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U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

Critical Survey of Data Sources:

Corrosion of Metals

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[2] Located at Boulder, Colorado 80302.

Critical Survey of Data Sources: Corrosion of Metals

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Foreword

The National Standard Reference Data System was established in 1963 for the purpose of promoting the critical evaluation and dissemination of numerical data of the physical sciences. The program is coordinated by the Office of Standard Reference Data of the National Bureau of Standards but involves the efforts of many groups in universities, government laboratories, and private industry. The primary aim of the program is to provide compilations of critically evaluated physical and chemical property data. These tables are published in the *Journal of Physical and Chemical Reference Data*, in the NSRDS-NBS series of the National Bureau of Standards, and through other appropriate channels.

The properties of commercial materials have thus far received rather limited coverage in the NSRDS program. However, many other groups select and compile data on the properties of such materials, using a variety of criteria. Thus, identifying the best data source for a given purpose requires something more detailed than an ordinary bibliographic listing.

This series is designed to provide such guides to data covering selected areas of materials and properties. Earlier publications covered Mechanical Properties of Metals (SP 396-1), and Properties of Ceramics (SP-396-2). The present volume covers corrosion of metals.

The sources covered in this series are primarily those which emphasize evaluated or selected compilations of numerical data, rather than monographs or other reports which are primarily descriptive in nature. Most publications dealing with corrosion necessarily contain a substantial amount of descriptive material, so this Survey includes more general monographs and similar publications than the earlier ones. However, the most specific and quantitative sources available have been selected.

For each of these surveys we have sought assistance from specialists, with emphasis on those involved in the production and use of important commercial materials, and we have been extremely fortunate in obtaining such advice from panels of relevant technical societies. For this survey the Publications Committee of the National Association of Corrosion Engineers, which is currently preparing a new series of Corrosion Handbooks, the first of which will be entitled "Corrosion Failures and Their Prevention", agreed to serve in this capacity. The assistance of these individuals, listed below, and of NACE is gratefully acknowledged. We would also like to acknowledge the assistance of J. Kruger, NBS, who assisted in the review of the coverage and text.

David R. Lide, Jr., Chief
Office of Standard Reference Data

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Abstract

This survey was undertaken to provide a directory of authoritative sources of information on corrosion of metals. It assesses the scope, assets, and deficiencies of about thirty-eight of the most important sources. These include handbooks and technical compilations, information centers, technical societies, and trade associations and institutes. The initial listing of sources to be included was drafted by the authors and submitted to members of the Publications Committee of the National Association of Corrosion Engineers. This Committee thus served as an ad hoc review group for the sources which appear. herein. The Directory is indexed by materials and types of corrosion.

Key words: Commercial alloys; corrosion; data sources; metals.

Contents

Critical Surveys of Data Sources: Corrosion of Metals

Ronald B. Diegle and Walter K. Boyd

Introduction

This Directory is the result of a survey undertaken to identify and compile important sources of information concerning corrosion of metals. Priority was given to those sources which contain reliable engineering data. The survey included an assessment of the scope, assets, and deficiencies of these selected sources.

Three categories of sources are included in the Directory: handbooks and technical compilations, information centers, and technical societies and trade associations. An information center was considered to be any repository of information which is extensive in at least one important area of corrosion, providing this data is available to the general public. This definition therefore includes technical and scientific societies, trade associations, research institutes and centers, and privately owned companies. Product literature from material producers, as well as technical handbooks now out of print, were in most cases excluded from the handbook section because of their limited availability.

Although numerous sources in each category were identified, none was complete in itself. Consequently, a variety of sources which are considered to provide reliable corrosion information were included, making this Directory in its entirety a fairly comprehensive document.

The initial selection of information sources was reviewed by an ad hoc committee consisting of members of the Publications Committee of the National Association of Corrosion Engineers (NACE).

An appendix section is provided which consists of a materials index and a properties index. These indexes are not all-inclusive, because many sources contain corrosion information which is not explicitly detailed under "Scope." Also, a list of useful references not covered in the handbook section is given.

This Directory should help to determine:

(1) What types of corrosion information are available for a given metal or alloy.
(2) What alloys are useful in a particular corrosive environment.
(3) What types of corrosion problems can be expected for a particular alloy-corrodent system.
(4) Current theories and proposed mechanisms for various forms of corrosive attack.
(5) In what systems corrosion information is deficient.

To keep the size and cost of the Directory within reasonable bounds, it was impossible to include every source of corrosion information. The more important ones have, however, been incorporated, and these provide coverage of most available data. It will be appreciated if users of the Directory will bring errors, significant omissions, and sources yet to appear to the attention of the authors.

Handbooks and Technical Compilations

(Sources 1-18)

Source 1. Advances in Corrosion Science and Technology.

M. G. Fontana and R. W. Staehle, Editors, Plenum Press, New York.

Cost: $27.50 each for Volumes 1, 2, and 4, and $29.50 for Volume 3.

Description: These state-of-the-art texts consist of four volumes which are part of a continuing series describing advances in the field of corrosion science. The series was organized to provide a forum for review papers relating to corrosion. The volumes are published on an approximately yearly basis, and each contains three to five reviews.

Scope: Volume 1 provides information on techniques for measuring electrode processes at temperatures above 100 °C, surface and environment sensitive mechanical behavior, mechanism and phenomenology of organic inhibitors, and anodic oxidation of aluminum.

Volume 2 provides information on biological corrosion, ellipsometry in corrosion technology, and stress corrosion cracking of high strength aluminum alloys.

Volume 3 provides information on corrosion and deposition of steels and nickel-base alloys in liquid sodium, stress corrosion cracking of titanium alloys, and intergranular corrosion of iron-nickel-chromium alloys.

Volume 4 provides information on the mechanical properties and breakdown of surface films at elevated temperatures, anodic dissolution of metals and anomalous valence, corrosion of metals in organic solvents, and chromium depletion and void formation in Fe-Ni-Cr alloys during molten salt corrosion and related processes.

Input Sources: Input is in the form of review papers contributed by recognized experts in each specialized area of corrosion science.

Size of Data Source: There are four volumes containing over 1400 pages of text and figures.

Timeliness of Data: The earliest volume was copyrighted in 1970 and the latest in 1974.

Remarks: This series provides detailed review information in specific, narrowly defined areas of corrosion science.

Source 2. Corrosion.

L. L. Shreir, Editor, John Wiley and Sons, Inc., New York (1963).

Cost: $43.50 for both volumes.

Description: This is a two-volume handbook treating the entire field of corrosion, with emphasis on corrosion control. It presents the subject as a synthesis of corrosion science and engineering. Subject matter in individual sections ranges from fundamental to applied.

Scope: Volume 1 provides information on the principles of corrosion and oxidation, corrosive environments, the corrosion of ferrous metals and alloys, nonferrous metals and alloys, and metals such as beryllium, molybdenum, niobium titanium, zirconium, tantalum, and uranium, and the noble metals. Discusses high temperature corrosion and stress assisted corrosion phenomena.

Volume 2 provides information on design and its relation to corrosion, cathodic protection, preparation for metal finishing, methods of applying metallic coatings and protection by coatings. Discusses conditioning the environment to mitigate corrosion, and also methods of corrosion testing. Provides tabulated property data for many metals of engineering interest.

Input Sources: Over 100 corrosion specialists contributed to the ideas expressed in the handbook.

Size of Data Source: The two volumes total nearly 1800 pages.

Remarks: The treatment of corrosion is centered around control and prevention. It is not a source of current information on specific alloy types.

Source 3. The Corrosion of Copper, Tin, and Their Alloys.

H. Leidheiser, Jr., John Wiley and Sons, Inc., New York (1971).

Cost: $38.50.

Description: This book is part of the Corrosion Monograph Series sponsored by The Electrochemical Society, Inc. It was written in two parts to provide a complete guide to the corrosion and deterioration of copper and tin and their alloys. Preference is given to quantitative information.

Scope: Provides information on atmospheric, gaseous, aqueous, and non-aqueous corrosion, stress corrosion, erosion-corrosion, corrosion of underground structures, and corrosion by microorganisms. Discusses tin plate and the electrochemistry of the iron-tin couple. Information is included on alloy properties and electrolytic and chemical polishing.

Input Sources: Information has been extracted from various technical journals as well as from publications of the Copper Development Association, Canadian Copper and Brass Development Association, International Copper Research Association, Tin Research Institute, and other organizations.

Size of the Data Source: This volume is over 400 pages in length.

Remarks: This book will assist the engineer or scientist to predict the corrosion performance of copper and tin alloys. Theoretical treatment is limited.

Source 4. Corrosion Data Survey.

National Association of Corrosion Engineers, Houston, Texas (1974).

Cost: $95.00.

Description: This handbook is the fifth edition of the 1960 version compiled by George A. Nelson and given to the National Association of Corrosion Engineers by Shell Development Company. It summarizes published corrosion data in a group of charts for ready reference, so that candidate materials for use in a particular environment can be recognized quickly and unsuitable ones rapidly eliminated. The 1974 edition was edited by Norman E. Hamner. A volume on nonmetallic materials, dated 1975, is also available.

Scope: Nearly every alloy of engineering interest is included in the handbook, such as ferrous cast and wrought alloys, austenitic and martensitic stainless steels, copper and nickel-base alloys, and aluminum, lead, gold, and platinum alloys.

Input Sources: Information was obtained from published corrosion data.

Size of Data Source: This handbook contains 283 pages of charts, tables, and graphs.

Remarks: This book is valid for rapid screening of candidate alloys. It should be used with caution, however, and the services of a corrosion engineer for precise interpretation are recommended.

Source 5. Corrosion Engineering.

M. G. Fontana and N. D. Greene, McGraw-Hill Book Company, New York (1967).

Cost: $17.50.

Description: This book covers practically all the important aspects of corrosion engineering and corrosion science.

Scope: Topics covered include corrosion principles, the forms of corrosion, corrosion testing procedures, corrosion problems in many alloy systems of engineering interest, and degradation of rubbers and plastics. Corrosion prevention techniques are discussed. A large range of corrosion environments is treated on an individual basis. The application of modern theory to predicting and preventing corrosion is discussed.

Input Sources: Information was obtained from the technical literature and from the authors' combined experience in the academic and industrial communities.

Size of Data Source: This book totals 391 pages.

Remarks: Corrosion data is presented in terms of corrosive environments rather than in terms of materials. The book does not contain a complete literature survey of any topic, although representative pertinent references are cited which enable pursuit of a problem in greater depth.

Source 6. Corrosion Handbook.

H. H. Uhlig, Editor, John Wiley and Sons, Inc., New York (1948).

Cost: $30.25.

Description: This handbook is the first of the Corrosion Monograph Series sponsored by The Electrochemical Society, Inc. It is a condensed summary of corrosion information obtained from both scientific and industrial sources. It provides a convenient reference volume covering the entire field of corrosion.

Scope: Emphasis is on quantitative rather than qualitative information. The handbook provides information on corrosion theory, including mechanisms, electrochemistry, oxidation and tarnish, and passivity. It provides specific data on the corrosion of various metals and alloys in existence in 1948. In addition, this handbook discusses corrosion by soils, seawater, microorganisms, and other specific factors, and also high temperature corrosion, chemically resistant materials, corrosion protection, and corrosion testing.

Input Sources: Sources include published and unpublished research data and examples from the contributors' fields of experience.

Size of Data Source: This handbook totals nearly 1200 pages

Remarks: This text provides a useful introduction to the principles of corrosion, but it does not consider the wealth of information acquired in the past twenty-five years for the newer alloy systems. Thus as a reference source for specific corrosion data it has largely been superseded by more recent publications.

Source 7. The Corrosion of Light Metals.

H. P. Godard, W. B. Jepson, M. R. Bothwell, and R. L. Kane,
John Wiley and Sons, Inc., New York (1967).

Cost: $17.75.

Description: This book is part of the Corrosion Monograph Series sponsored by the Electrochemical Society, Inc. The section on aluminum and its alloys was prepared by H. P. Godard; the sections on beryllium, magnesium, and titanium were written by W. B. Jepson, M. R. Bothwell, and R. L. Kane, respectively.

Scope: Provides information on aluminum, beryllium, magnesium, and titanium and their alloys. The section on aluminum is most comprehensive, including discussions of general corrosion, galvanic, crevice, pitting, and intergranular corrosion, stress corrosion, corrosion fatigue, and cavitation attack. Corrosive environments considered include the atmosphere, fresh and seawater, soils, building materials, and foods.

Input Sources: Information was obtained primarily from published and unpublished technical literature.

Size of the Data Source: This book totals nearly 360 pages.

Remarks: This handbook contains about 400 references to the worldwide literature on the corrosion of aluminum. The section on magnesium corrosion is the first extensive treatment to appear since that in H. H. Uhlig's *Corrosion Handbook.*

Source 8. Corrosion in Nuclear Applications.

W. E. Berry, John Wiley and Sons, Inc., New York (1971).

Cost: $28.00.

Description: This book is part of the Corrosion Monograph Series sponsored by The Electrochemical Society, Inc. It was written to bring under one cover the subjects of nuclear fuel mining and reprocessing, and nuclear reactor corrosion.

Scope: This book provides information on the problems and processes existing in nuclear reactors using water, liquid metals, gases, fused salts, or organic coolants, and in those reactors using liquid fuels. It includes chapters on the mining, refining, and reprocessing of nuclear reactor fuels.

Input Sources: Information has been extracted primarily from the open technical literature and from special publications of technical societies and government agencies.

Size of the Data Source: This handbook contains over 570 pages including figures, tables, and over 1200 references.

Remarks: The broad range of topics discussed make this book a useful reference source both for the professional engineer and for the student.

Source 9. The Corrosion and Oxidation of Metals.

U. R. Evans, Edward Arnold Ltd., London WIX 8LL.

Date/Cost: The present edition is dated 1963 and costs £13. A first supplement was published in 1968 and costs £8. A second supplement is due shortly.

Description: This book describes the author's theories of corrosion processes together with a summary of applicable experimental work. Corrosion is approached first from the scientific viewpoint, after which the application of scientific principles to engineering is considered.

Scope: Provides information on corrosion terminology, simple oxidation, electrochemical corrosion, inhibitors, galvanic coupling, crevice corrosion, passivation, hydrogen cracking, stress-assisted corrosion, and protective coatings.

Input Sources: Information was obtained from the author's own views and observations developed over the course of several decades. However, the opinions of other investigators were not neglected, since the author Index contains about 3000 names.

Size of Data Source: This book totals nearly 1100 pages.

Remarks: This text provides an excellent encyclopedia of the principles and mechanisms pertinent to corrosion.

Source 10. Corrosion Resistance of Metals and Alloys.

F. L. La Que and H. R. Copson, Editors, Second Edition,
Reinhold Publishing Corporation, New York (1963).

Cost: Out of print.

Description: This handbook is part of the Monograph Series of the American Chemical Society. It is directed toward the engineer dealing with immediate and specific corrosion problems, as was the first edition compiled by R. J. McKay and R. Worthington (1936).

Scope: Information is presented on the corrosion behavior of specific metal and alloy groups, such as iron and steel, stainless steels, nickel and nickel alloys, magnesium, aluminum, and copper alloys, and a large variety of other less common metals. All of the common types of attack are discussed as they pertain to each alloy system.

Input Sources: Information was obtained principally from the published technical literature.

Size of Data Source: This handbook contains 712 pages.

Remarks: This reference source contains valuable corrosion data, but the authors urge the reader to seek supplementary advice and consultation in solving any corrosion-related problem.

Source 11. Underground Corrosion.

M. Romanoff, National Bureau of Standards Circular 579 (1957).

Availability/Cost: Copies may be ordered from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia, 22161, at a cost of $7.50 ($10.00 overseas). Specify PB-168 350/LK.

Description: This book is a condensed summary of the Bureau's investigations on the corrosion of metals in soils conducted over a period of 45 years. It supersedes the National Bureau of Standards Circular 450, issued in 1945.

Scope: Provides information on all aspects of underground corrosion. Includes soil characteristics, theories and mechanisms, and the results of field and laboratory investigations conducted by NBS. Materials considered include wrought and cast ferrous base steels, and plain, low alloy, and high alloy content steels. Also considered are high silicon and malleable cast irons, copper and copper alloys, lead, zinc, and aluminum, nonmetallic materials, and metallic and nonmetallic coatings.

Input Sources: This Circular is the final report of the studies of underground corrosion conducted by the National Bureau of Standards from 1910 to 1955.

Size of the Data Source: This book totals nearly 230 pages of text, graphs, tables, and figures.

Remarks: It provides a useful reference for both the theoretical aspects of underground corrosion and for the practical methods of corrosion prevention.

Source 12. Handbook on Corrosion Testing and Evaluation.

W. H. Ailor, Editor, John Wiley and Sons, Inc., New York (1971).

Cost: $44.00.

Description: This handbook is part of the Corrosion Monograph Series sponsored by The Electrochemical Society, Inc. It provides insight into the current thinking and methods used for determining susceptibility to various forms of corrosion. It is a record of a four day Symposium on the State of the Art in Corrosion Testing held in Toronto, Ontario, Canada in 1970.

Scope: Both practical problems and theoretical aspects of corrosion testing are discussed. Information is provided on metallurgical considerations, effects of environments and temperature, and methods of corrosion evaluation. The interpretation and significance of test results are also considered.

Data Sources: This handbook is primarily a compilation of the thirty-three papers presented at the 1970 Symposium on the State of the Art in Corrosion Testing, Toronto, Ontario, Canada. More than 50 authors contributed.

Size of the Data Source: The handbook totals nearly 900 pages illustrated with more than 350 line drawings, schematic sketches, and photographs. An extensive bibliography is included.

Remarks: This handbook is one of the most comprehensive modern treatments of corrosion testing.

Source 13. Metals Handbook.

Eighth Edition, American Society for Metals, Metals Park, Ohio (1961).

Date/Cost: Volume 1 of the eighth edition was issued in 1961 and currently costs $45.00.

Description: The handbook is a comprehensive eight volume series treating all major aspects of metal properties, metals selection, and metalworking. Most of the corrosion information is contained in Volume I, entitled "Properties and Selection."

Scope: Volume 1 provides information on galvanic corrosion, corrosion fatigue, and corrosion testing. It also discusses the corrosion resistance of a large variety of metals, including aluminum, cobalt, copper, magnesium, steel, and nickel and their alloys, steel coatings, cast irons, stainless steels, titanium, tantalum, zinc, and others.

Input Sources: Contributors to the handbook include more than 1300 technical experts and about 600 plants in the metalworking field. Most of these sources are members or associates of The American Society for Metals.

Size of the Data Source: There are eight volumes currently in the eighth edition and the bulk of the corrosion information is contained in Volume 1. Volume 1, which is the largest in the series, contains 1300 pages, 6700 illustrations, 430 data compilations, and more than 100 major articles. There are also 1500 "case method" examples and 132 tables listing recommended selections for over 4400 combinations of service conditions.

Remarks: Volume 1, which is the most important reference source for mechanical properties and corrosion data, emphasizes selection for properties and economy. Volumes 2 through 6 treat metal processing operations, Volume 7 deals with microstructures, and Volume 8 considers metallography, structure, and phase diagrams. The Metals Handbook is a widely accepted and used reference source among metallurgists.

Source 14. NACE Reference Book Series 1-5.

National Association of Corrosion Engineers, Houston, Texas.

Date/Cost: The five research conferences were held in 1967, 1971 (June and December), and 1973 (January and June). Volumes 1, 2, and 3 cost $20, $27, and $45, respectively. Volumes 4 and 5 are in preparation.

Description: The NACE Reference Book Series consists of bound volumes of conference proceedings covering specific aspects of corrosion. The volume numbers and their respective titles and editors are presented below:

Volume Number	Title
NACE-1	Fundamental Aspects of Stress Corrosion Cracking, edited by R. W. Staehle, A. J. Forty, and D. Van Rooyen
NACE-2	Corrosion Fatigue: Chemistry, Mechanics, and Microstructure, edited by O. Devereux, A. J. McEvily, and R. W. Staehle
NACE-3	U. R. Evans Conference on Localized Corrosion, edited by R. W. Staehle, B. F. Brown, J. Kruger, and A. Agrawal
NACE-4	High Temperature High Pressure Electrochemistry in Aqueous Solutions, edited by D. de G. Jones, J. Slater, and R. W. Staehle
NACE-5	Stress Corrosion Cracking and Hydrogen Embrittlement of Iron Base Alloys, edited by J. Hochmann, J. Slater, and R. W. Staehle

The conferences, which were attended by corrosion specialists working in each of the five specialized areas, were held to promote information exchange and present state-of-the-art reviews of each topic.

Scope: This series presents state-of-the-art reviews of stress and corrosion and hydrogen embrittlement, corrosion fatigue, localized corrosion, and corrosion in high temperature aqueous systems. Most volumes contain a treatment of the theoretical aspects of the phenomenon under consideration as well as the more practical aspects of the problem. Alloys of engineering interest were primarily utilized for this research, including iron-chromium-nickel alloys, high strength steels, aluminum-, copper-, and titanium-base alloys, and more.

Input Sources: The conference volumes comprise review papers contributed by numerous corrosion specialists from many countries. The research papers describe the results of original research usually not previously published. Contributors represented the governmental, industrial, and academic communities.

Size of the Data Source: The first three volumes total about 700-750 pages each.

Remarks: The Reference Book Series is a reputable source of data on selected corrosion topics.

Source 15. Oxidation of Metals and Alloys.

O. Kubaschewski and B. E. Hopkins, Butterworth and Co., Ltd., London (1962).

Cost: Out of print.

Description: This text was written to bring into one volume the new ideas and theories of gaseous oxidation of metals developed in the 1950's.

Scope: This handbook provides information on oxidation theory and mechanisms, experimental techniques, and results obtained on a very wide range of metals and alloys with such gases as oxygen, nitrogen, chlorine, and those containing carbon and sulfur.

Input Sources: Information was obtained from the worldwide technical literature.

Size of the Data Source: This text totals 319 pages.

Remarks: This book was written to facilitate application of theory to the development of oxidation-resistant alloys. It contains extensive lists of references.

Source 16. Proceedings of the International Congresses on Metallic Corrosion.

National Association of Corrosion Engineers, Houston, Texas.

Publisher/Date/Cost: The Congresses were held in 1961, 1963, 1966, 1967, and 1972. Proceedings of the First and Second Congresses are out of print. Proceedings of the Third Congress may be purchased from Swets and Zeitlinger B. V., Publishing Dept., 347 B Heereweg, Lisse, The Netherlands, for $78.00. Proceedings of the Fourth and Fifth Congresses are available from the National Association of Corrosion Engineers at a cost of $50 and $75, respectively.

Description: The Proceedings consist of bound volumes of technical research papers presented at five international congresses on the corrosion of metals. Publishers of Congress Proceedings and locations of the Congresses were as follows:

First—Butterworths, London
Second—National Association of Corrosion Engineers, New York
Third—MIR Publishers, Moscow
Fourth—National Association of Corrosion Engineers, Amsterdam
Fifth—National Association of Corrosion Engineers, Tokyo

The Congresses were convened to provide a forum at the international level for the exchange of scientific information regarding corrosion of metals.

Scope: The combined series covers a very broad range of topics related to metallic corrosion. Each Congress consisted of a series of plenary lectures, which by nature were relatively fundamental and of broad application, accompanied by a number of research papers grouped into appropriate symposia. Symposium topics included inhibitors, high temperature oxidation, atmospheric corrosion, stress corrosion, underground corrosion, cathodic protection, boiler corrosion, corrosion in atomic energy, corrosion fatigue, protective coatings, pitting and crevice corrosion, and corrosion of stainless steels.

Input Sources: The Proceedings comprise research and review papers contributed by several hundred corrosion specialists from many countries. These papers describe the results of original research. Contributors represented the governmental, industrial, and academic communities.

Size of the Data Source: The First, Second, Fourth, and Fifth Proceedings total 712, 978, 822, and 1140 pages, respectively. (Proceedings of the Fifth Congress are in the final stages of preparation.) Proceedings from the Third Congress are a four-volume set totaling nearly 2200 pages.

Remarks: The Proceedings present in-depth treatment of specific research topics, and are therefore not general reference texts on all subjects relating to corrosion.

Source 17. Stress Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys.

B. F. Brown, Editor, Naval Research Laboratory, Washington, D.C. (1972).

Publisher/Cost: Copies may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (S.D. Stock No. 0851-0058) for $6.45.

Description: This handbook is a monograph sponsored by the Advanced Research Projects Agency (ARPA) to bring together in one volume the vast amount of stress corrosion data generated during the 1960's. It is essentially a condensed and edited compilation of published data in which researchers reported the results of their studies on stress corrosion cracking. Impetus for this research originated from the numerous serious problems encountered by the Department of Defense and DOD-related NASA programs of the previous decade.

Scope: Information is available on stress corrosion cracking of high strength steels, high strength aluminum alloys, and titanium. Some information is also included regarding the fundamentals of stress corrosion cracking and techniques for testing with precracked specimen geometries. The relationship of stress corrosion to fracture mechanics is discussed.

Input Sources: Information was obtained principally from the results of original research performed during the 1960's and reported in numerous conference proceedings.

Size of Data Source: This handbook totals 366 pages.

Remarks: This handbook is an excellent up-to-date reference source for stress corrosion cracking of the three materials considered.

Source 18. The Stress Corrosion of Metals.

Hugh L. Logan, John Wiley and Sons, Inc., New York (1966).

Cost: $19.75.

Description: This book is part of the Corrosion Monograph Series sponsored by The Electrochemical Society, Inc. It presents a general picture of the stress corrosion of metals together with current mechanistic theories.

Scope: This handbook provides information on stress corrosion in many alloy systems of engineering interest. One chapter is devoted to failure analysis and another to evaluating resistance to stress corrosion. Brief mention is made of liquid metal embrittlement, hydrogen embrittlement, and molten salt attack.

Input Sources: Information was obtained from English-language publications and others which are abstracted in English.

Size of Data Source: This book contains about 300 pages.

Remarks: Emphasis is on phenomenology rather than theory.

Information Centers

(Sources 19-32)

Source 19. ALCOA.

Alcoa Laboratories, Alcoa Center, Pennsylvania 15069.

Description: Alcoa is a privately owned and operated organization devoted to the production and development of aluminum and its alloys. Its research laboratory, located at Alcoa Technical Center, Alcoa Center, Pennsylvania, maintains in the Chemical Metallurgy Division a staff of twenty-five engineers active in corrosion research.

Scope: Information is available exclusively on aluminum and aluminum-base alloys. Corrosion data covers a broad range of problems, including general and intergranular attack, stress-corrosion cracking, corrosion fatigue, crevice and pitting corrosion, and atmospheric and marine corrosion.

Input Sources: Information is obtained from in-house research, technical journals, books, reports, research conferences, etc.

Facilities: Alcoa maintains a library consisting of approximately 16,000 bound volumes and an equal number of unbound reports. The fraction of entries devoted wholly or in part to corrosion is unavailable. Information retrieval is performed by computer search.

Services and Publications: Alcoa will attempt to answer inquiries channeled through the Alcoa Application Engineering Division, Alcoa Center, Pennsylvania 15069. It publishes the Alcoa Greenletter Series, which is a series of product information bulletins on specific alloys. Technical information including corrosion behavior is provided in these bulletins.

Costs and User Information: Published reports, papers, and literature, as well as papers by Alcoa Personnel that are approved for external distribution, are available at no cost. Corrosion consultation or testing is available on a fee basis. Inquiries regarding these services should be directed to Alcoa's Technology Marketing Division, 1501 Alcoa Building, Pittsburgh, Pennsylvania 15219.

Remarks: Alcoa is a recognized authority on aluminum corrosion and technology. It helps sponsor *World Aluminum Abstracts*, which documents the published literature on all phases of aluminum technology. *World Aluminum Abstracts* is available from the Aluminum Association.

Source 20. American Society for Metals (ASM).

Metals Park, Ohio 44073.

Description: The American Society for Metals is a 38,000 member organization with six major promotional goals in the fields of metals and engineering materials: (1) communications; (2) meetings; (3) education; (4) unity of the interdisciplinary field of metals; (5) interrelationship among scientists, engineers and technologists; and (6) professional responsibility and public understanding. The organization allocates 62 percent of its resources to technical, periodical, and reference publications, 14 percent to scientific and engineering conferences and exhibits, 9 percent to metals information, 8 percent to education, and the balance to membership and general services. Corrosion information is included in most of the above activities.

Scope: ASM is devoted to the entire spectrum of metals and their environmental compatibility, and hence its scope is extremely broad. Corrosion problems considered include general attack, pitting, crevice corrosion cracking, corrosion fatigue, and intergranular corrosion. Documented metals systems include elements, engineering metals and alloys, and precious metal alloys.

Input Sources: In-field experts from the membership plus associates from all over the world prepare the various publications. Data is extracted from technical literature, reports, handbooks, etc. A small permanent staff of less than 100 people coordinate the activities.

Facilities: A 10-year data base maintained on metals properties contains 13,000-15,000 items related to corrosion. In addition, a 7-year data base containing approximately 2500 document references on corrosion is maintained specifically for aluminum. Corrosion information is stored and retrieved primarily by means of a computerized data system.

Services and Publications: For a serious search of corrosion data the Information Retrieval Service of ASM should be utilized. ASM also provides on a monthly basis and for a fee a profile of selected information topics. It maintains bibliographic files on such subjects as stress corrosion cracking, atmospheric corrosion, and marine corrosion. It also publishes a variety of books and articles. Although none deals exclusively with corrosion, considerable corrosion-related information appears in the Metals Handbook (8th edition) and Metals Abstracts. In 1974 the latter publication alone abstracted 1,567 articles on corrosion.

Costs and User Information: Publications and information services are available on a worldwide basis. Costs vary.

For assistance contact Mr. David Chafe, (216) 333-5151, extension 437.

Remarks: ASM is an established and reputable center for the dissemination of metals-related information, including corrosion data.

Source 21. Armco Steel Corporation.

Research and Technology, Middletown, Ohio 45053.

Description: Armco Steel Corporation is a privately owned and operated steel company specializing in the production of carbon and stainless steels, precipitation hardening alloys, low alloy-high strength steels, and coated products. It ranks between third and fifth largest of United States steel companies. Armco maintains a corrosion research effort and an information storage site at its corporate research laboratory in Middletown.

Scope: Information is available on most all ferrous base alloys, especially stainless, precipitation-hardening, and low alloy-high strength steels. Data are available on such specific types of corrosion problems as general attack, pitting and stress corrosion cracking, atmospheric corrosion, and hydrogen embrittlement.

Input Sources: Information is obtained from in-house research, technical papers and reports, and industrial experience.

Facilities: Armco maintains a corrosion library at its corporate research center. Information retrieval is accomplished manually.

Services and Publications: Armco personnel will attempt to answer specific technical inquiries. Armco publishes data bulletins which contain corrosion information on specific products.

Costs and User Information: Inquiries relative to performance of Armco products are answered without charge.

For assistance contact Mr. Herbert H. Lawson at address above, or phone (513) 425-2738.

Remarks: Armco Steel has extensive experience with corrosion-resistant protective coatings. It performs only limited high-temperature corrosion research.

Source 22. BNF Metals Technology Centre.

Grove Laboratories, Denchworth Road, Wantage, Oxfordshire, England OX12 9BJ.

Description: The BNF Metals Technology Centre, an international organization serving the nonferrous metals

industry, has member firms in twenty-one countries. It conducts a broadly based research program (which includes corrosion research) funded by members or by sponsors outside the membership, and it also supplies a variety of technical services to assist the industry at large and the users of its products.

Scope: The Centre is involved with all aspects of corrosion relating to nonferrous metals, and also to the protection of ferrous metals with nonferrous coatings.

Input Sources: Information is obtained from BNF research, world technical and scientific literature, and industrial feedback from member companies.

Facilities: Approximately fifteen thousand corrosion related documents are stored. The most recent five thousand are registered in a coordinate indexing and retrieval system.

Services and Publications: The Metals Users' Consultancy Service deals with inquiries from metal users and undertakes investigation of problems and failures due to corrosion or other causes. It gives advice on the most efficient use of nonferrous metals for all applications. Technical memoranda are produced for guidance of users of nonferrous metals in various industries such as plumbing and central heating.

Costs and User Information: Costs depend upon the character of the work involved. Typical 1975 costs for short investigations are two hundred and fifty dollars per day plus expenses and for contract research they are forty-five thousand dollars per engineer year.

For assistance contact Mr. H. S. Campbell at the above address.

Remarks: The technical inquiry service gives practical advice or assistance on all aspects of production of nonferrous metals or components. Extensive laboratory facilities and staff are available to help solve inquirers' problems with a wide range of back-up services covering analysis, mechanical testing, structural examination of metals, nondestructive testing, etc.

Source 23. CEBELCOR.

Centre Belge d'Etude de La Corrosion, Avenue Paul Heger-Grille 2, 1050 Bruxelles, Belgium. Phone: Adm-(02) 649.63.96-Lab. (02) 649.35.16, Telex 23069 UNILIB B.

Description: CEBELCOR is an international nonprofit research center devoted to the study and solution of corrosion problems. Its activities include fundamental and applied corrosion research, direct help to industry, and documentation and education in electrochemistry and corrosion.

Scope: Information and assistance are available for a very broad range of corrosion problems. More than fifteen hundred particular problems have been studied, originating primarily from the chemical and building industries. Examples include: pitting corrosion, crevice corrosion, stress corrosion cracking, atmospheric corrosion, marine corrosion, and corrosion of steel in concrete.

Input Sources: Information is obtained from in-house research and from technical papers and reports.

Facilities: CEBELCOR maintains a collection of over three thousand documents. Information retrieval is accomplished by means of individual search.

Services and Publications: CEBELCOR answers inquiries, provides consultation, and performs research. Publications include technical reports and reviews. CEBELCOR is co-editor of the journal *Corrosion Science.*

Special services, which may include training on nonclassified topics, preferential option on the potential and non-patented results of research work, as well as the publication "Corrosion Week" are offered to members of the "Commission des Études Fondamentales et Applications," CEFA (Commission for Fundamental Research and Applications).

Source 24. Cobalt Information Center (CIC).

Battelle, Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201.

Description: CIC is a nonprofit organization supported by cobalt producing companies of the free world. Its objectives are to provide cobalt users with technical assistance, to disseminate technical information, to encourage and aid research, and to develop new uses for cobalt. The main office is in Brussels, Belgium.

Scope: Information is available on limited aspects of aqueous corrosion of cobalt and its alloys. Considerable data also exist regarding the high temperature sulfidation and oxidation of cobalt-base alloys.

Input Sources: Information is obtained from sponsored research, the worldwide technical literature, and metallurgical conference proceedings.

Facilities: Approximately 1,000 corrosion related documents are stored in a manual file.

Services and Publications: CIC will attempt to answer sperific technical inquiries. It visits industries, research laboratories, and educational institutions, distributes technical and scientific literature, and provides films to educational groups in America. It also sponsors research to promote the use of cobalt. A list of CIC publications is available upon request.

Costs and User Information: Inquiries are answered free of charge.

For assistance contact Mr. Daniel J. Maykuth at the above address, or phone (614) 424-6424, Extension 2234.

Remarks: CIC is a reputable source for corrosion data on cobalt. Such data is of limited extent, however.

Source 25. Copper Data Center (CDC).

Battelle, Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201.

Description: The Copper Data Center is a computer based information retrieval system established in 1965 by the Copper Development Association. CDC is operated by the Association through a contract with Battelle's Columbus Laboratories. Its purpose is to promote the use of copper and its alloys by making technical data readily available to engineers and metallurgists.

Scope: Information is available on copper and virtually every commercially available copper alloy. All phases of corrosion are covered with an especially comprehensive treatment of marine and freshwater corrosion problems.

Input Sources: Information is stored in English as extracts from the worldwide technical literature. About 90 percent is taken from technical journals.

Facilities: Nearly 10,000 extracts have been prepared in bound volumes, which are available at no cost to member companies of CDA. These extracts are indexed in depth; information retrieval is accomplished by computer search or manually by use of a computer-printed index.

Services and Publications: For CDA member companies the Center provides the "Extracts of Documents on Copper Technology" and a "Thesaurus of Terms on Copper Technology", which comprise a ready source of corrosion information. Automatic dissemination of data is accomplished through the Center's computer-coded Field of Interest Register. In addition, CDC distributes technical data bulletins on specific properties, answers specific inquiries, and performs complete literature searches.

Costs and User Information: Information, literature searches, and data bulletins are provided to the general public at no cost. Arrangements can be made for nonmember organizations to participate directly in the Data Center.

For assistance contact Mr. Robert T. Nichoff at the above address, or phone (614) 424-6424, extension 1467.

Remarks: CDC maintains the most comprehensive data base on copper corrosion in this country.

Source 26. International Lead and Zinc Research Organization, Inc. (ILZRO).

292 Madison Avenue, New York, New York 10017.

Description: ILZRO is a nonprofit organization supported by the sustaining membership of about thirty companies engaged in the mining and smelting of lead and zinc. Its purpose is to develop new applications and extend markets for these two metals.

Scope: Information is available on lead, zinc, and their alloys. Data centers principally on corrosion of sacrificial zinc anodes, corrosion of galvanized coatings in general and on steel reinforcing rod for concrete in particular, the use of lead and zinc in storage battery applications, corrosion of terneplate, and performance of zinc- and lead-containing paints.

Input Sources: Information is obtained from sustaining companies, the technical literature, and sponsored research.

Facilities: Data is stored in a manual file system. Size of the data bank is not known.

Services and Publications: ILZRO provides answers to specific inquiries. It publishes the Research Digest, a compilation of current research programs sponsored by ILZRO, and the ILZRO Guidelines, a series of two-page condensed summaries of successfully completed research projects.

Costs and User Information: Specific inquiries are answered at no charge. Occasionally a small fee is charged to cover the cost of literature and brochures.

For assistance contact Mr. Albert Cook at the above address, or phone (212) 532-2373.

Remarks: ILZRO, which possesses contacts worldwide to facilitate the rapid acquisition of information in response to an inquiry, is considered to be a reputable information source.

Source 27. The International Nickel Company, Inc.

One New York Plaza, New York, New York 10004; and Huntington Alloys, Inc., Huntington, West Virginia 25720.

Description: The International Nickel Company of Canada, Limited is the free world's leading nickel producer. It maintains a worldwide mining, ore processing, alloy production, and marketing organization through subsidiaries. Most of the mining and processing of nickel ores and other primary metals is carried out in Canada, although mining operations are also being undertaken in Guatemala and Indonesia and refining is also accomplished in the United Kingdom.

The International Nickel Company, Inc. is the U.S. marketing and research subsidiary with corporate offices in New York City and regional offices in Chicago, Detroit, Pittsburgh and Washington. High nickel alloys are produced in the U.S. by another subsidiary, Huntington Alloys, Inc., with main offices in Huntington, West Virginia.

Scope: Corrosion information on nickel and nickel-base Huntington alloys is available from Huntington Alloys, Inc. in Huntington, W. Va. or from any of its sales offices. Information from The International Nickel

Company, Inc. on all nickel containing alloys is available from the main office in New York City or from any of the regional offices.

Input Sources: Information is obtained from in-house research, technical papers and reports, research conferences, and industrial experience. In addition, more than 14,000 corrosion test spools have been exposed in a variety of industrial environments ranging from abietic acid to zirconium sulfate. These data are believed to represent the most complete file in the world on the corrosion resistance of nickel containing alloys.

Facilities: Corrosion research represents a major effort at three laboratories in the United States and at the International Nickel Limited European Research and Development Center in Birmingham, England. Research and development on Huntington alloys is carried out at Huntington, W. Va. Atmospheric exposure lots are devoted mainly to marine corrosion at the Francis L. LaQue Corrosion Laboratory at Wrightsville Beach, N. C. and nearby Kure Beach, N. C. The Paul D. Merica Research Laboratory at Sterling Forest, N. Y. performs corrosion research on most nickel containing alloys. Libraries, which have large sections devoted to corrosion, are maintained at each of the laboratories as well as at the main office in New York. The results of industrial corrosion test spool exposures are maintained in New York. The corrosion test spool data for industrial exposures are currently being computerized for rapid retrieval and analysis.

Services and Publications: Inco will answer specific technical inquiries. It publishes Corrosion Engineering Bulletins describing the performance of specific alloys in selected chemical environments, Marine Corrosion Bulletins, reprints technical papers of interest and other literature. A review of available literature may be obtained upon request. Separate publications on Huntington alloys are available from Huntington Alloys, Inc.

Costs and User Information: Specific technical inquiries on nickel containing alloys are answered without charge. Where there is need for extensive corrosion investigations to support a scientific need or commercial requirement, consideration will be given to undertaking such work under contract. Such investigations can include liquid chemical, high temperature oxidation, marine and atmospheric environments. Inco laboratories are well equipped for all forms of corrosion investigations.

For assistance on Huntington alloys contact any sales office, or call the main office in Huntington, W. Va. at (304) 696-2150.

For assistance on any nickel-containing alloys contact any Inco regional office or Corporate Headquarters at (212) 742-4000.

Remarks: Inco is a reputable source for corrosion information on nickel and nickel containing alloys.

Source 28. Magnesium Research Center (MRC).

Battelle, Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201.

Description: The Magnesium Research Center was established at Battelle's Columbus Laboratories in January, 1972. Its purpose is to provide the research and technological needs of the worldwide magnesium industry, of government agencies, and of all other interested parties.

Scope: Information is available on magnesium and its alloys. Available data cover a very broad range of corrosion problems, including general corrosion, stress corrosion, corrosion fatigue, localized forms of attack, atmospheric corrosion, marine and freshwater corrosion, and more.

Input Sources: A major data input has been the acquisition of The Dow Chemical Company proprietary report files. Information is also obtained from the open literature and from direct interaction with experts in the magnesium industry. In this regard, MRC is an associate member of the International Magnesium Association, and its personnel serve on several committees.

Facilities and Staff: MRC possesses the complete files of research and development reports of The Dow Chemical Company resulting from 52 years of intensive research on magnesium alloys and processes. Approximately 14,000 reports totaling nearly 250,000 pages are catalogued in a thoroughly indexed manual data retrieval

system. Former employees of The Dow Chemical Company having a total experience of 94 years in magnesium research and technology and who are thoroughly familiar with these files constitute the MRC staff.

Services and Publications: The Center answers inquiries, prepares in-depth reports, state-of-the-art reviews, literature searches, data compilations, and bibliographies. It also performs contract research.

Costs and User Information: Information is available to everyone for a fee.

For assistance contact Dr. Thomas E. Leontis at (614) 424-6424, extension 3473.

Remarks: The MRC is recognized as an international center of excellence in magnesium research and technology, including the various aspects of magnesium corrosion and electrochemical phenomena.

Source 29. Metals and Ceramics Information Center (MCIC).

Battelle, Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201.

Description: MCIC is an information analysis center sponsored by the U.S. Department of Defense. Its objectives are to collect, evaluate, and disseminate timely, authoritative, technical information on the characteristics and utilization of advanced metals, ceramics, and composites.

Scope: MCIC is primarily concerned with selected metal-or-ceramic base materials capable of being used under extreme conditions of temperature, stress, erosion, and corrosion in military structural applications.

MCIC maintains a large multidisciplinary information base on corrosion R&D, and it periodically publishes documents in the area of materials compatibility in various environments.

Input Sources: Government-sponsored research reports, technical journals, books, symposium proceedings, and trade literature.

Facilities:

Manual Files (1954-1970): 90,000 documents.
Computerized Data Base (1970 to present): 11,000 documents.
Reference citations are backed up with hard copy documents.

Services and Publications: The Center answers technical inquiries, provides advisory services, performs special assignments, prepares bibliographies, literature searches, technical assessment and engineering reports, state-of-the-art reports, databooks, handbooks, and publishes a series of current awareness periodicals, one of which is the "Review of Metals Technology-Corrosion Compatibility." A Newsletter is distributed monthly without charge. A listing of the Center's technical publications and associated costs is available upon request.

For general assistance contact MCIC at (614) 424-6424, extension 2758. For technical inquiries call the number given below.

Costs and User Information: Quick response to technical inquiries by a professional staff is a primary service of MCIC. Charges for this service are made on a cost-incurred basis. A cost estimate is provided for all requests.

For assistance contact Mr. Roy Endebrock at (614) 424-6424, extension 2926.

Remarks: MCIC is a technology oriented information center with property data included as part of its files. It is organized to provide authoritative technical information on the characteristics of advanced metals and ceramics. The diverse expertise of the Battelle staff is utilized in providing these services.

Source 30. The Metals Society.

1 Carlton House Terrace, London SW1Y 5DB.

Description: The Metals Society was formed from a merger of The Iron and Steel Institute and the Institute

of Metals. Its primary objective is to promote all aspects of the science and technology of metals and alloys and related materials. It accomplishes this objective by providing an international forum for discussion, by issuing publications, and by operating an information center.

Scope: The scope of The Metals Society is quite broad. Information is available for nearly all metals of engineering interest with special emphasis on iron and steel. Virtually all forms of corrosion are covered by its abstracting services.

Input Sources: Information is obtained from the worldwide published scientific literature, including books, periodicals, technical reports, and conference proceedings.

Facilities: The Society maintains an extensive metallurgical library of books and periodicals which contains a corrosion section. Although the present size of the library is not available, about 4000 corrosion related abstracts and profiles are added each year.

Services and Publications: The Society publishes the quarterly *British Corrosion Journal* and provides various abstracting and translating services (described below) which incorporate the worldwide scientific corrosion literature:

Metals Abstracts—A monthly abstracts and index journal published in conjunction with The American Society for Metals, which includes about 2000 abstracts annually on corrosion subjects.
Abstract and Book Title Index Card Services for Iron and Steel—ABTICS is a weekly card service covering the world's literature on ferrous metallurgy. About 1000 cards per year are corrosion-related.
Iron and Steel Industry Profiles—ISIP are weekly sheets providing selective dissemination of abstract and translation references on ferrous metallurgy. About 1000 profiles each year relate to corrosion.
British Industrial and Scientific International Translation Service of The Metals Society—BISITS provides English translations of significant articles from the worldwide metallurgical literature. Approximately 80 translations per year deal with corrosion subjects.
Library and Information Services of The Metals Society—This service utilizes the sources described above to provide lists of references from the published literature on corrosion subjects.
British Corrosion Journal—This is a quarterly journal covering metallurgical, chemical, electrochemical, and physical theory and practice as they affect corrosion and its prevention.

Costs and User Information: Costs of the various services are as follows:

Metals Abstracts—£150 per annum basic organizational subscription, £65 per annum basic institutional library subscription.
Metals Abstracts Index—£60 per annum basic subscription.
ABTICS—Available for an annual subscription rate of £122.
ISIP—A subscription for corrosion subjects ranges from about £7 to £24 per year.
BISITS—Free weekly lists are sent on request.
British Corrosion Journal—Subscription rates: Society members, £6 per annum; non-members (U.K.), £15 per annum; non-members (overseas), £17 per annum.

For assistance and additional information contact Mr. M. L. Pearl, Assistant Secretary, Library and Information Services, at the above address or phone 01 839-4071.

Remarks: The above-listed rates for services and publications are under consideration for revision in 1976.

Source 31. Tin Research Institute, Inc.

483 West Sixth Avenue, Columbus, Ohio 43201.

Description: The Tin Research is a nonprofit international organization dedicated to the tin user. Funded by the governments of tin-producing countries of the free world, it promotes and develops the use of tin and tin products through research, publicity, and promotion.

Scope: Information is available on all facets of tin, tin alloys, and chemical compounds of tin. A large spectrum of corrosion problems is covered, with emphasis on tin alloys such as bronzes and babbitts, and tin coatings for steel.

Input Sources: Information is obtained primarily from in-house research and from the open literature and technical reports.

Facilities: The Institute possesses considerable laboratory facilities for corrosion research at its Greenford, England, headquarters. It maintains a library of over 100 technical journals and other periodicals at its Columbus office, and it also maintains an information file in which corrosion constitutes a major classification. The size of the data file with respect to corrosion is not known. Data retrieval is performed manually.

Services and Publications: The Institute operates a technical inquiry service. It publishes a quarterly journal, "Tin and Its Uses," as well as information bulletins, specialty articles, and research reports.

Costs and User Information: Information is available to everyone upon request. Inquiries are answered free of charge. The Institute may require subsidization of its travel costs for on-site visitation and consultation.

For assistance contact Mr. Joseph B. Long at the above address, or phone (614) 294-3341.

Remarks: A little-known activity of the Institute is its function as an information center for reputable corrosion information. The west coast office at 2600 El Camino Real, Palo Alto, California 94306 (Telephone (415) 327-6650) serves the western U.S. and Canada, while the Columbus, Ohio, office is responsible for the eastern U.S., Canada, and Mexico.

Source 32. Titanium Metals Corporation of America.

1140 Bloomfield Avenue, West Caldwell, New Jersey 07006.

Description: Titanium Metals Corporation of America is a privately owned, completely integrated company engaged in the refining and production of titanium metals and its alloys. It maintains a separate research activity at Henderson, Nevada, including a research effort of about three man years per year to investigate the corrosion properties of titanium alloys and competitive materials.

Scope: Information is available for titanium, titanium-base alloys, and certain types of competitive corrosion-resistant alloys.

Input Sources: Information is obtained from technical papers, reports, and in-house research.

Facilities: TMCA maintains a collection of over 13,000 documents in a technical library located at Henderson, Nevada.

Services and Publications: TMCA answers inquiries and provides consultation, advice, and reference services.

Costs and User Information: Information is available free of charge to everyone upon request.

For assistance contact Mr. W. Minkler at the Corporate office in New Jersey, telephone number (201) 575-9500.

Remarks: TMCA maintains one of the most extensive libraries on titanium properties in existence.

Societies/Trade Associations and Institutes

(Sources 33-38)

Source 33. American Institute of Chemical Engineers (AIChE).

345 East 47th Street, New York, New York 10017.

Description: AIChE is a professional society whose objectives are to (1) advance chemical engineering in theory and practice, (2) maintain a high professional standard among its members, and (3) serve society in those areas where chemical engineering can contribute to the public interest.

Scope: Information is available for those materials used in the process industry, including organic and inorganic processes, nuclear engineering, petroleum refining, and pulp and paper manufacturing. The entire spectrum of corrosion problems is covered, especially general attack, stress corrosion cracking, intergranular attack, embrittlement, and sulfide cracking.

Input Sources: Information is obtained principally as feedback from industrial members of technical committees, from activities of the Materials and Engineering and Sciences Division, and from the technical literature.

Facilities: AIChE subscribes to the services of the Engineering Societies Library, 345 East 47th Street, New York, New York 10017. This library, which serves the many overlapping engineering disciplines, contains approximately 315,000 engineering-related documents, books, and periodicals. The Engineering Index system is used for information search and retrieval.

Services and Publications: AIChE will attempt to answer specific inquiries, but requests involving extensive searching are referred to the Engineering Societies Library. AIChE publishes several periodicals:

Chemical Engineering Progress,
AIChE Journal,
Translation Periodical (International Chemical Engineering).

In addition, it publishes a Symposia Series eight to twelve times per year on specific topics of general interest.

Costs and User Information: AIChE does not charge for answering simple inquiries. The Engineering Societies Library charges $20 per hour for producing an annotated bibliography on a specific topic. Photocopies may be obtained for a fee of 25 cents per page plus a $3.00 handling charge per volume.

For assistance contact Mr. F. J. Van Antwerpen of AIChE at the above address, or phone (212) 752-6800.

Remarks: The combined capabilities of AIChE and the Engineering Societies Library insure ready and complete access to corrosion information in all fields of engineering.

Source 34. Committee of Stainless Steel Producers, American Iron and Steel Institute (AISI).

1000 16th Street NW., Washington, D.C. 20036.

Description: AISI is an association of 74 iron and steel companies in the United States, Canada and Latin America. The Committee of Stainless Steel Producers engages in activities for the purpose of encouraging greater use of stainless steel through education, research, publicity, and promotion, and it prepares and distributes printed matter resulting from such activities.

Scope: Available information relates to the corrosion performance of stainless steel for many existing or potential applications, including desalination of sea water, home water supply, underground service, wastewater treatment, power plant condensers, gas scrubbers, architecture, etc.

Input Sources: Information is obtained principally as feedback from members of participating steel companies, from sponsored research, and from the open technical literature.

Facilities: Information is stored as pamphlets, booklets, and reports; no central library of documents is maintained. The size of the literature collection varies for different subjects.

Services and Publications: AISI will attempt to answer specific inquiries relating to stainless steels. The Committee of Stainless Steel Producers publishes pamphlets and reports on selected corrosion topics. No complete listing of all existing literature is available.

Costs and User Information: Inquiries are answered at no cost. Single copies of available literature are also provided free of charge.

For assistance contact Mr. Ernest S. Kopecki at the above address, or phone (202) 223-9040.

Remarks: The Committee of Stainless Steel Producers is a reputable source of corrosion information on the performance of stainless steel alloys.

Source 35. American Petroleum Institute (API).

1801 K Street N.W., Washington, D.C. 20006.

Description: API is a trade association supported by companies which are active in the petroleum industry. Its purposes are:

(1) To afford a means of cooperation with the government in all matters of national concern;
(2) To foster foreign and domestic trade in American petroleum products;
(3) To promote in general the interests of the petroleum industry in all its branches; and
(4) To promote the mutual improvement of its members and the study of the arts and sciences connected with the petroleum industry.

Scope: Information which has been obtained is specifically tailored to the needs of the oil industry. Corrosion information is available for such materials as carbon steel, chromium-molybdenum steels (1 percent to about 9 percent Cr), stainless steels, all nickel-base alloys, and titanium. Corrosion areas investigated include general attack, intergranular attack, hydrogen embrittlement, stress corrosion cracking including that caused by sulfides, corrosion fatigue, pitting, and high-temperature sulfidation, carburization, and catalyst erosion.

Input Sources: Information is obtained from sponsored research, the open literature, and as feedback from participating companies.

Facilities: API stores its information in the form of published documents and proceedings of technical symposia. It maintains a reference library of its own publications and related scientific and technical publications. The API Central Abstracting and Indexing Service in New York, N.Y., (212) 685-6251, indexes and abstracts worldwide refining and patent technical literature. Arrangements to search this literature can be made by contacting E. H. Brenner, Manager.

Services and Publications: Attempts are made to answer specific inquiries submitted as formal requests. API publishes the proceedings of technical symposia, and it furnishes a list of all available publications upon request.

Costs and User Information: Inquiries are answered free of charge. Publications are provided for a nominal fee.

For assistance contact Mr. R. R. Wright at the above address, or phone (202) 833-5640.

Remarks: Organizations with a continuing interest in corrosion problems of the petroleum industry are referred to the appropriate technical committees of the National Association of Corrosion Engineers for more specialized assistance. These committees are T1. Corrosion Control in Petroleum Production, and T8, Refining Industry Corrosion.

Source 36. American Society for Testing and Materials (ASTM).

1916 Race Street, Philadelphia, Pennsylvania 19103.

Description: The American Society for Testing and Materials, founded in 1898, is a scientific and technical organization formed for "the development of standards on characteristics and performance of materials, products, systems, and services, and the promotion of related knowledge." It is the world's largest source of voluntary consensus standards. The Society operates through more than 115 main technical committees. The organization currently has 22,000 active members, of which approximately 14,000 serve as technical experts on committees.

Scope: Information is available for nearly all alloys of engineering interest, including aluminum, copper, lead, magnesium, nickel, and titanium alloys, and carbon and stainless steels. Corrosion topics considered include testing precedures, corrosion standards and control, stress corrosion cracking, localized corrosion, corrosion in the atmosphere and seawater, and corrosion in petroleum, gas, automotive, pipeline, telephone, marine, nuclear, chemical, nonferrous, and ferrous industries.

Input Sources: Information is obtained from members of the Society. Specifications are adopted for publication only after approval by a series of votes by the membership.

Facilities: Corrosion information is available from Part 10 (880 pages) of the Annual Book of ASTM Standards and from selected publications totaling nearly 1600 pages. Information may be retrieved through published subject indexes and numeric lists of specification numbers.

Services and Publications: No literature searching service is provided by the Society. The following publications contain corrosion information:

Part 10, Annual Book of ASTM Standards
"Metals-Mechanical, Fracture, and Corrosion Testing; Fatigue; Erosion; Effect of Temperature"
Corrosion in Natural Environments—STP 558
Localized Corrosion—Cause of Metal Failure—STP 516
Manual of Industrial Corrosion Standards and Control—STP 534
Metal Corrosion in the Atmosphere—STP 435
Stress Corrosion Cracking of Metals—A State of the Art—STP 518.

Costs and User Information: Each ASTM standard is available as a separate publication at a cost of $1.50 each. Part 10 of the Annual Book of ASTM Standards is available for $26.00. The costs of the other corrosion related publications are:

STP 558—$29.75
STP 516—$22.50
STP 534—$16.75
STP 435—$27.00
STP 518—$11.75

All documents are available from the above address.

Remarks: ASTM is the primary source for standards related to materials testing and analysis in the USA, and it possesses an international recognition. It provides authoritative and comprehensive publications on all phases of industrial corrosion and corrosion testing.

Source 37. The Electrochemical Society (ECS).

P.O. Box 2071, Princeton, New Jersey 08540.

Description: The Electrochemical Society is a scientific and technical society serving the fields of electrochemistry and corrosion science.

Scope: The Society is concerned with all types of corrosion, generally with greater emphasis on theory and understanding than on immediate solution. All types of metals and alloys are considered, the noble and less common types as well as those of greater engineering interest.

Input Sources: Information is obtained from technical research papers contributed for publication in the Journal, from technical meetings sponsored by ECS, and from contributors to the Monograph and Society Symposium Series.

Facilities: Corrosion information is stored in the form of journals, books, and symposium volumes. The exact size of the data system is not known, but it includes several hundred thousand pages of printed material.

Services and Publications: The Society sponsors several technical meetings each year, nearly all of which include symposia on corrosion problems. Publications include:

Journal of the Electrochemical Society
Corrosion Monograph Series, including:
Corrosion Handbook
Stress Corrosion of Metals
The Corrosion of Light Metals
The Corrosion of Copper, Tin, and Their Alloys
Corrosion in Nuclear Applications
Handbook on Corrosion Testing and Evaluation
Society Symposium Series, including:
High Temperature Metallic Corrosion of Sulfur and Its Compounds
Electrochemical Contributions to Environmental Protection
Corrosion Problems in Energy Conversion and Generation
A list of all publications is available upon request.

Costs and User Information: Copies of journals may be obtained from University Microfilms, Inc., 300 Zeeb Street, Ann Arbor, Michigan 48106. The Monograph Series may be obtained from John Wiley and Sons, Inc., 605 Third Avenue, New York, New York 10016. The Society Symposium Series may be ordered directly from Society Headquarters at the above address. Information regarding prices and availability should be obtained directly from the suppliers.

Remarks: Information presented in the Journal of ECS is strongly oriented toward fundamental and mechanistic concepts. The Monograph and Society Symposium Series are directed more toward the solution of engineering problems.

Source 38. National Association of Corrosion Engineers (NACE).

2400 West Loop South, P.O. Box 1499, Houston, Texas 77027.

Description: NACE is an engineering society devoted to promoting the science and technology of corrosion control.

Scope: The scope of NACE is extremely broad. All forms of corrosion are considered, including those found in such industries as chemical process, nuclear, petroleum, pulp and papermaking, and energy conversion and generation, and in such environments as marine and atmospheric. Information is available for a very broad range of engineering metals and alloys. Theories, measurement techniques, economics, and other innovative ideas are considered.

Input Sources: Information is obtained from technical research papers contributed for publication in the *Corrosion* journal, from technical meetings sponsored by NACE, and from authors and contributors to the many publications sponsored by NACE.

Facilities: Corrosion information is stored as journals, books, technical committee reports, publications and standards, and bound proceedings of technical meetings, conferences, and corrosion congresses. Total size of the data bank is not known, but it exceeds approximately 100,000 pages of printed information.

Services and Publications: NACE sponsors several technical meetings each year as part of the regular activities of the association. In addition, it sponsors congresses and symposia on metallic corrosion and corrosion-related topics of particular interest. It encourages participation in one or more of its 200 technical committees. It publishes extensively, and the reader is referred to NACE headquarters at the above address for a comprehensive list. These publications include:

Corrosion Journal
Corrosion Abstracts
Materials Performance
NACE Reference Book Series on stress corrosion, corrosion fatigue and localized corrosion
NACE Technical Committee reports, publications, and standards
International Congress on Metallic Corrosion Series
NACE Basic Corrosion Course Text
Proceedings of the NACE annual conferences
Corrosion Data Survey
Corrosion Inhibitors
Control of Pipeline Corrosion
Atmospheric Corrosion of Metals
Atlas of Electrochemical Equilibria in Aqueous Solutions

Costs and User Information: NACE publications and other information may be obtained by writing to the above address. Costs are not included due to the voluminous amount of literature available.

Remarks: NACE is a reputable and recognized source of a great variety of corrosion information. It successfully bridges the gap between the fundamental and practical aspects of corrosion.

Appendix

- Additional Sources of Corrosion Information
- Materials Index
- Properties Index

Additional Sources of Corrosion Information

[1] *Applications Related Phenomena in Titanium Alloys*, ASTM Special Technical Publication No. 432, American Society for Testing and Materials, Philadelphia (1968).

[2] Rozenfeld, I. L., *Atmospheric Corrosion of Metals*, National Association of Corrosion Engineers, Houston (1973).

[3] *Boshoku Gijutsu (Corrosion Engineering)*, Edited by H. Shigeno, Japan Publications Trading Company Limited, Box 5030, Tokyo International, Tokyo, Japan.

[4] *Columbium Metallurgy*, Edited by D. L. Douglass and F. W. Kunz, Interscience Publishers, New York (1961), pp. 553-741.

[5] Uhlig, H. H., *Corrosion and Corrosion Control*, John Wiley and Sons, Inc., New York (1963).

[6] Butler, G., and Isen, H. C. K., *Corrosion and its Prevention in Waters*, Reinhold Publishing Corporation, New York (1966).

[7] Bregman, J. I., *Corrosion Inhibitors*, The MacMillan Company, New York (1963).

[8] Fink, F. W., and Boyd, W. K., *The Corrosion of Metals in Marine Environments*, Edited by D. J. Maykuth, Defense Metals Information Center Report 245, Bayer and Company, Inc., Columbus (1970).

[9] Schlain, D., *Corrosion Properties of Titanium and Its Alloys*, Bulletin 619, U.S. Dept. of the Interior, Bureau of Mines (1964).

[10] *Corrosion Science Journal*, Editor-in-Chief J. C. Scully, Pergamon Press, Oxford.

[11] *Lead for Corrosion Resistant Applications*, Lead Industries Association, New York (1974).

[12] *Localized Corrosion—Cause of Metal Failure*, American Society for Testing and Materials, Philadelphia (1972).

[13] *Metal Corrosion in the Atmosphere*, American Society for Testing and Materials, Philadelphia (1968).

[14] Hauffe, K., *Oxidation of Metals*, 1965 Edition, Plenum Press, New York (1965).

[15] Parker, M. E., *Pipe Line Corrosion and Cathodic Protection*, Second Edition, Gulf Publishing Company, Houston (1962).

[16] *Pulp and Paper Industry Corrosion Problems*, National Association of Corrosion Engineers, Houston (1974).

[17] *The Science, Technology, and Application of Titanium*, Edited by R. I. Jaffee and N. E. Promisel, Pergamon Press, New York (1970).

[18] Ewing, S., *Soil Corrosion and Pipe Line Protection*, American Gas Association, New York (1938).

[19] Tomashov, N. D., *Theory of Corrosion and Protection of Metals*, Edited by B. H. Tytell, I. Geld, and H. S. Preiser, The MacMillan Company, New York (1966).

[20] Champion, F. A., *Corrosion Testing Procedures*, John Wiley and Sons, Inc., New York (1964).

[21] *Werkstoffe und Korrosion*, Edited by H. J. Engell and D. Behrens, Verlag Chemie Gmbh, Pappelallee 3, Weinheim/Bergstrasse, West Germany.

[22] Slunder, C. J., and Boyd, W. K., *Zinc: Its Corrosion Resistance*, Zinc Institute Inc., New York (1971).

[23] Mathewson, C. W., *Zinc: The Metal, Its Alloys and Compounds*, Reinhold Publishing Corporation, New York (1959).

Materials Index to Source Numbers

Properties Index to Source Numbers

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16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

This survey was undertaken to provide a directory of authoritative sources of information on corrosion of metals. It assesses the scope, assets, and deficiencies of about thirty-eight of the most important sources. These include handbooks and technical compilations, information centers, technical societies, and trade associations and institutes. The initial listing of sources to be included was drafted by the authors and summitted to members of the Publications Committee of the National Association of Corrosion Engineers. This Committee thus served as an ad hoc review group for the sources which appear herein. The Directory is indexed by materials and types of corrosion.

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