Report on the activities of the Working Group Viscosity
April 28, 2005

Activities of the Ad-Hoc Working Group on Viscosity

Chairman: Dr. Kaarls

Meetings

September 1999	(18 participants)
May 2000 (workshop)	(10 participants)
October 2001	(20 participants)
October 2003	(21 participants)
April 2005	

Participating countries

APMP	SIM	EUROMET	COOMET
China (P. R.)	Mexico	Germany	Russian Federation
Japan	USA	France	
India		The Netherlands	
Egypt		Norway	
		Slowakia	
		Poland	
		Portugal	
		Italy	
		Romania	

Topics

- Primary methods (absolute measurements)
  - Viscosity of water (re-evaluation of data)
  - New absolute measurements at higher viscosity (~ 10^3 mPa·s)
  - Basic reference liquids of higher viscosity (10^2 to 10^3 mPa·s)
- Uncertainties in the measurement of viscosity
- Key comparisons
- RMO activities

Key comparisons 2002

Start: April 2002
Draft report A: Oct. 2002
Draft report B: Dec. 2002
Final report: Dec. 2003

5 samples (10 mm²/s up to 40 000 mm²/s;
20, 40, 100°C)

Participants (reference value)

APMP
NMIJ (Japan)
NRCCRM (China)

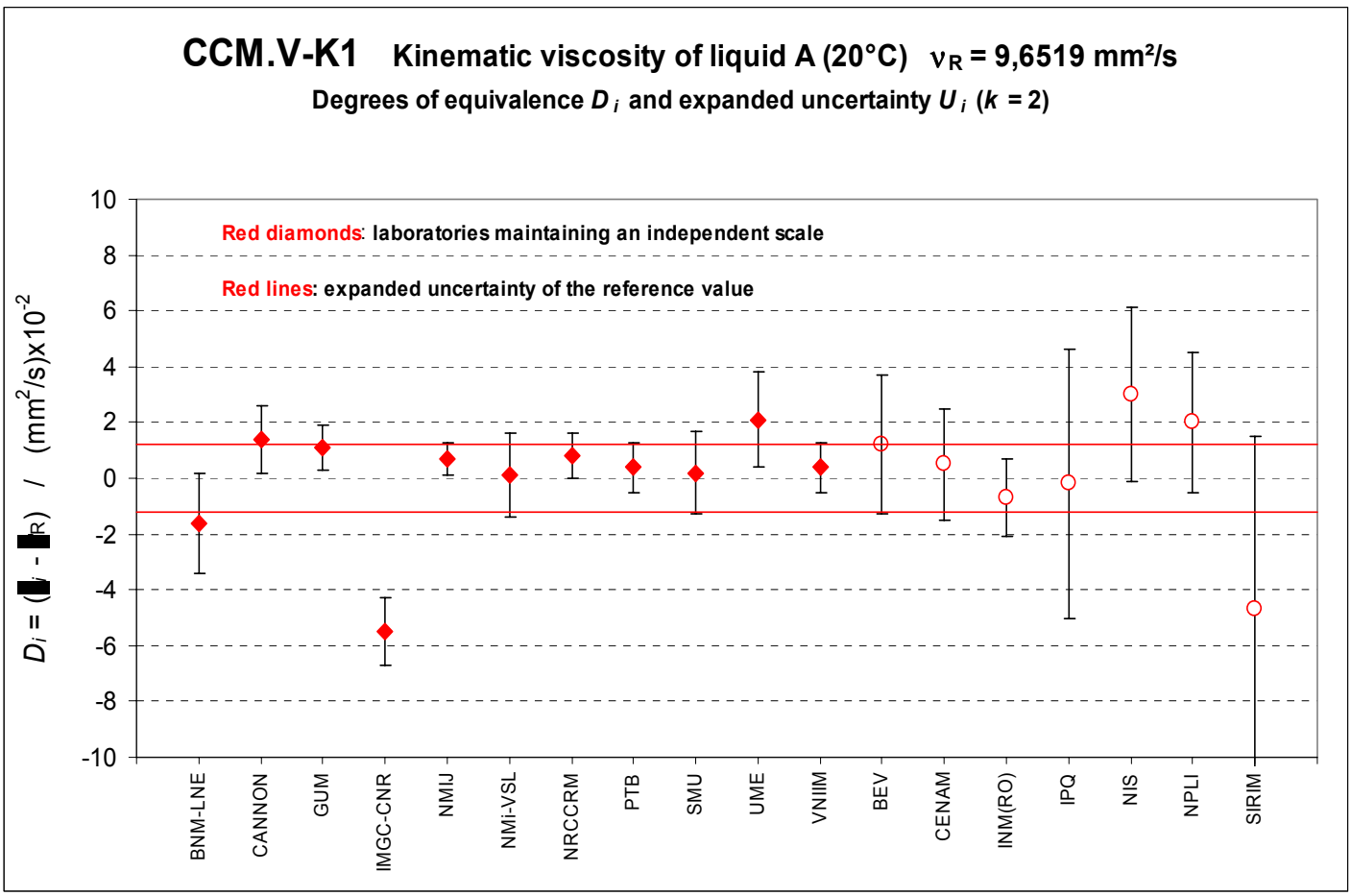
COOMET
VNIIM (Russian Federation)

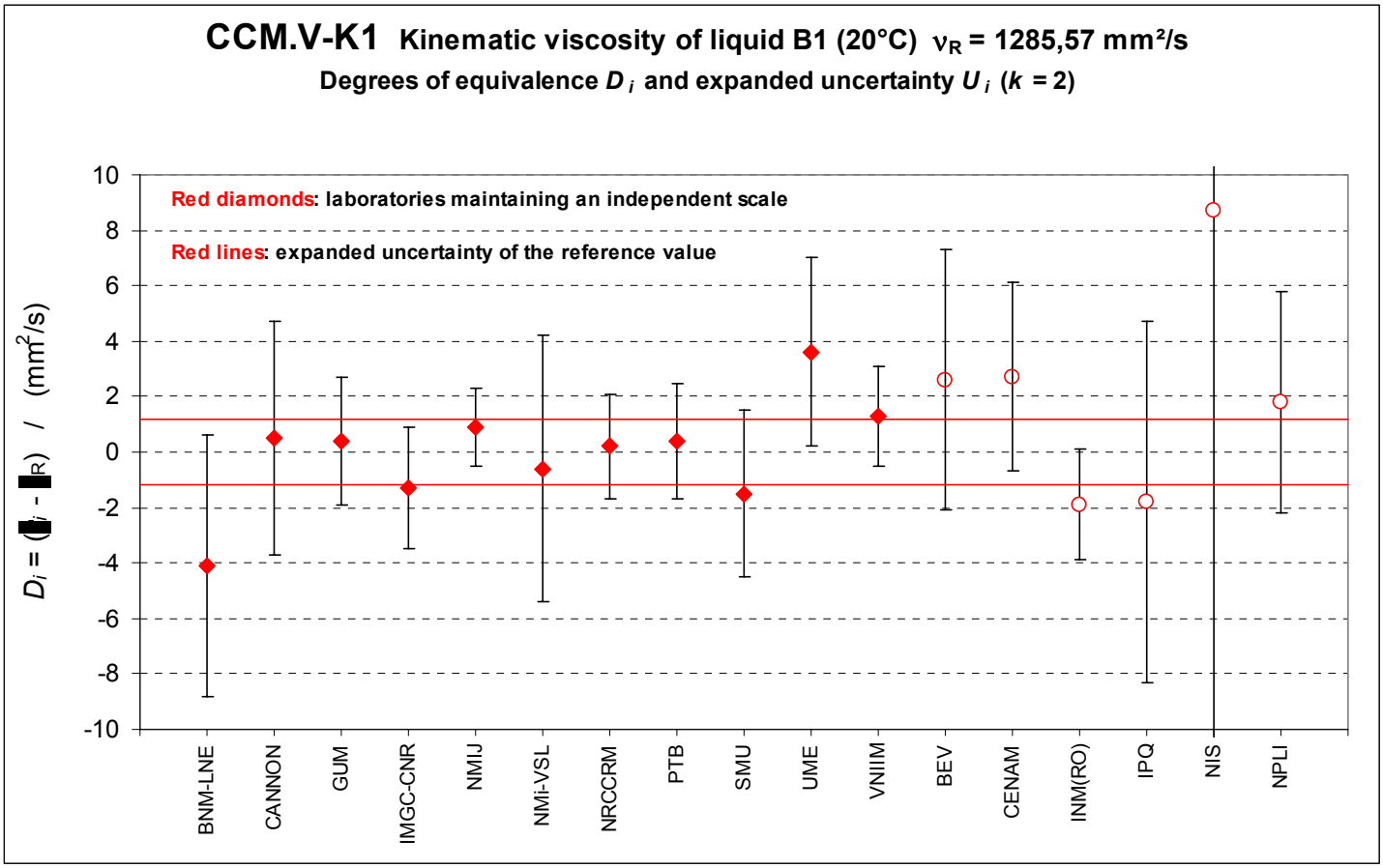
EUROMET
BNM-LNE (France)
CNR-IMGC (Italy)
GUM (Poland)
NMi VSL (The Netherlands)
PTB (Germany
SMU (Slovakia)
UME (Turkey)

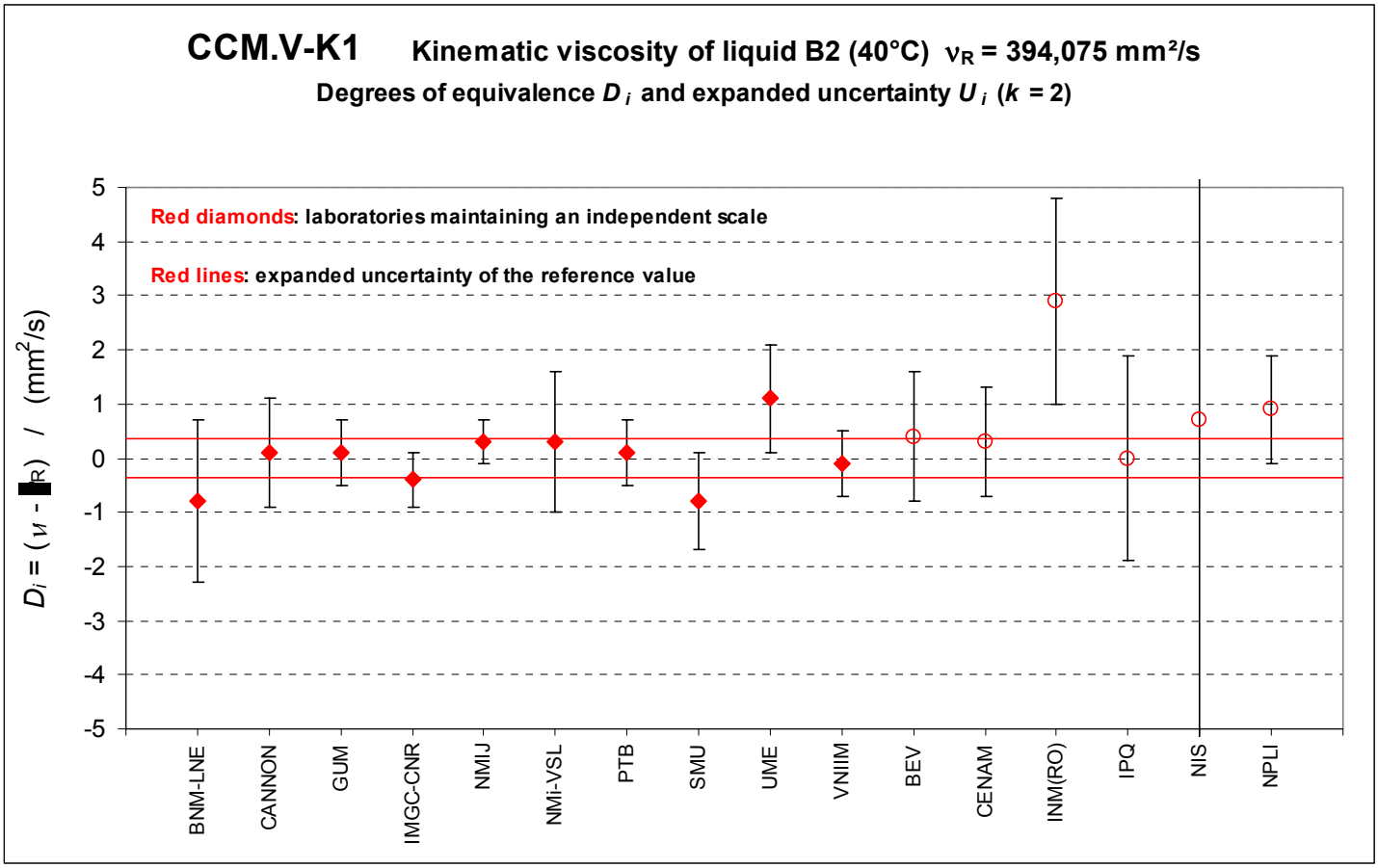
SIM
Cannon/NIST (USA)

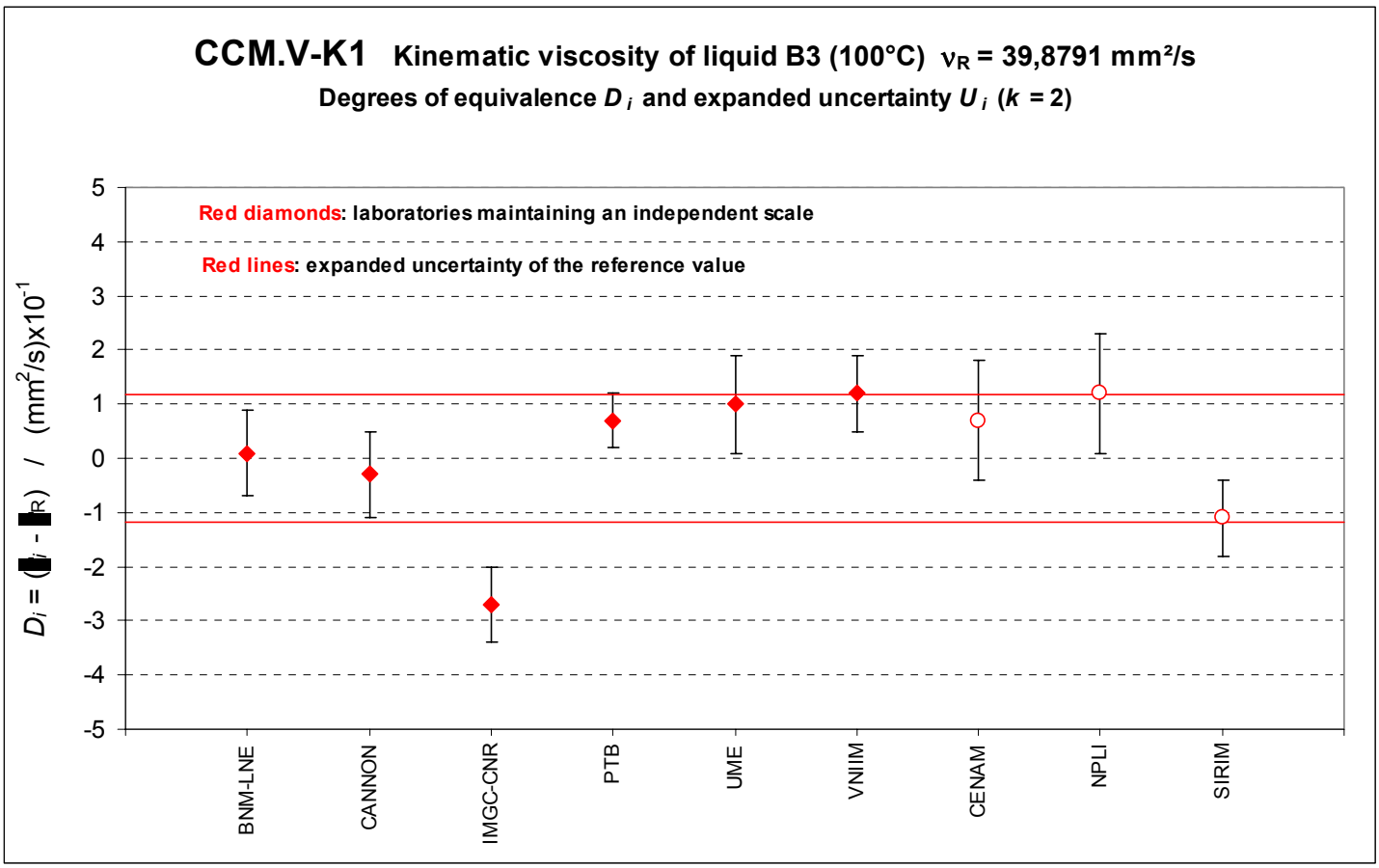
Additional participants

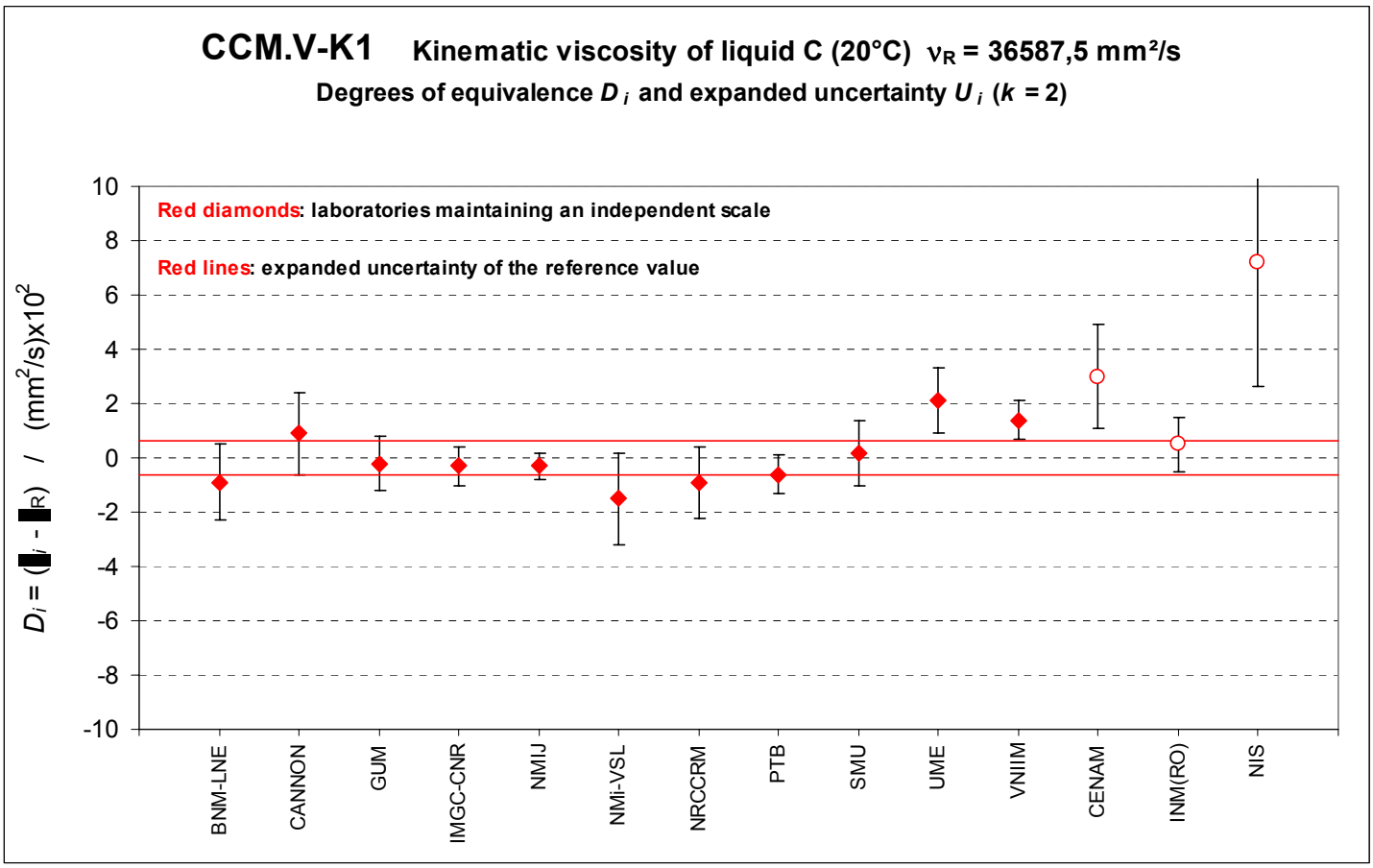
BEV (Austria)
CENAM (Mexico)
INM (Romania)
IPQ (Portugal)
NIS (Egypt)
NPLI (India)
SIRIM (Malaysia)

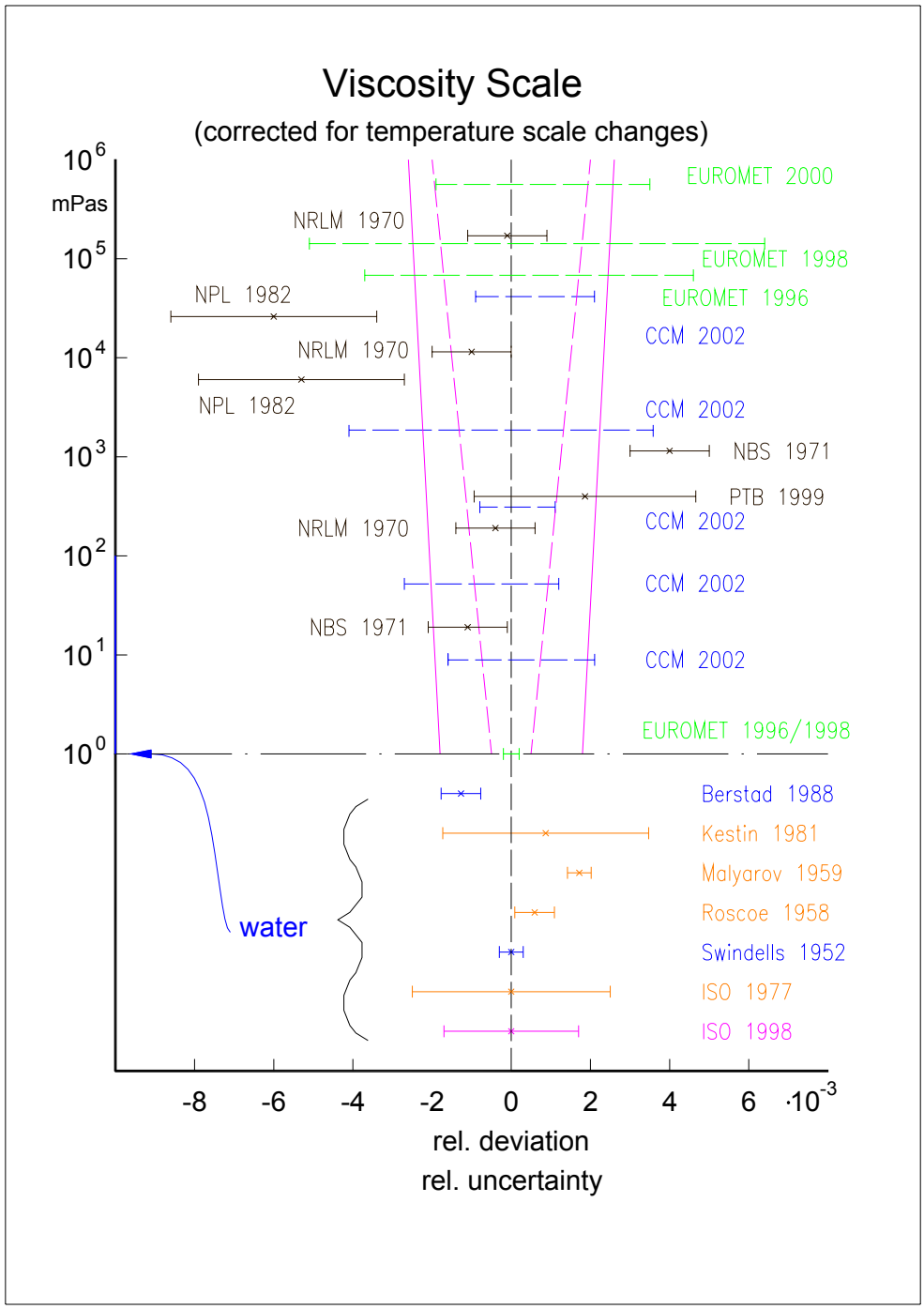

CCM.V-K1 Kinematic viscosity of liquid A (20°C) ν_R = 9,6519 mm²/s
Degrees of equivalence D_i and expanded uncertainty U_i (k = 2)
Red diamonds: laboratories maintaining an independent scale
Red lines: expanded uncertainty of the reference value
$D_i = (\nu_i - \nu_R)$ / (mm²/s)x10⁻²
10
8
6
4
2
0
-2
-4
-6
-8
-10
BNM-LNE
CANNON
GUM
IMGC-CNR
NMIJ
NMi-VSL
NRCCRM
PTB
SMU
UME
VNIIM
BEV
CENAM
INM(RO)
IPQ
NIS
NPLI
SIRIM


CCM.V-K1 Kinematic viscosity of liquid B1 (20°C) ν_R = 1285,57 mm²/s
Degrees of equivalence D_i and expanded uncertainty U_i (k = 2)
Red diamonds: laboratories maintaining an independent scale
Red lines: expanded uncertainty of the reference value
$D_i = (\nu_i - \nu_R)$ / (mm²/s)
10
8
6
4
2
0
-2
-4
-6
-8
-10
BNM-LNE
CANNON
GUM
IMGC-CNR
NMIJ
NMi-VSL
NRCCRM
PTB
SMU
UME
VNIIM
BEV
CENAM
INM(RO)
IPQ
NIS
NPLI


CCM.V-K1
Kinematic viscosity of liquid B2 (40°C) ν_R = 394,075 mm²/s
Degrees of equivalence D_i and expanded uncertainty U_i (k = 2)
Red diamonds: laboratories maintaining an independent scale
Red lines: expanded uncertainty of the reference value
$D_i = (\nu - \nu_R)$ / (mm²/s)
5
4
3
2
1
0
-1
-2
-3
-4
-5
BNM-LNE
CANNON
GUM
IMGC-CNR
NMIJ
NMi-VSL
PTB
SMU
UME
VNIIM
BEV
CENAM
INM(RO)
IPQ
NIS
NPLI


CCM.V-K1 Kinematic viscosity of liquid B3 (100°C) ν_R = 39,8791 mm²/s
Degrees of equivalence D_i and expanded uncertainty U_i (k = 2)
Red diamonds: laboratories maintaining an independent scale
Red lines: expanded uncertainty of the reference value
$D_i = (\nu_i - \nu_R)$ / (mm²/s)x10⁻¹
5
4
3
2
1
0
-1
-2
-3
-4
-5
BNM-LNE
CANNON
IMGC-CNR
PTB
UME
VNIIM
CENAM
NPLI
SIRIM


CCM.V-K1 Kinematic viscosity of liquid C (20°C) νR = 36587,5 mm²/s
Degrees of equivalence Di and expanded uncertainty Ui (k = 2)
Red diamonds: laboratories maintaining an independent scale
Red lines: expanded uncertainty of the reference value
Di = (νi - νR) / (mm²/s)x10²
10
8
6
4
2
0
-2
-4
-6
-8
-10
BNM-LNE
CANNON
GUM
IMGC-CNR
NMIJ
NMi-VSL
NRCCRM
PTB
SMU
UME
VNIIM
CENAM
INM(RO)
NIS


Viscosity Scale
(corrected for temperature scale changes)
10^6
mPas
10^5
10^4
10^3
10^2
10^1
10^0
EUROMET 2000
NRLM 1970
EUROMET 1998
EUROMET 1996
NPL 1982
CCM 2002
NRLM 1970
NPL 1982
CCM 2002
NBS 1971
PTB 1999
NRLM 1970
CCM 2002
CCM 2002
NBS 1971
CCM 2002
EUROMET 1996/1998
Berstad 1988
Kestin 1981
Malyarov 1959
Roscoe 1958
Swindells 1952
ISO 1977
ISO 1998
water
-8
-6
-4
-2
0
2
4
6
·10^-3
rel. deviation
rel. uncertainty

Explanation as regards the diagram „Viscosity Scale“

Blue and orange data points: (for water)	Absolute measurement (except ISO) of water and uncertainty as stated by the authors. The data on blue are considered to be the most reliable ones.
Red dashed lines:	Uncertainty of viscosity measurements relative to water (PTB step-up by capillary viscometers).
Brown data points:	Absolute viscosity measurements at higher viscosities and uncertainties as stated by the authors.
Green data:	Results of EUROMET intercomparisons.
Blue data:	Results of CCMV-K1 key comparison
	The average value of each intercomparison is set to the zero deviation line, the horizontal bars mark the maximum and minimum values obtained by the participants in the intercomparison.