

**Key comparison CCL-K4.b**

**MEASURAND : External diameter**

**TRAVELLING STANDARDS : Plug gauges**

**NOMINAL VALUES : 2 mm, 3.465 mm, 24 mm, 50 mm and 98.5 mm**

$x_i$  : deviation from nominal value reported by laboratory  $i$

$u_i$  : standard uncertainty of  $x_i$

Lab $i$ ↓	2 mm		3.465 mm		24 mm		50 mm		98.5 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	
<b>METAS</b>	<b>90</b>	37	<b>560</b>	29	<b>1400</b>	38	<b>1130</b>	33	<b>2300</b>	120	Nov 2000
<b>NPL Metro.</b>	<b>120</b>	41	<b>630</b>	40	<b>1370</b>	49	<b>1090</b>	68	<b>2498</b>	115	Jan 2001
<b>NPL Mesel.</b>	<b>40</b>	38	<b>560</b>	41	-	-	-	-	-	-	Jan 2001
<b>PTB MFU8</b>	<b>38</b>	29	<b>541</b>	32	<b>1328</b>	27	-	-	<b>2318</b>	42	Feb 2001
<b>PTB KOMF</b>	<b>85</b>	6	<b>548</b>	6	<b>1376</b>	26	<b>1159</b>	48	<b>2259</b>	20	Feb 2001
<b>INRIM</b>	<b>-34</b>	34	<b>543</b>	29	<b>1314</b>	35	<b>1090</b>	48	<b>2210</b>	68	Mar 2001
<b>NIST Comp./micro.</b>	<b>67</b>	19	<b>530</b>	19	<b>1406</b>	29	<b>1134</b>	53	<b>2288</b>	85	May 2001
<b>NIST CMM</b>	-	-	-	-	<b>1355</b>	50	<b>1077</b>	50	<b>2143</b>	50	May 2001
<b>CENAM</b>	<b>100</b>	100	<b>470</b>	100	<b>1180</b>	120	<b>1110</b>	140	<b>1777</b>	190	Aug 2001
<b>NMIA</b>	<b>110</b>	40	<b>650</b>	50	<b>1400</b>	50	<b>940</b>	80	<b>2194</b>	140	Oct 2001
<b>KRISS</b>	<b>60</b>	100	<b>420</b>	100	<b>1160</b>	120	<b>1230</b>	170	<b>2111</b>	270	Dec 2001
<b>NMISA</b>	<b>-100</b>	130	<b>200</b>	130	<b>1300</b>	100	<b>980</b>	80	<b>2075</b>	130	Apr 2002
<b>VNIIM</b>	<b>-330</b>	60	<b>65</b>	70	<b>740</b>	70	<b>815</b>	70	-	-	Jul 2002
<b>NIM Mahr</b>	<b>-30</b>	70	<b>200</b>	70	<b>1120</b>	80	<b>1010</b>	100	<b>2014</b>	130	Nov 2002

The abbreviations associated with acronyms of laboratories are explained in section 5 of the Final Report.

The 98.5 mm plug data given in the table above has been corrected using an artefact instability term of -19 nm per year.

## Key comparison CCL-K4.b

MEASURAND : External diameter

TRAVELLING STANDARDS : Plug gauges

NOMINAL VALUES : 2 mm, 3.465 mm, 24 mm, 50 mm and 98.5 mm

For each plug gauge, the key comparison reference value,  $x_R$ , is calculated as the average of the modified weighted mean value and the total bootstrap median value obtained from the measurement results as explained in the Appendix A of the Final Report.

The standard uncertainty  $u_R$  of  $x_R$  is calculated as explained in the Appendix A of the Final Report.

2 mm		3.465 mm		24 mm		50 mm		98.5 mm	
$x_R$ / mm	$u_R$ / nm	$x_R$ / mm	$u_R$ / nm	$x_R$ / mm	$u_R$ / nm	$x_R$ / mm	$u_R$ / nm	$x_R$ / mm	$u_R$ / nm
2.000067	22	3.465546	25	24.001343	36	50.001097	32	98.502229	39

The degree of equivalence of laboratory  $i$  with respect to the key comparison reference value is given by two terms both expressed in nm:

$D_i = (x_i - x_R + x_0)$ , where  $x_0$  is the nominal value, and its expanded uncertainty  $U_i$  ( $k = 2$ ). The calculation of  $U_i$  is explained in the Appendix B of the Final Report.

The pair-wise degrees of equivalence are not computed for this comparison.

Key comparison CCL-K4.b

MEASURAND : External diameter

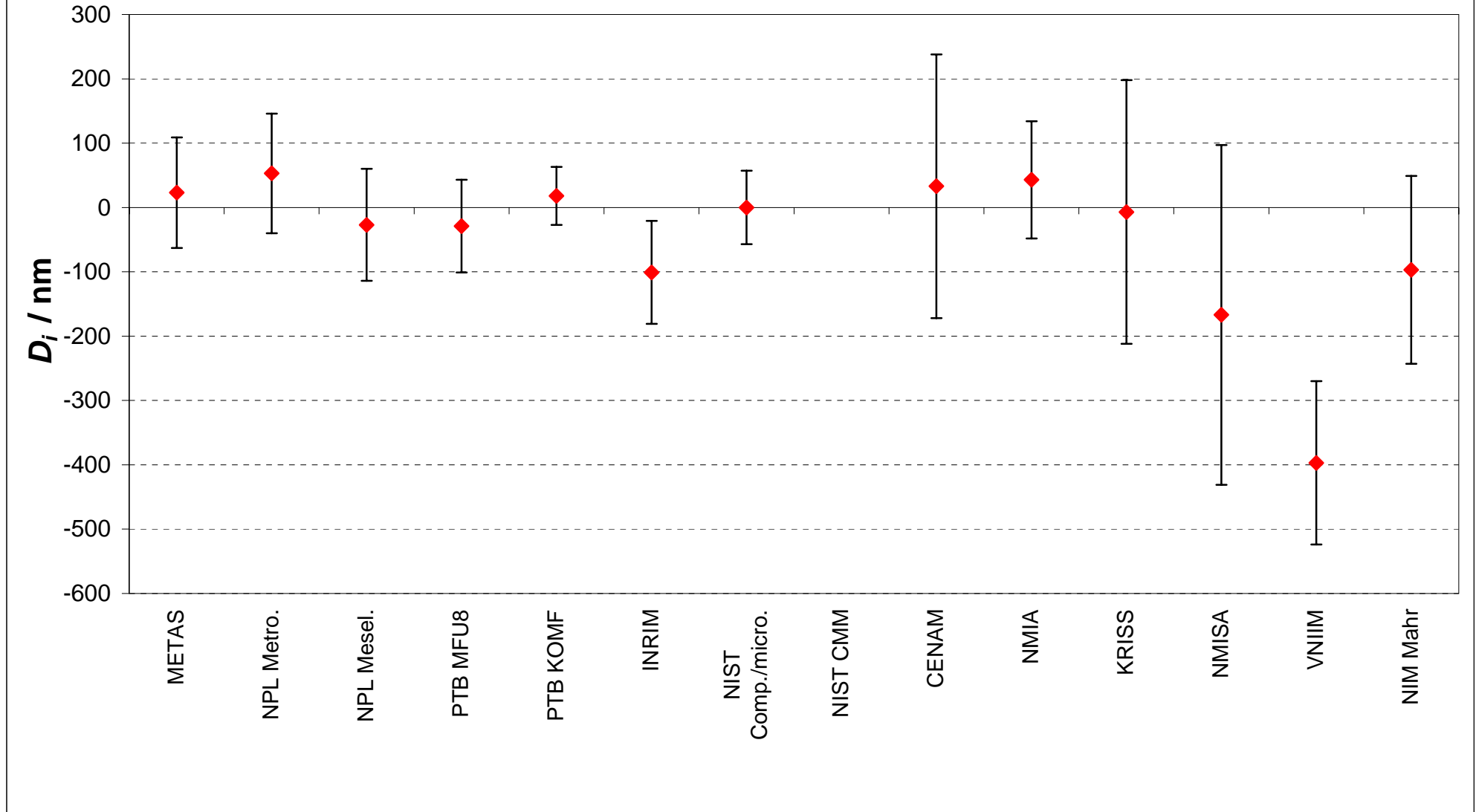
TRAVELLING STANDARDS : Plug gauges

NOMINAL VALUES : 2 mm, 3.465 mm, 24 mm, 50 mm and 98.5 mm

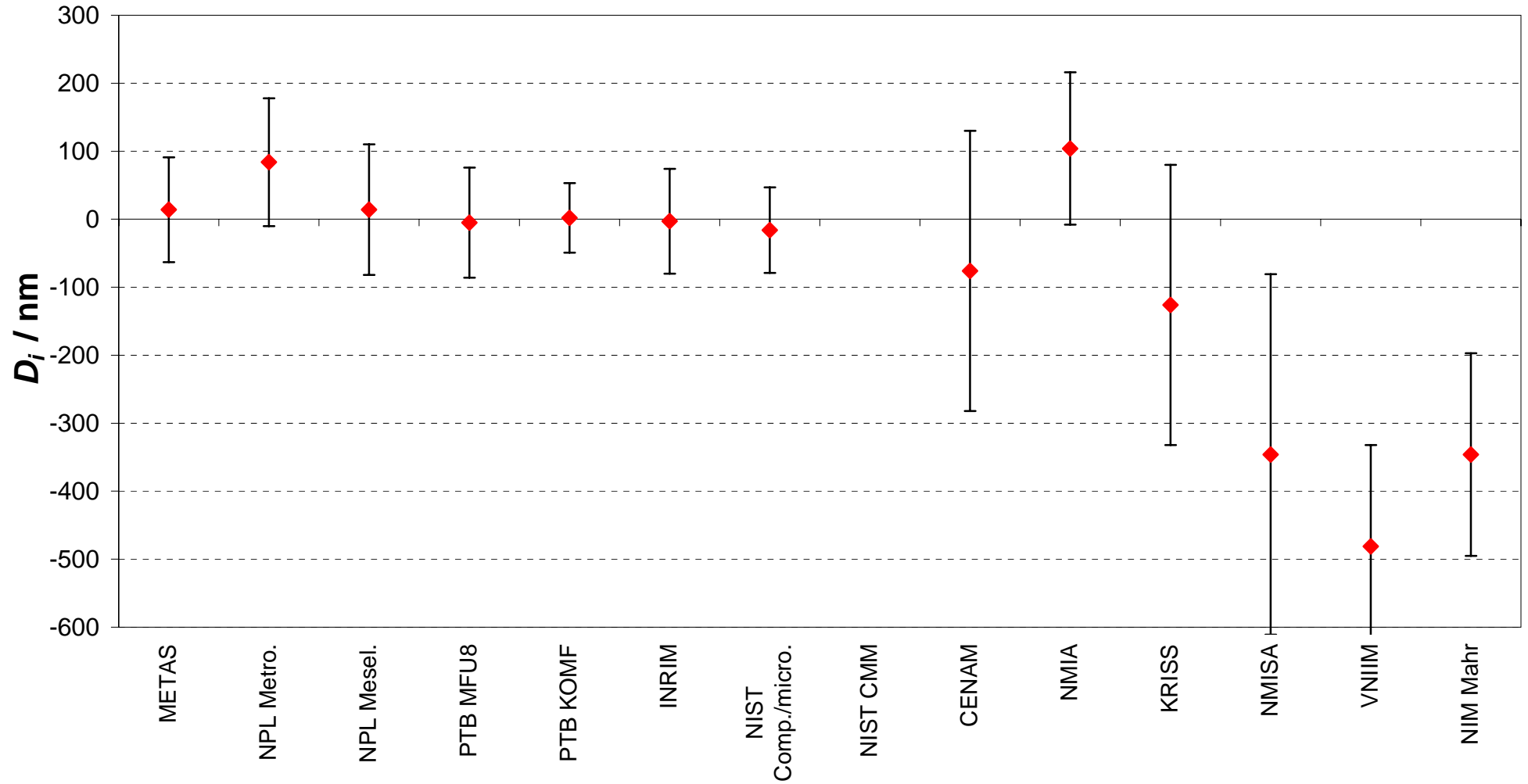
Lab <i>i</i>	2 mm		3.465 mm		24 mm		50 mm		98.5 mm	
	$D_i$	$U_i$	$D_i$	$U_i$	$D_i$	$U_i$	$D_i$	$U_i$	$D_i$	$U_i$
	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm	/ nm
METAS	23	86	14	77	57	104	33	93	71	255
NPL Metro.	53	93	84	94	27	121	-7	151	269	246
NPL Mesel.	-27	87	14	96	-	-	-	-	-	-
PTB MFU8	-29	72	-5	81	-15	90	-	-	89	120
PTB KOMF	18	45	2	51	33	88	62	116	30	95
INRIM	-101	80	-3	77	-29	100	-7	116	-19	161
NIST Comp./micro.	0	57	-16	63	63	92	37	124	59	191
NIST CMM	-	-	-	-	12	123	-20	119	-86	132
CENAM	33	205	-76	206	-163	250	13	287	-452	390
NMIA	43	91	104	112	57	123	-157	173	-35	293
KRISS	-7	205	-126	206	-183	250	133	346	-118	547
NMISA	-167	264	-346	265	-43	212	-117	173	-154	274
VNIIM	-397	127	-481	149	-603	157	-282	154	-	-
NIM Mahr	-97	146	-346	149	-223	175	-87	210	-215	274

# CCL-K4.b 2 mm plug gauge

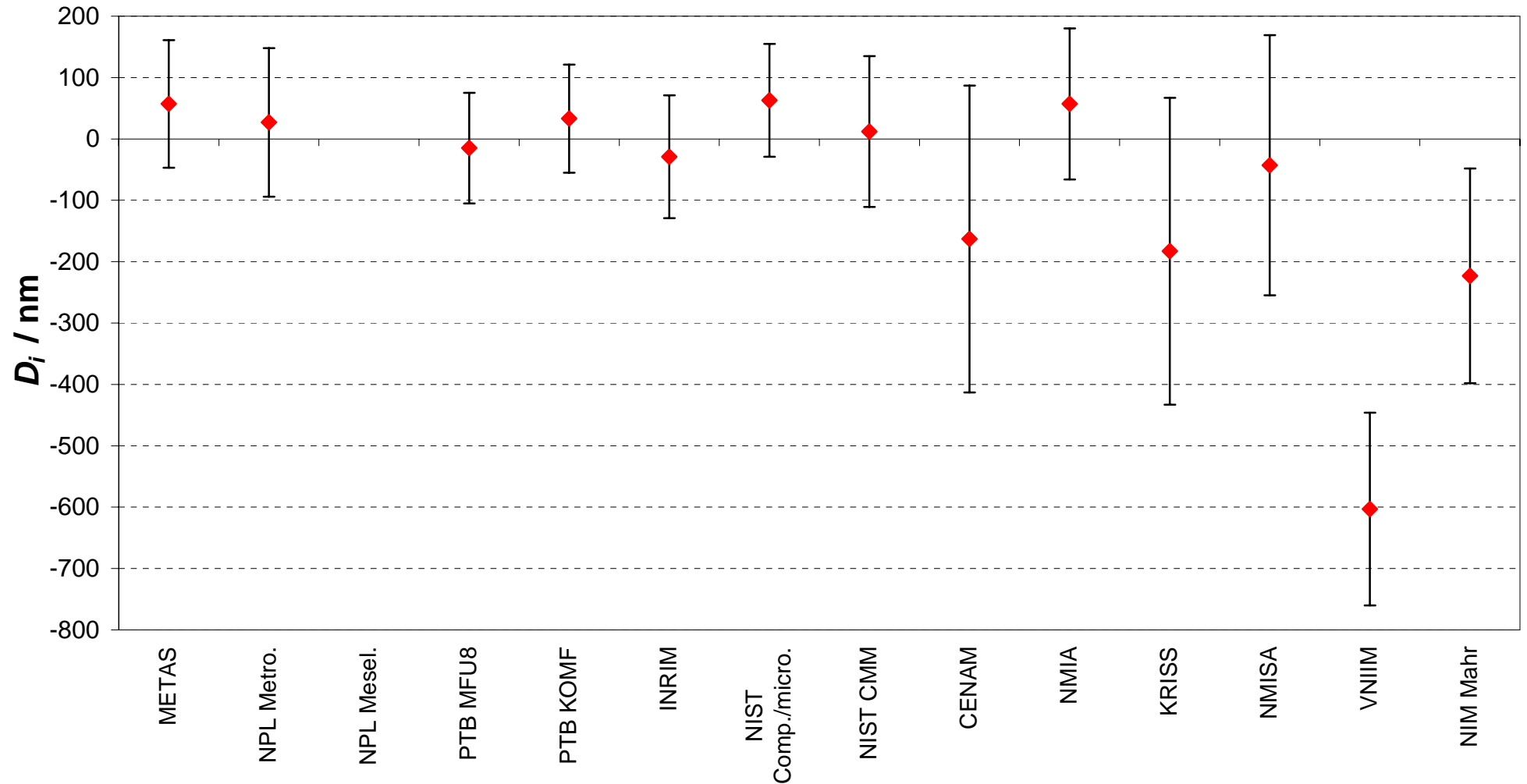
Degrees of equivalence [ $D_i$  and its expanded uncertainty ( $k = 2$ )  $U_i$ ]



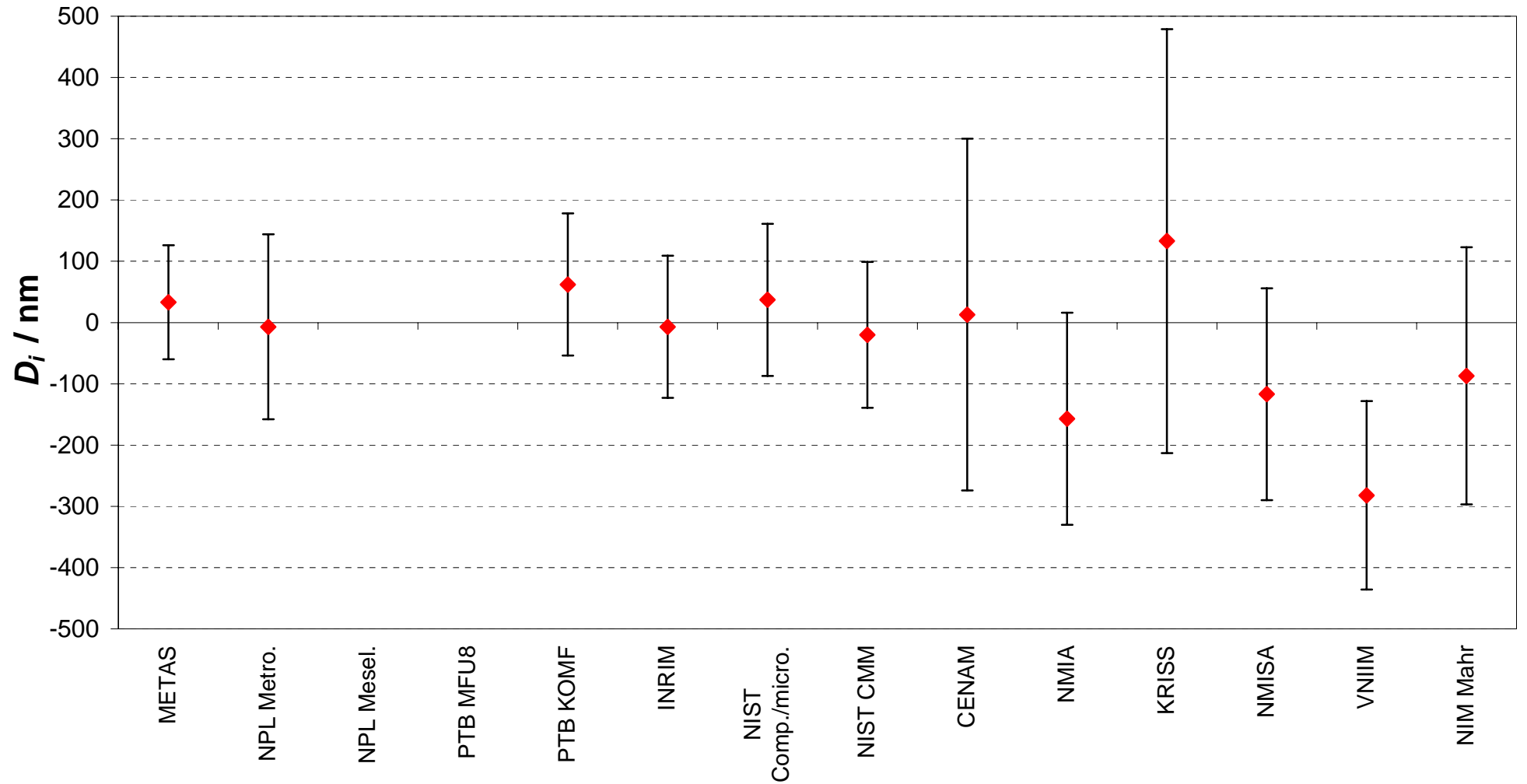
**CCL-K4.b    3.465 mm plug gauge**  
 Degrees of equivalence [ $D_i$  and its expanded uncertainty ( $k = 2$ )  $U_i$ ]



**CCL-K4.b    24 mm plug gauge**  
 Degrees of equivalence [ $D_i$  and its expanded uncertainty ( $k = 2$ )  $U_i$ ]



**CCL-K4.b 50 mm plug gauge**  
 Degrees of equivalence [ $D_i$  and its expanded uncertainty ( $k = 2$ )  $U_i$ ]



**CCL-K4.b 98.5 mm plug gauge**  
 Degrees of equivalence [ $D_i$  and its expanded uncertainty ( $k = 2$ )  $U_i$ ]

