# *TORELINA*® PPS

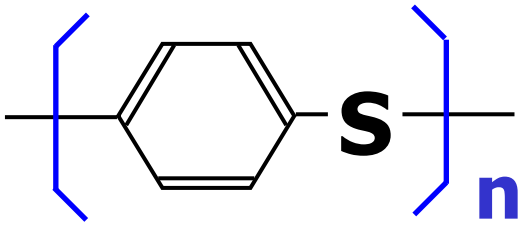
**High Rigidity**

**Glass Fiber + Inorganic Filler Reinforced Grade**

## *TORELINA*® PPS - A400M X05

# 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*®

| | |
|---|---|
| **Thermal resistance :** | Excellent long-term heat resistance properties (UL temperature index : 200-240℃, UL File No.E41797) |
| **Dimensional stability :** | 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. |
| **Chemical resistance :** | Excellent chemical resistance that is equivalent to that of fluorine resin. |
| **Mechanical properties :** | High strength, high rigidity, and low degradation characteristic even in high temperature conditions. It also shows excellent fatigue endurance and creep resistance |
| **Burning resistance :** | Passed the UL94V-0 standard without adding flame retardant. (UL File No. E41797) |
| **Electric characteristics :** | Excellent electric characteristics in high-temperature, high-humidity, and high-frequency conditions. |
| **Moldability :** | 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 + Inorganic Filler Reinforced<br>A400M X05<br>(High Rigidity)<br>>PPS-(GF+MD)55< |
|---|---|---|---|---|---|---|
| Color | | | | — | — | Brown・Black |
| Density | | | | kg/m$^3$ | 1183 | 1820 |
| Water Absorption(23℃ water for 24hrs) | | | | % | 62 | 0.02 |
| Mechanical | Tensile Strength | | 23℃ | MPa | 527-1,-2 | 165 |
| | Elongation | | 23℃ | % | | 1.1 |
| | Flexural Strength | | 23℃ | MPa | 178 | 250 |
| | Flexural Modulus | | 23℃ | GPa | | 18.5 |
| | Shear Strength | | 23℃ | MPa | JIS K7214 | - |
| | Charpy Impact Strength | V-notched | 23℃ | kJ/㎡ | 179-1 | 9 |
| | | Unnotched | 23℃ | kJ/㎡ | | 25 |
| | Rockwell Hardness | | | R scale | 2039-2 | 122 |
| | Taper Abrasion | | | mg/1000 times | 9352 | - |
| | Coefficient of Friction | | vs. Steel | — | JIS K7218 | - |
| Thermal | Melting Point | | | ℃ | 11357-3 | 278 |
| | Heat Deformation Temperature | | 1.80MPa | ℃ | 75 | >260 |
| | Liner Thermal Expansion (-40～150℃) | | Machine direction | ×10$^{-5}$/K | 11359-2 | 1.8 |
| | | | Transverse direction | | | 3.0 |
| | Flammability | | | — | UL94 | V-0<br>(0.36mmt) |
| Electrical | Volume Resistivity | | | Ω・m | IEC60093 | 10$^{14}$ |
| | Dielectric Strength | | | MV/m | IEC60243-1 | 20 |
| | Dielectric Constant | | 10$^6$Hz | — | IEC60250 | 4.9 |
| | Dissipation Factor | | 10$^6$Hz | — | | 0.002 |
| Moldability | Mold Shrinkage | | Machine direction | % | Toray | 0.20 |
| | | | Transverse direction | | | 0.75 |
| | Bar Flow | | | ×10$^{-3}$m | 320℃, 98MPa, 1mmt | 110 |

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℃ 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.

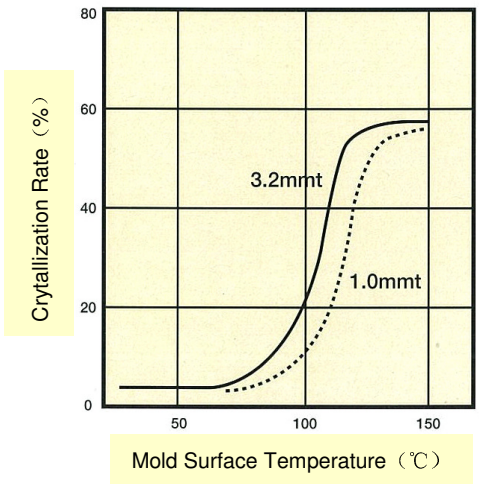
**(3) Standard Injection Molding Conditions as follow:**

| Property | | Condition |
|---|---|---|
| Pre-drying | | 130 ~ 150 ℃ X 3 hours |
| Cylinder Temperature | Zone 1 (Hopper Side) | 290 ~ 300 ℃ |
| | Zone 2 | 300 ~ 320 ℃ |
| | Zone 3 | 310 ~ 330 ℃ |
| | Zone 4 (Nozzle Side) | 310 ~ 330 ℃ |
| Nozzle Temperature | | 310 ~ 330 ℃ |
| Mold Temperature | | 130 ~ 150 ℃ (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℃, which is the glass transition temperature of PPS.

The temperatures range from 80 to 110℃ 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℃
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.