National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan

Reference Material Certificate
NMIJ CRM 4066-a01

Butane

This certified reference material (CRM) was produced in accordance with the NMIJ's management system and in compliance with ISO GUIDE 34:2009 and ISO/IEC 17025:2005. This CRM is intended for use in the calibration of instruments and source material of butane reference gas mixtures for natural gas analysis.

Certified Value
The certified value for butane in this CRM is given in the table below. The uncertainty of the certified value is the half-width of the expanded uncertainty interval calculated using a coverage factor (k) of 2, which gives a level of confidence of approximately 95%.

<table>
<thead>
<tr>
<th>Substance</th>
<th>CAS No.</th>
<th>Certified value, Amount-of-substance fraction (mol/mol)</th>
<th>Expanded uncertainty, Amount-of-substance fraction (mol/mol)</th>
<th>Cylinder Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butane</td>
<td>106-97-8</td>
<td>0.9990</td>
<td>0.0010</td>
<td>FVN55738</td>
</tr>
</tbody>
</table>

Analysis
The certified value was determined by the subtracting method which complies with requirement described in SO 6142-1:2015. Impurities in this CRM were determined using a gas chromatograph with a thermal conductivity detector (GC-TCD), a gas chromatograph with a flame ionization detector (GC-FID), and a capacitance type hygrometer.

<table>
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<tr>
<th>Impurities</th>
<th>Analytical Instruments</th>
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<tbody>
<tr>
<td>Nitrogen</td>
<td>Gas chromatograph with thermal conductivity detector (GC-TCD)</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Gas chromatograph with thermal conductivity detector (GC-TCD)</td>
</tr>
<tr>
<td>Argon</td>
<td>Gas chromatograph with thermal conductivity detector (GC-TCD)</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Gas chromatograph with thermal conductivity detector (GC-TCD)</td>
</tr>
<tr>
<td>Propane</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
</tr>
<tr>
<td>Isobutane (2-methylpropane)</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
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<tr>
<td>Isobutene (2-methylpropene)</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
</tr>
<tr>
<td>cis-2-butene</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
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<tr>
<td>trans-2-butene</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
</tr>
<tr>
<td>Pentane</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
</tr>
<tr>
<td>Water</td>
<td>Capacitance type hygrometer</td>
</tr>
</tbody>
</table>

Metrological Traceability
The gas chromatographs were calibrated using NMIJ primary reference gases prepared by the gravimetric method in accordance with ISO 6142-1:2015. The capacitance-type hygrometer was calibrated using a reference dew point meter traceable to the International System of Units (SI). Therefore, the certified value is traceable to the SI.

Expiration of Certification
This certificate is valid for one year from the date of shipment, provided that the material is stored in accordance with the...
Dare of Shipment: ****** xx, 20XX

instructions given in this certificate.

Sample Form
This CRM is supplied in a manganese steel cylinder with an inner volume of approximately 3.4 L. The specification of the cylinder outlet is a W22.5-14threads left female.

Instructions for Storage
This CRM should be stored in compliance with high pressure gas regulations and other relevant laws. This CRM should not be exposed to sunlight. This CRM should be stored at 40 ℃ or less and in well-ventilated area. This CRM should be secured with a chain to prevent it falling. As butane is flammable, open flames or other ignition source should not be permitted near this CRM. Care should be taken to ensure that there are no butane leaks. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use
The concentration of water, a major impurity in this CRM has been confirmed to decrease as the cylinder emptied. Therefore to avoid change in purity, do not use this CRM when the residual amount is below 0.1 kg. This CRM should be used at 19 ℃ to 28 ℃. We recommend sufficient substitution of residual gas in regulators, valves, piping, measuring instruments, and other apparatus with this CRM before use. To avoid contamination, we recommend checking pipe joints for leaks. Do not elute this CRM in the liquid phase. The certification is not valid if this CRM is used as a liquid.

Precautions for Handling
Wear protective equipment when handling this CRM. Open flames should not be permitted near this CRM. This CRM should be returned to Center for Quality Management of Metrology of AIST after use or after the expiry date. This CRM should be used in well-ventilated areas. Refer to the SDS on this CRM before use.

Preparation
Butane purification and filling the cylinder with butane were conducted by Takachiho Chemical Industrial Co., Ltd.

Technical Information
The tare weight of the cylinder containing CRM is 5.8 kg, obtained from the initial net weight and initial filling amount of this CRM.

NMIJ Analysts
The technical manager for this CRM is T. Shimosaka, the production manager is T. Watanabe, and the analysts are T. Watanabe, N. Matsumoto, and K. Takada.

Information
If substantive technical changes occur that affect the certification before the expiration of this certificate, NMIJ will notify the registered customer. Customer registration on the NMIJ Website (given below) will facilitate notification. Technical reports regarding this CRM can be obtained from the contact details given below.

Reproduction of Certificate
In reproducing this certificate, it should be clearly indicated that the document is a copy.

March 14, 2018

Ryoji Chubachi
President
National Institute of Advanced Industrial Science and Technology
If you have any questions about this CRM, please contact:

National Institute of Advanced Industrial Science and Technology,
National Metrology Institute of Japan,
Center for Quality Management of Metrology, Reference Materials Office,
1-1-1 Umezono, Tsukuba, Ibaraki 305-8563, Japan
Phone: +81-29-861-4059; Fax: +81-29-861-4009, https://www.nmij.jp/english/service/C/
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National Institute of Advanced Industrial Science and Technology
National Metrology Institute of Japan

Reference Material Certificate
NMIJ CRM 4066-a02

Butane

This certified reference material (CRM) was produced in accordance with the NMIJ’s management system and in compliance with ISO GUIDE 34:2009 and ISO/IEC 17025:2005. This CRM is intended for use in the calibration of instruments and source material of butane reference gas mixtures for natural gas analysis.

Certified Value
The certified value for butane in this CRM is given in the table below. The uncertainty of the certified value is the half-width of the expanded uncertainty interval calculated using a coverage factor (k) of 2, which gives a level of confidence of approximately 95%.

<table>
<thead>
<tr>
<th>CAS No.</th>
<th>Certified value, Amount-of-substance fraction (mol/mol)</th>
<th>Expanded uncertainty, Amount-of-substance fraction (mol/mol)</th>
<th>Cylinder Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butane</td>
<td>106-97-8</td>
<td>0.9985</td>
<td>0.0015</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FVN55989</td>
</tr>
</tbody>
</table>

Analysis
The certified value was determined by the subtracting method which complies with requirement described in SO 6142:1:2015. Impurities in this CRM were determined using a gas chromatograph with a thermal conductivity detector (GC-TCD), a gas chromatograph with a flame ionization detector (GC-FID), and a capacitance type hygrometer.

<table>
<thead>
<tr>
<th>Impurities</th>
<th>Analytical Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>Gas chromatograph with thermal conductivity detector (GC-TCD)</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Gas chromatograph with thermal conductivity detector (GC-TCD)</td>
</tr>
<tr>
<td>Argon</td>
<td>Gas chromatograph with thermal conductivity detector (GC-TCD)</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Gas chromatograph with thermal conductivity detector (GC-TCD)</td>
</tr>
<tr>
<td>Propane</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
</tr>
<tr>
<td>Isobutane (2-methylpropane)</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
</tr>
<tr>
<td>Isobutene (2-methylpropene)</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
</tr>
<tr>
<td>cis-2-butene</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
</tr>
<tr>
<td>trans-2-butene</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
</tr>
<tr>
<td>Pentane</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
</tr>
<tr>
<td>Water</td>
<td>Capacitance type hygrometer</td>
</tr>
</tbody>
</table>

Metrological Traceability
The gas chromatographs were calibrated using NMIJ primary reference gases prepared by the gravimetric method in accordance with ISO 6142:1:2015. The capacitance type hygrometer was calibrated using a reference dew point meter traceable to the International System of Units (SI). Therefore, the certified value is traceable to the SI.

Expiration of Certification
This certificate is valid for one year from the date of shipment, provided that the material is stored in accordance with the
instructions given in this certificate.

Sample Form
This CRM is supplied in a manganese steel cylinder with an inner volume of approximately 3.4 L. The specification of the cylinder outlet is a W22.5-14threads left female.

Instructions for Storage
This CRM should be stored in compliance with high pressure gas regulations and other relevant laws. This CRM should not be exposed to sunlight. This CRM should be stored at 40 °C or less and in well-ventilated area. This CRM should be secured with a chain to prevent it falling. As butane is flammable, open flames or other ignition source should not be permitted near this CRM. Care should be taken to ensure that there are no butane leaks. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use
The concentration of water, a major impurity in this CRM has been confirmed to decrease as the cylinder emptied. Therefore to avoid change in purity, do not use this CRM when the residual amount is below 0.1 kg. This CRM should be used at 19 °C to 28 °C. We recommend sufficient substitution of residual gas in regulators, valves, piping, measuring instruments, and other apparatus with this CRM before use. To avoid contamination, we recommend checking pipe joints for leaks. Do not elute this CRM in the liquid phase. The certification is not valid if this CRM is used as a liquid.

Precautions for Handling
Wear protective equipment when handling this CRM. Open flames should not be permitted near this CRM. This CRM should be returned to Center for Quality Management of Metrology of AIST after use or after the expiry date. This CRM should be used in well-ventilated areas. Refer to the SDS on this CRM before use.

Preparation
Butane purification and filling the cylinder with butane were conducted by Takachiho Chemical Industrial Co., Ltd.

Technical Information
The tare weight of the cylinder containing CRM is 5.9 kg, obtained from the initial net weight and initial filling amount of this CRM.

NMIJ Analysts
The technical manager for this CRM is T. Shimosaka, the production manager is T. Watanabe, and the analysts are T. Watanabe, N. Matsumoto, and K. Takada.

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If substantive technical changes occur that affect the certification before the expiration of this certificate, NMIJ will notify the registered customer. Customer registration on the NMIJ Website (given below) will facilitate notification. Technical reports regarding this CRM can be obtained from the contact details given below.

Reproduction of Certificate
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March 14, 2018

Ryoji Chubachi
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National Institute of Advanced Industrial Science and Technology

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National Metrology Institute of Japan,
Center for Quality Management of Metrology, Reference Materials Office,
1-1-1 Umezono, Tsukuba, Ibaraki 305-8563, Japan
Phone: +81-29-861-4059; Fax: +81-29-861-4009, https://www.nmij.jp/english/service/C/
This certified reference material (CRM) was produced in accordance with the NMJ’s management system and in compliance with ISO GUIDE 34:2009 and ISO/IEC 17025:2005. This CRM is intended for use in the calibration of instruments and source material of isobutane reference gas mixtures for natural gas analysis.

**Certified Value**
The certified value for butane in this CRM is given in the table below. The uncertainty of the certified value is the half-width of the expanded uncertainty interval calculated using a coverage factor \(k\) of 2, which gives a level of confidence of approximately 95%.

<table>
<thead>
<tr>
<th>CAS No.</th>
<th>Certified value, Amount-of-substance fraction (mol/mol)</th>
<th>Expanded uncertainty, Amount-of-substance fraction (mol/mol)</th>
<th>Cylinder Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butane</td>
<td>0.9985</td>
<td>0.0015</td>
<td>FVN66236</td>
</tr>
</tbody>
</table>

**Analysis**
The certified value was determined by the subtracting method which complies with requirement described in SO 6142-1:2015. Impurities in this CRM were determined using a gas chromatograph with a thermal conductivity detector (GC-TCD), a gas chromatograph with a flame ionization detector (GC-FID), and a capacitance type hygrometer.

<table>
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<th>Impurities</th>
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<tr>
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<td>Gas chromatograph with thermal conductivity detector (GC-TCD)</td>
</tr>
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<td>Oxygen</td>
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</tr>
<tr>
<td>cis-2-butene</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
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<td>Pentane</td>
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<td>Capacitance type hygrometer</td>
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Dare of Shipment: ***** xx, 20XX

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Preparation
Butane purification and filling the cylinder with butane were conducted by Takachiho Chemical Industrial Co., Ltd.

Technical Information
The tare weight of the cylinder containing CRM is 6.0 kg, obtained from the initial net weight and initial filling amount of this CRM.

NMIJ Analysts
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National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan

Reference Material Certificate

NMIJ CRM 4066-a04

Butane

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Certified Value

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<th>Cylinder Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butane 106-97-8</td>
<td>0.9985</td>
<td>0.0015</td>
<td>KDB7063</td>
</tr>
</tbody>
</table>

Analysis

The certified value was determined by the subtracting method which complies with requirement described in SO 6142-1:2015. Impurities in this CRM were determined using a gas chromatograph with a thermal conductivity detector (GC-TCD), a gas chromatograph with a flame ionization detector (GC-FID), and a capacitance type hygrometer.

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<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
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<td>cis-2-butene</td>
<td>Gas chromatograph with flame ionization detector (GC-FID)</td>
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<td>trans-2-butene</td>
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<td>Water</td>
<td>Capacitance type hygrometer</td>
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Preparation
Butane purification and filling the cylinder with butane were conducted by Takachiho Chemical Industrial Co., Ltd.

Technical Information
The tare weight of the cylinder containing CRM is 6.2 kg, obtained from the initial net weight and initial filling amount of this CRM.

NMIJ Analysts
The technical manager for this CRM is T. Shimosaka, the production manager is T. Watanabe, and the analysts are T. Watanabe, N. Matsumoto, and K. Takada.

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