

TOYOLACTM
Post-Consumer Recycled-PC//ABS
Halogen Free Flame Retardant Alloy Grade

Technical Guide

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1.0 INTRODUCTION

TOYOLAC™ RNX series is a newly developed specialty r-PC//ABS (Recycled-PC//ABS) by Toray Industries, Inc. to meet the market requirement for high performance green material. In conjunction with the global concern of environmental issue towards greener environment, TOYOLAC™ RNX series is of non-halogenated flame retarding system developed using high content of post-consumer recycled polycarbonate.

TOYOLAC™ r-PC//ABS remains the basic physical and mechanical properties that is comparable to virgin PC//ABS with good impact strength, good flowability and excellent flame retardance level

Typical Mechanical Properties of TOYOLAC™ r-PC//ABS Resin

ALLOY 合金型					
Property 代表物性	Test Method 试验法	Test Condition 试验条件	Units 单位	Non-Halogen Flame Retardant r-PC// ABS 无卤阻燃型 r-PC//ABS 树脂	
			Type 型号	RNX84	RNX86
			Suffix 区分字符	X01	X01
ISO STANDARD					
Melt Flow Rate 流动系数	ISO 1133	240°C / 10 kg	g/10min	40	60
		260°C / 2.16 kg		11	13
Charpy Impact Strength (notched) 缺口冲击强度	ISO 179/1eA	23°C / 50 %RH	kJ/m ²	43	18
Deflection Temperature Under Load 热变形温度	ISO 75	1.8 MPa / 120°C/hr	°C	84	82
Tensile Strength 引张强度;降伏点	ISO 527	50 mm/min	MPa	62	58
Tensile Elongation at Break 拉伸伸长率			%	>30	>20
Tensile Modulus 拉伸模数			1 mm/min	MPa	2600
Flexural Strength 弯曲强度	ISO 178	2 mm/min	MPa	92	90
Flexural Modulus 弯曲模数				2400	2400
Density 比重	ISO 1183	23°C	kg/m ³	1180	1170
Flammability 燃烧性	UL94 File No. E41797			1.5 mm V-0	1.5mm V-0 1.5mm 5VB

Note: The above values are typical data for the products under specific test conditions and not intended for use as limiting specifications.

「以上数据谨代表在特定条件下所得的测定值的代表例」

2.0 PROCESSING CONDITIONS

2.1 PRE-DRYING

Generally, TOYOLAC_{TM} r-PC//ABS resin is hygroscopic and absorbs moisture in proportion to the environmental humidity. The absorption process of moisture is reversible process, and therefore moisture from wet pellet can be removed to environment with low humidity. Dried pellet should absorb moisture until the content reaches equilibrium moisture in the air. The exact amount of moisture content depends on the relative humidity and the period of exposure.

Processing of non-dried r-PC//ABS resin can cause silver streak problem on molding and also hydrolysis problem which will cause low impact strength. For TOYOLAC_{TM} r-PC//ABS grades, the recommendable moisture content is less than 0.1%, more desirable is 0.05%.

Typical drying temperature and time of TOYOLAC_{TM} r-PC//ABS by using oven with internal air circulation are shown as follow:

Drying Temperature: 75 ~ 85 °C
Drying Time: 3 ~ 5 hrs

2.2 INJECTION TEMPERATURE, PRESSURE & SPEED

Injection molding conditions should be properly controlled according to the molding machine, the shape and size of the product, and the mold structure. Typical molding conditions are as below:

Melt temperature of polymer	: 240 ~ 270°C
Injection pressure	: 70 ~ 140 MPa
Mold temperature	: 30 ~ 60°C
Screw rotating speed	: 30 ~ 70 r. p. m.

Temperature in excess of above recommended range could result in discoloration or burn marks problems. These are sign of damage to the material. Melt temperature of resin should be between 240°C and 270°C. It should be checked frequently and maintained within above recommended range to prevent defect of appearance and mechanical properties. If shutdown is required, remove the material from the machine and purge out completely to avoid burning problem.

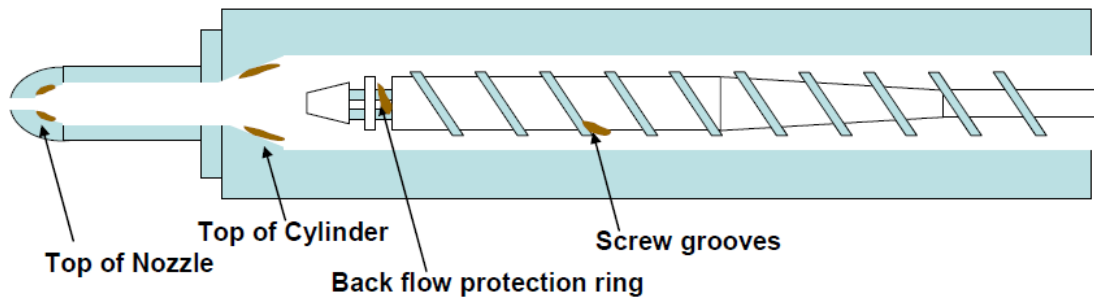
Injection speeds will be depending on products shape, gate structure and runner dimensions. Basically moderate injection speed is preferable in order to prevent orientation of rubber particles due to excessive shear.

Injection pressure should be controlled to mold full parts consistently with acceptable appearance. Many parameters affects injection pressure, such as injection temperature, products shape, nozzle and gate size, runner dimensions and mold temperature. Typical injection pressure range is 70 ~ 140 MPa for TOYOLAC_{TM} r-PC//ABS. It is important that injection pressure should drop off to holding pressure after fill-up immediately.

The mold temperature affects the surface quality and the level of residual stress in the molded products. To provide molded product having excellent surface finish and less residual stress, the mold temperature should be controlled as high as possible, ranging between 30°C ~ 60°C. However, higher mold temperature may cause longer cycle time and warpage problem. Excessive mold temperature should be avoided.

2.3 PURGING

Purging operation should be required if carbonized material is generated during continuous molding operation. Equipment cleaning should include frequent purging with natural color ABS resin or AS resin. In case of carbonized material does not stop generating even though purging operation has been carried out sufficiently, screw should be taken out and remove carbonized materials that are stuck on screw surface, screw grooves, top of nozzle and cylinder should be cleaned up.



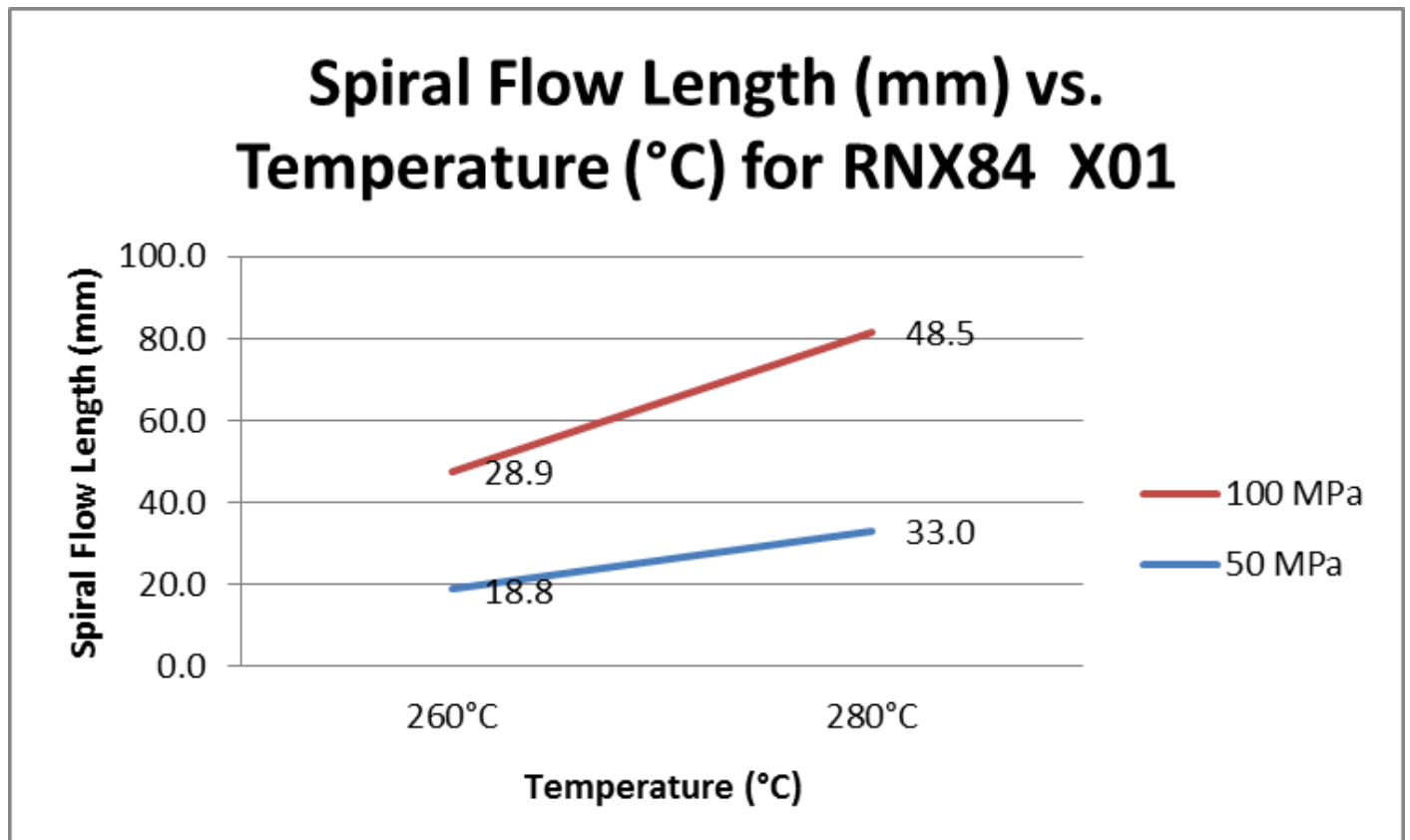
- If shut-down is required, remove the material from the machine and purge with natural ABS resin (or AS resin) or proper screw cleaning agent due to avoid the burning problem and the corrosion of equipment.
- In case of molding operation is resumed after shut-down, purging operation should be required until carbonized material does not come out throughout.

3.0 SPIRAL FLOW LENGTH

TOYOLAC™ RNX84 X01 has excellent flow ability. The flowability of TOYOLAC™ RNX84 X01 is determined as Spiral Flow Length as shown in figure below as a function of the injection temperature with injection pressure as parameter.

Molding Condition:

Molding Machine	: Toshiba Machinery, IS80A
Molding Temperature	: 260, 280°C
Mold Temperature	: 60°C
Injection Pressure	: 50, 100 MPa
Injection Speed	: Medium (FCV B-0: Fill-in Time 2 sec.)
Mold Dimension	: 10W x 2 mm ^t (Spiral Flow)



4.0 Mold Shrinkage Rate

Grade	Barrel Temp/ Mold Temp	Holding Pressure	Shrinkage Rate, %		
			Transverse Direction		Mold Direction
			A - A (near gate)	B - B (far gate)	C - C
TOYOLAC™ RNX84 X01	250°C/60°C	+ 5 MPa	0.47	0.50	0.50
		+ 10 MPa	0.40	0.42	0.40
TOYOLAC™ 700 X01	230°C/60°C	+ 5 MPa	0.59	0.72	0.70
		+ 10 MPa	0.56	0.65	0.66

Molding Condition

Molding Machine : Nissei ES4000

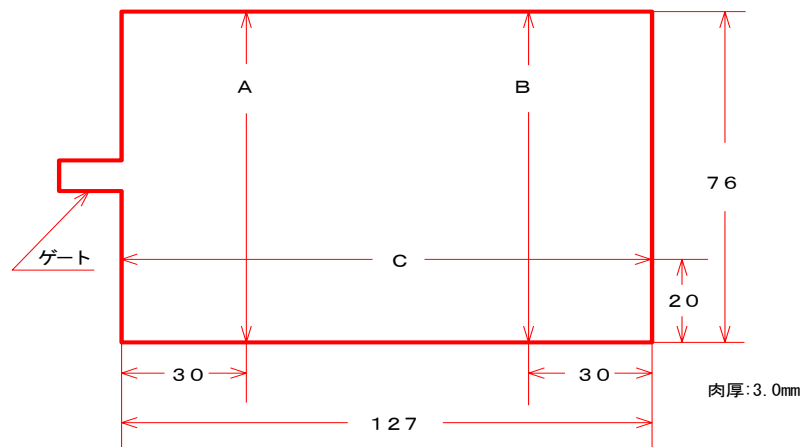
Molding Temperature : 250°C (TOYOLAC™ RNX84 X01),
230°C (TOYOLAC™ 700 X01)

Mold Temperature : 60°C

Holding Pressure : Minimum Holding Pressure + 5 MPa,
Minimum Holding Pressure + 10 MPa

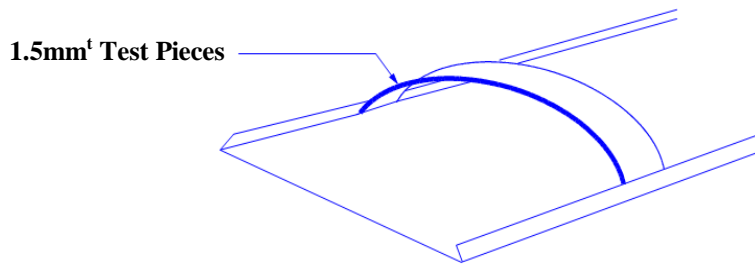
Mold Dimension : 127 x 76 x 3 mm[†]

Measuring Method : Measure test piece dimension after 24 hours conditioning
at 23°C/50%RH



5.0 Environmental Stress Cracking and Crazeing of TOYOLAC_{TM} RNX84 X01

TOYOLAC_{TM} RNX84 X01 will undergo stress cracking and crazing when subjected to certain chemical environments under high stress for given periods of time. This cracking and crazing will occur even though some chemicals will have no effect on unstressed (relaxed) parts, and therefore simple immersion of test pieces is an inadequate measure of chemical resistance of the polymer. There are two cases of stress generation. One is caused by external force (external stress), another is the stress that remains in molded parts (residual stress). Residual stress in molded parts is generated by uneven cooling speed and fluctuation of melt flow during molding. Residual stress relaxes gradually with time. However, degradation is accelerated by having contact with a chemical agent. It may cause cracking and crazing trouble. These phenomena are so called “Environmental Stress Cracking and Crazeing (ESC)”. Cracking phenomenon is observed on molded part surface when it is soaked in a chemical agent under applied stress.



$$\delta(\%) = \frac{\pi^2 2\sqrt{l' \times (l - l')}}{l^2 \times \pi} \times \frac{t}{2} \times 100$$

l : Test Pieces Length = 127 mm

l' : Test Pieces Length = 98 mm

δ : Strain = 3%

t : Test Pieces Thickness = 1.5 mm

Chemicals	TOYOLAC™ RNX84 X01
Distilled water	A
10% Sulfuric Acid	A
90% Sulfuric Acid	A
10% Acetic Acid	A
90% Acetic Acid	B
98% Ethyl alcohol	B
98% Methyl alcohol	A
10% Sodium Hydroxide	B
Silicon Oil	A
Labour dishwashing liquid	A

Judgment:

A- No Defect
B- Craze
C- Crack
D- Break

6.0 Troubleshooting

Typical molding problems and problem solutions are shown as following table. Most cause of molding troubles is the tangle of any kind of factors such as improper molding conditions, imperfect design of mold and moldings. Any one of the suggested remedies may solve a particular problem. However some problems may require a combination of suggested remedies.

Problems Remedy	Short Shots	Flash	Sink Marks	Burn Marks	Poor Weld Line	Low Gloss	Jetting	Excessive Warpage	Scratches	Air Marks	Silver Streaking	Crack, Whitening
Increase Injection Speed	✓		✓		✓	✓		✓				✓
Decrease Injection Speed				✓			✓			✓	✓	
Increase Injection Pressure	✓		✓		✓				✓			
Decrease Injection Pressure		✓		✓				✓			✓	✓
Increase Mold Temperature	✓				✓	✓	✓				✓	✓
Decrease Mold Temperature			✓					✓	✓			
Increase Barrel Temperature	✓				✓	✓	✓	✓				✓
Decrease Barrel Temperature		✓	✓	✓					✓		✓	
Decrease Nozzle Temperature				✓								
Increase Nozzle Temperature					✓	✓						
Check Nozzle, Sprue, Runner & Gate Size	✓		✓	✓			✓		✓		✓	✓
Check Gate Position & Number	✓				✓		✓		✓		✓	
Improve Venting	✓			✓	✓	✓				✓	✓	
Increase Filling Quantity	✓		✓						✓			
Decrease Filling Quantity		✓										
Check Clamping Force		✓										
Increase Holding Pressure						✓						
Decrease Holding Pressure		✓						✓				✓
Increase Holding Pressure Time			✓			✓						
Decrease Holding Pressure Time		✓						✓				✓
Increase Cooling Time			✓						✓			
Decrease Screw r.p.m.											✓	
Check Pellet Drying											✓	

Table 1: Troubleshooting Guide for TOYOLAC™ r-PC//ABS Resin

Important Notes:

1. In as much as Toray Plastics (Malaysia) Sdn. Bhd. has no control over the use to which other may put this material, it does not guarantee that the same result as those described herein will be obtained. Nor does Toray Plastics (Malaysia) Sdn. Bhd. guarantee the effectiveness or safety of any possible or suggested design for articles of manufacturer as illustrated herein by any photographs, technical drawing and the like. Each user of the material or design or both should make his own tests to determine the suitability of the material or any material for the design, as well as suitability or suggested uses of the material or design described herein are not to be construed as constituting a license under any Toray Plastics (Malaysia) Sdn. Bhd. patent covering such use or as recommendations for use of such material or design in infringement of any patent.

2. The material described here is not recommended for medical application involving any implantation inside the human body. Material Safety Data Sheet (MSDS) for the materials concerned should be referred to before any use.