



National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material[®] 1720

Northern Continental Air

(Ambient Nominal Amount-of-Substance Fraction: Carbon Dioxide, Methane, Nitrous Oxide)

This certificate reports the certified values for Lot 1720-A-XX.

This Standard Reference Material (SRM) is natural air for which the amount-of-substance fraction, expressed as concentration [1], may be related to secondary working standards. This SRM is intended for the calibration of instruments used for ambient carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) determinations and for other applications.

This SRM mixture is supplied in a DOT 3AL-specification aluminum (6061 alloy) cylinder with a water volume of 30 L. Cylinders are shipped with a nominal pressure exceeding 12.4 MPa (1800 psig). The cylinder is the property of the purchaser and is equipped with a CGA-590 brass valve, which is the recommended outlet for this ambient air mixture.

NIST Certified Value: This SRM mixture has been certified for CO₂, CH₄ and N₂O concentration. The certified values given below apply to the identified cylinder and NIST sample number.

Cylinder Number: CYLINDER
Hydrotest Date: August 2009

NIST Sample Number: SAMPLE
Fill Date: Individual Fill Date

CO₂: SAMPLE μmol/mol ± SAMPLE μmol/mol
CH₄: SAMPLE nmol/mol ± SAMPLE nmol/mol
N₂O: SAMPLE nmol/mol ± SAMPLE nmol/mol

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 coverage factor $k = 1.8$ to 2.0 for CO₂, $k = 1.6$ to 2.0 for CH₄, and $k = 2.0$ for N₂O. The true value for the CO₂, CH₄ and N₂O amount-of-substance fraction is asserted to lie in the interval defined by the certified value $\pm U$ with a level of confidence of approximately 95 % [2].

Expiration of Certification: The certification of **SRM 1720 Lot No. 1720-A-XX** is valid, from this certificate issue date, within the measurement uncertainties specified, until **01 September 2020**, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Cylinder and Gas Handling Information"). The certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Overall direction and coordination of the technical work required for certification of this SRM were performed by J.T. Hodges of the NIST Chemical Sciences Division.

Analytical measurements leading to the certification of the current SRM lot were performed by J. Carney, M.E. Kelley, W.R. Miller and G.C. Rhoderick of the NIST Chemical Sciences Division.

Carlos A. Gonzalez, Chief
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Gaithersburg, MD 20899
Certificate Issue Date: 08 September 2015

Robert L. Watters, Jr., Director
Office of Reference Materials

Support aspects involved in the issuance of this SRM were coordinated through the NIST Office of Reference Materials.

Maintenance of SRM Certification: Periodic analyses of SRM units from this lot are performed at NIST to monitor stability. If significant changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet or register online) will facilitate notification.

Cylinder and Gas Handling Information: NIST recommends the use of a high-purity, two-stage pressure regulator with a stainless steel diaphragm and CGA-590 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 3.5 MPa (500 psig). This SRM should be stored under normal laboratory conditions within the temperature range of 15 °C to 30 °C.

Mixture Preparation: The gas mixtures comprising this SRM lot were prepared in 2010 at Niwot Ridge, Colorado, to represent northern continental air in accordance with NIST technical specifications by the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colorado, using their whole air filling method [3]. The specifications stipulate that each SRM mixture be filled with ambient air scrubbed of moisture and stable with time.

Analytical Methods: Analyses of the CO₂, CH₄, and N₂O 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 cavity ring-down spectroscopy (CRDS) for CO₂, gas chromatography with flame-ionization (GC-FID) for CH₄ and off-axis cavity enhanced absorption spectroscopy (CEAS) for N₂O. Assignment of the CO₂, CH₄, and N₂O concentration to the LS was accomplished by comparison to primary gravimetric standards using those same instrumental methods.

Traceability: Each mixture that comprises this SRM lot was compared to the LS using the same instrumental method given above. Value assignment of the LS for CO₂, CH₄, and N₂O was accomplished by comparison to primary standards [4-6]. Each of the cylinders comprising this SRM lot will be individually certified allowing for the lowest uncertainty assignment. The measurand is the total concentration of CO₂, CH₄, and N₂O in air and the certified value is metrologically traceable to the SI unit for mass, expressed as micromole CO₂, nanomole CH₄, and nanomole N₂O per total moles of CO₂, CH₄, N₂O and air.

CO₂, CH₄, and N₂O Concentration Value Assignment: The certified CO₂, CH₄, and N₂O concentrations for this SRM lot were computed from the assigned concentrations for the LS and the individual sample to LS comparison data.

CAS Registry Numbers: This SRM is certified for CO₂, CH₄, and N₂O in compressed air. The relevant CAS Registry numbers for these components are given below.

Constituent	CAS Registry Number
Carbon dioxide	124-38-9
Methane	74-82-8
Nitrous oxide	10024-97-2
Compressed air	132259-10-0

Information Values: Results for additional analyses performed during the certification process are given below. The concentrations reported are **NOT** certified values. These values are given for informational purposes only. An informational value is considered to be a value that will be of interest to the SRM user, but for which insufficient information is available to assess adequately the uncertainty associated with the value, or for which only a limited number of analyses were performed [7]. Information values cannot be used to establish metrological traceability.

Constituent	Concentration	Method	CAS Registry
Carbon monoxide	130 – 180 nmol/mol	CEAS	630-08-0
Argon	0.935 %mol/mol	GC/TCD ^(a)	7440-37-1
Oxygen	20.93 %mol/mol	Paramagnetic	7782-44-7
Nitrogen	Balance		7727-37-9

^(a) Gas Chromatography with a Thermal Conductivity Detector (GC/TCD).

WMO Scale Values: The World Metrological Organization (WMO) requires those laboratories who report measurement values for CO₂, CH₄ and N₂O as WMO participants to use the WMO Central Calibration Laboratories (CCL) scale. The WMO scales for CO₂, CH₄ and N₂O are maintained by the NOAA Global Monitoring Division of the Earth System Research Laboratory, 325 Broadway, Boulder, Colorado, United States. For those users of this SRM that require the use of the WMO scale for calibration and the reporting of values to the WMO, the NOAA values are reported for informational purposes below [8,9].

CO₂: SAMPLE μmol/mol ± SAMPLE μmol/mol
CH₄: SAMPLE nmol/mol ± SAMPLE nmol/mol
N₂O: SAMPLE nmol/mol ± SAMPLE nmol/mol

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 <http://www.nist.gov/pml/pubs/sp811/index.cfm> (accessed Sep 2015).
- [2] JCGM 100:2008; *Evaluation of Measurement Data — Guide to the Expression of Uncertainty in Measurement* (GUM 1995 with Minor Corrections); Joint Committee for Guides in Metrology (2008); available at http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf (accessed Sep 2015); 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 <http://www.nist.gov/pml/pubs/tn1297/index.cfm> (accessed Sep 2015).
- [3] Kitzi, D.; *Preparation and Stability of Standard Reference Air Mixtures*; available at: <http://www.esrl.noaa.gov/gmd/ccl/airstandard.html> (accessed Sep 2015).
- [4] Rhoderick, G., Carney, J., Guenther, F.; *NIST Gravimetrically Prepared Atmospheric Level Methane in Dry Air Standards Suite*; Anal. Chem., Vol.84 (8) pp. 3802–3810, (2012).
- [5] Rhoderick, G.; *The National Institute of Standards and Technology Ambient Level Methane in Air Standard Reference Material Historical Record*; Anal. Bioanal. Chem., Vol. 403, pp. 537–548 (2012).
- [6] Kelley, M.; Rhoderick, G.; Guenther, F.; *Development and Verification of Air Balance Gas Primary Standards for the Measurement of Nitrous Oxide at Atmospheric Levels*; Anal. Chem., Vol. 86(9), pp. 4544–4549 (2014).
- [7] May, W., Parris, R., Beck, C., Fassett, J., Greenberg, R., Guenther, F., Kramer, G., Wise, S., Gills, T., Colbert, J. Gettings, R., MacDonald, B.; *Definitions of Terms and Modes Used at NIST for Value-Assignment of Reference Materials for Chemical Measurements*; NIST Special Publication 260-136, U.S. Government Printing Office; Washington, DC (2000); available at <http://www.nist.gov/srm/upload/SP260-136.PDF> (accessed Sep 2015).
- [8] *17th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases and Related Tracers Measurement Techniques (GGMT)*, GAW Report No. 123 (2013).
- [9] NOAA, Earth System Research Laboratory, Global Monitoring Division, Standard Reference Gases: Calibration Results, available at website: <http://www.esrl.noaa.gov/gmd/ccl/refgas.html> (accessed Sep 2015).

Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail srminfo@nist.gov; or via the Internet at <http://www.nist.gov/srm>.