National Institute of Standards and Technology
U.S. Department of Commerce

Date of Issue:
07 April 2023

Standard Reference Material® 2636a
Carbon Monoxide in Nitrogen

(Nominal Amount-of-Substance Fraction 250 µmol/mol)
Lot 57-G-XX

CERTIFICATE OF ANALYSIS

SAMPLE

Purpose: This SRM is intended for the calibration of instruments used for carbon monoxide determinations and for other applications.

Description: This Standard Reference Material (SRM) is a primary gas mixture for which the amount-of-substance fraction, expressed as concentration [1], may be related to secondary working standards. This SRM mixture is supplied in a DOT 3AL-specification aluminum (6061 alloy) cylinder with a water volume of 6 L. Mixtures are shipped with a nominal pressure exceeding 12.4 MPa (1800 psig), which provides the user with 0.73 m^3 (25.8 ft^3) of useable mixture. The cylinder is the property of the purchaser and is equipped with a CGA-350 brass valve, which is the recommended outlet for this carbon monoxide mixture.

Certified Value: This SRM mixture has been certified for carbon monoxide concentration. The certified value given below applies to the identified cylinder and NIST sample number. This value is traceable to International System of Units (SI).

Carbon Monoxide Concentration:	248.87 µmol/mol ± 0.54 µmol/mol
Cylinder Number: Sample	NIST Sample Number: Sample
Hydrotest Date: November 2015	Blend Date: January 2016

A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or taken into account [2]. The uncertainty of the certified value includes the estimated uncertainties in the NIST standards, the analytical comparisons to the lot standard (LS), and the uncertainty of comparing the LS with each of the mixtures comprising this lot. The uncertainty is expressed as an expanded uncertainty $U = ku_c$ with u_c determined by experiment and a coverage factor $k = 2$. The true value for the carbon monoxide amount-of-substance fraction is asserted to lie in the interval defined by the certified value ± U with a level of confidence of approximately 95 % [3].

Other Information: Appendix A lists information on other components in the mixture.

Period of Validity: The certified value delivered by **SRM 2636a Lot No. 57-G-XX** has an expiration date of **15 March 2031**. The certified values are nullified if the material is stored or used improperly, damaged, contaminated, or otherwise modified or the internal pressure drops below 0.7 MPa (100 psig).

Maintenance of Certified Values: NIST will monitor this SRM over the period of its validity. If substantive technical changes occur that affect the certification, NIST will issue an amended certificate through the NIST SRM website (https://www.nist.gov/srm) and notify registered users. SRM users can register online from a link available on the NIST SRM website or fill out the user registration form that is supplied with the SRM. Registration will facilitate notification. Before making use of any of the values delivered by this material, users should verify they have the most recent version of this documentation, available through the NIST SRM website (https://www.nist.gov/srm).

Carlos A. Gonzalez, Chief
Chemical Sciences Division
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Steven J. Choquette, Director
Office of Reference Materials

Storage: This SRM should be stored under normal laboratory conditions within the temperature range of 15 ºC to 30 ºC.

Cylinder and Gas Handling Information: NIST recommends the use of a high-purity, two-stage pressure regulator with a stainless steel diaphragm and CGA-350 outlet to safely reduce the pressure and to deliver this SRM mixture to the instrument. The regulator should be purged to prevent accidental contamination of the SRM by repeatedly (minimum three times) opening the valve and pressurizing the regulator, then closing the valve and releasing the pressure safely into a vent line. This SRM should not be used after the internal pressure drops below 0.7 MPa (100 psig).

Mixture Preparation: The gas mixtures comprising this SRM lot were prepared in accordance with NIST technical specifications by a commercial specialty gas vendor under contract to NIST. The specifications stipulate that each SRM mixture be identical in carbon monoxide concentration and stable with time.

Analytical Methods: Analyses of the carbon monoxide concentration for this lot of cylinders were conducted by comparing each cylinder mixture to a representative cylinder chosen from the lot, the lot standard (LS), using gas chromatography equipped with a methanizer and a flame ionization detector (GC/Meth/FID) to primary gravimetric standards.

Homogeneity Analysis: Each of the carbon monoxide mixtures that comprise this SRM lot was compared to the LS using a CO specific nondispersive infrared spectrometer (CO NDIR). A statistical analysis of the analytical results indicated that sample-to-sample carbon monoxide concentration differences were not statistically significant. This indicates that, within the precision of the NIST measurements, all of the cylinders comprising this SRM lot have identical carbon monoxide concentrations. Therefore, one concentration has been assigned to the entire SRM lot.

Carbon Monoxide Concentration Value Assignment: The certified carbon monoxide concentration for this SRM lot was computed from the assigned concentration for the lot standard and the homogeneity analysis.

CAS Registry Numbers: This SRM is certified for carbon monoxide in nitrogen. The relevant CAS Registry numbers for these components are: carbon monoxide CAS Registry 630-08-0; nitrogen CAS Registry 7727-37-9.

NOTICE TO USERS

NIST strives to maintain the SRM inventory supply, but NIST cannot guarantee the continued or continuous supply of any specific SRM. Accordingly, NIST encourages the use of this SRM as a primary benchmark for the quality and accuracy of the user's in-house reference materials and working standards. As such, the SRM should be used to validate the more routinely used reference materials in a laboratory. Comparisons between the SRM and in-house reference materials or working measurement standards should take place at intervals appropriate to the conservation of the SRM and the stability of relevant in-house materials. For further guidance on how this approach can be implemented, contact NIST by email at srms@nist.gov.

REFERENCES

[1] Thompson, A.; Taylor, B.N.; *Guide for the Use of the International System of Units (SI)*; NIST Special Publication 811; U.S. Government Printing Office: Washington, DC (2008); available at https://www.nist.gov/pml/special-publication-811 (accessed March 2023).

[2] Beauchamp, C.R.; Camara, J.E.; Carney, J.; Choquette, S.J.; Cole, K.D.; DeRose, P.C.; Duewer, D.L.; Epstein, M.S.; Kline, M.C.; Lippa, K.A.; Lucon, E.; Molloy, J.; Nelson, M.A.; Phinney, K.W.; Polakoski, M.; Possolo, A.; Sander, L.C.; Schiel, J.E.; Sharpless, K.E.; Toman, B.; Winchester, M.R.; Windover, D.; *Metrological Tools for the Reference Materials and Reference Instruments of the NIST Material Measurement Laboratory*; NIST Special Publication 260-136, 2021 edition; U.S. Government Printing Office: Washington, DC (2021); available at https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.260-136-2021.pdf (accessed March 2023).

[3] JCGM 100:2008; *Guide to the Expression of Uncertainty in Measurement*; (GUM 1995 with Minor Corrections), Joint Committee for Guides in Metrology (JCGM) (2008); available at https://www.bipm.org/en/committees/jc/jcg/publications (accessed March 2023); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297; U.S. Government Printing Office: Washington, DC (1994); available at https://www.nist.gov/pml/nist-technical-note-1297 (accessed March 2023).

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If you use this SRM in published work, please reference:

Cecelski C, Harris K, Goodman C, Kimes W, Liu Q, Miller W, Carney J (2021) Certification of NIST Gas Mixture Standard Reference Materials. (National Institute of Standards and Technology, Gaithersburg, MD), NIST Special Publication (SP) 260-222. https://doi.org/10.6028/NIST.SP.260-222

Certificate Revision History: 07 April 2023 (Change of period of validity; updated format; editorial changes); **06 June 2016** (Original certificate date).

Certain commercial equipment, instruments, or materials may be identified in this Certificate of Analysis to adequately specify the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the Office of Reference Materials 100 Bureau Drive, Stop 2300, Gaithersburg, MD 20899-2300; telephone (301) 975-2200; e-mail srminfo@nist.gov; or the Internet at https://www.nist.gov/srm.

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APPENDIX A

Balance Gas: The balance gas for SRM 2636a Lot 57-G-XX is nitrogen.

Trace Components: Trace components in SRM 2636a Lot 57-G-XX include:

Carbon dioxide: The mole fraction of water in this mixture is expressed as a maximum allowable purity level of <1 µmol/mol. While the best estimate of the carbon dioxide mole fraction lies within the interval [0 to 1] µmol/mol, this interval may not include the true value. Carbon dioxide was detected using GC/Meth/FID; carbon dioxide CAS Registry 124-38-9.

Water: The mole fraction of water in this mixture is expressed as a maximum allowable purity level of <1 µmol/mol. While the best estimate of the water mole fraction lies within the interval [0 to 1] µmol/mol, this interval may not include the true value. Water was detected using P_2O_5 adsorption; water CAS Registry 7732-18-5.

Methane: The mole fraction of methane in this mixture is expressed as an allowable purity level of <50 nmol/mol. While the best estimate of the total hydrocarbons mole fraction lies within the interval [0 to 50] nmol/mol, this interval may not include the true value. Total hydrocarbons expressed as methane was detected using GC/Meth/FID; methane CAS Registry 74-82-8.

Total Hydrocarbons (expressed as Methane): The mole fraction of total hydrocarbons in this mixture is expressed as an allowable purity level of <7.5 nmol/mol. While the best estimate of the total hydrocarbons mole fraction lies within the interval [0 to 7.5] nmol/mol, this interval may not include the true value. Total hydrocarbons expressed as methane was detected using a Total Hydrocarbon Analyzer.

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