





***ENCYCLOPEDIA OF  
PLASTICS, POLYMERS,  
AND RESINS***

**VOLUME IV**

***Compiled by***

**Michael and Irene Ash**

***Chemical Publishing Co., Inc.***

## **Encyclopedia of Plastics, Polymers, and Resins Volume 4**

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## ***PREFACE***

Volume IV of this Encyclopedia of Plastics, Polymers, and Resins serves as a supplement to the original set published five years ago. All the products in this edition are new. This supplement therefore serves as an update for new compounds in a continued effort to present comprehensive coverage of national and international plastics, polymers, and resins in industry.

Information from thousands of brochures, technical bulletins, and data sheets has been gleaned in order to make a complete profile on each product. Though sometimes limited by the information provided by the manufacturers, in most instances, the chemical description, applications, form and color, general, mechanical, thermal, and electrical properties are included.

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

We believe that this Encyclopedia will prove to be an invaluable reference tool for chemists, engineers, and all those associated with the chemical manufacturing industry. We would like to thank all those companies who made this work possible through their contributions and we would like to also extend our warmest heartfelt thanks to Roberta Dakan who has devoted herself to helping make this work as accurate and consistent as possible.

M. and I. Ash

## NOTE

Unless otherwise specified, when the temperatures are not given for properties such as viscosity, density, solubility, etc., a standard temperature of 25 C is to be assumed

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# ABBREVIATIONS

@	.....	at
ABS	.....	acrylonitrile-butadiene-styrene
absorp	.....	absorption
AEB	.....	average extent of burning
aq.	.....	aqueous
ASTM	.....	American Society for Testing and Materials
ATB	.....	average time of burning
atm	.....	atmosphere
avail	.....	available
avg.	.....	average
B.P.	.....	boiling point
BS	.....	British Standards
BS&D	.....	backwashed, settled, and drained
Btu	.....	British thermal unit
C	.....	degrees Centigrade
cal	.....	calories
cap	.....	capillary
cc	.....	cubic centimeter(s)
CC	.....	closed cup
CD	.....	cross direction
CFD	.....	cross flow direction
chem	.....	chemical
cm	.....	centimeter(s)
cm <sup>3</sup>	.....	cubic centimeter(s)
COC	.....	Cleveland Open Cup
coeff	.....	coefficient
comp	.....	compound
compr	.....	compressive
conc	.....	concentrated or concentration
cond	.....	condition

conduct	conductivity
const	constant
cps	centipoise or cycles per second
DADPS	diaminodiphenyl sulfone
defl.	deflection
dg	decigram
dielec	dielectric
DIN	Deutsche Industrie Normen
dissip	dissipation
distort	distortion
DMF	dimethylformamide
DMSO	dimethyl sulfoxide
DOT	Department of Transportation
DWV	drain, waste, and vent
elec	electrical
elong	elongation
EMAA	ethylene methacrylic acid
EPDM	ethylene-propylene-diene rubbers
EPM	ethylene-propylene rubbers
equiv	equivalent
ESCR	environmental stress crack resistance
esp	especially
EVA	ethylene vinyl acetate
exc	excellent
exp	expansion
F	degrees Fahrenheit
FAA	Federal Aviation Agency
FB	free base
FD	flow direction
FDA	Food and Drug Administration
flamm	flammability
flex	flexural
F.P.	freezing point
ft	foot, feet
g	gram(s)
G	giga
gal	gallon(s)
gen'l.	general
gr	gravity
GRP	glass-reinforced polyester

h	hour(s)
HAF	high abrasion furnace carbon black
HB	horizontal burning
HC	hydrocarbon
HDPE	high density polyethylene
HLB	hydrophilic lipophilic balance
hyd	hydroxyl
hydrog	hydrogenated
Hz	hertz
ICC	Interstate Commerce Commission
ignit	ignition
in	inch(es)
incl	including
indent	indentation
insol	insoluble
J	joule
k	kilo
K	Kelvin
kg	kilogram
l	liter
lb	pound
LDPE	low density polyethylene
lin	linear
LLDPE	linear low density polyethylene
m	milli or meter
M	mega
max	maximum
MC	megacycle
MD	mold direction or machine direction
MDA	methylene disalicylic acid
MDI	methylene diphenyl isocyanate
mech	mechanical
med	medium
MEK	methyl ethyl ketone
mfg	manufacturing
mg	milligram(s)
MIBK	methyl isobutyl ketone
MIL	Military Specifications
min	minute, minimum, or mineral
misc	miscellaneous

mm	.....	millimeter(s)
mo, mos	.....	month(s)
MOCA	.....	methylene-bis-ortho-chloroaniline
mod	.....	modulus
M.P.	.....	melting point
MSDS	.....	material safety data sheet
m.w.	.....	molecular weight
n	.....	nano
N	.....	Newton
NBR	.....	nitrile-butadiene rubber
no	.....	number
NR	.....	natural rubber
NSF	.....	National Sanitation Foundation
N.V.	.....	nonvolatiles
OC	.....	open crucible
oz	.....	ounce
Pa	.....	Pascal
PAN	.....	polyacrylonitrile
pbw	.....	parts by weight
PC	.....	polycarbonate
pcf	.....	pounds per cubic foot
PEEK	.....	polyetheretherketone
PET	.....	polyethylene terephthalate
pH	.....	hydrogen-ion concentration
phr	.....	parts per hundred of resin or rubber
PMCC	.....	Pensky-Martens Closed Cup
PMDI	.....	polymeric isocyanate
PP	.....	polypropylene
PPS	.....	polyphenylene sulfide
prop	.....	properties
PS	.....	polystyrene
psi	.....	pounds per square inch
pt	.....	point
PTFE	.....	polytetrafluoroethylene
PU	.....	polyurethane
PVAc	.....	polyvinyl acetate
PVAL	.....	polyvinyl alcohol
PVC	.....	polyvinyl chloride
PVDC	.....	polyvinylidene chloride
PVF	.....	polyvinyl fluoride

PW	potable water
qt	quart
quat	quaternary
R&B	Ring & Ball
r.h.	relative humidity
R.T.	room temperature
ref	refractive or reference
resist	resistance or resistivity
RIM	reaction injection molding
rpm	revolutions per minute
s	second(s)
SAN	styrene-acrylonitrile
sapon	saponification
SBR	styrene-butadiene rubbers
soften	softening
sol	solubility or soluble
sol'n	solution
sp	specific
spec	specification
S/S or SS	step by step
S/T or ST	short time
std	standard
str	strength or stress
surf	surface
TCC	Taggart Closed Cup
TD	transverse direction
TDI	toluene diisocyanate
temp	temperature
tens	tensile
therm	thermal
THF	tetrahydrofuran
TOC	Taggart Open Cup
trans	transitional
UL	Underwriter's Laboratory
USDA	United States Department of Agriculture
uv	ultraviolet
V	volt
visc	viscosity
vol	volume
W	watt

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 ..... micron(s)



# A

**ABS-G1FG-2.** Washington Penn Plastic Co., Inc.

*Chem. Descrip.:* 20% Glass-filled ABS

*Category/Applications:* Automotive components

*Composition:* 20% glass filler

*Gen'l. Prop.:* Melt Flow: 1.5–2.5 g/10 min (D1238); Density: 1.17 g/cc (D792)

*Mech. Prop.:* Tens. Str.: 9000 psi (D638); Elong. Break: 2.5% (2 in./min, D350); Flex. Str.: 13,000 psi (D790); Flex. Mod.: 650,000 psi (D790); Impact Str. (Izod): 1.0 ft-lb/in. (notched,  $\frac{1}{4}$  in., 73 F, D256); Hardness (Shore D): 81 (D2240); Mold Shrinkage: 0.000–0.002 in./in. (D953); Water Absorp.: 0.02% (24 h, 73 F, D570)

*Therm. Prop.:* Distort. Temp.: 194 F ( $\frac{1}{8}$  in., 264 psi, D648)

*Ref.:* Product catalog

**Alathon® H5530.** DuPont Co./Polymer Prod. Dept.

*Chem. Descrip.:* High-density polyethylene copolymer resin with narrow m.w. distribution

*Category/Applications:* HDPE designed for injection molding applications which require an optimum balance of processability and

toughness performance; offers exc. color, low odor, good rigidity, low warpage; used for thin-wall container and basecup; complies with FDA regulations

*Gen'l. Prop.:* Melt Flow: 30 dg/min (D1238-82); Density: 0.955 g/cm<sup>3</sup> (D1505-79)

*Mech. Prop.:* Tens. Str.: 27.6 MPa (2 in./min, D638-82); Elong.: 12% @ yield, 30% @ break (2 in./min, D638-82); Flex. Mod.: 1310 MPa (D790-81); Impact Str. (Izod): 19 J/m (notched, D256-81); ESCR (Lander's): 12 h (870 psi, D2552-80); Hardness (Shore D): 62 (D2240-81)

*Therm. Prop.:* Distort. Temp.: 49 C (264 psi, D648-82); Brittleness Temp.: –84 C (D746-79); Soften. Pt. (Vicat): 120 C (D1525-76)

*Ref.:* Data sheet E-64451

**Alathon® H5618.** DuPont Co./Polymer Prod. Dept.

*Chem. Descrip.:* High-density polyethylene copolymer resin with narrow m.w. distribution

*Category/Applications:* HDPE designed for injection molding applications which require an optimum balance of processability and toughness performance; offers exc. color, low odor, good rigidity, low warpage; used for

basic houseware, basecup, toy, cap and closure applications; complies with FDA regulations

*Gen'l. Prop.:* Melt Flow: 18 dg/min (D1238-82); Density: 0.956 g/cm<sup>3</sup> (D1505-79)

*Mech. Prop.:* Tens. Str.: 28.3 MPa (yield, 2 in./min, D638-82); Elong.: 18% @ yield, 600% @ break (2 in./min, D638-82); Flex. Mod.: 1448 MPa (D790-81); Impact Str. (Izod): 27 J/m (notched, D256-81); ESCR (Lander's): 20 h (870 psi, D2552-80); Hardness (Shore D): 64 (D2240-81)

*Therm. Prop.:* Distort. Temp.: 48 C (264 psi, D648-82); Brittleness Temp.: -86 C (D746-79); Soften. Pt. (Vicat): 125 C (D1525-76)

*Ref.:* Data sheet E-64454

**Alathon® L5840.** DuPont Co./Polymer Prod. Dept.

*Chem. Descrip.:* High-density polyethylene copolymer resin with broad m.w. distribution  
*Category/Applications:* HDPE designed for blow molding applications; offers good processability, high stiffness, high impact, high ESCR; allows lightweighting of small to medium-sized containers requiring environmental stress crack resistance; suitable for packaging bleach, most detergents, and edible oils; complies with FDA regulations; also avail. in antistatic version

*Gen'l. Prop.:* Melt Flow: 0.40 dg/min (D1238-82); Density: 0.958 g/cm<sup>3</sup> (D1505-79)

*Mech. Prop.:* Tens. Str.: 30 MPa @ yield, 35 MPa @ break (2 in./min, D638-82); Elong.: 16% @ yield, 1800% @ break (2 in./min, D638-82); Flex. Mod.: 1234 MPa (D790-81); Tens. Impact: 197 kJ/m<sup>2</sup> (S bar, D1822-79); ESCR: 105 h (D1693-70 F/50, A); Hardness (Shore D): 60 (D2240-81)

*Therm. Prop.:* Distort. Temp.: 42 C (264 psi, D648-82); Brittleness Temp.: -79 C (D746-79); Soften. Pt. (Vicat): 128 C (D1525-82)

*Ref.:* Data sheet E-64452

**Alathon® L5850.** DuPont Co./Polymer Prod. Dept.

*Chem. Descrip.:* High-density polyethylene copolymer resin with med. m.w. distribution  
*Category/Applications:* HDPE designed for blow molding applications; offers high stiffness, high impact resistance, and high ESCR allowing max. lightweighting of small to medium-sized containers for applications requiring environmental stress crack resistance; suitable for packaging bleach, common detergents, and oils; complies with FDA regulations; also avail. in antistatic version

*Gen'l. Prop.:* Melt Flow: 0.50 dg/min (D1238-82); Density: 0.958 g/cm<sup>3</sup> (D1505-79)

*Mech. Prop.:* Tens. Str.: 30 MPa @ yield, 34 MPa @ break (2 in./min, D638-82); Elong.: 16% @ yield, 1800% @ break (2 in./min, D638-82); Flex. Mod.: 1276 MPa (D790-81); Tens. Impact: 189 kJ/m<sup>2</sup> (S bar, D1822-79); ESCR: 110 h (D1693-70 F/50, A); Hardness (Shore D): 62 (D2240-81)

*Therm. Prop.:* Distort. Temp.: 42 C (264 psi, D648-82); Brittleness Temp.: -79 C (D746-79); Soften. Pt. (Vicat): 128 C (D1525-82)

*Ref.:* Data sheet E-64453

**Alathon® M5370.** DuPont Co./Polymer Prod. Dept.

*Chem. Descrip.:* High-density polyethylene copolymer resin with narrow m.w. distribution

*Category/Applications:* HDPE designed for injection molding applications; offers exc. balance of fast processing and finished part toughness, exc. color, low odor; used for open-head pail and shipping containers where high impact strength, stress crack resistance, and stacking properties are required; complies with FDA regulations

*Gen'l. Prop.:* Melt Flow: 7.0 dg/min (D1238-82); Density: 0.953 g/cm<sup>3</sup> (D1505-79)

*Mech. Prop.:* Tens. Str.: 23.4 MPa @ yield,

20.7 MPa @ break (2 in./min, D638-82); Elong.: 15% @ yield, 1100% @ break (2 in./min, D638-82); Flex. Mod.: 1379 MPa (D790-81); Tens. Impact: 76 kJ/m<sup>2</sup> (S bar, D1822-79); Impact Str. (Izod): 37 J/m (notched, D256-81); ESCR (Lander's): 6.0 h (1160 psi, D2552-80); Hardness (Shore D): 63 (D2240-81)

*Therm. Prop.:* Distort. Temp.: 46 C (264 psi, D648-82); Brittleness Temp.: -86 C (D746-79); Soften. Pt. (Vicat): 124 C (D1525-82)

*Ref.:* Data sheet E-64456

**Alcryn® R1101B-70A.** Du Pont Co./Polymer Prod. Dept.

*Chem. Descrip.:* Melt processable rubber

*Category/Applications:* See Alcryn® R1201B-60A; R1101B-70A is the low-cost, general-purpose grade serviceable to 70 C

*Gen'l. Prop.:* Density: 1.21 g/cc

*Mech. Prop.:* Tens. Str.: 13.2 MPa (D412); Elong.: 280% @ break (D412); 100% Mod.: 5.1 MPa (D412); Tear Str.: 30.6 kN/m (D624); Hardness (Shore A): 69 (D2240)

*Therm. Prop.:* Brittleness Temp.: -45 C (D746)

*Ref.:* Product bulletin

**Alcryn® R1201B-60A.** Du Pont Co./Polymer Prod. Dept.

*Chem. Descrip.:* Melt processable rubber

*Category/Applications:* Elastomer which does not require vulcanization; offers economies of melt processing on plastics equipment and modified rubber equipment; advantages incl. outstanding oil and heat-aging resistance, good tear str. and abrasion resistance, exc. ozone and weather resistance, and reusability of scrap; applications incl. reinforced hose, profile extrusions, weatherstripping, mechanical goods, molded gaskets/seals, tubing, coated fabrics, sheeting, elastomeric film, flat conveyor belts, automotive parts, wire and cable jacketing, footwear soling; 60A grade

serviceable at 100 C

*Form:* 4 mm diam. pellets; Color: Black

*Gen'l. Prop.:* Density: 1.21 g/cc

*Mech. Prop.:* Tens. Str.: 12.1 MPa (D412);

Elong.: 325% @ break (D412); 100% Mod.: 3.7 MPa (D412); Flex. Mod.: 7.6 MPa (D790);

Tear Str. (Graves) 21.9 kN/m (Die C, D1004);

Hardness (Shore A): 60 (D2240)

*Therm. Prop.:* Impact Brittleness Temp.: -46 C (D1790)

*Toxicity/Handling:* Not hazardous; local ventilation is recommended; HCl, if evolved, is irritating to eyes and mucous membranes

*Storage/Handling:* Prolonged exposure to temps. > 205 C or rapid heating to > 250 C will result in polymer degradation and the evolution of HCl

*Std. Pkgs.:* 24.9 kg net multiwall bags; 998 kg pallets

*Ref.:* Tech. guide E-74651

**Alcryn® R1201B-70A.** Du Pont Co./Polymer Prod. Dept.

*Chem. Descrip.:* Melt processable rubber

*Category/Applications:* See Alcryn® R1201B-60A; 70A grade serviceable at 100 C

*Form:* 4 mm diam. pellets; Color: Black

*Gen'l. Prop.:* Density: 1.23 g/cc

*Mech. Prop.:* Tens. Str.: 13.1 MPa (D412);

Elong.: 295% @ break (D412); 100% Mod.: 4.5 MPa (D412); Flex. Mod.: 8.3 MPa (D790);

Tear Str. (Graves) 23.6 kN/m (Die C, D1004);

Hardness (Shore A): 70 (D2240)

*Therm. Prop.:* Impact Brittleness Temp.: -44 C (D1790)

*Toxicity/Handling & Storage/Handling:* See Alcryn® R1201B-60A

*Std. Pkgs.:* 24.9 kg net multiwall bags; 998 kg pallets

*Ref.:* Tech. guide E-74651

**Alcryn® R1201B-80A.** Du Pont Co./Polymer Prod. Dept.

*Chem. Descrip.:* Melt processable rubber

*Category/Applications:* See Alcryn® R1201B-60A; 80A grade serviceable at 100 C  
*Form:* 4 mm diam. pellets; Color: Black

*Gen'l. Prop.:* Density: 1.25 g/cc

*Mech. Prop.:* Tens. Str.: 13.4 MPa (D412); Elong.: 210% @ break (D412); 100% Mod.: 7.2 MPa (D412); Flex. Mod.: 9.7 MPa (D790); Tear Str. (Graves) 21.0 kN/m (Die C, D1004); Hardness (Shore A): 80 (D2240)

*Therm. Prop.:* Impact Brittleness Temp.: -42 C (D1790)

*Toxicity/Handling & Storage/Handling:* See Alcryn® R1201B-60A

*Std. Pkgs.:* 24.9 kg net multiwall bags; 998 kg pallets

*Ref.:* Tech. guide E-74651

#### Amoco 10-4017. Amoco Chem. Corp.

*Chem. Descrip.:* Polypropylene resin

*Category/Applications:* General-purpose injection molding/extrusion grade resin; FDA compliance

*Gen'l. Prop.:* Melt Flow: 8 g/10 min (D1238, Cond. L); Density: 0.90 g/cm<sup>3</sup> (23 C, D792); Mold Shrinkage: 0.015–0.020 mm/mm (D-955); Water Absorp.: < 0.06% (24 h, 23 C, D570)

All properties— injection molded sample:

*Mech. Prop.:* Tens. Str.: 36 MPa @ yield (23 C, D638); Elong.: 8% @ yield, 30% @ break (23 C, D638); Flex. Mod.: 1450 MPa (23 C, D790A); Impact Str. (Izod): 27 J/m (notched, 23 C, D245); Tens. Impact: 53 kJ/m<sup>2</sup> (S bar, D1822); Hardness (Shore D): 76 (D2240)

*Therm. Prop.:* Distort. Temp.: 104 C (@ 66 psi, D648)

*Ref.:* Bulletin PP-2c

#### Amoco 1012. Amoco Chem. Corp.

*Chem. Descrip.:* Polypropylene resin

*Category/Applications:* Extrusion grade resin; FDA compliance

*Gen'l. Prop.:* Melt Flow: 1.2 g/10 min (D1238, Cond. L); Density: 0.90 g/cm<sup>3</sup> (23 C,

D792); Mold Shrinkage: 0.015–0.020 mm/mm (D-955); Water Absorp.: < 0.01% (24 h, 23 C, D570)

All properties— injection molded sample:

*Mech. Prop.:* Tens. Str.: 37 MPa @ yield (23 C, D638); Elong.: 9% @ yield, 50% @ break (23 C, D638); Flex. Mod.: 1450 MPa (23 C, D790A); Impact Str. (Izod): 53 J/m (notched, 23 C, D245); Tens. Impact: 137 kJ/m<sup>2</sup> (S bar, D1822); Hardness (Shore D): 75 (D2240)

*Therm. Prop.:* Distort. Temp.: 107 C (@ 66 psi, D648); Flamm.: 94HB (UL94)

*Ref.:* Bulletin PP-2c

#### Amoco 1046. Amoco Chem. Corp.

*Chem. Descrip.:* Polypropylene resin

*Category/Applications:* Injection molding/extrusion grade resin with LTHA; FDA compliance

*Gen'l. Prop.:* Melt Flow: 5.0 g/10 min (D1238, Cond. L); Density: 0.90 g/cm<sup>3</sup> (23 C, D792); Mold Shrinkage: 0.015–0.020 mm/mm (D-955); Water Absorp.: < 0.01% (24 h, 23 C, D570)

All properties— injection molded sample:

*Mech. Prop.:* Tens. Str.: 37 MPa @ yield (23 C, D638); Elong.: 9% @ yield, 50% @ break (23 C, D638); Flex. Mod.: 1500 MPa (23 C, D790A); Impact Str. (Izod): 27 J/m (notched, 23 C, D245); Tens. Impact: 74 kJ/m<sup>2</sup> (S bar, D1822); Hardness (Shore D): 76 (D2240)

*Therm. Prop.:* Distort. Temp.: 110 C (@ 66 psi, D648); Flamm.: 94HB (UL94)

*Ref.:* Bulletin PP-2c

#### Amoco 1088. Amoco Chem. Corp.

*Chem. Descrip.:* Polypropylene resin

*Category/Applications:* Blown film grade; FDA compliance

*Gen'l. Prop.:* Melt Flow: 8 g/10 min (D1238, Cond. L); Density: 0.90 g/cm<sup>3</sup> (23 C, D792); Mold Shrinkage: 0.015–0.020 mm/mm (D-955); Water Absorp.: < 0.01% (24 h, 23 C, D570)