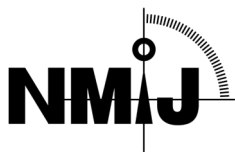


National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan



Reference Material Certificate

NMIJ CRM 3406-e01



Carbon Monoxide

This certified reference material (CRM) is produced in accordance with the NMIJ's management system and is in compliance with ISO 17034 and ISO/IEC 17025. This CRM is intended for the calibration of instruments used for the carbon monoxide determination.

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 (mol/mol)	Expanded uncertainty Amount-of-substance fraction (mol/mol)	Cylinder No.
Carbon monoxide	630-08-0	0.999966	0.000020	CPB16254

Analysis

The amount-of-substance fraction of each impurity in this CRM was determined by the analytical instruments listed below. The certified value was determined by the subtraction method (ISO 6142-1:2015).

Impurities	Analytical Equipments
Nitrogen	Micro gas chromatograph with thermal conductivity detector
Oxygen	Micro gas chromatograph with thermal conductivity detector
Carbon dioxide	Micro gas chromatograph with thermal conductivity detector
Hydrogen	Micro gas chromatograph with thermal conductivity detector
Helium	Micro gas chromatograph with thermal conductivity detector
Water	Moisture analyzer with crystal oscillator

Metrological Traceability

The micro gas chromatograph used for the certification was calibrated using primary reference gases prepared by the gravimetric method in NMIJ in accordance with ISO 6142-1:2015. A moisture analyzer with crystal-oscillator was calibrated using a reference dew point meter which is traceable to the International System of Units (SI). Therefore, the certified value is traceable to the SI.

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 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 in the form of colorless and odorless toxic gas and supplied in a 10-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).

Precautions for Storage

This CRM should be stored in compliance with regulations for high pressure gases. Avoid direct sunlight, and keep temperature below 40 °C at any time. Store the CRM at a place with good ventilation. Fasten the cylinder with chain to avoid it from falling down. Since carbon monoxide gas is flammable, toxic, and odorless gas, take care to leaks, do not use fire near the cylinder and do not place any flammable objects nearby. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use

This CRM should be used around room temperature science the certified value is based on the analytical results at room temperature. The purity of carbon monoxide in the CRM may be dependent on its residual pressure. When the pressure inside the cylinder becomes less than 2 MPa, please stop use of the CRM. We recommend sufficient substitution of residual gas in stainless regulators, valves, piping, measuring instruments, and so on with this CRM gas before use. To avoid contamination, we recommend check leakage from joints of piping.

Precautions for Handling

Refer to the SDS on this CRM before use. This CRM should be returned to Center for Quality Management of Metrology of AIST after use or after the expiry date.

Preparation

This CRM is filled in a 9.5 liter aluminum alloy cylinder by Taiyo Nippon Sanso Corporation.

NMIJ Analysts

The technical manager for this CRM is SHIMOSAKA T. The production manager is MATSUMOTO N. The analyst is MATSUMOTO N.

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.

April 1, 2020

ISHIMURA Kazuhiko

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://unit.aist.go.jp/nmij/english/refmate/>

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan



Reference Material Certificate

NMIJ CRM 3406-e02



Carbon Monoxide

This certified reference material (CRM) is produced in accordance with the NMIJ's management system and is in compliance with ISO 17034 and ISO/IEC 17025. This CRM is intended for the calibration of instruments used for the carbon monoxide determination.

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 (mol/mol)	Expanded Uncertainty Amount-of-substance fraction (mol/mol)	Cylinder No.
Carbon monoxide	630-08-0	0.999967	0.000020	CPB16255

Analysis

The amount-of-substance fraction of each impurity in this CRM was determined by the analytical instruments listed below. The certified value was determined by the subtraction method (ISO 6142-1:2015).

Impurities	Analytical Equipments
Nitrogen	Micro gas chromatograph with thermal conductivity detector
Oxygen	Micro gas chromatograph with thermal conductivity detector
Carbon dioxide	Micro gas chromatograph with thermal conductivity detector
Hydrogen	Micro gas chromatograph with thermal conductivity detector
Helium	Micro gas chromatograph with thermal conductivity detector
Water	Moisture analyzer with crystal oscillator

Metrological Traceability

The micro gas chromatograph used for the certification was calibrated using primary reference gases prepared by the gravimetric method in NMIJ in accordance with ISO 6142-1:2015. A moisture analyzer with crystal-oscillator was calibrated using a reference dew point meter which is traceable to the International System of Units (SI). Therefore, the certified value is traceable to the SI.

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 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 in the form of colorless and odorless toxic gas and supplied in a 10-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).

Precautions for Storage

This CRM should be stored in compliance with your country's regulations for high pressure gases. Avoid direct sunlight, and keep temperature below 40 °C at any time. Store the CRM at a place with good ventilation. Fasten the cylinder with chain to avoid it from falling down. Since carbon monoxide gas is flammable, toxic, and odorless gas, take care to leaks, do not use fire near the cylinder and do not place any flammable objects nearby. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use

This CRM should be used around room temperature because the certified value is based on the analytical results at room temperature. The purity of carbon monoxide in the CRM may be dependent on its residual pressure. When the pressure inside the cylinder becomes less than 2 MPa, please stop use of the CRM. We recommend sufficient substitution of residual gas in stainless regulators, valves, piping, measuring instruments, and so on with this CRM gas before use. To avoid contamination, we recommend check leakage from joints of piping.

Precautions for Handling

Refer to the SDS on this CRM before use. This CRM should be returned to Center for Quality Management of Metrology of AIST after use or after the expiry date.

Preparation

This CRM is filled in a 9.5 liter aluminum alloy cylinder by Taiyo Nippon Sanso Corporation.

NMIJ Analysts

The technical manager for this CRM is SHIMOSAKA T. The production manager is MATSUMOTO N. The analyst is MATSUMOTO N.

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

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April 1, 2020

ISHIMURA Kazuhiko

President

National Institute of Advanced Industrial Science and Technology

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Phone: +81-29-861-4059; Fax: +81-29-861-4009, <https://unit.aist.go.jp/nmij/english/refmate/>

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan



Reference Material Certificate

NMIJ CRM 3406-e03



Carbon Monoxide

This certified reference material (CRM) is produced in accordance with the NMIJ's management system and is in compliance with ISO 17034 and ISO/IEC 17025. This CRM is intended for the calibration of instruments used for the carbon monoxide determination.

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 (mol/mol)	Expanded Uncertainty Amount-of-substance fraction (mol/mol)	Cylinder No.
Carbon monoxide	630-08-0	0.999966	0.000020	CPB16257

Analysis

The amount-of-substance fraction of each impurity in this CRM was determined by the analytical instruments listed below. The certified value was determined by the subtraction method (ISO 6142-1:2015).

Impurities	Analytical Equipments
Nitrogen	Micro gas chromatograph with thermal conductivity detector
Oxygen	Micro gas chromatograph with thermal conductivity detector
Carbon dioxide	Micro gas chromatograph with thermal conductivity detector
Hydrogen	Micro gas chromatograph with thermal conductivity detector
Helium	Micro gas chromatograph with thermal conductivity detector
Water	Moisture analyzer with crystal oscillator

Metrological Traceability

The micro gas chromatograph used for the certification was calibrated using primary reference gases prepared by the gravimetric method in NMIJ in accordance with ISO 6142-1:2015. A moisture analyzer with crystal-oscillator was calibrated using a reference dew point meter which is traceable to the International System of Units (SI). Therefore, the certified value is traceable to the SI.

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 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 in the form of colorless and odorless toxic gas and supplied in a 10-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).

Precautions for Storage

This CRM should be stored in compliance with your country's regulations for high pressure gases. Avoid direct sunlight, and keep temperature below 40 °C at any time. Store the CRM at a place with good ventilation. Fasten the cylinder with chain to avoid it from falling down. Since carbon monoxide gas is flammable, toxic, and odorless gas, take care to leaks, do not use fire near the cylinder and do not place any flammable objects nearby. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use

This CRM should be used around room temperature because the certified value is based on the analytical results at room temperature. The purity of carbon monoxide in the CRM may be dependent on its residual pressure. When the pressure inside the cylinder becomes less than 2 MPa, please stop use of the CRM. We recommend sufficient substitution of residual gas in stainless regulators, valves, piping, measuring instruments, and so on with this CRM gas before use. To avoid contamination, we recommend check leakage from joints of piping.

Precautions for Handling

Refer to the SDS on this CRM before use. This CRM should be returned to Center for Quality Management of Metrology of AIST after use or after the expiry date.

Preparation

This CRM is filled in a 9.5 liter aluminum alloy cylinder by Taiyo Nippon Sanso Corporation.

NMIJ Analysts

The technical manager for this CRM is SHIMOSAKA T. The production manager is MATSUMOTO N. The analyst is MATSUMOTO N.

Information

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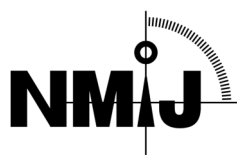
President

National Institute of Advanced Industrial Science and Technology

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National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan



Reference Material Certificate

NMIJ CRM 3406-e04



Carbon Monoxide

This certified reference material (CRM) is produced in accordance with the NMIJ's management system and is in compliance with ISO 17034 and ISO/IEC 17025. This CRM is intended for the calibration of instruments used for the carbon monoxide determination.

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 (mol/mol)	Expanded Uncertainty Amount-of-substance fraction (mol/mol)	Cylinder No.
Carbon monoxide	630-08-0	0.999968	0.000020	CPB16332

Analysis

The amount-of-substance fraction of each impurity in this CRM was determined by the analytical instruments listed below. The certified value was determined by the subtraction method (ISO 6142-1:2015).

Impurities	Analytical Equipments
Nitrogen	Micro gas chromatograph with thermal conductivity detector
Oxygen	Micro gas chromatograph with thermal conductivity detector
Carbon dioxide	Micro gas chromatograph with thermal conductivity detector
Hydrogen	Micro gas chromatograph with thermal conductivity detector
Helium	Micro gas chromatograph with thermal conductivity detector
Water	Moisture analyzer with crystal oscillator

Metrological Traceability

The micro gas chromatograph used for the certification was calibrated using primary reference gases prepared by the gravimetric method in NMIJ in accordance with ISO 6142-1:2015. A moisture analyzer with crystal-oscillator was calibrated using a reference dew point meter which is traceable to the International System of Units (SI). Therefore, the certified value is traceable to the SI.

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 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 in the form of colorless and odorless toxic gas and supplied in a 10-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).

Precautions for Storage

This CRM should be stored in compliance with your country's regulations for high pressure gases. Avoid direct sunlight, and keep temperature below 40 °C at any time. Store the CRM at a place with good ventilation. Fasten the cylinder with chain to avoid it from falling down. Since carbon monoxide gas is flammable, toxic, and odorless gas, take care to leaks, do not use fire near the cylinder and do not place any flammable objects nearby. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use

This CRM should be used around room temperature because the certified value is based on the analytical results at room temperature. The purity of carbon monoxide in the CRM may be dependent on its residual pressure. When the pressure inside the cylinder becomes less than 2 MPa, please stop use of the CRM. We recommend sufficient substitution of residual gas in stainless regulators, valves, piping, measuring instruments, and so on with this CRM gas before use. To avoid contamination, we recommend check leakage from joints of piping.

Precautions for Handling

Refer to the SDS on this CRM before use. This CRM should be returned to Center for Quality Management of Metrology of AIST after use or after the expiry date.

Preparation

This CRM is filled in a 9.5 liter aluminum alloy cylinder by Taiyo Nippon Sanso Corporation.

NMIJ Analysts

The technical manager for this CRM is SHIMOSAKA T. The production manager is MATSUMOTO N. The analyst is MATSUMOTO N.

Information

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ISHIMURA Kazuhiko

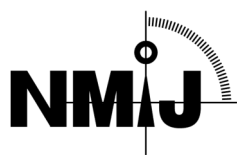
President

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National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan



Reference Material Certificate

NMIJ CRM 3406-e05



Carbon Monoxide

This certified reference material (CRM) is produced in accordance with the NMIJ's management system and is in compliance with ISO 17034 and ISO/IEC 17025. This CRM is intended for the calibration of instruments used for the carbon monoxide determination.

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 (mol/mol)	Expanded Uncertainty Amount-of-substance fraction (mol/mol)	Cylinder No.
Carbon monoxide	630-08-0	0.999967	0.000020	CPB31366

Analysis

The amount-of-substance fraction of each impurity in this CRM was determined by the analytical instruments listed below. The certified value was determined by the subtraction method (ISO 6142-1:2015).

Impurities	Analytical Equipments
Nitrogen	Micro gas chromatograph with thermal conductivity detector
Oxygen	Micro gas chromatograph with thermal conductivity detector
Carbon dioxide	Micro gas chromatograph with thermal conductivity detector
Hydrogen	Micro gas chromatograph with thermal conductivity detector
Helium	Micro gas chromatograph with thermal conductivity detector
Water	Moisture analyzer with crystal oscillator

Metrological Traceability

The micro gas chromatograph used for the certification was calibrated using primary reference gases prepared by the gravimetric method in NMIJ in accordance with ISO 6142-1:2015. A moisture analyzer with crystal-oscillator was calibrated using a reference dew point meter which is traceable to the International System of Units (SI). Therefore, the certified value is traceable to the SI.

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 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 in the form of colorless and odorless toxic gas and supplied in a 10-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).

Precautions for Storage

This CRM should be stored in compliance with your country's regulations for high pressure gases. Avoid direct sunlight, and keep temperature below 40 °C at any time. Store the CRM at a place with good ventilation. Fasten the cylinder with chain to avoid it from falling down. Since carbon monoxide gas is flammable, toxic, and odorless gas, take care to leaks, do not use fire near the cylinder and do not place any flammable objects nearby. Refer to the safety data sheet (SDS) on this CRM for storage.

Instructions for Use

This CRM should be used around room temperature because the certified value is based on the analytical results at room temperature. The purity of carbon monoxide in the CRM may be dependent on its residual pressure. When the pressure inside the cylinder becomes less than 2 MPa, please stop use of the CRM. We recommend sufficient substitution of residual gas in stainless regulators, valves, piping, measuring instruments, and so on with this CRM gas before use. To avoid contamination, we recommend check leakage from joints of piping.

Precautions for Handling

Refer to the SDS on this CRM before use. This CRM should be returned to Center for Quality Management of Metrology of AIST after use or after the expiry date.

Preparation

This CRM is filled in a 9.5 liter aluminum alloy cylinder by Taiyo Nippon Sanso Corporation.

NMIJ Analysts

The technical manager for this CRM is SHIMOSAKA T. The production manager is MATSUMOTO N. The analyst is MATSUMOTO N.

Information

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ISHIMURA Kazuhiko

President

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