

## Key comparison APMP.L-K1

MEASURAND : Length of gauge blocks

TRAVELLING STANDARDS : 10 ceramic gauge blocks

$x_i$  : average of the central length measured in two orientations by laboratory  $i$

$u_i$  : combined standard uncertainty of  $x_i$

Nominal value Lab $i$ ↓	0.5 mm		1 mm		1.01 mm		1.1 mm		6 mm		Date of measurement
	$x_i$ / nm	$u_i$ / nm	$x_i$ / nm	$u_i$ / nm	$x_i$ / nm	$u_i$ / nm	$x_i$ / nm	$u_i$ / nm	$x_i$ / nm	$u_i$ / nm	
NMIA	-1.0	10.0	-16.5	10.0	-9.0	10.0	74.0	10.0	29.5	10.0	Mar 01
NIM	-14.0	11.0	-16.5	11.0	-9.0	11.0	69.0	11.0	32.0	11.0	Apr - May 01
SPRING Singapore	-27.0	14.0	-21.0	14.0	-10.5	14.0	61.0	14.0	26.5	15.0	Jun 01
NMIJ	-10.1	8.6	-19.5	8.6	-9.8	8.6	71.0	8.6	28.1	8.7	Jan 01, Jul - Aug 01, Jul - Aug 02
KRISS	-31.5	14.8	-28.5	14.8	-18.0	14.8	61.0	15.1	21.0	15.7	Sep 01
NML-SIRIM	-15.5	15.0	-4.0	15.0	-7.0	15.0	74.0	15.0	40.0	15.0	Oct 01
NIMT	-29.5	11.0	-29.0	11.0	-8.5	11.0	60.0	11.0	20.0	11.0	Nov 01
VMI-STAMEQ	22.0	14.0	82.0	14.0	20.5	14.0	116.0	14.0	160.5	14.0	Dec 01 - Jan 02
MSL	16.0	19.0	15.0	19.0	30.0	19.0	93.5	19.0	59.0	19.0	Mar - Apr 02
NPLI	-19.0	19.3	-7.5	19.3	-2.5	19.3	66.0	19.3	56.0	20.7	May - Jun 02

CMS/ITRI was unable to participate due to instrument failure.

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Nominal value Lab $i$ ↓	7 mm		8 mm		80 mm		90 mm		100 mm		Date of measurement
	$x_i$ / nm	$u_i$ / nm	$x_i$ / nm	$u_i$ / nm	$x_i$ / nm	$u_i$ / nm	$x_i$ / nm	$u_i$ / nm	$x_i$ / nm	$u_i$ / nm	
NMIA	63.0	10.0	59.5	10.0	116.5	14.0	88.5	14.0	144.5	15.0	Mar 01
NIM	51.0	11.0	58.5	11.0	125.0	14.0	89.5	14.5	143.0	15.0	Apr - May 01
SPRING Singapore	55.0	15.0	56.0	16.0	116.5	26.0	76.5	27.0	113.0	29.0	Jun 01
NMIJ	58.4	8.7	56.2	8.7	144.1	12.6	105.3	13.4	158.1	14.3	Jan 01, Jul - Aug 01, Jul - Aug 02
KRISS	43.0	14.8	44.5	15.7	120.0	16.1	90.0	16.1	141.0	16.5	Sep 01
NML-SIRIM	58.5	15.0	70.5	15.0	212.0	17.0	197.0	17.0	281.0	18.0	Oct 01
NIMT	30.5	11.0	38.0	11.0	61.0	17.0	13.0	19.0	50.0	20.0	Nov 01
VMI-STAMEQ	-79.5	14.0	-41.0	14.0	-281.0	18.0	299.5	19.0	-52.5	20.0	Dec 01 - Jan 02
MSL	73.0	19.0	83.0	19.0	130.5	24.0	98.5	25.0	151.5	26.0	Mar - Apr 02
NPLI	56.0	21.0	79.0	21.3	-564.0	42.2	394.0	45.1	400.0	48.0	May - Jun 02

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For each nominal value, the reference value,  $x_R$ , is obtained as the weighted mean excluding outliers and MSL results (see Section 4 of the Final Report). The standard uncertainty,  $u_R$ , of the reference value is computed as the internal standard deviation of the weighted mean.

Nominal value	0.5 mm	1 mm	1.01 mm	1.1 mm	6 mm	7 mm	8 mm	80 mm	90 mm	100 mm
$x_R / \text{nm}$	-16.0	-19.0	-9.5	67.9	29.2	52.3	55.6	127.1	92.7	145.0
$u_R / \text{nm}$	4.2	4.2	4.2	4.2	4.3	4.2	4.3	6.8	7.0	7.3
$u_A / \text{nm}$	8.1	7.2	1.4	4.8	2.2	6.9	7.3	9.8	7.9	8.4

The degree of equivalence of each laboratory  $i$  with respect to the reference value is given by a pair of terms:

$D_i = x_i - x_R$ , and  $U_i$ , its expanded uncertainty ( $k = 2$ ) with  $U_i = 2(u_i^2 - u_R^2 + u_A^2)^{1/2}$ ;  $u_A$  is the uncertainty linked to the artefact.

No pair-wise degrees of equivalence are calculated.

Results of key comparison APMP.L-K1 are not linked to any other key comparison results.

## Key comparison APMP.L-K1

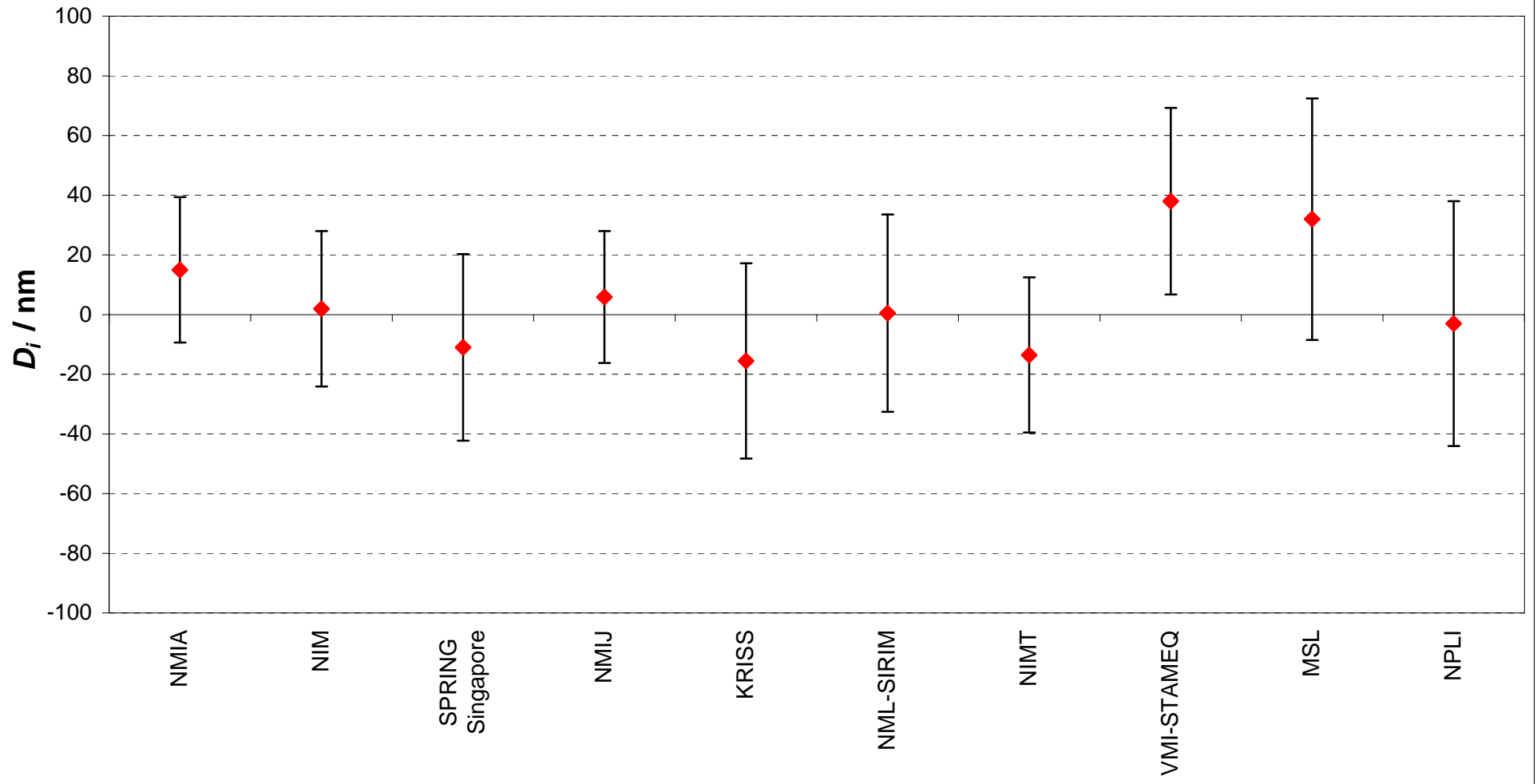
MEASURAND : Length of gauge blocks

TRAVELLING STANDARDS : 10 ceramic gauge blocks

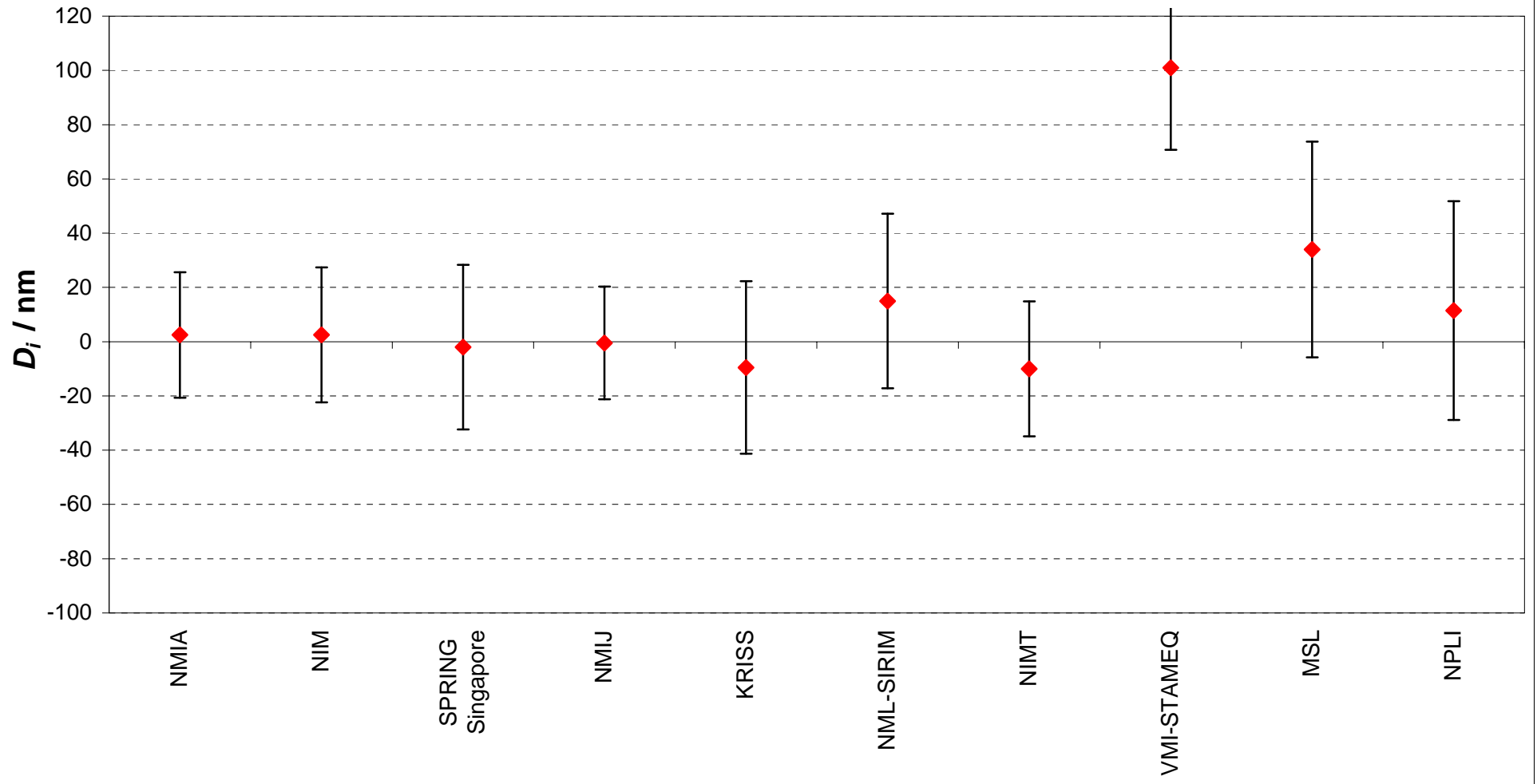
Degrees of equivalence relative to the reference value

Nominal value Lab <i>i</i> ↓	0.5 mm		1 mm		1.01 mm		1.1 mm		6 mm		7 mm		8 mm		80 mm		90 mm		100 mm	
	$D_i$ / nm	$U_i$ / nm	$D_i$ / nm	$U_i$ / nm	$D_i$ / nm	$U_i$ / nm	$D_i$ / nm	$U_i$ / nm	$D_i$ / nm	$U_i$ / nm	$D_i$ / nm	$U_i$ / nm	$D_i$ / nm	$U_i$ / nm	$D_i$ / nm	$U_i$ / nm	$D_i$ / nm	$U_i$ / nm	$D_i$ / nm	$U_i$ / nm
NMIA	15	24	2	23	1	18	6	21	0	19	11	23	4	23	-11	31	-4	29	-1	31
NIM	2	26	2	25	1	21	1	23	3	21	-1	25	3	25	-2	31	-3	30	-2	31
SPRING Singapore	-11	31	-2	30	-1	27	-7	28	-3	29	3	32	0	34	-11	54	-16	55	-32	59
NMIJ	6	22	0	21	0	15	3	18	-1	16	6	21	1	21	17	29	13	28	13	30
KRISS	-16	33	-10	32	-8	29	-7	31	-8	31	-9	32	-11	34	-7	35	-3	33	-4	34
NML-SIRIM	0	33	15	32	3	29	6	30	11	29	6	32	15	32	85	37	104	35	136	37
NIMT	-14	26	-10	25	1	21	-8	23	-9	21	-22	25	-18	25	-66	37	-80	39	-95	41
VMI-STAMEQ	38	31	101	30	30	27	48	28	131	27	-132	30	-97	30	-408	39	207	39	-198	41
MSL	32	40	34	40	40	37	26	38	30	37	21	40	27	40	3	50	6	51	6	53
NPLI	-3	41	11	40	7	38	-2	39	27	41	4	43	23	44	-691	86	301	91	255	96

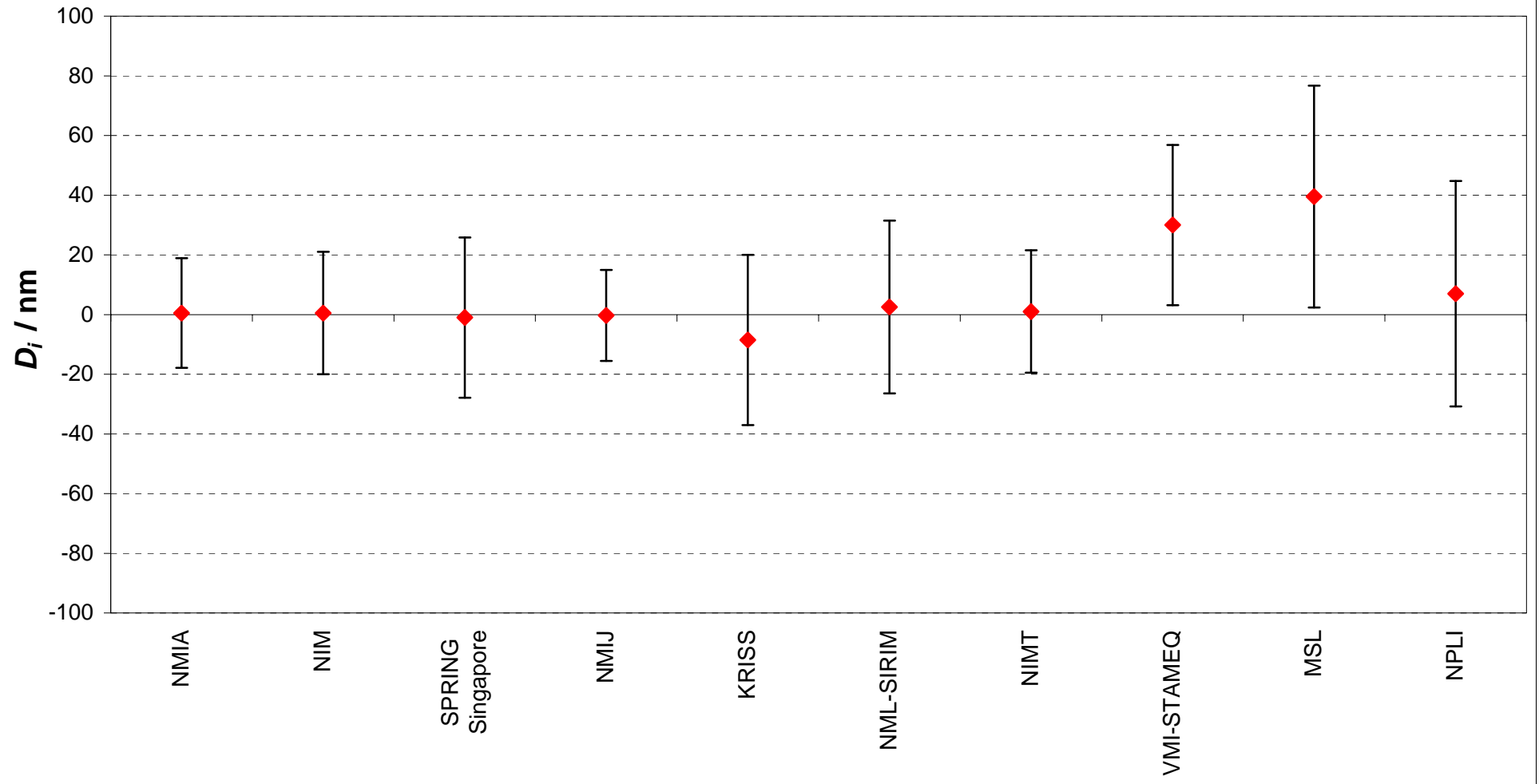
**APMP.L-K1** Ceramic gauge block, nominal length 0.5 mm  
Degrees of equivalence:  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )



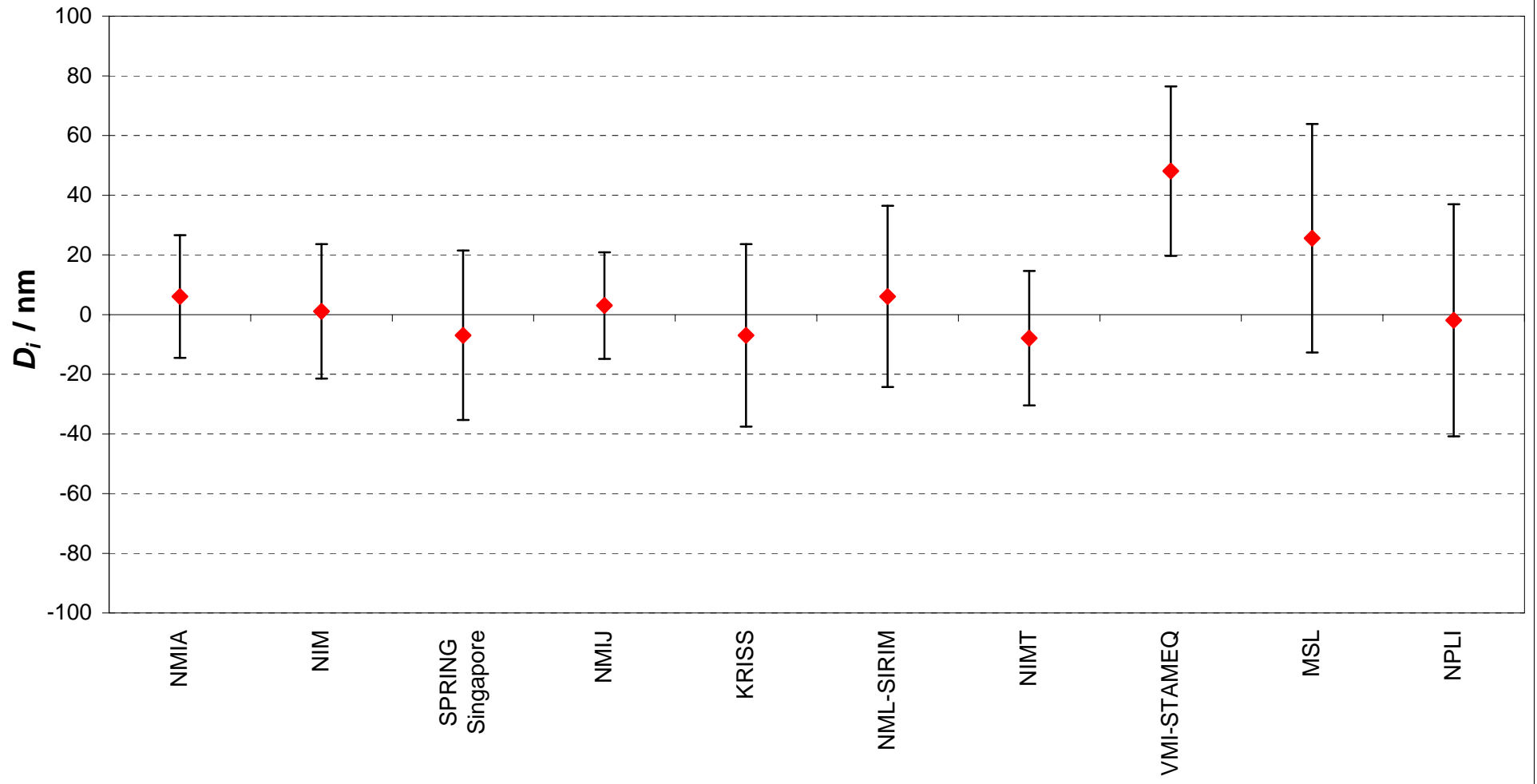
**APMP.L-K1** Ceramic gauge block, nominal length 1 mm  
Degrees of equivalence:  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )



**APMP.L-K1** Ceramic gauge block, nominal length 1.01 mm  
Degrees of equivalence:  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )

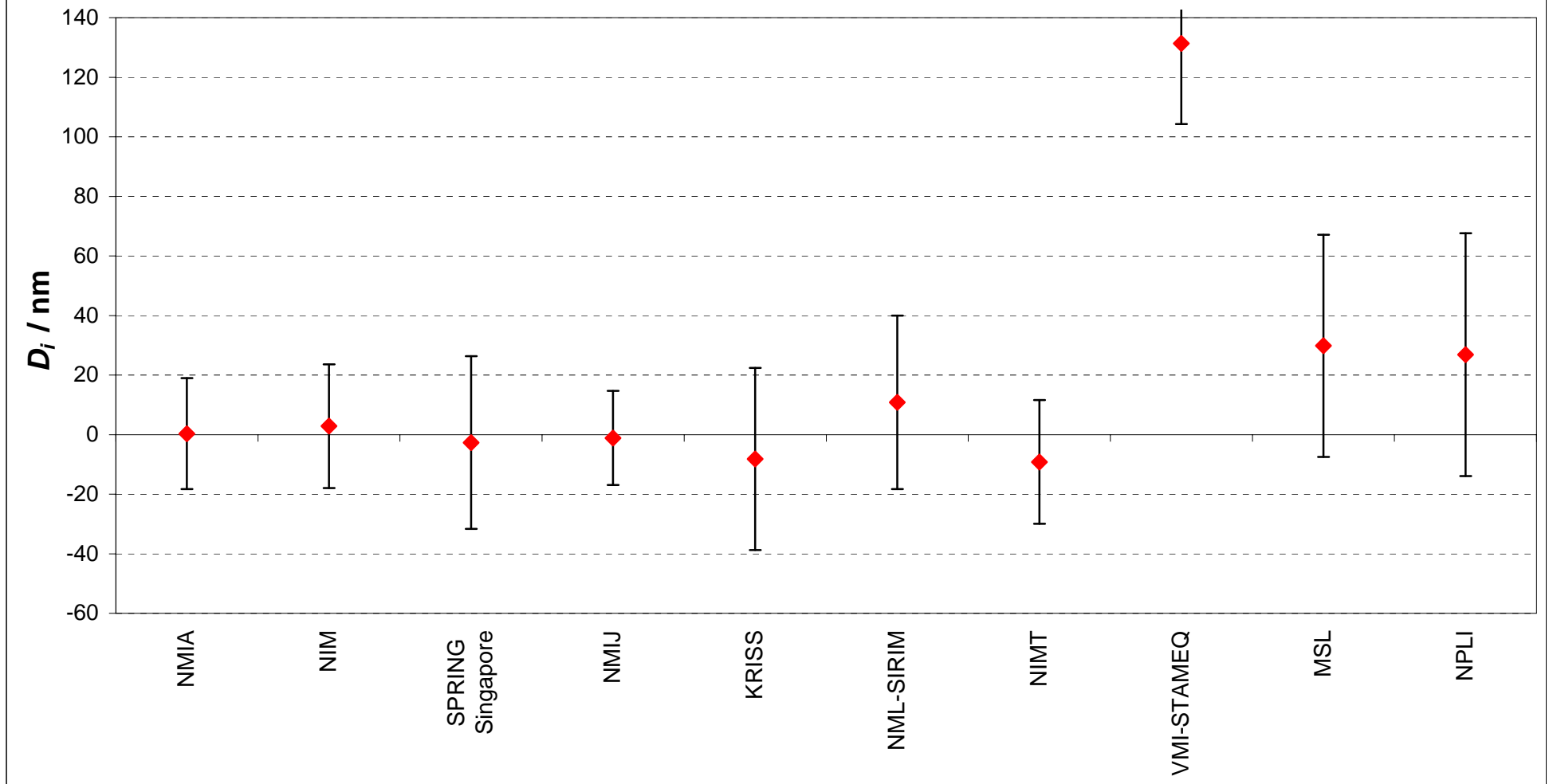


**APMP.L-K1** Ceramic gauge block, nominal length 1.1 mm  
Degrees of equivalence:  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )

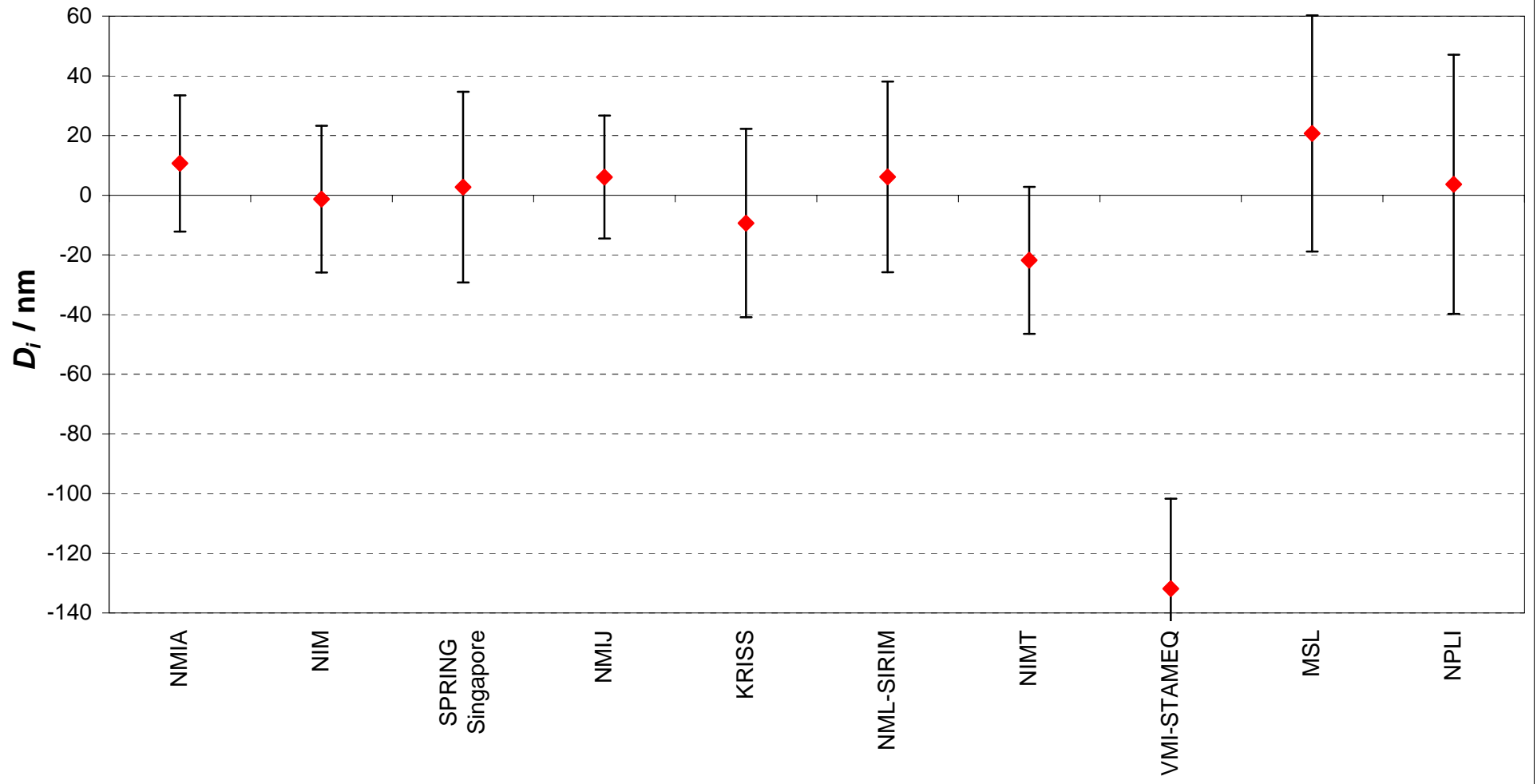




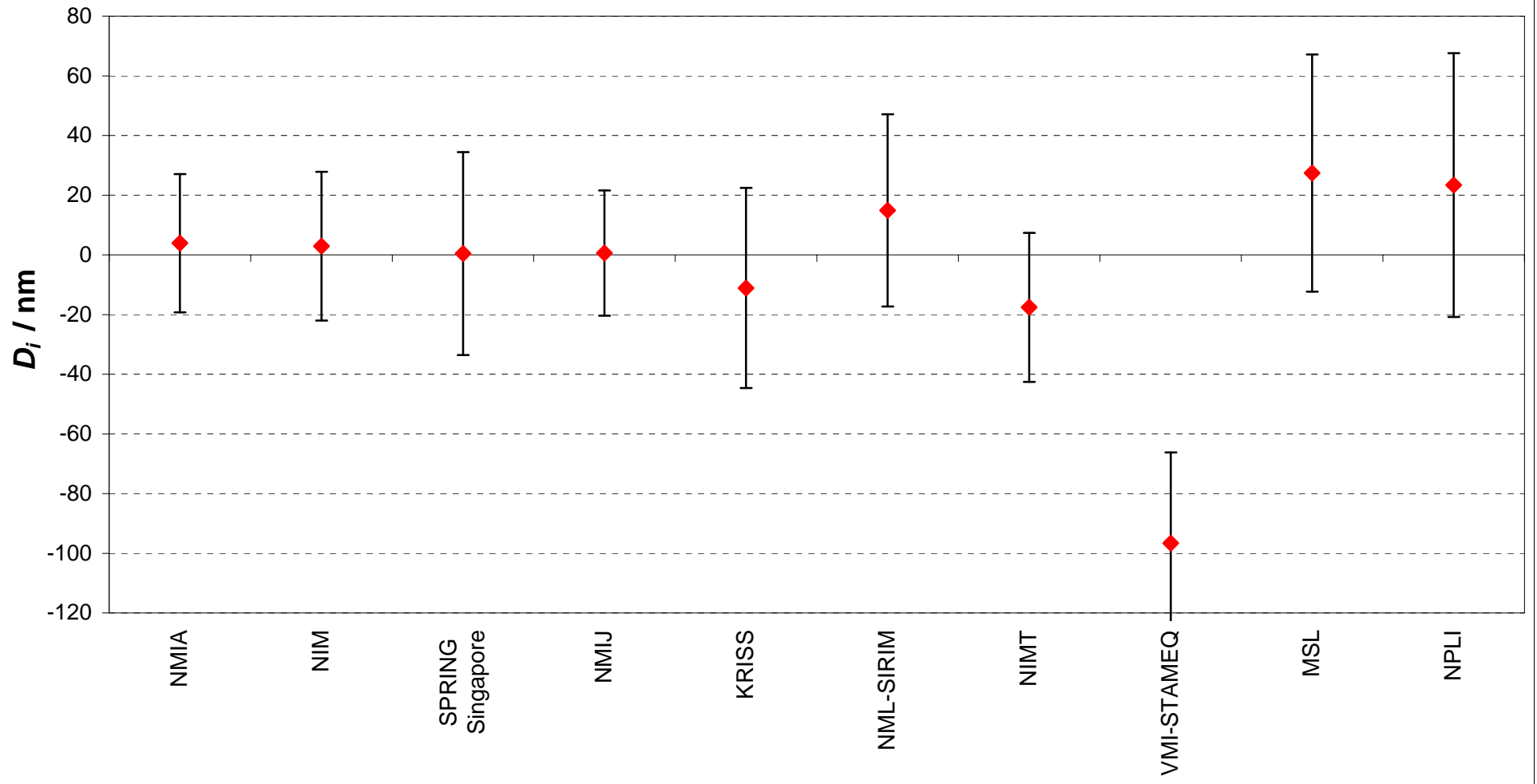
**APMP.L-K1** Ceramic gauge block, nominal length 6 mm  
Degrees of equivalence:  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )



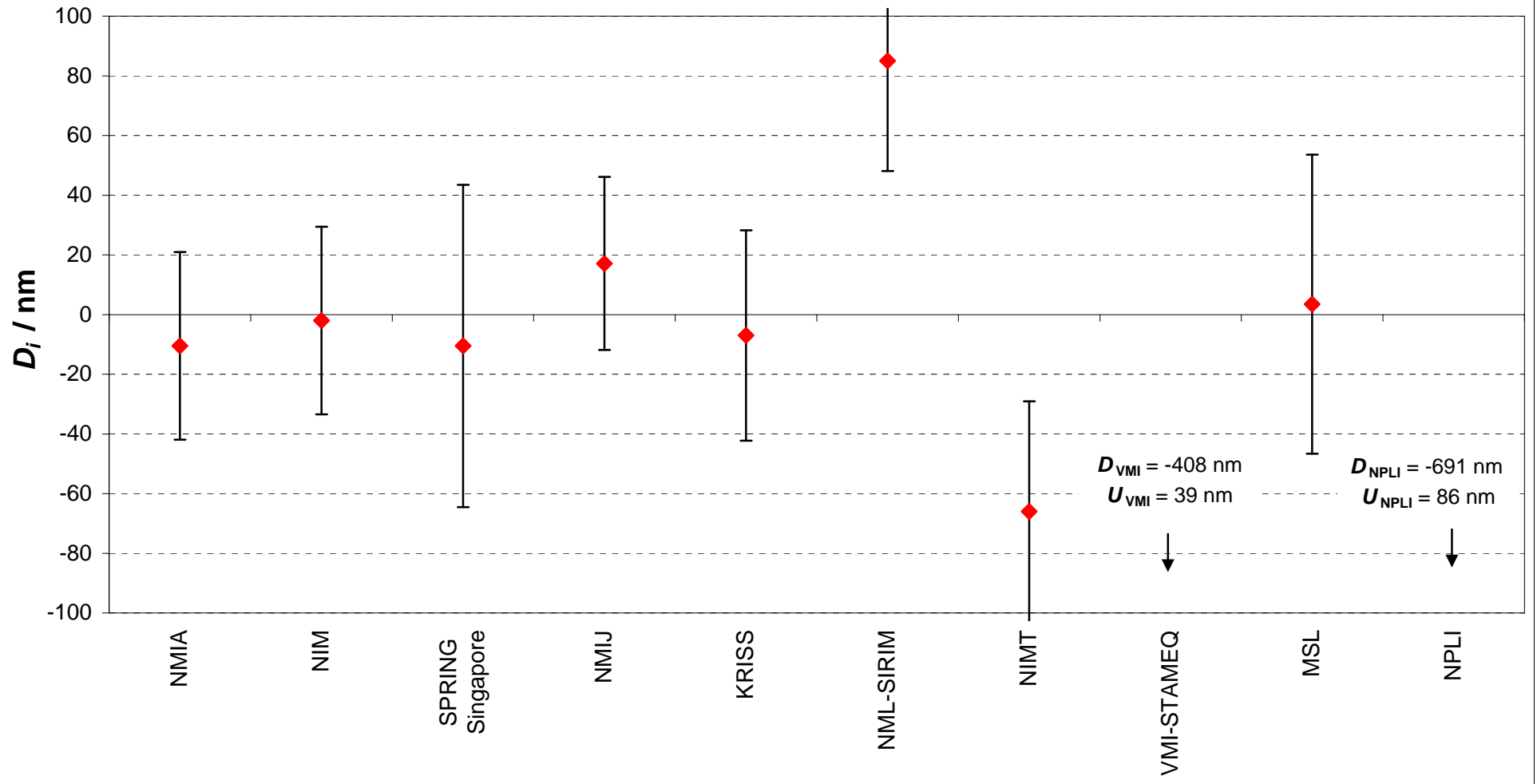
**APMP.L-K1** Ceramic gauge block, nominal length 7 mm  
Degrees of equivalence:  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )



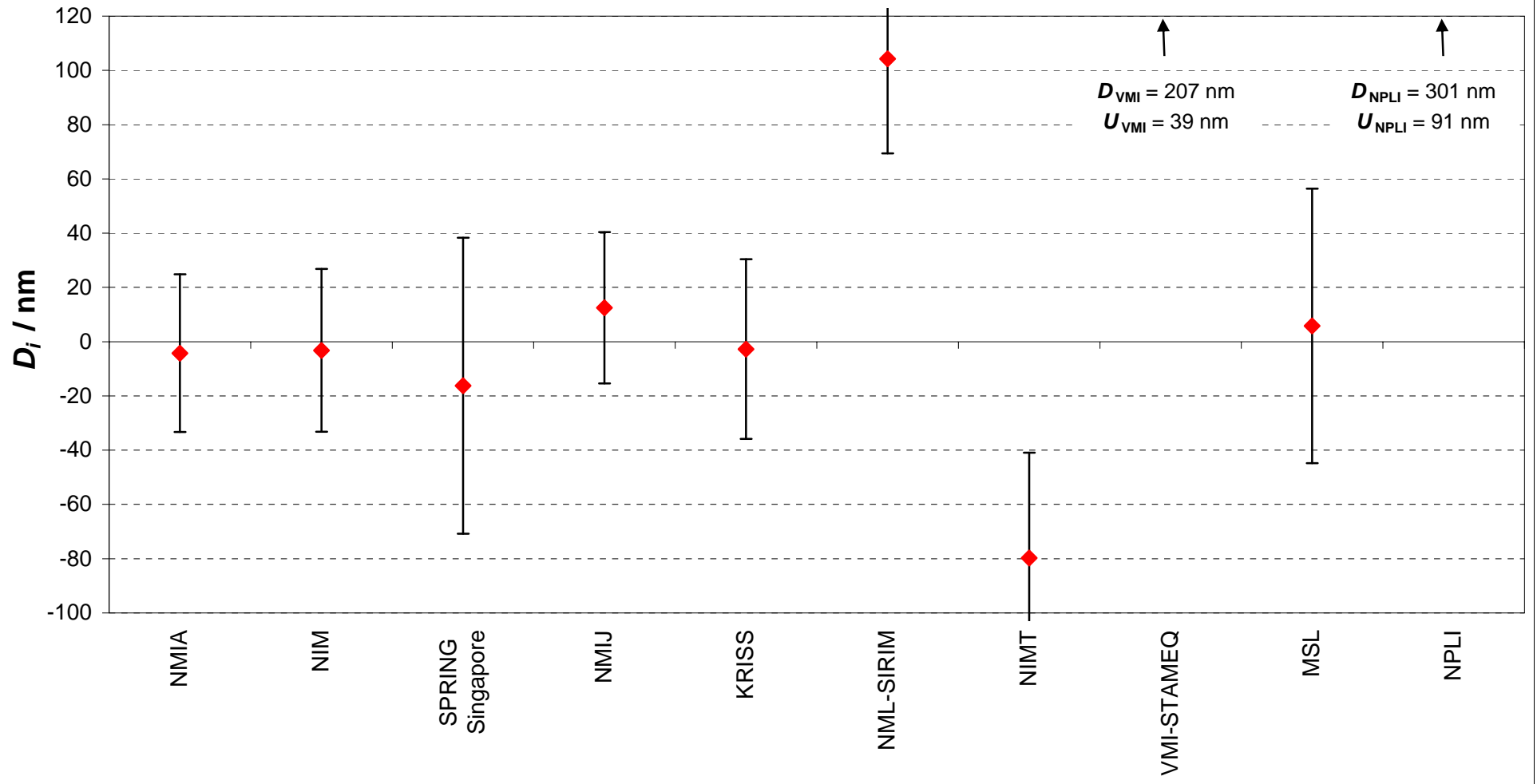
**APMP.L-K1** Ceramic gauge block, nominal length 8 mm  
Degrees of equivalence:  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )



**APMP.L-K1** Ceramic gauge block, nominal length 80 mm  
 Degrees of equivalence:  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )



**APMP.L-K1** Ceramic gauge block, nominal length 90 mm  
 Degrees of equivalence:  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )



**APMP.L-K1** Ceramic gauge block, nominal length 100 mm  
 Degrees of equivalence:  $D_i$  and expanded uncertainty  $U_i$  ( $k = 2$ )

