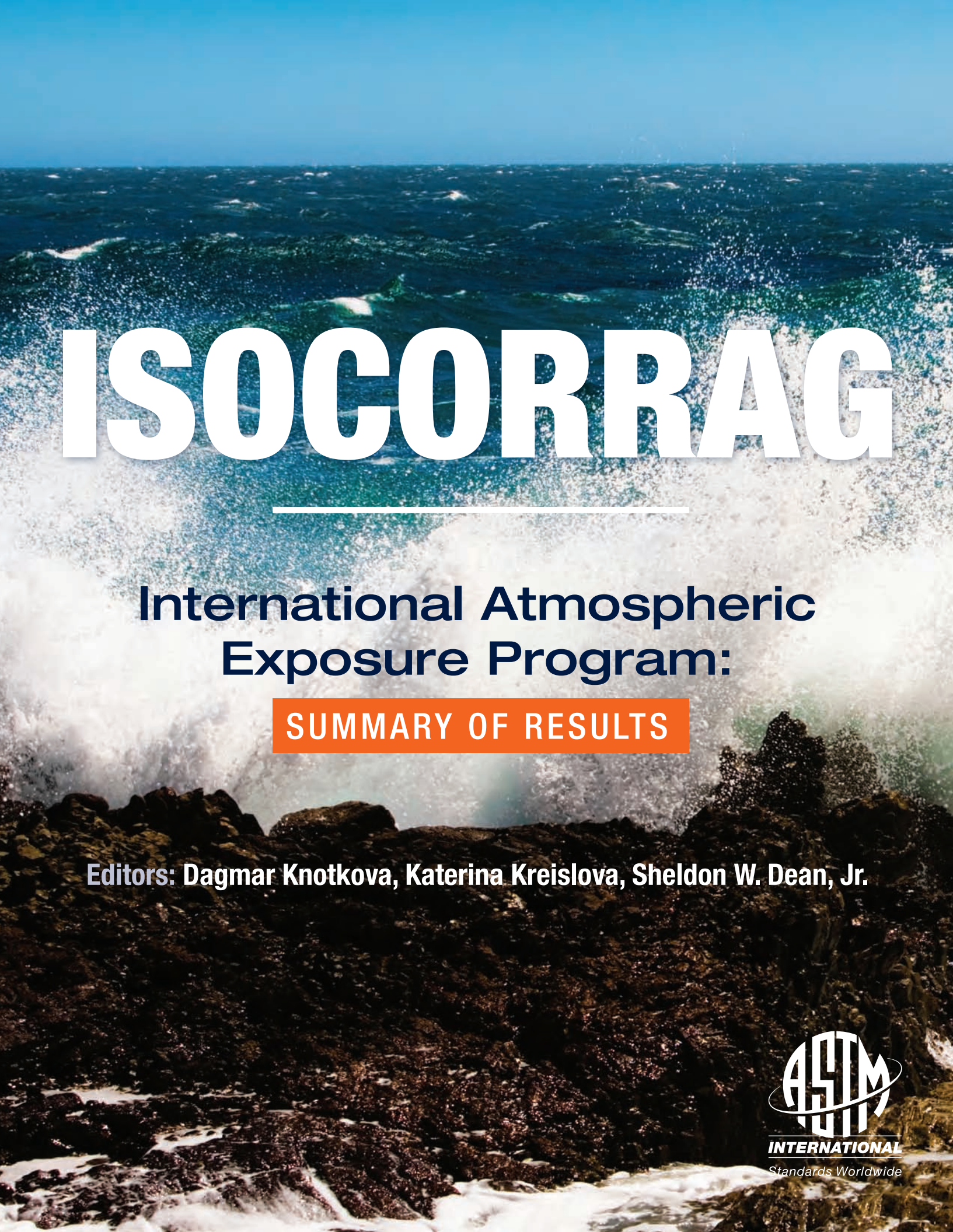

ISOCORRAG

International Atmospheric Exposure Program:

SUMMARY OF RESULTS

Editors: Dagmar Knotkova, Katerina Kreislova, Sheldon W. Dean, Jr.

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ISOCORRAG

International Atmospheric Exposure Program: Summary of Results

Developed by ISO/TC 156/WG 4,
Atmospheric Corrosion Testing and Classification of Corrosivity of Atmosphere

Sponsored by ASTM Committee G01 on Corrosion of Metals

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Preface

Metals, protective coatings, and other materials deteriorate when exposed to atmospheric environments. When selecting materials for such applications, it is important to have information on the rate and type of deterioration that can occur in order to estimate the service life and economic consequences of the materials. A standardized corrosivity classification system has been developed by the International Organization for Standardization (ISO) that is used throughout the world. It has been discovered that this system is less accurate than desired in several cases, and examples both of over and underestimation have been observed. As a result, the ISOCORRAG Program was developed to provide actual exposure data to update and improve the corrosivity classification system. This program was initiated in 1986 and closed in 1998.

The improvement of the standardized corrosivity classification system was achieved by a careful evaluation and analysis of the results of the data from the ISOCORRAG Program. This program was the first worldwide atmospheric testing program carried out by many different organizations in a number of nations participating in ISO. It had a well-defined structure to obtain both short and long-term kinetics of the corrosion processes that affect several important structural metals, together with a monitoring program to record the environmental parameters that affect outdoor atmospheric corrosion. Subsequently, the MICAT Program was organized and carried out through the cooperative efforts of Spain, Portugal, and many Latin American countries. There are many similarities between the ISOCORRAG and MICAT programs, and there has been sharing of the data and results.

The analysis of the data from the ISOCORRAG Program was based on a dose-response concept to develop a relationship between the environmental parameters and the observed corrosion rates. The analyses of the results have been carried out by members of ISO/TC 156/WG 4 on Atmospheric corrosion testing and classification of corrosivity of atmosphere using statistical regression analyses methods.

Both the ISOCORRAG and MICAT programs were designed to find simple dose-response relationships between the environmental parameters and the corrosion damage. The UN ECE Convention on Long-Range Transboundary Air Pollution has also been involved in developing dose-response functions that separate wet and dry deposition of pollutants as part of their International Cooperative Program on the Effects on Materials (ICP Materials). These large-scale programs have greatly improved our understanding of atmospheric corrosion processes in the past two decades.

This book presents the results of the ISOCORRAG Program in a single document so that engineers, scientists, students, and other interested parties may have access to them. In addition, an extensive list of references has been included to assist the reader in locating these analyses of the data contained in this book.

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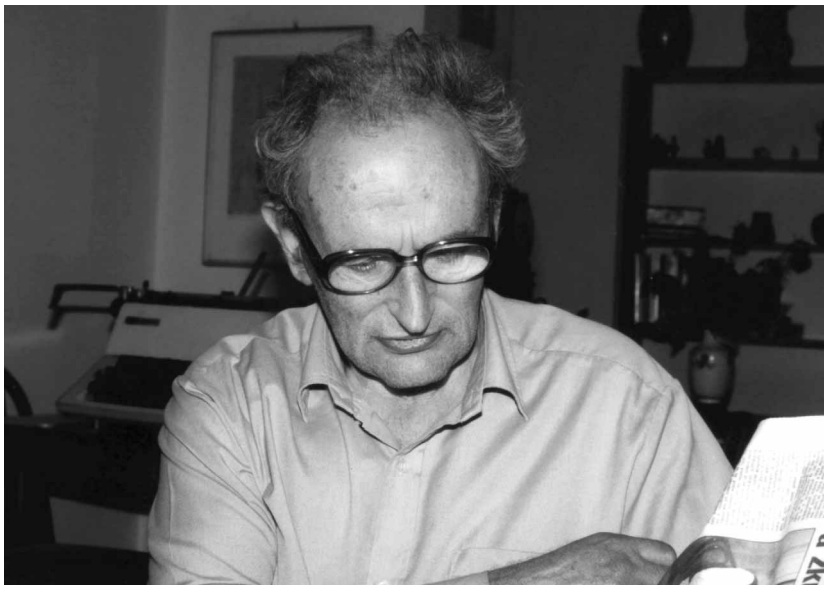
The authors acknowledge the long-term assistance of all participants of the ISOCORRAG program and all ISO/TC 156/WG 4 members who provided comments, analyses, and proposals concerned with this work. We especially appreciated the extensive cooperation among the Australian, Czech, Russian, Spanish, Swedish, and USA WG 4 members, and other colleagues in creating the data bases and protocols for handling the data. The results of these analyses have provided the technical basis for the revision of the atmospheric corrosivity classification system.

The authors gratefully acknowledge the sponsorship of ASTM Committee G01 on Corrosion of Metals that made it possible to publish this data series. In addition, support for the organization and treatment of the data in this book were provided by the R&D Project No. MSM 2579478701 Research of methods for precision of metallic materials and their protective layers service life prediction from point of view pollution in environment granted by the Ministry of Education, Youth and Sports of the Czech Republic.

Dedication

This volume is dedicated to the memory of our friend and colleague Dipl. Ing. Karel Bartoň, Ph.D., with whom we worked for decades. He was an internationally recognized expert in the field of atmospheric corrosion and corrosion protection from 1955 to 1990.

Karel Bartoň was born in 1923, in Ústí nad Labem, the Czech Republic. He spent the last years of World War II in labor camps. Thereafter, he graduated from the Institute of Chemical Technology in Prague (1950) with a degree in chemical engineering and then earned his Ph.D. in the field of physical metallurgy-corrosion from the Technical University for Mining and Metallurgy in Ostrava (1962). After receiving subsequent certificates from the Academy of Sciences of the Czechoslovak Socialist Republic, he was recognized as a leading research worker. In the course of his professional life, he worked in the fields of both corrosion science and corrosion engineering at the State Institute for the Protection of Materials (SVUOM) in Prague. He was the director from 1966 to 1970.



Karel Bartoň had many abilities and interests. He was a systematic research worker, who was able to produce a scientifically based project with complex field and laboratory tests, measurements, and monitoring. His wife worked with him in many of these activities. He always evaluated the results he obtained both in terms of their scientific contributions and in terms of their engineering applications. He was also an enthusiastic leader who stimulated his young research coworkers, and so he took part in their university education.

As a leading worker in the field of corrosion and corrosion protection he championed the concept of interdisciplinary approaches with the use of results from the fields of metallurgy, physical chemistry, climatology, statistics, and others. He worked systematically and in depth in atmospheric corrosion, where he combined the knowledge gained from laboratory tests, field testing, and practical solutions to create an integrated, theoretically supported model that was able to be widely applied.

He was a leader in standards development, and he formulated and introduced a national system of standardization in the field of corrosion and corrosion protection. This became the basis for the standardization system of the countries of the Council of Mutual Economic Assistance. Later he also influenced the approach to standardization of ISO/TC 156 "Corrosion of metals and alloys." He formulated the basis of the classification of the corrosivity of atmospheres, and he collaborated with the WG 4 working group. He made a significant contribution in the formulation of the ISO 11303 standard, "Corrosion of metals and alloys – Guidelines for selection of protection methods against atmospheric corrosion."

In his extensive lecturing activities, he used his ability to maintain a lively delivery with his excellent knowledge of languages. As the chairman of a regional section of the Scientific and Technical Society,

field of corrosion and corrosion protection, he directed their activities in a broad sense. Although his work was accepted throughout the world, his international involvement and cooperation were negatively affected by the political situation in the decades of the 1970s and 1980s.

He was the author of many scientific and specialized publications. His book Protection Against Atmospheric Corrosion (John Wiley & Sons, 1975) combined the principles of a scientific approach with engineering solutions and was one of the primary resources for the discipline. He participated in other publications, including "Atmospheric Corrosion" (Ed. W.H. Ailor, Wiley, New York, 1982) and "Degradation of Metals in the Atmosphere" (Ed. S.W. Dean, T.S. Lee, ASTM STP 960, West Conshohocken, PA, 1988).

After he retired in 1990, he was still active as a consultant and translator.

Karel Barton was able to combine the demands of scientific research and management with a rich personal and family life. He was fond of experiencing the beauty of nature. He enjoyed participation in and following sports, and he had musical talent. He played both the violin and viola.

His energy and universal creativity set a favorable example for all of us to emulate. Dip. Ing. Karel Bartoň died in 1995, but his influence lives on with this book. A number of his ideas have been utilized by the authors of this publication, which is dedicated to his memory. Messrs. Hanus and Vitek Barton (Dr. Barton's sons) have contributed to this dedication, and one of us (DK) had worked with Dr. Barton for 35 years.

Dr. Knotkova is a world-renowned scientist who has worked for more than 40 years in the Czech Republic on the atmospheric corrosion of metals. She has served as chair of ISO/TC 156/WG 4 and has published extensively in Europe and the USA. She has led the ISO efforts to develop standards on using atmospheric and pollution data to estimate atmospheric corrosion rates and to use this information to select appropriate protection systems for coping with atmospheric corrosion. She developed and led the ISO effort to conduct a worldwide atmospheric exposure program to understand the variables that affect the atmospheric corrosion of engineering metals. She has won the NACE International Frank Newman Speller Award for excellence in corrosion engineering based on her work in the atmospheric corrosion area.

Mrs. Katerina Kreislova has worked with Dr. Knotkova for many years and is quite familiar with the ISO CORRAG Program. She is a member of the UN ECE ICP Coordination Group and has been involved with the analysis of atmospheric corrosion data extensively.

Dr. Dean has been active in the field of atmospheric corrosion since 1962, and has been a member of ASTM International Committee G01 on Corrosion of Metals since 1965. He chaired ASTM Subcommittee G01.04 on Atmospheric Corrosion for several years and also the NACE International Unit Committee T3-R on Atmospheric Corrosion. He has represented the USA in ISO/TC 156/WG 3 and 4 from their creation in 1978 to the present and led the USA participation in the ISO CORRAG Program. He has published 29 papers on various aspects of atmospheric corrosion, and chaired three ASTM symposia on atmospheric corrosion and related topics and co-edited the STP books of collected papers resulting from these symposia. He has won the ASTM Award of Merit, the ASTM Sam Tour Award, the ASTM Charles Dudley Award, the ASTM Committee G01 Francis L. Laque Award, the ASTM William T. Cavanaugh Award, and the NACE Frank Newman Speller Award. He is a fellow of ASTM International, NACE International, American Institute of Chemical Engineers, and the Materials Technology Institute.

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