

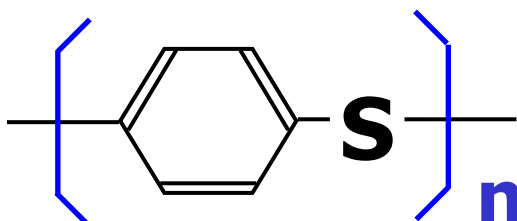
**TORELINA® PPS**

**Standard, High Strength**  
**Glass Fiber Reinforced Grade**

**TORELINA® PPS - A504 X90**

## Introduction

- TORAY is a diversified chemical company and deals with ABS , PA, PBT, PPS, and LCP.
- TORAY is vertically integrated, from polymerization to compounding.
- TORAY **TORELINA® PPS** resin is an engineering plastic having thermoplastic properties and has the chemical structure as shown below.



- **TORELINA®** is available in both **CROSS-LINK TYPES** and **LINEAR TYPES**.
- TORAY provides various grades of products from base polymers to compounds.
- Production capacity of PPS is 5,700 tons per year. **TORELINA®** is developed for **INJECTION MOLDINGS, EXTRUSION, FIBER, and FILM APPLICATIONS**.
- TORAY has developed PPS **TORELINA®** which are shown in this brochure by utilizing our polymerization and compound technology.

### ■ Features of **TORELINA®**

<b>Thermal resistance :</b>	Excellent long-term heat resistance properties (UL temperature index : 200–240°C, UL File No.E41797)
<b>Dimensional stability :</b>	Low mold shrinkage, Low linear thermal expansion, and low water absorption properties. Therefore, TORELINA shows an excellent dimensional stability even when it is used under high-temperature, high-humidity conditions.
<b>Chemical resistance :</b>	Excellent chemical resistance that is equivalent to that of fluorine resin.
<b>Mechanical properties :</b>	High strength, high rigidity, and low degradation characteristic even in high temperature conditions. It also shows excellent fatigue endurance and creep resistance
<b>Burning resistance :</b>	Passed the UL94V-0 standard without adding flame retardant. (UL File No. E41797)
<b>Electric characteristics :</b>	Excellent electric characteristics in high-temperature, high-humidity, and high-frequency conditions.
<b>Moldability :</b>	Good flow property, and it is possible to use the injection molding method by the same process as for engineering plastics commonly used.

## Typical properties of **TORELINA®**

Property	Unit	Test Method (ISO)	Glass Fiber Reinforced			
			A504 X90 (Standard) >PPS-GF40<			
Color	—	—	Brown · Black			
Density	kg/m <sup>3</sup>	1183	1660			
Water Absorption(23°C water for 24hrs)	%	62	0.02			
Mechanical	Tensile Strength	23°C	MPa	527-1,-2	200	
	Elongation	23°C			%	1.8
	Flexural Strength	23°C	MPa	178	305	
	Flexural Modulus	23°C			GPa	15.5
	Shear Strength	23°C	MPa	JIS K7214	80	
	Charpy Impact Strength	V-notched	23°C	kJ/m <sup>2</sup>	179-1	11
		Unnotched	23°C			kJ/m <sup>2</sup>
	Rockwell Hardness		R scale	2039-2	122	
	Taper Abrasion		mg/1000 times	9352	50	
	Coefficient of Friction	vs. Steel	—	JIS K7218	0.25	
Thermal	Melting Point		°C	11357-3	278	
	Heat Deformation Temperature	1.80MPa	°C	75	>260	
	Linear Thermal Expansion (-40~150°C)	Machine direction	×10 <sup>-5</sup> /K	11359-2	2.3	
		Transverse direction			3.1	
Flammability		—	UL94	V-0 (0.28mm)		
Electrical	Volume Resistivity		Ω · m	IEC60093	10 <sup>14</sup>	
	Dielectric Strength		MV/m	IEC60243-1	24	
	Dielectric Constant	10 <sup>6</sup> Hz	—	IEC60250	4.2	
	Dissipation Factor	10 <sup>6</sup> Hz	—		0.002	
Moldability	Mold Shrinkage	Machine direction	%	Toray	0.20	
		Transverse direction			0.80	
	Bar Flow		×10 <sup>-3</sup> m	320°C, 98MPa, 1mm	135	

These values are typical data for this product under specific test conditions and not intended for use as limiting specifications.

## Injection molding for **TORELINA® PPS**

### (1) Pre-drying of Pellet:

Although **TORELINA®** absorbs little water, it is recommended to pre-dry it for more than 3 hours at 130°C for a better appearance.

### (2) Injection Molding Machine:

A screw type injection machine is commonly used. Although either an open nozzle or shut-off nozzle can be used, it is advised to use a shut-off nozzle because open nozzle can cause drooling problem. Also, anti-corrosion/anti-abrasion type (commonly used on FRTP) cylinders and screws are recommended.

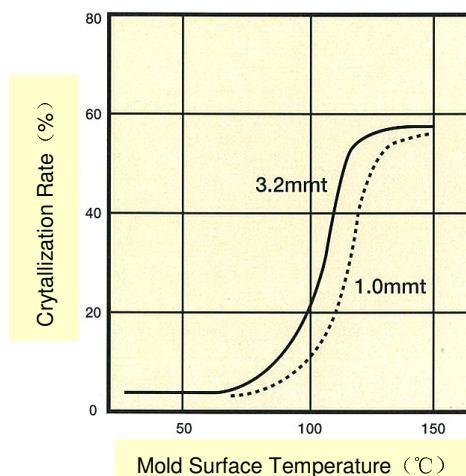
### (3) Standard Injection Molding Conditions as follow:

Property		Condition
Pre-drying		130 ~ 150 °C X 3 hours
Cylinder Temperature	Zone 1 (Hopper Side)	290 ~ 300 °C
	Zone 2	300 ~ 320 °C
	Zone 3	310 ~ 330 °C
	Zone 4 (Nozzle Side)	310 ~ 330 °C
Nozzle Temperature		310 ~ 330 °C
Mold Temperature		130 ~ 150 °C (see Note)
Injection Speed		Middle to High Speed (40 ~ 150 mm/sec)
Injection Pressure		80 ~ 150 MPa (60 ~ 95%)
Holding Pressure		30 ~ 70 MPa (20 ~ 45%)
Metering		Cushion 5 ~ 10 mm
Suck Back		3 ~ 5 mm
Screw Rotation Speed		50 ~ 120 rpm
Back Pressure		0.2 ~ 5 Mpa

Note:

When the mold temperature is varied, crystallinity of **TORELINA®** changes considerably at around 90°C, which is the glass transition temperature of PPS.

The temperatures range from 80 to 110°C is called transition area where the crystallinity changes greatly with a mold temperature change. The transition area should be avoided because it is difficult to control the quality of molded products and carry out smooth mold releasing.



Relationship between Mold Surface Temperature and Crystallization Rate  
Grade: A504, Cylinder Temperature: 320°C  
Measurement of crystallization : Wide angle X-ray scattering

## Injection molding for **TORELINA® PPS**

### (4) Material of Mold:

Steel which has anti-abrasion / anti-corrosion properties are recommendable. Especially mold sections such as the gate, flow end, and corners where direction of flow suddenly changes tend to be damaged more than other sections. Therefore, it is advised to design these sections using inserts so that it can be replace easily.

To carry out mold for **TORELINA®**, it is recommended to use SKD11 or SKD61 and apply the quenching process.

**Mold Material and its Properties**

Material	Strength	Friction Resistance	Corrosion Resistance	Workability	Surface Finishing
SKD11	◎~○	◎	○	○~△	○
SKD61	○	◎~○	○	◎	◎~○
SUS420	○	◎~○	◎~○	◎~○	◎
SUS630	○~△	○~△	◎	△~×	○
SCM440	△~×	○~△	△	○	○
S55C	×	×	×	◎	×

◎ Excellent

○ Fair

△ Poor

× Inferior

◎ ←→ ×

Best Suited

Suited

- **Vent**

Provide a vent of about 5/1000 mm at the end of material flow is recommended.

Provide a vent at the runner section is also effective.

### (5) Purging:

For purging after the molding process, the use of polyethylene with middle to high density is appropriate.

For other enquiry and question, please refer to Toray **TORELINA®** Technical Data Guide or contact Toray Sales Representative.