



# National Institute of Standards & Technology

## Certificate of Analysis

Standard Reference Material<sup>®</sup> 1672a

Carbon Dioxide in Air

(Nominal Amount-of-Substance Fraction - 355  $\mu\text{mol/mol}$ )

*This certificate reports the certified value for Lot 40-XX-B.*

This Standard Reference Material (SRM) is a primary gas mixture to which the amount-of-substance fraction, expressed as concentration [1], of secondary working standards may be related. The 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 psi), 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. NIST recommends that this cylinder not be used below 0.7 MPa (100 psi).

**Certified Value:** This SRM mixture has been certified for carbon dioxide (CO<sub>2</sub>) concentration. The certified value, given below, applies to the identified cylinder and NIST sample number.

Carbon Dioxide (CO<sub>2</sub>) Concentration =  $\mu\text{mol/mol} \pm 0.36 \mu\text{mol/mol}$

Cylinder Number:

NIST Sample Number:

The uncertainty of the certified value includes the estimated uncertainties of the gravimetrically prepared primary standards, the analytical comparisons of the primary standards to the lot standard (LS), and the uncertainty of comparing the LS with each of the mixtures comprising this lot. This 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:** This certification is valid until **12 March 2007**, within the measurement uncertainties specified, provided the SRM is handled and stored in accordance with the instructions given in this certificate. However, the certification will be nullified if the SRM is contaminated or modified.

**Cylinder and Gas Handling Information:** NIST recommends the use of a high purity, stainless steel, 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 several times to prevent accidental contamination of the sample.

The analytical measurements leading to the certification of this current SRM lot were performed by W.D. Dorko and T.L. Green of the NIST Analytical Chemistry Division.

Willie E. May, Chief  
Analytical Chemistry Division

Gaithersburg, MD 20899  
Certificate Issue Date: 03 September 2003  
*See Certificate Revision History on Last Page*

John Rumble, Jr., Acting Chief  
Standard Reference Materials Program

F.R. Guenther of the NIST Analytical Chemistry Division.

Support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the NIST Standard Reference Materials Program by the NIST Measurement Services Division.

**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 intercomparing each cylinder mixture to a representative cylinder chosen from the lot, the LS, using a non-dispersive infrared analyzer. Assignment of the carbon dioxide concentration to the LS was accomplished by intercomparison to primary gravimetric standards using non-dispersive infrared.

**Homogeneity Analysis:** Each of the carbon dioxide mixtures, which comprise this SRM lot, was compared to the LS using non-dispersive infrared. An analysis of variance indicated sample-to-sample differences in carbon dioxide concentrations. Therefore, each cylinder in the lot has been assigned an individual concentration. However, the same uncertainty 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 LS and the homogeneity analysis.

**Stability:** Periodic analyses of SRM units from this lot are performed at NIST to monitor stability. If significant changes in the carbon dioxide concentration are observed, the purchaser will be notified. Refer to the Cylinder and Gas Handling Information section for proper handling of this SRM.

**Other Analyses:** Additional analyses performed during the certification procedure are given below. The concentrations reported below are not certified values but are given for information only.

Constituent	Concentration
Oxygen	20.9 % mol/mol
Argon	0.964 % mol/mol
Water	3 µmol/mol

#### REFERENCES

- [1] Taylor, B.N., *Guide for the Use of the International System of Units (SI)*; NIST Special Publication 811, 1995 Ed., (1995).
- [2] *Guide to the Expression of Uncertainty in Measurement*; ISBN 92-67-10188-9, 1st Ed., ISO, Geneva, Switzerland, (1993); 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://physics.nist.gov/Pubs/>.

**Certificate Revision History:** 03 September 2003 (This revision reflect a change in the expiration date); 29 June 2003 (This revision reflects an editorial change); 21 November 2001 (This technical revision reports a change in the expiration date); 31 December 1998 (Original certificate date).

*Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-6776; fax (301) 926-4751; e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet <http://www.nist.gov/srm>.*