



# National Institute of Standards & Technology

## Certificate of Analysis

### Standard Reference Material<sup>®</sup> 2735

#### Nitric Oxide in Nitrogen

(Nominal Amount-of-Substance Fraction, 800  $\mu\text{mol/mol}$ )

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 may also be used for the calibration of instruments used for nitric oxide determinations and for other applications including the analysis of chemical and combustion process streams.

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-660 stainless steel valve which is the recommended outlet for this nitric oxide mixture. NIST recommends that this cylinder not be used below 0.7 MPa (100 psi).

**Certification:** This SRM mixture has been certified for nitric oxide concentration. The certified value given below applies to the identified cylinder and NIST sample number.

$$\text{Nitric Oxide} = 781.8 \mu\text{mol/mol} \pm 3.9 \mu\text{mol/mol}$$

Cylinder Number:

NIST Sample Number:

The uncertainty of the certified value includes the estimated uncertainties of the gravimetrically prepared primary standards, the imprecision of measurements intercomparing the primary standards to the lot standard (LS), and the imprecision of intercomparing the LS 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 concentration values of gaseous SRMs are assumed to be normally distributed with an experimental standard deviation of  $u_c$ , the true value for the nitric oxide concentration 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 **1 February 2004** 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-660 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 with oxygen. Contamination of this mixture with trace quantities of oxygen will cause a slow decrease in the nitric oxide value.

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 and S.K. Maxwell.

Gaithersburg, MD 20899  
Certificate Issue Date: 10 March 1998

Thomas E. Gills, Chief  
Standard Reference Materials Program

The analytical measurements leading to the certification of the current SRM lot was performed by W.J. Thorn III of the NIST Analytical Chemistry Division.

The overall direction and coordination of the technical work required for certification of this SRM lot was performed by F.R. Guenther of the NIST Analytical Chemistry 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 nitric oxide concentration and stable with time.

**Analytical Methods:** Analyses of the nitric oxide concentration for this lot of cylinders were conducted by intercomparing each cylinder mixture to a representative cylinder chosen from the lot, the lot standard (LS), using a chemiluminescent continuous analyzer. Assignment of the nitric oxide concentration to the LS was accomplished by intercomparison to primary gravimetric standards using chemiluminescence.

**Homogeneity Analysis:** Each of the nitric oxide mixtures which comprise this SRM lot was compared to the LS using chemiluminescence. An analysis of variance indicated that sample to sample nitric oxide concentration differences were not statistically significant. This indicates that within the precision of the NIST measurements, all of the cylinders comprising this SRM lot are identical in nitric oxide concentration. Therefore, a single concentration and uncertainty has been assigned to the entire SRM lot.

**Nitric Oxide Concentration Value Assignment:** The certified nitric oxide 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 will be performed at NIST to monitor stability. If significant changes in the nitric oxide concentration are observed, the purchaser will be notified. Refer to the Cylinder and Gas Handling Information section for proper handling instructions for this SRM.

**Total Oxides of Nitrogen (NO<sub>x</sub>):** Chemiluminescence measurements were used to estimate the nitrogen dioxide (NO<sub>2</sub>) contamination. Results on this SRM lot show that the mixtures contain negligible levels of NO<sub>2</sub> and therefore the NO<sub>x</sub> concentration equals the certified value.

#### 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 DC, (1994).

*It is the responsibility of users of this SRM to assure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: Phone (301) 975-6776 (select "Certificates"), Fax (301) 926-4751, e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov), or via the internet <http://ts.nist.gov/srm>.*