National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1686b

Nitric Oxide in Nitrogen

(Nominal Amount-of-Substance Fraction 500 µmol/mol)

This certificate reports the certified values for Lot 42-N-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 nitric oxide 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^3 (25.8 ft^3) 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.

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

Nitric Oxide Concentration:	496.98 µmol/mol ± 2.7 µmol/mol
Cylinder Number: <<SAMPLE>>	NIST Sample Number: <<SAMPLE>>
Hydrotest Date: <<SAMPLE>>	Blend Date: July 2014

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 a coverage factor $k = 2$. The true value for the nitric oxide 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 % [3].

Expiration of Certification: The certification of **SRM 1686b Lot No. 42-N-XX** is valid from this certificate issue date, within the measurement uncertainty specified, until **01 April 2023**, 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.

Cylinder and Gas Handling Information: NIST recommends the use of a high-purity, 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 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 ºC to 30 ºC.

The 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.

Carlos A. Gonzalez, Chief
Chemical Sciences Division

Gaithersburg, MD 20899
Certificate Issue Date: 06 April 2016

Steven J. Choquette, Acting Director
Office of Reference Materials

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Analytical measurements leading to the certification of the current SRM lot were performed by C.A. Goodman and J. Carney of the NIST Chemical Sciences Division.

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

Traceability: The measurand is the total concentration of nitric oxide in nitrogen and the certified value is metrologically traceable to the SI unit for mass expressed as micromole nitric oxide per total moles of nitric oxide and nitrogen.

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.

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 comparing each cylinder mixture to a representative cylinder chosen from the lot, the LS, using non dispersive ultraviolet (NDUV) spectroscopy. Assignment of the nitric oxide concentration to the LS was accomplished by comparison to primary gravimetric standards using chemiluminescence.

Homogeneity Analysis: Each of the nitric oxide mixtures that comprise this SRM lot was compared to the LS using non dispersive ultraviolet. A statistical analysis of the analytical results 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 have identical nitric oxide concentrations. Therefore, one concentration 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 lot standard and the homogeneity analysis.

CAS Registry Numbers: This SRM is certified for nitric oxide in nitrogen. The relevant CAS Registry numbers for these components are: nitric oxide CAS Registry 10102-43-9; nitrogen CAS Registry 7727-37-9.

Reference Concentration Values: Results for additional analyses performed during the certification process are given below. The concentrations reported are **NOT** certified values. A NIST reference value is a noncertified value that is the best estimate of the true value based on available data; however, the value does not meet the NIST criteria for certification [1] and is provided with associated uncertainties that may reflect only measurement reproducibility, may not include all sources of uncertainty, or may reflect a lack of sufficient statistical agreement among multiple analytical methods [2]. The measurand is the concentration of the total oxides of nitrogen in nitrogen as determined by the indicated method. Metrological traceability is to the SI unit for mass expressed as micromole of total oxides of nitrogen per total moles of total oxides of nitrogen and nitrogen.

Constituent	Concentration (µmol/mol)	Method
Total oxides of nitrogen	497.09 ± 2.7	NDUV

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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 Apr 2016).

[2] 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/publications.cfm (accessed Apr 2016).

[3] JCGM 100:2008; *Guide to the Expression of Uncertainty in Measurement*; (GUM 1995 with Minor Corrections), Joint Committee for Guides in Metrology (JCGM) (2008); available at http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf (accessed Apr 2016); 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/index.cfm (accessed Apr 2016).

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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) 948-3730; e-mail srminfo@nist.gov; or via the Internet at http://www.nist.gov/srm.