Date of Shipment: Xxxxx xx, 20xx 3404e01-250314-250314

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan

Reference Material Certificate

NMIJ CRM 3404-e01

Oxygen

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.

Certified Value

The certified value of this CRM is purity of oxygen in amount fraction and is given in the table below. The uncertainty of the certified value is the expanded uncertainty obtained by multiplying the combined standard uncertainty by a coverage factor (k) of 2, and it is the half-width of an interval estimated to have a level of confidence of approximately 95 %.

	CAS No.	Certified value Amount fraction (mol/mol)	Expanded uncertainty Amount fraction (mol/mol)	Cylinder Number
Oxygen	7782-44-7	0.999955	0.000052	PLN87941

Analysis

The certified value of this CRM was determined by the purity analysis in accordance with ISO 19229. Amount fractions of the impurities were determined by the analytical instruments listed below.

Impurities	Analytical instruments
Nitrogen	Gas chromatograph with thermal conductivity detector (GC-TCD)
Argon	Gas chromatograph with thermal conductivity detector (GC-TCD)
Methane	Fourier transform infrared spectrometer (FTIR)
Carbon Monoxide	Fourier transform infrared spectrometer (FTIR)
Carbon Dioxide	Fourier transform infrared spectrometer (FTIR)
Water	Capacitive hygrometer

Metrological Traceability

The GC-TCDand FTIR for the purity analysis were calibrated using reference gases prepared by NMIJ using the gravimetric method in accordance with ISO 6142-1. The capacitive hygrometer was calibrated using a hygrometer traceable to the International System of Units (SI). The certified value, therefore, is traceable to the SI.

Mutual Recognition Arrangement under Metre Convention

The certified value of this CRM is recognized for international equivalence based on the Mutual Recognition Arrangement under the Metre Convention (CIPM MRA). The calibration measurement capability (CMC) of NMIJ related to this CRM is registered in the Key Comparison Database (KCDB) (see https://www.bipm.org/kcdb/) of the International Bureau of Weights and Measures (BIPM).

Expiration of Certification

This certificate is valid for one year from the date of shipment, provided that this CRM is stored in accordance with the

instructions given in this certificate.

Description of the Material

This CRM is a pure oxygen gas and it is supplied in a manganese steel cylinder with an inner volume of 47 L. Specification of an outlet of the cylinder is W22-14thread right (male). A pressure of the CRM is above 12 MPa at 35 °C.

Instructions for Storage

This CRM should be stored in compliance with regulations for high-pressure gases. Temperature of the CRM should be kept below 40 °C. The CRM should be stored at a place with good ventilation. Since oxygen gas supports combustion, do not use fire near the cylinder and do not place any flammable objects nearby. Refer to the safety data sheet (SDS) on the CRM.

Instructions for Use

It is recommended that residual gases in regulators, valves, piping, measuring instruments and so on should be sufficiently substituted with this CRM before use. It is recommended to confirm that there is no leakage from joints of piping. This certificate is valid, provided the pressure of the CRM is more than 2 MPa in gauge pressure.

Precautions for Handling

Do not use fire near the cylinder and do not place any flammable objects nearby. Use the CRM at a place with good ventilation. Do not use any oils and other flammable objects to valves, pipings, measuring instruments and so on. Use this CRM in compliance with regulations for high-pressure gases. Use the CRM according to the SDS. This CRM should be returned to Center for Quality Management of Metrology of AIST after use or after the expiry date of this certificate.

Preparation

A highly pure oxygen gas was filled into a manganese steel cylinder with an inner volume of 47 L by Taiyo Nippon Sanso JFP.

NMIJ Analysts

The technical manager for this CRM is SHIMOSAKA T., the production manager is SHIMOSAKA T., and the analyst is SHIMOSAKA T.

Information

If substantive technical changes occur that affect the certification before the expiration of this certificate, NMIJ will notify the registered customers. 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, 2025

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, https://unit.aist.go.jp/nmij/english/refmate/

Date of Shipment: Xxxxx xx, 20xx 3404e02-250314-250314

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan

Reference Material Certificate

NMIJ CRM 3404-e02

Oxygen

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.

Certified Value

The certified value of this CRM is purity of oxygen in amount fraction and is given in the table below. The uncertainty of the certified value is the expanded uncertainty obtained by multiplying the combined standard uncertainty by a coverage factor (k) of 2, and it is the half-width of an interval estimated to have a level of confidence of approximately 95 %.

	CAS No.	Certified value Amount fraction (mol/mol)	Expanded uncertainty Amount fraction (mol/mol)	Cylinder Number
Oxygen	7782-44-7	0.999955	0.000052	PLN87942

Analysis

The certified value of this CRM was determined by the purity analysis in accordance with ISO 19229. Amount fractions of the impurities were determined by the analytical instruments listed below.

Impurities	Analytical instruments
Nitrogen	Gas chromatograph with thermal conductivity detector (GC-TCD)
Argon	Gas chromatograph with thermal conductivity detector (GC-TCD)
Methane	Fourier transform infrared spectrometer (FTIR)
Carbon Monoxide	Fourier transform infrared spectrometer (FTIR)
Carbon Dioxide	Fourier transform infrared spectrometer (FTIR)
Water	Capacitive hygrometer

Metrological Traceability

The GC-TCDand FTIR for the purity analysis were calibrated using reference gases prepared by NMIJ using the gravimetric method in accordance with ISO 6142-1. The capacitive hygrometer was calibrated using a hygrometer traceable to the International System of Units (SI). The certified value, therefore, is traceable to the SI.

Mutual Recognition Arrangement under Metre Convention

The certified value of this CRM is recognized for international equivalence based on the Mutual Recognition Arrangement under the Metre Convention (CIPM MRA). The calibration measurement capability (CMC) of NMIJ related to this CRM is registered in the Key Comparison Database (KCDB) (see https://www.bipm.org/kcdb/) of the International Bureau of Weights and Measures (BIPM).

Expiration of Certification

This certificate is valid for one year from the date of shipment, provided that this CRM is stored in accordance with the

instructions given in this certificate.

Description of the Material

This CRM is a pure oxygen gas and it is supplied in a manganese steel cylinder with an inner volume of 47 L. Specification of an outlet of the cylinder is W22-14thread right (male). A pressure of the CRM is above 12 MPa at 35 °C.

Instructions for Storage

This CRM should be stored in compliance with regulations for high-pressure gases. Temperature of the CRM should be kept below 40 °C. The CRM should be stored at a place with good ventilation. Since oxygen gas supports combustion, do not use fire near the cylinder and do not place any flammable objects nearby. Refer to the safety data sheet (SDS) on the CRM.

Instructions for Use

It is recommended that residual gases in regulators, valves, piping, measuring instruments and so on should be sufficiently substituted with this CRM before use. It is recommended to confirm that there is no leakage from joints of piping. This certificate is valid, provided the pressure of the CRM is more than 2 MPa in gauge pressure.

Precautions for Handling

Do not use fire near the cylinder and do not place any flammable objects nearby. Use the CRM at a place with good ventilation. Do not use any oils and other flammable objects to valves, pipings, measuring instruments and so on. Use this CRM in compliance with regulations for high-pressure gases. Use the CRM according to the SDS. This CRM should be returned to Center for Quality Management of Metrology of AIST after use or after the expiry date of this certificate.

Preparation

A highly pure oxygen gas was filled into a manganese steel cylinder with an inner volume of 47 L by Taiyo Nippon Sanso JFP.

NMIJ Analysts

The technical manager for this CRM is SHIMOSAKA T., the production manager is SHIMOSAKA T., and the analyst is SHIMOSAKA T.

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Date of Shipment: Xxxxx xx, 20xx 3404e03-250314-250314

National Institute of Advanced Industrial Science and Technology

National Metrology Institute of Japan

Reference Material Certificate

NMIJ CRM 3404-e03

Oxygen

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.

Certified Value

The certified value of this CRM is purity of oxygen in amount fraction and is given in the table below. The uncertainty of the certified value is the expanded uncertainty obtained by multiplying the combined standard uncertainty by a coverage factor (k) of 2, and it is the half-width of an interval estimated to have a level of confidence of approximately 95 %.

	CAS No.	Certified value Amount fraction (mol/mol)	Expanded uncertainty Amount fraction (mol/mol)	Cylinder Number
Oxygen	7782-44-7	0.999955	0.000052	PLN87943

Analysis

The certified value of this CRM was determined by the purity analysis in accordance with ISO 19229. Amount fractions of the impurities were determined by the analytical instruments listed below.

Impurities	Analytical instruments
Nitrogen	Gas chromatograph with thermal conductivity detector (GC-TCD)
Argon	Gas chromatograph with thermal conductivity detector (GC-TCD)
Methane	Fourier transform infrared spectrometer (FTIR)
Carbon Monoxide	Fourier transform infrared spectrometer (FTIR)
Carbon Dioxide	Fourier transform infrared spectrometer (FTIR)
Water	Capacitive hygrometer

Metrological Traceability

The GC-TCDand FTIR for the purity analysis were calibrated using reference gases prepared by NMIJ using the gravimetric method in accordance with ISO 6142-1. The capacitive hygrometer was calibrated using a hygrometer traceable to the International System of Units (SI). The certified value, therefore, is traceable to the SI.

Mutual Recognition Arrangement under Metre Convention

The certified value of this CRM is recognized for international equivalence based on the Mutual Recognition Arrangement under the Metre Convention (CIPM MRA). The calibration measurement capability (CMC) of NMIJ related to this CRM is registered in the Key Comparison Database (KCDB) (see https://www.bipm.org/kcdb/) of the International Bureau of Weights and Measures (BIPM).

Expiration of Certification

This certificate is valid for one year from the date of shipment, provided that this CRM is stored in accordance with the

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Description of the Material

This CRM is a pure oxygen gas and it is supplied in a manganese steel cylinder with an inner volume of 47 L. Specification of an outlet of the cylinder is W22-14thread right (male). A pressure of the CRM is above 12 MPa at 35 °C.

Instructions for Storage

This CRM should be stored in compliance with regulations for high-pressure gases. Temperature of the CRM should be kept below 40 °C. The CRM should be stored at a place with good ventilation. Since oxygen gas supports combustion, do not use fire near the cylinder and do not place any flammable objects nearby. Refer to the safety data sheet (SDS) on the CRM.

Instructions for Use

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Precautions for Handling

Do not use fire near the cylinder and do not place any flammable objects nearby. Use the CRM at a place with good ventilation. Do not use any oils and other flammable objects to valves, pipings, measuring instruments and so on. Use this CRM in compliance with regulations for high-pressure gases. Use the CRM according to the SDS. This CRM should be returned to Center for Quality Management of Metrology of AIST after use or after the expiry date of this certificate.

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Reference Material Certificate

NMIJ CRM 3404-e04

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	CAS No.	Certified value Amount fraction (mol/mol)	Expanded uncertainty Amount fraction (mol/mol)	Cylinder Number
Oxygen	7782-44-7	0.999955	0.000052	PLN87944

Analysis

The certified value of this CRM was determined by the purity analysis in accordance with ISO 19229. Amount fractions of the impurities were determined by the analytical instruments listed below.

Impurities	Analytical instruments
Nitrogen	Gas chromatograph with thermal conductivity detector (GC-TCD)
Argon	Gas chromatograph with thermal conductivity detector (GC-TCD)
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