

*ENCYCLOPEDIA OF PLASTICS,
POLYMERS, AND
RESINS*

VOLUME III

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POLYMERS, AND
RESINS***

VOLUME III

Compiled by

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PREFACE

This encyclopedia is an attempt to coordinate and unify practical information on plastic, polymer, and resin trademark products. These categories overlap, i.e., plastics are a subset of polymers, and resins are often, but not always, polymers. However, it has been our aim to give the user of this compilation fingertip availability to a large quantity of essential information about these products. This three-volume compendium has been made possible through the cooperation of the major national and international plastic, polymer, and resin manufacturers.

The information provided here has been gleaned from thousands of brochures, technical bulletins, and data sheets, but the extent of the information provided for each product has been limited by the amount of data given to us by the manufacturers. Whenever possible and/or appropriate, we have given the chemical description, applications, form and color, general, mechanical, thermal, and electrical properties of each product.

With the state of technological growth in these industries constantly increasing, this encyclopedia should serve as an important tool for chemists, engineers, and salespeople here and abroad.

We want to extend our thanks to Roberta Dakan for her tireless efforts in helping make this encyclopedia as accurate and consistent as possible.

It should be noted that when the temperatures of properties such as viscosity, density, solubility, etc. are not included, a standard temperature of 25 C is to be assumed. The information in this publication is reliable to the best of our knowledge. We would appreciate being informed of any errors or omissions so that these can be integrated into subsequent editions of this encyclopedia.

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ABBREVIATIONS

@	at
ABS	acrylonitrile-butadiene-styrene
aq.	aqueous
ASTM	American Society for Testing Materials
avail	available
B.P.	boiling pt.
BS	British Standards
BS&D	backwashed, settled, and drained
Btu.	British thermal unit
C	Centigrade
Cal	calories
cc.	cubic centimeter
CC	closed cup
CD	cross direction
charact.	characteristics
chem.	chemical
cm	centimeter
COC	Cleveland Open Cup
coeff.	coefficient
comp.	compound
compr.	compressive
conc..	concentrated
conduct.	conductivity
const.	constant
cps	centipoise or cycles per second
defl. or deflect'n	deflection
dg.	decigram
dielec.	dielectric
DIN	Deutsche Industrie Normen
dissip.	dissipation
distort.	distortion
DMF	dimethylformamide
DOT	Department of Transportation
DWV	drain, waste, and vent
elec.	electrical
elong.	elongation
EPDM	ethylene propylene-diene monomer
esp..	especially
EVA	ethylene vinyl acetate
exp.	expansion
F	Fahrenheit
FAA	Federal Aviation Agency
FB	free base

FDA	Food and Drug Administration
flamm.	flammability
flex.	flexural
F.P.	freezing point
ft	foot
g	gram
G	giga
gal	gallon
gen'l.	general
gr.	gravity
GRP	glass-reinforced polyester
h	hour
HAF	high abrasion furnace carbon black
HB	horizontal burning
HC	hydrocarbon
hyd.	hydroxyl
hydrog.	hydrogenated
Hz	hertz
ICC	Interstate Commerce Commission
ignit.	ignition
in.	inch
incl.	including
insol.	insoluble
insul.	insulation
J	joule
k	kilo
kg.	kilogram
l.	liter
lb	pound
LDPE	low density polyethylene
m	milli or meter
M	mega
max.	maximum
MC	megacycle
MD	mold direction or machine direction
MDA	methylene disalicylic acid
mech.	mechanical
med.	medium
MEK	methyl ethyl ketone
mfg.	manufacturing
mg	milligram
MIBK	methyl isobutyl ketone
MIL	Military Specifications

min.	minute
min.	minimum or mineral
misc.	miscellaneous
mm.	millimeter
mo	months
MOCA.	methylene-bis-orthochloroaniline
mod.	modulus
M.P.	melting point
m.w.	molecular weight
N	Newton
no.	number
NR	natural rubber
OC	open crucible
OR	operating room
oz.	ounce
Pa.	Pascal
pbw	parts by weight
pcf	pounds per cubic foot
PET	polyethylene terephthalate
PMCC	Pensky-Martens Closed Cup
pH	hydrogen-ion concentration
phr	parts per hundred parts of resin or rubber
pkgs.	packages
PPD	piperidine pentamethylene dithiocarbamate
psi	pounds per square inch
pt.	point
PU	polyurethane
PVAc	polyvinyl acetate
PVC	polyvinyl chloride
PW	potable water
quat.	quaternary
qt.	quart
R&B	Ring & Ball
ref.	refractive or reference
resist.	resistance or resistivity
r.h.	relative humidity
rpm	revolutions per minute
R.T.	room temperature
s.	second
SAN	styrene-acrylonitrile polymer
sapon.	saponification
SBR	styrene-butadiene elastomer
soften.	softening

sol.	solubility or soluble
sol'n.	solution
sp.	specific
spec.	specification
SS	stainless steel
S/S	step by step
std.	standard
S/T	short time
str.	strength
surf.	surface
TCC	Taggart Closed Cup
TD	transverse direction
temp.	temperature
tens.	tensile
TDI	toluene diisocyanate
therm.	thermal
THF	tetrahydrofuran
TOC	Taggart Open Cup
trans.	transitional
UL	Underwriter's Laboratory
USDA	Unites States Department of Agriculture
uv.	ultraviolet
V	volt
visc.	viscosity
vol.	volume
W.E. or W. Elec.	Western Electric
wk	week
wt.	weight
yrs	years
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
≈	approximately equal to
μ	microns

The following products which are included in this volume are registered with the U.S. Patent Office.

Reten®	Tynex®
Rilsan®	Uformite®
Solef®	Uralite®
Spauldite®	Valox®
Staybelite®	Varcum®
Stycast®	Versaflex®
Superdense®	Vestamid®
Superox®	Vestolen®
Surfynol®	Vestolit®
Surlyn®	Vinsol®
Synpol®	Vydyne®
Teflon®	Vylor®
Tenite®	Wellamid®
Terate®	XT®
Terlan®	Zonarez®
Thermocomp®	Zonester®
Tygon®	Zytel®

Q

QO Furfural. Quaker Oats Co./Chem. Div.

Chem. Descrip.: 2-Furaldehyde (aldehyde obtained industrially from pentosan-containing agricultural residues, e.g., corncobs, bagasse, cottonseed hulls, oat hulls, and rice hulls)

Category/Applications: Used in the manufacture of derivatives (furan and tetrahydrofuran types); selective solvent for separating saturated from unsaturated compounds in petroleum lubricating oil, gas oil, and diesel fuel; extractive distillation of C₄ and C₅ hydrocarbons for the manufacture of synthetic rubber; decolorizing agent for wood rosin; solvent and processing aid for anthracene; ingredient in resins, esp. of the phenol-aldehyde types; reactive solvent and wetting agent in the manufacture of abrasive wheels and brake linings

Form: Liquid; *Color:* Colorless when freshly distilled; darkens on contact with air; industrial furfural is light yellow to brown; *Odor:* Pungent almond-like

Gen'l. Prop.: M.W.: 96.08; Density: 1.1545 dt/4; Visc.: 1.49 cps; B.P.: 161.7 C (@ 760 mm); F.P.: -36.5 C; *Stability:* High order of thermal stability in the absence of oxygen; *Ref. Index:* 1.5235; *Flash Pt. (TCC):* 61.7 C; *Surface Tension:* 40.7 dynes/cm (29.9 C)

Therm. Prop.: Conduct.: 6.3×10^{-3}

Cal/s-cm²-C/cm (38 C); Sp. Heat: 0.401 Cal/g/deg (14-80 C)

Elec. Prop.: Dielec. Const.: 38

Toxicity/Handling: May be irritating to the eyes and nose; penetrates intact skin

Std. Pkgs.: Steel tank cars, aluminum tank trucks, and steel drums

Ref.: Bulletin 203-D

QO Polymeg 650. Quaker Oats Co./Chem. Div.

Chem. Descrip.: Diol having a terminal primary hydroxyl and a backbone formed by the tetramethylene oxide repeating unit

Category/Applications: Reacted with TDI to form a liquid prepolymer which is readily converted to the solid elastomer by extension with the proper diamine or glycol; solid cast elastomers made by the prepolymer method are used in rollers, solid tires, tooling, etc.; also used in polyurethanes for such diverse applications as thermoplastics, cast mechanical parts, sealants, coatings, and fibers; products based on QO Polymeg offer hydrolytic stability, fungus resistance, low-temp. flexibility, and provide good tensile strength, and good tear and abrasion resistance

Gen'l. Prop.: M.W.: 650; Visc.: 74,000 cps (30 C) [with 80/20 TDI in 3:2 mole ratio (TDI:QO Polymeg)]

Mech. Prop. (of elastomer made from

above prepolymer cured with 4,4'-methylenebis(o-chloroaniline): Tens. Str.: 5000 psi (Die C, D412); Tens. Elong.: 330% (Die C, D412); 100% Mod.: 1500 psi (Die C, D412); Tear Str.: 380 pli (Die C, D624); Compr. Set: 20% (D-395); Hardness (Shore A): 90

Ref.: Bulletin 208

QO Polymeg 1000. Quaker Oats Co./Chem. Div.

Chem. Descrip.: Diol having a terminal primary hydroxyl and a backbone formed by the tetramethylene oxide repeating unit

Category/Applications: See QO Polymeg 650

Gen'l. Prop.: M.W.: 1000; Visc.: 6000 cps (30 C) [with 80/20 TDI in 2:1 mole ratio (TDI:QO Polymeg)]

Mech. Prop. (of elastomer made from above prepolymer cured with 4,4'-methylenebis(o-chloroaniline): Tens. Str.: 5000 psi (Die C, D412); Tens. Elong.: 415% (Die C, D412); 100% Mod.: 1750 psi (Die C, D412); Tear Str.: 465 pli (Die C, D624); Compr. Set: 34% (D-395); Hardness (Shore A): 96

Ref.: Bulletin 208

QO Polymeg 2000. Quaker Oats Co./Chem. Div.

Chem. Descrip.: Diol having a terminal primary hydroxyl and a backbone formed by the tetramethylene oxide repeating unit

Category/Applications: See QO Polymeg 650

Gen'l. Prop.: M.W.: 2000; Visc.: 11,000 cps (30 C) [with 100% TDI in a 2:1 mole ratio (TDI:QP Polymeg)]

Mech. Prop. (of elastomer made from above prepolymer cured with 4,4'-methylenebis(o-chloroaniline): Tens. Str.: 4400 psi (Die C, D412); Tens. Elong.:

475% (Die C, D412); 100% Mod.: 935 psi (Die C, D412); Tear Str.: 345 pli (Die C, D624); Compr. Set: 25% (D-395); Hardness (Shore A): 88

Ref.: Bulletin 208

QuaCorr Resin/Catalyst System. Quaker Oats Co./Chem. Div.

Chem. Descrip.: Furfuryl alcohol based resin system

Category/Applications: Used in the manufacture of corrosion-resistant fiberglass-reinforced plastic equipment and high-performance laminates; these offer excellent chemical resistance, esp. at elevated temps., excellent retention of physical properties at elevated temps., flexibility with safety, easy fabrication by hand lay-up, spray-up, and filament winding techniques, improved toughness permitting fabrication and transportation of large structures

All properties—1/8 in. laminate with 25% glass content:

Gen'l. Prop.: Density: 1.4–1.6 g/cc (D-792); Stability: Resistant to attack by strong and weak acids and bases, aggressive solvents (e.g., ketones, chlorinated types, ethers, low-boiling esters, aromatics, carbon disulfide, etc.); attacked by free bromine, calcium hypochlorite, chlorosulfonic acid, hydrogen peroxide (over 5%), hypochlorous acid, piperidine, potassium peroxide, pyridine, sulfuric acid (over 60%), etc.

Mech. Prop.: Tens. Str.: 10,000 psi (D-638); Tens. Mod.: 600,000 psi (D638); Flex. Str.: 18,000 psi (D790); Flex. Mod.: 700,000 psi (D790); Compr. Str.: 12,000 psi (D695); Impact Str. (Izod): 14 ft lb/in. notch (D256)

Therm. Prop.: Conduct.: 1.8 Btu/ft²-h-F/in.; Coeff. of Linear Exp.: 1.16×10^{-5} in./in./F

Ref.: Bulletin 400-B

Q-Thane Series. K.J. Quinn & Co., Inc.

Chem. Descrip.: Fully reacted polyester, polyether, and aliphatic urethane elastomers

Category/Applications: Thermoplastic resins offering processing versatility for a wide variety of applications incl. agricultural components, appliance components, automotive components, bearings, biomedical tubing and gaskets, business machine parts, cable devices, chemical industry parts, closures, compounding, conveyor belting, electrical/electronic components, films, mechanical parts, packaging, paper and pulp industry, pipe and pipe fittings, plastics, rubber coatings and adhesives, sheeting, sporting equipment, tires, toy parts, wire and cable jacketing, etc.

Form: Solid $\frac{1}{4}$ in. granules; *Color:* Colorless to amber; *Odor:* None

Composition: 0% volatiles

Gen'l. Prop.: Sol.: Insol. in water; *Sp. Gr.:* 1.15–1.21; *M.P.:* 325–480 F; *Stability:* Stable unless overheated; indefinite shelf life when stored in a dry area at 60–90 F

Mech. Prop.: Hardness: 60A to 70D

Std. Pkgs.: 50-lb multiwall paper bags; avail. in gaylord containers, fiber drums, and steel drums on request

Ref.: Data sheets

Q-Thane P-49. K.J. Quinn & Co., Inc.

Chem. Descrip.: Polyurethane elastomers

Category/Applications: Resin for extrusion; see also Q-Thane Series

Gen'l. Prop.: *Sp. Gr.:* 1.17 (D792)

Mech. Prop.: *Tens. Str.:* 8500 psi (D412); *Tens. Elong.:* 500% (D412); 100% *Mod.:* 550 (D412); *Compr. Set:* 25–40% (D395); *Tear Str.:* 400 (Die C, D624); *Impact Str. (Izod):* No break (D256); *Hardness (Shore A):* 70–75 (D2240)

Therm. Prop.: *Brittle Pt.:* –90 F (D746)

Ref.: Data sheet

Q-Thane P-250. K.J. Quinn & Co., Inc.

Chem. Descrip.: Polyurethane elastomers

Category/Applications: Highly crystalline, thermoplastic resin for use in adhesives; exhibits good sol. in conventional adhesive solvents, incl. chlorinated solvents, and is compatible with a wide variety of other resins; features rapid bonding, high strength, plasticizer resistance, reactive hydroxyl content; 145 F adhesive activation temp.; 5 min open tack time; see also Q-Thane Series *Gen'l. Prop.:* *Sol.:* Sol. in acetone, benzene, butyl acetate, cyclohexanone, DMF, ethyl acetate, MEK, methylene chloride, toluol, xylol, tetra hydrofuran, 1,4-dioxane, etc.; *Visc. (Brookfield):* 300–500 cps (P-250-1) and 600–1200 cps (P-250-2) (15% solids in MEK)

Mech. Prop.: *Tens. Str.:* 2800 psi (@ break); *Tens. Elong.:* 615% @ break, 15% @ yield; *Mod.:* 400 psi (@ yield); 400% *Mod.:* 600 psi; *Tear Str.:* 400 pit

Ref.: Data sheet

Q-Thane P-279. K.J. Quinn & Co., Inc.

Chem. Descrip.: Polyester-based urethane elastomer

Category/Applications: Thermoplastic elastomer designed for its solubility in a variety of solvents, incl. chlorinated solvents, and as a modifier for other polymer systems; exhibits excellent tensiles, low solution and melt visc.; recommended for use in coating and adhesive applications in both solvent and hot melt processes; excellent bonds are obtained with fabrics and other substrates, e.g., polyvinyl chloride, Mylar, polyurethanes, and foils; may also be used for calendering and for polyblends with other thermoplastic polymers, e.g., PVC, ABS, and nylon; may be cross-linked to further increase rigidity and to minimize solvent and heat degradation