FINAL REPORT

SIM.M.V-S2

SIM Supplementary Comparison of Kinematic Viscosity Measurements of standards liquids

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Abstract

This report describes the SIM Supplementary comparison of kinematic viscosity measurements of standards liquids of two National Metrology Institutes (NMIs) carried out in the period from March 2025 and Jun, 2025. Two samples of Newtonian liquids with nominal kinematic viscosities of 120 mm²/s at 20°C, 90 mm²/s at 25 °C, and 45 mm²/s at 40 °C for sample 1 and 4 710 mm²/s at 20 °C, 3 310 mm²/s at 25 °C and 1 270 mm²/s at 40 °C for sample 2 were used to determine the degrees of equivalence between the NMIs. The mean values obtained by CENAM – pilot laboratory in the CCM.V-K4 comparison, were used as reference values for this SIM comparison.

The comparison includes an escrow, which was responsible for collecting the results from both the pilot and the participant after the measurements, and then forwarding them to the Pilot Laboratory for report preparation.

Contents

1. Introduction

The decision to conduct this comparison was made on February 5th, 2025, during an online meeting between the involved laboratories, supported by SIM WG 7 Mass and Related Quantities. The objective of this comparison is to demonstrate the degree of equivalence in viscosity measurements and to provide supporting evidence for the calibration and measurement capabilities (CMCs) claimed by the participating laboratories.

The viscosity comparison is identified as SIM.M.V-S2 and was carried out with the intention to compare the performance of viscosity measurements at 20 °C, 25 °C, and 40 °C, using two viscosity reference materials, designated as Liquid 1 and Liquid 2.

2. Participants

Information about the participants is shown in Table 1.

Table 1 Participants in SIM.M.V-S2

#	NMI/Laboratory	Acronym	Country	Contact Person	Remark
1	Centro Nacional de Metrología	CENAM	México	Sonia Trujillo strujill@cenam.mx	Pilot
2	Laboratorio Costarricense de Metrología	LACOMET	Costa Rica	Francisco Sequeira fsequeira@lcm.go.cr	SIM Participant
	Instituto Nacional de Metrología	INMETRO	Brazil	Dalni S Filho dsfilho@inmetro.gob.br	Data Custodian
	Instituto Nacional de Metrología	INMETRO	Brazil	Mila Rosendahl mrosendhal@inmetro.gov.br	Data Custodian

The INMETRO viscosity laboratory participated as escrow, ensuring the reliability of the comparison results and safeguarding the data from both CENAM and LACOMET until the completion of the measurements

3. Liquid samples

CENAM, as the pilot laboratory, provided the participating laboratory with two samples of Newtonian standard liquids, each containing half a liter, for measurement. Both standard liquids were prepared using Poly Alpha Olefins (PAO), that are labelled as non-dangerous goods.

The rate of viscosity change in 1 year is better than 0.2% for the two standard liquids, according to the statistics of CENAM´s viscosity laboratory.

Table 2. Nominal values of the liquid samples

Liquid sample	Temperature / °C	Nominal kinematic viscosity / mm^2s^{-1}	Temperature coefficient of viscosity / K^{-1}	Density / g/cm^3	Standard uncertainty / g/cm^3	Surface tension / mNm^{-1}	Standard uncertainty / mNm^{-1}
Standard liquid 1	20	120	0.054	0.828 21	0.000 04	30.14	0.19
	25	90	0.050	0.825 19	0.000 04	30.73	0.19
	40	45	0.041	0.815 98	0.000 04	29.70	0.21
Standard liquid 2	20	4 710	0.074	0.850 52	0.000 04	31.07	0.23
	25	3 310	0.069	0.847 22	0.000 04	30.73	0.23
	40	1 270	0.057	0.838 59	0.000 04	29.70	0.23

4. Organization of the comparison

The comparison schedule and additional information are given in table 3

Table 3. Schedule of the comparison SIM.M.V-S2

Date	Who	What
March 13 th, 2025	Pilot laboratory	Shipment of the standard liquids
March 19 th, 2025	Pilot laboratory	Sending the draft of the protocol to the participant
March 24 th, 2025	Laboratory participant	Deadline to send comments on the protocol
March 26 th, 2025	Pilot laboratory	Sending report forms and the final technical protocol to the participants.
April 30th, 2025	All participants	Deadline for submitting results to the escrow
May 5th, 2025	Escrow	Submission of the results to the pilot laboratory
Junio 28th, 2025	Pilot laboratory	Submission draft A report to the participant

5. Comments on the comparison

The participants measured the viscosity of the samples at temperatures of 20 °C, 25 °C, and 40 °C using two Ubbelohde viscometers.

The reference value was determined as the arithmetic mean of the pilot laboratory's measurements

The viscosity was calculate using the mathematical model equations for calculating the viscosity of the liquid samples:

$\nu = C(t - t_{KE})$.

were, ν is the kinematic viscosity in mm²/s, C is the viscometer constant in mm²/s², t is the flow time in s, and t_{KE} the kinetic energy correction in s.

The standard uncertainty of the viscosity was calculated (two viscometers, two thermometers and two stop clocks were used) according to

$$u_c'^2 = s_K'^2 + \frac{1}{2}\left(s_{timer}'^2 + s_t'^2 + s_{\theta v}'^2\right) \quad (1)$$

with s'_K : relative standard uncertainty of the viscometer constant; s'_{timer} : relative standard uncertainty of the time measuring device; s'_t : relative standard uncertainty of the flow time measurement as mean value of the standard uncertainties calculated from viscometers 1 and 2; $s'_{\vartheta\nu}$: relative standard uncertainty due to temperature. The constants of the viscometers used were calibrated by the same institute.

Once their measurements were completed, both laboratories, CENAM and Lacomet, sent their respective results to the custodian laboratory (Inmetro).

6. Results of the comparison

The reported results of measurement by the participating institutes are listed in Table 4

The viscosity ν at the nominal temperature was calculated by the pilot laboratory by correcting the reported results of the viscosity ν_0 at the measurement temperature ϑ and the standard uncertainty *u* was derived from the reported value of relative expanded uncertainty U_{r95}.

The degree of equivalence d_i of each laboratory is expressed quantitatively as the deviation of the reported laboratory viscosity value from the reference value, and the uncertainty of this deviation $U(d_i)$ at the 95 % level of confidence. The results are given in Table 4. The graphical representations of them are shown in Figure 1 to Figure 6

Using these values (d_i and $U(d_i)$), the normalized error *En* was calculated. The normalized error *En* describes the degree of equivalence of a laboratory related to the reference value.

Table 4. Results of the measurements for Liquid 1 and Liquid 2

	Nominal Temperature	Labratory	ν_0/(mm²/s)	ϑ/°C	ν /(mm²/s)	U_{r95}	u/(mm²/s)	d_i /(mm²/s)	$U(d_i)$/(mm2/s)	| *En* |
Liquid 1	20°C	CENAM	119.867	19.999	119.86	0.0025	0.15	-	-	
		Lacomet	119.859	19.997	119.84	0.0036	0.22	-0.021	0.32	0.04
	25°C	CENAM	92.534	24.999	92.529	0.0025	0.12	-	-	
		Lacomet	92.667	25.003	92.653	0.0034	0.16	0.12	0.21	0.3
	40°C	CENAM	46.784	40.000	46.784	0.0026	0.060	-	-	
		Lacomet	46.775	39.998	46.771	0.0032	0.076	-0.013	0.093	0.07
Liquid 2	20°C	CENAM	4492.584	19.997	4491.6	0.0035	7.9	-	-	
		Lacomet	4473.891	19.996	4472.6	0.0043	9.5	-19.0	10.8	0.8
	25°C	CENAM	3147.593	25.000	3147.6	0.0035	5.6	-	-	
		Lacomet	3139.690	25.001	3139.5	0.0040	6.3	-8.1	6.1	0.5
	40°C	CENAM	1229.065	40.010	1228.4	0.0036	2.2	-	-	
		Lacomet	1225.832	39.999	1225.8	0.0041	2.5	-2.6	5.1	0.4

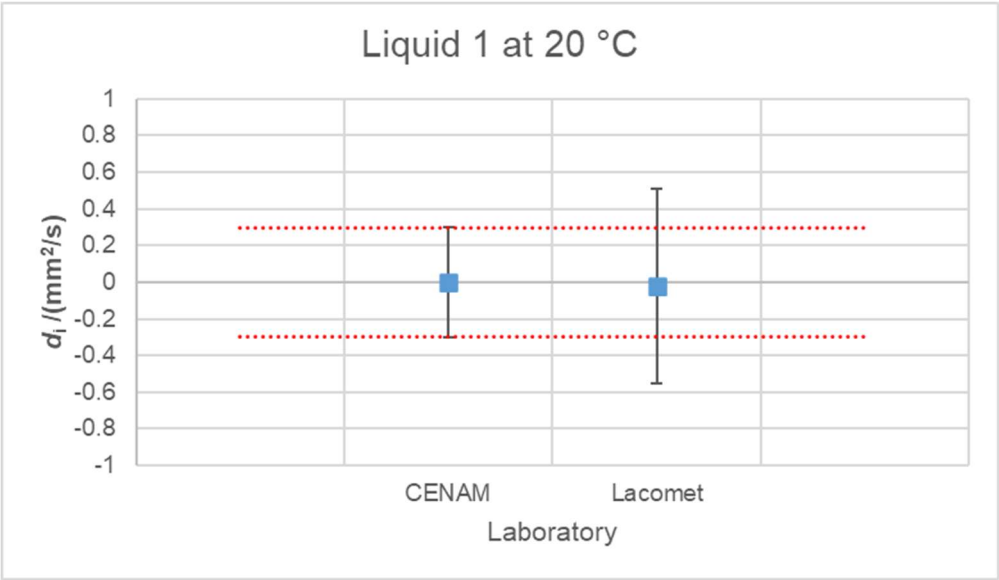

Figure 1. Degrees of equivalence of laboratories with respect to the reference value for the measurements of Liquid 1 at 20 ºC. The distance between two red lines expresses the expanded uncertainty of the reference value.

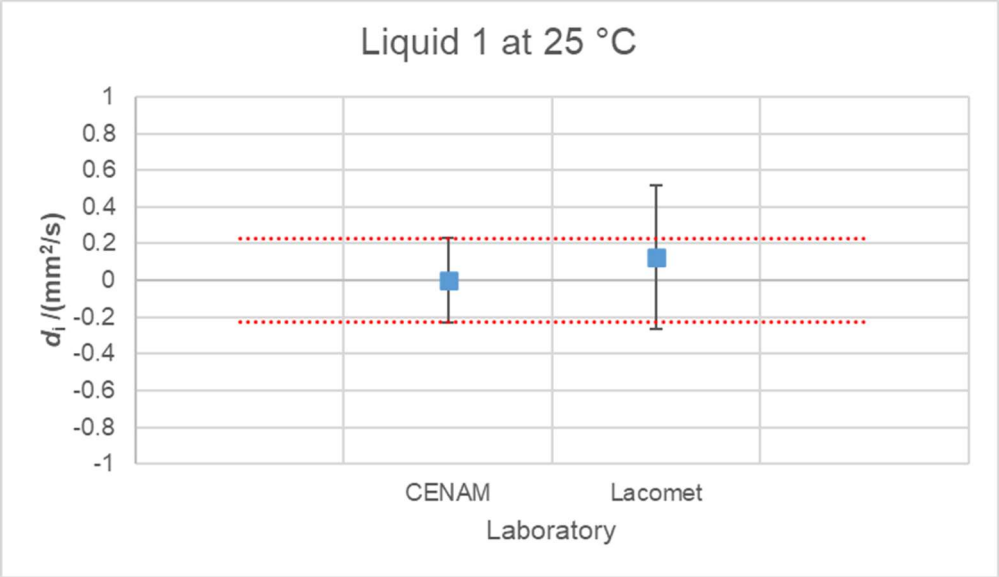

Figure 2. Degrees of equivalence of laboratories with respect to the reference value for the measurements of Liquid 1 at 25 ºC. The distance between two red lines expresses the expanded uncertainty of the reference value.

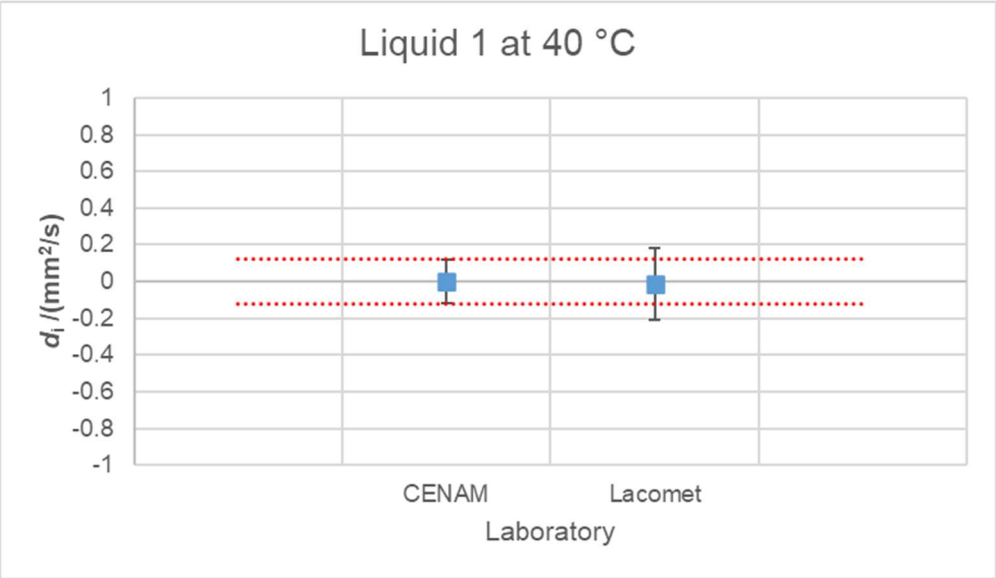

Figure 3. Degrees of equivalence of laboratories with respect to the reference value for the measurements of Liquid 1 at 40 ºC. The distance between two red lines expresses the expanded uncertainty of the reference value.

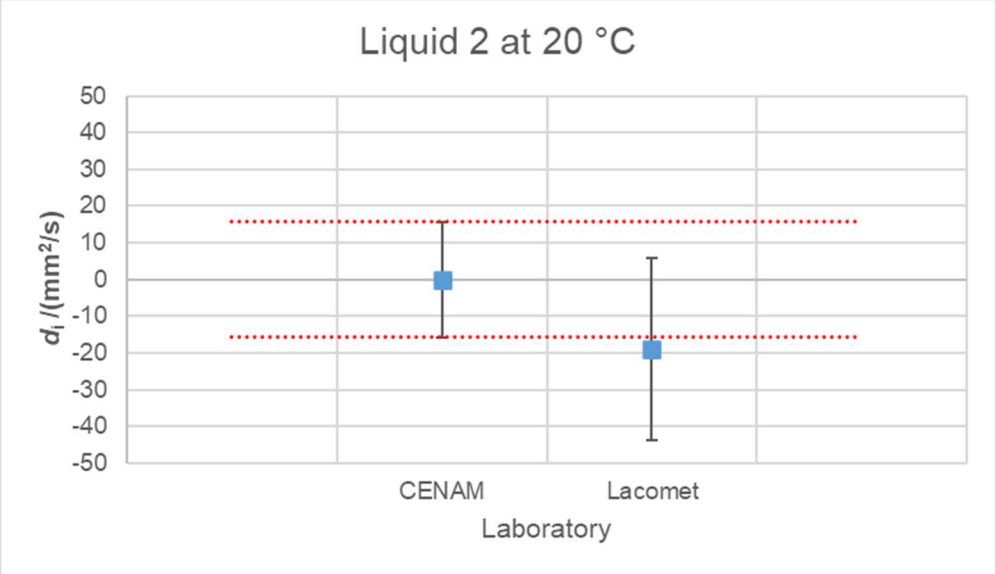

Figure 4. Degrees of equivalence of laboratories with respect to the reference value for the measurements of Liquid 2 at 20 ºC. The distance between two red lines expresses the expanded uncertainty of the reference value.

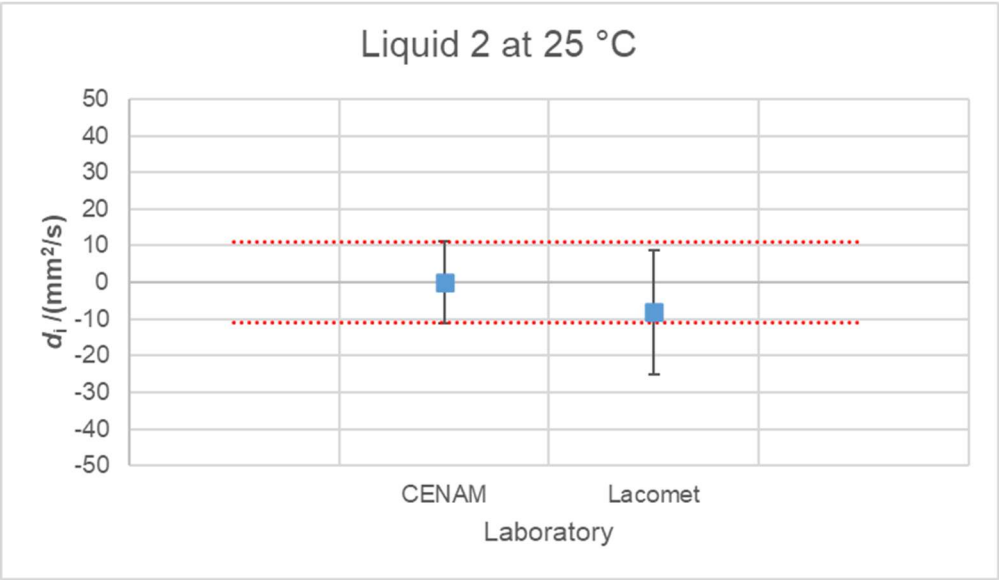

Figure 5. Degrees of equivalence of laboratories with respect to the reference value for the measurements of Liquid 2 at 25 ºC. The distance between two red lines expresses the expanded uncertainty of the reference value.

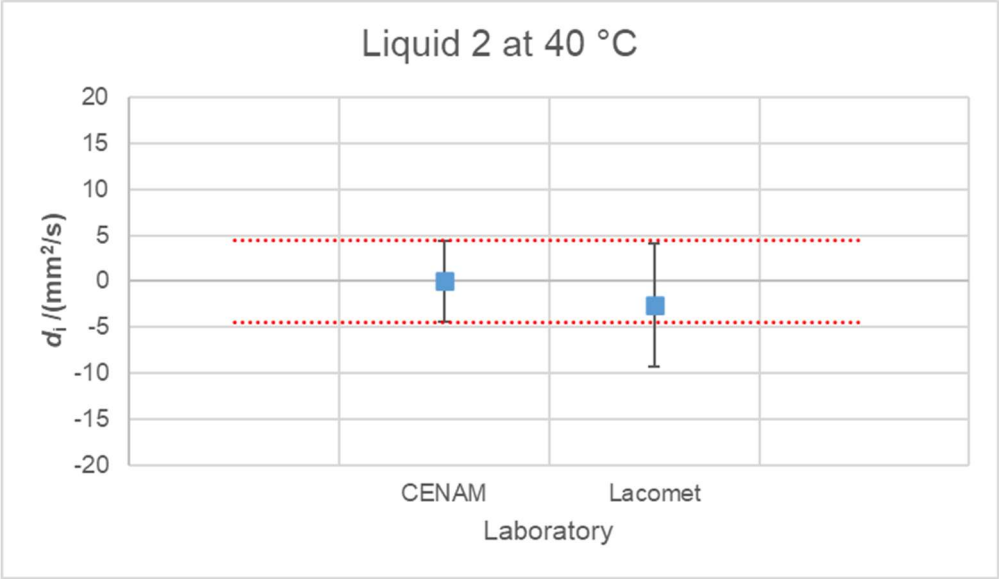

Figure 6. Degrees of equivalence of laboratories with respect to the reference value for the measurements of Liquid 2 at 40 ºC. The distance between two red lines expresses the expanded uncertainty of the reference value.

7. Conclusions

The main objective of this comparison was to compare viscosity measurements at 20 ºC, 25 ºC and 40 °C, using two different standard fluids.

The relative uncertainty of the reference value for liquid 1 at 20°C and 25°C is approximately 0.25%, while for liquid 2, the relative uncertainty of the reference value at 20°C and 25°C is approximately 0.35%. An increase in relative uncertainty is observed for measurements at 40°C, with values of 0.3% for liquid 1 and 0.4% for liquid 2.

The data of participants agree with respect the criterion *En*, which confirms the stated uncertainty claimed by Lacomet.

The results of this key comparison will be of interest for supporting the entries concerning viscosity in the Calibration and Measurement Capability (CMC) tables of the CIPM-MRA.

8. Acknowledge

We would like to thank the INMETRO viscosity laboratory, which kindly agreed to participate as guarantor of the reliability of the results of this comparison.

9. References

[1] CCM.V-K 3: CCM Key Comparison of Viscosity, Y Fujita. Metrologia 2018, 55, Tech. Suppl., 07010.

[2] CIPM Key Comparison of Viscosity CCM.V-K4, S Trujillo et al 2025. Metrologia 62, 07002

[3] The Evaluation of Key Comparison Data, M. G. Cox, Metrologia, 2002, 39, 589-595

[4] CIPM MRA-G-11 Measurement comparisons in the CIPM MRA

Appendix 1 Uncertainty Budget

participating lab (abbreviation), standard liquid	CENAM					
UNCERTAINTY BUDGET	**STANDARD LIQUID #1, 20 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.054	1/K	3.24E-05	1/K	can be neglect	50
Density of the sample	0.8282	g/cm³	4.00E-05	g/cm³	can be neglect	50
Time measuring device			1.00E-01	s	1.80E-04	50
Flow time measurements	384.070	s	1.40E-01	s	2.50E-04	9
Sample temperature	20.000	°C	4.50E-03	K	1.71E-04	100
Viscometer Number 1, Viscometer constant	0.3124	mm²/s²	3.75E-05	mm²/s²	1.20E-03	50
Kinetic energy correction t_{KE} (1)		s		s		
Viscometer Number 2, Viscometer constant	0.3118	mm²/s²	3.75E-05	mm²/s²	1.20E-03	50
Kinetic energy correction t_{KE} (2)		s		s		
additional uncertainty component 1						
additional uncertainty component 2						
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	1.23E-03					
Effective degrees of freedom, ν_{eff}	53					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	2.50E-03					

participating lab (abbreviation), standard liquid	CENAM					
UNCERTAINTY BUDGET	**STANDARD LIQUID #1, 25 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.050	1/K	0.000032	1/K	can be neglect	50
Density of the sample	0.8252	g/cm³	0.00004	g/cm³	can be neglect	50
Time measuring device			1.00E-01	s	1.80E-04	50
Flow time measurements	296.49	s	9.00E-02	s	2.10E-04	9
Sample temperature	25.00	°C	4.49E-03	K	1.59E-04	100
Viscometer Number 1, Viscometer constant	0.3124	mm²/s²	3.75E-04	mm²/s²	1.20E-03	50
Kinetic energy correction t_{KE} (1)		s		s		
Viscometer Number 2, Viscometer constant	0.3118	mm²/s²	3.75 E-4	mm²/s²	1.2 E-3	50
Kinetic energy correction t_{KE} (2)		s		s		
additional uncertainty component 1						
additional uncertainty component 2						
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	1.23E-03					
Effective degrees of freedom, ν_{eff}	53					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2.00					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	2.5E-03					

participating lab (abbreviation), standard liquid	CENAM					
UNCERTAINTY BUDGET	**STANDARD LIQUID #1, 40 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.042	1/K	3.24E-05	1/K	can be neglect	50
Density of the sample	0.8160	g/cm³	4.00E-05	g/cm³	can be neglect	50
Time measuring device			1.00E-01	s	2.40E-04	50
Flow time measurements	296.490	s	9.00E-02	s	2.10E-04	9
Sample temperature	40.000	°C	4.49E-03	K	1.30E-04	100
Viscometer Number 1, Viscometer constant	0.1026	mm²/s²	1.28E-04	mm²/s²	1.25E-03	50
Kinetic energy correction t_{KE} (1)		s		s		
Viscometer Number 2, Viscometer constant	0.1014	mm²/s²	1.28E-04	mm²/s²	1.25E-03	50
Kinetic energy correction t_{KE} (2)		s		s		
additional uncertainty component 1						
additional uncertainty component 2						
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	1.27E-03					
Effective degrees of freedom, ν_{eff}	53					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	2.55E-03					

participating lab (abbreviation), standard liquid	CENAM					
UNCERTAINTY BUDGET	**STANDARD LIQUID # 2, 20 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.074	1/K	3.24E-05	1/K	can be neglect	50
Density of the sample	0.8505	g/cm³	4.00E-05	g/cm³	can be neglect	50
Time measuring device			1.00E-01	s	1.60E-04	50
Flow time measurements	441.020	s	8.00E-02	s	1.30E-04	9
Sample temperature	20.000	°C	4.49E-03	K	2.35E-04	100
Viscometer Number 1, Viscometer constant	10.14715	mm²/s²	1.78E-02	mm²/s²	1.75E-03	50
Kinetic energy correction t_{KE} (1)		s		s		
Viscometer Number 2, Viscometer constant	10.22689	mm²/s²	1.79E-02	mm²/s²		50
Kinetic energy correction t_{KE} (2)		s		s		
additional uncertainty component 1						
additional uncertainty component 2						
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	1.76E-03					
Effective degrees of freedom, ν_{eff}	52					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	0.0035					

participating lab (abbreviation), standard liquid	CENAM					
UNCERTAINTY BUDGET	**STANDARD LIQUID # 2, 25 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.069	1/K	0.000032	1/K	na	50
Density of the sample	0.8472	g/cm³	0.00004	g/cm³	na	50
Time measuring device			1.00E-01	s	2.30E-04	50
Flow time measurements	308.990000	s	5.00E-02	s	1.10E-04	9
Sample temperature	25.000000	°C	4.49E-03	K	2.19E-04	100
Viscometer Number 1, Viscometer constant	10.147150	mm²/s²	1.78E-02	mm²/s²	1.75E-03	50
Kinetic energy correction t_{KE} (1)		s		s		
Viscometer Number 2, Viscometer constant	10.226890	mm²/s²	1.78E-02	mm²/s²	1.75E-03	50
Kinetic energy correction t_{KE} (2)		s		s		
additional uncertainty component 1						
additional uncertainty component 2						
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	1.77E-03					
Effective degrees of freedom, ν_{eff}	51					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	3.53E-03					

participating lab (abbreviation), standard liquid	CENAM					
UNCERTAINTY BUDGET	**STANDARD LIQUID #2, 40 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.057	1/K	3.24E-05	1/K	can be neglect	50
Density of the sample	0.8386	g/cm³	4.00E-05	g/cm³	can be neglect	50
Time measuring device			1.00E-01	s	1.80E-04	50
Flow time measurements	398.470	s	2.30E-01	s	4.05E-04	9
Sample temperature	40.000	°C	4.49E-03	K	1.81E-04	100
Viscometer Number 1, Viscometer constant	3.084	mm²/s²	5.40E-03	mm²/s²	1.75E-03	50
Kinetic energy correction t_{KE} (1)		s		s		
Viscometer Number 2, Viscometer constant	3.085	mm²/s²	5.40E-03	mm²/s²	1.75E-03	50
Kinetic energy correction t_{KE} (2)		s		s		
additional uncertainty component 1						
additional uncertainty component 2						
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	1.78E-03					
Effective degrees of freedom, ν_{eff}	54					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	0.0036					

participating lab (abbreviation), standard liquid	LACOMET					
UNCERTAINTY BUDGET	**STANDARD LIQUID #1, 20 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.054	1/K	0.0031	1/K	9.14E-06	500000
Density of the sample	0.8282	g/cm³	0.00004	g/cm³	-	50
Time measuring device			0.068	s	1.70E-04	400
Flow time measurements	403.085	s	-	s	-	-
Sample temperature	19.997	°C	0.018	K	9.83E-04	500000
Viscometer Number 1, Viscometer constant	0.3228	mm²/s²	0.00045	mm²/s²	1.39E-03	200
Kinetic energy correction t_{KE} (1)	neglected	s	-	s	-	-
Viscometer Number 2, Viscometer constant	0.2756	mm²/s²	0.00044	mm²/s²	1.60E-03	200
Kinetic energy correction t_{KE} (2)	neglected	s	-	s	-	-
Repeatibility between viscosity measurements	0	mm^2/s	0.023	mm^2/s	1.90E-04	9
Viscosity range betwee viscometers	0	mm^2/s	0.024	mm^2/s	1.99E-04	500000
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	1.82E-03					
Effective degrees of freedom, ν_{eff}	847					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	3.64E-03					

participating lab (abbreviation), standard liquid	LACOMET					
UNCERTAINTY BUDGET	**STANDARD LIQUID #1, 25 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.050	1/K	0.0029	1/K	9.14E-06	500000
Density of the sample	0.8252	g/cm³	0.00004	g/cm³	-	50
Time measuring device			0.06800	s	2.20E-04	400
Flow time measurements	311.67	s	-	s	-	-
Sample temperature	25.003	°C	0.01300	K	6.52E-04	500000
Viscometer Number 1, Viscometer constant	0.2756	mm²/s²	0.00044	mm²/s²	1.60E-03	202
Kinetic energy correction t_{KE} (1)	neglected	s	-	s	-	-
Viscometer Number 2, Viscometer constant	0.3228	mm²/s²	0.00045	mm²/s²	1.39E-03	200
Kinetic energy correction t_{KE} (2)	neglected	s	-	s	-	-
Repeatibility between viscosity measurements	0	mm^2/s	0.014	mm^2/s	1.46E-04	9
Viscosity range between viscometers	0	mm^2/s	0.034	mm^2/s	3.72E-04	500000
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	1.70E-03					
Effective degrees of freedom, ν_{eff}	645					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	3.40E-03					

participating lab (abbreviation), standard liquid	LACOMET					
UNCERTAINTY BUDGET	**STANDARD LIQUID #1, 40 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.042	1/K	0.0024	1/K	5.52E-06	500000
Density of the sample	0.8160	g/cm³	0.00004	g/cm³	-	50
Time measuring device			0.068	s	1.48E-04	400
Flow time measurements	464.19	s	-	s	-	-
Sample temperature	39.998	°C	0.019	K	8.04E-04	500000
Viscometer Number 1, Viscometer constant	0.1098	mm²/s²	0.00014	mm²/s²	1.27E-03	200
Kinetic energy correction t_{KE} (1)	neglected	s	-	s	-	-
Viscometer Number 2, Viscometer constant	0.09311	mm²/s²	0.00014	mm²/s²	1.51E-03	201
Kinetic energy correction t_{KE} (2)	neglected	s	-	s	-	-
Repeatibility between viscosity measurements	0	mm^2/s	0.0051	mm^2/s	1.10E-04	9
Viscosity range between viscometers	0	mm^2/s	0.022	mm^2/s	4.73E-05	500000
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	1.62E-03					
Effective degrees of freedom, ν_{eff}	711					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	3.24E-03					

participating lab (abbreviation), standard liquid	LACOMET					
UNCERTAINTY BUDGET	**STANDARD LIQUID #2, 20 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.074	1/K	0.0049	1/K	2.06E-05	500000
Density of the sample	0.8505	g/cm³	0.00004	g/cm³	-	50
Time measuring device			0.068	s	1.37E-04	400
Flow time measurements	496.36	s	-	s	-	-
Sample temperature	19.996	°C	0.013	K	1.09E-03	500000
Viscometer Number 1, Viscometer constant	9.276	mm²/s²	0.016	mm²/s²	1.78E-03	226
Kinetic energy correction t_{KE} (1)	neglected	s	-	s	-	-
Viscometer Number 2, Viscometer constant	8.817	mm²/s²	0.016	mm²/s²	1.81E-03	257
Kinetic energy correction t_{KE} (2)	neglected	s	-	s	-	-
Repeatibility between viscosity measurements	0	mm^2/s	0.77	mm^2/s	1.72E-04	9
Viscosity range between viscometers	0	mm^2/s	1.1	mm^2/s	2.42E-04	500000
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	2.13E-03					
Effective degrees of freedom, ν_{eff}	939					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	4.26E-03					

participating lab (abbreviation), standard liquid	LACOMET					
UNCERTAINTY BUDGET	**STANDARD LIQUID # 2, 25 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.069	1/K	0.0046	1/K	3.92E-06	500000
Density of the sample	0.8472	g/cm³	0.00004	g/cm³	-	50
Time measuring device			0.068	s	1.96E-04	400
Flow time measurements	347.285	s	-	s	-	-
Sample temperature	25.001	°C	0.011	K	8.89E-04	500000
Viscometer Number 1, Viscometer constant	8.817	mm²/s²	0.016	mm²/s²	1.81E-03	257
Kinetic energy correction t_{KE} (1)	-	s	-	s	-	-
Viscometer Number 2, Viscometer constant	9.276	mm²/s²	0.016	mm²/s²	1.78E-03	226
Kinetic energy correction t_{KE} (2)	-	s	-	s	-	-
Repeatibility between viscosity measurements	0	mm^2/s	0.41	mm^2/s	1.31E-04	9
Viscosity range between viscometers	0	mm^2/s	0.045	mm^2/s	1.43E-05	500000
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	2.02E-03					
Effective degrees of freedom, ν_{eff}	766					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	4.04E-03					

participating lab (abbreviation), standard liquid	LACOMET					
UNCERTAINTY BUDGET	**STANDARD LIQUID #2, 40 °C**					
Influence quantity	Value or mean value	Unit	Standard uncertainty	Unit	Rel. uncertainty in viscosity	Degrees of freedom
kin. viscosity - temperature coefficient of the sample	0.057	1/K	0.0039	1/K	6.13E-06	500000
Density of the sample	0.8386	g/cm³	0.00004	g/cm³	-	50
Time measuring device			0.068	s	1.65E-04	400
Flow time measurements	412.08	s	-	s	-	-
Sample temperature	39.999	°C	0.016	K	1.10E-03	500000
Viscometer Number 1, Viscometer constant	2.844	mm²/s²	0.0049	mm²/s²	1.71E-03	212
Kinetic energy correction t_{KE} (1)	-	s	-	s	-	-
Viscometer Number 2, Viscometer constant	3.118	mm²/s²	0.0054	mm²/s²	1.74E-03	221
Kinetic energy correction t_{KE} (2)	-	s	-	s	-	-
Repeatibility between viscosity measurements	0	mm^2/s	0.10	mm^2/s	8.28E-05	9
Viscosity range between viscometers	0	mm^2/s	0.31	mm^2/s	2.53E-04	500000
UNCERTAINTY OF MEASUREMENT RESULTS						
Rel. combined standard uncertainty of viscosity, u_c	2.07E-03					
Effective degrees of freedom, ν_{eff}	891					
Coverage faktor $k_{95} = t_{95}(\nu_{eff})$	2					
Relative expanded uncertainty of viscosity, $U_{95} = k_{95} \cdot u_c$	4.14E-03					