

The Basics of Testing Plastics

MECHANICAL PROPERTIES,
FLAME EXPOSURE, AND
GENERAL GUIDELINES

STEPHEN BURKE DRISCOLL, EDITOR

The Basics of Testing Plastics: Mechanical Properties, Flame Exposure, and General Guidelines

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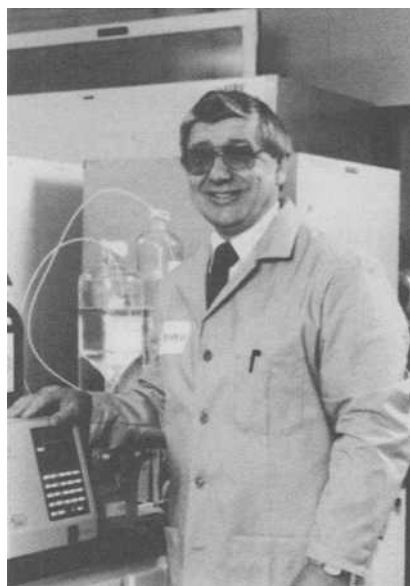
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NOTE: This manual does not purport to address (all of) the safety problems associated with its use. It is the responsibility of the user of this manual to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

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Dedication



William Grieve

THIS BOOK IS DEDICATED to the memory of William Grieve, a teacher, distinguished colleague and friend, and proactive contributor to the successes of many ASTM standards and projects.

Foreword

THIS PUBLICATION, *The Basics of Testing Plastics: Mechanical Properties, Flame Exposure, and General Guidelines*, was approved by ASTM Committee D-20 on Plastics. This is Manual 35 in ASTM's manual series.

Contents

Introduction	vii
Chapter 1 —Classifications and Definitions <i>by Stephen Burke Driscoll</i>	1
Chapter 2 —General Guidelines for Conducting Tests and Evaluating Data <i>by Alvin J. Flint, Jr.</i>	8
Chapter 3 —Measuring Mechanical Properties of Plastics <i>by Alvin J. Flint, Jr.</i>	19
Chapter 4 —Responses to Flame Exposure <i>by Alvin J. Flint, Jr.</i>	53

Introduction

THE GLOBAL PLASTICS INDUSTRY is a dynamic, rapidly growing, and extensively diversified business. The domestic consumption of all plastics in the United States will soon exceed 100 billion pounds. These are found in a myriad of applications including plastics packaging, building and construction products, automotive and other types of transportation components, medical and dental devices, and aerospace composites. Each material and fabricated product demands a series of quality control/quality assurance procedures at every stage of the manufacturing process.

The intent of this manual is to provide basic information for persons who are not well-experienced in the testing of plastics. Such people are most likely to be:

- chemists
- materials engineers
- technicians
- salesmen
- purchasing personnel
- newly-appointed laboratory supervisors
- quality control personnel
- shop foremen
- order correspondents
- any others who may work with test data

Accordingly, only a minimum of theory is included. The manual is intended to provide introductions to the various subjects so as to prepare individuals to carry out additional study. It is not a compendium of testing methods. The subjects have been limited in order to best fulfill the above intent.

The material in Chapters 2, 3, and 4 was included, up until 1997, in the short course, "Major Testing Techniques for Plastics," sponsored by ASTM Committee D-20 on Plastics.

Chapter One "Classifications and Definitions," explains briefly some of the more important characteristics of plastics and how these relate to end-use performance. The various classification schemes illustrate the unique versatility of the polymer industry and how simple changes in the composition or structure of the polymer can significantly influence its processability and how it is used. This chapter also includes an abbreviated glossary of terms, definitions, and explanations of those important chemical additives used to modify the performance of many polymers.

Chapter Two, "General Guidelines for Conducting Tests and Evaluating Data," provides basic information and introductions to the various subjects. Typical topics include some basic starting points, the important parts of typical specifications and test methods, as well as how to deal with the variability of test data.

Chapter Three, "Measuring Mechanical Properties of Plastics," addresses the important aspects of many very important properties, including measuring tensile, flexural, creep, impact, fatigue, and weathering behavior.

Chapter Four, "Responses to Flame Exposure," emphasizes the fact that, although there are numerous small-scale test methods, there is no test that will faithfully predict how a specific material or assembly will respond to an actual fire scenario. Case studies will illustrate the problems associated with monitoring the combustibility of plastics.

This manual is the first in a planned series of volumes addressing the challenges and problems associated with testing plastics. Future manuals will focus on electrical characteristics, optical and chemical properties, rheological behavior, as well as global concerns for international testing harmonization, recycling, and other important analytical techniques. Currently, ASTM Committee D-20 on Plastics is responsible for more

than 500 standard test methods, recommended practices, and guides. As the plastics industry grows, more sophisticated testing protocols are needed. One of the key components of the mission of Committee D-20 on Plastics is the continuous review and updating of existing documents and the authoring of new protocols that are necessary to ensure product quality.

Many of the Committee D-20 members actively involved in this mission have also contributed generously their time, energy, and expertise in preparing and reviewing this manual. Special appreciation is given to Paul Graboff, Chairman of D-20, for his guidance and encouragement, Alvin J. Flint for authoring these important foundation chapters, and the late William Grieve for his vision and enthusiasm for this project.

Stephen Burke Driscoll
Editor

ABOUT THE EDITOR

STEPHEN BURKE DRISCOLL

Since 1968 Stephen Burke Driscoll has been a Professor in The Department of Plastics Engineering at The University of Massachusetts Lowell (formerly The Lowell Technological Institute and the University of Lowell). He teaches undergraduate and graduate students polymeric materials engineering, additives for plastics, physical properties and polymer characterization, including dynamic mechanical rheological testing, and commercial development of polymers.

He joined ASTM in 1978 and is a founding member and Chair of the D20.10.15 Section on Dynamic Mechanical Properties of Plastics. He has also chaired D20.10.14 on Long Term Properties of Plastics. Within the D20 Committee on Plastics, he has completed three two-year terms as elected Vice-Chair of Test Methods and has recently been elected Vice-Chair of Materials. He has served ASTM as an appointed three-year member of The Committee on Technical Committee Operations (COTCO) and in 1998 will complete his three-year assignment as Chair of COTCO.

In addition to authoring/presenting more than 100 papers at various technical society meetings, he has authored several standard test methods (STMs) on dynamic mechanical properties and has contributed chapters to four ASTM STPs on RIM, polymeric materials and products, high modulus fiber composites, and instrumented impact testing. He has twice served the United Nations Industrial Development Organization (UNIDO) as a Consulting Fellow on Rheology in India.