

**"TOYOLAC" Heat Resistant ABS Resin**



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## **1. INTRODUCTION**

“TOYOLAC” is a highly-rigid material that exhibits great impact, flexural, and compression resistance. These characteristics demonstrate that Heat Resistant ABS is the ABS which introduced rigidity/stiffness into polymer to increase the glass transition temperature of polymer by high heat agent. Acrylonitrile-Styrene-N-Phenylmaleimide is the copolymer which used to modify the heat distortion temperature of “TOYOLAC” ABS resin.

## **2. FEATURE OF “TOYOLAC” HEAT RESISTANT ABS**

“TOYOLAC” Heat Resistant ABS resin are categorized as below Table 1.

Feature	Grade
Heat Resistant	420Y MH1    430Y MH1
	440Y MH1    440Y MH3
	440Y MH5
High Heat Resistant	450Y MH1    450Y MH5
	450Y X10    460Y MH1
Super High Heat Resistant	470Y MH1

*Table 1: Categories of “TOYOLAC” Heat Resistant ABS*

HIGH HEAT GRADE 耐热型														
Property 代表物性	Test Method 试验法	Test Condition 试验条件	Units 单位	Heat Resistant 耐热					High Heat Resistant 高耐热				Super High Heat Resistant 超耐热	
				Type 型号	420Y	430Y	440Y	440Y	440Y	450Y	450Y	450Y	460Y	470Y
				Suffix 区分字符	MH1	MH1	MH1	MH3	MH5	MH1	MH5	X10	MH1	MH1
ISO STANDARD														
Melt Flow Rate 流动系数	ISO 1133	220°C / 10 kg	g/10min	17	11	10	15	15	4	10	7	3	2	
Charpy Impact Strength (notched) 缺口冲击强度	ISO 179/1eA	23°C / 50 %RH	kJ/m <sup>2</sup>	15	14	15	15	10	14	8	14	14	13	
Deflection Temperature Under Load 热变形温度	ISO 75	1.8 MPa / 120°C/hr	°C	88	90	92	90	92	98	98	95	100	104	
Tensile Strength 引张强度;降伏点	ISO 527	50 mm/min	MPa	52	50	53	54	56	46	59	50	45	44	
Tensile Elongation at Break 拉伸伸长率			%	>8	>10	>10	>10	>10	>10	>10	>10	>10	>9	>9
Tensile Modulus 拉伸模数		1 mm/min	MPa	-	2850	2800	2800	3100	2300	3100	2500	2250	2200	
Flexural Strength 弯曲强度	ISO 178	2 mm/min	MPa	80	83	83	83	89	69	93	79	75	66	
Flexural Modulus 弯曲模数				2500	2620	2560	2500	2830	2100	2830	2300	2130	2010	
Density 比重	ISO 1183	23°C	kg/m <sup>3</sup>	1050	1050	1060	1060	1060	1070	1070	1070	1070	1080	
Flammability 燃烧性	UL94 File No. E41797			HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	

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」

Table 2: Catalogue Properties Data

### **3. Processing**

#### **Drying**

ABS resin is absorbent (hygroscopic) and absorbs moisture in proportion to environmental humidity. The absorbing process of moisture is reversible process. Therefore, wetted pellets can be removed moisture to environmental air with lower humidity. Dried pellets should absorb moisture until the amount touches equilibrium amount with the moisture in the air. The absorbing moisture content depends on the relative humidity in the air, how long the resin was exposed. While "TOYOLAC" HH ABS resin is exposed to humidity, the moisture is absorbed onto surface and into inside of the pellets itself, recycled materials and molded parts. Typical equilibrium moisture of "TOYOLAC" HH grade is around 0.2~0.3% at 23 °C , 50%RH, and 0.5~0.6% at 40 °C, 95%RH. The rate of absorbed moisture is depending on pellet size, shape and environmental temperature. Non-dried ABS resin can cause silver streaking problem on molded parts. The recommendable moisture content for "TOYOLAC" is less than 0.1%, more desirable is 0.05%. Generally, below drying conditions are recommended.

*Drying Temperature: 90 ~ 100 °C  
Drying Time: 3 ~ 5 hrs*

#### **Mold Shrinkage**

Generally, mold shrinkage is depending on actual molding conditions and dimension of molded parts.

#### **Molding Condition**

Molding machine:	Nissei ES4000-36E
Molding Temperature:	260 °C
Mold Temperature:	70 °C
Holding Pressure:	Minimum holding pressure, +3%, +6%
Mold dimension:	127.47 x 76.21 x 3 tmm
Measure Method:	Measure test piece dimension after 24 hours conditioning at 23 °C, 50% RH

Measure Position:

Calculation:

$$\text{Flow direction} = 100 \cdot (L_m - L_s) / L_m$$

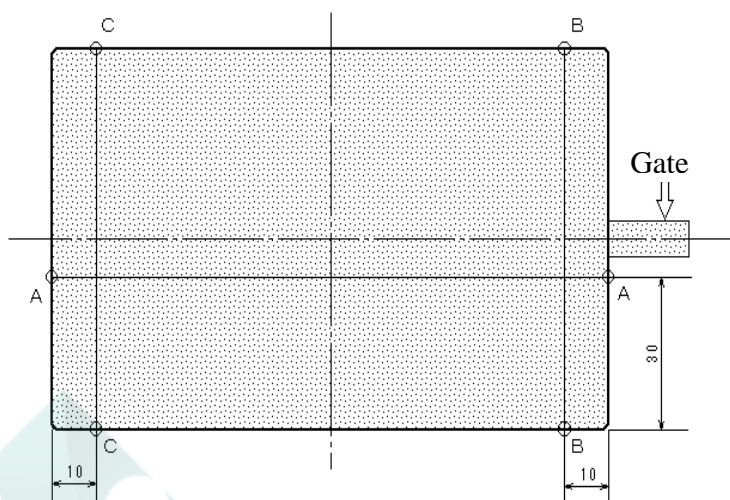
$$\text{Transverse direction} = 100 \cdot (W_m - W_s) / W_m$$

$L_m$  = Length of mold

$W_m$  = Width of mold

$L_s$  = Length of test plate after conditioning

$W_s$  = Width of test plate after conditioning



Grade	Holding Pressure	Unit	Flow Direction	Transverse Direction		Range
			A-A	B-B (near gate)	C-C (far gate)	
430Y MH1	min	%	0.68	0.67	0.70	0.51 - 0.71
	+3%		0.64	0.64	0.64	
	+6%		0.53	0.56	0.51	
440Y MH1	min	%	0.66	0.68	0.71	0.45 - 0.71
	+3%		0.58	0.64	0.62	
	+6%		0.45	0.51	0.45	
440Y MH5	min	%	0.64	0.64	0.67	0.46 - 0.72
	+3%		0.60	0.63	0.62	
	+6%		0.46	0.52	0.47	
450Y MH1	min	%	0.71	0.71	0.72	0.54 - 0.67
	+3%		0.69	0.60	0.60	
	+6%		0.55	0.56	0.54	
450Y MH5	min	%	0.64	0.64	0.67	0.46 - 0.67
	+3%		0.55	0.60	0.59	
	+6%		0.46	0.51	0.46	
450Y X10	min	%	0.67	0.73	0.72	0.49 - 0.73
	+3%		0.58	0.63	0.66	
	+6%		0.49	0.50	0.54	
470Y MH1	min	%	0.68	0.72	0.75	0.56 - 0.75
	+3%		0.63	0.64	0.67	
	+6%		0.56	0.58	0.60	

Table 3: Mold Shrinkage Data

Those data are typical values that have been obtained using test pieces shown below figure. Therefore, it should be made own tests to determine the suitability of the mold shrinkage rate for the design.

## Spiral Flow

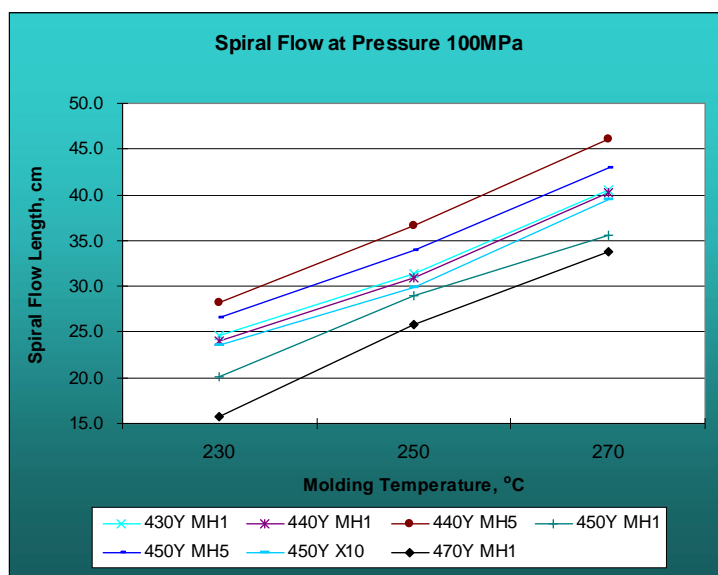
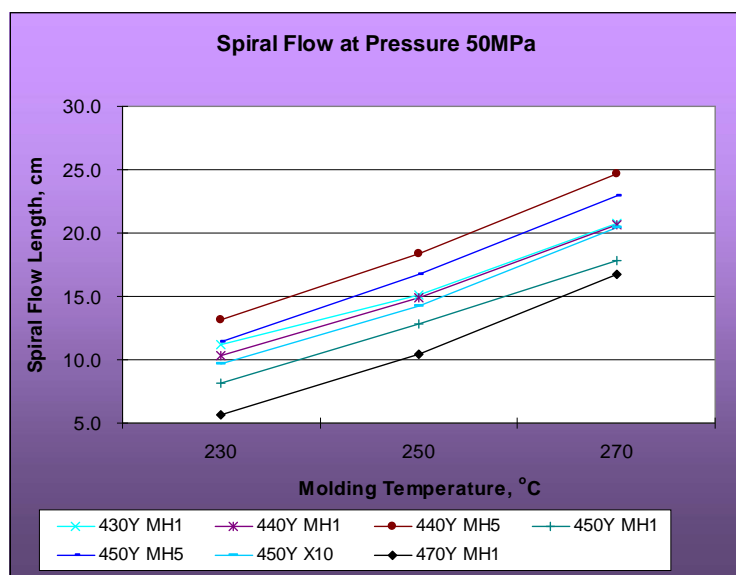
Melt Flow Rate (MFR) is primary property used to predict the resin's processability. MFR is measured by standard ISO 1133, 220 oC with 10kg load. This condition is conducted at shear rate that are lower compared to the actual injection molding process. Spiral flow test can be used to measure the processability of material under the more "actual" shear rates seen in injection molding process. The spiral flow is determined by the length of flow by the resin at injection molding condition which stimulating the actual molding condition.

## Molding Condition

Molding Machine: IS80-FPA Injection Molding Machine  
Molding Temperature: 230°C, 250°C, 270°C  
Mold Temperature: 60°C  
Injection Pressure: 50 MPa, 100 MPa  
Mold Dimension: 5w X 2 mm t spiral  
Measure Method: Measure spiral flow length after 24 hours conditioning at 23 °C, 50% RH

Condition		TORAY "TOYOLAC"						
Molding Temperature (°C)	Injection Pressure (Mpa)	430Y MH1	440Y MH1	440Y MH5	450Y MH1	450Y MH5	450Y X10	470Y MH1
230	50	11.2	10.3	13.2	8.1	11.4	9.7	5.6
	100	24.6	24.0	28.2	20.1	26.5	23.5	15.7
250	50	15.1	14.9	18.4	12.8	16.7	14.2	10.4
	100	31.3	30.9	36.6	28.9	34.0	29.9	25.8
270	50	20.8	20.6	24.7	17.8	22.9	20.4	16.7
	100	40.5	40.2	46.1	35.6	43.0	39.5	33.8

Table 4: Spiral Flow Test Data

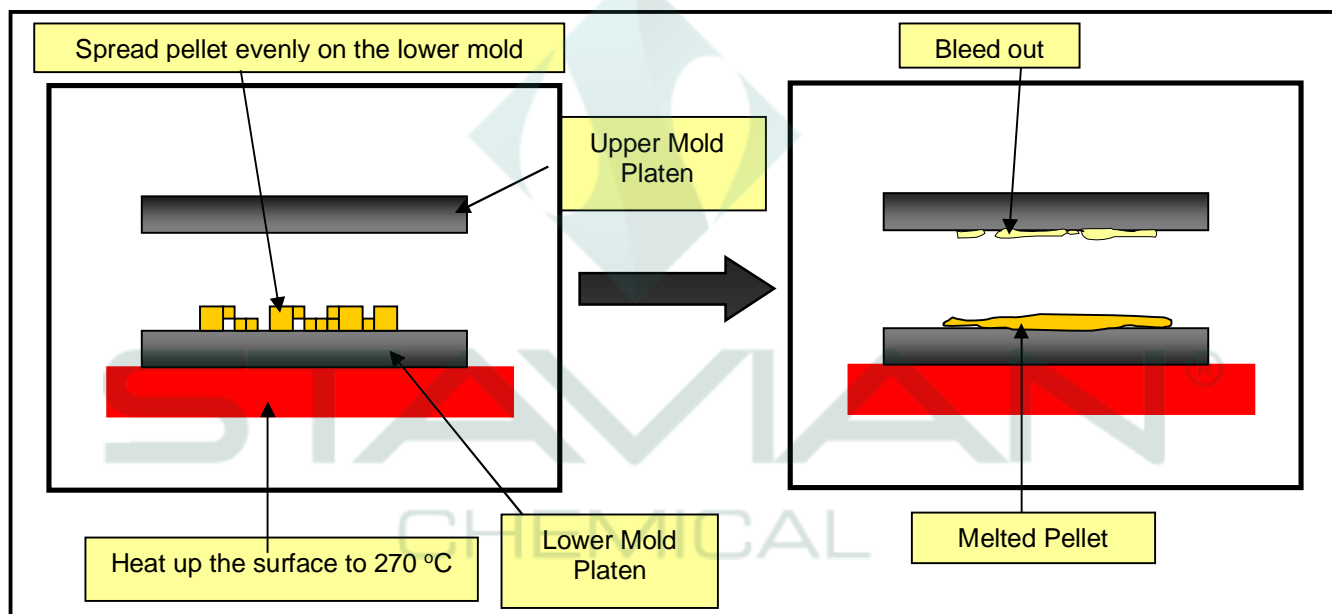


**Bleed Content**

Bleed content is to simulate the molding process to observe and quantitatively determine the bleed content of resin. High bleed content may contribute to mold deposit and mold damage. Furthermore, it will increase the mold surface cleaning frequency.

		TORAY "TOYOLAC"						
	Unit	430Y MH1	440Y MH1	440Y MH5	450Y MH1	450Y MH5	450Y X10	470Y MH1
Bleed Content	%	0.013	0.011	0.015	0.007	0.009	0.007	0.012

*Table 5: Bleed Content Data*



*Figure 1: Illustration of Bleed Content Test*

## **4. Injection Molding**

### **Injection Temperature**

The barrel temperature of injection molding machine should increase from the hopper to the nozzle gradually.

Nozzle (°C)	Zone 4 (°C)	Zone 3 (°C)	Zone 2 (°C)	Zone 1 (°C)	Hopper (°C)
250 ~ 260	250 ~ 260	250 ~ 260	240 ~ 250	240 ~ 250	240 ~ 250

*Table 6: Recommended Barrel Setting Temperature*

It should be properly controlled according to the injection molding machines, the shapes and size of the products, and the mold structure. Temperature in excess of above recommended could result of discoloration or burn marks troubles. Those troubles are a sign of damage to the material. Melt temperature of resin should be between 240°C and 260°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 trouble.

### **Mold Temperature**

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 40°C ~ 80°C. However, higher mold temperature may cause longer cycle time and warpage problem. It should be taken attention excessive mold temperature.

### **Injection Speed & Pressure**

Injection speeds will be depending on products shape, gate structure and runner dimensions. 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 70~140MPa for "TOYOLAC" Heat Resistant



Grades. It is important that injection pressure should drop off to holding pressure after fill-up immediately.

### **Purging**

General maintenance and equipment cleaning should include frequent purging with natural color ABS resin or AS resin. If prolonged shut-down is required, reduce barrel temperature less than 150°C, remove the material from the injection machine and purge with natural ABS resin or AS resin. Continue this operation until hopper is empty throughout and confirm barrel temperature has been dropped less than 150°C.

### **Regrind**

Runners, sprues and shot-shots of "TOYOLAC" Heat Resistant resin molded under proper molding conditions can be used for recycle materials. Those non-degraded regrind up to a 20% can be reprocessed with fresh pellets of the same grade. Please do not mix it up with other grades of "TOYOLAC" resin or other plastics. And dry it up before reprocessing.

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## 5. 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 Warp	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 7: Troubleshooting Guide for "TOYOLAC" Heat Resistant 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.

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