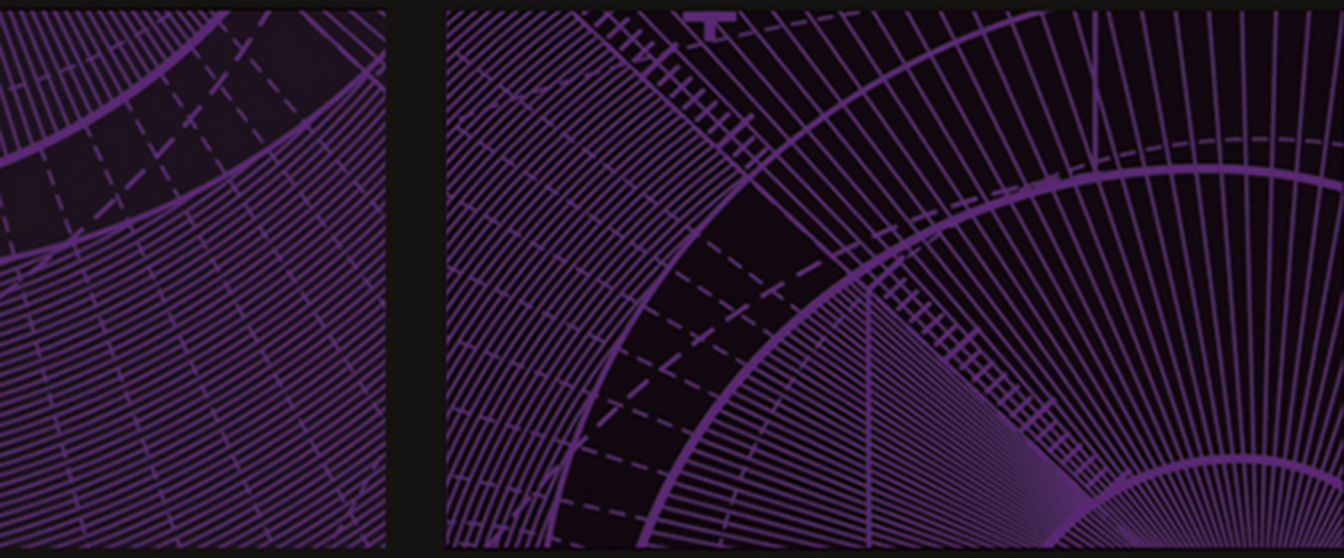
HANDBOOK OF MEASUREMENT

IN SCIENCE AND ENGINEERING

Volume 3



EDITED BY

MYER KUTZ

WILEY

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To Mark Berger, teacher

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LIST OF CONTRIBUTORS

M. Al Akerman, Emco-Williams Inc, Knoxville, TN, USA

Stephen W. Allison, Emco-Williams Inc, Knoxville, TN, USA

Beniamino Barbieri, ISS, Champaign, IL, USA

David L. Beshears, Emco-Williams Inc, Knoxville, TN, USA

Sandya Beeram, Department of Chemistry, University of Nebraska, Lincoln, NE, USA

Cong Bi, Department of Chemistry, University of Nebraska, Lincoln, NE, USA

John D. Bullough, Lighting Research Center, Rensselaer Polytechnic Institute, Troy, NY, USA

Grant Bunker, Department of Physics, Illinois Institute of Technology, Chicago, IL, USA

Michael R. Cates, Emco-Williams Inc, Knoxville, TN, USA

Dominic M. Desiderio, The Charles B. Stout Neuroscience Mass Spectrometry Laboratory, Department of Neurology, College of Medicine, University of Tennessee Health Science Center, Memphis, TN, USA

Marco Faifer, Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Milano, Italy

Alessandro Ferrero, Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Milano, Italy

Robert H. Giles, Biomedical Terahertz Technology Center and Submillimeter-Wave Technology Laboratory, Department of Physics and Applied Physics, University of Massachusetts Lowell, Lowell, MA, USA

Thomas M. Goyette, Submillimeter-Wave Technology Laboratory, Department of Physics and Applied Physics, University of Massachusetts Lowell, Lowell, MA, USA

David S. Hage, Department of Chemistry, University of Nebraska, Lincoln, NE, USA

Charles D. Hoyle, Jr., Department of Physics and Astronomy, Humboldt State University, Arcata, CA, USA

Cecil S. Joseph, Biomedical Terahertz Technology Center, Department of Physics and Applied Physics, University of Massachusetts Lowell, Lowell, MA, USA

Ellis Kaufmann, Department of Chemistry, University of Nebraska, Lincoln, NE, USA

Byung I. Kim, Department of Physics, Boise State University, Boise, ID, USA

Judah Levine, Time and Frequency Division and JILA, NIST and the University of Colorado, Boulder, CO, USA

Zhao Li, Department of Chemistry, University of Nebraska, Lincoln, NE, USA

Nicola Locci, Department of Electrical and Electronic Engineering, University of Cagliari, Cagliari, Italy

Ryan Matsuda, Department of Chemistry, University of Nebraska, Lincoln, NE, USA

Kenneth R. Metz, Chemistry Department, Merkert Chemistry Center, Boston College, Chestnut Hill, MA, USA

Carlo Muscas, Department of Electrical and Electronic Engineering, University of Cagliari, Cagliari, Italy

Kwok-Wai Ng, Department of Physics and Astronomy, University of Kentucky, Lexington, KY, USA

James E. Parks, Department of Physics, University of Tennessee, Knoxville, TN, USA

Maria Podariu, Department of Chemistry, University of Nebraska, Lincoln, NE, USA

Yevgen Povrozin, ISS, Champaign, IL, USA

Ray Radebaugh, Applied Chemicals and Materials Division, National Institute of Standards and Technology, Boulder, CO, USA

Elliott Rodriguez, Department of Chemistry, University of Nebraska, Lincoln, NE, USA

Matthew B. Scudiere, Emco-Williams Inc, Knoxville, TN, USA

W. Rudolf Seitz, Department of Chemistry, University of New Hampshire, Durham, NH, USA

Gargi Sharma, Biomedical Terahertz Technology Center, Department of Physics and Applied Physics, University of Massachusetts Lowell, Lowell, MA, USA

Paul J. Simmonds, Departments of Physics & Materials Science and Engineering, Boise State University, Boise, ID, USA

Clair J. Sullivan, Department of Nuclear, Plasma, and Radiological Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, USA

Brad Swarbrick, Quality by Design Consultancy, Sydney, New South Wales, Australia

Frank Westad, CAMO Software AS, Oslo, Norway

Xianquan Zhan, Key Laboratory of Cancer Proteomics of Chinese Ministry of Health, Xiangya Hospital, Central South University, Changsha, P. R. China

Xiwei Zheng, Department of Chemistry, University of Nebraska, Lincoln, NE, USA

PREFACE

The idea for the *Handbook of Measurement in Science and Engineering* came from a Wiley book first published over 30 years ago. It was *Fundamentals of Temperature, Pressure and Flow Measurements*, written by a sole author, Robert P. Benedict, who also wrote Wiley books on gas dynamics and pipe flow. Bob was a pleasant, unassuming, and smart man. I was the Wiley editor for professional-level books in mechanical engineering when Bob was writing such books, so I knew him as a colleague. I recall meeting him in the Wiley offices at a time when he seemed to be having some medical problems, which he was reluctant to talk about. Recently, I discovered a book published in 1972 by a London firm, Pickering & Inglis, which specializes in religion. This book was *Journey Away from God*, an intriguing title. The author's name was Robert P. Benedict. I do not know whether the two Benedicts are in fact the same person, although Amazon seems to think so. (See the Robert P. Benedict page.) In any case, I do not recall Bob's mentioning the book when we had an occasion to talk.

The moral of this story, if there is one, is that the men and women who contributed the chapters in this handbook are real people, who have real-world concerns, in addition to the expertise required to write about technology. They have families, jobs, careers, and all manner of cares about the minutia of daily life to deal with. And that they have been able to find the time and energy to write these chapters is remarkable. I salute them. I have spent a lot of time in my life writing and editing books. I wrote my first Wiley book somewhat earlier than Bob Benedict wrote his. When Wiley published *Temperature Control* in 1967, I was in my mid-twenties and was a practicing engineer, working on temperature control of the Apollo inertial guidance system at the MIT Instrumentation Lab, where I had done my bachelor's thesis. One of the coauthors of my book was to have been a Tufts Mechanical Engineering Professor by the name of John Sununu (yes, that John Sununu), but he and the other coauthor dropped out of the project before the contract was signed. So I wrote the short book myself.

Bob Benedict's measurement book, the third edition of which is still in print, surfaced several years ago, during a discussion I was having with one of my Wiley editors at the time, Bob Argentieri, about possible projects we could collaborate on. It turned out that no one had attempted to update Benedict's book. I have not been a practicing engineer for some time, so I was not in a position to do an update as a single author—or even with a collaborator or two. Most of my career life has been in scientific and technical publishing, however, and for over a decade I have conceived of, and edited, numerous handbooks for several publishers. (I also write fiction, but that is another story.) So, it was natural for me to think about using Benedict's book as the kernel of a much larger and broader reference work dealing with engineering measurements. The idea, formed during that discussion, that I might edit a contributed handbook on engineering measurements took hold, and with the affable and expert guidance of my other Wiley editor at the time, George Telecki, the volume you are holding in your hands, or reading on an electronic device, came into being.

Like many such large reference works, this handbook went through several iterations before the final table of contents was set, although the general plan for arrangement of chapters has been the same throughout the project. The initial print version of the handbook was divided into two volumes. The chapters were arranged essentially by engineering discipline. The first volume contains 30 chapters related to five engineering disciplines, which are divided into three parts:

Part I, "Civil and Environmental Engineering," which contains seven chapters, all but one of them dealing with measurement and testing techniques for structural health monitoring, GIS and computer mapping, highway bridges, environmental engineering, hydrology, and mobile source emissions (the exception being the chapter on traffic congestion management, which describes the deployment of certain measurements)

Part II, "Mechanical and Biomedical Engineering," which contains 16 chapters, all of them dealing with techniques for measuring dimensions, surfaces, mass properties, force, resistive strain, vibration, acoustics, temperature, pressure, velocity, flow, heat flux, heat transfer for nonboiling two-phase flow, solar energy, wind energy, human movement, and physiological flow

Part III, "Industrial Engineering," which contains seven chapters dealing with statistical quality control, evaluating and selecting technology-based projects, manufacturing systems evaluation, measuring performance of chemical process equipment, industrial energy efficiency, industrial waste auditing, and organizational performance measurement

The second volume contains 23 chapters divided into three parts:

Part IV, "Materials Properties and Testing," which contains 15 chapters dealing with measurement of viscosity, tribology, corrosion, surface properties, and thermal

conductivity of engineering materials; properties of metals, alloys, polymers, and particulate composite materials; nondestructive inspection; and testing of metallic materials, ceramics, plastics, and plastics processing

Part V, "Instrumentation," which contains five chapters covering electronic equipment used for measurements

Part VI, "Measurement Standards," which contains three chapters covering units and standards, measurement uncertainty, and error analysis

This new, third volume of the handbook expands the range of the handbook to cover measurements in physics, electrical engineering, and chemistry. This volume contains 20 chapters divided into two major parts:

Part VII, "Physics and Electrical Engineering," which contains 11 chapters, covering laser-based measurement systems, scanning probe microscopy, scanning tunneling microscopy, photometry, detection and measurement of ionizing radiation, time measurement systems, laboratory-based gravity measurement, cryogenic measurements, temperature-dependent fluorescence measurements, measurement of electrical quantities, and electrical power measurement

Part VIII, "Chemistry" which contains nine chapters, covering chemometrics/chemical metrology, liquid chromatography, mass spectrometry measurements, basic principles of fluorescence spectroscopy, X-ray absorption spectroscopy, NMR spectroscopy, near-infrared spectroscopy, nanomaterials properties, and chemical sensing

Thanks to Brett Kurzman, my new editor for this volume, and Kari Capone, Allison, McGinniss, and Alex Castro for shepherding the manuscript toward production and to the stalwarts Kristen Parrish and Shirley Thomas for bringing this handbook volume home. Thanks, also, to my wife Arlene, who helps me with everything else.

MYER KUTZ

Delmar, NY
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