



MODERN PLASTICS ENCYCLOPEDIA

1986-87

Nevro Corp

DOCKET
A L A R M

Find authenticated court documents without watermarks at docketalarm.com.

MODERN PLASTICS ENCYCLOPEDIA

OCTOBER 1986 VOLUME 63, NUMBER 10A

Decorating and printing 370
Electroplating 370
Embossing 371
Hot stamping 372
In-mold decorating 376
 With coatings 376
 With foils 376
Painting 377
Printing 378
Sputtering 370
Vacuum metallizing 381
EMI shielding and electrostatic discharge 382
 By internal compounding 382
 By surface treatments 382
Machining 383
 Machining with lasers 395
Slitting and winding 396

2 Design Guide

A systematic approach to plastics material selection and design 400
Designing for rigidity and strength under static load 403
 How to use the Creep Chart to design for static load 408
Selecting plastics for elevated temperature performance 411
 Dynamic mechanical properties by torsion pendulum 417
Selecting plastics for chemical resistance 419
Selecting plastics for fatigue resistance 424
Designing and selecting plastics for stress relaxation 428
Selecting materials for dielectric loss properties 433
Design and material selection for impact resistance 436
Selecting conductive plastics for EMI shielding effectiveness 441
Selecting plastics for fire-related properties 444

3 Data Bank

Property charts 512
 Resins and compounds 512
 Film and sheet 547
Design data charts 552
 Dielectric loss properties 552
 Dimensional stability 585
 Environmental stress-crack resistance 597
 Fatigue 614
 Optical properties 611
 Outdoor exposure resistance 620
 Poisson's ratio 609
 Stress relaxation 634

Chemicals and additives charts 636
 Antioxidants 636
 Antistatic agents 655
 Colorants 642
 Flame retardants 658
 Foaming agents 666
 Free radical initiators 668
 Lubricants (compounding) 684
 Optical brighteners 665
 Plasticizers 690
 Stabilizers 673
 Ultraviolet stabilizers 700
Machinery specifier 702
 Blow molding machines 702
 Compression molding machines 710
 Dispensing machines for urethane foam 717
 Extruders 722
 Granulators 728
 Injection molding machines 734
 Sprayup equipment for reinforced plastics 741
 Structural foam machines 743
 Thermoforming machines 745
 Transfer molding machines 755

4 Suppliers

Classified index of products and services 760
Products and services 765
 Custom processors and converters 838
 Fabrics, papers, reinforcements 793
 Film, sheet, shapes, laminates 787
 Foamed plastics 778
 Instruments and controls 820
 Machinery and equipment 794
 Modifiers, additives, and fillers 779
 Resins and compounds 765
 Specialized services 829
 Supplies 824

Advertisers' index 876

Alphabetical index of companies and addresses 850

Reader service cards 879

PERMISSIONS: Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any page herein for the flat fee of \$1.50 per copy of the page. Payment should be sent directly to the CCC, 21 Congress St., Salem, MA 01970. CCC copying done for other than personal or internal reference use without the express permission of McGraw-Hill is prohibited. Requests for special permission or bulk orders should be addressed to Modern Plastics Reprint Dept., 1221 Ave. of the Americas, New York, NY 10020. ISSN 0085-3518/86 \$0.00 + 1.50.

Editorial director

Robert J. Martino

Production editor

Lisa Nazarenko

Directory editor

Jean Corvington

Technical editors

Gordon M. Kline

James F. Carley

Engineering editors

George Smoluk

Joseph A. Sneller

Associate editors

Roland R. MacBride

A. Stuart Wood

Art director

Bob Barravecchia

Vice President-Publisher

Stuart S. Siegel

Officers of McGraw-Hill Inc.

Harold W. McGraw Jr., Chairman; Joseph L. Dionne, President and Chief Executive Officer; Robert N. Landes, Executive Vice President and Secretary; Ralph J. Webb, Vice President and Treasurer; Ralph R. Schulz, Senior Vice President, Editorial.

Officers of McGraw-Hill Publications Company

President: John G. Wrede. Executive Vice Presidents: Paul F. McPherson, Operations Support; John W. Patten, Management, Group Vice Presidents: Charlton H. Calhoun, III, Industrial and Process Industries; Michael K. Hehir, Energy; Harold W. McGraw, III, Transportation, Aerospace and Defense. Senior Vice Presidents: Kemp Anderson, Administration and Product Support Systems; John E. Slater, Energy Publications; H. John Sweger, Jr., Marketing/Special Operations. Vice Presidents: Peter J. Balestiero, Human Resources; Mark P. Bayer, Electronic Product Marketing; George R. Elsinger, Circulation; Harry Garrison, Application Systems Design & Development; John E. Johnsrud, Editorial & Product Delivery Systems; Richard H. Larsen, Industrial; Robert W. Mooney, Controller, Financial Operations; Marvin L. Rowlands, Jr., Planning.



Modern Plastics Encyclopedia is published annually by McGraw-Hill Inc., 1221 Ave. of the Americas, New York, NY 10020. Executive, editorial, and advertising offices, 1221 Ave. of the Americas, New York, NY 10020. Phone

212-512-2000. Teletype: TWX-710-581-4879. Cable: McGraw-Hill, N.Y. Please mail all circulation correspondence, subscription orders, and change of address notices to: Modern Plastics, Fulfillment Mgr., P.O. Box 1488, Riverton, NJ 08077. Modern Plastics has no connection with any company of similar name. Modern Plastics Encyclopedia printed in U.S.A. Modern Plastics issued monthly, 1221 Ave. of the Americas, New York, NY. Modern Plastics Encyclopedia issue published as second issue in October. Modern Plastics Encyclopedia is distributed to Modern Plastics subscribers as part of subscription service. Modern Plastics subscription rates (including Modern Plastics Encyclopedia issue) for manufacturing, engineering, and R & D companies, also government and schools, in the U.S. and its possessions, 1 year \$32, 2 years \$48, 3 years \$66; in Canada, 1 year \$CDN 48, 2 years \$CDN 73, 3 years \$CDN 99. Rates for other companies in the U.S. and its possessions \$38 per year; Canada \$CDN 60 per year. Single copies (except for Encyclopedia issues) \$5 each, \$CDN 6. For subscriber service, call collect 609-786-1735 in the U.S. except Alaska and Hawaii. The name 'Modern Plastics' is Registered (R), U.S. Patent Office. Contents copyrighted (C) 1986 by McGraw-Hill Inc. All rights reserved.

MOPLAY 63 (10A) 1-886 (1986)

Resins and compounds (Cont'd)

Materials	Properties	ASTM test method	Polystyrene and styrene copolymers (Cont'd)		Polyurethane (see also Thermoplastic elastomers)				
			Styrene methyl methacrylate	EMI shielding (conductive); 20% PAN carbon fiber	Thermoset			Thermoplastic	
					Casting resins		50-65% mineral-filled potting and casting compounds	10-20% glass fiber-reinforced molding compounds	EMI shielding (conductive); 30% PAN carbon fiber
					Liquid	Unsaturated			
Processing	1. Melting temperature, °C. T _m (crystalline) T _g (amorphous)				Thermoset	Thermoset	Thermoset		
	2. Processing temperature range, °F. (C = compression; T = transfer; I = injection; E = extrusion)		I: 375-475	I: 430-500	C: 185-250		25 (casting)	I: 360-410	I: 410-450
	3. Molding pressure range, 10 ³ p.s.i.		5-20		0.1-5			8-11	
	4. Compression ratio		2.5-3.5						
	5. Mold (linear) shrinkage, in./in.	D955	0.002-0.006	0.0005-0.003	0.020			0.001-0.002	0.007-0.010
Mechanical	6. Tensile strength at break, p.s.i.	D638 ^b	8100-9700	14,000	175-10,000	10,000-11,000	1000-7000	4800-6500	13,000
	7. Elongation at break, %	D638 ^b	2.1-3.0	1	100-1000	3-6	5-55	3-48	20
	8. Tensile yield strength, p.s.i.	D638 ^b							
	9. Compressive strength (rupture or yield), p.s.i.	D695			20,000			5000	
	10. Flexural strength (rupture or yield), p.s.i.	D790	14,500-15,800	20,700	700-4500	19,000		5500-6200	9000
	11. Tensile modulus, 10 ³ p.s.i.	D638 ^b	440-500	2000	10-100			0.95-1.40	500
	12. Compressive modulus, 10 ³ p.s.i.	D695	440-480		10-100				
	13. Flexural modulus, 10 ³ p.s.i.	73° F. D790 200° F. D790 250° F. D790 300° F. D790		1900	10-100	610		90	500
	14. Izod impact, ft.-lb./in. of notch (1/8-in. thick specimen)	D256A	0.2-0.3	0.7	25 to flexible	0.4		14-No break	10
	15. Hardness	Rockwell D785 Shore/Barcol D2240/D2583	M72-80					R45-55	
Thermal	16. Coef. of linear thermal expansion, 10 ⁻⁶ in./in./°C.	D696	40-72		100-200		71-100	34	
	17. Deflection temperature under flexural load, °F.	264 p.s.i. D648 66 p.s.i. D648	205-210	220	Varies over wide range	190-200		115-130	180
	18. Thermal conductivity, 10 ⁻⁴ cal.-cm./sec.-cm. ² -°C.	C177			5		6.8-10		
Physical	19. Specific gravity	D792	1.09-1.13	1.14	1.03-1.5	1.05	1.37-2.1	1.22-1.36	1.33
	20. Water absorption (1/8-in. thick specimen), %	24 hr. D570 Saturation D570	0.11-0.15	0.1	0.2-1.5	0.1-0.2	0.06-0.52	0.4-0.55	1.5
	21. Dielectric strength (1/8-in. thick specimen), short time, v./mil	D149			300-500		500-750 @ 1/8 in.	600	
Design and performance properties For more information on performance and design properties of plastics, see the following charts: Dielectric loss properties p. 552 Dimensional stability p. 585 Environmental stress-crack resistance p. 597 Fatigue p. 614 Film and sheet p. 547 Optical properties p. 611 Outdoor exposure resistance p. 620 Poisson's ratio p. 609 Stress relaxation p. 634 In the 1985-1986 edition of MPE, see: Creep p. 492 Electromagnetic shielding p. 528 Foams p. 486 Impact resistance p. 513 Laminates, by NEMA grades p. 489 In the 1984-1985 edition of MPE, see: Chemical resistance p. 482 In the 1981-1982 edition of MPE, see: Flammability p. 564 In the 1980-1981 edition of MPE, see: Specifications/materials p. 597 Temperature index p. 632		SUPPLIERS	Richardson	Wilson-Fiberfil	Dow Chem. (see ad, p. 53); Conap; Emerson & Cuming; Hexcel; Hysol; Thermoset Plastics; Union Carbide	Dow Chem. (see ad, p. 53); Emerson & Cuming; Thermoset Plastics	Conap; Emerson & Cuming; Thermoset Plastics	LNP; RTP; Thermofil; Union Carbide; Wilson-Fiberfil	Wilson-Fiberfil

a—Boldface listings identify advertisers in this issue. Where advertisements relate to the particular materials described, reference to the page number is included. See the Directory

b—Tensile test method varies with material: D638 is standard for thermoplastics; D615 for rigid thermosetting plastics; D412 for elastomeric plastics; D882 for thin plastics