



## Certificate of Calibration

## PRIMARY REFERENCE GAS MIXTURE

Cylinder Number: D99 4220

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. 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 Testing and Research, Dubendorf, CH-8600, Switzerland  
**CALIBRATION DATE:** 04 -21 February 2014  
**AMOUNT FRACTIONS:**

| Component                | Amount fraction / (nmol/mol) | Component              | Amount fraction / (nmol/mol) |
|--------------------------|------------------------------|------------------------|------------------------------|
| Ethane                   | 2.01 ± 0.04                  | Hexane                 | 1.97 ± 0.04                  |
| Ethene                   | 1.93 ± 0.04                  | Isoprene               | 1.99 ± 0.04                  |
| Propane                  | 2.02 ± 0.04                  | Heptane                | 1.99 ± 0.04                  |
| Propene                  | 1.98 ± 0.04                  | Benzene                | 2.00 ± 0.04                  |
| 2-methylpropane          | 2.08 ± 0.06                  | 2,2,4-trimethylpentane | 1.97 ± 0.04                  |
| Butane                   | 1.96 ± 0.04                  | Octane                 | 1.99 ± 0.04                  |
| Ethyne                   | 2.06 ± 0.06                  | Toluene                | 2.00 ± 0.05                  |
| <i>trans</i> -but-2-ene  | 1.96 ± 0.04                  | Ethylbenzene           | 2.00 ± 0.05                  |
| But-1-ene                | 1.96 ± 0.04                  | <i>m</i> -xylene       | 2.02 ± 0.06                  |
| <i>cis</i> -but-2-ene    | 1.99 ± 0.04                  | <i>p</i> -xylene       | 1.99 ± 0.05                  |
| 2-methylbutane           | 2.00 ± 0.04                  | <i>o</i> -xylene       | 2.00 ± 0.05                  |
| Pentane                  | 2.00 ± 0.04                  | 1,3,5-trimethylbenzene | 2.11 ± 0.06                  |
| 1,3-butadiene            | 1.96 ± 0.04                  | 1,2,4-trimethylbenzene | 2.06 ± 0.06                  |
| <i>trans</i> -pent-2-ene | 1.96 ± 0.04                  | 1,2,3-trimethylbenzene | 1.91 ± 0.05                  |
| Pent-1-ene               | 1.96 ± 0.04                  | Nitrogen               | Balance                      |
| 2-methylpentane          | 2.01 ± 0.04                  | -                      | -                            |

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.

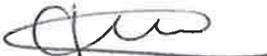
**METHODS:** Preparation: gravimetry; Analysis: gas chromatography (FID)  
**TRACEABILITY:** The values on this certificate are traceable to NPL Primary Standards  
**EXPIRY:** Certificate valid for 2 years from the date of issue  
**PRESSURE:** Fill pressure: 100 bar; minimum utilisation pressure: 10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

Reference: 2013120154

Date of issue: 03 March 2014

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 recognize 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>).