



Certificate of Calibration

PRIMARY REFERENCE GAS MIXTURE

Cylinder Number: D38 6648

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CUSTOMER: Empa
ADDRESS: Swiss Federal Laboratories for Materials Science and Technology,
Überlandstrasse 129, 8600 Dübendorf, Switzerland
CALIBRATION DATE: 10 December 2015
AMOUNT FRACTIONS:

| Component | Amount fraction / (nmol/mol) | Component | Amount fraction / (nmol/mol) |
|--------------------------|---------------------------------|-------------------------------------|---------------------------------|
| Ethane | 4.05 ± 0.08 | 2-methylpentane | 4.06 ± 0.08 |
| Ethene | 3.90 ± 0.08 | Hexane | 3.99 ± 0.08 |
| Propane | 4.09 ± 0.08 | Isoprene | 4.03 ± 0.09 |
| Propene | 4.01 ± 0.08 | Heptane | 4.02 ± 0.08 |
| 2-methylpropane | 4.20 ± 0.11 | Benzene | 4.00 ± 0.08 |
| Butane | 3.98 ± 0.08 | 2,2,4-trimethylpentane | 3.99 ± 0.08 |
| Ethyne | 4.13 ± 0.21 | Octane | 4.03 ± 0.08 |
| <i>trans</i> -but-2-ene | 3.97 ± 0.08 | Toluene | 4.00 ± 0.10 |
| But-1-ene | 3.98 ± 0.08 | Ethylbenzene | 4.00 ± 0.10 |
| <i>cis</i> -but-2-ene | 4.02 ± 0.08 | <i>m</i> -xylene + <i>p</i> -xylene | 8.04 ± 0.21 |
| 2-methylbutane | 4.05 ± 0.08 | <i>o</i> -xylene | 4.00 ± 0.10 |
| Pentane | 4.04 ± 0.08 | 1,3,5-trimethylbenzene | 4.01 ± 0.11 |
| 1,3-butadiene | 3.97 ± 0.08 | 1,2,4-trimethylbenzene | 4.03 ± 0.11 |
| <i>trans</i> -pent-2-ene | 3.97 ± 0.08 | 1,2,3-trimethylbenzene | 4.04 ± 0.11 |
| Pent-1-ene | 3.98 ± 0.08 | Nitrogen | Balance |

The reported expanded uncertainties are based on standard uncertainties multiplied by a coverage factor $k = 2$, providing a coverage probability of approximately 95 %. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

METHODS: Preparation: gravimetry; Analysis: gas chromatography (FID)
TRACEABILITY: The values on this certificate are traceable to NPL Primary Standards
EXPIRY: Certificate valid for 2 years from the date of issue
PRESSURE: Fill pressure: 100 bar; Minimum utilisation pressure: 10 bar
STORAGE: No special precautions are required
HANDLING: Refer to ISO 16664
OUTLET: DIN 477 No.1 valve
INTENDED USE: Calibration standard

Reference: 2015080160-5

Date of issue: 11 December 2015

Signed:  (Authorised Signatory)

Name: Dr P J Brewer (on behalf of NPLML)

Checked by: 

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This certificate is consistent with the capabilities that are included in Appendix C of the MRA drawn up by the CIPM. Under the MRA, all participating institutes recognise the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see <http://www.bipm.org>).