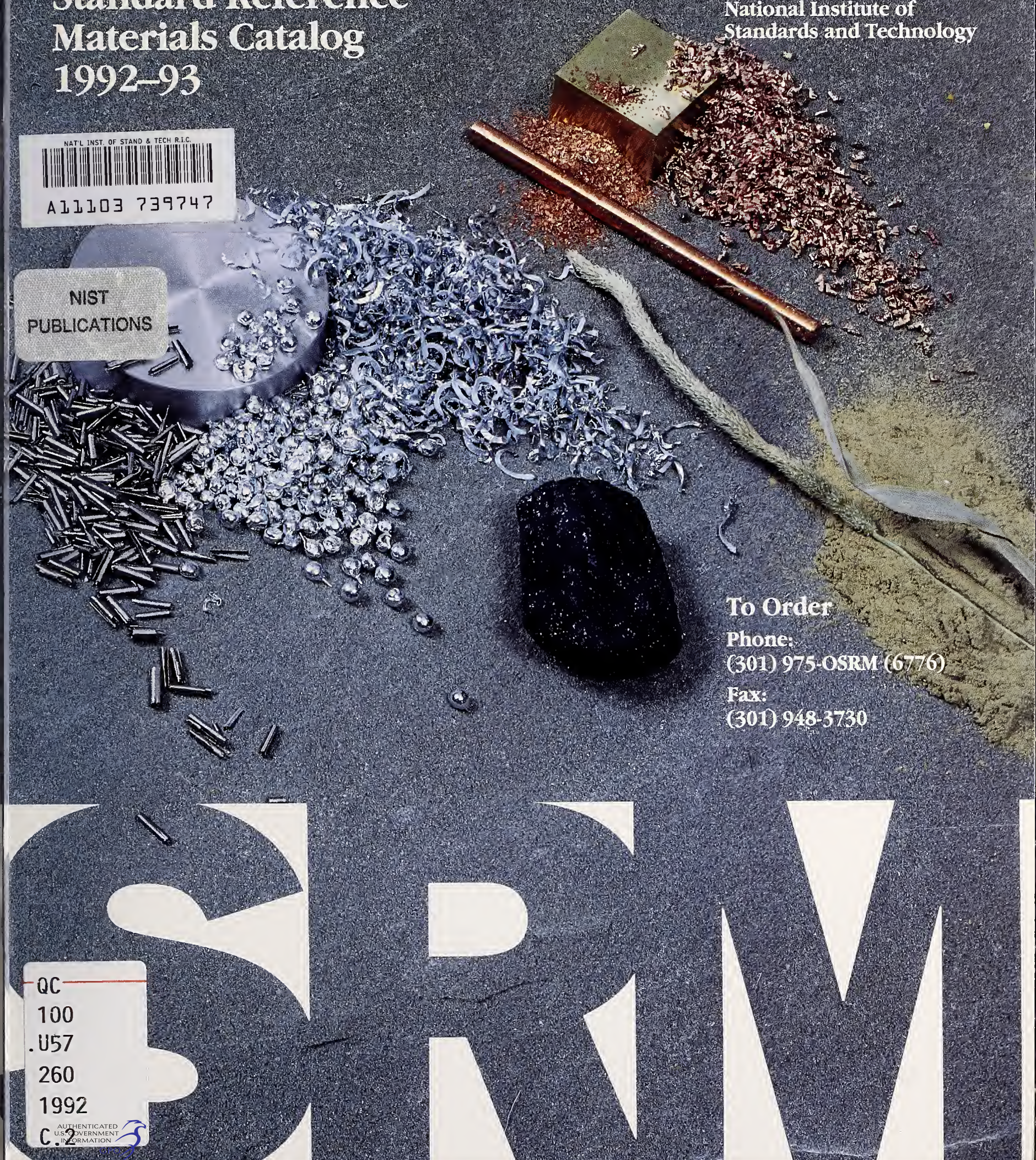
NIST

Standard Reference Materials Catalog 1992–93

NIST Special Publication 260

U.S. DEPARTMENT OF COMMERCE
Technology Administration
National Institute of Standards and Technology



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SRM

NIST | UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

Dear Colleague:

The past year (1991) marked the 90th Anniversary of the National Institute of Standards and Technology (NIST) formerly the National Bureau of Standards (NBS). As with other anniversaries, this is an opportunity to review the past and to plan and chart new directions for the future.

At the 50th Anniversary of NBS, Dr. Vannevar Bush asked, "Should an agency that is committed to the duty of setting standards also do research?" In my opinion the answer to his question is very clear. Those who set scientific standards cannot limit themselves only to the application of science but must constantly seek to improve the state of the art of the measurement process that can only be achieved through a concomitant effort of applied and basic research. Within this precept lie the uniqueness and strengths of NIST Standard Reference Materials (SRMs).

This catalog contains standards that were developed by scientists at NIST to aid and support industry, government, and science. Many of the SRMs were certified in cooperation with industry, others were certified using technology and scientific research based here at NIST. SRMs offered in this catalog can assure measurement compatibility and, in many cases, connect the measurement process to the "National Measurement System."

The number and type of SRMs described in the catalog have increased to over 1,200 since our previous issue. The catalog contains a guide and two revised indexes, each of which groups the SRMs and RMs according to a distinctive characteristic or descriptor. Please read the section entitled "How to Use This Catalog" as a starting point in examining NIST's available SRMs.

Many of you have informed us by letter or personally at exhibits of the need for new SRMs. We hope that some of the new SRMs recently developed at NIST will meet your standards needs. We have endeavored to provide at least some modest growth in our certification activities to accommodate your many requests. If you have a requirement that we currently do not meet, please contact us. There is a section in this catalog entitled "Guide for Requesting Development of Standard Reference Materials," that will facilitate processing your requests.

We appreciate your continued support for the SRM program and look forward to being able to serve you in the coming year.

Sincerely,

William P. Reed

William P. Reed
Chief
Standard Reference Materials Program

Standard Reference Materials Catalog 1992–93

NIST Special Publication 260

N. M. Trahey, Editor

Standard Reference Materials Program
National Institute of Standards and Technology
Gaithersburg, MD 20899

CAUTION: The values shown in the catalog are nominal values only. Users should consult the certificate issued with an SRM for the certified values.

To Order

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See page 8 for Ordering Instructions

U.S. DEPARTMENT OF COMMERCE
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Technology Administration
Robert M. White, Under Secretary for Technology

National Institute of Standards and Technology
John W. Lyons, Director

Issued February 1992

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Contents

Abstract and Key Words

This catalog provides technical and general ordering information for the Standard Reference Materials (SRMs) and Reference Materials (RMs) currently available from the National Institute of Standards and Technology (NIST) Standard Reference Materials Program (SRMP). The materials are arranged according to technical category and classified as follows: Standard Reference Materials for Chemical Composition; Standard Reference Materials for Physical Properties; and Standard Reference Materials for Engineering Materials. Technical descriptions are given for all materials and may include certified values. However, these values may be incomplete as they appear in the catalog and therefore cannot be referenced for actual measurement purposes. The certificates issued by SRMP are the only legitimate sources of certified information for NIST reference materials.

Key Words: analysis, calibration, Certified Reference Materials, characterization, composition, concentration, material, measurement, property, quality assurance, quality control, Reference Materials, Standard Reference Materials, standardization.

NIST Policy Regarding Use of Metric (SI) Units

In February 1991, the Director of NIST established the following policy:

> "In accordance with the Metric Conversion Act of 1975 as amended by Section 5164 of the Omnibus Trade and Competitiveness Act of 1988 and as required by related provisions of the Code of Federal Regulations, *the National Institute of Standards and Technology (NIST) will use the modern metric system of measurement units (International System of Units; abbreviation: SI) in all publications.* When the field of application or the special needs of users of NIST publications require the use of non-SI units, the values of quantities will be first stated in SI units and the corresponding values expressed in non-SI units will follow in parentheses."

This policy is part of the NIST Metric Transition Plan, developed in response to the legislation which mandates adoption of the SI system of units by all Federal agencies as the preferred system of weights and measures for United States trade and commerce. Governmental commitment to metrication has been further reinforced with the signing of Executive Order 12770 on July 25, 1991, by the President of the United States, which requires each Federal Agency to adopt use of the metric (SI) system into all its business-related activities by September 30, 1992.

The technical information contained in this catalog is consistent with the above-stated NIST policy. Only SI units and symbols have been used to describe the reference materials contained herein. Therefore, abrogated or obsolete quantifiers (i.e., the term, ppm), no longer appear, but rather have been replaced with the correct SI term, (mg/kg), and reference material values previously expressed in only inch-pound units, have been converted to the appropriate SI units. [1,2] Due to space limitations, the non-SI units converted are not shown in the catalog. The user should consult those SRM and RM certificates where data have been expressed in both SI and non-SI units. Lastly, in cases where SI unit conversions are not involved, terms in widest current usage (i.e., Wt. %), have been adopted and applied consistently throughout the catalog.

[1] ASTM E380-91 Standard Practice for Use of the International System of Units (SI) (the Modernized Metric System), ASTM, 1916 Race Street, Philadelphia, PA 19103.

[2] The International System of Units (SI), NIST Special Publication 330, 1991 Edition.

How to Use This Catalog

The *NIST Standard Reference Materials Catalog 1992–93* lists Standard Reference Materials (SRMs) and Reference Materials (RMs) issued by the NIST Standard Reference Materials Program. It consists of a guide and two (2) indexes, each of which groups the SRMs and RMs according to a distinctive characteristic or descriptor. Selection of the guide or one index over another to locate the information desired will depend on the user's prior knowledge of a specific SRM or RM and intended SRM or RM application.

Guide to SRM/RM Technical Categories – This is a general listing based on the three major categories into which all the SRMs and RMs have been assigned. The *categories* are divided into sequentially numbered sections, each of which describes a material class or technical property class. The *sections* are further divided into subsections, each of which describes a specific type of material or technical property and the physical form(s) of the SRMs and RMs contained therein. The titles of the *subsections* are the descriptors for the tables comprising the catalog.

EXAMPLE

Category	–	Standard Reference Materials for CHEMICAL COMPOSITION, 21 through 91 (page nos.)
Section	–	102. Nonferrous Metals, 36 (page no.)
Subsection (Descriptor)	–	Zinc Base Alloys (chip form), 43 (page no.)

SRM/RM Subject Index – This index is based on short word descriptors (one to four words) of the SRMs and RMs in the catalog. These descriptors may identify a section, subsection, a material class, a specific SRM property, a specific SRM application, or a measurement technique. Some descriptors may coincidently also identify an individual SRM or RM; however, only a few SRMs or RMs will be so described. The index is arranged in *alphabetical order of the first word of the descriptor.* Because of the variety of descriptors used, some SRM and RM materials may be cross-referenced.

EXAMPLE

Index Entry	–	ALLOYS (NONFERROUS)
Descriptor (s)	–	See NONFERROUS METALS, 36–43 (page nos.)
Index Entry	–	ZINC
Descriptor	–	Spelter (ZINC BASE ALLOYS), 43 (page no.)

SRM/RM Numerical and Certificate Index – This index is based on the unique numerical identifier assigned to each and every SRM and RM issued by NIST. This identifier is the *SRM or RM Number,* an integral part of the reference material name which appears on each SRM certificate or RM report of investigation. The index lists all the SRMs and RMs sequentially by this number, beginning with SRM 1c and ending with RM 9529. A short word descriptor of the SRM or RM, the category subsection in which it is assigned, and the *certificate or report-of-investigation date of issue* is also provided for reference.

EXAMPLE

SRM	–	94c
Descriptor	–	Zn Base Die Casting Alloy
Certificate Date	–	Aug 73
Section Code	–	102
Page	–	43 (page no.)

HOW TO LOCATE SPECIFIC INFORMATION

About an unknown SRM or RM material needed for a particular technical application –

Refer to the **Guide to SRM/RM Technical Categories,** select the most appropriate of the three categories, review all the sections and subsections therein and note the page numbers.

About a material from a specific class of materials and of known technical application –

Refer to the **SRM/RM Subject Index,** check for alternative descriptors and cross-references, and note page numbers.

About a material whose SRM or RM number is known –

Refer to the **SRM/RM Numerical and Certificate Index** and note the page number.

Program Information

The National Institute of Standards and Technology (NIST) offers for sale over 1,000 different materials through its Standard Reference Materials Program (SRMP). These materials are primarily Standard Reference Materials (SRMs) certified for their chemical compositions, chemical properties, or physical properties, but also include other reference materials. All materials bear distinguishing names and numbers by which they are permanently identified. Thus, each material bearing a given description is identical (within the specified limits) to every other sample bearing the same designation—with the exception of individually certified items, which are further identified by serial number.

Definitions

From "Terms and definitions used in connection with reference materials," ISO Guide 30–1981 (E):

1. "Reference Material (RM): A material or substance, one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials."

2. "Certified Reference Material (CRM): A reference material, one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body."

NIST Standard Reference Materials (SRMs): Certified reference materials issued by NIST. These are well-characterized materials produced in quantity to improve measurement science. SRMs are certified for specific chemical or physical properties, and are issued by NIST with certificates that report the results of the characterization and indicate the intended use of the material. They are prepared and used for three main purposes:

(1) To help develop accurate methods of analysis (reference methods);
(2) To calibrate measurement systems used to:
  (a) facilitate exchange of goods,
  (b) institute quality control,
  (c) determine performance characteristics, or
  (d) measure a property at the state-of-the-art limit; and
(3) To assure the long-term adequacy and integrity of measurement quality assurance programs.

NIST certified values are obtained by one of three routes of measurement:

(1) A previously validated reference method,
(2) Two or more independent, reliable measurement methods, or
(3) A network of cooperating laboratories, technically competent and thoroughly knowledgeable with the material being tested.

These measurement routes are described in "The Role of Standard Reference Materials in Measurement Systems," NBS Monograph 148, 54 pages (Jan. 1975).

Reference Materials (RMs) listed in this catalog are sold, but not certified, by NIST. They meet the ISO definition for RMs, and many meet the definition for CRMs. The documentation issued with these materials is either a:

(1) "Report of Investigation," the sole authority being the author of the report. RMs are intended to further scientific or technical research on particular materials. The principal consideration in issuing RMs is to provide a homogeneous material so that investigators in different laboratories are assured that they are investigating the same material.

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

SRM Catalog

New catalogs of NIST Standard Reference Materials (SRMs) are published approximately every 2 years, listing materials available and renewal materials in preparation, and deleting discontinued materials. The Catalog is supplemented by Price Lists issued simultaneously with each new catalog and approximately every 6 months to keep the catalog current between editions. These supplements list current prices, and reflect any changes in material availability—listing new and renewal materials and deleting discontinued ones.

A guide and two indexes are provided for user convenience. They are described in the section, **How to Use This Catalog**.

Preparation and Availability of Standard Reference Materials

New and renewal Standard Reference Materials (SRMs) are being prepared continually. While these SRMs are included in the next edition of the catalog and its supplements, prospective users whose names are on the SRM mailing list are notified as soon as the new items become available. Requests for placement on the SRM mailing list can be submitted at any time to SRMP.

Renewal SRMs are intended to be completed before the supply of an existing SRM is exhausted. However, this is not always possible and an SRM may be out of stock for a time. When this occurs, those ordering the material are so notified and possible substitute SRMs are suggested. When a renewal is issued, customers who have ordered the previous lot are promptly notified of the price and availability of the renewal. If little demand exists or if an alternate source of supply becomes available, production of an SRM may be discontinued permanently.

Renewal SRMs may not be identical to the preceding lot; however, they meet the same specifications and can be used for the same purpose. For example, the first 0.1% carbon Bessemer steel was prepared in 1909 (Standard Sample No. 8). Since then a number of renewals, 8a, 8b, 8c, etc., have been prepared. The current SRM 8j, 0.1% C, represents the eleventh lot of the material. Each lot differs somewhat in detailed analysis; thus the use of the specific certificate for that lot is essential.

Guide for Requesting Development of Standard Reference Materials

The National Institute of Standards and Technology has the responsibility to develop, produce, and distribute Standard Reference Materials (SRMs) that provide a basis for comparison of measurements on materials, and that aid in the control of production processes. To carry out this function, the Standard Reference Materials Program (SRMP) evaluates the requirements of science, industry, and government for well-characterized reference materials, and directs the production and distribution of such materials.

NIST currently has over 1,000 SRMs available, about 100 new ones in preparation, and requests for the production of many others.

To become an SRM, a candidate material must meet one or more of these criteria:

1. It would permit users to attain more accurate measurements.
2. Its production elsewhere would not be economically or technically feasible.
3. It would be an industry-wide standard for commerce from a neutral source not otherwise available to the public.
4. Its production by NIST would assure continued availability of a well-characterized material important to science, industry, or government.

NIST has recognized and responded to requests to enlarge the scope of the SRM program to include all types of well-characterized materials for use in calibrating measurement systems, or for producing scientific data that can be referred to a common base. However, the requests for new SRMs greatly exceed the Institute's capacity to produce and certify such materials. Consequently, requests for new SRMs of limited need or use are deferred in favor of requests that clearly show a critical need. To determine which requests receive priority, NIST seeks and uses information supplied by industry and such organizations as the American National Standards Institute (ANSI), American Nuclear Society (ANS), American Petroleum Institute (API), American Society for Testing and Materials (ASTM), etc., to objectively assess the urgency and importance of proposed new reference materials.

Requests to SRMP for the development of a new SRM should provide the following information:

1. Short title of the proposed SRM.
2. Purpose for which the SRM would be used.
3. Reasons why the SRM is needed.
4. Technical characteristics and requirements for the material. Include additional requirements and reasons if more than one SRM is necessary for standardization in this area.
5. Estimates of the probable present and future (6–10 years) demand for such an SRM, nationally and internationally.
6. Justification for SRM preparation by NIST, particularly if a similar one could be produced or obtained from another source.
7. Pertinent information to aid justification for the SRM, such as: (a) an estimate of the potential range of application, monetary significance of the measurement affected, scientific and technological significance including, when feasible, estimates of the impact upon industrial productivity, growth, quality assurance or control, and (b) supporting letters from industry leaders, trade organizations, interested standards committees, and others.

All such requests should be addressed to:

Standard Reference Materials Program
ATTN: SRM Development
Room 215, Building 202
National Institute of Standards and Technology
Gaithersburg, MD 20899

Ordering Standard Reference Materials

General

Purchase orders for all SRMs should be addressed to:

Standard Reference Materials Program
Room 204, Building 202
National Institute of Standards and Technology
Gaithersburg, MD 20899

Telephone: (301) 975–OSRM [6776]
FTS: 879-OSRM [6776]
Fax number: (301) 948–3730
Telex: TRT 197674NIST UT

Each order should give the number of units, catalog number(s), and name(s) of the material(s) requested. For example: "1 each, SRM 79a, Fluorspar (Customs Grade)." The materials described in this catalog are sold only in the units listed or multiples thereof.

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

In general, orders received for "out-of-stock" material will be filled with the renewal material, if available; otherwise they will be canceled. Customers are notified when an order is canceled and their names are placed on a notification list. This list is used when a renewal material is issued to notify customers of the price and availability of the item. Customers so notified are requested to submit a new order if they still want the item.

For some individually certified SRMs, production lots are small and may entail frequent stock outages. In these cases, the notification list is used to fill orders on a "first come, first served" basis. For such SRMs, customers are notified that the SRM is again available and are requested to confirm their original purchase orders.

Terms

Prices quoted are in U.S. dollars ($), and are published in the catalog supplements (price lists). When price lists are issued, they are sent to persons or organizations on the SRM mailing list. These prices are subject to change without notice and orders will be billed for the prices in effect at the time of shipment. Discounts are given on individual purchases of 50 or more units of SRMs, or combinations thereof.

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

a. Banker's draft against U.S.A. bank,
b. Bank to bank transfer to U.S.A. bank,
c. Cash against documents,
d. VISA or Mastercard only,
e. International money order, or
f. UNESCO coupons.

Letters of credit: If a letter of credit or any method of payment other than those listed above is to be used, the services of an agent in the United States must be secured to act in the customer's behalf. The agent must purchase the material and the NIST invoice will indicate that the agent is the purchaser. The material is then shipped to the agent, who transhipps in accordance with customer instructions.

NOTE: A customer identification number, i.e., social security number (SSN) for consumer customers; tax identification number (TIN) for commercial customers; or agency location code (ALC) for government customers, is required with each order.

Late Charges

Payment is due within 30 days of shipment of the order to the customer unless otherwise notified by NIST. U.S. Treasury regulations require that late charges be assessed for each 30-day period, or portion thereof, that the payment is overdue.

Proforma Invoice (Price Quotation)

Proforma service will be provided only upon request for such service.

Domestic Shipments

Shipments of material (except for certain restricted categories and refrigerated items) intended for the United States and Canada are normally shipped prepaid, provided the parcel does not exceed the weight limitations prescribed by postal laws and regulations. Refrigerated items are shipped prepaid air express with shipping costs added to the invoice. Hazardous shipments will have an additional handling charge added to the invoice.

Foreign Shipments

The regulations of various nations covering the importation of SRMs differ widely; any attempt to list all possible variations would be impractical. Therefore, where the shipping practices described as follows do not apply, customers will be informed of the best method of shipment for their countries.

Shipping Practices: Most foreign orders are shipped by prepaid International Air Parcel Post. Exceptions are those items in restricted categories, those items requiring refrigeration, and shipments exceeding parcel post weight limits. The exceptions are shipped FOB Gaithersburg, MD, unless an agent (shipping or brokerage firm) located in the United States is used or required. In this case, the customer is notified, requested to obtain the services of an agent and inform NIST of the agent's name and address. The material is then packed for overseas shipment and forwarded to the agent FOB Gaithersburg, MD.

Documentation

The documents NIST furnishes are:

a. Two (2) commercial invoices,
b. One (1) packing slip, and
c. One (1) air waybill for air shipments.

All documents are printed in English.

If documents other than those listed above are required, the services of an agent in the United States must be used to purchase and ship the material.

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

Certified Reference Materials From Other Sources

Special Nuclear Materials

The U.S. Department of Energy New Brunswick Laboratory issues special nuclear reference materials as NBL Certified Reference Materials (CRMs). These CRMs include the plutonium and uranium assay and isotopic materials previously issued by the National Institute of Standards and Technology. All orders or inquiries should be addressed to:

U.S. Department of Energy
New Brunswick Laboratory
Attn: Reference Materials Sales
9800 S. Cass Avenue, Bldg. 350
Argonne, IL 60439
(312) 972-2767

Other Services of the National Institute of Standards and Technology

Calibration and Related Measurement Services

The measurement services of NIST include the calibration of standards, test of instruments, and certain interlaboratory testing programs. These services are described in NIST Special Publication 250, National Institute of Standards and Technology Calibration Services Users Guide, 1991 ed. [Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.] For information on available measurement services, consult Special Publication 250, or write or telephone:

Physical Measurement Services Program
Room A112, Building 411
National Institute of Standards and Technology
Gaithersburg, MD 20899

Telephone: (301) 975–2002
FAX: (301) 975–2128

Requests for measurement services available in Boulder should be addressed to:

Measurement Services Clerk
National Institute of Standards and Technology
Boulder, CO 80303

Telephone: (303) 497–3753
FAX: (303) 497–3970

National Standard Reference Data System

The National Standard Reference Data System (NSRDS) is a nationwide program established to compile and critically evaluate quantitative physical science data and assure its availability to the technical community. The program publishes compilations of critically evaluated data, critical reviews of experimental techniques, and bibliographies. A complete list of NSRDS publications is available from the Standard Reference Data Program (SRDP). SRDP responds to inquiries within the scope of the program by providing references, referrals, documentation, or data, as available. Inquiries should be directed to:

Standard Reference Data Program
Room A323 Physics Building
National Institute of Standards and Technology
Gaithersburg, MD 20899

Telephone: (301) 975–2208
FAX: (301) 926–0416

Accreditation of Testing Laboratories

The National Voluntary Laboratory Accreditation Program (NVLAP) accredits public and private testing laboratories, based on evaluation of their technical qualifications and competence for conducting specific tests or types of tests in specified fields of testing. Accreditation is based on criteria published in the Code of Federal Regulations as part of the NVLAP procedures. Accreditation is granted following successful completion of a process which includes submission of an application and payment of fees by the laboratory, an on-site assessment, resolution of any deficiencies identified during the on-site assessment, participation in proficiency testing, technical evaluation, and administrative review. The accreditation is formalized through issuance of a Certificate of Accreditation and Scope of Accreditation

and publicized by announcement in various government and private media. Application packages may be obtained from:

Laboratory Accreditation Program
Room A146, Building 411
National Institute of Standards and Technology
Gaithersburg, MD 20899

Telephone: (301) 975–4016
FAX: (301) 975–3839

National Center for Standards and Certification Information

The National Center for Standards and Certification Information (NCSCI) contains title information or full texts for engineering or related standards issued by U.S. technical societies, professional organizations, and trade associations; State purchasing offices; U.S. Federal Government agencies; and major foreign national and international standardizing bodies. NCSCI publishes general and specific indexes of standards. Information services, which are free, consist of searching various indices to determine whether any published standards, specifications, codes, test methods, or recommended practices exist for a given item or product. Inquiries should be directed to:

National Center for Standards and Certification Information
Room A163, Building 411
National Institute of Standards and Technology
Gaithersburg, MD 20899

Telephone: (301) 975–4040
FAX: (301) 926–1559

Weights and Measures Program

The NIST Weights and Measures Program operates a Type Evaluation Program which provides for an evaluation of (1) prototype weighing and measuring devices to determine compliance with the requirements of NBS Handbook 44, "Specifications, Tolerances, and Other Technical Requirements for Commercial Weighing and Measuring Devices," (2) standards to determine compliance with the requirements of NBS Handbook 105–1, 105–2, 105–3, "Specifications and Tolerances for Reference Standard and Field Standard Weights and Measures." This program may be used by manufacturers and weights and measures officials in determining the acceptability of devices for commercial use or the suitability of reference and field standards. For information on programs of NIST and the States, write or telephone:

Weights and Measures Program
Room A617, Administration Building
National Institute of Standards and Technology
Gaithersburg, MD 20899

Telephone: (301) 975–4004
FAX: (301) 926–0647

Proficiency Sample Programs

General information on the Proficiency Sample Programs may be obtained from:

Materials Reference Laboratories
National Institute of Standards and Technology
Gaithersburg, MD 20899

Telephone: (301) 975–6704
FAX: (301) 330–1956

Information is available on the following programs:

Proficiency Sample Programs for Hydraulic Cements, Pozzolans, and Portland Cement Concrete,
Proficiency Sample Programs for Soils, Aggregates, and Bituminous Materials,
Inspection of Cement and Concrete Testing Laboratories,
Inspection of Soils and Bituminous Testing Laboratories.

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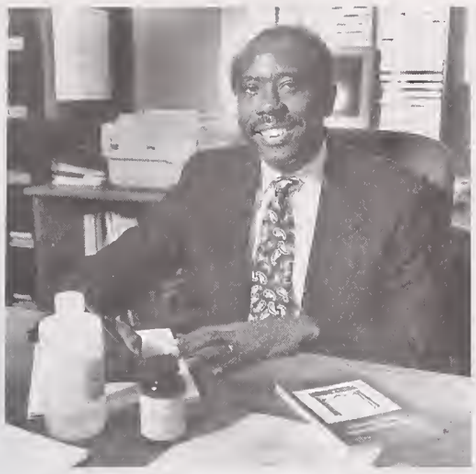

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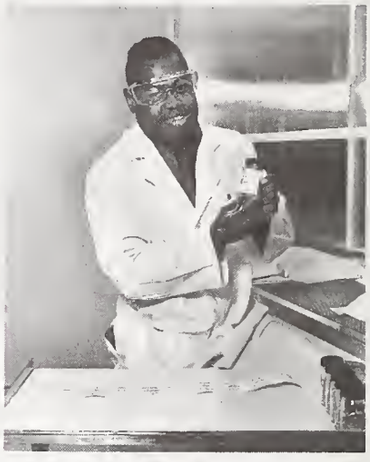

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Guide to SRM/RM Technical Categories

Standard Reference Materials for CHEMICAL COMPOSITION

Standard Reference Materials for PHYSICAL PROPERTIES

Standard Reference Materials for ENGINEERING MATERIALS

Standard Reference Materials for Chemical Composition

101. Ferrous Metals

Plain Carbon Steels (chip form)

These SRMs are for checking chemical methods of analysis. They consist of steel alloys selected to provide a wide range of analytical values for elements. They are furnished in 150-g units (unless otherwise noted) as chips usually sized between 0.4 to 1.2 mm, prepared from selected portions of commercial ingots.

SRM	Type	Elemental Composition (in Wt. %)				
		C	Mn	P	S	Si
8j	0.1C	0.081	0.505	0.095	0.077	0.058
11h	0.2C	0.200	0.510	0.010	0.026	0.211
12h	0.4C	0.407	0.842	0.018	0.027	0.235
13g	0.6C	0.613	0.853	0.006	0.031	0.355
14g	AISI 1078	0.735	0.456	0.006	0.019	0.232
15h	0.1C	0.076	0.373	0.005	0.019	0.008
16f	1.1C	0.97	0.404	0.014	0.026	0.214
19h	0.2C	0.215	0.393	0.016	0.022	0.211
20g	AISI 1045	0.462	0.665	0.012	0.028	0.305
152a	0.5C (Tin bearing)	0.486	0.717	0.012	0.030	0.202
178	0.4C	0.395	0.824	0.012	0.014	0.163
337a	1.1C (Carbon & Sulfur) (300 g)	0.969			0.024	
368	AISI 1211	0.089	0.82	0.084	0.132	0.007

SRM	Cu	Ni	Cr	V	Mo	Co	Ti	Sn	Al (total)	N
8j	0.020	0.113	0.047	0.015	0.038					
11h	0.061	0.028	0.025	0.001			0.004			
12h	0.073	0.032	0.074	0.003	0.006				(0.038)	0.006
13g	0.066	0.061	0.050	0.001					0.048	
14g	0.047	0.030	0.081	0.0008	0.011				0.025	
15h	0.013	0.017	0.018	<0.001	0.009				0.061	
16f	0.006	0.008	0.020	0.002	0.003	0.003				
19h	0.466	0.248	0.173	0.003	0.038				0.002	
20g	0.034	0.034	0.036	0.002	0.008				0.040	
152a	0.023	0.056	0.046	0.001	0.036			0.032		
178	0.032	0.010	0.016	0.001	0.003					
368	0.010	0.008	0.030	0.001	0.003					0.010

Values in parentheses are not certified and are given for information only.

Low Alloy Steels (chip form)

SRM	Type	Elemental Composition (in Wt. %)						
		C	Mn	P	S		Si	Cu
					Grav	Comb		
30f	Cr–V (SAE 6150)	0.490	0.79	0.011	0.009	0.283	0.074	
32e	Ni–Cr (SAE 3140)	0.409	0.798	0.008	0.022	0.021	0.278	0.127
33e	Ni–Mo (SAE 4820)	0.186	0.525	0.005	0.009	0.262	0.070	
36b	Cr–Mo	0.114	0.404	0.007	0.019	0.258	0.179	
72g	AISI 4130	0.278	0.492	0.009	0.014	0.223	0.011	
100b	Manganese (SAE 340)	0.397	1.89	0.023	0.029	0.028	0.210	0.064
106b	Cr–Mo–Al (Nitralloy G)	0.326	0.506	0.008	0.016	0.017	0.274	0.117
125b	High Silicon	0.028	0.278	0.029	0.008	2.89	0.071	
129c	High Sulfur (SAE 112)	0.125	0.769	0.076	0.245	0.020	0.013	
131e	High Silicon	In Prep						
139b	Cr–Ni–Mo (AISI 8640)	0.403	0.778	0.013	0.019	0.242	0.097	
155	Cr–W	0.905	1.24	0.015	0.010	0.011	0.322	0.083
163	Cr (100 g)	0.933	0.897	0.007	0.027	0.488	0.087	
179	High Silicon	0.027	0.094	0.006		0.026	3.19	0.056
291	Cr–Mo (ASTM A213)	0.177	0.550	0.008	0.020	0.230	0.047	
293	Cr–Ni–Mo (AISI 8620)	0.222	0.960	0.018	0.022	0.300		

SRM	Ni	Cr	V	Mo	Sn	Al (total)	N
30f	0.070	0.945	0.182				0.010
32e	1.19	0.678	0.002	0.023	(0.011)		0.009
33e	3.36	0.068	(0.001)	0.224	(0.002)	0.030	
36b	0.203	2.18	0.004	0.996			
72g	0.016	0.905	0.003	0.170		(0.041)	(0.008)
100b	0.030	0.063	0.003	0.237			0.004
106b	0.217	1.18	0.003	0.199		1.07	
125b	0.038	0.019		0.008	0.003	0.329	**Ca 0.0051**
129c	0.251	0.014	0.012	0.002			
139b	0.510	0.488	0.004	0.182			0.007
155	0.100	0.485	0.014	0.039			**W 0.517**
163	0.081	0.982		0.029			0.007
179	0.050	0.022	< 0.01	0.014	0.004	0.0028	
291	0.065	1.33		0.538		0.002	
293	0.480	0.510	0.004	0.204		0.039	

Values in parentheses are not certified and are given for information only.

Special Low Alloy Steels (chip form)

SRM	Type	Elemental Composition (in Wt. %)							
		C	Mn	P	S	Si	Cu	Ni	Cr
361	AISI 4340	0.383	0.66	0.014	0.0143	0.222	0.042	2.00	0.694
362	AISI 94B17 (mod.)	0.160	1.04	0.041	0.0360	0.39	0.50	0.59	0.30
363	Cr–V (mod.)	0.62	1.50	0.029	0.0068	0.74	0.10	0.30	1.31
364	High Carbon (mod.)	0.87	0.255	0.01	0.0250	0.065	0.249	0.144	0.063
2159	Carbon & Sulfur only	In Prep							
2160	Carbon & Sulfur only	In Prep							
2165	E	0.0059	0.144	0.0052	0.0038	(0.004)	0.0013	0.155	0.050
2166	F	0.015	0.066	0.0012	0.0023	0.010	0.015	0.022	0.024
2167	G	0.051	0.022	0.0031	0.0091	0.026	0.0014	0.002	0.0015

SRM	V	Mo	W	Co	Ti	As	Sn	Al (total)	Nb	Ta	Zr	N	Ca
361	0.011	0.19	0.017	0.032	0.020	0.017	0.010	0.021	0.022	0.020	0.009	(0.0037)	0.00010
362	0.040	0.068	0.20	0.30	0.097	0.092	0.016	0.083	0.29	0.20	0.19	(0.00404)	0.00021
363	0.31	0.028	0.046	0.048	0.050	0.010	0.104	0.24	0.049	(0.053)	0.049	(0.0041)	0.00022
364	0.105	0.49	0.10	0.15	0.24	0.052	0.008	(0.008)	0.157	0.11	0.068	(0.0032)	0.00003
2165	0.0040	0.0055		0.0012	0.0051	0.0010	0.002	(0.006)	0.0004	(0.004)			
2166	0.009	0.0035		0.0022	0.0007	0.0035	0.0010	0.012	0.005	(0.011)	(0.0004)		
2167	0.033	0.020		0.0050	0.010	0.0005	0.006	0.0045	0.0095	(0.002)	(0.004)		

SRM	B	Pb	Sb	Bi	Ag	Se	Te	Ce	La	Nd	Fe
361	0.00037	0.000025	0.0042	(0.0004)	0.0004	(0.004)	(0.0006)	0.0040	(0.001)	0.00075	(95.6)
362	0.0025	0.00048	0.013	(0.002)	0.0011	(0.0012)	0.0005	0.0019	(0.001)	0.00075	(95.3)
363	0.00078	0.00186	0.002	(0.0008)	0.0037	(0.00016)	(0.0009)	0.0030	(0.002)	0.0012	(94.4)
364	0.0106	0.0230	0.034	(0.0009)	(0.00002)	(0.00021)	(0.0002)	0.00057	(0.0002)	0.00018	(96.7)
2165	(0.0009)	0.0003	0.001	(<0.0001)	0.0002	(0.0035)	(0.003)				
2166	(0.0004)	0.003	0.0005	(<0.0001)	0.0005	(0.0035)	(0.003)				
2167	(0.001)	(<0.0001)	0.0020	(<0.0001)	0.0007		(0.0003)				

SRM	Mg	Zn	Pr	Ge	O	H	Au	Hf	Sr
361	0.00026	(0.0001)	(0.0003)	[0.006]	(0.0009)	(<0.0005)	(<0.00005)	(0.0002)	(0.001)
362	0.00068	0.00012	(0.0003)	[0.002]	(0.00107)	(<0.0005)	(<0.00005)	(0.0003)	
363	0.00062	(0.0004)	(0.0004)	[0.010]	(0.00066)	(<0.0005)	0.0005	(0.0005)	(<0.0005)
364	0.00016	[0.001]	(0.0001)	[0.003]	(0.0010)	(<0.0005)	0.0001	(0.0013)	(0.001)
2165	(<0.0001)								
2165	(<0.0001)								
2165	(<0.0001)								

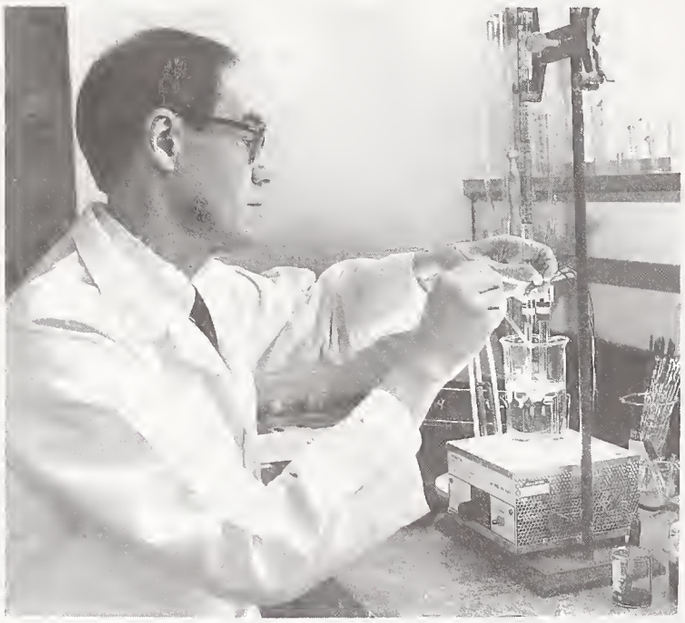
Values in parentheses are not certified and are given for information only.
Values in brackets are approximate values from heat analysis and are given for information only.

High Alloy Steels (chip form)

SRM	Type	Elemental Composition (in Wt. %)						
		C	Mn	P	S		Si	Cu
					Grav	Comb		
126c	High Nickel (36% Ni)	0.026	0.468	0.004		0.005	0.194	0.040
344	Cr–Ni (Mo Precipitation Hardening)	0.069	0.57	0.018		0.019	0.395	0.106
345	Cr–Ni (Cu Precipitation Hardening)	0.048	0.224	0.018	0.012	0.012	0.610	3.44
346a	Valve Steel	0.502	9.16	0.031		0.002	0.219	0.375
348a	High Temperature Alloy (A286) Ni–Cr	0.044	0.64	0.023		0.0007	0.43	0.14
868	High Temperature Alloy Fe–Ni–Co	0.022	0.052	<0.003		0.0025	0.097	0.022

SRM	Ni	Cr	V	Mo	Co	Ti	Al (total)	Nb	Ta	B	Fe
126c	36.05	0.062	0.001	0.011	0.008						
344	7.28	14.95	0.040	2.40		0.076	1.16				
345	4.24	16.04	0.041	0.122	0.089			0.231	0.002		
346a	3.43	21.08	0.096	0.237	(0.05)	(<0.001)	(0.001)	(0.01)	**Sn (0.008)**	(<0.001)	**N 0.442**
348a	24.2	14.8	0.23	1.18	0.15	2.12	0.24	(0.07)	**W (0.07)**	0.0055	(55.2)
868	37.78	0.077	0.077	0.014	16.1	1.48	0.99	2.99	0.003	0.0078	40.5

Values in parentheses are not certified and are given for information only.



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Stainless Steels (chip form)

SRM	Type	Elemental Composition (in Wt. %)					
		C	Mn	P	S	Si	Cu
73c	Cr (SAE 420)	0.310	0.330	0.018	0.036	0.181	0.080
101g	AISI 304 L (100 g)	0.0136	0.085	0.007	0.0078	1.08	0.029
121d	Cr–Ni–Ti (AISI 321)	0.067	1.80	0.019	0.013	0.54	0.121
123c	Cr–Ni–Nb (AISI 348)	0.056	1.75	0.024	0.014	0.59	0.103
133b	Cr–Mo	0.128	1.07	0.018	0.328	0.327	0.080
160b	Cr–Ni–Mo (AISI 316)	0.044	1.64	0.020	0.016	0.509	0.172
166c	Carbon Only (100 g)	0.0078					
339	Cr–Ni–Se (SAE 303Se)	0.052	0.738	0.129	0.013	0.654	0.199
343a	Cr–Ni (AISI 431)	0.149	0.42	0.026	0.001	0.545	0.162
367	Cr–Ni (AISI 446)	0.093	0.315	0.018	0.016	0.58	

SRM	Ni	Cr	V	Mo	Co	Ti	Nb	Ta	Pb	Se	N
73c	0.246	12.82	0.030	0.091							0.037
101g	10.00	18.46	0.041	0.004	0.09						
121d	11.17	17.43		0.165	0.10	0.342					
123c	11.34	17.40		0.22	0.12		0.65	< 0.001			
133b	0.230	12.63	0.071	0.052							
160b	12.26	18.45	0.047	2.38	0.101				0.001		0.039
339	8.89	17.42	0.058	0.248	0.096					0.247	
343a	2.16	15.64	0.056	0.164	(0.04)	(< 0.001)	(0.01)		(< 0.0001)		0.078
367	0.29	24.19	0.08								0.168

Values in parentheses are not certified and are given for information only.

Tool Steels (chip form)

SRM	Type	Elemental Composition (in Wt. %)						
		C	Mn	P	S		Si	Cu
					Grav	Comb		
50c	W–Cr–V	0.719	0.342	0.022	0.010	0.009	0.311	0.079
132b	Tool Steel (AISI M2)	0.864	0.341	0.012	0.004	0.185	0.088	
134a	Mo–W–Cr–V	0.808	0.218	0.018	0.007	0.007	0.323	0.101

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	0.230	4.38	1.83	4.90	6.28	0.029			
134a	0.088	3.67	1.25	8.35	2.00				

Steel SRMs described in this and the following five (5) pages are furnished in various forms. The 600 series is for microchemical methods of analysis, such as electron probe microanalysis, laser probe analysis and spark source mass spectrometry. The 1100, 1200, and 1700 series are for optical emission and X-ray spectrometric methods of analysis. These materials have been prepared to ensure high homogeneity.

Nominal Sizes for Solid Steel SRMs:

600 Series: 3.2 mm diameter, 51 mm long.
1100 and 1200 Series: 31 mm diameter, 19 mm thick.
1700 Series: 34 mm diameter, 19 mm thick.
A "C" preceding the SRM number indicates a chill cast sample: 31 mm diameter, 19 mm thick.

Low Alloy Steels (disk form)

SRM	Type	Elemental Composition (in Wt. %)				
		C	Mn	P	S	Si
661	AISI 4340	0.392	0.66	0.015	0.015	0.223
663	Cr–V (mod.)	0.57	1.50	0.029	0.0055	0.74
664	High Carbon (mod.)	0.871	0.258	0.010	0.025	0.066
665	Electrolytic Iron	0.008	0.0057	0.0025	0.0059	0.0080
1134	High Silicon	0.026	0.277	0.028	0.009	2.89
1135	High Silicon	0.027	0.094	0.006	0.026	3.19
1218	High Silicon, Low Carbon & Sulfur	0.0029	0.014	(0.002)	0.0011	(3.2)
C1221	Resulfurized/Rephosphorized (AISI 1211)	0.020	0.102	0.090	0.112	0.876
1222	Cr–Ni–Mo (AISI 8640)	0.43	0.78	0.013	0.022	0.24
1224	Carbon (AISI 1078)	0.75	0.41	0.009	0.039	0.173
1225	Low Alloy (AISI 4130)	0.274	0.48	0.007	0.014	0.221
1226	Low Alloy	0.085	0.274	0.0022	0.0044	0.231
1227	Basic Open Hearth, 1% C	0.97	0.402	0.014	0.026	0.215
1228	0.1% C	0.072	0.365	0.004	0.018	0.007
1254	Low Alloy (Calcium only)					
1261a	AISI 4340	0.391	0.67	0.016	0.015	0.228
1263a	Cr–V (mod.)	0.57	1.50	0.029	0.0055	0.74
1264a	High Carbon (mod.)	0.871	0.258	0.010	0.025	0.066
1265a	Electrolytic Iron	0.008	0.0057	0.0025	0.0059	0.0080
C1269	Line Pipe (AISI 1526 mod.)	0.298	1.35	0.012	0.0061	0.189
1270	Cr–Mo Low Alloy, A336 (F–22)	0.077	0.626	0.0065	0.0065	0.247
C1285	Low Alloy (A242 mod.)	0.058	0.332	0.072	0.020	0.36
1286	Low Alloy (Hy 80)	0.196	0.152	0.008	0.017	0.130
1761	Low Alloy Steel	1.03	0.678	0.040	0.035	0.18
1762	Low Alloy Steel	0.337	2.00	0.034	0.030	0.35
1763	Low Alloy Steel	0.203	1.58	0.012	0.023	0.63
1764	Low Alloy Steel	0.592	1.21	0.021	0.012	0.057
1765	Low Alloy Steel	0.006	0.144	0.006	0.0038	(0.004)
1766	Low Alloy Steel	0.015	0.067	0.001	0.0024	0.010
1767	Low Alloy Steel	0.052	0.022	0.003	0.0090	0.035

Values in parentheses are not certified and are given for information only.

Low Alloy Steels (disk form) – Continued

SRM	Cu	Ni	Cr	V	Mo	W	Co	Ti
661	0.042	1.99	0.69	0.011	0.19	0.017	0.032	0.020
663	0.098	0.32	1.31	0.31	0.30	0.046	0.048	0.050
664	0.250	0.142	0.066	0.106	0.49	0.102	0.15	0.23
665	0.0058	0.041	0.007	0.0006	0.005	(<0.0001)	0.007	0.0006
1134	0.070	0.038	0.019	0.008				
1135	0.056	0.050	0.022	<0.01	0.014			
1218	0.003	(0.002)	0.006	(<0.001)	(0.003)	(0.002)	(0.004)	
C1221	0.041	0.067	0.049	(0.0007)	0.038	(0.010)	(0.0014)	
1222	0.097	0.51	0.48	0.005	0.18	(0.016)	(0.002)	
1224	0.072	0.054	0.071	0.002	0.013			
1225	0.018	0.91	0.004	0.166				
1226	0.125	5.42	0.467	0.0018	0.446	(0.005)	0.029	0.0021
1227	0.006	0.007	0.019	0.002	0.003	0.003	(0.0008)	
1228	0.012	0.018	0.016	<0.001	0.009			
1261a	0.042	2.0	0.693	0.011	0.19	0.017	0.032	0.020
1263a	0.098	0.32	1.31	0.31	0.030	0.046	0.048	0.050
1264a	0.250	0.142	0.066	0.106	0.49	0.102	0.15	0.24
1265a	0.0058	0.041	0.0072	0.0006	0.0050	<1	0.0070	(0.0001)
1269	0.095	0.108	0.201	0.004	0.036	(0.001)	(0.014)	(0.009)
1270	0.114	0.174	2.34	0.013	0.956	(0.003)	0.038	(0.003)
C1285	0.37	1.17	0.80	0.150	0.164	(0.03)	0.036	Ce (0.0021)
1286	0.043	2.81	1.53	0.0057	0.334	(0.13)	0.116	0.040
1761	0.30	1.99	0.220	0.053	0.103	(0.02)	(0.028)	0.18
1762	0.120	1.15	0.92	0.200	0.35	(0.01)	0.062	0.095
1763	0.43	0.51	0.50	0.30	0.50	(0.03)	0.095	0.31
1764	0.51	0.202	1.48	0.106	0.200	(<0.01)	(0.01)	0.028
1765	0.0015	0.154	0.051	0.0040	0.005	(0.001)	0.001	0.0055
1766	0.015	0.022	0.024	0.009	0.0035	(0.001)	0.0020	0.0005
1767	0.0014	0.002	0.002	0.033	0.021	(0.003)	0.005	0.011

Values in parentheses are not certified and are given for information only.

Low Alloy Steels (disk form) – Continued

SRM	As	Sn	Al (total)	B	Pb	Ag	Ge
661	0.017	0.011	0.021	0.0005	0.000025	0.0004	[0.006]
663	0.010	(0.095)	0.024	0.0009	0.0022	(0.0038)	[0.010]
664	0.052	[0.005]	(0.008)	0.011	0.024	(0.00002)	[0.003]
665	(0.0002)	(<0.0005)	(0.0007)	0.00013	0.000015	(<0.00002)	(<0.0050)
1134		0.003	0.329				
1135		0.004	0.0028				
1218			0.005				
C1221			0.111				
1222			0.038				
1224			0.060				
1226		(0.003)	0.054		(0.0001)		
1227			(0.028)				
1228			0.061				
1254							
1261a	0.017	0.010	0.021	0.0005	0.000025	0.0004	[0.006]
1263a	0.010	0.104	0.24	0.00091	0.0022	0.0037	[0.010]
1264a	0.052	(0.008)	(0.0080)	(0.011)	0.024	(0.000002)	[0.003]
1265a	(0.0002)	<2	(0.0007)	0.00013	0.000015	<0.2	<50
1269	(0.006)	(0.039)	0.016	(<0.0001)	0.005	(0.0002)	
1270	(0.02)	(0.02)	(0.005)	(0.0033)	(0.0016)	(0.0001)	
C1285	(0.022)	0.35	(0.12)				
1286	0.019	0.012	0.109	(0.006)	(0.0002)		
1761	0.011	(0.05)	0.06	0.002			
1762	0.018	0.046	0.069	0.004			
1763	0.055	0.011	0.043	0.005			
1764	0.010	(0.02)	0.009	(0.001)			
1765	0.0010	0.002	(0.006)	(0.0009)	0.0003	0.0002	
1766	0.0035	0.0010	0.012	(0.0004)	0.003	0.0005	
1767	0.0005	0.006	0.004	(0.0010)	(0.0005)	0.0008	

SRM	O	N	H	Nb	Se	Ta	Zr
661	(0.0009)	(0.0037)	[<0.0005]	0.022	0.004	0.020	0.009
663	(0.0007)	(0.0041)	[<0.0005]	0.049	[0.0001]	(0.053)	0.050
664	[0.0017]	[0.003]	[<0.0005]	0.157	[0.0003]	0.11	0.069
665	(<0.0070)	(<0.0020)	(<0.0005)				
1218							(0.002)
1226				(0.005)			(0.010)
1227							(0.0006)
1254							
1261a	(0.0009)	(0.0037)	(<0.0005)	0.022	0.004	0.021	0.009
1263a	(0.00066)	(0.0041)	(<0.0005)	0.049	(0.00016)	(0.053)	0.050
1264a	(0.0010)	(0.0032)	(<0.0005)	0.157	(0.00021)	0.11	0.69
1265a	<70	<20	<5				
C1285							(0.02)
1286				(0.012)			(0.021)
1761				0.02		0.05	0.01
1762				0.07		0.02	0.03
1763				0.10		0.01	0.04
1764				0.04		0.03	<0.001
1765				0.0004		(0.005)	(0.001)
1766				(0.003)		(0.01)	(0.001)
1767				0.010		(<0.005)	(0.004)

Values in parentheses are not certified and are given for information only.
Values in brackets are approximate values from heat analysis and are given for information only.

Low Alloy Steels (disk form) – Continued

SRM	Sb	Bi	Ca	Mg	Te	Zn
661	0.0042	0.0004	(<0.0001)	(0.0001)	0.0006	(0.0001)
663	0.002	(0.0008)	(<0.0001)	(0.0005)	(0.0022)	(0.0004)
664	(0.035)	(0.0009)	(<0.0001)	(0.0001)	[0.0002]	[0.001]
665	(<0.00005)	(<0.00001)	(<0.00001)	(<0.00002)	(<0.00001)	(<0.0003)
1261a	0.0042	0.0004	0.00002	0.00018	0.0006	(0.0001)
1263a	0.002	(0.0008)	0.00013	0.00049	0.0009	(0.0004)
1264a	0.034	(0.0009)	0.00004	0.00015	0.00018	[0.001]
1265a						<3
1254			0.0053			
C1285	(0.04)					

SRM	Au	Ce	Hf	La	Nd	Pr	Fe
661	(<0.0005)	0.013	[0.00002]	0.0004	0.0003	(0.00014)	(95.6)
663	0.0005	(0.0016)	[0.0015]	0.0006	(0.0007)	(0.00018)	(94.4)
664	0.0001	(0.00025)	[0.005]	0.00007	(0.00012)	(0.00003)	(96.7)
665							99.9
1261a	(<0.00005)	0.0014	(0.0002)	0.0004	0.00029	(0.00014)	(95.6)
1263a	0.0005	0.0014	(0.0005)	0.0006	0.00060	(0.00018)	(94.4)
1264a	0.0001	0.00022	(0.0013)	0.00007	0.00007	(0.00003)	(96.7)
1265a							99.9

Values in parentheses are not certified and are given for information only.
Values in brackets are approximate values from heat analysis and are given for information only.

Stainless Steels (disk form)

SRM	Type	Elemental Composition (in Wt. %)							
		C	Mn	P	S	Si	Cu	Ni	Cr
C1151	23Cr–7Ni	0.039	2.50	0.017	0.038	0.38	0.418	7.29	22.70
C1152a	18Cr–11Ni	0.142	0.95	0.023	0.0064	0.64	0.097	10.86	17.76
C1153	17Cr–9Ni	0.264	0.50	0.030	0.018	1.07	0.23	8.77	16.69
C1153a	17Cr–9Ni	0.225	0.544	0.030	0.019	1.00	0.226	8.76	16.70
C1154	19Cr–13Ni	0.086	1.42	0.06	0.053	0.50	0.40	12.92	19.06
1155	Cr–Ni–Mo (AISI 316)	0.046	1.63	0.020	0.018	0.502	0.169	12.18	18.45
1171	Cr–Ni–Ti (AISI 321)	0.067	1.80	0.018	0.013	0.54	0.121	11.2	17.4
1172	Cr–Ni–Nb (AISI 348)	0.056	1.76	0.025	0.014	0.59	0.105	11.35	17.40
1219	Cr–Ni (AISI 431)	0.149	0.42	0.026	0.001	0.545	0.162	2.16	15.64
1223	Chromium Steel	0.127	1.08	0.018	0.329	0.327	0.081	0.232	12.64
1267	AISI 446	0.093	0.315	0.018	0.015	0.58		0.29	24.14
C1287	High Alloy (AISI 310 mod.)	0.36	1.66	0.029	0.024	1.66	0.58	21.16	23.98
C1288	High Alloy (A–743)	0.056	0.83	0.023	0.010	0.41	3.72	29.3	19.55
C1289	High Alloy (AISI 414 mod.)	0.014	0.35	0.017	0.021	0.156	0.205	4.13	12.12

SRM	V	Mo	Co	Ti	N	Al	Nb	Ta	W	Pb	Zr
C1151	0.037	0.80	0.032	(0.006)	(0.23)	(0.004)	(0.014)	(0.006)		0.0039	(0.005)
C1152a	0.033	0.44	0.22		(0.055)	(0.004)	(0.15)	(0.001)		0.0047	
C1153	0.18	0.24	0.127	(0.014)	(0.134)	(0.003)	(0.050)	(0.032)		0.0054	(0.003)
C1153a	0.176	0.24	0.127	(0.013)	(0.11)	(0.004)	(0.48)	(0.03)		0.006	(0.0001)
C1154	0.135	0.07	0.38	(0.004)	(0.084)	(0.004)	(0.23)	(0.075)		0.0178	(0.004)
1155	0.047	2.38	0.101							0.001	
1171		0.165	0.10	0.34							
1172		0.22	0.12				0.65	< 0.001			
1219	0.056	0.164	(0.04)	(< 0.001)	0.078	(0.001)	(0.01)	**Sn (0.008)**	(0.02)	(< 0.0001)	**B (< 0.001)**
1223	0.068	0.053			(0.05)	(< 0.005)		**Sn (0.004)**		(0.0001)	
1267	0.08				0.17						
C1287	0.09	0.46	0.31	0.050	(0.034)	(0.06)	(0.07)	**O (0.017)**		0.008	(0.006)
C1288	0.086	2.83	0.10	0.012	(0.028)	(0.0025)	(0.22)	**O (0.029)**	(0.2)	0.0041	(0.002)
C1289	0.007	0.82	0.035	0.005	(0.017)	(0.0016)	(0.10)	**O (0.027)**		0.0005	(0.001)

Values in parentheses are not certified and are given for information only.

Specialty Steels (disk form)

SRM	Type	Elemental Composition (in Wt. %)											
		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
1158	High Nickel (Ni 36)	0.025	0.468	0.004	0.005	0.194	0.039	36.03	0.062	0.001	0.010		0.008
1233	Valve Steel	0.502	9.16	0.031	0.002	0.219	0.375	3.43	21.08	0.096	0.237	(0.01)	**N 0.415**

High Temperature Alloys (disk form)

SRM	Type	Elemental Composition (in Wt. %)					
		C	Mn	P	S	Si	Cu
1230	A 286	0.044	0.64	0.023	0.0007	0.43	0.14
1243	Waspaloy	0.024	0.019	0.003	0.0018	0.018	0.007
1244	Inconel 600	0.062	0.29	0.010	0.003	0.12	0.26
1245a	Inconel 625	0.037	0.18	0.012	0.001	0.41	0.37
1246	Incoloy 800	0.082	0.91	0.018	0.001	0.18	0.49
1247	Incoloy 825	0.021	0.38	0.018	0.002	0.32	1.75
1250	Fe–Ni–Co	0.022	0.052	<0.003	0.0025	0.097	0.022
C2400	High Alloy Steel, ACI (17/4 PH)	0.036	0.71	0.013	0.003	0.61	2.63
C2401	High Alloy Steel (ACI–C–4M–Cu)	0.062	1.03	0.025	0.027	0.74	3.17
C2402	Hasteloy C	0.010	0.64	0.007	0.018	0.85	0.19

SRM	Ni	Cr	Mo	Co	Ti	Al	Nb	Ta	Fe	W	B
1230	24.2	14.8	1.18	0.15	2.12	0.24	(0.07)	**V 0.23**	(55)	(0.07)	0.0055
1243	58.78	19.20	4.25	12.46	3.06	1.23			0.79		
1244	73.2	15.7	0.20	0.058	0.25	0.26	(0.14)		9.6		<0.05
1245a	59.7	22.0	8.5	0.071	0.28	0.19	3.5	<0.01	4.5	<0.001	
1246	30.8	20.1	0.36	0.076	0.32	0.30	(0.09)		46.2		<0.001
1247	43.5	23.4	2.73	0.089	0.75	0.060	(0.46)		26.5		0.002
1250	37.78	0.077	0.014	16.1	1.48	0.99	2.99	0.003	40.5	**V 0.077**	0.0078
C2400	4.07	17.06	0.23	0.10			0.15	**V 0.092**		(0.1)	(0.0004)
C2401	5.46	25.1	2.13	0.19			(0.002)	**V 0.20**		(0.18)	(0.0004)
C2402	51.5	16.15	17.1	1.50	**Sn (0.001)**		(<0.01)	**V 0.22**	7.3	4.29	(0.0004)

Values in parentheses are not certified and are given for information only.

Steelmaking Alloys (powder form)

These SRMs are for checking chemical methods of analysis for major constituents and for selected minor elements. They are furnished as fine powders (usually <0.1 mm).

SRM	Type	Unit Size (in g)	Elemental Composition (in Wt. %)							
			C	Mn	P	S	Si	Cu	Ni	O
57a	Silicon Metal	60	0.024	0.015	0.003	0.003	98.55	0.004	0.008	(~0.3)
58a	Ferrosilicon (73% Si-Regular Grade)	75	0.014	0.16	0.009	<0.002	73.20	0.024	0.012	(0.20)
59a	Ferrosilicon	50	0.046	0.75	0.016	0.002	48.10	0.052	0.033	
64c	Ferrochromium, High Carbon	100	4.68	0.16	0.020	0.067	1.22	0.005	0.43	
68c	Ferromanganese, High Carbon	100	6.72	80.04	0.19	0.008	0.225			
71	Calcium Molybdate	60								
90	Ferrophosphorus	75			26.2					
195	Ferrosilicon (75% Si-High-Purity Grade)	75	0.034	0.17	0.017	0.001	75.3	0.047	0.032	(0.42)
196	Ferrochromium, Low Carbon	100	0.035	(0.282)	0.020	0.003	0.373			
340	Ferroniobium	100	0.061	1.70	0.036		4.39	Sn 0.063		
347	Magnesium Ferrosilicon	100	0.017	0.53	0.023	0.005	47.6	0.065	0.082	
689	Ferrochromium Silicon	100	0.043	0.32	0.026	0.002	39.5	0.013	0.20	(0.06)

SRM	Cr	V	Mo	Ti	Al	Nb	Zr	Ca	Fe	B	As
57a	0.024	0.013	Pb <0.001	0.040	0.47		0.002	0.17	0.50	0.001	<0.001
58a	0.020	(0.002)	(0.01)	0.051	0.95	Co <0.01	0.002	0.30	25.23	0.0010	(0.0020)
59a	0.080				0.35			0.042	50.05	0.058	
64c	68.00	0.15		0.02		Co 0.051		N 0.045	24.98		
68c	0.074								12.3		0.021
71			35.3	0.06					1.92		
90											
195	<0.01	(0.001)	(0.01)	0.037	0.046	Co <0.01	0.011	0.053	23.6	0.0010	(0.0024)
196	70.83	(0.12)									
340				0.89		57.51	Ta 3.73				
347	0.14			0.036	0.78		Co 0.004	0.81	Mg 4.49	Ce 0.45	La 0.26
689	36.4	0.09	Pb(0.004)	0.40	0.049	Co 0.034	Bi (<0.003)	N (0.002)	23.2	0.0017	(0.009)

Values in parentheses are not certified and are given for information only.

Cast Irons (chip form)

These SRMs are furnished in 150-g units (unless otherwise noted) for use in checking chemical methods of analysis.

SRM	Type	Elemental Composition (in Wt. %)							
		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
4L	Cast	3.21	2.66	0.825	0.149		0.043	1.33	0.240
5L	Cast	2.60	1.98	0.68	0.284		0.124	1.82	1.01
6g	Cast	2.85	2.01	1.05	0.557		0.124	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	0.745	0.025		0.007	2.10	0.038
107c	Cast (Ni–Cr–Mo)	2.99	1.98	0.480	0.079		0.059	1.21	0.205
115a	Cast (Cu–Ni–Cr)	2.62	1.96	1.00	0.086	0.064	0.065	2.13	5.52
122h	Cast (Car Wheel)	3.52	2.82	0.543	0.311		0.072	0.513	0.028
334	Gray Cast (Carbon & Sulfur)	2.83					0.043		
338	White Cast (Carbon & Sulfur)	3.33					0.015		
341	Ductile	1.81	1.23	0.92	0.024	0.007	0.007	2.44	0.152
342a	Nodular	1.86	1.38	0.274	0.019		0.006	2.73	0.135
890	HC 250 + V	2.91		0.62	0.025		0.015	0.67	0.055
891	Ni–Hard, Type I	2.71		0.55	0.038		0.029	0.56	0.150
892	Ni–Hard, Type IV	3.33		0.76	0.054		0.015	1.83	0.270

SRM	Ni	Cr	V	Mo	Co	Ti
3d	0.025	0.03	(0.002)	(0.007)		(0.003)
4L	0.042	0.118	0.024	0.040	Zn(< 0.001)	(0.03)
5L	0.086	0.148	0.034	0.020		0.050
6g	0.135	0.370	0.056	0.035		0.059
7g	0.120	0.048	0.010	0.012		0.044
82b	1.22	0.333	0.027	0.002		0.027
107c	2.20	0.693	0.015	0.83		0.019
115a	14.49	1.98	0.014	0.050		0.020
122h	0.078	0.052	0.041	(0.003)		0.034
341	20.32	1.98	0.012	0.010		0.018
342a	0.058	0.034		0.006		0.020
890	0.397	32.4	0.45	0.018	(0.03)	
891	4.48	2.23	0.039	0.27	0.19	(0.01)
892	5.53	10.18	0.041	0.20	0.31	(0.02)

Values in parentheses are not certified and are given for information only.

Cast Irons (chip form) – Continued

SRM	As	Sn	Al (total)	Mg	N	Fe
4L	(0.03)	(0.004)	(0.004)	Sb (<0.001)	(0.0016)	Pb (0.001)
5L					0.005	
6g	0.042				0.005	
7g	0.014				0.004	
341				0.068		
342a				0.070		
890	(0.008)		(<0.01)		(0.089)	(61.8)
891	(0.004)	(<0.01)	(0.008)		(0.012)	(88.5)
892	(0.006)	(0.02)	(0.009)		(0.019)	(77.4)

Values in parentheses are not certified and are given for information only.

Cast Steels, White Cast Irons and Ductile Irons (disk form)

These SRMs are for analysis of cast steels and cast irons by rapid instrumental methods.

SRM	Type	Elemental Composition (in Wt. %)							
		C	Mn	P	S	Si	Cu	Ni	Cr
C1137a	White Cast Iron	2.86	0.52	0.087	0.017	1.15	0.192	2.17	0.643
1138a	Cast Steel (No. 1)	0.118	0.35	0.035	0.056	0.25	0.09	0.10	0.13
1139a	Cast Steel (No. 2)	0.790	0.92	0.012	0.013	0.80	0.47	0.98	2.18
C1145a	White Cast Iron	2.92	0.187	0.215	0.191	0.271	0.46	0.62	0.63
C1146a	White Cast Iron	1.97	1.60	0.55	0.016	3.93	1.48	3.07	2.56
C1150a	White Cast Iron	3.32	0.77	0.078	0.065	1.35	0.112	0.097	0.155
C1173	Cast Steel 3	0.453	0.174	0.031	0.092	1.38	0.204	4.04	2.63
1173	Ni–Cr–Mo–V Steel	0.423	0.19	0.033	0.092	1.28	0.204	4.06	2.70
C1290	High Alloy (HC–250+V)	3.04	0.66	0.030	0.013	0.971	0.065	0.917	30.5
C1291	High Alloy (Ni–Hard, Type I)	2.67	1.14	0.028	0.032	1.34	0.26	4.34	2.78
C1292	High Alloy (Ni–Hard, Type IV)	3.47	0.55	0.049	0.016	0.59	0.36	5.04	11.4
C2423	Ductile Iron A	3.76	0.98	0.27	(0.0006)	1.67	1.55	0.146	0.322
C2423a	Ductile Iron B	3.66	0.91	0.246	(<0.001)	1.59	1.61	0.147	0.322
C2424	Ductile Iron C	2.68	0.268	0.041	0.024	3.37	0.125	0.061	0.13
C2424a	Ductile Iron D	2.76	0.207	0.034	0.016	3.30	0.099	0.045	0.15
C2425	Ductile Iron E	3.26	0.76	0.191	0.012	2.50	0.47	0.55	0.092
C2425a	Ductile Iron F	3.30	0.72	0.188	0.010	2.38	0.47	0.57	0.085

Cast Steels, White Cast Irons and Ductile Irons (disk form) – Continued

SRM	V	Mo	Ti	As	Al	Te	Co
C1137a	0.019	0.86	(0.04)		(0.007)	Mg 0.032	Ce0.016
1138a	0.02₀	0.05	(0.0012)	(<0.005)	(0.067)	Fe (98.7)	
1139a	0.26	0.51	(0.004)	(<0.005)	(0.13)	Fe (93.0)	
C1145a	0.112	0.48	0.012	(0.02)	(0.04)		0.058
C1146a	0.20	1.52	0.20	(0.16)	(0.028)	Pb 0.0018	0.13
C1150a	0.040	0.086	0.040	(0.017)	(0.005)	Pb 0.001	0.014
C1173	0.42	1.46	0.037	(0.02)	(0.005)	Pb (0.0006)	0.064
1173	0.42	1.50	(0.015)			Nb (0.045)	0.076
C1290	0.442	(0.041)					
C1291	0.031	0.32					
C1292	0.041	0.25					
C2423	0.048	0.155	0.10		(0.09)		(0.02)
C2423a	0.043	0.159	0.10		(0.08)		(0.02)
C2424	0.083	0.019	0.050		(<0.01)		(0.05)
C2424a	0.081	0.019	0.045		(<0.01)		(0.05)
C2425	0.013	0.30	0.19		(0.02)		(0.02)
C2425a	0.013	0.29	0.20		(0.02)		(0.03)

SRM	Mg	Ce	La	B
C2423	0.058	0.036	0.011	(0.01)
C2423a	0.076	0.031	0.0042	(0.01)
C2424	0.006	0.0046	0.0011	(0.002)
C2424a	0.014	0.0053	0.0010	(0.001)
C2425	0.040	0.0062	0.0015	(0.10)
C2425a	0.047	0.023	0.0037	(0.1)

Values in parentheses are not certified and are given for information only.

Gases in Metals (rod form)

These SRMs are for determining hydrogen, oxygen, and nitrogen by vacuum fusion, inert gas fusion, and neutron activation methods.

SRM	Type	Oxygen (in mg/kg*)	Hydrogen (in mg/kg*)	Nitrogen (in mg/kg*)
1090	Ingot Iron	491		(60)
1091a	Stainless Steel (AISI 431)	132.2		(876)
1093	Valve Steel	60		
1094	Maraging Steel	4.5		(71)
1095	Steel (AISI 4340)	9	(<5)	(37)
1096	Steel (AISI 94B17)	10.7	(<5)	40.4
1097	Cr–V Steel (mod.)	6.6	(<5)	(<11)
1098	Steel (High Carbon)	10	(<5)	32
1099	Electrolytic Iron	61	(<5)	(13)
1754	Low Alloy Steel (AISI 4320)	24		81

Values in parentheses are not certified and are given for information only.
*SI unit. Replaces terms "ppm" and "μg/g".

102. Nonferrous Metals

Aluminum Base Alloys (chip and disk forms)

SRM	Type	Unit Size (in g)	Elemental Composition (in Wt. %)					
			Mn	Si	Cu	Ni	Cr	V
87a	Al–Si	75	0.26	6.24	0.30	0.57	0.11	<0.01
853	Alloy 3004	30	1.26	0.18	0.15	0.004	<0.001	0.017
854	Alloy 5182	30	0.38	0.16	0.050	0.020	0.032	0.016
855a	Casting Alloy 356	30	0.057	7.17	0.13	0.015	0.013	
856a	Casting Alloy 380 (fine millings)	30	0.35	9.21	3.51	0.37	0.055	
858	Alloy 6011	35	0.48	0.79	0.84	0.0006	0.0011	0.0030
859	Alloy 7075	35	0.078	0.17	1.59	0.063	0.176	0.0082
1241b	Alloy 5182	disk	0.38	0.16	0.050	0.020	0.032	0.016
1255a	Casting Alloy 356	disk	0.053	7.22	0.12	0.017	0.012	0.024
1256a	Casting Alloy 380	disk	0.38	9.18	3.51	0.41	0.055	0.018
1258	Alloy 6011	disk	0.48	0.78	0.84	0.0006	0.0011	
1259	Alloy 7075	disk	0.079	0.18	1.60	0.063	0.173	

SRM	Ti	Sn	Ga	Fe	Pb	Mg	Zn	Zr	Be
87a	0.18	0.05	0.02	0.61	0.10	0.37	0.16		
853	0.018		0.018	0.50		1.11	0.052	0.002	
854	0.030		0.018	0.20		4.54	0.051	0.002	
855a	0.15	0.010		0.16	0.015	0.37	0.083		
856a	0.068	0.10		0.92	0.10	0.061	0.96		
858	0.042			0.078		1.01	1.04		<0.0001
859	0.041			0.202		2.45	5.46		0.0026
1241b	0.034		0.018	0.20		4.54	0.051	0.002	
1255a	0.156	0.013		0.14	0.017	0.36	0.083	**Sr 0.02**	
1256a	0.084	0.10		0.90	0.10	0.062	1.02	**Sr 0.020**	
1258	(0.04)		(0.010)	0.079		0.98	1.03		<0.0001
1259	(0.04)		(0.022)	0.205		2.48	5.44		0.0025

Values in parentheses are not certified and are given for information only.

Copper Base Alloys (chip form)

SRM	Type	Unit Size (in g)	Elemental Composition (in Wt. %)				
			Cu	Ni	Fe	Zn	Pb
158a	Bronze, Silicon	150	90.93	0.001	1.23	2.08	0.097
871	Bronze, Phosphor (CDA 521)	100	91.68		< 0.001	0.025	0.010
872	Bronze, Phosphor (CDA 544)	100	87.36	0.003	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	0.11	0.0092
879	Nickel Silver (CDA 762)	100	57.75	12.11	0.0020	30.04	0.002
880	Nickel Silver (CDA 770)	100	54.51	18.13	0.004	27.3	0.002
1034	Unalloyed Copper	rod	(99.96)	*(0.6)	*(2.0)	*(< 11)	*(0.5)
1035	Leaded-Tin Bronze Alloy	50	(78.5)	(0.75)	(0.001)	(0.25)	(13.5)

SRM	Mn	Sb	Sn	Cr	P	Ag	Si	Al	Te	Cd	Se
158a	1.11		0.96		0.026		3.03	0.46			
871			8.14		0.082						
872			4.16		0.26						
874	0.0020	< 0.001	0.007		0.002		(0.0006)			< 0.0002	0.00015
875	< 0.0007	< 0.001	0.009		0.0020		(0.0008)		(< 0.0001)	0.0022	0.0004
879	< 0.001										
880	< 0.001										
1034	*(< 0.1)	*(0.2)	*(< 0.2)	*(0.3)		*(8.1)	*(< 2)	*(< 2)	*(0.5)	*(< 1)	*(3.3)
1035			(6.8)		(0.004)						

SRM	Bi	O	Co	C	Au	H	S	As	Mg	Ti
874	< 0.0002	(0.06)		(0.0023)		(0.0016)	(0.0011)	(< 0.0006)	(0.0002)	(0.0001)
875	0.003	(0.14)		(0.0035)		(0.004)	(0.0011)	(0.0010)	(0.0010)	(< 0.0002)
1034	*(0.2)	*(363)	*(0.2)		*(< 0.05)		*2.8	*(0.2)	*(< 1)	
1035		(0.64)					**22.3			

Values in parentheses are not certified and are given for information only.
* Value is in mg/kg (SI unit).
** Sulfur value is in mg/kg (SI unit).

Copper Base Alloys (block and disk forms)

The SRMs with "C" prefix are chill-cast blocks, 31 mm square, 19 mm thick; the others are wrought disks, 31 mm in diameter and 19 mm thick. Both forms have nearly identical elemental compositions.

SRM		Type	Elemental Composition (in Wt. %)							
			Cu	Zn	Pb	Fe	Sn	Ni	Al	Sb
1103		Free-Cutting Brass	59.27	35.72	3.73	0.26	0.88	0.15		
1104		Free-Cutting Brass	61.33	35.31	2.77	0.088	0.43	0.070		
1107		Naval Brass B	61.21	37.34	0.18	0.037	1.04	0.098		
1108	C1108	Naval Brass C	64.95	34.42	0.063	0.050	0.39	0.033		
	C1110	Red Brass B	84.59	15.20	0.033	0.033	0.051	0.053		
1111	C1111	Red Brass C	87.14	12.81	0.013	0.010	0.019	0.022		
1112	C1112	Gilding Metal A	93.38	6.30	0.057	0.070	0.12	0.100		
1113	C1113	Gilding Metal B	95.03	4.80	0.026	0.043	0.064	0.057		
1114	C1114	Gilding Metal C	96.45	3.47	0.012	0.017	0.027	0.021		
1115	C1115	Commercial Bronze A	87.96	11.73	0.013	0.13	0.10	0.074		
1116	C1116	Commercial Bronze B	90.37	9.44	0.042	0.046	0.044	0.048		
1117	C1117	Commercial Bronze C	93.01	6.87	0.069	0.014	0.021	0.020	2.14	0.0005
1275		Cupro-Nickel (CDA 706)	88.2	0.085	0.006	1.46	0.008	9.76		0.0005
1276a		Cupro-Nickel (CDA 715)	67.8	0.038	0.004	0.56	0.023	30.5		0.0004

SRM		As	Be	Cd	Mn	P	Si	Ag
1103						0.003		
1104						0.005		
	C1106				0.005			
1108	C1108				0.025			
1112	C1112				0.009			
1113	C1113					0.008		
1114	C1114					0.009		
1115	C1115					0.005		
1116	C1116						0.008	
1117	C1117					0.002		
1275		(0.001)		0.0003	0.42	0.005	(0.001)	(0.004)
1276a				0.0002	1.01	0.006		

SRM	Te	Co	Cr	Se	Mg	B	S	Ti
1275	(0.0002)	0.024	(0.0002)	0.0004	0.003	(0.0009)	(0.008)	(0.0002)
1276a		0.045		0.0005	0.12			

Values in parentheses are not certified and are given for information only.

Copper "Benchmark" (chip and rod forms)

SRM (Chip)	SRM (Solid)	Type	Cu (in Wt. %)	Elemental Composition (in mg/kg*) Sb	As	Bi	Cr	Co	Fe	Pb	Mn
393		Unalloyed Copper "O"	99.998	0.25	0.41	<0.1	<0.5	0.02	<1	0.039	<0.01
394	494	Unalloyed Copper I	99.908	4.5	2.6	0.35	2.0	0.5	147	26.5	3.7
395	495	Unalloyed Copper II	99.944	8.0	1.6	0.50	6.0		96	3.25	5.3
396	496	Unalloyed Copper III	99.955	<1	<0.2	0.07	4.3	0.4	143	0.41	7.5
	457	Unalloyed Copper IV	99.96	0.2	0.2	0.2	(0.3)	(0.2)	2.0	0.5	<0.1
398	498	Unalloyed Copper V	99.98	7.5	25	2.0	(0.3)	2.8	11.4	9.9	(0.3)
399	499	Unalloyed Copper VI	99.79	30	47	10.5	(0.5)	0.5	20.0	114	(0.3)
400	500	Unalloyed Copper VII	99.70	102	140	24.5	(0.5)	0.6	41	128	(0.2)
	C1251	Phosphorized Copper VIII	99.96	14	14.4	(3)	2.8	8.8	(264)	7.5	(5)
	C1252	Phosphorized Copper IX	99.89	42	115	21	7.4	90	(35)	60	(17)
	C1253	Phosphorized Copper X	99.42	(140)	432	70	216	495	(330)	244	(380)
454		Unalloyed Copper XI	99.84	24	46	19		(4)	(50)	66	

SRM (Chip)	SRM (Solid)	Ni	Se	Ag	S	Te	Sn	Zn	Al	Cd	Au	Mg
393		0.05	<0.05	0.10	<1	<0.5	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1
394	494	11.7	2.00	50.5	15	0.58	70	405	(<2)	(0.5)	(0.07)	(<1)
395	495	5.4	0.63	12.2	13	0.32	1.5	12.2	(<2)	(0.4)	(0.13)	(<1)
396	496	4.2	0.62	3.30	9.5	(0.02)	0.8	5.0	(<2)	(0.6)	(<0.05)	(<1)
	457	0.6	4.2	8.1	(4)	0.29	<0.2	<11	(<2)	(<1)	(<0.05)	(<1)
398	498	7.0	17.5	20.1	(11)	10.1	4.8	24	(<2)	(22)	(0.1)	(<1)
399	499	506	95	117	(10)	50	(~90)	45	(<2)	(<1)	(4)	(<1)
400	500	603	214	181	(9)	153	(~200)	114	(<2)	(<1)	(10)	(<1)
	C1251	22	11.4	85	(31)	15	(15)	8	(2)	2	15.0	(10)
	C1252	128	53.6	166.6	(29)	51	(110)	60	(7)	14	34.9	(20)
	C1253	(500)	164	495	55	199	(470)	350	(180)	74	74.4	(80)
454		(150)	479	286		27	2.2	7			7.5	

SRM (Chip)	SRM (Solid)	Si	Be	B	Ca	Li	Pd	P	Ti	Zr
393	494	<0.5	<0.01	<0.01	<0.05	<0.01	<0.05	<0.05	<0.5	<0.5
394	494	(<2)								
395	495	(<2)								
396	496	(<2)								
398	498	(<2)								
399	499	(<2)								
400	500	(<2)								
	C1251	(15)	(<0.5)		(4)	(0.04)		400		
	C1252	(13)	(<5)		(6)	(0.03)				
	C1253	(350)	(12)		(1)	(9)		518		
454							(0.1)			

Values in parentheses are not certified and are given for information only.
*SI unit. Replaces terms "ppm" and "μg/g".

Lead Base Alloys (chip and disk forms)

SRM		Type	Elemental Composition (in Wt. %)							
Chip	Disk		Cu	Ni	As	Sn	Sb	Bi	Ag	Fe
1129		Solder 63Sn–37Pb	0.16	0.010	0.055	62.7	0.13	0.13	0.075	
127b	1131	Solder 40Sn–60Pb	0.011	0.012	0.01	39.3	0.43	0.06	0.01	
53e	1132	Bearing Metal(Pb–Sb–Sn)	0.054	0.003	0.057	5.84	10.26	0.052		<0.001

Lead Base Material (disk form)

These SRMs are issued in the form of disks 50 mm in diameter and 16 mm thick. They are intended for use with optical emission spectrometric methods of analysis.

SRM	C2415	C2416	C2417	C2418
Type	Battery Lead	Bullet Lead	Lead-Base Alloy	High-Purity Lead
Unit Size	50 mm	50 mm	50 mm	50 mm
	Elemental Composition (in Wt. %)			
Sb	2.95	0.79	0.010	(<0.0001)
As	0.20	0.056	0.011	(<0.0001)
Bi	0.054	0.10	0.010	(<0.0005)
Cu	0.095	0.065	0.010	(<0.0001)
S	0.0026	0.0015	(<0.0005)	
Ag	0.002	0.0044	0.010	0.0001
Sn	0.33	0.09	(<0.010)	(<0.0005)
Al	(<0.0003)	(<0.0001)	(<0.0001)	(<0.0001)
Cd	0.002	(0.0002)	(<0.0002)	0.0003
Ca	(<0.001)	(<0.001)	(<0.001)	(<0.0005)
Co		(<0.0002)	(<0.0002)	(<0.0005)
Fe	<0.001	(<0.0005)	(<0.0003)	(<0.0005)
Mn	<0.001	(<0.0005)	(<0.0003)	(<0.0005)
Ni	<0.001	(<0.0005)	(<0.0005)	(<0.0005)
Te	0.0045	(<0.0005)	(<0.0005)	(<0.0005)
Zn	<0.001	(<0.0005)	(<0.0005)	(<0.0005)

Values in parentheses are not certified and are given for information only.

Nickel Base Alloys (chip and disk forms)

SRM	Type	Unit Size (in g)	Elemental Composition (in Wt. %)							
			C	Mn	P	S	Si	Cu	Ni	Cr
349a	Waspaloy Ni–Co–Cr	150	0.035	0.019	0.003	0.0024	0.018	0.007	58.1	19.3
882	Ni–Cu–Al	100	0.006	0.0007		0.0014	0.006	31.02	65.25	
864	Inconel, 600	100	0.064	0.29	0.010	0.003	0.12	0.26	73.1	15.7
865	Inconel, 625	100	0.037	0.18	0.012	0.001	0.41	0.36	59.5	21.9
866	Incoloy, 800	100	0.082	0.92	0.017	0.001	0.17	0.49	30.8	20.1
867	Incoloy, 825	100	0.021	0.39	0.018	0.002	0.32	1.74	43.5	23.4
1159	Electronic and Magnetic Alloy Ni–Fe	disk	0.007	0.305	0.003	0.003	0.32	0.038	48.2	0.06
1160	Electronic and Magnetic Alloy Ni–Mo	disk	0.019	0.550	0.003	0.001	0.37	0.021	80.3	0.05
1243	Waspaloy	disk	0.024	0.019	0.003	0.0018	0.018	0.007	58.78	19.20
C1248	Ni–Cu	disk	0.266	0.31	0.002	0.0008	1.61	29.80	65.75	0.095

SRM	Mo	Co	Ti	Al	B	Fe	Nb
349a	4.25	12.46	3.06	1.23	0.005	1.15	V 0.12
882			0.57	2.85		0.009	
864	0.20	0.059	0.26	0.26	< 0.005	9.6	(0.14)
865	8.6	0.072	0.28	0.21	< 0.001	4.5	3.5
866	0.36	0.075	0.31	0.29	< 0.001	46.1	(0.09)
867	2.73	0.089	0.75	0.062	0.002	26.6	(0.45)
1159	0.010	0.022	51.0				
1160	4.35	0.054	14.3				
1243	4.25	12.46	3.06	1.23	0.005	0.79	V 0.12
C1248	0.006	Pb 3.8 mg/kg*	Sn 1.1 mg/kg*	0.009		2.10	Zn 3 mg/kg*

Values in parentheses are not certified and are given for information only.
*SI unit. Replaces terms "ppm" and "μg/g".

Trace Elements in Nickel Base Superalloys (chip form)

SRM	Type	Unit Size (in g)	Trace Composition (in mg/kg*)				
			Pb	Bi	Se	Te	Tl
897	"Tracealloy" A	35	11.7	(0.5)	9.1	1.05	0.51
898	"Tracealloy" B	35	2.5	(1.0)	2.00	0.54	2.75
899	"Tracealloy" C	35	3.9	(0.3)	9.5	5.9	0.252

SRM	Base Composition (in Wt. %)											
	C	Cr	Co	Ni	W	Nb	Al	Ti	B	Zr	Ta	Hf
897, 898, 899	(0.12)	(12.0)	(8.5)	(Bal)	(1.75)	(0.9)	(2.0)	(2.0)	(0.010)	(0.10)	(1.75)	(1.2)

Values in parentheses are not certified and are given for information only.
*SI unit. Replaces terms "ppm" and "μg/g".

Nickel Oxides (powder form)

SRM	Type	Unit Size (in g)	Elemental Composition (in Wt. %)								
			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	0.095	0.11	0.018	0.003	0.55	0.009	0.004	0.079	0.020
673	Oxide 3	25	0.0037	0.006	0.002	0.0003	0.016	0.003	0.001	0.029	0.003

SRM	Trace Composition (in mg/kg*)											
	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	0.3	(74)	(4)	(0.5)	(1.7)	(0.4)	(0.3)	(<0.2)	(<0.1)	(140)
673	3.5	0.2	0.06	(0.4)	(<0.5)	(<0.5)	(0.05)	(<0.1)	(<0.1)	(0.4)	(<0.1)	(1.7)

Values in parentheses are not certified and are given for information only.
*SI unit. Replaces terms "ppm" and "μg/g".

Titanium Base Alloys (chip and disk forms)

SRM	Type	Unit Size (in g)	Elemental Composition (in Wt. %)				
			C	Mn	Cr	Cu	Mo
173b	Al–V	50	0.025			0.008	0.013
176	Al–Sn	100	0.015	0.0008		0.003	0.0003
641	Mn (A)	disk		6.68			
642	Mn (B)	disk		9.08			
643	Mn (C)	disk		11.68			
644	Cr–Fe–Mo	disk			1.03		3.61
647	Al–Mo–Sn–Zr	50	0.006				1.96
648	Al–Sn–Zr–Cr–Mo	50	0.011		3.84		3.75
649	V–Al–Cr–Sn	50	0.011	(<0.01)	2.96	(<0.001)	
650	Unalloyed A	30		0.016	0.002	0.033	0.002
651	Unalloyed B	30		0.005	0.037	0.032	0.031
652	Unalloyed C	30		0.046	0.082	0.081	0.039
654b	Al–V	disk			(0.025)	0.004	(0.013)
1128	V–Al–Cr–Sn	disk	0.011	(<0.01)	2.96	(<0.003)	(0.006)
1133	Al–Sn–Zr–Cr–Mo	disk	0.011		3.84		3.75

SRM	Fe	Al	V	Sn	Si	N	W	Zr
173b	0.23	6.36	4.31	(0.03)	0.046	0.015		
176	0.070	5.16		2.47		0.010		
644	1.36							
647	0.075	5.88	(<0.02)	2.02		(<0.01)		3.90
648	0.15	5.13		1.98	0.027	(0.01)		1.84
649	0.133	3.08	15.1	3.04		(0.01)		
650	0.024	<0.01	0.009	0.03	0.004		1.55	
651	0.058	<0.006	0.021	0.026	0.011		0.39	
652	0.67	0.039	0.024	0.053	0.16		0.5	
654b	0.023	6.34	4.31	0.023	0.045		Ni 0.028	0.008
1128	0.134	3.06	15.13	3.04		(0.01)		
1133	0.15	5.13		1.98	0.027	(0.01)		1.84

Values in parentheses are not certified and are given for information only.

Zinc Base Alloys (chip and disk forms)

SRM	Type	Unit Size (in g)	Elemental Composition (in Wt. %)							
			Cu	Al	Mg	Fe	Pb	Cd	Sn	Cr
94c	Die Casting Alloy		1.01	4.13	0.042	0.018	0.006	0.002	0.006	
625	Zinc-base A–ASTM AG 40A	150	0.034	3.06	0.070	0.036	0.0014	0.0007	0.0006	0.0128
626	Zinc-base B–ASTM AG 40A	disk	0.056	3.56	0.020	0.103	0.0022	0.0016	0.0012	0.0395
627	Zinc-base C–ASTM AG 40A	disk	0.132	3.88	0.030	0.023	0.0082	0.0051	0.0042	0.0038
628	Zinc-base D–ASTM AC 41A	disk	0.611	4.59	0.0094	0.066	0.0045	0.0040	0.0017	0.0087
629	Zinc-base E–ASTM AC 41A	disk	1.50	5.15	0.094	0.017	0.0135	0.0155	0.012	0.0008
630	Zinc-base F–ASTM AC 41A	disk	0.976	4.30	0.030	0.023	0.0083	0.0048	0.0040	0.0031
631	Zinc spelter (mod.)	disk	0.0013	0.50	(<0.001)	0.005	(0.001)	0.0002	0.0001	0.0001

SRM	Mn	Ni	Si	In	Ga	Ca	Ag	Ge
94c	0.014	0.006						
625	0.031	0.0184	0.017					
626	0.048	0.047	0.042					
627	0.014	0.0029	0.021					
628	0.0091	0.030	0.008					
629	0.0017	0.0075	0.078					
630	0.0106	0.0027	0.022					
631	0.00015	(<0.0005)	(0.002)	0.0023	(0.002)	<0.001	(<0.0005)	(0.0002)

Values in parentheses are not certified and are given for information only.

Zirconium Base Alloys (chip and disk forms)

SRM	Type	Unit Size (in g)	Elemental Composition (in Wt. %)										
			C	Mn	Hf	Cu	Ni	Cr	Ti	Sn	Fe	N	Al
360b	Zircaloy–4	100	0.011	0.0010	0.008	0.002	0.0025	0.10	0.002	1.55	0.21	0.0045	0.004

SRM 32 mm D×32 mm ×19 mm thick	Type	Elemental Composition (in mg/kg*)											
		Hf	C	Cr	Cu	Fe	Mn	Mo	Ni	N	Si	Ti	W
1235	Zirconium B	95	(170)	(60)	(80)	(850)	(25)	(40)	(65)	(32)	(95)	(90)	(50)

Values in parentheses are not certified and are given for information only.
*SI unit. Replaces terms "ppm" and "μg/g".

Gases in Metals (platelet form)

SRM	Type	Oxygen (in mg/kg*)	Hydrogen (in mg/kg*)	Nitrogen (in mg/kg*)
352c	Unalloyed Titanium for Hydrogen		49	

*SI unit. Replaces terms "ppm" and "μg/g".

103. Microanalysis

Metals (rod and wire forms)

SRM	Type	Elemental Composition (in Wt. %)				
		Au	Cu	Ag	W	Mo
480	Tungsten–20% Mo Alloy				78.5	21.5
481	Au 100 A	100.00				
	Au–20% Ag B	80.05		19.96		
	Au–40% Ag C	60.05		39.92		
	Au–60% Ag	40.03		59.93		
	Au–80% Ag E	22.43		77.58		
	Ag 100 F			100.00		
482	Au 100 A	100.00				
	Au–20% Cu B	80.15	19.83			
	Au–40% Cu C	60.36	39.64			
	Au–60% Cu	40.10	59.92			
	Au–80% Cu E	20.12	79.85			
	Cu 100 F		100.00			

Synthetic Glasses (rod form)

	SRM 1871			SRM 1872			SRM 1873		
	Glass			Glass			Glass		
	K–456	K–493	K–523	K–453	K–491	K–968	K–458	K–489	K–963
	Composition (in Wt. %)								
Pb	65.67	63.28	63.10	54.21	54.69	54.74	–	(1.32)	–
Si	13.37	(13.09)	(12.94)	–	(0.11)	–	23.05	(22.23)	(21.96)
Ge	–	–	(0.20)	28.43	26.10	25.93	–	–	(0.47)
Ba	–	–	(0.61)	–	–	(0.46)	41.79	39.53	39.21
Zn	–	–	–	–	–	–	3.01	2.93	2.95
P	–	–	(0.24)	–	–	(0.21)	–	–	(0.33)
Mg	–	–	(0.12)	–	–	(0.22)	–	–	(0.34)
Al	–	(0.13)	–	–	(0.10)	–	–	(0.11)	–
B	–	–	–	–	–	–	–	–	–
Zr	–	(0.38)	(0.33)	–	(0.26)	(0.48)	–	(0.40)	(0.61)
Ti	–	(0.20)	(0.21)	–	(0.14)	(0.16)	–	(0.27)	(0.32)
Ce	–	(0.53)	–	–	(0.59)	–	–	[0.80]	–
Ta	–	(0.64)	–	–	(0.52)	–	–	(0.95)	–
Fe	–	(0.25)	–	–	(0.17)	–	–	(0.35)	–
Li	–	–	–	–	–	–	–	–	–
Ni	–	–	(0.25)	–	–	(0.20)	–	–	(0.33)
Eu	–	–	(0.73)	–	–	(0.64)	–	–	(0.95)
U	–	–	(0.23)	–	–	(0.05)	–	–	(0.16)
Th	–	–	(0.08)	–	–	(0.12)	–	–	(0.06)
Cr	–	–	(0.20)	–	–	(0.19)	–	–	(0.31)
O	(20.35)	(20.58)	(20.80)	(16.73)	(16.45)	(16.67)	(31.86)	(31.70)	(32.00)
Total	(99.39)	(99.08)	(100.19)	(99.37)	(99.13)	(100.07)	(99.71)	(100.59)	(100.00)

Values in parentheses are not certified and are given for information only.
Values in brackets were calculated from the weight of material added to the melt and are not certified.

104. High-Purity Materials

High-Purity Metals (solid forms)

These SRMs are for determining impurity elements in high-purity metals.

SRM	Type	Unit Size	Elemental Composition (in mg/kg*)				
			Cu	Ni	Sn	Pb	Zr
685W	High-Purity Gold (Wire)	1.4 mm × 102 mm long	0.1	(<0.05)	(<0.07)		
685R	High-Purity Gold (Rod)	5.9 mm × 25 mm long	0.1	(<0.05)	(<0.07)		
680a	High-Purity Platinum (Wire)	0.51 mm: L1 (10 cm); L2 (1 m)	0.1	<1		<1	<0.1
681	Doped-Platinum (Wire)	0.51 mm: L1 (10 cm); L2 (1 m)	5.0	0.5		12	11
682	High-Purity Zinc	semicirc 57 mm	0.042	(<0.1)	(0.02)		
683	Zinc Metal	semicirc 57 mm	5.9		(0.02)	11.1	
728	Zinc, Intermediate Purity	shot, 450 g	5.7		(0.02)	11.1	
726	Selenium, Intermediate Purity	shot, 450 g	<1	<0.5	<1	<1	Mn<0.3
†885	Refined Copper	pin		<0.0001	<0.0001	0.0002	

SRM	Ag	Mg	In	Fe	O	Pd	Au	Rh	Ir	Cd	Tl
685W	[0.1]	(<0.2)	0.007	0.3	[2]						
685R	[0.1]	(<0.2)	0.007	0.2	[<2]						
680a	<0.1	<1		1.3	4	0.2	<1	<0.2	<0.01		
681	2.0	12		5	7	6	9	9	11		
682	(0.02)	(<0.1)		(0.1)	(<0.5)					(0.1)	
683	1.3			2.2						1.1	(0.2)
728	1.1			2.7						1.15	(0.2)
726	<1	<1	S 12	1	Cr<1	Mo<0.3	Te 0.3	As<2	Al <1	B<1	Ca<1
†885	0.0005			<0.0005	0.31		S 0.0018	Sb<0.0002	As <0.0002	Bi<0.0001	Zn<0.0001

Values in parentheses are not certified and are given for information only.
Values in brackets are subject to greater error since only one method of analysis was employed.
* SI unit: Replaces terms "ppm" and "μg/g".
† SRM 885 values are in Wt. %.

RM 1R—Ultra-Purity Aluminum Polycrystalline (rod form)

This RM is 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. Unit of issue: 4.2 mm in diameter and 25.4 mm long.

Paul Paulsen, *Research Chemist*, Inorganic Analytical Research Division; **Ellyn Beary,** *Research Chemist*, Inorganic Analytical Research Division

Stoichiometry (powder form)

These SRMs are 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	Unit Size (in g)	Certified Use	Stoichiometric Purity
17d	Sucrose	60	Polarimetric Value	(99.9)[a]
40h	Sodium Oxalate	60	Reductometric Value	99.972
41c	Dextrose (D-Glucose)	70	Reductometric Value	99.9
83d	Arsenic Trioxide	60	Reductometric Value	99.9926
84j	Potassium Hydrogen Phthalate	60	Acidimetric Value	99.996
136e	Potassium Dichromate	60	Oxidimetric Value	99.984
350a	Benzoic Acid	30	Acidimetric Value	99.9958
723a	Tris(hydroxymethyl)aminomethane	50	Basimetric Value	99.9703
951	Boric Acid	100	Acidimetric and Boron Isotopic Value	100.00
987	Strontium Carbonate	1	Assay and Isotopic	99.98
999	Potassium Chloride	60	Assay Standard for:	
			Potassium	99.981
			Chloride	99.99

[a] Sucrose = Moisture < 0.02 percent, Ash < 0.005 percent.

Microchemistry (powder form)

SRM	Type	Unit Size (in g)	Composition (in Wt. %)							
			C	H	N	Br	Cl	F	S	CH_3O-
141c	Acetanilide	2	71.09	6.71	10.36					
142	Anisic Acid	2								20.40
143c	Cystine	2	29.99	5.03	11.66				26.69	
148	Nicotinic Acid	2	58.54	4.09	11.38					
2141	Urea	2			46.63					
2142	o-Bromobenzoic Acid	2				39.80				
2143	p-Fluorobenzoic Acid	2						13.54		
2144	m-Chlorobenzoic Acid	2					22.62			

Spectrometry, Single Element (solution form)

These SRMs are intended as standard stock solutions for use in atomic absorption spectrometry, optical emission (plasma) spectrometry, or any other analytical technique that requires aqueous solutions for calibrating instruments. Each SRM is a single element solution of 50 mL with a concentration of 10 mg/mL, except where noted.

SRM	Element	Acid Concentration
3101	Aluminum	HCl 10%
3102	Antimony	HCl 50%
3103	Arsenic	HCl 15%
3104	Barium	HCl 10%
3105	Beryllium	HCl 10%
3106	Bismuth	HNO_3 10%
3107	Boron (5.00 mg/mL)	Water
3108	Cadmium	HNO_3 10%
3109	Calcium	HCl 10%
3110	Cerium	HNO_3 10%
3111	Cesium	HCl 1%
3112	Chromium	HCl 10%
3113	Cobalt	HNO_3 10%
3114	Copper	HNO_3 10%
3115	Dysprosium	HCl 10%
3116	Erbium	HCl 10%
3117	Europium	HCl 10%
3118	Gadolinium	HCl 10%
3119	Gallium	HCl 10%
3120	Germanium	Oxalic Acid 10%
3121	Gold	HCl 10%
3122	Hafnium	HNO_3 10% + HF 2%
3123	Holmium	HCl 10%
3124	Indium	HCl 10%
3126	Iron	HCl 10%
3127	Lanthanum	HCl 10%
3128	Lead	HNO_3 10%
3129	Lithium	HCl 1%
3130	Lutetium	HCl 10%
3131	Magnesium	HCl 10%
3132	Manganese	HNO_3 10%
3133	Mercury	HNO_3 10%
3134	Molybdenum	HCl 10%
3135	Neodymium	HCl 10%
3136	Nickel	HNO_3 10%
3137	Niobium	5% HNO_3 + 2% HF
3138	Palladium	HCl 10%
3139	Phosphorus	HCl 0.05%
3140	Platinum	HCl 10%
3141	Potassium	HCl 1%
3142	Praseodymium	HCl 10%
3143	Rhenium	HNO_3 10%
3144	Rhodium	In Prep
3145	Rubidium	HCl 1%

Spectrometry, Single Element (solution form) – Continued

SRM	Element	Acid Concentration
3147	Samarium	HCl 10%
3148	Scandium	HCl 10%
3149	Selenium	HNO_3 10%
3150	Silicon	Water
3151	Silver	HNO_3 10%
3152	Sodium	HCl 1%
3153	Strontium	HCl 10%
3154	Sulfur	H_2SO_4 0.1%
3155	Tantalum	5% HNO_3 + 2% HF
3156	Tellurium	HCl 20%
3157	Terbium	HCl 10%
3158	Thallium	HNO_3 10%
3159	Thorium	HNO_3 10%
3160	Thulium	HCl 10%
3161	Tin	HCl 60%
3162	Titanium	HCl 40%
3163	Tungsten	7% HNO_3 + 4% HF
3164	Uranium	HNO_3 10%
3165	Vanadium (5.00 mg/mL)	HNO_3 10%
3166	Ytterbium	HCl 10%
3167	Yttrium	HCl 10%
3168	Zinc	HCl 10%
3169	Zirconium	10% HNO_3 + 2% HF

Theresa Butler, *Research Chemist*, Inorganic Analytical Research Division

Spectrometry, Multi-Element (solution form)

Element	Source, Purity (in Wt. %)	Concentration (in mg/L)
SRM 3171 Multielement Mix A Standard Solution		
Aluminum	Metal, (99.99+)	100.0 ± 0.5
Beryllium	Metal, (99.9)	10.0 ± 0.1
Cadmium	Metal, (99.99+)	100.0 ± 0.5
Chromium	Metal, (99.99+)	100.0 ± 0.5
Iron	Metal, (99.99+)	100.0 ± 0.5
Magnesium	Metal, (99.999)	100.0 ± 0.5
Manganese	Metal, (99.99)	100.0 ± 0.5
Nickel	Metal, (99.999)	100.0 ± 0.5
Potassium	KCl, (99.98)	500.0 ± 2.5
Sodium	NaCl, (99.98)	100.0 ± 0.5
SRM 3172 Multielement Mix B Standard Solution		
Arsenic	As_2O_3, (99.9926)	200.0 ± 1.0
Barium	$BaCO_3$, (99.99)	10.0 ± 0.1
Calcium	$CaCO_3$, (99.99)	10.0 ± 0.1
Cobalt	Metal, (99.99)	100.0 ± 0.5
Copper	Metal, (99.998)	100.0 ± 0.5
Lead	Metal, (99.99)	100.0 ± 0.5
Selenium	Metal, (99.99)	500.0 ± 2.5
Silver	Metal, (99.999+)	100.0 ± 0.5
Strontium	$SrCO_3$, (99.99)	10.0 ± 0.1
Zinc	Metal, (99.99+)	100.0 ± 0.5
SRM 3174 Multielement Mix D Standard Solution		
Aluminum	Metal, (99.99+)	100.0 ± 0.5
Beryllium	Metal, (99.9)	100.0 ± 0.5
Boron	H_3BO_3, (99.99)	100.0 ± 0.5
Cadmium	Metal, (99.999)	100.0 ± 0.5
Gold	Metal, (99.999)	100.0 ± 0.5
Hafnium	Metal, (99.95)	100.0 ± 0.5
Iron	Metal, (99.99)	100.0 ± 0.5
Lead	Metal, (99.995)	100.0 ± 0.5
Titanium	Metal, (99.99)	50.0 ± 0.25
Zirconium	Metal, (99.84)	100.0 ± 1.0

Anion Chromatography (solution form)

These SRMs are single-component solutions prepared gravimetrically for use in anion chromatography, or any other technique that requires aqueous standard solutions for calibration on control materials.

SRM	Anion	Unit Size (in mL)	Concentration (in mg/kg*)
3181	Sulfate	50	1000
3182	Chloride	50	1000
3183	Fluoride	50	1000
3184	Bromide	50	1000
3185	Nitrate	50	1000
3186	Phosphate	50	1000

*SI unit. Replaces terms "ppm" and "μg/g".

Stable Isotopic Materials (solid forms)

The isotopic composition of these SRMs has been determined by mass spectrometry.

SRM	Type	Element/Isotopic Composition Certified	Unit Size (in g)
951	Boric Acid, assay and isotopic	Boron	100
952	Boric Acid, 95% enriched ^{10}B	Boron	0.25
975	Sodium Chloride	Chlorine	0.25
976	Copper Metal	Copper	0.25
977	Sodium Bromide	Bromine	0.25
978a	Silver Nitrate	Silver	0.25
979	Chromium Nitrate	Chromium	0.25
980	Magnesium Metal	Magnesium	0.25
981	Lead Metal, natural	Lead	1.0
982*	Lead Metal, equal atom ($^{208}Pb/^{206}Pb$)	Lead	1.0 wire
983*	Lead Metal, radiogenic (92% ^{206}Pb)	Lead	1.0 wire
984	Rubidium Chloride, assay and isotopic	Rubidium	0.25
985	Potassium Chloride	Potassium	1.0
986	Nickel	Nickel	1.0
987	Strontium Carbonate, assay and isotopic	Strontium	1.0
989	Rhenium, assay and isotopic	Rhenium	pkg. (50)
990	Silicon, assay and isotopic	Silicon	3 cm × 0.2 cm wafer
991	Lead–206 Spike, assay and isotopic	Lead	15
994	Gallium Metal, isotopic	Gallium	0.25
997	Thallium Metal, isotopic	Thallium	0.25

* These SRMs are radioactive, containing Lead-210 of natural origin. All users and purchasers must comply with all national and international regulations regarding the use and disposal of these SRMs.

Light Stable Isotopic Materials (gas, liquid and solid forms)

These Reference Materials (RMs) are for calibration of isotope-ratio mass spectrometers and associated sample preparation systems. They are distributed by NIST on behalf of the International Atomic Energy Agency (IAEA). Quantities of these materials are limited to *one (1) unit of each RM per laboratory every three (3) years*.

The isotopic compositions are given in parts per thousand (1000) difference from isotope-ratio standards—Vienna Standard Mean Ocean Water (VSMOW), Vienna PeeDee Belemnite (VPDB), atmospheric N_2 (Air), NBS28 Silica Sand (optical), and Canyon Diablo Troilite (CDT); with the exception of Lithium (Li), which is expressed as an absolute isotopic ratio.

RM	Type	Nominal Isotopic Composition (in parts per 1000)						
		δD_{VSMOW}	$^6Li/^7Li$	$\delta^{13}C_{VPDB}$	$\delta^{15}N_{Air}$	$\delta^{18}O_{VSMOW}$	$\delta^{30}Si_{NBS28}$	$\delta^{34}S_{CDT}$
8535	VSMOW–water	0 *				0 *		
8536	GISP–water	−190				−24.8		
8537	SLAP–water	−428 *				−55.5 *		
8538	NBS30–biotite	−66				+5.1		
8539	NBS22–oil	−120		−29.7				
8540	PEFI–polyethylene foil	−100		−31.8				
8541	USGS24–graphite			−16				
8542	Sucrose ANU–sucrose			−10.5				
8543	NBS18–carbonatite			−5.0		+7.2		
8544	NBS19–limestone			+1.95 *		+28.6		
8545	LSVEC–lithium carbonate		0.0832†	−47		+3		
8546	NBS28–silica sand (optical)					+9.6	0 *	
8547	IAEA-N1–ammonium sulfate				+0.4			
8548	IAEA-N2–ammonium sulfate				+20.3			
8549	IAEA-N3–potassium nitrate				+2			
8550	USGS25–ammonium sulfate				~ −25			
8551	USGS26–ammonium sulfate				~ +60			
8552	NSVEC–gaseous nitrogen				−2.8			
8553	Soufre de Lacq–elemental sulfur							+16
8554	NZ1–silver sulfide							−0.3
8555	NZ2–silver sulfide							+21
8556	NBS123–sphalerite							+17
8557	NBS127–barium sulfate					+9.3		+20

† Absolute isotopic ratio
* Exactly defined isotopic abundances

105. Health and Industrial Hygiene

Clinical Laboratory Materials (gas and solid forms)

These SRMs are for calibrating apparatus and validating analytical methods used in clinical and pathology laboratories.

SRM	Type	Purity (in Wt. %)	Unit Size
900	Antiepilepsy Drug Level Assay (phenytoin, ethosuximide, phenobarbital, and primidone)		Set of 4 ampules
910	Sodium Pyruvate	98.7	25 g
911b	Cholesterol	99.8	2 g
912a	Urea	99.9	25 g
913	Uric Acid	99.7	10 g
914a	Creatinine	99.7	10 g
915	Calcium Carbonate	99.9	20 g
916a	Bilirubin	98.3	100 mg
917a	D-Glucose (Dextrose)	99.7	25 g
918	Potassium Chloride	99.9	30 g
919a	Sodium Chloride	99.89	30 g
920	D-Mannitol	99.8	50 g
921	Cortisol (Hydrocortisone)	98.9	1 g
922	Tris(hydroxymethyl) aminomethane	99.99	25 g
923	Tris(hydroxymethyl) aminomethane HCl	99.69	35 g
*924a	Lithium Carbonate	In Prep	
925	VMA (4–hydroxy–3–methoxymandelic acid)	99.4	1 g
928	Lead Nitrate	100.00	30 g
929	Magnesium Gluconate Dihydrate	(100.1)	5 g
937	Iron Metal	99.90	50 g
938	4–Nitrophenol	(99.75)	15 g
955a	Lead in Blood	In Prep	
*956	Electrolytes in Serum for ISE		Set of 12 ampules
968a	Fat Soluble Vitamins in Human Serum		Set of 6 ampules
998	Angiotensin I (Human)	4.1	0.5 mg
1595	Tripalmitin	99.5	2 g
1598	Inorganic Constituents in Bovine Serum		Set of 2 ampules
1599	Anticonvulsant Drug Level Assay (valproic acid and carbamazepine)		Set of 4 ampules
1700a	Blood Gas: CO_2–10%, Bal N_2		Cylinder, 0.56 m^3
1701a	Blood Gas: CO_2–5%, O_2–12%, Bal N_2		Cylinder, 0.56 m^3
1702a	Blood Gas: CO_2–5%, O_2–20%, Bal N_2		Cylinder, 0.56 m^3
1703a	Blood Gas: CO_2–10%, O_2–7%, Bal N_2		Cylinder, 0.56 m^3
1951a	Cholesterol in Human Serum (Frozen)	In Prep	Set of 6 bottles
1952a	Cholesterol in Human Serum (Freeze-dried)		Set of 6 bottles
RM 8430	Aspartate Aminotransferase (AST) Human Erythrocyte Source		Set of 3 bottles

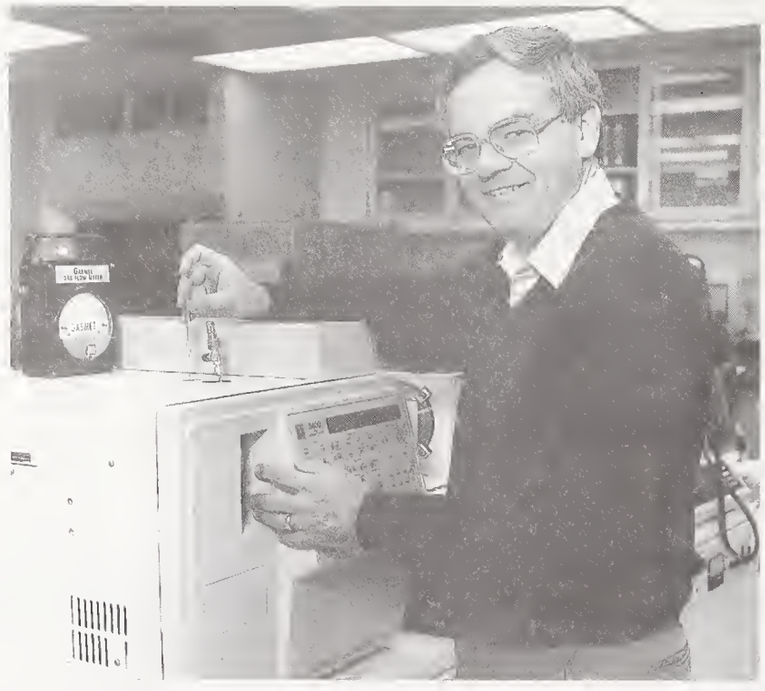
Values in parentheses are not certified and are given for information only.
*Conforms to National Committee for Clinical Laboratory Standards (NCCLS) specification ACC–1.

Serum Materials (powder and solution forms)

SRM	Type	Unit Size		Analyte Concentrations (in mmol/L)	
				909a-1	909a-2
909a	Human Serum	909a-1; 3 bottles	Calcium	2.322	3.338
		909a-2; 3 bottles	Chloride	92.4	119.1
			Cholesterol	4.892	4.463
			Creatinine	0.084	0.463
			Glucose	5.37	16.51
			Lithium	0.465	2.657
			Magnesium	0.868	1.846
			Potassium	3.656	6.21
			Sodium	148.5	126.5
			Urea	5.535	19.47
			Uric Acid	0.234	0.525
927a	Bovine Serum Albumin	Set of 10 ampules	Peptide Mass	72.17 g/L	

Ethanol Solutions

SRM	Type	Certified Constituent	Unit Size
1828	Ethanol-Water Solutions	Ethanol: 95.629 Wt. %	Set: 1, 15-mL ampules
		Ethanol: 0.2992 Wt. %	2, 3-mL ampules
		Ethanol: 0.1487 Wt. %	2, 3-mL ampules



Michael Welch, *Supervisory Research Chemist*, Organic Analytical Research Division

Freeze-dried Urine (powder form)

These SRMs are for determining toxic substances and drugs of abuse in human urine. SRMs 2670, 2671a and 2672a are provided in sets of four (4) 30-mL bottles, two (2) bottles each at normal and elevated levels. SRMs 1507b, 1508, and RM 8444 are also provided in sets of four (4), one (1) each at blank, low, medium, and high levels. SRMs 1507b and 1508 are contained in 20-mL bottles; RM 8444 is contained in 10-mL vials. The values listed for these SRMs apply only to reconstituted urine.

SRM	Type	Low/Elevated Elemental Composition (in mg/L)				
		Al	As	Be	Cd	Ca
2670 2671a 2672a	Toxic Metals Fluoride Mercury	(0.18)/(0.18)	(0.06)/0.48	(≤ 0.0005)/(0.033)	(0.00040)/0.088	0.105/0.105 g/L

SRM	Cl	Cr	Cu	F	Au	Pb	Mg	Mn
2670	(4.4)/(4.4) g/L	(0.013)/0.085	0.13/0.37		(0.008)*/(0.24)	(0.01)/0.109	0.063/0.063 g/L	(0.03)/(0.33)
2671a				0.55/5.7				
2672a								

SRM	Hg	Ni	Pt	K	Se	Na	V	SO_4
2670	(0.002)/0.105	(0.07)/(0.30)	(0.008)*/(0.12)	(1.5)/(1.5) g/L	0.030/0.46	2.62/2.62	−/(0.12)	(1.3)/(1.3) g/L
2671a								
2672a	(0.002)/0.105							

Values in parentheses are not certified and are given for information only.
* Values are in μg/L.

SRM/RM	Type	Component (in ng/L)			
		Blank	Low	Medium	High
1507b	THC–9–COOH		In Prep		
1508	Cocaine and Metabolites	**	90	263	429
8444	Cotinine	0.8	54		488

** Not detected

Materials on Filter Media

These SRMs consist of potentially hazardous materials deposited on filters to be used to determine the levels of these materials in industrial atmospheres.

SRM	Type	Unit Size	Element/Component (in μg/filter)				
				I	II	III	IV
2676c	Metals on Filter Media	Set of 8	Cadmium	0.954	2.83	10.09	(<0.01)
			Lead	7.47	14.92	29.81	(<0.01)
			Manganese	2.11	9.92	19.85	(<0.01)
			Zinc	9.99	49.68	99.28	(<0.01)
2677a	Beryllium and Arsenic on Filter Media	2 Sets of 5	Beryllium	0.129	0.643	2.58	0.050 ≤ 0.0005 Blank
			Arsenic	0.269	2.69	26.92	0.101 ≤ 0.0005 Blank
2679a	Quartz on Filter Media	Set of 4	Quartz	≤ 2	30.8	80.2	202.7
			Clay	(370)	(370)	(370)	(370)

Values in parentheses are not certified and are given for information only.

Blank Filters

These SRMs are for use in evaluating the performance of air sampling filter methods.

SRM	Type	Diameter (in mm)	Pore Size (in μm)	Filter Weight (in g)
2678	Cellulose Acetate Membrane	47	0.45	0.09
2680	Cellulose Acetate Membrane	37	0.80	0.05
2681	Ashless	42.5	–	0.14

Respirable Silica (powder form)

This SRM is a crystalline silica with particles in the respirable range. It is intended for use in determining the level of respirable material in an industrial atmosphere by X-ray diffraction.
Note: This is not a particle size reference material.

SRM	Type	Unit Size	Component (in Wt. %)
1879	Respirable Cristobalite	5 g	Crystalline Cristobalite, 98.0

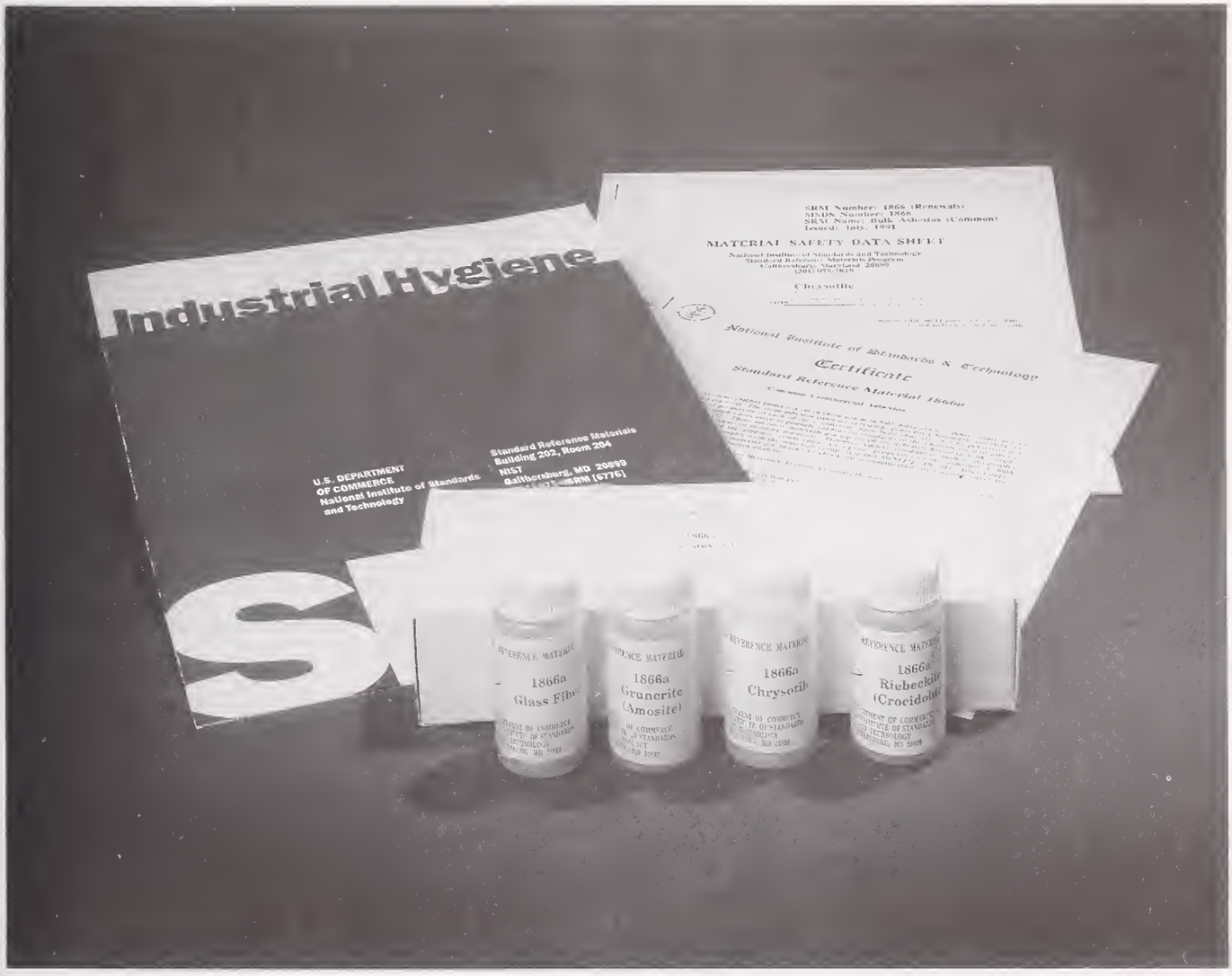
Asbestos

Reference Material (RM) 8411 consists of a 1-cm^2 section of collapsed mixed cellulose ester filter with a high concentration of chrysotile asbestos and a medium concentration of grunerite asbestos. It is intended for use in evaluating the techniques used to identify and count chrysotile and grunerite (Amosite) asbestos fibers in filter samples by transmission electron microscopy (TEM).

RM	Type	Fiber Loading
8411	Mixed Asbestos Research Filter	43 fibers/0.01^2 mm Grunerite

SRM 1866a consists of a set of the three (3) common bulk mine-grade asbestos materials and one (1) synthetic glass fiber sample. There are ~4 g of each material in the set. The three asbestos materials are chrysotile, grunerite (Amosite), and riebeckite (Crocidolite). Their optical properties, as observed by polarized light microscopy (PLM), have been characterized so that they may serve as primary calibration standards for the identification of asbestos types in building materials.

SRM	Type	Asbestos Type
1866a	Common Commercial Asbestos	Chrysotile, Grunerite, Riebeckite



106. Inorganics

Metal Constituents (liquid and solid forms)

These SRMs are for analysis of materials of health or environmental interest.

SRM	Type	Unit Size	Elemental Composition				
			Pb	Ni	S	Hg	V
1579	Powdered Lead Base Paint	35 g	11.87 Wt. %				
1618	Vanadium and Nickel in Residual Fuel Oil	100 mL		75 mg/kg	(4.3 Wt. %)		423 mg/kg
1630	Trace Mercury in Coal	50 g				0.13 mg/kg	
1638b	Lead in Reference Fuel	12 vials	767 mg/kg				
1641b	Mercury in Water	6 × 20 mL				1.52 µg/mL	
2712	Lead in Reference Fuel	6 × 20 mL	11.4 mg/kg				
2713	Lead in Reference Fuel	6 × 20 mL	19.4 mg/kg				
2714	Lead in Reference Fuel	6 × 20 mL	28.1 mg/kg				
2715	Lead in Reference Fuel	6 × 20 mL	784 mg/kg				
RM 8505	Vanadium in Crude Oil	250 mL					(390 mg/kg)

Simulated Rainwaters (liquid form)

This SRM was developed to aid in the analysis of acidic rainwater by providing a stable, homogeneous material at two levels of acidity.

SRM	Type	Unit of Issue	
2694a	Simulated Rainwater	Set of 4: 2 of 50 mL at each of 2 levels	
	Constituent Element/Parameter	**2694a–I**	**2694a–II**
	pH, 25 °C	4.30	3.60
	Electrolytic Conductivity (S/cm, 25 °C)	25.4	129.3
	Acidity, meq/L	0.0544	0.283
	Fluoride, mg/L	0.057	0.108
	Chloride, mg/L	(0.23)	(0.94)
	Nitrate, mg/L	(0.53)	7.19
	Sulfate, mg/L	2.69	10.6
	Sodium, mg/L	0.208	0.423
	Potassium, mg/L	0.056	0.108
	Ammonium, mg/L	(0.12)	(1.06)
	Calcium, mg/L	0.0126	0.0364
	Magnesium, mg/L	0.0242	0.0484

Values in parentheses are not certified and are given for information only.

Thin Films for X-ray Fluorescence

These SRMs are for standardizing X-ray spectrometers. They may be useful in elemental analysis of particulate matter collected on filter media, and where X-ray spectrometer calibration functions are determined using thin film standards. Each SRM is individually certified and consists of a silica base glass film (0.5 μm thick) deposited on a 47-mm diameter polycarbonate filter mounted on an aluminum ring.

SRM	Type	Elemental Composition per area (in μg/cm²)											
		Al	Ca	Co	Cu	Fe	Pb	K	Mn	Si	Ti	V	Zn
1832	Thin-Glass Film	15	20	1	2				5	36		5	
1833	Thin-Glass Film					15	17	18		35	14		4

Carbon Modified Silicon (powder form)

This SRM is intended for the calibration of instruments used to measure total elemental carbon. The SRM consists of three (3), 1-g bottles of chemically modified microparticulate silica.

SRM	Type	Bottle	% Carbon
1216	Carbon Modified Silicon	I	0.7
		II	9.06
		III	17.04

107. Analyzed Gases

Mixtures and Pollutants

These SRMs are for calibrating apparatus used to measure various components of gas mixtures and atmospheric pollutants. All cylinders conform to the appropriate DOT specifications.

SRM	Type	Certified Component	Concentration (in μmol/mol)
1811	Aromatic Organic Gases in Nitrogen		
	Benzene	C_6H_6	0.25
	Toluene	$C_6H_5CH_3$	0.25
	Chlorobenzene	C_6H_5Cl	0.25
	Bromobenzene	C_6H_5Br	0.25
1812	Aromatic Organic Gases in Nitrogen		
	Benzene	C_6H_6	10
	Toluene	$C_6H_5CH_3$	10
	Chlorobenzene	C_6H_5Cl	10
	Bromobenzene	C_6H_5Br	10
1813	Aliphatic Organic Gases in Nitrogen		
	Carbon Tetrachloride	CCl_4	0.25
	Chloroform	$CHCl_3$	0.25
	Tetrachloroethylene	CCl_2CCL_2	0.2
	Vinyl Chloride	CH_2CHCl	0.25
1814	Aliphatic Organic Gases in Nitrogen		
	Carbon Tetrachloride	CCl_4	10
	Chloroform	$CHCl_3$	10
	Tetrachloroethylene	CCl_2CCL_2	10
	Vinyl Chloride	CH_2CHCl	10
1805	Benzene in Nitrogen	C_6H_6	0.25
1806	Benzene in Nitrogen	C_6H_6	10
1700a	Blood Gas: CO_2–10%, Bal N_2	CO_2 in N_2	10%
1701a	Blood Gas: CO_2–5%, O_2–12%, Bal N_2	CO_2 & O_2 in N_2	5 mol % CO_2 12 mol % O_2
1702a	Blood Gas: CO_2–5%, O_2–20%, Bal N_2	CO_2 & O_2 in N_2	5 mol % CO_2 20 mol % O_2
1703a	Blood Gas: CO_2–10%, O_2–7%, Bal N_2	CO_2 & O_2 in N_2	10 mol % CO_2 7 mol % O_2
2607	Carbon Dioxide and Nitrous Oxide in Air		
	Carbon Dioxide	CO_2	340
	Nitrous Oxide	N_2O	300
2608	Carbon Dioxide and Nitrous Oxide in Air		
	Carbon Dioxide	CO_2	340
	Nitrous Oxide	N_2O	300
2609	Carbon Dioxide and Nitrous Oxide in Air		
	Carbon Dioxide	CO_2	380
	Nitrous Oxide	N_2O	330
2610	Carbon Dioxide and Nitrous Oxide in Air		
	Carbon Dioxide	CO_2	380
	Nitrous Oxide	N_2O	330

Mixtures and Pollutants – Continued

SRM	Type	Certified Component	Concentration (in μmol/mol)
1674b	Carbon Dioxide in Nitrogen	CO_2	7.0 mol %
1675b	Carbon Dioxide in Nitrogen	CO_2	14.0 mol %
2619a	Carbon Dioxide in Nitrogen	CO_2	0.5 mol %
2620a	Carbon Dioxide in Nitrogen	CO_2	1.0 mol %
2621a	Carbon Dioxide in Nitrogen	CO_2	1.5 mol %
2622a	Carbon Dioxide in Nitrogen	CO_2	2.0 mol %
2623a	Carbon Dioxide in Nitrogen	CO_2	2.5 mol %
2624a	Carbon Dioxide in Nitrogen	CO_2	3.0 mol %
2625a	Carbon Dioxide in Nitrogen	CO_2	3.5 mol %
2626a	Carbon Dioxide in Nitrogen	CO_2	4.0 mol %
2612a	Carbon Monoxide in Air	CO	10
2613a	Carbon Monoxide in Air	CO	20
2614a	Carbon Monoxide in Air	CO	45
1677c	Carbon Monoxide in Nitrogen	CO	10
1678c	Carbon Monoxide in Nitrogen	CO	50
1679c	Carbon Monoxide in Nitrogen	CO	100
1680b	Carbon Monoxide in Nitrogen	CO	500
1681b	Carbon Monoxide in Nitrogen	CO	1000
2635a	Carbon Monoxide in Nitrogen	CO	25
2636a	Carbon Monoxide in Nitrogen	CO	250
2637a	Carbon Monoxide in Nitrogen	CO	2500
2638a	Carbon Monoxide in Nitrogen	CO	5000
2639a	Carbon Monoxide in Nitrogen	CO	1 mol %
2640a	Carbon Monoxide in Nitrogen	CO	2 mol %
2641a	Carbon Monoxide in Nitrogen	CO	4 mol %
2642a	Carbon Monoxide in Nitrogen	CO	8 mol %
2725	Carbon Monoxide and Propane in Nitrogen	CO C_3H_8	1.6 mol % 600
2726	Carbon Monoxide and Propane in Nitrogen	CO C_3H_8	8 mol % 3000
2727	Carbon Monoxide, Propane and Carbon Dioxide in Nitrogen	CO C_3H_8 CO_2	1.6 mol % 600 11 mol %
2728	Carbon Monoxide, Propane and Carbon Dioxide in Nitrogen	CO C_3H_8 CO_2	8 mol % 3000 14 mol %
1658a	Methane in Air	CH_4	1
1659a	Methane in Air	CH_4	10
1660a	Methane-Propane in Air	CH_4 C_3H_8	4 1
1683b	Nitric Oxide in Nitrogen	NO	50
1684b	Nitric Oxide in Nitrogen	NO	100
1685b	Nitric Oxide in Nitrogen	NO	250
1686b	Nitric Oxide in Nitrogen	NO	500
1687b	Nitric Oxide in Nitrogen	NO	1000
2627a	Nitric Oxide in Nitrogen	NO	5
2628a	Nitric Oxide in Nitrogen	NO	10
2629a	Nitric Oxide in Nitrogen	NO	20

Mixtures and Pollutants – Continued

SRM	Type	Certified Component	Concentration (in μmol/mol)
2630	Nitric Oxide in Nitrogen	NO	1500
2631	Nitric Oxide in Nitrogen	NO	3000
2655	Nitrogen Dioxide in Air	NO_2	1000
2656	Nitrogen Dioxide in Air	NO_2	2500
2657a	Oxygen in Nitrogen	O_2	2 mol %
2658a	Oxygen in Nitrogen	O_2	10 mol %
2659a	Oxygen in Nitrogen	O_2	21 mol %
1665b	Propane in Air	C_3H_8	3
1666b	Propane in Air	C_3H_8	10
1667b	Propane in Air	C_3H_8	50
1668b	Propane in Air	C_3H_8	100
1669b	Propane in Air	C_3H_8	500
2645a	Propane in Nitrogen	C_3H_8	500
2646a	Propane in Nitrogen	C_3H_8	1000
2647a	Propane in Nitrogen	C_3H_8	2500
2648a	Propane in Nitrogen	C_3H_8	5000
2649a	Propane in Nitrogen	C_3H_8	1 mol %
2650	Propane in Nitrogen	C_3H_8	2 mol %
2651	Propane in Nitrogen and Oxygen	C_3H_8 O_2	0.01 mol % 5.0 mol %
2652	Propane in Nitrogen and Oxygen	C_3H_8 O_2	0.01 mol % 10.0 mol %
1661a	Sulfur Dioxide in Nitrogen	SO_2	500
1662a	Sulfur Dioxide in Nitrogen	SO_2	1000
1663a	Sulfur Dioxide in Nitrogen	SO_2	1500
1664a	Sulfur Dioxide in Nitrogen	SO_2	2500
1693a	Sulfur Dioxide in Nitrogen	SO_2	50
1694a	Sulfur Dioxide in Nitrogen	SO_2	100
1696	Sulfur Dioxide in Nitrogen	SO_2	3500
1804	Ambient Toxic Organics in Nitrogen	(Fifteen components – call for details.)	
1808	Tetrachloroethylene in Nitrogen	C_2Cl_4	0.25
1809	Tetrachloroethylene in Nitrogen	C_2Cl_4	10
2730	Hydrogen Sulfide in Nitrogen	H_2S	5
2731	Hydrogen Sulfide in Nitrogen	H_2S	20

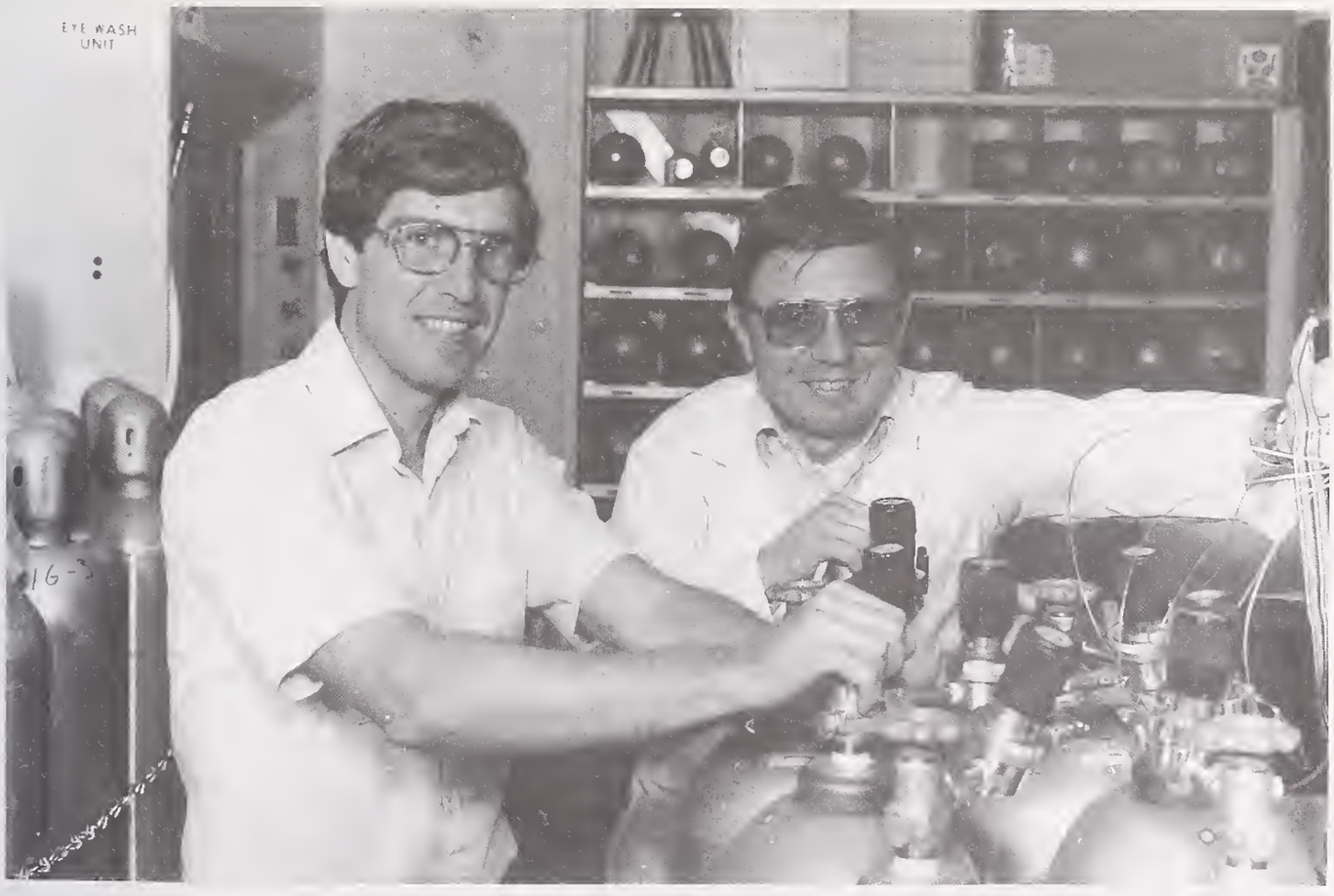
Permeation Devices

These SRMs are primarily intended for use in calibrating air pollution monitoring apparatus and for calibrating air pollution analytical methods and procedures. Each tube is individually calibrated and certified according to NIST procedures and protocols.

SRMs 1625 and 1627 are certified over the temperature range of 30 to 35 °C. SRM 1629a is calibrated at 25.0 °C only and cannot be shipped by air.

SRM	Type	Tube Length (in cm)	Permeation Rate at 30 °C (in μg/min)	Concentration* (in μmol/mol) @ Flow Rate (L/min) of		
				1	5	10
1625	Sulfur Dioxide Permeation Tube	10	3.7	1.4	0.3	0.1
1626	Sulfur Dioxide Permeation Tube	5	2.1	0.8	0.2	0.08
1627	Sulfur Dioxide Permeation Tube	2	0.8	0.3	0.06	0.03
1629a	Nitrogen Dioxide Permeation Tube	1	2.1	0.8	0.2	0.08

* Nominal values



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108. Fossil Fuels

Alcohols in Reference Fuels (liquid form)

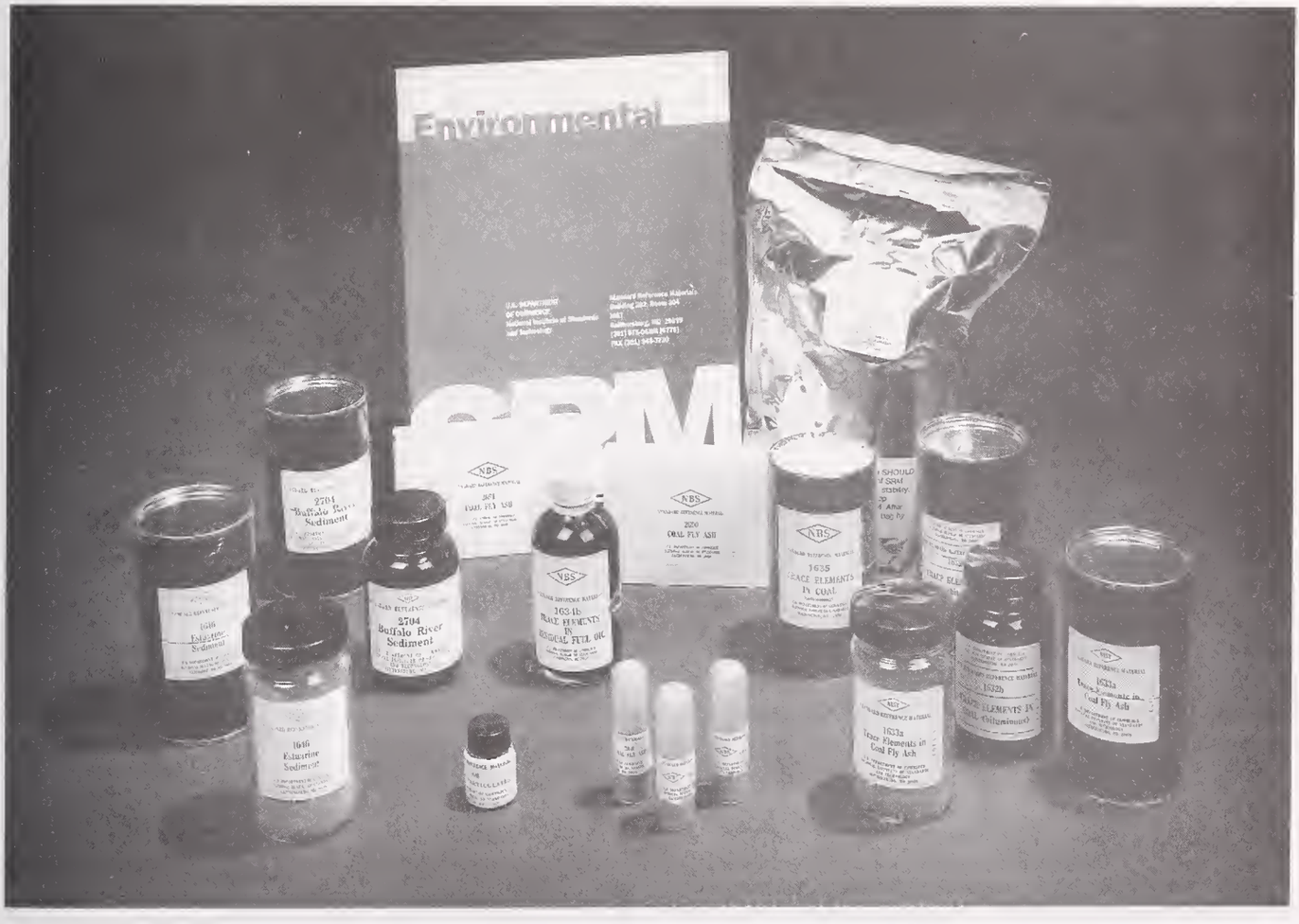
These SRMs are for calibrating instruments and validating methods used to determine various alcohols in gasoline. Each SRM is issued as a set of sealed 20-mL ampules.

SRM	Type	Concentration (in Wt. %)			
		Unit Size	Methanol	Ethanol	Methanol and t-Butanol
1829	Alcohols in Reference Fuel	Set of 6	0.335	11.39	10.33 + 6.63
1837	Methanol and t-Butanol	Set of 5			10.33 + 6.63
1838	Ethanol	Set of 5		11.39	
1839	Methanol	Set of 5	0.335		

Sulfur in Fossil Fuels (liquid and solid forms)

SRM	Type	Unit Size	Sulfur (in Wt. %)	Furnace Ash (in Wt. %)	HHV2 (in MJ/kg)
1616	Sulfur in Kerosine	100 mL	0.0152		
1617	Sulfur in Kerosine	100 mL	0.169		
1619a	Sulfur in Residual Fuel Oil	100 mL	0.725		
1620b	Sulfur in Residual Fuel Oil	100 mL	4.22		
1621d	Sulfur in Residual Fuel Oil	100 mL	1.011		
1622d	Sulfur in Residual Fuel Oil	100 mL	2.031		
1623b	Sulfur in Residual Fuel Oil	100 mL	0.348		
1624b	Sulfur in Distillate Fuel Oil	100 mL	0.332		
2717	Sulfur in Residual Fuel Oil	100 mL	3.022		
2682a	Coal (Sub-bituminous)	50 g	0.486	6.3	25.96
2683a	Coal (Bituminous)	50 g	1.89	6.8	32.22
2684a	Coal (Bituminous)	50 g	3.06	11.0	28.77
2685a	Coal (Bituminous)	50 g	4.730	16.21	27.10
2692	Sulfur in Coal, 1%	50 g	1.115	7.9	30.61

NOTE: The calorific values (MJ/kg) may decrease upon the aging or normal oxidation of the coals. NIST will continue to monitor these values and report any substantive change to purchasers.



Trace Elements (liquid and solid forms)

SRM	1632b	1633a	1634b	1635	1643c	1646	1648	2689	2690	2691	2704
Type	Coal (Bituminous)	Coal Fly Ash	Fuel Oil	Coal (Subbitum-inous)	Water	Estua-rine Sediment	Urban Particu-late	Coal Fly Ash	Coal Fly Ash	Coal Fly Ash	Buffalo River Sediment
Unit Size	55 g	75 g	100 mL	75 g	950 mL	75 g	2 g	30 g	30 g	30 g	50 g
ELEMENT	Concentrations are in mg/kg, unless noted by a single asterisk, *, for Wt. %, a double asterisk, **, for µg/kg, or a dagger, †, for µg/L.										
Aluminum	0.855 *	14.3 *	(16)	(0.32 *)	114.6 †	6.25 *	3.42 *	12.94 *	12.35 *	9.81 *	6.11 *
Antimony	(0.24)	6.8		(0.14)		(0.4)	(45)				3.79
Arsenic	3.72	145	0.12	0.42	82.1 †	11.6	115				23.4
Barium	67.5	(0.15 *)	(1.3)		49.6 †		(737)	(0.08 *)	(0.65 *)	(0.66 *)	414
Beryllium		(12)			23.2 †	(1.5)					
Bismuth					(12 †)						
Bromine	(17)						(500)				(7)
Cadmium	0.0573	1.00		0.03	12.2 †	0.36	75				3.45
Calcium	0.204 *	1.11 *	(15)		36800 †	0.83 *		2.18 *	5.71 *	18.45 *	2.60 *
Carbon	78.11 *										3.348 *
Cerium	(9)	(180)		(3.6)		(80)	(55)				(72)
Cesium	(0.44)	(11)				(3.7)	(3)				(6)
Chlorine	(1260)						(0.45 *)				(<0.01)
Chromium	(11)	196	(0.7)	2.5	19.0 †	76	403				135
Cobalt	2.29	(46)	(0.32	(0.65)	23.5 †	10.5	(18)				14.0
Copper	6.28	118		3.6	22.3 †	18	609				98.6
Europium	(0.17)	(4)		(0.06)		(1.5)	(0.8)				(1.3)
Gallium		(58)		(1.05)							(15)
Germanium						(1.4)					
Hafnium	(0.43)	(8)		(0.29)			(4.4)				(8)
Hydrogen	5.07 *										
Indium							(1.0)				
Iodine							(20)				(2)
Iron (Total)	0.759 *	9.4 *	31.6	0.239 *	106.9 †	3.35 *	3.91 *	9.32 *	3.57 *	4.42 *	4.11 *
Lanthanum	(5.1)						(42)				(29)
Lead	3.67	72.4	(2.8)	1.9	35.3 †	28.2	0.655 *				161
Lithium	(10)				16.5 †	(49)					(50)
Magnesium	0.0383 *	0.455 *			9450 †	1.09 *	(0.8 *)	0.61 *	1.53 *	3.12 *	1.20 *
Manganese	12.4	179	0.23	21.4	35.1 †	375	(860)	(0.03 *)	(0.03 *)	(0.02 *)	555
Mercury		0.16	(<0.001)			0.063					1.44
Molybdenum	(0.9)	(29)			104.3 †	(2.0)					
Nickel	6.10	127	28	1.74	60.6 †	32	82				44.1
Nitrogen	1.56 *										
Phosphorus						0.054 *		0.10 *	0.52 *	0.51 *	0.0998 *
Potassium	0.0748 *	1.88 *			(2300 †)	(1.4 *)	1.05 *	2.20 *	1.04 *	0.34 *	2.00 *
Rubidium	5.05	131			11.4 †	(87)	(52)				(100)
Samarium	(0.87)						(4.4)				(6.7)
Scandium	(1.9)	(40)		(0.63)		(10.8)	(7)				(12)
Selenium	1.29	10.3	0.18	0.9	12.7 †	(0.6)	27				(1.1)
Silicon	(1.4 *)	22.8 *				(31 *)		24.06 *	25.85 *	16.83 *	29.08 *
Silver					2.21 †		(6)				
Sodium	0.0515 *	0.17 *	(90)	(0.24 *)	12190 †	(2.0 *)	0.425 *	0.25 *	0.24 *	1.09 *	0.547 *
Strontium	(102)	830			263.6 †			(0.07 *)	(0.20 *)	(0.27 *)	(130)
Sulfur	1.89 *	(0.18 *)	2.80 *	0.33 *		(0.96 *)	(5 *)		0.15 *	0.83 *	(0.4) *
Tellurium					(2.7 †)	(0.5)					
Thallium		5.7			(7.9 †)	(0.5)					1.2
Thorium	1.342	24.7		0.62		(10)	(7.4)				(9.2)
Titanium	0.0454 *	(0.8 *)		(0.02 *)		(0.51 *)	(0.40 *)	0.75 *	0.52 *	0.90 *	0.457 *
Tungsten	(0.48)						(4.8)				
Uranium	0.436	10.2		0.24			5.5				3.13
Vanadium	(14)	297	55.4	5.2	31.4 †	94	140				95
Zinc	11.89	220	3.0	4.7	73.9 †	138	0.476 *				438

Values in parentheses are not certified and are given for information only.

Reference Liquids for Rating Fuels

SRMs 1815a and 1816a are high, purity liquids intended for use in maintaining the integrity of the octane rating of motor and aviation fuels as specified in the ASTM Manual for Rating Motor, Diesel, and Aviation Fuels.

SRM	Type	Purity (in Wt. %)	Unit Size
1815a	n-Heptane	99.987	100 mL
1816a	*Iso* octane (2,2,4-Trimethylpentane)	99.987	100 mL

109. Organics

Organic Constituents (liquid and solid forms)

These SRMs are further described in the following five (5) pages.

SRM	Type	Unit of Issue (per ampule)
1491	Aromatic Hydrocarbons in Hexane/Toluene	Set of 5, 1.2 mL
1492	Chlorinated Pesticides in Hexane	Set of 5, 1.2 mL
1580	Shale Oil	Set of 5, 1.2 mL
1581	Polychlorinated Biphenyls in Oil	Set of 8, 2.5 mL
1582	Petroleum Crude Oil	Set of 5, 1.2 mL
1583	Chlorinated Pesticides in *Iso*octane	Set of 6, 1.2 mL
1584	Phenols in Methanol	Set of 5, 1.2 mL
1585	Chlorinated Biphenyls	Set of 5, 1.2 mL
1586	Isotopically Labelled Priority Pollutants	Set of 6, 1.2 mL
1587	Nitro PAH in Methanol	Set of 4, 1 mL
1588	Organics in Cod Liver Oil	Set of 5, 1.2 mL
1589	Polychlorinated Biphenyls (as Aroclor 1260) in Human Serum	Set of 3, 2 g/ampule
1596	Dinitropyrene Isomers and 1-Nitropyrene in Methylene Chloride	Set of 5, 1.3 mL
1597	Complex Mixture of Polycyclic Aromatic Hydrocarbons	Set of 4, 1.2 mL
1614	Dioxin (2,3,7,8 TCDD) in *Iso*octane	Set of 6, 1.2 mL
1639	Halocarbons (in Methanol)	Set of 5, 1.5 mL
1647b	Priority Pollutant PAH (in Acetonitrile)	Set of 5, 1.2 mL
1649	Urban Dust/Organics	10 g
1650	Diesel Particulate Matter	Set of 5, 0.1 g
1939	Polychlorinated Biphenyls in River Sediment A	50 g
1941	Organics in Marine Sediment	70 g
1974	Organics in Mussel Tissue	Set of 3, 15 g/ampule
2260	Aromatic Hydrocarbons in Toluene	Set of 5, 1.2 mL
2261	Chlorinated Pesticides in Hexane	Set of 5, 1.2 mL
2262	Chlorinated Biphenyls	In Prep
RM 8464	Aldrin (neat)	In Prep
RM 8465	Dieldrin (neat)	In Prep
RM 8466	γ-HCH (Lindane) (neat)	In Prep
RM 8467	4,4′-DDE (neat)	In Prep
RM 8468	Heptachlor (neat)	In Prep
RM 8469	4,4′-DDE (neat)	In Prep

Organic Constituents (liquid and solid forms) – Continued

SRM	1491	1580	1582	1597	1647b	1649	1650	2260
Component (in mg/kg* except for SRMs 1597 and 1647b which are in mg/L)								
Anthracene	11.69			87.4	0.75			57.54
Benz[a]anthracene	5.37		3.0	85.3	3.94	2.6	6.5	66.0
Benzo[a]pyrene	10.14	21	1.1	82.9	4.92	2.9	1.2	68.61
Benzo[e]pyrene	8.40	18					(10)	75.98
Fluoranthene	8.84	54	2.5	278	7.76	7.1	51	76.31
o-Cresol	385							
Phenol	407							
Perylene	10.65	3.4	31	22.6			(0.13)	57.48
Pyrene	8.81	104		204	8.38		48	76.20
2,6–Dimethylphenol	175							
Benzo[f]quinoline (5,6-Benzoquinoline)	16							
Naphthalene	10.30			1000	19.80			76.3
Acenaphthylene	10.40				16.15			73.09
Acenaphthene	10.89				19.89			78.9
1–Nitropyrene							19	
Fluorene	10.87				4.97			75.62
Phenanthrene	10.48		101	400	3.50		(71)	76.01
Chrysene	10.50			62.0	3.69		(22)	76.6
Benzo[b]fluoranthene	7.85				4.16			75.97
Benzo[k]fluoranthene	8.33				4.70		(2.1)	75.67
Benzo[ghi]perylene	7.90			46.5	3.76	4.5	2.4	67.9
Dibenz[a,h]anthracene	7.74				3.64			67.1
Indeno[1,2,3–cd]pyrene	9.40			52.1	4.37	3.3	(0.23)	67.4
Dibenzothiophene			33					
Triphenylene				10.5				
1-Methylnaphthalene	12.4							75.7
Biphenyl	10.46							76.14
2,6-Dimethylnaphthalene	10.8							75.9
2,3,5-Trimethylnaphthalene	9.9							67.5
1-Methylphenanthrene	10.4							75.2

Values in parentheses are not certified and are given for information only.
* SI unit. Replaces "ppm" and "μg/g".

SRM 1639 Halocarbons (in methanol) for Water Analyses

Component	Concentration (in mg/L)
Chloroform	6235
Chlorodibromomethane	124.6
Bromodichloromethane	389.9
Bromoform	86.5
Carbon Tetrachloride	157.0
Trichloroethylene	85.8
Tetrachloroethylene	40.6

Organic Constituents (liquid and solid forms) – Continued

SRM 1492 Chlorinated Pesticides in Hexane

Pesticide	Concentration (in μg/kg)
Hexachlorobenzene	308
γ-HCH (Lindane)	310
Heptachlor	299
Aldrin	304
Heptachlor Epoxide	307
cis-Chlordane	305
trans-Nonachlor	297
Dieldrin	307
Mirex	306
2,4′–DDE	303
4,4′–DDE	306
2,4′–DDD	299
4,4′–DDD	296
2,4′–DDT	307
4,4′–DDT	302

SRM 1581 Polychlorinated Biphenyls in Oils

Matrix	Aroclor Type	Concentration (in mg/kg)
Motor Oil	1242	100
Motor Oil	1260	100
Transformer Oil	1242	100
Transformer Oil	1260	100

SRM 1583 Chlorinated Pesticides in 2,2,4–Trimethylpentane

Pesticide	Concentration (in mg/kg)
γ-BHC (Lindane)	1.11
δ-BHC	0.76
Aldrin	0.86
Heptachlor Epoxide	(0.997)
4,4′–DDE (p,p′–DDE)	1.23
4,4′–DDT (p,p′–DDT)	1.90

SRM 1584 Priority Pollutant Phenols in Methanol

Component	Concentration (in mg/L @ 25 °C)
2–Chlorophenol	64.4
Phenol	29.7
2–Nitrophenol	25.2
2,4–Dimethylphenol	51.6
2,4–Dichlorophenol	35.6
4–Chloro-m-cresol	27.4
2,4,6–Trichlorophenol	20.4
4–Nitrophenol	20.7
4,6–Dinitro-o-cresol	20.1
Pentachlorophenol	15.4
2,4–Dinitrophenol	(22.4)

Organic Constituents (liquid and solid forms) – Continued

SRM 1585 Chlorinated Biphenyls in 2,2,4-Trimethylpentane (*Iso* octane)

Polychlorinated Biphenyl (PCB)	Concentration (in mg/kg)
PCB 3	43.3
PCB 15	9.53
PCB 28	3.70
PCB 52	7.72
PCB 77	6.62
PCB 101	5.24
PCB 138	2.37
PCB 153	3.06

SRM 1586 Isotopically Labeled and Unlabeled Priority Pollutants in Methanol

Component	Concentration (in mg/kg)	
	1586–1 (unlabeled)	1586–2 (labeled)
Carbon Tetrachloride	128.5	124.4
Benzene	101.1	99.0
Chlorobenzene	133.0	144.0
Phenol	117.0	116.0
Nitrobenzene	126.0	134.5
2–Nitrophenol	103.6	101.9
2,4–Dichlorophenol	102.5	82.2
Naphthalene	126.5	126.6
Bis(2–ethylhexyl)phthalate	63.9	60.4
Benzo[a]pyrene	49.2	44.1

SRM 1587 Nitrated Polycyclic Aromatic Hydrocarbons in Methanol

Component	Concentration (in mg/kg)
2–Nitrofluorene	9.67
9–Nitroanthracene	5.01
3–Nitrofluoranthene	9.24
1–Nitropyrene	8.95
7–Nitrobenz[a]anthracene	9.27
6–Nitrochrysene	8.13
6–Nitrobenzo[a]pyrene	(6.1)

Values in parentheses are not certified and are given for information only.

Michele Schantz, *Research Chemist*, Organic Analytical Research Division; **Neal Craft,** *Biologist*, Organic Analytical Research Division; **Reenie Parris,** *Research Chemist*, Organic Analytical Research Division

Organic Constituents (liquid and solid forms) – Continued

SRM 1588 Organics in Cod Liver Oil

Component	Concentration (in µg/kg)
Hexachlorobenzene	148
α-HCH	86
trans-Chlordane	50
cis-Chlordane	158
trans-Nonachlor	209
Dieldrin	150
4,4′–DDD	277
4,4′–DDE	641
2,4′–DDT	156
4,4′–DDT	529
PCB 101	261
PCB 138	276
PCB 170	45
PCB 180	107

SRM 1589 Polychlorinated Biphenyls (as Aroclor 1260) in Human Serum

Component	Concentration * (in µg/kg)
Aroclor 1260	106.0
1, 2, 3, 4-TCDD	(0.153)
2, 3, 7, 8-TCDD	(0.081)

* when reconstituted

SRM 1596 Dinitropyrene Isomers and 1-Nitropyrene in Methylene Choride

Component	Concentration (in mg/kg)
1–Nitropyrene	4.38
1,3–Dinitropyrene	2.10
1,6–Dinitropyrene	4.82
1,8–Dinitropyrene	8.90

SRM 1614 Dioxin (2,3,7,8-TCDD in *Iso*octane)

Component	Concentration (in µg/kg)
2,3,7,8-TCDD	98.3
2,3,7,8-TCDD-^{13}C	95.6

SRM 1939 Polychlorinated Biphenyls (Congeners) in River Sediment A

Component	Concentration (in mg/kg)
PCB 26	4.20
PCB 28	2.21
PCB 44	1.07

Organic Constituents (liquid and solid forms) – Continued

SRM 1941 Organics in Marine Sediment

Component	Concentration (in µg/kg)
Phenanthrene	577
Anthracene	202
Fluoranthene	1220
Pyrene	1080
Benzo[a]anthracene	550
Benzo[b]fluoranthene	780
Benzo[k]fluoranthene	444
Benzo[a]pyrene	670
Perylene	422
Benzo[ghi]perylene	516
Indenol[1,2,3-cd]pyrene	569

SRM 1974 Organics in Mussel Tissue (Mytilus Edulis)

Component	Concentration (in µg/kg)
Phenanthrene	5.6
Anthracene	0.75
Fluoranthene	33.6
Pyrene	34.1
Perylene	1.05
Benzo[b]fluoranthene	6.5
Benzo[a]pyrene	2.29
Benzo[ghi]perylene	2.47
Indenol[1,2,3-cd]pyrene	1.80

SRM 2261 Chlorinated Pesticides in Hexane

Component	Concentration (in mg/kg)
Hexachlorobenzene	3.005
γ-HCH (Lindane)	3.012
Heptachlor	3.020
Aldrin	3.029
Heptachlor Epoxide	3.020
cis-Chlordane	3.012
trans-Nonachlor	3.034
Dieldrin	3.012
Mirex	3.041
2,4′–DDE	3.019
4,4′–DDE	3.019
2,4′–DDD	3.013
4,4′–DDD	3.043
2,4′–DDT	2.993
4,4′–DDT	3.004

GC/MS and LC System Performance (liquid form)

These SRMs are for evaluating the sensitivity of gas chromatography/mass spectrometry (GC/MS) instrumentation and for characterizing liquid chromatography (LC) column selectivity.

SRM	Type	Unit Size	Selectivity (C18 phases)	Concentration (in mg/L) Low/High
869	LC Selectivity	Set of 5, 1.1 mL	BaP≤ PhPh < TBN	
1543	GC/MS System	Set of 4, 1 mL		Methyl Stearate 0.99/4.98
RM 8443	Performance	Set of 20, 1 mL		Benzophenone 1.01/5.01

110. Food and Agriculture

These SRMs are for use in the calibration of apparatus and methods used in the analysis of foods and related products.

Foods and Beverages (liquid and powder forms)

SRM	1548	1549	1566a	1567a	1568a	1569	1577b
Type	Total Diet	Non-fat Milk Powder	Oyster Tissue	Wheat Flour	Rice Flour	Brewers Yeast	Bovine Liver
Unit Size	2×6 g	100 g	25 g	80 g	80 g	50 g	50 g
ELEMENTS	**Nominal Composition in mg/kg*, unless otherwise noted.**						
Aluminum	(33)	(2)	202.5	5.7	4.4		(2)
Antimony		(0.00027)	(0.01)		(0.0005)		(0.003)
Arsenic		(0.0019)	14.0	(0.006)	0.29		0.047
Bromine		(12)		(6)	(8)		(9)
Cadmium	0.028	0.0005	4.15	0.026	0.022		0.44
Calcium	0.17 Wt. %	1.30 Wt. %	0.196 Wt. %	0.0191 Wt. %	0.011 Wt. %		120
Chlorine	0.87 Wt. %	1.09 Wt. %	0.829 Wt. %	(565)	(300)		0.28 Wt. %
Chromium		0.0026	1.43			2.12	
Cobalt		(0.0041)	0.57	(0.006)	(0.018)		0.21
Copper	2.6	0.7	66.3	2.1	2.4		158
Fluorine		(0.20)	(240)				
Iodine		3.38	4.46	(0.0009)	(0.009)		
Iron	32.2	1.78	539	14.1	7.4		194
Lead	(0.05)	0.019	0.371	(<0.020)	(<0.010)		0.135
Magnesium	0.055 Wt. %	0.120 Wt. %	0.118 Wt. %	0.040 Wt. %	0.056 Wt. %		600
Manganese	5.2	0.26	12.3	9.4	20.0		9.9
Mercury		0.0003	0.0642	(0.0005)	0.0058		0.004
Molybdenum	(0.27)	(0.34)		0.48	1.46		3.5
Nickel	(0.41)		2.25		(0.16)		
Nitrogen	3.5 Wt. %		6.81 Wt. %				(10.7 Wt. %)
Phosphorus	0.32 Wt. %	1.06 Wt. %	0.623 Wt. %	0.134 Wt. %	0.153 Wt. %		1.11 Wt. %
Potassium	0.60 Wt. %	1.69 Wt. %	0.790 Wt. %	0.133 Wt. %	0.1280 Wt. %		0.996 Wt. %
Rubidium	(4.8)	(11)	(3)	0.68	6.14		12.5
Selenium	0.25	0.11	2.21	1.1	0.38		0.71
Silver		(<0.0003)	1.68				0.04
Sodium	0.63 Wt. %	0.497 Wt. %	0.417 Wt. %	6.1	6.6		0.243 Wt. %
Strontium			11.1				0.138
Sulfur	0.26 Wt. %	0.351 Wt. %	0.862 Wt. %	0.165 Wt. %	0.120 Wt. %		0.78 Wt. %
Tellurium					(<0.002)		
Thallium							(0.003)
Thorium			(0.04)				
Tin	(3.6)	(<0.02)	(3)	(0.0033)	(0.0047)		
Uranium			0.132	(0.0003)	(0.0003)		0.00071
Vanadium			4.68	(0.011)	(0.007)		0.099
Zinc	30.8	46.1	830	11.6	19.4		123

Values in parentheses are not certified and are given for information only.
* SI unit. Replaces "ppm" and "μg/g".

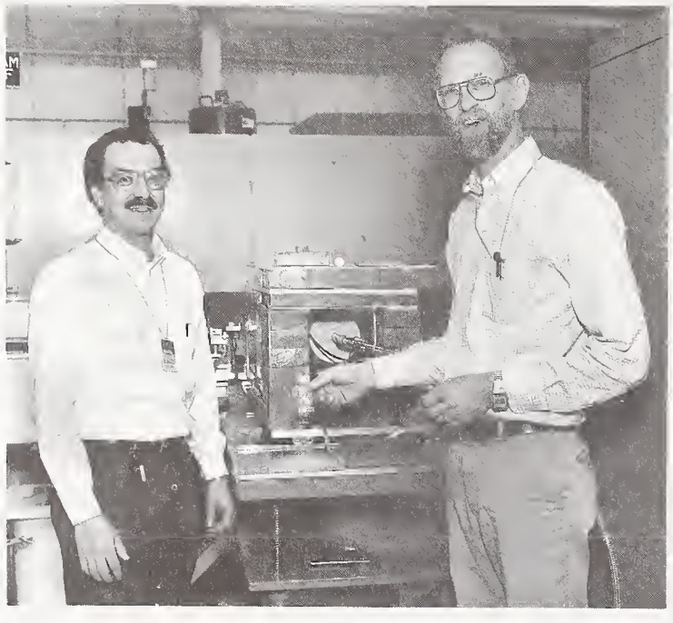
Foods and Beverages (liquid and powder forms) – Continued

SRM	1563	1590	1845
Type	Cholesterol and FSV in Coconut Oil	Stabilized Wine	Cholesterol in Whole Egg Powder
Unit Size	10 ampules	10 ampules	3 bottles
Certified Constituents	Composition in mg/kg unless otherwise noted.		
Cholesterol	642		19.0
Retinyl Acetate	12.2		
Ergocalciferol	10.9		
dl-α-Tocopherol Acetate	158.2		
Ethanol		18.57 Vol. %	

USA/Canada Collaborative Materials (powder form)

These materials, developed by Agriculture Canada in collaboration with NIST, are for calibrating apparatus and validating analytical methods applied to food/agricultural commodities.

RM	Type	Elements Certified
8414	Bovine Muscle Powder	Al, As, B, Ca, Cd, Cl, Co, Cr, Cu, Fe, Hg, I, K, Mg, Mn, Mo, N, Na, Ni, P, Rb, S, Se, Sr, Zn
8415	Whole Egg Powder	Al, B, Ca, Cl, Co, Cr, Cu, Fe, Hg, I, K, Mg, Mn, Mo, N, Na, P, Pb, S, Se, Sr, V, Zn
8416	Microcrystalline Cellulose	Al, Cl, Co, Cu, Mo, N, Ni, Se
8418	Wheat Gluten	Al, Ba, Ca, Cd, Cl, Co, Cr, Cu, Fe, Hg, I, K, Mg, Mn, Mo, N, Na, Ni, P, Pb, S, Se, Sr, Zn
8432	Corn Starch	Al, Ca, Cl, Cu, K, Mg, Mo, N, Na, Ni, P, Se
8433	Corn Bran	Al, As, B, Ba, Ca, Cd, Cl, Co, Cr, Cu, Fe, Hg, I, K, Mg, Mn, Mo, N, Na, Ni, P, Pb, S, Se, Sr, V, Zn
8435	Whole Milk Powder	Ba, Br, Ca, Cl, Cu, Fe, I, K, Mg, Mn, Mo, N, Na, P, Pb, Rb, S, Se, Sr, Zn
8436	Durum Wheat Flour	Al, Ba, Br, Ca, Cd, Cl, Cr, Cu, Fe, Hg, I, K, Mg, Mn, Mo, N, Na, Ni, P, Pb, S, Se, Sr, V, Zn
8437	Hard Red Spring Wheat Flour	Ca, Cl, Cr, Cu, Fe, K, Mg, Mn, Mo, N, Na, P, S, Se, Zn
8438	Soft Winter Wheat Flour	Ca, Cl, Cu, Fe, K, Mg, Mn, Mo, N, Na, P, S, Se, Zn



David Anderson, *Chemist*, U.S. Food & Drug Administration; **Richard Lindstrom,** *Research Chemist*, Inorganic Analytical Research Division

Agricultural Materials (powder form)

SRM	1515	1547	1575	2695	RM 8412	RM 8413
Type	Apple Leaves	Peach Leaves	Pine Needles	Fluoride in Vegetaton	Corn Stalk	Corn Kernel
Unit Size	50 g	50 g	70 g	2 × 25 g	34 g	47 g
ELEMENTS	**Composition in mg/kg* unless otherwise noted.**					
Aluminum	286	249	545			(4)
Antimony	(0.13)	(0.02)	(0.2)			
Arsenic	0.038	0.060	0.21			
Barium	49	124				
Boron	27	29				
Bromine	(1.8)	(11)	(9)			
Cadmium	(0.014)	(0.03)	(<0.5)			
Calcium	1.526 Wt. %	1.56 Wt. %	0.41 Wt. %		(2160)	(42)
Cerium	(3)	(10)	(0.4)			
Cesium						
Chlorine	579	360			(2440)	(450)
Chromium	(0.3)	(1)	2.6			
Cobalt	(0.09)	(0.07)	(0.1)			
Copper	5.64	3.7	3.0		(8)	(3.0)
Europium	(0.2)	(0.17)	(0.006)			
Fluorine				64/277	(0.65)	(0.24)
Iodine	(0.3)	(0.3)				
Iron	(80)	(220)	200		(139)	(23)
Lanthanum	(20)	(9)	(0.02)			
Lead	0.470	0.87	10.8			
Magnesium	0.271 Wt. %	0.432 Wt. %			(1600)	(990)
Manganese	54	98	675		(15)	(4.0)
Mercury	0.044	0.031	0.15			
Molybdenum	0.094	0.060				
Nickel	0.91	0.69	(3.5)			
Nitrogen	2.25 Wt. %	2.94 Wt. %	(1.2 Wt. %)		(6970)	(13750)
Phosphorus			0.12 Wt. %			
Potassium	1.61 Wt. %	2.43 Wt. %	0.37 Wt. %		(17350)	(3570)
Rubidium	(9)	(19)	11.7			
Samarium	(3)	(1)				
Scandium	(0.03)	(0.04)	(0.03)			
Selenium	0.050	0.120			(0.016)	(0.004)
Sodium	24.4	24			(28)	
Strontium	25	53	4.8		(12)	
Sulfur	(0.18 Wt. %)	(0.2 Wt. %)				
Tellurium						
Terbium	(0.4)	(0.1)				
Thallium			(0.05)			
Thorium	(0.03)	(0.05)	0.037			
Tin	(<0.2)	(<0.2)				
Uranium	(0.006)	(0.015)	0.020			
Vanadium	0.26	0.37				
Zinc	12.5	17.9			(32)	(15.7)

Values in parentheses are not certified and are given for information only.
* SI unit. Replaces "ppm" and "μg/g".

Fertilizers (powder form)

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

SRM	Type	Unit Size (in g)	Composition (in Wt. %)					
			N	P	K	P_2O_5	K_2O	CaO
120c	Phosphate Rock (Florida)	90				33.34	0.110	48.02
193	Potassium Nitrate	90	13.85		38.66			
194	Ammonium Dihydrogen Phosphate	90	12.15	26.92				
200	Potassium Dihydrogen Phosphate	90		22.74	28.76			
694	Phosphate Rock (Western)	90				30.2	0.51	43.6

SRM	SiO_2	F	Fe_2O_3	Al_2O_3	MgO	Na_2O	MnO	TiO_2	Cr_2O_3	CdO	U	V_2O_5
694	11.2	3.2	0.79	1.8	0.33	0.86	0.0116	(0.11)	(0.10)	0.015	0.01414	0.31

Biomass Materials (powder form)

These Reference Materials, RMs 8491 Sugar Cane Bagasse (*Saccharum spp. hybrid*), 8492 Eastern Cottonwood (*P. deltoides*), 8493 Pinus Radiata, and 8494 Wheat Straw (*Triticum aestivum*) are intended primarily for use in fundamental studies on the chemical and physical properties of cellulose, hemi-cellulose and lignin and of their effects on various conversion processes. As part of the International Energy Agency (IEA) Voluntary Standards Activity Group's work, these materials were selected initially for use as research materials for a world-wide round robin analytical laboratory comparison using the Uppsala Method. They were supplied by various institutions and were prepared, packaged and are being distributed by NIST.

At this time, no extensive property measurements have been made on these materials beyond ensuring that the materials are homogeneous. A round robin is in progress with participation by international laboratories and as results become available, the Report of Investigation that accompanies each of these materials will be revised to reflect those changes.

All of the ground and homogenized materials were irradiated with Cobalt-60. The irradiation was required to meet customs regulations for shipment of biomass materials to international destinations.

RM	Type	Unit Size
8491	Sugar Cane Bagasse	5 bags, 10 g
8492	Eastern Cottonwood	5 bags, 10 g
8493	Pinus Radiata	5 bags, 10 g
8494	Wheat Straw	5 bags, 10 g

Curtis Fales, *Physical Science Technician*, Standard Reference Materials Program; **Jennifer Colbert,** *Project Manager*, Standard Reference Materials Program

111. Geological Materials and Ores

Ores (powder form)

SRM/RM	79a	180	181	182	183	277	330	331	2430
Type	Fluorspar, Customs Grade	Fluorspar, High Grade	Lithium Ore (Spodumene)	Lithium Ore (Petalite)	Lithium Ore (Lepidolite)	Tungsten Concentrate	Copper Ore Mill Heads	Copper Ore Mill Tails	Scheelite Ore
Unit Size (in g)	120	120	45	45	45	100	100	100	100
Components (In Wt. % unless identified by an asterisk which indicates mg/kg)									
Ca						(0.37)			As 0.002
CaF_2	97.39	98.80							
Cu							0.84	0.91	(0.01)
Fe						(7.4)			(1.0)
Au							(0.093*)	(0.034*)	
Li_2O			6.39	4.34	4.12				
Mn						(10.0)			(0.12)
Mo						(0.06)	0.018	0.0022	0.22
Nb						(1.00)			
O_2						(21.4)			Al (0.4)
P						(0.03)			0.017
Pb						(0.07)			Bi 0.078
Re							0.30*	0.04*	
Si						(0.85)			Mg (0.5)
Ag							(1.51*)	(0.243*)	
S						(0.25)			0.26
Ta						(0.20)			(<0.01)
Sn						(0.54)			K (0.16)
Ti						(2.2)			Na (0.02)
WO_3						67.4			70.26

Values in parentheses are not certified and are given for information only.

Ores (powder form) – Continued

SRM	25d	27f	69b	120c	600	670	690	691	692	693
Type	Manganese Ore	Iron Ore, Sibley	Bauxite, Arkansas	Phosphate Rock, Florida	Bauxite, Australian	Rutile Ore	Iron Ore, Canada	Iron Oxide, Reduced	Iron Ore, Labrador	Iron Ore, Nimba
Unit Size (in g)	100	100	60	90	90	90	150	100	150	150
Components (in Wt. %)										
Al_2O_3	5.32	0.82	48.8	1.30	40.0		0.18	1.22	1.41	1.02
BaO	(0.21)		(0.008)							
CdO				0.0010						
CaO	(0.052)	0.039	0.13	48.02	0.22		0.20	0.63	0.023	0.016
Co			(0.0001)					0.030		
Cu								0.032		
Cr_2O_3			0.011		0.024	0.23				
Total Fe		65.97					66.85	90.8	59.58	65.11
Fe_2O_3	3.92		7.14	1.08	17.0	0.86				
MgO		0.019	0.085	0.32	0.05		0.18	0.52	0.035	0.013
MnO	Mn 51.78	0.011	0.110	0.027	0.013		0.23	0.043	0.46	0.091
P		0.041					0.011	0.006	0.039	0.056
P_2O_5		0.25	0.118	33.34	0.039					
K_2O	0.93	0.008	0.068	0.147	0.23		0.0030		0.039	0.0028
SiO_2	2.52	4.17	13.43	5.5	20.3	0.51	3.71	3.7	10.14	3.87
Na_2O		0.012	(0.025)	0.52	0.022		0.003	0.186	0.008	0.0028
S	0.005						0.003	0.008	0.005	0.005
SO_3			0.551		0.155					
TiO_2	0.13	0.019	1.90	0.103	1.31	96.16	0.022	0.27	0.045	0.035
V_2O_5			0.028	0.016	0.060	0.66				
ZnO			0.0035	CO_2 3.27	0.003			C 0.12		
ZrO_2			0.29	F 3.82	0.060	0.84				
Oxygen	14.28									
Moisture	(0.96)									
Loss on Ignition			27.2							

Values in parentheses are not certified and are given for information only.

Ores (powder form) – Continued

SRM	694	696	697	698	699	1835
Type	Phosphate Rock, Western	Bauxite, Surinam	Bauxite, Dominican	Bauxite, Jamaican	Alumina (reduction grade)	Borate Ore
Unit Size (in g)	90	60	60	60	90	60
Components (in Wt. %)						
Al_2O_3	1.8	54.5	45.8	48.2		3.474
BaO		(0.004)	(0.015)	(0.008)		0.0497
CdO	0.015					
CaO	43.6	0.018	0.71	0.62	0.036	21.622
Co	**F 3.2**	(0.00009)	(0.0013)	(0.0045)		**F 0.348**
Cr_2O_3	(0.10)	0.047	0.100	0.080	0.0002	
Fe_2O_3	0.79	8.70	20.0	19.6	0.013	1.141
MgO	0.33	0.012	0.18	0.058	0.0006	3.411
MnO	0.0116	0.004	0.41	0.38	0.0005	0.0333
P_2O_5	30.2	0.050	0.97	0.37	0.0002	
K_2O	0.51	0.009	0.062	0.010		1.261
SiO_2	11.2	3.79	6.81	0.69	0.014	18.408
Na_2O	0.86	(0.007)	(0.036)	(0.015)	0.59	3.484
SO_3		0.15	0.077	0.143		1.477
TiO_2	(0.11)	2.64	2.52	2.38		0.1332
U	0.01414					
V_2O_5	0.31	0.072	0.063	0.064	0.0005	
ZnO	(0.19)	0.0014	0.037	0.029	0.013	
ZrO_2		0.14	0.065	0.061		**SrO 0.9418**
Ga_2O_3					0.010	**B_2O_3 18.739**
Li_2O					0.002	
Loss on Ignition	27.2	29.9	22.1	27.3		

Values in parentheses are not certified and are given for information only.

Ore Bioleaching Substrate (powder form)

This Reference Material (RM) is for use as a bioleaching substrate and for testing bioleaching rates. The material consists of 100 g of pyrite from New Mexico. Thiobacillus ferrooxidans was used in the determinations.

RM	Type	Bioleaching Rate (in mg Fe/L/hr)
8455	Pyrite Ore	12.4

Clays (powder form)

SRM	97b	98b	679
Type	Flint Clay	Plastic Clay	Brick Clay
Unit Size (in g)	60	60	75
	Elemental Composition (in Wt. %) *		
Al	20.76	14.30	11.01
Ba	(0.018)	(0.07)	0.0432
Ca	0.0249	0.0759	0.1628
Ce			(105)*
Cs	(3.4)*	(16.5)*	(9.6)*
Cr	227*	119*	109.7*
Co	(3.8)*	(16.3)*	(26)*
Eu	(0.84)*	(1.3)*	(1.9)*
Hf	(13)*	(7.2)*	(4.6)*
Fe	0.831	1.18	9.05
Li	550*	215*	71.7*
Mg	0.113	0.358	0.7552
Mn	47*	116*	(1730)*
P	0.020	0.030	0.075
K	0.513	2.81	2.433
Rb	(33)*	(180)*	(190)*
Sc	(22)*	(22)*	(22.5)*
Si	19.81	26.65	24.34
Na	0.0492	0.1496	0.1304
Sr	84*	189*	73.4*
Th	(36)*	(21)*	(14)*
Ti	1.43	0.809	0.577
Zn	(87)*	(110)*	(150)*
Zr	(0.05)	(0.022)	
Sb	(2.2)*	(1.6)*	
Loss on Ignition	(13.3)	(7.5)	

Values in parentheses are not certified and are given for information only.
* Value is in mg/kg (SI unit).

Rocks and Minerals (powder form)

SRM	1c	70a	81a	88b	99a	165a	278	688	1413
Type	Lime-stone, argilla-ceous	Feld-spar, potash	Glass sand	Limestone, dolomite	Feld-spar, soda	Glass sand (low iron)	Obsidian Rock	Basalt Rock	Glass sand (high alumina)
Unit Size (in g)	50	40	75	75	40	75	35	60	75
Components (in Wt. %)									
Al_2O_3	1.30	17.9	0.66	0.336	20.5	0.059	14.15	17.36	9.90
BaO		0.02		CO_2 46.37	0.26		Ba (1140 mg/kg)		0.12
CaO	50.3	0.11		29.95	2.14		0.983	(12.17)	0.74
Cr_2O_3			46 mg/kg			(1 mg/kg)	Cr (6.1 mg/kg)	Cr 332 mg/kg	
Fe_2O_3 *	0.55	0.075	0.082	0.277	0.065	0.012	2.04	10.35	0.24
FeO *							1.36	7.64	
MgO	0.42			21.03	0.02		(0.23)	(8.4)	0.06
MnO	0.025			0.0160			0.052	0.167	
P_2O_5	0.04			0.0044	0.02		0.036	0.134	
K_2O	0.28	11.8		0.1030	5.2		4.16	0.187	3.94
Rb_2O		0.06					Rb 127.5 mg/kg	Rb 1.91 mg/kg	
SiO_2	6.84	67.12		1.13	65.2		73.05	48.4	82.77
Na_2O	0.02	2.55		0.0290	6.2		4.84	2.15	1.75
SrO	0.030			0.0076			Sr 63.5 mg/kg	Sr 169.2 mg/kg	
TiO_2	0.07	0.01	0.12	(0.016)	0.007	0.011	0.245	1.17	0.11
ZrO_2			0.034			0.006			
Loss on Ignition	39.9	0.40		(46.98)	0.26				

Values in parentheses are not certified and are given for information only.
* Refer to certificate to ascertain if the value reported represents total iron or species-specific iron.

Refractories (powder form)

SRM	76a	77a	78a	103a	154b	198	199
Type	Burnt Refractory (Al_2O_3–40%)	Burnt Refractory (Al_2O_3–60%)	Burnt Refractory (Al_2O_3–70%)	Chrome Refractory	Titanium Dioxide	Silica Brick	Silica Brick
Unit Size (in g)	75	75	75	60	90	45	45
Components (in Wt. %)							
Al_2O_3	38.7	60.2	71.7	29.96		0.16	0.48
CaO	0.22	0.05	0.11	0.69	(~0.01)	2.71	2.41
Cr_2O_3				32.06			
FeO *				12.43			
Fe_2O_3 *	1.60	1.00	1.2		(0.006)	0.66	0.74
Li_2O	0.042	0.025	0.12			0.001	0.002
MgO	0.52	0.38	0.70	18.54	(~0.01)	0.07	0.13
MnO				0.11		0.008	0.007
P_2O_5	0.120	0.092	1.3	0.01	(0.04)	0.022	0.015
K_2O	1.33	0.090	1.22			0.017	0.094
SiO_2	54.9	35.0	19.4	4.63	(0.01)		
Na_2O	0.07	0.037	0.078			0.012	0.015
SrO	0.037	0.009	0.25				
TiO_2	2.03	2.66	3.22	0.22	99.74	0.02	0.06
ZrO_2				0.01			
Loss on Ignition	(0.34)	(0.22)	(0.42)			0.21	0.17

Values in parentheses are not certified and are given for information only.
* Refer to certificate to ascertain if the value reported represents total iron or species-specific iron.

Soils and Sediments (powder form)

RM/SRM	Type	Unit Size	Component (in mg/kg)
8406	Mercury in	Set of 3, 25 g each	Hg (Low) – (0.06)
8407	Tennessee River		Hg (Medium) – (50)
8408	Sediments		Hg (High) – (107)
2709	Agricultural Soil	In Prep	
2710	Agricultural Soil	In Prep	
2711	Agricultural Soil	In Prep	

Values in parentheses are not certified and are given for information only.

112. Ceramics and Glasses

Carbides (powder form)

SRM	Type	Unit Size (in g)	Composition (in Wt. %)							
			SiC	Total C	Free C	Fe	O_2	N_2	Al	Ca
112b	Silicon Carbide	80	97.37	29.43	0.26	0.13			0.44	0.04
276a	Tungsten Carbide	75		6.11	(0.02)		(0.03)	(0.003)		

Values in parentheses are not certified and are given for information only.

Cemented Carbides (powder form)

SRMs 887–9 are prepared from sintered tungsten carbide base materials.

SRM	887	888	889
Type	Cemented Carbide (W83-Co10)	Cemented Carbide (W64-Co25-Ta5)	Cemented Carbide (W75-Co9-Ta5-Ti4)
Unit Size (in g)	100	100	100
Elemental Composition (in Wt. %)			
Co	10.35	24.7	9.50
Ta		4.77	4.60
Ti			4.03
C	(5.5)	(4.6)	(6.0)

Values in parentheses are not certified and are given for information only.

Glasses (solid forms)

SRM	89	91	92	93a	620	621	1411	1412	1830	1831	1834
Type	Lead-Barium	Opal Powder	Low-Boron Soda-Lime Powder	High-Boron Boro-silicate	Soda-Lime, Flat	Soda-Lime, Con-tainer	Soft Boro-silicate	Multi Compo-nent	Soda-Lime, Float	Soda-Lime, Sheet	Fused Ore Glass
Unit Size	45 g	45 g	45 g	wafer 32 mm D×6 mm	3 platelets 35×35×3 mm	3 disks 38 mm D×5 mm	10 platelets 32×32×3 mm	8 platelets 32×32×3 mm	3 platelets 38×38×6 mm	3 platelets 37×37×3 mm	disk 30 mm D×3 mm
Components (in Wt. %)											
SiO_2	65.35	67.5	(75.0)	80.8	72.08	71.13	58.04	42.38	73.07	73.08	**Si 20.19**
PbO	17.50	0.10						4.40			
Al_2O_3	0.18	6.01		2.28	1.80	2.76	5.68	7.52	0.12	1.21	**Al 20.71**
FeO				0.016					0.032	0.025	
Fe_2O_3	0.049	0.079		0.028	0.043	0.040	0.050	(0.031)	0.121	0.087	**Fe 0.32**
ZnO		0.08	(0.2)				3.85	4.48			
CdO								4.38			
MnO	0.088	(0.008)									
TiO_2	0.01	0.019		0.014	0.018	0.014	0.02		0.011	0.019	**Ti 1.11**
ZrO_2	0.005	0.009		0.042		0.007					**Zr 0.047**
CaO	0.21	10.49	(8.3)	0.01	7.11	10.71	2.18	4.53	8.56	8.20	**Ca 0.095**
BaO	1.40					0.12	5.00	4.67			**Ba 0.062**
Li_2O								(4.50)			**Li (4.6)**
MgO	0.03	(0.008)	(0.1)	0.005	3.69	0.27	0.33	(4.69)	3.90	3.51	**Mg 0.088**
K_2O	8.40	3.24	(0.6)	0.014	0.41	2.01	2.97	4.14	0.04	0.33	**K 0.42**
Na_2O	5.70	8.47	(13.1)	3.98	14.39	12.74	10.14	4.69	13.75	13.32	**Na (0.14)**
B_2O_3			0.70	12.56			10.94	4.53			**B (1.1)**
P_2O_5	0.23	0.023									**P 0.152**
As_2O_5	0.36	0.10									
As_2O_3	0.03	0.09			0.056	0.030					
SO_3	0.03				0.28	0.13			0.26	0.25	
Cl	0.05	0.015		0.060							
Cr											(0.02)
SrO							0.09	4.55			**Sr 0.153**
F		5.73									
Loss on Ignition	0.32		(0.42)								

Values in parentheses are not certified and are given for information only.

Trace Elements (powder and wafer forms)

These SRMs are for calibrating instruments and evaluating analytical techniques used to determine trace elements in inorganic matrices.

SRM	607	611	612 and 613	614 and 615	616 and 617
Type	Trace Elements in Potassium Feldspar	Trace Elements in Glass	Trace Elements in Glass	Trace Elements in Glass	Trace Elements in Glass
Wafer Thickness (in mm)		1	3 and 1	3 and 1	3 and 1
Unit Size	5 g	6 wafers	6 wafers	6 wafers	6 wafers
Element			Composition (in mg/kg)		
Antimony				(1.06)	(0.078)
Barium			(41)		
Boron		(351)	(32)	(1.30)	(0.20)
Cadmium				(0.55)	
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	(13.3)	(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 elements listed above, the glass SRMs 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.

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

Values in parentheses are not certified and are given for information only.

* Also certified for isotopic ratio – $^{87}Sr/^{86}Sr = 1.20039$.

113. Cement

Portland Cements (powder form)

These SRMs are for X-ray spectroscopic and chemical analysis of portland cements and related materials. Each unit consists of three (3) sealed vials, each containing ~5 g of material.

SRM	1880	1881	1882	1883	1884
Type	BLACK	WHITE	ORANGE	SILVER	IVORY
Components (in Wt. %)					
CaO	63.14	58.68	37.6	27.8	64.01
SiO_2	19.82	22.25	3.40	0.35	23.19
Al_2O_3	5.03	4.16	38.6	71.2	3.31
Fe_2O_3	2.91	4.68	15.8	0.08	3.30
SO_3	3.37	3.65			1.67
MgO	2.69	2.62	1.25	0.29	2.32
K_2O	0.91	1.17	0.12	(0.01)	0.51
TiO_2	0.25	0.23	1.83	(0.01)	0.16
Na_2O	0.28	0.04	(0.06)	0.32	0.13
SrO	0.06	0.11			0.048
P_2O_5	0.29	0.09			0.12
Mn_2O_3	0.08	0.26			0.11
F	0.10	0.09			(0.03)
ZnO	0.01	0.01			(0.02)
Cr_2O_3					(<0.01)
Cl	0.02	0.01			(0)
Loss on Ignition	1.38	2.01	1.58	0.42	1.17
Total	100.28	100.04			(100.05)

SRM	1885	1886	1887	1888	1889
Type	TURQUOISE	CRANBERRY	BROWN	PURPLE	GRAY
Components (in Wt. %)					
CaO	62.14	67.43	62.88	63.78	65.08
SiO_2	21.24	22.53	19.98	20.86	20.44
Al_2O_3	3.68	3.99	5.59	5.35	5.61
Fe_2O_3	4.40	0.31	2.16	3.18	2.67
SO_3	2.22	2.04	4.61	3.16	2.68
MgO	4.02	1.60	1.26	0.71	1.38
K_2O	0.83	0.16	1.27	0.56	0.32
TiO_2	0.20	0.19	0.27	0.29	0.21
Na_2O	0.38	0.02	0.10	0.14	0.11
SrO	0.037	0.11	0.07	0.07	0.20
P_2O_5	0.10	0.025	0.075	0.085	0.15
Mn_2O_3	0.12	0.013	0.072	0.025	0.24
F	(0.05)	(0.01)	(0.11)	(0.02)	(0.04)
ZnO	(0.03)	(<0.01)	(0.01)	(0.01)	(<0.01)
Cr_2O_3	(<0.01)	(<0.01)	(<0.01)	(0.01)	(0.01)
Cl	(0.02)	(0)	(0.007)	(0.015)	(0.002)
Loss on Ignition	0.74	1.73	1.49	1.79	0.02
Total	(100.19)	(100.02)	(99.908)	(100.05)	(100.04)

Values in parentheses are not certified and are given for information only.

Portland Cement Clinkers

These Reference Materials (RMs) are intended primarily for use in the determination of the abundance of major phases in cement clinkers, i.e., the percentages of alite (C_3S), belite (C_2S), aluminate (C_3A), and ferrite ($(C_2(A,F))$). **Note:** In cement chemist notation, $C = CaO$, $S = SiO_2$, $A = Al_2O_3$ and $F = Fe_2O_3$.

RM	8486	8487	8488
Type	Portland Cement Clinker	Portland Cement Clinker	Portland Cement Clinker
Unit Size (in g)	3×10	3×10	3×10
Components (in Wt. %)			
CaO	(63.36)	(67.20)	(66.50)
SiO_2	(22.48)	(21.43)	(22.68)
Al_2O_3	(4.70)	(5.53)	(4.90)
Fe_2O_3	(3.60)	(1.98)	(4.07)
SO_3	(0.27)	(0.88)	(0.31)
MgO	(4.73)	(1.48)	(0.98)
K_2O	(0.42)	(0.72)	(0.35)
TiO_2	(0.25)	(0.27)	(0.24)
Na_2O	(0.10)	(0.14)	(0.11)
SrO	(0.05)	(0.11)	(0.13)
P_2O_5	(0.06)	(0.29)	(0.08)
Mn_2O_3	(0.10)	(0.04)	(0.03)
Loss on Ignition	(0.16)	(0.17)	(0.21)
Total	(100.28)	(100.20)	(100.60)
Alite (C_3S)	(58.47)	(73.39)	(64.97)
Belite (C_2S)	(23.18)	(7.75)	(18.51)
Aluminate (C_3A)	(1.15)	(12.09)	(4.34)
Ferrite ($C_2(A,F)$)	(13.68)	(3.27)	(12.12)
Free CaO	(0.18)	(2.45)	(0.00)
Periclase	(3.21)	(0.09)	(0.05)
Alkali Sulfate	(0.14)	(0.98)	(0.03)
Total	(100.01)	(100.02)	(100.02)

Values in parentheses are not certified and are given for information only.

114. Engine Wear Materials

Metallo-Organic Compounds (liquid form)

These SRMs are for preparing solutions in oils of known and reproducible concentrations of metals. Each SRM consists of 5 g of material.

SRM	Type	Elemental Composition (in Wt. %)	
1051b	Barium cyclohexanebutyrate	Barium	28.7
1052b	Bis(1–phenyl–1,3-butanediono)oxovanadium (IV)	Vanadium	13.01
1053a	Cadmium cyclohexanebutyrate	Cadmium	24.8
1057b	Dibutyltin bis (2–ethylhexanoate)	Tin	22.95
1059c	Lead cyclohexanebutyrate	Lead	37.5
1060a	Lithium cyclohexanebutyrate	Lithium	4.1
1065b	Nickel cyclohexanebutyrate	Nickel	13.89
1066a	Octaphenylcyclotetrasiloxane	Silicon	14.14
1069b	Sodium cyclohexanebutyrate	Sodium	12.0
1070a	Strontium cyclohexanebutyrate	Strontium	20.7
1071b	Triphenyl phosphate	Phosphorus	9.48
1073b	Zinc cyclohexanebutyrate	Zinc	16.66
1075a	Aluminum 2–ethylhexanoate	Aluminum	8.07
1077a	Silver 2–ethylhexanoate	Silver	42.60
1078b	Tris (1–phenyl–1,3–butanediono)chromium (III)	Chromium	9.6
1079b	Tris (1-phenyl-1,3-butanediono)iron (III)	Iron	10.45
1080a	Bis(1–phenyl–1,3–butanediono)copper (II)	Copper	16.37

Lubricating Base Oils (liquid form)

These SRMs are for determining the concentrations of a single element in lubricating base oil. SRM 1818 consists of five (5) bottles, 20 g each; SRM 1836 consists of four (4) vials, ~4 g each.

SRM	Type	Elemental Composition (in mg/kg)				
		I	II	III	IV	V
1818	Total Chlorine	29	63	78	231	558
1836	Total Nitrogen	9.0	50.9	113.3	166.2	

Catalyst Package for Lubricant Oxidation (liquid form)

These reference materials are for evaluating the oxidation stability of lubricating oils, i.e., automotive crankcase lubricants. SRM 1817c consists of a set of five (5) ampules of each of three (3) materials. The fuel fraction and the metal mixture are sealed under inert atmosphere. RM 8501 consists of a set of five (5) ampules of each of four (4) materials. The fuel fraction, model compound, and metal mixture are sealed under inert atmosphere.

SRM	Type	Consisting of
1817c	Catalyst Package	1) an Oxidized/Nitrated Fuel Fraction, 2) a Metal Naphthenate Mixture, and 3) Distilled Water
RM 8501	Catalyst Package IIIE	1) an Oxidized/Nitrated Fuel Fraction, 2) a Nitro-Paraffin Model Compound, 3) a Metal Naphthenate Mixture, and 4) Distilled Water

Wear-Metals in Oil (liquid form)

SRM	Type	Elemental Composition (in mg/kg)							
		Al	Cr	Cu	Fe	Pb	Mg	Mn	Mo
1083	Wear-Metals (base oil)	(<0.5)	(<0.02)	(<0.5)	(<1)	(<0.04)	(<0.1)	(<0.005)	(<0.01)
1084a	Wear-Metals	(104)	98.3	100.0	98.9	101.1	99.5		100.3
1085a	Wear-Metals	(289)	296.3	295.1	296.8	297.4	296.0		302.9

SRM	Ni	Si	Ag	Na	Sn	S	Ti	V	Zn
1083	(<0.4)	(<1)	(<0.05)	(<0.06)	(<0.4)	(<1)	(<5)	(<0.3)	(<0.08)
1084a	99.7	(103)	101.4		97.2	(1700)	100.4	95.9	
1085a	302.9	(322)	305.7		296.0	(4500)	305.1	292.4	

Values in parentheses are not certified and are given for information only.

Catalyst Characterization Materials (liquid and powder forms)

These Reference Materials (RMs) are for determining the activity of FCC Catalysts by Microactivity Test. They are distributed by NIST in cooperation with the American Society for Testing and Materials (ASTM).

RM	Type	Unit Size
8589	Fluid Cracking Catalysts (FCC)	Set of 6, 50 g each
8590	High Sulfur Gas Oil Feed	946 mL

Standard Reference Materials

for

Physical Properties

201. Ion Activity

pH Calibration (powder form)

These SRMs are used to prepare solutions of known hydrogen ion concentration to calibrate commercial pH instruments. SRMs 186Ie and 186IIe, 191a and 192a, and 922 and 923 are each certified for use as an admixture only. SRMs 186Ie and 186IIe may be used to prepare solutions with a pH of 6.863 at 25 °C, or a physiological buffer solution with a pH of 7.41 at 25 °C.

SRM	Type	pH(S) Values (at 25 °C)	Unit Size (in g)
185g	Potassium Hydrogen Phthalate	4.006	60
186Ie	Potassium Dihydrogen Phosphate	(see above)	30
186IIe	Disodium Hydrogen Phosphate		30
187c	Sodium Tetraborate Decahydrate (Borax)	9.180	30
188	Potassium Hydrogen Tartrate	3.557	60
189a	Potassium Tetroxalate	1.681	65
191a	Sodium Bicarbonate	10.011	25
192a	Sodium Carbonate		30
922	Tris(hydroxymethyl)aminomethane	7.699	25
923	Tris(hydroxymethyl)aminomethane Hydrochloride		35
2193	Calcium Carbonate	12.46	30

pD Calibration (powder form)

These SRMs are for the preparation of solutions of known deuterium ion concentration to calibrate pH instruments to indicate pD data. SRMs 2186I and 2186II, and 2191a and 2192a are each certified for use as an admixture only.

SRM	Type	pD(S) Values (at 25 °C)	Unit Size (in g)
2185	Potassium Hydrogen Phthalate	4.518	60
2186I	Potassium Dihydrogen Phosphate	7.428	30
2186II	Disodium Hydrogen Phosphate		30
2191a	Sodium Bicarbonate	10.732	30
2192a	Sodium Carbonate		30

Zwitterionic Buffer Systems (powder form)

These SRMs are used to calibrate clinical instruments (e.g., blood pH measurements), in the physiologically important range of pH 7 to 8. They are based on a Zwitterionic buffer system for clinical pH measurements and are each certified for use as an admixture only. The pH(S) values for the buffer solutions are certified at 0.05 molal and 0.08 molal with respect to the free acid and the sodium salt admixture as a function of temperature. The certified temperature range is from 0 to 50 °C.

SRM	Type	pH(S) Values (at 37 °C)		Unit Size (in g)
		0.05 molal	0.08 molal	60
2181	HEPES Free Acid	7.364	7.373	60
2182	NaHEPESate			60
2183	MOPSO Free Acid	6.699	6.676	60
2184	NaMOPSOate			60

Ion-Selective Electrode Calibration (powder form)

These SRMs 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 mol/L.

SRM	Type	Certified Component	Unit Size (in g)
2201	Sodium Chloride	pNa, pCl	125
2202	Potassium Chloride	pK, pCl	160
2203	Potassium Fluoride	pF	125

Electrolytic Conductivity (liquid form)

These SRMs are for calibrating and standardizing conductivity cells and meters used in water purity determinations and in clinical applications. SRM 3190 is an aqueous solution of hydrochloric acids; SRMs 3191 through 3195 are solutions of high-purity potassium chloride in de-ionized water in equilibrium with atmospheric carbon dioxide.

SRM	Type	Nominal Conductance (μS/cm)	Unit Size (in mL)
3190	HCl in de-ionized H_2O	25	500
3191	KCl in de-ionized H_2O	100	500
3192	KCl in de-ionized H_2O	500	500
3193	KCl in de-ionized H_2O	1000	500
3194	KCl in de-ionized H_2O	10000	500
3195	KCl in de-ionized H_2O	100000	500

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202. Polymeric Properties

Molecular Weight and Melt Flow (pellet and powder forms)

These SRMs are for the calibration of equipment used in polymer technology.

SRM	Type	Unit Size (in g)
705a	Polystyrene, narrow molecular weight distribution, $M_w \approx 179{,}300$, $M_w/M_n \approx 1.07$	5
706	Polystyrene, broad molecular weight distribution, $M_w \approx 257{,}800$, $M_w/M_n \approx 2.1$	18
1473	Polyethylene Resin, low density, 10 W density, melt flow	60
1474	Polyethylene Resin	60
1476	Polyethylene, branched, melt flow,	50
1478	Polystyrene, narrow molecular weight distribution, $M_w \approx 37{,}400$ ($M_w/M_n \approx 1.04$)	2
1479	Polystyrene, narrow molecular weight distribution, $M_w \approx 1{,}050{,}000$	2
1482	Polyethylene, linear, $M_w \approx 13{,}600$ ($M_w/M_n \approx 1.19$)	1
1483	Polyethylene, linear, $M_w \approx 32{,}100$ ($M_w/M_n \approx 1.11$)	1
1487	Poly(methylmethacrylate), $M_n \approx 6{,}000$	2
1488	Poly(methylmethacrylate), $M_n \approx 29{,}000$	2
1489	Poly(methylmethacrylate), $M_n \approx 115{,}000$	2
1496	Polyethylene Gas Pipe Resin, melt flow (Unpigmented)	908
1497	Polyethylene Gas Pipe Resin, melt flow (Pigmented)	9080

Property	Method	705a	706	1473	1474	1476	1478	1479	1482	1483	1487	1488	1489	1496	1497
Molecular Weight:															
Weight Average	(Light Scattering)	X	X					X	X	X					
	(Sed. Equili.)	X	X				X				X	X			
	(Gel Permeation Chromatography-GPC)														
Number Average	(Osmometry)	X					X		X	X			X		
	(GPC)														
MolecularWeight Distribution	(GPC)														
Limiting Viscosity No.	(Capillary Viscometry)						X						X		
Benzene, 25 °C		X	X												
Benzene, 35 °C		X													
Cyclohexane, 35 °C		X	X												
1–Chloronaphthalene, 130 °C						X			X	X					
1,2,4–Trichlorobenzene, 130 °C						X			X	X					
Decahydronaphthalene, 130 °C						X									
Tetrahydrofuran, 25 °C											X				
Toluene, 25 °C												X			
Melt Flow	(ASTM)				X X	X								X	X
Density	(ASTM)					X									
Heat Capacity	(Adiabatic)	X													

Polyethylene Pipe Products

These Reference Materials (RMs) are for the testing and characterization of polyethylene pipe products.

RM	Type	Tensile Properties* (in MPa)	Melt Flow (in g/10 min)	Density (in g/cm^3)
8450	Polyethylene Piping, 1.3 cm	16.40/0.125	0.851	0.938
8451	Polyethylene Piping, 4.8 cm	17.35/0.127		0.937
8452	Polyethylene Piping, 10.2 cm			0.938
8453	Polyethylene Socket T Joint		0.508	
8454	Polyethylene Butt T Joint		0.996	

* Expressed as Yield Stress/Strain at Yield (Strain Rate = 81% per minute).

Rubbers and Rubber Compounding Materials

These SRMs 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 and rubber compounds, vulcanizing them in accordance with ASTM Designation D–3182 and determining the stress-strain properties of the resulting vulcanizates. Certificates are issued for the rubber SRMs 386j and 388p, because the properties of different lots are not the same. Replacement lots of rubber compounding SRMs 371h, 372i, and 383a, impart essentially the same characteristics to rubber vulcanizates so that certificates are not issued for these SRMs.

SRM	Type	Unit Size (in kg)
371h	Sulfur	6
372i	Stearic Acid	3.2
383a	Mercaptobenzothiazole	3.2
386j	Styrene-Butadiene 1500	34
388p	Isobutylene-Isoprene (Butyl Rubber)	34

203. Thermodynamic Properties

Combustion Calorimetry (powder form)

These SRMs are for use as standards for calibration of combustion bomb calorimeters used in checking the performance of apparatus and analytical procedures and for the characterization of high-purity compounds, fuels, and related fuel materials.

SRM	Type	Heat of Combustion (in MJ/kg)*	Unit Size (in g)
39i	Benzoic Acid	26.434	30
1656	Thianthrene	33.480	30
1657	Synthetic Refuse Derived Fuel	13.87 **	100
2151	Nicotinic Acid	22.184	25
2152	Urea	10.536	25
2682a	Coal, Sub-bituminous: %S = 0.486; %Ash = 6.3	25.96 **	50
2683a	Coal, Bituminous: %S = 1.89; %Ash = 6.8	32.22 **	50
2684a	Coal, Bituminous: %S = 3.06; %Ash = 11.0	28.77 **	50
2685a	Coal, Bituminous: %S = 4.730; %Ash = 16.21	27.10 **	50

* The calorific values (MJ/kg) may decrease upon the aging or normal oxidation of the coals. NIST will continue to monitor these calorific values and report any substantive change to the purchaser.
** Gross calorific value or HHV (Higher Heating Value).

Solution Calorimetry

SRM	Type	Heat of Solution (in MJ/kg)	Unit Size (in g)
724a	Tris(hydroxymethyl)aminomethane	HCl Evolved - 0.24576 NaOH Absorbed - 0.1418	50
1655	Potassium Chloride (Water Solution Calorimetry)	Absorbed (0.235)	30

Enthalpy and Heat Capacity (solid forms)

SRM	Type	Unit Size	Temperature Range (in K)	Molecular Weight (in g/mol)
RM 5	Copper	0.19 D × 12 cm	25–300	
705a	Polystyrene	5 g	10–350	170,900
720	Synthetic Sapphire	15 g	10–2250	
781-D1	Molybdenum	0.32 D × 10 cm	273.15–2800	
781-D2	Molybdenum	0.64 D × 10 cm	273.15–2800	

Differential Scanning Calorimetry (solid forms)

These SRMs are for calibrating differential scanning calorimeters, differential thermal analyzers, and similar instruments. SRM 1514 is for evaluating methods of determining purity by differential scanning calorimetry. It consists of pure phenacetin and phenacetin doped with p-aminobenzoic acid.

SRM	Type	Unit Size	Melting Temperature (in K)	Enthalpy of Fusion (in MJ/kg)
1514	Thermal Analysis Purity Set	Set of 4, 0.5 g/vial		*
2220	Tin (99.9995%)	2.5 × 2.5 × 0.0127 cm	505.10	60.22
2221a	Zinc (99.999%)	2.5 × 2.5 × 0.005 cm	692.74	107.46
2222	Biphenyl (99.984%)	1 g	342.41	120.41
2225	Mercury	2.5 g	234.30	11.469

* Certified for four (4) levels of p–ABA (in mol %).

Differential Thermal Analysis (liquid and solid forms)

These Reference Materials (RMs) are issued by NIST in cooperation with the International Confederation of Thermal Analysis (ICTA) for differential thermal analyzers, differential scanning calorimeters, and thermogravimetry equipment.

RM	Type		Peak Temp. (in °C)	Unit Size (in g)
754	Polystyrene	(glass transition)	105	10
757	1,2–Dichloroethane	(melting point)	−32	4 mL
	Cyclohexane	(transition point)	−83	4 mL
		(melting point)	7	
	Phenyl Ether	(melting point)	30	4 mL
	o-Terphenyl	(melting point)	58	5
758	Potassium Nitrate	(transition point)	128	10
	Indium	(melting point)	157	3
	Tin	(melting point)	232	3
	Potassium Perchlorate	(transition point)	300	10
	Silver Sulfate	(transition point)	430	3
759	Potassium Perchlorate	(transition point)	300	10
	Silver Sulfate	(transition point)	430	3
	Quartz	(transition point)	573	3
	Potassium Sulfate	(transition point)	583	10
	Potassium Chromate	(transition point)	665	10
760	Quartz	(transition point)	573	3
	Potassium Sulfate	(transition point)	583	10
	Potassium Chromate	(transition point)	665	10
	Barium Carbonate	(transition point)	810	10
	Strontium Carbonate	(transition point)	925	10
761	Permanorm 3	(magnetic transition)	259	1
	Nickel	(magnetic transition)	353	1
	Mumetal	(magnetic transition)	381	1
	Permanorm 5	(magnetic transition)	454	1
	Trafoperm	(magnetic transition)	750	1

Superconductive Thermometric Fixed Point Device

This SRM is composed of six (6) small cylinders of high-purity materials mounted in a threaded copper stud and enclosed in a measuring coil pair. It is intended to provide superconductive fixed points, i.e., temperature of transitions from the normal to the superconductive state.

SRM	Type	Material	Temperature (in K)
767a	Superconductive Thermometric Fixed Point Device	Niobium	9.2
		Lead	7.2
		Indium	3.4
		Aluminum	1.2
		Zinc	0.9
		Cadmium	0.5

Defining Fixed Point, International Temperature Scale, ITS-90 (solid forms)

These SRMs are for use in preparing defining fixed points of the International Temperature Scale of 1990 (ITS-90).

SRM	Type	Temperature (in °C)	Unit Size (in g)
740a	Zinc (Freezing Point)	419.58	200, shot
741	Tin (Freezing Point)	231.928	350, ingot
743	Mercury (Triple Point)	−38.8344	680, ampule

Secondary Reference Points (solid forms)

These SRMs are for use in preparing secondary reference-point devices and for calibrating thermometers, thermocouples and other temperature-measuring devices.

SRM	Type	Temperature (in °C)	Unit Size (in g ingot)
43h	Zinc (Freezing Point)	419.5	350
44f	Aluminum (Freezing Point)	660.3	200
45d	Copper (Freezing Point)	1084.8	450
49e	Lead (Freezing Point)	327.45	600
742	Alumina, 99.9+%	2052	10 (powder)

Melting Point and Triple Point (liquid and powder forms)

These SRM fixed point devices are for use in the realization of internationally accepted secondary reference points and/or triple points.

SRM	Type	Temperature (in °C)	Unit Size (in g)
1968	Gallium, 99.9999+%	29.7646	25, sealed cell
1969	Rubidium, 99.9+%	39.3	154, sealed cell
1970	Succinonitrile, 99.999+%	58.0642	60, sealed cell
1971	Indium, 99.9999+%	156.598	100, sealed cell

LGC Melting Point Materials

Reference Material (RM) 8000 is issued by NIST in cooperation with the Laboratory of the Government Chemist (LGC) Office of Reference Materials at the National Physical Laboratory (NPL) in Teddington, England. This set of five (5) highly purified substances is intended for use in the calibration of thermometers used in determining the melting points of samples in glass capillary tubes. Both the meniscus point and the liquefaction point for each substance are certified by NPL.

RM	Type	Meniscus Point (in °C)	Liquefaction (in °C)	Unit Size (in g)
8000	4–Nitrotoluene	51.81	52.34	1 each
	Benzil	95.08	95.49	1 each
	Benzoic Acid	122.47	122.92	1 each
	Anisic Acid	183.72	184.16	1 each
	Carbazole	246.21	246.58	1 each

Laboratory Thermometer (mercury in glass)

This thermometer is for use in clinical laboratories. Its main scale extends from 24.00 to 38.00 °C, in 0.05 °C divisions. It has an auxiliary scale from −0.20 to +0.20 °C.

SRM	Type	Calibrated Points (in °C)	Unit Size
934	Clinical Laboratory Thermometer	0, 25, 30, 37	1 each

Thermocouple Material, Platinum (wire form)

SRM	Type	Temperature Range (in °C)	Unit Size
1967	Pt, High Purity (99.999+%)	197–1767	0.051D × 100 cm

Vapor Pressure of Metals (rod and wire forms)

SRM	Type	Pressure Range (in Pa)	Temperature Range (in K, ITS-90)	Unit Size (in cm)
745	Gold	10^{-4} to 10^{+2}	1300–2100	wire, 0.14 × 15.2
746	Cadmium	10^{-6} to 10^{+1}	350–594	rod, 0.64 × 6.4
748	Silver	10^{-7} to 10^{+2}	800–1600	rod, 0.64 × 6.4

Thermal Conductivity of Graphite and Metals (rod form)

SRM	Type	Unit Size (in cm)	Temperature Range (in K)	Conductivity at 293 K (in W/m/K)
1460	Stainless Steel	0.64D × 5.0	2–1200	14.1
1461	Stainless Steel	1.27D × 5.0	2–1200	14.1
1462	Stainless Steel	3.4D × 5.0	2–1200	14.1
RM 8420	Electrolytic Iron	0.64D × 5.0	2–1000	77.9
RM 8421	Electrolytic Iron	3.17D × 5.0	2–1000	77.9
RM 8422	Sintered Tungsten	0.32D × 5.0	2–3000	173
RM 8423	Sintered Tungsten	0.64D × 5.0	2–3000	173
RM 8424	Graphite	0.64D × 5.0	5–2500	90.9
RM 8425	Graphite	1.27D × 5.0	5–2500	90.9
RM 8426	Graphite	2.54D × 5.0	5–2500	90.9

Thermal Expansion of Glass and Silica (rod form)

SRM	Type	Temperature Range (in K)	Unit Size (in cm)
731	Borosilicate Glass	L1: 80–680	0.64 × 5.1
		L2: 80–680	0.64 × 10.2
		L3: 80–680	0.64 × 15.2
736	Copper	20–800	0.64 × 5.1
738	Stainless Steel (AISI 446)	293–780	0.64 × 5.1
739	Fused Silica	L1: 80–1000	0.64 × 5.1
		L2: 80–1000	0.64 × 10.2
		L3: 80–1000	0.64 × 15.2

Thermal Resistance of Glass and Silica (solid forms)

SRM	Type	Unit Size (in cm)	Temperature Range (in K)	Thermal Resistance (in m^2K/W)
1449	Fumed Silica Board	60 × 60 × 2.54	297.1	1.2
1450b	Fibrous Glass Board	60 × 60 × 2.54	100–330	0.75
1451	Fibrous Glass Blanket	60 × 60 × 2.54	100–330	0.60
1452	Fibrous Glass Blanket	60 × 60 × 2.54	297.1	0.60
1459	Fumed Silica Board	30 × 30 × 2.54	297.1	1.2

204. Optical Properties

Molecular Absorption and Molecular Luminescence (filter, solid, and solution forms)

The optical SRMs for spectrophotometry are certified transfer standards that fall into three (3) general categories—transmittance, wavelength, and stray radiant energy—each of which addresses a specific instrumental parameter of an ultraviolet/visible absorption spectrometer that must be in control for accurate optical transmittance measurements. To obtain optimum verification results, each SRM must be used within the specified range of conditions for which it is intended.

SRM 930d: This SRM is for the verification and calibration of the transmittance and absorbance scales of visible absorption spectrometers. It consists of three (3) individual Schott NG-type glass filters in separate metal cuvette-style holders and an empty filter holder. The nominal percent transmittances of the three filters are 10, 20, and 30%T. The three filters are individually certified for transmittance at five (5) wavelengths in the visible spectrum: 440.0, 465.0, 546.1, 590.0, and 635.0 nm. The optical transmittance neutrality of SRM 930d is sufficient for the filters to be used to accurately verify absorption spectrometers with maximum spectral bandpasses ranging from 2.2 to 6.5 nm for the five wavelengths at which the transmittances are certified. When SRM 930d is used in combination with SRM 1930, a 6-point stepwise verification of the transmittance scale is possible over the transmittance range from 1 to 50%T. A detailed discussion of this SRM and SRM 1930 are given in Special Publication 260–116 which accompanies each unit.

SRM 931e: This SRM is for the verification and calibration of the absorbance scales of ultraviolet and visible absorption spectrometers having narrow spectral bandpasses. SRM 931e consists of three (3) sets of four (4) solutions in sealed 10-mL ampules. The four solutions include a blank solution and three concentrations of an empirical inorganic solution prepared from high-purity cobalt and nickel metals dissolved in a mixture of nitric and perchloric acids. The user must transfer the blank and standard solutions to cuvettes of known pathlength. The spectrum has absorption maxima at 302, 395, and 512 nm, and a plateau in the region of 678 nm at which the absorbances are certified. The nominal absorbances of the three empirical inorganic solution standards are 0.3, 0.6 and 0.9, respectively, at wavelengths 302, 395, and 512 nm. At wavelength 678 nm, the nominal absorbances of the three solutions are 0.1, 0.2, and 0.3, respectively. The liquid filters may be used to verify absorption spectrometers with maximum spectral bandpasses ranging from 1.5 to 8.5 nm for the four wavelengths at which the absorbances are certified.

SRM 935a: This SRM is for the verification and calibration of the absorbance scales of ultraviolet absorption spectrometers having spectral bandpasses not exceeding 2 nm. Issued in 15-g units, SRM 935a consists of crystalline potassium dichromate of established purity. Solutions of ten (10) known concentrations of this SRM in 0.001 N perchloric acid (between 20 and 200 mg/kg) are certified for their specific absorbances under well-defined conditions. The user must prepare the liquid solutions from SRM 935a and then transfer them to cuvettes of known pathlength. The certified specific absorbances for the solutions prepared may be converted to their corresponding reference absorbance values using Beer's Law. Acidic SRM 935a solutions may be prepared anywhere within the concentration range of 20 to 200 mg/kg to provide a standard with the desired absorbance at a specified wavelength. The spectrum has absorption maxima at 257 and 350 nm, and absorption minima at 235 and 313 nm at which the specific absorbance values are certified, and also at 345 nm, near one of the predicted isobestic points of the spectrum. A detailed discussion of this SRM is given in Special Publication 260–54 which accompanies each unit.

SRM 1930: This SRM complements SRM 930d for the verification and calibration of the transmittance and absorbance scales of visible absorption spectrometers. SRM 1930 consists of three (3) individual Schott NG-type glass filters in separate metal cuvette-style holders and an empty filter holder. The nominal percent transmittances of the three filters are 1, 3, and 50%T. The three filters are individually certified for transmittance at five (5) wavelengths in the visible spectrum: 440.0, 465.0, 546.1, 590.0, and 635.0 nm. The optical transmittance neutrality of SRM 1930 is sufficient for the filters to be used to accurately verify absorption spectrometers with maximum spectral bandpasses ranging from 2.2 to 6.5 nm for the five wavelengths at which the transmittances are certified. When SRM 1930 is used in combination with SRM 930d, a 6-point stepwise verification of the transmittance scale is possible over the transmittance range from 1 to 50%T. A detailed discussion of this SRM and SRM 930d is given in Special Publication 260–116 which accompanies each unit.

SRM 2009a: This SRM is for use in the verification and calibration of the wavelength scale in the visible wavelength region of scanning absorption spectrometers having nominal bandwidths in the range 1.5 to 10.5 nm. SRM 2009a consists of a single (1) didymium glass filter in a metal cuvette-style holder. Depending upon the bandwidth of the absorption spectrometer, 12 to 22 wavelength verifications can be determined from 389 to 760 nm. The certified wavelengths correspond to transmittance minima and to selected inflection points. A detailed discussion of this SRM is given in the Special Publication 260–66 which accompanies each unit.

SRM 2031: This SRM is for the verification and calibration of the transmittance and absorbance scales of ultraviolet and visible absorption spectrometers. SRM 2031 consists of three (3) individual non-fluorescent, fused-silica filters in separate metal cuvette-style holders and an empty filter holder. The nominal percent transmittances of the three filters are 10, 30, and 90%T. The fused-silica base plates of the 10 and 30%T filters carry different thicknesses of semi-transparent chromium metal that are optically contacted to fused-silica cover plates. The nominal 90%T filter is a single clear fused-silica plate. The three filters are individually certified for transmittances at ten (10) wavelengths in the ultraviolet and visible spectral regions: 250.0, 280.0, 340, 360.0, 400.0, 465.0, 500.0, 546.1, 590.0, and 635.0 nm. The optical transmittance neutrality of SRM 2031 is such that wider spectral bandpasses can be used. Consequently, SRM 2031 is the only transmittance SRM that is suitable for use with those absorption spectrometers with large spectral bandpasses, e.g., 8 to 20 nm. A detailed discussion of this SRM is given in Special Publication 260-68 which accompanies each unit.
NOTE: Because the 10 and 30%T chromium-coated filters attenuate incident radiation by reflection to a large extent, SRM 2031 may possibly generate interreflections between optical surfaces in the sample compartment of some absorption spectrometers. Such interreflections may result in isochromatic stray radiant energy that affects the accuracy of the transmittance measurement. Consequently, when contemplating the purchase of SRM 2031, the user should contact the instrument manufacturer to verify that metal-on-fused silica filters are compatible with the spectrometer.

SRM 2032: This SRM is for use in the assessment of heterochromatic stray radiation energy (stray light) in ultraviolet absorption spectrometers in the spectral region below 260 nm. Issued in 25-g units, SRM 2032 consists of reagent-grade crystalline potassium iodide (KI). Solutions of this SRM in distilled water are certified for their specific absorbances under well-defined conditions at 240, 245, 250, 255, 260, 265, 270, and 275 nm. The KI solutions exhibit sharp cutoffs in transmittances below about 260 nm. The user must prepare a liquid KI solution from SRM 2032 and then transfer it to a cuvette of known pathlength. The certified specific absorbance for the solution prepared is then converted to its corresponding reference transmittance or absorbance value using Beer's Law. The amount of heterochromatic stray light in the absorption spectrometer at a wavelength below 260 nm may be determined from the equations given in the certificate.

SRM 2033: This SRM has two different purposes in the assessment of stray radiant energy (stray light) in ultraviolet absorption spectrometers in the spectral region below 260 nm: (1) an extended dynamic range test for heterochromatic stray light, and (2) an assessment of isochromatic stray light. In addition to the reagent-grade crystalline potassium iodide as issued in SRM 2032, SRM 2033 also includes a radiation attenuator to extend the dynamic range of the heterochromatic stray light test for those absorption spectrometers that can not make measurements in the low-transmittance region. The radiation attenuator consists of two (2) non-fluorescent, semi-transparent metal-on-fused silica filters, each having a nominal percent transmittance of 10%T. One filter is mounted in a metal cuvette-style holder, and the other filter is mounted in one of the two removable sliding shutters of the holder. For the extended dynamic range test of heterochromatic stray light, the cuvette containing the KI solution is inserted into the sample-beam position and the radiation attenuator is used to provide stepwise 10- and 100-fold attenuations of the reference beam. For the isochromatic stray light test, the KI solution is not used, and the metal-on-fused silica filter is inserted into the sample-beam position.

SRM 2034: This SRM is for use in the verification and calibration of the wavelength scale of ultraviolet and visible absorption spectrometers having nominal spectral bandwidths not exceeding 3 nm. SRM 2034, a liquid consisting of 4% (w/v) holmium oxide in an aqueous solution of 10% (v/v) perchloric acid, is sealed in a non-fluorescent, fused-silica cuvette of optical quality. SRM 2034 is batch-certified for wavelength location of minimum transmittance of 14 bands in the spectral range from 240 to 650 nm for six spectral bandwidths from 0.1 to 3 nm. A detailed discussion of this SRM is given in Special Publication 260–102 which accompanies each unit.

SRM 936: This SRM is for use in the evaluation of methods and the calibration of fluorescence spectrometers. Issued in 1-g units, SRM 936 consists of solid quinine sulfate dihydrate. It is certified for the relative molecular emission spectrum, $E(\lambda)$, in radiometric units for a solution of 1.28×10^{-6} mol/L quinine sulfate dihydrate in 0.105 mol/L perchloric acid using an excitation wavelength of 347.5 nm. The values of the molecular emission spectrum are certified at 5-nm wavelength intervals from 375 to 675 nm. The user must prepare the solution and transfer it to a cuvette of known pathlength. A detailed discussion of this SRM is given in Special Publication 260–64 which accompanies each unit.

SRM 1931: This SRM is for use in the evaluation and calibration of the relative spectral response of fluorescence spectrometers. It consists of four fluorescence standards and a "blank" specimen mounted in anodized aluminum cuvette-sized holders. The standards are composed of inorganic phosphors in a sintered polytetrafluoroethylene matrix. The fluorescence standards are certified for the relative corrected emission spectrum, $E(\lambda)$, in energy/wavelength units. The values of the blue (400–550 nm), green (490–600 nm), yellow (490–740 nm) and orange (530–740 nm) emission spectra are certified at 2-nm wavelength intervals. SRM 1931 L and R are oriented for left- and right-handed fluorescence spectrometers, respectively, as defined by viewing the fluorescent sample along the excitation beam. If the first emission optical component is located to the right of the sample then this orientation is designated R, and if it is to the left then it is designated L.

SRM	Type	Wavelength Range (in nm)	Unit Size
930d	Glass Filters, Transmittance	440–635	3 filters/4 holders
931e	Liquid Filters, Absorbance	302–678	Set of 12 vials
935a	Potassium Dichromate, UV Absorbance	235–350	15 g
936	Quinine Sulfate Dihydrate, Fluorescence	375–675	1 g
1930	Glass Filters, Transmittance	440–635	3 filters/4 holders
1931	Fluorescence Corrected Emission Spectra	400–760	Set of 4 holders
2009a	Didymium-oxide Glass, Wavelength	400–760	1 filter/1 holder
2031	Metal-on-Quartz Filters, Transmittance	250–635	3 filters/4 holders
2032	Potassium Iodide, Stray Light	240–280	25 g
2033	Potassium Iodide with Attenuator	240–280	25 g and attenuator
2034	Holmium-oxide Solution, Wavelength	240–650	1 sealed cuvette

Specular Spectral Reflectance (plate form)

These SRMs are for calibrating the reflectance scale of integrating sphere reflectometers used to evaluate materials for solar energy collectors and to calibrate reflectometers used in evaluating the appearance of polished metals and metal-plated objects.

SRM	Type	Wavelength Range (in nm)	Unit Size (in cm)
2003e	First Surface, Aluminum on Glass	250–2500	5.1D × 0.95
2011	First Surface, Gold on Glass	600–2500	5.1D × 1.2
2023a	Second Surface, Aluminum on Fused Quartz	250–2500	5.1D
2026	First Surface, Black Glass	In Prep	

Infrared Reflectance (solid form)

This SRM is for establishing the accuracy of the near infrared (IR) wavelength scale of reflectance spectrophotometers.

SRM	Type	Wavelength Range (in nm)	Unit Size (in cm)
1920	Rare Earth Oxide Mixture	740–2000	holder: 5.1D × 1.2

Nancy Winchester, *Chemist*, Inorganic Analytical Research Division;
Melody Smith, *Physical Science Technician*, Inorganic Analytical Research Division

Directional Hemispherical Reflectance (wafer form)

SRM	Type	Wavelength Range (in nm)	Unit Size (in cm)
2015	Opal Glass	400–750	2.5 × 5.0 × 0.64
2021	Black Porcelain Enamel	280–2500	5.1 × 5.1 × 0.20

Optical Rotation (powder form)

These SRMs are for calibrating or checking polarimetric apparatus. In aqueous solution, the optical rotation of SRM 17d is certified at three (3) wavelengths, while that of SRM 41c is certified at two (2) wavelengths. SRM 41c is also certified at one (1) wavelength in a dimethyl sulfoxide solution.

SRM	Type	Optical Rotation (in mrad) – Aqueous Solution Wavelength (in nm)			Unit Size (in g)
		546	589	633	
17d	Sucrose	711.64	604.26	519.17	60
41c	Dextrose	1101.1	931.8	798.6	70

X-ray and Photography (chart and tablet forms)

SRM 1001 is a calibrated X-ray film step tablet of 17 steps that cover the optical density range from 0 to 4; it has a blue tint and emulsion on both sides. SRM 1008 is a calibrated photographic step tablet of 21 steps that cover the optical density range from 0 to 4; it has a black tint and emulsion on a single side.

SRM 1010a is used to test the resolving power of cameras or of whole microcopying systems. It consists of five (5) charts printed photographically on paper, which have 26 high-contrast, 5-line patterns ranging in spatial frequency from one cycle per mm to 18 cycles per mm. Instructions for the use of the charts are supplied with each unit.

SRM	Type	Unit Size
1001	X-ray Film 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

205. Radioactivity

Radiation Dosimetry (wire form)

This SRM is a cobalt-in-aluminum alloy wire 0.5 mm in diameter and 1 m in length for use as a neutron density monitor standard.

SRM	Type	Cobalt Composition (in Wt. %)
953	Neutron density monitor wire (Co in Al)	0.116

Fission Track Glass (wafer form)

These SRMs, which contain uranium, will aid laboratories performing fission track analyses in interlaboratory comparisons of data and in monitoring neutron fluences. The materials were irradiated in the NIST 10 Megawatt Research Reactor, at two different neutron energies. Each unit consists of four (4) unirradiated glass wafers and two (2) irradiated wafers.

SRM	Uranium Composition (in mg/kg)	Uranium-235 (in Atom %)	Reactor Position	Neutron Fluence Copper Foil	Neutron Fluence Gold Foil
961	461.5	0.2376	RT-4: (10^{12} n/cm^2)	1.31	1.46
			RT-3: (10^{12} n/cm^2)	4.56	5.43
963a	0.823	0.2792	RT-4: (10^{14} n/cm^2)	39.5	43.0
			RT-3: (10^{14} n/cm^2)	41.2	45.8

The SRMs in the following four (4) pages are shipped express or air freight (shipping charges collect). The amount of a radionuclide in an SRM, at a specified time, is stated as (1) the number of atoms (or the mass for old radium SRMs), (2) the activity, or "decays per second," or (3) the emission rate of a particular radiation, depending on the method of calibration or the intended use. For solution SRMs, the quantity is usually specified per gram of liquid. The active portion of gamma-ray "point-source" standards is usually restricted to the central few millimeters of a low-mass, low-Z support to minimize scattering. Alpha particle-emitting radionuclides are deposited or plated on metal backings.

The unit for activity has traditionally been the curie (Ci), but simpler relations between activity, emission rate, and counting rate result if the current SI (International System of Units) unit "1 per second" is used. This is symbolized as "s^{-1}" and has been given the special name becquerel (Bq). The relationship between the curie and the becquerel is: $1\ Ci = 3.7 \times 10^{10}$ Bq.

Many SRMs are measured and certified in terms of emission rate. In this catalog, $\alpha\, s^{-1}$, $\beta^- s^{-1}$, $\beta^+ s^{-1}$, $Kx\, s^{-1}$, and $\gamma\, s^{-1}$ are used for the emission rates of alpha particles, negatrons, positrons, K X-rays, and gamma rays, respectively.

The SRMs without an asterisk (*) may be ordered singly, without a license, under the general licensing provisions of the Atomic Energy Act of 1954, As Amended. Those marked by an asterisk (*) are available only under the special licensing provisions of the Atomic Energy Act of 1954, As Amended.

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 users who have expressed interest are notified of their availability. Requests for any radionuclide not listed, should be submitted to the Radioactivity Group, Ionizing Radiation Division, Room C114 Radiation Physics Building, National Institute of Standards and Technology, Gaithersburg, MD 20899: Telephone (301) 975-5531; FAX (301) 869-7682.

In addition, chemically stable solutions of many radionuclides may be submitted to NIST for calibration as described in Calibration Services Users Guide, NIST Special Publication 250 (1992 Edition). Requests for such tests should be submitted, with full source information, for approval of suitability to the Radioactivity Group at the above address.

Alpha Particle, Beta Particle, Gamma Ray, and Electron Capture (solution form)

SRM	Type Radionuclide	Activity per gram, at time of calibration (in Bq g^{-1})	(month/year)	Mass of Solution (in g)	Overall Uncertainty (in %)
4322*	Americium-241	38.7	11/86	5	1.0
4332C*	Americium-243	122	7/90	5	1.1
4251B*	Barium-133	5×10^{5}	6/87	5	1.4
4325	Beryllium-10-Beryllium-9	2.68×10^{-11}	8/86	50	5.1
4233C*	Cesium-137 Burn-up Standard	7×10^{5}	11/89	5	0.94
4943*	Chlorine-36	1×10^{4}	12/84	3	0.8
4915D*	Cobalt-60	3×10^{5}	2/84	5	0.8
4320	Curium-244	57	4/89	5.2	0.9
4329*	Curium-243	70	6/84	5.1	1.4
4370*	Europium-152	9×10^{4}	2/87	5	1.1
4926D	Hydrogen-3	3×10^{3}	7/89	18	0.9
4927D	Hydrogen-3	7×10^{5}	4/89	3	0.8
4947C	Hydrogen-3	3×10^{5}	3/87	4	1.2
4361B	Hydrogen-3	1.1	8/87	490	1.0
4949B	Iodine-129	7×10^{3}	1/82	1	1.9
4929D	Iron-55	4×10^{4}	8/85	5	2.6
4226B*	Nickel-63	1×10^{6}	12/84	4	1.1
4327*	Polonium-208	77	6/84	1	11.4
4323*	Plutonium-238	33	11/86	5	0.5
4338*	Plutonium-240	18	4/80	5	1.0
4334D*	Plutonium-242	25.58	12/89	5.9	1.2
4423	Strontium-90	4×10^{6}	11/85	5	1.1
4919F*	Strontium-90	4×10^{3}	5/88	5	1.2
4288*	Technetium-99	4×10^{4}	11/82	5	1.6
4328*	Thorium-229	884	5/84	2	1.5
4324*	Uranium-232	83	2/84	5	1.5
4321	Uranium-238 (Natural)	263	11/86	5	0.4
4276C*	Long-Lived Mixed Radionuclide:		9/88	5	
	Antimony-125	2×10^{4}			
	Europium-154	1×10^{4}			
	Europium-155	7×10^{3}			

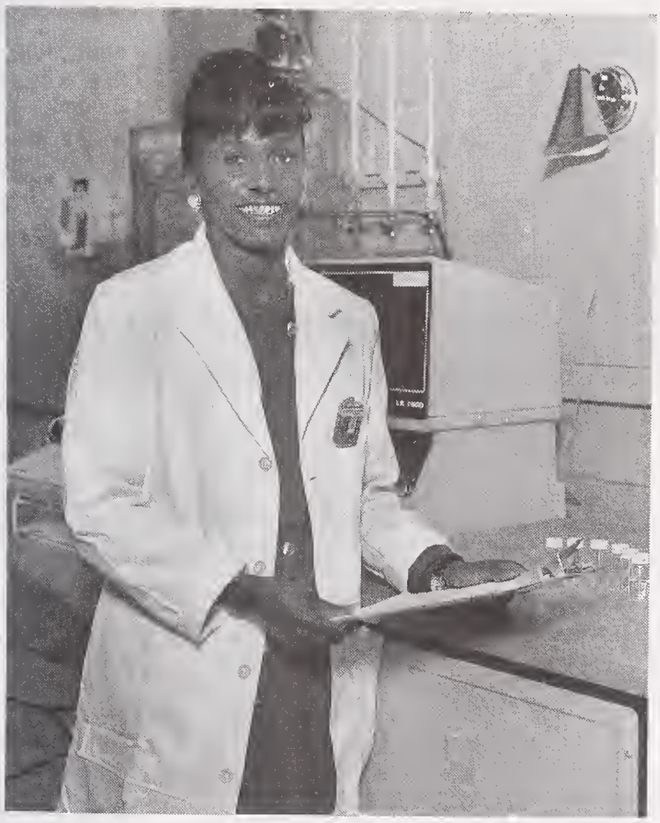
* License certification is required of purchaser by NIST before shipment.

Radiopharmaceuticals (solution form)

These SRMs, ~5 mL each, are contained in ampules.

SRM	Type Radionuclide	Half Life	Radioactivity at Time of Dispatch (in Bq g^{-1})	Overall Uncertainty (in %)
4400LN*	Chromium-51	27.702 d	3×10^{6}	0.7
4401LR*	Iodine-131	8.021 d	5×10^{6}	0.9
4404LO*	Thallium-201	72.91 h	4×10^{6}	1.2
4406LL*	Phosphorus-32	14.29 d	2×10^{6}	1.0
4407LP*	Iodine-125	59.6 d	1×10^{6}	1.1
4409LD*	Selenium-75	119.8 d	1×10^{6}	2.8
4410HR*	Technetium-99m	6.007 h	1×10^{9}	0.9
4412LQ*	Molybdenum-99-Technetium-99m	65.92 h	1×10^{7}	1.0
4415LP*	Xenon-133 (5 mL gas)	5.243 d	5×10^{8} s^{-1} total	1.0
4416LM*	Gallium-67	3.261 d	3×10^{6}	0.8
4417LK*	Indium-111	2.805 d	5×10^{6}	0.7

* License certification is required of purchaser by NIST before shipment.



Jacqueline Calhoun, *Research Chemist*, Ionizing Radiation Division

Alpha Particle Point Sources

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

SRM	Type Radionuclide	α-particle emission rate into 2π geometry and/or activity at time of calibration (month/year)		Overall uncertainty (in %)
4904NG*	Americium-241	2300 Bq g^{-1}	5/86	1.3
4904SG*	Americium-241	2300 Bq g^{-1}	5/86	1.0 to 1.3
4906HC*	Plutonium-238	$1 \times 10^3 - 5 \times 10^4$	10/87	1.3
4906C*	Plutonium-238	$1 \times 10 - 3 \times 10^2$	10/87	1.3

* License certification is required by NIST.

Radiocarbon Dating and Ground Water Studies (solid and solution forms)

Low-Level Tritiated-Water Standard

SRM	Material	Description
4361B	Hydrogen-3	490 g in a flame-sealed bottle. The radioactivity concentration was 1.123 Bq g^{-1}, as of the date of the most recent gas-counting measurement – August 1, 1987.

Contemporary Standard for Carbon-14 Dating

SRM	Material	Description
4990C	Oxalic Acid	225 g taken from specially prepared material for use as a common contemporary standard against which world-wide measurements can be compared.

Gaseous Materials

SRM	Type Radionuclide	Activity or radioactivity concentration at time of calibration (month/year)		Volume (in cm^3)	Pressure (in Pa)	Overall Uncertainty (in %)
4235B*	Krypton-85	1×10^7 Bq	10/86	3	1.013×10^5	1.1
4308C	Krypton-85	2×10^6 Bq	11/82	30	3.039×10^4	3.2
4415LN*	Xenon-133	5×10^8 Bq	3/90	5	1.013×10^4	1.5
4935C*	Krypton-85	5×10^7 Bq mol^{-1}	3/74	10	1.013×10^5	0.9

* License certification is required by NIST.

Gamma Ray and X-ray Point Sources

These SRMs are usually prepared by depositing the radioactive material and sealing it between two layers of polyester tape, mounted on an aluminum ring.

SRM	Type Radionuclide	Principal Photon Energy (MeV)	Activity at time of calibration (in Bq)	(month/year)	Overall Uncertainty (in %)
4200B	Cesium-137-Barium-137m	0.662	4×10^4	9/79	1.6
4201B	Niobium-94	0.702	5×10^3	4/70	1.5
4202D	Cadmium-109-Silver-109m	0.088	4×10^5	10/86	2
4203*	Cobalt-60	1.173–1.332	2×10^4 to 2×10^5	3/84	0.9
4207B	Cesium-137-Barium-137m	0.662	3×10^5	3/87	0.8
4218E*	Europium-152	0.122 to 1.408	5×10^4 to 5×10^5	11/82	1.5
4241B*	Barium-133	0.081–384	2×10^5	6/81	1.4
Long-Lived Mixed Radionuclide:					
4275C	Antimony-125-Tellurium-125m	0.027 to 1.596	5×10^4	9/88	
	Europium-154		6×10^4		
	Europium-155		3×10^4		

* License certification is required by NIST.

Low Energy Photon Point Sources

This SRM consists of a thin-layer deposit of the radionuclide on a thin stainless steel or platinum foil cemented to a monel disk.

SRM	Type Radionuclide	Principal Photon Energy (MeV)	Emission rate at time of calibration (month/year)		Overall Uncertainty (%)
4264B	Tin-121m-Antimony-121	0.0372	$5\times10^2 s^{-1}$	11/82	3.0

Radon Analysis (solution form)

These SRMs are contained in flame-sealed glass ampules.

SRM	Type Radionuclide	Radium Content (month/year)		Mass of Solution (in g)	Uncertainty (in %)
4950E	Radium-226	4×10^{-10}	6/84	5	1.3
4952B	Blank	8×10^{-15}	8/76	2	68
4953D	Radium-226	4×10^{-9}	6/84	5	1.2

Natural Matrix Materials (powder form)

SRM 4350B—Columbia River Sediment
This material was collected from a river downstream from a nuclear reactor facility. Concentrations of fission and activation products are elevated over typical world-wide levels. $^{239/240}$Pu and ^{241}Am are very homogeneously distributed through the sample and are in acid-leachable forms. Inhomogeneity is 3% or better for other radionuclides.

SRM 4351—Human Lung
This material contains radioactivity concentrations on the order of 10^{-4} Bq g^{-1}. It has been freeze-dried, cryogenically ground, homogenized, and packed in a glass bottle under vacuum. There is significant inhomogeneity in $^{239/240}$Pu which is unavoidable because plutonium was taken into the lungs in particulate form. Assessments of accuracy of measurement techniques can be improved by averaging over several samples.

SRM 4352—Human Liver
This material contains radioactivity concentrations on the order of 10^{-4} Bq g^{-1}. It has been freeze-dried, cryogenically ground, homogenized, and packed in a glass bottle under vacuum.

SRM 4353—Rocky Flats Soil Number 1
This material was collected within 13 cm of the soil surface at Rocky Flats, CO. $^{239/240}$Pu and ^{240}Am concentrations are about an order of magnitude higher than typical world-wide levels. Approximately 10% of the plutonium is in a acid-resistant form. The material also contains "hot" particles and a statistical method is provided for dealing with these. Inhomogeneities, excluding hot particles, are on the order of 3% or better.

SRM 4354—Freshwater Lake Sediment
This material (gyttja) contains approximately 25 g of freeze-dried, pulverized freshwater lake sediment (approximately 50% organic by weight) in a polyethylene bottle. The SRM is intended for use in tests of measurements of environmental radioactivity contained in matrices similar to the sample, for evaluating analytical methods, or as a generally available calibrated "real" sample matrix in interlaboratory comparisons.

SRM 4355—Peruvian Soil
This material has non-measurable radioactivity concentrations for many fallout radionuclides and can be used as a blank or for sensitive tests of radioanalytical procedures at low-radioactivity concentrations for other radionuclides. The results of a trace-element study are given for 57 elements.

206. Electrical Properties

Electrical Resistivity and Conductivity of Metals (rod form)

These materials are for evaluating methods of measuring electrical resistivity over wide temperature ranges.

SRM	Type	Temperature Range (in K)	Resistivity at 293 K (in μΩ · cm)	Unit Size (in cm)
1461	Stainless Steel	5 to 1200	80.5	rod: 1.27D × 5.0
1462	Stainless Steel	5 to 1200	80.5	rod: 3.40D × 5.0
RM 8420	Iron	6 to 1000	10.1	rod: 0.64D × 5.0
RM 8421	Iron	6 to 1000	10.1	rod: 3.17D × 5.0
RM 8422	Tungsten	4 to 3000	5.4	rod: 0.32D × 5.0
RM 8423	Tungsten	4 to 3000	5.4	rod: 0.64D × 5.0

Electrical Resistivity and Conductivity of Silicon (block and wafer forms)

SRMs 2526, 2527, 2528, and 2529 are mounted on beveling blocks for two-probe test equipment.

SRM	Type	Resistivity (in Ω · cm)	Unit Size (in mm)
2526	111 p-Type Silicon, Spreading Resistance	0.001 to 200	16 levels: 5 × 10 × 0.625
2527	111 n-Type Silicon, Spreading Resistance	0.001 to 200	16 levels: 5 × 10 × 0.625
2528	100 p-Type Silicon, Spreading Resistance	0.001 to 200	16 levels: 5 × 10 × 0.625
2529	100 n-Type Silicon, Spreading Resistance	0.001 to 200	16 levels: 5 × 10 × 0.625
2541	Silicon Resistivity	In Prep	
2542	Silicon Resistivity	In Prep	
2543	Silicon Resistivity	In Prep	
2544	Silicon Resistivity	In Prep	
2546	Silicon Resistivity	In Prep	
2547	Silicon Resistivity	In Prep	
2548	Silicon Resistivity	In Prep	
2549	Silicon Resistivity	In Prep	
2550	Silicon Resistivity	In Prep	

Residual Resistivity Ratio (rod form)

This SRM is a set of five (5) aluminum rods for use in checking four-terminal dc and eddy current decay techniques. The residual resistivity ratio (RRR), $\rho(273\ K)/\rho(4\ K)$, is a sensitive indicator of purity and of the mechanical state of a material.

SRM	Type	RRR Values	Unit Size (in cm)
769	Aluminum	130, 683, 1205, 2650, and 11,000	0.64D × 5.2

Eddy Current (block form)

This SRM is for the calibration of eddy current conductivity meters and of secondary electrical conductivity standards. Eddy current measurements are used in nondestructive inspection of conducting materials and in the sorting of alloys for composition and heat treatment.

SRM	Type	Conductivity	Unit Size (in cm)
1860	Aluminum	60% IACS*	4.4 × 4.4 × 0.95

* IACS – International Annealed Copper Standard.

Superconducting Critical Current (wire form)

This SRM is for checking the performance of measurement systems used in superconductor technology. It consists of 2.2 m of a multifilamentary niobium titanium, copper-stabilized superconducting wire wound in a single layer onto a spool with a core diameter of 8.7 cm.

SRM	Type	Magnetic Field (in T)	Critical Current (in A)
1457	Nb–Ti Wire	2.000	293.30
		4.000	187.38
		6.000	124.72
		8.000	69.72

207. Metrology

Scanning Electron Microscope (SEM)

These SRMs are for calibrating the magnification scale and evaluating the performance of scanning electron microscopes. SRM 484f, on a 6.5-mm specimen mount, can be used to calibrate the magnification scale of an SEM from 1000 to 20,000 X. SRM 2069b consists of graphitized rayon fibers with smooth and uniform edges on a 3-mm SEM specimen mount.

SRM	Type	Size
484f	SEM Magnification Standard	11 mm D
2069b	SEM Performance Standard	12 mm D

Optical Microscope Linewidth Measurement (wafer form)

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. It is not for use with partially transmitting materials, in reflected light with opaque materials, or in a scanning electron microscope. SRM 476 is patterned with bright chromium.

SRM	Type	Spacings (in μm)	Unit Size (in cm)
476	Linewidth Measurement Standard	0.5 to 12	6.35 × 6.35 × 0.15

Depth Profiling (wafer form)

These SRMs are for calibrating equipment used to measure sputtered depth and erosion rates in surface analysis. SRM 2135c consists of nine (9) alternating metal thin-film layers—five (5) layers of pure chromium and four (4) of pure nickel—on a polished silicon (100) substrate. It is certified for total chromium and total nickel thickness, for individual layer uniformity, for Ni/Cr bi-layer uniformity, and for individual layer thickness. The nominal thicknesses for Cr and Ni are 53 and 66 nm, respectively.

SRM	Type		Unit/Size (in cm)
2135c	Ni-Cr Thin-Film Depth Profile Standard	In Prep	1 × 2.54 × 0.04
2136	Cr/CrO Thin-Film Depth Profile Standard		1 × 2.54 × 0.04

Copper and Chromium Coating on Steel (plate form)

These SRMs are used to measure the thickness of nonmagnetic coatings on steel. The steel substrates have the properties of AISI 1010 steel and may be used to measure the thickness of paint and other organic coatings on steel, as well as zinc (galvanized) and other nonmagnetic metallic coatings.

SRM	Unit Size 30×30 mm	Coating Thickness (in μm)
1321	Set of 4	34, 37, 42, 47
1322	Set of 4	53, 60, 69, 80
1323	Set of 4	4, 112, 135, 167
1357	Set of 3	6, 20, 48
1358	Set of 3	80, 225, 1000
1359	Set of 4	48, 140, 505, 800
1360	Set of 4	2.5, 6, 12, 20
1361a	Set of 4	6, 12, 25, 48
1362a	Set of 4	40, 80, 140, 205
1363a	Set of 4	255, 385, 505, 635
1364a	Set of 4	800, 1000, 1525, 1935

Nickel Coating on Steel (plate form)

These SRMs are used for calibrating thickness gauges of the magnetic type. The nickel coating has the magnetic property of a Watts nickel electrodeposit free of iron.

SRM	Unit Size 30×30 mm	Coating Thickness (in μm)
1331a	1 each	3
1332a	1 each	9
1333a	1 each	15
1334a	1 each	20
1335a	1 each	25
1336a	1 each	34
1337a	1 each	40
1338a	1 each	50
1339a	1 each	62

Solder Thickness (plate form)

This SRM is for calibrating X-ray fluorescence equipment. Each unit, which consists of a 1.5 × 1.5 cm plate of an electroplated tin-lead alloy coating on a copper substrate, is individually certified for composition and mass per unit area.

SRM	Type	Composition (in Wt. %)	Mass per Unit Area (in mg/cm^2)
2321	Sn-Pb Alloy	Sn: 54	6.8

Gold Coating on Nickel (plate form)

These SRMs are for calibrating equipment used to measure weight per unit area of gold coating of equivalent purity. They were measured by beta-ray backscatter and X-ray fluorescence techniques relative to NIST gold coating materials for which the average weights per unit area were determined by weight and area measurements.

SRM	Unit Size 15×15 mm	Coating Weight (in mg/cm^2)	Coating Thickness (in μm)
1375	1 each	1.5	0.8
1376	1 each	3.0	1.5
1377	1 each	6.0	3
1378	1 each	14.0	7
1379	1 each	0.35	0.175
1380	1 each	0.55	0.275

Gold Coating on Fe-Ni-Co Alloy (plate form)

SRM	Unit Size 15×15 mm	Coating Weight (in mg/cm^2)	Coating Thickness (in μm)
1371	1 each	1.5	0.8
1372	1 each	3.0	1.5
1373	1 each	6.0	3
1374	1 each	14.0	7

Ellipsometry (wafer form)

These SRMs are certified for the ellipsometric parameters of delta (Δ) and psi (Ψ) and the derived thickness and refractive index of the silicon dioxide layer on the silicon wafer.

SRM	Type	Unit Size 76 mm D	Thickness (in nm)
2531	Thin Film Thickness	1 each	50
2532	Thin Film Thickness	1 each	100
2533	Thin Film Thickness	1 each	200
2534	Thin Film Thickness	1 each	25
2535	Thin Film Thickness	1 each	12

Barbara Belzer, *Physical Science Technician*,
Semiconductor Electronics Division

Gas Transmission Film

This SRM is for use in the measurement of gas transmission rates using a volumetric method (ASTM D1434), manometric method (ASTM D1434), or coulometric method (ASTM D3985) of measurement. The permeances of nitrogen, oxygen, carbon dioxide, and helium through this polyester film at 296.15 K are 0.0421, 0.352, 1.722, and 13.79 pmol-$s^{-1} \cdot Pa^{-1}$, respectively.

SRM	Type	Unit Size (in cm)
1470	Polyester Plastic Film for Gas Transmission	15 sheets: 23

NIST Time Software

The NIST Automated Time Service (ACTS) is a telephone time service designed to provide computers with telephone access to NIST time at occurrences approaching 1 millisecond (0.001 s). Features of the service include automated compensation for telephone-line delay, advanced alert for changes to and from daylight savings time and advanced notice of insertion of leap seconds. The ASCII-character time code should operate with standard modems and most computer systems. While the system can be used to set up computer time-of-day, simple hardware can be developed to set non-computer clock systems.

SRM	Type	Unit Size
8101	Automated Computer Time Service (ACTS)	13.34 cm diskette

208. Ceramics and Glasses

Chemical Resistance (Durability) of Glass (solid form)

This SRM is for checking test methods and calibrating equipment used to determine the resistance of glass containers to chemical attack. The value given represents the volume of 0.02 N 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	Unit Size	mL of N/50 H_2SO_4
623	Borosilicate	2.2 kg	0.34

Electrical Properties of Glass (bar and powder forms)

SRM 624 is for checking test methods and for calibrating equipment used to determine the dc volume resistivity of glass per ASTM C657. SRM 774 is for checking methods used to determine dielectric constant and ac loss characteristics of insulating materials per ASTM D150.

SRM	Type	Unit Size	Value
624	Lead-Silica, for dc resistivity	200 g	$\log_{10}\rho \sim 9.9$ Ω-cm at 300 °C
774	Lead-Silica, for dielectric constant	5 × 5 × 2.5 cm	K ~ 7.47
1414	Lead-Silica, for resistivity (molten range)	4 × 4 × 12 cm	13.5 Ω-cm at 1300 °C

Viscosity of Glass (bar form)

SRMs 710a, 711, and 717 are for checking the performance of high-temperature viscosity equipment (rotating cylinders) and low-temperature viscosity equipment (fiber elongation, beam bending, parallel plates, etc.).

SRM	Type	Temperature (°C) at Log 10 Viscosity (in Pa · s*)										
		1	2	3	4	5	6	7	8	9	10	11
710a	Soda-Lime-Silica	1464	1205	1037	918							
711	Lead-Silica	1327.1	1072.8	909.0	794.7	710.4	645.6	594.3	552.7	518.2	489.2	464.5
717	Borosilicate	1545.1	1248.8	1059.4	927.9	831.2	757.1	698.6	651.1	611.9	579.0	550.9

* SI unit. Replaces term, "poise". ($Pa \cdot s = poise \times 10^{-1}$)

Viscosity Fixpoints (solid forms)

These SRMs are for the calibration of equipment for the determination of the softening, annealing, and strain points of glass.

SRM	Type	Unit Size	Softening Point, °C	Annealing Point, °C	Strain Point, °C
709	Extra Dense Lead	4×4×5 cm	384	328	311
710a	Soda-Lime-Silica	10×10×4 cm	730.6	(545)	(504)
711	Lead-Silica	1.3 kg	602	432	392
712	Mixed Alkali Lead Silicate	225 g	528	386	352
713	Dense Barium Crown 620/603	225 g	738	631	599
715	Alkali-Free Aluminosilicate	200 g	961	764	714
716	Neutral	250 g	794	574	530
717	Borosilicate	4.2×4.2×12.5 cm	720	516	471

Relative Stress Optical Coefficient (bar form)

These glasses are for calibrating instruments used to measure relative stress optical coefficient of glass.

SRM	Type	Unit Size	Relative Stress Optical Coefficient (C) at λ=546.1 nm (Value × 10^{-12} m^2/N)
708	Glass A–Lead Silica	625 g	C=2.857
	Glass B–Borosilicate	275 g	C=3.652
709	Extra Dense Lead	4×4×5 cm	C=−1.359

Glass Liquidus Temperature (plate form)

This SRM is for checking test methods and for calibrating equipment used to determine the liquidus temperature of glass by the gradient furnace methods per ASTM C829.

SRM	Type	Unit Size	Method	Temperature, °C
773	Soda-Lime-Silica	2.5×2.5×0.6 cm	A (boat)	988
			B (perforated plate)	991

209. Miscellaneous Properties

Density and Refractive Index (liquid and solid forms)

These SRMs are for reference in the determination of the density of liquids and solids. The certified densities of SRMs 211c, 2211 and 2212 were measured with a special-design picnometer; the certified refractive indexes were measured with a precision spectrometer. The certified densities of SRMs 1825, 1826 and 1827 were determined by means of hydrostatic weighing.

SRM	Type	Unit Size	Density* (in g/cm^3)	Refractive Index **
211c	Toluene	5-mL ampule	0.86686	1.5180
1822	Soda-Lime Glass	slab – 3.8 × 3.8 × 0.6 cm		1.5200
1825	Fused Silica	rod – 1.6 × 5.0 cm	2.201855	
1826	Soda-Lime Glass	button – 3.20 × 1.3 cm	2.549382	
1827	Lead Silica Glass	slab – 0.6 × 4.0 × 2.5 cm	3.04948	1.528761
1919	Lead Silica Glass	slab – 0.6 × 4.0 × 2.5 cm	Indiv. Cert.	
2211	Toluene	8-mL ampule	0.86686	1.5180
2212	Toluene	22-mL ampule	0.86686	1.5180

* Values are at 20 °C.
** Values are at 20 °C and 435.83 nm (mercury spectral source).

Bleached Kraft Pulps (sheet form)

These Reference Materials, RMs 8495 Northern Softwood Bleached Kraft Pulp and 8496 Eucalyptus Hardwood Bleached Kraft Pulp, are intended primarily for use in fundamental studies on the physical properties of fibers and paper sheets. The materials selected for these two RMs are bleached dried lap pulp, each from a single lot of a standard commercial production run. The materials were selected because of their differing fiber size, differing papermaking properties, and similarity to commercially available materials.

RMs 8495 and 8496 were developed and prepared with input and support from the Pulp Material Research Committee (PMRC), a sub-committee of the Fundamental Research Committee. These materials were donated by industry and are being distributed by the Standard Reference Materials Program. At this time, no extensive property measurements have been made on these materials beyond ensuring they were within the control limits of the normal production run. A measurement error study is in progress with participation by international paper technical laboratories. As results become available, they will be published and added to the Report of Investigation that accompanies each of these materials.

RM	Type	Unit Size
8495	Northern Softwood	10 standard lap sheets × 0.5 kg
8496	Eucalyptus Hardwood	10 standard lap sheets × 0.5 kg

X-ray Diffraction of Ferrous Materials (disk and wafer forms)

SRMs 485a, 486, 487, and 488 are for calibrating X-ray diffraction equipment used in determining the amount of retained austenite in ferrous materials. SRM 493 is for calibrating X-ray diffraction and Mössbauer equipment to determine the relative amounts of iron carbide in steel.

SRM	Type	Unit Size (in cm)
485a	Austenite in Ferrite 5%	disk: 2.1D×0.24
487	Austenite in Ferrite 30%	disk: 2.1D×0.24
488	Austenite in Ferrite 2.5%	disk: 2.1D×0.24
493	Spheroidized Iron Carbide (Fe_3C) in Ferrite	wafer: 2.9×2.9×0.24

X-ray Fluorescence Emission Target (disk form)

This SRM is for 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.

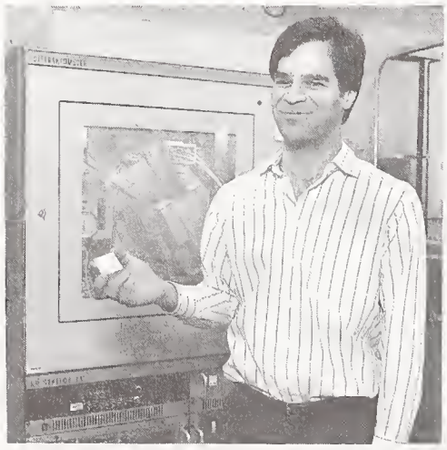
SRM	Type	Unit Size (in cm)
477	Glass Fluorescence Source	2.5D×2

X-ray Diffraction of Powder Materials

These SRMs are to be used as internal standards for powder diffraction measurements. SRM 674a is a set of five (5) oxides for use in the quantitative analysis (intensity measurement) of materials.

SRM	Type	Lattice Parameter at 25.0 °C (in nm)	Unit Size (in g)
640b	Silicon Powder	0.5430940	7.5
660	LaB_6-2Theta X-Ray Profile	0.415695	3
674a	Powder Diffraction Intensity		
	Al_2O_3 (α-alumina)	(0.4759397)	10
	CeO_2	(0.5411102)	10
	Cr_2O_3	(0.4959610)	10
	TiO_2 (Rutile)	(0.4593939)	10
	ZnO	(0.3249074)	10
675	Powder Diffraction (Mica)	0.998104	5
676	Crystalline Alpha Alumina	In Prep	20
1976	Alumina Plate, Sintered	0.4758846	4.5×0.16 cm

Values in parentheses are not certified and are given for information only.



James Cline, *Ceramic Scientist*, Ceramics Division

Standard Reference Materials for Engineering Materials

301. Sizing

Particle Size

SRMs 1003b, 1690, 1691, and 1960 are for calibrating various types of particle size measuring instruments, including light and electrical zone flow-through counters and optical and electron microscopes. SRMs 1004a, 1017a, 1018a, and 1019a are for calibrating test sieves.

SRM	Type	Particle Size (μm)	Unit Size
1003b	Glass Spheres	8–58	In Prep
1004a	Glass Spheres	34–120	In Prep
1017a	Glass Spheres	100–310	84 g
1018a	Glass Spheres	225–780	74 g
1019a	Glass Spheres	760–2160	200 g
1690	Polystyrene Spheres (0.5 Wt. % in H_2O)	0.895	5-mL vial
1691	Polystyrene Spheres (0.5 Wt. % in H_2O)	0.269	5-mL vial
1692	Polystyrene Spheres (0.25 Wt. % in H_2O)	2.982	5-mL vial
1960	Polystyrene Spheres (0.4 Wt. % in H_2O)	9.89	5-mL vial
1961	Polystyrene Spheres (0.5 Wt. % in H_2O)	29.64	5-mL vial
1962	Polystyrene Spheres (0.5 Wt. % in H_2O)	2.978	5-mL vial
1963	Polystyrene Spheres (0.5 Wt. % in H_2O)	0.1007	5-mL vial
1965	Polystyrene Spheres (0.5 Wt. % in H_2O)	9.94	1 slide

Cement Turbidimetry and Fineness

This SRM is for calibrating 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 (20) sealed vials, each containing approximately 10 g of cement.

SRM	Type	Properties Certified	Value
114n	Portland Cement	Residue on 45 μm, electroformed sieve wet method	8.3%
		Surface area (Wagner turbidimeter)	2020 $cm^2 \cdot g^{-1}$
		Surface area (Air permeability)	3460 $cm^2 \cdot g^{-1}$

Surface Area of Powders

These materials are for calibrating and checking instruments used to determine the specific surface area of powders by the Brunauer, Emmett and Teller (BET) method. Reference Materials (RMs) 8005, 8006, 8007, and 8008 are issued by NIST in cooperation with the Laboratory of the Government Chemist (LGC) Office of Reference Materials at the National Physical Laboratory in Teddington, England. RMs 8570, 8571, and 8572 are issued by NIST in cooperation with ASTM. Their surface areas were determined by both the static (volumetric) and single-point methods.

RM	Type	Surface Area (in m^2/g)		Unit Size (in g)
		Static	Single Point	
8005	α-Alumina		2.1	50
8006	α-Alumina		0.3	50
8007	α-Alumina		0.1	50
8008	α-Alumina		0.8	50
8570	Calcined Kaolin	10.9	10.3	10
8571	Alumina	158.7	153.2	10
8572	Silica-Alumina	291.2	277.6	10

302. Surface Finish

Microhardness (block form)

These SRMs are for use in calibrating and checking the performance of microhardness testers. Each is 1.25 × 1.25 cm and was made by electroforming the test metal on AISI 1010 steel substrate.

SRM	Type	Load (in Newtons)	Hardness (in kg/mm^2)
1893	Bright Copper (Knoop)	0.245, 0.490, 0.981	125
1894	Bright Copper (Vickers)	0.245, 0.490, 0.981	125
1895	Bright Nickel (Knoop)	0.245, 0.490, 0.981	600
1896	Bright Nickel (Vickers)	0.245, 0.490, 0.981	600
1905	Bright Nickel (Knoop)	2.943	600
1906	Bright Nickel (Knoop)	4.905	600
1907	Bright Nickel (Knoop)	9.81	600

Abrasive Wear (block form)

This SRM is for use in the dry sand/rubber wheel abrasion test per ASTM G65, Procedure A.

SRM	Type	Unit Size
1857	D–2 Tool Steel	2 blocks: 0.78 × 2.5 × 7.6

Corrosion (plate form)

This SRM is for determining the reliability of step test measurements of electrochemical potential and thickness of multilayered nickel deposits. It consists of a 5.0 × 5.0 cm plate of copper-plated steel over which a duplex nickel coating has been deposited.

SRM	Type	Step Test Potential (in mV)	Nickel Coating Thickness (in μm)	
			Bright	Semibright
2350	Nickel Step Test	110–150	7	20

Surface Roughness (block form)

These SRMs are for calibrating stylus instruments that measure surface roughness. These electroless-nickel coated steel blocks have a sinusoidal roughness profile machined on the top surface.

SRM	Type	Roughness (in μm)	Wavelength (in μm)	Unit Size (in cm)
2071a	Sinusoidal Roughness	0.3 μm	10	block: 2.4 × 3.3
2072	Sinusoidal Roughness	1.0 μm	100	block: 2.4 × 3.3
2073	Sinusoidal Roughness	3.0 μm	100	block: 2.4 × 3.3
2074	Sinusoidal Roughness	1.0 μm	40	In Prep
2075	Sinusoidal Roughness	1.0 μm	800	In Prep

303. Nondestructive Evaluation

Ultrasonics

SRM 1855 is for point-by-point calibration of apparatus used to measure ultrasonic power. SRM 1856 is a displacement-measuring transducer to be used to determine the size and character of surface vibrations.

SRM	Type	Frequency Range (in MHz)	Unit
1855	Ultrasonic Power Transducer	1.6 to 21.6	1 each
1856	Acoustic Emission Transducer	0.1 to 1	1 each

Dye Penetrant Test Blocks

These SRMs are for checking the performance of liquid dye penetrants and dye penetrant crack detection systems and devices for surface defect detection. These test blocks, composed of a laminate cross section of electrodeposited nickel and copper, have four (4) synthetic cracks, approximately 0.2, 0.5, 1, and 2 μm wide.

SRM	Type	Surface	Unit Size (in cm)
1850	Penetrant Test Block	Bright Finish	5D × 1
1851	NDE Penetrant Test Block	Matte Finish	5D × 1

Artificial Flaw for Eddy Current NDE

This Reference Material (RM) 8458 provides a flaw of known size and geometry that closely resembles an actual fatigue crack. It is intended to produce a response suitable for calibrating eddy current non-destructive evaluation (NDE) systems. The flaw size is 3.0 × 0.1 mm long by 1.0 mm deep in a 7 × 7 × 2 cm block of 7075–T651 aluminum alloy, heat treated to the T6 temper.

304. Automatic Data Processing

Magnetic Computer Storage Media

These SRMs are for evaluating the performance of magnetic computer storage media and systems in accordance with relevant standards and for maintaining control over their production. Each SRM is individually calibrated and certified.

SRM	Type	Used by Standard(s)	Unit Size
1600	Secondary Standard Magnetic Tape Cassette—3.8 mm wide tape, certified for signal amplitude output relative to the NIST Standard Reference Amplitude at 63 flux transitions per mm.	ANSI X3.48, X3.103, X3.104	cassette
3200	Secondary Standard Magnetic Tape—12.7 mm wide tape, certified for signal amplitude outputs relative to the NIST Standard Reference Amplitudes at 8, 32, and 126 flux transitions per mm.	ANSI X3.40, X3.14, X3.22, X3.39	open reel
3201	Secondary Standard Magnetic Tape—12.7 mm wide tape, certified for signal amplitude outputs relative to the NIST Standard Reference Tape at 262 and 394 flux transitions per mm.		cartridge
3202	Secondary Standard Magnetic Tape—12.65 mm wide tape, for use in the calibration of average signal amplitude, resolution and overwrite.	ANSI X3.180	cartridge
3216	Secondary Standard Magnetic Tape—6.3 mm wide tape, certified for signal amplitude outputs relative to the NIST Standard Reference Amplitude at 126 flux transitions per mm.	ANSI X3.55, X3.56, X3.72	cartridge
3217	Secondary Standard High Density Magnetic Tape Cartridge—6.3 mm wide tape, certified for signal amplitude outputs relative to the NIST Standard Reference Amplitude at 252 and 394 flux transitions per mm.	ANSI X3.127, X3.116, X3.136	cartridge
6250	Secondary Standard High Density Magnetic Tape—12.7 mm wide tape, certified for signal amplitude output relative to the NIST Standard Reference Amplitude at 356 flux transitions per mm.	ANSI X3.40, X3.157, X3.54	open reel

Flexible Disks

These Reference Materials (RMs) are issued by NIST in cooperation with the Physikalisch-Technische Bundesantalt (PTB), Germany, for signal amplitude, overwrite, and resolution. The RM numbers correspond to the ISO standard numbers. The materials conform to relevant standards for flexible disk cartridges.

RM	Type	Unformatted Capacity (in kilobytes)	Used by Standard	Unit Size (in mm)
6596	Flexible Disk Cartridge–130	125	ANSI X3.82	130
9529	Flexible Disk Cartridge–90	2000	ANSI X3.171	90

Centerline Drawings for Optical Character Recognition Style B

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 Size I Optical Character Recognition (OCR-B) applications in accordance with one or more of the following standards: ANSI X3.49–1975 (R 1982), Character Set for Optical Character Recognition (OCR-B); FIPS Publication (OCR), ECMA–11 for the Alphanumeric Character Set OCR-B for Optical Recognition, 3rd Edition, 1976; and ISO 1073/II-1976, Alphanumeric Character Sets for Optical Recognition Part II: Character Set OCR-B.

This SRM contains information on the shape, size, strokewidth, and position relative to the base line of the OCR-B characters.

SRM	Characters	Sheets	Size	Sheet Size
1901	118	118	OCR-B I	32 × 44 × 0.01 cm

305. Fire Research

Surface Flammability (sheet form)

This SRM is for checking the operation of radiant panel test equipment in accordance with the procedures outlined in ASTM E162–78.

SRM	Type	Certification	Unit Size
1002d	Hardboard Sheet	Flame Spread Index, I = 153 Heat Evolution Factor, Q = 36.5	Set of 4: 15.2 × 45.7 × 0.63 cm

Smoke Density Chamber (sheet form)

These SRMs are certified for maximum specific optical density and are for performing operational checks of smoke density chambers.

SRM	Type	Maximum Specific Optical Density	Unit Size (in cm)
1006c	Non-flaming Exposure Condition (α-cellulose)	Dm (corr.) = 178	6 sheets: 0.05 (thickness)
1007b	Flaming Exposure Condition (plastic)	Dm (corr.) = 421 to 493	3 sheets: 16 × 16 × 0.076

Smoke Toxicity (sheet form)

This SRM is for checking the operation of the Cup Furnace Smoke Toxicity Method under two (2) observation periods. It consists of eight (8) sheets, 16 × 16 × 0.76 cm each, of acrylonitrile-butadiene-styrene copolymer.

SRM	Type	Combustion Mode	Observation Time	Values	
				LC_{50}	N-Gas
1048	Smoke Toxicity	Flaming	WE *	27	1.4
			WE & PE **	25	1.5
		Nonflaming	WE *	58	1.2
			WE & PE **	53	1.4

* WE = within 30 min.
** WE & PE = 30 min + 14 d.

Flooring Radiant Panel (sheet form)

This SRM consists of three (3) sheets of kraft paperboard. It is for checking the operation of flooring radiant panel test apparatus used to measure critical radiant flux as per ASTM E648.

SRM	Type	Critical Radiant Flux	Unit Size
1012	Flooring Radiant Panel	00.36 W/cm^2	104.1 × 25.4 × 0.305 cm

309. Miscellaneous Performance Engineering Materials

Socketed Ball Bar

This SRM is for measuring the performance of coordinate measuring machines (CMMs) as per ASME Standard B89.1.12. It consists of a set of three (3) precision balls pinned and cemented onto threaded shafts, one (1) table-mount magnetic socket, one (1) ram-mount magnetic socket, and five (5) partially insulated extension tubes—50, 100, 200, 400, and 800 mm long.

SRM	Type	Measuring Lengths (in 50 mm steps)	Unit Size
2083	Socketed Ball Bar	100 to 1650	Set

Charpy V-Notch Test Blocks

These SRMs are test specimens for certification of Charpy V-Notch impact testing machines. This test is to be done in accordance with ASTM Standard E-23. Each SRM consists of five (5) $10 \times 10 \times 54$ mm bars of 4340 alloy steel. After completing the test and filling out the questionnaire, the bars are to be returned to the Charpy Program Coordinator, National Institute of Standards and Technology, Code 853, 325 Broadway, Boulder, CO 80303.

SRM	Type	Hardness Range (HRC)	Energy Range (in J)		(in m · kg)
2092	(Low Energy)	45 ± 1	15–20	(11–15 ft-lbs)	1.5–2.1
2096	(High Energy)	32 ± 1	90–106	(66–78 ft-lbs)	9.1–10.8
2098	(Super High Energy)*	29 ± 1	210–224	(155–165 ft-lbs)	

* *Until ASTM Standard E-23 is modified to include the use of super high energy specimens for machine certification, these specimens can only be used as reference materials; they cannot be used for certification of Charpy V-Notch testing machines.* Incorporation of the super high energy specimens into the above standard is currently being balloted by ASTM. Meanwhile, the user should send the fractured specimens and completed questionnaire to the National Institute of Standards and Technology (NIST), which will review the data and issue a report of its findings to the user's facility. If the user's machine produces acceptable values, this report will document the conformance (acceptable operation) of the machine. If the machine produces values outside the acceptable tolerance of the nominal energy value, this report will suggest changes (machine design, repair or replacement of worn parts, changes in testing procedures, etc.) to bring the machine into conformance.

Daniel Vigliotti, *Mechanical Engineering Technician*, Materials Reliability Division; **Dominique Shepherd,** *Materials Research Engineer*, Materials Reliability Division

Tape Adhesion Testing (sheet form)

This SRM 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
1810a	Linerboard for Tape Adhesion Testing	In Prep

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Trahey, N. M., editor, **NIST Standard Reference Materials Catalog (1992–93 edition),** NIST Spec. Publ. 260 (February 1992).

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**

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 1965). 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**

* Send order with remittance to New Orders, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954. 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, VA 22161.

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**

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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**

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694	Phosphate Rock (Western)	Jun 84	110/111	78/81
696	Bauxite (Surinam)	Jan 91	111	81
697	Bauxite (Dominican)	Jan 91	111	81
698	Bauxite (Jamaican)	Jan 91	111	81
699	Alumina, Reduction Grade	Aug 81	111	81
705a	Polystyrene 179K mol wt	Jul 90	202/203	95/97
706	Polystyrene 258K mol wt	Feb 79	202	95
708	Glass, Stress Optical Coefficient	Sep 73	208	120
709	Glass, Extra Dense Lead	Jun 74	208	120
710a	Glass, Soda-Lime-Silica Viscosity	Mar 91	208	119/120
711	Glass, Lead-Silica Viscosity	Jul 64	208	119/120
712	Glass, Alkali Lead-Silica Anneal. Pt.	Oct 65	208	120
713	Glass, Dense Barium Crown Anneal. Pt.	Oct 65	208	120
715	Glass, Alkali-free Alumina Anneal. Pt.	Sep 66	208	120
716	Glass, Neutral Anneal. Pt.	Sep 66	208	120
717	Glass, Borosilicate Viscosity	Nov 69	208	119/120
720	Synthetic Sapphire	Apr 82	203	97
723a	Tris, Basimetric	Apr 81	104	46
724a	Tris, Calorimetric	Sep 73	203	97
726	Selenium, Intermed. Purity	Jan 67	104	45
728	Zinc, Intermed. Purity	Nov 87	104	45
731	Glass, Borosilicate	Jul 72	203	101
736	Copper-Thermal Expansion	Oct 90	203	101
738	Steel, Stainless	Nov 86	203	101

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739	Fused Silica	May 71	203	101
740a	Zinc Freezing Point	Nov 90	203	99
741	Tin Freezing Point	Jun 90	203	99
742	Alumina Melting Pyrometric Std.	Jul 90	203	99
743	Mercury Triple Point	Jul 90	203	99
745	Gold-Vapor Pressure	Aug 90	203	100
746	Cadmium, Vapor Pressure	Jan 91	203	100
748	Silver, Vapor Pressure	Aug 70	203	100
RM754	ICTA Polystyrene DTA	– 92	203	98
RM757	ICTA Low Temp DTA	– 92	203	98
RM758	ICTA Mod Temp DTA	– 92	203	98
RM759	ICTA Mod Temp DTA	– 92	203	98
RM760	ICTA High Temp DTA	– 92	203	98
RM761	ICTA High Temp DTA	– 92	203	98
767a	Thermometric Fixed Points	Aug 90	203	99
769	Electrical "RRR" Set	Nov 82	206	114
773	Glass, Liquidus Temperature	Nov 80	208	120
774	Glass, Dielectric Constant	Jul 82	208	119
781	Molybdenum, Heat Capacity	Mar 77	203	97
853	Aluminum Alloy 3004	May 85	102	36
854	Aluminum Alloy 5182	May 85	102	36
855a	Aluminum Casting Alloy 356	Jan 90	102	36
856a	Aluminum Casting Alloy 380	Jan 90	102	36
858	Aluminum Alloy 6011	Jun 80	102	36
859	Aluminum Alloy 7075	Jun 80	102	36
864	Inconel 600	May 84	102	41
865	Inconel 625	May 84	102	41
866	Incoloy 800	May 84	102	41
867	Incoloy 825	May 84	102	41
868	High Temp Alloy Fe-Ni-Co	May 87	101	24
869	Polycyclic Aromatic Hydrocarbons	Mar 90	109	73
871	Bronze, Phosphor (CDA 521)	Aug 79	102	37
872	Bronze, Phosphor (CDA 544)	Aug 79	102	37
874	Cupro-Nickel, 10% (CDA 706) High Purity	Jan 78	102	37
875	Cupro-Nickel, 10% (CDA 706) Doped	Jan 78	102	37
879	Nickel Silver, (CDA 762)	Jun 79	102	37
880	Nickel Silver, (CDA 770)	Jun 79	102	37
882	Ni-Cu-Al	Aug 79	102	41
885	Refined Copper	Mar 91	104	45
887	Cemented Carbide	Sep 88	112	85
888	Cemented Carbide	Sep 88	112	85
889	Cemented Carbide	Sep 88	112	85
890	Iron, HC-250 + V	Apr 82	101	33
891	Iron, Ni-Hard I	Apr 82	101	33
892	Iron, Ni-Hard IV	Apr 82	101	33
897	Tracealloy A	Aug 83	102	41
898	Tracealloy B	Aug 83	102	41
899	Tracealloy C	Aug 83	102	41
900	Antiepilepsy Drug Level Assay	Apr 79	105	53
909a	Human Serum	Jul 91	105	54
910	Sodium Pyruvate	May 81	105	53
911b	Cholesterol	May 88	105	53
912a	Urea-Clinical	Dec 90	105	53
913	Uric Acid	Nov 73	105	53
914a	Creatinine	Oct 87	105	53
915	Calcium Carbonate	Nov 73	105	53
916a	Bilirubin	Jun 89	105	53
917a	D-Glucose (Dextrose)-Clinical	Aug 89	105	53
918	Potassium Chloride-Clinical	Nov 73	105	53
919a	Sodium Chloride-Clinical	Feb 91	105	53
920	D-Mannitol	Nov 73	105	53
921	Cortisol (Hydrocortisone)	Dec 73	105	53
922	Tris(hydroxymethyl)	Dec 73	105/201	53/93
923	Tris hydroxymethyl Hydrochloride	Dec 73	105/201	53/93
924a	Lithium Carbonate	– 92	105	53
925	4-Hydroxy-3-methoxy-dlmandelic	Dec 73	105	53
927a	Bovine Serum Albumin	Aug 86	105	54
928	Lead Nitrate	May 76	105	53
929	Magnesium Gluconate	Apr 79	105	53
930d	Glass Filters-Visible	Aug 84	204	104
931e	Liquid Filters UV & Visible	– 92	204	104
934	Clinical Laboratory Thermometer	Jun 90	203	100
935a	Crystal Potassium Dichromate	Apr 88	204	104
936	Quinine Sulfate Dihydrate	Apr 79	204	104
937	Iron Metal	Jun 78	105	53
938	4-Nitrophenol	May 81	105	53
951	Boric Acid	Oct 71	104	46/51
952	Enriched Boric Acid	Oct 71	104	51
953	Neutron Density Monitor Wire	Mar 69	205	107
955a	Lead in Blood	– 92	105	53
956	Electrolytes in Human Serum	Jun 90	105	53
961	Fission Track Glass	Jun 74	205	107
963a	Fission Track Glass	Feb 84	205	107
968a	Fat Soluble Vits. in Human Serum	– 92	105	53
975	Chlorine, Isotopic	Mar 65	104	51
976	Copper, Isotopic	Feb 88	104	51
977	Bromine, Isotopic	Mar 65	104	51
978a	Silver, Isotopic	Sep 84	104	51
979	Chromium, Isotopic	May 66	104	51
980	Magnesium, Isotopic	Jan 67	104	51
981	Lead, Common Isotopic	Mar 91	104	51
982	Lead, Equal-Atom Isotopic	Mar 91	104	51
983	Lead, Radiogenic Isotopic	Mar 91	104	51
984	Rubidium Chloride, Assay & Isotopic	Jul 70	104	51
985	Potassium, Assay & Isotopic	Aug 79	104	51
986	Isotopic Standard for Nickel	May 91	104	51
987	Strontium Carbonate	Oct 82	104	46/51
989	Rhenium, Assay & Isotopic	Feb 74	104	51
990	Silicon, Assay & Isotopic	Aug 75	104	51
991	Lead-206 Spike, Assay & Isotopic	Mar 76	104	51
994	Gallium, Isotopic	Feb 86	104	51
997	Thallium, Isotopic	Jul 86	104	51
998	Angiotensin I (Human)	Jan 83	105	53
999	Potassium Chloride	Sep 72	104	46
1001	X-Ray Film Step Tablet	Jan 91	204	106
1002d	Surface Flammability Standard	Aug 89	305	129
1003b	Calibrated Glass Spheres	– 92	301	123
1004a	Calibrated Glass Spheres	– 92	301	123
1006c	Smoke Density, Nonflame cellulose	Oct 88	305	129
1007b	Flaming Exposure Condition	Aug 90	305	129
1008	Photographic Step Tablet	Jan 91	204	106
1010a	Microscopy Resolution Test Charts	Jun 90	204	106
1012	Flooring Radiant Panel	Sep 84	305	129
1017a	Glass Beads	Sep 71	301	123
1018a	Glass Beads	May 73	301	123
1019a	Glass Spheres	Oct 84	301	123
1034	Unalloyed Copper	Feb 82	102	37
1035	Leaded-Tin Bronze Alloy	Feb 82	102	37
1048	Smoke Toxicity ABS	Nov 91	305	129
1051b	Barium Metallo-Organic-Ba	Jun 91	114	90
1052b	Vanadium Metallo-Organic-V	Mar 68	114	90
1053a	Cadmium Metallo-Organic-Cd	Jan 70	114	90
1057b	Tin Metallo-Organic-Sn	Aug 68	114	90
1059c	Lead Cyclohexanebutyrate-Pb	Sep 87	114	90
1060a	Metallo-Organic-Li	Apr 64	114	90
1065b	Metallo-Organic-Ni	Nov 67	114	90
1066a	Metallo-Organic-Si	Jun 91	114	90
1069b	Metallo-Organic-Na	Jun 91	114	90
1070a	Metallo-Organic-Sr	Apr 64	114	90
1071b	Metallo-Organic-P	Sep 91	114	90
1073b	Metallo-Organic-Zn	Sep 86	114	90
1075a	Metallo-Organic-Al	Oct 67	114	90
1077a	Metallo-Organic-Ag	Feb 68	114	90
1078b	Metallo-Organic-Cr	Jul 72	114	90
1079b	Metallo-Organic-Fe	Feb 69	114	90
1080a	Metallo-Organic-Cu	Feb 69	114	90
1083	Wear-Metals (Base Oil)	Jul 91	114	91
1084a	Wear-Metals	Apr 91	114	91
1085a	Wear-Metals	Apr 91	114	91
1090	Ingot Iron	Nov 85	101	35

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1091a	Steel, Stainless (AISI 431)	Nov 85	101	35
1093	Steel, Valve	Nov 84	101	35
1094	Steel, Maraging	Nov 84	101	35
1095	Steel, (AISI 4340)	Apr 86	101	35
1096	Steel, (AISI 94B17)	Apr 86	101	35
1097	Steel, Cr-V (mod.)	Apr 86	101	35
1098	Steel, High Carbon	Apr 86	101	35
1099	Iron, Electrolytic	Apr 86	101	35
1103	Brass, Free Cutting	Aug 65	102	38
1104	Brass, Free Cutting	Aug 65	102	38
1107	Brass, Naval B	Nov 81	102	38
1108	Brass, Naval C	Nov 81	102	38
C1108	Brass, Naval C	Nov 81	102	38
C1110	Brass, Red B	Oct 81	102	38
1111	Brass, Red C	Oct 81	102	38
C1111	Brass, Red C	Oct 81	102	38
1112	Gilding Metal A	Oct 81	102	38
C1112	Gilding Metal A	Oct 81	102	38
1113	Gilding Metal B	Oct 81	102	38
C1113	Gilding Metal B	Oct 81	102	38
1114	Gilding Metal C	Oct 81	102	38
C1114	Gilding Metal C	Oct 81	102	38
1115	Bronze, Commercial A	Nov 81	102	38
C1115	Bronze, Commercial A	Nov 81	102	38
1116	Bronze, Commercial B	Nov 81	102	38
C1116	Bronze, Commercial B	Nov 81	102	38
1117	Bronze, Commercial C	Nov 81	102	38
C1117	Bronze, Commercial C	Nov 81	102	38
1128	Ti Base Alloy V-Al-Cr-Sn	Jul 91	102	42
1129	Solder (63Sn-37Pb)	May 89	102	40
1131	Solder (40Sn-60Pb)	Oct 81	102	40
1132	Bearing Metal, Pb-Sb-Sn	Jan 70	102	40
1133	Ti Base Alloy Al-Sn-Zr-Cr-Mo	Jun 87	102	42
1134	LA Steel, High Silicon	Apr 70	101	26
1135	LA Steel, High Silicon	Jul 72	101	26
C1137a	Iron, White Cast	Jan 84	101	34
1138a	Steel, Cast 1	Jan 77	101	34
1139a	Steel, Cast 2	Jan 77	101	34
C1145a	Iron, White Cast	Jan 88	101	34
C1146a	Iron, White Cast	Jan 88	101	34
C1150a	Iron, White Cast	Jan 88	101	34
C1151	Steel, Stainless (23Cr-7Ni)	Jan 80	101	30
C1152a	Steel, Stainless (18Cr-11Ni)	Feb 90	101	30
C1153	Steel, Stainless (17Cr-9Ni)	Jan 80	101	30
C1153a	Steel, Stainless (17Cr-9Ni)	Sep 90	101	30
C1154	Steel, Stainless (19Cr-13Ni)	Jan 80	101	30
1155	Steel, Stainless Cr-Ni-Mo (AISI 316)	Aug 69	101	30
1157	Steel, Tool (AISI M2)	Aug 73	101	30
1158	Steel, High-Nickel (Ni36)	Dec 77	101	30
1159	Electronic and Magnetic Alloy Ni-Fe	Aug 81	102	41
1160	Electronic and Magnetic Alloy Ni-Mo	Aug 81	102	41
1171	Steel, Stainless Cr-Ni-Ti (AISI 321)	Jul 71	101	30
1172	Steel, Stainless Cr-Ni-Nb (AISI 348)	Jul 71	101	30
C1173	Steel, Cast 3	Jun 89	101	34
1173	Steel, Ni-Cr-Mo-V	Jun 89	101	34
1216	Carbon Modified Silicon	Nov 87	106	59
1218	LA Steel, High Silicon, Low C & S	Nov 84	101	26
1219	Steel, Stainless Cr-Ni (AISI 431)	Sep 85	101	30
C1221	LA Steel, Resulf./Rephos. (AISI 1211)	Jan 82	101	26
1222	LA Steel, Cr-Ni-Mo (AISI 8640)	Sep 90	101	26
1223	Steel, Stainless, Chromium	Sep 85	101	30
1224	LA Steel, Carbon (AISI 1078)	Feb 81	101	26
1225	LA Steel, (AISI 4130)	Mar 83	101	26
1226	LA Steel	Dec 82	101	26
1227	LA Steel, BOH 1%C	Mar 83	101	26
1228	LA Steel, BOH 0.1%C	Sep 82	101	26
1230	High Temperature Alloy	Jun 87	101	31
1233	Steel, Valve	Feb 86	101	30
1235	Zr Base Alloy, Zirconium B	Nov 80	102	43
1241b	Aluminum Alloy 5182	Aug 85	102	36
1243	Waspaloy	Jan 89	101/102	31/41
1244	Inconel 600	May 84	101	31
1245a	Inconel 625	May 84	101	31
1246	Incoloy 800	May 84	101	31
1247	Incoloy 825	May 84	101	31
C1248	Ni-Cu Alloy	Dec 86	102	41
1250	Fe-Ni-Co	Jul 87	101	31
C1251	Phosphorized Copper (Cu VIII)	Apr 86	102	39
C1252	Phosphorized Copper (Cu IX)	Apr 86	102	39
C1253	Phosphorized Copper (Cu X)	Apr 86	102	39
1254	LA Steel, (Ca only)	Apr 82	101	26
1255a	Aluminum Casting Alloy 356	Nov 86	102	36
1256a	Aluminum Casting Alloy 380	Nov 86	102	36
1258	Aluminum Alloy 6011	May 78	102	36
1259	Aluminum Alloy 7075	May 78	102	36
1261a	LA Steel, (AISI 4340)	Feb 81	101	26
1263a	LA Steel, Cr-V (mod.)	Feb 81	101	26
1264a	LA Steel, High Carbon (mod.)	Jan 88	101	26
1265a	LA Steel, Electrolytic Iron	Jun 89	101	26
1267	Steel, Stainless (AISI 446)	Jan 78	101	30
C1269	LA Steel (AISI 1526) Line Pipe (mod.)	Jun 81	101	26
1270	LA Steel, A336 (F-22) Cr-Mo	Jun 81	101	26
1275	Cupro-Nickel (CDA 706)	Mar 80	102	38
1276a	Cupro-Nickel (CDA 715)	Jun 89	102	38
C1285	LA Steel (A242) (mod.)	Jun 82	101	26
1286	Low Alloy Steel (Hy 80)	Jun 82	101	26
C1287	Steel, (AISI 310 mod.)	Jun 81	101	30
C1288	Steel, (A-743)	Aug 81	101	30
C1289	Steel, (AISI 414 mod.)	Jun 81	101	30
C1290	Iron, White Cast (HC-250+V)	Jan 85	101	34
C1291	Iron, White Cast (Ni-Hard, Type I)	Jan 85	101	34
C1292	Iron, White Cast (Ni-Hard, Type IV)	Jan 85	101	34
1321	Cu-Cr Coating (nonmagnetic) on Steel	Jul 91	207	116
1322	Cu-Cr Coating (nonmagnetic) on Steel	Jul 91	207	116
1323	Cu-Cr Coating (nonmagnetic) on Steel	Jul 91	207	116
1331a	Ni Coating on Steel	Dec 89	207	116
1332a	Ni Coating on Steel	Dec 89	207	116
1333a	Ni Coating on Steel	Dec 89	207	116
1334a	Ni Coating on Steel	Dec 89	207	116
1335a	Ni Coating on Steel	Dec 89	207	116
1336a	Ni Coating on Steel	Dec 89	207	116
1337a	Ni Coating on Steel	Dec 89	207	116
1338a	Ni Coating on Steel	Dec 89	207	116
1339a	Ni Coating on Steel	Dec 89	207	116
1357	Cu-Cr Coating (nonmagnetic)	Jul 91	207	116
1358	Cu-Cr Coating (nonmagnetic)	Jul 91	207	116
1359	Cu-Cr Coating (nonmagnetic)	Jul 91	207	116
1360	Cu-Cr Coating (nonmagnetic)	Jul 91	207	116
1361a	Cu-Cr Coating (nonmagnetic)	Jul 91	207	116
1362a	Cu-Cr Coating (nonmagnetic)	Jul 91	207	116
1363a	Cu-Cr Coating (nonmagnetic)	Jul 91	207	116
1364a	Cu-Cr Coating (nonmagnetic)	Jul 91	207	116
1371	Gold on Fe-Ni-Co Alloy	Oct 90	207	117
1372	Gold on Fe-Ni-Co Alloy	Oct 90	207	117
1373	Gold on Fe-Ni-Co Alloy	Oct 90	207	117
1374	Gold on Fe-Ni-Co Alloy	Oct 90	207	117
1375	Gold on Ni	Oct 90	207	117
1376	Gold on Ni	Oct 90	207	117
1377	Gold on Ni	Oct 90	207	117
1378	Gold on Ni	Oct 90	207	117
1379	Ultra-thin Gold on Ni	Oct 90	207	117
1380	Ultra-thin Gold on Ni	Oct 90	207	117
1411	Soft Borosilicate Glass	Aug 85	112	86
1412	Glass, Multicomponent	Aug 85	112	86
1413	Glass Sand, High Alumina	Aug 85	111	83
1414	Lead-Silica Glass	Jul 91	208	119
1449	Fumed Silica Board	Jan 89	203	101
1450b	Thermal Resis., Fibrous Glass Board	May 85	203	101
1451	Thermal Resis., Fibrous Glass Blanket	May 85	203	101
1452	Thermal Resis., Fibrous Glass Batt	Apr 86	203	101

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1457	Superconducting Critical Current	Jun 84	206	114
1459	Fumed Silica Board	Jan 89	203	101
1460	Steel, Stainless Therm. Conduct.	May 84	203	101
1461	Steel, Stainless Therm. Conduct.	May 84	203/206	101/113
1462	Steel, Stainless Therm. Conduct.	May 84	203/206	101/113
1470	Gas Transmission, Polyester Film	Feb 82	207	118
1473	Polyethylene Resin	Oct 91	202	95
1474	Polyethylene Resin	Apr 90	202	95
1476	Branched Polyethylene (viscosity)	Nov 69	202	95
1478	Polystyrene (37k mol wt)	Jan 79	202	95
1479	Polystyrene (1M mol wt)	Mar 81	202	95
1482	Linear Polyethylene (13k mol wt)	Oct 76	202	95
1483	Linear Polyethylene (32k mol wt)	Mar 76	202	95
1487	Poly (Methyl Methacrylate)	Jun 89	202	95
1488	Poly (Methyl Methacrylate)	Feb 88	202	95
1489	Poly (Methyl Methacrylate)	Mar 86	202	95
1491	Aromatic Hydrocarbons in Hexane	Aug 89	109	68
1492	Chlorinated Pesticides in Hexane	Apr 89	109	68
1496	Polyethylene Resin (Natural)	Sep 88	202	95
1497	Polyethylene Resin (Pigmented)	Jul 87	202	95
1507b	THC-9-COOH	– 92	105	55
1508	Cocaine & Metabs. in Fr.-Dried Urine	Oct 90	105	55
1514	Thermal Analysis Purity (DSC)	Jul 84	203	98
1515	Apple Leaves	Jul 91	110	77
1543	GC/MS System Performance	Aug 84	109	73
1547	Peach Leaves	Jul 91	110	77
1548	Total Diet	Nov 91	110	74
1549	Non-Fat Milk Powder	Jul 85	110	74
1563	Chol. & Fat Sol. Vit. in Cod Liver	Jul 87	110	75
1566a	Oyster Tissue	Oct 89	110	74
1567a	Wheat Flour	Sep 88	110	74
1568a	Rice Flour	Jan 88	110	74
1569	Brewers Yeast (Cr only)	Sep 76	110	74
1575	Pine Needles	Oct 76	110	77
1577b	Bovine Liver	Aug 91	110	74
1579	Powdered Lead-Base Paint (Pb only)	Jan 73	106	58
1580	Organics in Shale Oil	Nov 80	109	68
1581	Polychlorinated Biphenyls in Oils	Jun 90	109	68
1582	Petroleum Crude Oil	Jan 84	109	68
1583	Chlor. Pesticides in 2,2,4-Trimeth.	Feb 85	109	68
1584	Phenols in Methanol	Apr 84	109	68
1585	Chlorinated Biphenyls	Jan 86	109	68
1586	Isotopically Label Pollutants	Oct 84	109	68
1587	Nitrated PAH in Methanol	Jun 85	109	68
1588	Organics in Cod Liver Oil	Jan 89	109	68
1589	PCB's in Human Serum	Nov 85	109	68
1590	Stabilized Wine	Nov 85	110	75
1595	Tripalmitin	Jul 83	105	53
1596	Dinitropyrene Iso. & 1-Nitropyrene	Jul 87	109	68
1597	Complex Mix. of Polycyclic Arom.	Sep 87	109	68
1598	Inorganic Constituents in Bovine Ser.	Jan 89	105	53
1599	Anticonvulsant Drug Level Assay	Aug 82	105	53
1600	Second. Std. Magnetic Tape Cassette	Mar 74	304	127
1614	Dioxin in Isooctane	Jul 85	109	68
1616	Sulfur in Kerosene	Feb 88	108	65
1617	Sulfur in Kerosene	Feb 88	108	65
1618	V and Ni in Residual Fuel Oil	May 85	106	58
1619a	Sulfur in Residual Fuel Oil	Apr 91	108	65
1620b	Sulfur in Residual Fuel Oil	Jul 90	108	65
1621d	Sulfur in Residual Fuel Oil	Mar 91	108	65
1622d	Sulfur in Residual Fuel Oil	Apr 91	108	65
1623b	Sulfur in Redidual Fuel Oil	Jul 90	108	65
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1626	Sulfur Dioxide Perm Tube	Nov 91	107	63
1627	Sulfur Dioxide Perm Tube	Oct 90	107	63
1629a	Nitrogen Dioxide Perm Device	Feb 87	107	63
1630	Trace Mercury in Coal	Aug 79	106	58
1632b	Trace Elements in Coal (Bituminous)	Mar 90	108	66
1633a	Trace Elements in Coal Fly Ash	Jan 85	108	66
1634b	Trace Elements in Fuel Oil	Feb 86	108	66
1635	Trace Elements in Coal Subbit.	Aug 79	108	66
1638b	Lead in Reference Fuel	Aug 86	106	58
1639	Halocarbons (in method) for H_2O	Apr 83	109	68
1641b	Mercury in H_2O, (μg/mL)	Apr 83	106	58
1643c	Trace Elements in H_2O	Jun 91	108	66
1646	Estuarine Sediment	Jun 82	108	66
1647b	Priority Pollutant PAH	Aug 90	109	68
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1649	Urban Dust/Organics	Apr 82	109	68
1650	Diesel Particulate Matter	Feb 85	109	68
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1656	Thianthrene, Combustion	Jan 85	203	97
1657	Synthetic Refuse-Derived Fuel	Mar 85	203	97
1658a	Methane in Air	Mar 81	107	61
1659a	Methane in Air	Apr 91	107	61
1660a	Methane and Propane in Air	Mar 81	107	61
1661a	Sulfur Dioxide in Nitrogen	Jul 89	107	62
1662a	Sulfur Dioxide in Nitrogen	Jul 89	107	62
1663a	Sulfur Dioxide in Nitrogen	Mar 81	107	62
1664a	Sulfur Dioxide in Nitrogen	Mar 81	107	62
1665b	Propane in Air	Dec 87	107	62
1666b	Propane in Air	Dec 87	107	62
1667b	Propane in Air	Dec 87	107	62
1668b	Propane in Air	Aug 89	107	62
1669b	Propane in Air	Aug 89	107	62
1674b	Carbon Dioxide in Nitrogen	May 91	107	61
1675b	Carbon Dioxide in Nitrogen	Aug 88	107	61
1677c	Carbon Monoxide in Nitrogen	Jun 91	107	61
1678c	Carbon Monoxide in Nitrogen	Jan 80	107	61
1679c	Carbon Monoxide in Nitrogen	Jan 80	107	61
1680b	Carbon Monoxide in Nitrogen	Apr 91	107	61
1681b	Carbon Monoxide in Nitrogen	Nov 88	107	61
1683b	Nitric Oxide in Nitrogen	Nov 90	107	61
1684b	Nitric Oxide in Nitrogen	Apr 91	107	61
1685b	Nitric Oxide in Nitrogen	May 89	107	61
1686b	Nitric Oxide in Nitrogen	May 89	107	61
1687b	Nitric Oxide in Nitrogen	May 89	107	61
1690	Polystyrene Spheres	Dec 82	301	123
1691	Polystyrene Spheres	May 84	301	123
1692	Polystyrene Spheres	May 91	301	123
1693a	Sulfur Dioxide in Nitrogen	Jun 89	107	62
1694a	Sulfur Dioxide in Nitrogen	Jun 89	107	62
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1702a	Carbon Dioxide & Oxygen in Nitrogen	Aug 88	105/107	53/60
1703a	Carbon Dioxide & Oxygen in Nitrogen	Aug 88	105/107	53/60
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1761	Low Alloy Steel	Jun 89	101	26
1762	Low Alloy Steel	Jun 89	101	26
1763	Low Alloy Steel	Jun 89	101	26
1764	Low Alloy Steel	Jun 89	101	26
1765	Low Alloy Steel	Jun 89	101	26
1766	Low Alloy Steel	Jun 89	101	26
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1826	Glass Density	Aug 90	209	121
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1833	Thin Glass Film on Polycarbonate	May 84	106	59
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1839	Methanol in Reference Fuels	Mar 86	108	64
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4904S	Alpha Particle Std.	May 86	205	110
4906C	Plutonium-238 Point Source	Oct 87	205	110
4906H	Plutonium-238 Point Source	Oct 87	205	110
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4919G	Strontium-99 Soln	May 88	205	108
4926D	Hydrogen-3 Tritiated Water	Aug 89	205	108
4927D	Hydrogen-3 Tritiated Water	Jan 89	205	108
4929D	Iron-55 X-ray Soln	Feb 86	205	108
4935C	Krypton-85 Beta-Particle Gaseous	Jul 74	205	110
4943	Chlorine-36 Beta-Particle Soln	Dec 84	205	108
4947C	Hydrogen-3 Tritiated Toluene	May 87	205	108
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4950E	Radium-226 Soln	Jun 84	205	111
4952B	Radium-Standard Blank Soln	Aug 76	205	111
4953D	Radium-226 Soln	Jun 84	205	111
4990C	Carbon-14 Oxalic Acid	Jul 83	205	110
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RM8006	Alpha Alumina (Surface Area)NPL	Aug 90	301	124
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RM8008	Alpha Alumina (Surface Area)NPL	Aug 90	301	124
8101	Automated Computer Time Service	Jul 90	207	118
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8407	Mercury in Tennessee River Sed	Jun 90	111	84
8408	Mercury in Tennessee River Sed	Jun 90	111	84
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8413	Corn (Zea Mays) Kernel	Feb 89	110	77
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8415	Whole Egg Powder	Jan 92	110	76
8416	Microcry. Cellulose	Jan 92	110	76

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8423	Sintered Tungsten	May 84	203/206	101/113
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8425	Graphite	May 84	203	101
8426	Graphite	May 84	203	101
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8437	Hard Red Spr. Wheat Flour	Jan 92	110	76
8438	Soft Winter Wheat Flour	Jan 92	110	76
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8451	Polyethylene Piping	Jan 88	202	96
8452	Polyethylene Piping	Jan 88	202	96
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8469	4,4′-DDE (neat)	– 92	109	68
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8487	Portland Cement Clinker	May 89	113	89
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* U.S. G.P.O.:1992-317-626

Preparation of SRM 460 beryllium copper.

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