

Key comparison EUROMET.L-K2

MEASURAND: Central length of long gauge blocks measured by interferometry according to ISO 3650; gauge block material: steel
 NOMINAL VALUES: 6 gauge blocks from 150 mm to 900 mm
 (including three different 500 mm gauge blocks and two different 900 mm gauge blocks)

x_{ik} : result of measurement carried out by laboratory i for gauge block k with nominal length L_k , expressed as the deviation from nominal length in nm
 u_{ik} : combined standard uncertainty of x_{ik} reported by laboratory i

nominal length L_k ($k = 1$ to 6) \longrightarrow

Lab i	150 mm		500 mm		500 mm		900 mm		500 mm		900 mm		Date of measurement
	S/N 8728		S/N AA/71001		S/N 500 B		S/N EM/718		S/N 4 PTB 55		S/N PTB 5.13 11/2001		
	x_{i1}	u_{i1}	x_{i2}	u_{i2}	x_{i3}	u_{i3}	x_{i4}	u_{i4}	x_{i5}	u_{i5}	x_{i6}	u_{i6}	
	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	
NPL	-19	30	81	38	1632	38	-70015	52	-2445	38	748	52	February 2002
SMD	-15	19	85	124	1565	123	-70120	188					March 2002
NMi-VSL	-27	18	13	51	1577	51	-70133	91					April 2002
MIKES	-28	17	27	26	1618	26	-70080	41					May 2002
SP	6	18	43	35	1610	35	-70072	58					June 2002
BEV	-21	65	218	189	1777	189	-69793	284					July 2002
METAS	-5	21	16	47	1590	46	-70058	77					September 2002
CEM	-80	40	330	80	1490	80	-70110	140					October 2002
INRIM	21	28	85	33	1563	33	-70049	42	-2534	33	620	42	Nov 2002 and Jul 2004
PTB	-29	16	40	19	1478	36	-70156	42	-2450	18	685	25	Jan and Apr 2003
UME	-35	24	-7	79					-2484	79	664	137	May 2004
NCM	-140	32	-70	76					-2674	75	226	136	June 2004
NML(IE)	160	100	-320	390					-2550	390			August 2004
CMI	6	29	4	41					-2518	41	649	55	September 2004
SMU	62	68	108	80					-2370	102	741	109	October 2004
OMH	-50	150	170	230					-2210	230	480	390	November 2004
INM(RO)	40	120	40	242					-2310	243	560	443	December 2004
GUM	18	140	41	240					-2438	250	968	460	January 2005
VMT/VMC	-180	148	-80	437					-1930	437	540	688	February 2005
LNMC	320	190	170	270					-2030	270	660	380	March 2005
MIRS/LTM	10	130	90	300					-2470	300	1130	500	April 2005
LNE	60	140	140	220					-2510	220	750	350	May 2005

Results of IPQ were withdrawn by the laboratory as not representative of their instrument, which was still being developed.
 Not all gauge blocks were measured by all participants (due to damage, or limited equipment range)

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The EUROMET key comparison reference value, x_{Rk} , for each gauge block k is obtained from the weighted mean x_{wk} (with weights w_{ik} based on each reported uncertainty) of the participants' values x_{ik} by adding a constant C_k chosen such that the reference value is the nominal length:

$$x_{Rk} = L_k = x_{wk} + C_k.$$

The standard uncertainty u_{Rk} of x_{Rk} is obtained from the reported uncertainties u_{ik} . Outliers are excluded from the weighting, based on Birge ratio testing. Further information on the computation of x_{Rk} and u_{Rk} is given in Section 8 of the Final report.

	nominal length L_k ($k = 1$ to 6) →											
	150 mm		500 mm		500 mm		900 mm		500 mm		900 mm	
	S/N 8728		S/N AA/71001		S/N 500 B		S/N EM/718		S/N 4 PTB 55		S/N PTB 5.13 11/2001	
	x_{w1}	u_{R1}	x_{w2}	u_{R2}	x_{w3}	u_{R3}	x_{w4}	u_{R4}	x_{w5}	u_{R5}	x_{w6}	u_{R6}
	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	
Weighted mean x_{wk} / nm	-16	7	41	11	1599	15	-70061	22	-2469	14	678	19
Artefact uncertainty u_{Ak} / nm	27		12		40		25		7		49	

The degree of equivalence of each laboratory with respect to the reference value for each gauge block k is given by a pair of terms: the difference D_{ik} and its expanded uncertainty U_{ik} (coverage factor: 2) with

$$D_{ik} = (x_{ik} + C_k) - x_{Rk} = x_{ik} - x_{wk} \text{ and } U_{ik} = 2(u_{ik}^2 - u_{Rk}^2 + u_{Ak}^2)^{1/2}$$

u_{Ak} represents the artefact uncertainty, which takes into account uncorrelated errors including instability of the artefact.

The calculation of the degree of equivalence between two laboratories i and j is not recommended for comparisons involving several material standards, since it cannot be expressed with a single pair of terms.

It would have to be calculated separately for each gauge block k and would then be given by a pair of terms: the difference D_{ijk} and its expanded uncertainty U_{ijk} (coverage factor: 2).

$$D_{ijk} = x_{ik} - x_{jk} \text{ and } U_{ijk} = 2(u_{ik}^2 + u_{jk}^2)^{1/2}.$$

Key comparison EUROMET.L-K2 is parallel to key comparison CCL-K2.

Numerical linking of these comparisons is not recommended due to artefact dependent offsets. Instead, laboratories participating competently in both key comparisons establish the link and assure equivalence.

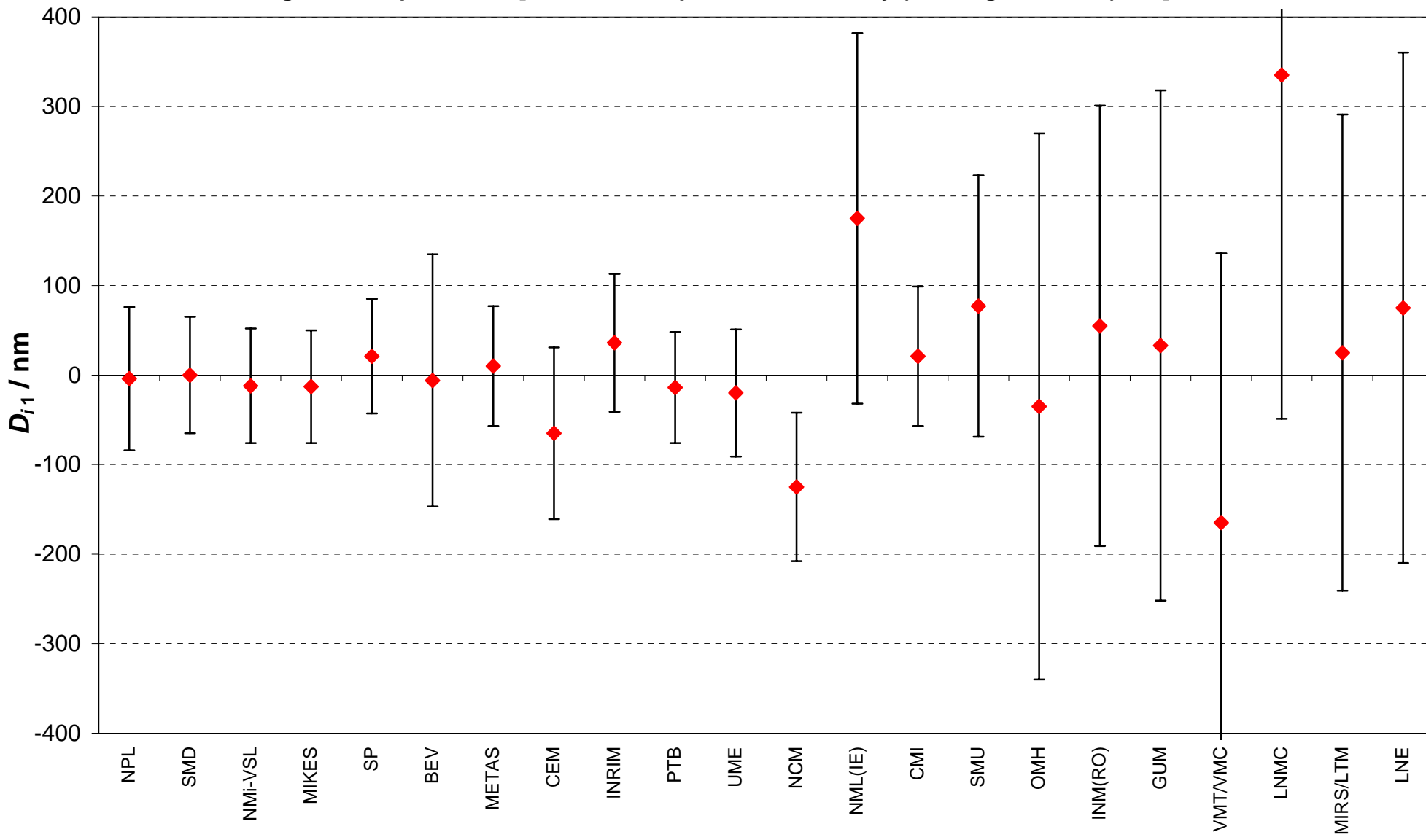
Key comparison EUROMET.L-K2

MEASURAND: Central length of long gauge blocks measured by interferometry according to ISO 3650; gauge block material: steel
 NOMINAL VALUES: 6 gauge blocks from 150 mm to 900 mm
 (including three different 500 mm gauge blocks and two different 900 mm gauge blocks)

Lab <i>i</i>	nominal length L_k ($k = 1$ to 6) →											
	150 mm		500 mm		500 mm		900 mm		500 mm		900 mm	
	S/N 8728		S/N AA/71001		S/N 500 B		S/N EM/718		S/N 4 PTB 55		S/N PTB 5.13 11/2001	
	D_{i1}	U_{i1}	D_{i2}	U_{i2}	D_{i3}	U_{i3}	D_{i4}	U_{i4}	D_{i5}	U_{i5}	D_{i6}	U_{i6}
	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm
NPL	-4	80	40	77	33	107	45	107	24	73	69	138
SMD	0	65	44	249	-34	257	-60	377	-	-	-	-
NMi-VSL	-12	64	-28	103	-22	127	-73	184	-	-	-	-
MIKES	-13	63	-14	53	19	91	-20	86	-	-	-	-
SP	21	64	2	71	11	102	-12	119	-	-	-	-
BEV	-6	141	177	379	178	386	267	569	-	-	-	-
METAS	10	67	-25	95	-9	119	2	156	-	-	-	-
CEM	-65	96	289	161	-109	177	-50	282	-	-	-	-
INRIM	36	77	44	67	-36	100	11	88	-65	62	-59	124
PTB	-14	62	-1	40	-121	104	-96	88	19	27	6	104
UME	-20	71	-48	159	-	-	-	-	-15	157	-15	289
NCM	-125	83	-111	153	-	-	-	-	-205	149	-453	287
NML(IE)	175	207	-361	781	-	-	-	-	-81	780	-	-
CMI	21	78	-37	83	-	-	-	-	-49	79	-30	143
SMU	77	146	67	161	-	-	-	-	99	203	62	236
OMH	-35	305	129	461	-	-	-	-	259	460	-199	786
INM(RO)	55	246	-1	485	-	-	-	-	159	486	-119	891
GUM	33	285	0	481	-	-	-	-	31	500	289	925
VMT/VMC	-165	301	-121	875	-	-	-	-	539	874	-139	1379
LNMC	335	384	129	541	-	-	-	-	439	540	-19	766
MIRS/LTM	25	266	49	601	-	-	-	-	-1	600	451	1005
LNE	75	285	99	441	-	-	-	-	-41	440	71	706

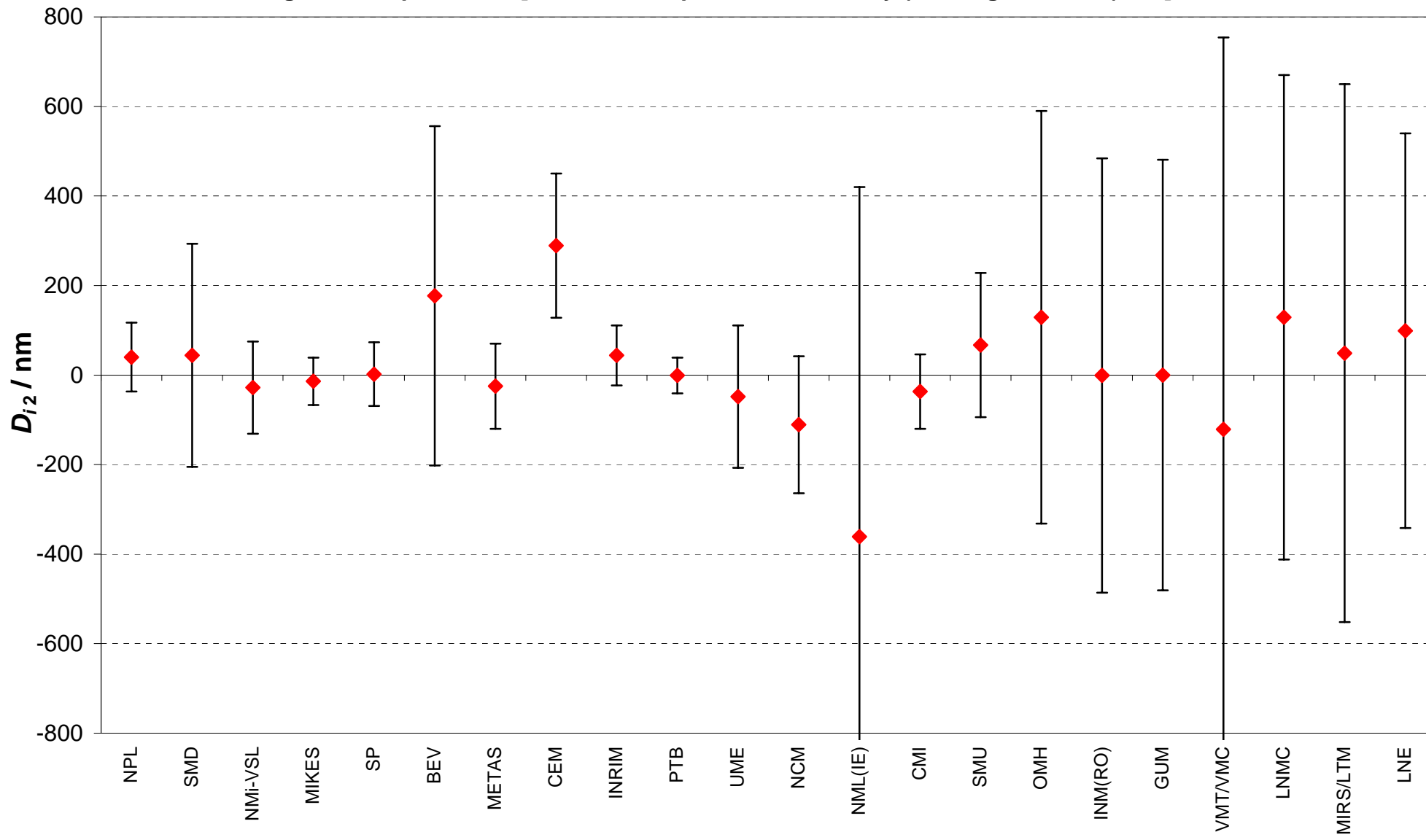
EUROMET.L-K2 150 mm steel gauge block, S/N 8728

Degrees of equivalence [D_{i1} and its expanded uncertainty (coverage factor: 2) U_{i1}]



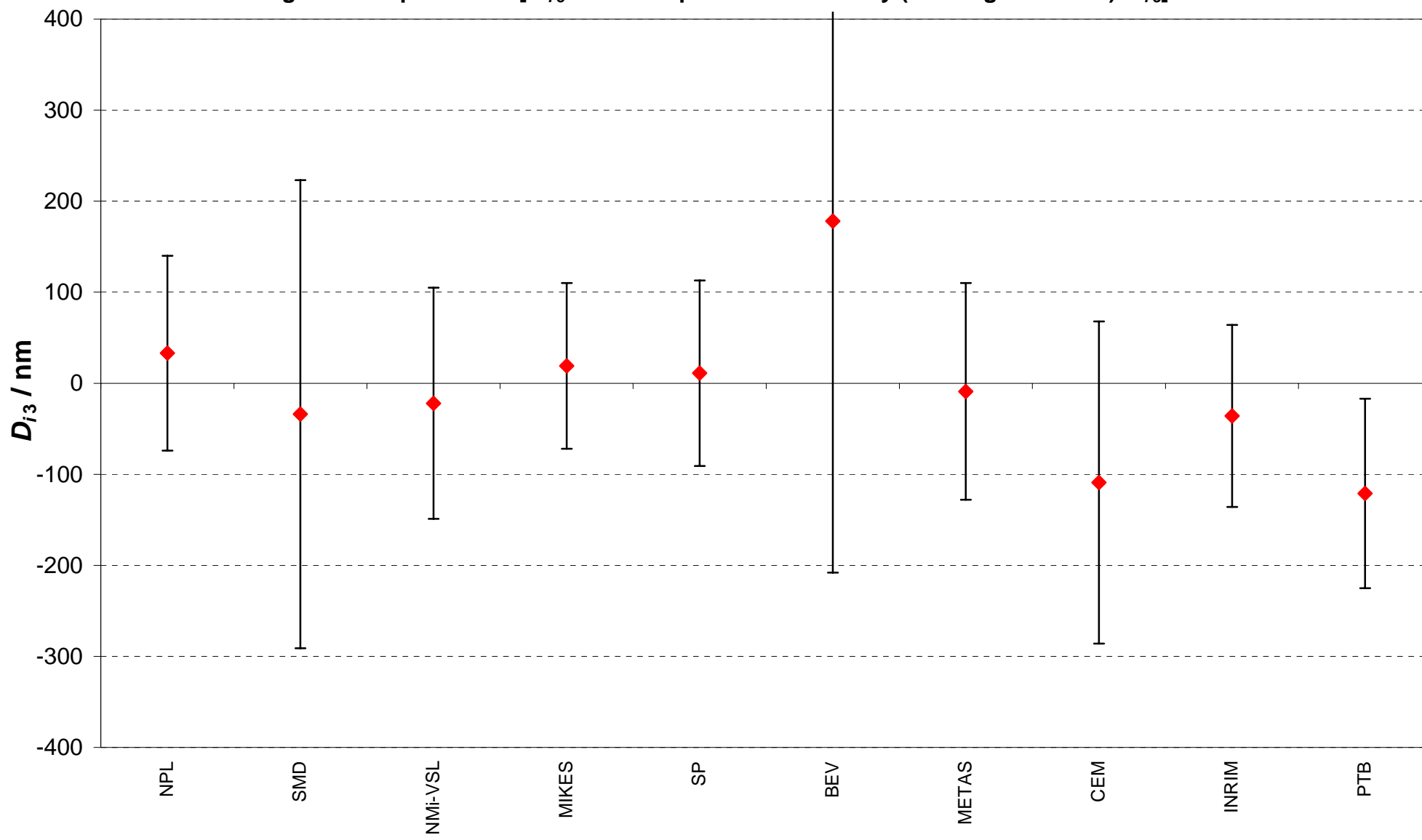
EUROMET.L-K2 500 mm steel gauge block, S/N AA/71001

Degrees of equivalence [D_{i2} and its expanded uncertainty (coverage factor: 2) U_{i2}]



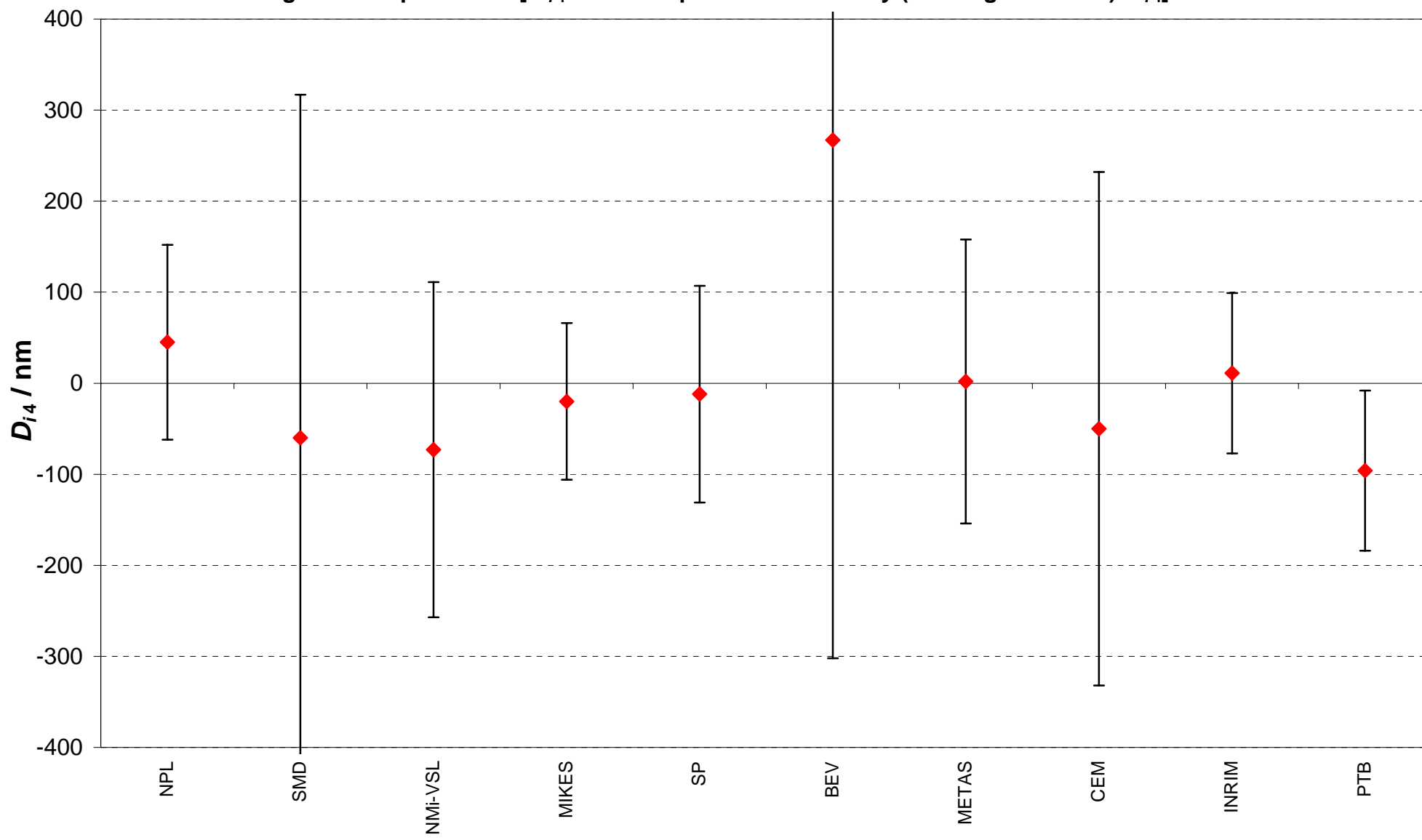
EUROMET.L-K2 500 mm steel gauge block, S/N 500 B

Degrees of equivalence [D_{i3} and its expanded uncertainty (coverage factor: 2) U_{i3}]



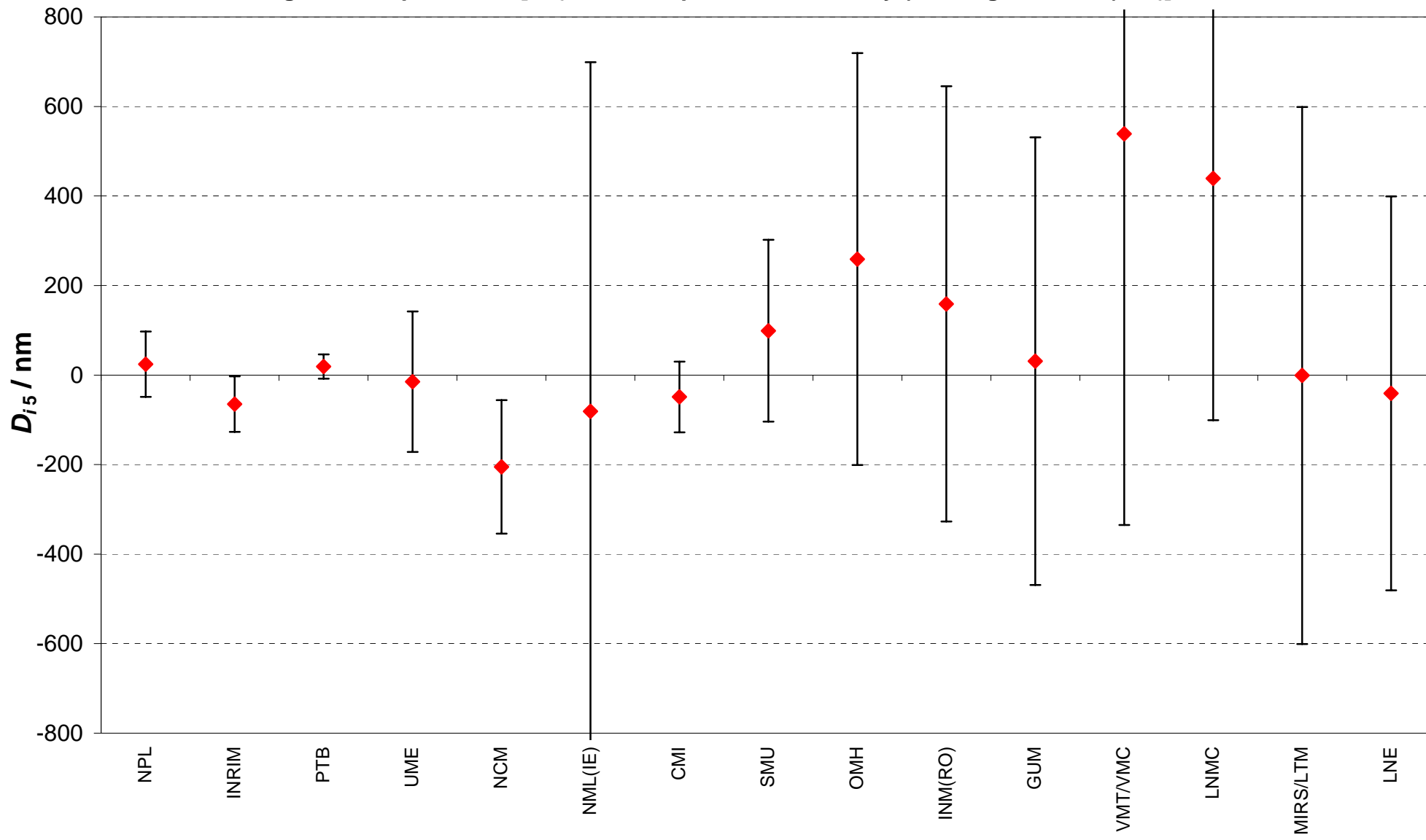
EUROMET.L-K2 900 mm steel gauge block, S/N EM/718

Degrees of equivalence [D_{i4} and its expanded uncertainty (coverage factor: 2) U_{i4}]



EUROMET.L-K2 500 mm steel gauge block, S/N 4 PTB 55

Degrees of equivalence [D_{i5} and its expanded uncertainty (coverage factor: 2) U_{i5}]



EUROMET.L-K2 900 mm steel gauge block, S/N PTB 5.13 11/2001

Degrees of equivalence [D_{i6} and its expanded uncertainty (coverage factor: 2) U_{i6}]

