BIPM.EM-K10.b, SIM.EM.BIPM-K10.b, SIM.EM.BIPM-K10.b.1, and COOMET.EM.BIPM-K10.b

Key comparison BIPM.EM-K10.b MEASURAND : DC voltage, Josephson standards, NOMINAL VALUE : 10 V

Lab *i*	x_i / nV	u_i / nV	Date of measurement
LNE	1.2	1.2	May 1994
PTB	-0.3	0.5	Jan 1998
SP	1.4	1.2	Jan 1998
SMU	14	11	May 1999
NPL	-1.5	2.2	Sep 2004
NRC	2.8	3.1	Oct 2004
CEM	0.4	1.5	Sep 2005
NMIJ	-1.2	1.3	Oct 2005
BEV	1.1	3.5	Nov 2005
INETI	0.8	4.6	Mar 2006
INMETRO	19	16	Apr 2006
NMIA	0.9	1.7	May 2006
VSL	-1.5	1.8	Oct 2006
KRISS	1.7	1.3	Feb 2008
LNE (1)	-4.3	1.5	Dec 2007
LNE (2)	-0.1	0.1	Dec 2007
NIST (1)	1.5	1.4	Mar 2009
NIST (2)	-0.8	1.0	Mar 2009
SMD (1)	0.3	3.3	Nov 2009
SMD (2)	-0.4	1.3	Nov 2009
EIM (1)	11.0	17.1	Mar 2010
EIM (2)	-0.6	2.0	Mar 2010
NMC, A*STAR (1)	-39.0	6.3	Sep 2010
NMC, A*STAR (2)	0.4	1.0	Sep 2010
VNIIM (1)	1.1	2.9	Nov 2010
VNIIM (2)	-0.1	2.0	Nov 2010
CMI (1)	14.1	11.1	Feb 2011
CMI (2)	9.6	10.3	Feb 2011
CENAM (1)	2.5	1.3	Sep 2011
CENAM (2)	-0.6	0.7	Sep 2011
METAS	0.3	1.0	Jan 2012
MSL (1)	-2.9	6.4	Apr 2011
MSL (2)	2.5	4.0	Apr 2011
NIM (1)	0.9	3.3	Nov 2013
NIM (2)	-0.2	0.9	Nov 2013
INM(RO)	3.3	2.6	Jun 2014
PTB (1)	-1.9	1.7	Oct 2014
PTB (2)	0.7	0.5	Oct 2014
DMDM (1)	-2.6	2.7	Jun 2015
DMDM (2)	-0.1	1.5	Jun 2015
NIMT (1)	-2.4	2.9	Nov 2015
NIMT (2)	-1.0	2.6	Nov 2015

x_i : result of measurement carried out by laboratory *i* expressed as the difference from the BIPM value
u_i : combined standard uncertainty of x_i

(1) initial result
(2) final result following technical improvements during the comparison

Key comparison SIM.EM.BIPM-K10.b

MEASURAND : DC voltage, Josephson standards
NOMINAL VALUE : 10 V

SIM.EM.BIPM-K10.b is a bilateral key comparison between NIST and NRC conducted from August 13 to August 17, 2007.

$d_{NIST-NRC}$: reported difference between NIST CJVS (Compact Josephson Voltage Standard) and NRC JVS

$U_{NIST-NRC}$: expanded uncertainty ($k = 2$) of $d_{NIST-NRC}$

$d_{NIST-NRC} = -0.28$ nV
$U_{NIST-NRC} = 2.07$ nV

Key comparison SIM.EM.BIPM-K10.b.1

MEASURAND : DC voltage, Josephson standards
NOMINAL VALUE : 10 V

SIM.EM.BIPM-K10.b.1 is a bilateral key comparison between INMETRO and NIST conducted in June 2009.

$d_{INMETRO-NIST}$: reported difference between INMETRO JVS and NIST CJVS

$u_{INMETRO-NIST}$: combined standard uncertainty of $d_{INMETRO-NIST}$

$d_{INMETRO-NIST} = 0.54$ nV
$u_{INMETRO-NIST} = 1.48$ nV

Key comparison COOMET.EM.BIPM-K10.b

MEASURAND : DC voltage, Josephson standards
NOMINAL VALUE : 10 V

COOMET.EM.BIPM-K10.b is a bilateral key comparison between VNIIM and BelGIM conducted from 4 September 2014 to 8 August 2014.

$d_{BelGIM-VNIIM}$: reported difference between BelGIM JVS and VNIIM JVS, obtained using a transportable VNIIM JVS

$U_{BelGIM-VNIIM}$: expanded uncertainty ($k = 2$) of $d_{BelGIM-VNIIM}$

$d_{BelGIM-VNIIM} = 0.99$ nV
$U_{BelGIM-VNIIM} = 3.0$ nV

BIPM.EM-K10.b, SIM.EM.BIPM-K10.b, SIM.EM.BIPM-K10.b.1, and COOMET.EM.BIPM-K10.b

Key comparison BIPM.EM-K10.b

MEASURAND : DC voltage, Josephson standards
NOMINAL VALUE : 10 V

Key comparison reference value: the BIPM value.
Since 2004, its standard uncertainty has been evaluated to be typically 0.04 nV and is included in the u_i's values.

The degree of equivalence of each laboratory with respect to the reference value is given by a pair of terms:
$D_i = x_i$ and its expanded uncertainty ($k = 2$), $U_i = 2u_i$, both expressed in nV.

When required, the degree of equivalence between two laboratories i and j can be computed by two terms:
$D_{ij} = D_i - D_j = (x_i - x_j)$ and its expanded uncertainty ($k = 2$), U_{ij}, both expressed in nV.
$U_{ij} = 2[u_i^2 + u_j^2 - 2\mathrm{cov}(i,j)]^{1/2}$, where cov($i$, j) is the estimated covariance that takes into account the correlation introduced by the BIPM measurements.

Linking SIM.EM.BIPM-K10.b to BIPM.EM-K10.b

The degree of equivalence of NIST with respect to the reference value is given by a pair of terms:
$D_{NIST} = (d_{NIST\text{-}NRC} + D_{NRC})$ and its expanded uncertainty ($k = 2$), U_{NIST}, both expressed in nV.
$U_{NIST} = (U_{NIST\text{-}NRC}^2 + U_{NRC}^2)^{1/2}$.

No pair-wise degrees of equivalence involving NIST have been explicitely computed.

Linking SIM.EM.BIPM-K10.b.1 to BIPM.EM-K10.b

The degree of equivalence of INMETRO with respect to the reference value is given by a pair of terms:
$D_{INMETRO} = (d_{INMETRO\text{-}NIST} + D_{NIST})$ and its expanded uncertainty ($k = 2$), $U_{INMETRO}$, both expressed in nV.
$U_{INMETRO} = 2[u_{INMETRO\text{-}NIST}^2 + (U_{NIST}/2)^2]^{1/2}$. The values taken for NIST are the most recent ones (2009).

No pair-wise degrees of equivalence involving INMETRO have been explicitely computed.

Linking COOMET.EM.BIPM-K10.b to BIPM.EM-K10.b

The degree of equivalence of BelGIM with respect to the reference value is given by a pair of terms:
$D_{BelGIM} = (d_{BelGIM\text{-}VNIIM} + D_{VNIIM})$ and its expanded uncertainty ($k = 2$), U_{BelGIM}, both expressed in nV.
$U_{BelGIM} = (U_{BelGIM\text{-}VNIIM}^2 + U_{VNIIM}^2]^{1/2}$.

No pair-wise degrees of equivalence involving BelGIM have been explicitely computed.

BIPM.EM-K10.b, SIM.EM.BIPM-K10.b, SIM.EM.BIPM-K10.b.1, and COOMET.EM.BIPM-K10.b

DC voltage, Josephson standards, 10 V
Matrix of equivalence

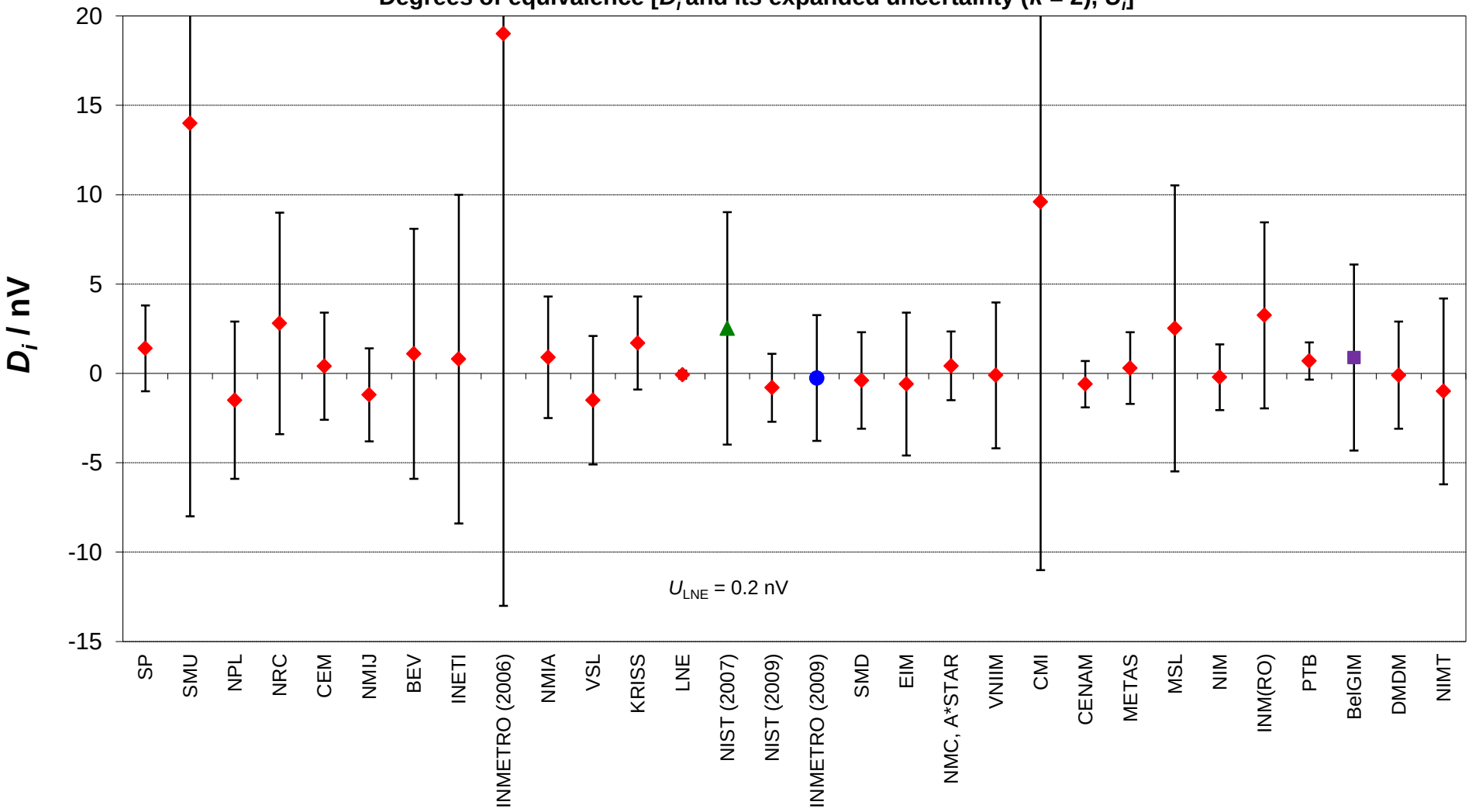
Lab *i* ⇩

	D_i / nV	U_i / nV
SP	**1.4**	2.4
SMU	**14**	22
NPL	**-1.5**	4.4
NRC	**2.8**	6.2
CEM	**0.4**	3.0
NMIJ	**-1.2**	2.6
BEV	**1.1**	7.0
INETI	**0.8**	9.2
INMETRO (2006)	**19**	32
NMIA	**0.9**	3.4
VSL	**-1.5**	3.6
KRISS	**1.7**	2.6
LNE*	**-0.1**	0.2
NIST* (2009)	**-0.8**	1.9
SMD*	**-0.4**	2.7
EIM*	**-0.6**	4.0
NMC, A*STAR*	**0.4**	1.9
VNIIM*	**-0.1**	4.1
CMI*	**9.6**	20.6
CENAM*	**-0.6**	1.3
METAS	**0.3**	2.0
MSL*	**2.5**	8.0
NIM*	**-0.2**	1.8
INM(RO)	**3.3**	5.2
PTB*	**0.7**	1.0
DMDM	**-0.1**	3.0
NIMT	**-1.0**	5.2
NIST (2007)	**2.5**	6.5
INMETRO (2009)	**-0.3**	3.5
BelGIM (2014)	**0.89**	5.2

Only the most recent comparison is retained

*** The degrees of equivalence are computed using the final result following technical improvements in the comparison setup**

BIPM.EM-K10.b, SIM.EM.BIPM-K10.b and K10.b.1, COOMET.EM.BIPM-K10.b
10 V Josephson standards
Degrees of equivalence [D_i and its expanded uncertainty (k = 2), U_i]



Red diamonds: participants in BIPM.EM-K10.b
Green triangle: participant in SIM.EM.BIPM-K10.b
Blue circle: participant in SIM.EM.BIPM-K10.b.1
Purple square : participant in COOMET.EM.BIPM-K10.b