Atmospheric Corrosion Investigation of Aluminum-Coated, Zinc-Coated, and Copper-Bearing Steel Wire and Wire Products

A Twenty-Year Report

Occasione/Britton/Collins

ASTM STP 585A

ATMOSPHERIC CORROSION INVESTIGATION OF ALUMINUM-COATED, ZINC-COATED, AND COPPER-BEARING STEEL WIRE AND WIRE PRODUCTS: A TWENTY-YEAR REPORT

Sponsored by
ASTM Committee A-5 on
Metallic-Coated Iron
and Steel Products

John F. Occasione
Thomas C. Britton, Jr.
Roy C. Collins

ASTM Special Technical Publication 585A

ASTM Publication Code Number (PCN)
04-585010-02

1916 Race Street, Philadelphia, Pa. 19103

Library of Congress Cataloging in Publication Data

Occasione, John F.
Atmospheric corrosion investigation of aluminum-coated, zinc-coated, and copper-bearing steel wire and wire products.
(ASTM special technical publication; 585A)
Includes bibliographical references.
"ASTM publication code number (PCN) 04-585010-02."
1. Steel wire—Corrosion. 2. Corrosion and anti-corrosives. I. Britton, Thomas C. 1951
II. Collins, Roy C. III. ASTM Committee-A-5 on Metallic-Coated Iron and Steel Products. IV. Title V. Series.
TA467.028 1984 620.1'723 83-73647
ISBN 0-8031-0205-4

Library of Congress Catalog Card Number: 83-73647

Printed in Ann Arbor, Mich.
August 1984

Second Printing, Philadelphia, PA
May 1992

Foreword

Committee A-5 on Metallic-Coated Iron and Steel Products[1] was organized in 1907, to investigate the corrosion of iron and steel. In 1908, the Committee sponsored its first atmospheric exposure of metallic-coated wires to evaluate their corrosion resistance. Since this date, there have been a considerable number of test programs involving wire, sheet, and hardware. Of particular interest is the program initiated in 1936 and reported on in ASTM Special Technical Publication 290 entitled "Twenty-Year Atmospheric Corrosion Investigation of Zinc-Coated and Uncoated Wire and Wire Products" by Fred M. Reinhart.

In June 1959, the Advisory Committee on Corrosion authorized Committee A-5 to conduct atmospheric corrosion tests of aluminum coated wire and wire products at seven ASTM sites in the United States (see map on next page) and an eighth site in Warrington, England. The responsibility for the latter site was assumed by Rylands Whitecross Limited.

Exposure of the wire and wire products specimens was initiated in 1961. For comparative purposes bare copper-bearing steel wire and zinc-coated steel wire and fabricated products were included in the testing program.

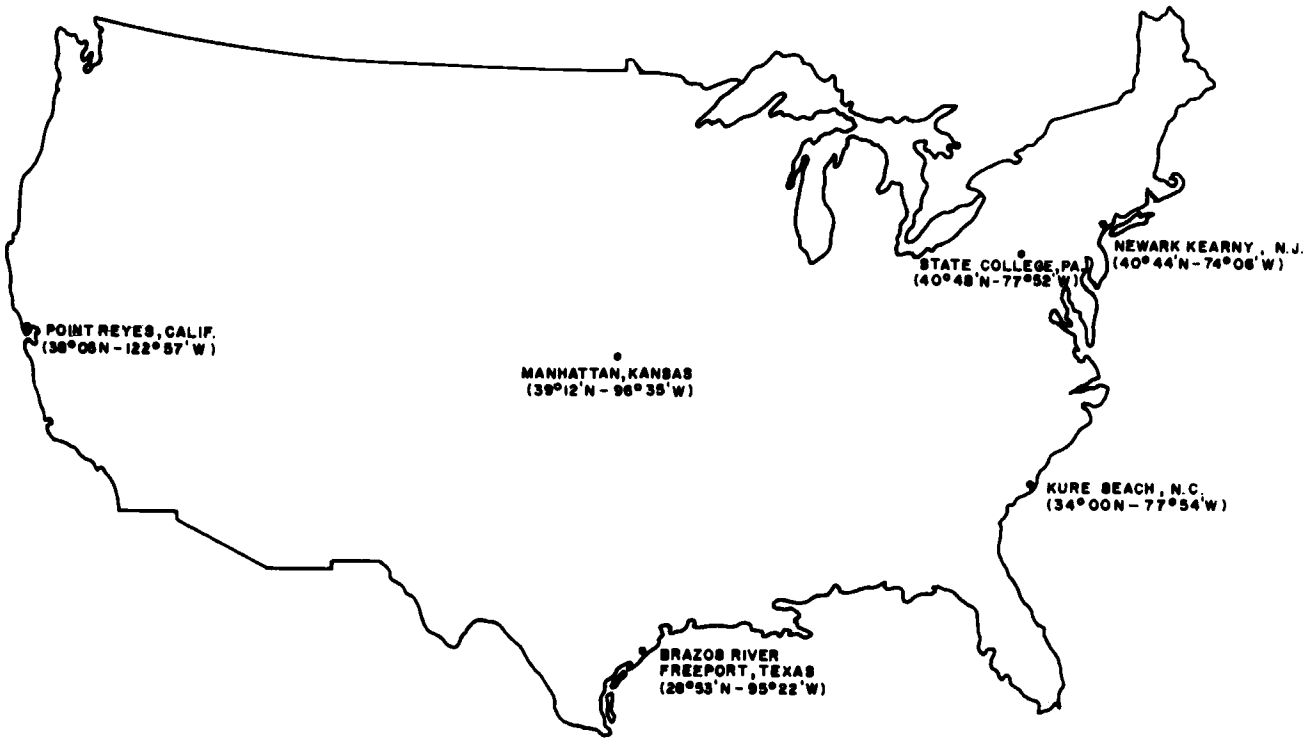
A twelve year report on the 1961 exposure program entitled ASTM STP 585 "Atmospheric Corrosion Investigation of Aluminum-Coated, Zinc-Coated, and Copper-Bearing Steel Wire and Wire Products" by V. I. Kelley was published in 1975.

This report presents the results of 20 years of exposure for the 1961 exposure program, and was prepared by John F. Occasione,[2] Thomas C. Britton, Jr.,[3] and Roy C. Collins.[3]

[1]Committee A-5 was originally titled "Corrosion of Iron and Steel."

[2]Retired in 1975 after 41 years with American Steel and Wire, Cleveland, Ohio and the U.S. Steel Corp., Pittsburgh, Pa., in various metallurgical positions.

[3]Duke Power Company, Charlotte, N.C. 28242.



MAP - LOCATION OF TEST SITES IN THE UNITED STATES

A Note of Appreciation to Reviewers

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

ASTM Committee on Publications

Related ASTM Publications

Corrosion of Metals in Association with Concrete, STP 818 (1983), 04-818000-27

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

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

Corrosion Fatigue Technology, STP 642 (1978), 04-642000-27

Brief Summary of Results

The wire and wire product specimens were exposed at the seven U.S. sites in the spring and summer of 1961 and at Warrington, England on 1 March, 1964. There were 340 unfabricated tension test specimens exposed at each of four sites. To date, 276 have been removed and tested. Wire product specimens (field fence, barbed wire, chain-link fence, and 7-wire strand) were exposed at all eight sites.

The hot dipped aluminum-coated specimens ranged from 0.08 to 0.19 kg/m^2 (0.27 to 0.63 oz/ft^2) of surface, and the aluminum powder metallurgy clad specimen ranged from 0.54 to 1.39 kg/m^2 (1.76 to 4.54 oz/ft^2) of surface. The hot dipped zinc coatings ranged from 0.11 to 0.86 kg/m^2 (0.36 to 2.81 oz/ft^2) of surface, and the electroplated zinc coatings ranged from 0.27 to 0.91 kg/m^2 (0.87 to 2.98 oz/ft^2) of surface.

The corrosion rate of the coatings to initial rust on aluminum-coated unfabricated wires ranged from 0.01 kg/m^2 (0.03 oz/ft^2) per year at the Newark, New Jersey, site to 0.02 kg/m^2 (0.07 oz/ft^2) per year at the Warrington, England, site. In general the corrosion rates of the coatings to initial rust on aluminum-coated fabricated product specimens was within this range at all locations. The corrosion rate of the coatings to initial rust on the zinc-coated unfabricated wire ranged from 0.02 kg/m^2 (0.06 oz/ft^2) per year at State College, Pennsylvania, to 0.06 kg/m^2 (0.20 oz/ft^2) per year at Warrington, England. The corrosion rates of the coatings to initial rust on zinc-coated fabricated products varied considerably from a low of 0.01 kg/m^2 (0.03 oz/ft^2) per year at the Manhattan, Kansas, site to a high of 0.12 kg/m^2 (0.38 oz/ft^2) per year at the Kure Beach, North Carolina, 80 ft site.

The loss in breaking strength over the 20-year period varied considerably from a high in excess of 60% for uncoated and lightly zinc-coated wires exposed at Warrington to some slight gain in strength for some of the heavier aluminum-coated specimens. In general, the aluminum-coated wires sustained less loss in strength than the zinc-coated wires.

Acknowledgments

The writer wishes to acknowledge and extend thanks to the following people who helped with the compilation and review of this document:

H. N. Alderson, Pacific Gas and Electric Co.
T. C. Britton, Duke Power Co., Chairman of A5.15
R. C. Collins, Duke Power Co.
S. W. Dean, Air Products and Chemicals, Inc.
J. I. Mickalonis, Bethlehem Steel Corp.
K. E. Niewoehner, Bethlehem Steel Corp.
D. C. Pearce, Asarco, Inc., Chairman of A-5
L. E. Peters, Bethlehem Steel Corp. (retired)
T. J. Summerson, Kaiser Aluminum and Chemical Corp.
B. G. Sweet, Page-Wilson Corp.
All the Site Inspectors who volunteered their time
The Staff people of ASTM who made it all possible

Contents

TEXT

TABLES

FIGURES

ISBN 0-8031-0205-4