

---

*Symposium on*

**STANDARDS FOR FILAMENT-  
WOUND REINFORCED PLASTICS**



Published by the  
AMERICAN SOCIETY FOR TESTING AND MATERIALS  
1916 Race St., Philadelphia 3, Pa.

---

***ASTM Special Technical Publication No. 327***

---

# SYMPOSIUM ON STANDARDS FOR FILAMENT- WOUND REINFORCED PLASTICS

Sponsored Jointly by the American Society for  
Testing and Materials and the U.S. Navy

---

Presented at the  
NAVAL ORDNANCE LABORATORY  
WHITE OAK, SILVER SPRING, MD.

June 6-7, 1962



Reg. U.S. Pat. Off.

---

*ASTM Special Technical Publication No. 327*

---

Price \$ 11.00; to Members \$ 8.80

Published by the  
AMERICAN SOCIETY FOR TESTING AND MATERIALS  
1916 Race St., Philadelphia 3, Pa.

---

© BY AMERICAN SOCIETY FOR TESTING AND MATERIALS 1963

Library of Congress Catalog Card Number: 63-22246

---

Printed in Baltimore, Md.  
March, 1963

## FOREWORD

---

This Symposium on Standards for Filament-Wound Reinforced Plastics was sponsored jointly by the Society and the U. S. Navy, Bureau of Weapons, Naval Ordnance Laboratory. ASTM participation was provided by Committee D-20 on Plastics, Subcommittee XVIII on Reinforced Plastics. H. A. Perry, Naval Ordnance Laboratory and chairman of the Subcommittee, was chairman of the Symposium Committee. Working with Mr. Perry as members of the Symposium Committee were J. W. Davis, Minnesota Mining and Manufacturing Co.; J. C. Hood, Owens-Corning Fiberglas Co.; R. M. Levy, Esso Research and Engineering Co.; J. A. McDarment, Molded Fiber Glass Co.; R. W. Meyer, The Glastic Corp.; F. W. Reinhart, Consultant; G. R. Rugger, Picatinny Arsenal; E. L. Smith, Johns Manville Fiber Glass, Inc.; J. Teti, E. I. duPont de Nemours & Co.; and R. R. Winans, New York Naval Shipyard.

The meeting arrangements were handled by S. Prosen, Naval Ordnance Laboratory. Members of the Symposium Committee presided at the sessions.

A paper by J. A. Kies and H. O. Ewing, Naval Research Laboratory, "A Notched Ring Test for Measuring the Resistance to Splitting in Fiber Reinforced Plastics" presented by title is not included in this publication. A paper by S. Yurenka, "Test Methods for Filament-Wound Specimens," presented on October 5, 1962, at a Symposium on Plastics held at the Fourth Pacific Area National Meeting of the Society in Los Angeles, Calif., is included in this publication because of its relevance to the subject of the symposium.

---

NOTE.—The Society is not responsible, as a body, for the statements  
and opinions advanced in this publication.

---

# CONTENTS

	PAGE
Introduction—H. A. Perry.....	1
<b>Problems of Testing and Specifications</b>	
Key Properties and Proposed Digital Code System for Glass Fiber Reinforcements for Filament Winding—H. A. Perry.....	3
Survey of Methods of Test for Parallel Filament Reinforced Plastics—N. Fried.....	13
<b>General Testing</b>	
Absolute and Differential Dilatometry for Measurement of Unrestrained Shrinkage on Resin Curing—Bernard Rosen and Adam E. Fornof.....	40
Discussion.....	51
A Proposed Method for Determining Percentage of Resin Flow in Preimpregnated Roving—Louis Rubin.....	53
Discussion.....	60
A Portable Proximity Probe for Detection of Moisture Within a Laminate—John O. Outwater.....	62
<b>Mechanical Testing</b>	
Compression Testing of NOL Rings—Robert A. Elkin.....	66
Discussion.....	81
Compressive Strength of Parallel Filament-Reinforced Plastics: Development of a New Test Method—N. Fried and R. R. Winans.....	83
Discussion.....	93
The NOL Ring Test as a Method for Selecting Finished Glass Fibers for Reinforce- ment of Epoxy Pipe—T. G. Roskos and F. R. Pfederer.....	96
Discussion.....	104
Compression, Fatigue, and Stress Studies on NOL Ring Specimens—S. P. Prosen, S. Karpe, M. A. Kinna, C. Mueller, H. A. Perry, and F. Robert Barnet.....	105
Discussion.....	122
Evaluation of Hoop Tension Tests as a Method of Screening Materials for Filament- Winding Applications—R. N. Dallas.....	123
Discussion.....	131
Research on Wire-Wound Composite Materials—F. J. McGarry and D. W. Marshall.....	133
Discussion.....	145
Evaluation of High-Strength-and-Modulus Brittle Materials in Filament and Com- posite Forms—Wendall J. Clark, Kenneth M. Gunn, and Claude P. Talley.....	146
Discussion.....	163
Single-End Glass Yarn Tension Test—Nozar Pirzadeh and Paul B. Kennedy.....	165
A Tension Test Method for Glass Fiber Strands, Yarns, and Rovings (OCF Strand Test)—James C. Hood.....	178
Comparative Evaluation of Methods for Measurement of Hoop Tensile Strength by Means of an NOL Type Filament-Wound Ring—Stanley L. Channon and Louis Rubin.....	187
Preparation and Testing of NOL Rings from Preimpregnated Rovings—Grant Brown and George E. Davis.....	197

	PAGE
A Segmented Cylinder Test for Determining Hoop Stress in Composite Structures— D. P. Hanley and C. K. Cole .....	207
Developing Standards for Use of Preimpregnated Roving—Maurice A. Leeds. ....	216
A Laboratory Scale Filament Winding System to Produce Pressure Vessels Rapidly and Simply—John O. Outwater.....	237
Photoelastic Studies of Filament-Wound Pressure Vessels—Robert Eshbaugh.....	240
Proposed Method of Test for Interlaminar Shear Properties of Sizings and Binders for Secondary Reinforcements Using a Polar-Cut Ovaloidal Specimen—H. A. Perry.....	243
ASTM Task Group Round-Robin Testing—J. William Davis.....	247
Test Methods for Filament-Wound Specimens—S. Yurenka.....	314
Discussion .....	329
<b>Nondestructive Testing</b>	
Craze Cracking in Glass Filament-Wound Pressure Chambers—Richard A. Rawe... ..	248
Discussion .....	259
Some Nondestructive Tests for Filament-Wound Structures—J. A. Hendron, K. K. Goble, R. W. Gruetzmacher, G. O. McClurg, and M. W. Retsky.....	261
Corona Detection Techniques as a Nondestructive Method for Locating Voids in Filament-Wound Structures—E. W. Lindsay and C. N. Works.....	273
Discussion .....	285
A Television X-ray Image Enlargement System for Nondestructive Testing of Fiber Glass Reinforced Plastic Missile Case Materials—Merle L. Rhoten and Robert C. McMaster.....	287
Discussion .....	298
Quality Control Procedures for Rocket Motor Cases: Reinforced Plastic Versus Steel— P. F. Duvall.....	299
Use of Lead Glass Fiber Yarns as Tracers in Radiography of Filament-Wound Prod- ucts—H. A. Perry.....	305

THIS PUBLICATION is one of many issued by the American Society for Testing and Materials in connection with its work of promoting knowledge of the properties of materials and developing standard specifications and tests for materials. Much of the data result from the voluntary contributions of many of the country's leading technical authorities from industry, scientific agencies, and government.

Over the years the Society has published many technical symposiums, reports, and special books. These may consist of a series of technical papers, reports by the ASTM technical committees, or compilations of data developed in special Society groups with many organizations cooperating. A list of ASTM publications and information on the work of the Society will be furnished on request.