CCQM-K23.b and COOMET.QM-K23.b

Key comparison CCQM-K23.b

MEASURAND : **Amount of substance fraction of Propane in Natural gas type II**

NOMINAL VALUE : **0.034 mol/mol**

GAS MIXTURE : Expressed in mol/mol: Nitrogen (0.07 mol/mol), Carbon dioxide (0.03 mol/mol), Ethane (0.094 mol/mol), Propane (0.034 mol/mol), *n*-Butane (0.01 mol/mol), *iso*-Butane (0.008 mol/mol), Methane (0.754 mol/mol)

$x_{\mathrm{Lab}i}$ result of measurement carried out by laboratory *i*

$U_{\mathrm{Lab}i}$ stated uncertainty of laboratory *i* at a 95 % level of confidence

$k_{\mathrm{Lab}i}$ stated coverage factor

$x_{i\,\mathrm{ref}}$ amount of substance fraction in the cylinder sent to laboratory *i*, from preparation

$u_{i\,\mathrm{ref}}$ combined standard uncertainty of $x_{i\,\mathrm{ref}}$

$u_{i\,\mathrm{ref}} = (u_{i\,\mathrm{prep}}^2 + u_{i\,\mathrm{ver}}^2)^{1/2}$ where $u_{i\,\mathrm{prep}}$ and $u_{i\,\mathrm{ver}}$ are the standard uncertainties of preparation and verification respectively for which the numerical values can be found in Table 8 of the Final Report.

Lab *i*	Cylinder number	$x_{\mathrm{Lab}i}$ / (10^{-2} mol/mol)	$U_{\mathrm{Lab}i}$ / (10^{-2} mol/mol)	$k_{\mathrm{Lab}i}$	$x_{i\,\mathrm{ref}}$ / (10^{-2} mol/mol)	$u_{i\,\mathrm{ref}}$ / (10^{-2} mol/mol)	Date of measurement
NPL	VSL205170	3.4059	0.0048	2	3.40658	0.00181	07 Sep 2005
SMU	VSL200238	3.4017	0.0087	2	3.40056	0.00181	13 Dec 2005
CMI	VSL200229	3.3050	0.0670	2	3.39542	0.00180	21 Sep 2005
VNIIM	VSL302766	3.3890	0.0100	2	3.39774	0.00180	05 Dec 2005
MKEH	VSL202794	3.4139	0.0031	2.87	3.40861	0.00181	03 Oct 2005
NMi-VSL	VSL133436	3.3940	0.0090	2	3.39578	0.00180	09 Sep 2005
CENAM	VSL302704	3.4150	0.0310	2	3.42494	0.00181	21 Dec 2005
CEM	VSL200231	3.4606	0.0120	2	3.46047	0.00183	20 Oct 2005
BAM	VSL200239	3.4027	0.0010	2	3.39859	0.00180	21 Sep 2005
NMIA	VSL200246	3.4078	0.0023	2.18	3.40258	0.00180	10 Sep 2005
IPQ	VSL200241	3.4370	0.0160	2	3.43192	0.00182	29 Sep 2005
INMETRO	VSL200236	3.4170	0.0290	2	3.41119	0.00181	17 Oct 2005
GUM	VSL200237	3.3970	0.0260	2	3.41239	0.00181	05 Jan 2006
NIM	VSL305182	3.4120	0.0171	2	3.40859	0.00181	06 Dec 2005
KRISS	VSL200230	3.4000	0.0068	2	3.39951	0.00180	27 Sep 2005
NMIJ	VSL200248	3.4025	0.0027	2	3.40150	0.00180	22 Dec 2005

Key comparison COOMET.QM-K23.b

MEASURAND : **Amount-of-substance fraction of Propane in Natural gas**

NOMINAL VALUE : **0.035 mol/mol**

GAS MIXTURE : Expressed in mol/mol: Nitrogen (0.07 mol/mol), Carbon dioxide (0.03 mol/mol), Ethane (0.095 mol/mol), Propane (0.035 mol/mol), *n* -Butane (0.01 mol/mol), *iso* -Butane (0.008 mol/mol), Methane (balance)

$x_{\mathrm{Lab}i}$ result of measurement carried out by laboratory *i* participant in COOMET.QM-K23.b

$U_{\mathrm{Lab}i}$ expanded uncertainty of laboratory *i* participant in COOMET.QM-K23.b at a 95% level of confidence

$k_{\mathrm{Lab}i}$ stated coverage factor

$x_{i\,\mathrm{ref}}$ amount of substance fraction in the cylinder sent to laboratory *i* participant in COOMET.QM-K23.b, from preparation

$u_{i\,\mathrm{ref}}$ combined standard uncertainty of $x_{i\,\mathrm{ref}}$

$u_{i\,\mathrm{ref}} = (u_{i\,\mathrm{prep}}^2 + u_{i\,\mathrm{ver}}^2)^{1/2}$ where $u_{i\,\mathrm{prep}}$ and $u_{i\,\mathrm{ver}}$ are the standard uncertainties of preparation and verification respectively

Lab *i*	Cylinder number	$x_{\mathrm{Lab}i}$ / (10^{-2} mol/mol)	$U_{\mathrm{Lab}i}$ / (10^{-2} mol/mol)	$k_{\mathrm{Lab}i}$	$x_{i\,\mathrm{ref}}$ / (10^{-2} mol/mol)	$u_{i\,\mathrm{prep}}$ / (10^{-2} mol/mol)	$u_{i\,\mathrm{ver}}$ / (10^{-2} mol/mol)	Date of measurement
VNIIM	D200273	3.413	0.009	2	3.41574	0.00076	0.00273	2008
UkrCSM	D200292	3.166	0.016	2	3.17676	0.00076	0.00254	2008
BelGIM	D200278	3.456	0.006	2	3.45496	0.00076	0.00276	2008
BAM	D200385	3.4707	0.010	2	3.46743	0.00076	0.00277	2008
SMU	D200368	3.378	0.014	2	3.37998	0.00074	0.00270	2008
CMI	D200383	3.400	0.041	2	3.44095	0.00076	0.00275	2008

CCQM-K23.b and COOMET.QM-K23.b

Key comparison CCQM-K23.b

MEASURAND :	**Amount of substance fraction of Propane in Natural gas type II**
NOMINAL VALUE :	**0.034 mol/mol**
GAS MIXTURE :	Expressed in mol/mol: Nitrogen (0.07 mol/mol), Carbon dioxide (0.03 mol/mol), Ethane (0.094 mol/mol), Propane (0.034 mol/mol), *n*-Butane (0.01 mol/mol), *iso*-Butane (0.008 mol/mol), Methane (0.754 mol/mol)

Key comparison reference value: there is no single reference value for this comparison, the value obtained from preparation, $x_{i\,ref}$, is taken as the reference value for laboratory *i*.

The degree of equivalence of each laboratory *i* with respect to the reference value is given by a pair of terms:
$D_i = (x_{Lab\,i} - x_{i\,ref})$ and U_i, its expanded uncertainty at a 95% level of confidence, both expressed in 10^{-2} mol/mol;
$U_i = 2[(U_{Lab\,i} / k_{Lab\,i})^2 + u_{i\,ref}^2]^{1/2}$, using a coverage factor $k = 2$. D_i and U_i are also given in relative terms.

The degree of equivalence between two laboratories is given by a pair of terms: $D_{ij} = D_i - D_j = (x_i - x_{i\,ref}) - (x_j - x_{j\,ref})$ and
U_{ij}, its expanded uncertainty at a 95% level of confidence, both expressed in 10^{-2} mol/mol;
$U_{ij} = 2[(U_{Lab\,i} / k_{Lab\,i})^2 + (U_{Lab\,j} / k_{Lab\,j})^2 + u_{i\,ref}^2 + u_{j\,ref}^2]^{1/2}$, using a coverage factor $k = 2$.
The pair-wise degrees of equivalence are not explicitely computed.

Linking COOMET.QM.23.b to CCQM-K23.b

The pilot laboratory VNIIM is used as the linking laboratory. In order to link the results of COOMET.QM-K23.b to those of CCQM-K23.b, an uncertainty term is added to the standard uncertainty of the reference value, $u_{i\,ref,}$ for the laboratory *i* participating in COOMET.QM-K23.b. This additional uncertainty term is equal to the absolute value of D_i obtained by VNIIM in CCQM-K23.b.

The degree of equivalence of a laboratory participant in COOMET.QM-K23.b with respect to the reference value is given by a pair of terms, both expressed in 10^{-2} mol/mol:
$D_i = (x_{Lab\,i} - x_{i\,ref})$ and its expanded uncertainty ($k = 2$), U_i,
with $U_i = [U_{Lab\,i}^2 + 2u_{ref}^2 + D_{VNIIM\,(CCQM\text{-}K23.b)}^2]^{1/2}$.
D_i and U_i are also given in relative terms.

No pair-wise degrees of equivalence have been computed for participants in COOMET.QM-K23.b.

CCQM-K23.b and COOMET.QM-K23.b

MEASURAND : **Amount of substance fraction of Propane in Natural gas type II**

NOMINAL VALUE : **0.034 mol/mol**

GAS MIXTURE : Expressed in mol/mol: Nitrogen (0.07 mol/mol), Carbon dioxide (0.03 mol/mol), Ethane (0.094 mol/mol), Propane (0.034 mol/mol), *n* -Butane (0.01 mol/mol), *iso* -Butane (0.008 mol/mol), Methane (0.754 mol/mol)

Degrees of equivalence, offset D_i and expanded uncertainty (k = 2) U_i, expressed in 10^{-2} mol/mol, and given in relative terms (%)

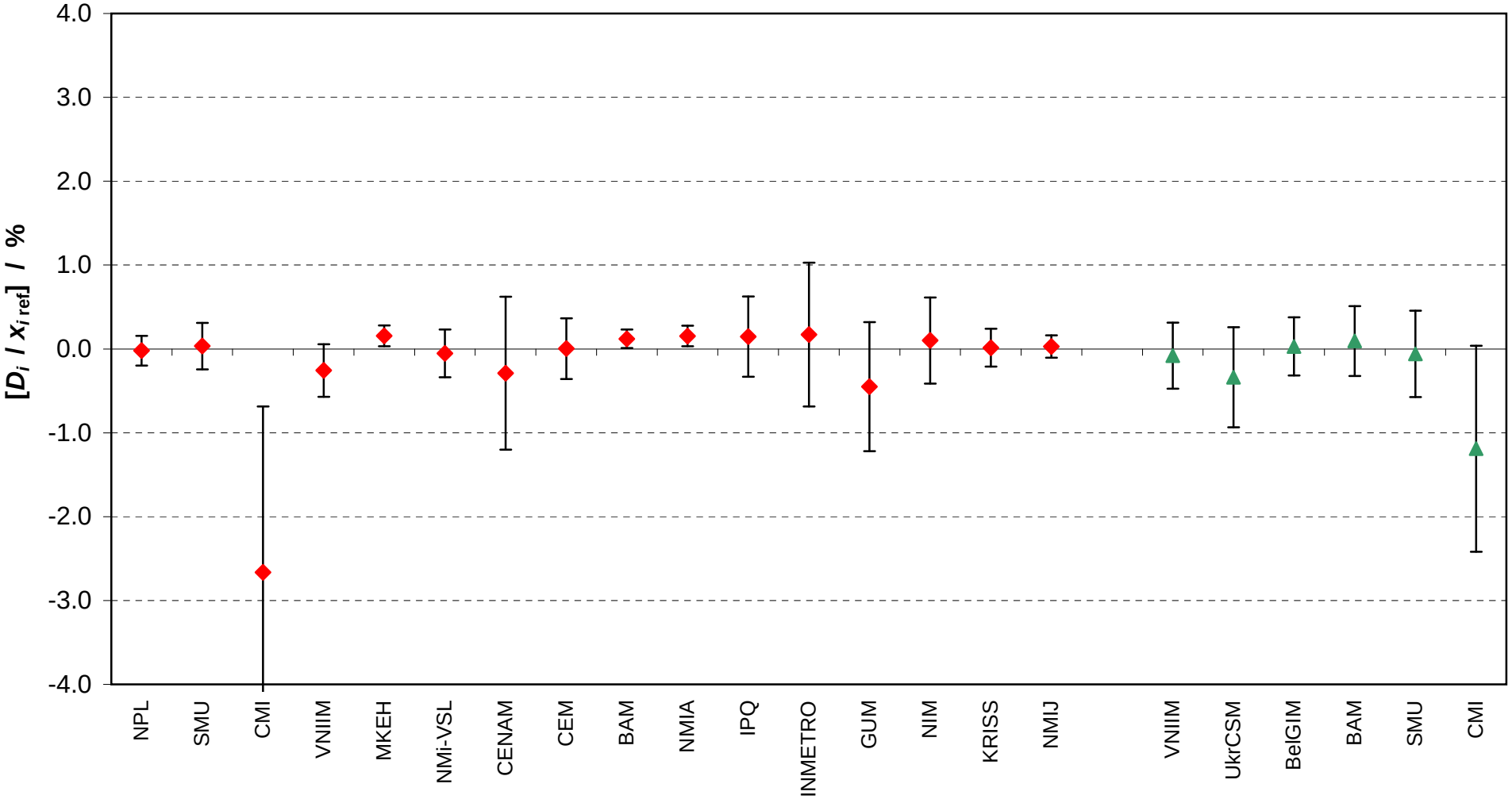
Lab *i* ⇩	D_i / (10^{-2} mol/mol)	U_i / (10^{-2} mol/mol)	$D_i / x_{i\,ref}$ / %	$U_i / x_{i\,ref}$ / %
NPL	**-0.0007**	0.0060	**-0.02**	0.18
SMU	**0.0011**	0.0094	**0.03**	0.28
CMI	**-0.0904**	0.0671	**-2.66**	1.98
VNIIM	**-0.0087**	0.0106	**-0.26**	0.31
MKEH	**0.0053**	0.0042	**0.16**	0.12
NMi-VSL	**-0.0018**	0.0097	**-0.05**	0.29
CENAM	**-0.0099**	0.0312	**-0.29**	0.91
CEM	**0.0001**	0.0125	**0.00**	0.36
BAM	**0.0041**	0.0037	**0.12**	0.11
NMIA	**0.0052**	0.0042	**0.15**	0.12
IPQ	**0.0051**	0.0164	**0.15**	0.48
INMETRO	**0.0058**	0.0292	**0.17**	0.86
GUM	**-0.0154**	0.0263	**-0.45**	0.77
NIM	**0.0034**	0.0175	**0.10**	0.51
KRISS	**0.0005**	0.0077	**0.01**	0.23
NMIJ	**0.0010**	0.0045	**0.03**	0.13
VNIIM*	**-0.0027**	0.0135	**-0.08**	0.40
UkrCSM*	**-0.0108**	0.0190	**-0.34**	0.60
BelGIM*	**0.0010**	0.0120	**0.03**	0.35
BAM*	**0.0033**	0.0144	**0.09**	0.42
SMU*	**-0.0020**	0.0174	**-0.06**	0.52
CMI*	**-0.0410**	0.0423	**-1.19**	1.23

* indicates participants in COOMET.QM-K23.b

CCQM-K23.b and COOMET.QM-K23.b Propane in Natural gas type II

Nominal value 0.034 mol/mol

Degrees of equivalence: D_i and expanded uncertainty U_i (k = 2) given in relative terms



Red diamonds: participants in CCQM-K23.b
Green triangles: participants in COOMET.QM-K23.b