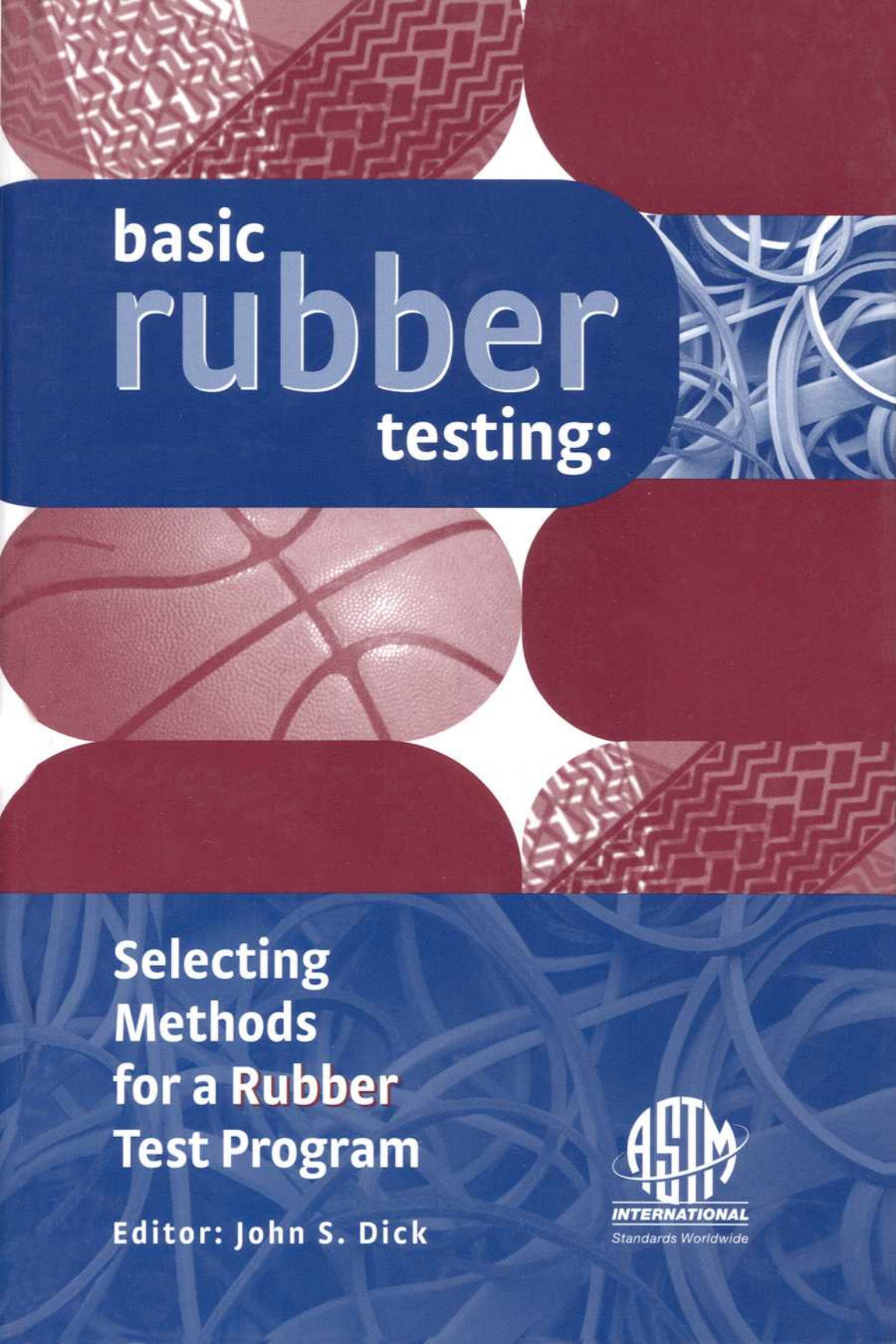




# **basic** **rubber** **testing:**

## **Selecting Methods for a Rubber Test Program**

**Editor: John S. Dick**



# **Basic Rubber Testing: Selecting Methods for a Rubber Test Program**

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**John S. Dick, editor**

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Bridgeport, NJ  
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# Foreword

THIS PUBLICATION, *Basic Rubber Testing: Selecting Methods for a Rubber Test Program*, was sponsored by Committee D11 on Rubber and D24 on Carbon Black. This is Manual 39 in ASTM International's manual series.

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# Preface

TODAY THERE IS A NEW initiative in the rubber industry, brought on by new quality programs such as Six Sigma, to reduce variation and eliminate quality problems significantly in the manufacture of a very wide scope of different rubber products. For example, the automotive manufacturers are beginning to design vehicles to last 150 000 miles with minimum maintenance. This severely challenges many rubber part manufacturers, perhaps more than other groups in the automotive supply base, to improve their quality and reduce variation.

One large source of product variation in the rubber industry can be non-uniformity of received raw rubber and other compounding ingredients. There are currently over 140 ASTM Standard Methods that are actively used to test these raw materials used in the rubber industry. The mixing process also is a very large source of variation in the factory. There are another 25 ASTM methods that are used to test the quality of mixed batches. This book is designed to be a practical guide to the rubber technologist in selecting the appropriate methods for use in a testing program of raw materials, compounding ingredients, or mixed stock.

This book characterizes each group of raw materials. It explains what are some of the important chemical and physical properties that should be used in making judgements on the quality of a raw material and its usability in the production plant. It gives a basic description of the test methods that are currently available. More importantly, this book compares and contrasts the advantages and disadvantages of selecting various test methods. However, this book is not a substitute for reading the actual ASTM method itself. This book will help the reader in deciding which ASTM methods should be selected for testing a given raw material or mixed stock. This information is important to assure that a rubber laboratory is running efficiently. In today's business climate where testing resources are being restricted in many cases, it is vital that the most important tests be selected and that redundant testing be eliminated. Selecting the wrong tests wastes valuable resources and money.

*John S. Dick*

### **Award of Merit Recipients (continued)**

| YEAR RECEIVED | AWARD RECIPIENTS        | ACHIEVEMENTS                                                                                                                                                                |
|---------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1981          | Edwin English           | Was secretary of D11 from 1975 to 1976. Was leader of the U.S. delegation to ISO TC45 for 12 years (succeeding R. Stiehler and retained this until 1992)                    |
| 1982          | Charles E. Tidd, Jr.    | Was Chairman of D11, Rubber. Also contributed to Physical Testing (D11.10). Active with ISO TC45 as well                                                                    |
| 1984          | William J. Holley       | Very active with Synthetic Rubber standards (D11.23). Also active with ISO TC45                                                                                             |
| 1987          | Charles P. Gerstenmaier | Major contributions in the development of Carbon Black Test Methods. Also active in ISO TC45                                                                                |
| 1989          | Rodney McGarry          | Past Chairman of D24, Carbon Black. Major contributions in the development of Carbon Black Test Standards. Also active in ISO TC45                                          |
| 1989          | Bobby Buffington        | Major contributions in the development of Carbon Black Test Standards. Also active in ISO TC45                                                                              |
| 1990          | John S. Dick            | Chairman of D11.20 on Compounding Materials from 1981 to 1991. Involved in Rubber Processability Test Methods. Became the leader of the U.S. Delegation to ISO TC45 in 1992 |
| 1993          | Thomas H. Spurlock      | Major contributions in the development of Carbon Black Test Methods                                                                                                         |

### **Distinguished Service Award**

| YEAR RECEIVED | AWARD RECIPIENT    | ACHIEVEMENTS                                                                                                    |
|---------------|--------------------|-----------------------------------------------------------------------------------------------------------------|
| 1998          | Peter Surette      | For his work in D11 Rubber, including physical testing (D11.10), time-temperature dependent properties (D11.14) |
| 1998          | Julia Zimmerman    | For her contributions in D11, Rubber, including Chemical Analysis (D11.11)                                      |
| 1998          | John Bailey        | For his activities in D24, Carbon Black, including his extensive statistical contributions                      |
| 1998          | Charles Gillingham | For his activities in D24, Carbon Black                                                                         |
| 1999          | Clair Harmon       | For his participation in D11, Rubber, including his involvement with Natural Rubber (D11.22)                    |
| 1999          | Paul Gatza         | For his contributions to D11, Rubber, including physical testing, and rubber products                           |
| 1999          | Jack Thompson      | For his achievements in D24, Carbon Black                                                                       |
| 2000          | Ricky MaGee        | For his contributions in D24, Carbon Black                                                                      |
| 2001          | Ivan Erwin         | For his accomplishments in D11, Rubber, including his chairmanship of D11.15, Rubber Degradation Testing        |
| 2001          | Denise Kotz        | For her contributions to D11, Rubber, including physical testing                                                |
| 2001          | Frank Lussier      | For his contributions to D11, Rubber, and especially toward Chemical Analysis (D11.11)                          |
| 2001          | Jeff Melsom        | For his leadership and contributions to D24, Carbon Black, and his chairmanship of D24                          |
| 2001          | Lee Coates         | For his contributions in D24, Carbon Black                                                                      |
| 2002          | Alec Vare          | For his accomplishments in D11—Rubber, and especially his chairmanship of D11 and D11.22 on Natural Rubber      |
| 2002          | Charles Rader      | For his activities in D11, Rubber, and especially for his chairmanship of D11.08 (Nomenclature and Terminology) |
| 2002          | Tom Powell         | For his contributions in D24, Carbon Black and his activities in the Executive Subcommittee                     |



# Acknowledgment

## **Acknowledgment of Contributors to ASTM Rubber Standards**

The many ASTM standards discussed in this book were created through the excellent technical knowledge, strong commitments, and hard work of hundreds of rubber technologists who volunteered their time and effort in various task groups and subcommittees of ASTM D11 (on Rubber) and D24 (on Carbon Black). These standards truly represent a consensus of the rubber industry.

Thousands of ASTM members have contributed over the last 90 years to the development of these rubber standards and their efforts should be recognized. Therefore, it is appropriate to recognize directly those ASTM members who received the ASTM “Award of Merit” or the “Distinguished Service Award” in the last 50 years. However, it should be noted that many other ASTM members, who are not listed below, have also given countless hours of excellent work to develop ASTM standards and should be recognized as well. If it were not for all these contributors, these ASTM standards would not be at the high quality level they are today.

**Award of Merit Recipients**

| YEAR RECEIVED | AWARD RECIPIENTS           | ACHIEVEMENTS                                                                                                                                                                                                                                                                                |
|---------------|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1956          | Simon Collier              | Chairman of D11 for 14 years (from 1944 to 1962)                                                                                                                                                                                                                                            |
| 1959          | Elmer G. Kimmich           | Very active in D11, Rubber                                                                                                                                                                                                                                                                  |
| 1961          | John J. Allen              | For work in D11, Rubber. Also an honorary member of D11                                                                                                                                                                                                                                     |
| 1962          | Harry G. Bimmerman         | For work in D11, Rubber. Also an honorary member of D11                                                                                                                                                                                                                                     |
| 1964          | Arthur Juve                | Very active in Rubber Compounding Materials (now D11.20), Recipient of the Goodyear Medal from the ACS                                                                                                                                                                                      |
| 1965          | Issac Drogin               | Very active in D11, Rubber                                                                                                                                                                                                                                                                  |
| 1966          | Benjamin S. Garvey, Jr.    | Known for his contributions in rubber processability testing as well as rubber testing in general. Known for the "Garvey Die" design                                                                                                                                                        |
| 1968          | Robert Stiehler            | Longest continuous participation in D11 activities. Major contributions to D11. Established the Technical Advisory Group to ISO TC 45 on Rubber. Held position as Leader of USA Delegation to ISO TC 45 from the formation date of the TAG until he retired in 1980.                        |
| 1969          | Joseph F. Kerscher         | Chairman of D11 from 1972 to 1978. Also made honorary member. Very active in the ISO TC45 TAG                                                                                                                                                                                               |
| 1970          | Gustav Maassen             | Contributions include Rubber Aging and Degradation Testing                                                                                                                                                                                                                                  |
| 1972          | Maynard Torrence           | Very active in Rubber Terminology (D11.08). Also active in ISO TC45                                                                                                                                                                                                                         |
| 1974          | William H. King            | Very active in developing Rubber Physical Testing Standards (D11.10). Also active in ISO TC45                                                                                                                                                                                               |
| 1974          | Thomas D. Bolt             | Significant contributions to development of Carbon Black Standards                                                                                                                                                                                                                          |
| 1975          | W. Howard Bryan            | Contributions include Coated Fabrics (D11.37) and Rubber Thread. Also active in ISO TC45                                                                                                                                                                                                    |
| 1976          | Francis G. Mees            | Chair of D24 on Carbon Black for six years. Major contributions in development of carbon black standards as well as Chemical Analysis (D11.11) and Rubber Nomenclature (D11.08). Very active in ISO TC45 activities                                                                         |
| 1977          | Floyd S. Conant            | Chairman of D11.14, Rubber Time and Temperature Dependent Properties. Also contributed to F9—Tires. Involved in ISO TC45 activities as well                                                                                                                                                 |
| 1977          | J. Frank Svetlik           | Major contributions in the development of Carbon Black Test Methods. Also active in ISO TC45                                                                                                                                                                                                |
| 1978          | Alan Veith                 | Next to R. D. Stiehler, probably has the record for longest continuous participation in D11 activities (beginning in 1952). Major contributions to D11 on Rubber as well as F9 on Tires. Also very active in statistical standards and participates in E11 and D17. Very active in ISO TC45 |
| 1978          | Francis Lyon               | Major contributions in the development of Carbon Black Test Methods                                                                                                                                                                                                                         |
| 1979          | Clifford E. McCormick, Jr. | Very much involved in Statistical Methods for application to Carbon Black testing (D24) as well as Rubber Testing (D11). Authored several publications on Statistical Analysis of Carbon Black Testing                                                                                      |
| 1981          | Peter Larsen               | Chaired Subcommittee on Time and Temperature Dependent Properties (D11.14) and Rubber Terminology. Very active in ISO TC45 on Rubber                                                                                                                                                        |



## ABOUT THE EDITOR

John Dick has over 30 years of experience in the rubber industry. He was with BF Goodrich and later Uniroyal Goodrich Tire Co. as a Section Manager and Development Scientist in R&D until 1991 when he joined Alpha Technologies (formerly Monsanto's Rubber Instruments Group) as a Senior Marketing Technical Service Specialist. Mr. Dick has authored over 45 journal and magazine publications and three books on polymer technology. He received the Monsanto Master Technical Service Award in 1994, the American Chemical Society Rubber Division "Best Paper Award" in 1995, and a University of Akron Appreciation Award in 1998 for Teaching Polymer Compounding Courses in their Continuing Education Program. He is a Fellow in ASTM International, receiving the Award of Merit in 1990. Also he has represented the United States as a delegate to the International Standards Organization (ISO) for the last 20 years. He was appointed in 1992 to be the leader of the U.S.A. Delegation to ISO TC-45 on Rubber. He teaches rubber technology courses at both University of Akron and University of Wisconsin Continuing Education Departments. He is a member of American Chemical Society, Society of Rheology, and the American Society for Quality with a CQE. He is also a representative to the RMA. Mr. Dick received his B.S. degree from Virginia Polytechnic Institute in 1970 and an M.A. from the University of Akron in 1979. His hobbies include photography and amateur radio.

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