

Standard Reference Material[®] 2745

Carbon Dioxide in Nitrogen

(Nominal Amount-of-Substance Fraction 16 % mol/mol)

Lot No. 9-E-XX

CERTIFICATE OF ANALYSIS

Purpose: The certified value delivered by this Standard Reference Material (SRM) is intended for use in producing metrologically traceable secondary standards for the calibration of instruments used for carbon dioxide determinations.

Description: This SRM is a primary gas mixture 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 m³ (25.8 ft³) of useable mixture. The cylinder is the property of the purchaser and is equipped with a CGA-580 brass valve, which is the recommended outlet for this carbon dioxide mixture.

Certified Values: A NIST certified value is a value for which NIST has the highest confidence in that all known or suspected sources of bias and imprecision have been accounted [1]. This SRM mixture has been certified for component amount-of-substance fraction (mole fraction, sometimes termed “molar concentration”). This certified value is traceable to the International System of Units (SI) through the gravimetric primary standards and procedures used in the preparation of this mixture. The certified value given below applies to the identified cylinder and NIST sample number.

Carbon Dioxide Mole Fraction: 15.8020 % mol/mol ± 0.0154 % mol/mol^(a)

Cylinder Number: SAMPLE

NIST Sample Number: SAMPLE

Hydrotest Date: October 25, 2019

Blend Date: May 28, 2020

^(a) The certified value is expressed as $x \pm U_{95\%}(x)$, where x is the value and $U_{95\%}(x)$ is the expanded uncertainty of the value. The true value of the analyte lies within the interval $x \pm U_{95\%}(x)$ with 95 % confidence. For guidance in propagating this uncertainty, see reference 2.

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

Period of Validity: The certified value delivered by **SRM 2745 Lot No. 9-E-XX** has an expiration date of **11 May 2029**. The certified value is 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>).

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

Cylinder and Gas Handling Information: NIST recommends the use of a high-purity, two-stage pressure regulator with a stainless steel diaphragm and CGA 580 outlet to safely reduce the pressure and to deliver this 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. The certified value for this SRM is no longer valid 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 dioxide mole fraction and stable with time.

Analytical Method: Analyses of the carbon dioxide mole fraction for this lot of cylinders were conducted by comparison to a representative cylinder chosen from the lot, designated as the SRM lot standard (LS). The LS was compared to NIST primary gravimetric standards using a gas chromatograph equipped with a thermal conductivity detector (GC/TCD). Each of the component mixtures that comprise this SRM lot was then compared to the LS using GC/TCD. Within the precision of the NIST measurements, all the cylinders comprising this SRM lot have identical carbon dioxide mole fractions.

CAS Registry Numbers: This SRM is certified for carbon dioxide in nitrogen. The relevant CAS Registry numbers for these components are: carbon dioxide CAS Registry 124-38-9; 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] 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 (NIST SP) 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 May 2022).
- [2] Possolo, A.M.; *Evaluating, Expressing, and Propagating Measurement Uncertainty for NIST Reference Materials*; NIST Special Publication (NIST SP) 260-202; U.S. Government Printing Office: Washington, DC (2020); available at <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.260-202.pdf> (accessed May 2022).

Certificate of Analysis Revision History: 03 May 2022 (Editorial changes); 09 December 2021 (Addition of CAS Registry numbers; editorial changes); 30 August 2021 (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>.

***** End of Certificate of Analysis *****

APPENDIX A

Balance Gas: The balance gas for SRM 2745 Lot No. 9-E-XX is nitrogen. The nitrogen was confirmed using gas chromatography with thermal conductivity detection (GC-TCD); nitrogen CAS Registry number 7727-37-9.

Trace Components: Trace components in SRM 2745 Lot No. 9-E-XX include:

Water: Water was detected using an electrolytic analyzer. The mole fraction of water of the four cylinders tested ranged from [<0.9 to 1.3] $\mu\text{mol/mol}$ for an average of <1.1 $\mu\text{mol/mol}$. While the water impurity is 0.1 $\mu\text{mol/mol}$ greater than the water content specification of [0 to 1] $\mu\text{mol/mol}$, the uncertainty in the analysis is such that this SRM is believed to have an acceptable water impurity level; water CAS Registry number 7732-18-5.

Carbon Monoxide: Carbon monoxide was detected using cavity ring-down spectroscopy (CRDS). The average mole fraction of carbon monoxide was <0.20 $\mu\text{mol/mol}$ in the three cylinders tested. The best estimate of the carbon monoxide mole fraction lies within the specification interval of [0 to 0.4] $\mu\text{mol/mol}$; carbon monoxide CAS Registry number 630-08-0.

Total Hydrocarbons expressed as Methane: Total hydrocarbons (expressed as methane) were detected using gas chromatography with flame ionization detection (GC-FID) with cryogenic preconcentration of the sample before injection onto the head of the column. The average mole fraction of total hydrocarbon was <20 nmol/mol in the three cylinders tested. The best estimate of the total hydrocarbons mole fraction lies within the specification interval of [0 to 40] nmol/mol ; methane CAS Registry number 74-82-8.

***** End of Appendix A *****