TORAY
Innovation by Chemistry

"TOYOLAC"
Chemical Resistant Grade ABS Resin

Technical Guide
for
Processing & Molding

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1. Introduction

"TOYOLAC" Chemical Resistant ABS are designed and develop to meet the market requirement on the resistance to detergent/cleaning agent. Also, "TOYOLAC" AX05 X03 are excellent in resistance to urethane foaming agent of refrigerator like cyclopentane, HCFC141b and HCFC245fa.

It offers similar processibility to current ABS for refrigerator applications.

1) It provides excellent resistance to cleaning agents which available in the market
2) It has excellent resistance to urethane forming agent of refrigerator.
3) It has similar mold shrinkage rate and processability to General purpose ABS.

2. General Properties

Table 1: Typical Properties of "TOYOLAC" Chemical Resistant ABS

CHEMICAL RESISTANT 耐药型						
Property 代表物性	Test Method 试验法	Test Condition 试验条件	Units 单位	Standard 一般	High Flow 高流动	High Rigidity 高刚性
			Type 型号	AX05	AX05	AX05
			Suffix 区分字符	X03	X08	X32
ISO STANDARD						
Melt Flow Rate 流动系数	ISO 1133	220°C / 10 kg	g/10min	17	29	24
Charpy Impact Strength (notched) 缺口冲击强度	ISO 179/1eA	23°C / 50 %RH	kJ/m^2	30	30	15
Deflection Temperature Under Load 热变形温度	ISO 75	1.8 MPa / 120°C/hr	°C	80	79	80
Tensile Strength 引张强度;降伏点	ISO 527	50 mm/min	MPa	47	42	48
Tensile Elongation at Break 拉伸伸长率			%	>10	15	12
Tensile Modulus 拉伸模数		1 mm/min	MPa	2100	-	-
Flexural Strength 弯曲强度	ISO 178	2 mm/min	MPa	59	66	75
Flexural Modulus 弯曲模数				1920	2010	2280
Density 比重	ISO 1183	23°C	kg/m^3	1040	1040	1050
Flammability 燃烧性	UL94 File No. E41797			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」

3. Resistance to Urethane forming agent of Refrigerator

Table 2 gives the results of resistance tests to cyclopentane, HCFC141b and HCFC245fa of “TOYOLAC” AX05 X03. These data show that “TOYOLAC” AX05 X03 has excellent resistance to urethane foraming agent of refrigerator.

Table 2: Results of Resistance tests to Forming Agent

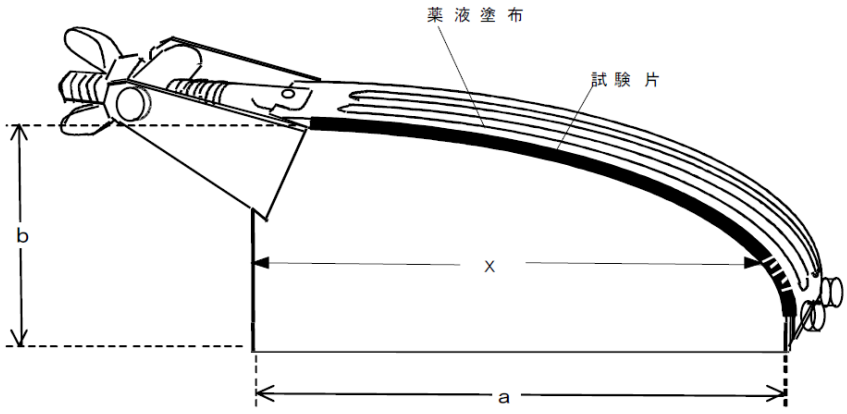
Resistance to;	**"TOYOLAC" AX05 X03**	**"TOYOLAC" 500**
Cyclopentane	≥ 7% (No change on the test piece)	0.2 % (Crazing)
HCFC141b	≥ 7% (No change on the test piece)	0.2 % (Crazing)
HCFC245a	≥ 7% (No change on the test piece)	0.2 % (Crazing)

Test Method

(1) Resistance test method for vapor phase forming agent

a. Charge forming agent into bottom of desiccator, and set UL test pieces (126 x 12.6 x 1.5 mmt) on the ¼ ellipse-jig (refer to Figure) , then keep them for 24 hours at 23˚C. After 24 hours, measure the length of crack position (X), then calculate the critical strain by using following formula.

b. Dismantle the test piece from jig, bend test piece on a 30 mm diameter pillar, then measure the length of crack position (X) and calculate the critical strain in the same way (Pillar Bending Test). Then, bend test piece forcibly , and observe on the surfaces of test piece (Enforcement Bending Test)



(2) Test condition

Treatment Time : 24 hours

Treatment temp. & Humidity : 23˚C / 50%RH

Calculation formula of Critical Strain:

$$\varepsilon = \frac{b.t}{2a^2} \times \left[1 - \frac{X^2(a^2 - b^2)}{a^4}\right]^{-3/2} \times 100\%$$

ε	: Critical strain
a	: Major axis of jig [127mm]
b	: Minor axis of jig [38mm]
t	: Thickness of test piece [1.5mm]
X	: Length of crack position [mm]

4. Chemical Resistance

Table 3 gives comparison result of chemical resistance test between “TOYOLAC” AX05 series and “TOYOLAC” General Purpose grade 500.

Table 3: Results of Resistance tests of Chemicals on “TOYOLAC” AX05

Detergents/ Chemicals	"TOYOLAC" AX05 X03	"TOYOLAC" AX05 X32	“TOYOLAC” 500
"Kitchin Haiter"(Kao Product)	◎	○	× ×
"Magiclean"(Kao Product)	○	△	× ×
"Strong rook"(Lion Product)	◎	△	× ×
"Kabi Killler"(Johnson Product)	◎	○	× ×
"Mama Royal"(Lion Product)	◎	○	◎
"Osouji rook"(Lion Product)	◎	△	× ×
Salad Oil(Hounen Product)	◎	△	× ×
Butyl Alcohol	×	×	× ×
90% Acetic Acid	× ×	× ×	× ×

Judgement Standard:

◎ : 7.0 % ≤ Critical Strain
○ : 2.0 % ≤ Critical Strain ≤ 6.9 %
△ : 1.0 % ≤ Critical Strain ≤ 1.9 %
× : 0.6 % ≤ Critical Strain ≤ 0.9 %
× × : Critical Strain ≤ 0.5 %

Test method (Refer to 3.0 term)

Similar to preceding clause, set UL test piece on the 1/4 ellipse jig, coat above chemicals on the test piece, then keep for 7 days at 23˚C. After 7 days, measure the length of crack position (X), and calculate the critical strain.

5. Mold Shrinkage Rate

Table 4: Mold Shrinkage Rate of “TOYOLAC” AX05 X03

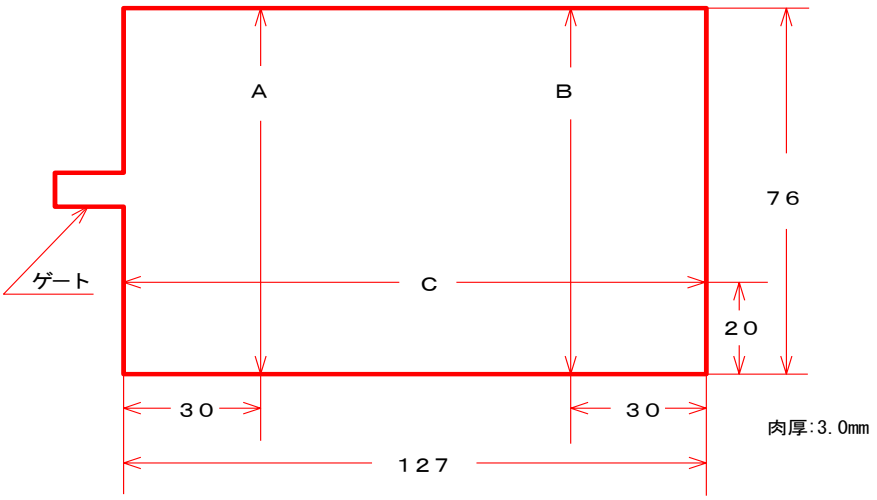
Grade	Molding temp/ Mold temp	Injection Pressure	Measuring Point		
			TD		MD
			A	B	C
“TOYOLAC” AX05 X03	230 ºC/ 60 ºC	Min Pressure	0.68	0.71	0.70
		Min Pressure + 5%	0.62	0.65	0.64
		Min Pressure + 10%	0.55	0.55	0.53
"TOYOLAC" 500 (GP ABS)	230 ºC/ 60 ºC	Min Pressure	0.62	0.69	0.67
		Min Pressure + 5%	0.60	0.63	0.61
		Min Pressure + 10%	0.50	0.52	0.52

Molding condition

Molding machine : Toshiba IS-50A
Molding temp : 230℃
Mold temp : 60℃
Injection pressure : Minimum pressure+10MPa
※fill up by pressure control
Mold measurement : 127 × 76 × 3mm^t

Dimension measurement

Measure test piece dimension after 24 hours remaining under 23℃, 50%RH



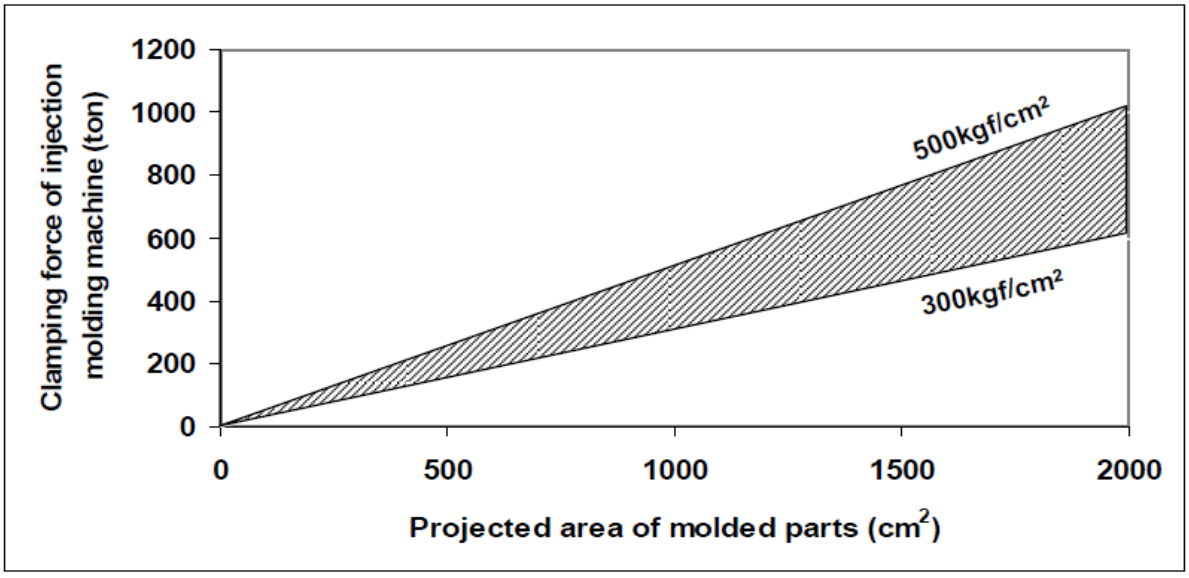
6. Molding Condition and Drying Condition

Processing & Molding Conditions

Injection molding machine

- Clamping force of injection molding machine should be calculated below mentioned formula (pressure in cavity of ABS resin is generally around 300-500 kgf/cm^2), and refer to below relation graph. Appropriate injection molding machine should be used to match the mold size.

Clamping force (ton)
= Projected area of molded parts (cm^2)×pressure in cavity (kgf/cm^2)÷1000



- Shot volume of injection molding machine is recommended around 60-80%. It's suitable for following below mentioned formula. In case of less than 50% shot volume, residence time of material inside cylinder should be longer. That situation causes discoloration and deterioration of mechanical property.

Shot volume of injection molding machine > Weight of molded parts ÷ Specific gravity

- Screw type of injection molding machine should be recommended full-fright type (compression ratio 2.0～2.5). There is a possibility that using of high compression ratio type and high kneading type cause burning and discoloration defects.

Molding conditions

Pre-Drying

Generally, ABS resin is hygroscopic and absorbs moisture in proportion to the environmental humidity. The absorb process of moisture is reversible process, therefore wet pellets can be removed moisture to environmental air with low humidity. Dried pellets should absorb

moisture until the content reaches equilibrium moisture with the moisture in the air. The exact amount of moisture content depends on the relative humidity, how long the resin was exposed.

Processing undried ABS resin can be cause in silver streaking problem on moldings. For "TOYOLAC" ABS the suggested moisture level for molding is less than 0.1%, more desirable is 0.05%.

Typical drying temperature and time of "TOYOLAC" ABS by using oven with internal air circulation are shown as follows;

Drying Temperature : 80～85°C
Drying Time : 3～5 hrs

Injection molding temperature and pressure
Injection molding conditions should be properly controlled according to the molding machines, the shape and size of the products, and the mold structure. Typical molding conditions show as follows;

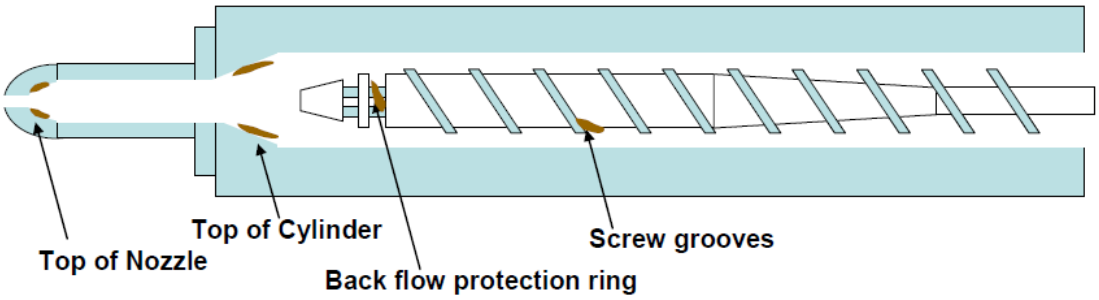
Melt temperature of polymer	: 210 ~ 230 °C
Injection pressure	: 70 ~ 140 MPa
Mold temperature	: 30 ~ 60 °C
Screw rotating speed	: 30 ~ 70 r. p. m.

It should be properly controlled according to the injection moulding machines, the shapes and size of the products, and the mould 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 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 trouble.

This excess heat could be controlled by gate and land dimension, slower injection rate or lower injection pressure. In case of accidental thermal degradation, noxious and corrosive gas may be occurred. Purge the barrel, shut off machine, quench purge shot in water. Please refer to further information that is mentioned under the title “Purging”.
Even though cylinder temperature of injection molding machine is controlling recommended temperature range, longer residence time might be cause of thermal degradation and carbonized materials should be generated.

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 trouble 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

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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