# National Institute of Standards & Technology

# Certificate of Analysis

## Standard Reference Material® 2745

### Carbon Dioxide in Nitrogen

(Nominal Amount-of-Substance Fraction - 16.0 % mol/mol)

This Standard Reference Material (SRM) is a gas mixture to which the concentration, expressed as the amount-of-substance fraction, [1] of secondary working standards may be related. This SRM is intended for the calibration of instruments used for carbon dioxide determinations and for other applications including the analysis of mobile source carbon dioxide emissions.

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 12.5 MPa (1800 psi) which provides the user with 0.85 $m^3$ (30 $ft^3$) of useable mixture. The cylinder is the property of the purchaser and is equipped with a CGA 580 brass packless 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. The amount-of-substance fraction given below applies to the identified cylinder and NIST sample number.

Carbon Dioxide = 15.69 % mol/mol ± 0.06 % mol/mol

Cylinder Number: NIST Sample Number:

The uncertainty of the certified value includes the estimated uncertainty of the gravimetrically prepared primary standards, the imprecision of measurements intercomparing the primary standards to the lot control standard, and the imprecision of intercomparing the lot control standard with each of the mixtures comprising the lot. The uncertainty is expressed as an expanded uncertainty $U = ku_c$, with $u_c$ determined from experimental standard deviations and the coverage factor $k$ equal to 2. Since the amount-of-substance fraction values of gaseous SRMs are assumed to be normally distributed with an experimental standard deviation of $u_c$, the true value for the carbon dioxide 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 % [2].

**Expiration of Certification:** The certified value on this certificate is valid for four years from the date of shipment from NIST. A validation sticker is supplied with the gas cylinder to identify its certification period. **The sticker should be affixed to the cylinder upon receipt of the SRM.**

**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 580 inlet 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 T.L. Green and W.R. Miller of the NIST Analytical Chemistry Division.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by T.E. Gills.

Gaithersburg, MD 20899
Certificate Issue Date: July 25, 1996

Thomas E. Gills, Chief
Standard Reference Materials Program

Statistical consultation and data analysis was performed by H.K. Liu of the NIST Statistical Engineering Division.

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

**Mixture Preparation:** The gas mixture comprising this SRM lot was prepared in accordance with NIST technical specifications for its preparation by a commercial specialty gas vendor under contract to NIST. The specifications require that each SRM mixture be identical in carbon dioxide amount-of-substance fraction and stable with time.

**Analytical Method:** Intercomparisons of the carbon dioxide amount-of-substance fraction for this lot of cylinders were performed using a research gas chromatograph equipped with a thermal conductivity detector (GC/TCD).

**Homogeneity Analysis:** Each of the carbon dioxide mixtures which comprise this SRM lot was compared to the Lot Control Standard (LCS) at least twice on different days using the GC/TCD method. An analysis of variance indicated that sample to sample carbon dioxide amount-of-substance fraction 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 amount-of-substance fractions. Therefore, a single carbon dioxide amount-of-substance fraction has been assigned to the entire SRM lot.

**Carbon Dioxide Amount-of-Substance Fraction Value Assignment:** The certified carbon dioxide amount-of-substance fraction for this SRM lot was computed from: the assigned carbon dioxide amount-of-substance fraction for the LCS as determined by a calibration curve using the GC/TCD response ratios of the NIST primary standards suite to the LCS; and the mean response ratio of the lot as determined by the intercomparison of the LCS to each sample within the lot.

**Stability:** This SRM is stable. No losses of carbon dioxide have been observed for retained samples of this SRM for periods of time greater than four years. Periodic analyses of SRM units from this lot will be performed at NIST to monitor the stability of the lot. If significant changes in the carbon dioxide amount-of-substance fraction are observed, the purchaser will be notified.

**Recertification:** NIST will recertify this SRM mixture for an established fee. However, sufficient SRM gas pressure should remain in the cylinder to make certification cost effective. The NIST Analytical Chemistry Division should be contacted directly at (301) 975-3108 to arrange for this service.

## REFERENCES


[1] Taylor, B.N., "Guide for the Use of the International System of Units (SI)," NIST Special Publication 811, 1995 Ed., (April 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. and Kuyatt, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results," NIST Technical Note 1297, U.S. Government Printing Office, Washington D.C., (1994).