
24.01.2018	30	243,555	29,922	29,927	2024,318	2,025	999,808	2,04	11,05	18,60	1,02	13471	6,6533	0,306	202554	100,0604	0,060				-8,950	0,260	0,020
24.01.2018	30	243,712	29,933	29,939	2026,421	2,027	999,805	2,04	11,08	18,60	1,02	13486	6,6538	0,313	202778	100,0671	0,067				-8,920	0,267	0,027
24.01.2018	60	121,687	60,542	60,554	2046,442	2,047	999,795	2,04	11,17	18,60	1,02	13627	6,6575	0,370	204775	100,0639	0,064				-8,830	0,350	0,003
24.01.2018	60	122,071	60,272	60,284	2043,739	2,044	999,794	2,04	11,18	18,60	1,02	13614	6,6599	0,406	204524	100,0735	0,073				-8,820	0,386	0,013
24.01.2018	60	122,571	60,194	60,206	2049,445	2,050	999,794	2,04	11,18	18,60	1,02	13649	6,6585	0,384	205041	100,0471	0,047				-8,820	0,364	-0,013
24.01.2018	60	122,693	60,146	60,158	2049,845	2,050	999,793	2,04	11,19	18,60	1,02	13651	6,6581	0,379	205060	100,0368	0,037				-8,810	0,359	-0,023
24.01.2018	60	122,594	60,188	60,201	2049,645	2,050	999,793	2,04	11,19	18,60	1,02	13654	6,6603	0,411	205113	100,0724	0,072				-8,810	0,391	0,012
24.01.2018	100	74,191	100,817	100,838	2077,674	2,078	999,791	2,04	11,21	18,60	1,02	13845	6,6623	0,442	207763	99,9979	-0,002				-8,790	0,426	-0,051
24.01.2018	100	74,148	100,665	100,686	2073,370	2,074	999,790	2,04	11,22	18,60	1,02	13818	6,6631	0,454	207339	100,0010	0,001				-8,780	0,438	-0,048
24.01.2018	100	73,992	100,794	100,815	2071,668	2,072	999,791	2,04	11,21	18,60	1,02	13810	6,6647	0,478	207244	100,0373	0,037				-8,790	0,462	-0,012
24.01.2018	100	74,072	100,870	100,891	2075,472	2,076	999,791	2,04	11,21	18,60	1,02	13836	6,6650	0,483	207616	100,0331	0,033				-8,790	0,467	-0,016
24.01.2018	100	74,134	100,801	100,822	2075,773	2,076	999,790	2,04	11,22	18,60	1,02	13836	6,6641	0,468	207645	100,0326	0,033				-8,780	0,452	-0,017
24.01.2018	140	79,191	140,631	140,661	3093,538	3,094	999,790	2,04	11,22	18,60	1,02	20635	6,6690	0,542	309413	100,0191	0,019				-8,780	0,562	-0,029
24.01.2018	140	79,480	140,837	140,867	3109,354	3,110	999,789	2,04	11,23	18,60	1,02	20739	6,6685	0,535	310951	100,0050	0,005				-8,770	0,554	-0,043
24.01.2018	140	79,299	140,836	140,866	3102,247	3,103	999,788	2,04	11,24	18,60	1,02	20695	6,6696	0,551	310301	100,0246	0,025				-8,760	0,571	-0,023
24.01.2018	140	79,450	140,799	140,829	3107,353	3,108	999,787	2,04	11,25	18,60	1,02	20727	6,6689	0,541	310769	100,0109	0,011				-8,750	0,561	-0,037
24.01.2018	140	79,212	140,816	140,847	3098,443	3,099	999,785	2,04	11,27	18,60	1,02	20668	6,6690	0,543	309899	100,0176	0,018				-8,730	0,563	-0,030
24.01.2018	180	62,392	180,276	180,309	3124,372	3,125	999,817	2,83	11,32	18,50	1,02	20860	6,6753	0,638	312521	100,0268	0,027				-8,680	0,673	-0,015
24.01.2018	180	62,473	180,399	180,432	3130,578	3,131	999,816	2,83	11,33	18,50	1,02	20902	6,6755	0,641	313140	100,0263	0,026				-8,670	0,676	-0,015
24.01.2018	180	62,451	180,162	180,195	3125,373	3,126	999,816	2,83	11,33	18,50	1,02	20866	6,6751	0,635	312579	100,0133	0,013				-8,670	0,670	-0,028
24.01.2018	180	62,410	180,078	180,111	3121,869	3,122	999,816	2,83	11,33	18,50	1,02	20845	6,6759	0,646	312285	100,0314	0,031				-8,670	0,681	-0,010
24.01.2018	180	62,631	180,393	180,427	3138,387	3,139	999,815	2,83	11,34	18,50	1,02	20953	6,6751	0,635	313912	100,0234	0,023				-8,660	0,670	-0,018
24.01.2018	200	74,869	199,908	199,948	4157,454	4,158	999,799	2,64	11,40	18,50	1,02	27771	6,6785	0,686	415932	100,0449	0,045				-8,600	0,720	0,004
24.01.2018	200	74,633	199,834	199,874	4142,839	4,144	999,800	2,64	11,39	18,50	1,02	27669	6,6774	0,670	414426	100,0343	0,034				-8,610	0,705	-0,007
24.01.2018	200	74,695	199,693	199,734	4143,339	4,144	999,799	2,64	11,40	18,50	1,02	27674	6,6778	0,676	414461	100,0307	0,031				-8,600	0,710	-0,011
24.01.2018	200	74,835	199,661	199,701	4150,447	4,151	999,800	2,64	11,39	18,50	1,02	27727	6,6792	0,696	415205	100,0386	0,039				-8,610	0,731	-0,003
24.01.2018	200	74,815	199,482	199,522	4145,642	4,146	999,800	2,64	11,39	18,50	1,02	27695	6,6792	0,696	414738	100,0419	0,042				-8,610	0,731	0,001

KRISS Laboratory – Day#2

Data report KRISS: Day#2

*Original data set

Turbine meter: $K_{V,nom}$ = 6,633 Pulses/ Liter; Coriolis_Mass: $K_{m,nom}$ = 100,000 Pulses/ kg; Coriolis_Vol: $K_{V,nom}$ = 100,000 Pulses/ Liter

Temperature correction of meter error: T_{nom} = 20 °C

		Laboratory reference					Fluid			Ambient conditions		Turbine meter			Coriolis_Mass			Coriolis_Vol				Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/ Liter]	[%]	[Pulses]	[Pulses/ kg]	[%]	[Pulses]	[Pulses/ Liter]	[%]	[°C]	[%]	[%]
02.02.2018	30	242,151	30,087	30,097	2023,782	2,024	999,779	2,04	11,32	23,30	1,00	13470	6,6537	0,313	202499	100,0597	0,060	202655	100,1049	0,105	-8,680	0,267	0,021
02.02.2018	30	242,314	30,110	30,120	2026,685	2,027	999,775	2,04	11,36	23,30	1,00	13491	6,6545	0,325	202788	100,0590	0,059	202941	100,1022	0,102	-8,640	0,280	0,021
02.02.2018	30	241,914	30,127	30,137	2024,483	2,025	999,774	2,04	11,37	23,30	1,00	13477	6,6549	0,330	202570	100,0601	0,060	202720	100,1018	0,102	-8,630	0,284	0,022
02.02.2018	30	241,916	30,131	30,141	2024,783	2,025	999,772	2,04	11,39	23,30	1,00	13476	6,6534	0,307	202585	100,0527	0,053	202735	100,0942	0,094	-8,610	0,262	0,015
02.02.2018	30	242,034	30,127	30,137	2025,484	2,026	999,769	2,04	11,42	23,30	1,00	13483	6,6545	0,324	202683	100,0664	0,066	202833	100,1076	0,108	-8,580	0,279	0,029
02.02.2018	60	122,713	59,953	59,973	2043,603	2,044	999,763	2,04	11,47	23,30	1,00	13614	6,6595	0,400	204485	100,0610	0,061	204631	100,0990	0,099	-8,530	0,381	0,003
02.02.2018	60	122,630	60,005	60,025	2044,003	2,045	999,762	2,04	11,48	23,30	1,00	13618	6,6602	0,410	204536	100,0664	0,066	204683	100,1047	0,105	-8,520	0,391	0,009
02.02.2018	60	122,655	60,072	60,092	2046,706	2,047	999,761	2,04	11,49	23,30	1,00	13634	6,6592	0,395	204762	100,0447	0,045	204909	100,0828	0,083	-8,510	0,376	-0,013
02.02.2018	60	122,453	60,124	60,144	2045,104	2,046	999,761	2,04	11,49	23,30	1,00	13625	6,6600	0,407	204625	100,0560	0,056	204771	100,0937	0,094	-8,510	0,389	-0,002
02.02.2018	60	122,434	60,142	60,163	2045,405	2,046	999,759	2,04	11,51	23,30	1,00	13625	6,6590	0,392	204639	100,0482	0,048	204785	100,0857	0,086	-8,490	0,374	-0,009
02.02.2018	100	75,171	99,581	99,615	2079,340	2,080	999,757	2,04	11,53	23,30	1,00	13864	6,6652	0,486	208011	100,0370	0,037	208153	100,0713	0,071	-8,470	0,471	-0,010
02.02.2018	100	74,950	99,615	99,649	2073,934	2,075	999,758	2,04	11,52	23,30	1,00	13828	6,6653	0,486	207487	100,0451	0,045	207629	100,0796	0,080	-8,480	0,471	-0,002
02.02.2018	100	75,249	99,569	99,603	2081,242	2,082	999,757	2,04	11,53	23,30	1,00	13876	6,6649	0,481	208190	100,0316	0,032	208331	100,0653	0,065	-8,470	0,466	-0,016
02.02.2018	100	74,975	99,515	99,549	2072,533	2,073	999,754	2,04	11,55	23,30	1,00	13819	6,6654	0,488	207337	100,0404	0,040	207479	100,0746	0,075	-8,450	0,473	-0,007
02.02.2018	100	75,115	99,584	99,618	2077,838	2,079	999,753	2,04	11,56	23,30	1,00	13850	6,6633	0,457	207800	100,0078	0,008	207942	100,0417	0,042	-8,440	0,441	-0,039
02.02.2018	140	79,272	140,740	140,789	3099,083	3,100	999,752	2,04	11,57	23,30	1,00	20676	6,6694	0,548	309986	100,0251	0,025	310188	100,0557	0,056	-8,430	0,567	-0,021
02.02.2018	140	79,332	140,765	140,814	3101,986	3,103	999,750	2,04	11,59	23,30	1,00	20692	6,6683	0,531	310205	100,0021	0,002	310407	100,0325	0,032	-8,410	0,551	-0,044
02.02.2018	140	79,312	140,704	140,753	3099,884	3,101	999,748	2,04	11,61	23,30	1,00	20680	6,6689	0,541	310040	100,0167	0,017	310242	100,0469	0,047	-8,390	0,560	-0,029
02.02.2018	140	79,475	140,662	140,711	3105,289	3,106	999,748	2,04	11,61	23,30	1,00	20717	6,6692	0,546	310572	100,0139	0,014	310775	100,0443	0,044	-8,390	0,565	-0,032
02.02.2018	140	79,535	140,614	140,664	3106,591	3,108	999,747	2,04	11,62	23,30	1,00	20723	6,6683	0,532	310687	100,0090	0,009	310893	100,0402	0,040	-8,380	0,552	-0,036
02.02.2018	180	62,774	179,617	179,681	3132,013	3,133	999,777	2,83	11,69	23,90	1,00	20921	6,6773	0,668	313322	100,0385	0,039	313518	100,0653	0,065	-8,310	0,702	-0,001
02.02.2018	180	62,973	179,639	179,704	3142,323	3,143	999,777	2,83	11,69	23,90	1,00	20986	6,6761	0,650	314325	100,0295	0,029	314524	100,0570	0,057	-8,310	0,683	-0,010
02.02.2018	180	62,753	179,465	179,529	3128,309	3,129	999,775	2,83	11,70	23,90	1,00	20888	6,6747	0,629	312850	100,0061	0,006	313047	100,0331	0,033	-8,300	0,662	-0,034
02.02.2018	180	62,950	179,526	179,591	3139,220	3,140	999,773	2,83	11,72	23,90	1,00	20962	6,6750	0,634	313951	100,0092	0,009	314152	100,0371	0,037	-8,280	0,667	-0,030
02.02.2018	180	62,892	179,377	179,442	3133,715	3,135	999,773	2,83	11,72	23,90	1,00	20929	6,6762	0,652	313466	100,0302	0,030	313666	100,0578	0,058	-8,280	0,685	-0,009
02.02.2018	200	74,851	199,249	199,322	4142,750	4,144	999,761	2,64	11,75	23,90	1,00	27682	6,6796	0,703	414407	100,0319	0,032	414655	100,0552	0,055	-8,250	0,736	-0,008
02.02.2018	200	75,074	198,873	198,946	4147,255	4,149	999,759	2,64	11,77	23,90	1,00	27711	6,6793	0,698	414840	100,0276	0,028	415093	100,0519	0,052	-8,230	0,731	-0,012
02.02.2018	200	75,031	198,915	198,988	4145,753	4,147	999,759	2,64	11,77	23,90	1,00	27699	6,6788	0,691	414677	100,0245	0,025	414926	100,0479	0,048	-8,230	0,724	-0,015
02.02.2018	200	75,070	199,095	199,168	4151,659	4,153	999,758	2,64	11,78	23,90	1,00	27742	6,6797	0,704	415305	100,0335	0,033	415554	100,0566	0,057	-8,220	0,737	-0,006
02.02.2018	200	74,893	198,930	199,003	4138,446	4,140	999,758	2,64	11,78	23,90	1,00	27655	6,6800	0,709	414025	100,0436	0,044	414265	100,0648	0,065	-8,220	0,742	0,004

KRISS Laboratory – Day#3

Data report KRISS: Day#3					*Original data set							Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error		
												$K_{V,nom}$	6,633	Pulses/ Liter	$K_{m,nom}$	100,000	Pulses/ kg	$K_{V,nom}$	100,000	Pulses/ Liter	T_{nom}	20	°C
		Laboratory reference					Fluid			Ambient conditions												Corrected meter error	
Date	Nominal flowrate	Measu-rement time	Standard mass flowrate	Standard volume flowrate	Mass	Volume	Water density	Line pressure	Water temp.	Air temp.	Air pressure	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	Pulse count	K-factor	Meter error	(T_{fluid} - T_{nom})	Turbine meter	Coriolis _Mass
	V^*_{nom}	t	m^*_{ref}	V^*_{ref}	m_{ref}	V_{ref}	ρ_{fluid}	p_{fluid}	T_{fluid}	T_{air}	p_{Air}	N	K_V	e_V	N	K_m	e_m	N	K_V	e_V	ΔT_{fluid}	$e_{V,cor}$	$e_{m,cor}$
	[m³/h]	[s]	[t/h]	[m³/h]	[kg]	[m³]	[kg/m³]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/ Liter]	[%]	[Pulses]	[Pulses/ kg]	[%]	[Pulses]	[Pulses/ Liter]	[%]	[°C]	[%]	[%]
30.01.2018	30	242,556	30,088	30,092	2027,200	2,027	999,865	2,04	10,47	21,30	1,00	13495	6,6561	0,348	202872	100,0750	0,075				-9,530	0,299	0,031
30.01.2018	30	242,175	30,098	30,102	2024,697	2,025	999,863	2,04	10,49	21,30	1,00	13477	6,6554	0,338	202616	100,0722	0,072				-9,510	0,289	0,029
30.01.2018	30	242,177	30,108	30,112	2025,398	2,026	999,861	2,04	10,52	21,30	1,00	13481	6,6550	0,332	202669	100,0638	0,064				-9,480	0,283	0,021
30.01.2018	30	241,933	30,104	30,108	2023,096	2,023	999,859	2,04	10,54	21,30	1,00	13466	6,6552	0,335	202452	100,0704	0,070				-9,460	0,286	0,027
30.01.2018	30	243,052	30,090	30,094	2031,505	2,032	999,856	2,04	10,57	21,30	1,00	13520	6,6542	0,320	203275	100,0613	0,061				-9,430	0,271	0,018
30.01.2018	30	242,491	30,099	30,103	2027,400	2,028	999,854	2,04	10,59	21,30	1,00	13493	6,6543	0,322	202840	100,0493	0,049				-9,410	0,273	0,006
30.01.2018	30	242,356	30,109	30,114	2027,000	2,027	999,851	2,04	10,62	21,30	1,00	13491	6,6547	0,326	202814	100,0562	0,056				-9,380	0,278	0,014
30.01.2018	30	242,115	30,107	30,111	2024,798	2,025	999,849	2,04	10,64	21,30	1,00	13475	6,6540	0,316	202578	100,0485	0,049				-9,360	0,268	0,006
30.01.2018	30	242,194	30,109	30,113	2025,599	2,026	999,846	2,04	10,67	21,30	1,00	13479	6,6533	0,306	202656	100,0475	0,047				-9,330	0,258	0,005
30.01.2018	30	242,096	30,099	30,103	2024,097	2,024	999,844	2,04	10,69	21,30	1,00	13473	6,6553	0,336	202545	100,0668	0,067				-9,310	0,287	0,025
30.01.2018	100	74,433	100,319	100,335	2074,170	2,074	999,842	2,04	10,71	18,90	1,00	13827	6,6652	0,486	207504	100,0420	0,042				-9,290	0,468	-0,011
30.01.2018	100	74,331	100,302	100,318	2070,966	2,071	999,842	2,04	10,71	18,90	1,00	13805	6,6649	0,481	207161	100,0311	0,031				-9,290	0,464	-0,022
30.01.2018	100	74,232	100,425	100,441	2070,766	2,071	999,840	2,04	10,73	18,90	1,00	13798	6,6622	0,440	207069	99,9963	-0,004				-9,270	0,422	-0,056
30.01.2018	100	74,653	100,265	100,281	2079,175	2,080	999,839	2,04	10,74	18,90	1,00	13855	6,6626	0,447	207929	100,0055	0,006				-9,260	0,429	-0,047
30.01.2018	100	74,537	100,197	100,214	2074,570	2,075	999,839	2,04	10,74	18,90	1,00	13830	6,6654	0,488	207543	100,0414	0,041				-9,260	0,471	-0,011
30.01.2018	100	74,492	100,312	100,328	2075,668	2,076	999,838	2,04	10,75	19,20	1,00	13836	6,6647	0,478	207635	100,0328	0,033				-9,250	0,461	-0,020
30.01.2018	100	74,691	100,300	100,317	2080,974	2,081	999,838	2,04	10,75	19,20	1,00	13871	6,6645	0,476	208157	100,0286	0,029				-9,250	0,458	-0,024
30.01.2018	100	74,531	100,302	100,318	2076,569	2,077	999,837	2,04	10,76	19,20	1,00	13842	6,6647	0,478	207713	100,0270	0,027				-9,240	0,461	-0,025
30.01.2018	100	74,676	100,282	100,299	2080,173	2,081	999,836	2,04	10,77	19,20	1,00	13865	6,6642	0,471	208041	100,0114	0,011				-9,230	0,453	-0,041
30.01.2018	100	74,392	100,204	100,220	2070,663	2,071	999,834	2,04	10,79	19,20	1,00	13800	6,6634	0,459	207095	100,0139	0,014				-9,210	0,441	-0,038
30.01.2018	200	74,389	200,329	200,354	4139,534	4,140	999,874	2,89	10,80	18,50	1,00	27656	6,6801	0,710	414111	100,0381	0,038				-9,200	0,748	-0,006
30.01.2018	200	74,395	200,391	200,418	4141,136	4,142	999,865	2,89	10,88	18,50	1,00	27666	6,6799	0,707	414250	100,0329	0,033				-9,120	0,744	-0,011
30.01.2018	200	74,735	200,410	200,437	4160,456	4,161	999,866	2,89	10,87	18,50	1,00	27792	6,6791	0,696	416146	100,0241	0,024				-9,130	0,733	-0,020
30.01.2018	200	74,935	200,034	200,061	4163,760	4,164	999,865	2,89	10,88	18,50	1,00	27814	6,6791	0,695	416469	100,0223	0,022				-9,120	0,733	-0,022
30.01.2018	200	74,436	200,116	200,143	4137,733	4,138	999,864	2,89	10,89	18,50	1,00	27642	6,6796	0,702	413903	100,0313	0,031				-9,110	0,739	-0,012
30.01.2018	200	74,415	200,036	200,063	4134,930	4,135	999,863	2,89	10,90	18,50	1,00	27625	6,6800	0,708	413649	100,0377	0,038				-9,100	0,745	-0,006
30.01.2018	200	74,631	200,008	200,035	4146,342	4,147	999,862	2,89	10,91	18,50	1,00	27699	6,6794	0,700	414735	100,0243	0,024				-9,090	0,737	-0,019
30.01.2018	200	74,634	199,904	199,932	4144,340	4,145	999,862	2,89	10,91	18,50	1,00	27686	6,6795	0,701	414571	100,0331	0,033				-9,090	0,738	-0,011
30.01.2018	200	74,835	199,797	199,824	4153,249	4,154	999,860	2,89	10,93	18,50	1,00	27746	6,6796	0,703	415457	100,0318	0,032				-9,070	0,740	-0,012
30.01.2018	200	74,436	199,972	200,000	4134,730	4,135	999,859	2,89	10,94	18,50	1,00	27620	6,6791	0,694	413572	100,0239	0,024				-9,060	0,731	-0,020

10.3 Additional documents

Declaration of NEL

National Engineering Laboratory

Report from TÜV SÜD National Engineering Laboratory regarding Key Comparison CCM.FF-K1.2015

TÜV SÜD National Engineering Laboratory
East Kilbride
Glasgow
G75 0QF

27/02/2020

In 2015, TÜV SÜD National Engineering Laboratory (NEL) participated in the key comparison CCM.FF-K1.2015 for water flow which was led by Physikalisch-Technische Bundesanstalt (PTB). This comparison followed on from EURAMET Project No. E 1201 between PTB and NEL and was completed in 2011 over comparable conditions with similar test meters. The results from EURAMET Project No. E 1201 were satisfactory and provided verification of NEL's water flow facility Calibration and Measurement Capability (CMC) value of 0.10 % (k=2).

Unfortunately, due to unexpected technical problems with the data collection system during the CCM.FF-K1.2015 key comparison, the results were deemed to be unacceptable. Whilst the test data recorded at NEL by PTB's own logging system indicated acceptable results, regrettably NEL's measurement system did not. As such, NEL have decided to withdraw from key comparison CCM.FF-K1.2015 due to technical issues during the calibrations which have proven impossible to rectify retrospectively. NEL will seek to participate in future water flow comparisons to maintain verification of our CMC.

10.4 Comparison results - based on Reynolds number

Submitted by KRISS (Dr. Sejong Chun) in January 2021

Use of weighted linear regression to investigate the relationship between Re and meter error

For a research purpose, two kinds of linear regressions (linear regression and weighted linear regression) were applied to the data of Draft A report (Appendix 10.2). Input parameter: nominal diameter of pipe, reference flow rate, fluid temperature and density, viscosity, temperature corrected meter error e_{corr} of turbine meter and Coriolis meter. Based on these data set, Reynolds numbers were calculated. A weighted linear regression using MATLAB was applied to the results.

The first step was to use Deming's linear regression, obtained from MATLAB Centrals and NCSS software manual. The parameter λ was so small that the Deming's linear regression was not meaningful. So, λ was defined as the variance of meter error divided by the variance of Reynolds number. The value of λ was in order of 10 to the minus 8$^{\mathrm{th}}$ to 10$^{\mathrm{th}}$ in this case.

The Deming's linear regression was changed into normal linear regression by letting λ equal to 1. Instead, the weighting factor was introduced, based on the definition of key comparison reference value and its uncertainty (Section 5.3).

$$w_i = \frac{\dfrac{1}{u_{\mathrm{CMC},i}^2}}{\left(\dfrac{1}{u_{\mathrm{CMC},1}^2} + \dfrac{1}{u_{\mathrm{CMC},2}^2} + \cdots + \dfrac{1}{u_{\mathrm{CMC},i}^2} + \cdots + \dfrac{1}{u_{\mathrm{CMC},N}^2}\right)} \tag{1}$$

$u_{\mathrm{CMC},i}$ was the calibration and measurement capability (CMC) of a participating laboratory. w_i was the weighting factor of the participating laboratory. In other words, the weighting factor was the normalized value of a reciprocal of squared CMC's. At first, all the reciprocals of squared CMC's were collected. After that, the reciprocals were normalized by summing to 1.

The uncertainty of the linear regression and the weighted linear regression was calculated as follows:

If $y = ax + b$ is sought, then its standard uncertainty (type B) is $u(\delta y) = a\,u(\delta x)$.

At first, $u(y) = \sqrt{a^2u^2(x) + x^2u^2(a) + u^2(b)}$ was assumed. However, there was a problem that $u(y)$ was indefinitely increasing while x was increasing. Instead, the mathematical expression was rearranged as $y = y_0 + a\,\delta x$, $y_0 = a\,x_0 + b$, and $\delta x = x - x_0$. After that, $u(y) = \sqrt{u^2(y_0) + a^2u^2(\delta x)}$ was calculated, followed by definitions of $u(y)$ as the standard uncertainty by meter error (u_{A}), and $a\,u(\delta x)$ as the standard uncertainty by linear regression or weighted linear regression (u_{B}). The term of $a\,u(\delta x)$ was set as the standard uncertainty of KCRV (u_{KCRV}).

Finally, the weighted linear regression could be used as KCRV in case that all the measurement data were arranged as a function of Reynolds number. The results of E_{N} numbers were similar with the original data suggested in the Draft A report as follows.

Turbine flowmeter

Figure 1: Scatter of linear regression and weighted linear regression between Reynolds number and temperature corrected meter error for turbine meter

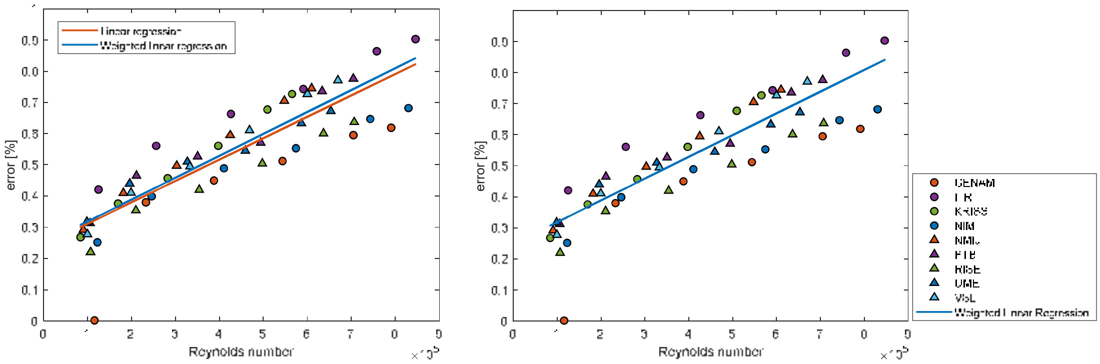


Table 1: Summary of E_N-values of each participating laboratory for turbine meter - based on weighted linear regression between Reynolds number and temperature corrected meter error for Turbine meter

Red color: Non-compliance

Orange color: Warning level

Blue color: Inconclusiveness

Nominal flowrate	30 m³/h		60 m³/h		100 m³/h		140 m³/h		180 m³/h		200 m³/h	
NMI	E_N	u_{comp}/u_{CMC}	E_N	u_{comp}/u_{CMC}	E_N	u_{comp}/u_{CMC}	E_N	u_{comp}/u_{CMC}	E_N	u_{comp}/u_{CMC}	E_N	u_{comp}/u_{CMC}
CENAM	-1.29	6.57	-0.15	5.58	-0.34	5.37	-0.58	5.27	-0.74	5.16	-0.91	5.21
ITRI	0.34	6.20	0.61	5.30	0.56	5.10	0.39	5.00	0.42	4.91	0.30	4.95
KRISS	-0.16	4.14	0.04	3.54	0.05	3.41	0.16	3.34	0.35	3.28	0.40	3.30
NIM	-0.33	4.96	-0.10	4.24	-0.23	4.08	-0.48	4.00	-0.61	3.92	-0.73	3.96
NMIJ	-0.08	5.91	0.16	5.05	0.17	4.86	0.24	4.77	0.36	4.67	0.34	4.72
PTB	-0.04	12.41	0.32	10.60	0.16	10.20	-0.06	16.13	0.22	9.80	0.17	9.90
RISE	-0.41	4.13	-0.19	3.53	-0.36	3.40	-0.45	3.33	-0.46	3.27	-0.52	3.30
UME	0.00	3.56	0.24	3.05	0.15	2.93	-0.12	2.87	-0.13	2.85	-0.16	2.83
VSL	-0.16	5.51	0.11	4.71	0.06	4.53	0.17	4.45	0.29	4.36	0.26	4.40

Coriolis Mass flowmeter

Figure 2: Scatter of linear regression and weighted linear regression between Reynolds number and temperature corrected meter error for Coriolis_Mass meter

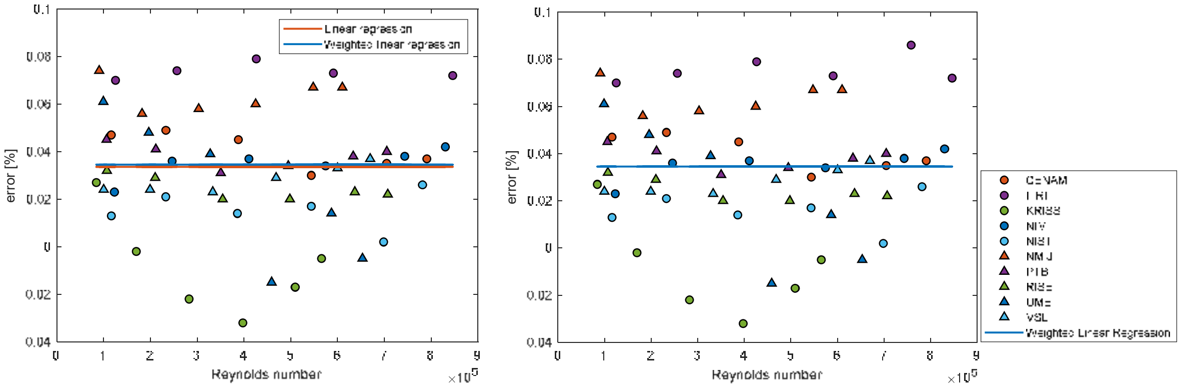


Table 2: Summary of E_N-values of each participating laboratory for Coriolis_Mass meter – based on weighted linear regression between Reynolds number and temperature corrected meter error for Coriolis_Mass meter
Red color: Non-compliance
Orange color: Warning level
Blue color: Inconclusiveness

Nominal flowrate	30 t/h		60 t/h		100 t/h		140 t/h		180 t/h		200 t/h	
NMI	E_N	u_{comp}/u_{CMC}	E_N	u_{comp}/u_{CMC}	E_N	u_{comp}/u_{CMC}	E_N	u_{comp}/u_{CMC}	E_N	u_{comp}/u_{CMC}	E_N	u_{comp}/u_{CMC}
CENAM	0.23	1.49	0.37	0.81	0.29	0.68	-0.13	0.60	0.02	0.54	0.08	0.47
ITRI	0.59	1.11	0.85	0.60	0.99	0.51	0.86	0.48	1.16	0.44	0.88	0.37
KRISS	-0.10	0.76	-0.54	0.46	-0.83	0.44	-1.04	0.33	-0.80	0.34	-0.63	0.26
NIM	-0.17	0.89	0.03	0.49	0.05	0.41	-0.01	0.36	0.07	0.32	0.14	0.28
NIST	-0.34	1.69	-0.29	1.01	-0.41	1.03	-0.33	1.12	-0.44	1.65	-0.25	0.50
NMIJ	0.64	1.06	0.44	0.58	0.50	0.49	0.54	0.47	0.72	0.38	0.71	0.37
PTB	0.21	2.22	0.20	1.23	-0.12	1.00	-0.02	0.91	0.13	0.81	0.22	0.71
RISE	-0.03	0.55	-0.07	0.31	-0.18	0.25	-0.18	0.23	-0.14	0.20	-0.15	0.18
UME	0.30	0.72	0.17	0.49	0.06	0.37	-0.65	0.36	-0.28	0.25	-0.54	0.25
VSL	-0.20	1.48	-0.37	1.61	-0.46	1.34	-0.23	1.21	-0.07	1.07	0.12	0.95