

POLYPROPYLENE (PPR AND PPH)

Asahi/America is the pioneer of piping systems made of polypropylene in the United States. For over 15 years, polypropylene systems have been successfully applied for a wide variety of applications. Polypropylene is used in double containment systems, chemical piping, and pure water systems. It is chemically resistant to many strong and weak acids. In addition, it is one of the few materials that is recommended for strong oxidizing acids, aromatics, and chlorinated hydrocarbons. An all inclusive chemical resistant table is available in Section E. Polypropylene has an extended operating range up to a maximum temperature of 200° F. See Appendix A for pressure rating charts on all materials.

Polypropylene is a fairly ductile material at ambient temperatures and it demonstrates good impact strength. Polypropylene is available in two grades: copolymer and homopolymer. Homopolymer polypropylene is a Type I resin according to ASTM D 4101 and is produced from 100% propylene monomer. Copolymer polypropylene is a blend of (6%) ethylene and

(94%) propylene. Copolymer resins generally exhibit better mechanical strength and offer higher safety factors into a system design. In addition, copolymer PP shows a greater purity level when tested in a static leach test, making it the ideal material for pure water systems. Table B-1 shows the differences between the two types of polypropylenes. Asahi/America uses both types of material based on the application.

Copolymer is referred to as PPR, with the R designating the term random copolymer. PPH is the standard designation for homopolymer polypropylene.

Toxicity

Polypropylene (PPR and PPH materials) comply with the relevant food stuff regulations as defined by ONÖRM B 5014, Part 1, FDA, BGA, KTW guidelines. Other modified polypropylenes are not compliant due to additives. Such materials include PPH-s, PPR-el, and PPR-s-el, which have been modified for improved fire ratings and electro-conductivity. These are discussed in the next section.

Table B-1. Polypropylene Physical Properties

Characteristic	Standard	Units	PPR	PPH
Density	ISO/R 1183	g/cm ³	0.91	0.91
Melt Flow Index	MFI 190/5 Code T ISO 1133 DIN 53 735	g/10 min	0.50	0.50
Tensile Strength at Yield	ISO/R 527 DIN 53 455	psi N/mm ²	3625 25	4350 30
Tensile Strength at Break	ISO/R 527 DIN 53 455	psi N/mm ²	5800 40	6525 45
Percent Elongation at Break	ISO/R 527 DIN 53 455	%	>50	>50
Modulus Elasticity (tensile test)	ISO 178 DIN 53 457	psi N/mm ²	108750 750	166750 1150
Charpy Impact Strength 23° C, notched	ISO 179/2C DIN 53 453	kJ/m ²	20	50
Charpy Impact Strength -30° C, notched	ISO 179/2D DIN 53 453	kJ/m ²	50	35
Coefficient of Thermal Expansion	DIN 53 752	1/° C 1/° F	1.5 x 10 ⁻⁴ 8.33 x 10 ⁻⁵	1.5 x 10 ⁻⁴ 8.33 x 10 ⁻⁵
Crystallinity Melt Temperature	DIN 53 736	° C ° F	150 - 154 302 - 309	160 - 165 320 - 329
Deflection Temperature Under Load				
Method A	DIN 53 461	° C/° F	45/113	50/122
Method B	ISO 75	° C/° F	68/154	90/194
UL 94 Fire Rating	UL 94	—	94-HB	94-HB
Thermal Conductivity (23° C)	DIN 52 612	W/mK	0.24	0.22
Surface Resistivity	DIN 53 482	Ohm	>10 ¹³	>10 ¹³
Specific Volume Resistivity	DIN 53 482 part 1	Ohm cm	>10 ¹⁶	>10 ¹⁶
Dielectric Strength	DIN 53 481	kV/mm	75	75
Color	RAL	—	gray	gray

SPECIAL GRADE POLYPROPYLENE

- Self-extinguishing polypropylene: PPH-s
- Electro-conductive polypropylene: PPR-el
- Self-extinguishing electro-conductive polypropylene: PPR-s-el

Polypropylene is also available in highly specialized grades developed for specific applications. PPH-s is a self-extinguishing homopolymer polypropylene with enhanced fire ratings as compared to standard polypropylenes. PPR-el is a copolymer polypropylene with the added property of being electro-conductive. Many applications call for a piping system to be grounded due to the transport of flammable materials. During operation, a static charge can build on the surface of a standard plastic pipe. If the material is not conductive, it cannot

be properly grounded and, therefore, runs the risk of potential static discharge to the media. Electro-conductive polypropylene can be grounded to avoid this hazard. Finally, PPR-s-el is the combination of the electro-conductive property and the enhanced fire ratings. PPR-s-el is a copolymer polypropylene.

PPH-s, PPR-el, and PPR-s-el have slightly different properties than standard polypropylene. These changes in the material also change the chemical resistance of the material. While the resistance to chemical attack is similar to that of common polypropylenes, verification of each application with the Engineering Department at Asahi/America is recommended.

These materials are produced by Agru and are available from Asahi/America. Consult Asahi/America for availability.

Table B-2. Special Grade Polypropylene Physical Properties

Characteristic	Standard	Units	PPH-S	PPR-EL	PPR-S-EL
Density	ISO/R 1183	g/cm ³	0.934	0.94	1.12
Melt Flow Index	MFI 190/5 Code T ISO 1133 DIN 53 735	g/10 min	0.5-0.8	1.0	1.0
Tensile Strength at Yield	ISO/R 527 DIN 53 455	psi N/mm ²	4060-5365 28-37	4350 30	4205 29
Tensile Strength at Break	ISO/R 527 DIN 53 455	psi N/mm ²	— —	4060 28	2900 20
Percent Elongation at Break	ISO/R 527 DIN 53 455	%	>50	15	>50
Modulus Elasticity (tensile test)	ISO 178 DIN 53 457	psi N/mm ²	152,250 1050	87,000 600	145,000 1000
Charpy Impact Strength 23° C, notched	ISO 179/2C DIN 53 453	kJ/m ²	10	3.5	4
Charpy Impact Strength -30° C, notched	ISO 179/2D DIN 53 453	kJ/m ²	40	2.5	—
Coefficient of Thermal Expansion	DIN 53 752	1/° C 1/° F	1.5 x 10 ⁻⁴ 8.33 x 10 ⁻⁵	— —	1.5 x 10 ⁻⁴ 8.33 x 10 ⁻⁵
Crystallinity Melt Temperature	DIN 53 736	° C ° F	164 - 168 327 - 334	— —	148 298
Deflection Temperature Under Load Method A	DIN 53 461	° C/° F	55/131	50/122	—
Method B	ISO 75	° C/° F	83-110/181-230	75/167	—
UL 94 Fire Rating	UL 94	—	V-2	94-HB	V-0
Thermal Conductivity (23 °C)	DIN 52 612	W/mK	0.22	—	—
Surface Resistivity	DIN 53 482	Ohm	>10 ¹³	3 x 10 ⁴	3 x 10 ²
Specific Volume Resistivity	DIN 53 482 part 1	Ohm cm	>10 ¹⁵	—	3 x 10 ²
Dielectric Strength	DIN 53 481	kV/mm	30-45	—	—
Color	RAL	—	dark gray	black	black