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Standard Reference Materials: Summary of Gas Cylinder and Permeation Tube Standard Reference Materials Issued by the National Bureau of Standards

R. Mavrodineanu and T. E. Gills

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Preface

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The 260 Series is dedicated to the dissemination of information on different phases of the preparation, measurement, certification, and use of NBS SRM's. In general, much more detail will be found in these papers than is generally allowed, or desirable, in scientific journal articles. This enables the user to assess the validity and accuracy of the measurement processes employed, to judge the statistical analysis, and to learn details of techniques and methods utilized for work entailing greatest care and accuracy. These papers also should provide sufficient additional information not found on the certificate so that new applications in diverse fields not foreseen at the time the SRM was originally issued will be sought and found.

Inquiries concerning the technical content of this paper should be directed to the author(s). Other questions concerned with the availability, delivery, price, and so forth, will receive prompt attention from:

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Seward, R. W., ed., NBS Standard Reference Materials Catalog 1986-87, NBS Spec. Publ. 260 SN003-003-02558-5. (June 1986)

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TABLE OF CONTENTS

ABSTRACT

This publication is a summary of the gas cylinders and permeation tubes issued by NBS as Standard Reference Materials (SRM's). The material, composition, certification, use, and remarks concerning each of the SRM's described are presented in tabular form. Copies of the certificates of these SRM's are contained in the appendices for more detailed information.

Key Words: air, benzene, carbon dioxide, carbon monoxide, gas, methane, nitric oxide, nitrogen, nitrogen dioxide, nitrous oxide, oxygen, permeation tubes, propane, Standard Reference Materials, sulfur dioxide.

INTRODUCTION

Since its inauguration in 1901, the National Bureau of Standards (NBS) has issued nearly 2,000 different Standard Reference Materials (SRM's). Many of these have been renewed several times; many have been replaced or discontinued as technology changes. Today, over 900 SRM's are available, together with a large number of scientific publications related to the fundamental and applied characteristics of these materials. Each material is certified for chemical composition, chemical properties, or its physical or mechanical characteristics. Each SRM is provided with a Certificate that contains the essential data concerning its properties or characteristics. The SRM's currently available cover a wide range of chemical, physical, and mechanical properties, and a corresponding wide range of measurement interests in practically all aspects of fundamental and applied science. These SRM's constitute a unique and invaluable means of transferring to the user accurate data obtained at NBS, and provide essential tools that can be used to improve accuracy in practically all areas where measurements are performed.

In addition to SRM's, the National Bureau of Standards issues a variety of Reference Materials (RM's). These RM's meet the ISO definition for RM's, and many meet the definition for CRM's. The documentation issued with these materials is either of the following:

(1) A "Report of Investigation," for a RM: the sole authority of which is the author of the report. RM's are intended to further scientific or technical research on that particular material. The principle consideration in obtaining a RM is to provide a homogeneous material so that investigators in different laboratories are assured that they are investigating the same material.

(2) A "Certificate," for a CRM: issued by the certifying agency (other than NBS), e.g., other national laboratories, government agencies, standardizing bodies, or non-profit organizations. When deemed to be in the public interest and when alternate means of national distribution do not exist, NBS acts as the distributor for such materials. This service is available to qualified organizations that have the reference materials to meet some national measurement need.

The categories of materials available from NBS are given in Table 1. This table lists these materials according to their chemical composition, physical properties, or engineering characteristics. A more detailed description and enumeration of these materials is given in the NBS Special Publication 260, NBS Standard Reference Materials Catalog, 1986-87 Edition[1]. The publication lists every material available from the NBS Office of Standard Reference Materials.

In addition to these types of materials, NBS provides many additional services. These include: Measurement Assurance Programs, Calibration and Related Measurement Services, Proficiency Sample Programs, a National Voluntary Laboratory Accreditation Program, Standard Reference Data, and Technical Information and Publications.

Further information on reference materials are available from NBS and may be obtained from the Office of Standard Reference Materials, National Bureau of Standards, Gaithersburg, MD 20899. Information on the other NBS services may be obtained from the Technical Information and Publications Division, National Bureau of Standards, Gaithersburg, MD 20899.

[1]For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Table 1. Categories of Standard Reference Materials Available From the National Bureau of Standards.

CERTIFIED CHEMICAL COMPOSITION STANDARDS

Ferrous Alloys
- Steels (Chip Form)
  - Plain Carbon
  - Low Alloy
  - Special Low Alloy
  - High Alloy
  - Stainless
  - Tool
- Steels (Solid Form)
  - Low Alloy
  - Stainless
  - Specialty
  - High Temperature
- Steelmaking Alloys
- Cast Irons (Chip Form)
- Cast Steels, White Cast Irons, Ductile Irons, and Blast Furnace Irons (Solid Form)

Nonferrous Alloys
- Aluminum-Base Alloys
- Copper-Base Alloys (Chip Form)
- Copper-Base Alloys (Solid Form)
- Copper "Benchmark"
- Lead-Base Alloys
- Nickel-Base Alloys
- Trace Elements in Nickel-Base Superalloys (Chip Form)
- Nickel Oxides (Powder Form)
- Titanium-Base Alloys (Chip Form)
- Titanium-Base Alloys (Solid Form)
- Zinc-Base Alloys
- Zirconium-Base Alloys

Gases in Metals

High Purity Metals

Microanalytical
- Metals for Microanalysis
- Mineral Glasses for Microanalysis
- Glasses for Microanalysis
- Glass Fibers for Microanalysis

Primary, Working, and Secondary Chemicals

Microchemicals

Spectrometric Solutions

Clinical Laboratory
- Serum Reference Materials

Biological Materials
- Food and Beverage
- Ethanol Solutions
- Agriculture

Environmental Materials
- Analyzed Gases
- Permeation Devices
- Analyzed Liquids and Solids
- Simulated Rainwaters
- Sulfur in Fossil Fuels
- Trace Elements
- Organic Constituents
- GC/MS System Performance

Industrial Hygiene
- Freeze-Dried Urine
- Materials on Filter Media
- Thin Films for X-ray Fluorescence
- Respirable Quartz
- Asbestos

Lubricating Materials
- Metallo-Organic Compounds
- Catalyst Package for Lubricant Oxidation
- Wear-Metals in Oil

Fertilizers

Ores

Rocks, Minerals, and Refractories

Carbides

Glasses

Cements

Trace Elements

Nuclear Materials
- Special Nuclear Materials
  - Plutonium Assay
  - Plutonium Isotopic
  - Uranium Assay
  - Uranium Isotopic
- Special Nuclear Containers
- Radiation Dosimetry
- Fission Track Glasses

Stable Isotopic Materials

PHYSICAL PROPERTIES

Ion Activity
- pH
- pD
- Ion-Selective Electrodes

Metrology
- Scanning Electron Microscope
- Optical Microscope Linewidth-Measurement
- Depth Profiling

Coating Thickness
- Nonmagnetic Coating on Magnetic Substrate
- Magnetic Coating on Magnetic Substrate

Coating Weight
- Gold Coating on Glass Sealing Alloy
- Gold Coating on Nickel

Particle, Gamma-ray, and Chemical Resistance (Durability of Glass)
- Electrical Properties of Glass
- Viscosity
- Viscosity Fixpoints
- Relative Stress Optical Coefficient
- Glass Liquidus Temperature

Elasticity

Density

Microhardness

Ultrasonics

Polymers
- Molecular Weight

Heat
- Calorimetric
  - Combustion
  - Solution
  - Heat Source
  - Enthalpy and Heat Capacity
  - Differential Scanning Calorimetry
  - Differential Thermal Analysis
- Superconductive Thermometric Fixed Point Devices
- Freezing Point Materials
  - Defining Fixed Points
  - Secondary Reference Points
  - Melting Point Materials
  - Laboratory Thermometer
  - Thermocouple Material

Vapor Pressure

Thermal Conductivity

Thermal Expansion

Magnetic
- Magnetic Susceptibility
- Magnetic Moment

Optical
- Spectrophotometric
- Reflectance
  - Specular Spectral Reflectance
  - Directional-Hemispherical Reflectance
  - Refractive Index
  - Optical Rotation

Radioactivity
- Alpha-particle, Beta-Glass Electron-capture Solutions
- Alpha-particle Point-Sources
- Radiocarbon Dating and Ground Water Studies
- Gaseous Materials
- Gamma-ray and X-ray Point Sources
- Low-Energy Photon Point-Sources
- Radium-226 Solutions
  - Radon Analysis
- Gamma-ray Solutions
- Rheology
- Environmental Natural Matrix Materials for Traceability Tests
- Radiopharmaceuticals
- Special Nuclear Material Packaging

Metallurgical

Abrasive Wear

Corrosion
- Electrochemical Potential and Thickness
- Pitting or Crevice Corrosion

X-ray Fluorescent Emission Target

X-ray Diffraction

Gas Transmission

Reference Fuels

Electrical Resistivity and Conductivity
- Metals
- Silicon
- Residual Resistivity Ratio
- Eddy Current

Superconducting Critical Current

Dye Penetrant Test Blocks

ENGINEERING STANDARDS

Standard Rubbers and Rubber-Compounding Materials
Sizing
- Particle Size
- Cement Turbidimetric and Fineness
- Surface Area

Performance Standards
- Socketed Ball Bar
- Radiographic Image Quality
- Surface Roughness

Color
X-ray and Photographic
Magnetic Computer Storage Media
Centerline Drawings for Optical Character Recognition
Fire Research
- Surface Flammability
- Smoke Density Chamber
- Flooring Radiant Panel

GAS CYLINDERS AND PERMEATION TUBES

This NBS Special Publication 260, "Summary of the Gas Cylinder and Permeation Tube Standard Reference Materials Issued by the National Bureau of Standards," is the fifth volume of a series that is designed to present to the reader, in a condensed form, the main characteristics of a number and variety of SRM's available from NBS.

The first volume, NBS SP 260-71 is entitled "Summary of the Clinical Laboratory Standards Issued by the National Bureau of Standards," and was issued in 1981. This was followed by the second volume NBS SP 260-97, "Summary of the Coal, Ore, Mineral, Rock, and Refractory Standards Issued by the National Bureau of Standards," which was published in 1985. The next NBS SP 260-104, "Summary of the Biological and Botanical Standards Issued by the National Bureau of Standards," in 1985 was followed by the fourth NBS Special Publication 260-105, "Summary of Environmental Research Analysis and Control Standards Issued by the National Bureau of Standards," which was published in 1986.

This fifth summary volume in the NBS SP 260 series gives in Tables 2 and 3 essential information concerning the material composition, the certification parameters, and the uses of various gases, gas mixtures, and permeation tube SRM's. Under "Remarks," additional data are provided. All the data and information contained in this table were extracted from the Certificates of Analysis issued for the included SRM's. An examination of the table gives the reader a general view, but for more detailed information, the individual Certificates reproduced in Appendix I should be consulted as well as any reference cited in each certificate. The Certificates in Appendix I are arranged in numerical order. The SRM's listed in the tables include all standards that were in stock as of January 1, 1986. These SRM's are the result of the concerted efforts of a number of scientists from the NBS National Measurement Laboratory, Center for Analytical Chemistry, and from industry. Each Certificate lists the individuals and laboratories who contributed to the preparation and certification of the SRM.

TABLE 2. SUMMARY OF THE GAS CYLINDER STANDARD REFERENCE MATERIALS

SRM: 1658 (renewals)
Methane in Air.

MATERIAL: Methane in air is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT (Department of Transportation) specifications and are equipped with CGA - 350 valves.

COMPOSITION: Nominal Concentration: 1 μmole/mole (ppm), CH_4.

CERTIFICATION: Each cylinder is individually analyzed by comparison with a secondary standard using gas chromatography with flame-ionization detector.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used for the analysis of methane in air.

REMARKS: The certified values are valid for 2 years from the date of shipment. The cylinder becomes the property of the purchaser.

SRM: 1659 (renewals)
Methane in Air.

MATERIAL: Same as SRM 1658.

COMPOSITION: Nominal concentration: 10 μmole/mole (ppm), CH_4.

CERTIFICATION: Same as SRM 1658.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1658.

REMARKS: Same as SRM 1658.

SRM: 1660 (renewals)
Methane and Propane in Air.

MATERIAL: The gas mixture is supplied in the same manner as for SRM 1658.

COMPOSITION: Nominal concentration: 4 μmole/mole (ppm), CH_4; and 1 μmole/mole (ppm), C_3H_8.

CERTIFICATION: Same as SRM 1658.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used to differentiate the methane and non-methane fractions of hydrocarbon in the air.

REMARKS: Same as SRM 1658.

SRM: 1661 (renewals)
Sulfur Dioxide in Nitrogen.

MATERIAL: Sulfur dioxide in nitrogen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 660 valves.

COMPOSITION: Nominal concentration: 500 μmole/mole (ppm), SO_2.

CERTIFICATION: Each cylinder is individually analyzed by comparison with a set of NBS primary standards using gas chromatography with a thermal conductivity detector and/or a non-dispersive infrared analyzer.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: This SRM is intended primarily for use as a primary standard to calibrate instruments used for the analysis of SO_2 emitted from stationary sources.

REMARKS: The certified values are valid for 2 years from the date of shipment. The cylinder becomes the property of the purchaser.

SRM:	1662 (renewals) Sulfur Dioxide in Nitrogen.
MATERIAL:	Same as SRM 1661.
COMPOSITION:	Nominal concentration: 1000 μmole/mole (ppm), SO_2.
CERTIFICATION:	Same as SRM 1661.
UNCERTAINTY OF CERTIFIED VALUE:	≤ 1% relative.
USE:	Same as 1661.
REMARKS:	Same as 1661.

SRM:	1663 (renewals) Sulfur Dioxide in Nitrogen.
MATERIAL:	Same as SRM 1661.
COMPOSITION:	Nominal concentration: 1500 μmole/mole (ppm), SO_2.
CERTIFICATION:	Same as SRM 1661.
UNCERTAINTY OF CERTIFIED VALUE:	≤ 1% relative.
USE:	Same as SRM 1661.
REMARKS:	Same as SRM 1661.

SRM: 1664 (renewals)
Sulfur Dioxide in Nitrogen.

MATERIAL: Same as SRM 1661.

COMPOSITION: Nominal concentration: 2500 μmole/mole (ppm), SO_2.

CERTIFICATION: Same as SRM 1661.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1661.

REMARKS: Same as SRM 1661.

SRM: 1665 (renewals)
Propane in Air.

MATERIAL: Propane in air is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 350 valves.

COMPOSITION: Nominal concentration: 3 μmole/mole (ppm), C_3H_8.
Oxygen content: 20.9 mole percent.

CERTIFICATION: Each cylinder is individually analyzed by comparison with gravimetric primary standards using gas chromatography and flame-ionization detector.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emission.

REMARKS: The certified values are valid for 2 years from date of shipment. The cylinder becomes the property of the purchaser.

SRM: 1666 (renewals)
Propane in Air.

MATERIAL: Same as SRM 1665.

COMPOSITION: Nominal concentration: 10 μmole/mole (ppm), C_3H_8.
Oxygen content: 20.9 mole percent.

CERTIFICATION: Same as SRM 1665.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1665.

REMARKS: Same as SRM 1665.

SRM: 1667 (renewals)
Propane in Air.

MATERIAL: Same as SRM 1665.

COMPOSITION: Nominal concentration: 50 μmole/mole (ppm), C_3H_8.
Oxygen content: 20.9 mole percent.

CERTIFICATION: Same as SRM 1665.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1665.

REMARKS: Same as SRM 1665.

SRM: 1668 (renewals)
Propane in Air.

MATERIAL: Same as SRM 1665.

COMPOSITION: Nominal concentration: 100 μmole/mole (ppm), C_3H_8.
Oxygen content: 20.9 mole percent.

CERTIFICATION: Same as SRM 1665.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1665.

REMARKS: Same as SRM 1665.

SRM: 1669 (renewals)
Propane in Air.

MATERIAL: Same as SRM 1665.

COMPOSITION: Nominal concentration: 500 μmole/mole (ppm), C_3H_8.
Oxygen content: 20.9 mole percent.

CERTIFICATION: Same as SRM 1665.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1665.

REMARKS: Same as SRM 1665.

SRM: 1670
Carbon Dioxide in Air.

MATERIAL: Carbon dioxide in air is supplied in cylinders with a deliverable volume of about 0.76 m^3 (27 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 580 valves.

COMPOSITION: Nominal concentration: 330 μmole/mole (ppm), CO_2. Estimated oxygen: 20.95 mole percent: nitrous oxide: 0.06 ppm by mole N_2O. Water vapor: 24 ppm by mole maximum.

CERTIFICATION: Each cylinder is individually analyzed by comparison with standards established by gravimetry, using gas chromatography and/or non-dispersive infrared method.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.06% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments and methods used for the measurement of CO_2 in air.

REMARKS: The certified values are valid for 2 years from the date of shipment. The gas should not be used as an analytical standard when the pressure falls below 2.07 MPa (300 psi). The cylinders become the property of the purchaser.

SRM: 1671
Carbon Dioxide in Air.

MATERIAL: Same as SRM 1670.

COMPOSITION: Nominal concentration: 340 μmole/mole (ppm), CO_2. Estimated oxygen: 20.95 mole percent; nitrous oxide: 0.08 ppm by mole N_2O; water vapor 24 ppm by mole maximum.

CERTIFICATION: Same as SRM 1670.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.06% relative.

USE: Same as SRM 1670.

REMARKS: Same as SRM 1670.

SRM: 1672
Carbon Dioxide in Air.

MATERIAL: Same as 1670.

COMPOSITION: Nominal concentration: 350 μmole/mole (ppm), CO_2. Estimated oxygen: 20.95 mole percent; nitrous oxide: 0.03 ppm by mole N_2O; water vapor 24 ppm by mole maximum.

CERTIFICATION: Same as SRM 1670.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.06% relative.

USE: Same as SRM 1670.

REMARKS: Same as SRM 1670.

SRM: 1674 (renewals)
Carbon Dioxide in Nitrogen.

MATERIAL: Carbon dioxide in nitrogen is supplied in cylinders at 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 580 valves.

COMPOSITION: Nominal concentration: 7 mole percent, CO_2.

CERTIFICATION: Same as SRM 1670. The method of intercomparison was gas chromatography using thermal conductivity.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1670.

REMARKS: SRM 1674 should be stored at room temperature and should not be allowed to experience high or low ambient temperature. The stability is considered to be excellent, however, the certified value is valid for only 2 years from date of shipment. The cylinders become the property of the purchaser.

SRM: 1675 (renewals)
Carbon Dioxide in Nitrogen.

MATERIAL: Same as SRM 1674.

COMPOSITION: Nominal concentration: 14 mole percent, CO_2.

CERTIFICATION: Same as SRM 1674.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1674.

REMARKS: Same as SRM 1674.

SRM: 1677 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Carbon monoxide in nitrogen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 350 valves.

COMPOSITION: Nominal concentration: 10 μmole/mole (ppm), CO.

CERTIFICATION: Each cylinder is individually analyzed by comparison with secondary standards using catalytic reduction of CO with hydrogen. The resulting methane is analyzed with flame-ionization hydrocarbon analyzer and non-dispersive infrared analysis.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used for the analysis of CO in mobile-source emissions.

REMARKS: The certified values are valid for 2 years from the date of shipment. The cylinders are the property of the purchaser.

SRM: 1678 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 1677.

COMPOSITION: Nominal concentration: 50 μmole/mole (ppm), CO.

CERTIFICATION: Same as SRM 1677.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1677.

REMARKS: Same as SRM 1677.

SRM: 1679 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 1677.

COMPOSITION: Nominal concentration: 100 μmole/mole (ppm), CO.

CERTIFICATION: Same as SRM 1677.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1677.

REMARKS: Same as SRM 1677.

SRM: 1680 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 1677.

COMPOSITION: Nominal concentration: 500 μmole/mole (ppm), CO.

CERTIFICATION: Same as SRM 1677.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1677.

REMARKS: Same as SRM 1677.

SRM: 1681 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 1677.

COMPOSITION: Nominal concentration: 1000 μmole/mole (ppm), CO.

CERTIFICATION: Same as SRM 1677.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1677.

REMARKS: Same as SRM 1677.

SRM: 1683 (renewals)
Nitric Oxide in Nitrogen.

MATERIAL: Nitric oxide in nitrogen is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 660 valves.

COMPOSITION: Nominal concentration: 50 μmole/mole (ppm), NO.

CERTIFICATION: Each cylinder is individually analyzed by comparison with standards using the chemiluminescent reaction of NO with ozone. No other oxides of nitrogen were detected at the 1 percent or less limit.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1.5% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used for the analysis of oxides of nitrogen in mobile-source emissions.

REMARKS: The certified values are valid for 2 years from the date of shipment. The gas should not be used below a pressure of 2.8 MPa (400 psi). The cylinder becomes the property of the purchaser.

SRM: 1684 (renewals)
Nitric Oxide in Nitrogen.

MATERIAL: Same as SRM 1683.

COMPOSITION: Nominal concentration: 100 μmole/mole (ppm), NO.

CERTIFICATION: Same as SRM 1683.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1683.

REMARKS: Same as SRM 1683.

SRM: 1685 (renewals)
Nitric Oxide in Nitrogen.

MATERIAL: Same as SRM 1683.

COMPOSITION: Nominal concentration: 250 μmole/mole (ppm), NO.

CERTIFICATION: Same as SRM 1683.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1.5% relative.

USE: Same as SRM 1683.

REMARKS: Same as SRM 1683.

SRM: 1686 (renewals)
Nitric Oxide in Nitrogen.

MATERIAL: Same as SRM 1683.

COMPOSITION: Nominal concentration: 500 μmole/mole (ppm), NO.

CERTIFICATION: Same as SRM 1683.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1683.

REMARKS: Same as SRM 1683.

SRM: 1687 (renewals)
Nitric Oxide in Nitrogen.

MATERIAL: Same as SRM 1683.

COMPOSITION: Nominal concentration: 1000 μmole/mole (ppm), NO.

CERTIFICATION: Same as SRM 1683.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1683.

REMARKS: Same as SRM 1683.

SRM: 1693 (renewals)
Sulfur Dioxide in Nitrogen.

MATERIAL: Sulfur dioxide in nitrogen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 660 valves.

COMPOSITION: Nominal concentration: 50 μmole/mole (ppm), SO_2.

CERTIFICATION: Each cylinder is individually analyzed by comparison with NBS primary standards, using gas chromatography with thermal conductivity detector and/or non-dispersive infrared analyzer.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 2% relative.

USE: This SRM is intended primarily for use as a primary standard to calibrate instruments used for the analysis of SO_2 emitted from stationary sources.

REMARKS: The certified values are valid for 2 years from the date of shipment. The cylinder becomes the property of the purchaser.

SRM: 1694 (renewals)
Sulfur Dioxide in Nitrogen.

MATERIAL: Same as SRM 1693.

COMPOSITION: Nominal concentration: 100 μmole/mole (ppm), SO_2.

CERTIFICATION: Same as SRM 1693.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 2% relative.

USE: Same as SRM 1693.

REMARKS: Same as SRM 1693.

SRM: 1696 (renewals)
Sulfur Dioxide in Nitrogen.

MATERIAL: Same as SRM 1693.

COMPOSITION: Nominal concentration: 3500 μmole/mole (ppm), SO_2.

CERTIFICATION: Same as SRM 1693.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1693.

REMARKS: Same as SRM 1693.

SRM: 1805
Benzene in Nitrogen.

MATERIAL: Benzene in nitrogen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 350 valves.

COMPOSITION: Nominal concentration: 0.25 μmole/mole (ppm), C_6H_6.

CERTIFICATION: Each cylinder is individually analyzed by comparison with gravimetric standards and with a calibrated benzene permeation system using gas chromatography and flame-ionization detector.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 2% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used to determine C_6H_6 in stationary-source emissions. For precautions in using this SRM, see Certificate.

REMARKS: The certified values are valid for 2 years from the date of shipment. The cylinders become the property of the purchaser.

SRM: 1806
Benzene in Nitrogen.

MATERIAL: Same as SRM 1805.

COMPOSITION: Nominal concentration: 10 μmole/mole (ppm), C_6H_6.

CERTIFICATION: Same as SRM 1805.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 1805.

REMARKS: Same as SRM 1805.

SRM: 1808
Tetrachloroethylene in Nitrogen.

MATERIAL: Tetrachloroethylene in nitrogen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a deliverable volume of 0.72 m^3 (25 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA - 350 valves.

COMPOSITION: Nominal concentration: 0.25 μmole/mole (ppm), CCL_2CCL_2 balance N_2.

CERTIFICATION: Each cylinder was certified by comparison with a set of gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a flame-ionization detector.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 2% relative.

USE: This Standard Reference Material (SRM) is intended for use in the calibration of instruments used for the determination of tetrachloroethylene in stationary-source emissions.

REMARKS: The certification of this SRM is considered valid for only 2 years from the date of shipment. The cylinder becomes the property of the purchaser.

SRM: 1809
Tetrachloroethylene in Nitrogen.

MATERIAL: Same as SRM 1808.

COMPOSITION: Nominal concentration: 10 μmole/mole (ppm), CCL_2CCL_2 balance N_2.

CERTIFICATION: Same as SRM 1808.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 2% relative.

USE: Same as SRM 1808.

REMARKS: Same as SRM 1808.

SRM: 1811
Benzene, Toluene, Chlorobenzene, and Bromobenzene in Nitrogen.

MATERIAL: Benzene, Toluene, Chlorobenzene, and Bromobenzene in Nitrogen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA - 350 valves.

COMPOSITION: Nominal concentration: 0.25 μmole/mole (ppm), C_6H_6, $C_6H_5CH_3$, C_6H_5CL, C_6H_5Br, balance N_2.

CERTIFICATION: Each cylinder is individually analyzed by comparison to a set of gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a flame-ionization detector.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 2% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used for the determination of volatile aromatic hydrocarbons (benzene, toluene, chlorobenzene, and bromobenzene) in stationary-source emissions.

REMARKS: The certified data are valid within the stated limits of uncertainty for 2 years from the date of shipment. The cylinder becomes the property of purchaser.

SRM: 1812
Benzene, Toluene, Chlorobenzene, and Bromobenzene in Nitrogen.

MATERIAL: Same as SRM 1811.

COMPOSITION: Nominal concentration: 10 μmole/mole (ppm), C_6H_6, $C_6H_5CH_3$, C_6H_5Cl, C_6H_5Br, balance N_2.

CERTIFICATION: Same as SRM 1811.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1.5% relative.

USE: Same as SRM 1811.

REMARKS: Same as SRM 1811.

SRM: 2607
Carbon Dioxide and Nitrous Oxide in Air.

MATERIAL: Carbon dioxide and nitrous oxide in air is supplied in aluminum cylinders with a deliverable volume of approximately 3.82 m^3 (135 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA - 660 valves.

COMPOSITION: Nominal concentration: 340 μmole/mole (ppm) CO_2; 300 nmole/mole (ppb) N_2O balance air.

CERTIFICATION: The carbon dioxide and nitrous oxide contents were determined by comparison to NBS working standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison was gas chromatography and/or a non-dispersive infrared spectrometric method for carbon dioxide, and electron capture-gas chromatography and tunable diode laser spectroscopy for nitrous oxide.

UNCERTAINTY OF CERTIFIED VALUE: CO_2, ≤ 0.06% relative; N_2O, ≤ 1% relative.

USE: As a primary standard for use in the calibration of instruments and the evaluation of methods used for the measurement of carbon dioxide and nitrous oxide in the atmosphere.

REMARKS: The certified values are valid for 2 years from the date of shipment from NBS. The cylinders become the property of purchaser.

SRM: 2608
Carbon Dioxide and Nitrous Oxide in Air.

MATERIAL: Same as SRM 2607 except that the cylinder is smaller and has a deliverable volume of approximately 0.76 m^3 (27 cubic feet) at STP.

COMPOSITION: Same as SRM 2607.

CERTIFICATION: Same as SRM 2607.

UNCERTAINTY OF CERTIFIED VALUE: CO_2, ≤ 0.06% relative; N_2O, ≤ 1% relative.

USE: Same as SRM 2607.

REMARKS: Same as SRM 2607.

SRM: 2609
Carbon Dioxide and Nitrous Oxide in Air.

MATERIAL: Same as SRM 2607.

COMPOSITION: Nominal concentration: 380 μmole/mole (ppm) CO_2, 330 nmole/mole (ppb) N_2O, balance air.

CERTIFICATION: Same as SRM 2607.

UNCERTAINTY OF CERTIFIED VALUE: CO_2, ≤ 0.05% relative; N_2O, ≤ 1% relative.

USE: Same as SRM 2607.

REMARKS: Same as SRM 2607.

SRM: 2610
Carbon Dioxide and Nitrous Oxide in Air.

MATERIAL: Same as SRM 2607 except the cylinder is smaller and has a deliverable volume of approximately 0.76 m^3 (27 cubic feet) at STP.

COMPOSITION: Same as SRM 2609.

CERTIFICATION: Same as SRM 2607.

UNCERTAINTY OF CERTIFIED VALUE: CO_2, ≤ 0.05% relative; N_2O, ≤ 1% relative.

USE: Same as SRM 2607.

REMARKS: Same as SRM 2607.

SRM: 2612 (renewals)
Carbon Monoxide in Air.

MATERIAL: Carbon monoxide in air is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 350 valves.

COMPOSITION: Nominal concentration: 10 μmole/mole (ppm), CO.

CERTIFICATION: Each cylinder is individually analyzed by comparison with standards related to a set of gravimetric standards, using non-dispersive infrared technique and by measurement of methane produced by catalytic reduction of CO.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: As a primary standard in the calibration of instruments for the analysis of CO in air and as a complement to SRM's 1677 and 1678.

REMARKS: The certified data are valid for 1 year from date of shipment. The cylinder becomes the property of the purchaser.

SRM: 2613 (renewals)
Carbon Monoxide in Air.

MATERIAL: Same as SRM 2612.

COMPOSITION: Nominal concentration: 20 μmole/mole (ppm), CO.

CERTIFICATION: Same as SRM 2612.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2612.

REMARKS: Same as SRM 2612.

SRM: 2614 (renewals)
Carbon Monoxide in Air.

MATERIAL: Same as SRM 2612.

COMPOSITION: Nominal concentration: 45 μmole/mole (ppm), CO.

CERTIFICATION: Same as SRM 2612.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2612.

REMARKS: Same as SRM 2612.

SRM: 2619
Carbon Dioxide in Nitrogen.

MATERIAL: Carbon dioxide in nitrogen is supplied in cylinders at 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 580 valves.

COMPOSITION: Nominal concentration: 0.5 mole percent CO_2.

CERTIFICATION: Each cylinder is individually analyzed by comparison with standards established in gravimetry, using gas chromatography with thermal conductivity detector.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.1% relative.

USE: This SRM is intended primarily for use as a primary standard to determine the fuel efficiency of motor vehicles.

REMARKS: The certified values are valid for 1 year from date of shipment. This SRM shall be stored at room temperature. The cylinder becomes the property of the purchaser.

SRM: 2620 (renewals)
Carbon Dioxide in Nitrogen.

MATERIAL: Same as SRM 2619.

COMPOSITION: Nominal concentration: 1.0 mole percent CO_2.

CERTIFICATION: Same as SRM 2619.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.1% relative.

USE: Same as SRM 2619.

REMARKS: Same as SRM 2619.

SRM: 2621 (renewals)
Carbon Dioxide in Nitrogen.

MATERIAL: Same as SRM 2619.

COMPOSITION: Nominal concentration: 1.5 mole percent CO_2.

CERTIFICATION: Same as SRM 2619.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.1% relative.

USE: Same as SRM 2619.

REMARKS: Same as SRM 2619.

SRM: 2622 (renewals)
Carbon Dioxide in Nitrogen.

MATERIAL: Same as SRM 2619.

COMPOSITION: Nominal concentration: 2.0 mole percent CO_2.

CERTIFICATION: Same as SRM 2619.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.1% relative.

USE: Same as SRM 2619.

REMARKS: Same as SRM 2619.

SRM: 2623 (renewals)
Carbon Dioxide in Nitrogen.

MATERIAL: Same as SRM 2619.

COMPOSITION: Nominal concentration: 2.5 mole percent CO_2.

CERTIFICATION: Same as SRM 2619.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.1% relative.

USE: Same as SRM 2619.

REMARKS: Same as SRM 2619.

SRM: 2624 (renewals)
Carbon Dioxide in Nitrogen.

MATERIAL: Same as SRM 2619.

COMPOSITION: Nominal concentration: 3.0 mole percent CO_2.

CERTIFICATION: Same as SRM 2619.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.1% relative.

USE: Same as SRM 2619.

REMARKS: Same as SRM 2619.

SRM: 2625 (renewals)
Carbon Dioxide in Nitrogen.

MATERIAL: Same as SRM 2619.

COMPOSITION: Nominal concentration: 3.5 mole percent CO_2.

CERTIFICATION: Same as SRM 2619.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.1% relative.

USE: Same as SRM 2619.

REMARKS: Same as SRM 2619.

SRM: 2626 (renewals)
Carbon Dioxide in Nitrogen.

MATERIAL: Same as SRM 2619.

COMPOSITION: Nominal concentration: 4.0 mole percent CO_2.

CERTIFICATION: Same as SRM 2619.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 0.1% relative.

USE: Same as SRM 2619.

REMARKS: Same as SRM 2619.

SRM: 2627 (renewals)
Nitric Oxide in Nitrogen.

MATERIAL: Nitric oxide in nitrogen is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 660 valves.

COMPOSITION: Nominal concentration: 5 μmole/mole (ppm), NO.

CERTIFICATION: Each cylinder is individually analyzed by comparison with standards using the chemiluminescent reaction of NO with ozone. No other oxides of nitrogen were detected at the 1 percent or less limit.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 2% relative.

USE: This SRM is intended primarily for use as a primary standard for the calibration of instruments used for the analysis of oxides of nitrogen in mobile-source emissions.

REMARKS: The certified values are valid for 1 year from date of shipment. The gas should not be used below a pressure of 2.8 MPa (400 psi). The cylinder becomes the property of the purchaser.

SRM: 2628 (renewals)
Nitric Oxide in Nitrogen.

MATERIAL: Same as SRM 2627.

COMPOSITION: Nominal concentration: 10 μmole/mole (ppm), NO.

CERTIFICATION: Same as SRM 2627.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 2% relative.

USE: Same as SRM 2627.

REMARKS: Same as SRM 2627.

SRM: 2629 (renewals)
Nitric Oxide in Nitrogen.

MATERIAL: Same as SRM 2627.

COMPOSITION: Nominal concentration: 20 μmole/mole (ppm), NO.

CERTIFICATION: Same as SRM 2627.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 2% relative.

USE: Same as SRM 2627.

REMARKS: Same as SRM 2627.

SRM: 2630 (renewals)
Nitric Oxide in Nitrogen.

MATERIAL: Same as SRM 2627. The gas is supplied in aluminum cylinders.

COMPOSITION: Nominal concentration: 1500 μmole/mole (ppm), NO.

CERTIFICATION: Same as SRM 2627. The maximum concentration of nitrogen dioxide does not exceed 0.5% relative to the NO in the sample.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2627.

REMARKS: The certified values are valid for 2 years from the date of shipment. The cylinder becomes the property of the purchaser.

SRM: 2631 (renewals)
Nitric Oxide in Nitrogen.

MATERIAL: Same as SRM 2630.

COMPOSITION: Nominal concentration: 3000 μmole/mole (ppm), NO.

CERTIFICATION: Same as SRM 2630.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2630.

REMARKS: Same as SRM 2630.

SRM: 2632 (renewals)--POSSIBLE DISCONTINUANCE
Carbon Dioxide in Nitrogen.

MATERIAL: Carbon dioxide in nitrogen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 580 valves.

COMPOSITION: Nominal concentration: 300 μmole/mole (ppm), CO_2.

CERTIFICATION: Each cylinder is individually analyzed by comparison with standards established by gravimetry, using non-dispersive infrared and gas chromatography with ultrasonic detector techniques.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used for the determination of carbon dioxide in mobile-source emissions.

REMARKS: The certified values are valid for 2 years from the date of shipment. The cylinder becomes the property of the purchaser.

SRM: 2633 (renewals)--POSSIBLE DISCONTINUANCE
Carbon Dioxide in Nitrogen.

MATERIAL: Same as SRM 2632.

COMPOSITION: Nominal concentration: 400 μmole/mole (ppm), CO_2.

CERTIFICATION: Same as SRM 2632.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2632.

REMARKS: Same as SRM 2632.

SRM: 2634 (renewals)--**POSSIBLE DISCONTINUANCE**
Carbon Dioxide in Nitrogen.

MATERIAL: Same as SRM 2632.

COMPOSITION: Nominal concentration: 800 μmole/mole (ppm), CO_2.

CERTIFICATION: Same as SRM 2632.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2632.

REMARKS: Same as SRM 2632.

SRM: 2635 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Carbon monoxide in nitrogen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with deliverable volumes of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 350 valves.

COMPOSITION: Nominal concentration: 25 μmole/mole (ppm), CO.

CERTIFICATION: Each cylinder is individually analyzed by comparing with a batch standard using non-dispersive infrared and/or gas chromatography techniques.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: This SRM is intended primarily for use as a primary standard for the calibration of instruments used for the determination of carbon monoxide in mobile-source emissions.

REMARKS: The certified values are valid for 2 years from date of shipment. The cylinders are the property of purchaser.

SRM: 2636 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 2635.

COMPOSITION: Nominal concentration: 250 μmole/mole (ppm), CO.

CERTIFICATION: Same as SRM 2635.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2635.

REMARKS: Same as SRM 2635.

SRM: 2637 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 2635.

COMPOSITION: Nominal concentration: 2500 μmole/mole (ppm), CO.

CERTIFICATION: Same as SRM 2635.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2635.

REMARKS: Same as SRM 2635.

SRM: 2638 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 2635.

COMPOSITION: Nominal concentration: 5000 μmole/mole (ppm), CO.

CERTIFICATION: Same as SRM 2635.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2635.

REMARKS: Same as SRM 2635.

SRM: 2639 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 2635, except for the valve which for SRM 2639 is a CGA - 580 type.

COMPOSITION: Nominal concentration: 1 mole percent CO.

CERTIFICATION: Same as SRM 2635.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2635.

REMARKS: Same as SRM 2635.

SRM: 2640 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 2639.

COMPOSITION: Nominal concentration: 2 mole percent.

CERTIFICATION: Same as SRM 2635.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2635.

REMARKS: Same as SRM 2635.

SRM: 2641 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 2639.

COMPOSITION: Nominal concentration: 4 mole percent, CO.

CERTIFICATION: Same as SRM 2635.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2635.

REMARKS: Same as SRM 2635.

SRM: 2642 (renewals)
Carbon Monoxide in Nitrogen.

MATERIAL: Same as SRM 2639.

COMPOSITION: Nominal concentration: 8 mole percent, CO.

CERTIFICATION: Same as SRM 2635.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2635.

REMARKS: Same as SRM 2635.

SRM: 2643 (renewals)--POSSIBLE DISCONTINUANCE
Propane in Nitrogen.

MATERIAL: Propane in nitrogen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 350 valves.

COMPOSITION: Nominal concentration: 100 μmole/mole (ppm), C_3H_8.

CERTIFICATION: Each cylinder is individually analyzed by comparison with gravimetric primary standard, using gas chromatography with flame-ionization detector.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions.

REMARKS: The certified values are valid for 2 years from date of shipment. The cylinders become the property of the purchaser.

SRM: 2644 (renewals)--POSSIBLE DISCONTINUANCE
Propane in Nitrogen.

MATERIAL: Same as SRM 2643.

COMPOSITION: Nominal concentration: 250 μmole/mole (ppm), C_3H_8.

CERTIFICATION: Same as SRM 2643.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2643.

REMARKS: Same as SRM 2643.

SRM: 2645 (renewals)
Propane in Nitrogen.

MATERIAL: Same as SRM 2643.

COMPOSITION: Nominal concentration: 500 μmole/mole (ppm), C_3H_8.

CERTIFICATION: Same as SRM 2643.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2643.

REMARKS: Same as SRM 2643.

SRM: 2646 (renewals)
Propane in Nitrogen.

MATERIAL: Same as SRM 2643.

COMPOSITION: Nominal concentration: 1000 μmole/mole (ppm), C_3H_8.

CERTIFICATION: Same as SRM 2643.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2643.

REMARKS: Same as SRM 2643.

SRM: 2647 (renewals)
Propane in Nitrogen.

MATERIAL: Same as SRM 2643.

COMPOSITION: Nominal concentration: 2500 μmole/mole (ppm), C_3H_8.

CERTIFICATION: Same as SRM 2643.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2643.

REMARKS: Same as SRM 2643.

SRM: 2648 (renewals)
Propane in Nitrogen.

MATERIAL: Same as SRM 2643.

COMPOSITION: Nominal concentration: 5000 μmole/mole (ppm), C_3H_8.

CERTIFICATION: Same as SRM 2643.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2643.

REMARKS: Same as SRM 2643.

SRM: 2649 (renewals)
Propane in Nitrogen.

MATERIAL: Same as SRM 2643.

COMPOSITION: Nominal concentration: 10,000 μmole/mole (ppm), C_3H_8.

CERTIFICATION: Same as SRM 2643.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2643.

REMARKS: Same as SRM 2643.

SRM: 2650
Propane in Nitrogen.

MATERIAL: Same as SRM 2643.

COMPOSITION: Nominal concentration: 20,000 μmole/mole (ppm), C_3H_8.

CERTIFICATION: Same as SRM 2643.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2643.

REMARKS: Same as SRM 2643.

SRM: 2651 (renewals)
Propane in Nitrogen and Oxygen.

MATERIAL: Propane in nitrogen and oxygen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 350 valves.

COMPOSITION: Certified concentration: 100 μmole/mole (ppm), C_3H_8 and 5 mole percent oxygen (not certified).

CERTIFICATION: Each cylinder is individually analyzed by comparison with primary gravimetric standards, using gas chromatography with flame-ionization detector.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used for the determination of hydrocarbon in mobile-source emissions when oxygen is of concern.

REMARKS: The certified value of propane is valid for 2 years from date of purchase. The cylinders become the property of the purchaser.

SRM: 2652 (renewals)
Propane in Oxygen and Nitrogen.

MATERIAL: Same as SRM 2651.

COMPOSITION: Certified nominal concentration: 100 μmole/mole (ppm), C_3H_8 and 10 mole percent (not certified).

CERTIFICATION: Same as SRM 2651.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2651.

REMARKS: Same as SRM 2651.

SRM: 2653 (renewals)--**DISCONTINUED**
Nitrogen Dioxide in Air.

MATERIAL: Nitrogen dioxide in air is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 660 valves.

COMPOSITION: Nominal concentration: 250 μmole/mole (ppm), NO_2.

CERTIFICATION: Each cylinder is individually analyzed by comparison with standards verified by gravimetry, using chemiluminescent reaction of NO with ozone.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 3% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used for the determination of NO_2 in stationary source emissions. This SRM should not be used below a pressure of 2.8 MPa (400 psi).

REMARKS: The certified values are valid for 1 year from date of shipment. The cylinder becomes the property of the purchaser.

SRM: 2654 (renewals)
Nitrogen Dioxide in Air.

MATERIAL: Same as SRM 2653.

COMPOSITION: Nominal concentration: 500 μmole/mole (ppm), NO_2.

CERTIFICATION: Same as SRM 2653.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 4% relative.

USE: Same as SRM 2653.

REMARKS: Same as SRM 2653.

SRM: 2655 (renewals)
Nitrogen Dioxide in Air.

MATERIAL: Same as SRM 2653.

COMPOSITION: Nominal concentration: 1000 μmole/mole (ppm), NO_2.

CERTIFICATION: Same as SRM 2653.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 3% relative.

USE: Same as SRM 2653.

REMARKS: Same as SRM 2653.

SRM: 2656 (renewals)
Nitrogen Dioxide in Air.

MATERIAL: Same as SRM 2653.

COMPOSITION: Nominal concentration: 2500 μmole/mole (ppm), NO_2.

CERTIFICATION: Same as SRM 2653.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 3% relative.

USE: Same as SRM 2653.

REMARKS: Same as SRM 2653.

SRM: 2657 (renewals)
Oxygen in Nitrogen.

MATERIAL: Oxygen in nitrogen is supplied in aluminum cylinders at 12.4 MPa (1800 psi) with deliverable volume of 0.88 m^3 (31 cubic feet) at STP. They conform to DOT specifications and are equipped with CGA - 580 valves.

COMPOSITION: Nominal concentration: 2 mole percent O_2.

CERTIFICATION: Each cylinder is individually analyzed by comparison with gravimetric standards, using gas chromatography and paramagnetic analyzer.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: This SRM is intended primarily for use as a primary standard in the calibration of instruments used for combustion control and respiratory gas analysis.

REMARKS: The certified values are valid for 2 years from date of shipment. The cylinders become the property of the purchaser.

SRM: 2658 (renewals)
Oxygen in Nitrogen.

MATERIAL: Same as SRM 2657.

COMPOSITION: Nominal concentration: 10 mole percent O_2.

CERTIFICATION: Same as SRM 2657.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2657.

REMARKS: Same as SRM 2657.

SRM: 2659 (renewals)
Oxygen in Nitrogen.

MATERIAL: Same as SRM 2657.

COMPOSITION: Nominal concentration: 21 mole percent O_2.

CERTIFICATION: Same as SRM 2657.

UNCERTAINTY OF CERTIFIED VALUE: ≤ 1% relative.

USE: Same as SRM 2657.

REMARKS: Same as SRM 2657.

PERMEATION TUBES

Permeation tubes manufactured commercially have gained widespread acceptance as analytical standards. However, it has been necessary for each user to calibrate his own tube or to rely on the manufacturer's lot calibration. The NBS-SRM permeation tubes are individually calibrated to provide more accurate calibrations than is available from the manufacturer. Furthermore, through the use of nationally recognized standards as SRM's, the consistency, accuracy, and compatibility of measurements on important air pollutants are made possible.

There are four different types of SRM permeation devices available from NBS. These SRM's provide a means for the production of a gas stream containing known amounts of an air pollutant at ambient levels. They are intended for use in the calibration of air pollution monitoring apparatus and, in addition may be used for the verification of air pollution analytical methods and procedures. Each tube is individually certified and is accompanied by a table of certified permeation rates for temperatures in the range of 20 to 30 °C, except in the case of the nitrogen dioxide permeation device (SRM 1629) which is only calibrated at 25 °C.

SULFUR DIOXIDE: SRM's 1625, 1626, and 1627 (renewals)

Sulfur dioxide permeation tubes are available in three lengths--2, 5, and 10 centimeters. The permeation rates are certified over the temperature range of 20 to 30 °C. The data in Table 3 is provided only as a guide in the selection of the desired SRM as the certified value may differ. (Shipment by air permitted except Canada.)

NITROGEN DIOXIDE: SRM 1629 (renewals)

Nitrogen dioxide permeation devices, as stated above, (SRM 1629a) are calibrated at 25.0 °C only. The temperature coefficient given with each tube provides the means to calculate permeation rates at other temperatures near 25 °C. The permeation rates for these tubes are between 0.5 and 1.5 μg/min at 25 °C. A tube with a rate of 1.0 μg/min, in an air flow of one liter per minute at 25 °C, will produce a concentration of 0.5 ppm of NO_2. (Cannot be shipped by air.)

BENZENE: SRM 1911 (renewals)

SRM 1911 is a permeation device that is certified for its permeation rate in micrograms of benzene at 25 °C. It is intended for use in the preparation of gases of known benzene content and for the standardization of air pollution and related chemical analyses. A typical permeation rate for this SRM is .4 μg/minute at 25 °C. (Cannot be shipped by air.)

TETRACHLOROETHYLENE: SRM 1912 (renewals)

SRM 1912 is a permeation device that is certified for its permeation rate in micrograms of tetrachloroethylene at 25 °C. SRM 1912 is intended for use in the standardization of apparatus and procedures used in air pollution and related chemical analyses and for the preparation of gas mixtures of known tetrachloroethylene concentration. SRM 1912 consists of a 10 cm permeation tube filled with liquid tetrachloroethylene that has a constant permeation rate at constant temperature. A typical permeation rate for this SRM is 1.0 μg/min, at 25 °C.

TABLE 3

SRM	Type	Tube Length (cm)	Permeation Rate (μg/min) at 25 °C	Typical Concentrations Flow Rates Various Flow Rates* 1	5	10
1625	Sulfur Dioxide Permeation Tube	10	2.8	1.07	0.214	0.107
1626	Sulfur Dioxide Permeation Tube	5	1.4	0.535	0.107	0.0535
1627	Sulfur Dioxide Permeation Tube	2	0.56	0.214	0.0428	0.0214
1629a	Nitrogen Dioxide Permeation Device	10	1.0	0.5	0.1	0.05
1911	Benzene Permeation Device	10	0.4	0.2	0.04	0.02
1912	Tetrachloroethylene Permeation Device	10	1.0	0.5	0.1	0.05

*Flow rate expressed as liters per minute

APPENDIX I

CERTIFICATES FOR GAS CYLINDER STANDARD REFERENCE MATERIALS

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1658a

Methane in Air

(Nominal Concentration 1 ppm)

(Ambient Air Quality Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of methane in ambient air. It is not intended as a daily working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Methane concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of methane is relative to all other constituents of the gas.

The uncertainty shown is the estimated upper limit of error of the methane concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate. This sample is certified only for the concentration of methane. However, representative samples from this lot have been analyzed for the presence of hydrocarbons other than methane. The estimated concentration of other hydrocarbons, expressed as methane, is μmole/mole (ppm).

The original development and evaluation of the methane in air series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. P. Schmidt and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
March 4, 1981
(Editorial Revision of
Certificate dated 12-12-78)

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information:

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that it is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for methane content.

Analysis:

Methane in this Standard Reference Material was determined by comparisons with a secondary standard that had been previously intercompared with a set of gravimetric primary standards. The method of intercomparison was gas chromatography using a flame-ionization detector. The limits of inaccuracy represent the uncertainty in the concentration of methane in the primary gravimetric standards and the imprecision of intercomparison.

Stability:

These samples are contained in aluminum cylinders. The stability is considered good and no loss of concentration has been observed in similar mixtures contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from the date stamped on this certificate. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1658a

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1659a

Methane in Air

(Nominal Concentration 10 ppm)

(Ambient Air Quality Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of methane in ambient air. It is not intended as a daily working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Methane concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of methane is relative to all other constituents of the gas.

The uncertainty shown is the estimated upper limit of error of the methane concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate. This sample is certified only for the concentration of methane. However, representative samples from this lot have been analyzed for the presence of hydrocarbons other than methane. The estimated concentration of other hydrocarbons, expressed as methane, is μmole/mole (ppm).

The original development and evaluation of the methane in air series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. P. Schmidt and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
March 4, 1981
(Editorial Revision of
Certificate dated 12-12-78)

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information:

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that it is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for methane content.

Analysis:

Methane in this Standard Reference Material was determined by comparisons with a secondary standard that had been previously intercompared with a set of gravimetric primary standards. The method of intercomparison was gas chromatography using a flame-ionization detector. The limits of inaccuracy represent the uncertainty in the concentration of methane in the primary gravimetric standards and the imprecision of intercomparison.

Stability:

These samples are contained in aluminum cylinders. The stability is considered good and no loss of concentration has been observed in similar mixtures contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from the date stamped on this certificate. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1659a

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1660a

Methane and Propane in Air

(Nominal Concentrations 4 ppm Methane and 1 ppm Propane)

(Ambient Air Quality Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used to differentiate the methane and non-methane fractions of hydrocarbon in the atmosphere. It is not intended as a daily working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Methane concentration:	±	μmole/mole (ppm)
Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentrations of methane and propane are relative to all other constituents of the gas.

The uncertainies shown are the estimated upper limit of error of the methane and the propane concentrations and are the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentrations given above apply only to the cylinder identified by cylinder number and sample number on this certificate. This sample is certified only for the concentration of methane and propane. However, representative samples from this lot have been analyzed for the presence of hydrocarbons other than methane and propane. The estimated concentration of other hydrocarbons, expressed as methane, is μmole/mole (ppm).

The original development and evaluation of the methane and propane in air series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. P. Schmidt and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
March 4, 1981
(Editorial Revision of
Certificate dated 12-12-78)

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information:

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that it is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for both methane and propane content.

Analysis:

Propane and methane fractions in this Standard Reference Material were determined by comparisons with secondary standards that had been previously intercompared with a set of gravimetric primary standards for each constituent. The method of intercomparison was gas chromatography using a flame-ionization detector. The limits of inaccuracy represent the uncertainty in the concentration of propane and methane in the primary gravimetric standards and the imprecision of intercomparison.

Stability:

These samples are contained in aluminum cylinders. The stability is considered good and no loss of concentration has been observed in similar mixtures contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from the date stamped on this certificate. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1660a

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards
Certificate of Analysis
Standard Reference Material 1661a
Sulfur Dioxide in Nitrogen
(Nominal Concentration 500 ppm)
(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of sulfur dioxide emitted from stationary sources. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related. Each cylinder is individually analyzed and the concentration that appears below applies to the cylinder identified on this certificate.

Sulfur dioxide concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of sulfur dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the sulfur dioxide concentration. This uncertainty includes the imprecision of the intercomparisons at the 95 percent confidence level and the inaccuracy in the peroxide method including the measurement of volume and the standardization of the reagent solution.

The original development and evaluation of the sulfur dioxide in nitrogen series of Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and E. R. Deardorff.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
March 20, 1981

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified in this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders which is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for sulfur dioxide content.

Analysis:

The sulfur dioxide content of this Standard Reference Material was determined by comparison with a set of NBS primary standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector and/or a non-dispersive infrared analyzer. The primary standards were analyzed by the hydrogen peroxide method which is considered to be inherently accurate in the concentration range of this SRM. This has been confirmed by the gravimetric determination of sulfur dioxide in samples previously analyzed by the peroxide method. The gravimetric method was evaluated by analyzing sulfuric acid standards prepared volumetrically. No evidence of a systematic error in the peroxide method has been observed.

Stability:

This SRM is contained in an aluminum cylinder. Samples of sulfur dioxide in nitrogen in similar containers have been periodically analyzed over a period of two years and no change in concentration has been observed.

The value appearing on this certificate is valid for two years from the latest date stamped on this certificate. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the two-year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of approximately 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA/660 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1661a

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1662a

Sulfur Dioxide in Nitrogen

(Nominal Concentration 1000 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of sulfur dioxide emitted from stationary sources. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related. Each cylinder is individually analyzed and the concentration that appears below applies to the cylinder identified on this certificate.

Sulfur dioxide concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of sulfur dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the sulfur dioxide concentration. This uncertainty includes the imprecision of the intercomparisons at the 95 percent confidence level and the inaccuracy in the peroxide method including the measurement of volume and the standardization of the reagent solution.

The original development and evaluation of the sulfur dioxide in nitrogen series of Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and E. R. Deardorff.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
March 20, 1981
(Revision of Certificate
dated 2-5-80)

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified in this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders which is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for sulfur dioxide content.

Analysis:

The sulfur dioxide content of this Standard Reference Material was determined by comparison with a set of NBS primary standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector and/or a non-dispersive infrared analyzer. The primary standards were analyzed by the hydrogen peroxide method which is considered to be inherently accurate in the concentration range of this SRM. This has been confirmed by the gravimetric determination of sulfur dioxide in samples previously analyzed by the peroxide method. The gravimetric method was evaluated by analyzing sulfuric acid standards prepared volumetrically. No evidence of a systematic error in the peroxide method has been observed.

Stability:

This SRM is contained in an aluminum cylinder. Samples of sulfur dioxide in nitrogen in similar containers have been periodically analyzed over a period of two years and no change in concentration has been observed.

The value appearing on this certificate is valid for two years from the latest date stamped on this certificate. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the two-year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of approximately 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA/660 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1662a

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1663a

Sulfur Dioxide in Nitrogen

(Nominal Concentration 1500 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of sulfur dioxide emitted from stationary sources. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related. Each cylinder is individually analyzed and the concentration that appears below applies to the cylinder identified on this certificate.

Sulfur dioxide concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of sulfur dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the sulfur dioxide concentration. This uncertainty includes the imprecision of the intercomparisons at the 95 percent confidence level and the inaccuracy in the peroxide method including the measurement of volume and the standardization of the reagent solution.

The original development and evaluation of the sulfur dioxide in nitrogen series of Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and E. R. Deardorff.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
March 20, 1981
(Revision of Certificate
dated 2-5-80)

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified in this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders which is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for sulfur dioxide content.

Analysis:

The sulfur dioxide content of this Standard Reference Material was determined by comparison with a set of NBS primary standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector and/or a non-dispersive infrared analyzer. The primary standards were analyzed by the hydrogen peroxide method which is considered to be inherently accurate in the concentration range of this SRM. This has been confirmed by the gravimetric determination of sulfur dioxide in samples previously analyzed by the peroxide method. The gravimetric method was evaluated by analyzing sulfuric acid standards prepared volumetrically. No evidence of a systematic error in the peroxide method has been observed.

Stability:

This SRM is contained in an aluminum cylinder. Samples of sulfur dioxide in nitrogen in similar containers have been periodically analyzed over a period of two years and no change in concentration has been observed.

The value appearing on this certificate is valid for two years from the latest date stamped on this certificate. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the two-year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of approximately 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA/660 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1663a

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1664a

Sulfur Dioxide in Nitrogen

(Nominal Concentration 2500 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of sulfur dioxide emitted from stationary sources. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related. Each cylinder is individually analyzed and the concentration that appears below applies to the cylinder identified on this certificate.

Sulfur dioxide concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of sulfur dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the sulfur dioxide concentration. This uncertainty includes the imprecision of the intercomparisons at the 95 percent confidence level and the inaccuracy in the peroxide method including the measurement of volume and the standardization of the reagent solution.

The original development and evaluation of the sulfur dioxide in nitrogen series of Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and E. R. Deardorff.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
March 20, 1981

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified in this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders which is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for sulfur dioxide content.

Analysis:

The sulfur dioxide content of this Standard Reference Material was determined by comparison with a set of NBS primary standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector and/or a non-dispersive infrared analyzer. The primary standards were analyzed by the hydrogen peroxide method which is considered to be inherently accurate in the concentration range of this SRM. This has been confirmed by the gravimetric determination of sulfur dioxide in samples previously analyzed by the peroxide method. The gravimetric method was evaluated by analyzing sulfuric acid standards prepared volumetrically. No evidence of a systematic error in the peroxide method has been observed.

Stability:

This SRM is contained in an aluminum cylinder. Samples of sulfur dioxide in nitrogen in similar containers have been periodically analyzed over a period of two years and no change in concentration has been observed.

The value appearing on this certificate is valid for two years from the latest date stamped on this certificate. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the two-year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of approximately 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA/660 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1664a

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1665b

Propane in Air

(Nominal Concentration 3 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standard and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

Each cylinder is individually analyzed and the concentration appearing above applies to the cylinder number and sample number identified on this certificate.

The original development and evaluation of the Propane in Air Series of these Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and W. D. Dorko.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
January 31, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

The oxygen content of this sample is 20.9 mole percent.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1665b

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1666b

Propane in Air

(Nominal Concentration 10 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standard and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

Each cylinder is individually analyzed and the concentration appearing above applies to the cylinder number and sample number identified on this certificate.

The original development and evaluation of the Propane in Air Series of these Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and W. D. Dorko.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
January 31, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

The oxygen content of this sample is 20.9 mole percent.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1666b

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1667b

Propane in Air

(Nominal Concentration 50 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standard and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

Each cylinder is individually analyzed and the concentration appearing above applies to the cylinder number and sample number identified on this certificate.

The original development and evaluation of the Propane in Air Series of these Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and W. D. Dorko.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
January 31, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

The oxygen content of this sample is 20.9 mole percent.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1667b

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards
Certificate of Analysis

Standard Reference Material 1668b

Propane in Air

(Nominal Concentration 100 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standard and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

Each cylinder is individually analyzed and the concentration appearing above applies to the cylinder number and sample number identified on this certificate.

The original development and evaluation of the Propane in Air Series of these Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and W. D. Dorko.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
January 31, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

The oxygen content of this sample is 20.9 mole percent.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1668b

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards
Certificate of Analysis

Standard Reference Material 1669b

Propane in Air

(Nominal Concentration 500 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standard and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

Each cylinder is individually analyzed and the concentration appearing above applies to the cylinder number and sample number identified on this certificate.

The original development and evaluation of the Propane in Air Series of these Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and W. D. Dorko.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
January 31, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

The oxygen content of this sample is 20.9 mole percent.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1669b

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1670

Carbon Dioxide in Air

(Nominal Concentration 330 ppm)

(Atmospheric Carbon Dioxide Standard)

This Standard Reference Material is intended for use in the calibration of instruments and methods used for the measurement of carbon dioxide in the atmosphere. It is not intended as a working standard, but rather as a primary laboratory standard, to which the concentration of carbon dioxide in other standards may be related.

Carbon dioxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of carbon dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas-handling system.

The research and development leading to the certification of this SRM were performed in the Gas and Particulate Science Division by E.E. Hughes, G.A. Sleater, and R.C. Myers.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E.E. Hughes and H.L. Rook of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
December 9, 1982

(over)

George A. Uriano, Chief
Office of Standard Reference Materials

Analysis

The carbon dioxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison was gas chromatography and/or a nondispersive infrared method.

Representative samples from this batch of Standard Reference Materials have been analyzed for nitrous oxide (N_2O) content, and oxygen. The concentrations of components listed in Table 1 are not certified but are given for information only.

Table 1

Component	Estimated Concentration in Samples of this Batch
Oxygen	20.95 mole percent
Nitrous Oxide	0.06 ppm by mole

Note: Water vapor was measured in a number of samples and while the concentration varied from sample to sample the maximum observed concentration in a full cylinder was 24 parts per million by mole.

Uncertainty

The estimated upper limit of the total uncertainty of the concentration of this SRM is 0.2 ppm at the 95% confidence interval. This value is based on systematic errors associated with gravimetric standards, the random errors associated with the comparison of the gravimetric standards to the secondary standards, and the comparison of the secondary standards to the SRM.

Two samples from this batch have been independently analyzed by P. Guenther at the laboratory of Dr. Charles Keeling at the Scripps Institute of Oceanography (SIO), LaJolla, California. The difference between the concentration assigned by NBS and that measured by SIO was no greater than 0.02 ppm.

	Concentration Assigned by NBS	Concentration Measured by SIO
Sample A	335.61	335.61
Sample B	335.49	335.47

The agreement between NBS and SIO on multiple intercomparisons of CO_2 standards allow direct intercomparison of data derived from analytical systems calibrated with either of the two standard materials.

Stability

Measurements have been made of many samples in this batch over time intervals up to 18 months and no evidence has been found of changes in the concentration of carbon dioxide. However, in several instances samples from this batch and other batches of carbon dioxide in air have exhibited an increase in concentration when the cylinder pressure fell to a pressure below 1.04 MPa (150 psi). It is not recommended that the sample be used as an analytical standard after the pressure has fallen below 2.07 MPa (300 psi).

The concentration on the certificate is valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS and, if significant changes are observed, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of approximately 0.76 m^3 (27 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for reanalysis.

Reanalysis

When this Standard Reference Material is used as a standard in a long-term program of analysis of atmospheric carbon dioxide, it may be analytically necessary to confirm the original certification during or at the end of the certification period. The National Bureau of Standards will reanalyze this Standard Reference Material for the original purchaser at a cost not to exceed the cost of similar materials available at the time of the request for reanalysis. The original purchaser should contact the Gas and Particulate Science Division of the National Bureau of Standards to arrange for reanalysis. Please contact William Dorko, 301-921-2886.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1671

Carbon Dioxide in Air

(Nominal Concentration 340 ppm)

(Atmospheric Carbon Dioxide Standard)

This Standard Reference Material is intended for use in the calibration of instruments and methods used for the measurement of carbon dioxide in the atmosphere. It is not intended as a working standard, but rather as a primary laboratory standard, to which the concentration of carbon dioxide in other standards may be related.

Carbon dioxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of carbon dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas-handling system.

The research and development leading to the certification of this SRM were performed in the Gas and Particulate Science Division by E.E. Hughes, G.A. Sleater, and R.C. Myers.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E.E. Hughes and H.L. Rook of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
December 9, 1982

(over)

George A. Uriano, Chief
Office of Standard Reference Materials

Analysis

The carbon dioxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison was gas chromatography and/or a nondispersive infrared method.

Representative samples from this batch of Standard Reference Materials have been analyzed for nitrous oxide (N_2O) content, and oxygen. The concentrations of components listed in Table 1 are not certified but are given for information only.

Table 1

Component	Estimated Concentration in Samples of this Batch
Oxygen	20.95 mole percent
Nitrous Oxide	0.08 ppm by mole

Note: Water vapor was measured in a number of samples and while the concentration varied from sample to sample the maximum observed concentration in a full cylinder was 24 parts per million by mole.

Uncertainty

The estimated upper limit of the total uncertainty of the concentration of this SRM is 0.2 ppm at the 95% confidence interval. This value is based on systematic errors associated with gravimetric standards, the random errors associated with the comparison of the gravimetric standards to the secondary standards, and the comparison of the secondary standards to the SRM.

Two samples from this batch have been independently analyzed by P. Guenther at the laboratory of Dr. Charles Keeling at the Scripps Institute of Oceanography (SIO), LaJolla, California. The difference between the concentration assigned by NBS and that measured by SIO was no greater than 0.02 ppm.

	Concentration Assigned by NBS	Concentration Measured by SIO
Sample A	342.31	342.36
Sample B	342.65	342.64

The agreement between NBS and SIO on multiple intercomparisons of CO_2 standards allow direct intercomparison of data derived from analytical systems calibrated with either of the two standard materials.

Stability

Measurements have been made of many samples in this batch over time intervals up to 18 months and no evidence has been found of changes in the concentration of carbon dioxide. However, in several instances samples from this batch and other batches of carbon dioxide in air have exhibited an increase in concentration when the cylinder pressure fell to a pressure below 1.04 MPa (150 psi). It is not recommended that the sample be used as an analytical standard after the pressure has fallen below 2.07 MPa (300 psi).

The concentration on the certificate is valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS and, if significant changes are observed, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of approximately 0.76 m^3 (27 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for reanalysis.

Reanalysis

When this Standard Reference Material is used as a standard in a long-term program of analysis of atmospheric carbon dioxide, it may be analytically necessary to confirm the original certification during or at the end of the certification period. The National Bureau of Standards will reanalyze this Standard Reference Material for the original purchaser at a cost not to exceed the cost of similar materials available at the time of the request for reanalysis. The original purchaser should contact the Gas and Particulate Science Division of the National Bureau of Standards to arrange for reanalysis. Please contact William Dorko, 301-921-2886.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1672

Carbon Dioxide in Air

(Nominal Concentration 350 ppm)

(Atmospheric Carbon Dioxide Standard)

This Standard Reference Material is intended for use in the calibration of instruments and methods used for the measurement of carbon dioxide in the atmosphere. It is not intended as a working standard, but rather as a primary laboratory standard, to which the concentration of carbon dioxide in other standards may be related.

Carbon dioxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of carbon dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas-handling system.

The research and development leading to the certification of this SRM were performed in the Gas and Particulate Science Division by E.E. Hughes, G.A. Sleater, and R.C. Myers.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E.E. Hughes and H.L. Rook of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
December 9, 1982

(over)

George A. Uriano, Chief
Office of Standard Reference Materials

Analysis

The carbon dioxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison was gas chromatography and/or a nondispersive infrared method.

Representative samples from this batch of Standard Reference Materials have been analyzed for nitrous oxide (N_2O) content, and oxygen. The concentrations of components listed in Table 1 are not certified but are given for information only.

Table 1

Component	Estimated Concentration in Samples of this Batch
Oxygen	20.95 mole percent
Nitrous Oxide	0.03 ppm by mole

Note: Water vapor was measured in a number of samples and while the concentration varied from sample to sample the maximum observed concentration in a full cylinder was 24 parts per million by mole.

Uncertainty

The estimated upper limit of the total uncertainty of the concentration of this SRM is 0.2 ppm at the 95% confidence interval. This value is based on systematic errors associated with gravimetric standards, the random errors associated with the comparison of the gravimetric standards to the secondary standards, and the comparison of the secondary standards to the SRM.

Two samples from this batch have been independently analyzed by P. Guenther at the laboratory of Dr. Charles Keeling at the Scripps Institute of Oceanography (SIO), LaJolla, California. The difference between the concentration assigned by NBS and that measured by SIO was no greater than 0.02 ppm.

	Concentration Assigned by NBS	Concentration Measured by SIO
Sample A	351.08	351.03
Sample B	351.11	351.14

The agreement between NBS and SIO on multiple intercomparisons of CO_2 standards allow direct intercomparison of data derived from analytical systems calibrated with either of the two standard materials.

Stability

Measurements have been made of many samples in this batch over time intervals up to 18 months and no evidence has been found of changes in the concentration of carbon dioxide. However, in several instances samples from this batch and other batches of carbon dioxide in air have exhibited an increase in concentration when the cylinder pressure fell to a pressure below 1.04 MPa (150 psi). It is not recommended that the sample be used as an analytical standard after the pressure has fallen below 2.07 MPa (300 psi).

The concentration on the certificate is valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS and, if significant changes are observed, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of approximately 0.76 m^3 (27 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for reanalysis.

Reanalysis

When this Standard Reference Material is used as a standard in a long-term program of analysis of atmospheric carbon dioxide, it may be analytically necessary to confirm the original certification during or at the end of the certification period. The National Bureau of Standards will reanalyze this Standard Reference Material for the original purchaser at a cost not to exceed the cost of similar materials available at the time of the request for reanalysis. The original purchaser should contact the Gas and Particulate Science Division of the National Bureau of Standards to arrange for reanalysis. Please contact William Dorko, 301-921-2886.

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 1674b

Carbon Dioxide in Nitrogen
(Nominal Concentration 7 percent)
(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon dioxide in mobile source emissions and related uses. It is not intended as a daily working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Carbon dioxide concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of carbon dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration appearing above applies to the cylinder identified by cylinder number and sample number on this certificate.

The original development and evaluation of the carbon dioxide in nitrogen series of Standard Reference Materials was performed at the National Bureau of Standards by W. D. Dorko and W. P. Schmidt.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

The carbon dioxide in this Standard Reference Material was determined by comparison with a secondary standard that had previously been intercompared with a set of gravimetric primary standards. The method of intercomparison was gas chromatography using thermal conductivity determination of carbon dioxide. The gravimetric standards were prepared from analyzed samples of nitrogen and carbon dioxide.

Stability

The stability of these mixtures is considered to be excellent. No loss of carbon dioxide has been observed in either the standards or in previous lots of this SRM. Periodic reanalyses of representative samples from this lot will be performed, and if any change in concentration is observed the purchasers of samples from this lot will be notified.

The Standard Reference Material should be stored at room temperature and should not be allowed to experience either high or low ambient temperature.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 1675b

Carbon Dioxide in Nitrogen
(Nominal Concentration 14 percent)
(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon dioxide in mobile source emissions and related uses. It is not intended as a daily working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Carbon dioxide concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of carbon dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration appearing above applies to the cylinder identified by cylinder number and sample number on this certificate.

The original development and evaluation of the carbon dioxide in nitrogen series of Standard Reference Materials was performed at the National Bureau of Standards by W. D. Dorko and W. P. Schmidt.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

The carbon dioxide in this Standard Reference Material was determined by comparison with a secondary standard that had previously been intercompared with a set of gravimetric primary standards. The method of intercomparison was gas chromatography using thermal conductivity determination of carbon dioxide. The gravimetric standards were prepared from analyzed samples of nitrogen and carbon dioxide.

Stability

The stability of these mixtures is considered to be excellent. No loss of carbon dioxide has been observed in either the standards or in previous lots of this SRM. Periodic reanalyses of representative samples from this lot will be performed, and if any change in concentration is observed the purchasers of samples from this lot will be notified.

The Standard Reference Material should be stored at room temperature and should not be allowed to experience either high or low ambient temperature.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards
Certificate of Analysis
Standard Reference Material 1677c
Carbon Monoxide in Nitrogen
(Nominal Concentration 10 ppm)
(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon monoxide in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related.

Carbon monoxide concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

The uncertainty shown is the estimated upper limit of error of the carbon monoxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

The original development and evaluation of the carbon monoxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by J. M. Ives and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

Carbon monoxide in the Standard Reference Material was determined by comparisons with a secondary standard that had been previously intercompared with a set of primary gravimetric standards. The methods of intercomparison involved catalytic reduction of carbon monoxide with hydrogen and subsequent analysis of the resulting methane with a flame-ionization hydrocarbon analyzer and nondispersive infrared analysis.

Stability

These samples are contained in aluminum cylinders. The stability is considered good and no loss of concentration has been observed in similar mixtures contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1677c

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards
Certificate of Analysis
Standard Reference Material 1678c
Carbon Monoxide in Nitrogen
(Nominal Concentration 50 ppm)
(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon monoxide in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related.

Carbon monoxide concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

The uncertainty shown is the estimated upper limit of error of the carbon monoxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

The original development and evaluation of the carbon monoxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by J. M. Ives and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

Carbon monoxide in the Standard Reference Material was determined by comparisons with a secondary standard that had been previously intercompared with a set of primary gravimetric standards. The methods of intercomparison involved catalytic reduction of carbon monoxide with hydrogen and subsequent analysis of the resulting methane with a flame-ionization hydrocarbon analyzer and nondispersive infrared analysis.

Stability

These samples are contained in aluminum cylinders. The stability is considered good and no loss of concentration has been observed in similar mixtures contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1678c

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards
Certificate of Analysis

Standard Reference Material 1679c

Carbon Monoxide in Nitrogen

(Nominal Concentration 100 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon monoxide in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related.

Carbon monoxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of carbon monoxide is relative to all other constituents of the gas.

The uncertainty shown is the estimated upper limit of error of the carbon monoxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

The original development and evaluation of the carbon monoxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by J. M. Ives and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

Carbon monoxide in the Standard Reference Material was determined by comparisons with a secondary standard that had been previously intercompared with a set of primary gravimetric standards. The methods of intercomparison involved catalytic reduction of carbon monoxide with hydrogen and subsequent analysis of the resulting methane with a flame-ionization hydrocarbon analyzer and nondispersive infrared analysis.

Stability

These samples are contained in aluminum cylinders. The stability is considered good and no loss of concentration has been observed in similar mixtures contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1679c

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 1680b

Carbon Monoxide in Nitrogen

(Nominal Concentration 500 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon monoxide in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related.

Carbon monoxide concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

The uncertainty shown is the estimated upper limit of error of the carbon monoxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

The original development and evaluation of the carbon monoxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by J. M. Ives and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

Carbon monoxide in the Standard Reference Material was determined by comparisons with a secondary standard that had been previously intercompared with a set of primary gravimetric standards. The methods of intercomparison involved catalytic reduction of carbon monoxide with hydrogen and subsequent analysis of the resulting methane with a flame-ionization hydrocarbon analyzer and nondispersive infrared analysis.

Stability

These samples are contained in aluminum cylinders. The stability is considered good and no loss of concentration has been observed in similar mixtures contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1680b

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 1681b

Carbon Monoxide in Nitrogen

(Nominal Concentration 1000 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon monoxide in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related.

Carbon monoxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of carbon monoxide is relative to all other constituents of the gas.

The uncertainty shown is the estimated upper limit of error of the carbon monoxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

The original development and evaluation of the carbon monoxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by J. M. Ives and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

Carbon monoxide in the Standard Reference Material was determined by comparisons with a secondary standard that had been previously intercompared with a set of primary gravimetric standards. The methods of intercomparison involved catalytic reduction of carbon monoxide with hydrogen and subsequent analysis of the resulting methane with a flame-ionization hydrocarbon analyzer and nondispersive infrared analysis.

Stability

These samples are contained in aluminum cylinders. The stability is considered good and no loss of concentration has been observed in similar mixtures contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1681b

. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards
Certificate of Analysis
Standard Reference Material 1683b
Nitric Oxide in Nitrogen
(Nominal Concentration 50 ppm)
(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of oxides of nitrogen in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related.

Nitric oxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of nitric oxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitric oxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Every precaution must be taken to avoid accidental contamination of the sample with atmospheric air during connection of the cylinder to any gas handling system.

The original development and evaluation of the nitric oxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by R. B. Marinenko and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The nitric oxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison utilized the chemiluminescent reaction of nitric oxide with ozone.

Representative samples have been analyzed for the presence of other nitrogen oxides by passing the sample through a high-temperature catalytic furnace which converts these other oxides to nitric oxide if present. Under the conditions of the experiment a minimum of one percent of other oxides would have been detected. No other oxides of nitrogen were detected in the samples analyzed within the stated limits.

Stability

Loss of nitric oxide by adsorption on the container walls may occur in new cylinders not previously used for nitric oxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitric oxide from the cylinder walls when the cylinder pressure is reduced to near ambient. To study this effect the pressure in some cylinders has been reduced stepwise from 13.7 to 2.8 MPa (2000-400 psi). No change in concentration was observed at the lower pressures or after the samples had been at 2.8 MPA (400 psi) for seven weeks. *It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).*

The concentration on the certificate is valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within two years the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1684b

Nitric Oxide in Nitrogen

(Nominal Concentration 100 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of oxides of nitrogen in mobile-source emissions. It is not intended as a working standard, but rather a primary standard to which the concentration of other standards may be related.

Nitric oxide concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of nitric oxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitric oxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Every precaution must be taken to avoid accidental contamination of the sample with atmospheric air during connection of the cylinder to any gas handling system.

The original development and evaluation of the nitric oxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by R. B. Marinenko and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The nitric oxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison utilized the chemiluminescent reaction of nitric oxide with ozone.

Representative samples have been analyzed for the presence of other nitrogen oxides by passing the sample through a high-temperature catalytic furnace which converts these other oxides to nitric oxide if present. Under the conditions of the experiment a minimum of one percent of other oxides would have been detected. No other oxides of nitrogen were detected in the samples analyzed within the stated limits.

Stability

Loss of nitric oxide by adsorption on the container walls may occur in new cylinders not previously used for nitric oxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitric oxide from the cylinder walls when the cylinder pressure is reduced to near ambient. To study this effect the pressure in some cylinders has been reduced stepwise from 13.7 to 2.8 MPa (2000-400 psi). No change in concentration was observed at the lower pressures or after the samples had been at 2.8 MPA (400 psi) for seven weeks. *It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).*

The concentration on the certificate is valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within two years the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1684b

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 1685b

Nitric Oxide in Nitrogen

(Nominal Concentration 250 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of oxides of nitrogen in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related.

Nitric oxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of nitric oxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitric oxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Every precaution must be taken to avoid accidental contamination of the sample with atmospheric air during connection of the cylinder to any gas handling system.

The original development and evaluation of the nitric oxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by R. B. Marinenko and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The nitric oxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison utilized the chemiluminescent reaction of nitric oxide with ozone.

Representative samples have been analyzed for the presence of other nitrogen oxides by passing the sample through a high-temperature catalytic furnace which converts these other oxides to nitric oxide if present. Under the conditions of the experiment a minimum of one percent of other oxides would have been detected. No other oxides of nitrogen were detected in the samples analyzed within the stated limits.

Stability

Loss of nitric oxide by adsorption on the container walls may occur in new cylinders not previously used for nitric oxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitric oxide from the cylinder walls when the cylinder pressure is reduced to near ambient. To study this effect the pressure in some cylinders has been reduced stepwise from 13.7 to 2.8 MPa (2000-400 psi). No change in concentration was observed at the lower pressures or after the samples had been at 2.8 MPA (400 psi) for seven weeks. *It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).*

The concentration on the certificate is valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within two years the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 1686b

Nitric Oxide in Nitrogen

(Nominal Concentration 500 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of oxides of nitrogen in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related.

Nitric oxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of nitric oxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitric oxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Every precaution must be taken to avoid accidental contamination of the sample with atmospheric air during connection of the cylinder to any gas handling system.

The original development and evaluation of the nitric oxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by R. B. Marinenko and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The nitric oxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison utilized the chemiluminescent reaction of nitric oxide with ozone.

Representative samples have been analyzed for the presence of other nitrogen oxides by passing the sample through a high-temperature catalytic furnace which converts these other oxides to nitric oxide if present. Under the conditions of the experiment a minimum of one percent of other oxides would have been detected. No other oxides of nitrogen were detected in the samples analyzed within the stated limits.

Stability

Loss of nitric oxide by adsorption on the container walls may occur in new cylinders not previously used for nitric oxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitric oxide from the cylinder walls when the cylinder pressure is reduced to near ambient. To study this effect the pressure in some cylinders has been reduced stepwise from 13.7 to 2.8 MPa (2000-400 psi). No change in concentration was observed at the lower pressures or after the samples had been at 2.8 MPA (400 psi) for seven weeks. *It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).*

The concentration on the certificate is valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within two years the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1686b

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1687b

Nitric Oxide in Nitrogen

(Nominal Concentration 1000 ppm)

(Mobile-Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of oxides of nitrogen in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related.

Nitric oxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of nitric oxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitric oxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Every precaution must be taken to avoid accidental contamination of the sample with atmospheric air during connection of the cylinder to any gas handling system.

The original development and evaluation of the nitric oxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by R. B. Marinenko and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The nitric oxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison utilized the chemiluminescent reaction of nitric oxide with ozone.

Representative samples have been analyzed for the presence of other nitrogen oxides by passing the sample through a high-temperature catalytic furnace which converts these other oxides to nitric oxide if present. Under the conditions of the experiment a minimum of one percent of other oxides would have been detected. No other oxides of nitrogen were detected in the samples analyzed within the stated limits.

Stability

Loss of nitric oxide by adsorption on the container walls may occur in new cylinders not previously used for nitric oxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitric oxide from the cylinder walls when the cylinder pressure is reduced to near ambient. To study this effect the pressure in some cylinders has been reduced stepwise from 13.7 to 2.8 MPa (2000-400 psi). No change in concentration was observed at the lower pressures or after the samples had been at 2.8 MPA (400 psi) for seven weeks. *It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).*

The concentration on the certificate is valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within two years the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1687b

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1693a

Sulfur Dioxide in Nitrogen

(Nominal Concentration 50 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of sulfur dioxide emitted from stationary sources. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related. Each cylinder is individually analyzed and the concentration that appears below applies to the cylinder identified on this certificate.

Sulfur dioxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of sulfur dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the sulfur dioxide concentration. This uncertainty includes the imprecision of the intercomparisons at the 95 percent confidence level and the inaccuracy in the peroxide method, including the measurement of volume and the standardization of the reagent solution.

The original development and evaluation of the sulfur dioxide in nitrogen series of Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and E. R. Deardorff.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Gaithersburg, MD 20899
July 20, 1984
(Revision of Certificate
dated March 20, 1981)

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified in this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders which is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for sulfur dioxide content.

Analysis:

The sulfur dioxide content of this Standard Reference Material was determined by comparison with a set of NBS primary standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector and/or a non-dispersive infrared analyzer. The primary standards were analyzed by the hydrogen peroxide method which is considered to be inherently accurate in the concentration range of this SRM. This has been confirmed by the gravimetric determination of sulfur dioxide in samples previously analyzed by the peroxide method. The gravimetric method was evaluated by analyzing sulfuric acid standards prepared volumetrically. No evidence of a systematic error in the peroxide method has been observed.

Stability:

This SRM is contained in an aluminum cylinder. Samples of sulfur dioxide in nitrogen in similar containers have been periodically analyzed over a period of two years and no change in concentration has been observed.

The value appearing on this certificate is valid for two years from the date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the two-year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of approximately 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA/660 valves. The cylinders become the property of the purchaser.

SRM 1693a

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1694a

Sulfur Dioxide in Nitrogen

(Nominal Concentration 100 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of sulfur dioxide emitted from stationary sources. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related. Each cylinder is individually analyzed and the concentration that appears below applies to the cylinder identified on this certificate.

Sulfur dioxide concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of sulfur dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the sulfur dioxide concentration. This uncertainty includes the imprecision of the intercomparisons at the 95 percent confidence level and the inaccuracy in the peroxide method,including the measurement of volume and the standardization of the reagent solution.

The original development and evaluation of the sulfur dioxide in nitrogen series of Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and E. R. Deardorff.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Gaithersburg, MD 20899
July 20, 1984
(Revision of Certificate
dated March 20, 1981)

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified in this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders which is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for sulfur dioxide content.

Analysis:

The sulfur dioxide content of this Standard Reference Material was determined by comparison with a set of NBS primary standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector and/or a non-dispersive infrared analyzer. The primary standards were analyzed by the hydrogen peroxide method which is considered to be inherently accurate in the concentration range of this SRM. This has been confirmed by the gravimetric determination of sulfur dioxide in samples previously analyzed by the peroxide method. The gravimetric method was evaluated by analyzing sulfuric acid standards prepared volumetrically. No evidence of a systematic error in the peroxide method has been observed.

Stability:

This SRM is contained in an aluminum cylinder. Samples of sulfur dioxide in nitrogen in similar containers have been periodically analyzed over a period of two years and no change in concentration has been observed.

The value appearing on this certificate is valid for two years from the date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the two-year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of approximately 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA/660 valves. The cylinders become the property of the purchaser.

SRM 1694a

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1696

Sulfur Dioxide in Nitrogen

(Nominal Concentration 3500 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of sulfur dioxide emitted from stationary sources. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related. Each cylinder is individually analyzed and the concentration that appears below applies to the cylinder identified on this certificate.

Sulfur dioxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of sulfur dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the sulfur dioxide concentration. This uncertainty includes the imprecision of the intercomparisons at the 95 percent confidence level and the inaccuracy in the peroxide method including the measurement of volume and the standardization of the reagent solution.

The original development and evaluation of the sulfur dioxide in nitrogen series of Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and E. R. Deardorff.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
March 20, 1981

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified in this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders which is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for sulfur dioxide content.

Analysis:

The sulfur dioxide content of this Standard Reference Material was determined by comparison with a set of NBS primary standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector and/or a non-dispersive infrared analyzer. The primary standards were analyzed by the hydrogen peroxide method which is considered to be inherently accurate in the concentration range of this SRM. This has been confirmed by the gravimetric determination of sulfur dioxide in samples previously analyzed by the peroxide method. The gravimetric method was evaluated by analyzing sulfuric acid standards prepared volumetrically. No evidence of a systematic error in the peroxide method has been observed.

Stability:

This SRM is contained in an aluminum cylinder. Samples of sulfur dioxide in nitrogen in similar containers have been periodically analyzed over a period of two years and no change in concentration has been observed.

The value appearing on this certificate is valid for two years from the latest date stamped on this certificate. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the two-year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of approximately 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA/660 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1696

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1696

Sulfur Dioxide in Nitrogen

(Nominal Concentration 3500 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of sulfur dioxide emitted from stationary sources. It is not intended as a working standard, but rather as a primary standard to which the concentration of other standards may be related. Each cylinder is individually analyzed and the concentration that appears below applies to the cylinder identified on this certificate.

Sulfur dioxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of sulfur dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the sulfur dioxide concentration. This uncertainty includes the imprecision of the intercomparisons at the 95 percent confidence level and the inaccuracy in the peroxide method including the measurement of volume and the standardization of the reagent solution.

The original development and evaluation of the sulfur dioxide in nitrogen series of Standard Reference Materials was performed at the National Bureau of Standards by W. P. Schmidt and E. R. Deardorff.

The overall direction and coordination of technical measurements leading to certification were performed in the Gas and Particulate Science Division under the chairmanship of E. E. Hughes and H. L. Rook.

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

Washington, D.C. 20234
March 20, 1981

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified in this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders which is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for sulfur dioxide content.

Analysis:

The sulfur dioxide content of this Standard Reference Material was determined by comparison with a set of NBS primary standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector and/or a non-dispersive infrared analyzer. The primary standards were analyzed by the hydrogen peroxide method which is considered to be inherently accurate in the concentration range of this SRM. This has been confirmed by the gravimetric determination of sulfur dioxide in samples previously analyzed by the peroxide method. The gravimetric method was evaluated by analyzing sulfuric acid standards prepared volumetrically. No evidence of a systematic error in the peroxide method has been observed.

Stability:

This SRM is contained in an aluminum cylinder. Samples of sulfur dioxide in nitrogen in similar containers have been periodically analyzed over a period of two years and no change in concentration has been observed.

The value appearing on this certificate is valid for two years from the latest date stamped on this certificate. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the two-year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at a pressure of approximately 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA/660 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 1696

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1805

Benzene in Nitrogen

(Nominal Concentration 0.25 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the determination of benzene in stationary-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Benzene concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of benzene is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the benzene concentration at the 95% confidence level. This uncertainty includes the inaccuracy in the concentration of benzene in gravimetrically prepared primary standards and the imprecision of intercomparison with these primary standards. This sample is certified only for the concentration of benzene. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as benzene, is μmole/mole (ppm).

Each cylinder was individually analyzed and the concentration appearing above applies only to the cylinder with identification number corresponding to the one on this certificate.

Stability and Precautions: See reverse side of this certificate.

The original development and evaluation of the benzene in nitrogen series of Standard Reference Materials were performed in the Gas and Particulate Science Division by W.P. Schmidt and W.F. Cuthrell.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of H.L. Rook, Chief of the Gas and Particulate Science Division.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. Alvarez.

Washington, D.C. 20234
December 27, 1982

(over)

George A. Uriano, Chief
Office of Standard Reference Materials

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that it is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for benzene content.

Analysis

The concentration of benzene in this Standard Reference Material was determined by comparison with a set of gravimetric standards and with a calibrated benzene permeation system. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability and Precautions

This SRM is contained in an aluminum cylinder. The stability of the gas mixture is considered good and no decrease in concentration has been observed in similar samples contained in aluminum cylinders. However, two precautions should be observed in using this SRM for accurate analyses.

1. Cylinder control valves should be used instead of regulators to sample from the high pressure gas cylinders and these valves should be conditioned by passing at least one liter of the SRM through the valve prior to actual sampling.
2. The delivered concentration of benzene from the cylinder increases as the cylinder pressure approaches ambient pressure. Therefore the SRM should not be used below a cylinder pressure of 2.8 MPa (400 psi).

The value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1806

Benzene in Nitrogen

(Nominal Concentration 10 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the determination of benzene in stationary-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Benzene concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of benzene is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the benzene concentration at the 95% confidence level. This uncertainty includes the inaccuracy in the concentration of benzene in gravimetrically prepared primary standards and the imprecision of intercomparison with these primary standards. This sample is certified only for the concentration of benzene. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as benzene, is μmole/mole (ppm).

Each cylinder was individually analyzed and the concentration appearing above applies only to the cylinder with identification number corresponding to the one on this certificate.

Stability and Precautions: See reverse side of this certificate.

The original development and evaluation of the benzene in nitrogen series of Standard Reference Materials were performed in the Gas and Particulate Science Division by W.P. Schmidt and W.F. Cuthrell.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of H.L. Rook, Chief of the Gas and Particulate Science Division.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. Alvarez.

Washington, D.C. 20234
December 27, 1982

(over)

George A. Uriano, Chief
Office of Standard Reference Materials

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that it is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for benzene content.

Analysis

The concentration of benzene in this Standard Reference Material was determined by comparison with a set of gravimetric standards and with a calibrated benzene permeation system. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability and Precautions

This SRM is contained in an aluminum cylinder. The stability of the gas mixture is considered good and no decrease in concentration has been observed in similar samples contained in aluminum cylinders. However, two precautions should be observed in using this SRM for accurate analyses.

1. Cylinder control valves should be used instead of regulators to sample from the high pressure gas cylinders and these valves should be conditioned by passing at least one liter of the SRM through the valve prior to actual sampling.
2. The delivered concentration of benzene from the cylinder increases as the cylinder pressure approaches ambient pressure. Therefore the SRM should not be used below a cylinder pressure of 2.8 MPa (400 psi).

The value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1808

Tetrachloroethylene in Nitrogen

(Nominal Concentration 0.25 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material (SRM) is intended for use in the calibration of instruments used for the determination of tetrachloroethylene in stationary-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of daily working standards may be related.

Tetrachloroethylene concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of tetrachloroethylene is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the tetrachloroethylene concentration at the 95% confidence level. This uncertainty includes the inaccuracy of the concentration of tetrachloroethylene in gravimetric primary standards and the imprecision of intercomparison with these primary standards. This SRM is certified only for the concentration of tetrachloroethylene. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as tetrachloroethylene, is μmole/mole (ppm).

Each cylinder of gas is individually analyzed and the concentration appearing above applies only to the cylinder identified by cylinder number and sample number on this certificate.

Stability and Precautions: See reverse side of this certificate.

The original development and evaluation of the tetrachloroethylene in nitrogen series of Standard Reference Materials were performed in the Gas and Particulate Science Division by W.P. Schmidt and W.F. Cuthrell.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of H.L. Rook, Chief, Gas and Particulate Science Division.

Support for measurement research and standard development was provided by the Quality Assurance Division, Environmental Monitoring and Support Laboratory, USEPA.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. Alvarez.

Washington, D.C. 20234
June 13, 1983

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that it is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for tetrachloroethylene content.

Analysis

The concentration of tetrachloroethylene in this SRM was determined by comparison with a set of gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability and Precautions

This SRM is contained in an aluminum cylinder. The stability of the gas mixture is considered good and no decrease in concentration has been observed in similar samples contained in aluminum cylinders. However, the following precaution should be observed when using this SRM for accurate analyses: Cylinder control valves should be used instead of regulators to sample from the high pressure gas cylinders and these valves should be conditioned by passing at least four liters of the SRM through the valve prior to actual sampling.

The certification of this SRM is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.72 m^3 (25 cubic feet) at STP. The cylinders conform to DOT specifications and are eqipped with CGA-350 valves.

The cylinders become the property of the purchasers.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1809

Tetrachloroethylene in Nitrogen

(Nominal Concentration 10 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material (SRM) is intended for use in the calibration of instruments used for the determination of tetrachloroethylene in stationary-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Tetrachloroethylene concentration: ± μmole/mole (ppm)

Cylinder Number: Sample Number:

The concentration of tetrachloroethylene is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the tetrachloroethylene concentration at the 95% confidence level. This uncertainty includes the uncertainty in the concentration of tetrachloroethylene in gravimetrically prepared primary standards and the imprecision of the intercomparison of the primary standards with the SRM. SRM 1809 is certified only for the concentration of tetrachloroethylene. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as tetrachloroethylene, is less than 0.03 μmole/mole (ppm).

Each cylinder of gas was individually analyzed and the concentration appearing above applies only to the cylinder identified by the cylinder number and the sample number on this certificate.

Stability and Precautions: See reverse side of this certificate.

The original development and evaluation of this tetrachloroethylene in nitrogen SRM were performed in the Gas and Particulate Science Division by W. P. Schmidt and W. F. Cuthrell.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of H. L. Rook, Chief of the Gas and Particulate Science Division.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. Alvarez.

Washington, DC 20234
December 12, 1983

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that it is homogeneous and stable. The tetrachloroethylene content of each cylinder in the lot has been individually determined at NBS.

Analysis

The concentration of tetrachloroethylene in this SRM was determined by comparison with a set of gravimetrically prepared primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability and Precautions

This SRM is contained in an aluminum cylinder. The stability of the gas mixture is considered good and no decrease in concentration has been observed in similar samples contained in aluminum cylinders. However, two precautions should be observed when using this SRM for accurate analyses.

1. A cylinder control valve should be used instead of a regulator when sampling from the high pressure gas cylinder and the valve should be conditioned by passing at least one liter of the SRM through the valve prior to actual sampling.
2. The SRM should not be used when the cylinder pressure is below 1.4 MPa (200 psi). At low pressure ($\leq$200 psi) the concentration of tetrachloroethylene may change.

The value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes in the certified value are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in a cylinder at a pressure of 10.3 MPa (1500 psi) with a deliverable volume of 0.60 m^3 (20 cubic feet) at STP. The cylinder conforms to DOT specifications and is equipped with a CGA-350 valve.

The cylinder becomes the property of the purchaser.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1811

Benzene, Toluene, Chlorobenzene, and Bromobenzene in Nitrogen

(Nominal Concentration, 0.25 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material (SRM) is intended for use in the calibration of instruments used for the determination of volatile aromatic hydrocarbons (benzene, toluene, chlorobenzene and bromobenzene) in stationary-source emissions. SRM 1811 consists of a mixture of these hydrocarbons in high purity nitrogen. This SRM is not intended as a working standard but rather as a primary standard to which the concentrations of the daily working standards may be related. The certified concentration of each hydrocarbon and its associated uncertainty is given below.

Benzene:	±	μmole/mole (ppm)
Toluene:	±	μmole/mole (ppm)
Chlorobenzene:	±	μmole/mole (ppm)
Bromobenzene:	±	μmole/mole (ppm)

Cylinder Number: Sample Number:

The certified concentration of each of these four aromatic hydrocarbons is relative to all other constituents of the gas mixture. The uncertainty shown is the estimated upper limit of error of each hydrocarbon concentration at the 95% confidence level and this uncertainty includes the estimated uncertainty in the gravimetric preparation of standards of this mixture, the analytical imprecision in comparing the gravimetric standards to a sample that was randomly selected from a homogeneously prepared batch of these SRM's (batch standard), and the analytical imprecision in comparing the batch standard to the rest of the samples in the batch. This SRM is certified only for the concentration of the four hydrocarbons listed above.

Each cylinder in this batch was individually analyzed and the concentration appearing above applies only to the cylinder number and sample number identified on this certificate.

Stability and Precautions: See reverse side of this certificate.

The original development and evaluation of this Standard Reference Material were performed in the Gas and Particulate Science Division by W.F. Cuthrell.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of W.L. Zielinski, Jr. and H.L. Rook of the Gas and Particulate Science Division.

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

Gaithersburg, MD 20899
November 18, 1985

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

Certification Information

The cylinder identified on this certificate is one of a group or "batch" of cylinders that were prepared commercially according to rigid technical specifications to ensure homogeneity and stability. Each cylinder in the batch was individually analyzed at NBS for the contents of benzene, toluene, chlorobenzene, and bromobenzene.

Analysis

The certified concentration of each of the aromatic hydrocarbons in this SRM was determined by comparison to a set of gravimetric standards. The concentration of benzene in this SRM also was analytically compared to SRM 1805, Benzene in Nitrogen (0.25 ppm). The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector. Typical analyses used a gas sampling valve and a chromatographic column, such as a 305 cm (10 ft) by 0.32 cm (1/8 inch) stainless steel column packed with 20% SP-2100 and 0.1% Carbowax 1500 on 100-120 mesh Supelcoport, operated at a column temperature of 130 °C and a nitrogen carrier gas flow rate of 50 mL/minute.

Stability and Precautions

This SRM is contained in an aluminum cylinder. The stability of the gas mixture is considered good and no significant decreases in concentrations have been observed with time. However, two precautions should be observed in using this SRM to obtain accurate analyses.

1. Cylinder control valves should be used instead of regulators to sample from the high pressure gas cylinder represented by this SRM, and these valves should be conditioned by passing at least one liter of the SRM through the valve prior to actual sampling.
2. The SRM should not be used below a cylinder pressure of 2.8 MPa (400 psi).

The concentration values appearing on this certificate are considered valid within the stated limits of uncertainty for 2 years from date of purchase. Periodic reanalyses of representative samples from this batch will be performed at NBS, and if statistically significant changes are observed within the 2 year period, purchasers of this SRM will be notified. This SRM may be returned to NBS for recertification at the discretion of the user to extend the certification period.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned prepaid, to the National Bureau of Standards for disposal.

Note

Trade names are mentioned in this certificate only for sake of technical clarity. This mention does not imply any endorsement of commercial products by the National Bureau of Standards.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 1812

Benzene, Toluene, Chlorobenzene, and Bromobenzene in Nitrogen

(Nominal Concentration, 10.0 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material (SRM) is intended for use in the calibration of instruments used for the determination of volatile aromatic hydrocarbons (benzene, toluene, chlorobenzene and bromobenzene) in stationary-source emissions. SRM 1812 consists of a mixture of these hydrocarbons in high purity nitrogen. This SRM is not intended as a working standard but rather as a primary standard to which the concentrations of the daily working standards may be related. The certified concentration of each hydrocarbon and its associated uncertainty is given below.

Benzene:	±	μmole/mole (ppm)
Toluene:	±	μmole/mole (ppm)
Chlorobenzene:	±	μmole/mole (ppm)
Bromobenzene:	±	μmole/mole (ppm)

Cylinder Number: Sample Number:

The certified concentration of each of these four aromatic hydrocarbons is relative to all other constituents of the gas mixture. The uncertainty shown is the estimated upper limit of error of each hydrocarbon concentration at the 95% confidence level and this uncertainty includes the estimated uncertainty in the gravimetric preparation of standards of this mixture, the analytical imprecision in comparing the gravimetric standards to a sample that was randomly selected from a homogeneously prepared batch of these SRM's (batch standard), and the analytical imprecision in comparing the batch standard to the rest of the samples in the batch. This SRM is certified only for the concentration of the four hydrocarbons listed above.

Each cylinder in this batch was individually analyzed and the concentration appearing above applies only to the cylinder number and sample number identified on this certificate.

Stability and Precautions: See reverse side of this certificate.

The original development and evaluation of this Standard Reference Material were performed in the Gas and Particulate Science Division by W.F. Cuthrell.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of W.L. Zielinski, Jr. and H.L. Rook of the Gas and Particulate Science Division.

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

Gaithersburg, MD 20899
November 18, 1985

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

Certification Information

The cylinder identified on this certificate is one of a group or "batch" of cylinders that were prepared commercially according to rigid technical specifications to ensure homogeneity and stability. Each cylinder in the batch was individually analyzed at NBS for the contents of benzene, toluene, chlorobenzene, and bromobenzene.

Analysis

The certified concentration of each of the aromatic hydrocarbons in this SRM was determined by comparison to a set of gravimetric standards. The concentration of benzene in this SRM also was analytically compared to SRM 1805, Benzene in Nitrogen (0.25 ppm). The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector. Typical analyses used a gas sampling valve and a chromatographic column, such as a 305 cm (10 ft) by 0.32 cm (1/8 inch) stainless steel column packed with 20% SP-2100 and 0.1% Carbowax 1500 on 100-120 mesh Supelcoport, operated at a column temperature of 130 °C and a nitrogen carrier gas flow rate of 50 mL/minute.

Stability and Precautions

This SRM is contained in an aluminum cylinder. The stability of the gas mixture is considered good and no significant decreases in concentrations have been observed with time. However, two precautions should be observed in using this SRM to obtain accurate analyses.

1. Cylinder control valves should be used instead of regulators to sample from the high pressure gas cylinder represented by this SRM, and these valves should be conditioned by passing at least one liter of the SRM through the valve prior to actual sampling.
2. The SRM should not be used below a cylinder pressure of 2.8 MPa (400 psi).

The concentration values appearing on this certificate are considered valid within the stated limits of uncertainty for 2 years from date of purchase. Periodic reanalyses of representative samples from this batch will be performed at NBS, and if statistically significant changes are observed within the 2 year period, purchasers of this SRM will be notified. This SRM may be returned to NBS for recertification at the discretion of the user to extend the certification period.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned prepaid, to the National Bureau of Standards for disposal.

Note

Trade names are mentioned in this certificate only for sake of technical clarity. This mention does not imply any endorsement of commercial products by the National Bureau of Standards.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2607

Carbon Dioxide and Nitrous Oxide in Air

(Nominal Concentration 340 ppm CO_2 and 300 ppb N_2O)

(Atmospheric Standard)

This Standard Reference Material (SRM) is intended for use in the calibration of instruments and the evaluation of methods used for the measurement of carbon dioxide and nitrous oxide in the atmosphere. It is not intended as a working standard, but rather as a primary laboratory standard, to which the concentration of carbon dioxide and/or nitrous oxide in other standards may be related.

Carbon dioxide concentration:	±	μmole/mole(ppm)
Nitrous oxide concentration:	±	nmole/mole(ppb)
Cylinder Number:	Sample Number:	

The concentrations of carbon dioxide and nitrous oxide are relative to all other constituents of this gas mixture. The uncertainties shown are the estimated upper limit of error of the carbon dioxide and nitrous oxide concentrations and are the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentrations given above apply only to the cylinder identified by the cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas-handling system.

The research and development leading to the certification of this SRM were performed in the Gas and Particulate Science Division by E.E. Hughes, J.W. Elkins, R.C. Myers, and P.A. Johnson.

The overall direction and coordination of the technical measurements leading to the certification of this SRM were performed under the chairmanship of W.L. Zielinski, Jr., and H.L. Rook of the Gas and Particulate Science Divison.

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

Gaithersburg, MD 20899
September 3, 1985

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

Analysis

The carbon dioxide and nitrous oxide contents of this Standard Reference Material were determined by comparison to NBS working standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison was gas chromatography and/or a nondispersive infrared spectrometric method for carbon dioxide, and electron capture-gas chromatography and tunable diode laser spectroscopy for nitrous oxide.

Representative samples from this batch of Standard Reference Materials have been analyzed for oxygen, water vapor, methane, and halocarbons F-11 and F-12. The concentrations of components listed in Table 1 are not certified but are given for information only.

Table 1

Component	Estimated Concentration in Samples of this Batch
Oxygen	20.95 mole percent
Water Vapor	ppm by mole*
Methane	ppm by mole
Trichlorofluoromethane (Halocarbon F-11)	ppt** by mole
Dichlorodifluoromethane (Halocarbon F-12)	ppt** by mole

*maximum
**ppt, parts per trillion

Uncertainty

The estimated upper limit of the total uncertainty at 95% confidence for the carbon dioxide concentration of this SRM does not exceed 0.1% of its certified value, while that for the nitrous oxide concentration of this SRM does not exceed 1.0% of its certified value. These estimates are based on systematic errors associated with gravimetric standards, the random errors associated with the comparison of the gravimetric standards to the NBS working standards, and the comparison of the NBS working standards to the SRM.

A sample from this batch has been independently analyzed for its carbon dioxide concentration by P. Guenther at the laboratory of Dr. Charles Keeling at the Scripps Institution of Oceanography (SIO) of the University of California, San Diego. The difference between the carbon dioxide concentration assigned by NBS and that measured by SIO was not significant considering the uncertainties in the two independent methods employed.

Stability

Measurements have been made of many samples in this batch over time intervals up to 18 months and no evidence has been found of changes in the concentration of carbon dioxide or in the concentration of nitrous oxide. However, in several instances, samples from this batch and other batches of carbon dioxide in air have exhibited an increase in concentration when the cylinder pressure fell to a pressure below 1.04 MPa (150 psi). It is not recommended that the sample be used as an analytical standard after the pressure has fallen below 2.76 MPa (400 psi).

The concentrations on the certificate are valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS and, if significant changes are observed, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of approximately 3.82 m^3 (135 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves. The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for reanalysis.

Reanalysis

When this Standard Reference Material is used as a standard in a long-term program of analysis of atmospheric carbon dioxide, it may be necessary to confirm the original certification during or at the end of the certification period. The National Bureau of Standards will reanalyze this Standard Reference Material for the original purchaser at a cost not to exceed the cost of similar materials available at the time of the request for reanalysis. The original purchaser should contact William Dorko, (301) 921-2888, of the Gas and Particulate Science Division of the National Bureau of Standards to arrange for reanalysis.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2608

Carbon Dioxide and Nitrous Oxide in Air

(Nominal Concentration 340 ppm CO_2 and 300 ppb N_2O)

(Atmospheric Standard)

This Standard Reference Material (SRM) is intended for use in the calibration of instruments and the evaluation of methods used for the measurement of carbon dioxide and nitrous oxide in the atmosphere. It is not intended as a working standard, but rather as a primary laboratory standard, to which the concentration of carbon dioxide and/or nitrous oxide in other standards may be related.

Carbon dioxide concentration:	±	μmole/mole(ppm)
Nitrous oxide concentration:	±	nmole/mole(ppb)
Cylinder Number:	Sample Number:	

The concentrations of carbon dioxide and nitrous oxide are relative to all other constituents of this gas mixture. The uncertainties shown are the estimated upper limit of error of the carbon dioxide and nitrous oxide concentrations and are the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentrations given above apply only to the cylinder identified by the cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas-handling system.

The research and development leading to the certification of this SRM were performed in the Gas and Particulate Science Division by E.E. Hughes, J.W. Elkins, R.C. Myers, and P.A. Johnson.

The overall direction and coordination of the technical measurements leading to the certification of this SRM were performed under the chairmanship of W.L. Zielinski, Jr., and H.L. Rook of the Gas and Particulate Science Divison.

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

Gaithersburg, MD 20899
September 3, 1985

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

Analysis

The carbon dioxide and nitrous oxide contents of this Standard Reference Material were determined by comparison to NBS working standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison was gas chromatography and/or a nondispersive infrared spectrometric method for carbon dioxide, and electron capture-gas chromatography and tunable diode laser spectroscopy for nitrous oxide.

Representative samples from this batch of Standard Reference Materials have been analyzed for oxygen, water vapor, methane, and halocarbons F-11 and F-12. The concentrations of components listed in Table 1 are not certified but are given for information only.

Table 1

Component	Estimated Concentration in Samples of this Batch
Oxygen	20.95 mole percent
Water Vapor	ppm by mole*
Methane	ppm by mole
Trichlorofluoromethane (Halocarbon F-11)	ppt** by mole
Dichlorodifluoromethane (Halocarbon F-12)	ppt** by mole

*maximum
**ppt, parts per trillion

Uncertainty

The estimated upper limit of the total uncertainty at 95% confidence for the carbon dioxide concentration of this SRM does not exceed 0.1% of its certified value, while that for the nitrous oxide concentration of this SRM does not exceed 1.0% of its certified value. These estimates are based on systematic errors associated with gravimetric standards, the random errors associated with the comparison of the gravimetric standards to the NBS working standards, and the comparison of the NBS working standards to the SRM.

A sample from this batch has been independently analyzed for its carbon dioxide concentration by P. Guenther at the laboratory of Dr. Charles Keeling at the Scripps Institution of Oceanography (SIO) of the University of California, San Diego. The difference between the carbon dioxide concentration assigned by NBS and that measured by SIO was not significant considering the uncertainties in the two independent methods employed.

Stability

Measurements have been made of many samples in this batch over time intervals up to 18 months and no evidence has been found of changes in the concentration of carbon dioxide or in the concentration of nitrous oxide. However, in several instances, samples from this batch and other batches of carbon dioxide in air have exhibited an increase in concentration when the cylinder pressure fell to a pressure below 1.04 MPa (150 psi). It is not recommended that the sample be used as an analytical standard after the pressure has fallen below 2.76 MPa (400 psi).

The concentrations on the certificate are valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS and, if significant changes are observed, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of approximately 0.76 m^3 (27 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves. The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for reanalysis.

Reanalysis

When this Standard Reference Material is used as a standard in a long-term program of analysis of atmospheric carbon dioxide, it may be necessary to confirm the original certification during or at the end of the certification period. The National Bureau of Standards will reanalyze this Standard Reference Material for the original purchaser at a cost not to exceed the cost of similar materials available at the time of the request for reanalysis. The original purchaser should contact William Dorko, (301) 921-2888, of the Gas and Particulate Science Division of the National Bureau of Standards to arrange for reanalysis.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2609

Carbon Dioxide and Nitrous Oxide in Air

(Nominal Concentration 380 ppm CO_2 and 330 ppb N_2O)

(Atmospheric Standard)

This Standard Reference Material (SRM) is intended for use in the calibration of instruments and the evaluation of methods used for the measurement of carbon dioxide and nitrous oxide in the atmosphere. It is not intended as a working standard, but rather as a primary laboratory standard, to which the concentration of carbon dioxide and/or nitrous oxide in other standards may be related.

Carbon dioxide concentration:	±	μmole/mole(ppm)
Nitrous oxide concentration:	±	nmole/mole(ppb)
Cylinder Number:	Sample Number:	

The concentrations of carbon dioxide and nitrous oxide are relative to all other constituents of this gas mixture. The uncertainties shown are the estimated upper limit of error of the carbon dioxide and nitrous oxide concentrations and are the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentrations given above apply only to the cylinder identified by the cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas-handling system.

The research and development leading to the certification of this SRM were performed in the Gas and Particulate Science Division by E.E. Hughes, J.W. Elkins, R.C. Myers, and P.A. Johnson.

The overall direction and coordination of the technical measurements leading to the certification of this SRM were performed under the chairmanship of W.L. Zielinski, Jr., and H.L. Rook of the Gas and Particulate Science Divison.

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

Gaithersburg, MD 20899
September 3, 1985

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

Analysis

The carbon dioxide and nitrous oxide contents of this Standard Reference Material were determined by comparison to NBS working standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison was gas chromatography and/or a nondispersive infrared spectrometric method for carbon dioxide, and electron capture-gas chromatography and tunable diode laser spectroscopy for nitrous oxide.

Representative samples from this batch of Standard Reference Materials have been analyzed for oxygen, water vapor, methane, and halocarbons F-11 and F-12. The concentrations of components listed in Table 1 are not certified but are given for information only.

Table 1

Component	Estimated Concentration in Samples of this Batch
Oxygen	20.95 mole percent
Water Vapor	ppm by mole*
Methane	ppm by mole
Trichlorofluoromethane (Halocarbon F-11)	ppt** by mole
Dichlorodifluoromethane (Halocarbon F-12)	ppt** by mole

*maximum
**ppt, parts per trillion

Uncertainty

The estimated upper limit of the total uncertainty at 95% confidence for the carbon dioxide concentration of this SRM does not exceed 0.1% of its certified value, while that for the nitrous oxide concentration of this SRM does not exceed 1.0% of its certified value. These estimates are based on systematic errors associated with gravimetric standards, the random errors associated with the comparison of the gravimetric standards to the NBS working standards, and the comparison of the NBS working standards to the SRM.

A sample from this batch has been independently analyzed for its carbon dioxide concentration by P. Guenther at the laboratory of Dr. Charles Keeling at the Scripps Institution of Oceanography (SIO) of the University of California, San Diego. The difference between the carbon dioxide concentration assigned by NBS and that measured by SIO was not significant considering the uncertainties in the two independent methods employed.

Stability

Measurements have been made of many samples in this batch over time intervals up to 18 months and no evidence has been found of changes in the concentration of carbon dioxide or in the concentration of nitrous oxide. However, in several instances, samples from this batch and other batches of carbon dioxide in air have exhibited an increase in concentration when the cylinder pressure fell to a pressure below 1.04 MPa (150 psi). It is not recommended that the sample be used as an analytical standard after the pressure has fallen below 2.76 MPa (400 psi).

The concentrations on the certificate are valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS and, if significant changes are observed, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of approximately 3.82 m^3 (135 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves. The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for reanalysis.

Reanalysis

When this Standard Reference Material is used as a standard in a long-term program of analysis of atmospheric carbon dioxide, it may be necessary to confirm the original certification during or at the end of the certification period. The National Bureau of Standards will reanalyze this Standard Reference Material for the original purchaser at a cost not to exceed the cost of similar materials available at the time of the request for reanalysis. The original purchaser should contact William Dorko, (301) 921-2888, of the Gas and Particulate Science Division of the National Bureau of Standards to arrange for reanalysis.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2610

Carbon Dioxide and Nitrous Oxide in Air

(Nominal Concentration 380 ppm CO_2 and 330 ppb N_2O)

(Atmospheric Standard)

This Standard Reference Material (SRM) is intended for use in the calibration of instruments and the evaluation of methods used for the measurement of carbon dioxide and nitrous oxide in the atmosphere. It is not intended as a working standard, but rather as a primary laboratory standard, to which the concentration of carbon dioxide and/or nitrous oxide in other standards may be related.

Carbon dioxide concentration:	±	μmole/mole(ppm)
Nitrous oxide concentration:	±	nmole/mole(ppb)
Cylinder Number:	Sample Number:	

The concentrations of carbon dioxide and nitrous oxide are relative to all other constituents of this gas mixture. The uncertainties shown are the estimated upper limit of error of the carbon dioxide and nitrous oxide concentrations and are the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentrations given above apply only to the cylinder identified by the cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas-handling system.

The research and development leading to the certification of this SRM were performed in the Gas and Particulate Science Division by E.E. Hughes, J.W. Elkins, R.C. Myers, and P.A. Johnson.

The overall direction and coordination of the technical measurements leading to the certification of this SRM were performed under the chairmanship of W.L. Zielinski, Jr., and H.L. Rook of the Gas and Particulate Science Divison.

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

Gaithersburg, MD 20899
September 3, 1985

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

Analysis

The carbon dioxide and nitrous oxide contents of this Standard Reference Material were determined by comparison to NBS working standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison was gas chromatography and/or a nondispersive infrared spectrometric method for carbon dioxide, and electron capture-gas chromatography and tunable diode laser spectroscopy for nitrous oxide.

Representative samples from this batch of Standard Reference Materials have been analyzed for oxygen, water vapor, methane, and halocarbons F-11 and F-12. The concentrations of components listed in Table 1 are not certified but are given for information only.

Table 1

Component	Estimated Concentration in Samples of this Batch
Oxygen	20.95 mole percent
Water Vapor	ppm by mole*
Methane	ppm by mole
Trichlorofluoromethane (Halocarbon F-11)	ppt** by mole
Dichlorodifluoromethane (Halocarbon F-12)	ppt** by mole

*maximum
**ppt, parts per trillion

Uncertainty

The estimated upper limit of the total uncertainty at 95% confidence for the carbon dioxide concentration of this SRM does not exceed 0.1% of its certified value, while that for the nitrous oxide concentration of this SRM does not exceed 1.0% of its certified value. These estimates are based on systematic errors associated with gravimetric standards, the random errors associated with the comparison of the gravimetric standards to the NBS working standards, and the comparison of the NBS working standards to the SRM.

A sample from this batch has been independently analyzed for its carbon dioxide concentration by P. Guenther at the laboratory of Dr. Charles Keeling at the Scripps Institution of Oceanography (SIO) of the University of California, San Diego. The difference between the carbon dioxide concentration assigned by NBS and that measured by SIO was not significant considering the uncertainties in the two independent methods employed.

Stability

Measurements have been made of many samples in this batch over time intervals up to 18 months and no evidence has been found of changes in the concentration of carbon dioxide or in the concentration of nitrous oxide. However, in several instances, samples from this batch and other batches of carbon dioxide in air have exhibited an increase in concentration when the cylinder pressure fell to a pressure below 1.04 MPa (150 psi). It is not recommended that the sample be used as an analytical standard after the pressure has fallen below 2.76 MPa (400 psi).

The concentrations on the certificate are valid for two years from the date of shipment from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS and, if significant changes are observed, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of approximately 0.76 m^3 (27 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves. The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for reanalysis.

Reanalysis

When this Standard Reference Material is used as a standard in a long-term program of analysis of atmospheric carbon dioxide, it may be necessary to confirm the original certification during or at the end of the certification period. The National Bureau of Standards will reanalyze this Standard Reference Material for the original purchaser at a cost not to exceed the cost of similar materials available at the time of the request for reanalysis. The original purchaser should contact William Dorko, (301) 921-2888, of the Gas and Particulate Science Division of the National Bureau of Standards to arrange for reanalysis.

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 2612a

Carbon Monoxide in Air
(Nominal Concentration 10 ppm)
(Ambient Air Quality Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon monoxide in air. It is also intended to complement Standard Reference Materials 1677 and 1678 (Carbon Monoxide in Nitrogen) for use with analytical techniques where the use of nitrogen as diluent gas may result in measurement error. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon monoxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of carbon monoxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the carbon monoxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified by the cylinder number and sample number on this certificate.

The original development and evaluation of the carbon monoxide in air series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and J. E. Suddueth.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

Carbon monoxide in this Standard Reference Material was determined by comparison with a secondary standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved both measurement by a nondispersive infrared technique and by measurement of methane produced by catalytic reduction of the carbon monoxide.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 1 year from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS and if significant changes are observed within the 1 year period, purchasers of this SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 28, 1980
(Revision of Certificate dated 1-17-77)

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 2613a

Carbon Monoxide in Air
(Nominal Concentration 20 ppm)
(Ambient Air Quality Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon monoxide in air. It is also intended to complement Standard Reference Materials 1677 and 1678 (Carbon Monoxide in Nitrogen) for use with analytical techniques where the use of nitrogen as diluent gas may result in measurement error. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon monoxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of carbon monoxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the carbon monoxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified by the cylinder number and sample number on this certificate.

The original development and evaluation of the carbon monoxide in air series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and J. E. Suddueth.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

Carbon monoxide in this Standard Reference Material was determined by comparison with a secondary standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved both measurement by a nondispersive infrared technique and by measurement of methane produced by catalytic reduction of the carbon monoxide.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 1 year from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS and if significant changes are observed within the 1 year period, purchasers of this SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 28, 1980
(Revision of Certificate
dated 1-17-77)

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 2614a

Carbon Monoxide in Air
(Nominal Concentration 45 ppm)
(Ambient Air Quality Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of carbon monoxide in air. It is also intended to complement Standard Reference Materials 1677 and 1678 (Carbon Monoxide in Nitrogen) for use with analytical techniques where the use of nitrogen as diluent gas may result in measurement error. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon monoxide concentration:	±	μmole/mole (ppm)
Cylinder Number:	Sample Number:	

The concentration of carbon monoxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the carbon monoxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified by the cylinder number and sample number on this certificate.

The original development and evaluation of the carbon monoxide in air series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and J. E. Suddueth.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

Carbon monoxide in this Standard Reference Material was determined by comparison with a secondary standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved both measurement by a nondispersive infrared technique and by measurement of methane produced by catalytic reduction of the carbon monoxide.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 1 year from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS and if significant changes are observed within the 1 year period, purchasers of this SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 28, 1980
(Revision of Certificate
dated 1-17-77)

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary
National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 2619a

Carbon Dioxide in Nitrogen

(Nominal Concentration 0.5 percent)

(Combustion Efficiency Gas Standard)

This Standard Reference Material is intended primarily for the determination of fuel efficiency of motor vehicles by a materials balance method and for other gas analysis applications where accurate measurements of carbon dioxide must be performed. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon dioxide concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of carbon dioxide is relative to all other constituents of the mixture. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95% confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified on this certificate.

The original development and evaluation of the carbon dioxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and E. E. Hughes.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

The carbon dioxide concentration in this Standard Reference Material (SRM) was determined by comparison with a secondary standard which had been intercompared with a set of primary gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector. The gravimetric standards were prepared from analyzed samples of nitrogen and carbon dioxide.

Stability

The stability of these mixtures is considered to be excellent. No loss of carbon dioxide has been observed in either the standards or in previous lots of this SRM. Periodic reanalyses of representative SRM's from this lot will be performed, and if any change in concentration is observed the purchasers of other SRM's from this lot will be notified. The value shown in this certificate is considered valid for a period of one year from receipt.

The SRM should be stored at room temperature and should not be allowed to experience either high or low ambient temperatures.

Cylinder

This SRM is supplied in a cylinder at a pressure of 12.4 MPa (1800 lb/in^2) with a deliverable volume of 0.88 m^3 (31 cubic ft)) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 2620a

Carbon Dioxide in Nitrogen

(Nominal Concentration 1.0 percent)

(Combustion Efficiency Gas Standard)

This Standard Reference Material is intended primarily for the determination of fuel efficiency of motor vehicles by a materials balance method and for other gas analysis applications where accurate measurements of carbon dioxide must be performed. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon dioxide concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of carbon dioxide is relative to all other constituents of the mixture. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95% confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified on this certificate.

The original development and evaluation of the carbon dioxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and E. E. Hughes.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

The carbon dioxide concentration in this Standard Reference Material (SRM) was determined by comparison with a secondary standard which had been intercompared with a set of primary gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector. The gravimetric standards were prepared from analyzed samples of nitrogen and carbon dioxide.

Stability

The stability of these mixtures is considered to be excellent. No loss of carbon dioxide has been observed in either the standards or in previous lots of this SRM. Periodic reanalyses of representative SRM's from this lot will be performed, and if any change in concentration is observed the purchasers of other SRM's from this lot will be notified. The value shown in this certificate is considered valid for a period of one year from receipt.

The SRM should be stored at room temperature and should not be allowed to experience either high or low ambient temperatures.

Cylinder

This SRM is supplied in a cylinder at a pressure of 12.4 MPa (1800 lb/in^2) with a deliverable volume of 0.88 m^3 (31 cubic ft) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 2621a

Carbon Dioxide in Nitrogen
(Nominal Concentration 1.5 percent)
(Combustion Efficiency Gas Standard)

This Standard Reference Material is intended primarily for the determination of fuel efficiency of motor vehicles by a materials balance method and for other gas analysis applications where accurate measurements of carbon dioxide must be performed. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon dioxide concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of carbon dioxide is relative to all other constituents of the mixture. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95% confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified on this certificate.

The original development and evaluation of the carbon dioxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and E. E. Hughes.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

The carbon dioxide concentration in this Standard Reference Material (SRM) was determined by comparison with a secondary standard which had been intercompared with a set of primary gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector. The gravimetric standards were prepared from analyzed samples of nitrogen and carbon dioxide.

Stability

The stability of these mixtures is considered to be excellent. No loss of carbon dioxide has been observed in either the standards or in previous lots of this SRM. Periodic reanalyses of representative SRM's from this lot will be performed, and if any change in concentration is observed the purchasers of other SRM's from this lot will be notified. The value shown in this certificate is considered valid for a period of one year from receipt.

The SRM should be stored at room temperature and should not be allowed to experience either high or low ambient temperatures.

Cylinder

This SRM is supplied in a cylinder at a pressure of 12.4 MPa (1800 lb/in^2) with a deliverable volume of 0.88 m^3 (31 cubic ft) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 2622a

Carbon Dioxide in Nitrogen

(Nominal Concentration 2.0 percent)

(Combustion Efficiency Gas Standard)

This Standard Reference Material is intended primarily for the determination of fuel efficiency of motor vehicles by a materials balance method and for other gas analysis applications where accurate measurements of carbon dioxide must be performed. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon dioxide concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of carbon dioxide is relative to all other constituents of the mixture. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95% confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified on this certificate.

The original development and evaluation of the carbon dioxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and E. E. Hughes.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

The carbon dioxide concentration in this Standard Reference Material (SRM) was determined by comparison with a secondary standard which had been intercompared with a set of primary gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector. The gravimetric standards were prepared from analyzed samples of nitrogen and carbon dioxide.

Stability

The stability of these mixtures is considered to be excellent. No loss of carbon dioxide has been observed in either the standards or in previous lots of this SRM. Periodic reanalyses of representative SRM's from this lot will be performed, and if any change in concentration is observed the purchasers of other SRM's from this lot will be notified. The value shown in this certificate is considered valid for a period of one year from receipt.

The SRM should be stored at room temperature and should not be allowed to experience either high or low ambient temperatures.

Cylinder

This SRM is supplied in a cylinder at a pressure of 12.4 MPa (1800 lb/in^2) with a deliverable volume of 0.88 m^3 (31 cubic ft) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 2623a

Carbon Dioxide in Nitrogen

(Nominal Concentration 2.5 percent)

(Combustion Efficiency Gas Standard)

This Standard Reference Material is intended primarily for the determination of fuel efficiency of motor vehicles by a materials balance method and for other gas analysis applications where accurate measurements of carbon dioxide must be performed. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon dioxide concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of carbon dioxide is relative to all other constituents of the mixture. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95% confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified on this certificate.

The original development and evaluation of the carbon dioxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and E. E. Hughes.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

The carbon dioxide concentration in this Standard Reference Material (SRM) was determined by comparison with a secondary standard which had been intercompared with a set of primary gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector. The gravimetric standards were prepared from analyzed samples of nitrogen and carbon dioxide.

Stability

The stability of these mixtures is considered to be excellent. No loss of carbon dioxide has been observed in either the standards or in previous lots of this SRM. Periodic reanalyses of representative SRM's from this lot will be performed, and if any change in concentration is observed the purchasers of other SRM's from this lot will be notified. The value shown in this certificate is considered valid for a period of one year from receipt.

The SRM should be stored at room temperature and should not be allowed to experience either high or low ambient temperatures.

Cylinder

This SRM is supplied in a cylinder at a pressure of 12.4 MPa (1800 lb/in^2) with a deliverable volume of 0.88 m^3 (31 cubic ft) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 2624a

Carbon Dioxide in Nitrogen
(Nominal Concentration 3.0 percent)
(Combustion Efficiency Gas Standard)

This Standard Reference Material is intended primarily for the determination of fuel efficiency of motor vehicles by a materials balance method and for other gas analysis applications where accurate measurements of carbon dioxide must be performed. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon dioxide concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of carbon dioxide is relative to all other constituents of the mixture. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95% confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified on this certificate.

The original development and evaluation of the carbon dioxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and E. E. Hughes.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

The carbon dioxide concentration in this Standard Reference Material (SRM) was determined by comparison with a secondary standard which had been intercompared with a set of primary gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector. The gravimetric standards were prepared from analyzed samples of nitrogen and carbon dioxide.

Stability

The stability of these mixtures is considered to be excellent. No loss of carbon dioxide has been observed in either the standards or in previous lots of this SRM. Periodic reanalyses of representative SRM's from this lot will be performed, and if any change in concentration is observed the purchasers of other SRM's from this lot will be notified. The value shown in this certificate is considered valid for a period of one year from receipt.

The SRM should be stored at room temperature and should not be allowed to experience either high or low ambient temperatures.

Cylinder

This SRM is supplied in a cylinder at a pressure of 12.4 MPa (1800 lb/in^2) with a deliverable volume of 0.88 m^3 (31 cubic ft) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 2625a

Carbon Dioxide in Nitrogen
(Nominal Concentration 3.5 percent)
(Combustion Efficiency Gas Standard)

This Standard Reference Material is intended primarily for the determination of fuel efficiency of motor vehicles by a materials balance method and for other gas analysis applications where accurate measurements of carbon dioxide must be performed. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon dioxide concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of carbon dioxide is relative to all other constituents of the mixture. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95% confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified on this certificate.

The original development and evaluation of the carbon dioxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and E. E. Hughes.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

The carbon dioxide concentration in this Standard Reference Material (SRM) was determined by comparison with a secondary standard which had been intercompared with a set of primary gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector. The gravimetric standards were prepared from analyzed samples of nitrogen and carbon dioxide.

Stability

The stability of these mixtures is considered to be excellent. No loss of carbon dioxide has been observed in either the standards or in previous lots of this SRM. Periodic reanalyses of representative SRM's from this lot will be performed, and if any change in concentration is observed the purchasers of other SRM's from this lot will be notified. The value shown in this certificate is considered valid for a period of one year from receipt.

The SRM should be stored at room temperature and should not be allowed to experience either high or low ambient temperatures.

Cylinder

This SRM is supplied in a cylinder at a pressure of 12.4 MPa (1800 lb/in^2) with a deliverable volume of 0.88 m^3 (31 cubic ft) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 2626a

Carbon Dioxide in Nitrogen
(Nominal Concentration 4.0 percent)
(Combustion Efficiency Gas Standard)

This Standard Reference Material is intended primarily for the determination of fuel efficiency of motor vehicles by a materials balance method and for other gas analysis applications where accurate measurements of carbon dioxide must be performed. It is not intended as a working standard, but rather as a primary standard to which the concentration of working standards may be related.

Carbon dioxide concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of carbon dioxide is relative to all other constituents of the mixture. The uncertainty shown is the estimated upper limit of error of the carbon dioxide concentration and is the 95% confidence interval based on allowances for known sources of possible error.

Each cylinder is individually analyzed and the concentration that appears above applies to the cylinder identified on this certificate.

The original development and evaluation of the carbon dioxide in nitrogen series of Standard Reference Materials was performed in the Gas and Particulate Science Division by W. D. Dorko and E. E. Hughes.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook, Chief of the Gas and Particulate Science Division.

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

Analysis

The carbon dioxide concentration in this Standard Reference Material (SRM) was determined by comparison with a secondary standard which had been intercompared with a set of primary gravimetric standards. The intercomparisons were performed using a gas chromatograph equipped with a thermal conductivity detector. The gravimetric standards were prepared from analyzed samples of nitrogen and carbon dioxide.

Stability

The stability of these mixtures is considered to be excellent. No loss of carbon dioxide has been observed in either the standards or in previous lots of this SRM. Periodic reanalyses of representative SRM's from this lot will be performed, and if any change in concentration is observed the purchasers of other SRM's from this lot will be notified. The value shown in this certificate is considered valid for a period of one year from receipt.

The SRM should be stored at room temperature and should not be allowed to experience either high or low ambient temperatures.

Cylinder

This SRM is supplied in a cylinder at a pressure of 12.4 MPa (1800 lb/in^2) with a deliverable volume of 0.88 m^3 (31 cubic ft) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinder becomes the property of the purchaser. However, it may be returned, prepaid, to the National Bureau of Standards for disposal.

Washington, D.C. 20234
January 25, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2627

Nitric Oxide in Nitrogen

(Nominal Concentration 5 ppm)

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of oxides of nitrogen in mobile-source emissions. It is not intended as a working standard, but rather as a primary laboratory standard to which the concentration of nitric oxide in other standards may be related.

Nitric oxide concentration:	±	μmole/mole(ppm)
Cylinder Number:	Sample Number:	

The concentration of nitric oxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitric oxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas handling system.

The research and development leading to the certification of this SRM were supported in part by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the nitric oxide in nitrogen series of Standard Reference Materials were performed in the Gas and Particulate Science Division by W. P. Thorn, W. R. Miller, and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
June 7, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for nitric oxide content.

Analysis

The nitric oxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison utilized the chemiluminescent reaction of nitric oxide with ozone.

Representative samples have been analyzed for the presence of other nitrogen oxides by passing the sample through a high-temperature catalytic furnace which converts these other oxides of nitrogen to nitric oxide. Under the conditions of the analysis a minimum of one percent of other nitrogen oxides would have been detected. No other oxides of nitrogen were detected in the samples analyzed within the stated limits.

Stability

Loss of nitric oxide by adsorption on the container walls may occur in new cylinders not previously used for nitric oxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitric oxide from the cylinder walls when the cylinder pressure is reduced. It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).

The concentration on this certificate is valid for one year from the date of purchase from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within one year, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2628

Nitric Oxide in Nitrogen

(Nominal Concentration 10 ppm)

(Mobile -Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of oxides of nitrogen in mobile-source emissions. It is not intended as a working standard, but rather as a primary laboratory standard to which the concentration of nitric oxide in other standards may be related.

Nitric oxide concentration:	±	μmole/mole(ppm)
Cylinder Number:	Sample Number:	

The concentration of nitric oxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitric oxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas handling system.

The research and development leading to the certification of this SRM were supported in part by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the nitric oxide in nitrogen series of Standard Reference Materials were performed in the Gas and Particulate Science Division by W. P. Thorn, W. R. Miller, and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
June 7, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for nitric oxide content.

Analysis

The nitric oxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison utilized the chemiluminescent reaction of nitric oxide with ozone.

Representative samples have been analyzed for the presence of other nitrogen oxides by passing the sample through a high-temperature catalytic furnace which converts these other oxides of nitrogen to nitric oxide. Under the conditions of the analysis a minimum of one percent of other nitrogen oxides would have been detected. No other oxides of nitrogen were detected in the samples analyzed within the stated limits.

Stability

Loss of nitric oxide by adsorption on the container walls may occur in new cylinders not previously used for nitric oxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitric oxide from the cylinder walls when the cylinder pressure is reduced. It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).

The concentration on this certificate is valid for one year from the date of purchase from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within one year, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2629

Nitric Oxide in Nitrogen

(Nominal Concentration 20 ppm)

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of oxides of nitrogen in mobile-source emissions. It is not intended as a working standard, but rather as a primary laboratory standard to which the concentration of nitric oxide in other standards may be related.

Nitric oxide concentration:	±	μmole/mole(ppm)
Cylinder Number:	Sample Number:	

The concentration of nitric oxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitric oxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas handling system.

The research and development leading to the certification of this SRM were supported in part by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the nitric oxide in nitrogen series of Standard Reference Materials were performed in the Gas and Particulate Science Division by W. P. Thorn, W. R. Miller, and W. D. Dorko.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
June 7, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications to ensure that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for nitric oxide content.

Analysis

The nitric oxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison utilized the chemiluminescent reaction of nitric oxide with ozone.

Representative samples have been analyzed for the presence of other nitrogen oxides by passing the sample through a high-temperature catalytic furnace which converts these other oxides of nitrogen to nitric oxide. Under the conditions of the analysis a minimum of one percent of other nitrogen oxides would have been detected. No other oxides of nitrogen were detected in the samples analyzed within the stated limits.

Stability

Loss of nitric oxide by adsorption on the container walls may occur in new cylinders not previously used for nitric oxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitric oxide from the cylinder walls when the cylinder pressure is reduced. It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).

The concentration on this certificate is valid for one year from the date of purchase from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within one year, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser.

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 2630

Nitric Oxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a mixture of nitric oxide in high purity nitrogen which is supplied in a high-pressure, compressed gas cylinder. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

CAUTION: Every precaution must be taken to avoid accidental contamination of the sample with atmospheric air during connection of the cylinder to any gas-handling system.

Nitric Oxide Concentration: ± μmol/mol (ppm)

Cylinder Number: Sample Number:

The concentration of nitric oxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ± 0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy. The estimated upper limit of error of the nitric oxide concentration is ± 1.0% relative. This estimate is the 95% confidence interval based on allowances for known sources of possible error.

The research and development of this Standard Reference Material was supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E.E. Hughes and H.L. Rook.

The technical and support aspects involved in the preparation, certification and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by W.P. Reed.

Washington, D.C. 20234
May 2, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

The nitric oxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison utilized the chemiluminescent reaction of nitric oxide with ozone.

The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1.0% relative at the 95% confidence level.

At least 8% of the samples from the lot have been analyzed for nitrogen dioxide by a wet chemical method (a modified Saltzman technique). The maximum concentration of nitrogen dioxide did not exceed 0.5% relative to the nitric oxide in the samples analyzed.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of nitric oxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 2 years. The value appearing on this certificate is considered valid for 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within a one year period the purchasers of other samples from the lot will be notified. Validation of the concentration of nitric oxide in cylinders that have been in the possession of the purchasers for more than one year can be made by the National Bureau of Standards at a nominal charge if more than 1000 psi remains in the cylinder.

Cylinder:

These gases are supplied in cylinders with a delivered volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to the DOT specification and are equipped with CGA 660 valves.

NOTE:

This cylinder is the property of the purchaser. If the user is unable to dispose of the cylinder it may be returned, prepaid, to the National Bureau of Standards for disposal.

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 2631

Nitric Oxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a mixture of nitric oxide in high purity nitrogen which is supplied in a high-pressure, compressed gas cylinder. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

CAUTION: Every precaution must be taken to avoid accidental contamination of the sample with atmospheric air during connection of the cylinder to any gas-handling system.

Nitric Oxide Concentration: ± μmol/mol (ppm)

Cylinder Number: Sample Number

The concentration of nitric oxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ± 0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy. The estimated upper limit of error of the nitric oxide concentration is ± 1.0% relative. This estimate is the 95% confidence interval based on allowances for known sources of possible error.

The research and development of this Standard Reference Material was supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W.R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E.E. Hughes and H.L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by W.P. Reed.

Washington, D.C. 20234
May 2, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

The nitric oxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously intercompared with a set of primary gravimetric standards. The method of intercomparison utilized the chemiluminescent reaction of nitric oxide with ozone.

The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1.0% relative at the 95% confidence level.

At least 8% of the samples from the lot have been analyzed for nitrogen dioxide by a wet chemical method (a modified Saltzman technique). The maximum concentration of nitrogen dioxide did not exceed 0.5% relative to the nitric oxide in the samples analyzed.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of nitric oxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 2 years. The value appearing on this certificate is considered valid for 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within a one year period the purchasers of other samples from the lot will be notified. Validation of the concentration of nitric oxide in cylinders that have been in the possession of the purchasers for more than one year can be made by the National Bureau of Standards at a nominal charge if more than 1000 psi remains in the cylinder.

Cylinder:

These gases are supplied in cylinders with a delivered volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to the DOT specification and are equipped with CGA 660 valves.

NOTE:

This cylinder is the property of the purchaser. If the user is unable to dispose of the cylinder it may be returned, prepaid, to the National Bureau of Standards for disposal.

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 2632

Carbon Dioxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon dioxide in high purity nitrogen, and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon dioxide concentration: ± μmol/mol (ppm)

Cylinder number: Sample number:

The concentration of carbon dioxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ± 0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by W. P. Reed.

Washington, D.C. 20234
April 1, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon dioxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved both measurements by a nondispersive infrared technique and by gas chromatography utilizing an ultrasonic detector. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon dioxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified. Validation of the concentration of carbon dioxide in cylinders which have been in the possession of the purchasers for more than 2 years can be made by the National Bureau of Standards at a nominal charge if more than 6.4 MPa (1000 psi) remains in the cylinder. Inquiries concerning recertification should be made to Chief, Gas and Particulate Science Division, NBS, at (301) 921-2886.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-580 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2632

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 2633

Carbon Dioxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon dioxide in high purity nitrogen, and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon dioxide concentration: ± μmol/mol (ppm)

Cylinder number: Sample number:

The concentration of carbon dioxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ±0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by W. P. Reed.

Washington, D.C. 20234
April 1, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon dioxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved both measurements by a nondispersive infrared technique and by gas chromatography utilizing an ultrasonic detector. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon dioxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified. Validation of the concentration of carbon dioxide in cylinders which have been in the possession of the purchasers for more than 2 years can be made by the National Bureau of Standards at a nominal charge if more than 6.4 MPa (1000 psi) remains in the cylinder. Inquiries concerning recertification should be made to Chief, Gas and Particulate Science Division, NBS, at (301) 921-2886.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-580 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2633

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 2634

Carbon Dioxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon dioxide in high purity nitrogen, and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon dioxide concentration: ± μmol/mol (ppm)

Cylinder number: Sample number:

The concentration of carbon dioxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ±0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by W. P. Reed.

Washington, D.C. 20234
April 1, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon dioxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved both measurements by a nondispersive infrared technique and by gas chromatography utilizing an ultrasonic detector. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon dioxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified. Validation of the concentration of carbon dioxide in cylinders which have been in the possession of the purchasers for more than 2 years can be made by the National Bureau of Standards at a nominal charge if more than 6.4 MPa (1000 psi) remains in the cylinder. Inquiries concerning recertification should be made to Chief, Gas and Particulate Science Division, NBS, at (301) 921-2886.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-580 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2634

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 2635

Carbon Monoxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon monoxide in high purity nitrogen and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon monoxide concentration: ± μmol/mol (ppm)

Cylinder number: Sample number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ± 0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
October 2, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon monoxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved measurements by a nondispersive infrared technique and/or by gas chromatography. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon monoxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-350 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2635

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 2636

Carbon Monoxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon monoxide in high purity nitrogen and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon monoxide concentration: ± μmol/mol (ppm)

Cylinder number: Sample number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ± 0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
October 2, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon monoxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved measurements by a nondispersive infrared technique and/or by gas chromatography. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon monoxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-350 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2636

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 2637

Carbon Monoxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon monoxide in high purity nitrogen and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon monoxide concentration: ± μmol/mol (ppm)

Cylinder number: Sample number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ± 0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
October 2, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon monoxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved measurements by a nondispersive infrared technique and/or by gas chromatography. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon monoxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-350 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2637

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 2638

Carbon Monoxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon monoxide in high purity nitrogen and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon monoxide concentration: ± μmol/mol (ppm)

Cylinder number: Sample number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ± 0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
October 2, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon monoxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved measurements by a nondispersive infrared technique and/or by gas chromatography. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon monoxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-350 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2638

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 2639

Carbon Monoxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon monoxide in high purity nitrogen, and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon Monoxide concentration: ± Mole Percent

Cylinder number: Sample Number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ±0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by W. P. Reed.

Washington, D.C. 20234
July 30, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon monoxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved measurements by a nondispersive infrared technique and/or by gas chromatography. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon monoxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified. Validation of the concentration of carbon monoxide in cylinders which have been in the possession of the purchasers for more than 2 years can be made by the National Bureau of Standards at a nominal charge if more than 6.4 MPa (1000 psi) remains in the cylinder. Inquiries concerning recertification should be made to Chief, Gas and Particulate Science Division, NBS, at (301) 921-2886.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-580 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2639

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 2640

Carbon Monoxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon monoxide in high purity nitrogen, and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon Monoxide concentration: ± Mole Percent

Cylinder number: Sample Number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ±0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by W. P. Reed.

Washington, D.C. 20234
July 30, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon monoxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved measurements by a nondispersive infrared technique and/or by gas chromatography. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon monoxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified. Validation of the concentration of carbon monoxide in cylinders which have been in the possession of the purchasers for more than 2 years can be made by the National Bureau of Standards at a nominal charge if more than 6.4 MPa (1000 psi) remains in the cylinder. Inquiries concerning recertification should be made to Chief, Gas and Particulate Science Division, NBS, at (301) 921-2886.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-580 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2640

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 2641

Carbon Monoxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon monoxide in high purity nitrogen, and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon Monoxide concentration: ± Mole Percent

Cylinder number: Sample Number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ±0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by W. P. Reed.

Washington, D.C. 20234
July 30, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon monoxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved measurements by a nondispersive infrared technique and/or by gas chromatography. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon monoxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified. Validation of the concentration of carbon monoxide in cylinders which have been in the possession of the purchasers for more than 2 years can be made by the National Bureau of Standards at a nominal charge if more than 6.4 MPa (1000 psi) remains in the cylinder. Inquiries concerning recertification should be made to Chief, Gas and Particulate Science Division, NBS, at (301) 921-2886.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-580 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2641

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 2642

Carbon Monoxide in Nitrogen

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is a gas mixture of carbon monoxide in high purity nitrogen, and is supplied in high-pressure, compressed gas cylinders. The statistical uncertainty in each step of the preparation and analysis of this mixture has been carefully evaluated at the 95% confidence level. This Standard Reference Material should be used sparingly as a valuable primary standard to which daily working standards may be related.

Carbon Monoxide concentration: ± Mole Percent

Cylinder number: Sample Number:

The concentration of carbon monoxide is relative to all other constituents of the gas.

Each cylinder of gas is individually analyzed, but the concentration appearing on this certificate applies to all samples within the lot. The concentration of all samples in the lot fell within a limit of ±0.3 percent of the average for the lot and all samples are considered identical within the stated limits of accuracy.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by W. P. Reed.

Washington, D.C. 20234
July 30, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

Carbon monoxide in this Standard Reference Material was determined by comparison with a batch standard that had been previously intercompared with a set of primary gravimetric standards. The intercomparison involved measurements by a nondispersive infrared technique and/or by gas chromatography. The imprecision of intercomparison is less than 0.2 percent relative and the inaccuracy of the primary gravimetric standard is less than 0.4% relative. The upper limit of the total uncertainty including both the imprecision of intercomparison and the inaccuracy of the gravimetric standards is less than 1% relative at the 95% confidence level.

Stability:

These samples are contained in aluminum cylinders. The stability is considered excellent and no losses of carbon monoxide have been observed for similar samples contained in aluminum cylinders for periods of time greater than 3 years. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed, and if significant changes are observed within the 2 year period the purchasers of other samples from the lot will be notified. Validation of the concentration of carbon monoxide in cylinders which have been in the possession of the purchasers for more than 2 years can be made by the National Bureau of Standards at a nominal charge if more than 6.4 MPa (1000 psi) remains in the cylinder. Inquiries concerning recertification should be made to Chief, Gas and Particulate Science Division, NBS, at (301) 921-2886.

Cylinder:

These gases are supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to a DOT specification and are equipped with CGA-580 valves.

These cylinders are the property of the purchaser. However, if desired they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2642

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2643

Propane in Nitrogen

(Nominal Concentration 100 ppm)

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:		Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

The content of each cylinder is individually analyzed and the concentration appearing above is the measured value for the cylinder and sample identified on this certificate.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
May 30, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2643

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2644

Propane in Nitrogen

(Nominal Concentration 250 ppm)

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:		Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is _____ μmole/mole (ppm).

The content of each cylinder is individually analyzed and the concentration appearing above is the measured value for the cylinder and sample identified on this certificate.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
May 30, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2644

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 2645

Propane in Nitrogen

(Nominal Concentration 500 ppm)

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:		Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

The content of each cylinder is individually analyzed and the concentration appearing above is the measured value for the cylinder and sample identified on this certificate.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
May 30, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2645

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2646

Propane in Nitrogen

(Nominal Concentration 1000 ppm)

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:		Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

The content of each cylinder is individually analyzed and the concentration appearing above is the measured value for the cylinder and sample identified on this certificate.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
May 30, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2646

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards
Certificate of Analysis

Standard Reference Material 2647

Propane in Nitrogen

(Nominal Concentration 2500 ppm)

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:		Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

The content of each cylinder is individually analyzed and the concentration appearing above is the measured value for the cylinder and sample identified on this certificate.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
May 30, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2647

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards
Certificate of Analysis
Standard Reference Material 2648
Propane in Nitrogen
(Nominal Concentration 5000 ppm)
(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:		Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

The content of each cylinder is individually analyzed and the concentration appearing above is the measured value for the cylinder and sample identified on this certificate.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
May 30, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2648

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2649

Propane in Nitrogen

(Nominal Concentration 10,000 ppm)

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:		Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm).

The content of each cylinder is individually analyzed and the concentration appearing above is the measured value for the cylinder and sample identified on this certificate.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
May 30, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2649

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards
Certificate of Analysis

Standard Reference Material 2650

Propane in Nitrogen

(Nominal Concentration 20,000 ppm)

(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:		Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for the presence of other hydrocarbons. The estimated concentration of other hydrocarbons, expressed as propane, is _____ μmole/mole (ppm).

The content of each cylinder is individually analyzed and the concentration appearing above is the measured value for the cylinder and sample identified on this certificate.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
May 30, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis

The concentration of propane in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using a gas chromatograph equipped with a flame ionization detector.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2650

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2651

Propane in Nitrogen and Oxygen
(Nominal 100 ppm Propane and Five Percent Oxygen)
(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions when the oxygen content of the calibration gas is of concern. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:		Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for oxygen concentration and for the presence of other hydrocarbons. The oxygen concentration is given below:

Oxygen concentration:	±	mole percent

The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm). The remainder of the sample is nitrogen.

The content of each cylinder is individually analyzed and the concentration of propane appearing above is the measured value for the cylinder and sample identified on this certificate.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
July 16, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Preparation

The samples in this lot were originally prepared by a commercial supplier under contract from the NBS, as a bulk mixture which was then transferred into the cylinders in the lot. The minimum lot size is 26 cylinders. The preparation and transfer of the mixture is conducted in a manner to assure homogeneity among all samples in the lot.

Analysis

The concentration of propane in each sample in the lot was determined by comparison with a set of primary gravimetric standards. The analyses were performed using a gas chromatograph equipped with a flame ionization detector. The results of this analysis indicated a high degree of homogeneity within the lot. Consequently, only ten percent of the samples were analyzed for oxygen. The analyses were performed with an analyzer that responds to the paramagnetic properties of oxygen which had been calibrated with gravimetrically prepared standards. All of the samples analyzed were found to have the same oxygen content.

The value for the estimated other hydrocarbons was determined by detailed gas chromatographic measurements on two samples from the lot.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2651

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2652

Propane in Nitrogen and Oxygen
(Nominal 100 ppm Propane and Ten Percent Oxygen)
(Mobile-Source Emission Gas Standard)

(In Cooperation with the Motor Vehicle Manufacturers Association)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of hydrocarbon in mobile-source emissions when the oxygen content of the calibration gas is of concern. It is not intended as a working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Propane concentration:	±	μmole/mole (ppm)
Cylinder Number:		Sample Number:

The concentration of propane is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the propane concentration at the 95 percent confidence level. This uncertainty includes the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison with the gravimetric standards. This sample is certified only for the concentration of propane. However, representative samples from the lot have been examined for oxygen concentration and for the presence of other hydrocarbons. The oxygen concentration is given below:

Oxygen concentration:	±	mole percent

The estimated concentration of other hydrocarbons, expressed as propane, is μmole/mole (ppm). The remainder of the sample is nitrogen.

The content of each cylinder is individually analyzed and the concentration of propane appearing above is the measured value for the cylinder and sample identified on this certificate.

The research and development leading to the certification of this Standard Reference Material were supported by the Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA), Detroit, Michigan.

The development and evaluation of the gravimetric primary standards used to certify this Standard Reference Material were performed at the National Bureau of Standards by MVMA Research Associates W. R. Miller and W. J. Thorn.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the NBS Gas and Particulate Science Division.

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

Washington, D.C. 20234
July 16, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Preparation

The samples in this lot were originally prepared by a commercial supplier under contract from the NBS, as a bulk mixture which was then transferred into the cylinders in the lot. The minimum lot size is 26 cylinders. The preparation and transfer of the mixture is conducted in a manner to assure homogeneity among all samples in the lot.

Analysis

The concentration of propane in each sample in the lot was determined by comparison with a set of primary gravimetric standards. The analyses were performed using a gas chromatograph equipped with a flame ionization detector. The results of this analysis indicated a high degree of homogeneity within the lot. Consequently, only ten percent of the samples were analyzed for oxygen. The analyses were performed with an analyzer that responds to the paramagnetic properties of oxygen which had been calibrated with gravimetrically prepared standards. All of the samples analyzed were found to have the same oxygen content.

The value for the estimated other hydrocarbons was determined by detailed gas chromatographic measurements on two samples from the lot.

Stability

This SRM is contained in an aluminum cylinder. The stability is considered good and no loss of concentration has been observed in similar samples contained in aluminum cylinders. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder

This SRM is supplied in cylinders at a pressure of 12.4 MPa (1800 psi) with a deliverable volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-350 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM 2652

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2653

Nitrogen Dioxide in Air

(Nominal Concentration 250 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of nitrogen dioxide in stationary source emissions. It is not intended as a working standard, but rather as a primary laboratory standard to which the concentration of other standards may be related.

Nitrogen dioxide concentration: ± μmole/mole(ppm)

Cylinder Number: Sample Number:

The concentration of nitrogen dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitrogen dioxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas handling system.

The original development and evaluation of this Standard Reference Material was performed in the Gas and Particulate Science Division by W. D. Dorko and G. Rhoderick.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
June 7, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for nitrogen dioxide content.

Analysis

The nitrogen dioxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously compared with a set of primary gravimetric standards of nitric oxide in nitrogen. The method of comparison utilized the chemiluminescent reaction of nitric oxide with ozone after the nitrogen dioxide had been catalytically converted to nitric oxide. The analysis was carefully evaluated to avoid errors arising from the use of nitric oxide in nitrogen standards to analyze nitrogen dioxide in air samples.

Stability

Loss of nitrogen dioxide by adsorption on the container walls may occur in new cylinders not previously used for nitrogen dioxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitrogen dioxide from the cylinder walls when the cylinder pressure is reduced. It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).

The concentration on this certificate is valid for one year from the date of purchase from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within one year, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser.

U. S. Department of Commerce
Malcolm Baldrige
Secretary
National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2654

Nitrogen Dioxide in Air

(Nominal Concentration 500 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of nitrogen dioxide in stationary source emissions. It is not intended as a working standard, but rather as a primary laboratory standard to which the concentration of other standards may be related.

Nitrogen dioxide concentration:	±	μmole/mole(ppm)
Cylinder Number:	Sample Number:	

The concentration of nitrogen dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitrogen dioxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas handling system.

The original development and evaluation of this Standard Reference Material was performed in the Gas and Particulate Science Division by W. D. Dorko and G. Rhoderick.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
June 7, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for nitrogen dioxide content.

Analysis

The nitrogen dioxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously compared with a set of primary gravimetric standards of nitric oxide in nitrogen. The method of comparison utilized the chemiluminescent reaction of nitric oxide with ozone after the nitrogen dioxide had been catalytically converted to nitric oxide. The analysis was carefully evaluated to avoid errors arising from the use of nitric oxide in nitrogen standards to analyze nitrogen dioxide in air samples.

Stability

Loss of nitrogen dioxide by adsorption on the container walls may occur in new cylinders not previously used for nitrogen dioxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitrogen dioxide from the cylinder walls when the cylinder pressure is reduced. It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).

The concentration on this certificate is valid for one year from the date of purchase from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within one year, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2655

Nitrogen Dioxide in Air

(Nominal Concentration 1000 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of nitrogen dioxide in stationary source emissions. It is not intended as a working standard, but rather as a primary laboratory standard to which the concentration of other standards may be related.

Nitrogen dioxide concentration:	±	μmole/mole(ppm)
Cylinder Number:	Sample Number:	

The concentration of nitrogen dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitrogen dioxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas handling system.

The original development and evaluation of this Standard Reference Material was performed in the Gas and Particulate Science Division by W. D. Dorko and G. Rhoderick.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
June 7, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for nitrogen dioxide content.

Analysis

The nitrogen dioxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously compared with a set of primary gravimetric standards of nitric oxide in nitrogen. The method of comparison utilized the chemiluminescent reaction of nitric oxide with ozone after the nitrogen dioxide had been catalytically converted to nitric oxide. The analysis was carefully evaluated to avoid errors arising from the use of nitric oxide in nitrogen standards to analyze nitrogen dioxide in air samples.

Stability

Loss of nitrogen dioxide by adsorption on the container walls may occur in new cylinders not previously used for nitrogen dioxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitrogen dioxide from the cylinder walls when the cylinder pressure is reduced. It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).

The concentration on this certificate is valid for one year from the date of purchase from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within one year, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2656

Nitrogen Dioxide in Air

(Nominal Concentration 2500 ppm)

(Stationary Source Emission Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for the analysis of nitrogen dioxide in stationary source emissions. It is not intended as a working standard, but rather as a primary laboratory standard to which the concentration of other standards may be related.

Nitrogen dioxide concentration: ± μmole/mole(ppm)

Cylinder Number: Sample Number:

The concentration of nitrogen dioxide is relative to all other constituents of the gas. The uncertainty shown is the estimated upper limit of error of the nitrogen dioxide concentration and is the 95 percent confidence interval based on allowances for known sources of possible error.

Each cylinder of gas is individually analyzed, and the concentration given above applies only to the cylinder identified by cylinder number and sample number on this certificate.

CAUTION: Care must be taken to avoid accidental contamination of the sample during the use of the cylinder with any gas handling system.

The original development and evaluation of this Standard Reference Material was performed in the Gas and Particulate Science Division by W. D. Dorko and G. Rhoderick.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook of the Gas and Particulate Science Division.

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

Washington, D.C. 20234
June 7, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Certification Information

The cylinder identified on this certificate is one of a group or "lot" of cylinders. A lot contains a minimum of 26 cylinders and is prepared commercially according to rigid specifications so that the lot is homogeneous and stable. Each cylinder in the lot is individually analyzed at NBS for nitrogen dioxide content.

Analysis

The nitrogen dioxide content of this Standard Reference Material was determined by comparison with secondary standards that had been previously compared with a set of primary gravimetric standards of nitric oxide in nitrogen. The method of comparison utilized the chemiluminescent reaction of nitric oxide with ozone after the nitrogen dioxide had been catalytically converted to nitric oxide. The analysis was carefully evaluated to avoid errors arising from the use of nitric oxide in nitrogen standards to analyze nitrogen dioxide in air samples.

Stability

Loss of nitrogen dioxide by adsorption on the container walls may occur in new cylinders not previously used for nitrogen dioxide mixtures. To ensure stability, a moderate preconditioning procedure was used for these cylinders. The use of this preconditioning procedure may result in desorption of nitrogen dioxide from the cylinder walls when the cylinder pressure is reduced. It is not recommended that the sample be used for accurate analyses at cylinder pressures below 2.8 MPa (400 psi).

The concentration on this certificate is valid for one year from the date of purchase from NBS. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within one year, the purchasers of samples from the lot will be notified.

Cylinder

This SRM is supplied in cylinders with a deliverable volume of 0.85 m^3 (30 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-660 valves.

The cylinder becomes the property of the purchaser.

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2657

Oxygen in Nitrogen

(Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for combustion control and respiratory gas analysis. It is not intended as a daily working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Oxygen concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of oxygen is relative to all other constituents of the gas.

Each cylinder is individually analyzed and the concentration that appears on this certificate applies to the cylinder identified by cylinder and sample number.

The original development and evaluation of the oxygen in nitrogen series of Standard Reference Materials were performed at the National Bureau of Standards by W. D. Dorko and W. P. Schmidt.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. Alvarez.

Washington, D.C. 20234
December 31, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

The concentration of oxygen in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using both a gas chromatograph equipped with a thermal conductivity detector and an analyzer sensitive to the paramagnetic properties of oxygen. The uncertainty shown is based on an estimate of the upper limit of the total uncertainty including the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison of the Standard Reference Material with the gravimetric standards. This uncertainty at the 95% confidence level does not exceed 1.0% relative.

This sample is certified only for the concentration of oxygen.

A representative number of samples were examined to determine the argon concentration and it is estimated to be _____ mole percent.

Stability:

This SRM is contained in an aluminum cylinder. The stability is considered good and no change in concentration is anticipated. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM
2657

U.S. Department of Commerce
Juanita M. Kreps
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2658

Oxygen in Nitrogen

(Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for combustion control and respiratory gas analysis. It is not intended as a daily working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Oxygen concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of oxygen is relative to all other constituents of the gas.

Each cylinder is individually analyzed and the concentration that appears on this certificate applies to the cylinder identified by cylinder and sample number.

The original development and evaluation of the oxygen in nitrogen series of Standard Reference Materials were performed at the National Bureau of Standards by W. D. Dorko and W. P. Schmidt.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. Alvarez.

Washington, D.C. 20234
December 31, 1979

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

The concentration of oxygen in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using both a gas chromatograph equipped with a thermal conductivity detector and an analyzer sensitive to the paramagnetic properties of oxygen. The uncertainty shown is based on an estimate of the upper limit of the total uncertainty including the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison of the Standard Reference Material with the gravimetric standards. This uncertainty at the 95% confidence level does not exceed 1.0% relative.

This sample is certified only for the concentration of oxygen.

A representative number of samples were examined to determine the argon concentration and it is estimated to be _____ mole percent.

Stability:

This SRM is contained in an aluminum cylinder. The stability is considered good and no change in concentration is anticipated. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2 year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at 12.4 MPa (1800 psi) pressure with a delivered volume of 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM
2658

U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 2659

Oxygen in Nitrogen

21 Mole Percent (Nominal)

(Gas Standard)

This Standard Reference Material is intended for use in the calibration of instruments used for combustion control, respiratory gas analysis, and atmospheric analysis. It is not intended as a daily working standard, but rather as a primary standard to which the concentration of the daily working standards may be related.

Oxygen concentration: ± mole percent

Cylinder Number: Sample Number:

The concentration of oxygen is relative to all other constituents of the gas.

Each cylinder is individually analyzed and the concentration that appears on this certificate applies to the cylinder identified by cylinder and sample number.

The original development and evaluation of the oxygen in nitrogen series of Standard Reference Materials were performed at the National Bureau of Standards by W.D. Dorko and G. Rhoderick.

The overall direction and coordination of technical measurements leading to certification were performed under the chairmanship of E.E. Hughes and H.L. Rook.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. Alvarez.

Washington, D.C. 20234
December 31, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

Analysis:

The concentration of oxygen in this Standard Reference Material was determined by comparison with a set of gravimetric primary standards. The intercomparisons were performed using both a gas chromatograph equipped with a thermal conductivity detector and an analyzer sensitive to the paramagnetic properties of oxygen. The uncertainty shown is based on an estimate of the upper limit of the total uncertainty including the inaccuracy of the gravimetric primary standards and the imprecision of intercomparison of the Standard Reference Material with the gravimetric standards. This uncertainty at the 95% confidence level does not exceed 1.0% relative.

This sample is certified only for the concentration of oxygen.

A representative number of samples were examined to determine the argon concentration and it is estimated to be _____ mole percent.

Stability:

This SRM is contained in an aluminum cylinder. The stability is considered good and no change in concentration is anticipated. However, the value appearing on this certificate is considered valid for only 2 years from date of purchase. Periodic reanalyses of representative samples from this lot will be performed at NBS, and if significant changes are observed within the 2-year period, purchasers of the SRM will be notified.

Cylinder:

This SRM is supplied in cylinders at about 12.4 MPa (1800 psi) pressure with a delivered volume of approximately 0.88 m^3 (31 cubic feet) at STP. The cylinders conform to DOT specifications and are equipped with CGA-580 valves.

The cylinders become the property of the purchaser. However, they may be returned, prepaid, to the National Bureau of Standards for disposal.

SRM
2659

APPENDIX II

CERTIFICATES FOR PERMEATION TUBE STANDARD REFERENCE MATERIALS

U. S. Department of Commerce
Frederick B. Dent
Secretary

National Bureau of Standards
Richard W. Roberts, Director

National Bureau of Standards

Certificate

Standard Reference Material 1625

Sulfur Dioxide Permeation Tube

(Individually Calibrated)

E. E. Hughes and W. P. Schmidt

This Standard Reference Material consists of a 10 cm sulfur dioxide permeation tube, individually calibrated, for use in the preparation of gases of known sulfur dioxide content. It is intended for standardization of apparatus and procedures used in air pollution and related chemical analyses. The permeation rates for temperatures in the range of 20 to 30 °C are given in the table accompanying each tube.

The tabulated values result from determinations of the permeation rates for the specified tube, using the method described on the reverse of this certificate. The uncertainty of the certified permeation rates, based on the results of the calibration of approximately 50 tubes, is less than ±0.5 percent at 25 °C and does not exceed ±1.0 percent at 20 and 30 °C, respectively.

Experiments in this laboratory have shown that the calibration remains valid as long as visible amounts of liquid sulfur dioxide remain in the tube.

The calibration measurements were made by E. E. Hughes and W. P. Schmidt, Analytical Chemistry Division, NBS Institute for Materials Research.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of J. K. Taylor.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by T. W. Mears.

Washington, D.C. 20234
December 1, 1970
(Revised January 5, 1973)

J. Paul Cali, Chief
Office of Standard Reference Materials

(over)

CALIBRATION

This tube was individually calibrated by gravimetric determination of weight losses at 20, 25, and 30 °C, respectively. The tube was held at constant temperature for several days at each level, and the permeation rate was determined by weighing the tubes at 24-hour intervals, using a microbalance. The measured rates were fitted by the method of least squares to an equation of the type $\log R = mt + b$. The resulting equation, given on the table accompanying the tube, was used to calculate the values of the permeation rates and may be used to calculate values not given, for temperatures not more than 2 °C beyond the range in the table.

The precision of calibration was estimated from measurements on approximately 25 tubes in this lot at each calibration temperature. The uncertainties indicated are the approximate half width of the 95 percent confidence interval. It is believed that the systematic errors concerned with the calibration are negligible.

USE

This tube can be used to produce known concentrations of sulfur dioxide in a gas stream when both the temperature and flow rate of the gas stream are known. Apparatus and techniques for this purpose are described in reference [3] and [4] and should be consulted for operational details. Because of the large temperature coefficient of the permeation rate, approximately 9 percent per degree celsius, the temperature must be maintained constant and measured accurately to 0.1 °C to provide concentrations consistent with the calibration uncertainty.

It is recommended that the tube temperature be held constant during use and that desired concentration levels be achieved by adjustment of the flow rate. If it is necessary to vary the concentration by changing the tube temperature, a suitable time interval must be allowed for equilibrium of the permeation rate to be re-established. For changes of 1 or 2 degrees celsius, a period of 3 hours should suffice. For changes of 10 degrees or when removed from low temperature storage, a period of 24 hours is advisable.

This permeation tube is a stable and relatively rugged source of sulfur dioxide and no extreme measures are necessary to ensure that the calibration of the tube will be maintained during its useful life. However, it should be treated with the care necessary to assure the user that no change occurs in the character of the tube. Precautions should be exercised to prevent contamination of the outer surface during handling. The tube should be protected from high concentrations of water vapor during storage and use. A relative humidity of 10 percent should have no effect on the permeation rate within the calibration uncertainty.

STORAGE

The useful life of this certified sulfur dioxide permeation tube is about 9 months. Storage at lower temperatures will prolong the life. However, it should be protected from moisture during storage. On removal from low temperature storage, the tube should be equilibrated at the operating temperature for at least 24 hours before use as an analytical standard.

PRECAUTION

This permeation tube contains liquid sulfur dioxide at a pressure of about 4 atmospheres at room temperature. While no failures have occured during use, there is the possibility of rupture due to internal pressure. However, it is believed that normal handling of the tubes at temperatures up to and slightly exceeding 35 °C does not constitute a hazard.

SELECTED REFERENCES

[1] A. E. O'Keefe and G. C. Ortman, Anal. Chem 38, 760 (1966).
[2] F. P. Scarringelli, S. A. Frey, and B. E. Saltzman, Amer. Ind. Hyg. Assoc. J. 28, 260 (1967).
[3] Health Laboratory Science 7, No. 1, 4 (1970).
[4] F. P. Scarringello, A. E. O'Keefe, E. Rosenbert, and J. P. Bell, Anal. Chem. 42, 871 (1970).
[5] J. K. Taylor, Ed., NBS Technical Note 545, December 1970.

U. S. Department of Commerce
Maurice H. Stans
Secretary

National Bureau of Standards
L. M. Branscomb, Director

National Bureau of Standards

Certificate

Standard Reference Material 1626

Sulfur Dioxide Permeation Tube

(Individually Calibrated)

This Standard Reference Material consists of a 5 cm sulfur dioxide permeation tube, individually calibrated, for use in the preparation of gases of known sulfur dioxide content. It is intended for standardization of apparatus and procedures used in air pollution and related chemical analyses. Permeation rates for temperatures in the range of 20 to 30 °C are given in the table accompanying each tube.

The tabulated values result from determinations of the permeation rates for the specified tube, using the method described on the reverse of this certificate. The uncertainty of the certified permeation rates, based on the results of the calibration of approximately 25 tubes, is less than ± 0.5 percent at 25 °C and does not exceed ± 1.0 percent at 20 and 30 °C, respectively.

Experiments in this laboratory have shown that the calibration remains valid as long as visible amounts of liquid sulfur dioxide remain in the tube.

The calibration measurements were made by E. E. Hughes and W. P. Schmidt, Analytical Chemistry Division, NBS Institute for Materials Research.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of J. K. Taylor.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by T. W. Mears.

Washington, D. C. 20234
August 12, 1971

J. Paul Cali, Chief
Office of Standard Reference Materials

(over)

CALIBRATION

This tube was individually calibrated by gravimetric determination of weight losses at 20, 25, and 30 °C, respectively. The tube was held at constant temperature for several days at each level, and the permeation rate was determined by weighing the tubes at 24-hour intervals, using a microbalance. The measured rates were fitted by the method of least squares to an equation of the type $\log R = mt + b$. The resulting equation, given on the table accompanying the tube was used to calculate the values of the permeation rates.

The precision of calibration was estimated from measurements on approximately 25 tubes in this lot at each calibration temperature. The uncertainties indicated are the approximate half width of the 95 percent confidence interval. It is believed that the systematic errors concerned with the calibration are negligible.

USE

This tube can be used to produce known concentrations of sulfur dioxide in a gas stream when both the temperature and flow rate of the gas stream are known. Apparatus and techniques for this purpose are described in references [3] and [4] and should be consulted for operational details. Because of the large temperature coefficient of the permeation rate, approximately 9 percent per degree celsius, the temperature must be maintained constant and measured accurately to 0.1 °C to provide concentrations consistent with the calibration uncertainty.

It is recommended that the tube temperature be held constant during use and that desired concentration levels be achieved by adjustment of the flow rate. If it is necessary to vary the concentration by changing the tube temperature, a suitable time interval must be allowed for equilibrium of the permeation rate to be re-established. For changes of 1 or 2 degrees celsius, a period of 3 hours should suffice. For changes of 10 degrees or when removed from low temperature storage, a period of 24 hours is advisable.

This permeation tube is a stable and relatively rugged source of sulfur dioxide and no extreme measures are necessary to ensure that the calibration of the tube will be maintained during its useful life. However, it should be treated with the care necessary to assure the user that no change occurs in the character of the tube. Precautions should be exercised to prevent contamination of the outer surface during handling. The tube should be protected from high concentrations of water vapor during storage and use. A relative humidity of 10 percent should have no effect on the permeation rate within the calibration uncertainty.

STORAGE

The useful life of this certified sulfur dioxide permeation tube is about 9 months. Storage at lower temperatures will prolong the life. However, it should be protected from moisture during storage. On removal from low temperature storage, the tube should be equilibrated at the operating temperature for at least 24 hours, before use as an analytical standard.

PRECAUTION

This permeation tube contains liquid sulfur dioxide at a pressure of about 4 atmospheres at room temperature. While no failures have occured during use, there is the possibility of rupture due to internal pressure. However, it is believed that normal handling of the tubes at temperatures up to and slightly exceeding 35 °C does not constitute a hazard.

SELECTED REFERENCES

[1] A. E. O'Keeffe and G. C. Ortman, Anal. Chem. 38, 760 (1966).
[2] F. P. Scaringelli, S. A. Frey, and B. E. Saltzman, Amer. Ind. Hyg. Assoc. J. 28, 260 (1967).
[3] Health Laboratory Science 7, No. 1, 4 (1970).
[4] F. P. Scaringelli, A. E. O'Keeffe, E. Rosenberg, and J. P. Bell, Anal. Chem. 42, 871 (1970).
[5] J. K. Taylor, Ed., NBS Technical Note 545, December 1970.

U. S. Department of Commerce
Maurice H. Stans
Secretary
National Bureau of Standards
L. M. Branscomb, Director

National Bureau of Standards Certificate

Standard Reference Material 1627

Sulfur Dioxide Permeation Tube

(Individually Calibrated)

E. E. Hughes and W. P. Schmidt

This Standard Reference Material consists of a 2 cm sulfur dioxide permeation tube, individually calibrated, for use in the preparation of gases of known sulfur dioxide content. It is intended for standardization of apparatus and procedures used in air pollution and related chemical analyses. The permeation rates for temperatures in the range of 20 to 30 °C are given in the table accompanying each tube.

The tabulated values result from determinations of the permeation rates for the specified tube, using the method described on the reverse of this certificate. The uncertainty of the certified permeation rates, based on the results of the calibration of approximately 25 tubes, is less than ± 1.0 percent at 25 °C and does not exceed ± 2.0 percent at 20 and 30 °C, respectively.

Experiments in this laboratory have shown that the calibration remains valid as long as visible amounts of liquid sulfur dioxide remain in the tube.

The calibration measurements were made by E. E. Hughes and W. P. Schmidt, Analytical Chemistry Division, NBS Institute for Materials Research.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of J. K. Taylor.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by T. W. Mears.

Washington, D. C. 20234
August 12, 1971

J. Paul Cali, Chief
Office of Standard Reference Materials

(over)

CALIBRATION

This tube was individually calibrated by gravimetric determination of weight losses at 20, 25, and 30 °C, respectively. The tube was held at constant temperature for several days at each level, and the permeation rate was determined by weighing the tubes at 24-hour intervals, using a microbalance. The measured rates were fitted by the method of least squares to an equation of the type $\log R = mt + b$. The resulting equation, given on the table accompanying the tube, was used to calculate the values of the permeation rates.

The precision of calibration was estimated from measurements on approximately 25 tubes in this lot at each calibration temperature. The uncertainties indicated are the approximate half width of the 95 percent confidence interval. It is believed that the systematic errors concerned with the calibration are negligible.

USE

This tube can be used to produce known concentrations of sulfur dioxide in a gas stream when both the temperature and flow rate of the gas stream are known. Apparatus and techniques for this purpose are described in references [3] and [4] and should be consulted for operational details. Because of the large temperature coefficient of the permeation rate, approximately 9 percent per degree celsius, the temperature must be maintained constant and measured accurately to 0.1 °C to provide concentrations consistent with the calibration uncertainty.

It is recommended that the tube temperature be held constant during use and that desired concentration levels be achieved by adjustment of the flow rate. If it is necessary to vary the concentration by changing the tube temperature, a suitable time interval must be allowed for equilibrium of the permeation rate to be re-established. For changes of 1 or 2 degrees celsius, a period of 3 hours should suffice. For changes of 10 degrees or when removed from low temperature storage, a period of 24 hours is advisable.

This permeation tube is a stable and relatively rugged source of sulfur dioxide and no extreme measures are necessary to ensure that the calibration of the tube will be maintained during its useful life. However, it should be treated with the care necessary to assure the user that no change occurs in the character of the tube. Precautions should be exercised to prevent contamination of the outer surface during handling. The tube should be protected from high concentrations of water vapor during storage and use. A relative humidity of 10 percent should have no effect on the permeation rate within the calibration uncertainty.

STORAGE

The useful life of this certified sulfur dioxide permeation tube is about 9 months. Storage at lower temperatures will prolong the life. However, it should be protected from moisture during storage. On removal from low temperature storage, the tube should be equilibrated at the operating temperature for at least 24 hours, before use as an analytical standard.

PRECAUTION

This permeation tube contains liquid sulfur dioxide at a pressure of about 4 atmospheres at room temperature. While no failures have occured during use, there is the possibility of rupture due to internal pressure. However, it is believed that normal handling of the tubes at temperatures up to and slightly exceeding 35 °C does not constitute a hazard.

SELECTED REFERENCES

[1] A. E. O'Keeffe and G. C. Ortman, Anal. Chem. 38, 760 (1966).
[2] F. P. Scaringelli, S. A. Frey, and B. E. Saltzman, Amer. Ind. Hyg. Assoc. J. 28, 260 (1967).
[3] Health Laboratory Science 7, No. 1, 4 (1970).
[4] F. P. Scaringelli, A. E. O'Keeffe, E. Rosenberg, and J. P. Bell, Anal. Chem. 42, 871 (1970).
[5] J. K. Taylor, Ed., NBS Technical Note 545, December 1970.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Calibration

Standard Reference Material 1629a

Nitrogen Dioxide Permeation Device

This Standard Reference Material consists of a nitrogen dioxide permeation device, individually calibrated, for use in the preparation of gases of known nitrogen dioxide content. It is intended for the standardization of apparatus and procedures used in air pollution and related chemical analyses.

Serial Number _____ Calibrated by _____ Date _____

The certified permeation rate in micrograms of nitrogen dioxide per minute at 25 °C is:

_____

The uncertainty given for this value is the 95 percent confidence limit of the mean based on ten measurements of the rate. This certified value is considered valid within the limits shown for a period of six months from the date of shipment from the National Bureau of Standards.

The nitrogen dioxide permeation device was calibrated in the Gas and Particulate Science Division of the Center for Analytical Chemistry.

The overall direction and coordination of the technical effort leading to certification were performed under the chairmanship of E. E. Hughes and H. L. Rook.

The technical and support aspects involved in the certification and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. W. Seward.

Washington, D.C. 20234
April 24, 1981

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

USE

This device can be used to produce mixtures of nitrogen dioxide in air or other gas by placing the device in a stream of the dry gas flowing at a known rate and at a known constant temperature. The accuracy of the concentration produced is dependent not only on the accuracy with which the device is calibrated, but, as importantly, on the accuracy with which the purity of the gas, the rate of flow, and the temperature are known. Systems for generating known concentrations of nitrogen dioxide with the device are describe elsewhere (1,2).

When the device is first placed in service, a period of at least 24 hours should be allowed for equilibration at the temperature at which it is to be used.

It is recommended that the device be used at the calibration temperature of 25.0 °C, but if the temperature does not vary more than 5 °C from 25 °C, an adjustment to the rate may be made according to the equation:

$$\log R_t = \log R_{25} + 0.034512\ (t\text{-}25.0)$$

where R_t is the permeation rate of the device at the temperature of use, t, and R_{25} is the certified rate of the device at 25.0 °C. The constant, 0.034512, is empirically determined using observations of the temperature-rate relationships for identical devices at temperatures between 20 and 30 °C. The additional uncertainty in the calculated value for the rate at temperatures of 1 °C above or below 25.0 °C is approximately ±0.4 percent; and 5 °C above or below 25.0 °C, the added uncertainty is ±2 percent of the certified rate.

Precautions and Storage

The rate of permeation of nitrogen dioxide from this device may be adversely affected by exposure to temperatures greater than 35 °C and by exposure to moist air. It is recommended that the device be stored between periods of use in a container maintained at about 25 °C and through which a slow flow of dry air (<5 percent relative humidity) is passed. Upon receipt of the device it should be removed from the protective plastic sleeve and placed in the above described storage container. At no time should the device be exposed to moist air other than for the brief period necessary for transfer from one container to another. Low temperature storage of the device is not recommended.

The device consists essentially of a stainless steel reservoir and a short Teflon permeation tube. The device contains less than one gram of liquid nitrogen dioxide at a pressure of one atmosphere (100kPa).

Calibration

This device was individually calibrated by gravimetric determination of the weight loss at 25 °C. The device was held at this temperature for a period of not less than three months during which time periodic measurements of weight were made.

The accuracy of calibration was estimated from measurements of approximately 50 devices in this lot. The uncertainties are the approximate half-width of the 95-percent confidence interval. It is believed that the systematic error concerned with these calibrations is negligible.

References

(1) Health Laboratory Science, No. 1, 4 (1970)

(2) F. P. Scarringelli, A. E. O'Keeffe, E. Rosenhart and J. P. Bell, Anal. Chem. 42, 871 (1970)

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Calibration

Standard Reference Material 1911

Benzene Permeation Device

This Standard Reference Material consists of a benzene permeation device, individually calibrated, for use in the preparation of gases of known benzene content. SRM 1911 is intended for the standardization of air pollution and related chemical analyses.

Serial Number _____ Calibrated by: _____ Date: _____

The certified permeation rate in micrograms of benzene per minute at 25.0 °C is: _____.

The uncertainty given for this value is the 95 percent confidence limit of the mean of 20 measurements of the rate. The certified value is considered valid within the limits shown for a period of one year from the date of shipment from the National Bureau of Standards.

The benzene permeation device was calibrated in the Gas and Particulate Science Division of the Center for Analytical Chemistry.

The overall direction and coordination of the technical effort leading to the certification of this Standard Reference Material were performed under the chairmanship of W.P. Schmidt and H.L. Rook.

The technical and support aspects involved in the certification and issuance of this SRM were coordinated through the Office of Standard Reference Materials by R.W. Seward.

Washington, D.C. 20234
August 4, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

USE:

This device can be used to produce known concentrations of benzene in air or another gas by placing the device in a stream of the pure, dry air/gas flowing at a known rate and at a known constant temperature. The accuracy of the concentration produced depends not only on the accuracy of the certified permeation rate, but also on the accuracy with which the purity of the gas, the rate of flow, and the temperature are known. Systems for generating known concentrations using permeation devices are described in ASTM D-2914.

When the device is first placed in service, a period of at least 24 hours should be allowed for equilibration at the temperature at which it is to be used. NOTE: See "Precautions and Storage" below. It is recommended that the device be used at the calibration temperature of 25.0 °C, but if the temperature does not vary more than 5 °C FROM 25 °C, an adjustment to the rate may be made according to the equation:

$$\text{Log } R_T = \text{Log } R_{25} + 0.0359(T-25.0)$$

Where R_T is the permeation rate of the device at the temperature of use, T, and R_{25} is the certified rate of the device at 25.0 °C. The constant, 0.0359, was empirically determined using observations of the temperature-rate relationships for identical devices at temperatures between 25 and 40 °C. The additional uncertainty in the calculated value for the rate at temperatures of 1 °C above or below 25.0 °C is approximately ± 1.0 percent; and between 1 °C and 5 °C above or below 25.0 °C, the added uncertainty is ±5 percent of the certified rate.

PRECAUTIONS and STORAGE:

The polymers of which this tube is constructed will absorb organic compounds (including benzene) if exposed to high concentrations of these compounds during storage. Subsequent desorption of these compounds during use may result in a concentration different from that predicted by the certified rate. It is therefore essential that upon receipt this device be removed from the shipping container and stored in a chamber through which a slow flow of air/gas is continuously passed. Low temperature storage of the device is not recommended. The exposure of the device to temperatures greater than 35 °C may permanently change the permeation rate from the certified value.

CALIBRATION:

This device was individually calibrated by gravimetric determination of the weight loss at 25.0 °C. The device was held at this temperature for a period of not less than three months during which time measurements of weight were made. In addition, each device was compared with primary gas standards using flame ionization detection (FID) to determine any systematic error associated with the gravimetric calibration.

U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Calibration

Standard Reference Material 1912

Tetrachloroethylene Permeation Device

This Standard Reference Material (SRM) is a tetrachloroethylene permeation device, individually calibrated. SRM 1912 is intended for use in the standardization of apparatus and procedures used in air pollution and related chemical analyses and for the preparation of gas mixtures of known tetrachloroethylene content.

The certified permeation rate in micrograms of tetrachloroethylene per minute at 25.0 °C is _____.

Serial Number _____ Date of Calibration _____

The uncertainty of the certified permeation rate is two standard deviations of the mean of ten measurements of the permeation rate over a 12 month period. The certified value is valid within these limits for a period of one year from the date of shipment from the National Bureau of Standards.

Note: The certified value of this permeation device is valid only if the use and recommended storage conditions given on page 2 are followed.

The tetrachloroethylene permeation device was calibrated in the Gas and Particulate Science Division, Center for Analytical Chemistry by G.D. Mitchell. The overall direction and coordination of the technical effort leading to the certification of this Standard Reference Material were performed under the chairmanship of W.L. Zielinski and H.L. Rook.

The technical and support aspects involved in the certification and issuance of this SRM were coordinated through the Office of Standard Reference Materials by R.W. Seward.

Gaithersburg, MD 20899
September 9, 1985

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

Notice and Warnings to Users:

Tetrachloroethylene has been defined by NIOSH as a possible carcinogen, therefore this SRM should be treated as a potential health hazard. Techniques used in handling radioactive and infectious materials are applicable to this SRM. Users in the United States should contact their Regional Office of the U.S. Environmental Protection Agency for information regarding proper disposal of these materials; in other countries, they should contact the appropriate organization responsible for public health or environmental control.

USE:

This device can be used to produce known concentrations of tetrachloroethylene in air or another gas by placing the device in a stream of the pure, dry air/gas (e.g., nitrogen) flowing at a known rate and at a known constant temperature. The accuracy of the concentration produced depends not only on the accuracy of the certified permeation rate, but also on the accuracy with which the purity of the air/gas, the rate of flow, and the temperature are known. Systems for generating known concentrations using permeation devices are described in ASTM D-2914.

When the device is first placed in service, a period of at least four weeks should be allowed for equilibration at the temperature at which it is to be used. Note: See "Storage" below. The device should be used at the calibration temperature of 25.0 °C; however, if the temperature used does not exceed more than 5 °C above or below 25 °C, an adjustment to the rate may be made according to the equation:

$$\text{Log } R_t = \text{Log } R_{25} + 0.0355\ (t - 25.0)$$

where R_t is the permeation rate of the device at temperature, t(°C), and R_{25} is the certified permeation rate of the device at 25.0 °C. The constant, 0.0355, was empirically determined using observations of the temperature-rate relationships for identical devices at temperatures between 20 and 30 °C. The additional uncertainty in the calculated value for the permeation rate at temperatures up to 5 °C above or below 25.0 °C is approximately ±5.0 percent of the certified permeation rate.

STORAGE:

The polymers from which this device is constructed will absorb organic compounds (including tetrachloroethylene) if exposed to high concentrations of these compounds during storage. Subsequent desorption of these compounds during use may result in a concentration different from that predicted by the certified rate. Therefore, upon receipt, this device must be removed from the shipping container and immediately stored in a chamber through which a flow of at least 100 mL/min of dry air/gas is continuously passed. Low temperature storage of the device is not recommended. Prolonged exposure of the device to temperatures greater than 30 °C or below 20 °C may permanently change the certified rate.

CALIBRATION:

This device was individually calibrated by gravimetric determination of its weight loss at 25.0 °C. The device was held at this temperature for a period of not less than one year during which time measurements of weight were made.

Analytical comparisons of several devices of this SRM batch to primary gas standards and SRM's of tetrachloroethylene in nitorgen in compressed gas cylinders using gas chromatography with flame ionization detection did not reveal any systematic errors associated with the gravimetric calibration of this device.

ACKNOWLEDGEMENT

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NBS-114A (REV. 2-8C)

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5. AUTHOR(S)

R. Mavrodineanu and T.E. Gills

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NATIONAL BUREAU OF STANDARDS
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GAITHERSBURG, MD 20899

7. Contract/Grant No.

8. Type of Report & Period Covered

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9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS (Street, City, State, ZIP)

Center for Analytical Chemistry
National Measurement Laboratory
National Bureau of Standards
Gaithersburg, MD 20899

Office of Standard Reference Materials
National Measurement Laboratory
National Bureau of Standards
Gaithersburg, MD 20899

10. SUPPLEMENTARY NOTES

Library of Congress Catalog Card Number: 87-619817

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

This publication is a summary of the gas cylinders and permeation tubes issued by NBS as Standard Reference Materials (SRM's). The material, composition, certification, use, and remarks concerning each of the SRM's described are presented in tabular form. Copies of the certificates of these SRM's are contained in the appendices for more detailed information.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

air; benzene; carbon dioxide; carbon monoxide; gas; methane; nitric oxide; nitrogen; nitrogen dioxide; nitrous oxide; oxygen; permeation tubes; propane; Standard Reference Materials; sulfur dioxide

13. AVAILABILITY

☒ Unlimited

☐ For Official Distribution. Do Not Release to NTIS

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15. Price

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NBS Technical Publications

Periodical

Journal of Research—The Journal of Research of the National Bureau of Standards reports NBS research and development in those disciplines of the physical and engineering sciences in which the Bureau is active. These include physics, chemistry, engineering, mathematics, and computer sciences. Papers cover a broad range of subjects, with major emphasis on measurement methodology and the basic technology underlying standardization. Also included from time to time are survey articles on topics closely related to the Bureau's technical and scientific programs. Issued six times a year.

Nonperiodicals

Monographs—Major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

Handbooks—Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

Special Publications—Include proceedings of conferences sponsored by NBS, NBS annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

Applied Mathematics Series—Mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

National Standard Reference Data Series—Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NBS under the authority of the National Standard Data Act (Public Law 90-396).
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