Handbook for Standard Reference Materials Users

Standard Reference Materials (SRMs) are well-characterized materials produced in quantity and certified for one or more physical or chemical properties. They are issued under the NIST trademark and are characterized using state-of-the-art measurement methods. SRMs are designed to ensure the accuracy, traceability, and compatibility of measurement results in many diverse fields of science, industry, and technology both in the United States and throughout the world. SRM users recognize that reliable measurements can help avoid costly manufacturing mistakes and unnecessary over-design of products and systems. Good measurements can provide the basis for sound and economical environmental and safety regulations and can improve health care by enhancing the validity of clinical tests and procedures. Thus the use of SRMs for measurement reliability contributes to the strength of this nation's economy and the well being of its citizens.

Many users of SRMs are interested in the details of the procedures used at NIST to certify the SRMs. In 1985, the late John Keenan Taylor prepared SP 260-100, *Handbook for SRM Users* [1] to provide guidance for the use of SRMs and to explain the philosophy behind the SRM Program. The book is dedicated to the dissemination of information on the phases of preparation, measurement, certification, and use of SRMs. While written from the viewpoint of a chemist, the basic concepts described are applicable to most areas of metrology. Taylor arranged the *Handbook* by sections in a logical progression, starting with the concepts of precision and accuracy, followed by discussions of calibration procedures and quality assurance of the measurement process, the use of SRMs to evaluate various kinds of measurements, and the reporting of data with evaluated limits of uncertainty. The statistical considerations most frequently applicable for the evaluation and interpretation of measurement data are reviewed in the Appendices. Each section is written with some degree of independence so that it can be comprehended without frequent reference to the content of others.

The original *Handbook* was published in 1985 and required a second printing in 1987. In 1992, work was begun on a revision of Special Publication 260-100 [2] to upgrade dated information and to reflect significant changes that had occurred within NIST and the Standard Reference Materials Program since the document was first issued in 1985. N. M. Trahey of the Standard Reference Materials Program performed an extensive editorial and technical review of the *Handbook* and its appendices. The text was determined to be consistent with current NIST guidance on measurements, but various sections and appendices (including Sections 8 and 9, Appendices A, B, and C, and the Guide for Requesting Development of Standard Reference Materials) required revision. There were extensive revisions in Appendix C. Statistical Tools, rewritten in accordance with current NIST policy by S. B. Schiller of the NIST Statistical Engineering Division. Two other sections and the remaining appendices were rewritten by N. M. Trahey, who also prepared new introductory material. The editing process had not yet begun when John Taylor passed away, and every effort was made to preserve those parts of the text that Taylor had prepared, essentially as he wrote them. Fifteen years after the original *Handbook for SRM Users* was published, the Standard Reference Materials Program continues to get approximately 800 requests for copies per year.

The National Bureau of Standards began to provide reference materials, originally known as standard samples, in 1906 in response to the needs of the metals industry. The SRM inventory has since become far more diverse and now contains over 1300 different SRMs and related samples. A large number of materials useful in physical metrology and engineering are included. Some technical areas are covered more completely than others for historical reasons, priorities for national issues, and to some extent the degree of industrial awareness of the quality assurance concept. Modern SRMs take into consideration the fact that a given substance for which an analysis is carried out may occur in different matrix environments. Thus the users must be made aware of the need to take the specific environment into account.

The Handbook is still making an impact on SRM users. It contains some of the course material used by John Taylor to teach classes at NBS/NIST and at national and international meetings of the American Chemical Society and the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy. At those meetings Taylor spent many hours in dialogues with reference materials users, analysts, and accreditors regarding reference materials and their importance in the metrology of chemical and physical measurements. Eight years after his death, the *Handbook* continues to

spark conversations with those who knew him and used his book. Former students are eager to tell how his teachings influenced their careers, and they cite the *Handbook* as one book they consider a collector's item that they will always keep in their library.

For 3 years at the Pittsburgh Conference, the Standard Reference Materials Program honored the author by sponsoring the *J. K. Taylor Symposium on the Development and Use of Reference Materials.* Taylor himself conceived the workshop, based on his feeling that U.S. industry needed to be both educated and informed of NIST's Standard Reference Materials role regarding measurement quality and data comparability.

John Keenan Taylor joined the National Bureau of Standards in 1929 at the age of 16; while working at the Bureau, he received his B.S. in Chemistry from George Washington University and later his PhD in Physical Chemistry from the University of Maryland. Over the course of a professional career spanning 57 years, Taylor performed research and directed activities in the Microanalysis, Gas and Particulate Science, and Standard Samples (a forerunner of the Standard Reference Materials Program) Sections of the NBS Analytical Chemistry Division. Even after his retirement from NBS in 1986, he devoted much of his time and attention to measurement quality control and assurance in the field of analytical chemistry. Taylor served as coordinator for Quality Assurance of the NIST Chemical Science and Technology Laboratory and continued to write articles, design seminars, and teach classes on the subject of quality assurance as applied to chemical measurements until shortly before his death on March 26, 1992.

Taylor was honored by the Department of Commerce with its Silver and Gold Medals. He was a member of the American Chemical Society, the Alpha Chi Sigma Chemical Fraternity, the American Institute of Chemists (AIC), and several ASTM technical committees, including Committee D22 on Sampling and Analysis of Atmospheres which he chaired from 1984 to 1990. He received an Award of Merit from ASTM, the Fitch Memorial Chemistry Award from George Washington University, the DC Educational Society Award, the AIC Honor Award, and the Chemical Society of Washington Achievement Award. He authored three books and some 200 scientific journal publications, served as editor of four books, and held two patents.

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Bibliography

[1] John K. Taylor, *Handbook for SRM Users,* NBS Special Publication 260-100, National Bureau of Standards, Gaithersburg, MD (1985).

[2] John K. Taylor (edited by Nancy M. Trahey), *Handbook for SRM Users,* 1993 Edition, NIST Special Publication 260-100, National Institute of Standards and Technology, Gaithersburg, MD (1993).