

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 1 MHz

TRANSFER STANDARD: 1 mm hydrophone IP039

x_i : result of measurement obtained by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	x_i / nV Pa ⁻¹	$2u_i$ / nV Pa ⁻¹	Date of measurement
NMi/TNO	167.6	10.1	Jan - Feb 2000
NPL	169.5	4.1	May 1999, Aug 2001 and Aug 2003
PTB	170.6	14.3	Apr - May 2000
NIM (1)	174	13.7	Jun - Aug 2000
NIM (2)	174	13.7	
FORCE	175	13.8	Sep - Nov 2000

(1): original data; (2): revised data after circulation (see Final Report)

The values submitted by FORCE are obtained from a relative method of calibration

TNO was under contract with NMi for ultrasound measurements at the time of the comparison

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 1 MHz

TRANSFER STANDARD: 1 mm hydrophone IP027

x_i : result of measurement obtained by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	x_i / nV Pa ⁻¹	$2u_i$ / nV Pa ⁻¹	Date of measurement
NMi/TNO (1)	155.1	9.3	Jan - Feb 2000
NMi/TNO (2)	155.1	9.3	
NPL	157.5	4.9	May 1999, Aug 2001 and Aug 2003
PTB	158.1	13.3	Apr - May 2000
NIM (1)	150	11.4	Jun - Aug 2000
NIM (2)	150	11.4	
NIM (3)	156.3	11.4	May 2003
FORCE	166	13.8	Sep - Nov 2000

(1): original data; (2): revised data after circulation; (3): data obtained from bilateral comparison (see Final Report)

The values submitted by FORCE are obtained from a relative method of calibration

TNO was under contract with NMi for ultrasound measurements at the time of the comparison

Results used for establishing equivalence

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity
FREQUENCY : 1 MHz

The key comparison reference value, x_R , is computed as the weighted average of the results from TNO, NPL, PTB, and NIM highlighted in pink in the table of data obtained with hydrophone IP027. Its standard uncertainty, u_R , is the standard uncertainty of the weighted mean.

$x_R = 157.0 \text{ nV Pa}^{-1}$ and $2u_R = 3.9 \text{ nV Pa}^{-1}$

The degree of equivalence of laboratory i relative to the key comparison reference value is given by a pair of terms:

$D_i = (x_i - x_R) / x_R$, where x_i is the result of laboratory i highlighted in pink in the table of data obtained with hydrophone IP027, and

U_i , its expanded uncertainty at a 95 % level of confidence, given by $U_i = 1.96 (u_i^2 - u_R^2)^{1/2} / x_R$.

D_i and U_i are dimensionless.

The degree of equivalence between two laboratories i and j is given by a pair of terms:

$D_{ij} = (D_i - D_j) / x_R = (x_i - x_j) / x_R$ where x_i and x_j are the results of laboratories i and j highlighted in pink in the table of data obtained with hydrophone IP027, and

U_{ij} , its expanded uncertainty at a 95 % level of confidence, given by $U_{ij} = 2(u_i^2 + u_j^2)^{1/2} / x_R$.

D_{ij} and U_{ij} are dimensionless.

Correlations between the FORCE results and those of PTB and NPL have not been taken into account.

Key comparison CCAUV.U-K2

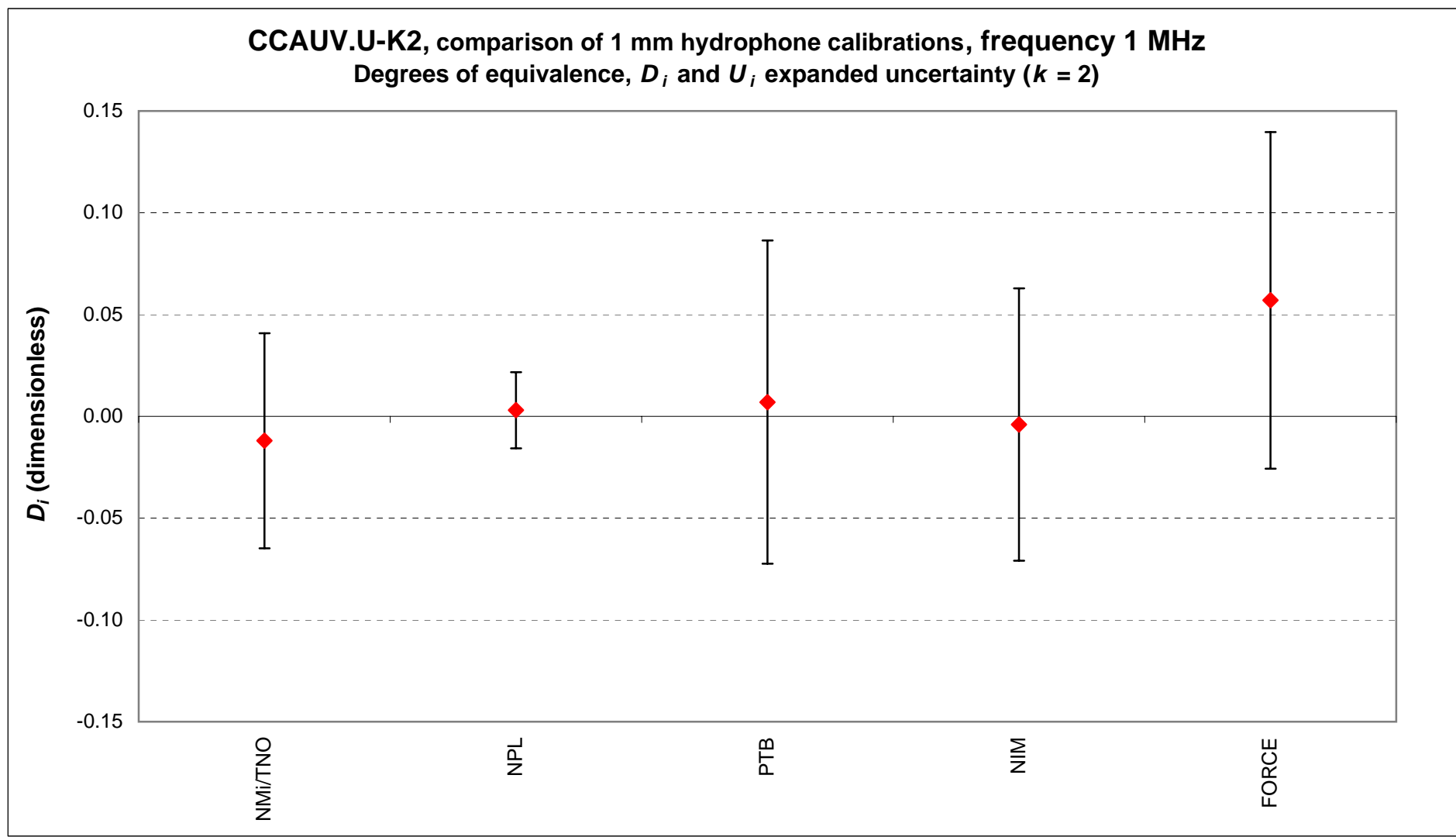
MEASURAND : End-of-cable open-circuit sensitivity
 FREQUENCY : 1 MHz

Matrix of equivalence

Lab *j* →

Lab <i>i</i> ↓			NMI/TNO		NPL		PTB		NIM		FORCE	
	<i>D_i</i>	<i>U_i</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>
NMI/TNO	-0.012	0.053			-0.015	0.067	-0.019	0.103	-0.008	0.094	-0.069	0.11
NPL	0.003	0.019	0.015	0.067			-0.004	0.09	0.008	0.079	-0.054	0.093
PTB	0.007	0.079	0.019	0.103	0.004	0.09			0.011	0.11	-0.050	0.12
NIM	-0.004	0.067	0.008	0.094	-0.008	0.079	-0.011	0.11			-0.062	0.11
FORCE	0.057	0.083	0.069	0.11	0.054	0.093	0.050	0.12	0.062	0.11		

CCAUV.U-K2, comparison of 1 mm hydrophone calibrations, frequency 1 MHz
Degrees of equivalence, D_i and U_i expanded uncertainty ($k = 2$)



Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 2 MHz

TRANSFER STANDARD: 1 mm hydrophone IP039

x_i : result of measurement obtained by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	x_i / nV Pa ⁻¹	$2u_i$ / nV Pa ⁻¹	Date of measurement
NMi/TNO	173.2	10.2	Jan - Feb 2000
NPL	170.7	4.3	May 1999, Aug 2001 and Aug 2003
PTB	170.9	14.0	Apr - May 2000
NIM (1)	181	13.6	Jun - Aug 2000
NIM (2)	181	13.6	
FORCE	174	13.8	Sep - Nov 2000

(1): original data; (2): revised data after circulation (see Final Report)

The values submitted by FORCE are obtained from a relative method of calibration

TNO was under contract with NMi for ultrasound measurements at the time of the comparison

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 2 MHz

TRANSFER STANDARD: 1 mm hydrophone IP027

x_i : result of measurement obtained by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	x_i / nV Pa ⁻¹	$2u_i$ / nV Pa ⁻¹	Date of measurement
NMi/TNO (1)	163.5	9.6	Jan - Feb 2000
NMi/TNO (2)	163.5	9.6	
NPL	158	4.0	May 1999, Aug 2001 and Aug 2003
PTB	161.4	13.6	Apr - May 2000
NIM (1)	163	12.1	Jun - Aug 2000
NIM (2)	163	12.1	
NIM (3)	164.3	11.9	May 2003
FORCE	164	13.1	Sep - Nov 2000

(1): original data; (2): revised data after circulation; (3): data obtained from bilateral comparison (see Final Report)

The values submitted by FORCE are obtained from a relative method of calibration

TNO was under contract with NMi for ultrasound measurements at the time of the comparison

Results used for establishing equivalence

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity
FREQUENCY : 2 MHz

The key comparison reference value, x_R , is computed as the weighted average of the results from TNO, NPL, PTB, and NIM highlighted in pink in the table of data obtained with hydrophone IP027. Its standard uncertainty, u_R , is the standard uncertainty of the weighted mean.

$x_R = 159.4 \text{ nV Pa}^{-1}$ and $2u_R = 3.4 \text{ nV Pa}^{-1}$

The degree of equivalence of laboratory i relative to the key comparison reference value is given by a pair of terms:
 $D_i = (x_i - x_R) / x_R$, where x_i is the result of laboratory i highlighted in pink in the table of data obtained with hydrophone IP027, and
 U_i , its expanded uncertainty at a 95 % level of confidence, given by $U_i = 1.96 (u_i^2 - u_R^2)^{1/2} / x_R$.
 D_i and U_i are dimensionless.

The degree of equivalence between two laboratories i and j is given by a pair of terms:
 $D_{ij} = (D_i - D_j) / x_R = (x_i - x_j) / x_R$ where x_i and x_j are the results of laboratories i and j highlighted in pink in the table of data obtained with hydrophone IP027, and
 U_{ij} , its expanded uncertainty at a 95 % level of confidence, given by $U_{ij} = 2(u_i^2 + u_j^2)^{1/2} / x_R$.
 D_{ij} and U_{ij} are dimensionless.
Correlations between the FORCE results and those of PTB and NPL have not been taken into account.

Key comparison CCAUV.U-K2

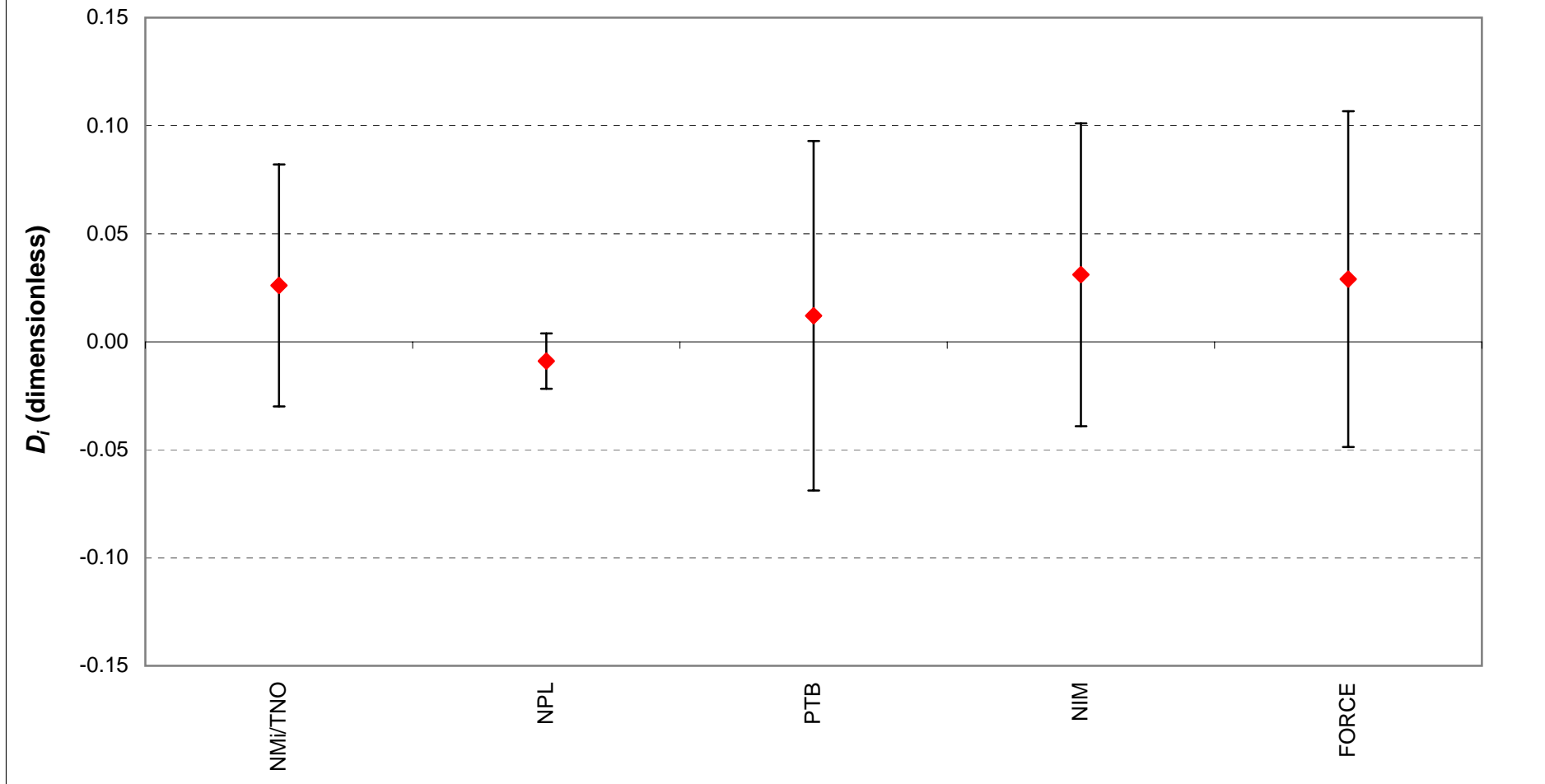
MEASURAND : End-of-cable open-circuit sensitivity
 FREQUENCY : 2 MHz

Matrix of equivalence

Lab *j* →

Lab <i>i</i> ↓	<i>D_i</i> <i>U_i</i>		NMI/TNO		NPL		PTB		NIM		FORCE	
	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>
NMI/TNO	0.026	0.056			0.034	0.065	0.013	0.104	-0.005	0.096	-0.003	0.102
NPL	-0.009	0.013	-0.034	0.065			-0.021	0.089	-0.040	0.079	-0.038	0.086
PTB	0.012	0.081	-0.013	0.104	0.021	0.089			-0.018	0.11	-0.016	0.12
NIM	0.031	0.070	0.005	0.096	0.040	0.079	0.018	0.11			0.002	0.11
FORCE	0.029	0.078	0.003	0.102	0.038	0.086	0.016	0.12	-0.002	0.11		

CCAUV.U-K2, comparison of 1 mm hydrophone calibrations, frequency 2 MHz
Degrees of equivalence, D_i and U_i expanded uncertainty ($k = 2$)



Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 5 MHz

TRANSFER STANDARD: 1 mm hydrophone IP039

x_i : result of measurement obtained by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	x_i / nV Pa ⁻¹	$2u_i$ / nV Pa ⁻¹	Date of measurement
NMi/TNO	177.1	10.8	Jan - Feb 2000
NPL	177	4.4	May 1999, Aug 2001 and Aug 2003
PTB	176.8	14.1	Apr - May 2000
NIM (1)	179	12.9	Jun - Aug 2000
NIM (2)	181	13.0	
FORCE	185	14.6	Sep - Nov 2000

(1): original data; (2): revised data after circulation (see Final Report)

The values submitted by FORCE are obtained from a relative method of calibration

TNO was under contract with NMi for ultrasound measurements at the time of the comparison

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 5 MHz

TRANSFER STANDARD: 1 mm hydrophone IP027

x_i : result of measurement obtained by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	x_i / nV Pa ⁻¹	$2u_i$ / nV Pa ⁻¹	Date of measurement
NMi/TNO (1)	169.3	10.2	Jan - Feb 2000
NMi/TNO (2)	169.3	10.2	
NPL	170.9	4.4	May 1999, Aug 2001 and Aug 2003
PTB	171.6	14.1	Apr - May 2000
NIM (1)	160	11.2	Jun - Aug 2000
NIM (2)	162	11.3	
NIM (3)	172.9	12.6	May 2003
FORCE	177	14.0	Sep - Nov 2000

(1): original data; (2): revised data after circulation; (3): data obtained from bilateral comparison (see Final Report)

The values submitted by FORCE are obtained from a relative method of calibration

TNO was under contract with NMi for ultrasound measurements at the time of the comparison

Results used for establishing equivalence

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity
FREQUENCY : 5 MHz

The key comparison reference value, x_R , is computed as the weighted average of the results from TNO, NPL, PTB, and NIM highlighted in pink in the table of data obtained with hydrophone IP027. Its standard uncertainty, u_R , is the standard uncertainty of the weighted mean.

$x_R = 170.9 \text{ nV Pa}^{-1}$ and $2u_R = 3.7 \text{ nV Pa}^{-1}$

The degree of equivalence of laboratory i relative to the key comparison reference value is given by a pair of terms:

$D_i = (x_i - x_R) / x_R$, where x_i is the result of laboratory i highlighted in pink in the table of data obtained with hydrophone IP027, and

U_i , its expanded uncertainty at a 95 % level of confidence, given by $U_i = 1.96 (u_i^2 - u_R^2)^{1/2} / x_R$.

D_i and U_i are dimensionless.

The degree of equivalence between two laboratories i and j is given by a pair of terms:

$D_{ij} = (D_i - D_j) / x_R = (x_i - x_j) / x_R$ where x_i and x_j are the results of laboratories i and j highlighted in pink in the table of data obtained with hydrophone IP027, and

U_{ij} , its expanded uncertainty at a 95 % level of confidence, given by $U_{ij} = 2(u_i^2 + u_j^2)^{1/2} / x_R$.

D_{ij} and U_{ij} are dimensionless.

Correlations between the FORCE results and those of PTB and NPL have not been taken into account.

Key comparison CCAUV.U-K2

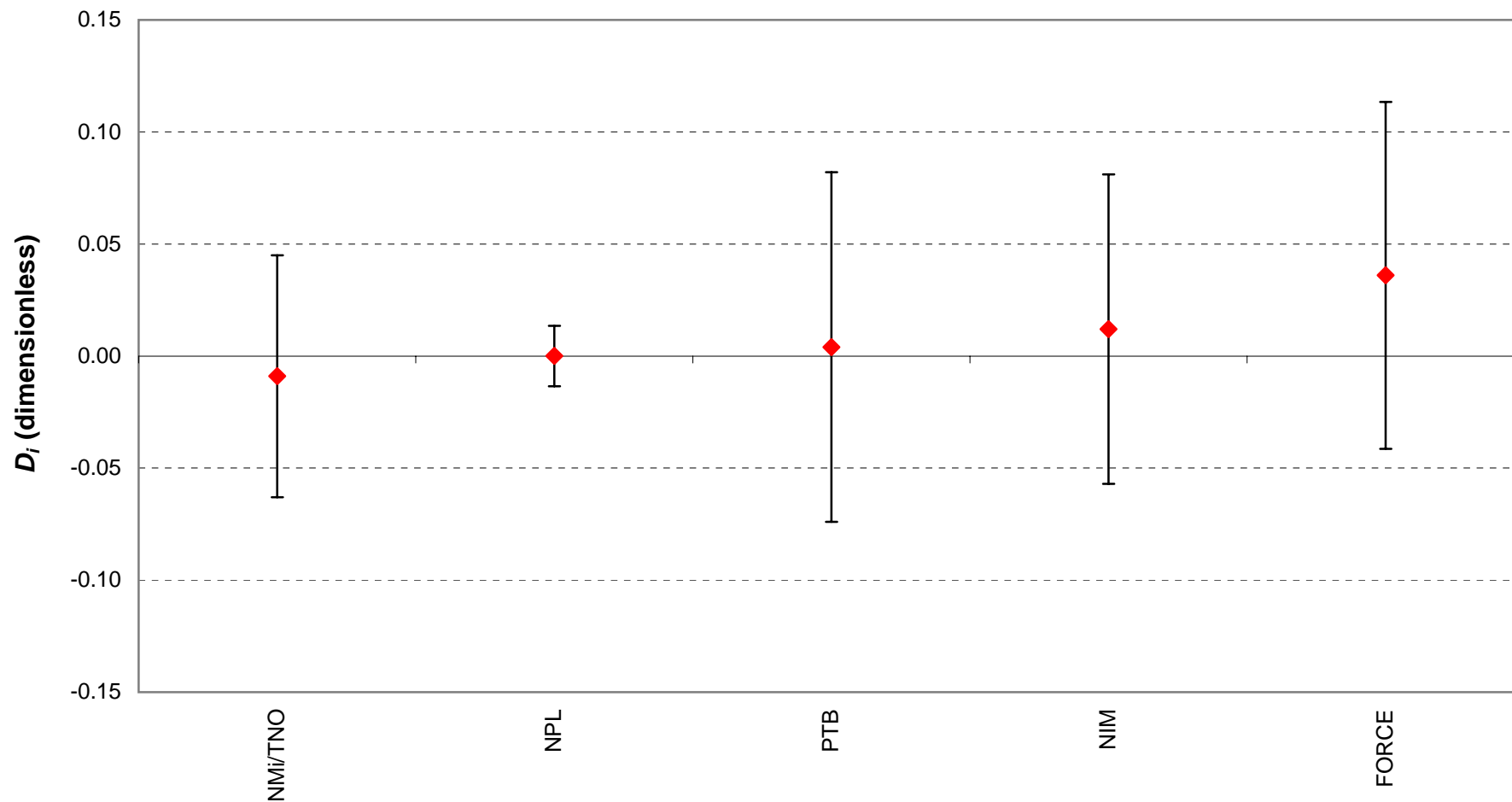
MEASURAND : End-of-cable open-circuit sensitivity
 FREQUENCY : 5 MHz

Matrix of equivalence

Lab *j* →

Lab <i>i</i> ↓			NMI/TNO		NPL		PTB		NIM		FORCE	
	<i>D_i</i>	<i>U_i</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>
NMI/TNO	-0.009	0.054			-0.009	0.065	-0.013	0.102	-0.021	0.095	-0.045	0.10
NPL	0.000	0.014	0.009	0.065			-0.004	0.086	-0.012	0.078	-0.036	0.086
PTB	0.004	0.078	0.013	0.102	0.004	0.086			-0.008	0.11	-0.032	0.12
NIM	0.012	0.069	0.021	0.095	0.012	0.078	0.008	0.11			-0.024	0.11
FORCE	0.036	0.077	0.045	0.10	0.036	0.086	0.032	0.12	0.024	0.11		

CCAUV.U-K2, comparison of 1 mm hydrophone calibrations, frequency 5 MHz
Degrees of equivalence, D_i and U_i expanded uncertainty ($k = 2$)



Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 10 MHz

TRANSFER STANDARD: 1 mm hydrophone IP039

x_i : result of measurement obtained by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	x_i / nV Pa ⁻¹	$2u_i$ / nV Pa ⁻¹	Date of measurement
NMi/TNO	185.8	11.1	Jan - Feb 2000
NPL	200.8	5.2	May 1999, Aug 2001 and Aug 2003
PTB	202.1	17.0	Apr - May 2000
NIM (1)	178	18.3	Jun - Aug 2000
NIM (2)	186	19.2	
FORCE	214	18.6	Sep - Nov 2000

(1): original data; (2): revised data after circulation (see Final Report)

The values submitted by FORCE are obtained from a relative method of calibration

TNO was under contract with NMi for ultrasound measurements at the time of the comparison

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 10 MHz

TRANSFER STANDARD: 1 mm hydrophone IP027

x_i : result of measurement obtained by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	x_i / nV Pa ⁻¹	$2u_i$ / nV Pa ⁻¹	Date of measurement
NMi/TNO (1)	180.4	12.3	Jan - Feb 2000
NMi/TNO (2)	207.8	12.3	
NPL	194.5	5.1	May 1999, Aug 2001 and Aug 2003
PTB	199.1	16.7	Apr - May 2000
NIM (1)	158	19.0	Jun - Aug 2000
NIM (2)	165	19.8	
NIM (3)	191.5	13.8	May 2003
FORCE	205	18.0	Sep - Nov 2000

(1): original data; (2): revised data after circulation; (3): data obtained from bilateral comparison (see Final Report)

The values submitted by FORCE are obtained from a relative method of calibration

TNO was under contract with NMi for ultrasound measurements at the time of the comparison

Results used for establishing equivalence

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity
FREQUENCY : 10 MHz

The key comparison reference value, x_R , is computed as the weighted average of the results from TNO, NPL, PTB, and NIM highlighted in pink in the table of data obtained with hydrophone IP027. Its standard uncertainty, u_R , is the standard uncertainty of the weighted mean.

$x_R = 196.1 \text{ nV Pa}^{-1}$ and $2u_R = 4.3 \text{ nV Pa}^{-1}$

The degree of equivalence of laboratory i relative to the key comparison reference value is given by a pair of terms:

$D_i = (x_i - x_R) / x_R$, where x_i is the result of laboratory i highlighted in pink in the table of data obtained with hydrophone IP027, and

U_i , its expanded uncertainty at a 95 % level of confidence, given by $U_i = 1.96 (u_i^2 - u_R^2)^{1/2} / x_R$.

D_i and U_i are dimensionless.

The degree of equivalence between two laboratories i and j is given by a pair of terms:

$D_{ij} = (D_i - D_j) / x_R = (x_i - x_j) / x_R$ where x_i and x_j are the results of laboratories i and j highlighted in pink in the table of data obtained with hydrophone IP027, and

U_{ij} , its expanded uncertainty at a 95 % level of confidence, given by $U_{ij} = 2(u_i^2 + u_j^2)^{1/2} / x_R$.

D_{ij} and U_{ij} are dimensionless.

Correlations between the FORCE results and those of PTB and NPL have not been taken into account.

Key comparison CCAUV.U-K2

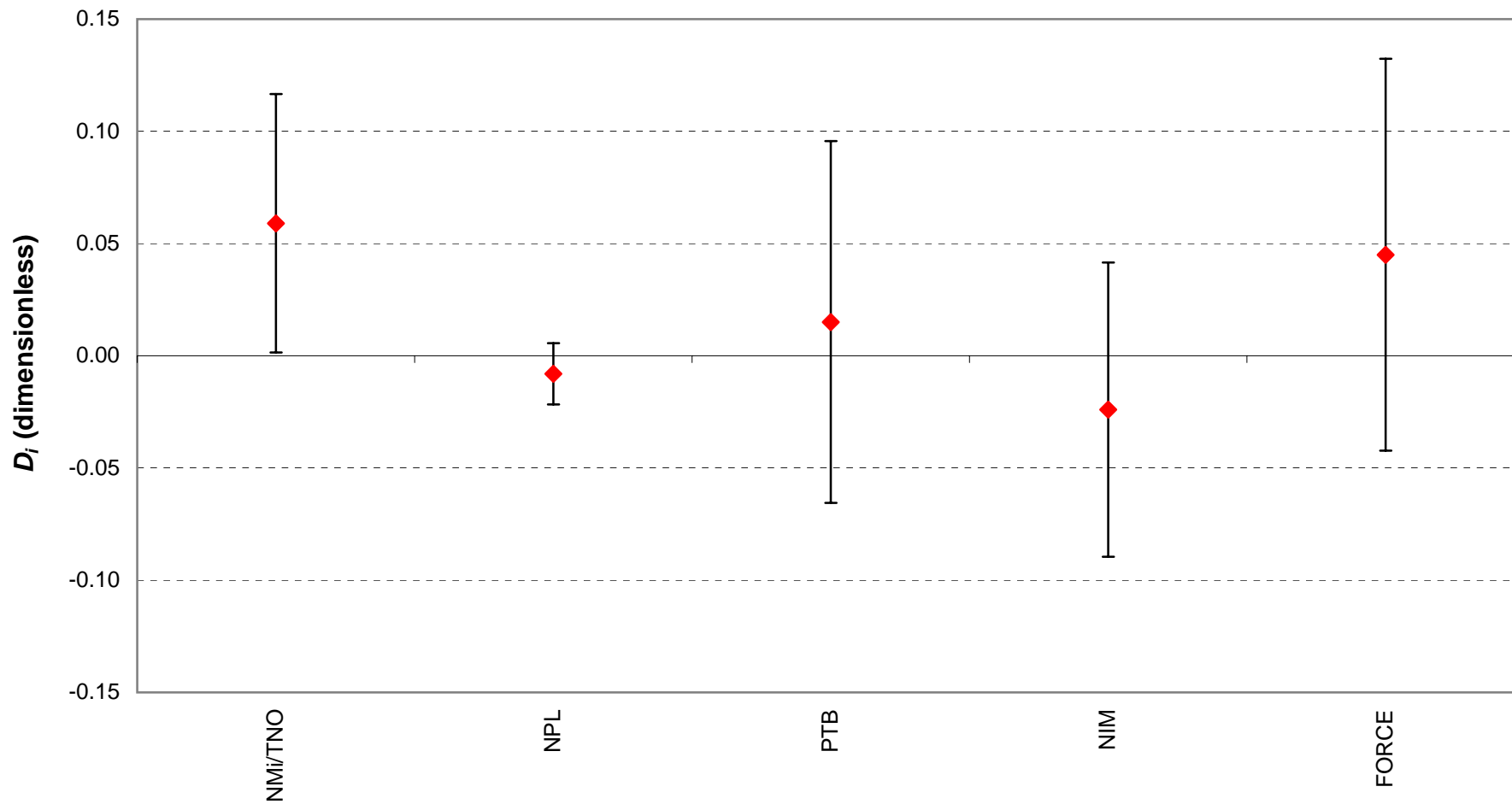
MEASURAND : End-of-cable open-circuit sensitivity
 FREQUENCY : 10 MHz

Matrix of equivalence

Lab *j* →

Lab <i>i</i> ↓			NMI/TNO		NPL		PTB		NIM		FORCE	
	<i>D_i</i>	<i>U_i</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>
NMI/TNO	0.059	0.058			0.068	0.068	0.044	0.106	0.083	0.094	0.014	0.11
NPL	-0.008	0.014	-0.068	0.068			-0.023	0.089	0.015	0.075	-0.054	0.095
PTB	0.015	0.081	-0.044	0.106	0.023	0.089			0.039	0.11	-0.03	0.125
NIM	-0.024	0.066	-0.083	0.094	-0.015	0.075	-0.039	0.11			-0.069	0.12
FORCE	0.045	0.087	-0.014	0.11	0.054	0.095	0.03	0.125	0.069	0.12		

CCAUV.U-K2, comparison of 1 mm hydrophone calibrations, frequency 10 MHz
Degrees of equivalence, D_i and U_i expanded uncertainty ($k = 2$)



Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 15 MHz

TRANSFER STANDARD: 1 mm hydrophone IP039

x_i : result of measurement obtained by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	x_i / nV Pa ⁻¹	$2u_i$ / nV Pa ⁻¹	Date of measurement
NMi/TNO	232.6	14.9	Jan - Feb 2000
NPL	258.7	10.3	May 1999, Aug 2001 and Aug 2003
PTB	265.2	22.8	Apr - May 2000
NIM (1)	169	15.7	Jun - Aug 2000
NIM (2)	259	24.1	
FORCE	261	25.6	Sep - Nov 2000

(1): original data; (2): revised data after circulation (see Final Report)

The values submitted by FORCE are obtained from a relative method of calibration

TNO was under contract with NMi for ultrasound measurements at the time of the comparison

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 15 MHz

TRANSFER STANDARD: 1 mm hydrophone IP027

x_i : result of measurement obtained by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	x_i / nV Pa ⁻¹	$2u_i$ / nV Pa ⁻¹	Date of measurement
NMi/TNO (1)	224.3	14.3	Jan - Feb 2000
NMi/TNO (2)	237.7	14.3	
NPL	244.6	7.6	May 1999, Aug 2001 and Aug 2003
PTB	252.8	22.8	Apr - May 2000
NIM (1)	139	13.6	Jun - Aug 2000
NIM (2)	213	20.9	
NIM (3)	244.9	18.2	May 2003
FORCE	246	24.4	Sep - Nov 2000

(1): original data; (2): revised data after circulation; (3): data obtained from bilateral comparison (see Final Report)

The values submitted by FORCE are obtained from a relative method of calibration

TNO was under contract with NMi for ultrasound measurements at the time of the comparison

Results used for establishing equivalence

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity

FREQUENCY : 15 MHz

The key comparison reference value, x_R , is computed as the weighted average of the results from TNO, NPL, PTB, and NIM highlighted in pink in the table of data obtained with hydrophone IP027.

Its standard uncertainty, u_R , is the standard uncertainty of the weighted mean.

$x_R = 244.0 \text{ nV Pa}^{-1}$ and $2u_R = 6.1 \text{ nV Pa}^{-1}$

The degree of equivalence of laboratory i relative to the key comparison reference value is given by a pair of terms:

$D_i = (x_i - x_R) / x_R$, where x_i is the result of laboratory i highlighted in pink in the table of data obtained with hydrophone IP027, and

U_i , its expanded uncertainty at a 95 % level of confidence, given by $U_i = 1.96 (u_i^2 - u_R^2)^{1/2} / x_R$.

D_i and U_i are dimensionless.

The degree of equivalence between two laboratories i and j is given by a pair of terms:

$D_{ij} = (D_i - D_j) / x_R = (x_i - x_j) / x_R$ where x_i and x_j are the results of laboratories i and j highlighted in pink in the table of data obtained with hydrophone IP027, and

U_{ij} , its expanded uncertainty at a 95 % level of confidence, given by $U_{ij} = 2(u_i^2 + u_j^2)^{1/2} / x_R$.

D_{ij} and U_{ij} are dimensionless.

Correlations between the FORCE results and those of PTB and NPL have not been taken into account.

Key comparison CCAUV.U-K2

MEASURAND : End-of-cable open-circuit sensitivity
 FREQUENCY : 15 MHz

Matrix of equivalence

Lab *j* →

Lab <i>i</i> ↓	<i>D_i</i> <i>U_i</i>		NMI/TNO		NPL		PTB		NIM		FORCE	
	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>	<i>D_{ij}</i>	<i>U_{ij}</i>
NMI/TNO	-0.026	0.052			-0.028	0.066	-0.062	0.11	-0.030	0.095	-0.034	0.12
NPL	0.003	0.018	0.028	0.066			-0.034	0.099	-0.001	0.081	-0.006	0.10
PTB	0.036	0.088	0.062	0.11	0.034	0.099			0.032	0.12	0.028	0.14
NIM	0.004	0.069	0.030	0.095	0.001	0.081	-0.032	0.12			-0.005	0.12
FORCE	0.008	0.095	0.034	0.12	0.006	0.10	-0.028	0.14	0.005	0.12		

CCAUV.U-K2, comparison of 1 mm hydrophone calibrations, frequency 15 MHz
Degrees of equivalence, D_i and U_i expanded uncertainty ($k = 2$)

