

Introduction

ASTM's AWARD-WINNING Manual 20 has been revised and updated to include current and state-of-the-art technologies in corrosion testing and standardization. The editors of this manual have many years of experience in this field and are well qualified in leading the task to provide state-of-the-art information on this subject for corrosion scientists and technologists throughout the world. The work of 80 highly qualified chapter authors and numerous reviewers has resulted in a revised, expanded, and updated Manual 20 on Corrosion Tests and Standards, Application and Interpretation.

Corrosion is the chemical or electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties. The direct cost of corrosion in countries throughout the world is estimated to be between 3 % and 4 % of the gross domestic product of each country. For example, that cost in the United States was estimated to be \$276 billion annually, for recent years. It was determined that a significant portion of these costs could be avoided through the more effective use of existing technologies and the use of sound corrosion management techniques. This manual is a key resource in addressing both of these subjects.

Corrosion testing is one of the most important aspects of corrosion control because it is used to advance technology and to determine the most effective and economical means to achieve acceptable performance. A large number of factors affect corrosion behavior so that there is no universal corrosion test. ASTM and other organizations such as NACE, ISO, and others have standardized many tests and practices. However, industry, government, and academic laboratories sometimes utilize in-house tests. Thus, this Manual provides a valuable resource describing and listing a large number of tests ranging from highly accelerated laboratory tests to field service trials.

Since standards are universally recognized as an important tool in effective corrosion control management, this Manual not only provides information required to find and use proper standards in specific applications, it also includes a CD with almost 200 of the most widely used ASTM and NACE corrosion standards. All of the chapter authors have included important standards specific to their topic and the Manual includes lists of standards according to subject, of which the most important are included in the CD.

The revised Manual is organized into eight sections.

Section I on **General Information** (R. Baboian, Section Editor) provides tools necessary for the corrosionist to define,

interpret, and evaluate the technology. This section is greatly expanded and includes a unified numbering system for metals and alloys and their common names, standards terminology, a glossary of terms and acronyms, abbreviations and units symbols, International System of Units and matrix guide, general conversion tables, corrosion rate calculations and all necessary conversion factors, chemical and physical properties of materials, properties of water and moist air, chemical and electrolytic cleaning procedures for corrosion products, physical properties of gases, liquids and elements, and densities of metals and alloys.

Section II on **Testing and Evaluation** (R. Baboian, Section Editor) is designed to provide important information on planning and design of tests and interpretation of results. This topic provides a foundation for corrosion testing and the use of corrosion standards. It includes chapters on planning and design of tests, types of corrosion data, metallographic and surface analysis, statistical treatment of data and data computerization and computer applications.

Section III covers **Types of Tests** (H. Hack, Section Editor) including laboratory-accelerated tests, field tests, and service tests. The chapters in this section provide basic principles, describe test techniques and specific considerations such as specimen preparation, test duration and acceleration factors, and cite pertinent standards. Chapters included under laboratory tests are electrochemical, cabinet, immersion, high temperature, and high pressure. Field Tests chapters include atmospheric exposure, seawater, fresh water, and soil. Under service tests are industrial applications and high temperature environments.

Section IV on **Testing for Corrosion Types** (J. Scully, Section Editor) describes the major forms of corrosion, how to recognize them and factors of influence. Each chapter includes an overview of basic principles and also descriptions of test techniques, methods of evaluation of test results, and standards used for testing. Subjects included are uniform, pitting, crevice, galvanic, intergranular, exfoliation, erosion, cavitation, fretting, dealloying, stress corrosion, corrosion fatigue and hydrogen damage.

Section V on **Testing in Environments** (H. Hack, Section Editor) includes chapters on outdoor and indoor atmospheres, seawater, fresh water, soils, concrete, industrial waters, industrial chemical, petroleum, high-temperature gases, organic liquids, molten salts, liquid metals, corrosion inhibitors, in-vivo, and microbiological effects. Each chapter provides a descriptive overview of the environment and factors and variables affecting corrosion rates and mechanisms,

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unique characteristics of testing, descriptions of appropriate laboratory and field tests and lists of standards used for corrosion testing in these environments.

Section VI is on **Materials Testing** (E. Hibner, Section Editor). This section provides overviews of important tests used in evaluating the corrosion behavior of metals and alloys. In addition, this testing information provides the means for the development of new and improved corrosion resistant materials. Each chapter includes a discussion of the nature of the material, such as the effect of composition, alloying, metallurgical treatments, microstructure, surface effects and natural films on the corrosion behavior. The chapter also includes descriptions of tests used for specific types of corrosion for the metals and alloys, methods of evaluation of corrosion damage and standards used for corrosion testing of the various materials. The chapters are zinc, lead (and alloys), aluminum (and alloys), steels, copper (and alloys), nickel (and alloys), stainless steels, cobalt-base alloys, titanium, zirconium and hafnium, tantalum and niobium alloys, metallic coatings on steel, nonmetallic coatings, metal matrix composites, electrodeposits, and powder metallurgy materials.

Section VII on **Testing in Industries** (S. Dean, Section Editor) provides an overview of corrosion testing unique to each industry and how these tests are used to address corrosion problems. Included are descriptions of environments encountered and materials used in specific industries. Test methods for corrosion control and evaluation are described along with appropriate standards. Chapters in this section include automotive, commercial aircraft, military aircraft

and equipment, pipeline, highways, tunnels and bridges, marine piers and docks, electric power, nuclear power, steam generation, flue gas desulfurization, electronics, telecommunications, metal processing, chemical processing, pulp and paper, petroleum production and refining, food and beverage, water handling systems, medical and dental, and pharmaceutical.

Section VIII on **Corrosion-Related Standards** (H. Hack and R. Baboian, Section Editors) is a comprehensive list of standards developed by various organizations including the American Petroleum Institute, American Waterworks Association, ASME International, ASTM International, International Electrotechnical Commission, ISO, NACE International, SAE International, and the Steel Structures Painting Council. The standards are listed and grouped according to subject within each organization. The accompanying CD includes many of the ASTM and NACE corrosion standards.

The revised Manual 20 on Corrosion Tests and Standards is certain to serve as a valuable resource for those in industry, government, and academia. Acknowledgment is given to the many authors who wrote the chapters providing the important information in this revision. Also acknowledged are the reviewers who work anonymously to help maintain a high level of quality throughout the book. The work of the editors can only be completed through the dedication and competence of these persons.

Robert Baboian
Editor