Standard Reference Materials:
GUIDE TO UNITED STATES REFERENCE MATERIALS
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2 Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.
3 Located at Boulder, Colorado 80302.
Standard Reference Materials:
GUIDE TO UNITED STATES REFERENCE MATERIALS

Special Publication

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Institute for Materials Research
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National Bureau of Standards
Washington, D.C. 20234

J. Paul Cali, Chief
Office of Standard Reference Materials
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Cooperative Study (SRM 758, 759, 760), NBS Spec. Publ. 260-40 (August 1972) COM-72-50776**


Electrolytic Iron, SRM’s 734 and 797 from 4 to 1000 K, NBS Spec. Publ. 260-50 (June 1975) 1.00* SN003-003-01425-7

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


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Standard Reference Materials:

GUIDE TO UNITED STATES REFERENCE MATERIALS

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Summarized is a list of reference materials produced and distributed by U.S. manufacturers, both public and private. Extensive tables are indexed by use to which reference materials may be put. Properties covered include: chemical composition (analytical chemical purposes), chemical composition (high purity), physical properties, engineering and technological properties, and biochemical properties. Names and addresses of 93 U.S. producers and/or distributors are included.

Key words: Measurement; reference materials; standardization;
Standard Reference Materials.
I. Background

In 1976, the Council Committee on Reference Materials (REMCO) of the International Organization for Standardization proposed as the term "reference materials" the following definition: "A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus or for the verification of a measurement method." "A certified reference material (CRM) is further defined as: "A RM accompanied by, or traceable to, a certificate stating the property value(s) concerned, issued by an organization, public or private, which is generally accepted as technically competent." A careful reading of this definition will lead the reader to the conclusion that a great many materials will rest comfortably under its umbrella. Thus, for an analytical chemist any pure chemical used to prepare what are usually called "standard solutions" can be considered to be a reference material. Simple devices, such as accurately calibrated optical filters, also are covered by this definition. Where to draw the line to exclude various chemicals or devices is somewhat arbitrary and no hard and fast rules have been developed to date. Weights used to calibrate or check balances are, e.g., not considered reference materials, even though they obviously fit the definition very well. For this reason then the reference materials listed herein are somewhat arbitrary. In fact, the inclusion or exclusion of a particular supplier's reference materials is first and foremost simply a function of whether or not he replied to our inquiry for information.

The current great interest in reference materials as an important means for helping to assure measurement compatibility in a wide variety of applications dates from 1969. In that year the National Bureau of Standards (NBS) and the International Committee on Weights and Measures (CIPM) cosponsored a meeting where the desirability of establishing a formal program internationally was explored. Representatives from 15 countries and 4 international agencies agreed unanimously that such a course of action would be desirable. The need for a central distributing agency for exchange of information on reference materials, preferably through an international agency was stressed. The CIPM was asked to assume this (and other) responsibilities. Subsequently however, the CIPM with regret had to decline due to a lack of resources and a misfit with regard to its scope. (1)
However, the matter was not dead for following the first large scale SRM Symposium held at NBS in 1973 - see reference (2), a meeting called by the International Organization for Legal Metrology was held to reactivate the matter. As a result of this meeting, attended by representatives of 12 countries and 7 international agencies, ISO subsequently agreed to provide secretariat services for international agencies interested in the exchange of information concerning reference materials.

Thus, ISO established REMCO in 1974 to coordinate reference material information exchange activities. Since one of the authors (J. P. Cali) is the U.S.-American National Standards Institute (ANSI) representative on REMCO, this report was prepared to provide information on reference material activity and availability in the U.S. for dissemination in international channels, as well as information of value to U.S. science, technology, and industry directly.

The other author (T. Plebanski) spent one year at NBS under a UNESCO fellowship studying RM's. With this work in place he helped gather, collate, and prepare for publication information on U.S. available reference materials. To this end, NBS contracted with him in 1974 to perform these functions.

II. Purpose of Guide

All measurement networks need to be compatible. By this we mean that producer and consumer, or regulator and those regulated, need to be able to measure the property(ies) of the same sample in such a way that, within agreed on limits of uncertainty, all obtain identical numerical values of the property(ies) under measurement. Cali, among others, has shown (see 3 or 4 e.g.) that when measurement systems are based on accuracy that measurement compatibility must logically ensue. However, to achieve accuracy in measurement, especially when the property under consideration is that of composition, five basic components of the measuring process need to be available or present (see, e.g., 5). One of these is reference materials and called at NBS for historical reasons Standard Reference Materials (SRM).

Thus, a knowledge of where to obtain reference materials is important. This then is the basic rationale and principal purpose for this guide.

III. Scope and Structure of Guide

Listed in the body of the report are over 17,000 reference materials. Of these approximately 7,200 fall into
the class "certified reference materials" (see Section IV, below). These 17,000 reference materials are either the direct product of or are distributed by the 93 U.S. companies and/or organizations who responded to the NBS request for information. The information supplied was primarily in the form of catalogues, product lists, etc.

Of the 17,000 reference materials listed, about 2,000 are produced in foreign countries, principally Japan and countries of Europe. There is, of course, considerable duplication among the reference materials. The duplication is especially strong in these classes: high purity elements and inorganic chemicals; spectrochemical mixtures, powders, and alloys; and, standard solutions and mixtures for atomic absorption calibration. We estimate there are listed approximately 10,000 different reference materials produced in the U.S.

No attempt has been made to make a quality assessment of either the producers or of their reference materials.

Two classes of reference materials have been listed: general reference materials (RM) and certified reference materials (CRM). These have been defined above. In attempting to decide whether a particular material was, in fact, suitable for use as a reference material, the general criteria listed by Cali in reference 6 were applied. Some of these criteria are: purity, homogeneity, stability, continuity of both supply and information, availability, and extent of certification process. Other factors considered were: (1) whether the producer states in his literature that his product is suitable for reference purposes (as calibrating material, e.g.); (2) whether the producer guarantees his product in some meaningful way; (3) whether useful technical information is supplied with his product (e.g., actual lot analysis); (4) by comparison of the same product from different sources; and/or, (5) by some evidence that traceability to national or international standards has been established. Thus, it is apparent that a considerable degree of subjective judgment was used by the authors. The ultimate test, of course, as to whether a particular material can serve usefully as a reference material must lie with the user.

The properties embodied in the reference materials are classified in five categories:

1. Chemical composition (Analytical RM) - multicomponent (usually) reference materials, often mixtures or solutions, used in chemical analytical systems. This class will include alloys, mixtures, natural materials, etc.
2. **Chemical composition** (High Purity RM) - single component (usually) reference materials of high purity used in chemical analytical systems. However, they may also serve for the realization or determination of other properties, e.g., physico-chemical, thermochemical, electrical, etc. Others, e.g., platinum, cesium, krypton serve as primary RM in defining international scales. These latter RM are certified for total purity of the main component and for trace impurities present.

3. **Physical properties** - reference materials characterized for optical, heat, radiation, etc. properties.

4. **Engineering and technological properties** - reference materials embodying properties as hardness, smoke density, etc.

5. **Biochemical properties** - reference materials of botanical, biological, clinical, bionuclear substances.

These categories are not necessarily mutually exclusive. Often RM's will be characterized for more than one property and thus will be found in the appropriate categories. E.g., some bionuclear RM's might be found in category(ies) 1, 3, and 5 if characterized for chemical composition, radioactivity, and biological activity.

Two tables are presented:

**Table A: Index of Reference Materials.** In this table are incorporated both matrices and properties of interest arranged in the five categories listed above. It would have been impractical to list individually every RM by chemical name or specific material. Therefore, we have tried to use classes or groups to lead the user to a supplier who can provide more specific information with regard to highly specific chemicals, matrices, or properties. In other words, the principal utility of this listing is to provide general guidance to the user to assist in shortening his search time and to make him aware of RM supplies he might otherwise have missed. Only in the catalogs of the various suppliers will be found the specific information usually required for the ultimate end-use.

**Table B: Index of Suppliers.** In this table we give the names and addresses of the suppliers who replied to our request for information. The addresses shown are those given by the supplier at the time his catalogues were delivered to NBS. Each is given a supplier number, an internal NBS file number, and the approximate number of RM's, either general or certified, produced or distributed.
IV. Disclaimer

In issuing this guide NBS makes no warranty, explicit or implied, that any RM listed will perform or not as claimed by the producer or distributor. Neither does NBS, through the inclusion or exclusion of any RM producer or distributor, impute either directly or indirectly the technical, scientific, or economic value or worth of the RM's referenced. This guide is issued by NBS for information only to provide RM users or potential users to RM sources in the U.S. NBS, an agency of the U.S. Government, assumes no liability for damages resulting from the use or misuse of any of the information given in the guide or from use or misuse of the RM's referenced.

V. Updating of Guide

It is our intention to update the guide from time to time as interest and demand warrant. RM producers, suppliers, and distributors may send catalogues and pertinent information, together with suggestions to improve the usefulness of the guide to:

J. Paul Cali
Chief, Office of Standard Reference Materials
Institute for Materials Research
National Bureau of Standards
Washington, D.C. 20234.

†Excepting RM's and CRM's directly produced by NBS itself (Supplier #86).
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| 8               | 72/9       | Amersham/Searle Corporation  
2636 S. Clearbrook Drive  
Arlington Heights, IL 60005 | 145             | 622            |
| 9               | 72/126     | Analytical Supplies Development Corp.  
48 Notch Road  
Little Falls, N. J. 07424 | 45              |                |
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678 E. Huron River Drive  
P. O. Box 248  
Belleville, Michigan 48111 | 16              | 40             |
| 11              | 72/11      | Apache Chemicals, Inc.  
P. O. Box 17  
Rockford, IL 61105 | 70              | 307            |
| 12              | 72/12      | Apex Smelting Company  
Division of Amax Aluminum Co., Inc.  
2537 W. Taylor Street  
Chicago, IL 60612 | 62              |                |
| 13              | 72/13      | Applied Science Laboratories, Inc.  
P. O. Box 440  
State College, Pa. 16801 | .265            |                |
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Division of Gallard-Schlesinger Mfg. Corp.  
584 Mineola Avenue, Carle Place  
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Route 100  
Exton, Pa. 19341  
Frederick Smith—See G. Frederick Smith | 1 | 8 |
| 35              | 72/26      | Gallard Schlesinger Chemical Manufacturing Corporation  
584 Mineola Avenue  
Carle Place, N. Y. 11514 | 91 | |
| 36              | 72/81      | General Graphites, Inc.  
First and Monroe Streets  
Bay City, Michigan 48706 | 53 | 7 |
| 37              | 72/28      | G. Frederick Smith Chemical Company  
P. O. Box 23344  
Columbus, Ohio 43223 | 68 | 17 |
| 38              | 72/29      | Glidden-Durkee Division of SCM Corporation Metals Group  
P. O. Box 217  
Johnstown, Pa. 15907 | 1 | |
| 39              | 72/30      | Handy & Harman  
Fairfield Plant  
1770 Kings Hwy.  
Fairfield, Conn. 06430 | 2 | |
B. INDEX OF SUPPLIERS
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17502 Armstrong Ave.  
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| 70              | 72/135     | Service Physical Testers  
Division of Service Diamond Tool Co.  
6169 Lakeshore Road  
Port Huron, Michigan 18060 | 1+ numerous     |                |
| 71              | 72/121     | Sigmund Cohn Corporation  
121 So. Columbus Ave.  
Mount Vernon, N. Y. 10553 | 2               |                |
| 72              | 72/58      | Smith and Underwood Laboratories  
1023 Troy Court  
Troy, Michigan 48084 | 55              |                |
| 73              | 72/59      | Spex Industries, Inc.  
3880 Park Avenue  
Metuchen, N. J. 08840 | 145             | 299            |
| 74              | 72/60      | Supelco, Inc.  
Supelco Park  
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REFERENCES


Summarized is a list of reference materials produced and distributed by U.S. manufacturers, both public and private. Extensive tables are indexed by use to which reference materials may be put. Properties covered include: chemical composition (analytical chemical purposes), chemical composition (high purity), physical properties, engineering and technological properties, and biochemical properties. Names and addresses of 93 U.S. producers and/or distributors are included.
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PERIODICALS

JOURNAL OF RESEARCH—The Journal of Research of the National Bureau of Standards reports NBS research and development in those disciplines of the physical and engineering sciences in which the Bureau is active. These include physics, chemistry, engineering, mathematics, and computer sciences. Papers cover a broad range of subjects, with major emphasis on measurement methodology, and the basic technology underlying standardization. Also included from time to time are survey articles on topics closely related to the Bureau's technical and scientific programs. As a special service to subscribers each issue contains complete citations to all recent NBS publications in NBS and non-NBS media. Issued six times a year. Annual subscription: domestic $17.00; foreign $21.25. Single copy, $3.00 domestic; $3.75 foreign.

Note: The Journal was formerly published in two sections: Section A “Physics and Chemistry” and Section B “Mathematical Sciences.”

DIMENSIONS/NBS

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

Annual subscription: Domestic, $12.50; Foreign $15.65.

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Handbooks—Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

Special Publications—Include proceedings of conferences sponsored by NBS, NBS annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

Applied Mathematics Series—Mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

National Standard Reference Data Series—Provides quantitative data on the physical and chemical properties of materials, compiled from the world’s literature and critically evaluated. Developed under a world-wide program coordinated by NBS. Program under authority of National Standard Data Act (Public Law 90-396).

NOTE: At present the principal publication outlet for these data is the Journal of Physical and Chemical Reference Data (JPYCRD) published quarterly for NBS by the American Chemical Society (ACS) and the American Institute of Physics (AIP). Subscriptions, reprints, and supplements available from ACS, 1155 Sixteenth St. N.W., Wash., D.C. 20056.

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

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

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

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


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


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

BIBLIOGRAPHIC SUBSCRIPTION SERVICES

The following current-awareness and literature-survey bibliographies are issued periodically by the Bureau:

Cryogenic Data Center Current Awareness Service. A literature survey issued biweekly. Annual subscription: Domestic, $25.00; Foreign, $30.00.

