TORAY
Innovation by Chemistry

Transparent ABS Resin

TOYOLAC™

920 555

Technical Guide

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1. Introduction

'TOYOLAC' is a well known ABS thermoplastics resin which consists of Acrylonitrile (A), Butadiene (B) and Styrene (S). Toray always strives to develop new grade by optimizing respective features of A, B and S to fulfill customer requirement.

'Toyolac' is widely used in automotive products, media products, OA machines, amusement products and other applications. 'Toyolac' consists of a variety of grades but this technical guide will focus only on Transparent Grade ABS, 'Toyolac' 920 555 which is widely demanded in various sectors.

Toray is the earliest company to start manufacturing and sales of transparent ABS in Japan domestic market. Thus, we have accumulated more than 20 years of experience in transparent ABS technology and know how. We do greatly appreciate your consideration to evaluate 'Toyolac' 920 555 in line with the expected expansion in demand for transparent ABS in future.

2. Special Features

'Toyolac' 920 555 special features are listed as following :

- High light transmittance (low haze)
- Excellent weathering resistant (transparency retention against high humidity / temperature)
- Low out gassing (weight loss upon heating)
- Balance of flow ability and impact strength
- Consistent and stable color / transparency

3. Property Data Table

Typical property data of Toyolac 920 555 (ISO)

Properties	Test Method	Test Condition	Unit	TOYOLAC 920 555
Tensile Strength	ISO 527	23℃, 50mm/min	MPa	54
Tensile Elongation at Break		23℃, 50mm/min	%	17
Flexural Strength	ISO 178	23℃, 2mm/min	MPa	77
Flexural Modulus		23℃, 2mm/min	MPa	2,260
Charpy Impact Strength, (notched)	ISO 179/1eA	23℃	kJ/m^2	9
Distortion Temperature Under Load	ISO 75	120°C/hr, 1.8MPa Load	℃	77
Melt Flow Rate	ISO 1133	220℃/10kg	g/10min	25
Density	ISO 1183	23℃/ 50%RH	kg/m^3	1,090
Flammability	UL94 File No. E41797			HB

Note;・These values are typical data for this product under specific test conditions and not intended for use as limiting specifications.

Typical property data of Toyolac 920 555 (ASTM)

Properties	Test Method	Test Condition	Unit	TOYOLAC 920 555
Tensile Stress at Yield	ASTM D638	23℃, 5mm/min	MPa	48
Tensile Elongation at Break		23℃, 5mm/min	%	20
Flexural Modulus	ASTM D790	23℃, 3mm/min	MPa	2,160
Flexural Strength		23℃, 3mm/min	MPa	74
Izod Impact Strength (notched)	ASTM D256	23℃, 12.7x62.5x12.7tmm	J/m	108
Distortion Temperature Under Load	ASTM D648	6.4tmm,1.8MPa	℃	83
Rockwell Hardness	ASTM D785	23℃/ 50%RH	R scale	115
Melt Flow Rate	ASTM D1238	220℃/10kg	g/10min	25
Light Transmittance	ASTM D1003	3tmm	%	88
Haze		3tmm	%	2
Specific gravity	ASTM D792	23℃	-	1.09
Flammability	UL94 File No. E41797			HB

Note: ・These values are typical data for this product under specific test conditions and not intended for use as limiting specifications.

4. Processing Condition

4.1 Pellet Pre-drying

Commonly, ABS resin is absorbent (hygroscopic) and absorbs moisture in proportion to environmental humidity. The moisture absorbing process is reversible. Therefore, moisture of the wet pellet can be removed to environmental air with lower humidity. Dried pellet 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' 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' ABS 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 is less than 0.1%, more desirable is 0.05%. Generally, below pre-drying conditions are recommended.

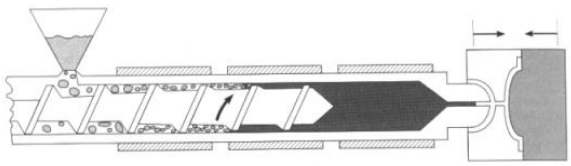
Hot air ventilated dryer: 80 °C ; 3 ~ 5 hours
90 °C ; 2 ~ 4 hours

4.2 Standard Molding Condition

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

Typical barrel temperature setting : 200 ~ 240°C (Example temperature profiles are shown in following table)

Profile	From hopper to nozzle	Remarks
Fixed		Constant profile is used to utilize plasticizing capacity.
Rising		Rising profile to allow moderate fusion of resin.
Mixed		Lower temperature at nozzle to prevent drooling or stringing.



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 and long cycle time with long retention time inside barrel could result in discoloration or yellowish problem on the molded part. Those problems are the sign of damage to the material. Melt temperature of resin should be between 230°C and 250°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 Speed & Pressure

Injection speed 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 stress.

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

Mold Temperature

The mold temperature affects the surface quality and the level of residual stress in the molded products. To provide a 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.

Purging

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

5. Troubleshooting Guide

Typical molding problems and problem solutions are shown in following table. Particular molding problem may be caused by several 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. Each user of 'Toyolac' 920 555 should make his own evaluation to determine the suitability of the material for his own particular use. If problems are still encountered after trying the remedies outlined below, contact Toray Plastics (M) Sdn. Bhd. for more information.

Defects		Barrel Temperature			Injection Conditions			Plasticizing Conditions		Holding Conditions		Cooling Conditions		Others	
		Rear	Centre-Front	Nozzle	Speed	Pressure	Cycle	Screw rpm	Back Pressure	Pressure	Time	Temp. (℃)	Time	Machine Size	Pre-drying
Molded Part Defect	Silver Streak	U	D	D	D			D						D	R
	Flow Mark		U		U							U			
	Jetting		U		D										
	Sink Mark		D			U				U		O	U		
	Warpage				U	U						O			
	Low Gloss		U		U	U				O		U			
	Burnt Mark		D		D	D	S	D	U					D	
	Weld Line		U		U							U		U	
Molding Defect	Poor Plasticizing	D						D	D						
	Crack during mold release				D	D						U	D		

Remark : U = up, D = down, O = optimize, R = reinforced, S = short