Precautions

1. General Precautions
   ● The data contained in this brochure are representative examples of actual measurement values recorded on the basis of our testing methods. The information contained herein are based on the information, data, etc. that are available at the moment. However, we do not provide any warranty as to the accuracy or suitability thereof for any particular applications.
   ● For detailed technical information, please contact us.
   ● For detailed safety information, please refer to the Materials Safety Data Sheet for TPX®.
   ● Please take care of industrial property rights with respect to the applications described in this brochure. Before using TPX®, please evaluate the practical applicability of TPX® and check to be certain that there will be no problem in using it.
   ● Please avoid fire, direct sunshine, water wetting and any abrupt change in temperature in the place of storage of TPX®.
   ● Please avoid the outdoor use of TPX® for a long period of time. Use of TPX® for a long period may cause a change in color or a deterioration in quality.
   ● These precautions are given on the assumption that TPX® will be used in a normal way. If TPX® is used in any special way, please take additional safety measures appropriate for such particular application or use.

2. Use of TPX® for Medical-related applications and Food contact applications
   ● Please consult us when you intend to use TPX® to such applications.

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**TPX is...**

TPX® is a high-performance resin that provides high-added-value products.

**Heat resistance**

Having a high melting point (depending on the selected grade within a range of 220°C to 240°C) TPX® can be used at high temperatures. At the same time it serves with a rather high Vicat softening point. However, in case of applications where load is applied to TPX®, special attention has to be paid to its heat distortion temperature, which is almost the same as that of polypropylene.

**Peel ability/Non-compatibility**

Since TPX® has a very low surface tension of only 24mN/m, what is even lower than that of some fluorocarbons, TPX® shows an excellent peel ability from a big variety of materials. Because of this characteristic, TPX® is used where an excellent separating property is required; for example as a release material at the time of curing thermostetting resins (such as urethane and epoxy). Furthermore, since TPX® does not mix with other thermoplastic resins (such as PET and PP), it is used for the purpose of making PET- and PP-films micro-porous.

**Low refractive index**

The refractive index of TPX® is only 1.463 \(n\), what is lower than that of fluorocarbon or other transparent resins. So in case low-refraction material is required, TPX® is one of the best choices.

**Oxygen permeability (cm³ × mm/m² × d × MPa) [25°C]**

<table>
<thead>
<tr>
<th>Resin</th>
<th>TPX</th>
<th>PVC</th>
<th>A-PET</th>
<th>PS</th>
<th>PE</th>
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<tbody>
<tr>
<td>0</td>
<td>12000</td>
<td>50</td>
<td>50</td>
<td>1200</td>
<td>1200</td>
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</table>

**Chemical resistance**

Like polyolefines TPX® shows an excellent chemical resistance which is better than that of e.g. polycarbonate or acrylics. That‘ s why TPX® for example is so often used in the cosmetic field for caps and tubes.

**Low density**

TPX® provides the lowest density (830kg/m³) among all thermoplastic resins; i.e. it offers the largest specific volume, what makes it possible to reduce moulded-part weight by substituting other resin with TPX®.

**Gas permeability**

TPX® has a very high gas permeability (10 times higher than that of PEI), what makes it an excellent material for gas-separating applications like permeable films, membranes and hollow-fibres.

**Low-dielectric properties**

Because of its outstanding dielectrical properties - \(\epsilon = 2.1\) and \(\tan \delta = 0.0028\) (at 12 GHz) - TPX® fits very well in the field of high-frequency applications.

**Transparency**

Although TPX® is a crystalline resin, it is transparent like glass and has an excellent transmission rate for visible light (\(>93\%\), haze <\(3\%\)). On top of this it shows a better transmission in the UV-range compared with glass or other transparent resins. That is why TPX®is for example used for spectroscopic analysis cells.

**Steam resistance**

The water absorption of TPX® is very low and therefore dimensional change caused by hydrolysis cannot be observed. Even in boiling water TPX® does not hydrolyze. Therefore TPX® is the predestined material for such applications which require steam sterilization.

**Food sanitation properties**

TPX® is available in a wide range of grades to meet requirements and regulations of various*, US FDA-standards and EU-food-standards. *Japanese standards tests.
TPX® provides specific support to state-of-the-art technology in various areas.

**As a supplementary material for the curing process**
- Peel ability
- Heat resistance
- Chemical resistance

RT18, MX004, MX002
DX231, DX310, DX820

**As a resin modifier for creating micro-pores**
- Non-compatibility
- Heat resistance

DX820

**As high-added-value products**
- Transparency
- Peel ability
- Gas permeability
- Heat resistance
- Low density
- Steam resistance
- Chemical resistance
- Low-dielectric properties
- Food sanitation properties

RT18, MX004, MX002, DX820

**Distribution is controllable by stretching conditions.**

TPX® Micro-pores

Thermoplastic resin

**Mandrels and sheaths for rubber hose production**
MX002, MX004

**Release film**
(sold under the name of TPX film “OPULENT®”)

Release paper for synthetic leather
DX820, DX231, DX310

**Animal Cage**
MX004(XB) RT18(XB)

**Chemical tubes**
MX004 MX002

**Cosmetics caps and tubes**
MX004 RT18

**Heat resistant non-woven**
DX820
TPX® meets a broad range of needs with a full grade mix.

### Physical Properties

<table>
<thead>
<tr>
<th>Item</th>
<th>Grade</th>
<th>RT18</th>
<th>RT31</th>
<th>DX845</th>
<th>DX231</th>
<th>DX350</th>
<th>DX820</th>
<th>MXO04</th>
<th>MXO02</th>
<th>MXO020</th>
<th>DX310</th>
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### Mechanical Properties

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</table>

### Precautions in Processing TPX®

- TPX® is made available in form of pellets.
- Since TPX® does not absorb water/moisture, it is not necessary to dry TPX® before processing provided that it has been stored under normal conditions.
- Because of its high melting point TPX® is normally processed at high temperature being in a range of ± 300°C. A moulding equipment which can be set to such temperatures is therefore a basic requirement.
- To control / minimize the decomposition of TPX® it is recommended to apply nitrogen-feeding at the hopper during moulding process.
- Unlike PE, PPMA and other aromatic resins TPX® is crystalline and is therefore showing a bigger mould shrinkage. To this fact special attention has to be paid in case an existing mould, which has been designed for any other resin, will be used for the processing of TPX®.
- Before starting to process TPX® please be sure that no other resin is remaining in your machine. Particularly in case of injection moulding even a small amount of foreign resin will result in an impair appearance of the product due to contamination. It is generally recommended to purge the equipment first with PP of low MFR and afterwards with TPX®.

### Injection Moulding

When TPX® is in a melted state its viscosity declines drastically. Because of this a pin gate is the most suitable gate for injection moulding. This will help to minimize deformation and stress in the gate area. Particularly for shallow products an off-center gate is highly recommended to avoid warpage. Injection moulding of TPX® is normally done within a range of 290°C and 310°C where 280°C and 320°C have to be regarded as lower and upper limits. For a good controlling it is generally recommended to measure the actual resin temperature. Because of the very low viscosity of TPX® at melted state it is strongly recommended to inject at very low speed and very low pressure to minimize stress. The mould temperature is normally set within a range of 20°C and 60°C.

### Extrusion

Because TPX® needs a lot of energy to melt an extruder with a L/D ratio of at least 28, preferable 30 or 32, and with minimum 4 heating zones is strongly recommended. Also a special screw-design will allow you to easy process TPX®. If desired, MCI will help you to find the optimum screw-design for your machine. Sometimes a preheating of TPX®-pellets can be helpful.

### Blow Moulding

Because the viscosity of TPX® declines sharply after it is melted, the blow moulding of TPX® is rather difficult and limited to the direct blow moulding process. For the same reason the injection blow moulding process does not work. It should be noted that the transversal blow moulding of TPX® products is inferior to those made by injection moulding.

### Post-processing and Colouring

Because of its very low surface tension TPX® has to be pre-treated with e.g. corona, plasma, flame etc. for printing, painting or bonding it. Moreover, since TPX® is low in mechanical strength, it is unsuitable for cutting or grinding. TPX® can be coloured by dry blending and the most suitable way is to use a colour masterbatch based on TPX®. However, please be sure to select pigments with high heat resistance, exceeding the moulding temperature of TPX®.

### As for the EU Directive, it is necessary to check the conformity of the application on the basis of the final product.

TPX® contains chemical substances whose Specific Migration Limit (SML) is 0.05 mg/kg and 5 mg/kg. For details about EU Directive as well as details about the conformity of TPX® with the FDA regulations, please contact our responsible department.