TOYO STYRENE　High Functional Polystyrene

◆ Extremely Transparent Polystyrene : GA

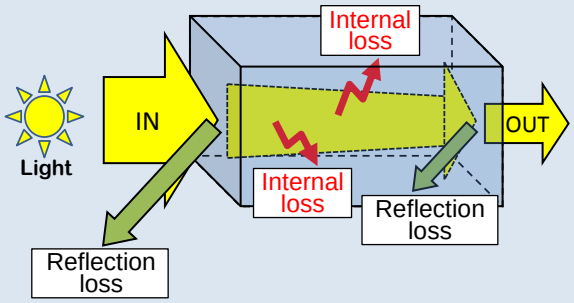
Advantages of polystyrene

- Transparency
- Lightness
- Hard to warp

	PS ⇒ GA	PMMA	PC
Specific gravity	◎ (1.05)	△ (1.19)	△ (1.19)
Moisture absorption	◎	×	△
Formability	◎	○	○
Transparency	○ ⇒ ◎	◎	○
Yellowing	○ ⇒ ◎	◎	○
Heat resistance	○	○	◎
Strength	△	△	◎

"Light transmittance of thin plate" ≠ "Transparency of materials"

Thin plate (thickness = 2mm)		PS	GA10	PMMA	PC
Light transmittance (%)		90	90	92	90
Breakdown of losses	Reflection @ IN	5	5	4	5
	Internal	≒0	≒0	≒0	≒0
	Reflection @ OUT	5	5	4	5



- **Thin** plate: Internal loss is negligible.
  Reflection loss exclusively determines the light transmittance.
- **Thick** object: Internal loss is **not** negligible.
  Internal loss have a strong effect on the transparency.

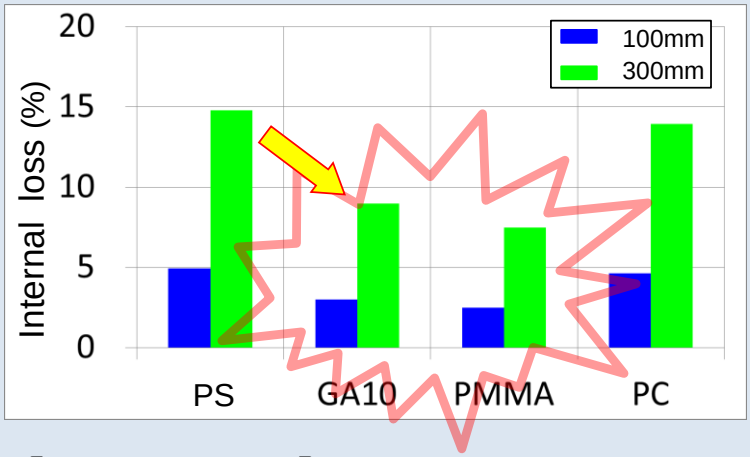
$$\text{Light transmittance} = \frac{\text{OUT}}{\text{IN}} \times 100\ (\%)$$

"Extremely Transparent Polystyrene" significantly reduced internal loss

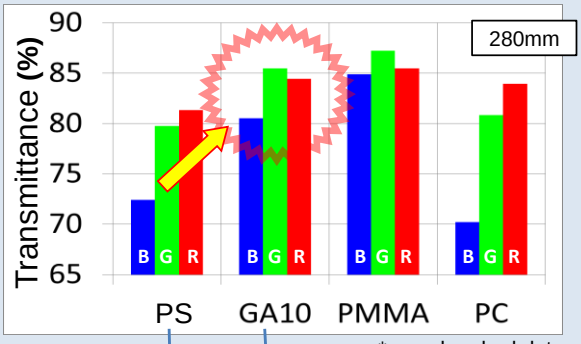
	Light path	PS	GA10	PMMA	PC
Internal loss (%)	2mm	≒0	≒0	≒0	≒0
	100mm	5	3	2.5	4.5
	300mm	15	9	8	14

* our observed data

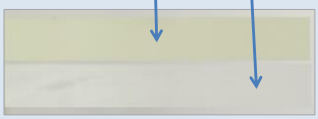
GA10 is almost the same as PMMA at its internal loss.

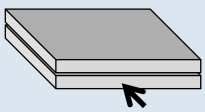


— Less Yellowish —
Transmittance of blue light is higher !

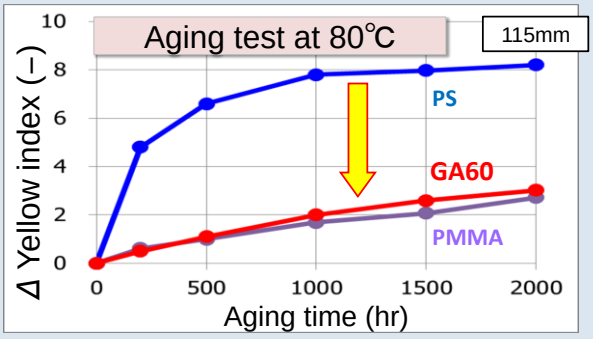


* our obserbed data


View of long path


Observed

GA60 is prevented from yellowing.



* our obserbed data

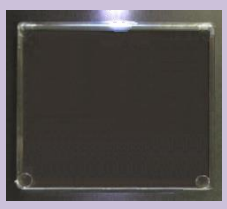
【 Applications 】
Light guide plates
Lightings
Optical components, etc.

2015.12.1

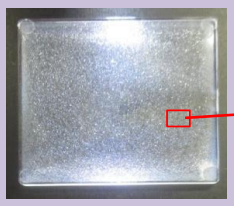
TOYO STYRENE　High Functional Polystyrene

◆ Whitening Resistant Polystyrene : WR

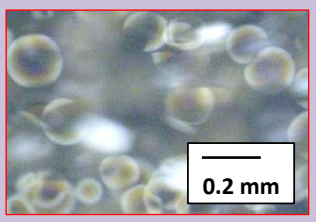
Whitening: A phenomenon PS become hazy because of the various environment.
e. g.) high temperature / humidity, hot water.



high temp./ humid. etc..

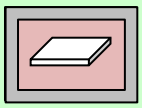


*A lot of disk-shaped voids are inside.



Polystyrene without Whitening: WR

High Temperature and High Humidity Exposure Test

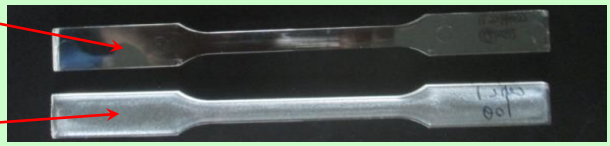


23℃, 50%RH×2 hr

60℃, 90%RH×48 hr

WR: keep transparency

Conventional PS:



【 Applications 】 Items exposed to hot / wet condition, Bathroom, etc.

◆ High Heat Resistant Polystyrene : TF

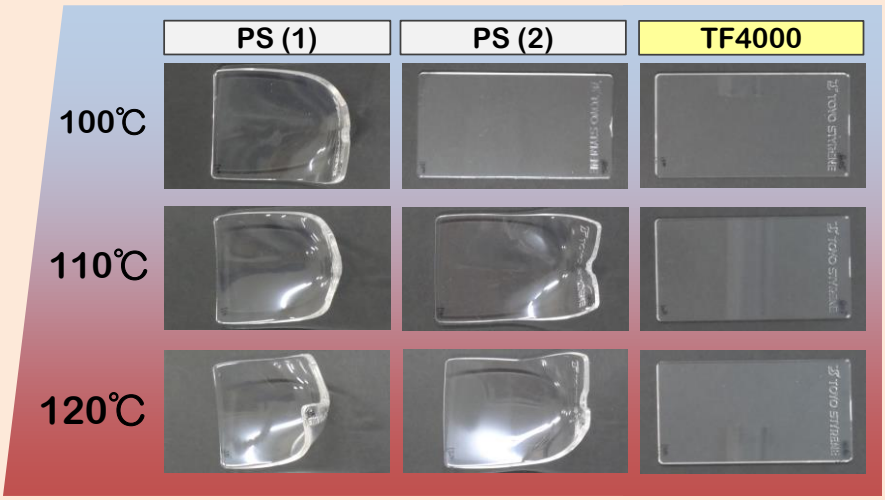
Heat Resistance of Various Plastics

	PS(1) for Injection	PS(2) for Extrusion	TF4000	T080	PMMA for LGP	PC
Vicat softening temp. (℃)	92	103	**122**	**117**	100～109	145～150
Total light transmittance (%)	90	90	90	90	92	90

Vicat softening temp. of TF is 20℃ higher, compare to a normal PS.

Test pieces after heated

after 20 min.



Properties

Features	Unit	PS(2)	T080
Vicat softening temp. (under 50 N)	℃	103	**117**
Heat deflection temp. (under 1.80 MPa)	℃	82	**94**
Melt mass-flow rate (200℃, 5 kg)	g/10min	1.6	**1.7**
Charpy impact strength (notched)	kJ/m^2	2.0	**1.1**
Tensile stress at break	MPa	50	**46**
Tensile strain at break	%	3	**2**
Flexural strength	MPa	104	**100**
Flexural modulus	MPa	3,200	**3,250**

【 Applications 】 items needed heat resistance and transparency

* All data are not as guaranteed values.　2015.12.1

TOYO STYRENE　Flame Retardant Polystyrene

Toyo Styrene Flame Retardant PS is a polystyrene resin with a certain flame-retardant.
By the flame-retardant class, we have not only V-2/V-0 series but also 5VA that is usually difficult in PS systems.
It has been adopted in response to needs such as consumer electronics, OA equipments and housing equipments.

◆ Representative grade

LCD TV-B/C

Heat Stability and Super Light Resistance
Halogen type　:LH30 (V-2)
:ES150 (5VA)

Copying Machine

High Flow and Good Heat Resistance
Halogen type　:FS100S (V-0)

High Flow and Good Light Resistance
Halogen type　:J2 (V-2)

Distribution Board

Flame-Retardant Compound Resin
・Halogen type
・Non-Halogen type

High Strength and Heat Stability
Non-Halogen　:NR5 (5VB)

LCD Monitor Housing-B/C

High Cycle Molding and
High Heat Creep Endurance
Halogen type　:LH30 (V-2)
Non-Halogen　:LX20 (V-2)

Toner Container

Properties	Test Method	Unit	Halogen type				Non-Halogen	
			LH30	J2	FS100S	ES150	LX20	NR5
Melt mass-flow rate	ISO 1133	g/10min	7.5	14.5	14.0	7.0	7.3	4.5
Heat deflection temp.	ISO 75-2	℃	75	71	69	70	72	68
Charpy Impact Strength	ISO 179	kJ/m2	9.7	7.5	11.5	10.0	8.3	13.0
Tensile strain at break	ISO 527-2	%	40	45	60	50	35	25
Flexural modulus	ISO 178	MPa	2500	2500	2050	2250	2400	2600
Density	ISO 1183	kg/m3	1090	1100	1165	1185	1070	1110
Flammability	UL94	-	V-2/0.8mm	V-2/0.75mm	V-0/1.5mm	V-0/1.5mm 5VA/1.5mm	V-2/0.8mm	V-0/1.5mm 5VB/2.0mm

※Data shown above is the mean values of neat resin (natural color).
This means that the values are not guarantee ones.

◆ FR-PS Masterbatch

Name	Direction
Flame-retardant MB (V-0) :Halogen type	Good control for combination ratio between MB & Resin: Enable customer to design FR-HIPS which is suitable for anticipated Flame Retardance by mixed with optional resins. (compatibility is needed)
Flame-retardant MB (V-2) :Halogen type	

FR-MB
(Bromine contents : x%)

※ Color : All color and Black color

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－Options by Customers－

Thinner Base Resin (PS) → Plasticization (Extrusion、Processing)

Ratio between MB & Resin mast be controled.

→ **Finished FR-HIPS V-0 or V-2**