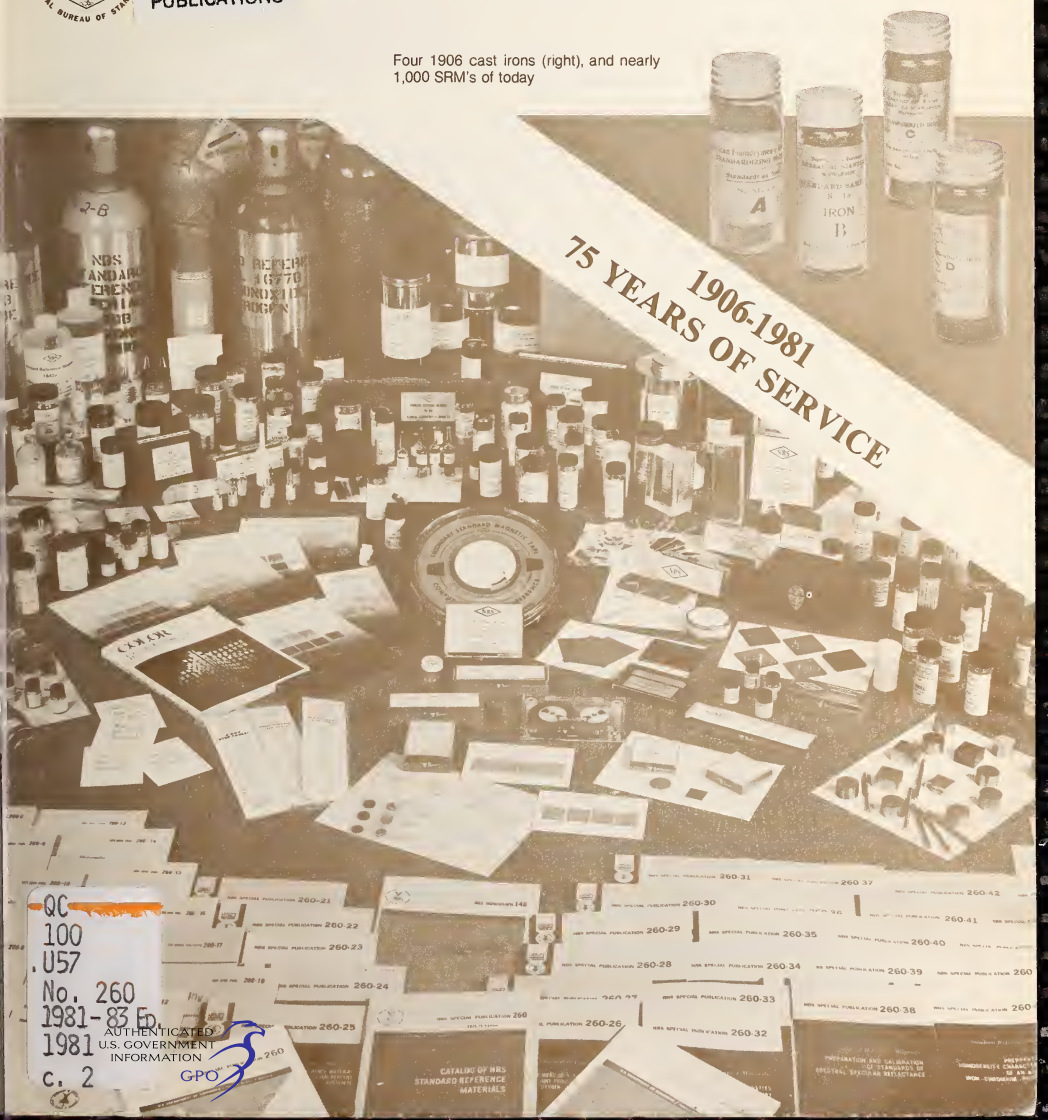
NBS Special Publication 260

NBS Standard Reference Materials Catalog 1981-83 Edition

Four 1906 cast irons (right), and nearly 1,000 SRM's of today



NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards[1] was established by an act of Congress on March 3, 1901. The Bureau's overall goal is to strengthen and advance the Nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the Nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau's technical work is performed by the National Measurement Laboratory, the National Engineering Laboratory, and the Institute for Computer Sciences and Technology.

THE NATIONAL MEASUREMENT LABORATORY provides the national system of physical and chemical and materials measurement; coordinates the system with measurement systems of other nations and furnishes essential services leading to accurate and uniform physical and chemical measurement throughout the Nation's scientific community, industry, and commerce; conducts materials research leading to improved methods of measurement, standards, and data on the properties of materials needed by industry, commerce, educational institutions, and Government; provides advisory and research services to other Government agencies; develops, produces, and distributes Standard Reference Materials; and provides calibration services. The Laboratory consists of the following centers:

Absolute Physical Quantities[2] — Radiation Research — Thermodynamics and Molecular Science — Analytical Chemistry — Materials Science.

THE NATIONAL ENGINEERING LABORATORY provides technology and technical services to the public and private sectors to address national needs and to solve national problems; conducts research in engineering and applied science in support of these efforts; builds and maintains competence in the necessary disciplines required to carry out this research and technical service; develops engineering data and measurement capabilities; provides engineering measurement traceability services; develops test methods and proposes engineering standards and code changes; develops and proposes new engineering practices; and develops and improves mechanisms to transfer results of its research to the ultimate user. The Laboratory consists of the following centers:

Applied Mathematics — Electronics and Electrical Engineering[2] — Mechanical Engineering and Process Technology[2] — Building Technology — Fire Research — Consumer Product Technology — Field Methods.

THE INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY conducts research and provides scientific and technical services to aid Federal agencies in the selection, acquisition, application, and use of computer technology to improve effectiveness and economy in Government operations in accordance with Public Law 89-306 (40 U.S.C. 759), relevant Executive Orders, and other directives; carries out this mission by managing the Federal Information Processing Standards Program, developing Federal ADP standards guidelines, and managing Federal participation in ADP voluntary standardization activities; provides scientific and technological advisory services and assistance to Federal agencies; and provides the technical foundation for computer-related policies of the Federal Government. The Institute consists of the following centers:

Programming Science and Technology — Computer Systems Engineering.

[1]Headquarters and Laboratories at Gaithersburg, MD, unless otherwise noted; mailing address Washington, DC 20234.
[2]Some divisions within the center are located at Boulder, CO 80303.

NBS Special Publication 260

NBS Standard Reference Materials Catalog 1981-83 Edition

Office of Standard Reference Materials
National Measurement Laboratory
National Bureau of Standards
Washington, DC 20234

CAUTION: The values given in the following sections are listed primarily as a guide to purchase. The values shown are nominal and may differ from those shown on the certificates. Space limitations have required that some values be omitted. For these reasons, the certificates issued with the standards should always be consulted to obtain the certified values.

U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Bureau of Standards
Ernest Ambler, Director

Issued November 1981

National Bureau of Standards Special Publication 260
Supersedes NBS Spec. Publ. 260-1979-80 Edition
Nat. Bur. Stand. (U.S.), Spec. Publ. 260-1981-83 catalog, 122 pages (Nov. 1981)
CODEN: XNBSAV

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1981

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402
Price
(Add 25 percent for other than U.S. mailing).

OTHER NBS PUBLICATIONS IN THIS SERIES

Catalog of NBS Standard Reference Materials (1979-80 edition), R. W. Seward, ed., NBS Spec. Publ. 260 (April 1979) $3.00* SN003-003-02048-6

Michaelis, R. E., and Wyman, L. L., Standard Reference Materials: Preparation of White Cast Iron Spectrochemical Standards, NBS Misc. Publ. 260-1 (June 1964). COM74-11061**

Michaelis, R. E., Wyman, L. L., and Flitsch, R., Standard Reference Materials: Preparation of NBS Copper-Base Spectrochemical Standards, NBS Misc. Publ. 260-2 (October 1964). COM74-11063**

Michaelis, R. E., Yakowitz, H., and Moore, G. A., Standard Reference Materials: Metallographic Characterization of an NBS Spectrometric Low-Alloy Steel Standard, NBS Misc. Publ. 260-3 (October 1964). COM74-11060**

Hague, J. L., Mears, T. W., and Michaelis, R. E., Standard Reference Materials: Sources of Information, NBS Misc. Publ. 260-4 (February 1965). COM74-11059

Alvarez, R., and Flitsch, R., Standard Reference Materials: Accuracy of Solution X-Ray Spectrometric Analysis of Copper-Base Alloys, NBS Misc. Publ. 260-5 (March 1965). PB168068**

Shultz, J. I., Standard Reference Materials: Methods for the Chemical Analysis of White Cast Iron Standards, NBS Misc. Publ. 260-6 (July 1975). COM74-11068**

Bell, R. K., Standard Reference Materials: Methods for the Chemical Analysis of NBS Copper-Base Spectrochemical Standards, NBS Misc. Publ. 260-7 (October 1965). COM74-11067**

Richmond, M. S., Standard Reference Materials: Analysis of Uranium Concentrates at the National Bureau of Standards, NBS Misc. Publ. 260-8 (December 1965). COM74-11066**

Anspach, S. C., Cavallo, L. M., Garfinkel, S. B., Hutchinson, J. M. R., and Smith, C. N., Standard Reference Materials: Half Lives of Materials Used in the Preparation of Standard Reference Materials of Nineteen Radioactive Nuclides Issued by the National Bureau of Standards, NBS Misc. Publ. 260-9 (November 1965). COM74-11065**

Yakowitz, H., Vieth, D. L., Heinrich, K. F. J., and Michaelis, R. E., Standard Reference Materials: Homogeneity Characterization on NBS Spectrometric Standards II: Cartridge Brass and Low-Alloy Steel, NBS Misc. Publ. 260-10 (December 1965). COM74-11064**

Napolitano, A., and Hawkins, E. G., Standard Reference Materials: Viscosity of Standard Lead-Silica Glass, NBS Misc. Publ. 260-11 (November 1966). NBS Misc. Publ. 260-11**

Yakowitz, H., Vieth, D. L., and Michaelis, R. E., Standard Reference Materials: Homogeneity Characterization of NBS Spectrometric Standards III: White Cast Iron and Stainless Steel Powder Compact, NBS Misc. Publ. 260-12 (September 1966). NBS Misc. Publ. 260-12**

Spijkerman, J. L., Snediker, D. K., Ruegg, F. C., and DeVoe, J. R., Standard Reference Materials: Mossbauer Spectroscopy Standard for the Chemical Shift of Iron Compounds, NBS Misc. Publ. 260-13 (July 1967). NBS Misc. Publ. 260-13**

Menis, O., and Sterling, J. T., Standard Reference Materials: Determination of Oxygen in Ferrous Materials - SRM 1090, 1091, and 1092, NBS Misc. Publ. 260-14 (September 1966). NBS Misc. Publ. 260-14**

Passaglia, E., and Shouse, P. J. Standard Reference Materials: Recommended Method of Use of Standard Light-Sensitive Paper for Calibrating Carbon Arcs Used in Testing Textiles for Colorfastness to Light, NBS Misc. Publ. 260-15 (June 1967). (Replaced by NBS Spec. Publ. 260-41.)

Yakowitz, H., Michaelis, R. E., and Vieth, D. L., Standard Reference Materials: Homogeneity Characterization of NBS Spectrometric Standards IV: Preparation and Microprobe Characterization of W-20% MO Alloy Fabricated by Powder Metallurgical Methods, NBS Spec. Publ. 260-16 (January 1969). COM74-11062**

Catanzaro, E. J., Champion, C. E., Garner, E. L., Marinenko, G., Sappenfield, K. M., and Shields, W. R. Standard Reference Materials: Boric Acid; Isotopic and Assay Standard Reference Materials, NBS Spec. Publ. 260-17 (February 1970). Out of Print

Geller, S. B., Mantek, P.A., and Cleveland, N. G., Standard Reference Materials: Calibration of NBS Secondary Standard Magnetic Tape (Computer Amplitude Reference) Using the Reference Tape Amplitude Measurement "Process A, "NBS Spec. Publ. 260-18 (November 1969). (See NBS Spec. Publ. 260-29.)

Paule, R. C., and Mandel, J., Standard Reference Materials: Analysis of Interlaboratory Measurements on the Vapor Pressure of Gold (Certification of Standard Reference Material 745). NBS Spec. Publ. 260-19 (January 1970). PB190071**

Paule, R. C., and Mandel, J., Standard Reference Materials: Analysis of Interlaboratory Measurements on the Vapor Pressures of Cadmium and Silver, NBS Spec. Publ. 260-21 (January 1971). COM74-11359**

Yakowitz, H., Fiori, C. E., and Michaelis, R. E., Standard Reference Materials: Homogeneity Characterization of Fe-3 Si Alloy, NBS Spec. Publ. 260-22 (February 1971). COM74-11357**

Napolitano, A., and Hawkins, E. G., Standard Reference Materials: Viscosity of a Standard Borosilicate Glass, NBS Spec. Publ. 260-23 (December 1970). COM71-00157**

Sappenfield, K. M., Marineko, G., and Hague, J. L., Standard Reference Materials: Comparison of Redox Standards, NBS Spec. Publ. 260-24 (January 1972). COM72-50058**

Hicho, G. E., Yakowitz, H., Rasberry, S. D., and Michaelis, R. E., Standard Reference Materials: A Standard Reference Material Containing Nominally Four Percent Austenite, NBS Spec. Publ. 260-25 (February 1971). COM74-11356**

Martin, J. F., Standard Reference Materials: National Bureau of Standards-US Steel Corportion Joint Program for Determining Oxygen and Nitrogen in Steel, NBS Spec. Publ. 260-26 (February 1971). 85 cents* SN003-003-00786-2

Garner, E. L., Machlan, L. A., and Shields, W. R., Standard Reference Materials: Uranium Isotopic Standard Reference materials, NBS Spec. Publ. 260-27 (April 1971). COM74-11358**

Heinrich, K. F. J., Myklebust, R. L., Rasberry, S. D., and Michaelis, R. E., Standard Reference Materials: Preparation and Evaluation of SRM's 481 and 482 Gold-Silver and Gold-Copper Alloys for Microanalysis, NBS Spec. Publ. 260-28 (August 1971). COM71-50365**

Geller, S. B., Standard Reference Materials: Calibration of NBS Secondary Standard Magnetic Tape (Computer Amplitude Reference) Using the Reference Tape Amplitude Measurement "Process A-Model 2," NBS Spec. Publ. 260-29 (June 1971). COM71-50282

Gorozhanina, R. S., Freedman, A. Y., and Shaievitch, A. B. (translated by M. C. Selby), Standard Reference Materials: Standard Samples Issued in the USSR (A Translation from the Russian). NBS Spec. Publ. 260-30 (June 1971). COM71-50283**

Hust, J. G., and Sparks, L. L., Standard Reference Materials: Thermal Conductivity of Electrolytic Iron SRM 734 from 4 to 300 K, NBS Spec. Publ. 260-31 (November 1971). COM71-50563**

Mavrodineanu, R., and Lazar, J. W., Standard Reference Materials: Standard Quartz Cuvettes, for High Accuracy Spectrophotometry, NBS Spec. Publ. 260-32 (December 1973). 55 cents* SN003-003-01213-1

Wagner, H. L., Standard Reference Materials: Comparison of Original and Supplemental SRM 705, Narrow Molecular Weight Distribution Polystyrene, NBS Spec. Publ. 260-33 (May 1972). COM72-50526**

Sparks, L. L., and Hust, J. G., Standard Reference Materials: Thermoelectric Voltage, NBS Spec. Publ. 260-34, (April 1972). COM72-50371**

Sparks, L. L., and Hust, J. G., Standard Reference Materials: Thermal Conductivity of Austenitic Stainless Steel, SRM 735 from 5 to 280 K, NBS Spec. Publ. 260-35 (April 1972.) 35 cents* COM72-50368**

Cali, J. P., Mandel, J., Moore, L. J., and Young, D. S., Standard Reference Materials: A Referee Method for the Determination of Calcium in Serum, NBS SRM 915, NBS Spec. Publ. 260-36 (May 1972). COM72-50527**

Shultz, J. I. Bell., R. K. Rains, T. C., and Menis, O., Standard Reference Materials: Methods of Analysis of NBS Clay Standards, NBS Spec. Publ. 260-37 (June 1972). COM72-50692**

Richmond, J. C., and Hsia, J. J., Standard Reference Materials: Preparation and Calibration of Standards of Spectral Specular Reflectance, NBS Spec. Publ. 260-38 (May 1972). COM72-50528**

Clark, A. F., Denson, V.A., Hust, J. G., and Powell, R. L., Standard Reference Materials The Eddy Current Decay Method for Resistivity Characterization of High-Purity Metals, NBS Spec. Publ. 260-39 (May 1972). COM72-50529**

McAdie, H. G., Garn, P. D., and Menis, O., Standard Reference Materials: Selection of Thermal Analysis Temperature Standards Through a Cooperative Study (SRM 758, 759, 760), NBS Spec. Publ. 260-40 (August 1972.) COM-72 50776**

Wood, L. A., and Shouse, P. J., Standard Reference Materials: Use of Standard Light-Sinsitive Paper for Calibrating Carbon Arcs Used in Testing Textiles for Colorfastness to Light, NBS Spec. Publ. 260-41 (August 1972) COM72-50775**

Wagner, H. L., and Verdier, P. H., eds., Standard Reference Materials: The Characterization of Linear Polyethylene, SRM 1475, NBS Spec. Publ. 260-42 (September 1972). COM72-50944**

Yakowitz, H., Ruff, A. W., and Michaelis, R. E., Standard Reference Materials: Preparation and Homogeneity Characterization of an Austenitic Iron-Chromium-Nickel Alloy, NBS Spec. Publ. 260-43 (November 1972). COM73-50760**

Schooley, J. F., Soulen, R. J., Jr., and Evans, G. A., Jr., Standard Reference Materials: Preparation and Use of Superconductive Fixed Point Devices, SRM 767, NBS Spec. Publ. 260-44 (December 1972). COM73-50037**

Greifer, B., Maienthal, E. J., Rains, T. C., and Rasberry, S. D., Standard Reference Materials: Powdered Lead-Based Paint, SRM 1579, NBS Spec. Publ. 260-45 (March 1973). COM73-50226**

Hust, J. G., and Giarratano, P. J., Standard Reference Materials: Thermal Conductivity and Electrical Resistivity Standard Reference Materials: Austenitic Stainless Steel, SRM's 735 and 798, from 4 to 1200 K, NBS Spec. Publ. 260-46 (March 1975). SN003-003-01278-5

Hust, J. G., Standard Reference Materials: Electrical Resistivity of Electrolytic Iron, SRM 797, and Austenitic Stainless Steel, SRM 798, from 5 to 280 K, NBS Spec. Publ. 260-47 (February 1974). COM74-50176**

Mangum, B. W., and Wise, J. A., Standard Reference Materials: Description and Use of Precision Thermometers for the Clinical Laboratory, SRM 933 and SRM 934, NBS Spec. Publ. 260-48 (May 1974). 60 cents* SN003-003-01278-5

Carpenter, B. S., and Reimer, G. M., Standard Reference Materials: Calibrated Glass Standards for Fission Track Use, NBS Spec. Publ. 260-49 (November 1974). SN003-003-01344-7

Hust, J. G., and Giarratano, P. J., Standard Reference Materials: Thermal Conductivity and Electrical Resistivity Standard Reference Materials: Electrolytic Iron, SRM's 734 and 797 from 4 to 1000 K, NBS Spec. Publ. 260-50 (June 1975). 1.00* SN003-003-01425-7

Mavrodineanu, R., and Baldwin, J. R., Standard Reference Materials: Glass Filters As a Standard Reference Material for Spectrophotometry; Selection; Preparation; Certification; Use - SRM 930, NBS Spec. Publ. 260-51 (November 1975). $1.90* SN003-003-01481-8

Hust, J. G., and Giarratano, P. J., Standard Reference Materials: Thermal Conductivity and Electrical Resistivity Standard Reference Materials 730 and 799, from 4 to 3000 K, NBS Spec. Publ. 260-52 (September 1975). $1.05* SN003-003-01464-8

Durst, R. A., Standard Reference Materials: Standardization of pH Measurements, NBS Spec. Publ. 260-53 (December 1975, Revised). $1.05* SN003-003-01551-2

Burke, R. W., and Mavrodineanu, R., Standard Reference Materials: Certification and Use of Acidic Potassium Dichromate Solutions as an Ultraviolet Absorbance Standard, NBS Spec. Publ. 260-54 (August 1977). $3.00* SN003-003-01828-7

Ditmars, D. A., Cezairliyan, A., Ishihara, S., and Douglas, T. B., Standard Reference Materials: Enthalpy and Heat Capacity; Molybdenum SRM 781, From 273 to 2800 K, NBS Spec. Publ. 260-55 (September 1977). $2.20* SN003003-01836-8

Powell, R. L., Sparks, L. L., and Hust, J. G., Standard Reference Materials: Standard Thermocouple Material, Pt.-67:SRM1967, NBS Spec. Publ. 260-56 (February 1978). $2.20* SN003-003-018864

Cali, J. P. and Plebanski, T., Guide to United States Reference Materials, NBS Spec. Publ. 260-57 (February 1978). $2.20* SN003-003-01883-0

Barnes, J. D. and Martin, G. M., Standard Reference Materials: Polyester Film for Oxygen Gas Transmission Measurements. SRM 1470, NBS Spec. Publ. 260-58 (in press).

Chang, T. and Kahn, A. H., Standard Reference Materials: Electron Paramagnetic Resonance Intensity Standard: SRM 2601, NBS Spec. Publ. 260-59 (August 1978). $2.30* SN-003-003-01975-5

Velapoldi, R. A., Paule, R. C., Schaffer, R., Mandel, J., and Moody, J. R., Standard Reference Materials: A Reference Method for the Determination of Sodium in Serum, NBS Spec. Publ. 260-60 (August 1978). $3.00* SN003-003 01978-0

Verdier, P. H., and Wagner. H. L., Standard Reference Materials: The Characterization of Linear Polyethylene (SRM 1482, 1483, 1484), NBS Spec. Publ. 260-61 (December 1978). $1.70* SN003-003-02006-1

Soulen, R. J., and Dove, R. B., Standard Reference Materials: Temperature Reference Standard for Use Below 0.5 K (SRM 768). NBS Spec. Publ. 260-62 (April 1979. $2.30* SN003-003-02047-8

Velapolid, R. A., Paule, R. C., Schaffer, R., Mandel, J., Machlan, L. A., and Gramlich, J. W., Standard Reference Materials: A Reference Method for the Determination of Potassium in Serum, NBS Spec. Publ. 260-63 (May 1979). $3.75 SN003-003-02068

Velapoldi, R. A., and Mielenz, K. D., Standard Reference Materials: A Fluorescence Standard Reference Material Quinine Sulfate Dihydrate (SRM 936). NBS Spec. Publ. 260-64 (January 1980). $4.25* SN003-003-02148-2.

Marinenko, R. B., Heinrich, K. F. J., and Ruegg, F. C., Standard Reference Materials: Micro-Homogeneity Studies of NBS Standard Reference Materials, NBS Research Materials, and Other Related Samples, NBS Spec. Publ. 260-65 (September 1979). $3.50* SN003-003-02114-1

Venable, W. H., Jr. and Eckerle, K. L., Standard Reference Materials: Didymium Glass Filters for Calibrating the Wavelength Scale of Spectrophotometers (SRM 2009, 2010, 2013), NBS Spec. Publ. 260-66 (October 1979). $3.50* SN003-003-02127-0

Velapoldi, R. A., Paule, R. C., Schaffer, R., Mandel, J., Murphy, T. J., and Gramlich, J. W., Standard Reference Materials: A Reference Method for the Determination of Chloride in Serum, NBS Spec. Publ. 260-67 (November 1979). $3.75* SN003-003-02136-9

Mavrodineanu, R. and Baldwin, Jr., Standard Reference Materials: Metal-On-Quartz Filters as a Standard Reference Material for Spectrophotometry-SRM 2031, NBS Spec. Publ. 260-68 (April 1980). $4.25* SN003-003-02167-9

Velapoldi, R. A., Paule, R. C., Schaffer, R., Mandel, J., Machlan, L. A., Garner, E. L., and Rains, T. C., Standard Reference Materials: A Reference Method for the Determination of Lithium in Serum, NBS Spec. Publ. 360-69 (July) 1980). $4.25* SN003-003-02214-4

Marinenko, R. B., Biancaniello, F., Boyer, P. A., Ruff, A. W., DeRobertis, L., Standard Reference Materials: Preparation and Characterization of an Iron-Chromium-Nickel Alloy for Micro-analysis, NBS Spec. Publ. 260-70 (in press).

Reeder, D. J., Coxon, B., Enagonio, D., Christensen, R. G., Schaffer, R., Howell, B. F., Paule, R. C., Mandel, J., Standard Reference Materials: SRM 900, Antiepilepsy Drug Level Assay Standard, NBS Spec. Publ. 260-72 (in press).

* Send order with remittance to Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Remittance from foreign countries should include an additional one-fourth of the purchase price for postage.

** May be ordered from: National Technical Information Services (NTIS), Springfield, Virginia 22151.

CONTENTS

National Bureau of Standards

Catalog of Standard Reference Materials - 1981-83

This Catalog lists those Standard Reference Materials (SRM's), Research Materials (RM's), and Special Reference Materials (GM's) that are available from the National Bureau of Standards (NBS), and those that are soon to be available. The Catalog describes these materials as to their certified characterization, unit size, and type, as well as providing ordering information. Prices for these materials are listed separately in annual supplements to this Catalog.

Key words: Analysis; characterization; composition; properties; Standard Reference Materials; Research Materials; materials.

Introduction

The National Bureau of Standards issues over 1000 different materials through its Standard Reference Materials Program. These materials are primarily Standard Reference Materials (SRM's) certified for their chemical composition, chemical property, or physical property, but also include Research Materials (RM's) and Special Reference Materials (GM's). All SRM's, RM's, and GM's bear distinguishing names and numbers by which they are permanently identified. Thus, each SRM, RM, or GM bearing a given description is identical (within the required or intended limits) to every other sample bearing the same designation—with the exception of individually certified items, which are further identified by serial number.

The first materials issued by NBS were called Standard Samples and consisted of a group of ores, irons, and steels certified for their chemical composition. Since the mid-1960's these materials have been issued as Standard Reference Materials, and cover a wide range of chemical and physical properties and an equally wide range of measurement interests.

Definitions

The different terms, SRM, RM, or GM, are used to indicate differences in the types of information supplied and in the purposes for which the material is intended.

Standard Reference Materials have been characterized by the National Bureau of Standards for some chemical or physical property and are issued with a Certificate that gives the results of the charaterization. These results are obtained by one of the three established routes of certification, i.e., measurement of the property using: (1) a previously validated reference method, (2) two or more independent, reliable measurement methods, or (3) an *ad hoc* network of cooperating laboratories, technically competent and thoroughly knowledgeable with the material being tested. These routes are described in detail in, "The Role of Standard Reference Materials in Measurement Systems," NBS Monograph 148, 54 pages (Jan. 1975). SRM's are defined as being well-characterized and certified materials produced in quantity to improve measurement science. They are prepared and used for three main purposes: to help develop accurate methods of analysis (reference methods); to calibrate measurements systems used to: (a)facilitate the exchange of goods, (b) institute quality control, (c) determine performance characteristics, or (d) measure some property at the limit of the state-of-the-art; to assure the long-term adequacy and integrity of quality control processes. In these ways, SRM's help ensure the compatibility and accuracy of measurements in many facets of national life—from science and technology to trade and commerce.

Research Materials, unlike SRM's, are not certified. Instead of a Certificate, RM's are issued with a "Report of Investigation," the sole authority of which is the NBS staff member who authored the report. An RM is intended primarily to further scientific or technical research on that particular material. The principal consideration in issuing an RM is to provide a homogeneous material so that investigators in different laboratories are assured that they are investigating the same material.

Special Reference Materials differ from both SRM's and RM's in that NBS does not participate in the

characterization of these materials. GM's are reference materials produced and certified or guaranteed by other government agencies, standards bodies, or other non-profit organizations. When deemed to be in the public interest and when alternate methods of national distribution do not exist, NBS acts as the distributor for such materials. This service is available to all organizations that qualify and have reference materials that would help solve a national measurement problem.

SRM Catalog

New Catalogs of NBS Standard Reference Materials are published approximately every 3 years, listing new materials available, materials in preparation, and deleting discontinued materials. To keep the Catalog current between editions, annual supplements are published that list: the current prices charged, new materials, discontinued materials (with suggested substitutes), and revised Certificates.

The materials listed in this Catalog are separated into several major groups: Chemical Composition Standards, Physical Property Standards, Engineering Type Standards, Research Materials, and Special Reference Materials. The first three groups include SRM's only and are subdivided into the categories shown in the Table of Contents.

The numerical values given in the Catalog to describe the materials' properties are *nominal* values only and are to be used only as guides in selecting the materials. They are not to be used in lieu of the Certificate issued with the material.

Note: Some SRM's are not issued with Certificates. These exceptions are noted in both the SRM description and the numerical index.

The numerical index provides the SRM, RM, and GM numbers of all materials listed in the Catalog, together with either the date of the current Certificate or a note to explain the absence of a Certificate.

An alphabetical index is also provided. For the most part, this index lists SRM catagories and the primary constituent or element of an SRM, rather than the names of specific SRM's. RM's and GM's are listed as groups only.

Preparation and Availability of Standard Reference Materials

New and renewal SRM's are being prepared continually. When completed, prospective users are notified directly of their availability, and the SRM's are described in the next catalog supplement.

In preparing renewal SRM's, the intention is to complete the renewal before the supply of the existing SRM is exhausted. Frequently, this is not possible and the SRM will be out-of-stock for a time. When this occurs, those ordering the material are so notified and, when feasible, of possible substitutes. (See Ordering below). When the renewal becomes available, customers who have requested either the previous lot or the renewal are promptly notified.

Renewal SRM's will not usually be identical to their predecessors, but will be quite similar especially with regard to the characteristics certified. Generally, the renewal can be used in place of its predecessor. As an example, when the first 0.1 percent carbon Bessemer steel was prepared in 1909, it was called Standard Sample No. 8. During the following years, a number of renewals, 8a, 8b, etc., were prepared. The current SRM 8j, Bessemer Steel (Simulated), 0.1% Carbon, represents the 10th renewal batch of this material. While each of these batches differs somewhat in detailed analysis, all have had the relatively high level of phosphorus, sulfur, and nitrogen, and low alloy metal content characteristic of this type of material.

It is not possible to supply preceding numbers of a renewal series when the stock is exhausted. If little demand exists or an alternate source of supply becomes available for a material, production may be discontinued permanently.

Ordering

Orders should be addressed to:

Office of Standard Reference Materials
Room B311, Chemistry Building
National Bureau of Standards
Washington, DC 20234
Telephone (301) 921-2045

Orders should give the amount (number of units), catalog number, and name of the material requested. For example: 1 each, No. 11h, Basic-Open-Hearth Steel, 0.2 percent C. The materials described in this Catalog are distributed in the units listed or in multiples thereof only.

Acceptance of an order does not imply acceptance of any provision set forth in the order contrary to the policy, practice, or regulations of the National Bureau of Standards or the U.S. Government.

Orders received for "out-of-stock" materials are cancelled if only out-of-stock items are ordered. On other orders, shipment is made of available materials and out-of-stock items are cancelled. Backorders are not accepted for out-of-stock materials; if a renewal lot of material is available, it will be furnished automatically.

Terms

Prices quoted are in U.S. dollars, and are published in the SRM Price List (Supplement to this Catalog). New SRM Price Lists, when issued, are sent to users who have made purchases during the preceeding 12 months and to persons or organizations who have requested them. These prices are subject to revision without notice and orders will be billed for the prices in effect at the time of shipment. No discounts are given on purchases of SRM's, RM's, or GM's.

Remittances of the purchase price need not accompany purchase orders. Payment of invoices is expected within 30 days of receipt of an invoice. Payment on foreign orders may be made by any of the following:

(a) UNESCO coupons.
(b) banker's draft against a U.S.A. bank,
(c) bank to bank transfer to a U.S.A. bank,
(d) letter of credit on a U.S.A. bank, or
(e) by International Money Order.

Pro-forma invoice service will frequently require 6 to 8 weeks to process, and will be furnished only to those requiring such service.

Letters of Credit may be used as advance payment for SRM's. Letters of credit will be accepted from banks in the United States only. Listed below are the only documents that we will furnish:

(1) Six Commercial Invoices
(2) Packing List
(3) Certificate of Origin
(4) Airway Bill (This can only be furnished if material is shipped *collect*; if shipped prepaid International Air Parcel Post, receipts cannot be furnished.)

If, however, the purchaser requests a different mode of shipment, the shipment will be sent collect. For items shipped collect NBS cannot "prepay and add" such shipping charges to the invoice. Restricted categories such as hydrocarbons, organic sulfur compounds, compressed gases, rubber, rubber compounding materials, radioactive standards, and similar materials are shipped FOB Gaithersburg, MD.

Domestic Shipments

Shipments of material (except for certain restricted categories) intended for the United States, Mexico, and Canada are normally shipped prepaid (providing that the parcel does not exceed the weight limitations as prescribed by Postal Laws and Regulations).

Foreign Shipments

The regulations of various nations covering the importation of SRM's, GM's, and RM's differ widely; any attempt to list all possible variations would be impractical. Therefore, where the shipping practices outlined below do not apply, purchasers will be informed of the best method of shipment for their countries.

Most orders will be shipped by prepaid International Air Parcel Post. Exceptions are items in restricted categories and those shipments that exceed parcel post weight limitations. These exceptions will be shipped FOB Gaithersburg, MD, unless an agent (shipping or brokerage firm) located in the United States is required. Where an agent is required, the purchaser will be so notified and will be requested to designate an agent of his/her choice. In this case, the material will be packaged for overseas shipment and will be forwarded to the agent FOB Gaithersburg, MD.

NOTE: Orders and inquiries submitted in English will be processed more rapidly than those requiring translations.

National Bureau of Standards

Catálogo de Materiales Patrones de Referencia del año 1981-83

En este catálogo figuran todos los Materiales Patrones de Referencia (SRM's), Materiales de Investigación (RM's) y Materiales Especiales de Referencia (GM's) que pueden ser obtenidos en el National Bureau of Standards (NBS) en la actualidad y aquellos que estarán disponibles en breve plazo. Estos materiales están descritos en el catálogo en la misma forma que en el certificado haciendo referencia al tamaño, clase, y características asi como información para hacer los pedidos. Los precios figuran por separado en un suplemento anual de este catálogo.

Palabras Claves: Análisis; certificación; caracterización; composición; propiedades; Materiales de Investigácion (RM's); Materiales Especiales de Referencia (GM's) y Materiales Patrones de Referencia (SRM's).

Introducción

NBS emite más de 1000 materiales diferentes a través de su programa para SRM's. Estos materiales son principalmente SRM's que han sido certificados por su composición química y propiedades químicas y físcas pero también incluye RM's y GM's. Todos los SRM's, RM's y GM's llevan nombres y números que los identifican permanentemente. Cada SRM, RM o GM al cual se la ha dado una descripción determinada es idéntica a todas las otras muestras que llevan la misma designación (dentro de los límites requeridos para su uso) con excepción de aquellas que han sido certificadas individualmente y a las cuales se les asigna un número de serie.

Los primeros materiales emitidos por el N.B.S. fueron llamados "muestras patrones" (standard samples) y consistián en un grupo de minerales, hierros y aceros que habián sido certificados por su composición química, pero a partir del año de 1960 se les disignó con el nombre de Materiales Patrones de Referencia (SRM's) que cubre un campo más amplio de propiedades físicas y químicas y que refleja el interés por las medidas.

Definiciones

Los términos SRM, RM, y GM son usados para indicar las diferentes clases de información suministrada y el propósito al cual el material ha sido destinado.

Materials Patrones de Referencia: N.B.S. ha caracterizado los SRM's por algunas de sus propiedades físicas y químicas y los emite con un certificado en el cual aparece el resultado de dicha caracterización. Estos resultados son obtenidos por una de las tres vías de certificación establecidas. Medida de la propiedad usando:

(1) Un método de referencia con validez probada previamente.
(2) Dos o más métodos independientes de medidas dignos de confianza.
(3) Una red de cooperativas de laboratorios tecnicamente competentes y con conocimiento cabal del material comprobado para este específico propósito.

Estas vías han sido descritas detalladamente en "La Función de los Materiales Patrones de Referencia en el Sistema de Medidas" (The Role of Standard Reference Materials in Measurement Systems, NBS Monograph 148, 54 pages, Jan. 1975). Se ha definido los SRM's como materiales que se han certificado y analizado en cantidades suficientes para ser usados en el mejoramiento de las ciencias de las medidas. Los SRM's han sido preparados y usados con tres principales propósitos: para ayudar a desarrollar métodos de análisis de alta calidad (Metodos de Referencia); para calibrar sistemas de medidas destinados a: (a) facilitar el intercambio de mercancías; (b) implantar control de la calidad, (c) determinar las características representadas y (d) llevar la medida de algunas propiedades al límite de la Obra de Arte; y para asegurar un método de control de la calidad adecuado, durадero e íntegro. En esta forma los SRM's auydan a asegurar la compatibilidad y alta calidad de las medidas en muchos aspectos de la vida nacional desde la ciencia y la tecnología hasta los oficios y el comercio.

Materiales de Investigación (RM's): A diferencia de los SRM's, éstos no están certificados. En lugar de un certificado, ellos son emitidos con un informe de investigación (Report of Investigation) el cual es responsabilidad del miembro del cuerpo de científicos del NBS que produce el informe. RM's estan destinados principalmente a fomentar la investigación científica y técnica sobre determinado material con la principal concideración de proveer un material homogéneo a los científicos en los diferentes laboratorios, con la seguridad de que están investigando el mismo material.

Los Materiales Especiales de Referencia (GM's) se distinguen de los SRM's y de los RM's en que el N.B.S. no participa en su investigación. Los GM's son materiales de referencia producidos y certificados por otras agencias del gobierno, otros grupos de patrones de referencia o algunas organizaciones no lucrativas. N.B.S. actúa como el distribuidor de dichos materiales cuando considera que es del interés público o cuando no hay otro medio mejor para la distribución nacional. Este servicio esta al alcance de las organizaciones que llenen los requisitos requeridos y tengan materiales de referencia que pudieran ayudar a resolver un problema nacional de medida.

Catálogo de Materiales Patrones de Referencia

El Programa de los SRM's del N.B.S. publica nuevos catálogos cada 3 años en los cuales se registran los nuevos materiales disponibles, materiales en preparación y materiales que han sido descontinuados.

Para mantener el catálogo al corriente entre ediciones se publica un suplemento con la lista de los precios actuales, nuevos materiales, materiales descontinuados (con algunas sugerencias de sustitutos) y certificados revisados.

Los materiales que figuran en el catálogo han sido clasificados en varios grandes grupos: Patrones de Composición Química, Patrones de Propiedades Físicas, Patrones de Tipo de Ingeniería y Patrones Generales. Los 3 primeros tipos incluyen solamente SRM's y están divididos en diferentes sub-grupos que aparecen en el Indice General.

Los valores numéricos ofrecidos en el catálogo que describen las propiedades de los materiales son valores nominales para ser usados solamente como guías al seleccionar los materiales. Estos valores numéricos no deben ser usados en lugar del certificado emitido con el material.

Nota: Algunos SRM's no son emitidos con certificados. Estas excepciones aparecen en la descripción de SRM's y en el indice numérico.

El indice numérico ofrece números para todos los materiales que aparecen en el catálogo junto con la fecha vigente o en su lugar una nota explicando la ausencia del certificado.

Un índice alfabético es ofrecido donde se enumera los SRM's y el componente o elemento principal en lugar del nombre del SRM's en cuestión. Los SRM's y GM's aparecen en grupos solamente.

Preparación Y Disponibilidad de los Materiales Patrones de Referencia.

Continuamente se están renovando y preparando nuevos SRM's. Cuando están disponibles se notifica a los interesados y se describen en el próximo suplemento del catálogo.

La renovación de los SRM's tiene como finalidad asegurar la existencia de los materiales antes que se agoten sus reservas. Algunas veces ésto no es posible y algunos materiales están fuera del mercado por un tiempo. Cuando ésto ocurre se le notifica a aquellos que han encargado el material informándoles cuando podrán ser obtenidos o la posibilidad de sustitutos. Cuando el material renovado vuelve a estar disponible se le notifica a los clientes que lo habián solicitado previamente (vea pedidos). Por lo general el material de renovación no será idéntico a su predecesor pero será bastante similar en especial a lo que a sus caracteres certificados se refiere. En general el material renovado puede ser usado en lugar de su predecesor. Por ejemplo cuando el primer acero Bessemer con 0.1 por ciento de Carbono fué preparado en el año 1909 fué designado como "Standard Sample No. 8". Durante los años subsiguientes fueron preparados lotes de renovacion 8a, 8b etc. En la actualidad está disponible el SRM 8j que representa la décima renovación del acero Bessemer con 0.1 por ciento de Carbono. Si bien cada uno de estos lotes difiere en algo en cuanto al análisis detallado entre uno otro lote, todos tienen el nivel relativamente alto de contenido de fósforo, azufre, nitrógeno y metal de baja aleación que es característica de este material.

Una vez agotadas las existencias no es posible suministrar números precedentes de una serie de renovaciones. Si existe poca demanda o se dispone de otra fuente de suministro de determinado material, la producción puede ser descontinuada en forma permanente.

Pedidos

Los pedidos deberán ser hechos a la siguiente dirección.

Office of Standard Reference Materials
Room B311, Chemistry Building
National Bureau of Standards
Washington, D.C. 20234
Teléfono (301) 921-2045

En los pedidos se deberá indicar la cantidad (Número de unidades), el número del catálogo y el nombre del material ordenado. Por ejemplo: una muestra, No. 11h, Basic-open-Hearth Steel, 0.2 por ciento C. Estos materiales son distribuidos solamente en las medidas que figuran en la lista. La aceptación de un pedido no implica la aceptación de ninguna estipulación que vaya en contra de la política, práctica o regulaciones del N.B.S. o del Gobierno de los E.U.

Pedidos que se reciban de materiales "agotados" son cancelados, si se ha pedido solamente materiales agotados. Si el pedido incluye otros materiales disponibles se envían éstos y se cancelan los materiales agotados. No se aceptan pedidos de materiales agotados. Si un lote de material de renovación está desponible será suministrado automaticamente.

Los precios están fijados en moneda de los E.U. y son publicados en la lista de precios de los SRM's (suplemento del catálogo). Cuando las nuevas listas de precios son emitidas se les envían a los clientes que han hecho compras en el curso de los últimos doce meses y a las personas y organizaciones que las soliciten.

Estos precios están sujetos a revisiones sin previa notificación y los pedidos se enviarán con los precios que estén vigentes en el momento del despacho de la mercancía.

Las órdenes de compra no necesitan ir acompañadas del valor de la compra. Se espera que las facturas sean pagadas dentro de los treinta días después de recibidas. El pago de pedidos desde el extrajero se puede hacer mediante cualquiera de las siguientes vías:

a) Cupones de la Unesco
b) Giro bancario contra un banco en los E.U.
c) Transferencia bancaria
d) Carta de Crédito en un banco de los E.U. (ver nota)
e) Giro Internacional.

Suele requirir ocho semanas procesar facturas proforma y serán suministradas solamente a aquellos que requieran tal servicio.

Nota: Se puede emplear cartas de crédito para pagar por adelantado los SRM's. Se aceptarán unicamente cartas de crédito de bancos en los E.U. A continuación se indican los únicos documentos que serán suministrados.

1) Seis facturas comerciales.
2) Lista de embalaje.
3) Certificado de origen.
4) Factura de embarque aéreo (solamente si el flete se remite a ser pagado). No se suministrará recibo cuando la mercancía es enviada por el Servicio Postal Aereo Internacional (Porte pagado).

Envíos Domésticos

Los envíos de materiales (a excepción de ciertas categorías restringidas) destinados a los E. U. y Canada por lo general son remesados con importe pagado (siempre cuando el paquete no exceda las limitaciones prescritas por las leyes y el reglamento postal). Sin embargo, si el comprador solicita una forma diferente de envío, la mercancía se enviará con flete por pagar. *N.B.S. no Paga Por Tales Fletes.* Algunas categorías restringidas como hidrocarburos, compuestos orgánicos de azufre, gases comprimidos, materiales para compuestos de goma, muestras radioactivas y materiales semejantes serán enviados desde Gaithersburg, MD. por expreso con flete por pagar.

Envios al extranjero

Las regulaciones que cubren la importación de SRM's, GM's y RM's de algunos paises difieren grandemente. Hacer una lista de estas diferencias no tiene objeto por lo tanto los compradores deberán informarse de cual es el mejor método de envío existente en sus paises cuando la siguiente lista de prácticas no es aplicable.

La mayoría de los pedidos con flete pagado serán enviados por Encomienda Postal Internacional Aerea. Son excepciones los artículos en categorías restringidas y aquellos que excedan las limitaciones de peso establecidas por la oficina postal de paquetes. Estas excepciones serán enviadas por expreso con flete por cobrar a menos que un agente (empresa de transporte o corredor) ubicado en los E.U. sea requerido. Si es necesario hacer el envío a través de un agente se notificará al comprador para que escoja al agente que deseé. En este caso el material será embalado para embarque marítimo y despachado por expreso con flete por cobrar a la empresa en las E.U. que ha sido designada como agente.

Nota: Pedidos y consultas presentados en idioma inglés serán tramitados en forma más rápida que aquellos que requieran traducción.

National Bureau of Standards (NBS)

Catalogue des Materiaux Standard de Reference 1981-83

Ce catalogue répertorie les matériaux standard de référence (Standard Reference Materials, SRM's), les matériaux de recherches (Research Materials, RM's) et les materiaux speciaux de références (Special Reference Materials, GM's) disponibles au Bureau National des Standards (National Bureau of Standards, NBS) et ceux qui seront bientôt disponibles. Pour chacun de ces matériaux, le catalogue donne les caractéristiques certifiées, la description de l'échantillon (dimensions, forme), et fournit des renseignements commerciaux. Les prix sont portés séparément dans des suppléments annuels à ce catalogue.

Mots-clés: Analyse; certification; caractérisation; composition; propriétés; Research Materials; Special Reference Materials; Standard Reference Materials.

Introduction

Le Bureau National des Standards (National Bureau of Standards, NBS)* délivre plus de 1000 matériaux différents grâce à son programme de Materiaux Standard de Référence (Standard Reference Materials, SRM's)*. Ces matériaux sont principalement des SRM's certifiés pour leur composition chimique, leur propriété chimique ou leur propriété physique, mais comprennent également des matériaux de recherche (Research Materials, RM's)* et des materiaux specials de references (Special References Materials, GM's).* Tous les SRM's, RM's et GM's portent des noms et des numéros distinctifs qui permettent de les identifier en permanence. Ainsi, chaque SRM, RM, ou GM désigné par une description donnée est identique (dans les limites spécifiées ou visées) à tous les autres échantillons de même désignation, à l'exception des articles certifiés isolément, qui sont identifiés en plus par un numéro de série.

**Nota:* Ces expressions ou les abreviations correspondentes seront utilisées par la suite dans ce document.

Les premiers matériaux délivrés par le NBS portaient le nom d'échantillon standard (Standard Samples) et comprenaient un groupe de minerais, de fers, et d'aciers, certifiés pour leur composition chimique. Depuis le milieu des années 60, ces matériaux ont été délivrés sous la forme de "Standard Reference Materials" et couvrent une large gamme de propriétés physiques et chimiques, et une gamme tout aussi large de domaines d'intérêt.

Definitions

L'emploi des différents termes SRM, RM, ou GM, est destiné á différencier les types d'informations fournies et les utilisations auxquelles est destiné le matériau.

Standard Reference Materials. Ils sont caractérisés par le NBS pour une propriété physique ou chimique donnée et sont délivrés avec un Certificat donnant les résultats de la caractérisation. Ces résultats sont obtenus par l'une des trois procédures de certification, c'est-à-dire de mesure de la propriété, suivantes: (1) par une méthode de référence précédemment reconnue, (2) par deux ou plusieurs méthodes de mesures différentes et fiables, ou (3) par un réseau ad hoc de laboratoires participants, ayant la compétence technique et la connaissance du matériau à caractériser. Ces procédures sont décrites en détail dans "The Role of Standard Reference Material Measurement Systems" NBS Special Publication 148 (1975). Les SRM's sont définis comme des matériaux caractérisés avec soin et certifiés, produits en quantité, afin d'améliorer la science des mesures. Ils sont élborés et utilizés pour répondre à trois objectifs principaux: Aider à développer des méthodes d'analyses de justesse (méthodes de référence); Etalonner des appareillages de mesures pour: (a) faciliter les échanges de produits, (b) instituer les contrôles de qualité, (c) évaluer des performances, ou (d) mesurer une propriété donnée au mieux des connaissances actuelles; Assurer à long terme la validité et l'intégrité des processus de contrôle de qualité. Sous tous ces aspects, les SRM's permettent d'assurer la cohérence et la justesse des mesures, dans de nombreuses facettes de la vie nationale – depuis la science et la technologie jusqu'aux échanges commerciaux.

Research Materials. Contrairement aux SRM's, ils ne sont pas certifiés. Au lieu d'un Certificat, ces RM's sont délivrés avec un "Rapport d'Essais", sous la seule autorité de l'expérimentateur du NBS auteur du

rapport. Un RM est essentiellement destiné à permettre la poursuite de recherches scientifiques ou techniques sur ce matériau. Pour un RM, le souci majeur est de fournir un matériau homogène, afin que les chercheurs de différents laboratoires soient assurés de travailler sur le même matériau.

Special Reference Materials. Ils diffèrent à la fois des SRM's et des RM's par le fait que NBS ne participe pas à leur caractérisation. Les GM's sont des matériaux de référence produits et certifiés ou garantis par d'autres agences gouvernementales, des organismes de normalisation ou d'autres organisations à but non lucratif. S'il apparait qu'ils correspondent à un intérêt général et s'il n'existe pas d'autres circuits nationaux de distribution, le NBS fait office de distributeur pour ces matériaux. Ce service est ouvert à toute organisation qui qualifie, et qui dispose de matériaux de référence pouvant permettre de résoudre un problème de mesure au niveau national.

Catalogue des SRM's

La publication d'un nouveau catalogue des Standard Reference Materials du NBS intervient environ tous les trois ans. Il répertorie les nouveaux matériaux disponibles, les matériaux en préparation, et supprime les matériaux épuisés. Entre les publications, la mise à jour du catalogue est assurée par des suppléments annuels, qui répertorient: les prix en vigueur, les nouveaux matériaux, les matériaux épuisés (et proposent des matériaux de remplacement), et les révisions apportées aux Certificats.

Les matériaux répertoriés dans ce catalogue sont séparés en plusieurs grandes classifications: Références de composition chimique (Chemical Composition Standards), Références de propriété physiques (Physical Property Standards), Références à caractère technologique (Engineering Type Standards), "Research Materials", et "Special Reference Materials". Les trois premières classifications correspondent aux seuls SRM's, et sont subdivisées en diverses catégories indiquées à la table de matières.

Les valeurs numériques données dans le catalogue pour décrire les propriétés des matériaux ne sont que de valeurs *nominales*, à utiliser à titre indicatif pour choisir les matériaux. Elles ne doivent pas être utilisées en lieu et place du Certificate délivré avec le matériau.

Nota: Certains SRM's sont délivrés sans Certificat. Ces exceptions sont précisées à la fois dans la description du SRM et à l'index numérique correspondant.

L'index numérique donne les numéros de SRM, RM et GM de tous les matériaux répertoriés dans le catalogue, ainsi que, soit la date du dernier Certificat, soit une Nota expliquant l'absence de certificat. Il existe également un index alphabétique. Cet index répertorie principalement les catégories de SRM et l'élément ou la matrice de base, plutôt que sa dénomination précise. Les RM's et les GM's sont regroupés uniquement en grandes rubriques.

Préparation et Disponibilité des Standard Reference Materials

La préparation de nouveaux SRM's et le renouvellement d'anciens sont effectués continuellement. Au terme de ces opérations, les utilisateurs potentiels sont avertis de leur disponibilité, et le SRM est décrit dans le supplément au catalogue suivant.

L'objectif, pour les SRM's de renouvellement, est d'assurer une relève avant que le stock du SRM existant ne soit épuisé. Fréquemment, cette condition ne peut être remplie, et, pour un temps, le SRM se trouve en rupture de stock. Quand cela se produit, les demandeurs en sont informés. Eventuellement, ils sont aussi informés de l'existance d'un matériau de remplacement. (voir ci-après "Commandes"). Dès que le lot de renouvellement est disponible, les clients ayant demandé soit le lot antérieur, soit le nouveau, sont rapidement avertis.

Les SRM's de renouvellement ne sont ordinairement pas identiques aux précedénts, mais présentent une grande similitude, en particulier quant aux caractéristiques certifiées. En règle générale, le lot de renouvellement peut être utilizé à la place du précédent. Par exemple, quant le premier acier Bessemer a 0,1 % de carbone a été préparé en 1909, il a été désigné sous le nom de "Standard Sample No. 8". Les années suivantes, on a préparé un certain nombre de lots de renouvellement, 8a, 8b, etc. . . L'actuel SRM 8j, Bessemer Steel (simulé) à 0,1 % de carbone, représente le dixième lot de renouvellement de ce matériau. Alors que ces lots diffèrent quelque peu dans l'analyse détaillée des teneurs, par contre, ils contiennent tous des teneurs relativement élevées en phosphore, soufre et azote, et un faible taux de métaux alliés caractéristique de ce type de matériau.

Une fois le stock épuisé, il devient impossible de fournir les numéros antérieurs à une série de renouvellement. Si la demande pour un matériau est moindre, ou bien si une source équivalente divient disponible, sa production peut être définitivement interrompue.

Commandes

Les commandes doivent être adressées a:

Office of Standard Reference Materials
Room B311, Chemistry Building
National Bureau of Standards
Washington, D.C. 20234
Telephone: (301) 921-2045

Les commandes doivent mentionner la quantité (nombre d'unités), la référence figurant au catalogue et le nom du matériau demandé. Par exemple:

1 each, No. 11h, Basic-Open-Hearth Steel, 0,2 % C.

Les matériaux décrits dans le catalogue sont distribués seulement dans la quantité unitaire précisée ou des multiples de celle-ci.

L'acceptation d'une commande n'implique pas l'acceptation de quelque condition qui serait contraire aux principes, pratiques ou réglementations du National Bureau of Standards ou du Gouvernement des Etats-Unis.

Les commandes reçues pour des matériaux "en rupture de stock" sont annulées quant elles ne portent que sur des articles épuisés. Pour les autres commandes l'expédition des matériaux disponibles est effectuée, et les commandes d'articles épuisés sont annulées. Les rappels de commande ne sont pas acceptés pour les matériaux de rupture de stock. Si un lot de renouvellement du matériau est disponible, il sera automatiquement fourni.

Les prix mentionnés sont en dollars U.S. et sont publiés dans le tarif joint à ce catalogue. Quand de nouveaux tarifs sont appliqués, ils sont envoyés aux utilisateurs qui ont effectué des achats dans les douze mois précédents, et aux personnes ou organisations qui en font la demande. Ces prix sont sujets à révision sans avis préalable, et les commandes sont facturées aux prix en vigueur à la date d'expédition. Il n'est consenti aucune remise sur l'achat de SRM's, RM's, ou GM's.

Il n'est pas nécessaire de joindre a une commande ferme le montant du réglement correspondant à l'achat. Les factures doivent être réglées dans un délai de 30 jours à compter du reçu de la facture. Le paiement des commandes en provenance de l'étranger doit être effectué en dollars U.S., selon l'une des modalités suivantes:

a) Coupons UNESCO
b) Tirage d'un effet sur une banque des Etats-Unis.
c) Transfert bancaire à une banque des Etats-Unis.
d) Lettre de crédit sur une banque des Etats-Unis (voir ci-aprés).
e) Mandat international.

La fourniture de factures pro-forma demande un delai de 6 à 8 semaines; ce service n'est assuré que sur demande.

Nota: Les lettres de crédit peuvent être utilisées pour payer à l'avance des SRM's. Elles seront acceptées seulement en provenance d'une banque des Etats-Unis. Ci-dessous sont énumérés les seuls documents qui pourront être fournis:

1) Six factures commerciales.
2) Liste des colis
3) Certificat d'origine
4) Taxe de transport aérienne (document qui ne peut être fourni que si l'acheteur paye les frais de transport; s'il est expedié affranchi en paquet poste aérien international, ce type de reçu ne pourra être fourni).

Expéditions: Régime intérieur

L'expédition de matériaux (sauf pour certains types de matériaux réglementés) à destination des Etats-Unis et du Canada est effectuée au taux d'affranchissement normal (à condition que le paquet ne dépasse pas le poids limite autorisé par les lois et réglements postaux). Cependant, si l'acheteur demande un autre mode d'expédition, elle sera effectuée au compte de l'acheteur. Pour les produits expédiés ainsi, le NBS ne peut payer les taxes de port et les ajouter ensuite à la facture. Les types de matériaux réglementés, tels que hydrocarbures, composés organo-soufrés, gaz comprimés, caoutchoucs, matériaux à base caoutchouc, sources radioactives étalons, et autres matériaux similaires, sont expédiés franco à bord (FOB) de Gaithersburg, Md.

Expéditions: Régime international

Les réglementations de nombreux pays pour l'importation de SRM's, RM's et GM's comportent de grandes différences; toute tentative d'énumérer toutes les possibilités s'avèrerait impossible. Aussi, quand les modes d'expédition dont nous donnons un aperçu ci-dessous ne sont pas applicables, les acheteurs sont informés du mode d'expédition adéquat vers leur pays.

La plupart des commandes sont expédiées affranchies en paquet poste aérien international, exceptions faites des types de matériaux réglementés et des envois excédant le poids limite postal autorizé. Les envois se

rapportant à ces exceptions seront expédiés FOB Gaithersburg, Md, àmoins qu'il ne soit nécessaire d'avoir recours à un agent établi aux Etats-Unis (firme de courtage, d'import-export). Dans ce dernier cas, l'acheteur en est averti et devra désigner un agent de son choix. Le matériau sera alors conditionné pour être expédié outre-mer et sera envoyé à l'agent FOB Gaithersburg, Md.

Nota: Les commandes ou demandes de renseignements écrites en anglais seront plus vite traitées que celles nécessitant une traduction.

National Bureau of Standards

Katalog für Bezugs-Standards verschiedener Materialien, Ausgabe 1981-83

In diesem Katalog sind alle vom National Bureau of Standards sofort oder in nächster Zeit lieferbaren Bezugs-Standard Materialien (Standard Reference Materials, SRM's), Versuchs-Materialien (Research Materials, RM's) und Spezial-Materialien (Special Reference Materials, GM's) aufgeführt. Sie werden im einzelnen hinsichtlich ihrer garantierten Eigenschaften, der Menge pro Einheit und des Typs beschrieben. Ausserdem werden Hinweise für die Aufgabe von Bestellungen gegeben. Die Preise sind in getrennt zu diesem Katalog erscheinenden Ergänzungslisten enthalten, die jährlich neu herausgegeben werden.

Stichworte: Analysis (Analyse)—Certification (Attest)—Characterization (Kennzeihnung)—Composition (Zusammensetzung)—Research Materials (Versuch-Materials)—Special Reference Materials (Spezial-Materials)—Standards Reference Materials (Standards Bezugs Materials)

Einleitung

Das Bezugs-Standards-Programm des National Bureau of Standards umfasst über 1000 verschiedene Materialien. In der Hauptsache sind es Standard-Materialien (SRM's) deren chemische Zusammensetzung, sowie chemische oder physikalische Eigenschaften bescheinigt werden. Aber auch Versuch-Materialien (RM's) und Spezial-Materialien (GM's) gehören dazu. Alle SRM's, RM's und GM's tragen kennzeichenende Namen und Nummern, mit denen sie jederzeit identifizierbar sind. Somit ist jedes mit einer bestimmten Bezeichnung versehenes SRM, RM oder GM in den geforderten oder vorgesehenen Grenzen mit jeder anderen Probe gleicher Bezeichnung identisch, ausgenommen individuell garantiere Materialien, die zudem durch eine Seriennummer unterschieden werden.

Die ersten vom National Bureau of Standard gelieferten Materialien hiessen Standard-Proben und bestanden aus einer Gruppe von Erzen, Eisenwerkstoffen und Stählen, deren chemische Zusammensetzung bescheinigt wurde. Seit Mitte der 60er Jahre werden diese Materialien als Bezugs-Standard-Proben geliefert und umfassen ein breites Spektrum chemischer und physikalischer Eigenschaften sowie einen ebenso weiten Bereich von Messwerten.

Definitionen

Die Bezeichnungen "SRM", "RM" oder "GM" kennzeichnen die Unterschiede bezüglich der mit den einzelnen Proben verbundenen Art der Information und Anwendungsmöglichkeiten.

Standard-Materialien (SRM) werden vom National Bureau of Standards durch bestimmte chemische oder physikalische Eigenschaften gekennzeichnet und mit einem Zertifikat geliefert, in dem die kennzeichnenden Daten aufgeführt sind. Diese Daten werden über einen von drei für die Kennzeichnung festgelegten Wegen ermittelt, und zwar durch Messung der Eigenschaften mittels:

1. eines zuvor bestätigten Referenz-Verfahrens;
2. zweier oder mehrerer voneinander unabhängiger Messmethoden;
3. einer ad hoc Gruppe kooperierender Laboratorien, die technisch dazu in der Lage sind und gründliche Kenntnisse über das zu unterzuchende Material besitzen.

Diese Wege werden im einzelnen in "The Role of Standard Reference Materials in Measurement Sys-

tems" NBS Special Publication 148 (1975) beschrieben. Standard-Materialien (SRM's) werden als genau gekennzeichnete und garantierte Materialien definiert, die zur Verbesserung der Messtechnik in entsprechenden Mengen hergestellt werden. Drei Hauptzwecke sind es, für die sie hergestellt und eingesetzt werden:

—Die Entwicklung genauer Analysenmethoden (Referenz-Methoden) zu unterstützen.
—Zur Eichung von Mess-systemen, die dazu dienen
  a) den Warenaustausch zu erleichtern,
  b) die Grundlage für eine Qualitätskontrolle zu bilden,
  c) Leistungsfähigkeit, Wirkingsweise oder Gebrauchswert festzulegen, oder
  d) bestimmte Eigenschaften an der Grenze des Entwicklungsstandes zu messen.
—Zur langfristigen Sicherung der Angemessenheit und Integrität von Qualitäts-Prüfverfahren.

Damit tragen die SRM's dazu bei, die Vergleichbarkeit und Genauigheit von Messungen unter den verschiedensten Aspekten des täglichen Lebens—von der Wissenschaft und Technologie bis zu Handel und Wirtschaft—sicherzustellen.

Versuch-Materialien (RM). Anders als bei den SRM's werden hierfür keine Zertifikate erstellt. An deren Stelle tritt ein "Report of Investigation" (Untersuchungsbericht), der unter der ausschliesslichen Verantwortung des ihn erstellenden Mitgliedes des National Bureau of Standards steht. Ein RM soll in erster Linie der Unterstützung der wissenschaftlichen oder technischen Forschung für dieses Material dienen. Hauptgrund für die Ausgabe eines RM ist die Lieferung eines homogenen Materials, das den Forschern in den verschiedenen Laboratorien die Gewähr dafür geben soll, dass sie auch dasselbe Material untersuchen.

Spezial-Materialien (GM). Diese unterscheiden sich von den SRM's und RM's dadurch dass das National Bureau of Standards bei der Festlegung der Kennzeichen für dieses Material nicht mitwirkt. GM's sind Bezungs-Materialien, die von anderen Regierungsstellen, Normen-Ausschüssen oder anderen gemeinnützigen Organisationen hergestellt, beglaubigt oder garantiert werden. Wenn ein öffentliches Interesse an diesen Materialien besteht oder wenn keine entsprechenden Wege der Verteilung im Lande gegeben sind, übernimmt das National Bureau of Standards deren Vertrieb. Dieser Service ist allen Organisation zugänglich, die entsprechend qualifiziert sind und im Besitz von Referenz-Materialien sind, die dazu beitragen könnten, ein nationales Messproblem zu lösen.

SRM-Katalog

Das National Bureau of Standards veröffentlicht etwa alle drei Jahre neue Kataloge mit den von ihm erhältlichen Standard-Bezugs-Materialien, in denen neue zur Verfügung stehende Materialien sowie solche, die sich in Vorbereitung befinden, aufgeführt sind und auch Angaben über nicht weiter lieferbare Proben enthalten sind. Um aber auch in der Zwischenzeit den Katalog auf dem laufenden zu halten, werden alljährlich Ergänzungen herausgegeben. Sie enthalten die jeweils gültigen Preise, neue Materialien, ausgelaufene Materialien (ggf. mit Ersatzvorschlägen) und revidierte Zertifikate.

Die in diesem Katalog aufgeführten Materialien sind in verschieden Hauptgruppen unterteilt: Chemical Composition Standards (Standards für die chemische Zusammensetzung), Physical Property Standards (Standards für physikalische Eigenschaften), Engineering Type Standards (Technische Standards), Research Materials (Versuchs-Materialien) und Special Reference Materials (Spezial-Materialien). Die ersten drei Gruppen umfassen ausschliesslich SRM's und sind in die im Inhaltsverzeichnis aufgeführten Kategorien unterteilt.

Die zur Beschreibung der Material-Eigenschaften im Katalog angegebenen Zahlenwerte sind lediglich Richtwerte und dienen nur als Hinweis bei der Auswahl der Materialien. Sie dürfen nicht anstelle des für das Material ausgegebenen Zertifikats verwendet werden.

Anmerkung: Einige SRM's werden ohne Zertifikat geliefert. Diese Ausnahmen sind sowohl in der SRM-Beschreibung als auch im Zahlen-Index entsprechend gekennzeichnet.

Der Zahlenindex enthält die SRM-, RM- und GM-Nummern aller im Katalog aufgeführten Materialien sowie das Datum des zur Zeit gültigen Zertifikats beziehungsweise eine Begründung, weshalb ein solches nicht vorhanden ist.

Daneben gibt es einen alphabetischen Index. Zum grössten Teil enthält dieser Index die SRM-Gruppen und den Hauptbestandteil oder das Hauptelement des SRM oder zumindest den Namen spezifischer SRM's. RM's und GM's sind lediglich als Gruppen aufgeführt.

Auftragserteilung

Aufträge sind zu richten an

Office of Standard Reference Materials
Room B311, Chemistry Building
National Bureau of Standards
Washington, D.C. 20234
Telephon (301) 921-2045

Die Aufträge müssen enthalten: die gewünschte Menge (Anzahl der Proben), Katalog-Nummer und Bezeichnung des gewünschten Materials. Beispiel: Je eine Nr. 11h, basischer Siemens-Martin-Stahl, 0,2% C. Die im Katalog beschriebenen Materialien werden in den angegebenen Mengen oder entsprechenden Vielfachen davon geliefert.

Die Annahme eines Auftrages ist nicht gleichbedeutend mit der Anerkennung irgendeiner zusätzlich in dem Auftrag enthaltenen Vorschrift, die nicht der Politik, der Praxis oder den Regeln des National Bureau of Standards oder der U.S. Regierung entspricht.

Für nicht mehr am Lager befindliche Materialien eingehende Aufträge werden, wenn darin nur solche Materialien enthalten sind, anulliert. Sind in den Aufträgen auch noch andere Materialien enthalten, werden diese geliefert und nur die nicht am Lager befindlichen gestrichen. Für nicht am Lager befindliche Materialien werden auch keine Aufträge zurückgestellt. Sobald die Neuauflage eines Materials zur Verfügung steht, wird automatisch dieses geliefert.

Herstellung und Lieferbarkeit von Standard-Bezugs-Materialien

Neue oder erneuerte SRM's werden ständig hergestellt. Sobald sie bereit stehen, werden interessierte Anwender direkt über die Lieferbarkeit unterrichtet, und im folgenden Katalog-Nachtrag erfolgt die Beschreibung des SRM's.

Die Uberlegung bezüglich der Neuauflage von SRM's geht davon aus, deren Herstellung bereits in Angriff zu nehmen, bevor die Liefermöglichkeit des bestehenden SRM's erschöpft ist. Manchmal ist dies nicht möglich, und so kann ein SRM vorübergehend vergriffen sein. Wenn dies der Fall ist, werden Besteller dieses Materials darüber informiert und, soweit möglich, auf entsprechenden Ersatz hingewiesen. (Siehe auch unter "Auftragserteilung".) Sobald die Neuauflage zur Verfügung steht, werden alle Kunden, die einen Auftrag auf das frühere oder das neuaufgelegte Material erteilt hatten, sofort benachrichtigt.

Neuaufgelegte SRM's sind gewöhnlich mit ihren Vorgängern nicht identisch, doch sind sie hinsichtlich der spezifizierten Eigenschaften genau so hervorragend. Grundsätzlich kann die Neuauflage anstelle ihres Vorgängers Verwendung finden. Beispiel: Als der erste 0,1 %ige Bessemer-Kohlestahl im Jahre 1909 hergestellt wurde, erhielt er die Bezeichnung "Standard-Probe Nr. 8". Im Verlauf der folgenden Jahre wurden mehrere Neuauflagen unter der Bezeichnung 8a, 8b usw., hergestellt. Die zur Zeit geltende Nummer für diesen Bessemer-Stahl ist SRM 8j und stellt die zehnte Neuauflage dieses Materials dar. Obwohl jede dieser neuaufgelegten Serien in der genauen Analyses von den anderen etwas abweicht, weisen jedoch alle den relativ hohen Anteil an Phosphor, Schwefel und Stickstoff und einen geringen Gehalt an Legierungsmetall auf, was für diese Art von Material charakteristisch ist.

Wenn das Lager geräumt ist, ist es nicht mehr möglich, vorangegangene Nummern eines neuaufgelegten Materials zu liefern. Besteht nur ein geringer Bedarf oder ist für ein bestimmtes Material eine andere Lieferquelle vorhanden, kann die Produktion durch das National Bureau of Standards für immer eingestellt werden.

Die Priese sind in U.S.-Dollar festgelegt und in der diesem Katalog beigefügten SRM-Preisliste enthalten. Neue SRM-Preislisten werden nach Erscheinen allen Kunden, die in den vorangegangenen 12 Monaten käufe getätigt haben, sowie Personen oder Organisationen, die danach verlangt haben, zugestellt. Die Preise sind unverbindlich und können ohne diesbezügliche Nachricht Änderungen unterliegen. Bei Aufträgen werden stets die im Augenblick der Lieferung gültigen Preise in Rechnung gestellt. Auf SRM's, RM's und GM's werden keinerlei Abzüge gewährt.

Vorauszahlung bei Auftragserteilung ist nicht notwendig. Für die Begleichung einer Rechnung werden 30 Tage Ziel nach Erhalt gewährt. Die Begleichung ausländischer Aufträge muss in U.S.-Dollar erfolgen. Dies kann in folgender Weise geschehen:

a) mit UNESCO-Kupons,
b) durch Scheck einer U. S. Bank,
c) durch Bank-zu-Bank-Uberweisung auf eine U. S. Bank,
d) durch Kreditbrief auf eine U. S. Bank (siehe unten) oder
e) durch internationale Postanweisung.

Die Ausstellung von proforma-Rechnungen erfordert gewöhnlich 6 bis 8 Wochen und wird deshalb nur auf Wunsch vorgenommen.

Anmerkung: Für die Vorauszahlung können Kreditbriefe verwendet werden. Sie werden nur von Banken in den Vereinigten Staaten angenommen.

Folgende Begleitdokumente werden den Sendungen beigefügt:

1. Sechs Waren-Rechnungen
2. Packzettel
3. Ursprungs-Zertifikat
4. Luftfracht-Rechnung (Sie wird nur ausgestellt, wenn das Material gegen Nachnahme versandt wird. Erfolgt der Versand portofrei mit der internationalen Luftpaketpost, können keine Empfangsbestätigungen gegeben werden.)

Inland-Versand

Nach den USA und Canada erfolgt der Versand (einige beschränkte Gruppen ausgenommen) normalerweise portofrei, vorausgesetzt dass das Gewicht des Pakets nicht die postalisch vorgeschriebenen Gewichtsgrenzen überschreitet. Verlangt der Käufer jedoch eine andere Versandart, so erfolgt die Lieferung gegen Nachnahme. Bei Nachnahmesendungen kann das National Bureau of Standards nicht die Portokosten usw. auf der Rechnung vermerken. Bestimmte Gruppen wie Kohlenwaseerstoffe, organische Schwefelverbindungen, komprimierte Gase, Gummi, Gummi-Zusatz-Materialien, radioaktive Standards und ähnliche Materialien werden fob Gaithersburg, Md. (USA) zum Versand gebracht.

Versand ins Ausland

Die Einfuhr-Vorschriften für SRM's, RM's und GM's sind für die einzelnen Länder sehr unterschiedlich. Es wäre zwecklos, alle möglichen Abweichungen hier zusammenzustellen. Deshalb werden die Käufer überall dort, wo die nachfolgenden Versandpraktiken nicht anwendbar sind, über die für ihr Land beste Versandform informiert.

Die meisten Aufträge werden portofrei mit der internationalen Luftpaketpost versandt. Ausgenommen sind Proben der beschränkten Gruppen und Sendungen, die das für Postpakete zulässige Gewicht überschreiten. In diesen Fällen erfolgt der Versand fob Gaithersburg, Md. (USA), es sei denn, ein Vertreter (Transport-oder Makler-Firma) mit sitz in den USA gewünscht wird. Wenn dies der Fall ist, wird der Käufer entsprechend unterrichtet und aufgefordert, einen Vertreter seiner Wahl zu benennen. In diesem Falle wird das Material für den Übersee-Versand verpackt und dem Vertreter fob Gaithersburg, Md. (USA) zugestellt.

Anmerkung: Aufträge und Anfragen in englischer Sprache werden schneller abgewickelt als solche, die erst einer Übersetzung bedürfen.

SAMPLES OF STANDARDIZED IRON AND STEEL

Department of Commerce and Labor
BUREAU OF STANDARDS
Washington

BUREAU CIRCULAR No. 11

February 1, 1906.

Under the provisions of the act of Congress establishing the Bureau of Standards, the Bureau is authorized, among other things, to determine "physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests."

DESCRIPTION OF SAMPLES.

For several years the American Foundrymen's Association has prepared and distributed samples of standardized irons. By an agreement with that association the samples which have been prepared under its direction have been transferred to the Bureau of Standards, and this Bureau will, in the future, have charge of the preparation and distribution of such samples, and will also, as soon as practicable, undertake the preparation and distribution of samples of standardized steels. The samples now ready for distribution are as follows:

Sample A (*iron*).—The analysis of this sample gives total carbon, graphite, and combined carbon. The sample has been ground to pass a 40-mesh sieve to secure greater homogeneity.

Sample B (*iron*).—The analysis of Sample B gives total carbon, graphite, and combined carbon, phosphorus (by three methods), silicon, titanium, total sulphur and sulphur by evolution as hydrogen sulphide, manganese, and copper. The silicon and manganese in this iron are low, and the phosphorus is within the Bessemer limit.

Sample C (*iron*).—The analysis of Sample C gives the same determinations as in Sample B, with the exception of copper. The silicon, phosphorus, and manganese in the iron are medium.

Sample D (*iron*).—The analysis of Sample D gives the same determinations as in Sample C. The silicon, phosphorus, and manganese in the iron are high.

Sample 0.5 (*steel*).—At present only a single sample of steel has been prepared. This is designated Sample 0.5. The analysis of this sample gives total carbon, silicon, total sulphur and sulphur by evolution as hydrogen sulphide, phosphorus (by two methods), and manganese. The sample is an open-hearth steel of about 0.5 per cent carbon, is almost free from silicon, and is low in sulphur. As the sample is not as homogeneous as is desirable, determinations of its carbon and manganese in different parts of the ingot, as well as the average, are given. A better sample will be obtained as soon as possible.

METHODS OF ANALYSIS.

Five independent analyses, made by different individuals, are given for Samples B, C, and D, and three independent analyses for the sample of steel. The methods of analysis used at the Bureau of Standards were, in brief outline, as follows:

Total carbon.—Two grams of the iron were dissolved in 100 cc of a solution of copper potassium chloride containing 300 grams of the salt and 100 cc of concentrated hydrochloric acid per liter. The solution was stirred by a mechanical stirrer. When solution was complete, 5 per cent more of concentrated hydrochloric acid was added and the carbon filtered off on a platinum boat, washed with water and dilute hydrochloric acid, dried

at 100° and burned in a current of oxygen in a porcelain tube, using a ten-burner combustion furnace.

Graphite.—Two grams of iron were dissolved in dilute nitric acid (sp. gr. 1.20), using 35 cc and heating very gently. The residue was filtered off on a platinum boat, washed out with hot water, then with a hot solution of potassium hydroxide (sp. gr. 1.10), followed by dilute hydrochloric acid and finally by hot water. After drying at 100°, the graphite was burned in the same manner as the total carbon.

Combined carbon.—This was obtained by subtracting graphitic carbon from total carbon.

Silicon.—Two grams of iron were dissolved in 30 cc of nitric acid (sp. gr. 1.20) and the solution evaporated to dryness and baked on a hot plate until the ferric nitrate was decomposed. The dish was then cooled and 30 cc of strong hydrochloric acid added to dissolve the ferric oxide. When solution was complete, the acid was evaporated and the residue again baked on the hot plate. Thirty cubic centimeters of strong hydrochloric acid were added and the dish heated until all iron had gone into solution, when hot water was added and the residue filtered off and washed with hot water and dilute hydrochloric acid. The filter and contents were then placed in a platinum crucible and the filter paper and graphite burned off and the residue strongly ignited over the blast. After weighing, the silica was volatilized with hydrofluoric acid with the addition of a little sulphuric acid, and the residue ignited. The difference between the two weights was called "silica," and the silicon calculated therefrom.

Titanium.—Titanium was determined by treating 5 grams of iron with 40 cc of hydrochloric acid (1 : 1) and heating until all iron had gone into solution. Dissolving in this manner it was found that all but a negligible quantity of titanium remained in the insoluble residue. The filtrate was tested for titanium by extracting the iron with ether after oxidation with a small amount of nitric acid, using the method of Rothe (Stahl und Eisen, **12**, 1052 (1892), and **13**, 333 (1893),) and adding hydrogen peroxide to the extracted solution, after expelling the ether and oxidizing with nitric acid. In all cases only a faint coloration was obtained. The insoluble residue was filtered off and washed with hot water, and the filter paper and carbonaceous matter were burned. The residue in the crucible was treated with hydrofluoric acid and a little sulphuric acid, and all silicon volatilized. The residue was fused with sodium carbonate, treated with water and acidified with sulphuric acid. A sufficient amount of ferric alum was added to the standard titanium solution to give the same tint as the sample when they were at the same dilution, for it was found that the residue from the silica always contained a little iron along with the titanium. Hydrogen peroxide was added to the solution and standard and the comparison made in a Wolff colorimeter.

Phosphorus.—Two grams of iron were dissolved in nitric acid (sp. gr. 1.133) and boiled until yellow fumes no longer came off. Ten cubic centimeters of a permanganate solution (15 grams to 1 liter) were added, and the boiling continued. Sodium sulphite solution was added to dissolve the oxide of manganese, and the solution again boiled and filtered. After cooling, 40 cc of ammonia (sp. gr. 0.96) were added, the solution agitated, and when the temperature was at 40°, 40 cc of molybdate solution (prepared according to Blair's "Chemical Analysis of Iron," 5th ed., p. 97) were added and the solution shaken vigorously for five minutes. After settling out, the yellow precipitate was filtered off and washed with acid ammonium sulphate (prepared according to Blair) until the washings did not react for iron or molybdic acid. The precipitate was treated on the filter with 25 cc of ammonia (5 cc of ammonia sp. gr. 0.90 to 20 cc of water). The filter was washed out with water and 10 cc of strong sulphuric acid added to the filtrate, which was then run through the reductor and titrated against a permanganate solution containing about 2 grams to the liter. A blank was always run with the reductor before each

titration, using the same quantities of ammonia and sulphuric acid. The insoluble residue was always tested for phosphorus.

Sulphur, gravimetric.--Five grains of iron were dissolved in a 400 cc Erlenmeyer flask, using 50 cc of strong nitric acid. A little sodium carbonate was then added, the solution evaporated to dryness, and the residue baked for an hour on the hot plate. The residue was dissolved in 30 cc of strong hydrochloric acid and the solution again evaporated to dryness and baked. Thirty cubic centimeters of strong hydrochloric acid were then added, and, after the iron had dissolved, the solution was evaporated to sirupy consistency and from 2 to 4 cc of strong hydrochloric acid added. When all iron was in solution, between 30 and 40 cc of hot water were added, and the solution was filtered and the residue washed with hot water. The sulphur was precipitated in the cold solution with 10 cc of a 10 per cent solution of barium chloride. The precipitate was filtered off after standing for twenty-four hours. The insoluble residue was ignited, fused with sodium carbonate and nitrate, extracted with water, acidified with hydrochloric acid, evaporated to dryness, extracted with water and a few drops of hydrochloric acid, and the solution precipitated with barium chloride, the sulphur obtained in this way being added to that from the main filtrate. All evaporations were carried on over electrically heated hot plates to avoid sulphur from gas flames, and careful blank determinations were made with all reagents.

Sulphur evolved as hydrogen sulphide.—Five grams of iron were dissolved in 60 cc of hydrochloric acid (1 : 1) in the usual evolution apparatus, the air of which had been previously displaced by hydrogen. The hydrogen sulphide evolved was absorbed in a solution of sodium hydroxide (sp. gr. 1.1). The solutions in the absorbing vessels were poured into a beaker and diluted to about 500 cc, acidified with hydrochloric acid, a little potassium iodide added, and titrated with a standard iodine solution, using freshly prepared starch solution as an indicator. Blanks were always made. The iodine solution was standardized against anhydrous sodium thiosulphate (prepared according to Young, J. Am. Chem. Soc., **26**, 1028 (1904).)

Manganese.—Two grams of iron were dissolved in 30 cc of nitric acid (sp. gr. 1.20), and after filtration the solution was evaporated to about 15 cc. Two grams of potassium chlorate were added and the boiling continued for fifteen minutes; 10 cc more of strong nitric acid were then added, with 1 gram of potassium chlorate, and the solution boiled ten minutes longer. The precipitated manganese was filtered on asbestos, washed with strong nitric acid till free from iron, and then washed with water till free from acid. The asbestos pad holding the manganese was transferred to a flask and shaken up with 25 cc of a solution of ammonium ferrous sulphate containing 5 per cent sulphuric acid, and when solution of the manganese was completed the excess of ferrous iron was determined by titration with a permanganate solution.

Manganese was also determined as follows: Two grams of iron were dissolved in 30 cc of nitric acid (sp. gr. 1.20). When solution was complete, the solution was nearly neutralized with sodium carbonate, and zinc oxide emulsion added. After standing a few minutes, an excess of zinc oxide was added, and the solution made up to a definite volume and one-half or three-fifths filtered off through a dry filter and diluted to about 200 cc. To this were added 20 cc of sodium acetate solution (30 grams crystalized sodium acetate, 30 cc of 30 per cent acetic acid, 170 cc of water) and 40 cc of bromine water. The solution was warmed gently until all manganese had separated. The precipitate was filtered, washed, dissolved, and titrated as before.

Copper.—Ten grams of iron were treated with 10 per cent sulphuric acid. All the copper was found in the insoluble residue. This was digested with aqua regia, and excess of ammonia added. The solution was filtered and compared with a standard copper solution treated with the same excess of ammonia.

11—1925

The methods used by the other analysts were as follows: Booth, Garrett, and Blair used the acetate method for gravimetric phosphorus; Bamber's fusion method for gravimetric sulphur; also an evolution method, absorbing hydrogen sulphide in an alkaline solution of a lead salt, with fusion of the residue; the nitric acid and potassium chlorate separation, with weighing as manganese pyrophosphate, for manganese, and Drown's method for silicon.

Andrew S. McGreath used for silicon both Drown's method and the method of fusion of the residue from the nitric acid solution for phosphorus with sodium carbonate, evaporating the solution of the fusion with hydrochloric acid. He determined sulphur by solution in nitric acid, conversion of this to a chloride solution and precipitation by barium chloride in a small volume. For phosphorus both the acetate and molybdate methods were used, and for manganese the chlorate method.

Cremer and Bicknell used the molybdate separation for phosphorus, weighing as pyrophosphate; oxidation with nitrohydrochloric and precipitation in the ferric chloride solution for sulphur, and the acetate separation and weighing as Mn_3O_4 for manganese.

Albert W. Smith used the molybdate separation for phosphorus, weighing as magnesium pyrophosphate; oxidation with nitrohydrochloric acid and precipitation in the ferric chloride solution for sulphur; the acetate separation and weighing as manganese pyrophosphate for manganese, and Drown's method for silicon.

In all cases the total carbon was determined by solution in copper-potassium chloride solution and combustion of the residue, and the graphite by solution in dilute acid and combustion.

USE OF THE SAMPLES.

Great pains have been taken to make the contents of all the bottles uniform, and the agreement of the analyses indicates that these efforts have been successful. In shipping, however, the fine and coarse particles in the bottles become segregated *so that it is of the greatest importance that the contents of each bottle be thoroughly mixed again before any is used for analysis.* Each bottle will be labeled with its letter only, but gummed labels containing the average of the analyses by the different chemists will be furnished with each sample, and also certificates giving the complete analysis of each chemist, as it is believed that many will desire to know how close an agreement has been secured in these analyses.

FEES.

The following schedule of fees has been adopted for samples of the same or different irons or steels:

SCHEDULE 101.—*Samples of Standardized Iron and Steel.*

(*a*) Single samples, of 150 grams, each	$2.00
(*b*) Three to nine samples, each	1.67
(*c*) Ten to nineteen samples, each	1.50
(*d*) Twenty samples or more, each	1.25

Orders for samples should be accompanied by a remittance, which may be by check, draft, or post-office order, and should be made payable to the Bureau of Standards.

S. W. STRATTON,
Director.

Approved:

V. H. METCALF,
Secretary.

11—1925

Steels (Chip Form)

These SRM's were prepared for the steel industry primarily for use with methods involving sample solutions in checking chemical methods of analysis for both production control and customer acceptance. These SRM's consist of nominal composition steel alloys selected to provide a wide range of analytical values for various elements of vital concern to the chemist. They are furnished in 150-gram units (unless otherwise noted) as chips usually sized between 0.4 to 1.2 mm, prepared from selected portions of commercial ingots.

Plain Carbon Steels

SRM	Type	Chemical Composition (Nominal Weight Percent)					
		C	Mn	P	S		Si
					Grav	Comb	
8j	Bessemer (simulated), 0.1C	0.081	0.505	0.095	.....	0.077	0.058
11h	BOH, 0.2C	.200	.510	.010	.....	.026	.21$_1$
12h	BOH, 0.4C	.407	.842	.018	.....	.027	.235
13g	BOH, 0.6C	.61	.85	.006	.....	.031	.35$_5$
14e	BOH, 0.8C	.753	.404	.008	.....	.039	.177
15g	BOH, 0.1C	.094	.485	.005	.....	.026	.095
16e	BOH, 1.1C	1.09	.381	.028	.....	.029	.20$_2$
19g	AOH, 0.2C	0.223	.554	.046	0.032	.033	.186
20g	AISI 1045	.462	.665	.012	.....	.028	.305
152a	BOH, 0.5C (Tin bearing)	.486	.717	.012	.....	.030	.202
178	Basic Oxygen 0.4C	.395	.824	.012	.....	.014	.163
335	BOH, 0.1C (Carbon only) 300 g	.092	.....	.....	.....	.....	.....
337	BOH, 1.1C (Carbon only) 300 g	1.07	.....	.....	.....	.....	.....
368	AISI 1211	0.089	.82	.084	.....	.132	.007

SRM	Cu	Ni	Cr	V	Mo	Co	Ti	Sn	Al (total)	N	Other
8j	0.020	0.113	0.047	0.015	0.038	.....	.....	.....	.....	.....	.....
11h	.061	.028	.025	.001	.....	.....	0.004	.....	.....	.....	.....
12h	.073	.032	.074	.003	.006	.....	.....	.....	(0.038)	0.006	.....
13g	.066	.061	.050	.001	.....	.....	.....	.....	.04$_8$	.....	.....
14e	.072	.053	.071	.002	.013	.....	.....	.....	.060	.....	.....
15g	.036	.017	.028	.001	.....	.....	.....	.....	.....	.....	.....
16e	.052	.072	.118	.002	.....	.....	.....	.....	.....	.....	.....
19g	.093	.066	.374	.012	.013	0.012	.027	0.008	.031	.....	Nb 0.026
20g	.034	.034	.036	.002	.008	.....	.....	.....	.040	.....	.....
152a	.023	.056	.046	.001	.036	.....	.....	.032	.....	.....	.....
178	.032	.010	.016	.001	.003	.....	.....	.....	.....	.....	.....
335	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
337	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
368	.010	.008	.030	.001	.003	.....	.....	.....	.....	.010	.....

SRM	Type	Chemical Composition (Nominal Weight Percent)								
		(Other Forms)	C	Mn	P	S		Si	Cu	Ni
						Gray	Comb			
30f	Cr-V (SAE 6150)		0.490	0.79	0.011		0.009	0.243	0.074	0.070
32e	Ni-Cr (SAE 3140)		.409	.798	.008	0.022	.021	.278	.127	1.19
33d	Ni-Mo (SAE 4820)		.173	.537	.006	.010	.011	.253	.123	3.58
36b	Cr2-Mol		.114	.404	.007		.019	.258	.179	0.203
72g	Cr-Mo (SAE X4130) IN PREP.									
100b	Manganese (SAE T1340)		.397	1.89	.023	.029	.028	.210	.064	.030
105	High-Sulfur 0.2C (Carbon only).		.193				(.60)			
106b	Cr-Mo-A1 (Nitralloy G)		.326	0.506	.008	.016	.017	.274	.117	.217
125b	High-Silicon	1134	.028	.278	.029		.008	2.89	.071	.038
129c	High-Sulfur		.125	.769	.076		.245	0.020	.013	.251
131c	Low Carbon-Silicon (100g)		.0029				.020			
139b	Cr-Ni-Mo (AISI 8640)	1222	.403	.778	.013		.019	.242	.097	.510
155	Cr0.5-W0.5		.905	1.24	.015	.010	.011	.322	.083	.100
179	High-Silicon	1135	.027	0.094	.006		.026	3.19	.056	.050
291	Cr-Mo (ASTM A213)		.177	$.55_0$	.008		.020	0.23_0	.047	.065
293	Cr-Ni-Mo (AISI 8620)		.222	$.96_0$	.018		.022	$.30_0$	.032	$.48_0$
361	AISI 4340	661,1095,1261	.383	.66	.014		.015	.222	.042	2.00
362	AISI 94B17 (Mod)	662,1096,1262	.160	1.04	.041		.038	.39	.50	0.59
363	Cr-V(Mod)	663,1097,1263	.62	1.50	$.02_9$		.009	.74	.10	.30
364	High Carbon (Mod)	664,1098,1264	.87	0.25_5	$.01_9$		$.02_9$	$.06_5$	$.24_9$	$.14_4$

SRM	Cr	V	Mo	W	Co	Ti	As	Sn	A1 (total)	Nb	Ta	Zr	N
30f	0.95	0.18											0.010
32e	.678	.002	0.023					(0.011)					0.009
33d	.143	.002	.246										(.011)
36b	2.18	.004	.996										
72g													
100b	0.063	.003	.237										.004
105													
106b	1.18	.003	.199						1.07				
125b	0.019		.008					.003	0.329				
129c	.014	.012	.002										
139b	.488	.004	.182										.007
155	.485	.014	.039	0.517									
179	.022	<.01	.014					.004	.0028				
291	1.33		$.53_9$						.002				
293	0.51_0	.004	$.20_4$						.039				
361	$.69_4$	.011	.19	.017	0.032	0.020	0.017	.010	$.02_1$	0.022	0.020	0.009	(.0037)
362	.30	.040	.068	.20	.30	.084	$.09_2$	.016	$.09_5$	.29	.20	.19	(.00404)
363	1.31	.31	.028	.046	.048	.050	.010	$.10_4$	.24	.049	(.053)	.049	(.0041)
364	0.06_3	$.10_5$	.49	.10	.15	.24	$.05_2$	.008	(.008)	$.15_7$	.11	.068	(.0032)

SRM	B	Pb	Sb	Bi	Ag	Se	Te	Ce	La	Nd
361	0.0003_7	(45.6)	0.0042	(0.0004)	0.0004	(0.004)	(0.0006)	0.0040	(0.001)	0.0007_5
362	.0025	$.0004_8$	.013	(.002)	.0011	(.0012)	(.0011)	.0019	(.001)	$.0007_5$
363	$.0007_9$	$.0018_6$	.002	(.0008)	.0037	(.00016)	(.0009)	.0030	(.002)	.0012
364	.0106	$.023_0$	.034	(.0009)	(.00002)	(.00021)	(.0002)	$.0005_7$	(.0002)	$.0001_8$

SRM	Ca	Mg	Zn	Pr	Ge	O	H	Au	Hf	Sr
361	0.0001_0	0.0002_6	(0.0001)	(0.0003)	[0.006]	(0.0009)	(<0.0005)	(<0.00005)	(0.0002)	(<0.0005)
362	$.0002_1$	$.0006_8$	(.0005)	(.0003)	[.002]	(.00107)	(<.0005)	(<.00005)	(.0003)	.....
363	$.0002_2$	$.0006_2$	(.0004)	(.0004)	[.010]	(.00066)	(<.0005)	.0005	(.0005)	.....
364	.00003	.00016	[.001]	(.0001)	[.003]	(.0010)	(<.0005)	.0001	(.0013)	.....

High Alloy Steels

SRM	Type	Chemical Composition (Nominal Weight Percent)						
		C	Mn	P	S		Si	Cu
					Grav	Comb		
126c	High-Nickel (36% Ni)	0.026	0.47	0.004	.....	0.006	0.19	0.040
344	Cr15-Ni7-Mo2-All	.69	.57	.018	.....	.019	.395	.106
345	Cr16-Ni4-Cu3	.048	.224	.018	0.012	.012	.610	3.44
348	Ni26-Cr15 (A286)	.044	1.48	.015	.....	.002	.54	0.22

SRM	Ni	Cr	V	Mo	Co	Ti	Al (Total)	Nb	Ta	B	Fe
126c	36.05	0.06_4	0.001	0.011	0.008	.....	.....	.....	.....	.....	.....
344	7.28	14.95	.040	2.40	.....	0.076	1.16	.....	0.002	.....	.....
345	4.24	16.04	.041	0.122	.089	.....	.....	0.231	.....	.....	.....
348	25.8	14.54	.25	1.3	.....	2.24	0.23	.....	.....	0.0031	53.3

Stainless Steels

SRM	Type	Chemical Composition (Nominal Weight Percent)							
		(Other Forms)	C	Mn	P	S		Si	Cu
						Grav	Comb		
73c	Cr13 (SAE 420)	.....	0.310	0.330	0.018	.....	0.036	0.181	0.080
121d	Cr17-Ni11-Ti0.3 (AISI 321)	1171	.067	1.80	.019	.....	.013	.54	.121
123c	CR17-Ni11-Nb0.6 (AISI 348)	1172	.056	1.7_5	.024	.....	.014	.59	.103
133a	CR13-Mo0.3-S0.3	.....	.120	1.03	.026	0.326	.330	.412	.118
160b	Cr19-Ni12-Mo3	1155	.044	1.64	.020	.....	.018	$.50_9$	.172
166c	Low Carbon (AISI 3162) Carbon Only	.....	.0078	.....	.....	.....	.....	.....	.....
339	Cr17-Ni9-Se0.2 (SAE 303Se)	.....	.052	0.738	.129	.....	.013	.654	.199
367	Cr24-Ni0.3(AISI 446)	1267	.093	.315	.018	.....	.016	.58	.....

SRM	Ni	Cr	V	Mo	Co	Ti	Nb	Ta	Pb	Se	N
73c	0.246	12.82	0.030	0.091							0.037
121d	11.17	17.4$_3$		.165	0.10	0.342					
123c	11.3$_4$	17.4$_6$		.22	.12		0.65	<0.001			
133a	0.241	12.89	.026	.294							.032
160b	12.2$_6$	18.4$_5$	.047	2.38	.10$_1$				0.001		.03$_9$
166c											
339	8.89	17.42	.058	0.248	.096					0.247	
367	0.29	24.19	.08								.168

Tool Steels

SRM	Type	Chemical Composition (Nominal Weight Percent)						
		C	Mn	P	S		Si	Cu
					Grav	Comb		
50c	W18-Cr4-V1	0.719	0.342	0.022	0.010	0.009	0.311	0.079
132b	Mo-W-Cr-V	.86$_5$	.34$_6$	.01$_3$		.005	.18	.08$_7$
134a	Mo8-W2-Cr4-V1	.808	.218	.18	.007	.007	.323	.101
153a	Co8-Mo9-W2-Cr4-V2	.902	.192	.023	.007	.007	.270	.094

SRM	Ni	Cr	V	Mo	W	Co	Sn	As	N
50c	0.069	4.13	1.16	0.082	18.44		0.018	0.022	0.012
132b	.23	4.38	1.84	4.9$_3$	6.2$_8$	0.028			
134a	.088	3.67	1.25	8.35	2.00				
153a	.168	3.72	2.06	8.85	1.76	8.47			.024

Steels (Granular Form)

These granular-form SRM's are prepared by a pre-alloyed powder metallurgical process, which generally includes argon atomization and hydrogen annealing. The materials normally are sized between 0.07 to 0.7 mm to ensure satisfactory homogeneity and are issued in 100-gram units.

SRM	Type	Chemical Composition (Nominal Weight Percent)						
		C	Mn	P	S	Si	Cu	Ni
163	Low Alloy, 1.0 Cr	0.933	0.897	0.007	0.027	0.488	0.087	0.081
101f	Stainless (AISI 304L)	.014	.087	.008	.008	.876	.030	9.96

SRM	Cr	V	Mo	W	Co	N	As	Sb	Ga
163	0.982	.....	0.029	.....	.....	0.007	.....	.....	.....
101f	18.49	0.034	.007	(0.0002)	0.088	.....	(0.003)	(0.0009)	(0.004)

Steels (Solid Form)

Several groups of SRM's have been prepared to meet the basic needs of the steel industry for analytical control primarily by optical emission and x-ray spectroscopic methods of analysis. Both nominal composition and analytical range SRM's are provided for ingot iron, low-alloy steel, stainless steel, tool steel, and specialty steel.

These SRM's are furnished in various forms. The 400 series is intended for optical emission spectroscopic methods of analysis utilizing the "point-to-point" technique. The 600 series is intended for microchemical methods of analysis such as electron probe microanalysis, spark source mass spectrometric analysis, and laser probe analysis. The 800, 1100, and 1200 series are intended for "point-to-plane" optical emission spectroscopic methods of analysis. The D800 series, and the 1100 and 1200 series also are intended for x-ray spectroscopic methods of analysis.

Because of the special homogeneity requirements, most of these materials have been prepared by using the most modern techniques of melting, casting, fabrication, and heat treatment to ensure adequate uniformity of composition.

NOTE: Values in parentheses are not certified as they are based on the results from a single laboratory. Values in brackets are not certified but are nominal values obtained from heat analyses. These values are given for additional information on the chemical composition.

Nominal Sizes for Solid Steel SRM's

400 Series:	5.5 mm (7/32 in) diameter, 102 mm (4 in) long
600 Series:	3.2 mm (1/8 in) diameter, 51 mm (2 in) long
800 Series:	13 mm (1/2 in) diameter, 51 mm (2 in) long
D800 Series:	31 mm (1 1/4 in) diameter, 6.4 mm (1/4 in) thick
1100 and 1200 Series:	31 mm (1 1/4 in) diameter, 19 mm (3/4 in) thick

Ingot Iron and Low-Alloy Steels

The preparation of these original spectroscopic SRM's began in about 1944 when the cores remaining after lathe cutting the materials for chip form standards were tested for homogeneity. Those found satisfactory were fabricated to the final shapes and sizes. To meet the urgent need in the mid-1950's for calibration standards for x-ray spectroscopic methods of analysis, portions of the material from five of these SRM's were converted to the applicable disk form. Although entirely satisfactory for conventional spectroscopic methods of analysis, these SRM's generally do not meet the stringent requirements for homogeneity necessary for use with the newer microchemical methods of analysis. These standards will be discontinued when the supply is exhausted.

	SRM		Type	Chemical Composition (Nominal Weight Percent)									
				Mn	Si	Cu	Ni	Cr	V	Mo	Sn	Al (Total)	Other
.....	803a	D803a	Acid Open Hearth, 0.6C	1.04	0.34	0.096	0.190	0.101	0.005	0.033	.....	.....	.....
404a	804a	.....	Basic Electric	0.88	.44	.050	.040	.025	.002	.007	.....	.....	.....
405a	805a	.....	Medium Manganese	1.90	.27	.032	.065	0.37	.....	.005	.....	0.056	.....
407a	807a	D807a	Chromium-Vanadium	0.76	.29	.132	.169	.92	.146	.....	.....	.....	.....
408a	808a	.....	Chromium-Nickel	.76	.28	.10	1.20	.655	.002	.065	.....	.....	.....
409b	809b	.....	Nickel	.46	.27	.104	3.29	.072	.002	.009	0.012	.....	Co 0.025
413	.....	.....	Acid Open Hearth, 0.4C	.67	.22	.25	0.18	.055	.007	.006	.....	.....	.....
414	.....	.....	Cr-Mo (SAE 4140)	.67	.26	.11	.080	.99	.003	.32	.014	.020	.....
417a	817a	.....	Basic Open Hearth, 0.4C	.78	.....	.13	.062	.050	.....	.013	.036	.....	.....
418a	.....	.....	Cr-Mo (SAE X4130)	.52	.27	.040	.125	1.02	.....	.21	.....	.....	.....
420a	820a	.....	Ingot Iron	.017	.....	.027	.0092	0.0032	.....	.0013	.0017	.003	Co .006
.....	821	.....	Cr-W, 0.9C	1.24	.....	.080	.10	.49	.012	.040	.....	.....	W .52
427	827	.....	Cr-Mo (SAE 4150) (B only)	.....	.....	.....	.....	.....	.....	.....	.....	.....	B .0027

Special Ingot Irons and Low-Alloy Steels

The planning of the 1100 series SRM's began in late 1952 to meet critical requirements of calibration in the iron and steel industry. Steel for these SRM's was prepared by the most modern melting, casting, and fabrication techniques to provide large quantities of material of the highest possible homogeneity. The materials were fully characterized and included investigations by means of electron probe microanalysis and quantitative metallographic techniques. It was concluded that, for example, SRM's 461 and 463 are sufficiently homogeneous that any present microanalytical technique can be carried out with little chance of inaccuracy caused by inhomogeneity. Details of the metallographic and homogeneity characterization are given in NBS Miscellaneous Publication 260-3 and 260-10, respectively (see inside back cover for ordering instructions).

The 1200 series replaces the 1100 series which has been exhausted and consists of four low alloy steels and an electrolytic iron containing a graded series of 40 elements. Material from the same melts are available in three other forms: chip form, 361-365, for chemical methods of analysis (page 18); rods, 661-665, 3.2 mm (1/8 in) in diameter and 51 mm (2 in) long for microchemical methods of analysis such as electron probe microanalysis, spark source mass spectrometric analysis, and laser probe analysis (see below); and rods (1095-1099), 6.4 mm (1/4 in) in diameter and 102 mm (4 in) long for determining gases in metals by vacuum fusion and neutron activation methods of analysis (page 41). The preparation of the 1200 series involved a cooperative effort between Industry and NBS, and represents the first application of the "benchmark" concept to SRM's. With thousands of industrial processes requiring analytical control, demands for SRM's far exceeded the NBS production capacity. An ever widening gap between supplies and demands led to a program to produce essential "benchmark" SRM's to serve as calibration points in measurement systems. While other selected low-alloy steel SRM's will be prepared to augment the 1200 series, this series is expected to be the primary "benchmarks," especially for some 25 trace elements that affect the physical properites of steels.

NOTE: Values in parentheses not certified, based on a single analytical method.
Values in brackets not certified, approximate values from the heat analyses.
†From Gasometric Certificates: SRM's 1095 through 1099.
—Not detected, value given is conservative "Upper Limit" of detection by a specific method of analysis.

SRM	Type	Chemical Composition (Nominal Weight Percent)								
		(Other Forms)	C	Mn	P	S	Si	Cu	Ni	Cr
1134	High-Silicon	125b	0.026	0.277	0.028	0.009	2.89	0.070	0.038	0.019
1135	High-Silicon	179	.027	.094	.006	.026	3.19	.056	.050	.022
1136	High-Sulfur	129c	.11_3	.75_5	.066	.22_0	0.018	.014	.27	.014
461	Low Alloy A		.15	.36	.053	(.02)	.047	.34	1.73	.13
462	Low Alloy B		.40	.94	.045	(.02)	.28	.20	0.70	.74
464	Low Alloy D		.54	1.32	.017	(.02)	.48	.094	.13_5	.078
465	Ingot Iron E		.037	0.032	.008	(.01)	.029	.019	.026	.004
466 1166	Ingot Iron F		.065	.11_3	.012	(.01)	.025	.033	.051	.011
467	Low Alloy G		.11	.27_5	.033	(.01)	.26	.067	.088	.036
468	Low Alloy H		.26	.47	.023	(.02)	.075	.26	1.03	.54
1169a	Lead-Bearing		(.1)	(1.0)	(.07)	(.3)	(.01)	(.1)	(0.05)	(.04)
1222	Cr-Ni-Mo (AISI 8640)	139b	.43	0.78	.013	.022	.24	.097	.51	.48
*661 1261a	AISI 4340	361,1095	.39_1	.67	.016	.015	.228	.042	2.00	.69_3
*662 1262a	AISI 94B17 (Mod)	362,1096	.16_1	1.05	.044	.037	.40	.51	0.60	.30
*663 1263a	Cr-V (Mod)	363,1097	.62_6	1.50	.02_9	.005_7	.74	.09_8	.32	1.31
*664 1264a	High Carbon (Mod)	364,1098	.87	.25_8	.010	.025	.067	.25_0	.14_2	0.06_6
*665 1265a	Electrolytic Iron	365,1099	.0067	.0057	.002_5	.0055	.008_0	.0058	.041	.007_2

SRM's 661, 662, 663, 664, and 665 are sold in a set only as SRM 668.

SRM	B	Pb	Ag	Ge	O	N	H
461	0.000_2	(0.003)	(0.001_3)	(0.001_3)	(0.02_9)	(0.00_8)	
462	.000_5	.006	(<.0002)	(.003_6)	(.006)	(.00_8)	
464	.005	.020	(.003_2)	(.001_5)	(.006)	(.00_7)	
465	.000_1	(<.0005)	(.0002_8)	(.003_8)	(.003)	(.00_8)	
466 1166	(.000_2)	(.001_3)	(.0004_8)	(.003_0)	(.005)	(.00_8)	
467	(.000_2)	.000_6	(.004_0)	(.003_0)	(.004)	(.00_4)	
468	.009	(<.0005)	(<.0005)	(.001_6)	(.004)	(.00_6)	
1169a		.29					
1222						(.007)	
*661 1261a	.0005	.00002_5	.0004	[.006]	(.0009)†	(.0037)†	[<0.0005]†
*662 1262a	.0025	.0004_3	.0011	[.002]	(.00107)†	(.00404)†	[<.0005]†
*663 1263a	.0009_1	.0022	(.0037)	[.010]	(.00066)†	(.0041)†	[<.0005]†
*664 1264a	.011	.024	(.00002)	[.003]	(.0010)†	(.0032)†	[<.0005]†
*665 1265a	.00013	.00001_5	(.000002)	(~.0014)	(.0063)†	(~.0011)	(~.0001)†

*SRM's 661, 662, 663, 664, and 665 are sold in a set only as SRM 668.

SRM	V	Mo	W	Co	Ti	As	Sn	Al (Total)	Nb	Ta	Zr
1134		0.008					0.003	0.329			
1145	<0.01	.014					.004	.0028			
1136	.012	.002									
461	.024	.30	0.012	0.26	(0.01)	0.028	.022	.005	0.011	0.002	(<0.005)
462	.058	.080	.053	.11	.037	.046	.066	.02_3	.096	.036	.063
464	.29_5	.029	.022	.02_8	.004	.018	.043	.005	.037	.069	.010
465	.002	.005	(.001)	.008	.20	.010	.001	.19	(.001)	.001	(.002)
466 1166	.007	.011	(.006)	.04_6	.057	.014	.005	.01_5	.005	.002	(<.005)
467	.041	.021	.20	.07_4	.26	.14	.10	.16	.29	.23	.094
468	.17	.20	.077	.16	.011	.008	.009	.04_2	.006	.005	(<.005)
1169a	(.001)	(.02)									

SRM	V	Mo	W	Co	Ti	As	Sn	Al (Total)	Nb	Ta	Zr
1222	.005	.18	.....	(.016)	(.002)	.....	.....	(.038)	(.002)	.....	.....
*661 1261a	.011	.19	.017	.032	.020	.017	.010	$.02_1$	.022	.021	.009
*662 1262a	$.04_1$	$.07_0$	.20	.30	.085	$.09_5$	.016	$.09_5$	.30	.21	.20
*663 1263a	.31	.030	.046	.048	.050	.010	$.10_4$	.24	.049	(.053)	.050
*664 1264a	$.10_6$	.49	$.10_2$	.15	.24	$.05_2$	.008	(.0080)	$.15_7$	.11	.069
*665 1265a	.0006	.0050	(.0004)	$.007_0$	.0006	(.0002)	(.0002)	(.0007)	.....	(<.00005)	(<.00001)

SRM	Sb	Bi	Ca	Mg	Se	Te
1222	.....	.....	.....	.....	.....	.....
*661 1261a	0.0042	0.0004	0.00002_8	0.00018	0.004	0.0006
*662 1262a	$.012_0$	(.002)	.00014	.00062	(.0012)	.0011
*663 1263a	.002	(.0008)	.00013	.00049	(.00016)	.0009
*664 1264a	.034	(.0009)	.00004	.00015	(.00021)	.00018
*665 1265a	−(<.00005)	−(<.00001)	−(<.00001)	−(<.00002)	−(<.00001)	−(<.00001)

SRM	Zn	Au	Ce	Hf	La	Nd	Pr	Fe
*661 1261a	(0.0001)	(<0.00005)	0.0014	(0.0002)	0.0004	0.0002_9	(0.00014)	(95.6)
*662 1262a	(.0005)	(<.00005)	.0015	(.0003)	.0004	$.0006_4$	(.00012)	(95.3)
*663 1263a	(.0004)	.0005	.0014	(.0005)	.0006	$.0006_0$	(.00018)	(94.4)
*664 1264a	[.001]	.0001	$.0002_2$	(.0013)	.00007	.00007	(.00003)	(96.7)
*665 1265a	(<.0001)	−(<.000002)	−(<.000005)	−(<.00002)	−(<.000005)	−(<.000005)	−(<.000005)	(99.9)

*SRM's 661, 662, 663, 664, and 665 are sold in a set only as SRM 668.

Stainless Steel

Three groups of stainless steel SRM's designed primarily for calibration in spectroscopic methods of analysis are available.

Groups I and II have been extensively tested for homogeneity and found satisfactory for application in conventional spectroscopic methods of analysis. Neither group, however, has been tested for microanalytical methods and their use in these applications is not recommended.

Group III are for the "point-to-plane" technique of emission spectoscopy and for x-ray spectroscopy. They were prepared by melting, casting, and fabrication techniques known to produce material of high homogeneity.

(Values in parentheses are not certified, but are given for additional information only.)

GROUP I

SRM	Name	Chemical Composition (Nominal Weight Percent)								
		Mn	Si	Cu	Ni	Cr	V	Mo	W	Co
442	Cr16-Ni10	2.88	(0.09)	0.11	9.9	16.1	0.032	0.12	(0.08)	0.13
443	Cr18.5-Ni9.5	3.38	(.15)	.14	9.4	18.5	.064	.12	(.09)	.12
444	Cr20.5-Ni10	4.62	(.65)	.24	10.1	20.5	.12	.23	(.17)	.22

SRM	Ti	Sn	Nb	Ta	B	Pb	Zr	Zn
442	0.002	0.0035	0.032	(0.0006)	0.0005	0.0017	(0.004)	(0.003)
443	.003	.006	.056	(.0008)	.0012	.0025	.....	(.005)
444	.019	.014	.20	(.004)	.0033	.0037	(.011)	(.004)

GROUP II

	SRM		Name	Chemical Composition (Nominal Weight Percent)					
				Mn	Si	Cu	Ni	Cr	V
445			Cr13-Mo0.9 (Mod. AISI 410)	0.77	0.52	0.065	0.28	13.31	(0.05)
446			Cr18-Ni9 (Mod. AISI 321)	.53	1.19	.19	9.11	18.35	(.03)
447			Cr24-Ni13 (Mod. AISI 309)	.23	0.37	.19	13.26	23.72	(.03)
448			Cr9-Mo0.3 (Mod. AISI 403)	2.13	1.25	.16	0.52	9.09	(.02)
449	849	D849	Cr5.5-Ni6.5	1.63	0.68	.21	6.62	5.48	(.01)
450	850	D850	Cr3-Ni25	.....	.12	.36	24.8	2.99	(.006)

	SRM		Mo	W	Ti	Sn	Nb	Ta
445			0.92	(0.42)	(0.03)	.....	0.11	(0.002)
446			.43	(.04)	(.34)	(0.02)	.60	(.030)
447			.059	(.06)	(.02)	.....	.03	(.002)
448			.33	(.14)	(.23)	(.05)	.49	(.026)
449	849	D849	.15	(.19)	(.11)	(.07)	.31	(.021)
450	850	D850	.....	(.21)	(.05)	(.09)	.05	(.002)

GROUP III

SRM	Name	Chemical Composition (Nominal Weight Percent)								
		Other Forms	C	Mn	P	S	Si	Cu	Ni	Cr
1151a	Cr22-Ni7—IN PREP	.....	.....	.....	.....	.....	.....	.....	.....	.....
C1151	Cr22-Ni7	.....	0.039	2.50	0.017	0.38	0.38	0.418	7.29	22.70
1152a	Cr18-Ni10—IN PREP	.....	.....	.....	.....	.....	.....	.....	.....	.....
C1152	Cr18-Ni10	.....	.148	0.96	.021	.0064	.80	.102	10.88	17.81
1153a	Cr16Ni8—IN PREP	.....	.....	.....	.....	.....	.....	.....	.....	.....
C1153	Cr16-Ni8	.....	.264	.50	.030	.018	1.07	.23	8.77	16.69
1154a	Cr19-Ni12—IN PREP	.....	.....	.....	.....	.....	.....	.....	.....	.....
C1154	Cr19-Ni12	.....	.086	1.42	.06	.053	0.50	.40	12.92	19.06
1155	Cr18-Ni12-Mo2 (AISI 316)	160b	.046	1.63	.020	.018	.50	.169	12.18	18.45
1170b	Selenium-Bearing	.....	(.052)	(0.738)	(.129)	(.013)	(.654)	(.199)	(8.89)	(17.42)
1171	Cr17-Ni11-Ti0.3	121d	.067	1.8$_0$	.018	.01$_3$	.54	.121	11.2	17.4
1172	Cr17-Ni11-Nb0.6	123c	.056	1.7$_6$	.025	.01$_4$	.59	.10$_5$	11.3$_5$	17.4$_0$
1267	AISI 446	367	.093	0.315	.018	.015	.58	.....	0.29	24.24

SRM	V	Mo	Co	Ti	As	Sn	Al	Nb	Ta	B	Pb	Zr
1151a												
C1151	0.037	0.80	0.032								0.0039	
1152a												
C1152	.030	.43	.22								.0047	
1153a												
C1153	.18	.24	.127								.0054	
1154a												
C1154	.135	.07	.38								.0178	
1155	.047	2.38	.101								.001	
1170b	(.058)	(0.248)	(.096)									Se 0.23
1171		$.16_5$	.10	.34								
1172		.22	.12					.65	<.001			
1267	.08											N 0.17

Specialty Steels

SRM's 1156, Maraging Steel, and 1158, High-Nickel Steel (Invar), are designed primarily for use in optical emission and x-ray spectrometric methods of analysis.

SRM 1156 derives its name from the formation of martensite on age hardening. Alloys of this type are used extensively in submarines, missiles, and aircraft.

SRM 1158 has good impact toughness down to −269°C and has an extremely low coefficient of expansion between −253 and 203°C. These properties make this material very useful for cryogenic application. SRM 1158 also serves as a "benchmark" for the production control of ferronickel (40Ni–60Fe) alloys.

SRM	Type	Chemical Composition (Nominal Weight Percent)					
		C	Mn	P	S	Si	Cu
1156	Maraging (Ni 19)	0.023	0.21	0.011	0.012	0.184	0.025
1158	High-Nickel (Ni 36)	.026	.47	.004	.006	.19	.040

SRM	Ni	Cr	Mo	Co	Ti	Al	Zr	B	Ca	V
1156	19.0	0.20	3.1	7.3	0.21	0.047	0.004	0.003	<0.001	
1158	36.0_5	$.06_4$	0.011	0.008						0.001

High-Temperature Alloys (Solid Form)

High-temperature alloy SRM's were prepared to meet the critical needs of industry, particularly the aerospace industry, and government agencies. These SRM's are useful in instrument calibration, primarily for x-ray and optical emission spectroscopic methods of analysis.

SRM	Type	Chemical Composition (Nominal Weight Percent)					
		C	Mn	P	S	Si	Cu
1198	Incoloy 901	(0.048)	(0.49)	(0.006)	(0.002)	(0.38)	(0.012)
1199	L 605	(.14)	1.42	(.005)	.....	.83	.....
1200	S 816	(.40)	1.34	(.015)	.....	.86	.....
1201	Hastelloy X	(.039)	.....	(.008)	.....	(.54)	.....
1206–2	René-41	$.21_7$	0.030	(.004)	.006	$.21_8$	.040
1207–1	Waspaloy(1)	.043	.34	.005	.009	$.47_2$	.026
1207–2	Waspaloy(2)	.083	$.29_5$	.005	.009	$.61_5$	.033
1208–1	Inco 718(1)	.046	$.38_5$	.003	$.01_1$	$.43_4$	$.14_7$
1208–2	Inco 718(2)	.022	$.23_0$	.003	.007	$.08_3$	.077

SRM	Ni	Cr	Mo	Co	Ti	Al	Nb	Ta	Fe	W	B	Zr
1198	40.1	12.9	6.0_6	0.70	2.59	0.24	(<0.02)	.....	36.2	(0.2)	(0.0064)	(0.014)
1199	10.2	19.9	(<0.02)	51.6	(<0.01)	.....	(<.02)	.....	0.6_5	15.4	.....	.....
1200	20.0	19.9	4.0_0	42.0	(.03)	.....	3.1_8	1.08	3.19	3.8_8	.....	.....
1201	45.7	20.7	9.1_8	0.56	(<.01)	.....	(<.02)	.....	23.2	(0.15)	.....	.....
1206–2	53.3	19.7	10.3_0	11.5_5	2.9_4	1.7_4	.....	.....	0.46	.....	.....	.....
1207–1	56.1	18.88	4.50	13.0_5	3.09	1.26	.....	.....	2.22	.....	.....	.....
1207–2	55.7	19.4_4	4.34	13.5_0	2.54	1.3_9	.....	.....	2.09	.....	.....	.....
1208–1	51.9	17.5	3.2_4	0.82	0.46	(0.15)	5.3_8	(0.012)	19.2	.....	.....	.....
1208–2	51.5	17.4	3.13	.76	$(.8_5)$	$(.8_5)$	4.9_8	(.012)	19.8	.....	.....	.....

Tool Steels

SRM			Type	Chemical Composition (Nominal Weight Percent)							
				Mn	Si	Cu	Cr	V	Mo	W	Co
436			Special (Cr6-Mo3-W10)	0.21	0.32	0.075	6.02	0.63	2.80	9.7	.....
437	837	D837	Special (Cr8-Mo2-W3-Co3)	.48	.53	.....	7.79	3.04	1.50	2.8	2.9
438			Mo High Speed (AISI-SAE-M30)	.20	.17	.17	4.66	1.17	8.26	1.7	4.9
439			Mo High Speed (AISI-SAE-M36)	.18	.21	.12	2.72	1.50	4.61	5.7	7.8
440	840	D840	Special W High Speed (Cr2-W13-Co12)	.15	.14	.059	2.12	2.11	0.070	13.0	11.8
441		D841	W High Speed (AISI-SAE-TI)	.27	.16	.072	4.20	1.13	.84	18.5	.....

SRM	Type	C	Mn	P	S	Si	Cu	Ni	Cr	V	Mo	W	Co
1157	Tool (AISI M2)	0.836	0.34	0.011	0.004	0.18	0.088	0.228	4.36	1.82	4.86	6.28	0.028

Steelmaking Alloys

These SRM's provide standards of known chemical composition primarily for checking chemical methods of analysis for the major constituents and for selected minor elements covered by ASTM specifications. They are furnished as fine powders (usually <0.1 mm). These SRM's are finding increased use in calibration with instrumental methods of analysis.

SRM	Type	Chemical Composition (Nominal Weight Percent)							
		Wt/ Unit (grams)	C	Mn	P	S	Si	Cu	Ni
57a	Refined Silicon IN PREP								
58a	Ferrosilicon (73% Si)	75	0.014	0.16	0.009	<0.002	73.20	0.024	0.012
59a	Ferrosilicon (50% Si)	50	.04	.76	.016		48.2	.05	.03
195	Ferrosilicon (75% Si) Hi-Purity	75	.034	.17	.02	<.002	75.3	.047	.032
64c	Ferrochromium (HC)	100	4.68	.16	.020	.067	1.22	.005	.43
196	Ferrochromium (LC)	100	0.035	.28			0.38		
71	Calcium Molybdate	60							
90	Ferrophosphorus	75			26.2				
340	Ferroniobium	100	.060	1.71	0.035		4.39		
68c	Ferromanganese (HC)	100	6.72	80.04	.19	.008	0.225		

SRM	Cr	V	Mo	Ti	Al	Nb	Zr	Ca	Mg	Fe	B	N	Co	As
57a														
58a	0.020	(0.002)	(0.01)	0.051	0.95		0.002			25.22	0.0010		<0.01	
59a	.08				.35			0.04		50.0	.06			
195	.047		(.01)	.037	(.05)		(<.02)			23.6	.001		<.01	
64c	68.00	.15		.02						24.98		0.045	.051	
196	70.87	.12												
71			35.3	.06						1.92				
90														
340				.89		57.51	Ta 3.73							
68c	0.074									12.3				0.021

Cast Irons (Chip Form)

This group of cast iron SRM's is similar to the chip-form steels and was prepared for use in checking chemical methods in the cast iron industry. These SRM's are furnished in 150-g units (unless otherwise noted) and in the form of chips; usually sized between 0.7 to 1.2 mm. They are prepared by lathe cutting of chips with a multiple-tooth cutting tool from thin-wall cylindrical castings especially made for the purpose. Supplied with each SRM is a Certificate of Analysis listing the chemical composition determined at NBS and other laboratories that cooperated in the certification of the SRM's. For SRM 365, Electrolytic Iron, the Certificate provides information on these additional elements: W, Nb, Ag, Zn, Ge, O, H, Ta, Nd, Zr, Sb, Bi, Ca, Mg, Se, Te, Ce, La, Pr, Au, Hf, and Fe.

(Values in parentheses are not certified, but are given for information only.)

SRM	Type	Chemical Composition (Nominal Weight Percent)							
		C		Mn	P	S		Si	Cu
		Total	Graphitic			Grav	Comb		
3d	White (110 g)	2.54	.....	0.40	0.025	.....	0.052	1.31	0.043
4k	Cast	3.2_2	2.6_5	$.82_5$	.149	.....	.043	1.33	$.24_3$
5L	Cast	2.59	1.99	.68	.280	.....	.123	1.83	1.01
6g	Cast	2.85	2.01	1.05	.557	.....	.124	1.05	0.502
7g	Cast (High Phosphorus)	2.69	2.59	0.612	0.794	0.061	0.060	2.41	0.128
82b	Cast (Ni-Cr)	2.85	2.37	.745	.025	.....	.007	2.10	.038
107b	Cast (Ni-Cr-Mo)	2.75	1.87	.510	.058	.067	.067	1.35	.235
115a	Cast (Cu-Ni-Cr)	2.62	1.96	1.00	.086	.064	.065	2.13	5.52
122g	Cast (Car Wheel)	3.43	2.76	0.540	.315	.....	.074	0.517	0.030
341	Ductile	1.81	1.23	.92	.024	.007	.007	2.44	.152
342a	Nodular	1.86	1.38	.275	.018	.....	.006	2.73	.14
365	Electrolytic Iron	0.0068	.....	.0056	.0025	.....	.0056	0.0080	.0058

SRM	Ni	Cr	V	Mo	Co	Ti	As	Sn	Al (total)	Mg	N	Fe
3d	0.025	0.03	(0.002)	(0.007)	.....	(0.003)	.....	.....	.....	.....	.....	.....
4k	.042	.116	.024	.040	.....	(.03)	(.03)	(0.004)	(0.004)	.....	(0.0016)	.....
5L	.086	.15	.036	.020	.....	.05	<.005	.....	.....	.....	.006	.....
6g	.135	.370	.056	.035	.....	.059	.042	.....	.....	.....	.005	.....
7g	.120	.048	.010	.012	.....	.044	.014	.....	.....	.....	.004	.....
82b	1.22	.333	.027	.002	.....	.027	.....	.....	.....	.....	.....	.....
107b	2.12	.560	.008	.750	.....	.016	.....	.....	.....	.....	(.008)	.....
115a	14.49	1.98	.014	.050	.....	.020	.....	.....	.....	.....	.....	.....
122g	0.030	0.050	.038	(.003)	.....	.034	.....	.....	(.003)	.....	.....	.....
341	20.32	1.98	.012	.010	.....	.018	.....	.....	.....	0.068	.....	.....
342a	0.06	0.034	.....	.....	.....	.020	.....	.....	.....	.069	.....	.....
365	.041	$.007_2$	.0006	.0050	0.007_2	.0006	(.0002)	(.0002)	(.0007)	N .001	Pb .00002	99.90

Cast Steels, White Cast Irons, Ductile Irons and Blast Furnace Irons (Solid Form)

These chill-cast SRM's were prepared for use in analytical control of cast steels and cast irons by rapid instrumental methods. Although employed in x-ray spectroscopic analysis, they are particularly useful for calibrating vacuum optical emission spectrometers because they permit the determination of carbon, phosphorus, and sulfur in addition to the metallic elements.

The "benchmark" concept was used in preparing three new white irons (1145, 1146, and 1150) with compositions tailored to provide low, nominal, and high values for elements normally specified in cast iron materials, as well as most malleable, ductile, and grey irons. A concentration range for a number of trace elements of interest was provided to enhance the utility of the standards. The planning, preparation, homogeneity testing, and analysis of these SRM's were done through a cooperative Industry-ASTM-NBS program.

These SRM's are chill-cast sections. Details of the preparation and intended use of the SRM's are given in the NBS Miscellaneous Publication 260–1. (See inside back cover for ordering instructions.)

(Values in parentheses are not certified, but are given for information only.)

SRM	Type	Chemical Composition (Nominal Weight Percent)							
		C	Mn	P	S	Si	Cu	Ni	Cr
1138a	Cast Steel (No. 1)	0.11_8	0.35	0.035	0.056	0.25	0.09	0.10	0.13
1139a	Cast Steel (No. 2)	$.79_0$	.92	.012	.013	.80	.47	.98	2.1_8
1143a	Blast Furnace (1)	4.08	$.29_6$	$.16_4$	.067	1.60	$.13_8$	$.11_6$	0.16_3
1144a	Blast Furnace (2)	4.32	1.23	$.08_4$	.083	0.18_2	$.09_1$	$.06_3$	.029
1145	White Cast Iron	2.85	0.040	.24	.21	.29	.52	.59	.67
1146	White Cast Iron	2.01	1.64	.55	.022	3.68	1.49	3.01	2.56
1150	White Cast Iron	3.48	0.81	.063	.070	1.24	0.092	0.074	0.95

SRM	V	Mo	Ti	As	Al	Te	Co
1138a	0.020_6	0.05	(0.0012)	(<0.005)	(0.067)	.....	.....
1139a	.26	.51	(.004)	(<.005)	(.13)	.....	.....
1143a	.018	(.004)	$.08_7$	(.003)	(.008)	0.01_6	.....
1144a	$.02_5$	(.007)	.32	(.004)	(<.005)	$.02_2$	.....
1145	.11	.48	.017	.....	.....	.....	0.058
1146	.20	1.51	.20	.....	.....	.....	.13
1150	.034	0.074	.045	.....	.....	.....	.014

Nonferrous Alloys (Chip Form)

These SRM's provide materials of known composition for checking the performance of chemical methods of analysis and in calibration with instrumental methods. The aluminum-, magnesium-, and zinc-base alloys are furnished as approximately 0.4 to 1.4 mm chips prepared by cutting thin wall castings or wrought bar stock. Certificates of Analysis provided with these standards give the composition as determined at NBS, and most give values obtained by industrial and other outside laboratories cooperating in certification of the standards.

Aluminum-Base Alloys

SRM	Type	Chemical Composition (Nominal Weight Percent)													
		Wt/ Unit (grams)	Mn	Si	Cu	Ni	Cr	V	Ti	Sn	Ga	Fe	Pb	Mg	Zn
85b	Wrought	75	0.61	0.18	3.99	0.084	0.211	0.006	0.022	.....	0.019	0.24	0.021	1.49	0.030
87a	Al-Si	75	.26	6.24	0.30	.57	.11	<.01	.18	0.05	.02	.61	.10	0.37	.16

Copper-Base Alloys

SRM's 871, 872, 874, 875, 879, and 880 are fine granules produced by a water atomization technique for use primarily in checking chemical methods of analysis. The homogeneity of these materials is exceptionally high, and for certain alloys such as SRM 872, Phosphor Bronze (CDA 544) it is the only form that can readily be prepared to exhibit acceptable homogeneity. For many alloys (for which homogeneity requirements can be met), both granules (or chips) for chemical analysis and solids for optical emission and x-ray fluorescence methods, are desirable.

SRM	Type	Chemical Composition (Nominal Weight Percent)					
		Wt/ Unit (grams)	Cu	Ni	Fe	Zn	Pb
37e	Brass, Sheet	150	69.61	0.53	0.004	27.85	1.00
158a	Bronze, Silicon	150	90.93	.001	1.23	2.08	0.097
184	Bronze, Leaded Tin	150	88.96	.50	.005	2.69	1.44
871	Bronze, Phosphor (CDA 521)	100	91.68	.....	<.001	0.025	.010
872	Bronze, Phosphor (CDA 544)	100	87.36	.....	.003	4.0	4.13
874	Cupro-Nickel, 10% (CDA 706) "High-Purity"	100	88.49	10.18	1.22	0.002	<0.0005
875	Cupro-Nickel, 10% (CDA 706) "Doped"	100	87.83	10.42	1.45	.11	.0092
879	Nickel Silver (CDA 762)	100	57.75	12.11	0.0020	30.04	.002
880	Nickel Silver (CDA 770)	100	54.51	18.13	.004	27.3	.002

SRM	Mn	Sb	Sn	P	Si	Al	Cd	Se
37e	.....	.....	1.00	.....	.....	.....	.....	.....
158a	1.11	.....	0.96	0.026	3.03	0.46	.....	.....
184	.....	.....	6.38	.009	.....	.....	.....	.....
871	.....	.....	.....	.082	.....	.....	.....	.....
872	.....	.....	.....	.26	.....	.....	.....	.....
874	0.0020	<0.001	0.007	.002	(0.0006)	.....	<0.0002	0.00015
875	<.0007	<.001	.009	.0020	(.0008)	.....	.0022	.0004
879	<.001	.....	.....	.....	.....	.....	.....	.....
880	<.001	.....	.....	.....	.....	.....	.....	.....

SRM	Bi	O	C	H	S	As	Mg	Ti
37e	.....	.....	.....	.....	.....	.....	.....	.....
158a	.....	.....	.....	.....	.....	.....	.....	.....
184	.....	.....	.....	.....	.....	.....	.....	.....
871	.....	.....	.....	.....	.....	.....	.....	.....
872	.....	.....	.....	.....	.....	.....	.....	.....
874	<0.0002	(0.06)	(0.0028)	(0.0016)	(0.0011)	(<0.0006)	(0.0002)	(0.0001)
875	.003	(.14)	(.0035)	(.004)	(.0011)	(.0010)	(.0010)	(<.0002)
879	.....	.....	.....	.....	.....	.....	.....	.....
880	.....	.....	.....	.....	.....	.....	.....	.....

Copper "Benchmark" Standards

The copper "benchmark" standards were prepared in a cooperative Industry-ASTM-NBS program and were designed primarily for use in calibration with optical emission methods of analysis. They should also serve in the development of other new or improved trace methods of analysis. Twelve different compositions are to be issued as 25 SRM's. Cu "0" and Cu XI will be issued in chip form only. Cu IV is available only in rod form 6.60 mm in diameter and 103 mm long, but is to be issued later as a water-atomized powder. Cu I, II, III, V, VI, and VII are available both as chips and as rods 6.35 mm in diameter, 103 mm long. Cu VIII, IX, and X will be issued as chill-cast and unidirectionally solidfied blocks 32 mm square and 19 mm thick. Cu VIII-Cu X are phosphorized copper containing a nominal concentration range from about 10 to 500 ppm for the same 20 trace elements contained in the other copper "benchmark" SRM's, plus 5 to 8 additional elements. These SRM's are applicable for x-ray fluorescence methods of analysis and, because of deliberate additions of gold and silver (in ratios of 1 to 4), for calibration of fire assay equipment.

SRM	Type	Chemical Composition (Nominal Parts Per Million By Weight)									
		Wt/ Unit (grams)	Sb	As	Bi	Cr	Co	Fe	Pb	Mn	Cu (Wt %)
393	Unalloyed—Cu "0" IN PREP										
394	Unalloyed—Cu I	50	4.5	2.6	0.35	2.0	0.5	147	26.5	3.7	99.908
395	Unalloyed—Cu II	50	8.0	1.6	.50	6.0	.3	96	3.25	5.3	99.944
396	Unalloyed—Cu III	50	<1	<.2	.07	4.3	.4	143	0.41	7.5	99.955
398	Unalloyed—Cu V	50	7.5	25	2.0	(0.3)	2.8	11.4	9.9	(0.3)	99.98
399	Unalloyed—Cu VI	50	30	47	10.5	(.5)	0.5	20.0	114	(.3)	99.79
400	Unalloyed—Cu VII	50	102	140	24.5	(.5)	.6	41	128	(.2)	99.70
454	Unalloyed—Cu XI		24	46	19		(4)	(50)	66		99.84

SRM	Ni	Se	Ag	S	Te	Sn	Zn	Al	Cd	Au	Mg	O	Si
393													
394	11.7	2.1	50.5	15	0.57	70	405	(<2)	(0.5)	(0.07)	(<1)	(230)	(<2)
395	5.4	0.60	12.2	13	.32	1.5	12.2	(<2)	(.4)	(.13)	(<1)	(435)	(<2)
396	4.2	.50	3.30	9.5	<.1	0.8	5.0	(<2)	(.6)	(<.05)	(<1)	(270)	(<2)
398	7.0	14	20.1	(11)	11	4.8	24	(<2)	(22)	(.1)	(<1)	(30)	(<2)
399	506	(~95)	116.8	(10)	(~50)	(~90)	45	(<2)	(<1)	(4)	(<1)	(950)	(<2)
400	603	(~250)	181	(9)	(~155)	(~200)	114	(<2)	(<1)	(10)	(<1)	(1025)	(<2)
454	(150)	400	286			2.2	7			7.5			

Lead-Base Alloys

SRM	Type	Chemical Composition (Nominal Weight Percent)									
		Wt/ Unit (gram)	(Other Forms)	Cu	Ni	As	Sn	Sb	Bi	Ag	Fe
53e	Bearing Metal (84Pb–10Sb–6Sn)	150	1132	0.054	0.003	0.057	5.84	10.26	0.052		<0.001
127b	Solder (40Sn–60Pb)	150	1131	.011	.012	.01	39.3	0.43	.06	0.001	

Magnesium-Base Alloys

SRM	Type	Chemical Composition (Normal Weight Percent)								
		Wt/Unit (grams)	Mn	Si	Cu	Ni	Al	Pb	Fe	Zn
171	Alloy	100	0.45	0.0118	0.0112	0.0009	2.98	0.0033	0.0018	1.05

Nickel-Base Alloys

SRM	Type	Chemical Composition (Nominal Weight Percent)								
		Wt/ Unit (grams)	C	Mn	P	S	Si	Cu	Ni	Cr
349	Ni57–Cr20	150	0.08	0.43	0.002		0.29	0.006	57.15	19.50
882	Ni66–Cu31–A13	150	.006	.0007		0.0014	.006	31.02	65.25	

SRM	V	Mo	W	Co	Ti	Al	B	Fe	Nb	Ta	Zr
349	0.081	4.04	<0.01	13.95	3.05	1.23	0.0046	0.13	<0.01	<0.01	0.081
882	.....	.....	.....	.....	0.57	2.85	.....	.009	.....	.....	.....

Trace Elements in Nickel-Base Superalloy

The Gas Turbine Panel of the ASTM–ASME–MPG Joint Committee, through recommendation of its Task Force on Trace Elements in Superalloys, prepared a set of three "Tracealloy" materials, which have the same common matrix. These were given to NBS for "definitive analysis" of: Pb, Bi, Se, Te, and Tl; trace elements that vary over the concentration range of interest. These SRM's 897, 898, and 899 are in the form of fine articles.

SRM	Type	Nominal Trace Composition (Parts Per Million by Weight)				
		Pb	Bi	Se	Te	Tl
897	"Tracealloy" A	14.7	(0.53)	9.1	1.05	0.51
898	"Tracealloy" B	3.1	(1.1)	2.00	0.54	2.75
899	"Tracealloy" C	4.9	(0.26)	9.5	5.9	0.252

	Approximate Base Composition (Weight Percent)											
	C	Cr	Co	Ni	W	Nb	Al	Ti	B	Zr	Ta	Hf
897	(0.12)	(12.0)	(8.5)	(Bal)	(1.75)	(0.9)	(2.0)	(2.0)	(0.010)	(0.10)	(1.75)	(1.2)
898	(0.12)	(12.0)	(8.5)	(Bal)	(1.75)	(0.9)	(2.0)	(2.0)	(0.010)	(0.10)	(1.75)	(1.2)
899	(0.12)	(12.0)	(8.5)	(Bal)	(1.75)	(0.9)	(2.0)	(2.0)	(0.010)	(0.10)	(1.75)	(1.2)

Nickel Oxide

The nickel oxide SRM's are available primarily for application in the electronics industry to the analysis of cathode grade nickel. The "Standard Method for Spectrochemical Analysis of Thermionic Nickel Alloys by the Powder-DC Arc Technique," ASTM Designation E129, is based on calibration with these standards. The values given are for the percentage of the element in nickel oxide. Values in parentheses are not certified, but are given for information only.

SRM	Type	Chemical Composition (nominal Weight Percent)									
		Wt/ Unit (grams)	Mn	Si	Cu	Cr	Co	Ti	Al	Fe	Mg
671	Oxide 1	25	0.13	0.047	0.20	0.025	0.31	0.024	0.009	0.39	0.030
672	Oxide 2	25	.095	.11	.018	.003	.55	.009	.004	.079	.020
673	Oxide 3	25	.0037	.006	.002	.0003	.016	.003	.001	.029	.003

SRM	Nominal Trace Composition (Parts Per Million by Weight)											
	Pb	Se	Bi	As	Sn	Sb	Cd	Ga	Ag	Te	Tl	Zn
671	16	2.0	0.07	(59)	(2.7)	(0.4)	(0.7)	(0.8)	(0.5)	(<0.2)	(<0.1)	(160)
672	38	0.40	.3	(74)	(4)	(.5)	(1.7)	(.4)	(.3)	(<.2)	(<.1)	(140)
673	3.5	.2	.06	(0.4)	(<0.5)	(<.05)	(0.05)	(<.1)	(<.1)	(.4)	(<.1)	(1.7)

Selenium

SRM	Type	Chemical Composition (Nominal Parts Per Million)									
		Wt/ Unit (grams)	Mn	S	Cu	Ni	Cr	V	Mo	Co	As	Sn
726	Selenium, Intermediate Purity	450	<0.3	12±3	<1	<0.5	<1	N.D.	<0.3	N.D.	<2	<1

SRM	Al	B	Pb	Bi	Ag	Ca	Mg	Te	Fe	Cl	Ti	Be	Cd	In
726	<1	<1	<1	N.D.	<1	<1	<1	0.3±0.1	1	<0.5	<0.5	N.D.	N.D.	N.D.

N.D.=Not detected at limits of detection of <0.5 ppm.

Tin-Base Alloys

SRM	Type	Chemical Composition (Nominal Weight Percent)									
		Wt/ Unit (grams)	Pb	Sn	Sb	Bi	Cu	Fe	As	Ag	Ni
54d	Bearing Metal	170	0.62	88.57	7.04	0.044	3.62	0.027	0.088	0.0032	0.0027

Titanium-Base Alloys

SRM	Type	Chemical Composition (Nominal Weight Percent)										
		Wt/ Unit (grams)	C	Mn	Si	Cu	V	Mo	Sn	Al	Fe	N
173b	6Al-4V (IN PREP)											
174	4Al-4Mn	100		4.57	0.015					4.27	0.175	0.012
176	5Al-2.5Sn	100	.015	0.0008		.003		.0003	2.47	5.16	.070	.010
650	Unalloyed (IN PREP)											
651	Unalloyed (IN PREP)											
652	Unalloyed (IN PREP)											

Zinc-Base

SRM	Type	Wt/ Unit (grams)	Chemical Composition (Nominal Weight Percent)										
			Mn	Cu	Ni	Sn	Al	Cd	Fe	Pb	Ag	Mg	Ti
94c	Die Casting Alloy.	150	0.014	1.01	0.006	0.006	4.13	0.002	0.018	0.006	.....	0.042	.....
728	Zinc.....	450	.....	0.00057	.....	(.000002)	.....	.00012	.00027	.00111	0.00011	.....	.....

Zirconium-Base

SRM	Type	Chemical Composition (Nominal Parts Per Million)											
		Wt/ Unit (grams)	C	Mn	Si	Cu	Ni	Cr	Ti	Sn (Wt%)	Fe	N	U
360a	Zircaloy-2	100	136	3	51	140	554	1060	27	1.42	1441	43	0.15

Nonferrous Alloys (Solid Form)

These SRM's are designed to fill the basic needs of the nonferrous primary and secondary metals industries for analytical control, primarily with optical emission and x-ray spectroscopic methods. Both nominal chemical composition and analytical range SRM's have been prepared for many of the commercially important nonferrous alloy systems.

Aluminum "Benchmark" Standards

Aluminum "benchmark" standards are being prepared in a cooperative Industry-ASTM-NBS program. Five SRM's in disk form, are intended for use primarily in optical emission and x-ray spectrometric methods of analysis. Selection was made to include (annealed) aluminum alloys, 6011 (Modified) and 7075/ 7078; two large tonnage casting alloys 356 and 380; and a high purity aluminum. These materials will also be available in the form of chips, for checking chemical methods of analysis (See page 31).

SRM	Type	Size	Chemical Composition (Nominal Weight Percent)										
			Si	Fe	Cu	Mn	Cr	Ni	Zn	Mg	Be	Ti	Pb	Sn
1255	Casting (356).....	64mm dia X 19mm thick	7.17	0.15	0.12	0.055	0.013	0.014	0.083	0.35	.....	0.15	0.015	0.018
1256	Casting (A380) (IN PREP).	64mm dia X 19mm thick	9.18	.94	3.51	.35	.055	.37	.96	.063	.....	.077	.10	.10
1257	Pure Aluminum ..	(IN PREP)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1258	Alloy 6011.....	35mm dia X 19mm thick	.78	.079	.84	.48	.0011	.0006	1.03	.98	<0.0001	.....	.....	.....
1259	Alloy 7075.....	35mm dia X 19mm thick	.18	.205	1.60	.079	.173	.063	5.44	2.48	.0025	.....	.....	.....

A number of copper-base alloy SRM's were prepared to provide for analytical control by rapid instrumental methods in the copper industry. These SRM's are for calibration of optical emission and x-ray spectroscopic equipment. Eight groups were prepared in two forms: chill-cast (with "C" prefix) for the producer (blocks, 31 mm square, 19 mm thick), and wrought for the consumer (disks, 31 mm in diameter and 19 mm thick). Both forms have nearly identical chemical compositions. Consequently, when the supply of one form is exhausted, the other is the recommended replacement. For each of the eight principal copper-base alloys, three SRM's were prepared to comprise a "nominal-composition", and both a low- and high-composition standard. To make the cartridge-brass SRM's more widely applicable, a number of trace elements were purposely added and certified. The beryllium copper SRM's are representative of the nominal chemical composition of three Copper and Brass Research Association (CABRA) alloy designations. Values in parentheses are not certified, but are given for information only.

SRM		Type	Chemical Composition (Nominal Weight Percent)								
			Cu	Zn	Pb	Fe	Sn	Ni	Al	Sb	As
.....	C1101	Cartridge Brass B	69.50	30.30	0.05	0.037	0.016	0.013	0.0006	0.012	0.009
1102	.....	Cartridge Brass C	72.85	27.10	.020	.011	.006	.005	.0007	.005	.004
1103	.....	Free-Cutting Brass A	59.23	35.7	3.73	.26	.88	.16	.....	.....	.....
1104	C1104	Free-Cutting Brass B	61.33	35.3	2.77	.088	.43	.070	.....	.....	.....
.....	C1105	Free-Cutting Brass C	63.7	34.0	2.0	.044	.21	.043	.....	.....	.....
1106	C1106	Naval Brass A	59.08	40.08	0.032	.004	.74	.025	.....	.....	.....
1107	C1107	Naval Brass B	61.21	37.34	.18	.037	1.04	.098	.....	.....	.....
1108	C1108	Naval Brass C	64.95	34.42	.063	.050	0.39	.033	.....	.....	.....
1109	C1109	Red Brass A	82.2	17.4	.075	.053	.10	.10	.....	.....	.....
1110	C1110	Red Brass B	84.59	15.20	.033	.033	.051	.053	.....	.....	.....
1111	C1111	Red Brass C	87.14	12.81	.013	.010	.019	.022	.....	.....	.....
1112	C1112	Gilding Metal A	93.38	6.30	.057	.070	.12	.100	.....	.....	.....
1113	C1113	Gilding Metal B	95.03	4.80	.026	.043	.064	.057	.....	.....	.....
1114	C1114	Gilding Metal C	96.45	3.47	.012	.017	.027	.021	.....	.....	.....
1115	C1115	Commercial Bronze A	87.96	11.73	.013	.13	.10	.074	.....	.....	.....
1116	C1116	Commercial Bronze B	90.37	9.44	.042	.046	.044	.048	.....	.....	.....
1117	C1117	Commercial Bronze C	93.01	6.87	.069	.014	.021	.020	.....	.....	.....
1118	C1118	Aluminum Brass A	75.1	21.9	.025	.065	.....	.....	2.80	.010	.007
1119	C1119	Aluminum Brass B	77.1	20.5	.050	.030	.....	.....	2.14	.050	.040
1120	C1120	Aluminum Brass C	80.1	18.1	.105	.015	.....	.....	1.46	.100	.090
.....	C1121	Beryllium Copper CA-172	97.49	(0.01)	(.002)	.085	.01	.012	0.07	.....	.....
1122	C1122	Beryllium Copper CA-170	97.45	(.01)	(.003)	.16	(.01)	(.01)	.17	.....	.....
1123	C1123	Beryllium Copper CA-175	97.10	(.01)	(.001)	.04	(.01)	(.01)	.02	.....	.....
1275	.....	Cupro-Nickel (CDA 706)	88.2	.085	.006	1.46	.008	9.76	.....	.0005	(≤0.001)
1276	.....	Cupro-Nickel (CDA 715)	67.8	.038	.004	0.56	20.3	30.5	.....	.0004	(<.001)

SRM		Be	Bi	Cd	Mn	P	Si	Ag	Te	Co	Cr	Se	Mg	B	S	Ti
	C1101	0.00055	0.0004	0.0055	0.0055	0.0020	(0.005)	0.003	0.0015	.....	.....	.....	.....	.....	.....	.....
1102	.....	.00003	.0005	.0045	.0045	.0048	.002	.0010	.0003	.....	.....	.....	.....	.....	.....	.....
	C1103	.....	.....	.....	.....	.003	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1104	C1104	.....	.....	.....	.....	.005	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	C1105	.....	.....	.....	.....	.003	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1106	C1106	.....	.....	.....	.005	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1107	C1107	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1108	C1108	.....	.....	.....	.025	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1109	C1109	.....	.....	.....	.....	.006	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1110	C1110	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1111	C1111	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1112	C1112	.....	.....	.....	.....	.009	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1113	C1113	.....	.....	.....	.....	.008	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1114	C1114	.....	.....	.....	.....	.009	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1115	C1115	.....	.....	.....	.....	.005	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1116	C1116	.....	.....	.....	.....	.008	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1117	C1117	.....	.....	.....	.....	.002	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1118	C1118	.....	.....	.....	.....	.13	.0021	.....	.....	.....	.....	.....	.....	.....	.....	.....
1119	C1119	.....	.....	.....	.....	.070	.0015	.....	.....	.....	.....	.....	.....	.....	.....	.....
1120	C1120	.....	.....	.....	.....	.018	.0011	.....	.....	.....	.....	.....	.....	.....	.....	.....
	C1121	1.90	.....	.....	(.004)	(.005)	.11	(.005)	.....	0.295	(0.002)	.....	.....	.....	.....	.....
1122	C1122	1.75	.....	.....	(.004)	(.004)	.17	(.005)	.....	.220	(.002)	.....	.....	.....	.....	.....
1123	C1123	0.46	.....	.....	(.002)	(.002)	.03	(.009)	.....	2.35	(.002)	.....	.....	.....	.....	.....
1275	.....	.....	(≤0.001)	.0003	.42	.005	(.001)	(.004)	(.0002)	0.024	(.0002)	0.0004	0.003	(0.0009)	(0.008)	(0.0002)
1276	.....	.....	(<.0001)	.0002	1.01	.006	(.001)	(.004)	(.0002)	.045	(.0002)	.0005	.12	(.0001)	.008)	(.0002)

Copper "Benchmark" Standards

The copper "benchmark" standards were prepared in a cooperative Industry-ASTM-NBS program and were designed primarily for use in calibration with optical emission methods of analysis. They should also serve in the development of other new or improved trace methods of analysis. Twelve different compositions are to be issued as 25 SRM's Cu "O" and Cu XI will be issued in chip form only. Cu IV is available only in rod form 6.60 mm in diameter and 103 mm long, but is to be issued later as a water-atomized powder. Cu I, II, III, V, VI, VII are available both as chips and as rods 6.35 mm in diameter, 103 mm long. Cu VIII, IX, and X will be issued as chill-cast and unidirectionally solidfied blocks 32 mm square and 19 mm thick, Cu VIII-Cu X are phosphorized copper containing a nominal concentration range from about 10 to 500 ppm for the same 20 trace elements contained in the other copper "benchmark" SRM's, plus 5 to 8 additional elements. These SRM's are applicable for x-ray fluorescence methods of analysis and, because of deliberate additions of gold and silver (in ratios of 1 to 4), for calibration of fire assay equipment.

SRM	Type	Chemical Composition (Nominal Parts Per Million)					
		Form	Cu(Wt%)	Sb	As	Bi	Fe
494	Unalloyed—Cu I	rod	99.91	4.5	2.6	0.35	(~155)
495	Unalloyed—Cu II	rod	99.94	8.0	1.6	.50	(~100)
496	Unalloyed—Cu III	rod	99.95	<1	<0.2	.07	(~150)
457	Unalloyed—Cu IV	rod	99.96	0.2	0.2	.2	2.0
498	Unalloyed—Cu V	rod	99.98	7.4	25	2.0	11
499	Unalloyed—Cu VI	rod	99.79	30	47	10.5	21
500	Unalloyed—Cu VII	rod	99.70	100	140	25	42
C1251	Unalloyed—Cu VIII	disk	99.96	12.6	(8)	(3)	(10)
C1252	Unalloyed—Cu IX	disk	99.89	42	124	20	(40)
C1253	Unalloyed—Cu X	disk	99.42	(132)	244	70	(300)

SRM	Pb	Mn	Ni	Se	Ag	Te	Sn	Zn
494	26.5	3.7	11.7	2.1	50	0.6	70	400
495	3.2	5.3	5.4	0.6	12.2	.3	1.5	12
496	0.4	7.5	4.2	.5	3.3	<.1	0.8	5.0
457	.5	<0.1	0.6	3.3	8.1	.5	<.2	<11
498	10	(.3)	7.0	14	20.1	11	5	25
499	114	(.3)	504	(~90)	114	(~50)	(~90)	41
500	128	(.2)	603	(~200)	176	(~155)	(~250)	111
C1251	7.5	(7)	22	8.6	81.4	(12)	(15)	8.3
C1252	60	(28)	128	46	166.6	(44)	(124)	60
C1253	244	[~300]	(500)	140	503	(193)	(489)	368

SRM	Al	Cd	Cr	Co	Au	Mg	O	S
494	(<2)	(0.5)	2.0	0.5	(0.07)	(<1)	(230)	15
495	(<2)	(.4)	6.0	.3	(.13)	(<1)	(435)	13
496	(<2)	(.6)	4.3	.4	(<.05)	(<1)	(270)	9
457	(<2)	(<1)	(0.3)	(.2)	(<.05)	(<1)	(360)	(4)
498	(<2)	(22)	(.3)	2.7	(.1)	(<1)	(30)	(11)
499	(<2)	(<1)	(.5)	0.5	(4)	(<1)	(950)	(10)
500	(<2)	(<1)	(.5)	.5	(10)	(<1)	(1025)	(9)
C1251	[~5]	[~3]	2.8	8.8	15.0	(10)	[~120]	(22)
C1252	[~40]	[~15]	7.4	90	34.9	(20)	[~150]	(29)
C1253	[~160]	[~60]	(187)	(510)	74.4	(80)	[~85]	(50)

Lead-Base Alloys

SRM 31.4 mm D × 19 mm thick	Type	Chemical Composition (Nominal Weight Percent)								
		Other Forms	Cu	Ni	As	Sn	Sb	Bi	Ag	Fe
1131	Solder Pb60-Sn40	127b	0.011	0.012	0.01	39.3	0.43	0.06	0.01	.....
1132	Bearing Metal	53e	.054	.003	.057	5.84	10.2	.052	.....	<0.001

Nickel-Base Alloys

SRM 31 mm D × 19 mm thick	Type	Chemical Composition (Nominal Weight Percent)										
		C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Co	Fe
1159	Ni48, balance Fe	0.007	0.305	0.003	0.003	0.32	0.038	48.2	0.06	0.010	0.022	51.0
1160	Ni80, Mo4, balance Fe	.019	.550	.003	.001	.37	.021	80.3	.05	4.35	.054	14.3

Titanium-Base Alloys

SRM 31 mm D × 19 mm thick	Type	Chemical Composition (Nominal Weight Percent)					
		Mn	Cr	Fe	Mo	Al	V
641	8Mn (A)	6.68					
642	8Mn (B)	9.08					
643	8Mn (C)	11.68					
644	2Cr-2Fe-2Mo (A)		1.03	1.36	3.61		
645	2Cr-2Fe-2Mo (B)		1.96	2.07	2.38		
646	2Cr-2Fe-2Mo (C)		3.43	2.14	1.11		
654a*	6Al-4V (B)	(<0.1)	(0.20)	(0.20)	(<0.05)	6.3_4	3.9_8

*31 mm D × 6.4 mm thick.

Zinc-Base Alloys

Zinc-base alloy SRM's are available ranging from very high-purity zinc to commercial materials such as spelter and die-casting alloy compositions. They are supplied as bar segments (disks) intended for calibrating and checking optical emission and x-ray spectroscopic techniques. The certificate of analysis supplied with each gives the chemical composition determined at NBS and values determined by other laboratories that have cooperated in the certification of the SRM's. For high-purity Zinc, see High-Purity Metals, page 41.

(Values in parentheses are not certified, but are given for information only.)

SRM	Type	Chemical Composition (Nominal Weight Percent)							
		Cu	Al	Mg	Fe	Pb	Cd	Sn	Cr
625	Zinc-base A-ASTM AG 40A	0.034	3.06	0.070	0.036	0.0014	0.0007	0.0006	0.0128
626	Zinc-base B-ASTM AG 40A	.056	3.56	.020	.103	.0022	.0016	.0012	.0395
627	Zinc-base C-ASTM AG 40A	.132	3.88	.030	.023	.0082	.0051	.0042	.0038
628	Zinc-base D-ASTM AC 41A	.611	4.59	.0094	.066	.0045	.0040	.0017	.0087
629	Zinc-base E-ASTM AC 41A	1.50	5.15	.094	.017	.0135	.0155	.012	.0008
630	Zinc-base F-ASTM AC 41A	0.976	4.30	.030	.023	.0083	.0048	.0040	.0031
631	Zinc spelter (modified)	.0013	0.50	(<001)	.005	(.001)	.0002	.0001	.0001

SRM	Mn	Ni	Si	In	Ga	Ca	Ag	Ge
625	0.031	0.0184	0.017					
626	.048	.047	.042					
627	.014	.0029	.021					
628	.0091	.030	.009					
629	.0017	.0075	.078					
630	.0106	.0027	.022					
631	.0015	(<.0005)	<.002	(0.0023)	(0.002)	<0.001	(<0.0005)	(0.0002)

Zirconium-Base Alloys

SRM 31 mm D × 9.5 mm thick	Type	Chemical Composition (Nominal Weight Percent)												
		Hf	C	Cr	Cu	Fe	Mn	Mo	Ni	N	Si	Ti	W	U
1212a	Zirconium C		0.28	0.063	0.015	0.071	0.030	0.012	0.043	0.012	0.035	0.015	0.014	0.010
1234	Unalloyed Zirconium A	46	(80)	(55)	(<10)	(240)	(10)	(2)	(20)	(14)	(40)	(20)	(25)	
1235	Unalloyed Zirconium B	95	(170)	(60)	(80)	(850)	(25)	(40)	(65)	(32)	(95)	(90)	(50)	
1236	Unalloyed Zirconium C	198	(240)	(250)	(250)	(1700)	(45)	(100)	(140)	(69)	(205)	(185)	(140)	
1237	Zircaloy D	31	(100)	(1510)	(<10)	(1650)	(10)	(<10)	(40)	(19)	(35)	(30)	(25)	
1238	Zircaloy E	178	(310)	(580)	(160)	(2500)	(60)	(120)	(100)	(72)	(170)	(100)	(95)	
1239	Zircaloy F	77	(170)	(1655)	(130)	(2300)	(50)	(45)	(45)	(42)	(95)	(40)	(45)	

Gases in Metals

Certified for Hydrogen, Oxygen, and Nitrogen

The SRM's are used in the determination of hydrogen, oxygen and nitrogen by vacuum fusion, inert gas fusion, and neutron activation methods. SRM's 1095 to 1099 were prepared from the same melt as the "1200" series (1261–1265), see page 24. Values in parentheses are not certified; they are given for information only.

SRM	Type	Form	Oxygen (ppm)	Hydrogen (ppm)	Nitrogen (ppm)
352a	Unalloyed titanium for hydrogen	Platelets		20	
354	Unalloyed titanium for hydrogen	Platelets		215	
355	Unalloyed titanium	Rod	3031		
357	Unalloyed Zirconium	Wire	(1200)	19	49
358	Unalloyed Zirconium	Wire	(1100)	107	28
1086	Unalloyed Titanium	Chips	(1350)	116	
1087	Unalloyed Titanium	Chips	(840)	57.5	
1088	Unalloyed Titanium	Chips	(1450)	88.5	
1090	Ingot iron	Rod	491		(60)
1091	Stainless steel (AISI 431)	Rod	131		(945)
1092	Vacuum-melted steel	Rod	28		(40)
1093	Valve steel	Rod	60		(4807)
1094	Maraging steel	Rod	4.5		(71)
*1095	AISI 4340 steel	Rod	9		(37)
*1096	AISI 94B17 (Mod) steel	Rod	10.7		40.4
*1097	Cr-V (Mod) steel	Rod	6.6		(41)
*1098	High Carbon (Mod) steel	Rod	10		32
*1099	Electrolytic iron	Rod	61		(13)
1089	Set of 5: 1095, 1096, 1097, 1098, and 1099	Rods			

*Sold only in sets as SRM 1089.

High-Purity Metals

Very high-purity metal SRM's are being made available to fill the needs of analysts determining impurity elements in high-purity metal materials. They are intended to serve as bench marks in calibration of methods and equipment; also, they are expected to be valuable in the development of new or improved methods and techniques for extending the sensitivity of detection in the determination of trace constituents

in various materials by chemical, optical emission, solid mass spectroscopy, activation, and resistivity methods of analysis.

The Certificate of Analysis supplied with each high-purity SRM gives the state-of-the-art information on chemical composition in the cooperating laboratories for the various trace determinations reported.

High-purity gold is available in both wire and rod form. The wire form (W), is intended for applications such as spark source mass spectroscopic techniques. The low levels of impurities make it important for evaluating instrument and system blanks. The rod form (R), is intended for application in other methods of characterization.

Platinum is available in wire form as a high-purity material and as doped composition material.

Zinc is available in a high-purity and in a less pure version. Both were prepared from the same starting material. The high-purity material is the result of further purification by vacuum distillation, zone refining, and degasification. The zinc is supplied in the form of semi circular bar segments.

SRM	Type	Unit Size	Chemical Compositions (Nominal Parts Per Million by Weight)				
			Cu	Ni	Sn	Pb	Zr
685W*	High-Purity Gold (Wire)	1.4mm D × 102mm long	0.1				
685R*	High-Purity Gold (Rod)	5.9mm D × 25mm long	.1				
680aL1	High-Purity Platinum (Wire)	0.51mm D × 102mm long	.1	<1		<1	<0.1
680aL2	High-Purity Platinum (Wire)	0.51mm D × 1.0m long	.1	<1		<1	<0.1
681L1	Doped-Platinum (Wire)	0.51mm D × 102mm long	5.1	0.5		12	11
681L2	Doped-Platinum (Wire)	0.51mm D × 1.0m long	5.1	0.5		12	11
682*	High-Purity Zinc	Semicircular segments 57mm D × 19mm long.	0.042		(0.02)		
683*	Zinc Metal	Semicircular segments 57mm D × 19mm long.	5.9		(.02)	11.1	

SRM	Ag	Mg	In	Fe	O	Pd	Au	Rh	Ir	Cd	Ti
685W*	[0.1]		0.007	0.3	[2]						
685R*	[.1]		.007	.2	[<2]						
680aL1	<.1	<1		1.3	4	0.2	<1	<0.2	<0.01		
680aL2	<.1	<1		1.3	4	.2	<1	<.2	.01		
681L1	2.0	12		5	7	6	9	9	11		
681L2	2.0	12		5	7	6	9	9	11		
682*	(0.02)			(0.1)						(0.1)	
683*	1.3			2.2						1.1	(0.2)

*Certificate gives upper limits for other elements found to be present.

Microanalytical Standards

These SRM's provide a highly homogeneous material at about the micrometer of spatial resolution. They are intended primarily for use in calibration of quantitative electron probe, secondary ion mass spectrometry, spark sources, mass spectrometry, and laser probe microanalytical techniques.

Cartridge Brass

Cartridge Brass, SRM 478, consists of two specimens: A chill-cast cube (6mm on edge) with a polished chill-cast face and a wrought right circular cylinder (6mm in diameter and height).

SRM 478 is homogeneous at micrometer levels of spatial resolution for both copper and zinc. Details of the homogeneity testing are in NBS Miscellaneous Publication 260-10. Extensive tests of SRM 478 with electron probe microanalyzers show that satisfactory analytical calibration can be performed using SRM 478.

Fe-Cr-Ni Alloy

The Fe-Cr-Ni alloy, SRM 479a, is a wafer (4.6 mm in diameter and 1 mm thick) and is characterized for chemical homogeneity of iron, chromium, and nickel at the micrometer level of spatial resolution. It is satisfactory for use as a homogeneous material for electron probe microanalysis.

Tunsten—20% Molybdenum

The tunsten-20% molybdenum alloy, SRM 480, is a wafer (1 mm in diameter and 1 mm thick) with a core of tunsten-20% molybdenum wire embedded in pure molybdenum onto which pure tungsten has been deposited by electroplating to provide a composite. Details on homogeneity characterization are given in NBS Spec. Publ. 260-16. (See inside back cover for ordering instructions.)

Gold-Silver

Six color-coded wires (0.5 mm in diameter and 50 mm long) comprise SRM 481. The wires consist of a high-purity gold and a high-purity silver wire and four wires with nominal chemical composition differences in steps of 20%.

Gold-Copper

Six color-coded wires (0.5 mm in diameter and 50 mm long) comprise SRM 482, which is similar to the gold-silver set. In both sets special precautions were taken to achieve homogeneity on a microscopic scale.

Iron-3% Silicon

The iron-3% silicon microprobe, SRM 483, is a platelet (3 mm × 3 mm × 0.28 mm), and is characterized for chemical homogeneity of iron and silicon at the micrometer level of spatial resolution. It is satisfactory for use as a homogeneous material for electron probe microanalysis.

SRM	Type	Chemical Composition (Nominal Weight Percent)									
		Au	Cu	Ag	W	Mo	Si	Fe (by difference)	Cr	Ni	Zn
478	Cartridge Brass		72.8$_5$								27.1$_0$
479a	Fe-Cr-Ni Alloy							71.0	18.1	10.9	
480	Tungsten-20 Mo Alloy				78.5	21.5					
481	Au100A	100.00									
	Au80-Ag20B	80.05		19.96							
	Au60-Ag40C	60.05		39.92							
	Au40-Ag60D	40.00		59.90							
	Au20-Ag80E	22.43		77.58							
	Ag100F			100.00							
482	Au100A	100.00									
	Au80-Cu20B	80.15	19.83								
	Au60-Cu40C	60.36	39.64								
	Au40-Cu60D	40.10	59.92								
	Au20-Cu80E	20.12	79.85								
	Cu100F		100.00								
483	Iron-3% Silicon						3.22	96.7–96.8			

Primary, Working, and Secondary Standard Chemicals

These SRM's are high-purity chemicals defined as primary, working, and secondary standards in accordance with recommendations of the Analytical Chemistry Section of the International Union of Pure and Applied Chemistry [Ref. Analyst **90,** 251 (1965)]. These definitions are as follows:

Primary Standard:
a commercially available substance of purity 100±0.02 percent (Purity 99.98+ percent).

Working Standard:
a commercially available substance of purity 100±0.05 percent (Purity 99.95+ percent).

Secondary Standard:
a substance of lower purity which can be standardized against a primary grade standard.

SRM	Type	Wt/Unit (grams)	Certified Use	Purity Stoichiometric
17c	Sucrose	60	Polarimetric Value	[a]
40h	Sodium Oxalate	60	Reductometric Value	99.95
41b	Dextrose (D-glucose)	70	Reductometric Value	[b]
83d	Arsenic Trioxide (IN PREP)		Reductometric Value	
84j	Acid Potassium Phthalate	60	Acidimetric Value	99.996
136c	Potassium Dichromate	60	Oxidimetric Value	99.98
350a	Benzoic Acid	30	Acidimetric Value	99.99
723a	Tris(hydroxymethyl)aminomethane	50	Basimetric Value	99.97
944	Plutonium Sulfate Tetrahydrate	0.5	Assay	100.00
949e	Plutonium Metal	0.5	Assay	99.996
950b	Uranium Oxide (U_3O_8)	25	Uranium Oxide Standard Value	99.968
951	Boric Acid	100	Acidimetric and Boron Isotopic Value	100.00
960	Uranium Metal	26	Assay	99.975
984	Rubidium Chloride	0.25	Assay and Isotopic	99.90
985	Potassium Chloride	1	Assay and Isotopic	99.99
987	Strontium Carbonate	1	Assay and Isotopic	99.98
999	Potassium Chloride	60	Assay Standard for:	
			Potassium	99.98
			Chloride	99.99

[a] Sucrose = Moisture < 0.01 percent, Reducing Substances < 0.02 percent, Ash 0.001 percent.
[b] Dextrose = Moisture 0.07 percent, Ash 0.002 percent.

Microchemical Standards

These SRM's are furnished as fine crystals of suitable homogeneity for use as standards for conventional microchemical methods of analysis employing samples of approximately 5 mg. See also Microanalytical Standards, page 42.

SRM	Type	Wt/Unit (grams)	Elements Certified
140b	Benzoic Acid	2	C,H
141c	Acetanilide	2	N,C,H
142	Anisic Acid	2	Methoxyl (CH_3O—)
143c	Cystine	2	S,C,H,N
148	Nicotinic Acid	2	N,C,H
2141	Urea	2	N
2142	o-Bromobenzoic Acid	2	Br
2143	p-Fluorobenzoic Acid	2	F
2144	m-Chlorobenzoic Acid	2	Cl

Clinical Laboratory Standards

These SRM's are intended for use in calibrating apparatus and validating analytical methods used in clinical and pathological laboratories, and to assist manufacturers of clinical products in meeting the chemical and physical specifications required for clinical chemicals. (For details on SRM's 930D and 931c, see Spectrophotometric Filters, page 75.)

SRM	Type	Associated NBS Publications	Purity %	Wt/Unit
900	Antiepilepsy Drug Level Assay	.....	4 drugs/3 levels	Set of 4 vials
909	Human Serum	.....	.....	.....
910	Sodium Pyruvate (IN PREP)	.....	.....	.....
911a	Cholesterol	.....	99.8	2 g
912a	Urea	.....	99.8	25 g
913	Uric Acid	.....	99.7	10 g
914	Creatinine	.....	99.8	10 g
915	Calcum Carbonate	SP 260–36	99.9	20 g
916	Bilirubin	.....	99.0	100 mg
917	D-Glucose	.....	99.9	25 g
918	Potassium Chloride	SP 260–63	99.9	30 g
919	Sodium Chloride	SP 260–60	99.9	30 g
920	D-Mannitol	.....	99.8	50 g
921	Cortisol	.....	98.9	1 g
922	Tris (hydroxymethyl) aminomethane	.....	99.9	25 g
923	Tris (hydroxymethyl) aminomethane HCl	.....	99.7	35 g
924	Lithium Carbonate	SP 260–70	100.0	30 g
925	VMA (4-hydroxy-3-methoxymandelic acid)	.....	99.4	1 g
926	Bovine Serum Albumin (Powder)	.....	**	5 g
927	Bovine Serum Albumin (7% Solution)	.....	**	10 vials, 2.15 mL ea.
928	Lead Nitrate	.....	100.00	30 g
929	Magnesium Gluconate	.....	100.1	5 g
930D	Glass Filters for Spectrophotometry	SP 260–51	+	Set of 3
931c	Liquid Filters for Spectrophotometry	.....	+	3 sets of 4
932	Quartz Cuvette for Spectrophotometry	SP 260–32	+	1 each
934	Clinical Laboratory Thermometer	SP 260–48	††	1 each
935	Crystalline Potassium Dichromate (UV Absorbance) Standard	SP 260–54	(99.972)***	15 g
936	Quinine Sulfate Dihydrate (Fluorescence)	SP 260–64	(98.2)***	1 g
937	Iron Metal	.....	99.90	50 g
1968	Gallium Melting Point	SP 481	+++	1 ea.

+Certified for optical properties (see p. 76.)
††Individually calibrated at 0, 25, 30, and 37 °C.
**Conforms to NCCLS specification ACC–1.
***Apparent purity, certified for optical properties.
+++Melting Point Certified at 29.7723 °C. (See p. 71.)

Biological Standards

These SRM's are intended for use in the calibration of apparatus and methods used in the analysis of biological materials for major, minor, and trace constituents.

(Values in parentheses are not certified, but are given for information only.)

SRM	Type	Wt/Unit (grams)	SRM	Type	Wt/Unit (grams)
1566	Oyster Tissue	30	1572	Citrus Leaves (IN PREP)	.....
1567	Wheat Flour	80	1573	Tomato Leaves	70
1568	Rice Flour	80	1575	Pine Needles	70
1569	Brewers Yeast	50	1577a	Bovine Liver (IN PREP)	50

Element	SRM	Content in μg/g (or where noted, wt %)					
		1566	1567	1568	1569	1573	1575
Aluminum						**(0.12%)**	545
Antimony							(0.2)
Arsenic		13.41	(0.006)	0.41		0.27	0.21
Beryllium							
Boron						(30)	
Bromine		(55)	(9)	(1)		(26)	(9)
Cadmium		3.5	0.032	0.029			(<0.5)
Calcium		**0.15%**	**0.019%**	**0.014%**		**3.00%**	**0.41%**
Cerium						(1.6)	(0.4)
Chlorine		**(1.0%)**					
Chromium		0.69			2.12	4.5	2.6
Cobalt		(0.4)		0.02		(0.6)	(0.1)
Copper		63.0	2.0	2.2		11	3.0
Europium						(0.04)	(0.006)
Indium							
Iodine		(2.8)					
Iron		195	18.3	8.7		690	200
Lanthanum						(0.9)	(0.2)
Lead		0.48				6.3	10.8
Magnesium		**.128%**				**(0.7%)**	
Manganese		17.5	8.5	20.1		238	675
Mercury		0.057	0.001	0.0060		(0.1)	0.15
Molybdenum		(≤0.2)	(0.4)	(1.6)			
Nickel		1.03	(0.18)	(0.16)			(3.5)
Nitrogen						**(5.0%)**	**(1.2%)**
Phosphorus		**(0.81%)**				**0.34%**	**0.12%**
Potassium		**0.969%**	**0.136%**	**0.112%**		**4.46%**	**0.37%**
Rubidium		4.45	(1)	(7)		16.5	11.7
Scandium						(0.13)	(0.03)
Selenium		2.1	1.1	0.4			
Silicon							
Silver		0.89					
Sodium		**0.51%**	8.0	6.0			
Strontium		10.36				44.9	4.8
Sulfur		**(.076%)**					
Tellurium			(>0.002)	(>0.002)			
Thallium		(≤0.005)				(0.05)	(0.05)
Thorium		(0.1)				0.17	0.037
Uranium		0.116				0.061	0.020
Zinc		852	10.6	19.4		62	

Analyzed Gases

These SRM's are intended for the calibration of apparatus used for the measurement of various components in gas mixtures, and in some cases for particular atmospheric pollutants. Each SRM is accurately certified and is primarily intended to monitor and correct for long-term drifts in instruments used. Each cylinder contained 870 liters at STP prior to certification, and thus contains somewhat less than 870 L. All cylinders conform to the appropriate DOT specifications.

SRM	Type	Nominal Concentrations
1658a	Methane in Air	CH_4, 0.951 μmol/mol(ppm).
1659a	Methane in Air	CH_4, 9.43 μmol/mol(ppm).
1660a	Methane-Propane in Air	CH_4, 4.10 μmol/mol(ppm). C_3H_8, 0.976 μmol/mol(ppm).
1661	Sulfur Dioxide in N_2	SO_2, 480 μmol/mol(ppm).
1662a	Sulfur Dioxide in N_2	SO_2, 942 μmol/mol(ppm).
1663a	Sulfur Dioxide in N_2	SO_2, 1497 μmol/mol(ppm).
1664	Sulfur Dioxide in N_2	SO_2, 2521 μmol/mol(ppm).
1665b	Propane in Air	C_3H_8, 3 ppm.
1666b	Propane in Air	C_3H_8, 10 ppm.
1667b	Propane in Air	C_3H_8, 50 ppm.
1668b	Propane in Air	C_3H_8, 100 ppm.
1669b	Propane in Air	C_3H_8, 500 ppm.
1674b	Carbon Dioxide in Nitrogen	CO_2, 7.5 mol %.
1675b	Carbon Dioxide in Nitrogen	CO_2, 15.0 mol %.
1677c	Carbon Monoxide in Nitrogen	CO, 10 ppm.
1678c	Carbon Monoxide in Nitrogen	CO, 50 ppm.
1679c	Carbon Monoxide in Nitrogen	CO, 100 ppm.
1680b	Carbon Monoxide in Nitrogen	CO, 500 ppm.
1681b	Carbon Monoxide in Nitrogen	CO, 1000 ppm.
1683a	Nitric Oxide in Nitrogen	NO, 50 ppm.
1684a	Nitric Oxide in Nitrogen	NO, 100 ppm.
1685a	Nitric Oxide in Nitrogen	NO, 250 ppm.
1686a	Nitric Oxide in Nitrogen	NO, 500 ppm.
1687a	Nitric Oxide in Nitrogen	NO, 1000 ppm.
2612a	Carbon Monoxide in Air	CO, 10 μmol/mol(ppm).
2613a	Carbon Monoxide in Air	CO, 18.1 μmol/mol(ppm).
2614a	Carbon Monoxide in Air	CO, 43.0 μmol/mol(ppm).
2619a	Carbon Dioxide in N_2	CO_2, 0.5 mol percent.
2620a	Carbon Dioxide in N_2	CO_2, 1.0 mol percent.
2621a	Carbon Dioxide in N_2	CO_2, 1.5 mol percent.
2622a	Carbon Dioxide in N_2	CO_2, 2.0 mol percent.
2623a	Carbon Dioxide in N_2	CO_2, 2.5 mol percent.
2624a	Carbon Dioxide in N_2	CO_2, 3.0 mol percent.
2625a	Carbon Dioxide in N_2	CO_2, 3.5 mol percent.
2626a	Carbon Dioxide in N_2	CO_2, 4.0 mol percent.

SRM	Type	Nominal Concentrations
2630	Nitric Oxide in N_2	NO, 1500 μmol/mol(ppm).
2631	Nitric Oxide in N_2	NO, 3000 μmol/mol(ppm).
2632	Carbon Dioxide in N_2	CO_2 300 μmol/mol(ppm).
2633	Carbon Dioxide in N_2	CO_2 400 μmol/mol(ppm).
2634	Carbon Dioxide in N_2	CO_2 800 μmol/mol(ppm).
2635	Carbon Monoxide in N_2	CO, 25 μmol/mol(ppm).
2636	Carbon Monoxide in N_2	CO, 250 μmol/mol(ppm).
2637	Carbon Monoxide in N_2	CO, 2500 μmol/mol(ppm).
2638	Carbon Monoxide in N_2	CO, 5000 μmol/mol(ppm).
2639	Carbon Monoxide in N_2	CO, 1 mol %.
2640	Carbon Monoxide in N_2	CO, 2 mol %.
2641	Carbon Monoxide in N_2	CO, 4 mol %.
2642	Carbon Monoxide in N_2	CO, 8 mol %.
2657	Oxygen in Nitrogen	O_2, 2 mol %.
2658	Oxygen in Nitrogen	O_2, 10 mol %.

Analyzed Liquids and Solids

These SRM's are intended for use in the analysis of materials for constituents of interest in health or environmental problems. See also: Clinical SRM's page 45, and Industrial Hygiene SRM's page 51.

SINGLE ELEMENT Concentrations:
Weight percent—boldface
Microgram per gram—light face
Nanogram per milliliter—italics

SRM	Type	Unit Size	Lead	Sulfur	Mercury
1579	Powdered Lead Base Paint	35 g	**11.87%**		
1620	Sulfur in Residual Fuel Oil	100mL		4.48%	
1621a	Sulfur in Residual Fuel Oil	100mL		0.94%	
1622a	Sulfur in Residual Fuel Oil	100 mL		1.96%	
1623a	Sulfur in Residual Fuel Oil	IN PREP			
1624	Sulfur in Distillate Fuel Oil	IN PREP			
1630	Trace Mercury in Coal	50 g			0.13μg/g.
1641a	Mercury in Water (μg/mL)	Set 6			1.10μg/mL.
1642a	Mercury in Water (ng/mL)	950 mL			*1.10* ng/mL.

SRM	Type	Element Certified	Nominal Concentration	No. Units
1636a	Lead in Reference Fuel	Pb	0.03, 0.05, 0.07, 2.0g/gal	3 vials each.
1637a	Lead in Reference Fuel	Pb	0.03, 0.05, 0.07 g/gal	4 vials each.
1638a	Lead in Reference Fuel	Pb	2.0 g/gal	12 vials each.

MULTI-ELEMENT Concentrations:
Weight percent—boldface
Microgram per gram—light face
Nanogram per gram—italics

SRM	Type	Unit size	Al	Sb	As	Ba	Be	Br
1632a	Trace Elements in Coal (Bituminous).	75g	**(3.1)**	(0.6)	9.3			
1633a	Trace Elements in Coal Fly Ash	75g	**(14)**	(7)	145	**(0.15)**	(12)	
1634	Trace Elements in Fuel Oil	IN PREP						
1635	Trace Elements in Coal (Subbituminous).	75g	**(0.32)**	(0.14)	0.42			
1643a	Trace Elements in Water (ng/g)	950mL			76	46	19	
1645	River Sediment	70g		(51)	(66)			
1646	Estuarine Sediment	IN PREP						
1648	Urban Particulate	2g	**(3.3)**	(45)	115	(737)		(500)

SRM	Cd	Ca	Ce	Cs	Cl	Cr
1632a	0.17	**0.23**	(30)	(2.4)		34.4
1633a	1.0	**1.11**	(180)	(11)		196
1634a						
1635	0.03		(3.6)			2.5
1643a	10					17
1645	10.2					**2.96**
1646						
1648	75		(55)	(3)	**(0.45)**	403

SRM	Co	Cu	Eu	Ga	Hf	In
1632a	(6.8)	16.5	(0.5)	(8.5)	(1.6)	
1633a	(46)	118	(4)	(58)	(7.6)	
1634a						
1635	(0.65)	3.6	(0.06)	(1.05)	(0.29)	
1643a	19	18				
1645	(8)	109				
1646						
1648	(18)	609	(.8)		(4.4)	(1.0)

SRM	I	Fe	La	Pb	Mg	Mn
1632a		**1.11**		12.4	**(0.1)**	28
1633a		**9.40**			**.455**	(190)
1634a						
1635		**0.239**		1.9		21.4
1643a		88		27		31
1645		**11.3**	(9)	714		785
1646						
1648	(20)	**3.91**	(42)	**0.655**	**(.8)**	(860)

SRM	Hg	Mo	Ni	K	Rb	Sm
1632a	0.13	.....	19.4	**0.42**	(31)	.....
1633a	.16	(29)	127	**1.88**	72.4	.....
1634a	.....	.....	.....	.....	.....	.....
1635	.....	.....	1.74	.....	.....	.....
1643a	(.2)	95	55	.....	.....	.....
1645	1.1	.....	45.8	**(1.2)**	.....	.....
1646	.....	.....	.....	.....	.....	.....
1648	.....	.....	82	**(1.0)**	.....	(4.4)

SRM	Sc	Se	Si	Ag	Na	Sr
1632a	(6.3)	2.6	.....	.....	840	.....
1633a	(40)	10.3	22.8	.....	0.17	830
1634a	.....	.....	.....	.....	.....	.....
1635	(0.63)	0.9	.....	.....	**(0.24)**	.....
1643a	.....	11	.....	2.8	.....	239
1645	(2)	.....	.....	.....	**(.55)**	.....
1646	.....	.....	.....	.....	.....	.....
1648	(7)	(24)	.....	(6)	**(.40)**	.....

SRM	S	Tl	Th	Ti	W	U	V	Zn
1632a	**1.62**	.....	4.5	**(0.18)**	.....	1.28	44	28
1633a	.....	5.7	24.7	**(.8)**	.....	10.2	(300)	220
1634a	.....	.....	.....	.....	.....	.....	.....	.....
1635	**0.33**	.....	0.62	**(.02)**	.....	0.24	5.2	4.7
1643a	.....	.....	.....	.....	.....	.....	53	72
1645	.....	1.44	1.62	.....	.....	1.11	23.5	1720
1646	.....	.....	.....	.....	.....	.....	.....	.....
1648	.....	.....	(7.4)	**(.40)**	(4.8)	.....	(130)	4760

Organic Constituents

SRM	Type	Unit of Issue
1580	Shale Oil.....	Set of 5–2 mL ampoules.
1644	PAH Generator columns...	Set of 3 columns.

Constituents	SRM 1580 (μg/g)	SRM 1644
Anthracene.....	.....	(IN PREP).
Benzo [a] anthracene.....	.....	(IN PREP).
Benzo [a] pyrene.....	21	(IN PREP).
Benzo [e] pyrene.....	18	
Fluoranthrene	54	
o-Cresol	385	
Phenol.....	407	

Permeation Tubes

These SRM's are intended for calibrating air pollution monitoring apparatus, and may be used to verify air pollution analytical methods and procedures. Each tube is individually certified.

Sulfur Dioxide

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 following table is provided as a guide in the selection of the appropriate length. The values in the table do not represent certified values for any SRM. The concentrations of SO_2 in ppm are based on an approximate permeation rate of 0.28 micrograms per centimeter per minute at 25°C, for flow rates of 1, 5, and 10 liters per minute.

SRM	Type	Tube Length (cm)	Permeation Rate (μg/min)	Typical Concentrations (ppm) Flow Rates (liters per minute)		
				(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	.107	.0535
1627	Sulfur Dioxide Permeation Tube	2	0.56	.214	.0428	.0214

Nitrogen Dioxide

Nitrogen dioxide permeation device (SRM 1629a) is 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 1.5μg/min at 25°C. A tube with a rate of 1.0μg/min, in an air-flow of one liter per minute at 25°C, will produce a concentration of 0.5 ppm of NO_2.

Industrial Hygiene Standards

Freeze-Dried Urine

These SRM's consist of two bottles of freeze-dried human urine, one containing a low and one an elevated level of the element certified.

SRM	Element	Low Level (mg/L)	Elevated Level (mg/L)
2671	Florine (F−) (IN PREP)		
2672	Mercury (IN PREP)		

Materials on Filter Media

These SRM's consist of potentially hazardous materials deposited on filters to be used to determine the levels of these materials in industrial atmosphere.

SRM	Type	Material Certified	Quantity Certified (μg/filter)			
			I	II	III	IV
2674	Lead on Filter Media	Lead	100	303	1505	1.4
2673	Sulfate and Nitrate on Filter Media	Sufate	500	2000	7000	.....
		Nitrate	100	1000	2500	.....
2675	Beryllium on Filter Media	Beryllium	0.052	0.26	1.00	.....
2676a	Metals on Filter Media	Cadmium	1.02	2.50	10.18	.....
		Lead	6.96	15.23	29.64	.....
		Manganese	1.97	9.89	19.70	.....
		Zinc	9.86	49.52	99.22	.....
2679	Quartz on Filter Media	Quartz	3.8	29.9	76.1	193.2
		Clay	(400)	(370)	(320)	(200)

Forensic Standards

These SRM's are intented for use in the calibration of apparatus and the evaluation of methods used in the analysis of materials of interest to law enforcement agencies. (For details on SRM 1820, see Refractive Index Standards, page 77.)

SRM	Type	Certification	Unit of Issue
1820	Glass, Borosilicate	Refractive Index	2 slabs; one polished, one unpolished.
1822	Glass, Window (Soda-Lime)	Refractive Index	2 slabs; one polished, one unpolished.
1823	Silicone liquids—I & II	Refractive Index	Set of 2; 60 mL each.

Metallo-Organic Compounds

These SRM's are intended for the preparation of solutions in oils of known and reproducible concentrations of metals. Because "matrix" effects occur, it is desirable to prepare the standard solutions in oil identical or similar to the oil being studied. Possession of an adequate collection of these metallo-organic SRM's permits the preparation of any desired blend of known concentrations of metal in the appropriate lubricating oil. They are used primarily for the calibration of spectrochemical equipment used in the determination of metals in lubricating oil. This technique is used extensively in the defense program, the transportation industry, and other industries where the consequences of failure of a moving metal part may range from inconvenient to catastrophic.

The Certificate supplied with each SRM gives the percentage of the element of interest and directions for preparing a solution of known concentration in lubricating oil.

SRM	Constituent Certified		Wt/ Unit (grams)	Type
	Element	(wt. percent)		
1075a	Al	8.07	5	Aluminum 2-ethylhexanoate.
1051b	Ba	28.7	5	Barium cyclohexanebutyrate.
1053a	Cd	24.8	5	Cadmium cyclohexanebutyrate.
1074a	Ca	12.5	5	Calcium 2-ethylhexanoate.
1078b	Cr	9.6	5	Tris(1-phenyl-1,3-butanediono)chromium (III).
1055b	Co	14.8	5	Cobalt cyclohexanebutyrate.
1080a	Cu	16.37	5	Bis (1-phenyl-1,3-butanediono) copper (II).
1079b	Fe	10.45	5	Tris (1-phenyl-1,3-butanediono) iron (III).
1060a	Li	4.1	5	Lithium cyclohexanebutyrate.
1061c	Mg	6.45	5	Magnesium cyclohexanebutyrate.
1062b	Mn	13.2	5	Manganous cyclohexanebutyrate.
1065b	Ni	13.89	5	Nickel cyclohexanebutyrate.
1071b	P	9.48	5	Triphenyl phosphate.
1066a	Si	14.14	5	Octaphenylcyclotetrasiloxane.
1077a	Ag	42.60	5	Silver 2-ethylhexanoate.
1069b	Na	12.0	5	Sodium cyclohexanebutyrate.
1070a	Sr	20.7	5	Strontium cyclohexanebutyrate.
1057b	Sn	22.95	5	Dibutyltin bis (2-ethylhexanoate).
1052b	V	13.01	5	Bis (1-phenyl-1,3-butanediono) oxovanadium (IV).
1073b	Zn	16.66	5	Zinc cyclohexanebutyrate.

These SRM's consist of 12 metallo-organic compounds blended into a base oil.

SRM	Type	Unit	Elements, μg/g	
			Ag	Al
1084	Wear metal-in-oil (100 ppm)	85 mL	( )	(98.6)
1085	Wear metal-in-oil (300 ppm)	85 mL	( )	(297)

Cr	Cu	Fe	Mg	Mo	Ni	Pb	Si	Sn	Ti
(102)	(97.8)	(101)	(100)	( )	(98.9)	(102)	( )	( )	(102)
(298)	(299)	(302)	(297)	( )	(301)	(299)	( )	( )	( )

Fertilizer Standards

These SRM's are intended for use in the fertilizer industry as working standards for the determination of the certified constituents.

SRM	Type	Wt/Unit (grams)	Certified Composition (Wt percent)		
			N	P	K
193	Potassium Nitrate	90	13.85	.....	38.66
194	Ammonium Dihydrogen Phosphate	90	12.15	29.92	.....
200	Potassium Dihydrogen Phosphate	90	.....	22.74	28.76

Ores

These SRM's are intended for use in checking the accuracy of assay methods. They are certified for their content of elements of economic interest, and occasionally, have additional data given for information only. These SRM's are supplied in the form of fine powders, usually less than 0.15 mm.

SRM	Type	Wt/ Unit (grams)	Chemical Compositions (Nominal Weight Percent)				
			CaF_2	Li_2O	Cu	Re	Mo
79a	Fluorspar	120	97.39	.....	.....	.....	.....
180	Fluospar, high grade	120	98.8	.....	.....	.....	.....
181	Lithium (Spodumene)	45	.....	6.4	.....	.....	.....
182	Lithium (Petalite)	45	.....	4.3	.....	.....	.....
183	Lithium (Lepidolite)	45	.....	4.1	.....	.....	.....
330	Copper, millheads	100	.....	.....	0.84	0.3 ppm	0.018
331	Copper, milltails	100	.....	.....	.091	0.4 ppm	.0022
332	Copper, concentrate	50	.....	.....	28.45	10.2 ppm	.64
333	Molybdenum, concentrate	55	.....	.....	1.038	0.087	55.3

SRM	Type	Wt/Unit (grams)	Chemical Composition (Nominal Weight Percent)					
			Al_2O_3	BaO	Cd	CdO	CaO	CO_2
27f	Iron Ore, Sibley	100	0.82				0.039	
690	Iron Ore, Canada (Conc.)	150	.18				.20	
691	Iron Oxide, reduced	IN PREP	(*)				(*)	
692	Iron Ore, Labrador	150	1.41				.023	
693	Iron Ore, Nimba	150	1.02				.016	
69b	Bauxite, Arkansas	80	49.3	<0.01			.12	
696	Bauxite, Surinam	80	54.5	(0.004)			.018	
697	Bauxite, Dominican	80	45.8	(.015)			.71	
698	Bauxite, Jamaican	80	48.2	(.008)			.62	
120b	Phosphate Rock, Florida	90	1.06			0.002	49.40	2.79
277	Tungsten Concentrate	100		Ta (0.20)			Ca (0.37)	
113a	Zinc Concentrate	100			0.78		1.1_9	
329	Zinc Concentrate	100			.14		0.08	

SRM	Cu	Cr_2O_3	F	In	Total Fe	Fe_2O_3	Pb	MgO	MnO
27f					65.97			0.019	0.011
690					66.85			.18	.23
691					(*)			(*)	(*)
692					59.58			.035	.46
693					65.11			.013	.091
69b		0.011				7.14		.085	.09
696		.047				8.70		.012	.004
697		.100				20.0		.18	.41
698		.080				19.6		.058	.38
120b			3.84			1.10		.28	.032
277		Nb (1.00)			(7.4)		(0.07)		Mn (10.0)
113a	031			ND	2.08		2.80	.75	
329	$.13_2$			0.019	12.9_4		6.0_6	$.16_5$	

*To be certified.

SRM	P	P_2O_5	K_2O	SiO_2	Ag	Na_2O	S	SO_3	TiO_2
27f	0.041		0.008	4.17		0.012	0.005		0.019
690	.011		.0030	3.71		.003	.003		.022
691	(*)		(*)	(*)		(*)	(*)		(*)
692	.039		.039	10.14		.008	.005		.045
693	.056		.0028	3.87		.0028	.005		.035
69b		0.012	.80	13.4		.030		0.63	2.0
696		.050	.009	3.79		(.007)		.21	2.64
697		.97	.062	6.81		(.036)		.13	2.52
698		.37	.010	0.69		(.015)		.22	2.38
120b		34.57	.12	4.68		.35			0.15
277	(.03)			Si (0.85)			(.25)	O_2 (21.4)	Ti (2.2)
113a				(1.54)	0.046_7		(30.6)		
329				(0.61)	.0089		(31.7)		

SRM	U	V_2O_5	WO_3	Zn	ZnO	ZrO_2	Loss on ignition	Moisture
27f								
690								
691								
692								
693								
69b		0.03			0.003		27.22	
696		.063			.0014	0.14	29.9	
697		.072			.037	.065	22.1	
698		.064			.029	.061	27.3	
120b	128.4μg/g							
277		Mo (0.06)	67.4		Sn (0.54)			
113a				57.3				0.08
329				45.5				.4[5]

Minerals, Refractories, Glasses, and Carbides

These SRM's are supplied in the form of powders, usually less than 0.15 mm. They are intended to provide materials for checking the accuracy of methods used in the analysis of similar materials, primarily in the glass, ceramics, and steel industries.

Minerals

SRM	Type	Wt/ Unit (grams)	Chemical Composition (Normal Weight Percent as the Oxide)					
			SiO_2	Fe_2O_3	Al_2O_3	TiO_2	MnO	CaO
1c	Limestone, argillaceous*	50	6.84	0.55	1.30	0.07	0.025	50.3
88a	Limestone, dolomitic	50	1.20	.28	0.19	.02	.03	30.1
70a	Feldspar, potash	40	67.1	.075	17.9	.01		0.11
99a	Feldspar, soda	40	65.2	.065	20.5	.007		2.14
97a	Clay, flint	60	43.7	.45	38.8	1.90		0.11
98a	Clay, plastic	60	48.9	1.34	33.2	1.61		.31
81a	Glass sand	75		0.082	0.66	0.12		
165a	Glass sand (low iron)	75		.012	.059	.011		
154b	Titanium dioxide	90				99.74		

*Information values only: S (0.1); SO_3 (0.1); F (0.009); and Cl (0.004).

SRM	SrO	MgO	Cr_2O_3	Na_2O	K_2O	Li_2O	ZrO_2	BaO	Rb_2O	P_2O5	CO_2	Loss on Ignition
1c	0.030	0.42		0.02	0.28					0.04		39.9
88a	.010	21.3		.01	.12					.01	46.6	46.7
70a				2.55	11.8			0.02	0.06			0.40
99a		0.02		6.2	5.2			.26		.02		.26
97a	.18	.15	0.03	0.037	0.50	0.11	0.063	.078		.36		13.32
98a	.039	.42	.03	.082	1.04	.070	.042	.03		.11		12.44
81a			*46μg/g*				.034					
165a			*(1.1 μ/g)*				.006					
154b												

Refractories

SRM	Type	Wt/ Unit (grams)	Chemical Composition (Nominal Weight Percent as the Oxide)							
			SiO_2	Al_2O_3	Fe_2O_3	FeO	TiO_2	ZrO_2	MnO	P_2O_5
76a	Burnt Refractory (Al_2O_3–40%)	75	54.9	38.7	1.6[b]	.....	2.0[3]	(0.15)	.....	0.12[b]
77a	Burnt Refractory (Al_2O_3–60%)	75	35.0	60.2	1.0[b]	.....	2.6[6]	(.21)	.....	.092
78a	Burnt Refractory (Al_2O_3–70%)	75	19.4	71.7	1.2	.....	3.2[2]	(.31)	.....	1.3
103a	Chrome refractory	60	4.6	29.96	.....	12.43	0.22	.01	0.11	0.01
198	Silica refractory	45	.....	0.16	0.66	.....	.02	<.01	.008	.022
199	Silica refractory	45	.....	.48	.74	.....	.06	.01	.007	.015

SRM	Cr_2O_3	CaO	MgO	Li_2O	Na_2O	K_2O	SrO	Loss on Ignition
76a	.....	0.22	0.52	0.042	0.07	1.33	0.037	(0.34)
77a	.....	.05	.38	.02[5]	.037	0.09[6]	.009	(.22)
78a	.....	.11	.70	.12	.078	1.22	.25	(.42)
103a	32.06	.69	18.54	.....	.....	.....	.....	.....
198	.....	2.71	0.07	.001	.012	0.017	.....	.21
199	.....	2.41	.13	.002	.015	.094	.....	.17

Glasses

SRM	Type	Unit Size	Chemical Composition (Nominal Weight Percent)							
			SiO_2	PbO	Al_2O_3	Fe_2O_3	ZnO	MnO	TiO_2	ZrO_2
89	Lead-Barium	45 g	65.35	17.50	0.18	0.049	.....	0.088	0.01	0.005
91	Opal	45 g	67.53	0.097	6.01	.081	0.08	.008	.019	.0095
92	Low-Boron	45 g	.....	.....	.....	.....	.....	.....	.....	.....
93a	High-Boron	Wafer 32 mm D × 6 mm	80.8	.....	2.3	.029	.....	.....	.012	.03
620	Soda-Lime, Flat	3 platelets	.....	.....	.....	.....	.....	.....	.....	.....
	.....	35 × 35 × 3 mm	72.1	.....	1.8	.04	.....	.....	.02	.....
621	Soda-Lime, Container	3 disks	.....	.....	.....	.....	.....	.....	.....	.....
	.....	38 mm D × 5 mm	71.14	.....	2.77	.040	.....	.....	.014	.009
1830	Soda-Lime Float	(in prep.)	.....	.....	.....	.....	.....	.....	.....	.....
1831	Soda-Lime Float	(in prep.)	.....	.....	.....	.....	.....	.....	.....	.....

SRM	CaO	BaO	MgO	K_2O	Na_2O	B_2O_3	P_2O_5	As_2O_5	As_2O_3	SO_3	Cl	F	Loss on Ignition
89	0.21	1.40	0.03	8.40	5.70	.....	0.23	0.36	0.03	0.03	0.05	.....	0.32
91	10.48	.....	.008	3.25	8.48	.....	.022	.102	.091	.....	.014	5.72	.....
92	.....	.....	.....	.....	.....	0.70	.....	.....	.....	.....	.....	.....	.....
93a	<0.02	.....	<.01	0.01	4.0	12.6	.....	.....	.....	.....	.....	.....	.....
620	7.1	.....	3.7	.4	14.4	.....	.....	.....	.06	.3	.....	.....	.....
621	10.71	0.12	0.27	2.01	12.71	.....	.....	.....	.03	.13	.....	.....	.....

Carbides

SRM	Type	Wt/ Unit (grams)	Total Carbon (Wt. %)
276a	Tungsten Carbide	75	6.11

Cements

These SRM's are furnished for x-ray spectroscopic analysis and for chemical analysis of cements and related materials. Because these SRM's are hygroscopic, each unit consists of three sealed vials each containing approximately 5 g of material.

SRM	Type	Wt/Unit (grams)	Chemical Composition (Nominal Weight Percent)					
			CaO	SiO_2	Al_2O_3	Fe_2O_3	SO_3	MgO
633	Portland cement (red)	15	64.5_0	21.8_8	3.7_8	4.20	2.2_0	1.0_4
634	Portland cement (gold)	15	62.5_8	20.7_3	5.2_1	2.84	2.2_1	3.3_0
635	Portland cement (blue)	15	59.8_3	18.4_1	6.2	2.61	7.0_7	1.2_3
636	Portland cement (yellow)	15	63.5_4	23.2_2	3.0_2	1.61	2.3_1	3.9_5
637	Portland cement (pink)	15	66.0_4	23.0_7	3.2_8	1.80	2.3_8	0.6_7
638	Portland cement (green)	15	62.0_9	21.4_8	4.4_5	3.55	2.3_4	3.8_3
639	Portland cement (clear)	15	65.7_6	21.6_1	4.2_8	2.40	2.4_8	1.2_6

SRM	K_2O	TiO_2	Na_2O	SrO	P_2O_5	Mn_2O_3	F	ZnO	Cr_2O_3	Loss on Ignition
633	0.17	0.24	0.64	0.31	0.24	0.04	0.08	0.01	0.01	0.7_5
634	.42	.29	.15	.12	.10	.28	.08	.02	.08	1.6_2
635	.45	.32	.07	.21	.17	.09	.04	.01	.01	3.2_4
636	.59	.18	.11	.04	.08	.12	.06	.03	.01	1.1_6
637	.25	.21	.15	.09	.24	.06	.04	.01	.01	1.6_9
638	.59	.25	.13	.07	.06	.05	.04	.10	.01	0.9_5
639	.06	.32	.65	.15	.08	.08	.02	.01	.01	1.0_6

Trace Element Standards

The SRM's listed below were designed for trace chemical analysis, specifically for calibrating instruments and checking analytical techniques and procedures used to determine trace elements in various inorganic matrices. In addition many SRM's certified for chemical composition have one or more constituents certified or below the 100 μg/g level. Some SRM's in the following categories may be of use of in trace analytical work:

Steels (pages 18–30); High Purity Metals (page 41); Non ferrous alloys (pages 31–40); Environmental Standards (page 47); and Biological Standards (page 45).

SRM	Type-Matrix	Size	Unit of Issue
607	Trace Elements in Feldspar		5 gram.
608	Trace Elements in Glass, Set	Wafers 3 mm thick	Set: 2 each 614 and 616.
609	Trace Elements in Glass, Set	Wafers 1 mm thick	Set: 2 each 615 and 617.
610	Trace Elements in Glass, 500 ppm	Wafers 3 mm thick	6 Wafers.
611	Trace Elements in Glass, 500 ppm	Wafers 1 mm thick	6 Wafers.
612	Trace Elements in Glass, 50 ppm	Wafers 3 mm thick	6 Wafers.
613	Trace Elements in Glass, 50 ppm	Wafers 1 mm thick	6 Wafers.
614	Trace Elements in Glass, 1 ppm	Wafers 3 mm thick	6 Wafers.
615	Trace Elements in Glass, 1 ppm	Wafers 1 mm thick	6 Wafers.
616	Trace Elements in Glass, 0.02 ppm	Wafers 3 mm thick	6 Wafers.
617	Trace Elements in Glass, 0.02 ppm	Wafers 1 mm thick	6 Wafers.
618	Trace Elements in Glass, Set	Wafers 3 mm thick	Set: 1 each 610, 612, 614 and 616.
619	Trace Elements in Glass, Set	Wafers 1mm thick	Set: 1 each 611, 613, 615 and 617.

NOTE: Glass—Nominal Composition: 72% SiO_2, 12% CaO, 14% Na_2O, and 2% Al_2O_3.

Trace Element Standards (Nominal Concentrations)

Element	607 (ppm)	610–611 (ppm)	612–613 (ppm)	614–615 (ppm)	616–617 (ppm)
Antimony				(1.06)	(0.078)
Barium			(41)		
Boron		(351)	(32)	(1.30)	(0.20)
Cerium			(39)		
Cobalt		(390)	(35.5)	0.73	
Copper		(444)	(37.7)	1.37	(0.80)
Dysprosium			(35)		
Erbium			(39)		
Europium			(36)	(0.99)	
Gadolinium			(39)		
Gallium				(1.3)	(0.23)
Gold		(25)	(5)	(0.5)	(0.18)
Iron		458	51	13.5	(11)
Lanthanum			(36)	(0.83)	(0.034)
Lead		426	38.57	2.32	1.85
Manganese		485	(39.6)		
Neodymium			(36)		
Nickel		458.7	38.8	(0.95)	
Potassium		(461)	(64)	30	29
Rubidium	523.90	425.7	31.4	0.855	0.100
Samarium			(39)		
Scandium				(0.59)	(0.026)
Silver		(254)	22.0	0.42	
Strontium	65.485	515.5	78.4	45.8	41.72
Thallium		(61.8)	(15.7)	(0.269)	(0.0082)
Thorium		457.2	37.79	0.748	0.0252
Titanium		(437)	(50.1)	(3.1)	(2.5)
Uranium		461.5	37.38	0.823	0.0721
Ytterbium			(42)		
Zinc		(433)			

In addition to the 36 elements listed above, the Glass SRM's contain the following 25 elements: As, Be, Bi, Cs, Cl, F, Ge, Hf, Hg, Li, Lu, Mg, Nb, P, Pr, Se, S, Te, Tb, Tm, Sn, W, V, Y, and Zr.

Special Nuclear Materials

These SRM's are available to DOE contractors, NRC or State Licensees, and foreign governments that have entered an Agreement for Cooperation with the U.S. Government concerning the Civil Uses of Atomic Energy. The purchase request for these SRM's must be made on special forms obtainable from the Office of Standard Reference Materials, Room B311, Chemistry Building, National Bureau of Standards, Washington, D.C. 20234.

Plutonium Assay Standards

SRM	Type	Certified for	Wt/unit (grams)	Purity (percent)
944	Plutonium sulfate tetrahydrate	Plutonium Content	0.5	*47.50
945	Plutonium metal, standard matrix	Impurities	5	(99.9)
949e	Plutonium metal assay	Plutonium Content	†0.5	99.996
996	Plutonium—244 Spike	IN PREP		

*Stoichiometric †Nominal weight (Values in parentheses are not certified, but are given for information only.)

Plutonium Isotopic Standards

SRM	Type	Wt/units (grams)	Atom Percent				
			^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{242}Pu
946	Plutonium Sulfate Tetrohydrate	0.25	0.247	83.128	12.069	3.991	0.565
947	Plutonium Sulfate Tetrohydrate	.25	.296	75.696	18.288	4.540	1.180
948	Plutonium Sulfate Tetrohydrate	.25	.011	91.574	7.914	0.468	0.0330

Uranium Assay Standards

SRM	Type	Certified for	Wt/ unit (grams)	Purity (percent)
950b	Uranium Oxide	Uranium Oxide	25	99.968 (U_3O_8)
960	Uranium Metal	Uranium	26	99.975 (U)
993	Uranium—235 Spike (solution)	Uranium	15	99.8195 (U–235)
995	Uranium—233 Spike (solution)	Uranium	10	99.9245 (U–233)

Uranium Isotopic Standards

SRM	Uranium Oxide (U_3O_8)	Wt (grams)	Atom Percent			
			^{234}U	^{235}U	^{236}U	^{238}U
U–0002	Depleted	1.0	0.00016	0.01755	<0.00001	99.9823
U–005	Depleted	1.0	.00218	.4895	.0046	99.504
U–010	Enriched	1.0	.00541	1.0037	.00681	98.984
U–015	Enriched	1.0	.00850	1.5323	.0164	98.443
U–020	Enriched	1.0	.0125	2.038	.0165	97.933

SRM	Uranium Oxide (U_3O_8)	Wt (grams)	Atom Percent			
			^{234}U	^{235}U	^{236}U	^{238}U
U-030	Enriched	1.0	.0190	3.046	.0204	96.915
U-050	Enriched	1.0	.0279	5.010	.0480	94.915
U-100	Enriched	1.0	.0676	10.190	.0379	89.704
U-150	Enriched	1.0	.0993	15.307	.0660	84.528
U-200	Enriched	1.0	.1246	20.013	.2116	79.651
U-350	Enriched	1.0	.2498	35.190	.1673	64.393
U-500	Enriched	1.0	.5181	49.696	.0755	49.711
U-750	Enriched	1.0	.5923	75.357	.2499	23.801
U-800	Enriched	1.0	.6563	80.279	.2445	18.820
U-850	Enriched	1.0	.6437	85.137	.3704	13.848
U-900	Enriched	1.0	.7777	90.196	.3327	8.693
U-930	Enriched	1.0	1.0812	93.336	.2027	5.380
U-970	Enriched	1.0	1.6653	97.663	.1491	0.5229

Neutron Density Standard

This SRM is provided as a reference source of a cobalt-in-aluminum alloy to serve as a neutron density monitor wire SRM. Accurate determination of thermal neutron densities is essential in irradiation tests to obtain a basis for comparison of densities among reactors, in applying data in the design of reactors, in understanding the mechanisms of radiation damage, and for use in neutron activation analysis. The wire is 0.5 mm in diameter and 1 meter long.

SRM	Type	Cobalt Content (Weight percent)
953	Neutron density monitor wire (Co in Al)	0.116

Fission Track Glass Standards

These SRM's, at four uranium concentration levels, will aid fission track laboratories in interlaboratory comparisons of data and in monitoring neutron flux for irradiations. The fission track glass standards are certified for the neutron flux ($n \cdot cm^{-2} \cdot sec^{-1}$) that induced uranium fission in selected wafers. The materials were irradiated in the NBS 10 Megawatt Research Reactor, at two different neutron energies.

Each SRM unit contains four unirradiated glass wafers and two irradiated wafers.

SRM	Total U concentration; ppm (by weight)	^{235}U Atom Percent	Irradiation time (sec.)
961	461.5	0.2376	RT-3 8 RT-4 12
962a	IN PREP		
963a	IN PREP		
964	0.0721	0.616	RT-3 360 RT-4 540

Isotopic Reference Standards

The isotopic composition of these SRM's has been determined by mass spectrometry, by comparison with mixtures prepared from high-purity separated isotopes: They are useful for those looking for small variations in the isotopic composition of the elements, and for the evaluation of mass discrimination effects encountered in the operation of mass spectrometers.

SRM	Isotopic Reference Standards	Element Certified	Wt/Unit (grams)
951	Boric Acid	Boron	100
952	Boric Acid, 95% Enriched ^{10}B	Boron	0.25
975	Sodium Chloride	Chlorine	.25
976	Copper Metal	Copper	.25
977	Sodium Bromide	Bromine	.25
978	Silver Nitrate	Silver	.25
979	Chromium Nitrate	Chromium	.25
980	Magnesium Metal	Magenesium	.25
*981	Lead Metal, Natural	Lead	1.0
*982	Lead Metal, Equal Atom (206/208)	Lead	1.0
*983	Lead Metal, Radiogenic (92%–206)	Lead	1.0
984	Rubidium Chloride, assay and isotopic	Rubidium	0.25
987	Strontium Carbonate, assay and isotopic	Strontium	1.0
989	Rhenium, assay and isotopic	Rhenium	pkg. (50)
990	Silicon, assay and isotopic	Silicon	wafer, 3 cm D × 0.2 cm
991	Lead-206 Spike, assay and isotopic	Lead	15
**993	Uranium-235 Spike, assay and isotopic (Solution)	Uranium	15
995	Uranium-233 Spike, assay and isotopic (Solution)	Uranium	10

*Sold as a set only of three 981, 982, and 983.
**Special Nuclear forms required.

CERTIFIED PHYSICAL PROPERTIES STANDARDS

Ion Activity Standards

These SRM's are intended for use in the preparation of solutions for the calibration of specification electrodes. This include the pH and pD measuring systems.

pH Standards

These SRM's are furnished as crystals for the preparation of solutions of known hydrogen ion concentration for calibrating and checking the performance of commercially available pH materials and instruments. They are furnished with certificates giving directions for preparation of the solutions and tables of pH values at various temperatures.

SRM's 186Ic and 186IIc, 191 and 192, and 922 and 923, are certified for use in admixture only. At an equimolar (0.025 molal) mixture of SRM's 186Ic and 186IIc, a pH(S) of 6.863 at 25°C is obtained. Directions also are furnished for the preparation of a physiological reference solution from 186Ic and 186IIc having a pH(S) of 7.415 at 25°C.

SRM	Type	pH(S)(at 25 °C)	Wt/Unit (grams)
185e	Postassium acid phthalate	4.004	60
186Ic	Postassium dihydrogen phosphate	6.863	30
186IIc	Disodium hydrogen phosphate	7.415	30
187b	Borax	9.183	30
188	Postassium hydrogen tartrate	3.557	60
189	Postassium tetroxalate	1.679	65
191	Sodium bicarbonate	10.01	30
192	Sodium carbonate		30
922	Tris(hydroxymethyl)aminomethane	7.699	25
923	Tris(hydroxymethyl)aminomethane hydrochloride		35

pD Standards

These SRM's are furnished as crystals for preparation of solutions of known deuterium-ion concentration for the calibration and correction of pH indicating equipment to indicate pD data. SRM's 2186I and 2186II, and 2191 and 2192, are certified for use in admixtures only.

SRM	Type	pD(S) Values	Wt/Unit (grams)
2186I	Potassium dihydrogen phosphate	7.43	30
2186II	Disodium hydrogen phosphate		30
2191	Sodium bicarbonate	10.74	30
2192	Sodium carbonate		30

Ion-Selective Electrodes

These SRM's are certified for the calibration of ion-selective electrodes and have conventional ionic activities based on the Stokes-Robinson hydration theory for ionic strengths greater than 0.1 mole per liter.

SRM	Type	Certified Property	Wt/Unit (grams)
2201	Sodium Chloride	pNa, pCl	125
2202	Potassium Chloride	pK, pCl	160
2203	Potassium Fluoride	pF	125

Mechanical and Metrology Standards

Scanning Electron Microscope Standards

These SRM's are for use in calibrating the magnification scale and for evaluating the resolution and performance of an SEM. SRM 484b has spacings of 1, 2, 3, 5 and 50 mm and can be used to calibrate the magnification scale of an SEM from 1000 to 20,000 X to an accuracy of 5 percent or better. This standard is a metallographic cross-section of alternate layers of electro deposited gold and nickel, encapsulated in copper-filled epoxy, and mounted within a section of stainless steel tubing. If the surface of this SRM were etched by de sputtering, it would be useful for calibrating optical microscopes. SRM 469 is a small bead (about 5 mm in diameter) of an aluminum-tungsten alloy that has a fine dendritic surface suitable for both high and low resolution testing. This structure has high secondary electron emission, high contrast, and spacings varying from about 20 to 200 nm. This bead is non-magnetic, vacuum clean, has no adverse reaction in the electron beam, needs no surface preparation or coating, and can be used repeatedly. Extracted replicas of the dendritic structure have been used to test transmission electron microscopes (TEM).

SRM	Type	Spacings	Size
469	SEM Resolution Test Specimen	0.02 to 0.2 mm	5-mm bead
484b	SEM Magnification Standard	1, 2, 3, 5 and 50 mm	6.5 × 11 mm tube

Optical Microscope Linewidth-Measurement Standard

This SRM is for use in calibrating optical microscopes used to measure the widths of opaque lines and clear spaces on integrated-circuit photomasks. It can also be used to calibrate line spacings and line-to-space ratios. The accuracy of a measured linewidth or line spacing on SRM 474 is ± 0.05 mm or better. Recommended procedures are provided with each SRM for the adjustment and calibration of measurement systems using transmitted illumination, including filar, image shearing, and video micrometer. SRM 474 is an anti-reflective chromium photoplate on a borosilicate glass substrate. This SRM is not recommended for use with partially transmitting materials or in reflected light with opaque materials and it should not be used in a scanning electron microscope.

SRM	Type	Spacings	Size
474	Linewidth Measurement Standard	0.5 to 10 mm	6.4 × 6.4 × 0.2 cm.

Coating Thickness Standards

These SRM's have a specimen size of 3 X 3 cm and are for calibrating coating thickness gages of the magnetic type for the measurement of thickness of nonmagnetic coatings on steel, nickel on steel, or nickel on nonmagnetic substrates. The steel substrates have the magnetic properties of AISI 1010 steel and the nickel coatings have the magnetic properties of an annealed, Watts nickel electrodeposit free of cobalt and iron.

The magnetic type thickness gages are often used to measure the thickness of paint and other organic coatings on steel, as well as zinc (galvanized) and other nonmagnetic metallic coatings. The number of different thicknesses required for these calibrations depends on the type of gage and the coating thicknesses to be measured.

The magnetic type thickness gages can be used to estimate magnetic properties of austenitic stainless steel weld metal. Because the magnetic properties of the weld metal are closely related to the ferrite content of the weld, these instruments are used to estimate the ferrite content. For these measurements, the coating thickness SRM 1370a is used to calibrate the instrument. The ferrite contents having magnetic properties similar to those of the various coating thickness SRM's have been established by other laboratories.

SRM's with gold and tin coatings on various substrates have a specimen size of 15 X 15 mm and are for calibrating coating thickness gages of the beta-backscatter type and for calibrating x-ray fluorescence methods for the measurement of the weight per unit area of gold or tin coatings.

The gold coating standards were measured by beta-ray backscatter and x-ray fluorescence techniques relative to NBS gold coating materials for which the average weights per unit area were determined by weight and area measurements. They are suitable for the direct calibration of equipment used to measure weight per unit area of gold coating of equivalent purity. From the density and weight per unit area, the instruments can be calibrated in terms of the thickness of the standard.

For the tin coating standards, x-ray fluorescence techniques were used to measure the thickness of the tin coating relative to NBS tin coating material for which the average weights per unit area were determined by weight and area measurements.

ASTM Methods of Measuring Coating Thickness

Instrumental methods of measuring coating thickness are set forth in the following ASTM Methods of Test:

B244 Measuring Thickness of Anodic Coatings on Aluminum with Eddy-Current Instruments.

B487 Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section.

B499 Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals.

B504 Measuring the Thicknesses of Metallic Coatings by the Coulometric Method.

B530 Measurement of Coating Thicknesses by the Magnetic Method: Electrodeposited Nickel Coatings on Magnetic and Nonmagnetic Substrates.

B567 Measurement of Coating Thickness by the Beta Backscatter Method.

B568 Measurement of Coating Thickness by X-Ray Spectrometry.

E376 Recommended Practice for Measuring Coatings on Thickness by Magnetic-Field or Eddy-Current (electro-magnetic) Test Methods.

D1186 Measurement of Dry Film Thickness of Nonmagnetic Organic Coatings Applied on a Magnetic Base.

D1400 Measurement of Dry Film Thickness of Nonmetallic Coatings of Paint, Varnish, Lacquer, and Related Products Applied on a Nonmagnetic Metal Base.

G12 Nondestructive Measurement of Film Thickness of Pipeline Coatings on Steel.

Nonmagnetic Coating on Magnetic Substrate (Copper and Chromium on Steel).

SRM	Unit Size	Nominal Coating Thickness—	
		micrometer	milliinch (mil)
1301a	Set of 4	2.5	0.10
1302a	Set of 4	6	.24
1303a	Set of 4	12	.5
1304a	Set of 4	20	.8
1305a	Set of 4	25	1.0
1306a	Set of 4	40	1.6
1307a	Set of 4	50	2.0
1308a	Set of 4	65	2.6
1310a	Set of 4	80	3.1
1311a	Set of 4	140	5.5
1312a	Set of 4	200	7.9
1313a	Set of 4	250	9.8
1314a	Set of 4	400	16
1351a	Set of 4: 2 each	50	2.0
		40	5.5
1361a	Set of 4	6	0.24
		12	.5
		25	1.0
		50	2.0
1362a	Set of 4	40	1.6
		80	3.1
		140	5.5
		200	7.9
1363a	Set of 4	250	9.8
		400	16
		500	20
		650	26

SRM	Unit Size	Nominal Coating Thickness—	
		micrometer	milliinch (mil)
1364a	Set of 4	820	32
		1000	39
		1500	59
		2000	79
1370a	Set of 8	200	7.9
		250	9.8
		400	16
		500	20
		650	26
		820	32
		1000	39
		1500	59

Magnetic Coating on Magnetic Substrate (Nickel on Steel)

SRM	Unit Size	Nominal Coating Thickness	
		micrometer	milliinch (mil)
1352a	Set of 4: 2 each	9	0.35
		20	.8
1353a	Set of 4: 2 each	25	1.0
		60	2.4
1365a	Set of 4: 1 each	3	0.1
		9	.4
		15	.6
		20	.8
1366a	Set of 4: 1 each	25	1.0
		35	1.4
		40	1.6
		50	2.0

Magnetic Coating on Non-Magnetic Substrate (Nickel and Chromium on Brass)

SRM	Unit Size	Nominal Coating Thickness	
		micrometer	milliinch (mil)
1367a	Set of 4: 1 each	3	0.12
		9	.35
		16	.6
		25	1.0

Gold Coating on Glass Sealing Alloy—ASTM Designation F15; Fe–53, Ni–29, and Co–17

SRM	Unit Size	Nominal Coating Weight (mg/cm^2)	Nominal Coating Thickness	
			micrometer	microinch
1398a	Set of 4: 1 each	1.5	0.8	30
		3.0	1.5	60
		6.0	3	120
		14.0	7	280

Gold Coating on Nickel

SRM	Unit Size	Nominal Coating Weight (mg/cm^2)	Nominal Coating Thickness	
			micrometer	microinch
1384a	Set of 4: 2 each	1.5	0.8	30
		3.0	1.5	60
1399a	Set of 4: 1 each	1.5	0.8	30
		3.0	1.5	60
		6.0	3	120
		17.0	9	350

Gold Coating on Copper-Clad, Glass-Epoxy Laminate

SRM	Unit Size	Nominal Coating Weight (mg/cm^2)	Nominal Coating Thickness	
			micrometer	microinch
2308a	Set of 4: 1 each	1.5	0.8	30
		3.0	1.5	60
		6.0	3	120
		14.0	7	280

Gold Coating on Copper

SRM	Unit Size	Nominal Coating Weight (mg/cm^2)	Nominal Coating Thickness	
			micrometer	microinch
2318a	Set of 4: 1 each	1.5	0.8	30
		3.0	1.5	60
		6.0	3	120
		14.0	7	280

Tin Coating on Steel

SRM	Unit Size	Nominal Coating Weight (mg/cm^2)	Nominal Coating Thickness	
			micrometer	microinch
2338a	Set of 4: 2 each	2.0	2.8	110
		12.0	16.5	650
2339a	Set of 4: 1 each	1.1	1.5	60
		3.0	4.1	160
		5.0	7	280
		14.0	19	750

SRM	Type	Unit of Issue
622	Soda-lime-silica	2.2 kg.
623	Borosilicate	2.2 kg.
624	Lead-silica, for dc resistivity	200 g.
708	Lead-silica glass A	625 g.
	Borosilicate glass B	275 g.
709	Extra dense lead	500 g.
710	Soda-lime silica glass-type 523/586	2 lb.
711	Lead-silica glass-type 617/366	3 lb.
712	Mixed alkalai lead silicate glass, ¼ in patties (6 pcs.)	0.5 lb.
713	Dense barium crown 620/603 glass, 1⅜ in diam × ⅝ in thick gobs (4 pcs.)	.5 lb.
714	Alkaline earth alumina silicate glass, ¼ in diam cane (16 pcs—6 in long)	.5 lb.
715	Alkalai-free aluminosilicate glass, ¼ in diam cane (13 pcs—6 in long)	200 g
716	Neutral (borosilicate) glass, ½ in diam cane (6 pcs—6 in long)	250 g.
717	Borosilicate glass, 4.2 cm × 4.2 cm × 12.5 cm bar	500 g.
723	Soda-lime-silica, for liquidus temperature, 2.5 × 2.5 × 0.6 cm	60g.

Chemical Resistance (Durability) of Glass

These SRM's are certified for use in checking test methods and for calibrating equipment used to determine the resistance of glass containers to chemical attack. The values given in the table represent the volume of fiftieth-normal sulfuric acid used to titrate to the methyl-red end point the alkaline extract from a crushed sample of glass after exposure to high-purity water at 121 °C.

SRM	Type	mL of N/50 H_2SO_4
622	Soda-lime-silica	7.67
623	Borosilicate	0.34

Electrical Volume Resistivity

This SRM is certified for use in checking test methods and for calibrating equipment used to determine the dc volume resistivity of glass in accordance with ASTM C 657–72.

SRM	Type	Log_{10} Electrical Volume Resistivity	Temperature, °C
624	Lead-silica	11.07 Ω·cm	250
		9.88 Ω·cm	300
		8.88 Ω·cm	350

Glass Viscosity Standards

SRM's 710, 711, and 717 are furnished as rectangular-shaped bars, and are certified for viscosity between values of 10^2 and 10^{12} poises. They are furnished to check the performance of high-temperature viscosity equipment (rotating cylinders) and low-temperature viscosity equipment (fiber elongation, beam-bending, parallel-plates, etc.)

SRM	Temperature (°C) at Viscosity (poises)										
	10^2	10^3	10^4	10^5	10^6	10^7	10^8	10^9	10^{10}	10^{11}	10^{12}
710	1434.3	1181.7	1019.0	905.3	821.5	757.1	706.1	664.7	630.4	601.5	576.9
711	1327.1	1072.8	909.0	794.7	710.4	645.6	594.3	552.7	518.2	489.2	464.5
717	1545.1	1248.8	1059.4	927.9	831.2	757.1	698.6	651.1	611.9	579.0	550.9

Glass Viscosity Fixpoints

SRM	Type of Glass	Softening Point °C	Annealing Point °C	Strain Point °C
709	Extra Dense Lead	384	328	311
710	Soda Lime-Silica	724	546	504
711	Lead-Silica	602	432	392
712	Alkali Lead Silicate	528	386	352
713	Dense Barium Crown	738	631	599
714	Alkaline Earth Alumina Silicate	908	710	662
715	Alkali-Free Aluminosilicate	961	764	714
716	Neutral	794	574	530
717	Borosilicate	720	516	471

Relative Stress Optical Coefficient

Three glasses have been certified for relative stress optical coefficient. These glasses will be used to check calibrations of instruments to measure this property, especially by the methods of test proposed by ASTM C770–73T. The glasses are in rectangular-shaped bars.

SRM	Type of Glass	Relative Stress Optical Coefficient at $\lambda = 546.1$ nm
708	Lead-Silica	Glass A $C = 2.857$ Brewsters, 10^{-12} m²/N
	Borosilicate	Glass B $C = 3.652$ Brewsters, 10^{-12} m²/N
709	Extra Dense Lead	$C = -1.359$ Brewsters, 10^{-12} m²/N

Glass Liquidus Temperature

This SRM is certified for use in checking test methods and for calibrating equipment used to determine the liquidus temperature of glass by the gradient furnace methods in accordance with ASTM C829–76.

SRM	Type	Temperature, °C
773	Soda-lime-silica	990

Elasticity Standards

This SRM is polycrystalline alumina prepared from a single block of material by isostatically cold pressing and then sintering alumina powder containing 0.1 percent magnesium oxide. It is intended for the calibration of apparatus used in the measurement of resonance frequencies from which elastic moduli are calculated. Each bar has been individually measured and calibrated, and all surfaces were machined flat and parallel.

SRM	Type	Size
718	Polycrystalline Alumina	12.7×1.27×0.32 cm

Density Standards

SRM's 211c and 217c are certified for density (air saturated at 1 atm) at 20, 25, and 30° C; and may be used to calibrate pycnometers and density balances. [See also, Refractive Index, page 77, and Combustion Calorimetric Standards, page 71.]

SRM	Type	Density 20° C (g/mL)	Amount, mL
211c	Toluene	0.867	IN PREP
217c–5	2,2,4 Trimethlypentane	0.692	IN PREP

Polymer Standards

These materials are certified for the properties indicated in the table, such as weight and number average molecular weight, molecular weight distribution, limiting viscosity numbers (intrinsic viscosities) in several solvents, density, and melt flow.

These SRM's have wide application not only in the calibration of instruments used in polymer characterization, such as light scattering photometers, osmometers, gel permeation chromatographs, but also wherever a well characterized polymer material is needed, as for example in studies of dilute solution behavior, rheology, and polymer crystal physics.

SRM 1475 is accompanied by a series of papers, reprinted from the Journal of Research of the National Bureau of Standards, which describe how the measurements were obtained.

SRM	Type	Wt/Unit (grams)
705	Polystyrene, narrow molecular weight distribution, $M_w \approx 179{,}000$, $M_w/M_n \approx 1.07$	5
706	Polystyrene, broad molecular weight distribution, $M_w \approx 258{,}000$, $M_w/M_n \approx 2.1$	18
1475	Polyethylene, linear, $M_w \approx 52{,}000$, $M_w/M_n \approx 2.9$	50
1476	Polyethylene, branched	50
1478	Polystyrene, narrow molecular weight distribution, $M_w \approx 37{,}000$, $M_w/M_n \approx 1.04$	2
1479	Polystyrene, narrow molecular weight distribution, $M_w \approx 1{,}100{,}000$	2
1482	Polyethylene, linear, $M_w \approx 13{,}600$	2
1483	Polyethylene, linear, $M_w \approx 32{,}100$	5
1484	Polyethylene, linear, $M_w \approx 119{,}600$	2

The following table lists the properties (and method) certified for these SRM's.

Property	Method	705	706	1475	1476	1478	1479	1482	1483	1484
Molecular Weight:										
Weight Average	(Light Scattering)	X	X	X			X	X	X	X
	(Sedimentation Equilibrium)	X	X			X				
	(Gel Permeation Chromatography-GPC).			X						
Number Average	(Osmometry)	X				X		X	X	X
	(GPC)			X						
Molecular Weight Distribution	(GPC)			X						
Limiting Viscosity Number	(Capillary Viscometer)					X				
Toluene 25° C										
Benzene 25° C		X	X							
Benzene 35° C		X								
Cyclohexane 35° C		X	X							
1-Chloronaphthalene 130° C				X	X			X	X	X
1,2,4-trichlorobenzene 130° C				X	X			X	X	X
Decahydronaphthalene 130° C				X	X					
Melt Flow	(ASTM)			X	X					
Density	(ASTM)			X	X					
Heat Capacity	(Adiabatic)	X		X						

Rheology Standard

This SRM is intended for the calibration and checking of instruments used in polymer technology and science for the determination of rheological properties of polymer melts or solutions. It is certified for Rate of Shear, Viscosity, and First Normal Stress Difference at 25° C.

SRM	Type	Unit size
1490	Polyisobutylene Solution in Cetane	250 mL

Heat Standards

These SRM's are intended to relate heat and temperature measurements made in industrial, university, and government laboratories with the International Practical Temperature Scale-1968.[1]

Superconductive Thermometric Fixed Point Devices

Each device is composed of five small cylinders of high purity material mounted in a threaded copper stud and enclosed by a mutual inductance coil set. They should prove particularly valuable to users of ^{3}He-^{4}He dilution refrigerators, in which direct calibrations on the liquid helium vapor pressure-temperature scales are difficult, and to those who wish to determine the temperature reproducibility of physical phenomena or of cryogenic equipment.

SRM	Type	Material	Nominal Temperature (K)
767a	Superconductive Thermometric Fixed Point Device	Lead	7.2
		Indium	3.4
		Aluminum	1.2
		Zinc	0.8
		Cadmium	.5
768	Superconductive Thermometric Fixed Point Device (Low)	Gold-Indium	.205
		Gold-Aluminum	.157
		Iridium	.098
		Beryllium	.024
		Tungsten	.015

[1] "International Practical Temperature Scale of 1968," Metrologia, **5**, 535–44 (1969).

Freezing Point Standards

Defining Fixed Points—International Practical Temperature Scale

These SRM's are of such purity that they are suitable for defining fixed points for the International Practical Temperature Scale of 1968.

SRM	Type	Temperature °C	Wt/Unit (grams)
740	Zinc	419.58	350
741	Tin	231.9681	350

Determined Reference Points

These SRM's are intended for use in calibration of thermometers, thermocouples, and other temperature measuring devices. The temperatures certified are in accord with the International Practical Temperature Scale of 1968.

SRM	Type	Temperature °C	Wt/Unit (grams)
42g	Tin	231.967	350
43h	Zinc	*419.58	350
44f	Aluminum	660.3	200
45d	Copper	1084.8	450
49e	Lead	327.493	600
743	Mercury	−38.841	680

*SRM 43h is less pure than SRM 740 and has a freezing point 0.001 °C lower.

Melting Point Standards

SRM	Type	Temperature °C	Wt/Unit (grams)
742	Alumina, 99.9+%	2053	10
1968	Gallium, 99.9999+%	29.7723	25

[1] "International Practical Temperature Scale of 1968," Metrologia, 5, 535–44 (1969).

Calorimetric Standards

These SRM's are intended to relate the gain or loss of energy and work experienced during a chemical reaction or by change of temperature to the units of energy and work as defined by the National Measurement System. This system uses the units prescribed by the International System of Units (SI). The unit for energy and work under this system is the joule, which is related to the calorie by the equation: 4.184 joule = 1 calorie.

Combustion Calorimetric Standards

SRM	Type	Unit amount
39i	Benzoic acid, 26.4 absolute kilojoules/gram	30 g
217c–5	2,2,4-Trimethylpentane	IN PREP

Solution Calorimetric Standards

SRM	Type	Wt/Unit (grams)
724a	tris(hydroxymethyl)aminomethane	50
1654	α-Quartz for HF acid solution calorimetry	25
1655	Potassium Chloride	IN PREP

Heat Source Calorimetric Standards

SRM	Type	Wt/Unit (grams)
1651	Zirconium-barium chromate heat source powder (ca 350 cal/g)	50
1652	Zirconium-barium chromate heat source powder (ca 390 cal/g)	50
1653	Zirconium-barium chromate heat source powder (ca 425 cal/g)	50

Enthalpy and Heat Capacity Standards

SRM	Type	Range K	Unit Size
705	Polystyrene, powder	10–350	5g.
720	Sapphire, synthetic (Al_2O_3)	0–2250	15g.
729	Graphite, rod	300–2500	10 cm × 0.64 cm D.
781–D1	Molybdenum, sintered rod	273.15–2800	10 cm × 0.32 cm D.
781–D2	Molybdenum, sintered rod	273.15–2800	10 cm × 0.64 cm D.
782	Tungsten, rod	273–1200	10 cm × 0.32 cm D.
1475	Polyethylene, powder	5–360	50g.

Vapor Pressure Standards

These SRM's are intended for use in the testing and calibration of vapor pressure measurement apparatus and techniques.

SRM	Type	Pressure Range (atmosphere)	Temperature Range (K)	Unit Size
745	Gold	10^{-3} to 10^{-8}	1300–2100	Wire 1.44 mm × 152 mm.
746	Cadmium	10^{-4} to 10^{-11}	350–594	Rod 6.4 mm × 64 mm.
748	Silver	10^{-3} to 10^{-12}	800–1600	Rod 6.4 mm × 64 mm.

Conductivity Standards

This SRM is intended for use in calibrating eddy current devices for measuring the electrical conductivity of metals.

SRM	Type	Conductivity, %IACS
1456	Set of 4 aluminum alloy blocks, 4.5 × 4.5 ×1 cm	29, 41, 48 and 60

Resistivity Standards

These SRM's are intended for use calibrating instruments used to measure the electrical resistivity of silicon wafers using both four-probe and eddy current methods.

SRM	Type	Unit of Issue
1521	Boron Doped Silicon, 0.1 and 10 Ω•cm	Set of 2 wafers
1522	Phosphorous Doped Silicon (Power Device Level). 25.80, and 180 Ω•cm	Set of 3 wafers
1523	Boron Doped Silicon (Eddy Current Tester). 0.01 and 0.9 Ω•cm	Set of 2 wafers

Thermal Conductivity and Electrical Resistance Standards

These SRM's cover the high, medium, and low conductivity ranges. They will be useful for intercomparing thermal conductivity apparatus, debugging new apparatus, and calibrating comparative apparatus.

SRM	Type	Temperature Range (K)	Diameter (mm)	Length (mm)
1465	Tungsten, sintered	4–3000	3.2	50
1466	Tungsten, sintered	4–3000	6.4	50
1467	Tungsten, arc-cast	4–3000	8.3	50
1468	Tungsten, arc-cast	4–3000	10.2	50
1469	Tungsten, arc-cast	4–3000	12.7	50
1463	Electrolytic Iron	4–1000	6.4	305
1464	Electrolytic Iron	4–1000	31.8	152
1460	Stainless Steel	5–1200	6.4	50
1461	Stainless Steel	5–1200	12.7	50
1462	Stainless Steel	5–1200	34	50

Thermal Expansion Standards

These SRM's cover the temperature range from 20 to 2000 K having coefficients of thermal expansion over the range of 0.5 to 17 $\times$ 10^{-6} K.

SRM	Type	Temperature Range (K)	Diameter (mm)	Length (mm)
731–L1	Borosilicate Glass	80–680	6.4	51
731–L2	Borosilicate Glass	80–680	6.4	102
731–L3	Borosilicate Glass	80–680	6.4	152
732	Sapphire	293–2000	6.4	51
736a	Copper (IN PREP)	20–800	6.4	51
737	Tungsten	80–1800	6.4	51
738	Stainless Steel	293–900	6.4	51
739–L1	Fused Silica	80–1000	6.4	51
739–L2	Fused Silica	80–1000	6.4	102
739–L3	Fused Silica	80–1000	6.4	152

Thermocouple Materials

These SRM's are intended to serve as a convenient mechanism for the comparison of manufactured wire to standard reference thermocouple tables.

SRM	Type	Form
733	Silver-28 Atomic Percent Gold	Wire: 32AWG(0.2019 mm) diameter, 3 meters long.
1967	Platinum, High-Purity (99.999+%)	Wire: 0.51 mm diameter, 1 meter long.

Thermal Resistance Standards

This SRM is intended for use in calibrating, and verifying apparatus such as the guarded hot-plate (ASTM C177) and heat flow meter (ASTM C518) used to determine the thermal resistance of thermal insulation materials.

SRM	Type	Density	Temperature	Size
1450b	Fibrous Glass Board (IN PREP)			
1451	Fibrous Glass Batt	~13	255–330	60 × 60 × 2.54

*Smaller square can be supplied.

Magnetic Standards

Magnetic Susceptibility Standards

These SRM's are intended for use in the calibration of instruments used to measure magnetic susceptibility.

SRM	Type	Form/Unit
763–1	Aluminum	Cylinder 3 mm diameter × 3 mm.
763–2	Aluminum	Wire 0.5 mm diameter × 250 mm.
763–3	Aluminum	Rod 6 mm diameter × 175 mm.
764–1	Platinum	Cylinder 3 mm diameter × 3 mm.
764–2	Platinum	Wire 0.5 mm diameter × 50 mm.
765–1	Palladium	Cylinder 3 mm diameter × 3 mm.
765–2	Palladium	Wire 0.5 mm diameter × 50 mm.
765–3	Palladium	Sponge 1 gram
766–1	Manganese Fluoride	Cube 3 × 3 × 3 mm.

Magnetic Moment

This SRM is intended for the calibration of instruments used to measure magnetic moment.

SRM	Type	Size
772	Nickel Sphere	2.4 mm D.

Paramagnetic Resonance Standards

This SRM is intended for use in electron paramagnetic resonance (EPR) measurements for determining the number of active paramagnetic centers in a test sample. This SRM consists of two pieces of synthetic ruby.

SRM	Type	Form
2601	Crystalline Al_2O_3; Cr^{3+} (Ruby)	1.5 × 1.5 × 0.5 mm. 0.5 × 0.5 × 4 mm.

Optical Standards

Spectrophotometric Standards

Filters for Spectrophotometry and Luminescence

The spectrophotometric SRM's are intended primarily for use in verifying the accuracy of the transmittance scale of spectrophotometers. The luminescence SRM provides relative emission spectra to determine spectral responsivity and to verify the accuracy of spectrofluorimeters. All of these SRM's provide a means of interlaboratory comparison of data.

Glass Filters, SRM 930D, consists of three neutral glass filters. The glass filters have transmittances of approximately 10, 20, and 30 percent. Each filter is individually calibrated and certified for transmittance and transmission density at wavelengths of 440, 465, 546.1, 590, and 635 nm. The 546.1 nm wavelength coincides with the Mercury emission line.

Liquid Filters, SRM 931b, are absorbance standards for use in ultraviolet and visible spectrophotometry. This SRM consists of 3 sets of 4 vials, each containing a blank solution and three solutions of different concentrations of an absorbing liquid. Each vial contains approximately 10 mL of solution. The net absorbances are certified for each concentration at wavelengths 302, 395, 512, and 678 nm.

Quartz Cuvette, SRM 932, is an all-quartz rectangulr parallelepiped cuvette designed to fit the holder of conventional spectrophotometers. The distances between the parallel, optically-transparent windows are measured at 10 positions along the vertical axis. The cuvettes range in pathlength between 9.97 and 10.03 mm, and the inner surfaces of the opposite windows are parallel within ± 0.002 mm. Each cuvette is certified for pathlength and parallelism of the windows to within ± 0.0005 mm.

Potassium Dichromate, SRM 935, consists of crystalline potassium dichromate of established purity certified for use as an ultraviolet absorbance standard. Solutions made with this SRM in 0.001 N perchloric acid are certified for their apparent specific absorbances, ϵ_a, at 23.5°C and wavelengths of 235, 257, 313, 345, and 350 nm.

Quinine Sulfate Dihydrate, SRM 936, consists of powdered quinine sulfate dihydrate of known purity certified for use as a spectrofluorimetric emission standard. A solution made with this SRM in 0.1 N perchloric acid is certified for its molecular emission spectrum, E(λ) at 25.0°C over the wavelength range of 375.0 to 675 nm.

Didymium-Oxide Glass Filters, SRM's 2009, 2010, 2013 and 2014, are wavelength standards for use in checking the wavelength scale of spectrophotometers between 400 and 760 nm for bandpasses between 1.5 and 10.5 nm. SRM's 2009 and 2010 were batch calibrated whereas SRM's 2013 and 2014 were individually calibrated. SRM's 2009 and 2013 are approximately 1 cm wide by 3 cm high and are supplied in a holder which fits in the place of a standard analytical cuvette. SRM's 2010 and 2014 are in the form of squares approximately 5.1 cm by 5.1 cm.

Glass Filter, SRM 2030, consists of one neutral glass filter. It is intended as a reference source for one-point verification of the transmittance and absorbance scales of spectrophotometers at a wavelength of 465 nm and a nominal 30% transmittance.

Metal-on-Quartz Filters, SRM 2031, consists of three filters mounted in metal holders and an empty holder, all holders are equipped with shutters. Two of the filters have an evaporated layer of semitransparent metal sandwiched between two quartz plates that have been assembled by optical contact. The third filter consists of two clear quartz plates assembled by the same technique. Each filter is individually calibrated at 250, 280, 340, 360, 400, 465, 500, 546, 590 and 635 nm.

Potassium Iodide, SRM 2032, consists of crystalline KI of established purity for use as a stray light standard in the ultraviolet. Aqueous solutions made with this material are certified for their specific absorbance at 23.5°C over a wavelength range from 240 to 280 nm.

Potassium Iodide with Attenuator, SRM 2033, consists of the same material used for SRM 2032 plus a reference beam attenuator for extending the dynamic range of the stray light test.

SRM	Type	Unit
930D	Glass Filters for Spectrophotometry	Set: 3 filters, 4 holders
931c	Liquid Filters for Spectrophotometry	Set: 12 vials
932	Quartz Cuvette for Spectrophotometry	1 each
935	Crystalline Potassium Dichromate for Use as an Ultraviolet Absorbance Standard	15 grams
936	Quinine Sulfate Dihydrate	1 gram
2009	Didymium-oxide glass	1 filter in holder
2010	Didymium-oxide glass	51 × 51 mm
2013	Didymium-oxide glass	1 filter in holder
2014	Didymium-oxide glass	51 × 51 mm
2030	Glass Filter for Transmittance Measurement	1 filter, 2 holders
2031	Metal-on-Quartz Filters for Spectrophotometry	
2032	Potassium Iodide for Use as a Stray Light Standard	
2033	Potassium Iodide with Attenuator for Use as Stray Light Standard	IN PREP

Reflectance Standards

These SRM's are intended primarily for calibration of the reflectance scale of integrating sphere reflectometers used in evaluating materials for solar energy collectors and for calibration of reflectometers used in evaluating the appearance of polished metals and metal plated objects.

Specular Spectral Reflectance Standards

SRM 2003a is a first-surface mirror of vacuum deposited aluminum on glass that is certified for near-normal reflectance over the wavelenth range of 250 to 2500 nm. SRM's 2023, 2024 and 2025 are second-surface mirrors of vacuum deposited aluminum on a fused quartz plate and covered with a second plate of fused quartz. These mirrors are also certified for near-normal reflectance from 250 to 2500 nm and for a few wavelengths at 15, 30, 45 and 60 degrees from normal. SRM 2025 has a small angle between the front and rear surfaces.

SRM	Type	Size
2003a	First Surface, Aluminum on Glass	5.1 cm dia.
2023	Second Surface, Aluminum on Fused Quartz	5.1 × 5.1 cm
2024	Second Surface, Aluminum on Fused Quartz	2.5 × 10.2 cm
2025	Second Surface, Aluminum on Fused Quartz	2.5 × 10.2 cm

Directional-Hemispherical Reflectance Standards

SRM's 2015 and 2016 are made from a white glass and are certified for near-normal reflectance from 400 to 750 nm. SRM's 2019 and 2020 are white ceramic tiles certified from 350 to 2500 nm. SRM's 2021 and 2022 are black porcelain enamel squares certified from 280 to 2500 nm. These last four SRM's are primarily certified for near-nomal reflectance but are also certified for reflectance at a few wavelengths at 15, 30, 45 and 60 degrees from normal.

SRM	Type	Size
2015	White Glass	2.5 × 5.0 × 0.64 cm
2016	White Glass	10 × 10 × 0.64 cm
2019	White Ceramic Tile	5.1 × 5.1 × 0.81 cm
2020	White Ceramic Tile	3.8 × 7.6 × 0.81 cm
2021	Black Porcelain Enamel	5.1 × 5.1 × 0.20 cm
2022	Black Porcelain Enamel	2.5 × 2.5 × 0.20 cm

Refractive Index Standards

SRM's 211c and 217c are certified for refractive index at 20, 25 and 30 °C, from 435.8 to 667.8 nm for seven wavelengths, and are available in 5 and 25 mL ampoules.

SRM's 1820 and 1822 are certified for refractive index at thirteen wavelengths from 404.7 nm to 706.5 nm. These SRM's are designed for calibrating refractometers and certifying refractive index immersion liquids, and should provide a basis for accurate measurements of refractive index and dispersion. They consist of two rectangular glass slabs: one slab has polished faces and is to be used to check the performance of a refractometer; the second slab is unpolished and can be broken into fragments to certify the refractive index of immersion liquids by microscopic methods.

SRM 1823 consists of two silicone liquids that are chemically and thermally stable. The liquids are miscible and span the refractive index range of a variety of glasses and glass fibers that are examined microscopically by immersion techniques. Used independently, the liquids are suitable for the calibration of refractometers. These liquids are certified for refractive index at ten wavelengths from 435.8 to 667.8 nm, at temperatures of 20, 40, 60 and 80 °C.

SRM	Type	n^{20}
211c	Toluene	1.497
217c	2,2,4-Trimethylpentane	1.391
1820	Glass (Borosilicate)	1.488
1822	Glass (Soda-Lime)	1.518
1823-I	Silicone Liquid (I)	1.518
1823-II	Silicone Liquid (II)	1.559

Radioactivity Standards

Information concerning the SRM appears on it or its container. A Certificate containing pertinent information on the SRM is sent under separate cover; a photocopy of the certificate is sent with the SRM. Copies of these Certificates and information concerning the applications of these SRM's are available on request to the NBS Office of Standard Reference Materials. These materials are shipped only by express or air freight (shipping charges collect). The prices of SRM's may change as current stocks are depleted and are replaced. Purchasers will be billed at the prices in effect at the time of shipment.

The stated accuracies of the older standards are, in general, an estimate of the standard deviation added to an estimate of maximum possible systematic error. The accuracies of more recent standards are based on the 99 percent confidence level of precision, with the same estimate of systematic error.

The International Commission on Radiation Units (ICRU) recommended definition of the activity (A) of a quantity of a radioactive nuclide is the quotient of ΔN by Δt, where ΔN is the number of nuclear transformations that occur in this quantity, in time Δt: ($A = \Delta N/\Delta t$). NBS has used the abbreviation ntps for nuclear transfromation per second. In this list both ntps and dps are used: the latter when dps has been used in certificates printed before 1968.[2] The terms: αps, β^- ps, β^+ps, K-x-rays ps, γps are used for the emission rates of alpha particles, beta particles, positrons, K-x-rays, and gamma-rays, respectively.

The SRM's listed below, not marked with an asterisk(*), may be ordered singly, without a license, under the general licensing provisions of the Atomic Energy Act of 1954. Those marked by an asterisk are available only under the special licensing provisions of the Atomic Energy Act of 1954.

NOTE: Certain radionuclides are not economical to maintain in stock because of short half lives or low demand. When sufficient demand exists, based on letters of inquiry, these materials are prepared and those who have expressed interest are notified of their availability. If you need any radionuclides not listed, contact the Radioactivity Section, Room C114, Radiation Physics Building, National Bureau of Standards, Washington, D.C. 20234 (Telephone: 301–921–2668).

In addition, chemically stable solutions of most radionuclides, including those no longer issued by NBS or that are currently out of stock, may be submitted to NBS for calibration as described in "Calibration and Related Measurement Services of the National Bureau of Standards," NBS Special Publication 250 (1980). Requests for these tests should be submitted, with full source information for approval of suitability, to the Radioactivity Section.

Alpha-Particle, Beta-Particle, Gamma-Ray, and Electron-Capture Solution Standards

SRM	Radionuclide	Approximate activity, per gram, at time of calibration (month/year)		Approx. mass of solution (g)	Overall uncertainty (%)
4229	Alumimum-26	39	11/71	4.6	±1.1
4219B	Cadmium-109	10^5	11/76	5	2.0
4245	Carbon-14(Na_2CO_3 in H_2O)	4×10^5	5/74	5	1.0
4246	Carbon-14(Na_2CO_3 in H_2O)	4×10^4	5/74	5	0.9
4247	Carbon-14(Na_2CO_3 in H_2O)	4×10^2	5/74	5	1.1
4925	Carbon-14(C_6H_5COOH in $C_6H_5CH_3$)	2×10^4	7/58	3	2.4
4222	Carbon-14($C_{16}H_{34}$)	4×10^4	6/67	3	3.1
4223	Carbon-14($C_{16}H_{34}$)	4×10^3	6/67	3	3.1
4224	Carbon-14($C_{16}H_{34}$)	4×10^2	6/67	3	3.1
4233B*	Cesium-137	1×10^{15} atoms	8/79	5.1	0.5
		(7×10^5 s^{-1}			1.4
4943	Chlorine-36 (NaCl)	1×10^4 (β^-)	1962	3	2.3
4422L*	Chlorine-36 (HCl)	4×10^5 (β^-)	1980	5.1	1.6
4913B	Cobalt-60	IN PREP			
4370B*	Europium-152	1.8×10^6	6/79	5	1.5
4926C	Hydrogen-3 (H_2O)	3×10^3	9/78	18	0.6
4927B	Hydrogen-3 (H_2O)	78×10^5	9/78	3	0.6
4947	Hydrogen-3 ($C_6H_5CH_3$)	1×10^5	9/78	4	1.0
4929C	Iron-55	2×10^4 (k-x)	4/70	3.9	2.7
4257*	Manganese-54	6×10^5	4/79	5	1.02
4226	Nickel-63	2×10^6	5/68	4.1	1.0
4331	Plutonium-239	6(α)	3/75	2	1.0
4940B	Promethium-147	5×10^3	2/76	3	1.9
4919D	Strontium-Yttrium-90	4.0×10^3	4/75	2.9	2.1

[2] NBS now uses the SI (International System of Units) unit for activity, which is "1 per second," symbolized as s^{-1}.

Alpha-Particle Standards

These SRM's consist of a practically weightless deposit of the nuclide on a thin platinum foil cemented to a monel disk.

SRM	Radionuclide	Approx. α-particle-emission rate into 2π geometry and/or approx. activity at time of calibration (month/year)		Overall uncertainty (%)
4904F	Americum-241	10^3 to 6×10^3 s^{-1}	9/77	±1.3
4907	Gadolinium-148	4×10^2 to 2×10^4 s^{-1}	8/79	0.7 to 1.6
4906B	Plutonium-238	30 to 5×10^4 s^{-1}	7/78	0.7 to 2.2

Contemporary Standard for Carbon-14 Dating Labaratories

SRM	Material	Description
RM49	Oxalic Acid	One-half pound of oxalic acid taken from specially prepared material for use as a common contemporary standard against which world-wide measurements can be compared; no specific activity given; no certificate issued.

Beta-Particle and Gamma-Ray Gas Standards

These SRM's contain the radionuclide in the inactive gas at a pressure of about one atmosphere in a glass break-seal ampoule.

SRM	Radionuclide	Approximate activity, radioactivity concentration or emission rate at time of calibration (month/year)		Approximate volume (mL)	Overall uncertainty (%)
4302	Argon-39	3.3×10^4 s^{-1}	7/75	10	±1.5
4935C	Krypton-85	5×10^7 s^{-1} per mole	3/74	10	0.9
4235	Krypton-85	9×10^6 to 1.5×10 s^{-1}	11/74	3	1.2
4308B	Krypton-85	1.6×10^6 s^{-1}	11/79	32.5	3.1
4309C	Xenon-127	IN PREP			

Gamma-Ray "Point-Source" Standards

This group of Standard Reference Materials is usually prepared by depositing the radioactive material and sealing it between two layers of polyester tape, mounted on an aluminum ring. Exceptions to this procedure are americium, krypton, and thorium SRM's. The americium-241 SRM's, 4211 and 4213, are prepared by electroplating americium onto a 0.010-cm thick platinum foil, which is covered with a 0.005-cm thick aluminum foil. The aluminum-covered source is sandwiched between two layers of 0.036-cm thick polyurethane film tape. The krypton-85 SRM, 4212, is prepared by sealing a krypton-85 impregnated aluminum foil between two glass disks, with an epoxy adhesive. The thorium-228 SRM, 4206 (In Prep), is prepared by depositing and sealing the radionuclide between two layers of gold foil and this sandwich is then sealed between two double layers of polyurethane-film tape.

SRM	Radionuclide	Gamma-ray energy (MeV)	Approximate activity, s^{-1}, at time of calibration (except MRN) (month/year)	Overall uncertainty (%)
4211	Americium-241	0.060	4.0 to 18 × 10^4—2/70	±2.8
4213	Americium-241	0.060	1.9 to 4.1 × 10^4—2/70	2.8
4202C	Cadmium-109	0.088	3 to 6 × 10^3—11/76	2.1
4212	Krypton-85	0.514	6.5 to 36.5 × 10^6—5/71	2.6
4200B	Cesium-137—Barium-137m	0.662	2.6 to 6.2 × 10^4—9/79	1.6

Gamma-Ray "Point-Source" Standards

These SRM's are listed in order of ascending gamma-ray energy (except the ^{152}Eu).

SRM	Radionuclide	Gamma-ray energy (MeV)	Approximate activity, s^{-1}, at time of calibration (except MRN) (month/year)	Overall uncertainty (%)
4207	Cesium-137—Barium-137m	0.662	1.7 to 3.6 × 10^5—9/79	±1.6
4201B	Niobium-94	0.702, 0.871	4 to 6 × 10^3—4/70	1.5
*4997E	Manganese-54	0.835	2 to 4 × 10^5—4/79	1.02
4240	Bismuth-207	0.5696, 1.0634, 1.7697	5.4 to 11 × 10^4—1/73	1.4
4203C	Cobalt-60	1.173, 1.333	1.0 to 2.3 × 10^5—2/73	1.2
4991C	Sodium-22	1.2745	6 × 10^4—4/69	1.5
4996B	Sodium-22	1.2745	3 × 10^5—4/69	1.5
*4218D	Europium-152	0.122—1.40	4 × 10^4 to 5 × 10^5—6/79	1.5

Low Energy Photon Sources

These SRM's consist of a thin-layer deposit of the radionuclide on a thin stainless steel or platinum foil cemented to a monel disk.

SRM	Radionuclide	Approx. emission rate at time of calibration (month/year)	Overall uncertainty (%)
4262	Americium-241	IN PREP	
4260B	Iron-55	1.0 × 10^4 to 1.9× 10^4 kxs^{-1}/Steradian—4/77	±1.8

Radium Solution Standards for Radon Analysis

These samples are contained in flame-sealed glass ampoules.

SRM	Nominal Radium Content. Per Gram (Month/Year)	Approx. Wt. Soln. (grams)	Uncertainty (%)
4952B	Blank Solution—8/76	20	±68
4951C	10^{-11}—4/78	10.4	1.8
4950D	10^{-9}—4/78	10.3	1.5
4953C	10^{-8}—4/78	10.3	1.3

Radium Gamma-Ray Solution Standards

These samples are contained in flame-sealed glass ampoules.

SRM	Nominal Radium Content (μg) (Month/Year)	Approximate Mass of Solution (g)	Overall Uncertainty (%)
4956	0.2—9/67	5.1	4.4
4957	0.5—9/67	5.1	1.8
4958	1.0—9/67	5.1	1.8
4959	2.0—9/67	5.1	1.3
4960	5.0—9/67	5.1	1.3
4961	10.0—9/67	5.1	1.1
4962	20.0—9/67	5.1	1.1
4963	50.0—9/67	5.1	1.1
4964B	102.0—6/65	5.2	0.5

Environmental Standards

SRM	Form	Radionuclides	Approx. Mass (g)
RM45B	River Sediment	^{40}K, ^{54}Mn, ^{60}Co, ^{65}Zn, ^{90}Sr, ^{90}Y, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{228}Ac, ^{239}Pu, ^{240}Pu, ^{55}Fe, ^{125}Sb, ^{155}Eu, ^{208}Tl, ^{212}Pb, ^{212}Bi, ^{214}Pb, ^{214}Bi, ^{224}Cm, ^{226}Ra, ^{228}Th, ^{224}Th, ^{232}Th, ^{231}Pa, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, ^{241}Am.	100

Metallurgical Standards

SRM 493 is intended for calibration X-ray diffraction equipment to determine the relative amounts of iron carbide in steel. SRM's 485a and 488 are intended for the calibration of X-ray diffraction equipment used in determining the amount of retained austenite in ferrous materials.

SRM	Type	Form
485a	Austenite in Ferrite ~ 5%	IN PREP.
486	Austenite in Ferrite ~ 15%	Disk: 20.6 mm dia × 2.5 mm thick.
493	Spheroidized Iron Carbide (Fe_3C) in Ferrite	Wafer: 29×29× 2.4 mm.

Mössbauer Standards

These SRM's are issued for the calibration of the isomer shift of iron compounds and alloys and to provide a uniform basis for presentation of mössbauer isomer shift data.

SRM	Type	Form
1541	Iron Foil	Foil: 2.5 cm × 2.5 cm × 23 μm.

X-ray Fluorescent Emission Target

This SRM is intended for use in determining the detector window absorption in semiconductor x-ray spectrometers according to ANSI-IEEE Standard STO 759. When excited by a ^{55}Fe source this glass target will emit fluorescent x-rays in the range 1.0 to 5.2 keV.

SRM	Type	Unit size
477	Glass Disk	2 × 25 mm D.

X-ray Diffraction Standards

SRM's 640 and 674 are powdered materials to be used as internal standards for powder diffraction measurements. The lattice parameter of SRM 640 has been accurately determined at 25.0°C using a high angle goniometer and the NBS tungsten internal standard. The use of SRM 640 will allow the results to be coupled to Powder Diffraction File (when converted to the same wavelength) base on the NBS internal standards of 1966. The weighted average of the lattice parameter, a, uncorrected for refraction is 5.43088 Å and the standard error is estimated to be $3.5 \times 10-5$ Å, SRM 674 is a set of five oxides for use in the quantitative analysis (intensity measurement) of materials. Both peak height and integrated intensity of diffraction lines will be certified.

SRM	Type	Unit size
640	Silicon Powder	10 g.
674	Powder Diffraction Intensity	IN PREP.
	Al_2O_3 (α-alumina)	
	CeO_2	
	Cr_2O_3	
	TiO_2 (rutile)	
	ZnO	

Gas Transmission Standard

SRM 1470 is for use in the measurement of the oxygen gas transmission rate using a volumetric method (ASTM D1434), manometric method (ASTM D1434 or ISO 2556), or coulometric method of measurement. The oxygen gas transmission rate of SRM 1470 is 0.325 pmol/m²/sec/Pa at 296.16K and 0.1013 M Pa.

SRM	Type	Unit size
1470	Polyester Plastic film for oxygen gas transmission	15 sheets; 23 cm square.

Permittivity Standards

The three solution SRM's (1511, 1512, and 1513) are for calibrating cells and test capacitors used to determine the relative permittivity (dielectric constant) of liquids. The nominal dielectric constants (ϵ) for SRM's 1511, 1512, and 1513 are: 2.0, 10.4, and 35.7, respectively. The three polymer SRM's (1516, 1517, and 1519) are for calibrating systems used to measure permittivity and related dielectric quantities. These SRM's are disks of a fluorinated ethylene-propylene copolymer and are individually calibrated.

SRM	Type	Unit size
1511	Cyclohexane	400 mL.
1512	1,2-Dichloroethane	400 mL.
1513	Nitrobenzene	400 mL.
1516	Permittivity	38 mm diameter 2.5 mm thick.
1517	Permittivity	38 mm diameter 5 mm thick.
1519	Permittivity	51 mm diameter 5 mm thick.

Reference Fuel Standards

SRM's 1815 and 1816 are intended for use in maintaining the integrity of motor and aviation fuels as specified in the ASTM Manual for Rating Motor, Diesel and Aviation Fuels, Third Edition.

SRM	Type	Unit
1815a	n-Heptane	IN PREP.
1816a	Isooctane (2,2,4-Trimethylpentane)	IN PREP.

Resistivity Standards

SRM's 1460 through 1469 are certified for electrical resistivities over wide temperature ranges for use in calibrating knife edge and similar electric resistivity apparatus. At room temperature these SRM's have the following resistivities: Iron, $10 \cdot 10^{-8}$ Ω·m, Steel, $81 \cdot 10^{-8}$ Ω·m, and Tungsten, $6 \cdot 10^{-8}$ Ω·m.

SRM's 1521 and 1522 Boron-Doped Silicon, are both sets of two single-crystal wafers, with nominal resistivities of 0.1 and 10 Ω·cm, respectively. With the exception of thickness, these two SRM's are physically identical. They are intended for use in calibrating instruments used to measure the resistivity of silicon wafers by four-probe method (ASTM Method F-84).

SRM	Type	Unit of issue
1463	Electrolytic Iron	Rod 0.64 cm dia. × 5 cm long.
1464	Electrolytic Iron	Rod 3.17 cm dia. × 5 cm long.
1460	Austenitic Stainless Steel	Rod 0.64 cm dia. × 5 cm long.
1461	Austenitic Stainless Steel	Rod 1.27 cm dia. × 5 cm long.
1462	Austenitic Stainless Steel	Rod 3.4 cm dia. × 5 cm long.
1465	Tungsten, sintered	0.32 cm dia. × 5 cm long.
1466	Tungsten, sintered	0.64 cm dia. × 5 cm long.
1467	Tungsten, ARC-CAST	0.83 cm dia. × 5 cm long.
1468	Tungsten, ARC-CAST	1.02 cm dia. × 5 cm long.
1469	Tungsten, ARC-CAST	1.27 cm dia. × 5 cm long.
1521	Boron-Doped Silicon	2 Wafers 4.2 cm dia. × <0.74 mm thick.
1522	Silicon Power Device	3 Wafers 5.1 cm dia. × <0.64 mm thick.

ENGINEERING TYPE STANDARDS

These SRM's are intended to relate measurements used for production or quality control data to a central point of reference. The values certified for these materials are in some cases empirical and do not necessarily relate to the National Measurement System.

Standard Rubbers and Rubber-Compounding Materials

These SRM's have been prepared to provide the rubber industry with standard materials for rubber compounding. They are useful for the testing of rubber and rubber-compounding materials in connection with quality control of raw materials and for the standardization of rubber testing.

Each material has been statistically evaluated for uniformity by mixing rubber compounds and vulcanizing them in accordance with ASTM Designation D-15 and determining the stress-strain properties of the resulting vulcanizates. Certificates are issued for the rubbers because the properties of different lots are not the same. Replacement lots of rubber-compounding SRM's impart essentially the same characteristics to rubber vulcanizates so that Certificates are not issued for these SRM'S.

Standard Rubbers

SRM	Type	Wt/Unit (grams)	Pounds
385c	Natural (IN PREP)	31,400	69
386h	Styrene-butadiene 1500	34,000	75
388k	Butyl	37,000	81.5

Rubber Compounding Materials

SRM	Type	Wt/Unit (grams)	Pounds
370e	Zinc Oxide	8,000	17.6
371g	Sulfur	6,000	13.2
372h	Stearic Acid	3,200	7.1
373f	Benzothiazyl disulfide	2,000	4.4
374c	Tetramethylthiuram disulfide	2,000	4.4
375g	Channel Black	28,000	61.6
378b	Oil Furnance Black	28,000	61.6
379	Conducting Black	5,500	12.1
382a	Gas Furnace Black	32,000	70.6
384d	N-tertiary-Butyl-2-benzothiazolesulfenamide	3,200	7.1
391	Acrylonitrile-Butadiene	25,000	5.5

Reference Magnetic Tapes

These SRM's are intended for use in evaluating the performance of magnetic computer tapes and maintaining control over their production. Each SRM is individually calibrated and certified.

SRM	Type	Unit
1600	Secondary standard magnetic tape-computer amplitude reference	Cassette.
3200	Secondary standard magnetic tape-computer amplitude reference	Reel/600 ft.
3210	Secondary standard flexible disk cartridge-computer amplitude reference	Flexible disk.
3216	Secondary standard magnetic tape-computer amplitude reference	Cartridge.
6250	Secondary standard high density magnetic tape-computer amplitude reference	Reel/2400 ft.

Centerline Drawings for Optical Character Recognition-B Characters

This SRM is an exact copy of the centerline drawings that uniquely define each printed character shape and size used in constant strokewidth Style B Optical Character Recognition (OCR-B) applications in accordance with one or more of the following standards: American National Standard X3.49-1975, Character Set for Optical Character Recognition (OCR-B); Federal Information Processing Standards Publication 32-1974, Optical Character Recognition Character Sets; European Computer Manufacturers Association Standard ECMA-II for the Alphanumeric Character Set OCR-B for Optical Recognition, 3rd Edition, 1975; and Draft International Standard ISO/DIS 1073/II, Alphanumeric Character Sets for Optical Recognition.

This standard contains information on the nominal size, strokewidth, tolerance, and relative position of characters.

SRM	Size	OCR-B Characters
1901	I	118

Sizing Standards

Glass Spheres for Particle Size

SRM	Type	Size (μm)	Sieve Nos.	Wt/Unit (grams)
1003	Calibrated Glass Spheres	5–30		40–45
1004	Calibrated Glass Beads	34–120	400–140	63
1017a	Calibrated Glass Beads	100–310	140–50	84
1018a	Calibrated Glass Beads	225–780	60–25	74
1019a	Glass Spheres	IN PREP		

Turbidimetric and Fineness Standard (Cement)

This SRM is available to calibrate the Blaine fineness meter according to the latest issue of Federal Test Method Standard 158, Method 2101 or ASTM Designation C204; to calibrate the Wagner turbidimeter according to ASTM Designation C115; and to determine sieve residue according to ASTM Designation C430. Each set consists of twenty sealed vials, each containing approximately 10 grams of cement. This SRM is supplied only in sets of twenty vials or multiples thereof.

SRM	Type	Certification	Unit
114m	Portland Cement	Residue on No. 325 sieve, electroformed wet method. Surface area (Wagner turbidimeter) Surface area (Air-permeability) Mean particle diameter (Air-permeability)	Set of 20 vials.

Color Standards

These SRM's are available to illustrate a characteristic color for each of the ISCC-NBS color-name blocks in NBS Special Publication 440, COLOR: Universal Language and Dictionary of Names. SRM 2106 consists of 251 color chips on 18 constant-hue centroid color charts, and constitutes a supplement to SP 440. SRM 2107 combines SRM 2106 with SP 440 to form a complete color kit. The centroid colors

represent a systematic sampling of the whole color solid, each color of which has been carefully measured. Each centroid color has its own specification and can be used as a color standard. (NOTE: SP 440, may be purchased separately from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

SRM	Type	Unit of Issue
2106	Centroid Color Charts	Set: 18 Charts.
2107	Color Kit	Set: SRM 2106 and SP 440.

Light-Sensitive Papers and Plastic Chips

Light-Sensitive Papers

Standard light-sensitive paper and booklets of standard faded strips of this paper are available for use in standardizing the dosage of radiant energy when testing textiles for color fastness by exposure in commercial carbon-arc fading lamps. The paper is distributed in units of 100 pieces 2⅝ by 3¼ in. The booklet contains six strips of the paper 1¼ in wide that have been faded by exposure in the NBS master lamp. A copy of NBS Spec. Publ. 260–41, which describes the preparation and use of the materials, is furnished with each booklet.

SRM	Type	Unit of Issue
700d	Light-sensitive paper	Pkg. of 100 pieces—2⅝ in × 3¼ in.
701d	Standard faded strips	Booklet—6 strips 1¼ in wide.

Light-Sensitive Plastic Chips

Standard light-sensitive plastic chips are available for use in calibration and standardization of artificial weathering and fading apparatus. These chips are distributed in two thicknesses (0.060 and 0.124 in) in units of five plates 2 in by 4⅛ in, and have been standardized by the measurement of the change of transmittance as a function of exposure (in standard fading hours) to the NBS master lamps.

SRM	Type	Unit of Issue
702	Light-sensitive plastic chips	Package of 5 chips 0.124 in thick.
703	Light-sensitive plastic chips	Package of 5 chips 0.060 in thick.

X-Ray and Photographic Standards

SRM 1001 is a calibrated X-ray film step tablet of 17 steps that cover the optical density range from 0 to 4. SRM 1008 is a calibrated photographic step tablet of 21 steps that cover the optical density range from 0 to 4.

Both step tablets are individually calibrated and certified for diffuse transmission density in conformance with conditions specified for American National Standard Diffuse Visual Transmission Density, D_t (90; 3000 K: $\leqslant 10°$; V), in "ANSI PH2.19–1976, American National Standard for Diffuse and Doubly Diffuse Transmission Measurements (Transmission Density)."

SRM 1010a, Microcopy Resolution Test Charts, is used to test the resolving power of cameras or of whole microcopying systems. SRM 1010a consists of five charts printed photographically on paper, and

have 26 high-contrast five-line patterns ranging in spatial frequency from one cycle per millimeter to 18 cycles per millimeter. Instructions for the use of the charts are supplied with each order.

SRM	Type	Unit
1001	X-ray Flim Step Tablet (0–4)	1 tablet, 17 steps.
1008	Photographic Step Tablet (0–4)	1 tablet, 21 steps.
1010a	Microcopy Resolution Test Chart	Set of 5 charts.

Surface Flammability Standard

SRM 1002c, Hardboard Sheet, is issued for checking the operation of radiant panel test equipment in accordance with the procedures outlined in ASTM Standard E162–78.

SRM	Type	Certification	Unit of Issue
1002c	Hardboard Sheet	Flame Spread Index, I=153 Heat Evolution Factor, Q=36.5	Set of 4: 6×18×¼ inch.

Smoke Density Chamber Standards

These SRM's are certified for maximum specific optical density and are issued for performing operational checks of smoke density chambers.

SRM	Type	Maximum Specific Optical Density	Unit of Issue
1006a	Non-flaming Exposure Condition (α-cellulose)	Dm (corr.)=161	3 sheets.
1007a	Flaming Exposure Condition (plastic)	Dm (corr.)=17850(t)-132	3 sheets.

Tape Adhesion Testing Standard

This material is intended as a uniform source of linerboard for use under ASTM Designation D2860, Procedure A: Adhesion of Pressure Sensitive Tape to Fiberboard at 90 Degree Angle and Constant Stress.

SRM	Type	Unit
1810	Linerboard for Tape Adhesion Testing.	Package of 50 sheets.

RESEARCH MATERIALS

Research Materials (RM's) are in addition to and distinct from the Standard Reference Materials (SRM's) issued by NBS. The distinctions between Research Materials and Standard Reference Materials are in the information supplied with them and purpose for which they are used. Unlike SRM's, the RM's are not issued with Certificates of Analysis; rather they are accompanied by a "Report of Investigation," the sole authority of which is the author of the report. A Research Material is intended primarily to further scientific or technical research on that particular material. One of the principal considerations in issuing an RM is to provide homogeneous material so that an investigator in one laboratory can be assured that the material he has is the same as that being investigated in a different laboratory.

RM-1C Ultra-purity aluminum single crystal cubes (1 cm on a side) are intended for use in studies of a variety of solid state phenomena for which both extreme purity and knowledge of crystallographic orientation are required; e.g., in studies of electron spin resonance, De Haas-Van Alphen effect, cyclotron resonance, and in a variety of studies relating to the Fermi surface and the transport properties of aluminum.

RM-1R Ultra-purity aluminum polycrystalline rods (4.2 mm in diameter and 25.4 mm long) are intended for use in research on the mechanical and physical properties of extremely pure aluminum: e.g., in the determination of resistivity as a function of strain at cryogenic temperatures to facilitate the design of cryogenic magnets or superconductor stabilizing elements.

RM 5 Copper Heat Capacity Test Specimen. This Research Material is intended for the comparison of heat capacity results from different laboratories and as a test specimen for heat capacity measurement below 25K, but it may also be useful at higher temperatures. It is available as a rod of high purity polycrystalline copper 19 mm (0.75 in) in diameter and 120 mm (4.75 in) in length.

RM 31 Glass Fibers for Microanalysis (RM 31). This homogeneous vitreous solid contains known, low-concentration additions of several elements which were developed for electron probe microanalysis (EMPA) and secondary ion mass spectrometry (SIMS). This RM contains ten compositions of various oxides: in fiber form.

RM 40 Polystyrene solution in a mixture of tri-cresyl-phosphate and Aroclor. This Research Material can be used to check instruments used in polymer technology and science for the determination of rheological properties of polymer melts or solutions. It was designed so that the limiting viscosity is obtained at 25° C at shear rates as high as 1 reciprocal second. Values are given for rate of shear, viscosity, and first and second normal stress difference at 25° C. Unit of issue: 250 mL.

RM 45b Homogeneous River Sediment. This Research Material should be particularly useful for testing radiochemical procedures for the assay of radioactivity in sediments and soils. Unit of issue: 100 grams.

RM 50 Albacore Tuna. This Research Material is intended to be used in the measurement of elements present at trace concentration. It has been issued as a lyophilized (freeze-dried) marine biological tissue sample in an attempt to satisfy many of the analytical requirements for a base-line marine reference material. The Report of Investigation provides informational data (not certified) on mercury, selenium, zinc, arsenic, lead, and a number of other elements of interest to marine scientists. Unit of issue: two 35-g cans.

Phosphors

These materials are issued without Certification. NBS Technical Note 417, Spectral Emission Properties of NBS Standard Phosphor Samples Under Photo-Excitation, is issued with these materials, and is

equivalent to the "Report of Investigation" issued with Research Materials. They are issued so that those interested in developing methods of measurement for phosphor materials can work on a common source of materials. NBS Technical Note 417 may be purchased from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for 25 cents, by SD Catalog No. C13.46:47.

SRM	Type	Wt/Unit (grams)
1020	Zinc sulfide phosphor	14
1021	Zinc silicate phosphor	28
1022	Zinc sulfide phosphor	14
1023	Zinc-cadmium sulfide phosphor (AG activator).	14
1024	Zinc-cadmium sulfide phosphor (Cu activator).	14
1025	Zinc phosphate phosphor	28
1026	Calcium tungstate phosphor	28
1027	Magnesium tungstate phosphor	28
1028	Zinc silicate phosphor	28
1029	Calcium silicate phosphor	14
1030	Magnesium arsenate phosphor	28
1031	Calcium halophosphate phosphor	28
1032	Barium silicate phosphor	28
1033	Calcium phosphate phosphor	28

SPECIAL REFERENCE MATERIALS

Special Reference Materials (GM's) are distributed by NBS to meet industry needs. These materials have been standardized either by some Government agency other than NBS, or by some standards-making body such as the American Society for Testing and Materials (ASTM), the American National Standards Institute (ANSI), and the Organization for International Standardization (ISO). For this class of materials, NBS acts only as a distribution point and does not participate in the standardization of these materials.

GM-1 Hydrogen in Steel Standards were produced and certified by the Welding Institute in Cambridge, England, and are distributed in the United States by NBS. GM-1 is a set of 15 cylinders, 5 each of H1, H2, and H3, containing nominally 0.05, 0.10, and 0.20 mL hydrogen, respectively. The cylinders are 6.35 mm in diameter and about 30 mm long, weighing approximately 6 grams.

GM-2 Hydrogen in Steel Standards were produced and certified by the Welding Institute in Cambridge, England, and are distributed in the United States by NBS. GM-2 is a set of 15 cylinders, 5 each of H4, H5, and H6, containing nominally 0.20, 0.60, and 1.10 mL hydrogen, respectively. The cylinders are 12.7 mm in diameter and about 30 mm long, weighing approximately 22 grams.

GM-5 Nickel and Vanadium in Residual Oil was produced and analyzed under the sponsorship of the Western Oil and Gas Association and the American Petroleum Institute, and is distributed by NBS. The assigned values for nickel and vanadium are 93 and 79 ppm, respectively. GM-5 is issued in 475 mL units.

GM-6 This GM, DOT 6M Shipping Container, is manufactured in accordance with the applicable DOT specifications, the Nuclear Regulatory Commission Quality Assurance Program Requirements, and the National Bureau of Standards specifications. This container is to be used in the transport of plutonium or all type B quantities of fissile or nonfissile radioactive materials in special or non-special form.

When plutonium materials are ordered from NBS, certified containers may be supplied by customers or these GM's may be purchased from NBS. These containers may be reused for additional orders to NBS of subsequent materials.

GM-21 Cellular Plastics. These GM's are to be used in comparison of fire research data. Each of these
GM-57 GM's is shipped FOB: Gaithersburg, MD.

GM	Type	Density (lb/ft^3)	Thickness (inches)	Size Width (ft)	Length (ft)
21	Flexible Polyurethane	2	6	2	2
23	Flexible Polyurethane, FR	2	6	2	2
25	Flexible Polyurethane, HR	4	6	2	2
27	Flexible Polyurethane, HR/FR	4	6	2	2
29	Rigid Polyurethane	2	4	2	2
31	Rigid Polyurethane, FR>25 FS	2	4	2	2
35	Rigid Polyurethane, HR	4	6	2	2
37	Rigid Polyurethane, HR/FR	20	6	2	2
39	Rigid Polyurethane sprayed on Asbestos Cement Board, >25 FS	2	1.5	4	4
40	Rigid Polyurethane sprayed on Asbestos Cement Board, <25 FS	2	1.5	4	4
41	Rigid Trimer	2	4	2	2
43	Rigid Trimer, ~25 FS	2	4	2	2
47	Polystyrene Expanded	1	4	2	2
49	Polystyrene Expanded, FR	1	4	2	2
51	Polystyrene Extruded	1	3	2	2
53	Polystyrene Extruded, FR	1	3	2	2
57	Phenolic Foam	2	4	2	2

Differential Thermal Analysis Standards

GM's 754, 757, 758, 759, and 760 have been issued by NBS in cooperation with the International Confederation of Thermal Analysis as standards for calibrating differential thermal anaylsis and related thermoanalytical equipment under operating conditions.

GM	Material	Peak Temp. (°C)	Unit
754	Polystyrene	~ 105 °C	10 g.
757	1,2-Dichloroethane	~ −32 °C	4 mL.
	Cyclohexane:		
	(transition)	~ −83 °C	4 mL.
	(melting)	~ + 7 °C	
	Phenyl Ether	~ 30 °C	4 mL.
	o-Terphenyl	~ 58 °C	5 g.
758	Potassium Nitrate	~ 128 °C	10 g.
	Indium	~ 157 °C	3 g.
	Tin	~ 232 °C	3 g.
	Potassium Perchlorate	~ 300 °C	10 g.
	Silver Sulfate	~ 430 °C	3 g.
759	Potassium Perchlorate	~ 300 °C	10 g.
	Silver Sulfate	~ 430 °C	3 g.
	Quartz	~ 573 °C	3 g.
	Potassium Sulfate	~ 583 °C	10 g.
	Potassium Chromate	~ 665 °C	10 g.
760	Quartz	~ 573 °C	3 g.
	Potassium Sulfate	~ 583 °C	10 g.
	Potassium Chromate	~ 665 °C	10 g.
	Barium Carbonate	~ 810 °C	10 g.
	Strontium Carbonate	~ 925 °C	10 g.

STANDARD REFERENCE MATERIALS TO BE DISCONTINUED

When the current supplies are exhausted, the SRM's listed below will be discontinued, because of limited user demand or technological obsolescence.

SRM	Type
404a	Steel, basic electric
405a	Steel, medium manganese
407a	Steel, chromium-vanadium
408a	Steel, chromium-nickel
409b	Steel, nickel
413	Steel, A.O.H. 0.4C
414	Steel, Cr-Mo (SAE 4140)
417a	Steel, B.O.H. 0.4C
418a	Steel, Cr-Mo (SAE X4130)
420a	Iron, ingot
427	Steel, Cr-Mo (boron only) (SAE 4150)
436	Steel, special Cr6-Mo3-W10
437	Steel, special Cr8-Mo2-W3-Co3
438	Steel, Mo high speed (AISI-SAE-M30)
439	Steel, Mo high speed (AISI-SAE-M36)
440	Steel, special W high speed Cr2-W13-Co12
441	Steel, W high speed (AISI-SAE-T1)
442	Steel, stainless, Cr16-Ni10
443	Steel, stainless, Cr18.5-Ni9.5
444	Steel, stainless, Cr20.5-Ni10
445	Steel, stainless, Cr13-Mo0.9 (Modified AISI 410)
446	Steel, stainless, Cr18-Ni9 (Modified AISI 321)
447	Steel, stainless, Cr24-Ni13 (Modified AISI 309)
448	Steel, stainless, Cr9-Mo0.3 (Modified AISI 403)
449	Steel, stainless, Cr5.5-Ni6.5
450	Steel, stainless, Cr3-Ni25
803a	Steel, A.O.H. 0.6C
D803a	Steel, A.O.H. 0.6C
804a	Steel, basic electric
805a	Steel, medium manganese
807a	Steel, chromium-vanadium
D807a	Steel, chromium-vanadium
808a	Steel, chromium-nickel

SRM	Type
817a	Steel, B.O.H. 0.4C
820a	Iron, ingot
821	Steel, Cr-W, 0.9C
827	Steel, Cr-Mo (boron only) (SAE 4150)
837	Steel, special (Cr8-Mo2-W3-Co3)
D837	Steel, special (Cr8-Mo2-W3-Co3)
840	Steel, special W high speed (Cr2-W13-Co12)
D840	Steel, special W high speed (Cr2-W13-Co12)
D841	Steel, W high speed (AISI-SAE-T1)
849	Steel, Cr5.5-Ni6.5
D849	Steel, Cr5.5-Ni6.5
850	Steel, Cr3-Ni25
D850	Steel, Cr3-Ni25
1020	Zinc sulfide phosphor
1021	Zinc silicate phosphor
1022	Zinc sulfide phosphor
1023	Zinc-cadmium sulfide phosphor (Ag activator)
1024	Zinc-cadmium sulfide phosphor (Cu activator)
1025	Zinc phosphate phosphor
1026	Calcium tungstate phosphor
1027	Magnesium tungstate phosphor
1028	Zinc silicate phosphor
1029	Calcium silicate phosphor
1030	Magnesium arsenate phosphor
1031	Calcium halophosphate phosphor
1032	Barium silicate phosphor
1033	Calcium phosphate phosphor
1511	Cyclohexane, dielectric
1512	1,2 Dichloroethane, dielectric
1513	Nitrobenzene, dielectric
1516	permittivity std., 38 mm x 2.5 mm
1517	Permittivity std., 38 mm x 5 mm
1519	Permittivity std., 51 mm x 5 mm

OTHER SERVICES OF THE NATIONAL BUREAU OF STANDARDS

The following is a list of some of the services offered by NBS that may be of interest to SRM users. For general information see the entry on Technical Information and Publications.

Calibration and Related Measurement Services of the National Bureau of Standards

The measurement services of the National Bureau of Standards include the calibration of standards, test of instruments, and certain interlaboratory testing programs. These services are listed in NBS Special Publication 250, Calibration and Related Measurement Services of the National Bureau of Standards. [Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (1980 edition) for $4.50].

These services are performed at the National Bureau of Standards Washington laboratories (Gaithersburg, Md.) or the National Bureau of Standards laboratories in Boulder, Colorado.

An abbreviated list of the services offered under this program is given below. For information concerning services not listed below or in Special Publication 250 contact:

Office of Measurement Services
National Bureau of Standards
Washington, D.C. 20234
Telephone: (301) 921–2805

Washington Services

Acoustics	(301) 921–3607
Aerodynamics	(301) 921–3684
Angular	(301) 921–2216
Computer Science (general)	(301) 921–3723
Density	(301) 921–3681
Dosimetry in High-Energy Electron Beams	(301) 921–2361
Electrical Instruments (AC)	(301) 921–3121
Electrical Instruments (DC)	(301) 921–2715
Engineering Tests	(301) 921–3471
Flatness	(301) 921–2216
Flow Rate Meters	(301) 921–3481
Fluid Quantity	(301) 921–3681
Force Measurements	(301) 921–3884
Gamma-Ray Sources	(301) 921–2361
Humidity	(301) 921–2794
Hydraulics	(301) 921–2124
Image Optics	(301) 921–3550
Impedance	(301) 921–2715
Interlaboratory Testing Programs	(301) 921–2946
Length	(301) 921–2216
Mass	(301) 921–3681
Neutron Sources	(301) 921–2234
Photography	(301) 921–3550
Photometric Calibrations	(301) 921–3613

Precision Apparatus	(301) 921-2715
Proving Rings	(301) 921-3884
Radiation Thermometry	(301) 921-3613
Radioactivity	(301) 921-2665
Radiometric Calibrations	(301) 921-3613
Resistance	(301) 921-2715
Resistance Thermometers	(301) 921-2757
Roundness	(301) 921-2216
Spectrophotometric Standards	(301) 921-2453
Straightness	(301) 921-2216
Surface Texture	(301) 921-2159
Thermocouples and Thermocouple Materials	(301) 921-2069
Thermometers, Laboratory	(301) 921-2087
Ultraviolet Spectral Radiance Standard	(301) 921-2011
Vibration	(301) 921-3607
Voltage, High	(301) 921-3121
Voltage	(301) 921-2715
Weights and Measure	(301) 921-2401
X- and Gamma-Ray Measuring Instruments	(301) 921-2361

Boulder Services

All measurement services available in Boulder should be directed to:

Measurement Services Clerk
National Bureau of Standards
Boulder, Colorado 80303
Telephone: (303) 499-1000, ext. 3753

Cryogenics

Electromagnetics (Radio, Microwave, and Laser Frequencies)

1. Attenuation
2. Fields (Electromagnetic)
3. Impedance
4. Laser Parameters
5. Noise Temperature (Effective)
6. Phase Shift
7. Power
8. Voltage

Time and Frequency Measurements

Standards Information Service

The Standards Information Service (SIS) maintains a reference collection of some 240,000 engineering standards issued by U.S. technical societies, professional organizations, and trade associations; State purchasing offices; U.S. civilian government agencies; and the major foreign national and international standardizing bodies. The collection is open to the public Monday through Friday from 8:30 a.m. to 5 p.m.

SIS publishes general and special indices of standards. Information services consist of responding to inquiries by searching Key-Word-In-Context (KWIC) Indices to determine whether there are any published standards, specifications, test methods, or recommended practices for a given item, product, or material. Inquirers are referred to the appropriate source to obtain copies of standards. SIS neither sells nor distributes standards.

Inquiries or requests for additional information should be directed to:

Standards Information Service
Room B162, Technology Building
National Bureau of Standards
Washington, D.C. 20234
Telephone: (301) 921–2587

Standard Reference Data

The National Standard Reference Data System (NSRDS) is a nationwide program established to make critically evaluated data in the physical sciences available to the technical community. It publishes compilations of critically evaluated data, critical reviews and bibliographies. A complete listing of the publications of the NSRDS is available from the Office of Standard Reference Data (OSRD). The OSRD responds in a limited way to queries within the scope of the program by providing references, referrals, documentation, or data, as available. The program's bimonthly newsletter is available on request. Inquiries or requests for further information should be directed to:

Information Services
Office of Standard Reference Data Reference Center
Room A320, Physics Building
National Bureau of Standards
Washington, D.C. 20234
Telephone: (301) 921–2228

Technical Information and Publications

The Technical Information and Publications Division maintains a general correspondence and inquiry service on the technical activities of the National Bureau of Standards. Inquiries of a general nature and not covered by the services listed above should be directed to:

Technical Information and Publications Division
Room A617, Administration Building
National Bureau of Standards
Washington, D.C. 20234
Telephone: (301) 921–2318

GUIDE FOR REQUESTING DEVELOPMENT OF STANDARD REFERENCE MATERIALS

The National Bureau of Standards has the function to develop, produce, and distribute Standard Reference Materials (SRM's) that provide a basis for comparison of measurements on materials and that aid in the control of production processes. To perform this function, the Office of Standard Reference Materials evaluates the requirements of science, industry, and government for carefully characterized reference materials, and directs their production and distribution.

NBS currently has over 1000 SRM's available, about 100 new ones in preparation, and requests for the preparation of many others.

In developing and NBS-SRM, the candidate material must meet one or more of the criteria listed below.

1. The SRM must permit users to attain more accurate measurements.
2. The production of the SRM elsewhere is not economically or technically feasible.
3. The SRM would be an industry-wide standard for commerce from a neutral source not otherwise available.
4. NBS production of the SRM would provide continued availability from a common source for a highly characterized material that is important to science, industry, or government.

NBS has recognized and responded to the need to enlarge the scope of the program to include all types of well-characterized materials that can be used to calibrate a measurement system or to produce scientific data that can be readily referred to a common base. However, the demand for new SRM's greatly exceeds the Bureau's capacity to produce and certify these materials. Consequently, requests for new SRM's that would have limited use, or for which the need is not very great, are deferred in favor of requests that clearly show a critical need. To determine which requests are to receive top priority, NBS needs and heavily relies upon the information supplied by industry, either through its own representatives or through interested organizations, such as the American National Standards Institute, American Nuclear Society, American Petroleum Institute, American Society for Testing and Materials, etc.

Accordingly, while the Bureau welcomes all requests for the development of new SRM's, both the Bureau and industry would be helped, if such requests are accompanied by information that will permit an objective assessment of the urgency and importance of proposed new reference materials.

Requests for the development of new Standard Reference Materials should include as much of the information listed below as possible.

1. Short title of the proposed Standard Reference Material.
2. Purpose for which the SRM would be used.
3. Reasons why the SRM is needed.
4. Special characteristics and/or requirements for the material. Include additional requirements and reasons, if more than one SRM is necessary for standardization in this area.
5. Your estimate of the possible present and future (6–10 year) demand for such an SRM in your own operations and elsewhere. (National and international estimates are very useful.)
6. Whether such an SRM, or a similar one, can be produced by, or obtained from a source other than NBS. If so, give reasons to justify its preparation by NBS.
7. Miscellaneous pertinent information to aid justification for the SRM, such as: (a) an estimate of the range of application, monetary significance of the measurement affected, and scientific and/or technological significance including, when feasible, estimates of the impact upon industrial productivity or growth, and (b) supporting letters from industry leaders, trade organizations, interested committees, and others.

CERTIFIED REFERENCE MATERIALS FROM OTHER SOURCES

Sources of certified reference materials (CRM's) are now world wide. Currently, no international catalog exists, but the International Standards Organization (ISO), through its Council Committee on Reference Materials (REMCO), is in the process of preparing such a catalog. Publication of this international catalog is still in preparation; inquiries should be directed to:

Mr. M. Parkany
Secretary for REMCO
International Organization for Standardization
1, Rue de Varembe
Case Postale 56
1211 Geneva 20
Suisse, Switzerland

In the period 1972–1977, the International Union of Pure and Applied Chemistry (IUPAC) through its Commission on Physicochemical Measurements and Standards prepared and issued a catalog of CRM's that are useful for the realization of physicochemical properties. The national laboratories that responded to the request for such information were:

COUNTRY	NATIONAL LABORATORY
Australia	Commonwealth Scientific and Industrial Research Organization National Standards Laboratory University Grounds, City Road Chippendale, NSW 2008 Australia
Canada	Canadian Certified Reference Materials Project C/O Mineral Sciences Laboratories, CANMET Canada Centre for Mineral and Energy Technology 555 Booth Street Ottawa, Ontario K1A 0G1 Canada
Germany (West)	Bundesanstalt für Materialprüfung Unter den Eichen 87, D1 Berlin 45 Federal Republic of Germany The Physikalische-Technische Bundesanstalt Bundesalle 100, 33 Braunschweig Federal Republic of Germany
Hungary	National Office of Measures Németölogyi ut 37–39, .sz. Budapest XII Hungary

Japan	Standards Department Agency of Industrial Science and Technology Ministry of International Trade and Industry 3-1, Kasumigaseki 1, Chiyodaku, Tokyo, Japan (Cable address: Mitijisc Tokyo)
Netherlands	Institute for Physical Chemistry TNO Utrechtseweg 48, P.O. Box 108 Zeist The Netherlands
Poland	Division of Physico-Chemical Metrology National Board for Quality Control and Measures 2, Elektoralna Street, Warsaw Poland
United Kingdom	National Physical Laboratory Teddington, Middlesex England

The current IUPAC edition is: *Physicochemical Measurements: Catalogue of Reference Materials from National Laboratories,* Revised 1976, Pure & Appl. Chem., **48,** 503–414 (1976).

Domestic (US) sources, of CRM's, including a large number of uncertified reference materials, are listed in, *Guide to United States Reference Materials,* NBS Spec. Publ. 260–57 (Feb. 1978), U.S. Government Printing Office, Washington D.C. 20402.

ALPHABETICAL INDEX

NUMERICAL INDEX TO SRM CERTIFICATES

The Certificate Date listed is the current version of the Certificate. Those dates followed by the letter "P" indicate that it is a Provisional Certificate.

In general, Provisional Certificates are issued for Standard Reference Materials before all of the values have been certified, but after a sufficient number of values are certified so that the material is a valuable standard for the intended purpose. As additional values are certified, the Provisional Certificate may be revised and when and if all of the values are certified, the final Certificate is issued.

When new or revised Certificates are issued for SRM's they are announced in the SRM Price and Availability List which supplements this catalog. SRM purchasers whose Certificate shows an earlier date than listed below may obtain the current version of the Certificate from the Office of Standard Reference Materials, Room B311, Chemistry Building, National Bureau of Standards, Washington, D.C. 20234.

One or more of the following letters apply to materials where no date is listed.

A. Individually Certified.
B. The Material is issued with "Instructions for Use" in lieu of a Certificate.
C. This Material is not certified, refer to page reference for details.
D. Material is in preparation.
E. Research Material: Issued with a "Report of Investigation."
F. Special Reference Material: Information provided, but not certified by NBS.
G. Set of SRM's: Issued with Certificates for the individual SRM's.
H. Not individually issued, part of a set.

SRM	Certificate date	Page
1c	12–14–78	55
3d	4–2–79	30
4k	5–27–76	30
5L	11–9–70	30
6g	11–9–70	30
7g	10–5–59	30
8j	4–10–72	18
11h	4–30–74	18
12h	3–7–66	18
13g	4–30–74	18
14e	11–9–65	18
15g	4–30–74	18
16e	4–30–74	18
17c	D	44
19g	9–30–64	18
20g	10–23–70	18
27f	5–31–77	54
30f	6–5–79	19
32e	4–5–57	19
33d	6–10–55	19
36b	7–18–69	19
37e	8–28–58	32
39i	7–15–68	71
40h	4–24–69P	44
41b	4–10–75	44
42g	7–18–72	71
43h	8–15–73	71
44f	4–5–73	71
45d	12–6–71	71
49e	12–6–71	71
50c	6–25–57	21
53e	1–20–70	33
54d	9–20–57	34
58a	4–25–78	29
59a	11–6–69	29
64c	8–24–77	29
68c	8–15–71	29
69b	8–24–79	54
70a	3–26–65P	55
71	2–1–29	29
72g	D	19
73c	7–13–66	20
76a	4–5–77	56
77a	4–5–77	56
78a	4–5–77	56
79a	1–8–80	53
81a	1–78	55
82b	4–12–66	30
83d	D	44
84j	10–11–78	44
85b	5–9–57	31
87a	11–17–69P	31
88a	1–31–67P	55
89	8–27–32	56
90	10–1–28	29
91	6–15–31	56
92	4–30–71P	56
93a	8–31–73	56
94c	8–15–73	36
97a	10–8–69	55

SRM	Certificate date	Page
98a	10–8–69	55
99a	3–26–65P	55
100b	8–18–59	19
101f	5–19–70	21
103a	9–28–62	56
105	4–22–37P	19
106b	3–24–61	19
107b	11–1–62	30
113a	12–29–75	54
114m	4–15–73	85
115a	4–19–62	30
120b	7–31–79	54
121d	7–7–71P	20
122g	4–2–79	30
123c	7–7–71P	20
125b	4–10–70	19
126c	12–30–77	20
127b	1–25–68P	33
129c	8–7–73	19
131c	6–2–77	19
132b	8–16–73	21
133a	6–8–56	20
134a	5–6–57	21
136c	3–24–70P	44
139b	5–17–78	19
140b	4–16–70	44
141c	9–27–76	44
142	7–9–69	44
143c	9–27–76	44
148	12–22–70	44
152a	10–11–65	18
153a	1–5–60	21
154b	5–16–73	55
155	10–1–46	19
158a	8–8–61	32
160b	8–4–69P	20
163	1–11–68	21
165a	10–16–78	55
166c	3–17–70	20
171	11–27–51	33
173b	D	35
174	8–20–70P	35
176	8–20–70P	35
178	7–14–69	18
179	6–15–76	19
180	3–31–71	53
181	8–20–70P	53
182	8–20–70P	53
183	8–20–70P	53
184	2–26–73	32
185e	5–23–73	62
186Ic	9–1–70	62
186IIc	9–1–70	62
187b	9–9–70	62
188	1–10–64	62
189	1–10–64	62
191	7–15–68	62
192	7–15–68	62
193	11–14–74	53
194	1–8–74	53

SRM	Certificate date	Page
195	1–7–76	29
196	11–9–70	29
198	1–6–60	56
199	1–6–60	56
200	8–7–74	53
211c	D	69, 77
217c	D	69, 71, 77
276a	D	57
277	10–24–78	54
291	10–1–75	19
293	3–27–75	19
329	12–29–75	54
330	1–20–77	53
331	11–20–77	53
332	6–26–77	53
333	1–20–77	53
335	4–7–66	18
337	8–16–66	18
339	7–21–65	20
340	11–9–70	29
341	3–26–62	30
342a	4–27–70	30
344	10–2–63	20
345	1–23–64	20
348	1–17–66P	20
349	5–15–59P	33
350a	4–27–81	44
352a	6–16–80	41
354	8–7–61	41
355	9–8–66	41
356	9–8–66	41
357	6–16–80	41
358	6–16–80	41
360a	1–30–67	36
361	6–5–79	19
362	1–8–76	19
363	1–8–76	19
364	1–8–76	19
365	6–1–79	30
367	7–21–77	20
368	1–1–78	18
370e	C	84
371g	C	84
372h	C	84
373f	C	84
374c	C	84
375g	C	84
378b	C	84
379	C	84
382a	C	84
384d	C	84
385b	8–15–67	84
386h	3–10–75	84
388k	3–19–80	84
391	9–15–72	84
393	D	33
394	7–4–76	33
395	7–4–76	33
396	7–4–76	33
398	1–23–78	33
399	1–23–78	33
400	1–23–78	33
404a	5–5–65	23, 92
405a	5–5–65	23, 92
407a	5–5–65	23, 92
408a	5–5–65	23, 92
409b	5–5–65	23, 92
413	5–5–65	23, 92
414	5–5–65	23, 92
417a	5–5–65	23, 92
418a	5–5–65	23, 92
420a	5–5–65	23, 92
427	5–5–65	23, 92
436	9–22–59	28, 92
437	9–22–59	28, 92
438	9–22–59	28, 92
439	9–22–59	28, 92
440	9–22–59	28, 92
441	9–22–59	28, 92
442	10–25–65	25, 92
443	10–25–65	25, 92
444	10–25–65	25, 92
445	1–19–66	26, 92
446	1–19–66	26, 92
447	1–19–66	26, 92
448	1–19–66	26, 92
449	1–19–66	26, 92
450	1–19–66	26, 92
454	9–16–80	33
457	1–20–78	39
461	5–5–65P	24
462	5–5–65P	24
463	5–5–65P	.....
464	5–5–65P	24
465	5–5–65P	24
466	5–5–65P	24
467	5–5–65P	24
468	5–5–65P	24
469	D	63
474	D	63
477	D	82
478	2–28–74	43
479a	D	43
480	11–22–68P	43
481	2–14–69	43
482	6–6–69	43
483	6–11–71	43
484b	11–26–80	63
485a	D	81
486	D	81
493	8–28–70	81
494	1–20–78	39
495	1–20–78	39
496	1–20–78	39
498	1–20–78	39
499	1–20–78	39
500	1–20–78	39
607	5–21–73	58
608	G	58
609	G	58

SRM	Certificate date	Page
610	8–8–72P	58
611	8–8–72P	58
612	8–8–72P	58
613	8–8–72P	58
614	8–8–72P	58
615	8–8–72P	58
616	8–8–72P	58
617	8–8–72P	58
618	G	58
619	G	58
620	5–17–72P	56
621	3–13–75	56
622	3–19–76	67
623	3–19–76	67
624	10–25–77	67
625	4–24–64	40
626	4–24–64	40
627	4–24–64	40
628	4–24–64	40
629	4–24–64	40
630	4–24–64	40
631	4–16–70P	40
633	2–24–77	57
634	2–24–77	57
635	2–24–77	57
636	2–24–77	57
637	2–24–77	57
638	2–24–77	57
639	2–24–77	57
640	8–7–74	82
641	1–26–60P	40
642	1–26–60P	40
643	1–26–60P	40
644	1–26–60P	40
645	1–26–60P	40
646	1–26–60P	40
650	D	35
651	D	35
652	D	35
654a	3–22–71P	40
661	H(8–15–72P)	24
662	H(8–15–72P)	24
663	H(2–12–73P)	24
664	H(2–12–73P)	24
665	H(2–12–73)	24
668	G	24
671	6–29–79	34
672	6–29–79	34
673	6–29–79	34
674	D	82
680a	3–1–77	42
681	3–1–77	42
682	2–1–71P	42
683	7–9–68P	42
685	9–26–68P	42
690	10–28–78	54
691	D	54
692	10–24–78	54
693	10–24–78	54
696	8–24–79	54
697	8–24–79	54
698	8–24–79	54
700d	B	86
701d	1–15–77	86
702	11–1–66	86
703	11–1–66	86
705	11–28–78	69,72
706	undated	69
708	9–15–73	67
709	6–5–74	67, 68
710	6–29–62	67, 68
711	7–1–64	67, 68
712	10–4–65	67, 68
713	10–4–65	67, 68
714	10–4–65	67, 68
715	9–7–66	67, 68
716	9–7–66	67, 68
717	11–18–69	67, 68, 69
718	4–28–72	69
720	8–26–70	72
723a	4–20–81	44, 67
724a	9–24–73	72
726	1–31–67	34
728	7–9–68	36
729	D	72
731	7–31–72	73
732	10–3–77	73
733	12–30–71	74
736a	D	73
737	5–19–76	73
738	D	73
739	5–12–71	73
740	2–19–70	71
741	7–18–72	71
742	6–5–70	71
743	4–22–76	71
745	5–14–69	72
746	8–11–70	72
748	8–10–70	72
763	4–5–73	74
764	4–5–73	74
765	4–5–73	74
766	4–5–73	74
767a	D	70
768	12–13–78	70
772	7–11–78	74
773	D	68
781	4–1–77	72
782	D	72
803a	5–5–65	92
D803a	5–5–65	92
804a	5–5–65	92
805a	5–5–65	92
807a	5–5–65	92
D807a	5–5–65	92
808a	5–5–65	92
809b	5–5–65	
817b	5–5–65	92
820a	5–5–65	92
821	5–5–65	92

SRM	Certificate date	Page
827	5–5–65	92
837	9–22–59	28, 92
D837	9–22–59	28, 92
840	9–22–59	28, 92
D840	9–22–59	28, 92
D841	9–22–59	28, 92
849	1–19–66	92
D849	1–19–66	92
850	1–19–66	92
D850	1–19–66	92
871	8–2–79	32
872	8–2–79	32
874	1–19–78	32
875	1–19–78	32
879	6–20–79	32
880	6–20–79	32
882	6–20–79	33
897	D	34
898	D	34
899	D	34
900	4–5–79	45
909	5–21–80	45
910	D	45
911a	3–9–80	45
912a	11–16–79	45
913	11–23–73	45
914	11–28–73	45
915	11–21–73	45
916	3–10–71	45
917	9–20–73	45
918	11–23–73	45
919	11–23–73	45
920	11–23–73	45
921	12–16–73	45
922	8–20–76	45, 62
923	8–20–76	45, 62
924	11–23–73	45
925	12–26–73	45
926	7–18–77	45
927	7–18–77	45
928	5–19–76	45
929	4–27–79	45
930D	A	45, 76
931c	D	45, 76
932	A	45, 76
934	A	45
935	6–1–77	45, 76
936	9–1–78	45, 76
937	6–9–78	45
944	2–14–69	44, 59
945	4–6–71	59
946	12–3–71P	59
947	12–3–71P	59
948	9–1–72P	59
949e	10–1–75	44, 59
950b	3–1–78	44, 59
951	10–12–71	44, 61
952	10–12–71	61
953	3–12–69	59, 60
960	5–12–72	44

SRM	Certificate date	Page
961	6–11–74	60
962a	D	60
963a	D	60
964	6–11–74	60
975	3–11–65	61
976	3–24–65	61
977	3–24–65	61
978	3–24–65	61
979	5–3–66	61
980	1–31–67	61
981–3	4–10–73	61
984	7–27–70	44, 61
985	8–31–79	44
987	3–6–72P	44
989	2–19–74	61
990	8–75	61
991	3–19–76	61
993	6–30–75	59, 61
995	8–25–80	59, 61
996	D	59
999	9–6–72	44
1001	A(8–14–78)	87
1002c	12–13–78	87
1003	7–1–65P	85
1004	4–3–72	85
1006a	6–1–79	87
1007a	2–27–76	87
1008	A	87
1010a	8–12–78	87
1017a	9–24–71	85
1018a	5–16–73	85
1019a	D	85
1020	E	90, 92
1021	E	90, 92
1022	E	90, 92
1023	E	90, 92
1024	E	90, 92
1025	E	90, 92
1026	E	90, 92
1027	E	90, 92
1028	E	90, 92
1029	E	90, 92
1030	E	90, 92
1031	E	90, 92
1032	E	90, 92
1033	E	90, 92
1051b	7–15–68	52
1052b	3–1–68	52
1053a	1–23–70	52
1055b	7–23–68	52
1057b	8–5–68	52
1060a	4–24–64	52
1061c	9–9–70P	52
1062b	4–12–76	52
1065b	11–1–67	52
1066a	4–23–69	52
1069b	2–13–69	52
1070a	4–24–64	52
1071b	2–26–76	52
1073b	7–15–67	52

SRM	Certificate date	Page
1263a	2–24–81	24
1264a	2–24–81	24
1265a	2–24–81	24
1267	1–19–76	26
1275	3–10–80	37
1276	3–10–80	37
C1285	D	
1301a	A	64
1302a	A	64
1303a	A	64
1304a	A	64
1305a	A	64
1306a	A	64
1307a	A	64
1308a	A	64
1310a	A	64
1311a	A	64
1312a	A	64
1313a	A	64
1314a	A	64
1351a	A	64
1352a	A	65
1353a	A	65
1361a	A	64
1362a	A	64
1363a	A	64
1364a	A	65
1365a	A	65
1366a	A	65
1367a	A	65
1370a	A	65
1384a	A	66
1398a	A	65
1399a	A	66
1451	D	74
1456	D	72
1460	1–17–79	73, 83
1461	1–17–79	73, 83
1462	1–17–79	73, 83
1463	1–17–79	73, 83
1464	1–17–79	73, 83
1465	1–17–79	73, 83
1466	1–17–79	73, 83
1467	1–17–79	73, 83
1468	1–17–79	73, 83
1469	1–17–79	73, 83
1470	1–78	82
1475	12–2–71	69, 70, 72
1476	11–6–69	69, 70
1478	1–17–79	69, 70
1482	10–18–76	69, 70
1483	3–9–76	69, 70
1484	10–18–76	69, 70
1490	2–21–77	70
1511	4–24–69	83, 92
1512	7–2–69	83, 92
1513	9–17–69	83, 92
1516	7–9–69	83, 92
1517	7–9–69	83, 92
1519	7–9–69	83, 92

SRM	Certificate date	Page
1521	A	73, 83
1522	A	73, 83
1523	12–12–80	73
1541	3–1–71P	81
1566	12–12–79	46
1567	1–3–78	46
1568	1–3–78	46
1569	9–7–76	46
1572	D	60
1573	10–18–76	46
1575	10–18–76	46
1577a	D	60
1579	1–23–73	48
1580	3–10–80	50
1600	A	84
1620	12–1–79	48
1621a	2–1–80	48
1622a	8–31–79	48
1623a	D	48
1624a	D	48
1625	A(1–5–73)	51
1626	A(8–12–71)	51
1627	A(8–12–71)	51
1629a	A (5–81)	51
1630	11–31–71	48
1632a	1–23–78	49
1633a	4–18–79	49
1634a	D	49
1635	1–23–78	49
1636a	2–5–80	48
1637a	2–5–80	48
1638a	2–5–80	48
1641a	12–12–78	48
1642a	8–24–77	48
1643a	3–3–80	49
1644	D	50
1645	11–16–78	49
1646	D	49
1648	11–16–78	49
1651	11–12–68	72
1652	11–12–68	72
1653	11–12–68	72
1654	4–7–71	72
1655	D	72
1658a	A	47
1659a	A	47
1660a	A	47
1661a	A	47
1662a	A	47
1663a	A	47
1664	A	47
1665b	A	47
1666b	A	47
1667b	A	47
1668b	A	47
1669b	A	47
1674b	A	47
1675b	A	47
1677c	A	47
1678c	A	47

SRM	Certificate date	Page
1679c	A	47
1680b	A	47
1681b	A	47
1683a	A	47
1684a	A	47
1685a	A	47
1686a	A	47
1687a	A	47
1810	5-5-72	87
1815a	D	83
1816a	D	83
1820	9-6-74	52, 77
1821a	D	.....
1822	D	52, 77
1823	12-9-76	52, 77
1830	D	56
1831	D	56
1901	3-1-76	85
1967	2-23-77	74
1968	6-77	45, 71
2003a	D	76
2009	1-8-80	76
2010	1-8-80	76
2013	1-8-80	76
2014	1-8-80	76
2015	D	77
2016	D	77
2019	D	77
2020	D	77
2021	D	77
2022	D	77
2023	D	76
2024	D	76
2025	D	76
2030	A(9-23-76)	76
2031	A	76
2032	10-31-79	76
2033	5-9-80	76
2106	C	86
2107	C	86
2141	8-28-70	44
2142	9-1-70	44
2143	1-23-73	44
2144	4-5-73	44
2186I	5-28-68	62
2186II	5-28-68	62
2191	5-28-68	62
2192	5-28-68	62
2201	2-22-71	62
2202	2-22-71	62
2203	5-21-73	62
2308a	A	66
2318a	A	66
2338a	A	66
2339a	A	66
2601	A	75
2612a	A	47
2613a	A	47
2614a	A	47
2619a	A	47
2620a	A	47
2621a	A	47
2622a	A	47
2623a	A	47
2624a	A	47
2625a	A	47
2626a	A	47
2630	A	48
2631	A	48
2632	A	48
2633	A	48
2634	A	48
2635	A	48
2637	A	48
2638	A	48
2639	A	48
2640	A	48
2641	A	48
2642	A	48
2657	A	48
2658	A	48
2671	10-1-75	51
2672	2-27-76	51
2673	6-25-79	51
2674	12-18-79	51
2675	8-19-75	51
2676a	4-13-78	51
2679	9-24-76	51
3200	A	84
3210	A	84
3216	A	84
4200B	A	80
4201B	A	80
4202C	A	80
4203C	A	80
4206B	A	.....
4207	A	80
4211	5-70	80
4212	A	80
4213	A	80
4218D	A	80
4219B	6-74	78
4222	8-67	78
4223	8-67	78
4224	8-67	78
4226	5-68	78
4229	5-72	78
4233B	4-25-73	78
4235	A	79
4240	A	80
4245	5-74	78
4246	5-74	78
4247	5-74	78
4257	4-79	78
4260B	A	80
4302	A	79
4308	A	79
4331	3-75	78
4370B	5-78	78
4904F	A	79

✪U.S. GOVERNMENT PRINTING OFFICE: 1981-360-997/1868

NBS TECHNICAL PUBLICATIONS

PERIODICALS

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. As a special service to subscribers each issue contains complete citations to all recent Bureau publications in both NBS and non-NBS media. Issued six times a year. Annual subscription: domestic $13; foreign $16.25. Single copy, $3 domestic; $3.75 foreign.

NOTE: The Journal was formerly published in two sections: Section A "Physics and Chemistry" and Section B "Mathematical Sciences."

DIMENSIONS/NBS—This monthly magazine is published to inform scientists, engineers, business and industry leaders, teachers, students, and consumers of the latest advances in science and technology, with primary emphasis on work at NBS. The magazine highlights and reviews such issues as energy research, fire protection, building technology, metric conversion, pollution abatement, health and safety, and consumer product performance. In addition, it reports the results of Bureau programs in measurement standards and techniques, properties of matter and materials, engineering standards and services, instrumentation, and automatic data processing. Annual subscription: domestic $11; foreign $13.75.

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).

NOTE: The principal publication outlet for the foregoing data is the Journal of Physical and Chemical Reference Data (JPCRD) published quarterly for NBS by the American Chemical Society (ACS) and the American Institute of Physics (AIP). Subscriptions, reprints, and supplements available from ACS, 1155 Sixteenth St., NW, Washington, DC 20056.

Building Science Series—Disseminates technical information developed at the Bureau on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

Technical Notes—Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NBS under the sponsorship of other government agencies.

Voluntary Product Standards—Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The standards establish nationally recognized requirements for products, and provide all concerned interests with a basis for common understanding of the characteristics of the products. NBS administers this program as a supplement to the activities of the private sector standardizing organizations.

Consumer Information Series—Practical information, based on NBS research and experience, covering areas of interest to the consumer. Easily understandable language and illustrations provide useful background knowledge for shopping in today's technological marketplace.

Order the **above** *NBS publications from: Superintendent of Documents, Government Printing Office, Washington, DC 20402.*

Order the **following** *NBS publications—FIPS and NBSIR's—from the National Technical Information Services, Springfield, VA 22161.*

Federal Information Processing Standards Publications (FIPS PUB)—Publications in this series collectively constitute the Federal Information Processing Standards Register. The Register serves as the official source of information in the Federal Government regarding standards issued by NBS pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations).

NBS Interagency Reports (NBSIR)—A special series of interim or final reports on work performed by NBS for outside sponsors (both government and non-government). In general, initial distribution is handled by the sponsor; public distribution is by the National Technical Information Services, Springfield, VA 22161, in paper copy or microfiche form.

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, DC 20234

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE
COM—215

OFFICIAL BUSINESS

Penalty for Private Use, $300

THIRD CLASS