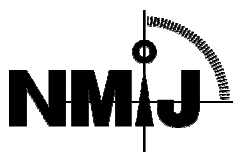


National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan

Reference Material Certificate



NMIJ CRM 3406-d01

Carbon Monoxide



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.

Certified Value

The certified value for carbon monoxide 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 %.

	CAS No.	Certified value, Amount-of-substance fraction ($\mu\text{mol/mol}$)	Expanded uncertainty, Amount-of-substance fraction ($\mu\text{mol/mol}$)	Cylinder No.
Carbon Monoxide	630-08-0	0.999963	0.000020	CPB16255

Analysis

The certified value of this CRM is determined by the method (the subtracting method) stipulated in ISO 6142 (2001), based on the concentration of impurities measured with the methods shown in the table below:

Impurity	Analysis Method
Nitrogen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Oxygen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Carbon Dioxide	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Hydrogen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Helium	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Water	Crystal oscillator method

Metrological Traceability

The certified value of this CRM is traceable to the International System of Units (SI) as the impurities given in the above table are quantified for each high-pressure cylinder by means of the measurement methods traceable to the SI and the certified value is calculated with the subtracting method. The micro gas chromatograph is calibrated at NMIJ by using the calibration gases prepared with the gravimetric blending method (ISO 6142 (2001)). The crystal-oscillation-type moisture meter is calibrated by using the standard gases whose values are assigned by the chilled mirror dew point meter traceable to the National Physical Laboratory (NPL).

Mutual Recognition Arrangement under Meter Convention

This certificate is consistent with the calibration and measurement capabilities (CMCs) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures (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 (as for Appendix C of MRA, see <http://kcdb.bipm.org/AppendixC/default.asp>).

Expiration of Certification

This certificate is valid from the date of shipment to June 30, 2018, provided that the material is stored in accordance with the instructions given in this certificate.

Sample Form

This CRM is in the form of colorless and odorless toxic gas and supplied in a 9.5-liter high-pressure aluminum-alloy cylinder with W22-14-OL outlet. At the time of shipment, the internal pressure is 9 MPa or more (35 °C).

Instructions for Storage

This CRM, which is flammable and toxic high-pressure gas, should be stored in accordance with the High Pressure Gas Safety Act. Care must be taken because this CRM is colorless, odorless, and toxic gas. A cylinder of this CRM should be stored away from direct sunlight and fire at a temperature of 40 °C or less in a well-ventilated place. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use

This CRM should be used at around room temperature since its certified value is determined based on the analysis performed at room temperature. Purity of this CRM may change along with the drop of the internal pressure, and the rate of the change tends to become higher as the internal pressure drops more. This CRM, therefore, should be used only when the internal pressure is 1.5 MPa or more. Use pressure-reducing valves and pipes made of stainless steel etc. which are designed specifically for high-purity gases, when using this CRM, and purge the piping thoroughly in order to prevent decline of the purity.

Precautions for Handling

This CRM, which is colorless, odorless, flammable and toxic high-pressure gas, should be handled with care in accordance with the High Pressure Gas Safety Act. Refer to the SDS on this CRM before use.

Preparation Method

This CRM was packed into 9.5-liter high-pressure aluminum-alloy cylinders in Japan Fine Products.

NMIJ Analysts

The technical manager for this CRM is T. Shimosaka; the production manager is N. Matsumoto, and the analyst is N. Matsumoto.

Technical Information

Customer registration on the NMIJ Website (given below) will facilitate notification of any revision of the information given above. 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.

April 1, 2015

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/>

Revision history

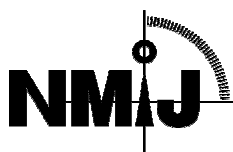
April 1, 2015: "Metrology Management Center" was renamed to "Center for Quality Management of Metrology."
March 9, 2016: Expanded uncertainty of this CRM was changed from 0.000012 mol/mol to 0.000020 mol/mol.

Sample

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan

Reference Material Certificate



NMIJ CRM 3406-d02

Carbon Monoxide



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.

Certified Value

The certified value for carbon monoxide 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 %.

	CAS No.	Certified value, Amount-of-substance fraction ($\mu\text{mol/mol}$)	Expanded uncertainty, Amount-of-substance fraction ($\mu\text{mol/mol}$)	Cylinder No.
Carbon Monoxide	630-08-0	0.999961	0.000020	CPB16257

Analysis

The certified value of this CRM is determined by the method (the subtracting method) stipulated in ISO 6142 (2001), based on the concentration of impurities measured with the methods shown in the table below:

Impurity	Analysis Method
Nitrogen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Oxygen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Carbon Dioxide	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Hydrogen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Helium	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Water	Crystal oscillator method

Metrological Traceability

The certified value of this CRM is traceable to the International System of Units (SI) as the impurities given in the above table are quantified for each high-pressure cylinder by means of the measurement methods traceable to the SI and the certified value is calculated with the subtracting method. The micro gas chromatograph is calibrated at NMIJ by using the calibration gases prepared with the gravimetric blending method (ISO 6142 (2001)). The crystal-oscillation-type moisture meter is calibrated by using the standard gases whose values are assigned by the chilled mirror dew point meter traceable to the National Physical Laboratory (NPL).

Mutual Recognition Arrangement under Meter Convention

This certificate is consistent with the calibration and measurement capabilities (CMCs) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures (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 (as for Appendix C of MRA, see <http://kcdb.bipm.org/AppendixC/default.asp>).

Expiration of Certification

This certificate is valid from the date of shipment to June 30, 2018, provided that the material is stored in accordance with the instructions given in this certificate.

Sample Form

This CRM is in the form of colorless and odorless toxic gas and supplied in a 9.5-liter high-pressure aluminum-alloy cylinder with W22-14-OL outlet. At the time of shipment, the internal pressure is 9 MPa or more (35 °C).

Instructions for Storage

This CRM, which is flammable and toxic high-pressure gas, should be stored in accordance with the High Pressure Gas Safety Act. Care must be taken because this CRM is colorless, odorless, and toxic gas. A cylinder of this CRM should be stored away from direct sunlight and fire at a temperature of 40 °C or less in a well-ventilated place. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use

This CRM should be used at around room temperature since its certified value is determined based on the analysis performed at room temperature. Purity of this CRM may change along with the drop of the internal pressure, and the rate of the change tends to become higher as the internal pressure drops more. This CRM, therefore, should be used only when the internal pressure is 1.5 MPa or more. Use pressure-reducing valves and pipes made of stainless steel etc. which are designed specifically for high-purity gases, when using this CRM, and purge the piping thoroughly in order to prevent decline of the purity.

Precautions for Handling

This CRM, which is colorless, odorless, flammable and toxic high-pressure gas, should be handled with care in accordance with the High Pressure Gas Safety Act. Refer to the SDS on this CRM before use.

Preparation Method

This CRM was packed into 9.5-liter high-pressure aluminum-alloy cylinders in Japan Fine Products.

NMIJ Analysts

The technical manager for this CRM is T. Shimosaka; the production manager is N. Matsumoto, and the analyst is N. Matsumoto.

Technical Information

Customer registration on the NMIJ Website (given below) will facilitate notification of any revision of the information given above. 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.

April 1, 2015

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/>

Revision history

April 1, 2015: “Metrology Management Center” was renamed to “Center for Quality Management of Metrology.”

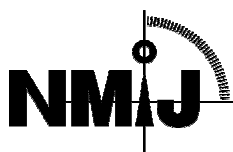
March 9, 2016: Expanded uncertainty of this CRM was changed from 0.000012 mol/mol to 0.000020 mol/mol.

Sample

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan

Reference Material Certificate



NMIJ CRM 3406-d03

Carbon Monoxide



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.

Certified Value

The certified value for carbon monoxide 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 %.

	CAS No.	Certified value, Amount-of-substance fraction ($\mu\text{mol/mol}$)	Expanded uncertainty, Amount-of-substance fraction ($\mu\text{mol/mol}$)	Cylinder No.
Carbon Monoxide	630-08-0	0.999969	0.000020	CPB16081

Analysis

The certified value of this CRM is determined by the method (the subtracting method) stipulated in ISO 6142 (2001), based on the concentration of impurities measured with the methods shown in the table below:

Impurity	Analysis Method
Nitrogen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Oxygen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Carbon Dioxide	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Hydrogen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Helium	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Water	Crystal oscillator method

Metrological Traceability

The certified value of this CRM is traceable to the International System of Units (SI) as the impurities given in the above table are quantified for each high-pressure cylinder by means of the measurement methods traceable to the SI and the certified value is calculated with the subtracting method. The micro gas chromatograph is calibrated at NMIJ by using the calibration gases prepared with the gravimetric blending method (ISO 6142 (2001)). The crystal-oscillation-type moisture meter is calibrated by using the standard gases whose values are assigned by the chilled mirror dew point meter traceable to the National Physical Laboratory (NPL).

Mutual Recognition Arrangement under Meter Convention

This certificate is consistent with the calibration and measurement capabilities (CMCs) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures (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 (as for Appendix C of MRA, see <http://kcdb.bipm.org/AppendixC/default.asp>).

Expiration of Certification

This certificate is valid from the date of shipment to June 30, 2018, provided that the material is stored in accordance with the instructions given in this certificate.

Sample Form

This CRM is in the form of colorless and odorless toxic gas and supplied in a 9.5-liter high-pressure aluminum-alloy cylinder with W22-14-OL outlet. At the time of shipment, the internal pressure is 9 MPa or more (35 °C).

Instructions for Storage

This CRM, which is flammable and toxic high-pressure gas, should be stored in accordance with the High Pressure Gas Safety Act. Care must be taken because this CRM is colorless, odorless, and toxic gas. A cylinder of this CRM should be stored away from direct sunlight and fire at a temperature of 40 °C or less in a well-ventilated place. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use

This CRM should be used at around room temperature since its certified value is determined based on the analysis performed at room temperature. Purity of this CRM may change along with the drop of the internal pressure, and the rate of the change tends to become higher as the internal pressure drops more. This CRM, therefore, should be used only when the internal pressure is 1.5 MPa or more. Use pressure-reducing valves and pipes made of stainless steel etc. which are designed specifically for high-purity gases, when using this CRM, and purge the piping thoroughly in order to prevent decline of the purity.

Precautions for Handling

This CRM, which is colorless, odorless, flammable and toxic high-pressure gas, should be handled with care in accordance with the High Pressure Gas Safety Act. Refer to the SDS on this CRM before use.

Preparation Method

This CRM was packed into 9.5-liter high-pressure aluminum-alloy cylinders in Japan Fine Products.

NMIJ Analysts

The technical manager for this CRM is T. Shimosaka; the production manager is N. Matsumoto, and the analyst is N. Matsumoto.

Technical Information

Customer registration on the NMIJ Website (given below) will facilitate notification of any revision of the information given above. Technical reports regarding this CRM can be obtained from the contact details given below.

Reproduction of Certificate

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April 1, 2015

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/>

Revision history

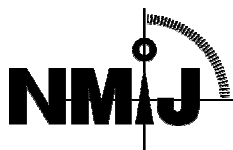
April 1, 2015: “Metrology Management Center” was renamed to “Center for Quality Management of Metrology.”
March 9, 2016: Expanded uncertainty of this CRM was changed from 0.000012 mol/mol to 0.000020 mol/mol.

Sample

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan

Reference Material Certificate



NMIJ CRM 3406-d04

Carbon Monoxide



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.

Certified Value

The certified value for carbon monoxide 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 %.

	CAS No.	Certified value, Amount-of-substance fraction ($\mu\text{mol/mol}$)	Expanded uncertainty, Amount-of-substance fraction ($\mu\text{mol/mol}$)	Cylinder No.
Carbon Monoxide	630-08-0	0.999971	0.000020	CPB16395

Analysis

The certified value of this CRM is determined by the method (the subtracting method) stipulated in ISO 6142 (2001), based on the concentration of impurities measured with the methods shown in the table below:

Impurity	Analysis Method
Nitrogen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Oxygen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Carbon Dioxide	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Hydrogen	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Helium	Gas chromatography (Micro gas chromatograph with thermal conductivity detector)
Water	Crystal oscillator method

Metrological Traceability

The certified value of this CRM is traceable to the International System of Units (SI) as the impurities given in the above table are quantified for each high-pressure cylinder by means of the measurement methods traceable to the SI and the certified value is calculated with the subtracting method. The micro gas chromatograph is calibrated at NMIJ by using the calibration gases prepared with the gravimetric blending method (ISO 6142 (2001)). The crystal-oscillation-type moisture meter is calibrated by using the standard gases whose value are assigned by the chilled mirror dew point meter traceable to the National Physical Laboratory (NPL).

Mutual Recognition Arrangement under Meter Convention

This certificate is consistent with the calibration and measurement capabilities (CMCs) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures (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 (as for Appendix C of MRA, see <http://kcdb.bipm.org/AppendixC/default.asp>).

Expiration of Certification

This certificate is valid from the date of shipment to June 30, 2018, provided that the material is stored in accordance with the instructions given in this certificate.

Sample Form

This CRM is in the form of colorless and odorless toxic gas and supplied in a 9.5-liter high-pressure aluminum-alloy cylinder with W22-14-OL outlet. At the time of shipment, the internal pressure is 9 MPa or more (35 °C).

Instructions for Storage

This CRM, which is flammable and toxic high-pressure gas, should be stored in accordance with the High Pressure Gas Safety Act. Care must be taken because this CRM is colorless, odorless, and toxic gas. A cylinder of this CRM should be stored away from direct sunlight and fire at a temperature of 40 °C or less in a well-ventilated place. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use

This CRM should be used at around room temperature since its certified value is determined based on the analysis performed at room temperature. Purity of this CRM may change along with the drop of the internal pressure, and the rate of the change tends to become higher as the internal pressure drops more. This CRM, therefore, should be used only when the internal pressure is 1.5 MPa or more. Use pressure-reducing valves and pipes made of stainless steel etc. which are designed specifically for high-purity gases, when using this CRM, and purge the piping thoroughly in order to prevent decline of the purity.

Precautions for Handling

This CRM, which is colorless, odorless, flammable and toxic high-pressure gas, should be handled with care in accordance with the High Pressure Gas Safety Act. Refer to the SDS on this CRM before use.

Preparation Method

This CRM was packed into 9.5-liter high-pressure aluminum-alloy cylinders in Japan Fine Products.

NMIJ Analysts

The technical manager for this CRM is T. Shimosaka; the production manager is N. Matsumoto, and the analyst is N. Matsumoto.

Technical Information

Customer registration on the NMIJ Website (given below) will facilitate notification of any revision of the information given above. Technical reports regarding this CRM can be obtained from the contact details given below.

Reproduction of Certificate

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April 1, 2015

Ryoji Chubachi
President

National Institute of Advanced Industrial Science and Technology

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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/>

Revision history

April 1, 2015: “Metrology Management Center” was renamed to “Center for Quality Management of Metrology.”
March 9, 2016: Expanded uncertainty of this CRM was changed from 0.000012 mol/mol to 0.000020 mol/mol.

Sample