

12 April 2000

Key comparison CCQM-K1.b

MEASURAND : Amount-of-substance fraction of Carbon dioxide (CO₂) in Nitrogen (N₂)

NOMINAL VALUE : 100 µmol/mol

x_i : result of measurement carried out by laboratory i

u_i : combined standard uncertainty of x_i

$x_{i\text{grav}}$: gravimetric value of the CO₂ amount-of-substance fraction in the cylinder received by laboratory i

$u_{i\text{grav}}$: combined standard uncertainty of $x_{i\text{grav}}$

Lab i	x_i µmol/mol	u_i µmol/mol	$x_{i\text{grav}}$ µmol/mol	$u_{i\text{grav}}$ µmol/mol	Date of measurement
NPL	100.50	0.25	99.945	0.004	93-10
NIST	99.96	0.25	99.931	0.004	93-11
NMi	100.10	0.20	99.917	0.004	93-06
BAM	99.40	0.25	99.945	0.004	93-12
BNM-LNE	99.62	0.24	99.935	0.004	93-07
KRISS	98.69	0.45	99.934	0.004	93-08
NRLM	99.75	0.25	99.979	0.004	93-10
NRCCRM	99.48	0.16	99.810	0.004	93-07
VNIIM	104.00	0.50	100.030	0.004	93-09
OMH	100.80	0.72	99.810	0.004	94-03

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NOMINAL VALUE: 100 µmol/mol

Key comparison reference value: there is no single reference value for this comparison, the value $x_{i\text{grav}}$ is taken as the reference value for laboratory i .

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

$D_i = (x_i - x_{i\text{grav}})$ and U_i , its expanded uncertainty ($k = 2$), both expressed in µmol/mol

$$U_i^2 = 2^2(u_i^2 + u_{i\text{grav}}^2)$$

The degree of equivalence between two laboratories is given by a pair of numbers:

$D_{ij} = D_i - D_j = (x_i - x_{i\text{grav}}) - (x_j - x_{j\text{grav}})$ and U_{ij} , its expanded uncertainty ($k = 2$), both expressed in µmol/mol

$$U_{ij}^2 = 2^2(u_i^2 + u_j^2 + u_{i\text{grav}}^2 + u_{j\text{grav}}^2)$$

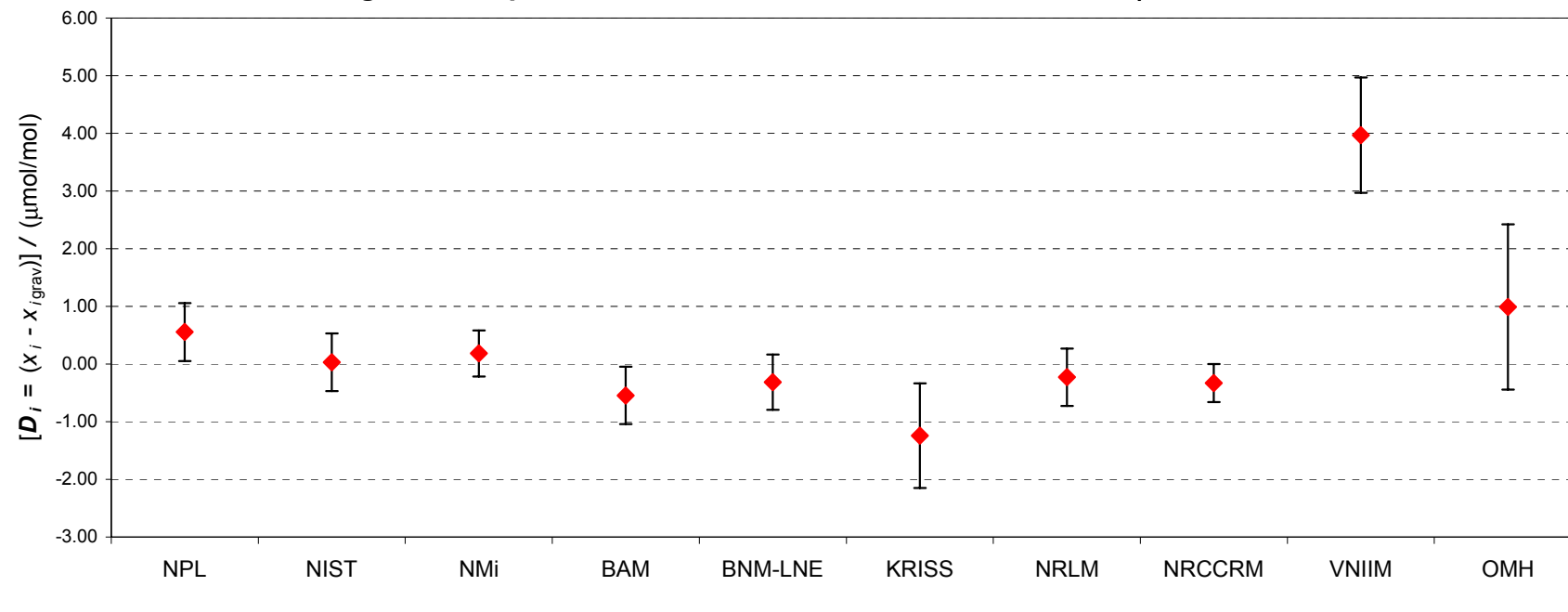
The approximation $U_{ij}^2 \sim 2^2(u_i^2 + u_j^2)$ is used in the Matrix of equivalence.

Lab j \Rightarrow

Lab i \Downarrow

	D_i U_i		NPL		NIST		NMI		BAM		BNM-LNE		KRISS		NRLM		NRCCRM		VNIIM		OMH		
	µmol/mol	µmol/mol	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	
NPL	0.55	0.50																					
NIST	0.03	0.50	-0.53	0.71																			
NMI	0.18	0.40	-0.37	0.64	0.15	0.64																	
BAM	-0.55	0.50	-1.10	0.71	-0.57	0.70	-0.73	0.64															
BNM-LNE	-0.32	0.48	-0.87	0.69	-0.34	0.69	-0.50	0.62	0.23	0.69													
KRISS	-1.24	0.91	-1.80	1.04	-1.27	1.04	-1.43	0.99	-0.70	1.04	-0.93	1.03											
NRLM	-0.23	0.50	-0.78	0.71	-0.26	0.71	-0.41	0.64	0.32	0.70	0.09	0.69	1.01	1.04									
NRCCRM	-0.33	0.33	-0.88	0.60	-0.36	0.60	-0.51	0.52	0.22	0.60	-0.01	0.58	0.91	0.97	-0.10	0.60							
VNIIM	3.97	1.00	3.41	1.12	3.94	1.12	3.79	1.08	4.51	1.12	4.28	1.11	5.21	1.35	4.20	1.12	4.30	1.05					
OMH	0.99	1.43	0.44	1.52	0.96	1.52	0.81	1.49	1.54	1.52	1.31	1.51	2.23	1.70	1.22	1.52	1.32	1.47	-2.98	1.75			

CCQM-K1.b
Degrees of equivalence for CO₂ in N₂ at nominal value 100 μmol/mol



Key comparison CCQM-K1.b

MEASURAND : Amount-of-substance fraction of Carbon dioxide (CO₂) in Nitrogen (N₂)

NOMINAL VALUE : 1000 µmol/mol

x_i : result of measurement carried out by laboratory i

u_i : combined standard uncertainty of x_i

$x_{i\text{grav}}$: gravimetric value of the CO₂ amount-of-substance fraction in the cylinder received by laboratory i

$u_{i\text{grav}}$: combined standard uncertainty of $x_{i\text{grav}}$

Lab i	x_i µmol/mol	u_i µmol/mol	$x_{i\text{grav}}$ µmol/mol	$u_{i\text{grav}}$ µmol/mol	Date of measurement
NPL	998.5	1.6	994.38	0.05	93-10
NIST	996.6	1.7	995.10	0.05	93-11
NMi	995.4	1.0	994.76	0.05	93-09
BAM	997.0	2.0	995.69	0.05	94-01
BNM-LNE	996.2	1.8	994.25	0.05	93-08
KRISS	990.6	5.1	994.65	0.05	93-08
NRLM	991.9	2.5	994.60	0.05	93-10
NRCCRM	994.4	1.6	995.85	0.05	93-07
VNIIM	981.0	2.5	994.87	0.05	93-09
OMH	995.6	1.0	995.85	0.05	94-03

Key comparison CCQM-K1.b

MEASURAND : Amount-of-substance fraction of Carbon dioxide (CO₂) in Nitrogen (N₂)

NOMINAL VALUE: 1000 µmol/mol

Key comparison reference value: there is no single reference value for this comparison, the value $x_{i\text{grav}}$ is taken as the reference value for laboratory i .

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

$D_i = (x_i - x_{i\text{grav}})$ and U_i , its expanded uncertainty ($k = 2$), both expressed in µmol/mol

$$U_i^2 = 2^2(u_i^2 + u_{i\text{grav}}^2)$$

The degree of equivalence between two laboratories is given by a pair of numbers:

$D_{ij} = D_i - D_j = (x_i - x_{i\text{grav}}) - (x_j - x_{j\text{grav}})$ and U_{ij} , its expanded uncertainty ($k = 2$), both expressed in µmol/mol

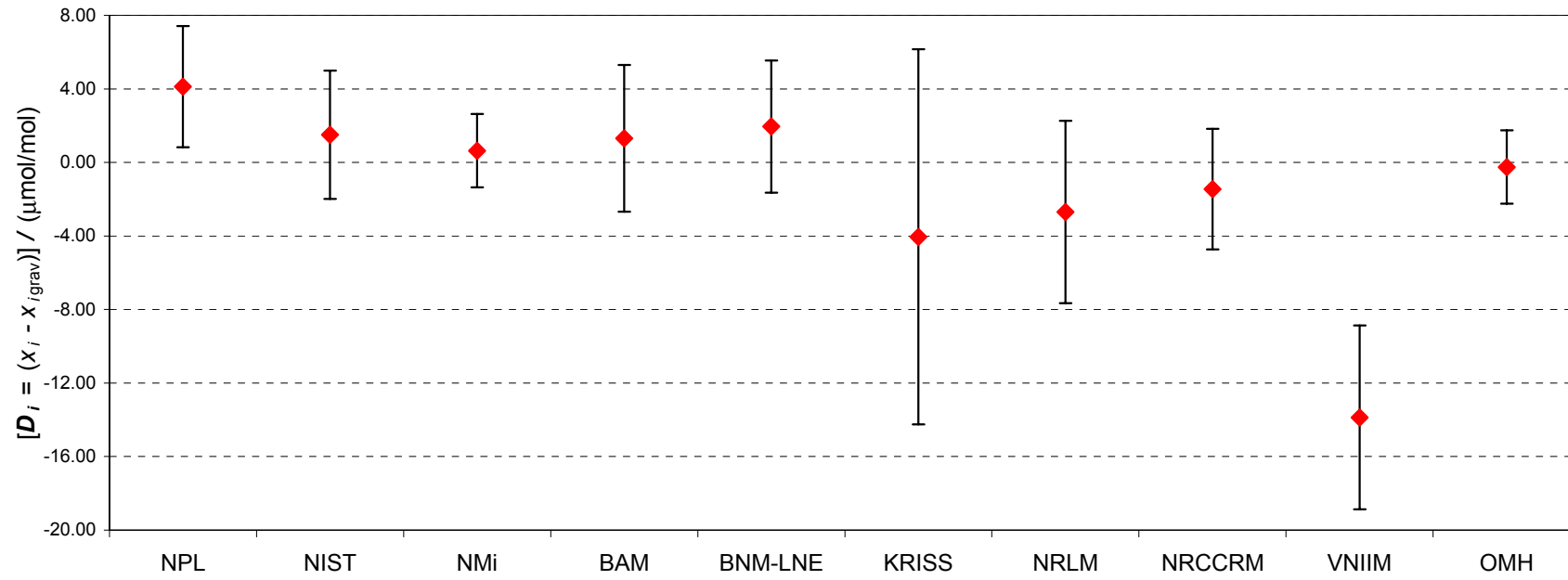
$$U_{ij}^2 = 2^2(u_i^2 + u_j^2 + u_{i\text{grav}}^2 + u_{j\text{grav}}^2)$$

The approximation $U_{ij}^2 \sim 2^2(u_i^2 + u_j^2)$ is used in the Matrix of equivalence.

Lab j \Rightarrow

Lab i \Downarrow	D_i U_i µmol/mol		NPL		NIST		NMI		BAM		BNM-LNE		KRISS		NRLM		NRCCRM		VNIIM		OMH		
	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	
NPL	4.12	3.30																					
NIST	1.50	3.49	-2.62	4.80			0.86	4.02	0.19	5.30	-0.45	5.00	5.55	10.78	4.20	6.06	2.95	4.79	15.37	6.10	1.75	4.02	
NMI	0.64	1.99	-3.48	3.85	-0.86	4.02			-0.67	4.46	-1.31	4.10	4.69	10.40	3.34	5.34	2.09	3.84	14.51	5.38	0.89	2.82	
BAM	1.31	3.99	-2.81	5.17	-0.19	5.30	0.67	4.46			-0.64	5.36	5.36	10.95	4.01	6.36	2.76	5.16	15.18	6.40	1.56	4.46	
BNM-LNE	1.95	3.59	-2.17	4.87	0.45	5.00	1.31	4.10	0.64	5.36			6.00	10.82	4.65	6.12	3.40	4.86	15.82	6.16	2.20	4.10	
KRISS	-4.05	10.20	-8.17	10.72	-5.55	10.78	-4.69	10.40	-5.36	10.95	-6.00	10.82			-1.35	11.34	-2.60	10.72	9.82	11.36	-3.80	10.40	
NRLM	-2.70	4.96	-6.82	5.95	-4.20	6.06	-3.34	5.34	-4.01	6.36	-4.65	6.12	1.35	11.34			-1.25	5.95	11.17	7.04	-2.45	5.34	
NRCCRM	-1.45	3.28	-5.57	4.65	-2.95	4.79	-2.09	3.84	-2.76	5.16	-3.40	4.86	2.60	10.72	1.25	5.95			12.42	5.98	-1.20	3.84	
VNIIM	-13.87	5.00	-17.99	5.99	-15.37	6.10	-14.51	5.38	-15.18	6.40	-15.82	6.16	-9.82	11.36	-11.17	7.04	-12.42	5.98			-13.62	5.38	
OMH	-0.25	1.99	-4.37	3.85	-1.75	4.02	-0.89	2.82	-1.56	4.46	-2.20	4.10	3.80	10.40	2.45	5.34	1.20	3.84	13.62	5.38			

CCQM-K1.b
Degrees of equivalence for CO₂ in N₂ at nominal value 1000 μmol/mol



Key comparison CCQM-K1.b

MEASURAND : Amount-of-substance fraction of Carbon dioxide (CO₂) in Nitrogen (N₂)

NOMINAL VALUE : 150 mmol/mol

x_i : result of measurement carried out by laboratory i

u_i : combined standard uncertainty of x_i

$x_{i\text{ grav}}$: gravimetric value of the CO₂ amount-of-substance fraction in the cylinder received by laboratory i

$u_{i\text{ grav}}$: combined standard uncertainty of $x_{i\text{ grav}}$

Lab i	x_i mmol/mol	u_i mmol/mol	$x_{i\text{ grav}}$ mmol/mol	$u_{i\text{ grav}}$ mmol/mol	Date of measurement
NPL	150.30	0.15	150.110	0.005	93-10
NIST	149.95	0.19	149.950	0.004	93-11
NMi	149.70	0.15	149.530	0.004	93-06
BAM	149.90	0.22	149.950	0.004	94-01
BNM-LNE	150.30	0.30	150.170	0.005	93-09
KRISS	150.03	0.19	149.980	0.004	93-08
NRLM	150.00	0.38	150.030	0.005	93-10
NRCCRM	150.20	0.25	150.080	0.005	93-07
VNIIM	149.60	0.25	150.130	0.005	93-09
OMH	150.15	0.05	150.080	0.005	94-03

Key comparison CCQM-K1.b

MEASURAND : Amount-of-substance fraction of Carbon dioxide (CO₂) in Nitrogen (N₂)
 NOMINAL VALUE: 150 mmol/mol

Key comparison reference value: there is no single reference value for this comparison, the value $x_{i\text{grav}}$ is taken as the reference value for laboratory i .

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

$D_i = (x_i - x_{i\text{grav}})$ and U_i , its expanded uncertainty ($k = 2$), both expressed in mmol/mol

$$U_i^2 = 2^2(u_i^2 + u_{i\text{grav}}^2)$$

The degree of equivalence between two laboratories is given by a pair of numbers:

$D_{ij} = D_i - D_j = (x_i - x_{i\text{grav}}) - (x_j - x_{j\text{grav}})$ and U_{ij} , its expanded uncertainty ($k = 2$), both expressed in mmol/mol

$$U_{ij}^2 = 2^2(u_i^2 + u_j^2 + u_{i\text{grav}}^2 + u_{j\text{grav}}^2)$$

The approximation $U_{ij}^2 \sim 2^2(u_i^2 + u_j^2)$ is used in the Matrix of equivalence.

Lab j \Rightarrow

Lab i \Downarrow	D_i U_i mmol/mol		NPL		NIST		NMI		BAM		BNM-LNE		KRISS		NRLM		NRCCRM		VNIIM		OMH	
	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}	D_{ij}	U_{ij}
NPL	0.19	0.30																				
NIST	0.00	0.37	-0.19	0.48																		
NMI	0.17	0.30	-0.02	0.42	0.17	0.48																
BAM	-0.05	0.45	-0.24	0.54	-0.05	0.59	-0.22	0.54														
BNM-LNE	0.13	0.60	-0.06	0.67	0.13	0.71	-0.04	0.67	0.18	0.75												
KRISS	0.05	0.38	-0.14	0.48	0.05	0.53	-0.12	0.48	0.10	0.59	-0.08	0.71										
NRLM	-0.03	0.75	-0.22	0.81	-0.03	0.84	-0.20	0.81	0.02	0.87	-0.16	0.96	-0.08	0.84								
NRCCRM	0.12	0.50	-0.07	0.58	0.12	0.62	-0.05	0.58	0.17	0.67	-0.01	0.78	0.07	0.62	0.15	0.90						
VNIIM	-0.53	0.49	-0.72	0.58	-0.53	0.62	-0.70	0.58	-0.48	0.67	-0.66	0.78	-0.58	0.62	-0.50	0.90	-0.65	0.70				
OMH	0.07	0.10	-0.12	0.32	0.07	0.39	-0.10	0.31	0.12	0.46	-0.06	0.61	0.02	0.39	0.10	0.76	-0.05	0.50	0.60	0.50		

CCQM-K1.b
Degrees of equivalence for CO₂ in N₂ at nominal value 150 mmol/mol

