

General information

Designation

Polypropylene (Homopolymer, high flow)

Tradenames

A. Schulman PP; Acclear; Accpro; Acctuf; Accucomp; Achieve; Addilene; Adflex; Adpro; Adstif; Akrolen; Albis PP; Alphacan; Amoco PP; Aanpro; Aplax; Appryl; Aqua by; ARCO PP; Arcoplen; Armlen; Arpak; Arpro; Astryn; Atofina Polypropylene; Azdel; Bapolene; Bergaprop; Bicolor; Borealis PP; Borflow; Bormed; Borstar; Braskem PP; Bras-Tec; Bynel; Capilene; Carboprene; Carmelstat; Cefor; Clyrell; Compel; Compotene; Comshield; Corton; Cosmoplene; Cotene; CP PrymeE Polypropylene; Cuyolen; DaelimPoly; Dafnelen; DaicelPP; Danapro; Daplen; Daploy; Delta; Denilen; DEP; Dexflex; DigiLyte; Domolen; Dow Polypropylene; Ecoplast PP; El-Pro; EltexP; Endura; Epsilon; EquistarPP; Escalloy; Esdash; Estaprop; Eticourt; Extron; ExxonMobil PP; Exxpol Enhance; Exxtral; FerrexNewfoamer; Ferro PP; Ferrolene; Fiberfil; Finapro; FHR Polypropylene; Flametec; Formolene; Fortilene; Gapex; Globalene; Global PP; Grand Polpro; Haiplen; Halene; Hi-Fax; Hi-Glass; Hipol; Hishiplate; Hival; HMS; Hopelen; Hostacen; Hostacom; Hostalen PP; Huntsman PP; Hyosung PP; Hypro; Icorene; Inertec; Ineos PP Med; Innovene PP; Inspire; Ipiranga; Isplen; Jazz; Kelburon; Kopelen; Koylene; Koylene ADL; Latene; Lupol; Luvogard; M. Holland; Mafill; Magnacomp; Malen-P; Marlex PP; Maspolene; Maxbatch; Maxpro; Maxxam; Metallyte; Metocene; Microthene; Moplen; Mosten; Multipro; Network Polymers PP; Neviprop; Newstren; Niplene; Nissen; Noblen; Nortuff; Novatec; Novolen; Oleform; Olehard; Olesafe; Oppalyte Trespaphan; Osstyrol; Palprop; Percom; Permastat; Petoplen; Petrothene; Pinnacle PP; Piolen; Plastiflam; Polene; Polifin PP; Polifor; Polybatch; Polycom; Polycomp; Polyfill; Polyflam; Polyfort; Polystone; Polyvance; Ponalen; Pre-Elec; Procom; Pro-Fax; Prolen; Propak; Propilco PP; Propilven; Propylux; Protec; Proteus; Purell; Qenos PP; Ranplen; Refax; Repol; Repolen; Reptol; Retpol; Rexene; Rhetch PP; Rotothon; Sabic PP; Samsung Total; Sanalite; Sanren; Saxene; Scolefin; Seetec; Sequel; Simona; Sinpolene; Spartech Polycom; Spolen; StaMax; Starnylan; Starpylen; Strandfoam; Sunlet; Sunoco PP; Syntegum; Taboren; Taffen; Taipolene; Tairipro; Talcoprene; Tatren; Tecafine; Teknoplen; Terez; Thermolen; Thermylene; Tipcolene; Tipplen; TITANPRO; Topilene; Torayfan; Total Petrochemicals Polypropylene; Tracolen; Trapylen; Trilen; Triene; Umastyr; Valmax; Valtec; Vamplem; Vylene; Vycon; Wintec; WPP; Xenopren; Xmod; Yuhwa; Yuplene; Zeral

Typical uses

Containers, thin-walled, cups, toys, fibers, staple, filaments, yarn, bcf, film, bi-axially oriented, film, cast, blow molding applications, film, oriented, appliance components, automotive interior parts, electrical/electronic applications, packaging, cosmetic, furniture, filtration media, textile applications, packaging, food, general purpose, parts, thin-walled, molds/dies/tools, packaging, thin-walled, bcf multi-filaments, fabrics, disposable, spun bonding, containers, food, handles, household goods, vials, writing instruments, parts, engineering, automotive exterior parts, color concentrates, non-wovens, spunbond, stationary supplies, bags, non-wovens, hospital goods, packaging, rigid, lids, coating applications, fiber, slit-film, fibers, hi-speed slit-film, labware, laminates, fabrics, rope, twine, yarn, course weaving, automotive electronics, automotive instrument panel, valves/valve parts, packaging, pharmaceutical, coatings, foil, coatings, non-wovens, coatings, paper, personal care, carpet backing, trays, support, agricultural applications, industrial applications, food applications, non-specific, blending, liners, automotive under the hood, electrical parts, drinkware, disposable, packaging, media, coatings, fabric, ribbons, sheet, wire & cable applications, kitchenware, construction applications, consumer applications, parts, thick-walled, outdoor furnishings, straws, drinking, cosmetics, monofilaments, sporting goods, tool/tote box, yarn, flat-high tenacity, belts/belt repair, strapping, foam, lawn and garden equipment, body implants, packaging, medical, buckets, bowls, general mechanical parts, bottle crates, medical components, washing machine drums, pipes, battery cases, bottles, bottle caps, bumpers, films for packaging, fibers for carpeting and artificial sports surfaces.

Composition overview

Compositional summary

(CH₂-CH(CH₃))_n - isotactic

Material family	Plastic (thermoplastic, semi-crystalline)
Base material	PP (Polypropylene)
Polymer code	PP

Composition detail (polymers and natural materials)

Polymer	100		%
---------	-----	--	---

Price

Price	* 1.07	- 1.19	GBP/kg
Price per unit volume	* 964	- 1.09e3	GBP/m ³

Physical properties

Density	898	- 908	kg/m ³
---------	-----	-------	-------------------

Mechanical properties

Young's modulus	1.37	- 1.58	GPa
Specific stiffness	1.52	- 1.76	MN.m/kg
Yield strength (elastic limit)	31.9	- 36.4	MPa
Tensile strength	22.5	- 33.5	MPa
Specific strength	35.3	- 40.3	kN.m/kg
Elongation	52.1	- 232	% strain
Elongation at yield	8.09	- 11.1	% strain
Compressive modulus	* 1.37	- 1.58	GPa
Compressive strength	* 39.9	- 41.9	MPa
Flexural modulus	1.33	- 1.61	GPa
Flexural strength (modulus of rupture)	34.4	- 51.4	MPa
Shear modulus	* 0.519	- 0.532	GPa
Bulk modulus	* 2.5	- 2.56	GPa
Poisson's ratio	* 0.399	- 0.407	
Shape factor	4.9		
Hardness - Vickers	10		HV
Hardness - Rockwell M	60	- 76	
Hardness - Rockwell R	95	- 104	
Hardness - Shore D	64	- 69	
Hardness - Shore A	* 94	- 99	
Elastic stored energy (springs)	341	- 455	kJ/m ³
Fatigue strength at 10 ⁷ cycles	* 10.7	- 11.2	MPa

Impact & fracture properties

Fracture toughness	* 1.66	- 1.75	MPa.m ^{0.5}
Toughness (G)	1.81	- 2.15	kJ/m ²
Ductility index	0.21	- 0.26	µm
Impact strength, notched 23 °C	2.26	- 3.17	kJ/m ²
Impact strength, notched -30 °C	1.29	- 1.52	kJ/m ²
Impact strength, unnotched 23 °C	61.6	- 73.9	kJ/m ²
Impact strength, unnotched -30 °C	14.3	- 15.7	kJ/m ²

Thermal properties

Melting point	161	-	170	°C
Glass temperature	-14	-	-6	°C
Heat deflection temperature 0.45MPa	92.7	-	111	°C
Heat deflection temperature 1.8MPa	50.5	-	66.9	°C
Vicat softening point	143	-	164	°C
Maximum service temperature	95.1	-	114	°C
Minimum service temperature	* -17	-	-3	°C
Thermal conductivity	* 0.205	-	0.214	W/m.°C
Specific heat capacity	1.66e3	-	1.7e3	J/kg.°C
Thermal expansion coefficient	81.1	-	109	µstrain/°C
Thermal shock resistance	208	-	292	°C
Thermal distortion resistance	* 0.00193	-	0.00259	MW/m

Electrical properties

Electrical resistivity	2.55e23	-	1.63e24	µohm.cm
Electrical conductivity	1.06e-22	-	6.75e-22	%ACS
Dielectric constant (relative permittivity)	2.16	-	2.24	
Dissipation factor (dielectric loss tangent)	1.96e-4	-	2.04e-4	
Dielectric strength (dielectric breakdown)	17.6	-	18.4	MV/m
Comparative tracking index	600			V

Magnetic properties

Magnetic type	Non-magnetic			
---------------	--------------	--	--	--

Optical, aesthetic and acoustic properties

Refractive index	1.48	-	1.5	
Transparency	Translucent			
Softness to touch	* 50.1	-	52	
Warmth to touch	* 175	-	179	
Acoustic velocity	1.23e3	-	1.33e3	m/s
Mechanical loss coefficient (tan delta)	* 0.0265	-	0.0278	

Healthcare & food

Food contact	Yes			
--------------	-----	--	--	--

Restricted substances risk indicators

RoHS (EU) compliant grades?	✓			
REACH Candidate List indicator (0-1, 1 = high risk)	0.02			
Notes	May contain restricted (w%): UV-stabilizer up to 2%			
SIN List indicator (0-1, 1 = high risk)	0.02			
Notes	May contain restricted (w%): Anti-oxidant up to 0.3%, UV-stabilizer up to 2%			

Absorption & permeability

Water absorption @ 24 hrs	0.0195	-	0.0205	%
---------------------------	--------	---	--------	---

Water absorption @ sat	0.195	-	0.205	%
Water vapor transmission	0.118	-	0.184	g.mm/m ² .day
Permeability (O2)	58.3	-	99.7	cm ³ .mm/m ² .day.atm
Permeability (CO2)	121	-	357	cm ³ .mm/m ² .day.atm
Permeability (N2)	10.4	-	26.1	cm ³ .mm/m ² .day.atm

Processing properties

Polymer injection molding	Excellent			
Polymer extrusion	Excellent			
Polymer thermoforming	Acceptable			
Linear mold shrinkage	1.4	-	1.96	%
Melt temperature	203	-	251	°C
Mold temperature	11.9	-	38.4	°C
Molding pressure range	18.6	-	95.6	MPa

Durability

Water (fresh)	Excellent			
Water (salt)	Excellent			
Weak acids	Excellent			
Strong acids	Excellent			
Weak alkalis	Excellent			
Strong alkalis	Excellent			
Organic solvents	Excellent			
Chem. resistance index (0=worst, 1=best)	0.76			
Env. stress crack index (0=worst, 1=best)	0.88			

Notes

Reported stress cracking agents (NPL, ESC database, A.S. Maxwell, A. Turnbull, 2003)
Moderate: Toluene
Severe: none

Oxidation at 500C	Unacceptable			
UV radiation (sunlight)	Poor			
Flammability	Highly flammable			
Notes	Currently NOT UL tested but expected to pass the HB test			
Flammability - typical UL 94 rating	HB			
Oxygen index	18	-	20	%

Chemical resistance of polymers

Chemical resistance, data sources

Derived from Rapra ChemRes record for Polypropylene (homopolymer)

Acetaldehyde	Satisfactory			
Acetic acid (10%)	Satisfactory			
Acetic acid (glacial)	Satisfactory			
Acetic anhydride	Satisfactory			
Acetone	Satisfactory			

Acetonitrile	Satisfactory
Acetophenone	Satisfactory
Acetyl chloride	Limited
Acrylic acid	Probably satisfactory
Aluminum chloride (10%)	Satisfactory
Aluminum sulfate	Satisfactory
Ammonium hydroxide (35%)	Satisfactory
Ammonium sulfate (50%)	Satisfactory
Amyl acetate	Satisfactory
Amyl alcohol	Satisfactory
Aniline	Satisfactory
Antimony trichloride (10%)	Satisfactory
Aqua regia	Limited
Arsenic acid	Satisfactory
ASTM fuel A	Probably satisfactory
ASTM fuel B	Probably satisfactory
ASTM fuel C	Probably satisfactory
ASTM oil No. 1	Satisfactory
ASTM oil No. 2 or IRM902	Probably satisfactory
ASTM oil No. 3 or IRM903	Limited
Barium chloride	Satisfactory
Benzaldehyde	Limited
Benzene	Limited
Benzyl alcohol	Satisfactory
Benzyl chloride	Limited
Boric acid	Satisfactory
Bromine liquid	Unsatisfactory
Butyl acetate	Limited
Butyl alcohol (butanol)	Satisfactory
Butyl chloride	Unsatisfactory
Butylamine	Satisfactory
Butyric acid	Satisfactory
Calcium chloride	Satisfactory
Carbon disulfide	Limited
Carbon tetrachloride	Limited
Castor oil	Satisfactory
Cellosolve	Satisfactory
Cellosolve acetate	Satisfactory
Chloroacetic acid	Satisfactory
Chlorine dioxide	Limited
Chlorine gas (dry)	Unsatisfactory
Chlorine water	Limited
Chlorobenzene	Satisfactory

Chloroform	Limited
Chlorosulfonic acid	Unsatisfactory
Chrome plating solution	Probably satisfactory
Chromic acid	Satisfactory
Citric acid (10%)	Satisfactory
Cod liver oil	Satisfactory
Copper sulfate	Satisfactory
Cotton seed oil	Probably satisfactory
Cresols	Satisfactory
Cyclohexane	Limited
Cyclohexanol	Satisfactory
Cyclohexanone	Satisfactory
Decalin	Limited
Diesel oil	Satisfactory
Diethyl ether	Satisfactory
Diethylamine	Satisfactory
Diethylene glycol	Satisfactory
Dimethyl formamide	Satisfactory
Dimethylamine	Satisfactory
Dimethylhydrazine	Satisfactory
Dioctyl phthalate	Satisfactory
Dioxane	Satisfactory
Ethyl acetate	Satisfactory
Ethyl alcohol (ethanol)	Satisfactory
Ethyl chloride	Unsatisfactory
Ethylamine	Probably satisfactory
Ethylene bromide	Doubtful
Ethylene chloride (1,2 dichloroethane)	Satisfactory
Ethylene glycol	Satisfactory
Ferric chloride	Satisfactory
Fluoboric acid	Probably satisfactory
Fluorine (gas)	Unsatisfactory
Fluosilicic acid	Satisfactory
Formaldehyde (40%)	Satisfactory
Formic acid (90%)	Satisfactory
Freon - 11	Doubtful
Freon - 113	Satisfactory
Freon - 115	Satisfactory
Freon - 12	Satisfactory
Freon - 13 B1	Satisfactory
Freon - 21	Satisfactory
Freon - 22	Satisfactory
Freon - 32	Satisfactory

Furfural	Satisfactory
Glycerol	Satisfactory
Hexane	Satisfactory
Hydrazine	Satisfactory
Hydrobromic acid (50%)	Satisfactory
Hydrochloric acid (10%)	Satisfactory
Hydrochloric acid (36%)	Satisfactory
Hydrofluoric acid (40%)	Satisfactory
Hydrogen peroxide (35%)	Satisfactory
Hydrogen peroxide (87%)	Doubtful
Hydrogen sulfide gas	Satisfactory
Iso-octane	Satisfactory
Iso-propyl alcohol (iso-propanol)	Satisfactory
Lactic acid (90%)	Satisfactory
Lead acetate (10%)	Satisfactory
Linseed oil	Satisfactory
Lubricating oil	Satisfactory
Magnesium chloride	Satisfactory
Manganese sulfate	Satisfactory
Mercuric chloride	Satisfactory
Methyl alcohol (methanol)	Satisfactory
Methyl bromide (gas)	Limited
Methyl ethyl ketone	Satisfactory
Methylene chloride (dichloromethane)	Limited
Molasses	Satisfactory
Monoethanolamine (2-aminoethanol)	Probably satisfactory
Nickel chloride	Satisfactory
Nitric acid (10%)	Satisfactory
Nitric acid (70%)	Satisfactory
Nitrobenzene	Satisfactory
Nitromethane	Probably satisfactory
Nitropropane	Probably satisfactory
n-propanol	Satisfactory
Oleic acid	Satisfactory
Olive oil	Satisfactory
Oxalic acid (solutions)	Satisfactory
Ozone (gas)	Limited
Paraffin oil (kerosene)	Satisfactory
Perchlorethylene	Unsatisfactory
Peroxymonosulfuric acid	Probably satisfactory
Petrol (gasoline)	Satisfactory
Phenol	Satisfactory
Phosphoric acid (85%)	Satisfactory

Picric acid (solutions)	Satisfactory
Plating solutions (non-chrome)	Satisfactory
Potassium cyanide	Satisfactory
Potassium fluoride	Satisfactory
Potassium hydroxide (50%)	Satisfactory
Potassium permanganate (25%)	Satisfactory
Potassium sulfate	Satisfactory
Propionic acid	Satisfactory
Propylene oxide	Satisfactory
Pyridine	Limited
Rapeseed oil	Probably satisfactory
Silicone fluids	Satisfactory
Silver nitrate	Satisfactory
Sodium borate	Satisfactory
Sodium carbonate (10%)	Satisfactory
Sodium chloride (25%)	Satisfactory
Sodium chlorite	Satisfactory
Sodium cyanide	Satisfactory
Sodium hydroxide (10%)	Satisfactory
Sodium hydroxide (60%)	Satisfactory
Sodium hypochlorite (20%)	Satisfactory
Sodium nitrate	Satisfactory
Sour oil	Probably satisfactory
Stannic chloride	Satisfactory
Styrene	Doubtful
Sulfamic acid (solutions)	Satisfactory
Sulfur dioxide (gas)	Satisfactory
Sulfuric acid (10%)	Satisfactory
Sulfuric acid (70%)	Satisfactory
Sulfuric acid (96%)	Limited
Sulfuric acid (fuming)	Unsatisfactory
Tetrachlorethane	Satisfactory
Tetrahydrofuran	Limited
Tetralin	Limited
Thionyl chloride	Unsatisfactory
Titanium tetrachloride	Probably satisfactory
Toluene	Satisfactory
Transformer oil	Satisfactory
Trichloroacetic acid	Satisfactory
Trichlorethane	Probably satisfactory
Trichlorethylene	Limited
Tricresyl phosphate	Satisfactory
Triethanolamine	Satisfactory

Triethylamine	Limited
Turpentine	Unsatisfactory
Vegetable oils (general)	Probably satisfactory
Vinyl acetate	Satisfactory
Vinyl chloride	Limited
Water (distilled)	Satisfactory
Water (sea)	Satisfactory
White spirit	Satisfactory
Wine	Satisfactory
Xylene	Limited
Zinc chloride (aq. sol.)	Satisfactory

Primary production energy, CO2 and water

Embodied energy, primary production	66.6	-	73.4	MJ/kg
Sources 49.1 MJ/kg (Argonne National Laboratory); 64.7 MJ/kg (Potting and Blok, 1996); 77.9 MJ/kg (PlasticsEurope, 2014); 75.5 MJ/kg (Sullivan and Gaines, 2010); 83 MJ/kg (Thiriez and Gutowski, 2006)				
CO2 footprint, primary production	1.71	-	1.89	kg/kg
Sources 1.97 kg/kg (Kemna et al. 2005); 1.63 kg/kg (PlasticsEurope, 2014)				
Water usage	* 37.3	-	41.2	l/kg

Processing energy, CO2 footprint & water

Polymer extrusion energy	* 5.88	-	6.5	MJ/kg
Polymer extrusion CO2	* 0.441	-	0.488	kg/kg
Polymer extrusion water	* 4.85	-	7.28	l/kg
Polymer molding energy	* 20.4	-	22.6	MJ/kg
Polymer molding CO2	* 1.53	-	1.69	kg/kg
Polymer molding water	* 13.3	-	20	l/kg
Coarse machining energy (per unit wt removed)	* 0.905	-	1	MJ/kg
Coarse machining CO2 (per unit wt removed)	* 0.0679	-	0.075	kg/kg
Fine machining energy (per unit wt removed)	* 4.78	-	5.28	MJ/kg
Fine machining CO2 (per unit wt removed)	* 0.358	-	0.396	kg/kg
Grinding energy (per unit wt removed)	* 9.08	-	10	MJ/kg
Grinding CO2 (per unit wt removed)	* 0.681	-	0.753	kg/kg

Recycling and end of life

Recycle	✓			
Embodied energy, recycling	* 24.6	-	27.2	MJ/kg
CO2 footprint, recycling	* 1.06	-	1.17	kg/kg
Recycle fraction in current supply	5.26	-	5.81	%
Downcycle	✓			
Combust for energy recovery	✓			
Heat of combustion (net)	* 44	-	46.2	MJ/kg
Combustion CO2	* 3.06	-	3.22	kg/kg

Landfill	✓
Biodegrade	✗

Recycle mark



Geo-economic data for principal component

Principal component	Polypropylene		
Annual world production, principal component	6.19e7		tonne/yr
Reserves, principal component	5.7e8	- 6.3e8	tonne

Links

- [CAMPUS and M-Base records](#)
- [ProcessUniverse](#)
- [Producers](#)
- [Prospector Plastics](#)
- [Reference](#)
- [Shape](#)