MITSUI CHEMICALS,INC.

Introduction for FORTIMO™ TPU & CPU

June 12th, 2017

Coatings & Engineering Materials Div.,

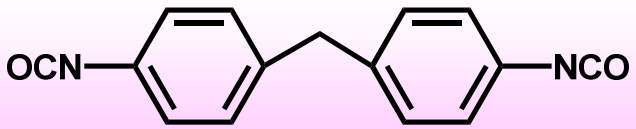
Mitsui Chemicals, INC.

1. Concept of FORTIMO™ 1,4-H_6XDI

FORTIMO™ 1,4-H_6XDI based elastomer shows
both of High Elasticity, Heat Resistance & Non-yellowing.

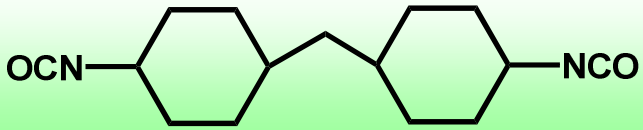
Elasticity, Heat Resistant

Aromatic isocyanate
(MDI)



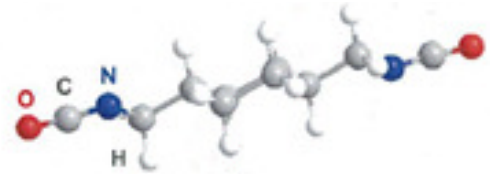
FORTIMO™
1,4-H_6XDI*

Aliphatic isocyanate
(H_{12}MDI)



Light Stability
(Non-Yellowing)

【Structure of 1,4-H_6XDI】



High symmetrical

* ***trans*** **1,4-bis (isocyanatomethyl) cyclohexane**

2. Advantages of FORTIMO™

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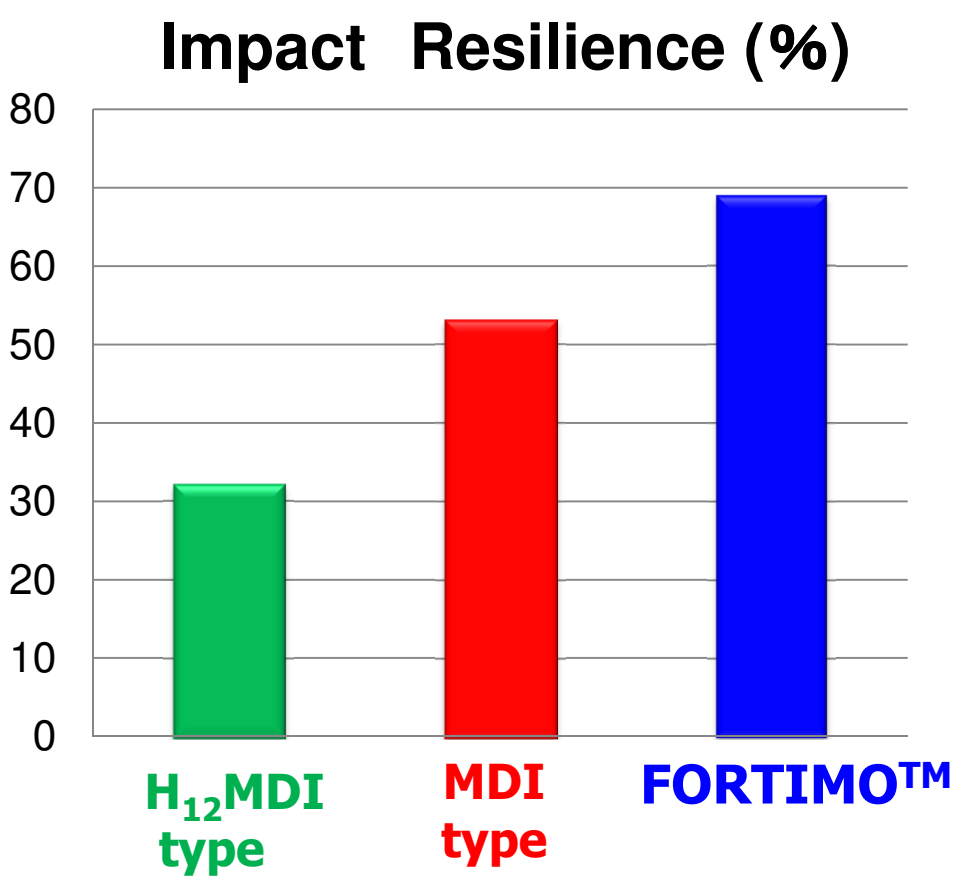
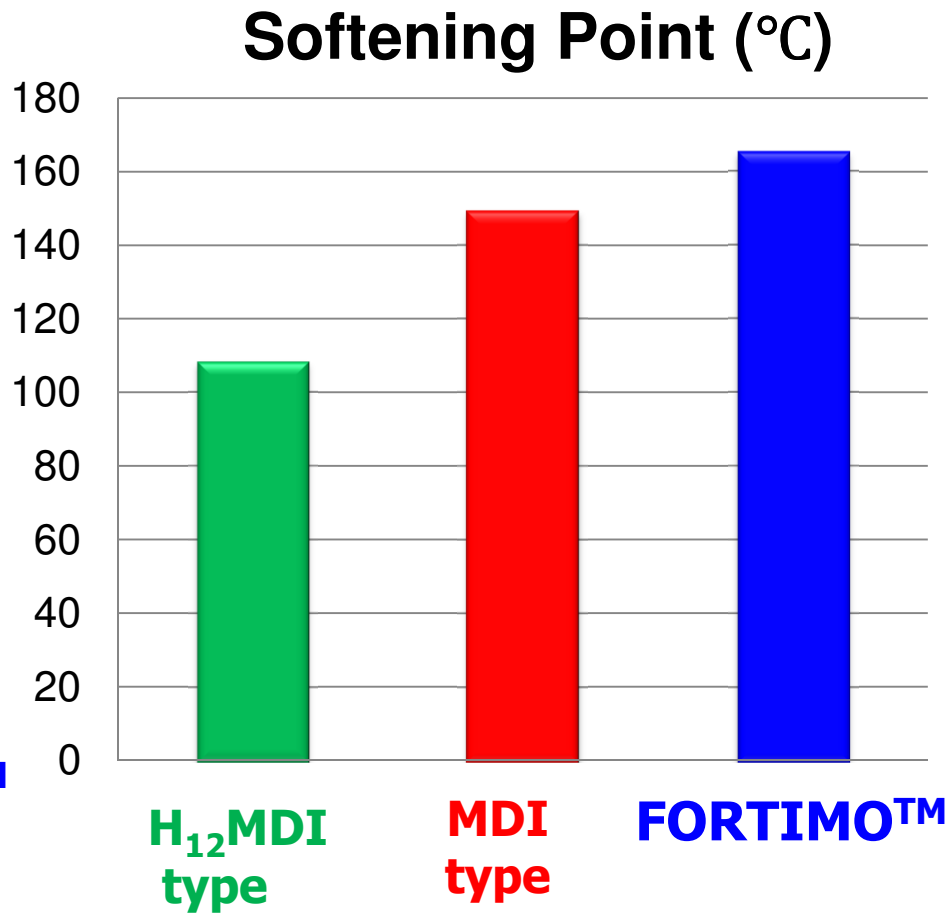
FORTIMO has both high elasticity & thermal resistance.





* Compared with same hardness, ASKER 85A

2. Advantages of FORTIMO™

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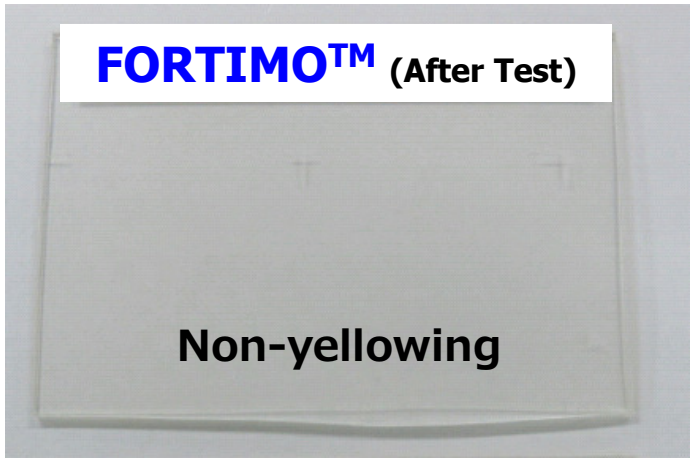
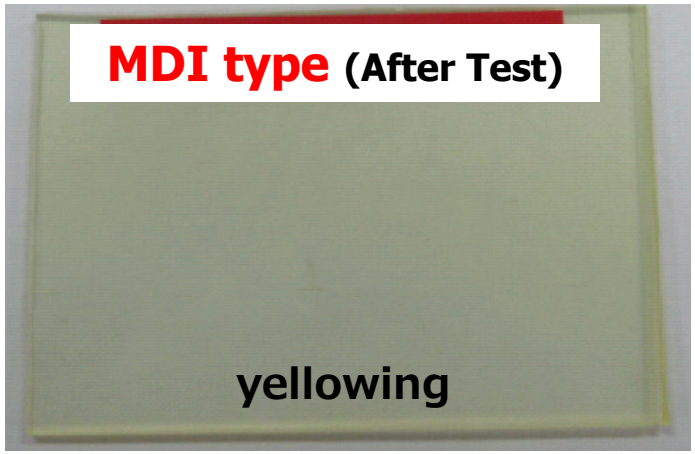
FORTIMO has Non-Yellowing properties.





Appearance after Xe exposure (100W/m² x1week)

2. Advantages of FORTIMO™ TPU

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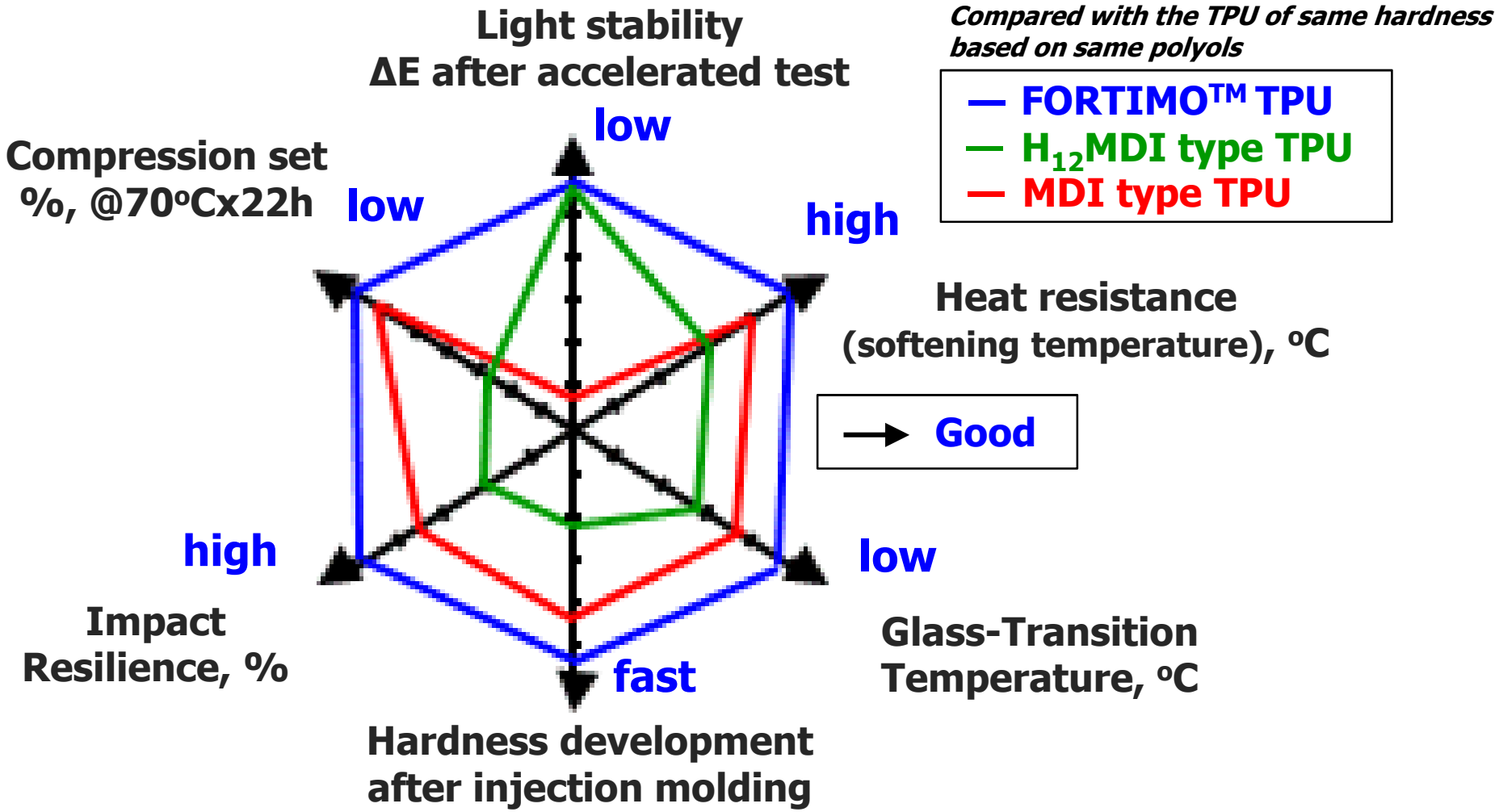
FORTIMO™ TPU has Good Mechanical Property, Light Stability & Processability.



3. Processability of FORTIMO™ TPU

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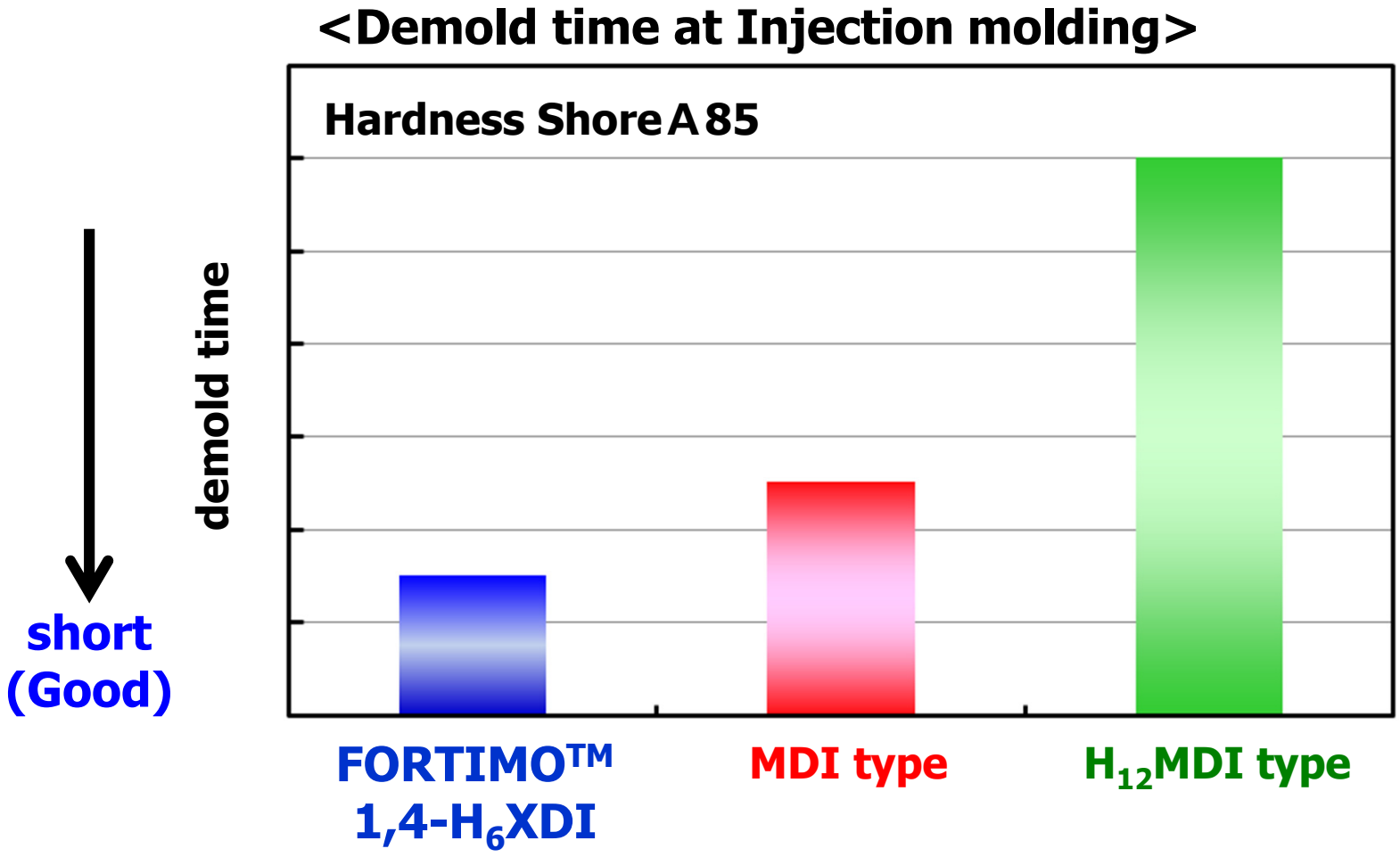
FORTIMO™ TPU showed advantages of short demold time compared to MDI and H_{12}MDI based TPUs.



4. Solvent resistance of FORTIMO™ TPU

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<Immersion test results with DMF and NMP solvents>

Sample	unit	FORTIMO™ 1,4-H_6XDI	H_{12}MDI	MDI
Polyol Type		Ester Type (85A)		
N,N'-Dimethylformamide (DMF)	⊿W/⊿V (%)	390/560 (insoluble)	dissolved	dissolved
N-Methyl-2-pyrrolidone (NMP)		900/1100 (insoluble)	dissolved	dissolved

FORTIMO™ TPU has advantages of solvent resistance compared with MDI and H_{12}MDI type.

4. Solvent resistance of FORTIMO™ (CPU)

Swelling rate after 23℃ for 10days Soaking

Solvent	Swelling Ratio(%)		
	FORTIMO™ 1,4-H_6XDI	PPDI	TODI
NMP	110	dissolved	900
THF	93	120	130
Toluene	58	49	48
MEK	51	49	45
Acetone	46	45	40
Butyl Acetate	41	35	33
Gasoline	36	28	25
Iso-Propanol	18	12	10
Diesel	10	9	7
Transmission Oil	2.2	1.9	1.3
ASTM Oil #1	0.1	0.3	0.1

5. The Properties of typical grades(TPU)

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Properties		Unit	Polycaprolactone based TPU		PTMEG based TPU	
			FORTIMO™ XCT-P3095[1)]	MDI based TPU	FORTIMO™ XET-T3092[1)]	MDI based TPU
Hardness(ASKER)		A	93	95	92	91
Impact Resilience		%	60	35	65	40
T_g (E''peak/DMA)		°C	-52	-32	-72	-40
Softening Temperature (Tangent/TMA)		°C	178	NA	162	NA
Tensile properties	100%Mod.	MPa	11	11	9	9
	300%Mod.	MPa	19	21	15	17
	Tensile Strength	MPa	45	50	36	45
	Elongation at break	%	600	500	680	500
Tear Strength[2)]		kN/m	168	150	144	130

[1)] All data were measured with injection sheet of 2mm thickness based on JIS-K7311 by Mitsui Chemicals Inc.
[2)] JIS K7311 standard: Angle type specimen, Tear Speed:300mm/min(http://www.jisc.go.jp/app/pager?id=1168449)

5. The Properties of typical grades(CPU)

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Properties		Unit	Polycaprolactone based TSU		PTMEG based TSU	
			FORTIMO™ XHL-8110A[1)]	TDI based TSU	FORTIMO™ XHL-8120A[1)]	TDI based TSU
Hardness(ASKER)		A	92	90	94	95
Impact Resilience		%	72	48	71	42
Tensile properties	100%Mod.	MPa	8.3	5.6	7.6	12
	300%Mod.	MPa	13	14	11	31
	Tensile Strength	MPa	58	59	41	44
	Elongation at break	%	620	430	650	350
Tear Strength[2)]		kN/m	168	84	115	83
Compression Set[3)]		%	25	36	22	40

[1)] All data were measured with casting sheet of 2mm thickness based on JIS-K7312 by Mitsui Chemicals Inc.
[2)] JIS K7312 standard: Angle type specimen, Tear Speed:500mm/min(http://www.jisc.go.jp/app/pager?id=1168449)
[3)] JIS K7312 standard: 25%, 70℃, 22hrs

6. Technical Information for injection molding condition

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<Preliminary drying>

Before extrusion molding, moisture content in TPU is recommended to decrease below 500ppm. TPU which we shipped to you had dried fully at low level of moisture content of below 200ppm. However, you had better dry TPU again at 80°C for more than 5 hours by using hot air circulating oven or hopper dryer before extrusion molding. Insufficient drying causes to decrease several properties of TPU and generate such as bubble in the articles.

<Recommended conditions of injection molding>

Screw speed:80rpm, Injection speed:60mm/s, Injection time:10s
Holding pressure:60MPa, Limit speed:50mm/s, Back pressure:15MPa

Samples	Type	Set Temperature (°C)		
		C1-C4	Nozzle	Mold
FORTIMO™ XCT-P3095	Polycaprolactone based TPU	230-235		20
FORTIMO™ XET-T3092	PTMEG based TPU	235-240		20

>Molding temperature should be adjusted by even 1-2°C according to resin pressure and molten state.

>After injection molding,
we recommend to anneal articles at 100°C for at least 2 days.

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