

# TPX<sup>®</sup>

## 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<sup>®</sup>.
- Please take care of industrial property rights with respect to the applications described in this brochure. Before using TPX<sup>®</sup>, please evaluate the practical applicability of TPX<sup>®</sup> 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<sup>®</sup>.
- Please avoid the outdoor use of TPX<sup>®</sup> for a long period of time. Use of TPX<sup>®</sup> for a long period may cause a change in color or a deterioration in quality.
- These precautions are given on the assumption that TPX<sup>®</sup> will be used in a normal way. If TPX<sup>®</sup> is used in any special way, please take additional safety measures appropriate for such particular application or use.

### 2. Use of TPX<sup>®</sup> for Medical-related applications and Food contact applications

- Please consult us when you intend to use TPX<sup>®</sup> to such applications.

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Polymethylpentene (PMP)

# TPX<sup>®</sup>

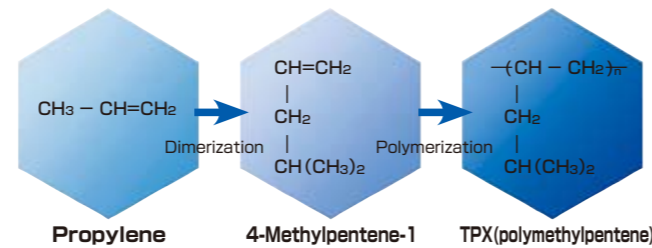
High-performance resin...

TPX



[www.mitsui-chem.co.jp/info/tpx/etpx/eindex.html](http://www.mitsui-chem.co.jp/info/tpx/etpx/eindex.html)

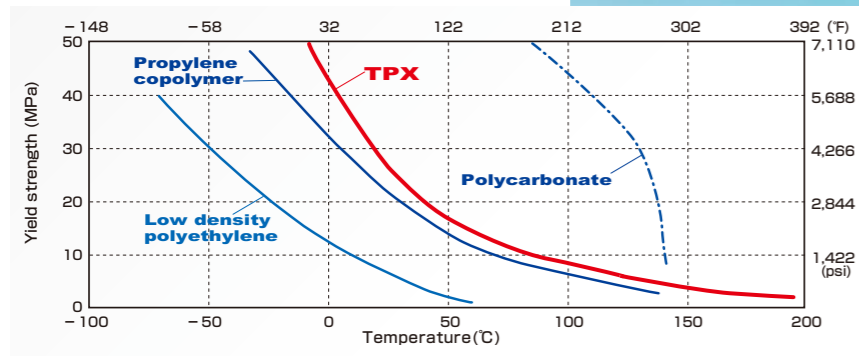
# TPX is...



*TPX<sup>®</sup> is a high-performance resin that provides high-added-value products.*

## Heat resistance

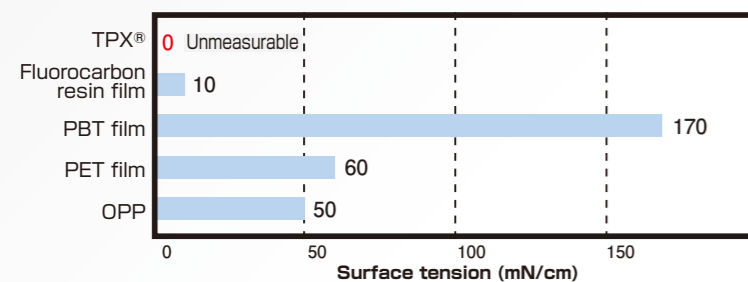
Having a high melting point (depending on the selected grade within a range of 220°C to 240°C) TPX<sup>®</sup> can be used at high temperatures. At the same time it serves with a rather high Vicat softening point. However, in case of applications where load is applied to TPX<sup>®</sup>, special attention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



## Peel ability / Non-compatibility

Since TPX<sup>®</sup> has a very low surface tension of only 24mN/m, what is even lower than that of some fluorocarbons, TPX<sup>®</sup> shows an excellent peel ability from a big variety of materials. Because of this characteristic, TPX<sup>®</sup> is used where an excellent separating property is required; for example as a release material at the time of curing thermosetting resins (such as urethane and epoxy). Furthermore, since TPX<sup>®</sup> 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.

Separating force from Epoxy



## Low refractive index

The refractive index of TPX<sup>®</sup> is only 1.463  $n_D^{20}$ , what is lower than that of fluorocarbon or other transparent resins. So in case low-refraction material is required, TPX<sup>®</sup> is one of the best choices.

## Gas permeability

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

Resin	TPX	PVC	A-PET	PS	PE
O <sub>2</sub> permeability	12000	50	50	1200	1200

## Chemical resistance

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

Resin	TPX	PMMA	PC	PS	PA
Concentrated sulfuric acid (98%)	A	C	C	A	D
Ammonia water	A	A	C	A	A
Sodium hydroxide (40%)	A	A	C	A	A
Sodium oxalate	A	A	A	A	
Acetone	A	C	C	C	B
Methyl ethyl ketone	A	C	C	C	C
Ethanol	A	C	A	A	A
Brake oil	A	D	C	B	

[25°C]  
A: Not attacked; B: Practically not attacked; C: Attacked (swelling); D: Attacked (cracked)

## Steam resistance

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

## Low-dielectric properties

Because of its outstanding dielectrical properties -  $\epsilon = 2.1$  and  $\tan \delta = 0.0008$  (at 12 GHz) - TPX<sup>®</sup> fits very well in the field of high-frequency applications.

## Food sanitation properties

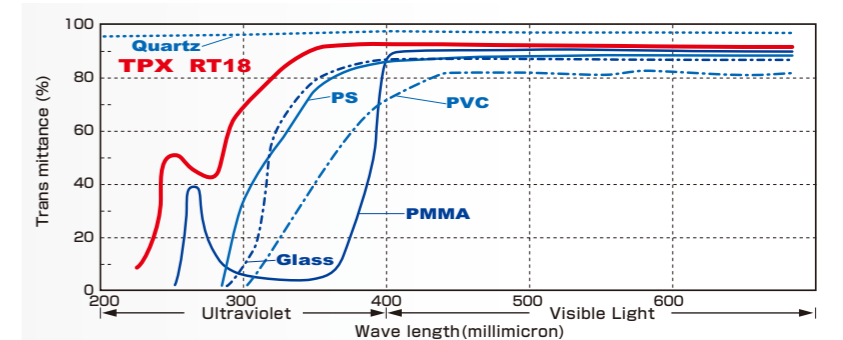
TPX<sup>®</sup> is available in a wide range of grades to meet requirements and regulations of various\*, US FDA-standards and EU-food-standards. \*Japanese standards tests.

## Low density

TPX<sup>®</sup> provides the lowest density (830kg/m<sup>3</sup>) 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<sup>®</sup>.

## Transparency

Although TPX<sup>®</sup> is a crystalline resin, it is transparent like glass and has an excellent transmission rate for visible light (> 93%; haze < 5%). On top of this it shows a better transmission in the UV-range compared with glass or other transparent resins. That is why TPX<sup>®</sup> is for example used for spectroscopic analysis cells.



# TPX<sup>®</sup> provides specific support to state-of-the-art technology in various areas.

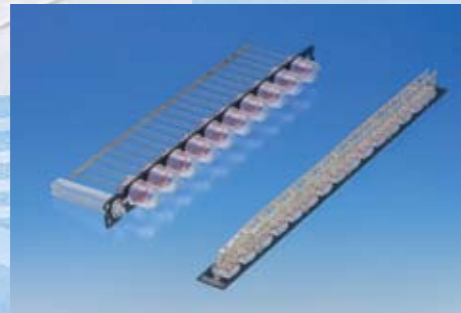
**As a supplementary material for the curing process**

- Peel ability
- Heat resistance
- Chemical resistance

RT18, MX004, MX002  
DX231, DX310, DX820



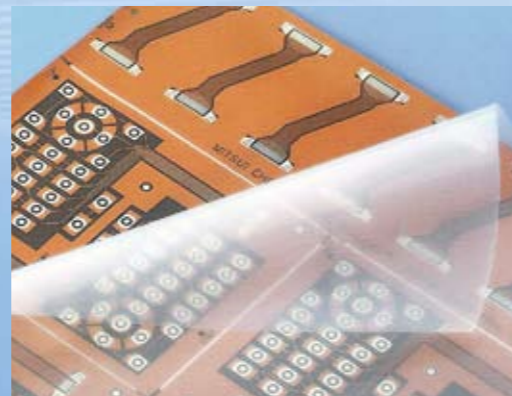
LED Mould RT18



Mandrels and sheaths for rubber hose production  
MX002, MX004



Release paper for synthetic leather  
DX820  
DX231  
DX310

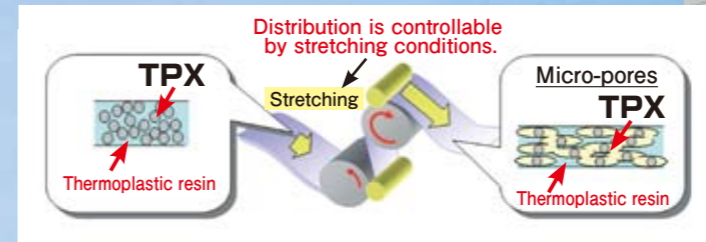


Release film  
(sold under the name of TPX film "OPULENT<sup>®</sup>")

**As a resin modifier for creating micro-pores**

- Non-compatibility
- Heat resistance

DX820

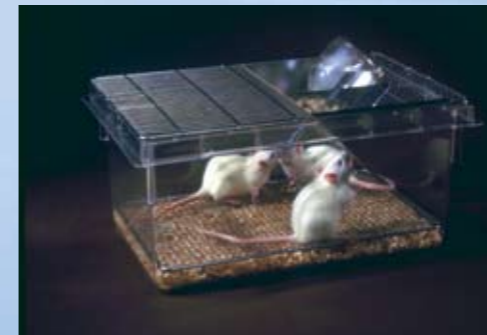


Synthetic paper DX820

**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



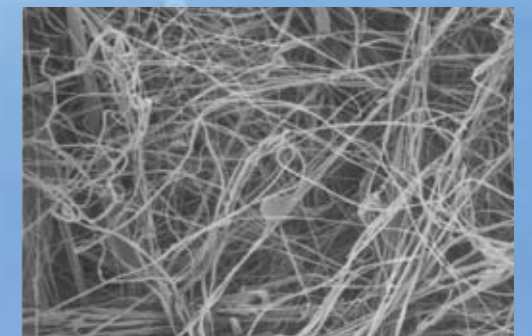
Animal Cage  
MX004(XB)  
RT18(XB)



Chemical tubes  
MX004  
MX002



Cosmetics caps and tubes  
MX004  
RT18



Heat resistant non-woven DX820

# TPX<sup>®</sup> meets a broad range of needs with a full grade mix.

## Precautions in Processing TPX<sup>®</sup>

Physical Properties				Grade	RT18 (RT18XB <sup>*2</sup> )	RT31 <sup>*1</sup> (RT31XB <sup>*2</sup> )	DX845	DX231	DX350	DX820	MX004 (MX004XB <sup>*2</sup> )	MX002	MX0020	DX310	
	Item	Test Condition	Unit	Test Method											
Basic Properties	Density		kg/m <sup>3</sup> lb/in <sup>3</sup>	ASTM-D1505	833 0.030	833 0.030	833 0.030	833 0.030	833 0.030	833 0.030	833 0.030	833 0.030	833 0.030	833 0.030	
	MFR	P=5kg, 260°C	g/10min	ASTM-D1238	26	21	9	100	110	180	25	21	21	100	
	Melting Point	peak temperature	°C °F	JIS-K7121 (DSC method)	233 451.4	233 451.4	233 451.4	232 449.6	233 451.4	236 456.8	228 442.4	224 435.2	224 435.2	223 433.4	
	Water Absorption		%	ASTM-D570	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Thermal Properties	Vicat Softening Point		°C °F	ASTM-D1525	174 345.2	174 345.2	174 345.2	180 356.0	169 336.2	185 365.0	165 329.0	153 307.4	153 307.4	147 296.2	
	Heat Distortion Temperature	0.43MPa	°C °F	ASTM-D648	127 260.6	127 260.6	127 260.6	126 258.8	124 255.2	132 269.6	100 212.0	93 199.4	93 199.4	80 176.0	
	Expansion Coefficient		cm/cm°C cm/cm°F	ASTM-E831	1.17×10 <sup>-4</sup> 2.11×10 <sup>-4</sup>	1.17×10 <sup>-4</sup> 2.11×10 <sup>-4</sup>	1.17×10 <sup>-4</sup> 2.11×10 <sup>-4</sup>	1.17×10 <sup>-4</sup> 2.11×10 <sup>-4</sup>	1.17×10 <sup>-4</sup> 2.11×10 <sup>-4</sup>	1.17×10 <sup>-4</sup> 2.11×10 <sup>-4</sup>	1.17×10 <sup>-4</sup> 2.11×10 <sup>-4</sup>	1.17×10 <sup>-4</sup> 2.11×10 <sup>-4</sup>	1.17×10 <sup>-4</sup> 2.11×10 <sup>-4</sup>	1.17×10 <sup>-4</sup> 2.11×10 <sup>-4</sup>	
Mechanical Properties	23°C 73°F	Yield Stress	MPa PSI	ASTM-D638	30 4350	30 4350	30 4350	29 4200	29 4200	32 4641	25 3625	21 3046	21 3046	20 2900	
		Tensile Strength	MPa PSI	ASTM-D638	25 3625	25 3625	25 3625	25 3625	25 3625	25 3625	20 2900	10 1450	10 1450	10 1450	
		Elongation at Break	%	ASTM-D638	12	12	12	14	14	10	30	60	60	40	
		Tensile Modulus	MPa PSI	ASTM-D638	1900 275500	1900 275500	1900 275500	1860 269700	1800 261000	2050 297300	1300 188500	890 129100	880 127600	820 118900	
	23°C 73°F	Flexural Modulus	MPa PSI	ASTM-D790	1600 232000	1600 232000	1600 232000	1550 224800	1500 217500	1770 214600	1050 256700	660 152300	660 95720	630 91370	
		Flexural Strength	MPa PSI	ASTM-D790	46 6670	44 6380	47 6820	43 6240	41 5950	49 7110	32 4640	27 3920	27 3920	21 3046	
	23°C 73°F	Izod Impact Properties	with notch	J/m ft-ibs/in	ASTM-D256	20 0.37	20 0.37	20 0.37	18 0.34	19 0.36	19 0.36	24 0.45	28 0.52	28 0.52	25 0.47
			without notch	kJ/m <sup>2</sup> ft-ibs/in <sup>2</sup>	ASTM-D256	9 4.3	9 4.3	10 4.8	8 3.8	9 4.3	8 3.8	40 19.0	129 61.4	129 61.4	127 60.4
		Rockwell Hardness	R scale	—	ASTM-D785	87	87	87	91	87	92	75	42	42	42
	Optical Properties	Haze		%	ASTM-D1003	0.7	0.8	1.1	2.1	2.1	2.1	0.7	2.1	1.2	2.1
Transmittance			%	ASTM-D1003	94	94	94	93	93	92	94	93	93	93	
Refractive Index			—	ASTM-D542	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	1.46	
Electrical Properties	Volume Resistivity		Ω · cm	ASTM-D257	>10 <sup>16</sup>	>10 <sup>16</sup>	>10 <sup>16</sup>	>10 <sup>16</sup>	>10 <sup>16</sup>	>10 <sup>16</sup>	>10 <sup>16</sup>	>10 <sup>16</sup>	>10 <sup>16</sup>	>10 <sup>16</sup>	
	Dielectric Breakdown Voltage		KV/mm V/mil	ASTM-D149	65 1600	65 1600	65 1600	65 1600	65 1600	65 1600	65 1600	65 1600	65 1600	65 1600	
	Dielectric Constant		—	ASTM-D150	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	
Moulding Properties	Spiral Flow	310 ~ 320°C Mould temp. 73°C	cm	MCI Method-1	51	51	50				53	56	56		
	Moulding Shrinkage	Longitudinal	%	MCI Method-2	1.5	1.5	1.5				1.5	1.5	1.5		
		Transverse	%	MCI Method-2	1.2	1.2	1.2				1.1	1.1	1.1		
Processing Method	Injection Moulding	◎ : Highly recommended ○ : Possible × : Impossible			◎	◎	○	×	×	×	◎	◎	◎	×	
	Paper Coating Extrusion		×	×	×	◎	◎	◎	×	×	×	×	◎		
	Film Extrusion		○	○	◎	×	×	×	◎	◎	◎	◎	×		
	Mandrel Extrusion		×	×	×	×	×	×	◎	◎	◎	○	×		
	Fiber Extrusion		○	○	○	○	○	○	◎	○	○	○	○		
	Blow Moulding		×	×	○	×	×	×	○	○	○	○	×		
Safety / Sanitation	JHOPA Regulation (Positive List)	◎ : Approved × : Not approved			◎	◎	◎	×	×	◎	◎	×	◎	×	
	FDA Regulation (21 CFR)		◎	◎	◎	×	×	◎	◎	◎	×	◎	×		
	EU Directive (2002/72/EC and its amendment)		◎	◎	◎	×	×	◎	×	◎	×	×	×	×	

- ◆ TPX<sup>®</sup> is made available in form of pellets.
- ◆ Since TPX<sup>®</sup> does not absorb water / moisture, it is not necessary to dry TPX<sup>®</sup> before processing provided that it has been stored under normal conditions.
- ◆ Because of its high melting point TPX<sup>®</sup> 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<sup>®</sup> it is recommended to apply nitrogen-feeding at the hopper during moulding process.
- ◆ Unlike PC, PMMA and other amorphous resins TPX<sup>®</sup> 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<sup>®</sup>.
- ◆ Before starting to process TPX<sup>®</sup> 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<sup>®</sup>.

### Injection moulding:

When TPX<sup>®</sup> 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<sup>®</sup> 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<sup>®</sup> at melted state it is also 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<sup>®</sup> 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<sup>®</sup>. If desired, MCI will help you to find the optimum screw-design for your machine. Sometimes a preheating of TPX<sup>®</sup>-pellets can be helpful.

### Blow moulding:

Because the viscosity of TPX<sup>®</sup> declines sharply after it is melted, the blow moulding of TPX<sup>®</sup> 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 transparency of blow moulded TPX<sup>®</sup>-products is inferior to those made by injection moulding.

### Post-processing and colouring:

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

MCI Method-1 Moulding Temp. : 310 ~ 330°C (depending on the grade)

MCI Method-2 Moulding Temp. : 260 ~ 280°C (depending on the grade)

Note: Figures shown here are representative values but not specified values.

\*1 RT31, RT31XB : Low odor grade

\*2 RT18XB, RT31XB, MX004XB : Blue tint grade

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

**TPX<sup>®</sup> 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<sup>®</sup> with the FDA regulations, please contact our responsible department.



# TPX<sup>®</sup>