LABORATORY CORROSION TESTS AND STANDARDS

A symposium by
ASTM Committee G-1 on
Corrosion of Metals
Bal Harbour, FL, 14–16 Nov. 1983

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William Henry Ailor, Jr.

15 July 1917 to 9 November 1983

Dedication

This volume, recording the activities of the International Symposium on Laboratory Corrosion Tests and Standards and serving as a permanent record of contributions to the field of laboratory corrosion testing, is hereby dedicated as a living memorial to our professional colleague and personal friend, Bill Ailor, who passed away on 9 November 1983.

Bill received his Bachelor of Science degree in history from the University of Tampa in 1939 and his Bachelor of Chemical Engineering from North Carolina State University in 1948.

A Lieutenant Commander in the U.S. Naval Reserve from 1942 to 1946 and from 1952 to 1953, Bill joined the Atlantic Coast Line Railroad as a chemist in 1948. In 1953, he became a research engineer in diesel engineering for North Carolina State University. He was an adjunct math instructor for Virginia Commonwealth University from 1959 to 1979, and joined Reynolds Metals Company in 1954 as a research engineer. He retired in 1982.

The author of 45 papers and editor of four books, Bill concentrated his career in atmospheric, marine, and deep sea corrosion, corrosion testing, engine coolant testing, and diesel engineering.

Bill served as Chairman of Committee G-1 on Corrosion of Metals from 1966 to 1972 and was active in committee

task groups and subcommittees for many years including chairing the ASTM Advisory Committee on Exposure Testing Facilities. In addition to his many other honors, he received the ASTM Award of Merit in 1970.

Bill will truly be missed, by his many friends and colleagues in Committee G-1. His many contributions to the Committee, however, provide a legacy that will serve its membership for years to come.

Foreword

The symposium on Laboratory Corrosion Tests and Standards was presented at Bal Harbour, FL, 14–16 Nov. 1983. The symposium was sponsored by ASTM Committee G-1 on Corrosion of Metals. Gardner S. Haynes and Robert Baboian of Texas Instruments, Incorporated presided as chairmen of the symposium and are editors of this publication.

Related ASTM Publications

Atmospheric Corrosion of Metals, STP 767 (1982), 04-767000-27

Electrochemical Corrosion Testing, STP 727 (1981), 04-727000-27

Corrosion of Reinforcing Steel in Concrete, STP 713 (1980), 04-713000-27

Stress Corrosion Cracking—The Slow Strain-Rate Technique, STP 665 (1979), 04-665000-27

Intergranular Corrosion of Stainless Alloys, STP 656 (1978), 04-656000-27

A Note of Appreciation to Reviewers

The quality of the papers that appear in this publication reflects not only the obvious efforts of the authors but also the unheralded, though essential, work of the reviewers. On behalf of ASTM we acknowledge with appreciation their dedication to high professional standards and their sacrifice of time and effort.

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Introduction

The corrosion resistance of a product or material is evaluated by service history, field testing, or laboratory corrosion testing. The most reliable predictor of performance is, of course, service experience followed closely by field testing since they are based upon the actual environment. When service history is lacking and time or budget constraints prohibit field testing, laboratory corrosion tests are used to predict corrosion performance. They are particularly useful for quality control, specification, materials selection, and materials development.

Laboratory corrosion tests fall into the following categories: immersion tests, simulated atmosphere tests, electrochemical tests, and environmentally aggressive tests. All of these are accelerated tests by design and therefore must be used carefully. The problems associated with laboratory corrosion tests include inappropriate test selection or evaluation, and incorrect or misleading results. The need for standardization of laboratory testing procedures and for determining the applicability of the results is obvious. Therefore, ASTM Committee G-1 on Corrosion of Metals, through Subcommittee G01.05 on Laboratory Corrosion Tests, sponsored the International Symposium on Laboratory Corrosion Tests and Standards from which the papers from the basis of this STP. The intent of this symposium was to provide a forum for discussion of existing standardized tests as well as the design and interpretation of new tests. It was truly international in scope with authors from eight countries.

The topics discussed in the STP include (1) the design and interpretation of laboratory tests, (2) laboratory tests for specific environments, and (3) laboratory tests for specific types of corrosion. An Appendix containing the standards most often referred to in the papers is included in the STP.

The papers on design and interpretation of laboratory tests deal with the engineering aspects of development of relevant tests as well as the newest electrochemical laboratory tests. New accelerated tests for salt-sulfur dioxide environments, high-temperature acidic environments, crevice corrosion, corrosion of cans, and atmospheric corrosion are described. Electrochemical techniques that are addressed include AC impedance, linear polarization, potentiodynamic polarization, current versus voltage hysteresis, and computer data acquisition. The papers on tests for specific environments address laboratory tests for potable waters, seawater, hydrogen sulfide environments, steel in concrete, inhibitors, and coinage environments. Results from these tests are correlated with field tests

and service performance. The topics of papers on tests for specific types of corrosion include crevice corrosion, erosion corrosion, stress corrosion cracking, and intergranular corrosion.

The information in this STP is useful for experienced as well as new investigators involved with conducting, specifying, or evaluating laboratory corrosion tests. It defines the state of the art in laboratory corrosion testing, describes limitations of accelerated tests, provides significant information on relevance of existing tests as well as information useful for the development of new tests, and includes the standards most often used for laboratory corrosion testing.

Gardner S. Haynes and
Robert Baboian
Texas Instruments, Incorporated
Attleboro, MA 02703, symposium cochairmen and coeditors

Design and Interpretation of Laboratory Tests