



# Certificate of Analysis

Standard Reference Material<sup>®</sup> 1676

Carbon dioxide in Air

(Nominal Amount-of-Substance Fraction – 365  $\mu\text{mol/mol}$ )

*This certificate reports the certified values for Lot 19-B-XX.*

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 is intended for the calibration of instruments used for carbon dioxide determinations and for other applications.

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<sup>3</sup> (25.8 ft<sup>3</sup>) of useable mixture. The cylinder is the property of the purchaser and is equipped with a CGA-590 brass valve, which is the recommended outlet for this carbon dioxide mixture.

**Certified Value:** This SRM mixture has been certified for carbon dioxide concentration. The certified value given below applies to the identified cylinder and NIST sample number.

Carbon Dioxide Concentration: 367.81  $\mu\text{mol/mol} \pm 0.37 \mu\text{mol/mol}$

Cylinder Number: SAMPLE  
Hydrotest Date: February 2000

NIST Sample Number: SAMPLE  
Blend Date: August 2000

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. 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 dioxide 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 1676 Lot No. 19-B-XX** is valid, within the measurement uncertainty specified, until **01 September 2017**, provided the SRM is handled and stored in accordance with instructions given in this certificate (see “Cylinder and Gas Handling Information”). The certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

**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 0.7 MPa (100 psig). This SRM should be stored under normal laboratory conditions within the temperature range of 15 °C to 30 °C.

The overall direction and coordination of the technical work required for certification of this SRM were performed by F.R. Guenther of the NIST Analytical Chemistry Division.

Stephen A. Wise, Chief  
Analytical Chemistry Division

Gaithersburg, MD 20899  
Certificate Issue Date: 05 August 2010  
*See Certificate Revision History on Last Page*

Robert L. Watters, Jr., Chief  
Measurement Services Division

The analytical measurements leading to the certification of the current SRM lot were performed by M.E. Kelley of the NIST Analytical Chemistry Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Measurement Services Division.

**Maintenance of SRM Certification:** NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

**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 concentration and stable with time.

**Analytical Methods:** Analyses of the carbon dioxide 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 a non-dispersive infrared analyzer. Assignment of the carbon dioxide concentration to the LS was accomplished by comparison to primary gravimetric standards using a non-dispersive infrared analyzer.

**Homogeneity Analysis:** Each of the carbon dioxide mixtures that comprise this SRM lot was compared to the LS using a non-dispersive infrared analyzer. A statistical analysis of the analytical results indicated that sample-to-sample carbon dioxide 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 dioxide concentrations. Therefore, one concentration has been assigned to the entire SRM lot.

**Carbon dioxide Concentration Value Assignment:** The certified carbon dioxide 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 dioxide in air. The relevant CAS Registry numbers for these components are: carbon dioxide CAS Registry 124-38-9; compressed air CAS Registry 132259-10-0. Other relevant CAS Registry numbers appear in the table below.

**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 information 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 only a limited number of analyses were performed [3].

Constituent	Concentration	Method	CAS Registry
Argon	0.98 % mol/mol	Mass spectrometry	7440-37-1
Oxygen	20.8 % mol/mol	Paramagnetic	7782-44-7
Nitrogen	Balance		7727-37-9

## 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://ts.nist.gov/WeightsAndMeasures/Metric/mpo\\_pubs.cfm](http://ts.nist.gov/WeightsAndMeasures/Metric/mpo_pubs.cfm) (accessed Aug 2010).
- [2] JCGM 100:2008; Evaluation of Measurement Data — Guide to the Expression of Uncertainty in Measurement (ISO 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](http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf) (accessed Aug 2010); 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/physlab/pubs/index.cfm> (accessed Aug 2010).
- [3] May, W.; Parris, R.; Beck II, C.; Fassett, J.; Greenberg, R.; Guenther, F.; Kramer, G.; Wise, S.; Gills, T.; Colbert, J.; Gettings, R.; MacDonald, B.; *Definition of Terms and Modes Used at NIST for Value-Assignment of Reference Materials for Chemical Measurements*; NIST Special Publication 260-136 (2000); available at <http://ts.nist.gov/MeasurementServices/ReferenceMaterials/PUBLICATIONS.cfm> (accessed Aug 2010).

<p><b>Certificate Revision History:</b> 05 August 2010 (This revision includes an extension of the certification period and minor editorial changes.); 28 February 2006 (Extension of certification period); 18 September 2001 (Original certificate date).</p>
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*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) 926-4751; e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet at <http://www.nist.gov/srm>.*