Final report

SIM.M.FF-S9.2016

Water flow: 10 m³/h … 130 m³/h

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1 Summary

The objective of the Supplementary Comparison (SC) SIM.M.FF-S9 for water flow measurement was to support and prove the Calibration and Measurement Capabilities (CMC) of the participating NMIs of Chile (CISA), Peru (INACAL), Bolivia (IBMETRO) and Argentina (INTI). As pilot laboratories, the national metrology institutes of Germany (PTB) and CENAM (Mexico) supported the comparison with reference values. The comparison was organized as a single round robin, started in January 2016 at PTB and finished in August 2019, also at PTB. A combined setup of a turbine meter and Coriolis meter was used as a transfer standard. The nominal calibration conditions of the SC were defined in the flow range between 10 m³/h and 130 m³/h, 20 °C fluid temperature and 3 bar line pressure.

In order to estimate the uncertainties u_{TS}, both transfer meter were subjected to extensive characterisation measurements at pilot laboratory PTB. The following parameters were researched in detail: fluid temperature, line pressure, reproducibility, flow stability and meter sensitivity to different inflow conditions. The E_{N} values for turbine meter were calculated based on PTB data, only. The E_{N} values for Coriolis meter are partly linked to Key Comparison CCM.FF-K1.2015 and were calculated by using a common reference value of PTB and CENAM data.

The uncertainty of turbine meter u_{TS} was clearly dominated by the sensitivity to disturbed inflow conditions which leads to large values of u_{TS} with > 0.20 %. Beside one calibration, all labs passed the E_{N} criteria of ≤ 1.20. But, due to large values of u_{TS}, the calibrations for all labs were evaluated as inconclusive. The evaluation criteria $u_{\mathrm{comp}}/u_{\mathrm{base}}$ exceeded the critical value of 2.00 for all calibrations. Finally, the turbine meter was not suitable for a confirmation of the submitted CMC values.

The calibration results of Coriolis meter were characterized by a strong dependency on zero setting. The observed effect was adjusted for the data of both reference laboratories by introducing a new method for autozero correction. Maximum uncertainty values for Coriolis u_{TS} were estimated with 0.069 % at low flowrates and 0.033 % at high flowrates. Beside two calibrations, all laboratories complied with the E_{N} criteria of < 1.20. In contrast to turbine meter, the evaluation criteria $u_{\mathrm{comp}}/u_{\mathrm{base}}$ exceeded the critical value of 2.00 at one calibration, only. In consequence, the calibrations by using Coriolis meter were suitable for a confirmation of the submitted CMC values.

In summary, the comparison was successfully finished for a confirmation of the submitted CMC values, related to mass calibrations. For volume related CMC`s this comparison was not suitable.

Acknowledgements

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

A special thank goes to Carl Felix Wolff - (PTB - International Cooperation Department) who supported the comparison by his organizing and his maintaining contact with the partners.

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2 Introduction and objective

The objective of the Supplementary Comparison SIM.M.FF-S9 for water flow measurement was to support and prove the Calibration and Measurement Capabilities (CMC) of the participating National Metrology Institutes as part of the CIPM MRA (http://kcdb.bipm.org).

The CMC-values of participating laboratories (Table 1) were evaluated by establishing a "Supplementary Comparison Reference Value" (*SCRV*) and the Degree of Equivalence (E_N) between laboratories and *SCRV*.

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 transfer meters, 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)

3 Participants and measurement schedule

Participant list and measurement schedule are presented in Table 1. After three years of preparation, the comparison officially started in January 2016.

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

NMI	Country	RMO	Contact	Calibration period
PTB*	Germany	EURAMET	enrico.frahm@ptb.de	13.01. - 15.01.2016
CISA	Chile	SIM	j.vargas@ci-sa.com	28.04. – 04.05.2016
INACAL	Peru	SIM	cochoa@inacal.gob.pe	13.03. – 16.03.2017
IBMETRO	Bolivia	SIM	fespejo@ibmetro.org	01.03. – 05.03.2018
INTI	Argentina	SIM	marsil@inti.gob.ar	06.12. – 14.12.2018
CENAM*	Mexico	SIM	rarias@cenam.mx	03.06. – 05.06.2019
PTB*	Germany	EURAMET	enrico.frahm@ptb.de	08.08. – 12.08.2019

4 Description of the transfer standard

4.1 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 pilot laboratory (PTB):

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

In order 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 this SC [1].

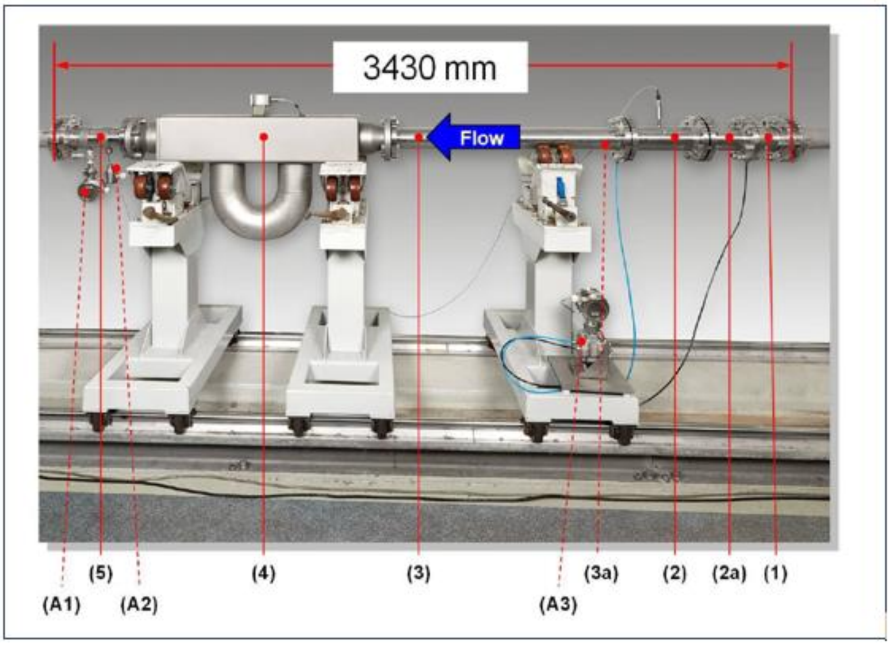


Figure 1: Transfer meter setup and pipework - Sample installation at pilot laboratory

(1) Inlet pipe section	(2) Turbine meter
(2a) Tube-bundle flow conditioner dedicated to the turbine	
(3) Connecting pipe section	(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

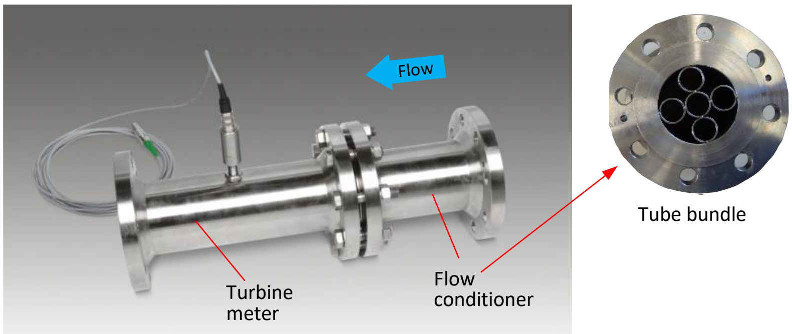


Figure 2: Transfer meter #1 - Turbine meter, DN80 mm

Figure 3: Transfer meter #2 - Coriolis flowmeter, DN80 mm

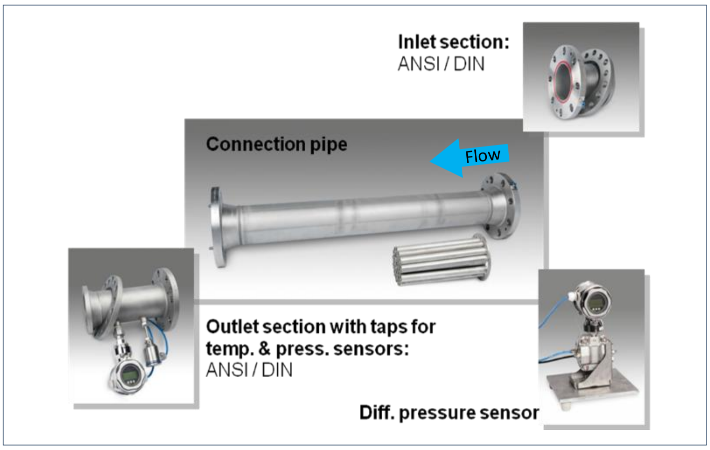


Figure 4: Transfer setup – pipework

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

Manufacturer:	KEM Küppers Elektromechanik GmbH	Germany
Type:	HM 080.71.FDE040-TS15-D	
Serial No.:	01130721	
Pipe size:	DN80	Nominal: 80 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: $K_{V,nom}$	11.4850 pulses/L
Additional equipment:	Tube-bundle flow conditioner	Permanently installed at the inflow to meter

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

Manufacturer:	Rota Yokogawa GmbH & Co KG	Germany
Type:	ROTAMASS	
Serial No.:	D1K601386 (flow sensor) D1K601375 (flow transmitter and indicator)	
Pipe size:	DN80	Nominal: 80 mm
Signal output #1:	Mass-flowrate related: frequency	0 kHz … 10 kHz
	Nominal meter K-factor: $K_{m,nom}$	144.056 pulses/kg
Signal output #2:	Volume-flowrate related: frequency	0 kHz … 10 kHz
	Nominal meter K-factor: $K_{V,nom}$	28.800 pulses/L
Signal output #3:	Fluid density: current signal	4 mA … 20 mA

4.2 Additional data logging

For the reported SC an additional datalogging system was designed. Beside standard impulse logging of the laboratory, an electronic device was provided by the pilot laboratory (PTB) for a separate and independent data recording. Basically, electric pulses from transfer meters and additional process parameter, measured by the auxiliary devices (chapter 4.1), were logged by the electronic box (Figure 5). Also, power supply of the measurement instruments was provided by the box. The detailed use of the electronic box is described in SC Technical Protocol [1].

The electronic box was developed as a parallel working system, which does not affect the standard impulse count recording of the laboratories.

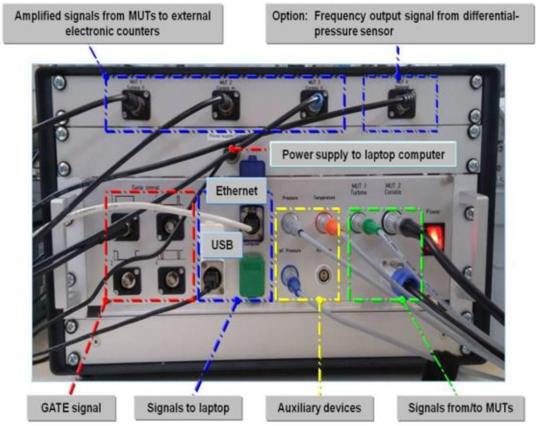


Figure 5: Front side of the electronic box - Connectivity to MUTs, external electronic counters and laptop computer

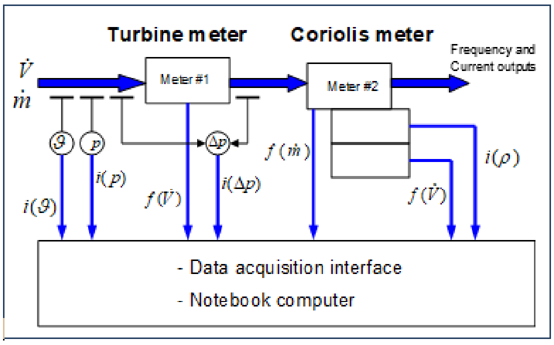


Figure 6: Electronic box - signal acquisition

5 Measurement program

5.1 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 SC reference conditions.

SC reference conditions:

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 SC setup (Figure 1).

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

Calibration day	Main task	Preparations before calibration	Autozero setting at Coriolis meter	Repeated measure-ments	Nominal flowrate	Post-processing
					m³/h	
Day #1	Lab-to-lab reproducibility	Installation of transfer meters	yes	5	10, 30, 60, 100, 130	Transfer package remains in calibration line
Day #2	Main calibration of KC1 and Day-to-day reproducibility	-	no	5	10, 30, 60, 100, 130	Transfer package remains in calibration line
Day #3	Repeatability at selected flowrates	-	no	10	30, 60, 130	Transfer package is removed from calibration line

5.2 Calibration methods and uncertainties of participating laboratories

During SC 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 11.1.) All laboratories had an independent traceability in realization of their standards.

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

NMI/DI	Country	Calibration method and reference	CMC Water CIPM MRA Database (*k* = 2)	
			U(Mass)	*U*(Volume)
			%	%
PTB	Germany	Gravimetric / flying-start-stop	0.020	0.020
CISA	Chile	Gravimetric / flying-start-stop	0.150	0.150
INACAL	Peru	Gravimetric / flying-start-stop	0.076	0.076
IBMETRO	Bolivia	Master meter / flying-start-stop	0.100	0.100
INTI	Argentina	Volumetric tank / standing-start-stop (10 m³/h until 60 m³/h) Master meter / standing-start-stop (100 m³/h until 130 m³/h)	0.070 0.220	0.060 0.200
CENAM	Mexico	Gravimetric / flying-start-stop	0.030	0.038

5.3 Meter characterisation at pilot laboratory (PTB)

The transfer setup was subjected to extensive characterisation measurements at pilot laboratory (Table 6). These calibrations were made under clearly defined conditions, which are basically derived from SC reference conditions (Chapter 5.1). The goal of the characterisation measurements was to analyze the impact of the following parameters to transfer meter setup: fluid temperature, line pressure and reproducibility. The results aimed in a detailed knowledge about meter uncertainties u_{TS}.

Additionally, a strong dependency of turbine meter characteristics to different inflow condition was assumed (Chapter 7.6). In order to consider this type of effects, data of KC1 calibrations were used within the presented SC report. During KC1 calibration an identical turbine meter was used, but with an inner diameter of 100 mm instead of 80 mm. For a simulation of real inflow conditions, the KC1 transfer setup was calibrated with several flow disturber (Figure 7) and different inflow lengths (Figure 8).

Table 6: Characterisation measurements at pilot laboratory

Task of calibrations	Nominal flowrate	Temperature	Line pressure	Repeated measu-rements	Measurement periods at pilot laboratory
	m³/h	°C	bar		
Temperature dependency	10, 30, 60, 100, 130, 150	10, 15, 20, 25, 30	3	5	16.06.2015 - 02.07.2015
Pressure dependency	10, 30, 60, 100, 130, 150	20	2, 3, 4	5	01.09.2015 - 03.09.2015
Long term reproducibility	10, 30, 60, 100, 130	20	3	5	25.11.2015
Inflow conditions (with DN100 setup of KC1)	30, 100, 200	20	3	5	03/2019 during KC1 calibrations

Figure 7: Used flow disturber for meter characterisation during KC1 - inner pipe diameter: 100 mm

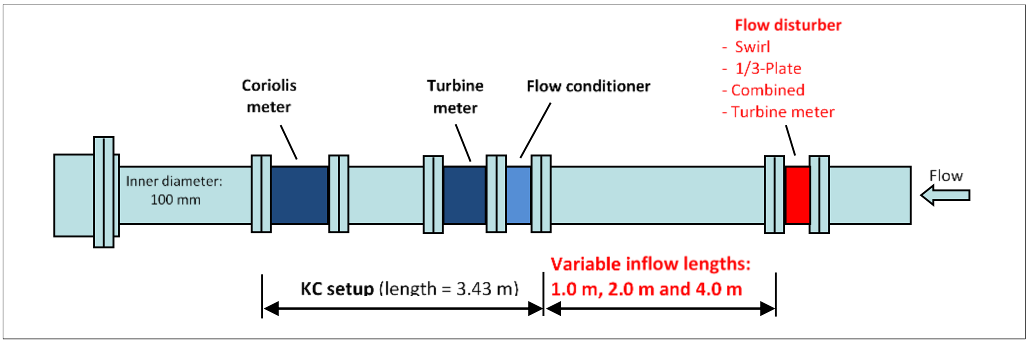


Figure 8: Calibration setup for meter characterisation during KC1 using several flow disturber and inflow lengths

6 Data calculation and evaluation criteria

6.1 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.

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

$$K_m = \frac{N}{m_{ref}} \tag{2}$$

where		
	K_{V}	- *K*-factor of turbine meter (pulses/L)
	K_{m}	- *K*-factor of Coriolis meter (pulses/kg)
	N	- Counted number of pulses by 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:

$$e_{\mathrm{V}} = \frac{K_{\mathrm{V}} - K_{\mathrm{V,nom}}}{K_{\mathrm{V,nom}}} \cdot 100\ \% \tag{3}$$

$$e_{\mathrm{m}} = \frac{K_{\mathrm{m}} - K_{\mathrm{m,nom}}}{K_{\mathrm{m,nom}}} \cdot 100\ \% \tag{4}$$

where		
	e_{V}	- Relative measurement error of turbine meter – volume (%)
	e_{m}	- Relative measurement error of Coriolis meter - mass (%)
	$K_{\mathrm{V,nom}}$	- Nominal *K*-factor of turbine meter (pulses/L)
	$K_{\mathrm{m,nom}}$	- Nominal *K*-factor of Coriolis meter - mass output (pulses/kg)

6.2 Postprocessing of reported data and estimation of relative meter error x_i

Autozero correction of Coriolis data

The data of Coriolis meter were characterized by a strong drift in meter error. Especially at low flowrates, the meter showed differences of up to 1.33 % between calibration periods 2016 and 2019 (Figure 9). This observed drift was interpreted as an instability of meter autozero setting, which was confirmed by manufacturer of the meter [2]. Data of the turbine meter, which were recorded at the same time, did not show such a highly drift at low flowrates (Figure 13). Additionally, the recorded autozero value of the Coriolis meter was +59.615 kg/h during calibrations in 2016 and, respectively, -92.115 kg/h in 2019, which do underline the discussed autozero instability.

In consequence, a correction of Coriolis data was introduced as followed. The differences between flowrates of Coriolis meter and lab reference were calculated and plotted against reference flowrate itself (Figure 10). The interception term of the fitted linear function was detected as the "zero missetting" value, separately for **each** calibration day, but over full flow scale (Table 7). The original flowrates of Coriolis meter were corrected by this method and a new meter error was calculated (Figure 11).

This method is based on the following two assumptions: The Coriolis meter is a linear device and the non-linear characteristics of the results in Figure 9 were not caused by leakage effects of the calibration facility. Both pilot laboratories can guarantee the nonexistence of leakage during reported calibrations, which was verified by previous comparisons (e.g. CCM-K1.2015). In consequence, the **correction method was only applied to the results of pilot laboratories**.

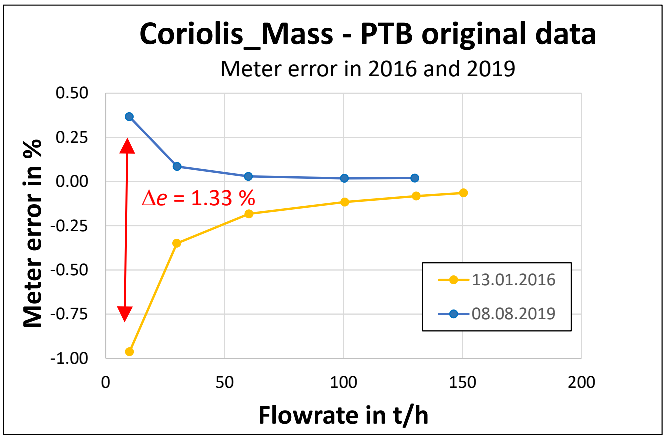


Figure 9: Meter drift of Coriolis_Mass - original PTB data of day #1 in 2016 and 2019

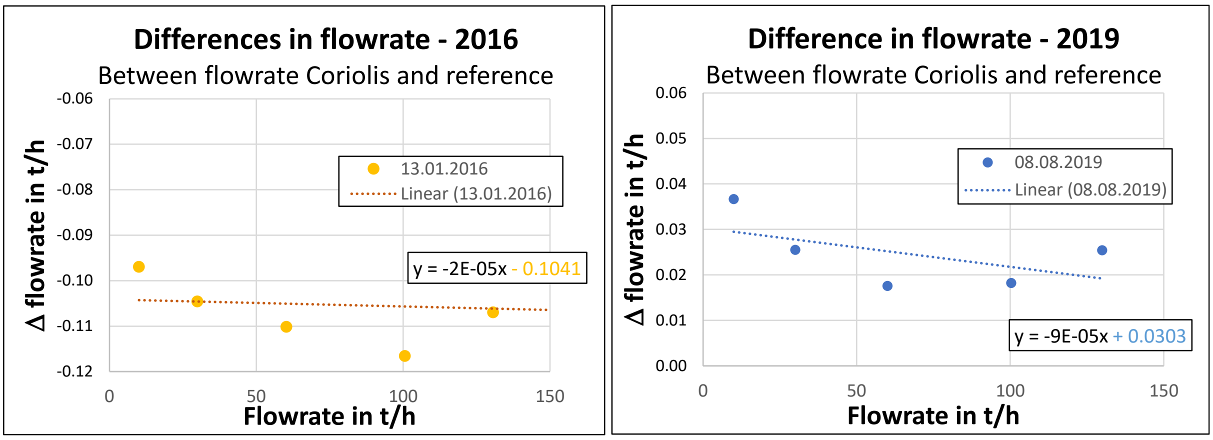


Figure 10: Example of differences in flowrate between Coriolis and reference data - original PTB data of day #1 in 2016 and 2019; interception value of fitted linear function for correction of Coriolis data

Table 7: Correction values for Coriolis_Mass data, based on autozero discussion and estimated interception, e.g. in Figure 10

	Correction value for Coriolis_Mass flowrate		
Pilot laboratory and calibration period	**Day #1**	**Day #2**	**Day #3**
	t/h	t/h	t/h
PTB_1 in 01/2016	–0.104	–0.084	–0.068
PTB_2 in 08/2019	0.030	0.039	0.065
CENAM in 06/2019	–0.003	–0.008	–0.015

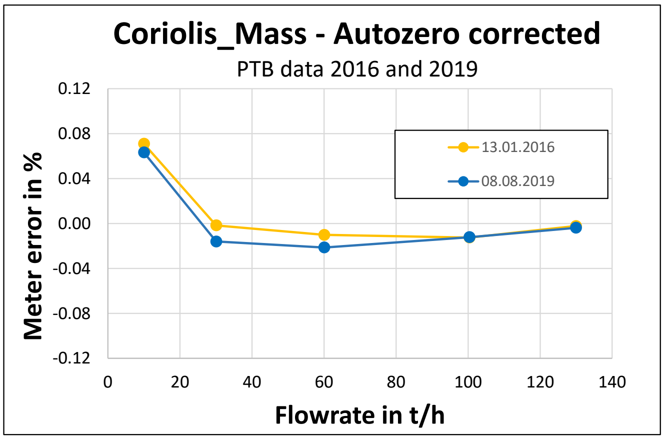


Figure 11: Example of autozero corrected final Coriolis_Mass data - PTB of day #1 in 2016 and 2019

Temperature correction

Both transfer meters showed a systematic temperature dependency in meter error (Section 7.3). All reported meter error of participated laboratories, including autozero corrected data of pilot laboratories, were corrected by applying Equation (22) until Equation (25) and Table 15, to aim a temperature corrected meter error $e_{\mathrm{V,cor}}$ for volume and $e_{\mathrm{m,cor}}$ for mass.

For final evaluation by E_{N} values, 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).

$$x_{\mathrm{i}} = \frac{\sum_{k=1}^{n}(e_{\mathrm{cor,k}})}{n} \qquad \textbf{(5)}$$

where

x_{i} - Temperature corrected meter error for E_{N}-value evaluation
n - Number of measurements at calibrated test point
i - Laboratory index

6.3 Uncertainty $u_{\mathrm{x,i}}$ of reported and temperature corrected values x_{i}

As described in [2], [3] and [4], the uncertainty of reported values x_{i} include uncertainties introduced by the participant's flow reference ($u_{\mathrm{base,i}}$), by transfer meter (u_{TS}) and by repeatability of the reported values (Equation 6). The used input parameter of $u_{\mathrm{base,i}}$ 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 given in Table 10 and Table 11. The term $\frac{s}{\sqrt{n}}$ (Equation 6) represents the repeatability of measurements made in the participating 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

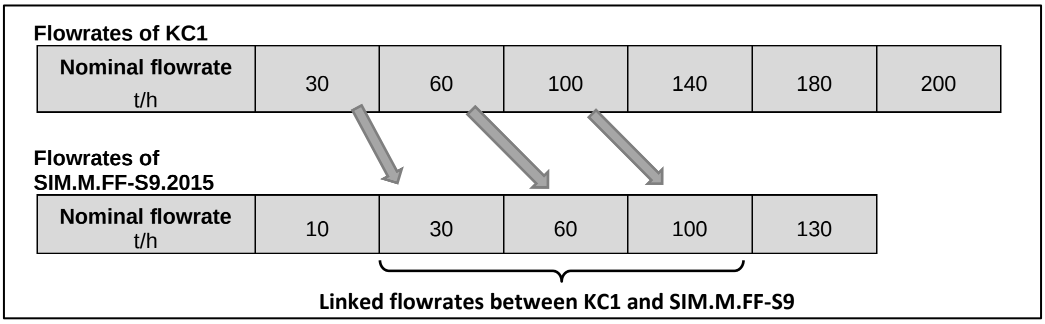
$u_{\mathrm{x,i}}$ - Uncertainty of reported and temperature corrected meter error (%)
$u_{\mathrm{base,i}}$ - Uncertainty of laboratory reference, here it is equal to $\mathrm{CMC_i}$ (%)
u_{comp} - Uncertainty of transfer meter measurements (%)
u_{TS} - Uncertainty of transfer meter (%)
s - Standard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

All values of u are valid for k = 1.

6.4 Coriolis meter - Method for E_N value calculation and linkage to KC1

6.4.1 Linkage of SIM comparison to Key Comparison KC1

The evaluation of Coriolis data is partly based on a linkage to key comparison CCM.FF-K1.2015 (KC1). The pilot laboratories CENAM and PTB took part in KC1 and supported the presented SIM comparison by the higher-ordered results of KC1 (Figure 12). The applied procedure is described in follow and was applied for Coriolis_Mass data only.



Flowrates of KC1

Nominal flowrate t/h	30	60	100	140	180	200

Flowrates of SIM.M.FF-S9.2015

Nominal flowrate t/h	10	30	60	100	130

Linked flowrates between KC1 and SIM.M.FF-S9

Figure 12: Linkage between comparison KC1 and SIM.M.FF-S9

SCC*i* - Supplementary comparison *correction* value

$$SCC_\mathrm{i} = x_\mathrm{KC1,i} - KCRV \qquad \textbf{(7)}$$

where
SCC_i - Supplementary comparison correction for laboratory *i* (%)
$KCRV$ - Key Comparison Reference value of KC1 (%)
$x_\mathrm{KC1,i}$ - Results of laboratory *i* during KC1 (%)

Uncertainty of SCC*i*

$$u(SCC_\mathrm{i}) = \sqrt{u_\mathrm{x,KC1,i}^2 - u_\mathrm{KCRV}^2} \qquad \textbf{(8)}$$

where
$u_\mathrm{SCC\_i}$ - Uncertainty of SCC for laboratory *i* (%)
$u_\mathrm{x,KC1,i}$ - Uncertainty of calibration results of laboratory *i* during KC1 (%)
u_KCRV - Uncertainty of KCRV during KC1 (%)

Table 8: Input parameter and results of *SCCi* for PTB, based on KC1 data

Nominal Flowrate	*KCRV*	*u*(*KCRV*)	$x_\mathrm{KC1,i}$	$u(x_\mathrm{KC1,i})$	SCC_i	$u(SCC_i)$
		k = 1		*k* = 1		*k* = 1
t/h	%	%	%	%	%	%
30	0.041	0.010	0.045	0.024	0.004	0.022
60	0.038	0.007	0.041	0.016	0.004	0.014
100	0.033	0.006	0.032	0.014	-0.001	0.013

Table 9: Input parameter and results of SCC_i for CENAM, based on KC1 data

Nominal Flowrate	*KCRV*	*u*(*KCRV*)	$x_\mathrm{KC1,i}$	$u(x_\mathrm{KC1,i})$	SCC_i	$u(SCC_\mathrm{i})$
		k = 1		*k* = 1		*k* = 1
t/h	%	%	%	%	%	%
30	0.041	0.010	0.047	0.027	0.006	0.025
60	0.038	0.007	0.049	0.019	0.012	0.018
100	0.033	0.006	0.045	0.018	0.012	0.017

6.4.2 Supplementary Comparison reference value $SCRV_{Cor}$ and its uncertainty

The Supplementary Comparison Reference Value for Coriolis_Mass data was calculated following the procedure A of [6]:

Input data and uncertainties at linked flowrates of 30 t/h, 60 t/h and 100 t/h:

- ⇨ original data of CENAM and PTB were corrected by using SCC_i (Equation 9)
- ⇨ the uncertainties of the corrected value were calculated by using (Equation 10)

Input data and uncertainties at flowrates of 10 t/h and 130 t/h:

- ⇨ the results of equation (5) were used as $x_{\mathrm{Cor,i}}$
- ⇨ the uncertainties of equation (5) were used as $u\left(x_{\mathrm{Cor,i}}\right)$

$$x_{\mathrm{Cor,i}} = x_{\mathrm{i}} - SCC_{\mathrm{i}} \qquad \textbf{(9)}$$

where $x_{\mathrm{Cor,i}}$ - By SCC_i corrected results of reference laboratory *i* during SIM comparison (%)

$$u\left(x_{\mathrm{Cor,i}}\right) = \sqrt{u_{\mathrm{x,i}}^2 + u_{\mathrm{SCC,i}}^2} \qquad \textbf{(10)}$$

where $u(x_{\mathrm{Cor,i}})$ - Uncertainty of $x_{\mathrm{Cor,i}}$ for reference laboratory *i* during SIM comparison (%)

The refence value $SCRV_{Cor}$ was calculated for each flowrate as a weighted mean error of both reference laboratories, including standard uncertainties $u(x_{\mathrm{Cor,i}})$ of the measurements as the weights:

$$SCRV_{\mathrm{Cor}} = \frac{\left(\frac{x_{\mathrm{Cor,i}}}{u_{\mathrm{x,Cor,i}}^2} + \frac{x_{\mathrm{Cor,j}}}{u_{\mathrm{x,Cor,j}}^2}\right)}{\left(\frac{1}{u_{\mathrm{x,Cor,i}}^2} + \frac{1}{u_{\mathrm{x,Cor,j}}^2}\right)} \qquad \textbf{(11)}$$

where $SCRV_{Cor}$ - Reference value of the comparison for Coriolis_Mass meter (%)

The standard uncertainty $u(SCRV_{Cor})$ is given with:

$$\frac{1}{u_{\mathrm{SCRV,Cor}}^2} = \frac{1}{u_{\mathrm{x,Cor,i}}^2} + \frac{1}{u_{\mathrm{x,Cor,j}}^2} \qquad \textbf{(12)}$$

where $u(SCRV_{Cor})$ - Standard uncertainty of $SCRV_{Cor}$ with $k = 1$ (%)

In equations 11 and 12, *i* stands for PTB and *j* for CENAM.

6.4.3 Determination of d_i and E_N-values

The differences of participating laboratories to $SCRV_{Cor}$ were calculated with Equation (13), the extended uncertainty of the difference with Equation (14). The final E_N values for comparison evaluation were calculated by using Equation (15).

$$d_i = SCRV_{\mathrm{Cor}} - x_{\mathrm{i}} \qquad \textbf{(13)}$$

where d_i - Degree of equivalence (DoE) as the difference of SIM-participant *i* to $SCRV_{Cor}$ (%)

Uncertainty of di

$$U(d_{\mathrm{i}}) = 2 \cdot \sqrt{u_{x,\mathrm{i}}^2 + u_{\mathrm{SCRV,Cor}}^2} \qquad \textbf{(14)}$$

where $U(d_i)$ - Uncertainty of d_i of participant *i* during SIM comparison with $k = 2$ (%)

$E_{N,i}$ - value of participant

$$E_{\mathrm{N,i}} = d_{\mathrm{i}} \,/\, U(d_{\mathrm{i}}) \qquad \textbf{(15)}$$

where $E_{N,I}$ - Normalized Degree of Equivalence as the difference of SIM-participant *i* to $SCRV_{Cor}$ (%)

6.5 Turbine meter - Method for E_N value calculation

6.5.1 Supplementary Comparison reference value $SCRV_{Turb}$ and it`s uncertainty

The Supplementary Comparison Reference Value $SCRV_{\mathrm{Turb}}$ for turbine meter is based on PTB data as the reference laboratory, only. Over full flow scale, the calibration results x_{i} (Equation 5) of PTB were used as $SCRV_{\mathrm{Turb}}$ as well as the uncertainty $u(x_{\mathrm{i}})$ of PTB-data (Equation 6) were used as $u(SCRV_{\mathrm{Turb}})$.

6.5.2 Determination of d_i and E_N-values

The differences of participants to $SCRV_{\mathrm{Turb}}$ were calculated with Equation (13), the expanded uncertainty of the difference with Equation (17). The final E_{N} values for comparison evaluation were calculated by using Equation (15).

$$d_{\mathrm{i}} = SCRV_{\mathrm{Turb}} - x_{\mathrm{i}} \tag{16}$$

where d_{i} - difference of SIM-participant *i* to $SCRV_{\mathrm{Turb}}$ %

$$U(d_{\mathrm{i}}) = 2 \cdot \sqrt{u_{x,\mathrm{i}}^2 + u_{S\mathrm{CRV,Turb}}^2} \tag{17}$$

where $U(d_{\mathrm{i}})$ - Uncertainty of d_{i} of participant *i* during SIM comparison with $k = 2$ (%)

6.6 Evaluation criteria of comparison data

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

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

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

- The comparison can not confirm the participant’s uncertainty **if** $E_{\mathrm{N,i}} \leq 1.2$ and $u_{\mathrm{comp}}/u_{\mathrm{base,i}} > 2$
  The results were **inconclusive**, because the calibrations did not show sufficient low uncertainties to discern lab to *SCRV* below certain level. The transfer meter and/or the calibrations were not suitable for a confirmation of the declared CMC values.

- The participant **failed the comparison if** $E_{\mathrm{N,i}} > 1.2$
  The results did indicate that the agreement was outside of uncertainty expectations.

7 Laboratory conditions, transfer meter characteristics and meter uncertainties

In accordance to the WGFF recommendation for comparison calculations [4], the standard uncertainty u_{TS} of the transfer meter is the root-sum-of-square (RSS) of several transfer meter characteristics. For this comparison the considered meter characteristics and input uncertainties of turbine meter are given in Equation (18), for Coriolis meter in Equation (19). The final values of u_{TS} were calculated separately for each flowrate (Table 10 and Table 11).

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.

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

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

where

u_{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 (%)

All values of *u* are expressed as *k* = 1.

Table 10: Final values of meter uncertainties u_{TS} for turbine meter (with *k* = 1)

Nominal flowrate	**Meter uncertainty u_{TS} for turbine meter**	**Input uncertainties for u_{TS}**					
		u_{drift}	u_{reprod}	u_{temp}	u_{pres}	u_{flow}	u_{inflow}
m³/h	%	%	%	%	%	%	%
10	0.207	0.034	0.010	0.014	0.017	0.006	0.203
30	0.207	0.034	0.007	0.009	0.017	0.006	0.203
60	0.211	0.057	0.003	0.002	0.017	0.006	0.203
100	0.215	0.071	0.004	0.001	0.017	0.006	0.203
130	0.219	0.080	0.005	0.000	0.017	0.006	0.203

Table 11: Final values of meter uncertainties u_{TS} for Coriolis_Mass (with *k* = 1)

Nominal flowrate	**Meter uncertainty u_{TS} for Coriolis_Mass meter**	**Input uncertainties for u_{TS}**				
		u_{drift}	u_{reprod}	u_{temp}	u_{pres}	u_{flow}
t/h	%	%	%	%	%	%
30	0.069	0.040	0.024	0.043	0.029	0.006
60	0.056	0.010	0.010	0.045	0.029	0.006
100	0.035	0.008	0.010	0.013	0.029	0.006
140	0.032	0.006	0.009	0.004	0.029	0.006
180	0.033	0.010	0.010	0.006	0.029	0.006

7.1 Drift of transfer meter - uncertainty u_{drift}

The uncertainty due to meter drift u_{drift} was quantified by performing repeated calibrations at pilot laboratory #1 (Table 1 and Table 6), using the reference standard as described in Figure 1 under reference conditions of 3 bar and 20 °C fluid temperature. For each calibration period a mean value was calculated (Figure 13 and Figure 14). The final values of u_{drift} (Table 12) were calculated by using Equation (20), separately for each flowmeter and flowrate.

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

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

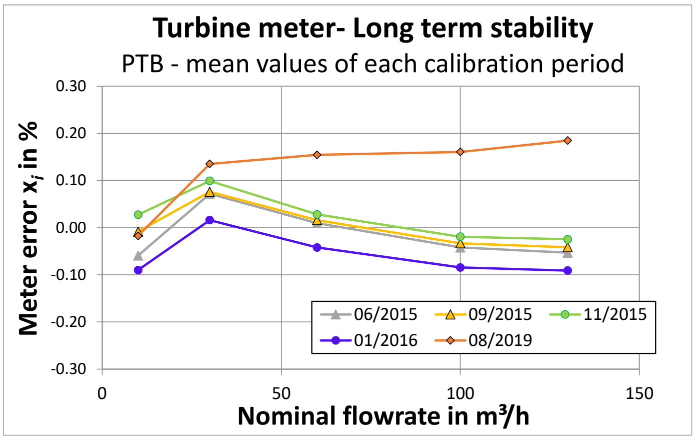


Figure 13: Long term stability of turbine meter - Mean values of corrected meter error x_i for each calibration period, measured at PTB laboratory under reference conditions of 3 bar line pressure and 20 °C fluid temperature

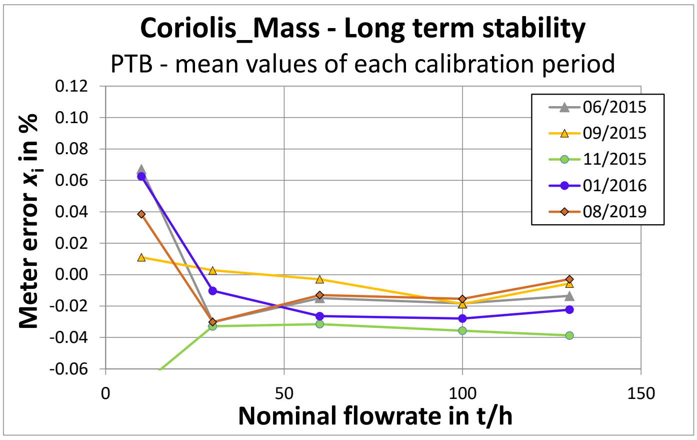


Figure 14: Long term stability of Coriolis_Mass - Mean values of corrected meter error x_i for each calibration period, measured at PTB laboratory under reference conditions of 3 bar line pressure and 20 °C fluid temperature

Table 12: Uncertainties u_{drift} caused by drift of meter error – turbine meter and Coriolis_Mass

	Nominal Flowrate				
k = 1	10 m³/h	30 m³/h	60 m³/h	100 m³/h	130 m³/h
u_{drift} **Turbine meter in %**	0.034	0.034	0.057	0.071	0.080
u_{drift} **Coriolis_Mass in %**	0.040	0.010	0.008	0.006	0.010

7.2 Quantification of reproducibility - uncertainty u_{reprod}

The uncertainty due to reproducibility characteristics u_{reprod} of the transfer meter were estimated at pilot laboratory, based on maximum values of long- and short-term reproducibility. For each period, a span of meter error $[\text{Max}(x_{\text{i}}) - \text{Min}\ (x_{\text{i}})]$ was calculated (Figure 15). 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 13) did include the following sources of uncertainty: short term drift between calibration day #1 until day #3, residual uncertainty after correction of autozero (at Coriolis meter) and reassembly of the transfer setup.

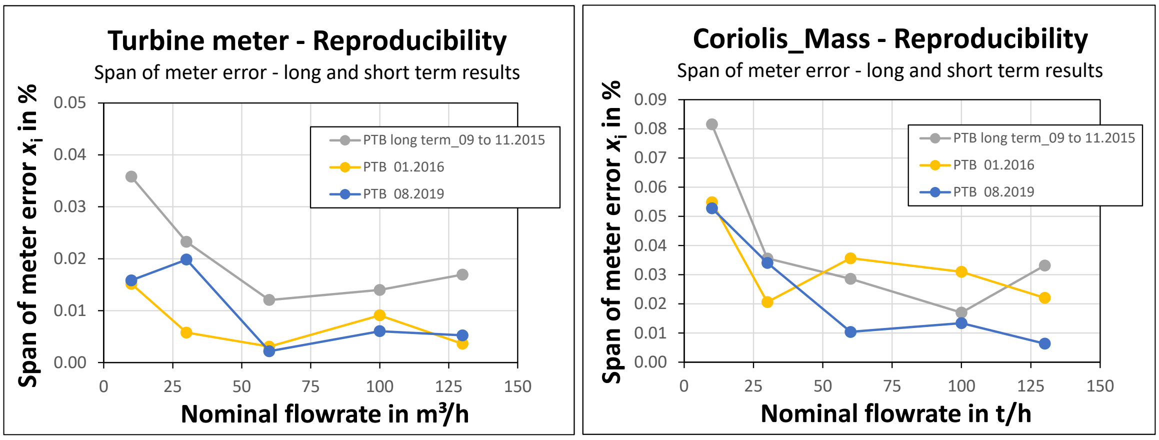


Figure 15: Results of reproducibility calibrations at pilot laboratory – Span of corrected meter error x_i (max - min) during each calibration period - measured at PTB laboratory under reference conditions of 3 bar line pressure and 20 °C fluid temperature

$$u_{\text{reprod}} = \frac{\text{Max}\ [\text{Max}(x_{\text{i}}) - \text{Min}\ (x_{\text{i}})]}{2 \cdot \sqrt{3}} \tag{21}$$

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

Table 13: Uncertainties u_{reprod} due to reproducibility characteristics of the transfer meters

	Nominal Flowrate				
k = 1	10 m³/h	30 m³/h	60 m³/h	100 m³/h	130 m³/h
u_{reprod} **Turbine meter in %**	0.010	0.007	0.003	0.004	0.005
u_{reprod} **Coriolis_Mass in %**	0.024	0.010	0.010	0.009	0.010

7.3 Temperature dependency - uncertainty u_{temp}

Laboratory conditions

During calibrations in participating laboratories, the span of fluid temperature ranged between 16.80 °C and 31.13 °C. The maximum variation of fluid temperature within one participating lab, expressed as max(T_{fluid}) - min(T_{fluid}), was reported with 5.99 °C (Table 14, Figure 16).

Table 14: Fluid temperatures T_{fluid} (°C) in participating laboratories during calibrations

NMI	PTB 1	CISA	INACAL	IBMETRO	INTI	CENAM	PTB 2
Max	20.01	25.39	31.13	21.10	24.00	28.12	20.22
Min	19.85	23.16	25.15	16.80	21.40	27.19	19.94
Max - Min	0.16	2.23	5.99	4.30	2.60	0.93	0.28
Mean	19.92	24.29	28.02	18.73	22.77	27.65	20.06

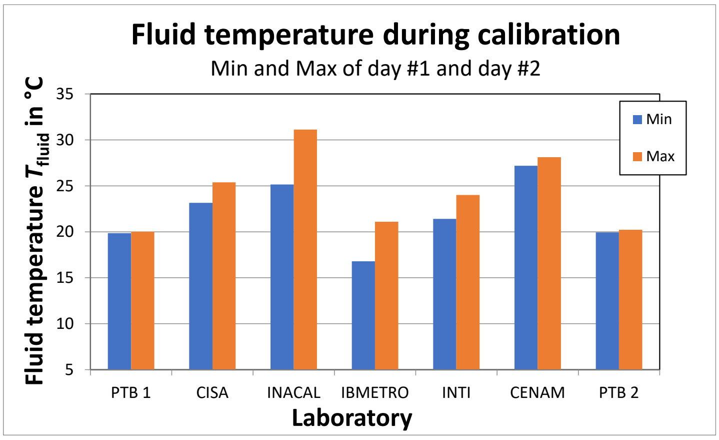


Figure 16: Fluid temperature T_{fluid} during calibrations in participating laboratories - Maximum and minimum of calibration on day #1 and day #2

Meter characteristics

The temperature characterisation measurements were realised in pilot laboratory (PTB) in 2015. The goal of characterisation measurements was to analyze meter error characteristics if the fluid temperature deviates from nominal temperature. All reported data were corrected by the following procedure, because both meters showed a distinctive dependency of meter error due to changes in fluid temperature (Figure 17).

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 by fitting a second-degree polynomial function using least squares fits (Figure 18 and Figure 19).

The resulting model parameter of Table 15 were used to calculate a correction value of meter error Δe_{cor} (Equation 24) and the final meter error e at current temperature conditions (Equation 25**)**.

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

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

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

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

$$\Delta e_{\mathrm{cor}} = a + b \cdot \Delta T_{\mathrm{fluid}} + c \cdot \Delta T_{\mathrm{fluid}} \qquad \textbf{(24)}$$

where
Δe_{cor} - Correction value of meter error (%)
a, b, c - Parameter of fitted polynomial model (Table 15) (-)

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

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

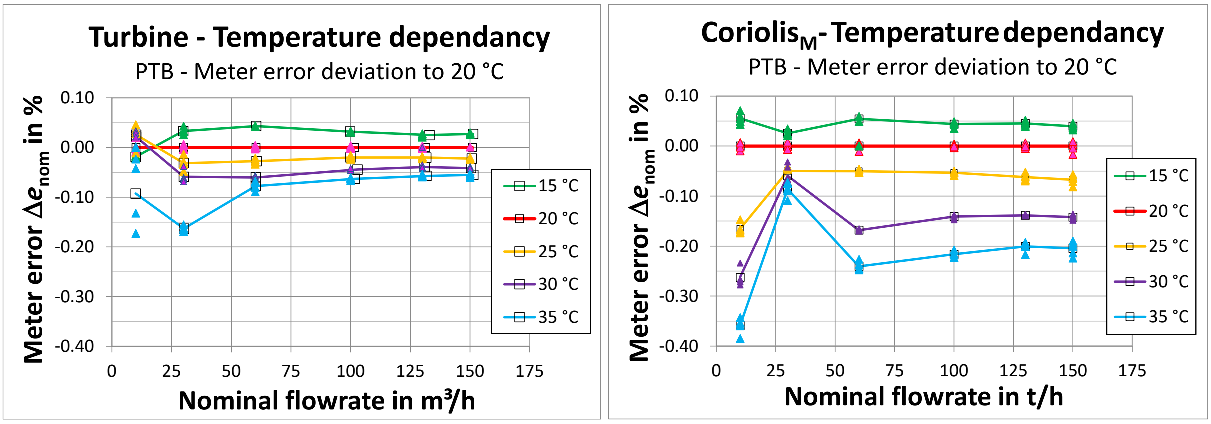


Figure 17: Temperature dependencies of turbine meter and Coriolis_Mass - Differences of meter error Δe_{nom}, expressed as results of Equation (23). All calibrations were made at pilot laboratory (PTB) in 2015.

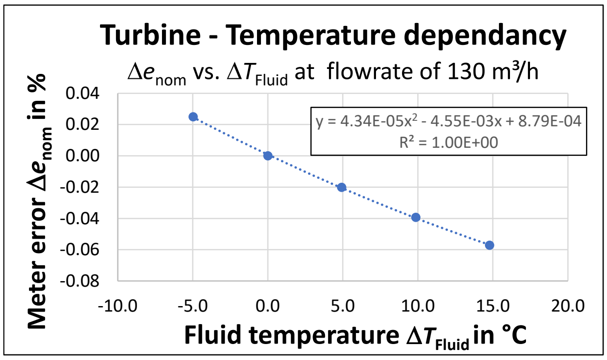


Figure 18: Temperature dependency of Turbine meter - Example relationship between $\Delta T_{\mathrm{fluid}}$ and Δe_{nom} at flowrate of 100 m³/h (results of Equation 22 and Equation 23) in order to estimate model parameters of Equation (24).

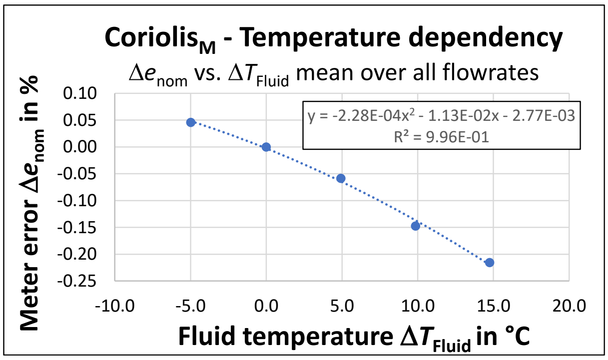


Figure 19: Temperature dependency of Coriolis meter - relationship between $\Delta T_{\mathrm{fluid}}$ and Δe_{nom}, this mean function is based on flowrates between 60 t/h and 150 t/h (Equation 22 and Equation 23) in order to estimate model parameters of Equation (24).

Table 15: Model Parameter for temperature dependent correction of meter error *e* by using Equation (13) until Equation (25) for turbine meter and Coriolis_Mass meter

	Turbine meter – model parameter			**Coriolis_Mass – model parameter**		
Nominal flowrate in m³/h	a	b	c	a	b	c
10	2.11E-02	6.01E-03	-8.75E-04	-2.77E-03	-1.13E-02	-2.28E-04
30	1.10E-02	-5.13E-03	-4.11E-04			
60	2.20E-03	-7.41E-03	1.33E-04			
100	2.74E-03	-5.38E-03	6.38E-05			
130	8.79E-04	-4.55E-03	4.34E-05			

Meter uncertainty u_{temp}

The presented method was successfully applied during model evaluation by using the temperature characterisation measurements at pilot laboratory (PTB) in 2015 (Figure 21). Especially for Coriolis_Mass, a meter uncertainty reduction (u_{temp}) of up to 94 % 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 both meters.

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 +/- 15 °C during characterisation measurements at pilot laboratory (Figure 16). 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 20). Maximum and minimum values of e_{residual} were used to calculate u_{temp} (Table 16) with an assumption of a rectangular probability distribution (Equation 27). 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 flow rate 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 (%)

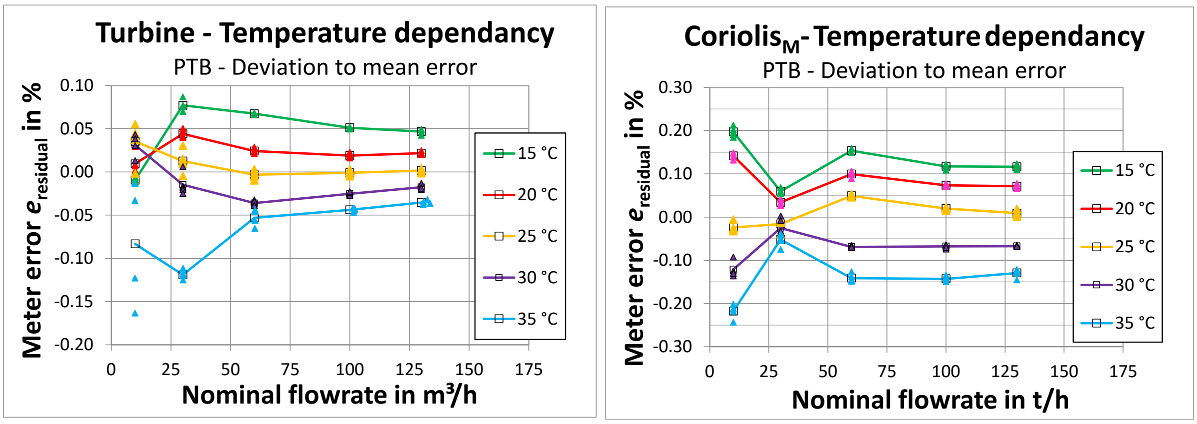


Figure 20: Temperature dependencies of Turbine meter and Coriolis_Mass - Residuals to mean values of Equation (26) for original meter error *e*

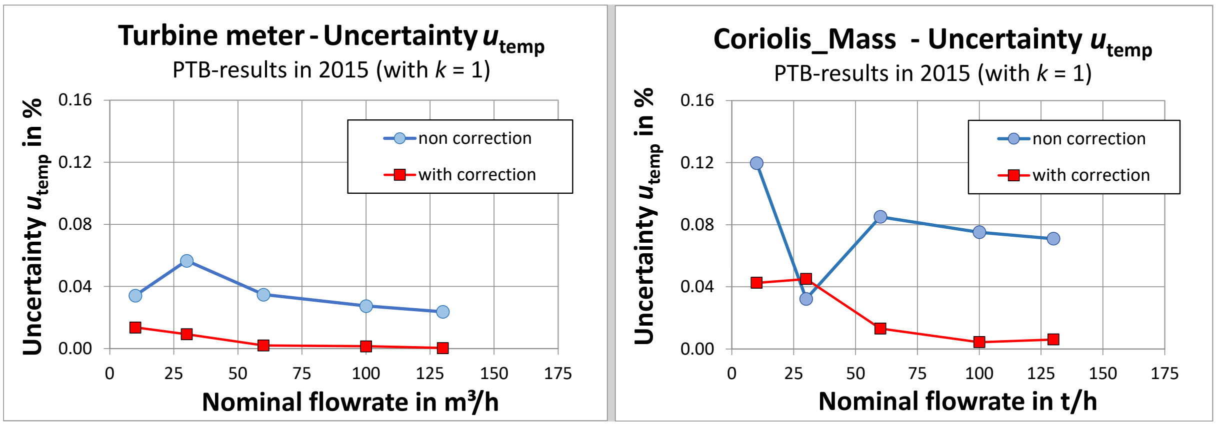


Figure 21: Meter uncertainties u_{temp} for turbine meter and Coriolis_Mass - based on non-corrected meter error e and on corrected meter error e_{cor} in 2015 - using Equation (22) until Equation (27).

Table 16: Final uncertainties of meter temperature sensitivity u_{temp}

	Nominal Flowrate				
u_{temp} (k = 1)	10 m³/h	30 m³/h	60 m³/h	100 m³/h	130 m³/h
Turbine meter in %	0.014	0.009	0.002	0.001	0.000
Coriolis_Mass in %	0.043	0.045	0.013	0.004	0.006

7.4 Pressure dependency - uncertainty u_{pres}

Laboratory conditions

The span of line pressure in participating laboratories p_{fluid} ranged between 0.27 bar and 3.00 bar (positive pressure after calibration setup) Figure 22.

Table 17: Line pressure p_{fluid} (bar) in participating laboratories during calibrations on day#1 and day#2; *) values for INTI representing general facility specifications

NMI	PTB 1	CISA	INACAL	IBMETRO	INTI*)	CENAM	PTB 2
Max	3.02	3.00	2.15	2.11	3.5	2.93	3.00
Min	2.97	2.45	2.00	0.27	2.2	2.51	2.98
Max - Min	0.06	0.55	0.15	1.85		0.41	0.03
Mean	3.00	2.84	2.06	1.59		2.77	2.99

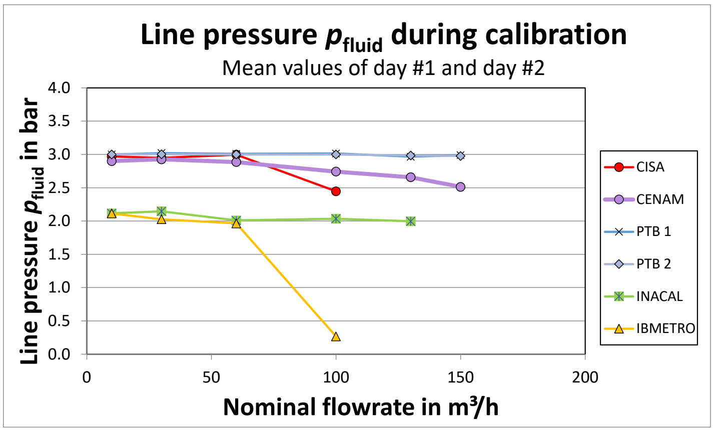


Figure 22: Line pressure during calibrations in participating laboratories – Mean values at each flowrate of calibration day #1 and day #2

Meter characteristics

Pressure dependencies of transfer meters were analyzed at pilot laboratory (PTB) during characterisation measurements in 2015 (Table 6). Due to technical restrictions, calibrations were only possible at line pressure between 2 bar and 4 bar (Figure 23).

The deviations of meter error to mean values, expressed as residuals are presented in Figure 24. For pressure differences of +/- 1 bar, the sensitivity of meter error does not exceed +/- 0.03 % for turbine meter and +/- 0.05 % for Coriolis_Mass.

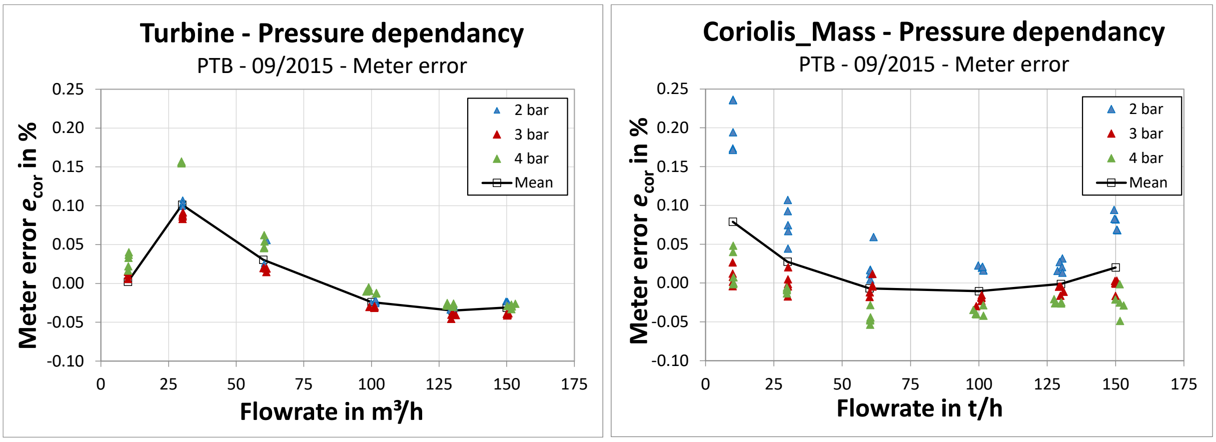


Figure 23: Pressure dependencies of turbine and Coriolis meter - Calibration results and mean values of characterization measurements at pilot laboratory PTB in 2015

Meter uncertainty u_{pres}

For uncertainty calculation of u_{pres} it was assumed that the following conservative estimation of meter sensitivities did include the pressure range between 0.27 bar and 3.02 bar of reported data (Figure 22). The pressure sensitivities were treated as uncertainty contribution for turbine meter by $u_{pres} = 0.030\ \% / \sqrt{3}$ and for Coriolis by $u_{pres} = 0.050\ \% / \sqrt{3}$, based on a rectangular probability distribution.

The results for turbine meter ($u_{pres} = 0.017$ %) and Coriolis ($u_{pres} = 0.029$ %), were used as constant values, valid for full investigated flow scale. For final calculation of E_N values, no pressure corrections were made to the data submitted by participating laboratories.

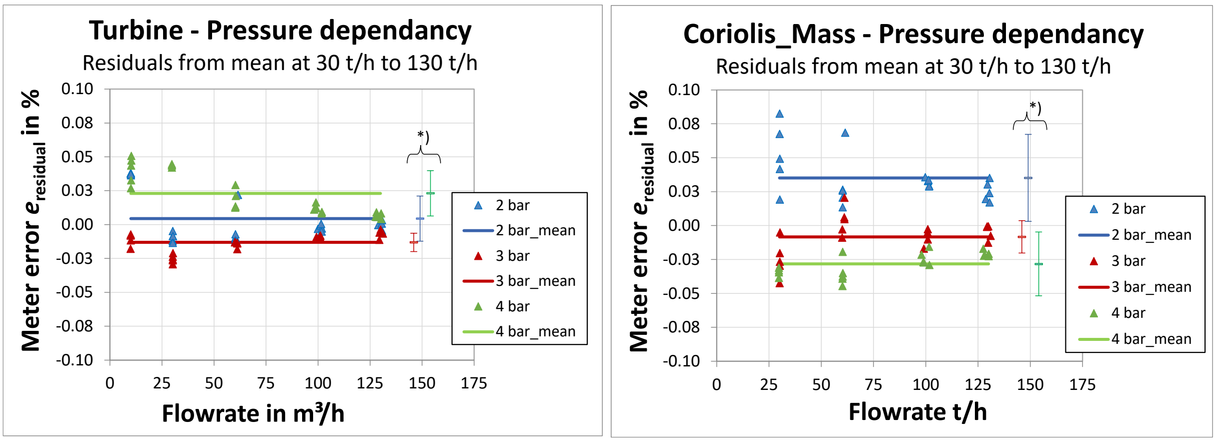


Figure 24: Pressure dependencies of turbine meter and Coriolis_Mass - Residuals to mean values of temperature corrected meter error e_{cor}. *) represents the standard deviation of e_{cor} for each pressure rate. For Coriolis meter the values at 10 t/h were not considered because of the still present autozero effect (Figure 23)

7.5 Dependency on flow stability - uncertainty u_{flow}

Laboratory conditions

For data analysis of flow stability, the deviations of reference flow between pilot laboratory (PTB) and participating laboratories were analyzed. The mean values of observed differences did not exceed +/- 3 % of flowrate at pilot laboratory (Figure 25).

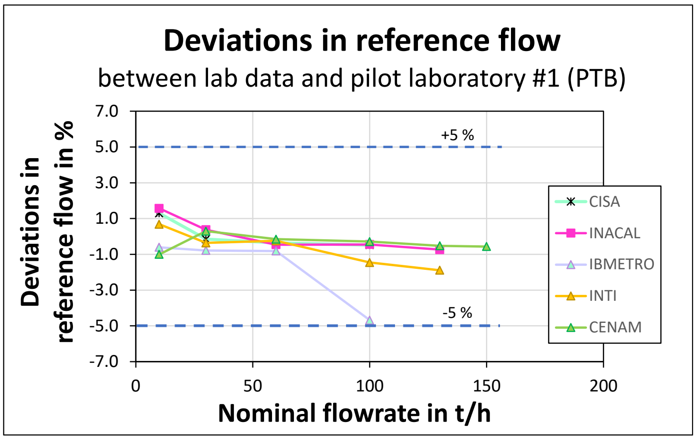


Figure 25: Flow stability $\dot{m}$ (t/h), expressed as deviations in reference flow between pilot laboratory (PTB) calibrated in 01/2016 and reported values of participating laboratories

Meter characteristics

For analyzing meter error sensitivity to changes in flowrate, calibration results at reference laboratory (PTB) 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 26). Based on the previously discussed maximum limits in flowrate stability of +/- 5 % (Figure 25), both meter showed a maximum sensitivity in meter error of +/- 0.010 % (Figure 26).

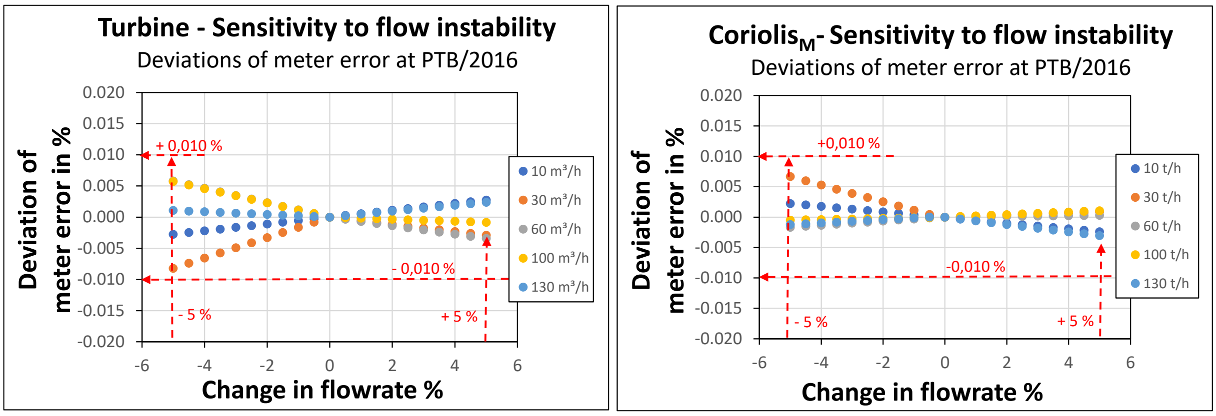


Figure 26: Sensitivity of transfer meters to flow instability - based on PTB data set in 01/2016

Meter uncertainty u_{flow}

The estimated maximum values of flow meter sensitivity were used for calculation of u_{flow}. For both meter, the flow stability sensitivities were treated as a rectangular uncertainty contribution, with $u_{\mathrm{flow}} = 0.010\ \% / \sqrt{3}$. It was assumed, that the results of u_{flow} = 0.006 % were 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.

7.6 Dependency of inflow conditions to Turbine meter

Laboratory conditions

The span of undisturbed inflow length in participating laboratories ranged between 0.1 m and 4.6 m. Typical fittings like valves, tube bundle or elbows were installed at the inflow of calibration line (Table 18).

Table 18: Reported inflow lengths of undisturbed flow and pipe installation at the inflow of calibration line in participating laboratories

NMI	PTB (pilot lab)	CISA	INACAL	IBMETRO	INTI
Undisturbed inflow length	8.5 m	4.6 m	0.1 m	3.5 m	> 2.0 m
Pipe installation before inflow	tube bundle, line reducer	line reducer	elbow, tube bundle	line reducer, valve	line reducer, valve

Turbine meter characteristics

The used turbine meter was identical to the type of flow meter, which was used during KC1, but with an inner diameter of 80 mm instead of 100 mm. During KC1, the turbine meter showed a distinctive sensitivity to disturbed inflow conditions. Within the ranges of reported SC inflow lengths (Table 18), the turbine meter of KC1 showed maximum sensitivities of meter error (Figure 27) in positive direction with +0.351 % (disturber type: 30 % closed orifice plate, inflow length: 1 m), in negative direction -0.092 % (disturber type: 2nd turbine meter, inflow length: 4 m).

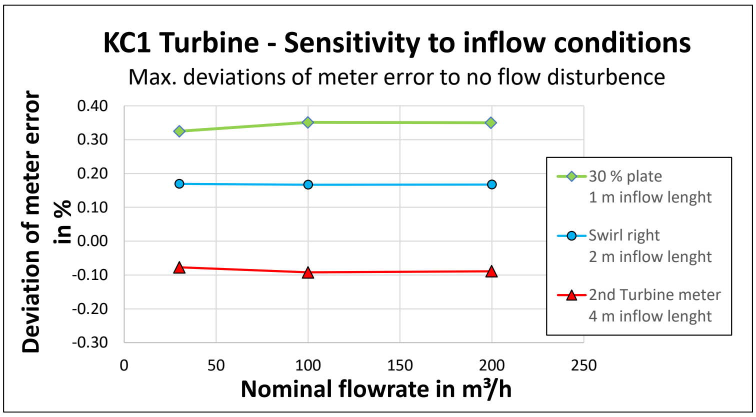


Figure 27: Maximum observed sensitivity of turbine meter to different flow disturber and inflow lengths - based on PTB calibrations in 03/2019 during KC1 comparison with a DN100 mm turbine meter

Meter uncertainty

This research was necessary, because of significant differences in turbine meter calibrations between participating laboratories. Whereas, for flowrates higher than 10 m³/h, the maximum span of Coriolis meter error reached 0.222 % between laboratories (Figure 42, without INTI). At the same time the results of turbine meter differ up to 1.048 % (Figure 29). Such differences could not be explained by a standard estimation of transfer meter uncertainties. Behind this background and according to KC1 procedure, an additional uncertainty parameter (u_{inflow}) was introduced for turbine meter to consider the influence of different inflow conditions to calibration characteristics of turbine meter.

With reference to the minimum reported inflow length of 0.10 m at participating laboratories (Table 18), the maximum observed meter error deviation at 1 m inflow length (Figure 27) was used for the estimation of turbine meter sensitivity u_{inflow}. The inflow sensitivity was treated as a rectangular uncertainty contribution with $u_{\text{inflow}} = 0.351\ \% / \sqrt{3} = 0.203\ \%$. 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.

8 Results and final data evaluation

8.1 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 28).

Table 19: Air temperatures T_{air} (°C) in participating laboratories during calibrations on day#1 and day#2; *) values for INTI representing general facility specifications

NMI	PTB 1	CISA	INACAL	IBMETRO	INTI	CENAM	PTB 2
Max	21.99	26.16	26.30	19.20		28.48	22.70
Min	21.73	21.19	22.70	16.90		25.40	21.90
Max - Min	0.26	4.97	3.60	2.30		3.07	0.80
Mean	21.88	24.76	24.74	17.95	25 °C ± 3 °C	26.65	22.46

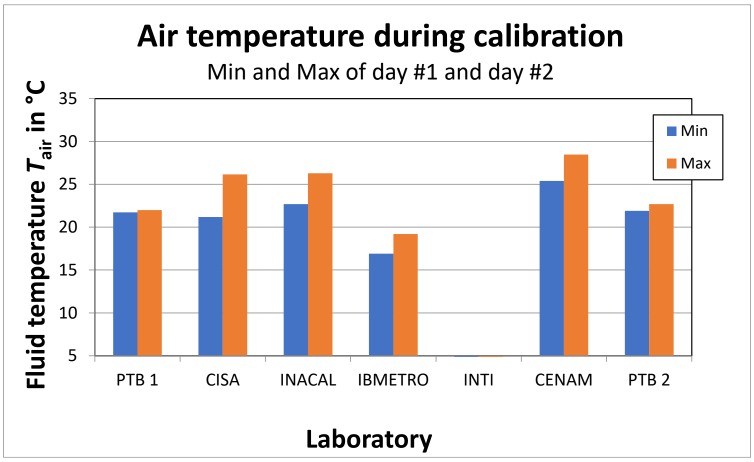


Figure 28: Air temperature T_{air} during calibrations in participating laboratories - maximum and minimum of calibration day #1 and day #2

8.2 Turbine transfer meter

8.2.1 Summarized results

Laboratory results

Table 20: Relative measurement error x_i (%) of turbine meter at participated laboratories - temperature corrected mean values of day #1 and day #2, comparison reference value $SCRV_{Turb}$ and U($SCRV_{Turb}$)

Flowrate	CISA	INACAL	IBMETRO	INTI	PTB_2 = $SCRV_{Turb}$	$U(SCRV_{Turb})$ $k = 2$
m³/h	%	%	%	%	%	%
10	−0.700	0.222	−2.255	−0.153	−0.025	0.414
30	−0.140	0.386	−0.541	0.564	0.135	0.414
60	−0.220	0.420	−0.187	0.433	0.154	0.423
100	−0.230	0.450	−0.221	0.476	0.161	0.433
130		0.488		0.327	0.185	0.438

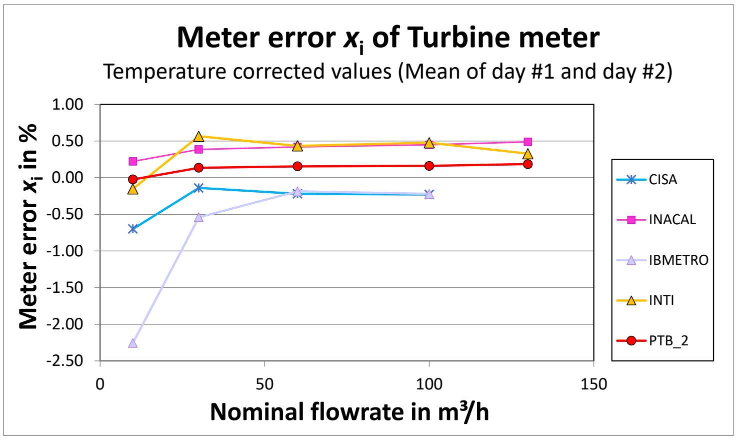


Figure 29: Relative measurement error x_i of turbine meter at participating laboratories - temperature corrected mean values of day #1 and day #2. The values of PTB_2 were used as the comparison reference value $SCRV_{Turb}$.

The degree of equivalence value E_N is a measure of result agreement of each participating laboratory to the $SCRV_{Turb}$. Expressed as the normalized differences of “lab to $SCRV_{Turb}$”, the final E_N values of turbine meter are summarized in Table 21 and Figure 30. Beside one calibration, all labs passed the E_N criteria of ≤ 1.20.

Table 21: Summary of E_N-values for turbine meter of each participating laboratory. $^{a)}$ represents data at warning level, $^{b)}$ represents data with E_N values > 1.20

Flowrate	CISA	INACAL	IBMETRO	INTI
m³/h	-	-	-	-
10	1.11 $^{a)}$	0.41	3.69 $^{b)}$	0.20
30	0.46	0.42	1.01 $^{a)}$	0.72
60	0.61	0.43	0.54	0.46
100	0.62	0.47	0.62	0.49
130		0.48		0.22

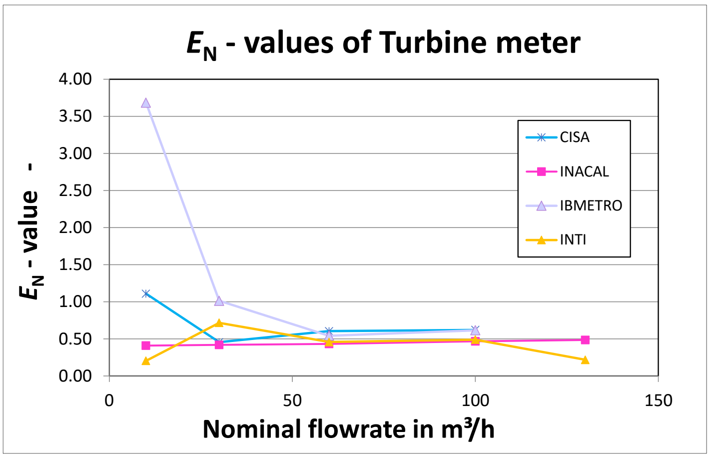


Figure 30: Summarized E_N-values of participating laboratories for turbine meter

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 $SCRV_{Turb}$, the comparison uncertainty ratio $u_{comp}/u_{base,i}$ should be < 2.

Results from all participating laboratories couldn't comply with this limit (Table 22). For the purpose of the presented SC 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 22: Summarized results of conclusive proof $u_{comp}/u_{base,i}$ of each participating laboratory for turbine meter - $^{c)}$ represents inconclusive data

Flowrate	CISA	INACAL	IBMETRO	INTI
m³/h	-	-	-	-
10	2.80 $^{c)}$	5.67 $^{c)}$	4.29 $^{c)}$	7.83 $^{c)}$
30	2.77 $^{c)}$	5.55 $^{c)}$	5.13 $^{c)}$	7.16 $^{c)}$
60	2.84 $^{c)}$	5.72 $^{c)}$	4.55 $^{c)}$	7.26 $^{c)}$
100	2.87 $^{c)}$	5.74 $^{c)}$	4.31 $^{c)}$	7.18 $^{c)}$
130		5.80 $^{c)}$		7.29 $^{c)}$

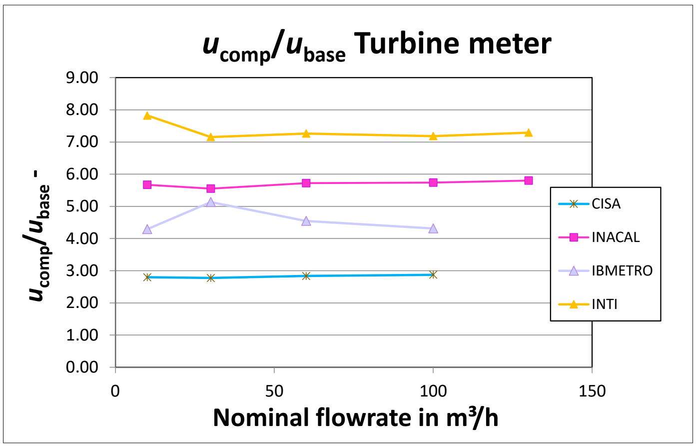


Figure 31: Summarized results of conclusive proof $u_{comp}/u_{base,i}$ of each participating laboratory for turbine meter

8.2.2 Final CMC-decision tables for participating laboratories

CISA - laboratory (Chile)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 23), because of inconclusive data - at all calibrated flowrates the ratio of $u_{\text{comp}}/u_{\text{base}}$ was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

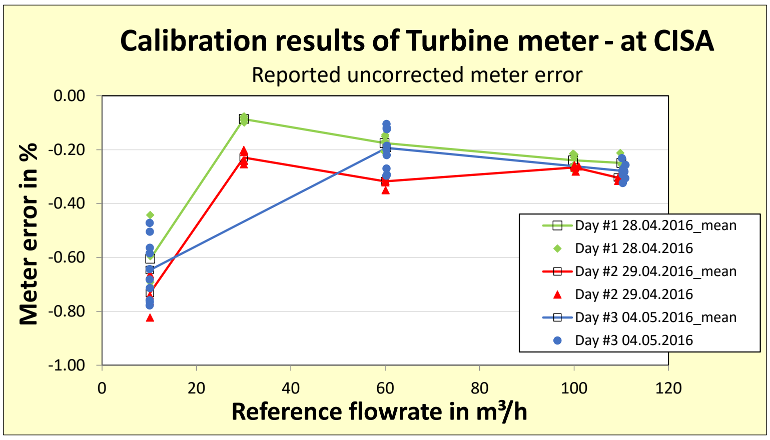


Figure 32: Calibration results of CISA laboratory for turbine meter – reported uncorrected meter error e_V

Table 23: Comparison decision table for CISA (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - $^{a)}$ represents E_N -values at warning level, $^{c)}$ represents inconclusive data

	CISA / Chile						
Nominal flowrate	Relative measurement error	Expanded laboratory uncertainty	Expanded measurement uncertainty	Degree of equivalence	***Normalized degree of equivalence***	$u_{\text{comp}}/u_{\text{base,i}}$	CMC decision status
	x_i	$U_{\text{base,i}}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{\text{N,i}}$		
m³/h	%	%	%	-	-	-	
10	−0.700	0.150	0.445	−0.675	1.11 $^{a)}$	2.80 $^{c)}$	inconclusive
30	−0.140	0.150	0.442	−0.276	0.46	2.77 $^{c)}$	inconclusive
60	−0.220	0.150	0.451	−0.374	0.61	2.84 $^{c)}$	inconclusive
100	−0.230	0.150	0.457	−0.390	0.62	2.87 $^{c)}$	inconclusive
130							

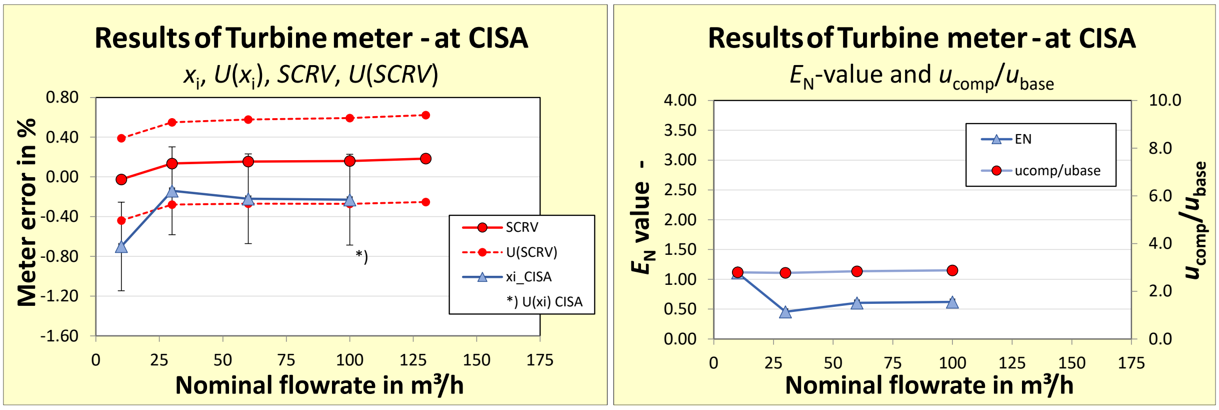


Figure 33: Comparison results of CISA laboratory for turbine meter

INACAL - laboratory (Peru)

For volume calibration this comparison couldn't support the declared base uncertainties of the participant (Table 24), because of inconclusive data - at all calibrated flowrates the ratio of $u_{\mathrm{comp}}/u_{\mathrm{base}}$ was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

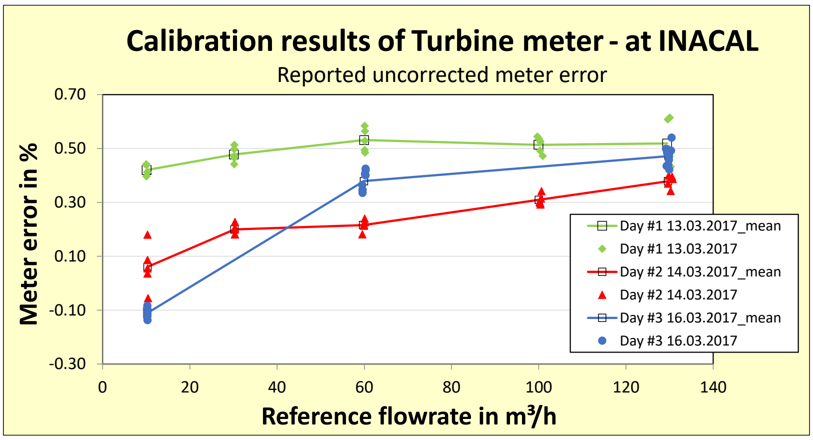


Figure 34: Calibration results of INACAL laboratory for turbine meter - reported uncorrected meter error e_V

Table 24: Comparison decision table for INACAL (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) – $^{b)}$ represents E_N -values > 1.20, $^{c)}$ represents inconclusive data

	INACAL / Peru						
Nominal flowrate	Relative measure-ment error	Expanded laboratory uncertainty	Expanded measurement uncertainty	Degree of equivalence	*Normalized degree of* equivalence	$u_{\mathrm{comp}}/u_{\mathrm{base}}$	CMC decision status
	x_i	$U_{\mathrm{base,i}}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{\mathrm{N,i}}$		
m³/h	%	%	%	-	-	-	
10	0.222	0.076	0.438	0.247	0.41	5.67 $^{c)}$	inconclusive
30	0.386	0.076	0.429	0.251	0.42	5.55 $^{c)}$	inconclusive
60	0.420	0.076	0.442	0.265	0.43	5.72 $^{c)}$	inconclusive
100	0.450	0.076	0.443	0.289	0.47	5.74 $^{c)}$	inconclusive
130	0.488	0.076	0.447	0.304	0.48	5.80 $^{c)}$	inconclusive

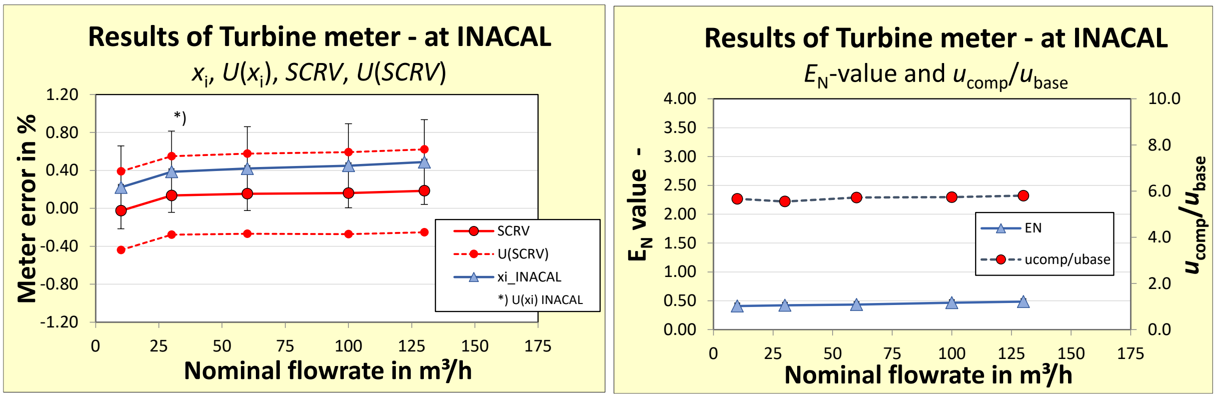


Figure 35: Comparison results of INACAL laboratory for turbine meter

IBMETRO - laboratory (Bolivia)

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 $u_{\text{comp}}/u_{\text{base}}$ was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

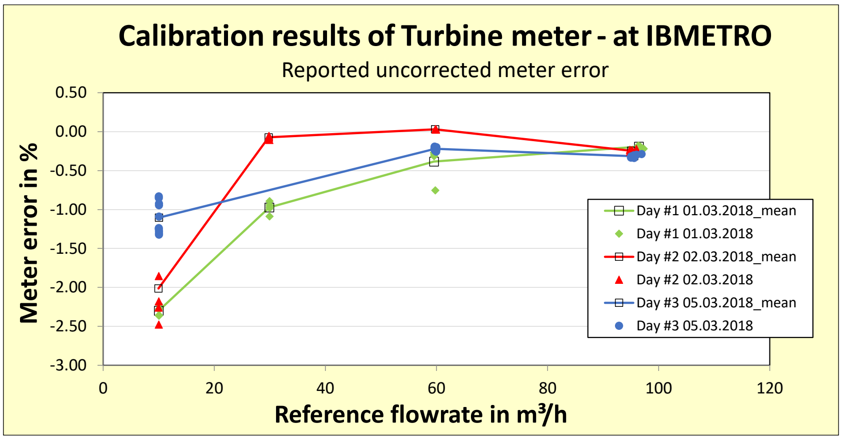


Figure 36: Calibration results of IBMETRO for turbine meter - reported uncorrected meter error e_V

Table 25: Comparison decision table for IBMETRO (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - $^{a)}$ represents E_N -values at warning level, $^{b)}$ represents E_N -values > 1.20, $^{c)}$ represents inconclusive data

	IBMETRO / Bolivia						
Nominal flowrate	Relative measurement error	Expanded laboratory uncertainty	Expanded measurement uncertainty	Degree of equivalence	*Normalized degree of* equivalence	$u_{\text{comp}}/u_{\text{base}}$	CMC decision status
	x_i	$U_{\text{base},i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
m³/h	%	%	%	-	-	-	
10	−2.255	0.100	0.441	−2.230	3.69 $^{b)}$	4.29 $^{c)}$	inconclusive
30	−0.541	0.100	0.523	−0.676	1.01 $^{a)}$	5.13 $^{c)}$	inconclusive
60	−0.187	0.100	0.466	−0.341	0.54	4.55 $^{c)}$	inconclusive
100	−0.221	0.100	0.443	−0.382	0.62	4.31 $^{c)}$	inconclusive
130							

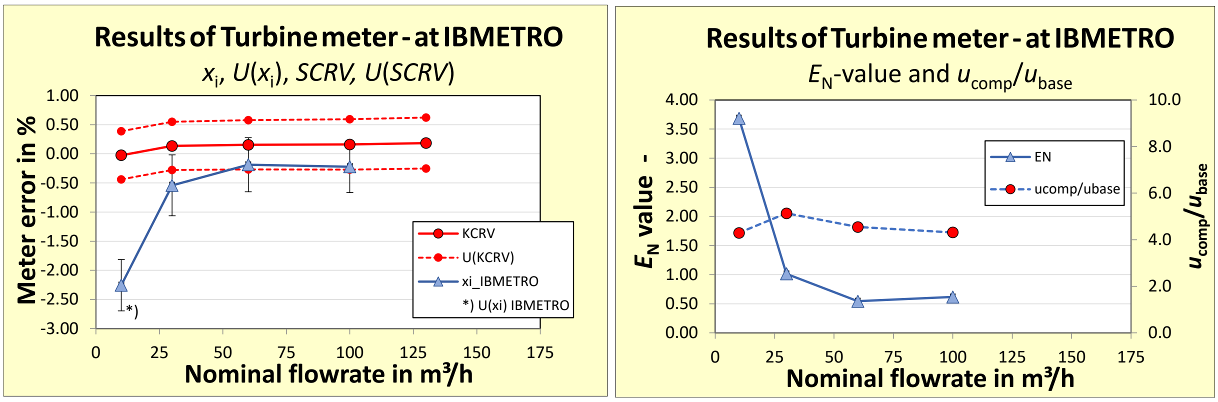


Figure 37: Comparison results of IBMETRO laboratory for turbine meter

INTI - laboratory (Argentina)

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 $u_{\mathrm{comp}}/u_{\mathrm{base}}$ was > 2. The turbine meter was not suitable for a confirmation of the declared CMC values.

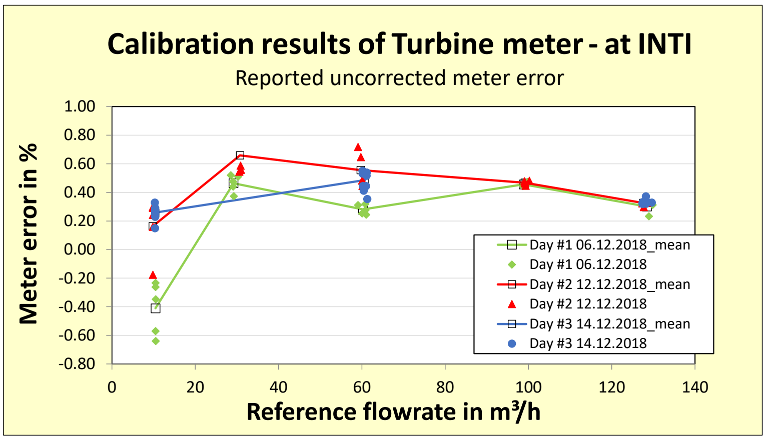


Figure 38: Calibration results of INTI for turbine meter - reported uncorrected meter error e_V

Table 26: Comparison decision table for INTI (turbine meter), where x_i is the temperature corrected meter error (mean of day #1 and day #2) - $^{c)}$ represents inconclusive data

	INTI / Argentina						
Nominal flowrate	**Relative measurement error**	**Expanded laboratory uncertainty**	**Expanded measurement uncertainty**	**Degree of equivalence**	***Normalized degree of equivalence***	$u_{\mathrm{comp}}/u_{\mathrm{base}}$	**CMC decision status**
	x_i	$U_{\mathrm{base},i}$ (k = 2)	$U(x_i)$ (k = 2)	d_i	$E_{N,i}$		
m³/h	%	%	%	-	-	-	
10	−0.153	0.060	0.473	−0.128	0.20	7.83 $^{c)}$	inconclusive
30	0.564	0.060	0.433	0.429	0.72	7.16 $^{c)}$	inconclusive
60	0.433	0.060	0.440	0.279	0.46	7.26 $^{c)}$	inconclusive
100	0.476	0.200	0.475	0.315	0.49	7.18 $^{c)}$	inconclusive
130	0.327	0.200	0.481	0.142	0.22	7.29 $^{c)}$	inconclusive

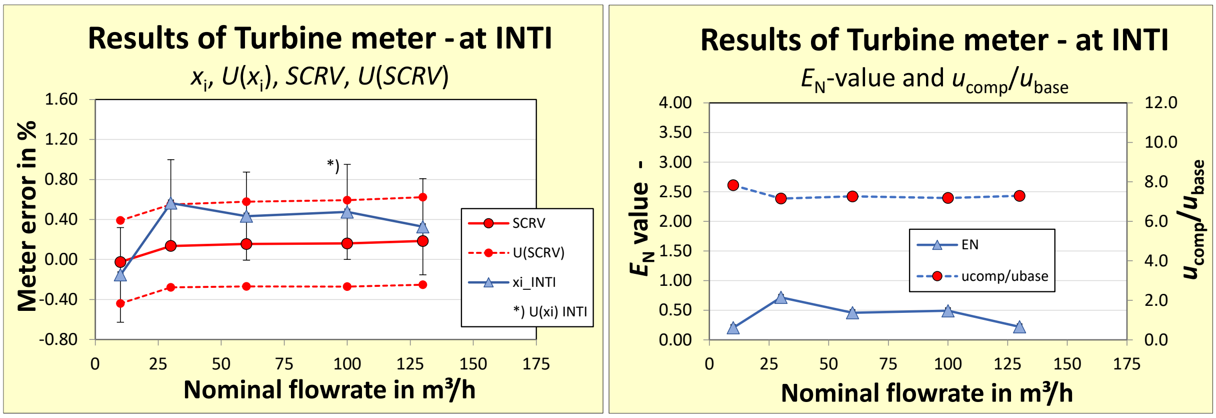


Figure 39: Comparison results of INTI laboratory for turbine meter

8.3 Coriolis_Mass transfer meter

8.3.1 Results of $SCRV_{\mathrm{Cor}}$ calculation and E_{N} values for CENAM and PTB

The comparison reference value for Coriolis meter ($SCRV_{\mathrm{Cor}}$) was partially linked to Key Comparison CCM.FF-K1.2015 (KC1) - see Chapter 6.4.1. The data of both pilot laboratories (PTB and CENAM) were used for the calculation of $SCRV_{\mathrm{Cor}}$. - see Chapter 6.4.2. The input data are given in Table 27, the calculated values of $SCRV_{\mathrm{Cor}}$ and it's uncertainties are presented in Table 28 and Figure 40, the final E_{N} values are summarized in Table 29 and Figure 41.

Table 27: Input data for calculation of $SCRV_{\mathrm{Cor}}$

	SIM comparison data				**KC1 comparison data** (based on Table 8 and Table 9)			
Nominal flowrate	**Autozero corrected measurement error**		**Measurement uncertainty of x_{i}**		**Supplementary comparison correction value**		**Uncertainty of SCC_{i}**	
	CENAM	**PTB**	**CENAM**	**PTB**	**CENAM**	**PTB**	**CENAM**	**PTB**
	x_{i}	x_{i}	$u(x_{\mathrm{i}})$ (k = 1)	$u(x_{\mathrm{i}})$ (k = 1)	SCC_{i}	SCC_{i}	$u(SCC_{\mathrm{i}})$ (k = 1)	$u(SCC_{\mathrm{i}})$ (k = 1)
t/h	%	%	%	%	%	%	%	%
10	–0.049	0.062	0.071	0.070				
30	–0.025	–0.030	0.058	0.057	0.006	0.004	0.025	0.022
60	–0.015	–0.013	0.038	0.036	0.012	0.004	0.018	0.014
100	–0.027	–0.009	0.035	0.033	0.012	-0.001	0.017	0.013
130	–0.027	–0.003	0.036	0.035				

Table 28: Calculation of $SCRV_{\mathrm{Cor}}$

	SIM comparison data					
Nominal flowrate	**SCC_{i} corrected measurement error**		**Measurement uncertainty of $x_{\mathrm{Cor,i}}$**		$SCRV$	$U(SCRV)$
	CENAM	**PTB**	**CENAM**	**PTB**		
	$x_{\mathrm{Cor,i}}$	$x_{\mathrm{Cor,i}}$	$u(x_{\mathrm{Cor,i}})$ (k = 1)	$u(x_{\mathrm{Cor,i}})$ (k = 1)		(k = 2)
t/h	%	%	%	%	%	%
10	–0.049	0.062	0.070	0.071	0.007	0.100
30	–0.032	–0.034	0.061	0.063	–0.033	0.088
60	–0.026	–0.017	0.039	0.042	–0.021	0.057
100	–0.039	–0.008	0.035	0.039	–0.022	0.053
130	–0.027	–0.003	0.035	0.036	–0.014	0.050

Table 29: E_{N}-values for comparison between CENAM and PTB

	SIM comparison data					
Nominal flowrate	d_i		$U(\mathrm{d_i})$		E_{N}	
	CENAM	**PTB**	**CENAM**	**PTB**	**CENAM**	**PTB**
			(k = 2)	(k = 2)		
t/h	%	%	%	%	-	-
10	–0.056	0.055	0.101	0.099	–0.56	0.56
30	0.001	–0.001	0.090	0.085	0.01	–0.01
60	–0.005	0.004	0.062	0.053	–0.08	0.08
100	–0.017	0.014	0.058	0.048	–0.29	0.29
130	–0.013	0.011	0.053	0.048	–0.24	0.24

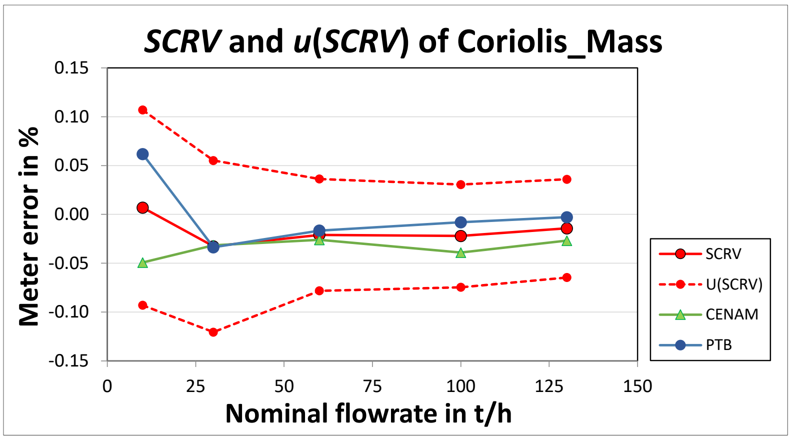


Figure 40: Results of corrected meter error for Coriolis_Mass and *SCRV*$_{Cor}$ of the comparison between CENAM and PTB, including *U*(*SCRV*$_{Cor}$)

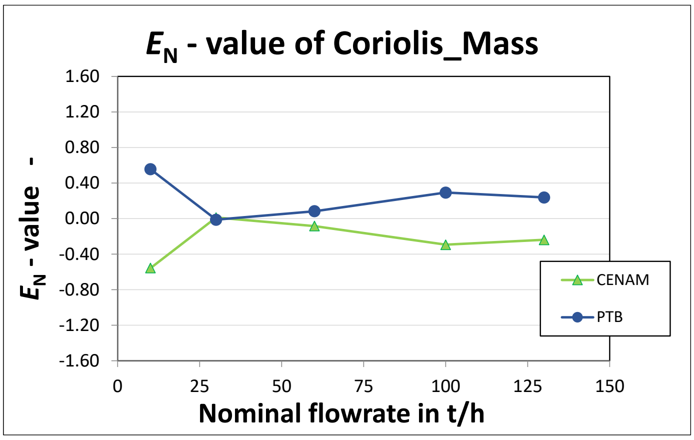


Figure 41: E_N values of basic comparison between CENAM and PTB

8.3.2 Comparison results of participating laboratories

Laboratory results

Table 30: Relative measurement error x_i (%) of Coriolis_Mass at participating laboratories – temperature corrected mean values of day #1 and day #2, comparison reference value $SCRV_{Cor}$ and $U(SCRV_{Cor})$

Flowrate	**CISA**	**INACAL**	**IBMETRO**	**INTI**	***SCRV*Cor**	***U*(*SCRV*Cor)** k = 2
t/h	%	%	%	%	%	%
10	–0.194	–0.348	–0.154	–0.137	0.007	0.100
30	–0.101	–0.120	–0.143	–0.073	–0.033	0.088
60	–0.075	0.040	–0.160	–0.004	–0.021	0.057
100	–0.064	0.059	–0.157	0.439	–0.022	0.053
130		0.072		0.338	–0.014	0.050

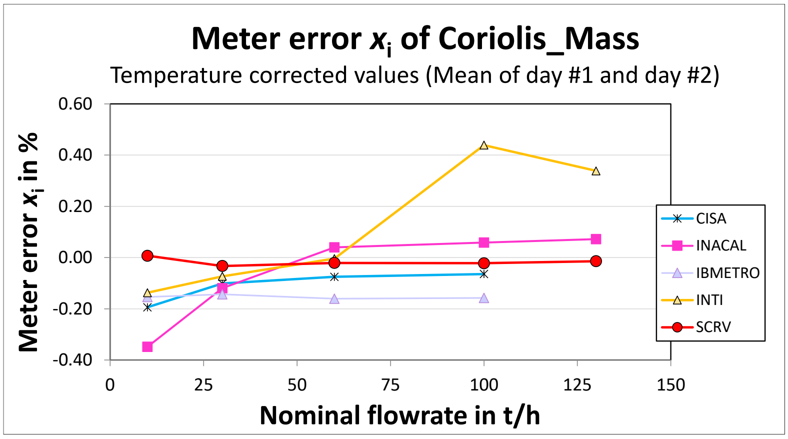


Figure 42: Relative measurement error x_i of Coriolis_Mass at participating laboratories - temperature corrected mean values of day #1 and day #2

The E_N values of participating laboratories are summarized in Table 31 and Figure 43. Beside two calibrations, all laboratories complied with the E_N criteria of < 1.2. Only at the flowrates of 100 t/h and 130 t/h this critical value.

Table 31: Summary of E_N-values of participating laboratories for Coriolis_Mass transfer meter - $^{a)}$ represents E_N – values at warning level between 1.00 and 1.20, $^{b)}$ represents E_N -values > 1.20

Flowrate	**CISA**	**INACAL**	**IBMETRO**	**INTI**
t/h	-	-	-	-
10	0.82	0.91	0.81	0.77
30	0.33	0.47	0.63	0.25
60	0.31	0.47	1.03 $^{a)}$	0.11
100	0.24	0.65	1.04 $^{a)}$	1.96 $^{b)}$
130		0.72		1.50 $^{b)}$

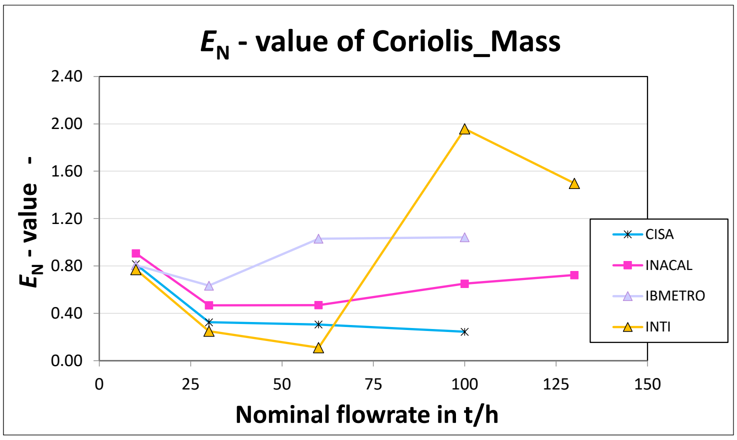


Figure 43: Summarized E_N-values of participating laboratories for Coriolis_Mass transfer meter

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

Based on [3], for a conclusive proof of participant results and an agreement with the $SCRV_{Cor}$, the comparison uncertainty ratio u_{comp}/u_{base} should be < 2. The results for participating laboratories are summarized in Table 32 and Figure 44.

Beside one calibration, all results complied with this limit. For the final purpose of this SC 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 32: Summarized results of conclusive proof u_{comp}/u_{base} of participating laboratories for Coriolis_Mass transfer meter - $^{c)}$ represents inconclusive data

Flowrate	CISA	INACAL	IBMETRO	INTI
t/h	-	-	-	-
10	1.12	4.88 $^{c)}$	1.41	2.00
30	0.79	1.91	1.13	1.66
60	0.50	1.16	0.71	1.76
100	0.44	1.09	0.64	0.93
130		1.02		0.95

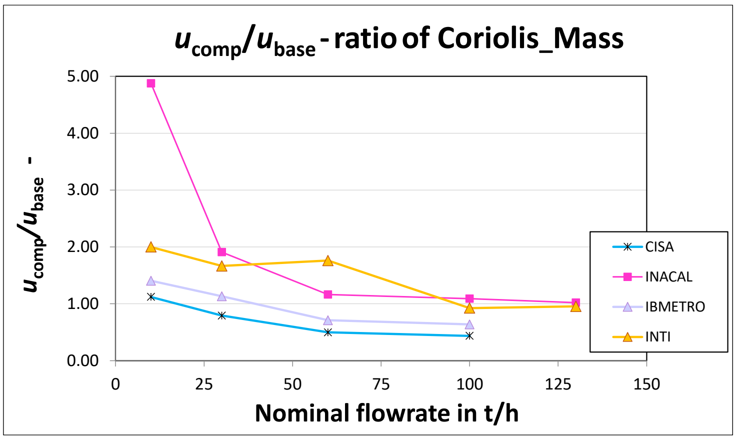


Figure 44: Summarized results of conclusive proof u_{comp}/u_{base} of participated laboratories for Coriolis_Mass transfer meter

8.3.3 Final CMC-decision tables for participating laboratories

CISA - laboratory (Chile)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 33).

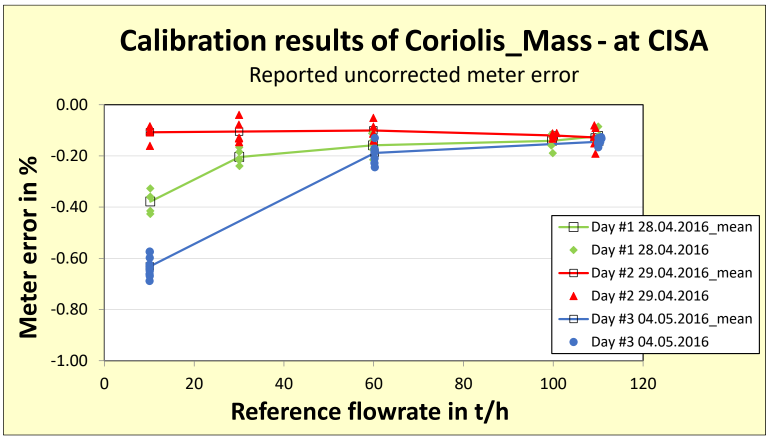


Figure 45: Calibration results of CISA for Coriolis_Mass transfer meter – reported uncorrected meter error e_m

Table 33: Comparison decision table for CISA (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2)

	CISA / Chile						
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	$E_{N,i}$		
t/h	%	%	%	-	-	-	
10	−0.194	0.150	0.225	−0.201	0.82	1.12	acceptable
30	−0.101	0.150	0.192	−0.069	0.33	0.79	acceptable
60	−0.075	0.150	0.168	−0.054	0.31	0.50	acceptable
100	−0.064	0.150	0.164	−0.042	0.24	0.44	acceptable

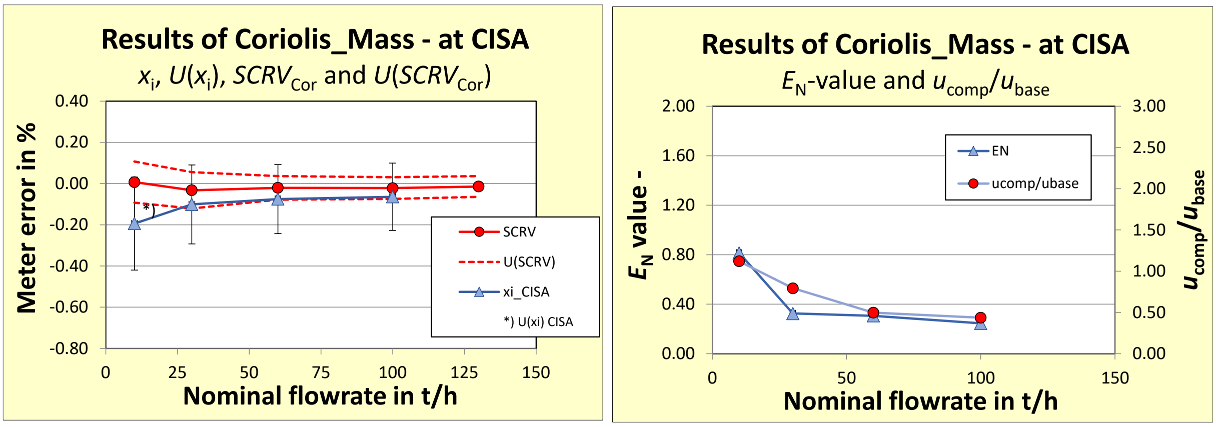


Figure 46: Comparison results of CISA laboratory for Coriolis_Mass transfer meter

INACAL - laboratory (Peru)

Beside the flowrate of 10 t/h, for mass calibration this comparison supported the declared base uncertainties of the participant (Table 34). The calibrations with Coriolis meter were not suitable for a confirmation of the declared CMC at the flowrate of 10 t/h, because the ratio of $u_{\mathrm{comp}}/u_{\mathrm{base}}$ was > 2.

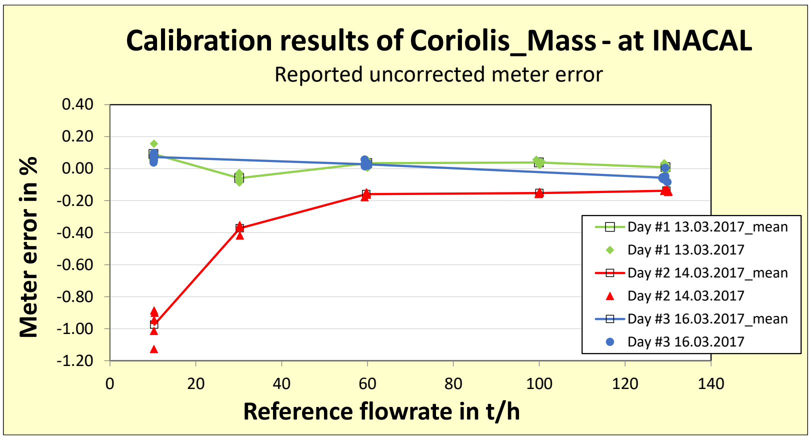


Figure 47: Calibration results of INACAL for Coriolis_Mass transfer meter – reported uncorrected meter error e_{m}

Table 34: Comparison decision table for INACAL laboratory (Coriolis_Mass transfer meter), where x_{i} is the temperature corrected meter error (mean of day #1 and day#2) - $^{c)}$ represents inconclusive data

	INACAL / Peru						
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}	$U_{\mathrm{base,i}}$ (k = 2)	$U(x_{\mathrm{i}})$ (k = 2)	d_{i}	$E_{\mathrm{N,i}}$		
t/h	%	%	%	-	-	-	
10	–0.348	0.076	0.378	–0.355	0.91	4.88 $^{c)}$	inconclusive
30	–0.120	0.076	0.164	–0.087	0.47	1.91	acceptable
60	0.040	0.076	0.117	0.061	0.47	1.16	acceptable
100	0.059	0.076	0.113	0.081	0.65	1.09	acceptable
130	0.072	0.076	0.109	0.087	0.72	1.02	acceptable

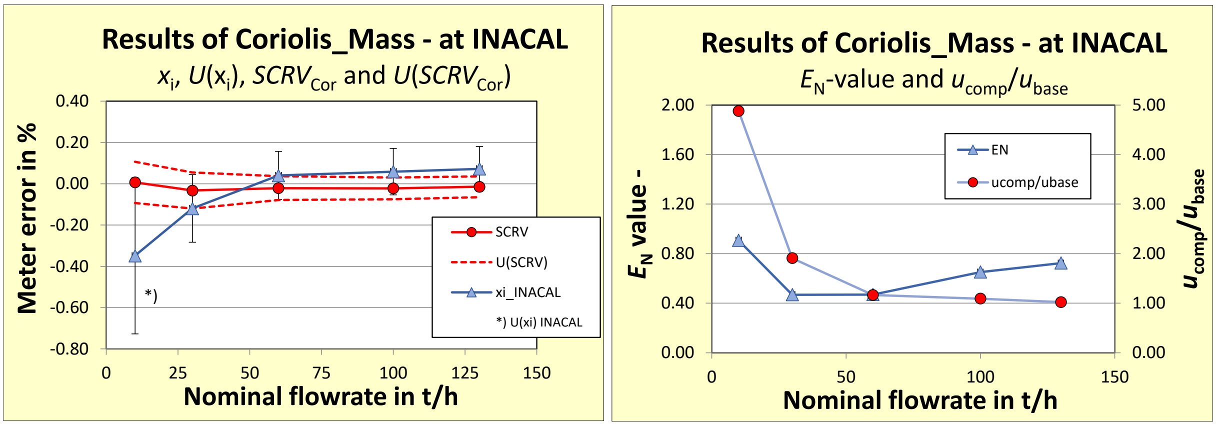


Figure 48: Comparison results of INACAL laboratory for Coriolis_Mass transfer meter

IBMETRO - laboratory (Bolivia)

For mass calibration this comparison supported the declared base uncertainties of the participant (Table 35).

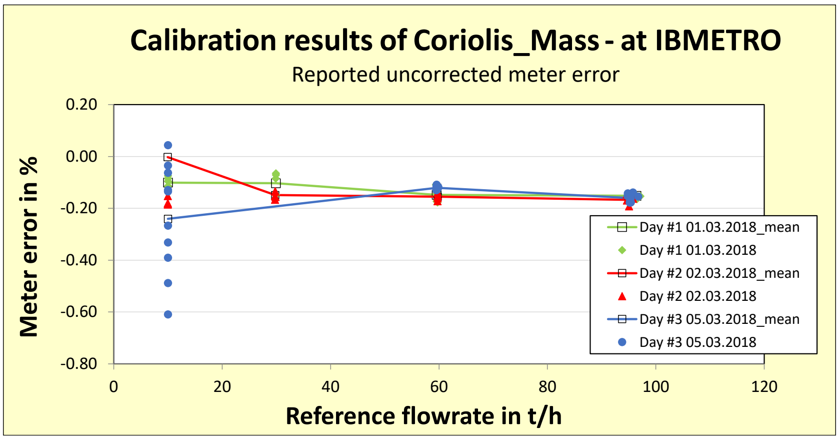


Figure 49: Calibration results of IBMETRO for Coriolis_Mass transfer meter - reported uncorrected meter error e_m

Table 35: Comparison decision table for IBMETRO laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2) - a) represents E_N - values at warning level between 1.00 and 1.20

	IBMETRO / Bolivia						
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	$E_{N,i}$		
t/h	%	%	%	-	-	-	
10	−0.154	0.100	0.172	−0.161	0.81	1.40	acceptable
30	−0.143	0.100	0.151	−0.111	0.63	1.12	acceptable
60	−0.160	0.100	0.123	−0.139	1.03 a)	0.70	warning level
100	−0.157	0.100	0.119	−0.135	1.04 a)	0.64	warning level

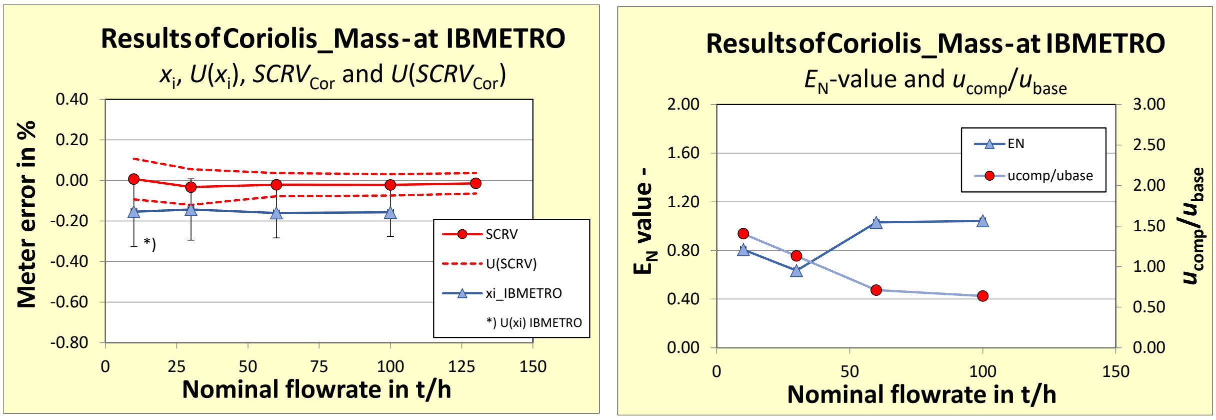


Figure 50: Comparison results of IBMETRO laboratory for Coriolis_Mass transfer meter

INTI - laboratory (Argentina)

For mass calibration between flowrates of 10 t/h and 60 t/h this comparison supported the declared base uncertainties of the participant (Table 36). The laboratory uncertainties for mass calibration at 100 t/h and 130 t/h must be declined, because the E_N value at both flowrates were > 1.20.

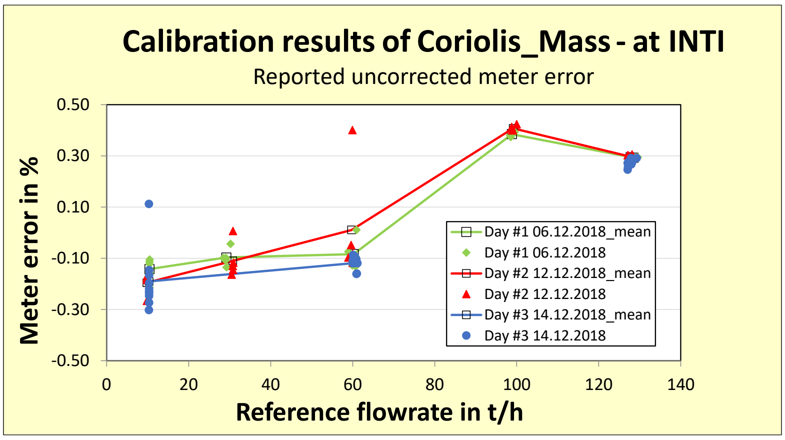


Figure 51: Calibration results of INTI for Coriolis_Mass transfer meter – reported uncorrected meter error e_m

Table 36: Comparison decision table for INTI laboratory (Coriolis_Mass transfer meter), where x_i is the temperature corrected meter error (mean of day #1 and day#2) - $^{b)}$ represents E_N -values > 1.20

	INTI / Argentinia						
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	$E_{N,i}$		
t/h	%	%	%	-	-	-	
10	–0.137	0.070	0.158	–0.144	0.77	2.00	acceptable
30	–0.073	0.070	0.136	–0.040	0.25	1.66	acceptable
60	–0.004	0.070	0.142	0.017	0.11	1.76	acceptable
100	0.439	0.220	0.229	0.461	1.96 $^{b)}$	0.93	not accepted
130	0.338	0.220	0.230	0.353	1.50 $^{b)}$	0.95	not accepted

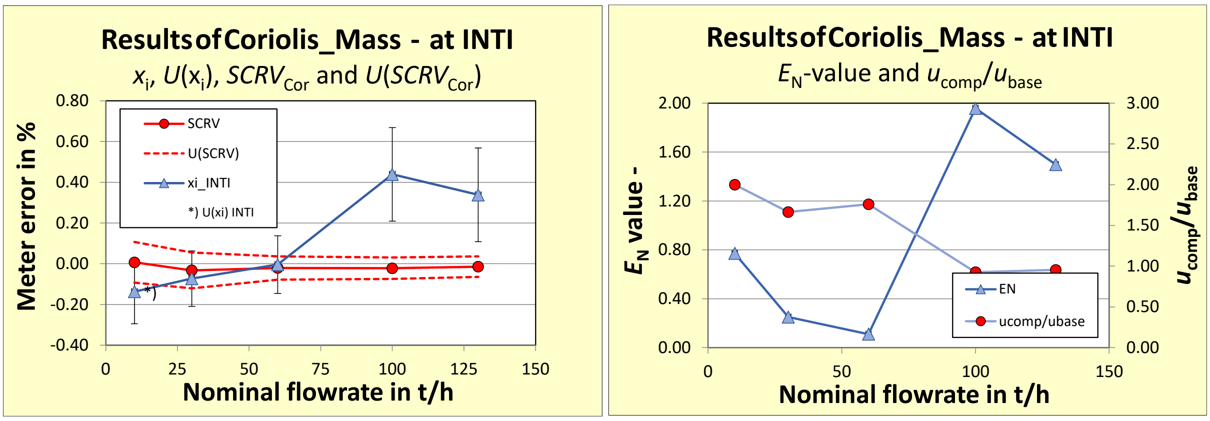


Figure 52: Comparison results of INTI laboratory for Coriolis_Mass transfer meter

9 Nomenclature and unit symbols

Terms and abbreviations

BIPM	Bureau International des Poids et Mesures
CCM	Consultative Committee for Mass and Related Quantities
CCM.FF-K1.2015	Official identifier of Key Comparison CCM-K1.2015
CENAM	Centro Nacional de Metrología - Mexico
CIPM	International Committee for Weights and Measures
CISA	Calibraciones Industriales S.A. - Chile
CMC	Calibration and Measurement Capabilities
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
IBMETRO	Instituto Boliviano de Metrología - Bolivia
INACAL	Instituto Nacional de Calidad - Peru
KC1	Key comparison CCM.FF-K1.2015
KCRV	Key comparison reference value
MRA	(CIPM) Mutual Recognition Arrangement
NMI	National Metrology Institute
PTB	Physikalisch-Technische Bundesanstalt - Germany
RMO	Regional Metrology Organisation
SC	Supplementary Comparison
SIM	Sistema Interamericano de Metrología
TP	Technical Protocol
WGFF	(CCM) Working Group on Fluid Flow

Symbols and units

d_i	Degree of equivalence (DoE) as the difference of SIM-participant *i* to $SCRV_\mathrm{Cor}$ (%)
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 (%)
$E_\mathrm{N,i}$	Normalized Degree of Equivalence as the difference of SIM-participant *i* to *SCRV* (%)
e_nom	Meter error at nominal temperature of 20 °C (%)
e_m	Relative measurement error of Coriolis meter – mass (%)
$e_\mathrm{m,cor}$	Temperature corrected measurement error of Coriolis meter (%)
e_residual	Model residuals (%)
e_V	Relative measurement error of turbine meter – volume (%)
$e_\mathrm{V,cor}$	Temperature corrected measurement error of turbine meter (%)
i	Laboratory index

k	Coverage factor (-)
$KCRV$	Key Comparison Reference value of KC1 (%)
K_{m}	meter *K*-factor - mass-related output (Coriolis meter) (pulses/kg)
$K_{\mathrm{m,nom}}$	Nominal *K*-factor of Coriolis meter - mass output (pulses/kg)
K_V	meter *K*-factor - volume-related output (turbine meter) (pulses/L)
ΔK_{V}	Difference in meter K-factor of turbine meter (%)
$K_{\mathrm{V,nom}}$	Nominal *K*-factor of turbine meter (pulses/L)
m_{ref}	Mass, measured by the reference standard (kg)
n	Number of measurements at calibrated test point (-)
N	Counted number of pulses by the transfer meter (pulses)
p_{fluid}	Line pressure (bar)
s	Standard deviation of the mean of measurements at one flowrate point (%)
SCC_{i}	Supplementary comparison correction for laboratory *i (*%)
$SCRV$	Supplementary Comparison Reference value (%)
$SCRV_{\mathrm{Cor}}$	Reference value of the comparison for Coriolis_Mass meter (%)
$SCRV_{\mathrm{Turb}}$	Reference value of the comparison for turbine meter (%)
T_{air}	Air temperature (°C)
T_{fluid}	Fluid temperature (°C)
$\Delta T_{\mathrm{fluid}}$	Difference of current fluid temperature to nominal temperature of 20 °C (°C)
T_{nom}	Nominal fluid temperature of 20°C
$u_{\mathrm{base,i}}$	Standard uncertainty of laboratory reference (%)
u_{comp}	Standard uncertainty of transfer meter measurements (%)
u_{TS}	Standard uncertainty of transfer meter (%)
$U_{\mathrm{d,i}}$	Extended uncertainty of d_{i} of participant *i* during SIM comparison (%)
u_{drift}	Standard uncertainty due to drift of transfer meter (%)
u_{reprod}	Standard uncertainty due to reproducibility characteristics of transfer meter (%)
$\mathrm{u}_{\mathrm{SCC\_i}}$	Uncertainty of SCC for laboratory *i* (%)
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_{KCRV}	Standard uncertainty of Key comparison reference value during KC1 (%)
$\mathrm{u}_{\mathrm{SCRV,Cor}}$	Standard uncertainty of $SCRV_{\mathrm{Cor}}$ (%)
$u_{\mathrm{x,i}}$	Standard uncertainty of reported and temperature corrected meter error (%)
$u\mathrm{x}_{\mathrm{,Cor,i}}$	Uncertainty of $x_{\mathrm{Cor,i}}$ for reference laboratory *i* during SIM comparison (%)
$u_{\mathrm{x,KC1,i}}$	Uncertainty of calibration results of laboratory *i* during KC1 (%)
V_{ref}	Volume, measured by the reference standard (m^3)
x_{i}	Temperature corrected meter error for E_{N}-value evaluation
$\mathrm{x}_{\mathrm{KC1,i}}$	Results of laboratory *i* during KC1 (%)
$x_{\mathrm{Cor,i}}$	By SCC_{i} corrected results of reference laboratory *i* during SIM comparison (%)

10 References

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

[2] Personal communications

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

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

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

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

11 Appendices

11.1 Information about participating laboratories

NMI/DI	Country	RMO	Contact	Address
PTB	Germany	EURAMET	Enrico Frahm enrico.frahm@ ptb.de	**PTB - Physikalisch-Technische Bundesanstalt** Department 1.5 Liquid Flow Bundesallee 100 38116 Braunschweig, Germany
CENAM	Mexico	SIM/ Noramet	Roberto Arias Romero rarias@ cenam.mx	**CENAM - Centro Nacional de Metrología** km 4.5 carretera a los Cués, El Marqués, Querétaro México, 76246
CISA	Chile	SIM	Jeny Vargas Angel j.vargas@ci-sa.com	**Calibraciones Industriales S.A.** Nacional Flujo Líquido Barros Arana 73 Iquique República de Chile
INACAL	Peru	SIM	Adriel Arredondo aarredondo@ inacal.gob.pe	**Instituto Nacional de Calidad** Laboratorio de Flujo de Líquidos Calle De La Prosa 150, San Borja, Lima 41 Perú
IBMETRO	Bolivia	SIM	Juan José Mendoza Aguirre jjmendoza@ibmetro. gob.bo	**Instituto Boliviano de Metrología** Av. Camacho Nro. 1488 La Paz Bolivia
INTI	Argentina	SIM	Marcelo Alejandro Silvosa msilvosa@inti.gob.ar	**INSTITUTO NACIONAL DE TECNOLOGÍA INDUSTRIAL** Dirección Técnica de Eficiencia Energética Subgerencia de Áreas de Conocimiento Parque Tecnológico Miquelete Av. General Paz 5445 B1650WAB San Martín Buenos Aires Argentina

<table>
<tr><th>Characteristic information of primary standard used during SC</th><th>Working procedure</th></tr>
<tr><td>

CISA – Chile

<table>
<tr><td>Range of flowrate</td><td>8 to 300 t/h</td></tr>
<tr><td>Fluid temperature</td><td>17 °C to 28 °C</td></tr>
<tr><td>Line pressure</td><td>3 bar</td></tr>
<tr><td>Uncertainty (k = 2)</td><td>0.15 % (Reading)</td></tr>
<tr><td>Reference</td><td>Weighing System
Max. Cap: 3000 kg</td></tr>
<tr><td>Operating method</td><td>Diverter-operated flying start and finish</td></tr>
<tr><td>Calibration line diameter</td><td>80 mm (used during SC)
Note:
Max Diameter 250 mm</td></tr>
<tr><td>Test fluid</td><td>Cold water</td></tr>
</table>

</td><td>

Gravimetric calibration – static weighing – method.

The used method for flowmeter calibration (Coriolis and Turbine) is Gravimetric Method.

The gravimetric method comprises weighing the collected water, and time registration. The initial mass (m0) is automatically registered before the diverter turns the flow towards the weighing tank, starting the measurement of time. After collecting an appropriate amount of liquid, the diverter is activated in the opposed direction, turning aside the water towards the reserve tank; automatically, the measurement of the time stops. Thus, the time of filling (t) of the weighing tank is determined. When the movement of the water in the weighing tank has stopped, the final mass (m1) is registered. Then, the weighing tank is drained.

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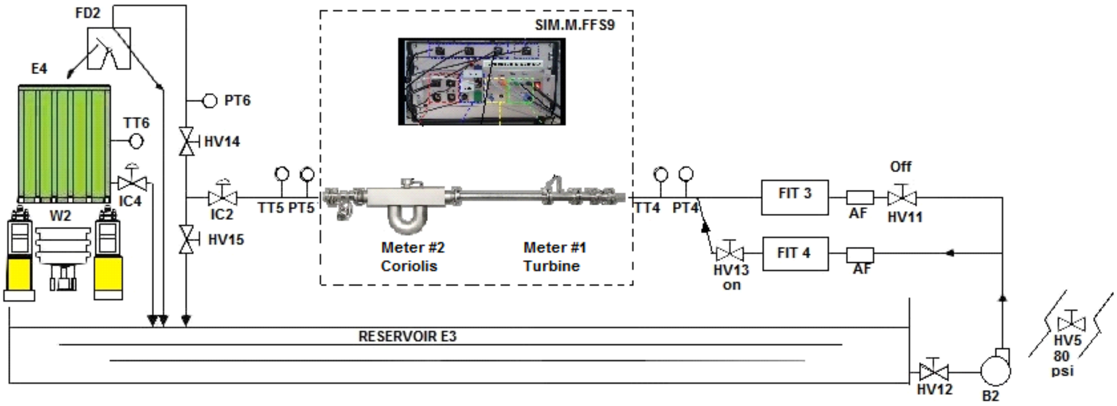

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</table>

Characteristic information of primary standard used during SC	Working procedure
INACAL – Peru	The static weighing system for flow determination represents the National Liquid Flow Standard of Peru. The static weighing system has two independent flow measurement lines; each one consists of a diverter, a set of nozzles for every flow interval and a weighing system, with maximum load capacities of 500 kg and 2000 kg, respectively. The test flow is established by means of frequency converters. Piping lengths upstream of 15D and downstream of 10D are available. The temperature of the test water is not controlled.

Range of flowrate	0.26 m³/h – 130 m³/h
Fluid temperature	15 °C – 30 °C
Line pressure	up to 3 bar
Uncertainty (k = 2)	0.26 m³/h – 10 m³/h : 0.11 % 10 m³/h – 130 m³/h : 0.08 % mass, volume
Reference	Weighing method
Operating method	Flying start and stop
Calibration line diameter	DN06 – DN100
Test fluid	Water

Fig. 1: Diverter and nozzle

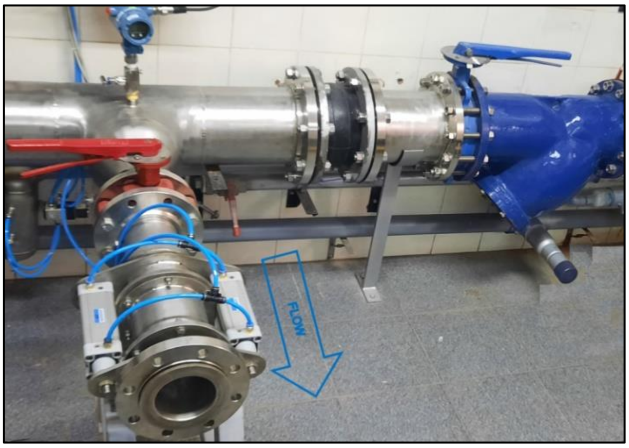


Fig. 2: Water flow entry

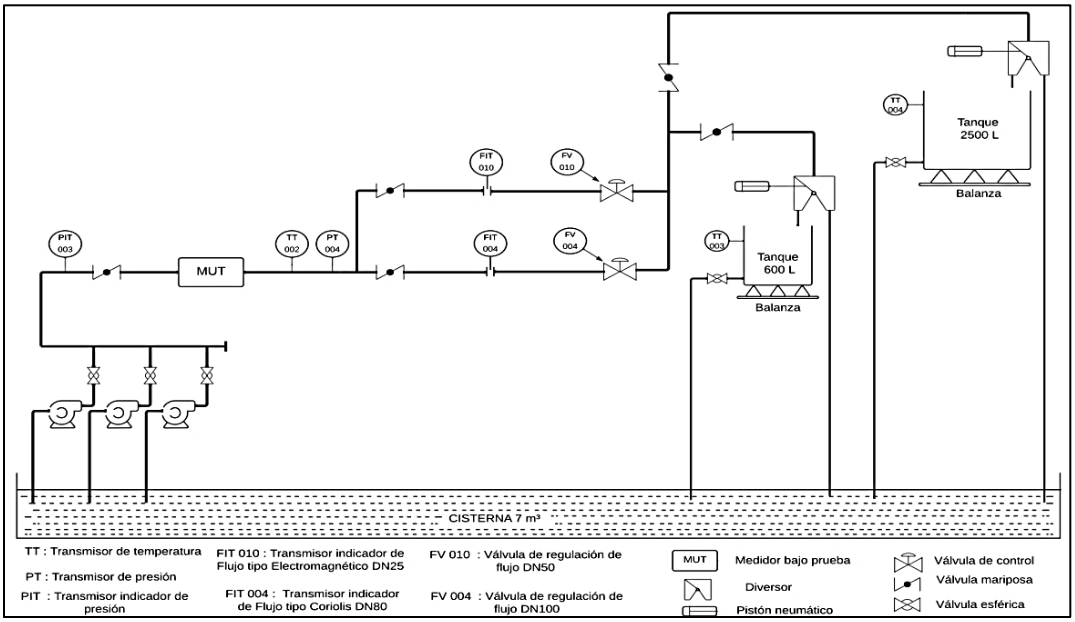


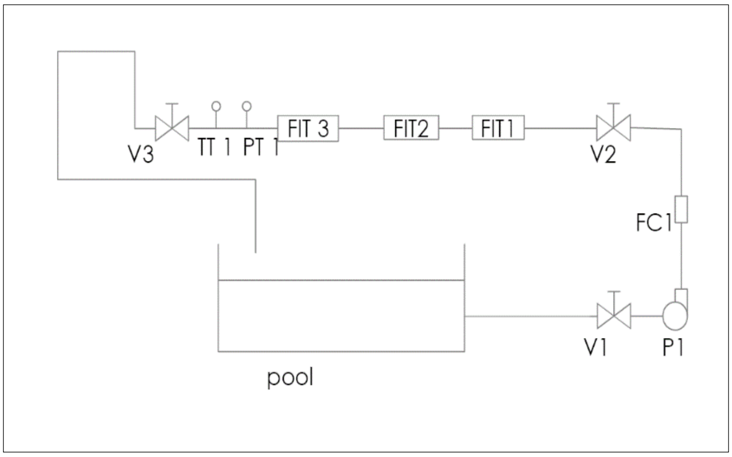
Fig. 3: Instrumentation diagram and the main components of the Static Weighing System

Characteristic information of primary standard used during SC	Working procedure
IBMETRO – Bolivia (see table below)	The calibration points of the flow meter under test (MUT) are established according to the comparison standards. Start the data acquisition program in the computer to determine the number of pulses to capture. The pulses were collected from MUT and the Electromagnetic Flow meter (reference meter). For each measurement, record the number of pulses from the reference meter and MUT. Also, fluid temperature, line pressure and measurement time were recorded. The ambient conditions at the beginning and at the end of each test flow were recorded.

IBMETRO – Bolivia

Range of flowrate	3 m³/h – 100 m³/h
Fluid temperature	16 °C – 28 °C
Line pressure	up to 3 bar
Uncertainty (k = 2)	0.10 %
Reference	master meter (Electromagnetic Flow meter)
Operating method	flying start stop
Calibration line diameter	50 mm … 125 mm
Test fluid	water

Calibration line



Schematic diagram of the flow line

TAG	DESCRIPTION
V1	Valve
P1	Pump
FC1	Flow stabilizer
V2	Valve
FIT 1	Meter under Test Turbine
FIT 2	Meter under Test Coriolis
FIT 3	Flow meter Krohne
PT 1	Pressure Sensor
TT 1	Temperature Sensor
V3	Valve
pool	Recipe

<table>
<tr><th>Characteristic information of primary standard used during SC</th><th>Working procedure</th></tr>
<tr><td>

INTI - Argentina

<table>
<tr><td>Range of flowrate</td><td>0.12 m^3/h – 130 m^3/h</td></tr>
<tr><td>Fluid temperature</td><td>15 °C – 30 °C</td></tr>
<tr><td>Line pressure</td><td>up to 3 bar</td></tr>
<tr><td>Uncertainty (k = 2)</td><td>Volumetric tank
mass: 0.07 %
volume: 0.06 %
Master meter
mass: 0.22 %
volume: 0.20 %</td></tr>
<tr><td>Reference</td><td>Volumetric tank
Master meter (turbine meter)</td></tr>
<tr><td>Operating method</td><td>standing-start-stop</td></tr>
<tr><td>Calibration line diameter</td><td>25 mm, 50 mm, 100 mm, 150 mm</td></tr>
<tr><td>Test fluid</td><td>water</td></tr>
</table>

</td><td>

The calibration system consists of two reference systems, a volumetric tank and a reference meter. Flow and line pressure are regulated by pump and valves. The calibration starts at zero flow with an enabled pump, the manual tank inlet valve will be opened at the same time as the time count begins. To calculate the density and the corrected volume of the tank, the temperature of the water is measured as well as the temperature difference compared to the reference temperature of 20 °C at which the tank was calibrated.

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<tr><td colspan="2">

Installed MUT during comparison calibration

Reference turbine meter

Calibration test rig

</td></tr>
</table>

Characteristic information of primary standard used during KC

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-stop
Calibration line diameter	100 mm 200 mm
Test fluid	Water

Working procedure

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.

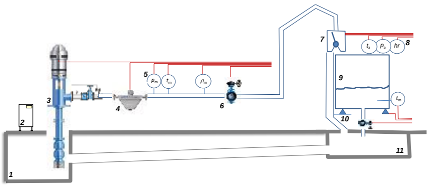


Fig. 1: Schematic diagram of CENAM water flow facility

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

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

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

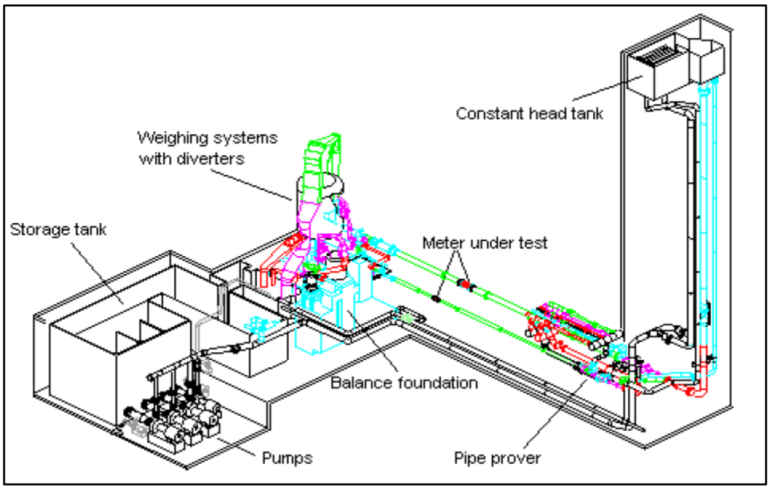
PTB – Germany

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

11.2 Detailed data report of participating laboratories

CISA laboratory – Day#1

Data report CISA : Day#1

*Original data set

		Laboratory reference					Fluid			Ambient conditions		Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error		
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	Pulses/ Liter	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}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
28.04.2016	10	353.513	10.221	10.234	1003.726	1.005	998.759	2.93	23.16	24.83	1.01	11491	11.4341	-0.443	144069	143.5342	-0.362	28837	28.6943	-0.367	3.160	-0.474	-0.321
28.04.2016	10	353.039	10.232	10.245	1003.424	1.005	998.747	2.96	23.20	25.24	1.01	11457	11.4036	-0.709	144076	143.5844	-0.327	28841	28.7066	-0.324	3.200	-0.740	-0.286
28.04.2016	10	352.740	10.244	10.257	1003.727	1.005	998.711	2.98	23.32	24.74	1.01	11475	11.4177	-0.586	144073	143.5380	-0.360	28842	28.6979	-0.355	3.320	-0.618	-0.317
28.04.2016	10	353.586	10.225	10.241	1004.324	1.006	998.516	2.99	23.94	25.79	1.01	11483	11.4166	-0.596	144078	143.4577	-0.415	28851	28.6841	-0.402	3.940	-0.627	-0.364
28.04.2016	10	353.124	10.240	10.254	1004.424	1.006	998.606	2.93	23.66	25.69	1.01	11472	11.4055	-0.692	144076	143.4414	-0.427	28845	28.6779	-0.424	3.660	-0.723	-0.379
28.04.2016	30	240.100	30.047	30.088	2003.957	2.007	998.634	2.90	23.57	25.87	1.01	23026	11.4746	-0.091	288149	143.7900	-0.185	57434	28.6211	-0.621	3.570	-0.078	-0.138
28.04.2016	30	240.993	29.946	29.988	2004.660	2.007	998.593	2.95	23.70	25.61	1.01	23038	11.4761	-0.078	288169	143.7496	-0.213	57448	28.6169	-0.636	3.700	-0.064	-0.165
28.04.2016	30	240.020	30.070	30.114	2004.861	2.008	998.567	2.97	23.78	25.46	1.01	23039	11.4751	-0.086	288184	143.7426	-0.218	57446	28.6123	-0.652	3.780	-0.072	-0.169
28.04.2016	30	239.771	30.082	30.126	2003.563	2.007	998.529	3.01	23.90	25.25	1.01	23022	11.4736	-0.099	288144	143.8158	-0.167	57430	28.6218	-0.619	3.900	-0.084	-0.116
28.04.2016	30	239.912	30.087	30.132	2005.063	2.008	998.499	2.97	23.99	25.32	1.01	23045	11.4762	-0.077	288150	143.7112	-0.239	57438	28.6035	-0.682	3.990	-0.061	-0.188
28.04.2016	60	120.809	59.678	59.771	2002.666	2.006	998.433	3.01	24.19	24.74	1.01	22989	11.4612	-0.207	288172	143.8942	-0.112	57090	28.4623	-1.172	4.190	-0.181	-0.058
28.04.2016	60	120.365	59.931	60.027	2003.766	2.007	998.389	3.04	24.32	24.88	1.01	23003	11.4614	-0.206	288218	143.8382	-0.151	57095	28.4479	-1.222	4.320	-0.178	-0.095
28.04.2016	60	120.506	59.876	59.974	2004.266	2.008	998.361	3.12	24.40	24.82	1.01	23018	11.4657	-0.168	288219	143.8028	-0.176	57098	28.4415	-1.245	4.400	-0.140	-0.119
28.04.2016	60	120.391	59.906	60.007	2003.366	2.007	998.320	3.04	24.52	24.79	1.01	23014	11.4684	-0.145	288194	143.8549	-0.140	57095	28.4516	-1.210	4.520	-0.116	-0.081
28.04.2016	60	120.518	59.891	59.994	2004.970	2.008	998.274	3.02	24.65	24.51	1.01	23032	11.4676	-0.151	288207	143.7463	-0.215	57102	28.4311	-1.281	4.650	-0.122	-0.155
28.04.2016	100	108.639	99.597	99.776	3005.586	3.011	998.202	2.43	24.85	24.68	1.01	34507	11.4603	-0.215	432283	143.8265	-0.159	86769	28.8173	0.060	4.850	-0.193	-0.096
28.04.2016	100	108.317	99.916	100.102	3006.282	3.012	998.140	2.46	25.02	24.85	1.01	34516	11.4599	-0.218	432253	143.7833	-0.189	86743	28.8002	0.001	5.020	-0.196	-0.124
28.04.2016	100	108.397	99.803	99.993	3005.084	3.011	998.095	2.45	25.14	24.79	1.01	34500	11.4587	-0.229	432347	143.8719	-0.128	86753	28.8138	0.048	5.140	-0.206	-0.061
28.04.2016	100	108.368	99.806	100.000	3004.389	3.010	998.061	2.47	25.23	24.47	1.01	34477	11.4533	-0.276	432306	143.8915	-0.114	86771	28.8254	0.088	5.230	-0.252	-0.046
28.04.2016	100	108.428	99.741	99.941	3004.095	3.010	998.000	2.47	25.39	24.09	1.01	34482	11.4554	-0.258	432262	143.8909	-0.115	86773	28.8271	0.094	5.390	-0.234	-0.044
28.04.2016	110	98.468	109.874	110.109	3005.300	3.012	997.871	2.28	25.72	23.70	1.01	34501	11.4556	-0.256	432332	143.8565	-0.138	86765	28.8092	0.032			
28.04.2016	110	98.097	110.286	110.525	3005.201	3.012	997.835	2.31	25.81	23.66	1.01	34501	11.4556	-0.256	432402	143.8846	-0.119	86784	28.8154	0.053			
28.04.2016	110	98.245	110.065	110.309	3003.702	3.010	997.786	2.29	25.93	23.63	1.01	34483	11.4547	-0.263	432329	143.9321	-0.086	86779	28.8267	0.093			
28.04.2016	110	98.058	110.312	110.560	3004.704	3.011	997.753	2.26	26.01	23.43	1.01	34497	11.4552	-0.259	432293	143.8721	-0.128	86765	28.8115	0.040			
28.04.2016	110	98.762	109.536	109.787	3005.007	3.012	997.720	2.23	26.09	23.27	1.01	34518	11.4606	-0.212	432272	143.8506	-0.143	86739	28.7990	-0.003			

CISA laboratory – Day#2

Data report CISA: Day#2					*Original data set							Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error		
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
29.04.2016	10	355.677	10.131	10.147	1000.924	1.003	998.389	2.97	24.32	24.34	1.01	11437	11.4080	-0.670	144065	143.9320	-0.086	28845	28.7719	-0.097	4.320	-0.701	-0.030
29.04.2016	10	355.301	10.145	10.160	1001.228	1.003	998.542	2.96	23.86	23.51	1.01	11428	11.3973	-0.763	144077	143.9003	-0.108	28843	28.7656	-0.119	3.860	-0.795	-0.058
29.04.2016	10	355.699	10.132	10.148	1001.126	1.003	998.486	2.99	24.03	23.91	1.01	11430	11.3999	-0.741	144073	143.9110	-0.101	28843	28.7669	-0.115	4.030	-0.772	-0.048
29.04.2016	10	354.861	10.154	10.170	1000.925	1.002	998.459	2.98	24.11	24.07	1.01	11437	11.4088	-0.663	144068	143.9349	-0.084	28844	28.7730	-0.094	4.110	-0.694	-0.031
29.04.2016	10	355.386	10.147	10.163	1001.726	1.003	998.433	2.99	24.19	24.09	1.01	11428	11.3904	-0.823	144072	143.8238	-0.161	28844	28.7492	-0.176	4.190	-0.854	-0.107
29.04.2016	30	240.313	29.989	30.036	2001.872	2.005	998.433	2.90	24.19	24.01	1.01	22972	11.4573	-0.241	288156	143.9433	-0.078	57447	28.6517	-0.515	4.190	-0.224	-0.024
29.04.2016	30	239.957	30.023	30.071	2001.170	2.004	998.402	2.94	24.28	24.11	1.01	22965	11.4575	-0.240	288165	143.9983	-0.040	57447	28.6608	-0.483	4.280	-0.221	0.015
29.04.2016	30	240.082	30.031	30.081	2002.770	2.006	998.334	2.97	24.48	21.19	1.01	22992	11.4610	-0.209	288140	143.8707	-0.129	57437	28.6310	-0.587	4.480	-0.189	-0.070
29.04.2016	30	240.320	30.009	30.060	2003.266	2.007	998.306	2.94	24.56	24.70	1.01	22988	11.4558	-0.254	288161	143.8456	-0.146	57448	28.6286	-0.595	4.560	-0.233	-0.087
29.04.2016	30	240.359	30.001	30.053	2003.064	2.007	998.260	2.94	24.69	24.91	1.01	22999	11.4619	-0.201	288173	143.8661	-0.132	57457	28.6346	-0.574	4.690	-0.179	-0.071
29.04.2016	60	120.353	59.918	60.013	2003.157	2.006	998.433	2.99	24.19	25.16	1.01	22972	11.4499	-0.305	288238	143.8919	-0.114	57094	28.4573	-1.190	4.190	-0.279	-0.060
29.04.2016	60	120.201	59.946	60.032	2001.551	2.004	998.567	2.92	23.78	25.93	1.01	22948	11.4487	-0.316	288187	143.9818	-0.051	57076	28.4750	-1.128	3.780	-0.292	-0.003
29.04.2016	60	120.230	59.959	60.046	2002.449	2.005	998.542	2.91	23.86	26.16	1.01	22964	11.4512	-0.294	288217	143.9323	-0.086	57081	28.4640	-1.167	3.860	-0.270	-0.036
29.04.2016	60	120.274	59.943	60.033	2002.651	2.006	998.499	2.94	23.99	25.88	1.01	22961	11.4481	-0.321	288175	143.8968	-0.111	57077	28.4579	-1.188	3.990	-0.296	-0.059
29.04.2016	60	120.250	59.976	60.067	2003.354	2.006	998.473	2.97	24.07	25.60	1.01	22963	11.4448	-0.350	288189	143.8533	-0.141	57076	28.4467	-1.227	4.070	-0.324	-0.088
29.04.2016	100	108.347	99.848	100.020	3005.073	3.010	998.288	2.42	24.61	24.96	1.01	34482	11.4550	-0.262	432323	143.8644	-0.133	86770	28.8251	0.087	4.610	-0.241	-0.073
29.04.2016	100	107.287	100.805	101.005	3004.177	3.010	998.016	2.46	25.35	24.55	1.01	34481	11.4549	-0.262	432289	143.8960	-0.111	86758	28.8218	0.076	5.350	-0.238	-0.041
29.04.2016	100	107.985	100.173	100.357	3004.779	3.010	998.169	2.48	24.94	24.39	1.01	34476	11.4527	-0.281	432320	143.8775	-0.124	86756	28.8198	0.069	4.940	-0.259	-0.060
29.04.2016	100	108.180	99.983	100.171	3004.481	3.010	998.125	2.46	25.06	24.23	1.01	34479	11.4543	-0.267	432295	143.8834	-0.120	86733	28.8138	0.048	5.060	-0.244	-0.054
29.04.2016	100	108.290	99.878	100.072	3004.381	3.010	998.061	2.37	25.23	24.31	1.01	34483	11.4553	-0.258	432314	143.8945	-0.112	86762	28.8225	0.078	5.230	-0.235	-0.044
29.04.2016	110	98.935	109.409	109.641	3006.777	3.013	997.887	2.30	25.68	24.41	1.01	34503	11.4508	-0.298	432313	143.7795	-0.192	86769	28.7968	-0.011			
29.04.2016	110	99.045	109.182	109.423	3003.877	3.010	997.802	2.32	25.89	24.49	1.01	34471	11.4503	-0.302	432375	143.9390	-0.081	86781	28.8262	0.091			
29.04.2016	110	99.156	109.086	109.331	3004.581	3.011	997.753	2.33	26.01	24.21	1.01	34476	11.4487	-0.316	432286	143.8756	-0.125	86816	28.8296	0.103			
29.04.2016	110	99.119	109.155	109.407	3005.380	3.012	997.699	2.24	26.14	24.18	1.01	34492	11.4503	-0.302	432287	143.8377	-0.152	86771	28.8055	0.019			
29.04.2016	110	98.800	109.450	109.708	3003.782	3.011	997.648	2.28	26.26	24.12	1.01	34476	11.4505	-0.300	432320	143.9252	-0.091	86780	28.8223	0.077			

CISA laboratory – Day#3

					*Original data set																Temperature correction of meter error		
Data report CISA: Day#3												Turbine meter			Coriolis_Mass			Coriolis_Vol			T_{nom}	20	°C
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
04.05.2016	10	357.301	10.134	10.142	1005.850	1.007	999.230	3.00	21.42	20.71	1.01	11503	11.4271	-0.504	144067	143.2292	-0.574	28828	28.6383	-0.562	1.420	-0.532	-0.555
04.05.2016	10	357.852	10.119	10.127	1005.849	1.007	999.178	3.04	21.63	20.88	1.01	11479	11.4030	-0.714	144065	143.2272	-0.575	28829	28.6378	-0.563	1.630	-0.742	-0.553
04.05.2016	10	359.076	10.089	10.098	1006.350	1.007	999.158	3.02	21.71	20.99	1.01	11489	11.4067	-0.682	144065	143.1560	-0.625	28827	28.6210	-0.622	1.710	-0.711	-0.602
04.05.2016	10	358.458	10.105	10.114	1006.149	1.007	999.115	3.03	21.88	21.15	1.01	11498	11.4178	-0.585	144075	143.1945	-0.598	28831	28.6294	-0.592	1.880	-0.614	-0.573
04.05.2016	10	358.241	10.114	10.123	1006.449	1.007	999.083	3.04	22.00	21.27	1.01	11504	11.4202	-0.565	144065	143.1419	-0.635	28828	28.6170	-0.635	2.000	-0.594	-0.608
04.05.2016	10	359.369	10.083	10.093	1006.549	1.007	999.062	3.00	22.08	21.38	1.01	11497	11.4111	-0.644	144072	143.1346	-0.640	28831	28.6166	-0.637	2.080	-0.673	-0.612
04.05.2016	10	358.912	10.098	10.108	1006.748	1.008	999.028	3.06	22.21	21.55	1.01	11519	11.4308	-0.472	144068	143.1023	-0.662	28830	28.6089	-0.663	2.210	-0.502	-0.633
04.05.2016	10	358.523	10.110	10.122	1006.840	1.008	998.798	3.05	23.03	23.45	1.01	11489	11.3970	-0.766	144071	143.0922	-0.669	28835	28.6047	-0.678	3.030	-0.797	-0.630
04.05.2016	10	359.414	10.087	10.097	1007.048	1.008	998.960	3.05	22.46	21.84	1.01	11490	11.3978	-0.759	144072	143.0637	-0.689	28835	28.6034	-0.683	2.460	-0.790	-0.657
04.05.2016	10	358.526	10.108	10.120	1006.637	1.008	998.783	3.04	23.08	24.24	1.01	11485	11.3956	-0.778	144070	143.1202	-0.650	28836	28.6110	-0.656	3.080	-0.809	-0.610
04.05.2016	60	119.885	60.195	60.262	2004.574	2.007	998.879	2.97	22.75	24.77	1.01	22986	11.4540	-0.270	288238	143.7901	-0.185	57073	28.4395	-1.252	2.750	-0.253	-0.149
04.05.2016	60	119.681	60.255	60.345	2003.167	2.006	998.516	2.98	23.94	25.53	1.01	22998	11.4637	-0.186	288193	143.8687	-0.130	57075	28.4501	-1.215	3.940	-0.161	-0.079
04.05.2016	60	119.978	60.175	60.249	2005.477	2.008	998.783	2.92	23.08	24.49	1.01	22993	11.4509	-0.297	288240	143.7264	-0.229	57075	28.4249	-1.302	3.080	-0.277	-0.189
04.05.2016	60	119.800	60.271	60.346	2005.674	2.008	998.747	2.91	23.20	24.85	1.01	22996	11.4513	-0.293	288222	143.7033	-0.245	57085	28.4261	-1.298	3.200	-0.273	-0.203
04.05.2016	60	119.860	60.201	60.293	2004.367	2.007	998.486	2.90	24.03	25.55	1.01	23004	11.4597	-0.220	288239	143.8055	-0.174	57089	28.4392	-1.253	4.030	-0.195	-0.122
04.05.2016	60	119.840	60.208	60.288	2004.266	2.007	998.684	2.88	23.41	25.74	1.01	23003	11.4621	-0.200	288228	143.8072	-0.173	57063	28.4333	-1.273	3.410	-0.178	-0.129
04.05.2016	60	119.892	60.212	60.294	2005.266	2.008	998.646	2.84	23.53	25.81	1.01	23033	11.4708	-0.124	288264	143.7535	-0.210	57079	28.4260	-1.299	3.530	-0.101	-0.164
04.05.2016	60	119.771	60.258	60.342	2004.766	2.008	998.606	2.94	23.66	25.90	1.01	23028	11.4708	-0.124	288265	143.7899	-0.185	57085	28.4349	-1.268	3.660	-0.100	-0.137
04.05.2016	60	119.804	60.226	60.312	2004.265	2.007	998.580	2.90	23.74	25.96	1.01	23025	11.4715	-0.118	288198	143.7924	-0.183	57071	28.4344	-1.270	3.740	-0.094	-0.135
04.05.2016	60	119.879	60.183	60.270	2004.066	2.007	998.555	2.87	23.82	25.74	1.01	23026	11.4730	-0.105	288200	143.8076	-0.172	57072	28.4369	-1.261	3.820	-0.081	-0.123
04.05.2016	110	97.692	110.746	110.889	3005.267	3.009	998.711	2.20	23.32	26.54	1.01	34471	11.4555	-0.257	432352	143.8648	-0.133	86701	28.8125	0.043			
04.05.2016	110	98.387	109.982	110.132	3005.769	3.010	998.634	2.27	23.57	26.38	1.01	34488	11.4584	-0.232	432356	143.8420	-0.149	86714	28.8098	0.034			
04.05.2016	110	98.123	110.259	110.421	3005.276	3.010	998.542	2.26	23.86	25.83	1.01	34473	11.4540	-0.270	432273	143.8381	-0.151	86737	28.8195	0.068			
04.05.2016	110	98.156	110.211	110.377	3004.975	3.009	998.499	2.24	23.99	25.89	1.01	34469	11.4534	-0.275	432258	143.8475	-0.145	86729	28.8185	0.064			
04.05.2016	110	98.262	110.089	110.260	3004.877	3.010	998.446	2.29	24.15	25.66	1.01	34468	11.4528	-0.280	432306	143.8681	-0.130	86741	28.8219	0.076			
04.05.2016	110	97.715	110.694	110.871	3004.578	3.009	998.402	2.20	24.28	25.61	1.01	34457	11.4499	-0.306	432278	143.8731	-0.127	86694	28.8079	0.027			
04.05.2016	110	97.926	110.482	110.669	3005.282	3.010	998.306	2.25	24.56	25.23	1.01	34477	11.4527	-0.281	432298	143.8461	-0.146	86737	28.8126	0.044			
04.05.2016	110	98.357	110.056	110.248	3006.881	3.012	998.260	2.22	24.69	25.24	1.01	34498	11.4532	-0.277	432437	143.8158	-0.167	86797	28.8159	0.055			
04.05.2016	110	98.274	110.105	110.302	3005.680	3.011	998.217	2.25	24.81	25.32	1.01	34481	11.4514	-0.293	432317	143.8333	-0.155	86742	28.8079	0.027			
04.05.2016	110	98.230	110.132	110.333	3005.081	3.011	998.184	2.19	24.90	25.32	1.01	34464	11.4478	-0.324	432281	143.8500	-0.143	86744	28.8134	0.046			

INACAL Laboratory – Day#1

					*Original data set																Temperature correction of meter error		
Data report INACAL: Day#1												Turbine meter			Coriolis_Mass			Coriolis_Vol			T_{nom}	20	°C
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
13.03.2017	10	118.482	10.273	10.302	338.086	0.339	997.161	2.15	25.57	24.80	992.70	3910	11.5323	0.412	48779	144.2798	0.155	9781	28.8484	0.168	5.572	0.384	0.228
13.03.2017	10	141.597	10.210	10.238	401.595	0.403	997.272	2.15	25.15	25.00	992.40	4644	11.5323	0.412	57906	144.1899	0.093	11612	28.8358	0.124	5.146	0.383	0.160
13.03.2017	10	133.559	10.061	10.090	373.267	0.374	997.161	2.15	25.57	25.00	992.40	4318	11.5353	0.438	53803	144.1406	0.059	10791	28.8275	0.096	5.572	0.410	0.132
13.03.2017	10	141.591	10.042	10.070	394.952	0.396	997.158	2.15	25.58	25.00	992.40	4567	11.5306	0.397	56924	144.1290	0.051	11416	28.8227	0.079	5.583	0.370	0.124
13.03.2017	10	134.009	10.008	10.037	372.560	0.374	997.156	2.15	25.59	25.10	992.30	4310	11.5357	0.441	53722	144.1968	0.098	10772	28.8312	0.108	5.594	0.414	0.171
13.03.2017	30	231.027	30.141	30.227	1934.260	1.940	997.141	2.19	25.65	25.30	991.80	22393	11.5439	0.513	278399	143.9305	-0.087	55573	28.6487	-0.525	5.649	0.544	-0.013
13.03.2017	30	230.808	30.121	30.208	1931.162	1.937	997.120	2.19	25.73	25.40	991.60	22354	11.5421	0.497	277988	143.9486	-0.075	55478	28.6450	-0.538	5.731	0.529	0.001
13.03.2017	30	228.048	30.119	30.207	1907.970	1.914	997.096	2.19	25.82	25.40	991.40	22079	11.5384	0.465	274659	143.9535	-0.071	54815	28.6461	-0.535	5.821	0.498	0.005
13.03.2017	30	227.785	30.105	30.194	1904.871	1.910	997.076	2.19	25.90	25.60	991.30	22045	11.5391	0.471	274309	144.0040	-0.036	54755	28.6607	-0.484	5.896	0.505	0.041
13.03.2017	30	230.657	30.116	30.205	1929.562	1.935	997.041	2.19	26.03	25.60	991.10	22325	11.5357	0.442	277888	144.0161	-0.028	55454	28.6541	-0.506	6.027	0.477	0.052
13.03.2017	60	116.970	60.008	60.188	1949.755	1.956	997.001	2.02	26.18	25.70	990.90	22587	11.5498	0.564	280887	144.0627	0.005	55718	28.4912	-1.072	6.178	0.603	0.086
13.03.2017	60	117.683	60.011	60.194	1961.751	1.968	996.960	2.02	26.33	25.90	990.80	22709	11.5407	0.485	282661	144.0861	0.021	56077	28.4983	-1.048	6.333	0.524	0.105
13.03.2017	60	117.300	59.916	60.101	1952.254	1.958	996.922	2.01	26.47	25.90	990.80	22602	11.5418	0.494	281358	144.1196	0.044	55823	28.5061	-1.020	6.472	0.534	0.130
13.03.2017	60	117.230	59.961	60.148	1952.554	1.959	996.884	2.01	26.61	26.00	990.80	22614	11.5457	0.528	281414	144.1261	0.049	55833	28.5058	-1.022	6.613	0.569	0.136
13.03.2017	60	119.703	59.909	60.099	1992.040	1.998	996.845	2.01	26.76	26.00	990.60	23085	11.5521	0.584	287118	144.1327	0.053	56964	28.5056	-1.022	6.758	0.626	0.143
13.03.2017	100	72.162	99.363	99.685	1991.740	1.998	996.777	2.00	27.01	26.00	990.40	23074	11.5475	0.544	287080	144.1353	0.055	57744	28.8983	0.341	7.005	0.576	0.148
13.03.2017	100	70.122	99.986	100.317	1947.556	1.954	996.706	2.02	27.26	26.10	990.30	22552	11.5415	0.492	280663	144.1104	0.038	56444	28.8865	0.300	7.262	0.525	0.135
13.03.2017	100	70.300	100.572	100.912	1963.950	1.971	996.630	2.03	27.54	26.20	990.10	22739	11.5392	0.472	283034	144.1147	0.041	56923	28.8863	0.300	7.536	0.506	0.142
13.03.2017	100	70.982	99.712	100.055	1966.049	1.973	996.576	2.00	27.73	26.20	990.10	22779	11.5465	0.536	283327	144.1098	0.037	56976	28.8807	0.280	7.728	0.571	0.141
13.03.2017	100	70.817	100.051	100.400	1968.148	1.975	996.526	2.01	27.91	26.30	989.90	22802	11.5453	0.525	283586	144.0877	0.022	57034	28.8778	0.270	7.909	0.560	0.129
13.03.2017	130	54.974	129.147	129.608	1972.147	1.979	996.446	1.70	28.19	26.30	989.80	22869	11.5548	0.608	284193	144.1034	0.033	57167	28.8842	0.292	8.190	0.641	0.144
13.03.2017	130	55.121	129.561	130.034	1983.743	1.991	996.363	1.97	28.48	26.20	990.00	23007	11.5556	0.615	285821	144.0817	0.018	57496	28.8782	0.271	8.481	0.649	0.133
13.03.2017	130	54.080	129.332	129.829	1942.857	1.950	996.169	2.00	29.15	26.20	990.00	22498	11.5355	0.440	279923	144.0780	0.015	56326	28.8803	0.279	9.149	0.477	0.141
13.03.2017	130	54.571	129.738	130.249	1966.649	1.974	996.078	2.01	29.46	26.30	990.20	22774	11.5347	0.433	283284	144.0440	-0.008	57004	28.8717	0.249	9.461	0.471	0.122
13.03.2017	130	54.586	129.332	129.853	1961.051	1.969	995.993	1.99	29.75	26.30	990.20	22726	11.5422	0.498	282459	144.0345	-0.015	56838	28.8673	0.234	9.746	0.538	0.120

INACAL Laboratory – Day#2

					*Original data set																Temperature correction of meter error		
Data report INACAL: Day#2												Turbine meter			Coriolis_Mass			Coriolis_Vol			T_{nom}	20	°C
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
14.03.2017	10	152.569	10.411	10.449	441.211	0.443	996.354	2.08	28.51	22.70	993.80	5083	11.4786	-0.056	62986	142.7571	-0.902	12639	28.5417	-0.897	8.512	-0.065	-0.786
14.03.2017	10	137.512	10.299	10.336	393.385	0.395	996.365	2.08	28.47	23.10	993.90	4537	11.4913	0.055	56167	142.7786	-0.887	11271	28.5472	-0.878	8.473	0.046	-0.771
14.03.2017	10	137.043	10.302	10.339	392.160	0.394	996.365	2.08	28.47	22.70	993.70	4522	11.4891	0.036	55959	142.6943	-0.945	11229	28.5296	-0.939	8.473	0.026	-0.830
14.03.2017	10	137.791	10.270	10.308	393.086	0.395	996.357	2.08	28.50	22.70	993.70	4535	11.4949	0.086	56052	142.5949	-1.014	11248	28.5104	-1.006	8.503	0.077	-0.899
14.03.2017	10	141.501	10.273	10.311	403.801	0.405	996.352	2.08	28.52	22.70	993.70	4663	11.5056	0.180	57514	142.4317	-1.128	11539	28.4717	-1.140	8.520	0.171	-1.012
14.03.2017	30	228.894	30.268	30.378	1924.476	1.931	996.365	2.11	28.47	22.80	993.70	22228	11.5082	0.202	276072	143.4531	-0.419	55141	28.5483	-0.874	8.473	0.264	-0.303
14.03.2017	30	228.168	30.258	30.369	1917.772	1.925	996.370	2.10	28.46	23.60	993.50	22156	11.5111	0.227	275256	143.5290	-0.366	54983	28.5662	-0.812	8.456	0.289	-0.251
14.03.2017	30	230.767	30.241	30.351	1938.485	1.946	996.369	2.10	28.46	23.60	993.50	22385	11.5057	0.181	278232	143.5306	-0.365	55573	28.5642	-0.819	8.459	0.242	-0.250
14.03.2017	30	229.234	30.246	30.357	1925.978	1.933	996.356	2.10	28.51	23.80	993.40	22241	11.5058	0.181	276469	143.5474	-0.353	55225	28.5693	-0.801	8.505	0.244	-0.237
14.03.2017	30	231.050	30.246	30.356	1941.187	1.948	996.363	2.10	28.48	24.00	993.30	22422	11.5087	0.206	278638	143.5400	-0.358	55657	28.5673	-0.808	8.481	0.268	-0.243
14.03.2017	60	119.022	59.335	59.553	1961.715	1.969	996.341	2.00	28.56	24.00	993.30	22654	11.5058	0.181	282091	143.7982	-0.179	56000	28.4420	-1.243	8.558	0.233	-0.062
14.03.2017	60	118.136	59.716	59.936	1959.613	1.967	996.335	1.99	28.58	23.90	993.10	22638	11.5099	0.217	281868	143.8386	-0.151	55945	28.4444	-1.235	8.580	0.269	-0.034
14.03.2017	60	117.376	59.728	59.951	1947.406	1.955	996.295	2.00	28.72	23.90	992.60	22497	11.5095	0.213	280118	143.8416	-0.149	55607	28.4486	-1.220	8.718	0.266	-0.030
14.03.2017	60	117.084	59.930	60.153	1949.106	1.956	996.280	2.02	28.77	23.90	992.60	22520	11.5110	0.227	280350	143.8351	-0.153	55652	28.4463	-1.228	8.770	0.279	-0.034
14.03.2017	60	118.767	59.872	60.099	1975.223	1.983	996.224	2.01	28.96	24.00	992.50	22826	11.5125	0.240	284077	143.8202	-0.164	56395	28.4434	-1.238	8.963	0.293	-0.041
14.03.2017	100	71.046	100.112	100.497	1975.711	1.983	996.168	2.06	29.15	24.50	992.10	22850	11.5211	0.315	284199	143.8465	-0.145	57194	28.8376	0.131	9.154	0.356	-0.020
14.03.2017	100	69.718	100.020	100.409	1936.986	1.945	996.123	2.05	29.31	24.50	992.10	22398	11.5185	0.292	278618	143.8410	-0.149	56057	28.8281	0.098	9.308	0.333	-0.021
14.03.2017	100	72.109	99.845	100.238	1999.926	2.008	996.077	2.05	29.46	24.60	992.10	23129	11.5196	0.301	287643	143.8268	-0.159	57880	28.8275	0.096	9.462	0.343	-0.029
14.03.2017	100	71.751	99.967	100.367	1992.422	2.000	996.014	2.05	29.68	24.20	992.10	23043	11.5192	0.298	286566	143.8280	-0.158	57667	28.8278	0.097	9.675	0.341	-0.024
14.03.2017	100	69.990	100.234	100.639	1948.694	1.957	995.974	2.06	29.81	24.20	992.10	22548	11.5242	0.342	280300	143.8399	-0.150	56432	28.8423	0.147	9.809	0.386	-0.014
14.03.2017	130	55.043	129.703	130.236	1983.116	1.991	995.905	2.01	30.04	24.20	992.10	22948	11.5243	0.342	285317	143.8731	-0.127	57398	28.8248	0.086	10.039	0.383	0.013
14.03.2017	130	55.056	129.090	129.637	1974.210	1.983	995.783	2.06	30.44	24.00	992.00	22854	11.5275	0.370	283998	143.8540	-0.140	57164	28.8333	0.116	10.443	0.412	0.006
14.03.2017	130	54.736	129.226	129.792	1964.805	1.973	995.642	2.06	30.91	24.00	992.00	22755	11.5308	0.399	282664	143.8637	-0.134	56935	28.8511	0.178	10.905	0.443	0.020
14.03.2017	130	53.723	130.141	130.715	1942.090	1.951	995.603	2.08	31.03	23.70	992.00	22490	11.5294	0.386	279369	143.8496	-0.143	56211	28.8163	0.057	11.033	0.430	0.012
14.03.2017	130	54.280	129.987	130.565	1959.902	1.969	995.572	2.07	31.13	23.70	992.00	22699	11.5304	0.395	281923	143.8455	-0.146	56736	28.8202	0.070	11.131	0.440	0.011

INACAL Laboratory – Day#3

Data report INACAL: Day#3					*Original data set							Turbine meter			Coriolis_Mass			Coriolis_Vol			Temperature correction of meter error		
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
16.03.2017	10	133.411	10.294	10.329	381.468	0.383	996.616	2.04	27.59	24.60	994.40	4390	11.4692	-0.137	54991	144.1563	0.070	11031	28.8194	0.067	7.588	-0.154	0.172
16.03.2017	10	129.440	10.186	10.221	366.248	0.367	996.617	2.05	27.58	24.70	994.40	4216	11.4724	-0.110	52800	144.1644	0.075	10593	28.8251	0.087	7.584	-0.126	0.177
16.03.2017	10	134.707	10.207	10.242	381.949	0.383	996.617	2.05	27.58	24.90	994.10	4396	11.4704	-0.127	55069	144.1788	0.085	11047	28.8248	0.086	7.584	-0.143	0.187
16.03.2017	10	125.138	10.258	10.292	356.557	0.358	996.617	2.05	27.58	24.90	994.10	4104	11.4711	-0.121	51413	144.1928	0.095	10314	28.8288	0.100	7.582	-0.137	0.197
16.03.2017	10	119.761	10.257	10.292	341.214	0.342	996.615	2.05	27.59	25.10	993.80	3928	11.4729	-0.106	49192	144.1674	0.077	9868	28.8223	0.078	7.591	-0.122	0.179
16.03.2017	10	118.457	10.249	10.283	337.231	0.338	996.615	2.05	27.59	25.10	993.80	3883	11.4754	-0.084	48605	144.1295	0.051	9748	28.8081	0.028	7.589	-0.100	0.153
16.03.2017	10	113.721	10.256	10.291	323.982	0.325	996.613	2.05	27.60	25.10	993.70	3730	11.4740	-0.096	46717	144.1962	0.097	9372	28.8296	0.103	7.597	-0.112	0.199
16.03.2017	10	126.534	10.174	10.208	357.594	0.359	996.614	2.05	27.59	25.20	993.60	4117	11.4741	-0.095	51545	144.1439	0.061	10341	28.8204	0.071	7.593	-0.111	0.163
16.03.2017	10	115.743	10.195	10.230	327.776	0.329	996.615	2.05	27.59	25.20	993.50	3773	11.4719	-0.114	47236	144.1104	0.038	9476	28.8121	0.042	7.592	-0.130	0.140
16.03.2017	10	126.548	10.249	10.284	360.285	0.362	996.611	2.05	27.60	25.30	993.30	4147	11.4713	-0.119	51944	144.1748	0.083	10421	28.8263	0.091	7.604	-0.135	0.185
16.03.2017	60	112.450	59.412	59.614	1855.791	1.862	996.602	2.01	27.64	25.30	993.20	21458	11.5234	0.335	267415	144.0976	0.029	53067	28.4982	-1.048	7.636	0.381	0.132
16.03.2017	60	117.018	59.405	59.609	1930.964	1.938	996.579	2.00	27.72	25.40	993.10	22330	11.5246	0.345	278250	144.0990	0.030	55227	28.5029	-1.032	7.721	0.392	0.134
16.03.2017	60	118.320	59.393	59.599	1952.057	1.959	996.552	2.01	27.81	25.50	993.00	22575	11.5249	0.347	281246	144.0768	0.014	55810	28.4918	-1.070	7.815	0.395	0.120
16.03.2017	60	117.762	59.329	59.537	1940.761	1.948	996.521	2.00	27.93	25.70	992.90	22449	11.5269	0.365	279738	144.1383	0.057	55500	28.4975	-1.050	7.927	0.413	0.164
16.03.2017	60	112.842	59.419	59.628	1862.489	1.869	996.487	2.02	28.05	25.70	992.80	21540	11.5245	0.344	268343	144.0777	0.015	53264	28.4978	-1.049	8.046	0.393	0.124
16.03.2017	60	115.957	60.079	60.295	1935.163	1.942	996.422	2.03	28.27	25.90	992.50	22400	11.5338	0.425	278865	144.1042	0.033	55356	28.5030	-1.031	8.275	0.475	0.146
16.03.2017	60	116.281	60.128	60.347	1942.160	1.949	996.374	2.03	28.44	26.00	992.20	22481	11.5333	0.420	279834	144.0839	0.019	55554	28.5005	-1.040	8.441	0.471	0.134
16.03.2017	60	117.239	60.101	60.321	1957.255	1.964	996.340	2.03	28.56	26.00	992.20	22652	11.5310	0.400	282012	144.0855	0.020	55982	28.4976	-1.050	8.561	0.452	0.137
16.03.2017	60	116.213	59.993	60.216	1936.663	1.944	996.296	2.02	28.71	26.00	992.20	22415	11.5312	0.402	279064	144.0953	0.027	55406	28.5030	-1.031	8.714	0.454	0.146
16.03.2017	60	116.838	59.971	60.196	1946.359	1.954	996.262	2.01	28.83	26.10	992.20	22529	11.5317	0.406	280470	144.0998	0.030	55679	28.4998	-1.042	0.000	0.000	0.000
16.03.2017	130	54.565	129.331	129.826	1960.251	1.968	996.187	1.99	29.09	26.20	992.20	22703	11.5375	0.457	282399	144.0627	0.005	56833	28.8822	0.285	9.089	0.494	0.129
16.03.2017	130	53.996	128.808	129.321	1931.961	1.940	996.028	1.99	29.63	26.10	992.20	22374	11.5350	0.435	278163	143.9796	-0.053	55990	28.8658	0.229	9.627	0.474	0.080
16.03.2017	130	53.672	129.404	129.927	1929.262	1.937	995.975	2.03	29.81	26.10	992.20	22341	11.5335	0.422	277789	143.9872	-0.048	55911	28.8639	0.222	9.805	0.462	0.088
16.03.2017	130	54.831	129.142	129.672	1966.949	1.975	995.909	2.03	30.03	26.10	992.20	22783	11.5355	0.440	283172	143.9651	-0.063	56979	28.8497	0.173	10.027	0.480	0.076
16.03.2017	130	54.177	128.643	129.182	1935.960	1.944	995.829	2.02	30.29	26.00	992.20	22439	11.5423	0.499	278722	143.9710	-0.059	56100	28.8570	0.198	10.291	0.540	0.085
16.03.2017	130	54.093	128.863	129.413	1936.260	1.945	995.750	2.02	30.55	26.10	992.20	22441	11.5406	0.484	278747	143.9616	-0.066	56106	28.8533	0.185	10.552	0.527	0.082
16.03.2017	130	54.003	129.083	129.646	1936.360	1.945	995.654	2.03	30.87	26.30	992.20	22443	11.5399	0.478	278786	143.9743	-0.057	56138	28.8655	0.227	10.866	0.522	0.096
16.03.2017	130	54.510	129.308	129.880	1957.952	1.967	995.596	2.04	31.05	26.30	992.20	22693	11.5391	0.471	281857	143.9550	-0.070	56775	28.8694	0.241	11.054	0.515	0.086
16.03.2017	130	53.547	129.765	130.341	1930.162	1.939	995.577	2.05	31.12	26.30	992.20	22376	11.5415	0.492	277826	143.9392	-0.081	55928	28.8476	0.165	11.116	0.537	0.076
16.03.2017	130	54.266	129.869	130.449	1957.652	1.966	995.556	2.03	31.18	26.30	992.20	22706	11.5470	0.540	281774	143.9347	-0.084	56716	28.8427	0.148	11.182	0.585	0.074

IBMETRO Laboratory – Day#1

					*Original data set																	Temperature correction of meter error		
Data report IBMETRO: Day#1												Turbine meter			Coriolis_Mass			Coriolis_Vol				T_{nom}	20	°C
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[m^3/h]	[s]	[t/h]	[m^3/h]	[kg]	[m^3]	[kg/m^3]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]		[°C]	[%]	[%]
01.03.2018	10	301.094	10.009	10.034	837.120	0.839	997.500	2.23	17.10	18.10	0.89	9425	11.2307	-2.214	120455	143.8921	-0.114	24110	28.7291	-0.246		-2.900	-2.211	-0.142
01.03.2018	10	300.871	10.014	10.039	836.910	0.839	997.500	2.21	16.80	18.00	0.89	9409	11.2144	-2.356	120446	143.9175	-0.096	24109	28.7351	-0.225		-3.200	-2.349	-0.127
01.03.2018	10	301.337	10.008	10.031	837.727	0.840	997.700	2.23	16.90	18.00	0.89	9424	11.2236	-2.276	120589	143.9479	-0.075	24136	28.7450	-0.191		-3.100	-2.270	-0.105
01.03.2018	10	300.454	10.014	10.034	835.742	0.837	998.000	2.23	16.90	18.00	0.89	9398	11.2226	-2.285	120291	143.9331	-0.085	24076	28.7503	-0.173		-3.100	-2.279	-0.116
01.03.2018	10	301.162	10.017	10.035	838.008	0.840	998.200	2.23	17.00	18.00	0.89	9414	11.2136	-2.363	120558	143.8626	-0.134	24130	28.7426	-0.199		-3.000	-2.359	-0.163
01.03.2018	30	299.817	29.902	29.956	2490.292	2.495	998.200	2.04	16.90	18.10	0.89	28376	11.3741	-0.965	358507	143.9618	-0.065	71467	28.6466	-0.533		-3.100	-0.988	-0.096
01.03.2018	30	300.843	29.903	29.954	2498.891	2.503	998.300	2.04	17.10	18.10	0.89	28467	11.3725	-0.980	359724	143.9535	-0.071	71708	28.6471	-0.531		-2.900	-1.002	-0.099
01.03.2018	30	301.602	29.890	29.935	2504.147	2.508	998.500	2.04	17.20	18.10	0.89	28533	11.3772	-0.939	360431	143.9336	-0.085	71851	28.6498	-0.522		-2.800	-0.961	-0.112
01.03.2018	30	301.830	29.916	29.946	2508.222	2.511	999.000	2.05	17.20	18.10	0.89	28522	11.3600	-1.088	360789	143.8425	-0.148	71925	28.6470	-0.531		-2.800	-1.110	-0.175
01.03.2018	30	300.953	29.923	29.950	2501.507	2.504	999.100	2.06	17.30	18.10	0.89	28499	11.3825	-0.893	359825	143.8433	-0.148	71734	28.6505	-0.519		-2.700	-0.914	-0.174
01.03.2018	60	301.088	59.728	59.782	4995.416	5.000	999.100	2.06	17.60	18.30	0.89	56991	11.3984	-0.754	718343	143.8004	-0.177	142272	28.4549	-1.198		-2.400	-0.775	-0.201
01.03.2018	60	301.136	59.569	59.628	4982.846	4.988	999.000	2.03	17.90	18.40	0.89	57117	11.4513	-0.294	716572	143.8078	-0.172	141914	28.4520	-1.208		-2.100	-0.312	-0.192
01.03.2018	60	301.185	59.520	59.597	4979.552	4.986	998.700	2.01	18.10	18.40	0.89	57099	11.4518	-0.289	716357	143.8597	-0.136	141869	28.4533	-1.204		-1.900	-0.306	-0.154
01.03.2018	60	301.161	59.483	59.567	4976.108	4.983	998.600	2.00	18.20	18.50	0.89	57051	11.4489	-0.314	715797	143.8468	-0.145	141656	28.4274	-1.294		-1.800	-0.330	-0.162
01.03.2018	60	301.642	59.425	59.521	4979.234	4.987	998.400	1.99	18.30	18.50	0.89	57124	11.4541	-0.269	716505	143.8986	-0.109	141695	28.4117	-1.348		-1.700	-0.284	-0.125
01.03.2018	100	301.361	97.148	97.313	8132.361	8.146	998.300	0.28	18.80	18.20	0.89	93355	11.4599	-0.218	1169720	143.8352	-0.153	234507	28.7873	-0.044		-1.200	-0.228	-0.164
01.03.2018	100	301.093	96.482	96.656	8069.470	8.084	998.200	0.28	18.90	18.20	0.89	92669	11.4632	-0.190	1160540	143.8186	-0.165	232667	28.7811	-0.066		-1.100	-0.198	-0.174
01.03.2018	100	301.318	96.143	96.326	8047.091	8.062	998.100	0.27	19.00	18.10	0.89	92424	11.4636	-0.187	1157520	143.8433	-0.148	232062	28.7832	-0.058		-1.000	-0.195	-0.156
01.03.2018	100	301.432	96.290	96.483	8062.446	8.079	998.000	0.27	19.10	18.00	0.89	92610	11.4636	-0.186	1159710	143.8410	-0.149	232503	28.7801	-0.069		-0.900	-0.194	-0.157
02.03.2018	100	301.847	96.145	96.337	8061.365	8.078	998.000	0.27	19.30	18.00	0.89	92606	11.4647	-0.177	1159610	143.8478	-0.144	232512	28.7851	-0.052		-0.700	-0.184	-0.150

IBMETRO Laboratory – Day#2

					*Original data set																Temperature correction of meter error		
Data report IBMETRO: Day#2												Turbine meter			Coriolis_Mass			Coriolis_Vol			T_{nom}	20	°C
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
02.03.2018	10	301.197	9.980	10.000	834.979	0.837	998.000	2.01	19.00	16.90	0.89	9371	11.2006	-2.476	120064	143.7929	-0.183	24043	28.7372	-0.218	-1.000	-2.491	-0.191
02.03.2018	10	301.007	9.970	9.990	833.596	0.835	998.000	1.99	19.00	17.00	0.89	9384	11.2347	-2.179	119901	143.8358	-0.153	24011	28.7465	-0.186	-1.000	-2.193	-0.161
02.03.2018	10	300.871	9.966	9.984	832.946	0.834	998.200	2.01	19.10	17.00	0.89	9406	11.2721	-1.853	119768	143.7885	-0.186	23985	28.7436	-0.196	-0.900	-1.868	-0.193
02.03.2018	10	301.032	9.962	9.980	833.027	0.835	998.200	2.00	19.20	17.00	0.89	9368	11.2255	-2.259	119786	143.7961	-0.180	23988	28.7444	-0.193	-0.800	-2.275	-0.187
02.03.2018	10																						
02.03.2018	30	301.323	29.839	29.896	2497.573	2.502	998.100	2.01	19.00	17.20	0.89	28709	11.4729	-0.105	359229	143.8312	-0.156	71634	28.6270	-0.601	-1.000	-0.121	-0.164
02.03.2018	30	301.106	29.795	29.852	2492.104	2.497	998.100	2.01	19.10	17.20	0.89	28655	11.4765	-0.074	358516	143.8608	-0.136	71493	28.6333	-0.579	-0.900	-0.090	-0.143
02.03.2018	30	303.546	29.753	29.807	2508.762	2.513	998.200	2.01	19.20	17.20	0.89	28846	11.4774	-0.066	360850	143.8359	-0.153	71964	28.6334	-0.578	-0.800	-0.081	-0.159
02.03.2018	30	301.634	29.777	29.837	2494.949	2.500	998.000	2.01	19.20	17.30	0.89	28696	11.4786	-0.055	358931	143.8631	-0.134	71578	28.6318	-0.584	-0.800	-0.070	-0.140
02.03.2018	30	301.207	29.750	29.800	2489.105	2.493	998.300	1.99	19.30	17.30	0.89	28619	11.4782	-0.060	357971	143.8151	-0.167	71389	28.6318	-0.584	-0.700	-0.074	-0.172
02.03.2018	60	301.093	59.761	59.869	4998.229	5.007	998.200	1.97	19.50	17.50	0.89	57524	11.4882	0.028	719024	143.8557	-0.139	142449	28.4486	-1.220	-0.500	0.022	-0.142
02.03.2018	60	305.268	59.797	59.893	5070.580	5.079	998.400	1.93	19.80	17.70	0.89	58346	11.4884	0.029	729347	143.8390	-0.151	144508	28.4537	-1.202	-0.200	0.026	-0.150
02.03.2018	60	301.362	59.761	59.857	5002.675	5.011	998.400	1.90	19.90	17.70	0.89	57565	11.4884	0.030	719510	143.8251	-0.160	142557	28.4506	-1.213	-0.100	0.027	-0.159
02.03.2018	60	301.268	59.733	59.835	4998.796	5.007	998.300	1.86	20.00	17.80	0.89	57528	11.4888	0.033	718996	143.8338	-0.154	142464	28.4512	-1.211	0.000	0.031	-0.151
02.03.2018	60	302.564	59.721	59.823	5019.278	5.028	998.300	1.90	20.10	17.90	0.89	57764	11.4889	0.034	721811	143.8077	-0.172	143023	28.4463	-1.228	0.100	0.032	-0.168
02.03.2018	100	300.803	95.812	95.994	8005.691	8.021	998.100	0.26	20.60	18.50	0.89	91917	11.4596	-0.221	1151390	143.8214	-0.163	230932	28.7912	-0.031	0.600	-0.220	-0.153
02.03.2018	100	301.012	94.659	94.849	7914.889	7.931	998.000	0.26	20.80	18.80	0.88	90850	11.4554	-0.258	1138250	143.8112	-0.170	228299	28.7866	-0.047	0.800	-0.256	-0.158
02.03.2018	100	300.766	94.631	94.821	7906.057	7.922	998.000	0.26	20.90	18.90	0.88	90771	11.4582	-0.233	1137250	143.8454	-0.146	228114	28.7954	-0.016	0.900	-0.231	-0.133
02.03.2018	100	300.665	94.971	95.152	7931.785	7.947	998.100	0.26	21.00	19.10	0.88	91020	11.4535	-0.274	1140720	143.8163	-0.166	228776	28.7881	-0.041	1.000	-0.271	-0.152
02.03.2018	100	302.445	95.048	95.229	7985.202	8.000	998.100	0.27	21.10	19.20	0.88	91669	11.4580	-0.235	1148100	143.7785	-0.193	230284	28.7841	-0.055	1.100	-0.232	-0.177

IBMETRO Laboratory – Day#3

					*Original data set																Temperature correction of meter error		
Data report IBMETRO: Day#3												Turbine meter			Coriolis_Mass			Coriolis_Vol			T_{nom}	20	°C
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
05.03.2018	10	300.658	10.018	10.040	836.645	0.838	997.800	2.04	19.00	16.80	0.89	9507	11.3382	-1.278	119789	143.1779	-0.610	23991	28.6122	-0.652	-1.000	-1.292	-0.618
05.03.2018	10	301.036	10.010	10.032	837.023	0.839	997.800	2.05	19.00	16.70	0.89	9507	11.3331	-1.322	119989	143.3520	-0.489	24032	28.6481	-0.527	-1.000	-1.337	-0.497
05.03.2018	10	299.869	9.994	10.015	832.437	0.834	997.900	2.05	19.10	16.70	0.89	9462	11.3428	-1.239	119449	143.4932	-0.391	23924	28.6794	-0.419	-0.900	-1.253	-0.398
05.03.2018	10	299.809	9.990	10.012	831.933	0.834	997.800	2.05	19.20	16.70	0.89	9456	11.3413	-1.251	119447	143.5777	-0.332	23923	28.6927	-0.373	-0.800	-1.267	-0.338
05.03.2018	10	299.990	10.005	10.027	833.706	0.836	997.800	2.06	19.20	16.70	0.89	9471	11.3351	-1.305	119780	143.6718	-0.267	23986	28.7070	-0.323	-0.800	-1.321	-0.273
05.03.2018	10	301.555	9.994	10.015	837.156	0.839	997.900	2.05	19.50	16.70	0.89	9553	11.3873	-0.851	120650	144.1189	0.044	24160	28.7990	-0.003	-0.500	-0.869	0.041
05.03.2018	10	301.225	10.002	10.024	836.898	0.839	997.800	2.06	19.60	16.80	0.89	9528	11.3599	-1.090	120484	143.9650	-0.063	24126	28.7645	-0.123	-0.400	-1.108	-0.065
05.03.2018	10	301.173	10.006	10.026	837.066	0.839	998.000	2.04	19.60	16.80	0.89	9542	11.3765	-0.944	120428	143.8692	-0.130	24118	28.7549	-0.157	-0.400	-0.963	-0.131
05.03.2018	10	300.718	10.006	10.026	835.840	0.838	998.000	2.04	19.70	16.80	0.89	9530	11.3789	-0.924	120245	143.8613	-0.135	24084	28.7565	-0.151	-0.300	-0.943	-0.136
05.03.2018	10	301.370	9.995	10.015	836.717	0.838	998.000	2.05	19.70	16.90	0.89	9549	11.3896	-0.830	120492	144.0056	-0.035	24130	28.7812	-0.065	-0.300	-0.850	-0.036
05.03.2018	60	301.337	59.863	59.983	5010.824	5.021	998.000	1.94	19.70	17.00	0.88	57551	11.4624	-0.197	720984	143.8853	-0.118	142851	28.4515	-1.210	-0.300	-0.202	-0.119
05.03.2018	60	300.832	59.859	59.979	5002.106	5.012	998.000	1.99	19.80	17.10	0.88	57432	11.4586	-0.230	719734	143.8862	-0.118	142616	28.4542	-1.201	-0.200	-0.234	-0.117
05.03.2018	60	301.769	59.820	59.946	5014.419	5.025	997.900	1.95	19.90	17.20	0.88	57564	11.4556	-0.256	721478	143.8807	-0.122	142955	28.4489	-1.219	-0.100	-0.259	-0.120
05.03.2018	60	301.067	59.673	59.794	4990.411	5.001	997.980	1.94	19.90	17.20	0.88	57290	11.4568	-0.245	718011	143.8781	-0.123	142284	28.4539	-1.202	-0.100	-0.248	-0.122
05.03.2018	60	301.229	59.581	59.707	4985.451	4.996	997.900	1.92	20.00	17.90	0.88	57241	11.4575	-0.239	717327	143.8841	-0.119	142135	28.4501	-1.215	0.000	-0.242	-0.117
05.03.2018	60	302.543	59.583	59.697	5007.372	5.017	998.100	1.92	20.10	17.40	0.89	57489	11.4591	-0.226	720445	143.8769	-0.124	142758	28.4554	-1.197	0.100	-0.227	-0.120
05.03.2018	60	301.096	59.574	59.687	4982.635	4.992	998.100	1.93	20.20	17.40	0.88	57222	11.4625	-0.196	716853	143.8703	-0.129	142046	28.4540	-1.201	0.200	-0.197	-0.124
05.03.2018	60	301.504	59.559	59.684	4988.137	4.999	997.900	1.93	20.20	17.40	0.88	57291	11.4613	-0.206	717790	143.8994	-0.109	142226	28.4530	-1.205	0.200	-0.207	-0.104
05.03.2018	60	301.283	59.528	59.647	4981.865	4.992	998.000	1.93	20.30	17.50	0.88	57222	11.4631	-0.191	716846	143.8911	-0.114	142044	28.4552	-1.197	0.300	-0.191	-0.108
05.03.2018	60	300.933	59.505	59.630	4974.145	4.985	997.900	1.92	20.40	17.60	0.88	57124	11.4601	-0.217	715623	143.8685	-0.130	141789	28.4453	-1.231	0.000	0.000	0.000
05.03.2018	100	302.065	96.749	96.923	8117.905	8.133	998.200	0.28	20.70	17.90	0.88	93135	11.4521	-0.286	1167620	143.8327	-0.155	234216	28.7998	-0.001	0.700	-0.285	0.011
05.03.2018	100	301.072	95.788	95.989	8010.815	8.028	997.900	0.26	20.90	18.20	0.88	91926	11.4511	-0.295	1152400	143.8555	-0.139	231144	28.7934	-0.023	0.900	-0.293	0.013
05.03.2018	100	302.564	94.791	94.991	7966.781	7.984	997.900	0.25	20.90	18.40	0.88	91387	11.4469	-0.332	1145910	143.8360	-0.153	229860	28.7917	-0.029	0.900	-0.330	0.013
05.03.2018	100	300.431	94.828	95.028	7913.675	7.930	997.900	0.26	21.00	18.40	0.88	90791	11.4486	-0.317	1138390	143.8510	-0.142	228321	28.7909	-0.032	1.000	-0.315	0.014
05.03.2018	100	301.541	95.327	95.528	7984.743	8.002	997.900	0.24	21.10	18.60	0.88	91609	11.4489	-0.314	1148370	143.8205	-0.163	230340	28.7869	-0.045	1.100	-0.311	0.016
05.03.2018	100	301.343	95.323	95.514	7979.115	7.995	998.000	0.28	21.20	18.70	0.88	91545	11.4501	-0.304	1147720	143.8405	-0.150	230218	28.7949	-0.018	1.200	-0.300	0.017
05.03.2018	100	300.767	95.374	95.566	7968.180	7.984	998.000	0.26	21.30	18.70	0.88	91390	11.4464	-0.336	1145830	143.8007	-0.177	229836	28.7865	-0.047	1.300	-0.332	0.018
05.03.2018	100	300.910	95.212	95.403	7958.447	7.974	998.000	0.26	21.40	18.80	0.88	91285	11.4473	-0.329	1144470	143.8057	-0.174	229875	28.8266	0.092	1.400	-0.324	0.019
05.03.2018	100	301.115	95.198	95.391	7962.673	7.979	997.980	0.26	21.50	18.90	0.88	91340	11.4479	-0.323	1145030	143.7997	-0.178	229701	28.7889	-0.038	1.500	-0.318	0.020
05.03.2018	100	301.189	95.286	95.479	7971.986	7.988	997.980	0.27	21.60	19.00	0.88	91453	11.4486	-0.317	1146410	143.8048	-0.174	229966	28.7885	-0.040	1.600	-0.311	0.022

INTI Laboratory – Day#1

					*Original data set																Temperature correction of meter error		
Data report INTI: Day#1												Turbine meter			Coriolis_Mass			Coriolis_Vol			T_{nom}	20	°C
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[m^3/h]	[s]	[t/h]	[m^3/h]	[kg]	[m^3]	[kg/m^3]	[bar]	[°C]	[°C]	[bar]	[Pulses]	[Pulses/Liter]	[%]	[Pulses]	[Pulses/kg]	[%]	[Pulses]	[Pulses/Liter]	[%]	[°C]	[%]	[%]
06.12.2018	10	343.780	10.481	10.502	1000.888	1.003	998.024		21.40			11478	11.4452	-0.347	144032	143.9042	-0.105	28776	28.6936	-0.369	1.400	-0.375	-0.086
06.12.2018	10	344.540	10.465	10.487	1001.603	1.004	997.979		21.60			11453	11.4116	-0.639	144061	143.8304	-0.157	28781	28.6769	-0.428	1.600	-0.668	-0.135
06.12.2018	10	344.770	10.451	10.472	1000.904	1.003	997.979		21.60			11453	11.4195	-0.570	143878	143.7480	-0.214	28746	28.6620	-0.479	1.600	-0.599	-0.192
12.12.2018	10	344.930	10.442	10.463	1000.505	1.003	997.979		21.60			11484	11.4550	-0.261	143965	143.8923	-0.114	28764	28.6914	-0.377	1.600	-0.290	-0.092
06.12.2018	10	345.160	10.437	10.458	1000.655	1.003	997.979		21.60			11489	11.4583	-0.233	143974	143.8798	-0.122	28765	28.6881	-0.389	1.600	-0.261	-0.101
06.12.2018	30	126.960	28.463	28.521	1003.799	1.006	997.979		21.60			11612	11.5447	0.520	144460	143.9133	-0.099	28756	28.5893	-0.732	1.600	0.518	-0.078
06.12.2018	30	123.900	29.211	29.270	1005.346	1.007	997.979		21.60			11613	11.5279	0.374	144630	143.8609	-0.135	28790	28.5790	-0.767	1.600	0.372	-0.114
06.12.2018	30	124.330	29.041	29.099	1002.950	1.005	997.979		21.60			11593	11.5355	0.440	144339	143.9144	-0.098	28723	28.5806	-0.762	1.600	0.438	-0.077
06.12.2018	30	119.440	30.194	30.270	1001.785	1.004	997.512		23.60			11593	11.5435	0.510	144250	143.9930	-0.044	28745	28.6224	-0.617	3.600	0.523	0.003
06.12.2018	30	124.490	29.017	29.077	1003.414	1.005	997.934		21.80			11603	11.5396	0.476	144391	143.8997	-0.108	28746	28.5890	-0.733	1.800	0.475	-0.085
06.12.2018	60	61.000	58.931	59.058	998.553	1.001	997.843		22.20			11529	11.5208	0.312	143741	143.9493	-0.074	28572	28.5517	-0.862	2.200	0.325	-0.045
06.12.2018	60	59.330	60.732	60.863	1000.898	1.003	997.843		22.20			11552	11.5167	0.276	144048	143.9188	-0.095	28533	28.4459	-1.229	2.200	0.290	-0.066
06.12.2018	60	59.340	60.897	61.025	1003.779	1.006	997.889		22.00			11581	11.5130	0.244	144616	144.0716	0.011	28510	28.3427	-1.588	2.000	0.256	0.037
06.12.2018	60	59.950	59.923	60.050	997.890	1.000	997.889		22.00			11514	11.5140	0.252	143568	143.8716	-0.128	28444	28.4440	-1.236	2.000	0.264	-0.102
06.12.2018	60	59.490	60.696	60.827	1002.994	1.005	997.843		22.20			11581	11.5215	0.318	144296	143.8652	-0.132	28582	28.4352	-1.267	2.200	0.331	-0.104
06.12.2018	100	184.580	98.414	98.638	5045.900	5.057	997.727		22.70			58342	11.5360	0.444	729652	144.6030	0.380	146282	28.9244	0.432	2.700	0.455	0.415
06.12.2018	100	182.550	99.536	99.763	5047.319	5.059	997.727		22.70			58375	11.5393	0.472	729959	144.6231	0.394	146340	28.9277	0.443	2.700	0.484	0.429
06.12.2018	100	184.360	98.524	98.748	5045.513	5.057	997.727		22.70			58342	11.5369	0.452	729612	144.6061	0.382	146270	28.9242	0.431	2.700	0.463	0.417
06.12.2018	100	183.230	99.160	99.386	5046.979	5.058	997.727		22.70			58365	11.5381	0.462	729922	144.6255	0.395	146317	28.9251	0.434	2.700	0.473	0.430
06.12.2018	100	184.380	98.529	98.753	5046.312	5.058	997.727		22.70			58349	11.5364	0.448	729666	144.5939	0.373	146289	28.9234	0.428	2.700	0.459	0.408
06.12.2018	130	142.260	128.199	128.494	5065.995	5.078	997.704		22.80			58505	11.5221	0.323	731943	144.4816	0.295	146578	28.8673	0.234	2.800	0.334	0.332
06.12.2018	130	141.790	128.616	128.912	5065.668	5.077	997.704		22.80			58449	11.5118	0.233	731882	144.4789	0.294	146341	28.8224	0.078	2.800	0.245	0.330
06.12.2018	130	142.500	127.946	128.240	5064.514	5.076	997.704		22.80			58484	11.5213	0.316	731651	144.4662	0.285	146530	28.8663	0.230	2.800	0.327	0.321
06.12.2018	130	142.440	128.002	128.297	5064.610	5.076	997.704		22.80			58488	11.5219	0.321	731749	144.4828	0.296	146451	28.8501	0.174	2.800	0.332	0.333
06.12.2018	130	140.760	129.535	129.833	5064.805	5.076	997.704		22.80			58485	11.5208	0.312	731761	144.4796	0.294	146649	28.8880	0.306	2.800	0.323	0.330

INTI Laboratory – Day#2

Data report INTI: Day#2

***Original data set**

Temperature correction of meter error

T_{nom}	20	°C

												Turbine meter			**Coriolis_Mass**			**Coriolis_Vol**					
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
12.12.2018	10	367.640	9.794	9.817	1000.202	1.003	997.656		23.00			11494	11.4647	-0.176	143824	143.7949	-0.181	28767	28.6938	-0.369	3.000	-0.208	-0.142
12.12.2018	10	366.630	9.810	9.833	999.055	1.001	997.656		23.00			11529	11.5129	0.243	143673	143.8089	-0.172	28735	28.6948	-0.365	3.000	0.211	-0.133
12.12.2018	10	368.130	9.784	9.808	1000.457	1.003	997.536		23.50			11537	11.5033	0.159	143871	143.8053	-0.174	28772	28.6880	-0.389	3.500	0.128	-0.129
12.12.2018	10	367.430	9.794	9.819	999.659	1.002	997.536		23.50			11543	11.5185	0.292	143741	143.7901	-0.185	28750	28.6889	-0.386	3.500	0.260	-0.139
12.12.2018	10	367.600	9.798	9.822	1000.457	1.003	997.536		23.50			11553	11.5193	0.298	143738	143.6724	-0.266	28751	28.6671	-0.462	3.500	0.267	-0.221
12.12.2018	30	116.370	30.906	30.975	999.030	1.001	997.751		22.60			11564	11.5492	0.559	143747	143.8866	-0.118	28630	28.5933	-0.718	2.600	0.564	-0.084
12.12.2018	30	116.280	30.786	30.855	994.390	0.997	997.751		22.60			11566	11.6051	1.046	143257	144.0652	0.006	28494	28.5903	-0.728	2.600	1.051	0.040
12.12.2018	30	117.920	30.501	30.570	999.080	1.001	997.751		22.60			11563	11.5476	0.545	143687	143.8194	-0.164	28619	28.5809	-0.761	2.600	0.550	-0.130
12.12.2018	30	116.740	30.794	30.863	998.581	1.001	997.751		22.60			11562	11.5524	0.587	143642	143.8462	-0.146	28608	28.5842	-0.749	2.600	0.592	-0.112
12.12.2018	30	116.760	30.739	30.809	996.984	0.999	997.751		22.60			11540	11.5489	0.556	143435	143.8689	-0.130	28567	28.5890	-0.733	2.600	0.561	-0.096
12.12.2018	60	60.310	59.929	60.067	1003.982	1.006	997.704		22.80			11613	11.5404	0.482	145209	144.6330	0.401	28698	28.5185	-0.977	2.800	0.500	0.437
12.12.2018	60	60.100	60.010	60.148	1001.837	1.004	997.704		22.80			11584	11.5362	0.446	144150	143.8857	-0.118	28560	28.4422	-1.242	2.800	0.463	-0.082
12.12.2018	60	60.970	58.954	59.089	998.444	1.001	997.704		22.80			11576	11.5674	0.718	143692	143.9159	-0.097	28469	28.4479	-1.223	2.800	0.735	-0.061
12.12.2018	60	60.290	59.988	60.126	1004.631	1.007	997.704		22.80			11621	11.5409	0.486	144603	143.9365	-0.083	28641	28.4435	-1.238	2.800	0.504	-0.047
12.12.2018	60	60.260	59.631	59.771	998.157	1.001	997.656		23.00			11565	11.5592	0.646	143721	143.9864	-0.048	28461	28.4467	-1.227	3.000	0.665	-0.009
12.12.2018	100	183.890	98.765	99.019	5044.978	5.058	997.438		23.90			58368	11.5399	0.478	729758	144.6504	0.413	146346	28.9339	0.465	3.900	0.495	0.463
12.12.2018	100	181.730	99.963	100.220	5046.204	5.059	997.438		23.90			58384	11.5402	0.481	730018	144.6668	0.424	146388	28.9352	0.469	3.900	0.498	0.474
12.12.2018	100	183.710	98.849	99.098	5044.338	5.057	997.487		23.70			58350	11.5384	0.465	729575	144.6325	0.400	146308	28.9315	0.457	3.700	0.481	0.448
12.12.2018	100	183.530	98.968	99.219	5045.424	5.058	997.463		23.80			58365	11.5386	0.466	729727	144.6315	0.399	146340	28.9309	0.455	3.800	0.483	0.449
12.12.2018	100	183.360	99.045	99.302	5044.684	5.058	997.413		24.00			58348	11.5363	0.447	729632	144.6338	0.401	146320	28.9298	0.451	4.000	0.465	0.453
12.12.2018	130	142.300	128.113	128.445	5064.024	5.077	997.413		23.90			58510	11.5242	0.341	731734	144.4965	0.306	146358	28.8268	0.093	3.900	0.357	0.356
12.12.2018	130	143.210	127.250	127.580	5062.080	5.075	997.413		23.90			58487	11.5241	0.340	731423	144.4906	0.302	146328	28.8319	0.111	3.900	0.356	0.352
12.12.2018	130	143.510	127.019	127.349	5063.490	5.077	997.413		23.70			58494	11.5222	0.324	731630	144.4913	0.302	146461	28.8501	0.174	3.700	0.340	0.350
12.12.2018	130	143.150	127.351	127.681	5063.970	5.077	997.413		23.80			58484	11.5192	0.297	731587	144.4691	0.287	146494	28.8539	0.187	3.800	0.313	0.336
12.12.2018	130	142.280	128.129	128.461	5063.924	5.077	997.413		24.00			58500	11.5224	0.326	731609	144.4747	0.291	146587	28.8724	0.252	4.000	0.342	0.342

INTI Laboratory – Day#3

					*Original data set																	Temperature correction of meter error		
Data report INTI: Day#3												Turbine meter			Coriolis_Mass			Coriolis_Vol				T_{nom}	20	°C
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	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}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
14.12.2018	10	347.430	10.360	10.385	999.815	1.002	997.608		23.20			11544	11.5185	0.292	143819	143.8456	-0.146	28764	28.7005	-0.345		3.200	0.261	-0.105
14.12.2018	10	348.840	10.316	10.341	999.627	1.002	997.560		23.40			11526	11.5022	0.149	144164	144.2178	0.112	28837	28.7774	-0.079		3.400	0.118	0.156
14.12.2018	10	350.950	10.284	10.309	1002.521	1.005	997.560		23.40			11580	11.5227	0.328	143983	143.6209	-0.302	28800	28.6575	-0.495		3.400	0.297	-0.258
14.12.2018	10	348.990	10.335	10.361	1001.923	1.004	997.560		23.40			11564	11.5137	0.249	144015	143.7386	-0.220	28805	28.6796	-0.418		3.400	0.218	-0.176
14.12.2018	10	347.530	10.359	10.384	1000.026	1.002	997.560		23.40			11544	11.5155	0.266	143720	143.7162	-0.236	28745	28.6741	-0.437		3.400	0.234	-0.192
14.12.2018	10	347.480	10.357	10.383	999.727	1.002	997.560		23.40			11541	11.5160	0.270	143734	143.7733	-0.196	28748	28.6857	-0.397		3.400	0.238	-0.152
14.12.2018	10	347.690	10.355	10.380	1000.076	1.003	997.560		23.40			11546	11.5170	0.278	143673	143.6621	-0.273	28737	28.6647	-0.470		3.400	0.247	-0.229
14.12.2018	10	349.100	10.345	10.370	1003.170	1.006	997.560		23.40			11576	11.5113	0.229	144181	143.7255	-0.229	28837	28.6758	-0.431		3.400	0.197	-0.185
14.12.2018	10	347.500	10.358	10.384	999.877	1.002	997.560		23.40			11542	11.5153	0.263	143799	143.8167	-0.166	28765	28.6984	-0.353		3.400	0.232	-0.122
14.12.2018	10	347.440	10.361	10.387	999.976	1.002	997.560		23.40			11542	11.5141	0.253	143697	143.7004	-0.247	28899	28.8292	0.101		3.400	0.222	-0.203
14.12.2018	60	59.950	60.303	60.455	1004.209	1.007	997.487		23.70			11610	11.5323	0.412	144490	143.8844	-0.119	28634	28.4423	-1.242		3.700	0.435	-0.071
14.12.2018	60	59.780	60.096	60.247	997.924	1.000	997.487		23.70			11541	11.5359	0.444	143632	143.9308	-0.087	28456	28.4435	-1.238		3.700	0.467	-0.039
14.12.2018	60	59.330	60.990	61.144	1005.157	1.008	997.487		23.70			11633	11.5442	0.516	144632	143.8900	-0.115	28675	28.4562	-1.194		3.700	0.539	-0.067
14.12.2018	60	59.330	60.530	60.683	997.575	1.000	997.487		23.70			11548	11.5470	0.540	143572	143.9210	-0.094	28869	28.8665	0.231		3.700	0.563	-0.046
14.12.2018	60	58.910	60.904	61.057	996.627	0.999	997.487		23.70			11536	11.5460	0.531	143339	143.8241	-0.161	28800	28.8248	0.086		3.700	0.554	-0.113
14.12.2018	60	59.910	60.027	60.184	998.942	1.002	997.388		24.10			11564	11.5460	0.531	143748	143.9002	-0.108	28483	28.4387	-1.255		4.100	0.557	-0.055
14.12.2018	60	58.840	61.136	61.297	999.242	1.002	997.388		24.10			11547	11.5256	0.353	143775	143.8841	-0.119	28444	28.3912	-1.419		4.100	0.379	-0.066
14.12.2018	60	59.950	59.994	60.153	999.072	1.002	997.363		24.20			11568	11.5482	0.550	143750	143.8835	-0.120	28335	28.2865	-1.783		4.200	0.577	-0.065
14.12.2018	60	59.170	60.990	61.153	1002.444	1.005	997.338		24.30			11606	11.5469	0.539	144177	143.8255	-0.160	28434	28.2892	-1.774		4.300	0.566	-0.104
14.12.2018	60	59.280	60.849	61.013	1001.975	1.005	997.313		24.40			11590	11.5361	0.445	144191	143.9068	-0.104	28438	28.3057	-1.716		4.400	0.473	-0.046
14.12.2018	130	141.010	129.245	129.603	5062.454	5.076	997.237		24.70			58495	11.5227	0.329	731404	144.4762	0.292	146326	28.8243	0.084		4.700	0.348	0.353
14.12.2018	130	142.550	127.859	128.213	5062.846	5.077	997.237		24.70			58525	11.5278	0.372	731456	144.4753	0.291	146313	28.8195	0.068		4.700	0.392	0.352
14.12.2018	130	142.170	128.165	128.520	5061.430	5.075	997.237		24.70			58485	11.5231	0.332	731138	144.4528	0.275	146410	28.8467	0.162		4.700	0.351	0.337
14.12.2018	130	143.170	127.276	127.628	5061.683	5.076	997.237		24.70			58482	11.5219	0.322	731060	144.4302	0.260	146324	28.8283	0.098		4.700	0.341	0.321
14.12.2018	130	143.240	127.236	127.589	5062.583	5.077	997.237		24.70			58492	11.5219	0.321	731310	144.4539	0.276	145843	28.7284	-0.248		4.700	0.341	0.337
14.12.2018	130	142.460	127.937	128.291	5062.741	5.077	997.237		24.70			58494	11.5219	0.321	731263	144.4401	0.267	143218	28.2105	-2.047		4.700	0.341	0.328
14.12.2018	130	143.210	127.278	127.630	5063.179	5.077	997.237		24.70			58502	11.5225	0.326	731370	144.4488	0.273	142900	28.1454	-2.273		4.700	0.346	0.334
14.12.2018	130	143.450	127.048	127.400	5062.494	5.077	997.237		24.70			58490	11.5217	0.319	731078	144.4107	0.246	146431	28.8448	0.155		4.700	0.339	0.307
14.12.2018	130	143.450	127.018	127.369	5061.298	5.075	997.237		24.70			58481	11.5226	0.328	731095	144.4481	0.272	145930	28.7529	-0.164		4.700	0.347	0.333
14.12.2018	130	143.380	127.115	127.467	5062.689	5.077	997.237		24.70			58500	11.5232	0.333	731186	144.4264	0.257	146307	28.8192	0.067		4.700	0.352	0.318

CENAM Laboratory – Day#1

																					Correction of autozero at Coriolis meter	Temperature correction of meter error		
					*Original data set																			
Data report CENAM: Day#1												Turbine meter			Coriolis_Mass			Coriolis_Vol				T_{nom}	20	°C
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	Pulses/ Liter				
		Laboratory reference					Fluid			Ambient conditions											Corrected 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	Coriolis _Mass	(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	$e_{cor,m}$	ΔT_{fluid}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
03.06.2019	10	423.090	9.912	9.941	1164.861	1.168	997.016	2.90	27.62	25.70	0.81				167522	143.8129	-0.169	33633	28.7868	-0.046	-0.139	7.620	-0.146	-0.036
03.06.2019	10	422.990	9.846	9.876	1156.927	1.160	997.007	2.90	27.65	25.80	0.81				166362	143.7965	-0.180	33400	28.7832	-0.058	-0.150	7.650	-0.160	-0.047
03.06.2019	10	423.070	9.822	9.852	1154.325	1.158	996.996	2.90	27.69	26.00	0.81				165980	143.7897	-0.185	33324	28.7821	-0.062	-0.155	7.690	-0.131	-0.051
03.06.2019	10	422.929	9.795	9.825	1150.763	1.154	996.996	2.90	27.69	25.90	0.81				165473	143.7942	-0.182	33222	28.7828	-0.060	-0.152	7.690	-0.131	-0.048
03.06.2019	10	422.993	9.786	9.816	1149.853	1.153	996.988	2.90	27.72	25.90	0.81				165305	143.7619	-0.204	33189	28.7768	-0.081	-0.174	7.720	-0.128	-0.070
03.06.2019	30	178.095	30.095	30.186	1488.829	1.493	996.983	2.93	27.74	26.10	0.81				214154	143.8406	-0.150	42810	28.6674	-0.460	-0.140	7.740	13.691	-0.035
03.06.2019	30	177.791	30.129	30.221	1487.978	1.492	996.981	2.93	27.75	26.10	0.81				214017	143.8307	-0.156	42770	28.6569	-0.497	-0.147	7.750	13.978	-0.042
03.06.2019	30	177.998	30.147	30.238	1490.578	1.495	996.980	2.92	27.75	26.20	0.81				214386	143.8274	-0.159	42844	28.6564	-0.499	-0.149	7.750	14.210	-0.044
03.06.2019	30	177.998	30.162	30.253	1491.338	1.496	996.983	2.92	27.74	26.20	0.81				214501	143.8313	-0.156	42872	28.6606	-0.484	-0.146	7.740	14.094	-0.042
03.06.2019	30	178.096	30.148	30.240	1491.478	1.496	996.980	2.92	27.75	26.30	0.81				214558	143.8560	-0.139	42883	28.6652	-0.468	-0.129	7.750	14.031	-0.025
03.06.2019	60	89.091	59.987	60.169	1484.519	1.489	996.978	2.88	27.75	26.50	0.81				213596	143.8823	-0.121	42422	28.4899	-1.077	-0.116	7.750	3.214	-0.011
03.06.2019	60	89.094	59.964	60.146	1484.008	1.489	996.976	2.89	27.76	26.60	0.81				213531	143.8880	-0.117	42404	28.4876	-1.085	-0.112	7.760	3.086	-0.007
03.06.2019	60	88.951	60.110	60.293	1485.239	1.490	996.976	2.88	27.76	26.70	0.81				213707	143.8873	-0.117	42441	28.4888	-1.081	-0.112	7.760	2.965	-0.008
03.06.2019	60	88.976	60.122	60.304	1485.949	1.490	996.982	2.89	27.74	26.70	0.81				213796	143.8784	-0.123	42457	28.4861	-1.090	-0.118	7.740	3.086	-0.014
03.06.2019	60	88.975	60.102	60.284	1485.438	1.490	996.982	2.89	27.74	26.80	0.81				213736	143.8875	-0.117	42450	28.4912	-1.072	-0.112	7.740	3.572	-0.008
03.06.2019	100	53.194	100.024	100.329	1477.957	1.482	996.964	2.75	27.78	26.89	0.81				212651	143.8817	-0.121	42800	28.8710	0.246	-0.118	7.780	1.169	-0.013
03.06.2019	100	52.902	99.682	99.986	1464.823	1.469	996.964	2.76	27.78	26.89	0.81				210755	143.8774	-0.124	42420	28.8712	0.247	-0.121	7.780	1.169	-0.016
03.06.2019	100	53.004	99.993	100.297	1472.215	1.477	996.967	2.75	27.77	26.89	0.81				211827	143.8832	-0.120	42633	28.8706	0.245	-0.117	7.770	1.145	-0.012
03.06.2019	100	52.999	99.884	100.189	1470.485	1.475	996.964	2.76	27.78	26.89	0.81				211582	143.8859	-0.118	42584	28.8713	0.247	-0.115	7.780	1.293	-0.010
03.06.2019	100	53.025	99.818	100.122	1470.224	1.475	996.967	2.75	27.77	26.89	0.81				211539	143.8821	-0.121	42584	28.8764	0.265	-0.118	7.770	1.158	-0.013
03.06.2019	130	275.076	130.161	130.561	9945.628	9.976	996.936	2.70	27.87	27.98	0.81				1430654	143.8475	-0.145	287979	28.8666	0.231	-0.142	7.870	0.664	-0.036
03.06.2019	130	275.155	130.165	130.566	9948.732	9.979	996.928	2.70	27.90	28.08	0.81				1431280	143.8656	-0.132	288099	28.8694	0.241	-0.130	7.900	0.637	-0.023
03.06.2019	130	274.847	130.046	130.447	9928.541	9.959	996.925	2.70	27.91	28.18	0.81				1428334	143.8614	-0.135	287519	28.8698	0.242	-0.133	7.910	0.651	-0.026
03.06.2019	130	275.063	129.966	130.367	9930.233	9.961	996.921	2.67	27.92	28.28	0.81				1428660	143.8697	-0.129	287566	28.8695	0.241	-0.127	7.920	0.597	-0.020
03.06.2019	130	274.947	130.178	130.581	9942.224	9.973	996.914	2.70	27.95	28.38	0.81				1430342	143.8654	-0.132	287899	28.8678	0.236	-0.130	7.950	0.616	-0.023
03.06.2019	150	239.075	150.412	150.882	9988.796	10.020	996.886	2.53	28.02	28.08	0.81				1437110	143.8722	-0.128	289295	28.8718	0.249	-0.126	8.020	0.452	-0.017
03.06.2019	150	239.003	150.120	150.590	9966.405	9.998	996.880	2.53	28.04	28.28	0.81				1433866	143.8699	-0.129	288626	28.8695	0.241	-0.127	8.040	0.446	-0.018
03.06.2019	150	239.084	150.242	150.714	9977.894	10.009	996.869	2.53	28.08	28.38	0.81				1435564	143.8744	-0.126	288965	28.8698	0.242	-0.124	8.080	0.505	-0.015
03.06.2019	150	238.917	150.411	150.885	9982.189	10.014	996.860	2.53	28.11	28.48	0.81				1436156	143.8718	-0.128	289094	28.8700	0.243	-0.126	8.110	0.469	-0.016
03.06.2019	150	239.008	150.047	150.520	9961.798	9.993	996.858	2.53	28.12	28.48	0.81				1433140	143.8636	-0.134	288456	28.8652	0.226	-0.132	8.120	0.439	-0.022

CENAM Laboratory – Day#2

Data report CENAM: Day#2					*Original data set							Turbine meter			Coriolis_Mass			Coriolis_Vol			Correction of autozero at Coriolis meter	Temperature correction of meter error		
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	Pulses/ Liter		T_{nom}	20	°C
		Laboratory reference					Fluid			Ambient conditions											Corrected meter error		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	Coriolis _Mass	(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	$e_{cor,m}$	ΔT_{fluid}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
04.06.2019	10	423.087	10.099	10.128	1186.877	1.190	997.136	2.89	27.19	25.40	0.81				170629	143.7630	-0.203	34251	28.7754	-0.085	-0.120	7.190	-0.095	-0.024
04.06.2019	10	422.992	10.088	10.117	1185.306	1.189	997.128	2.90	27.22	25.40	0.81				170381	143.7443	-0.216	34201	28.7713	-0.100	-0.133	7.220	-0.073	-0.036
04.06.2019	10	423.082	10.083	10.112	1184.956	1.188	997.122	2.90	27.24	25.40	0.81				170304	143.7218	-0.232	34186	28.7670	-0.115	-0.148	7.240	-0.110	-0.051
04.06.2019	10	422.920	10.075	10.104	1183.545	1.187	997.111	2.91	27.28	25.50	0.81				170078	143.7022	-0.246	34140	28.7622	-0.131	-0.162	7.280	-0.087	-0.064
04.06.2019	10	422.985	10.057	10.086	1181.634	1.185	997.106	2.90	27.30	25.60	0.81				169801	143.7002	-0.247	34084	28.7613	-0.134	-0.163	7.300	-0.095	-0.065
04.06.2019	30	178.094	30.255	30.342	1496.709	1.501	997.118	2.93	27.26	25.90	0.81				215337	143.8736	-0.127	43033	28.6689	-0.455	-0.099	7.260	22.552	-0.002
04.06.2019	30	177.990	30.206	30.293	1493.438	1.498	997.115	2.92	27.27	26.00	0.81				214848	143.8613	-0.135	42940	28.6695	-0.453	-0.107	7.270	22.966	-0.010
04.06.2019	30	178.019	30.046	30.133	1485.746	1.490	997.115	2.93	27.27	26.00	0.81				213736	143.8577	-0.138	42724	28.6730	-0.441	-0.110	7.270	23.345	-0.012
04.06.2019	30	176.998	30.399	30.487	1494.618	1.499	997.112	2.93	27.28	26.10	0.81				214999	143.8488	-0.144	42966	28.6641	-0.472	-0.116	7.280	22.607	-0.019
04.06.2019	30	178.022	30.042	30.129	1485.605	1.490	997.110	2.93	27.29	26.10	0.81				213692	143.8417	-0.149	42717	28.6708	-0.449	-0.121	7.290	24.034	-0.023
04.06.2019	60	89.154	59.962	60.136	1484.959	1.489	997.107	2.88	27.29	26.10	0.81				213640	143.8693	-0.130	42426	28.4878	-1.084	-0.116	7.290	3.937	-0.018
04.06.2019	60	89.011	60.058	60.232	1484.939	1.489	997.108	2.89	27.29	26.10	0.81				213635	143.8679	-0.131	42424	28.4869	-1.087	-0.117	7.290	4.237	-0.019
04.06.2019	60	88.923	60.074	60.248	1483.868	1.488	997.108	2.89	27.29	26.20	0.81				213474	143.8632	-0.134	42394	28.4873	-1.086	-0.120	7.290	3.885	-0.022
04.06.2019	60	89.000	59.939	60.113	1481.827	1.486	997.102	2.88	27.31	26.20	0.81				213187	143.8677	-0.131	42337	28.4880	-1.083	-0.117	7.310	3.858	-0.019
04.06.2019	60	88.999	59.923	60.097	1481.407	1.486	997.101	2.87	27.31	26.20	0.81				213124	143.8659	-0.132	42321	28.4853	-1.093	-0.118	7.310	3.641	-0.020
04.06.2019	100	53.096	100.648	100.941	1484.436	1.489	997.092	2.73	27.32	26.20	0.81				213523	143.8412	-0.149	42968	28.8615	0.214	-0.141	7.320	1.148	-0.043
04.06.2019	100	53.031	100.376	100.669	1478.614	1.483	997.087	2.73	27.34	26.30	0.81				212665	143.8273	-0.159	42797	28.8597	0.207	-0.150	7.340	1.340	-0.052
04.06.2019	100	52.974	100.327	100.620	1476.313	1.481	997.090	2.73	27.33	26.40	0.81				212359	143.8442	-0.147	42724	28.8554	0.192	-0.139	7.330	1.304	-0.040
04.06.2019	100	52.997	100.354	100.648	1477.342	1.482	997.084	2.73	27.35	26.60	0.81				212504	143.8421	-0.149	42770	28.8662	0.230	-0.140	7.350	1.286	-0.042
04.06.2019	100	52.999	100.386	100.680	1477.883	1.482	997.078	2.71	27.37	26.50	0.81				212599	143.8537	-0.140	42801	28.8764	0.265	-0.132	7.370	0.984	-0.033
04.06.2019	130	275.081	129.521	129.913	9896.867	9.927	996.984	2.64	27.69	26.89	0.81				1423794	143.8631	-0.134	286598	28.8711	0.247	-0.127	7.690	1.072	-0.024
04.06.2019	130	274.995	129.389	129.781	9883.678	9.914	996.980	2.61	27.70	26.80	0.81				1421875	143.8609	-0.135	286210	28.8704	0.244	-0.129	7.700	1.034	-0.025
04.06.2019	130	275.030	129.595	129.988	9900.673	9.931	996.975	2.62	27.72	26.80	0.81				1424243	143.8531	-0.141	286669	28.8669	0.232	-0.134	7.720	1.017	-0.030
04.06.2019	130	274.985	129.445	129.839	9887.673	9.918	996.969	2.61	27.74	26.89	0.81				1422352	143.8510	-0.142	286290	28.8665	0.231	-0.136	7.740	1.127	-0.032
04.06.2019	130	275.079	129.563	129.957	9899.972	9.930	996.964	2.61	27.76	26.80	0.81				1424136	143.8525	-0.141	286657	28.8674	0.234	-0.135	7.760	1.137	-0.030
04.06.2019	150	238.237	150.047	150.510	9929.650	9.960	996.926	2.53	27.88	26.70	0.81				1428696	143.8818	-0.121	287621	28.8768	0.267	-0.115	7.880	0.854	-0.009
04.06.2019	150	237.813	150.017	150.481	9909.959	9.941	996.915	2.48	27.91	26.80	0.81				1425824	143.8779	-0.124	287052	28.8767	0.266	-0.118	7.910	0.865	-0.011
04.06.2019	150	237.997	150.021	150.486	9917.957	9.949	996.910	2.50	27.93	26.80	0.81				1426969	143.8773	-0.124	287252	28.8733	0.255	-0.118	7.930	0.766	-0.011
04.06.2019	150	237.996	149.777	150.243	9901.762	9.933	996.898	2.48	27.97	26.80	0.81				1424566	143.8699	-0.129	286741	28.8688	0.239	-0.124	7.970	0.833	-0.016
04.06.2019	150	238.000	150.007	150.475	9917.158	9.948	996.893	2.49	27.99	26.80	0.81				1426877	143.8796	-0.122	287236	28.8735	0.255	-0.117	7.990	0.822	-0.009

CENAM Laboratory – Day#3

Data report CENAM: Day#3

*Original data set

		Laboratory reference					Fluid			Ambient conditions		Turbine meter			Coriolis_Mass			Coriolis_Vol			Correction of autozero at Coriolis meter	Temperature correction of meter error		
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	Pulses/ Liter		T_{nom}	20	°C
																					Corrected meter error		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**	**Coriolis _Mass**	(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	$e_{cor,m}$	ΔT_{fluid}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
05.06.2019	10	432.999	9.910	9.940	1191.932	1.196	996.965	2.90	27.80	25.30	0.81				171314	143.7280	-0.228	34395	28.7689	-0.108	-0.120	7.800	-0.124	0.033
05.06.2019	10	433.027	9.901	9.931	1190.891	1.195	996.959	2.90	27.82	25.40	0.81				171156	143.7209	-0.233	34363	28.7671	-0.114	-0.133	7.820	-0.103	0.028
05.06.2019	10	432.963	9.891	9.922	1189.620	1.193	996.951	2.90	27.85	25.50	0.81				171033	143.7711	-0.198	34339	28.7775	-0.078	-0.148	7.850	-0.143	0.064
05.06.2019	10	433.079	9.883	9.913	1188.910	1.193	996.945	2.90	27.87	25.60	0.81				170881	143.7292	-0.227	34309	28.7694	-0.106	-0.162	7.870	-0.098	0.035
05.06.2019	10	432.913	9.872	9.902	1187.098	1.191	996.934	2.90	27.91	25.70	0.81				170562	143.6798	-0.261	34245	28.7592	-0.142	-0.163	7.910	-0.107	0.002
05.06.2019	10	433.043	9.880	9.911	1188.489	1.192	996.934	2.91	27.91	25.80	0.81				170749	143.6690	-0.269	34283	28.7574	-0.148	-0.099	7.910	-0.129	-0.006
05.06.2019	10	432.947	9.875	9.905	1187.548	1.191	996.928	2.91	27.93	25.80	0.81				170598	143.6557	-0.278	34253	28.7549	-0.157	-0.107	7.930	-0.116	-0.015
05.06.2019	10	433.006	9.873	9.904	1187.568	1.191	996.925	2.90	27.94	25.80	0.81				170612	143.6651	-0.271	34257	28.7577	-0.147	-0.110	7.940	-0.111	-0.008
05.06.2019	10	432.995	9.865	9.895	1186.516	1.190	996.917	2.90	27.97	25.90	0.81				170435	143.6432	-0.287	34221	28.7527	-0.164	-0.116	7.970	-0.132	-0.023
05.06.2019	10	432.988	9.859	9.889	1185.736	1.189	996.914	2.90	27.98	26.00	0.81				170270	143.5986	-0.318	34189	28.7446	-0.192	-0.121	7.980	-0.125	-0.054
05.06.2019	100	53.093	100.025	100.336	1475.172	1.480	996.900	2.72	28.00	26.30	0.81				212275	143.8985	-0.109	42733	28.8784	0.272	-0.116	8.000	1.737	0.014
05.06.2019	100	53.063	99.931	100.241	1472.950	1.478	996.899	2.69	28.00	26.40	0.81				212003	143.9309	-0.087	42669	28.8786	0.273	-0.117	8.000	1.760	0.037
05.06.2019	100	52.965	99.833	100.143	1468.799	1.473	996.902	2.69	27.99	26.40	0.81				211390	143.9203	-0.094	42549	28.8788	0.274	-0.120	7.990	1.717	0.029
05.06.2019	100	53.002	100.034	100.345	1472.780	1.477	996.905	2.69	27.98	26.50	0.81				211874	143.8599	-0.136	42657	28.8739	0.257	-0.117	7.980	1.584	-0.013
05.06.2019	100	53.029	100.060	100.371	1473.910	1.478	996.902	2.70	27.99	26.60	0.81				212055	143.8724	-0.127	42680	28.8673	0.234	-0.118	7.990	1.865	-0.004
05.06.2019	100	52.981	99.968	100.278	1471.209	1.476	996.908	2.70	27.97	26.60	0.81				211681	143.8823	-0.121	42611	28.8737	0.256	-0.141	7.970	1.663	0.003
05.06.2019	100	52.993	99.871	100.181	1470.139	1.475	996.910	2.68	27.96	26.50	0.81				211509	143.8700	-0.129	42577	28.8717	0.249	-0.150	7.960	1.649	-0.006
05.06.2019	100	53.134	99.869	100.178	1474.010	1.479	996.913	2.68	27.95	26.60	0.81				212059	143.8654	-0.132	42680	28.8656	0.228	-0.139	7.950	1.612	-0.010
05.06.2019	100	52.864	99.912	100.222	1467.157	1.472	996.910	2.69	27.96	26.70	0.81				211085	143.8735	-0.127	42482	28.8658	0.229	-0.140	7.960	1.802	-0.004
05.06.2019	150	239.099	149.891	150.366	9955.202	9.987	996.841	2.43	28.16	27.09	0.81				1432466	143.8912	-0.114	288361	28.8744	0.258	-0.127	8.160	0.692	0.006
05.06.2019	150	238.974	150.014	150.489	9958.198	9.990	996.842	2.44	28.16	27.19	0.81				1433011	143.9026	-0.106	288511	28.8807	0.280	-0.129	8.160	0.689	0.014
05.06.2019	150	239.002	150.048	150.523	9961.603	9.993	996.841	2.43	28.16	27.19	0.81				1433482	143.9007	-0.108	288565	28.8762	0.265	-0.134	8.160	0.654	0.013
05.06.2019	150	239.078	150.281	150.758	9980.289	10.012	996.838	2.48	28.18	27.19	0.81				1436144	143.8980	-0.110	289094	28.8749	0.260	-0.136	8.180	0.664	0.011
05.06.2019	150	238.921	149.969	150.446	9953.008	9.985	996.830	2.43	28.20	27.19	0.81				1432292	143.9054	-0.105	288338	28.8781	0.271	-0.135	8.200	0.671	0.017
05.06.2019	150	239.200	150.158	150.640	9977.175	10.009	996.801	2.48	28.31	27.39	0.81				1435626	143.8910	-0.115	289019	28.8753	0.262	-0.115	8.310	0.601	0.009
05.06.2019	150	239.079	149.945	150.429	9957.983	9.990	996.781	2.42	28.37	27.39	0.81				1432888	143.8934	-0.113	288460	28.8745	0.259	-0.118	8.370	0.628	0.011
05.06.2019	150	238.997	150.113	150.599	9965.682	9.998	996.772	2.48	28.41	27.29	0.81				1433976	143.8914	-0.114	288698	28.8757	0.263	-0.118	8.410	0.657	0.010
05.06.2019	150	239.006	150.187	150.675	9970.980	10.003	996.761	2.42	28.44	27.29	0.81				1434734	143.8910	-0.115	288832	28.8734	0.255	-0.124	8.440	0.665	0.010
05.06.2019	150	238.991	149.863	150.353	9948.892	9.981	996.746	2.42	28.49	27.29	0.81				1431406	143.8759	-0.125	288171	28.8709	0.246	-0.117	8.490	0.609	0.001

PTB Laboratory – Day#1

Data report PTB: Day#1

*Original data set

												Turbine meter			Coriolis_Mass			Coriolis_Vol			Correction of autozero at Coriolis meter	Temperature correction of meter error		
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	Pulses/ Liter		T_{nom}	20	°C
		Laboratory reference					Fluid			Ambient conditions											Corrected meter error		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	Coriolis _Mass	(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	$e_{cor,m}$	ΔT_{fluid}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
08.08.2019	10	972.108	10.067	10.084	2718.304	2.723	998.311	3.00	20.01	22.25	1.00	31275	11.4859	0.007	392944	144.5548	0.346				0.045	0.008	-0.014	0.048
08.08.2019	10	972.106	9.966	9.983	2691.085	2.696	998.313	3.00	20.00	22.28	1.00	30957	11.4841	-0.008	389143	144.6045	0.381				0.077	0.000	-0.030	0.079
08.08.2019	10	972.132	9.946	9.963	2685.814	2.690	998.313	3.00	20.00	22.32	1.00	30896	11.4840	-0.010	388295	144.5726	0.359				0.054	0.000	-0.031	0.057
08.08.2019	10	972.109	10.008	10.025	2702.589	2.707	998.314	3.00	20.00	22.32	1.00	31090	11.4844	-0.006	390767	144.5899	0.371				0.068	-0.005	-0.027	0.071
08.08.2019	10	972.132	10.006	10.023	2701.974	2.707	998.312	3.00	20.00	22.36	1.00	31083	11.4844	-0.006	390701	144.5984	0.377				0.074	0.001	-0.027	0.076
08.08.2019	30	324.129	30.191	30.242	2718.290	2.723	998.312	2.99	20.00	22.47	1.00	31316	11.5010	0.139	391908	144.1745	0.082				-0.018	0.005	0.128	-0.015
08.08.2019	30	324.111	30.068	30.119	2707.026	2.712	998.314	3.01	19.99	22.49	1.00	31184	11.5002	0.132	390287	144.1756	0.083				-0.018	-0.009	0.121	-0.015
08.08.2019	30	324.114	30.058	30.108	2706.142	2.711	998.313	3.01	20.00	22.50	1.00	31175	11.5007	0.135	390157	144.1746	0.082				-0.018	-0.002	0.124	-0.016
08.08.2019	30	324.111	29.986	30.037	2699.682	2.704	998.313	3.02	20.00	22.51	1.00	31101	11.5008	0.137	389263	144.1885	0.092				-0.009	0.000	0.126	-0.006
08.08.2019	30	324.109	30.054	30.105	2705.784	2.710	998.312	3.01	20.00	22.53	1.00	31172	11.5011	0.139	390114	144.1778	0.085				-0.016	0.004	0.128	-0.013
08.08.2019	60	162.117	60.213	60.315	2711.537	2.716	998.308	3.00	20.02	22.53	1.00	31244	11.5031	0.157	390689	144.0839	0.019				-0.031	0.023	0.155	-0.028
08.08.2019	60	162.094	59.890	59.992	2696.594	2.701	998.296	3.01	20.08	22.55	1.00	31071	11.5027	0.153	388548	144.0885	0.023				-0.028	0.080	0.151	-0.024
08.08.2019	60	162.137	60.129	60.231	2708.110	2.713	998.311	3.00	20.01	22.55	1.00	31204	11.5030	0.156	390265	144.1097	0.037				-0.013	0.006	0.153	-0.010
08.08.2019	60	162.095	60.267	60.369	2713.620	2.718	998.310	2.98	20.01	22.57	1.00	31268	11.5031	0.157	391053	144.1075	0.036				-0.015	0.011	0.155	-0.012
08.08.2019	60	162.113	59.771	59.872	2691.568	2.696	998.312	3.02	20.00	22.59	1.00	31013	11.5028	0.154	387857	144.1008	0.031				-0.020	0.002	0.152	-0.017
08.08.2019	100	97.319	99.872	100.043	2699.848	2.704	998.294	3.00	20.09	22.58	1.00	31110	11.5032	0.158	388982	144.0755	0.014				-0.017	0.091	0.155	-0.013
08.08.2019	100	97.318	100.282	100.453	2710.894	2.716	998.294	2.99	20.09	22.61	1.00	31239	11.5038	0.163	390591	144.0820	0.018				-0.012	0.089	0.161	-0.008
08.08.2019	100	97.339	100.416	100.587	2715.092	2.720	998.294	3.02	20.09	22.61	1.00	31287	11.5037	0.162	391202	144.0842	0.020				-0.011	0.089	0.160	-0.007
08.08.2019	100	97.339	100.440	100.612	2715.759	2.720	998.294	2.99	20.09	22.63	1.00	31293	11.5031	0.157	391300	144.0849	0.020				-0.010	0.089	0.154	-0.006
08.08.2019	100	97.319	100.778	100.950	2724.331	2.729	998.293	2.99	20.10	22.62	1.00	31394	11.5039	0.164	392532	144.0838	0.019				-0.011	0.096	0.161	-0.007
08.08.2019	130	74.860	131.330	131.555	2730.918	2.736	998.290	2.95	20.11	22.67	1.00	31476	11.5061	0.183	393472	144.0805	0.017				-0.006	0.108	0.182	-0.002
08.08.2019	130	74.883	131.988	132.214	2745.437	2.750	998.289	2.93	20.11	22.69	1.00	31643	11.5059	0.182	395589	144.0896	0.023				0.000	0.114	0.181	0.004
08.08.2019	130	74.905	128.615	128.836	2676.073	2.681	998.289	2.99	20.11	22.70	1.00	30844	11.5061	0.183	385562	144.0776	0.015				-0.009	0.113	0.183	-0.005
08.08.2019	130	74.882	128.951	129.172	2682.238	2.687	998.289	3.01	20.11	22.69	1.00	30915	11.5061	0.183	386472	144.0857	0.021				-0.003	0.113	0.183	0.001
08.08.2019	130	74.883	128.900	129.121	2681.206	2.686	998.288	3.01	20.12	22.69	1.00	30903	11.5061	0.182	386328	144.0874	0.022				-0.002	0.117	0.182	0.002

PTB Laboratory – Day#2

Data report PTB: Day#2					*Original data set							Turbine meter			Coriolis_Mass			Coriolis_Vol			Correction of autozero at Coriolis meter	Temperature correction of meter error		
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	Pulses/ Liter		T_{nom}	20	°C
		Laboratory reference					Fluid			Ambient conditions											Corrected 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	Coriolis _Mass	(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	$e_{cor,m}$	ΔT_{fluid}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
09.08.2019	10	972.127	9.983	10.000	2695.814	2.700	998.313	3.00	20.00	21.90	1.00	31011	11.4840	-0.010	390160	144.7281	0.467				0.071	-0.001	-0.031	0.074
09.08.2019	10	972.118	10.091	10.108	2724.923	2.730	998.315	3.00	19.99	21.97	1.00	31349	11.4852	0.001	394183	144.6584	0.418				0.027	-0.014	-0.020	0.030
09.08.2019	10	972.116	10.016	10.033	2704.742	2.709	998.311	3.01	20.01	22.03	1.00	31116	11.4848	-0.003	391363	144.6951	0.444				0.050	0.009	-0.024	0.053
09.08.2019	10	972.138	10.020	10.036	2705.651	2.710	998.312	3.00	20.00	22.09	1.00	31126	11.4846	-0.004	391524	144.7060	0.451				0.057	0.005	-0.025	0.060
09.08.2019	10	972.106	10.052	10.069	2714.458	2.719	998.314	3.00	19.99	22.15	1.00	31229	11.4853	0.002	392832	144.7184	0.460				0.067	-0.009	-0.019	0.070
09.08.2019	30	324.110	30.084	30.135	2708.498	2.713	998.318	3.00	19.97	22.24	1.00	31205	11.5018	0.145	390456	144.1596	0.072				-0.059	-0.028	0.134	-0.057
09.08.2019	30	324.109	30.024	30.075	2703.099	2.708	998.325	2.99	19.94	22.27	1.00	31146	11.5030	0.156	389716	144.1738	0.082				-0.050	-0.059	0.145	-0.048
09.08.2019	30	324.111	30.065	30.116	2706.795	2.711	998.314	3.00	19.99	22.29	1.00	31190	11.5034	0.160	390227	144.1657	0.076				-0.055	-0.009	0.149	-0.052
09.08.2019	30	324.113	30.092	30.143	2709.196	2.714	998.307	3.00	20.03	22.31	1.00	31218	11.5035	0.160	390752	144.2317	0.122				-0.009	0.029	0.149	-0.006
09.08.2019	30	324.114	30.078	30.129	2707.992	2.713	998.318	3.00	19.98	22.33	1.00	31204	11.5035	0.161	390318	144.1356	0.055				-0.076	-0.024	0.149	-0.073
09.08.2019	60	162.136	60.130	60.232	2708.114	2.713	998.309	3.00	20.02	22.35	1.00	31207	11.5040	0.165	390349	144.1405	0.059				-0.007	0.015	0.163	-0.004
09.08.2019	60	162.095	60.064	60.166	2704.484	2.709	998.308	3.00	20.02	22.37	1.00	31163	11.5032	0.158	389809	144.1344	0.054				-0.011	0.020	0.156	-0.008
09.08.2019	60	162.118	60.366	60.468	2718.435	2.723	998.310	2.99	20.01	22.39	1.00	31323	11.5030	0.156	391811	144.1311	0.052				-0.013	0.013	0.153	-0.010
09.08.2019	60	162.095	60.544	60.647	2726.088	2.731	998.312	2.98	20.00	22.40	1.00	31411	11.5029	0.155	392918	144.1325	0.053				-0.012	0.005	0.153	-0.009
09.08.2019	60	162.073	60.065	60.166	2704.132	2.709	998.311	3.00	20.01	22.42	1.00	31158	11.5029	0.155	389763	144.1361	0.056				-0.010	0.006	0.153	-0.007
09.08.2019	100	97.297	100.812	100.984	2724.619	2.729	998.292	3.01	20.10	22.44	1.00	31398	11.5041	0.166	392578	144.0854	0.020				-0.019	0.097	0.164	-0.015
09.08.2019	100	97.320	102.340	102.515	2766.582	2.771	998.294	3.00	20.09	22.47	1.00	31882	11.5043	0.167	398634	144.0890	0.023				-0.016	0.089	0.165	-0.012
09.08.2019	100	97.297	100.057	100.228	2704.236	2.709	998.294	3.00	20.09	22.47	1.00	31163	11.5041	0.166	389665	144.0943	0.027				-0.013	0.089	0.163	-0.009
09.08.2019	100	97.321	100.028	100.199	2704.103	2.709	998.293	3.00	20.10	22.46	1.00				389663	144.1006	0.031				-0.008	0.096	-0.002	-0.005
09.08.2019	100	97.319	99.994	100.165	2703.135	2.708	998.295	2.99	20.09	22.47	1.00	31150	11.5040	0.165	389500	144.0920	0.025				-0.014	0.087	0.162	-0.011
09.08.2019	130	74.882	130.406	130.629	2712.496	2.717	998.289	2.99	20.12	22.49	1.00	31265	11.5066	0.187	390804	144.0754	0.013				-0.017	0.115	0.187	-0.013
09.08.2019	130	74.866	129.764	129.987	2698.582	2.703	998.289	2.98	20.12	22.50	1.00	31105	11.5067	0.188	388824	144.0846	0.020				-0.011	0.116	0.188	-0.006
09.08.2019	130	74.885	129.917	130.140	2702.435	2.707	998.289	2.98	20.11	22.52	1.00	31150	11.5069	0.190	389370	144.0812	0.017				-0.013	0.114	0.190	-0.009
09.08.2019	130	74.881	130.240	130.464	2709.021	2.714	998.289	3.00	20.11	22.54	1.00	31225	11.5066	0.187	390315	144.0797	0.016				-0.014	0.113	0.187	-0.010
09.08.2019	130	74.883	130.104	130.327	2706.249	2.711	998.289	2.99	20.12	22.54	1.00	31193	11.5066	0.187	389982	144.1043	0.034				0.003	0.116	0.187	0.007
09.08.2019	150	64.918	150.843	151.105	2720.138	2.725	998.267	3.02	20.22	22.55	1.00	31359	11.5085	0.204	391884	144.0677	0.008				-0.018	0.217	0.205	-0.013
09.08.2019	150	64.899	147.519	147.772	2659.373	2.664	998.284	2.99	20.14	22.57	1.00	30655	11.5074	0.194	383140	144.0715	0.011				-0.016	0.136	0.195	-0.012
09.08.2019	150	64.897	147.180	147.433	2653.234	2.658	998.285	2.96	20.13	22.57	1.00	30586	11.5080	0.200	382250	144.0694	0.009				-0.017	0.132	0.200	-0.013
09.08.2019	150	64.918	151.346	151.606	2729.212	2.734	998.283	2.93	20.14	22.57	1.00	31463	11.5084	0.203	393199	144.0705	0.010				-0.016	0.142	0.204	-0.012
09.08.2019	150	64.922	151.419	151.680	2730.657	2.735	998.282	2.99	20.15	22.57	1.00	31479	11.5082	0.201	393402	144.0686	0.009				-0.017	0.149	0.202	-0.013

PTB Laboratory – Day#3

					*Original data set																	Correction of autozero at Coriolis meter		Temperature correction of meter error		
Data report PTB: Day#3												Turbine meter			Coriolis_Mass			Coriolis_Vol						T_{nom}	20	°C
												$K_{V,nom}$	11.4850	Pulses/ Liter	$K_{m,nom}$	144.0560	Pulses/ kg	$K_{V,nom}$	28.8000	Pulses/ Liter						
		Laboratory reference					Fluid			Ambient conditions												Corrected 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		Coriolis _Mass		(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		$e_{cor,m}$		ΔT_{fluid}	$e_{cor,V}$	$e_{cor,m}$
	[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]	[%]	[%]
12.08.2019	10	972.111	10.030	10.047	2708.332	2.713	998.311	3.00	20.01	22.68	1.01	31161	11.4862	0.009	392722	145.0051	0.659					0.013		0.009	-0.012	0.015
12.08.2019	10	972.133	9.967	9.983	2691.382	2.696	998.319	3.00	19.97	22.63	1.01	30965	11.4859	0.007	390140	144.9590	0.627					-0.024		-0.031	-0.014	-0.021
12.08.2019	10	972.116	9.929	9.946	2681.208	2.686	998.306	3.00	20.03	22.63	1.01	30847	11.4854	0.003	388851	145.0283	0.675					0.022		0.034	-0.019	0.025
12.08.2019	10	972.114	10.029	10.046	2708.083	2.713	998.314	3.00	20.00	22.72	1.01	31159	11.4865	0.012	392712	145.0148	0.666					0.019		-0.004	-0.009	0.022
12.08.2019	10	972.109	10.033	10.049	2709.090	2.714	998.313	3.00	20.00	22.79	1.01	31171	11.4867	0.014	392798	144.9926	0.650					0.004		-0.001	-0.007	0.007
12.08.2019	10	972.114	10.002	10.019	2700.880	2.705	998.311	3.00	20.01	22.81	1.01	31076	11.4865	0.012	391623	144.9983	0.654					0.006		0.008	-0.009	0.009
12.08.2019	10	972.112	10.066	10.083	2718.086	2.723	998.313	3.00	20.00	22.84	1.01	31275	11.4868	0.015	394073	144.9818	0.643					-0.001		0.001	-0.006	0.001
12.08.2019	10	972.116	10.039	10.056	2710.910	2.715	998.313	3.00	20.00	22.86	1.01	31193	11.4871	0.017	393106	145.0089	0.661					0.016		-0.002	-0.004	0.019
12.08.2019	10	972.148	9.946	9.962	2685.711	2.690	998.313	3.00	20.00	22.88	1.01	30901	11.4863	0.010	389521	145.0346	0.679					0.028		0.001	-0.011	0.030
12.08.2019	10	972.124	10.006	10.023	2701.922	2.706	998.313	3.00	20.00	22.88	1.01	31088	11.4865	0.012	391911	145.0490	0.689					0.041		0.000	-0.009	0.044
12.08.2019	100	97.297	100.284	100.456	2710.362	2.715	998.292	3.01	20.10	22.88	1.01	31234	11.5042	0.167	390592	144.1106	0.038					-0.027		0.101	0.164	-0.023
12.08.2019	100	97.318	100.459	100.631	2715.688	2.720	998.292	3.00	20.10	22.90	1.01	31295	11.5041	0.165	391323	144.0972	0.029					-0.036		0.102	0.163	-0.032
12.08.2019	100	97.299	97.939	98.107	2647.051	2.652	998.293	2.98	20.10	22.91	1.01	30504	11.5041	0.165	381466	144.1098	0.037					-0.029		0.096	0.163	-0.025
12.08.2019	100	97.318	99.647	99.817	2693.721	2.698	998.293	2.99	20.10	22.91	1.01	31042	11.5042	0.166	388224	144.1218	0.046					-0.019		0.098	0.164	-0.015
12.08.2019	100	97.319	99.646	99.816	2693.726	2.698	998.295	2.99	20.09	22.92	1.01				388186	144.1075	0.036					-0.029		0.087	-0.002	-0.026
12.08.2019	100	97.296	99.752	99.923	2695.958	2.701	998.294	3.00	20.09	22.93	1.01	31068	11.5043	0.167	388502	144.1054	0.034					-0.031		0.091	0.165	-0.027
12.08.2019	100	97.319	99.788	99.958	2697.556	2.702	998.293	3.00	20.10	22.94	1.01	31086	11.5041	0.165	388784	144.1245	0.048					-0.017		0.097	0.163	-0.014
12.08.2019	100	97.318	99.870	100.041	2699.746	2.704	998.292	3.00	20.10	22.94	1.00	31112	11.5044	0.168	389060	144.1099	0.037					-0.028		0.100	0.166	-0.024
12.08.2019	100	97.298	99.671	99.842	2693.829	2.698	998.293	2.99	20.10	22.96	1.00	31044	11.5044	0.168	388228	144.1175	0.043					-0.022		0.098	0.166	-0.018
12.08.2019	100	97.297	99.561	99.731	2690.810	2.695	998.294	2.99	20.09	22.96	1.00	31009	11.5044	0.168	387813	144.1250	0.048					-0.017		0.091	0.166	-0.013
12.08.2019	150	64.919	151.582	151.842	2733.468	2.738	998.285	2.95	20.13	22.96	1.00	31514	11.5092	0.210	393892	144.0997	0.030					-0.012		0.134	0.210	-0.008
12.08.2019	150	64.920	150.555	150.813	2714.980	2.720	998.286	2.99	20.13	22.96	1.00	31300	11.5089	0.207	391241	144.1046	0.034					-0.009		0.132	0.207	-0.005
12.08.2019	150	64.899	150.675	150.934	2716.275	2.721	998.285	2.99	20.14	22.97	1.00	31315	11.5089	0.207	391473	144.1213	0.045					0.002		0.135	0.208	0.007
12.08.2019	150	64.896	150.375	150.634	2710.784	2.715	998.285	2.98	20.14	22.96	1.00	31252	11.5090	0.208	390554	144.0742	0.013					-0.030		0.136	0.209	-0.026
12.08.2019	150	64.920	150.902	151.161	2721.249	2.726	998.285	3.00	20.13	22.97	1.00	31373	11.5091	0.209	392102	144.0890	0.023					-0.020		0.134	0.210	-0.016
12.08.2019	150	64.896	150.832	151.091	2719.011	2.724	998.283	3.00	20.14	22.96	1.00	31347	11.5090	0.208	391793	144.0940	0.026					-0.017		0.143	0.209	-0.012
12.08.2019	150	64.898	151.011	151.271	2722.291	2.727	998.284	3.01	20.14	22.96	1.00	31385	11.5091	0.209	392325	144.1157	0.041					-0.001		0.142	0.210	0.003
12.08.2019	150	64.898	150.289	150.548	2709.280	2.714	998.285	2.98	20.13	22.96	1.00	31235	11.5091	0.209	390428	144.1077	0.036					-0.007		0.134	0.210	-0.003
12.08.2019	150	64.899	150.171	150.429	2707.227	2.712	998.284	2.97	20.14	22.96	1.00	31210	11.5086	0.205	390089	144.0917	0.025					-0.018		0.142	0.205	-0.014
12.08.2019	150	64.921	151.123	151.382	2725.309	2.730	998.285	3.01	20.14	22.96	1.00				392668	144.0820	0.018					-0.025		0.135	0.001	-0.021