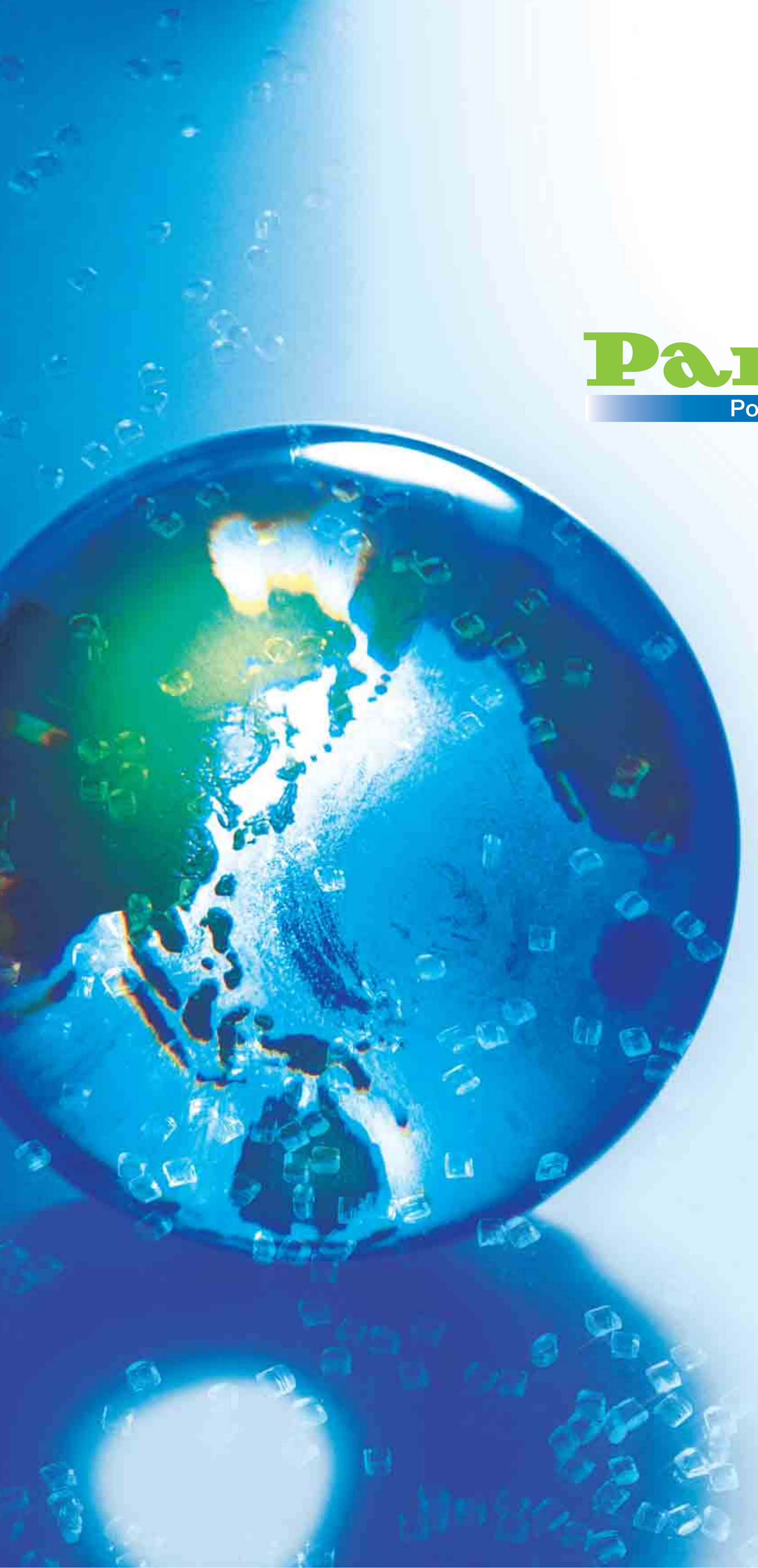
TEIJIN

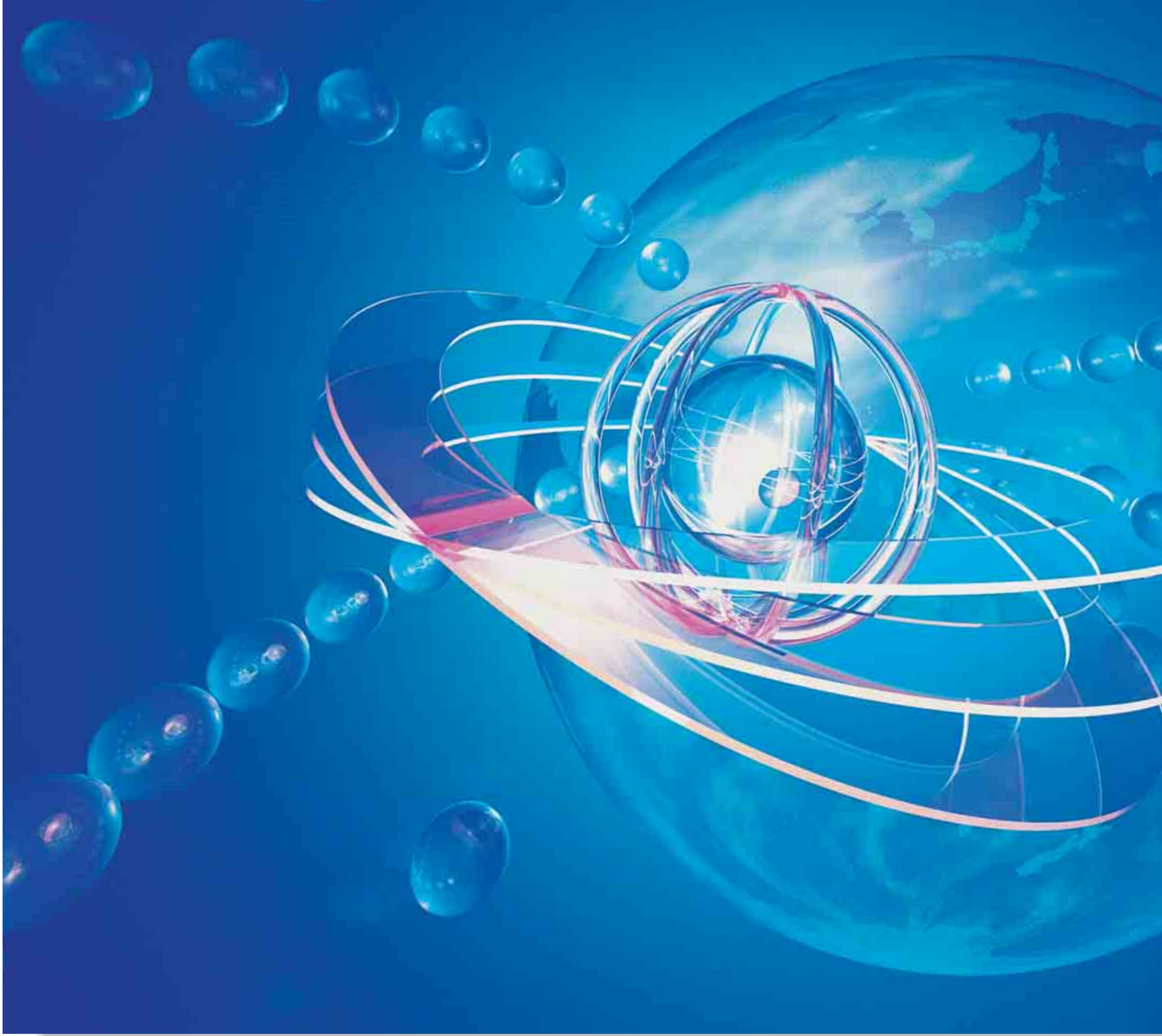
Human Chemistry, Human Solutions

Panlite®

Polycarbonate



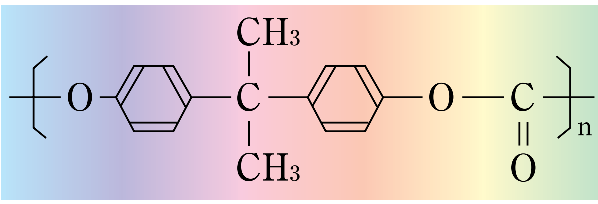
Creating a Future of Limitless Po



The first company to commercially produce polycarbonate resin in Japan, Teijin Chemicals Ltd. is proud to introduce its product, "Panlite", in these pages. Since its introduction, Teijin Chemicals Ltd. has dedicated itself to a continual improvement of quality and development of applications utilizing Panlite, enjoying numerous successes. Through these tireless effots, Panlite has become widely accepted as one of the world's premier engineering plastics.

Teijin Chemicals Ltd. pioneering spirit continues today, with our products widely used in fields ranging from precision machinery to housewares, from the automotive industry to advanced medical equipment. Panlite's remarkable collection of qualities such as heat resistance, dimensional stability, impact strength and transparency make it an ideal choice to meet a variety of product needs. Our customers can rest assured that the superior quality for which Teijin Chemicals Ltd. products are known will always be the cornerstone of our company's approach to business.

Panlite is a thermoplastic resin having the following molecular structure, and is an ideal material for injection molding, extrusion, blow molding, etc.



Contents

Teijin Chemicals Ltd. has been recognized as a company that has established a world-class management system for quality assurance, environmental conservation, and occupational safety and health.

ISO 9001
Matsuyama Plant JMI-0035
Mihara Plant JMI-0034
Plastics Technical Center JQA-1206

ISO 14001
Matsuyama Plant JQA-EM0455
Mihara Plant JQA-EM0442
Plastics Technical Center JQA-EM1013

OHSAS 18001
Matsuyama Plant JQA-OH0075
Mihara Plant JQA-OH0066

CERT NO.: 2000-2-1212
SS ISO 9001 : 2000
TEIJIN POLYCARBONATE SINGAPORE PTE LTD.

CERT NO.: 2003-0219
SS ISO 14001 : 2004
TEIJIN POLYCARBONATE SINGAPORE PTE LTD.

CERT NO.: OHS-2003-0060
OHSAS 18001 : 1999
TEIJIN POLYCARBONATE SINGAPORE PTE LTD.

TEIJIN CHEMICALS PLASTIC COMPOUNDS SHANGHAI LTD.

TEIJIN CHEMICALS PLASTIC COMPOUNDS SHANGHAI LTD.

GB/T19001
TEIJIN POLYCARBONATE CHINA LTD.
00206Q14396ROM

Characteristics

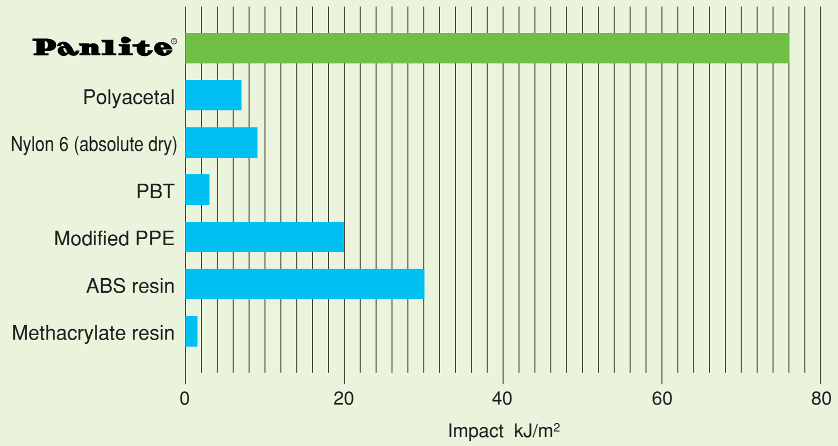
Impact strength	The highest impact strength among all plastics. It is superior to zinc and alminum die castings in impact strength.
Temperature range	Stable properties over a wide temperature range allows for a variety of potential applications (-100 ~ 129°C).
Electrical properties	Panlite electrical properties are excellent in that they show only slight changes throughout a wide range of temperatures ; especially good as an insulating material.
Transparency	It has outstanding rare transparency among all plastics and suitable for optical and sheet applications.
Dimensional stability	Excellent creep property, and only slight dimensional changes throughout a wide range of moisture, temperature and duration conditions.
Flame resistance	Outstanding flame resistance ; satisfies 94V-0, 94V-1, 94V-2 and 94HB (UL standard Subject 94).

Comparative Properties

Specific properties of "Panlite" in comparison with other plastics are shown in the following graphs.

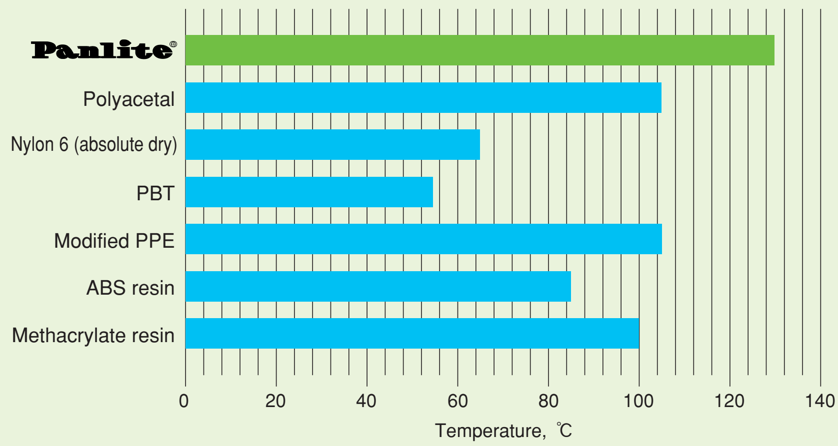
Impact properties

(Charpy, notched, non-reinforced grade)

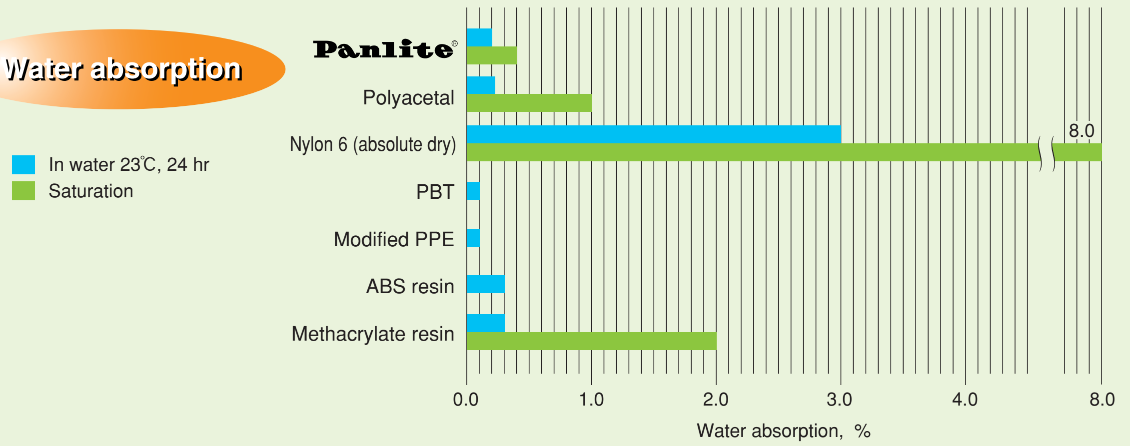


Load-deflection temperature

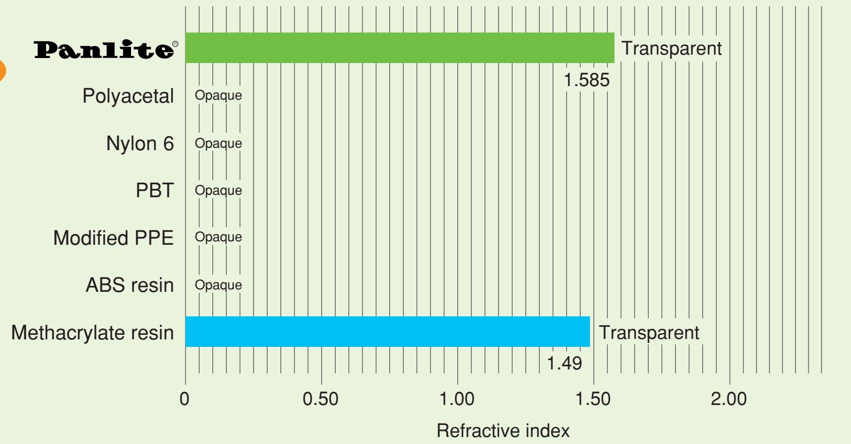
(load 1.80MPa)



Water absorption

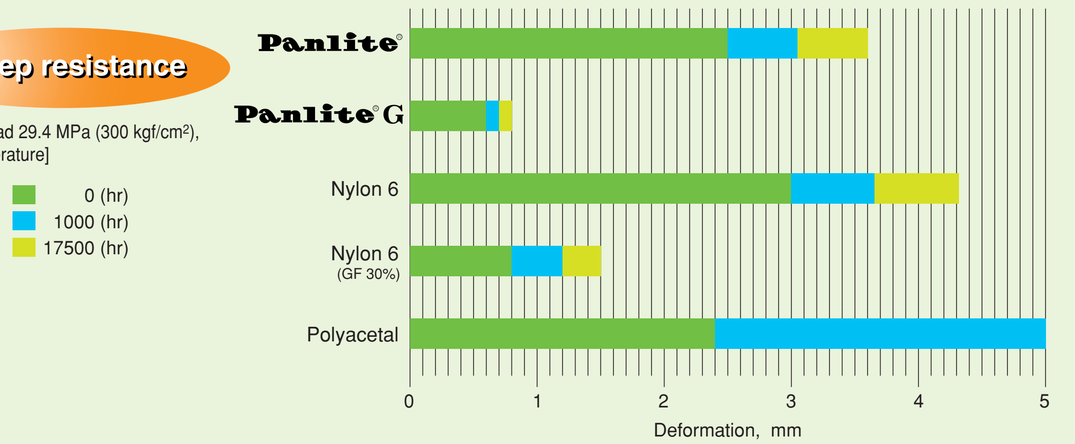


Transparency & refractive index

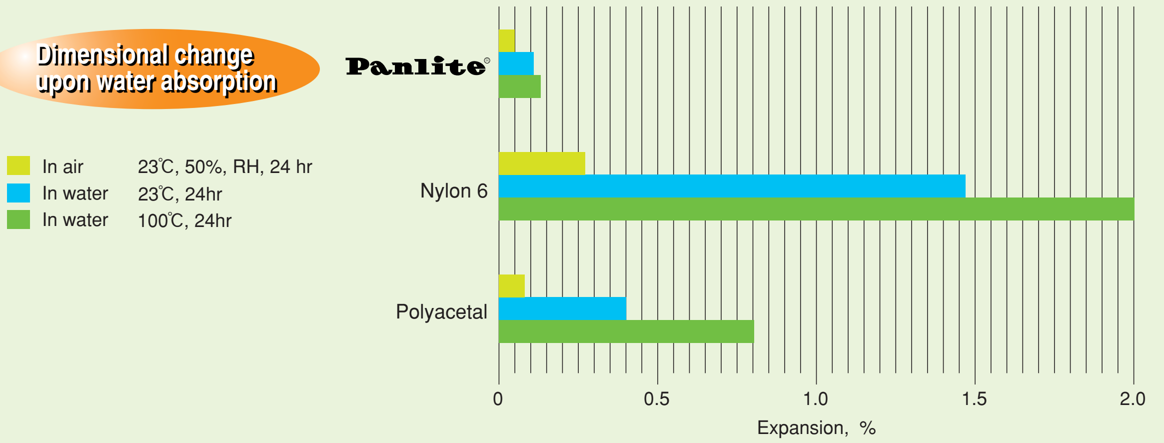


Creep resistance

[Bending load 29.4 MPa (300 kgf/cm²), room temperature]



Dimensional change upon water absorption



Grades

General grades

Type	Grade	Page referring to properties	Characteristics	MVR* (cm³/10min)	MFR* (g/10min)	Main molding methods
Standard (mold release /ice color)	L -1225LM	39	Ultra low viscosity	24	26	Injection molding
	L -1225L LV-2225L	39 40	Ultra low viscosity	18	19	Injection molding
	L -1225Y LV-2225Y	39 40	Low viscosity	11	12	Injection molding/ Injection blow molding
	L -1250Y LV-2250Y	39 40	Medium viscosity	8	9	Injection molding/ Injection blow molding
	K -1300Y	39	High viscosity	2.8	3	Extrusion/Blow molding/ Injection molding
Weather resistance	L -1225ZL 100	40	Ultra low viscosity	25	30	Injection molding
	L -1225Z 100M	40	Ultra low viscosity	19	20	Injection molding
	L -1225Z 100 LV-2225Z	40	Low viscosity	11～12	12～13	Injection molding
	L -1250Z 100 LV-2250Z	40	Medium viscosity	8	9	Injection molding
Extrusion	L -1250ZW	40	Medium viscosity	6	7	Extrusion/ Injection molding
Optical use	AD-5503	41	Optical property/ Low contamination	54	70	Injection molding
Flame resistance	LN-1250G	41	Flame resistance/ Mold release/Translucency	11	12	Injection molding
	LN-2250Y	41	Flame resistance/ Mold release/Transparency	11	12	Injection molding
	LN-2250Z	41	Flame resistance/ Mold release/Transparency/ Weather resistance	11	12	Injection molding
	LN-2520	41	Flame resistance (non-bromine/non-phosphor type)/ Mold release/Translucency	18	19	Injection molding
	LN-2520A	41	Flame resistance (non-bromine/non-phosphor type)/ Mold release/Translucency	18	19	Injection molding
Frictional wear resistance	LS-2250	42	Frictional wear resistance	—	—	Injection molding
High light reflection	LD-1000RM	42	Light reflection/Whiteness/ Mold release	—	—	Injection molding
	LN-3010RM	42	Light reflection/Whiteness/ Mold release/Flame resistance (non-bromine/non-phosphor type)	—	—	Injection molding
	LN-3000RM	42	Light reflection/Whiteness/ Mold release/Flame resistance (phosphor type)	—	—	Injection molding
	LN-1010RM	42	Light reflection/Whiteness/ Mold release/Flame resistance	—	—	Injection molding
Light diffusion	ML-1102	42	High light transmission	—	—	Injection molding
	ML-1103	42	Standard	—	—	Injection molding
	ML-1105	42	High light diffusion	—	—	Injection molding

Note: L and K grades differ from LV grades in UL registration value. (For more details, refer to p.39 and 40.)
*MVR (Melt volume flow rate.) Test method: ISO1133. Measurement condition: 300℃ load 1.2kgf.
*MFR (Melt mass-flow rate.) Test method: ASTM D1238. Measurement condition: 300℃ load 1.2kgf.

Glass fiber reinforced grades

Type	Grade	Page referring to properties	Characteristics	Main molding methods
Standard	G -3410R	43	Glass fiber 10%/Mold release/UL94 V-2	Injection molding
	G -3415R	43	Glass fiber 15%/Mold release/UL94 V-2	
	G -3420R	43	Glass fiber 20%/Mold release/UL94 V-2	
	G -3430R	43	Glass fiber 30%/Mold release/UL94 V-2	
Low anisotropy	G -34**H	43	Glass fiber contained/Low anisotropy/Good appearance/UL94 V-2	Injection molding
Isotropy	G -33**M	44	Glass fiber contained/Isotropy/Good appearance/UL94 V-2	Injection molding
Flame resistance	GN-34**R	44	Glass fiber contained/UL94 V-0	Injection molding
	GN-3610L	44	Glass fiber 10%/non-bromine/non-phosphor/UL94 V-0	Injection molding
	GN-3620L	44	Glass fiber 20%/non-bromine/non-phosphor/UL94 V-0	Injection molding
	GN-3630H	44	Glass fiber 30%/non-bromine/non-phosphor/Low anisotropy/UL94 V-0	Injection molding
High flame resistance	GV-34**R	44	Glass fiber contained/UL94 V-0	Injection molding
Frictional wear resistance	GS-34**	45	Glass fiber contained/Frictional wear resistance/UL94 V-2	Injection molding
Camera use	G -3110PH	45	Glass fiber 10%/Low anisotropy/Good appearance/Paintwork	Injection molding
	G -3120PH	45	Glass fiber 20%/Low anisotropy/Good appearance/Paintwork	Injection molding
	G -3130PH	45	Glass fiber 30%/Low anisotropy/Good appearance/Paintwork	Injection molding

Notes: ** varies according to the filler content.

Carbon fiber reinforced grades

Type	Grade	Page referring to properties	Characteristics	Main molding methods
Standard	B -8110R	46	Carbon fiber 10%/Mold release/UL94 V-2	Injection molding
	B -8120R	46	Carbon fiber 20%/Mold release/UL94 V-2	
	B -8130R	46	Carbon fiber 30%/Mold release/UL94 V-2	
Flame resistance	BN-81**R	46	Carbon fiber contained/Mold release/UL94 V-0	Injection molding
	B -41**R	47	Carbon fiber contained/Mold release/non-bromine/non-phosphor/UL94 V-2	Injection molding
Frictional wear resistance	BS-81**R	47	Carbon fiber contained/Frictional abrasion resistance/UL94 V-2	Injection molding
EMI shield	E -8715	47	EMI shield/Mold release/High heat resistance/High impact resistance/ Phosphor type flame resistance/UL94 V-2	Injection molding
	EN-8515N	47	EMI shield/Mold release/Phosphor type flame resistance/ High flame resistance/UL94 V-0, 5VA	Injection molding
	EN-8615N	47	EMI shield/Mold release/Phosphor type flame resistance/UL94 V-0	Injection molding

Notes: ** varies according to the filler content.

PC alloy grades

Type	Grade	Page referring to properties	Characteristics	Main molding methods
Standard	AM-18**	48	Polycarbonate [Low-temperature and high impact resistance]	Injection molding
	AM-8***	48	Polycarbonate/polyester alloy [Chemical resistance]	
	AM-9***	48	Polycarbonate/polyester alloy [Heat resistance, Chemical resistance]	
Flame resistance	MN-3600H	48	Polycarbonate [Flame resistance, High heat resistance]	Injection molding
	MN-3705	48	Polycarbonate [High flame resistant, High flow]	Injection molding
Fiber reinforced grade	AM-9***F	48	Polycarbonate/polyester alloy (Special fine filament) [High rigidity, High appearance,Chemical resistance]	Injection molding
	GM-93**	48	Polycarbonate/polyester alloy (Glass fiber mixed) [High rigidity, Chemical resistance]	Injection molding

Note: ** Value differs depending on the type of compounded agent and compounding amount.

Panlite® is also supplied in grades other than those listed here for speciality uses.

Applications

Optical

Ophthalmic lens

DVD-R／RW／RAM　　HD DVD-R　　BD-R／RE

Electric & Electronics Appliance, Lighting Fixtures

Relay case

Lighting switches

Silicon wafer container

Electric & Electronics Appliance, Lighting Fixtures

Iron

Lighting globe

Ship lamp

Digital audio player

Mobile phone buttons

Mobile phone

Liquid crystal projector

Business Machines

Lap-top PC enclosure

Optical box

Copier

Head lamp Inner lens Turn signal lamp

High-mounted stop lamp

Automotive

Head lamp

Automotive


Door handle


Motorcycle window screen


Extra window

Roof rail leg

Center panel

Instrument panel

Precision & Machinery

Interchangeable lens

Digital video camera

Digital camera

Digital camera

Interchangeable lens

Interchangeable lens

Electric power tool

Safety

Smoke detector

Traffic light lens

Protective glasses

Helmet

Miscellaneous

Goggles Sport sunglasses

Karate mask

Suitcase

Fish-breeding tank

Mechanical Properties

Panlite has stable mechanical characteristics over a wide range of temperatures. Panlite has particularly impressive tensile strength, flexural strength, impact strength and creep characteristics, and as such is a highly regarded engineering plastic material.

Tensile characteristics

Panlite shows stable tensile strength over a wide temperature range. Especially, it will not show any conspicuous change in quality even under high temperatures.
Panlite G is a glass fiber reinforced grade, and its tensile strength increases as the glass fiber content increases. For example, see Fig. 1.

Flexural characteristics

Panlite shows stable flexural characteristics over a wide temperature range.
The flexural strength and the flexural modulus of Panlite G increase as the glass fiber content increases.

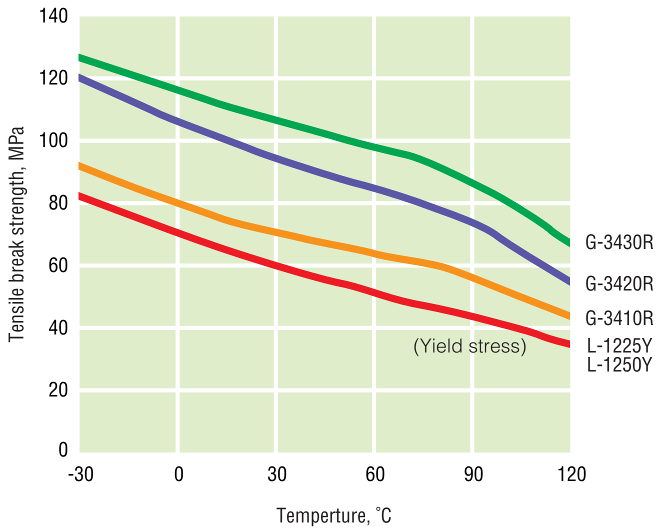


Fig. 1 Tensile break strength of Panlite vs. temperature

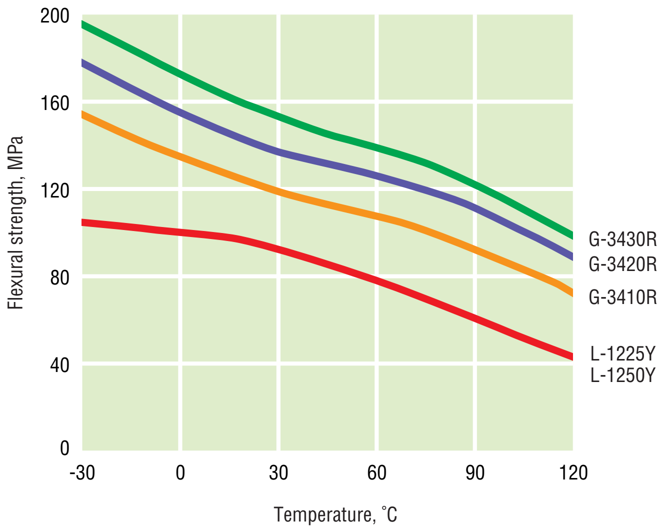


Fig. 3 Flexural strength of Panlite vs. temperature

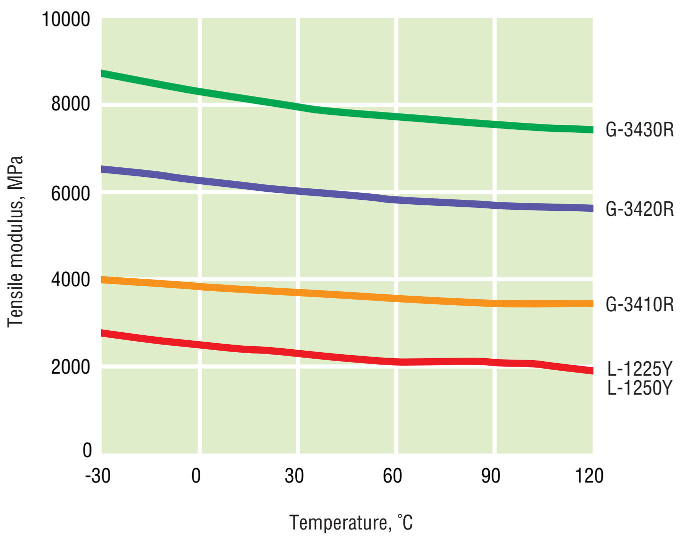


Fig. 2 Tensile modulus of Panlite vs. temperature

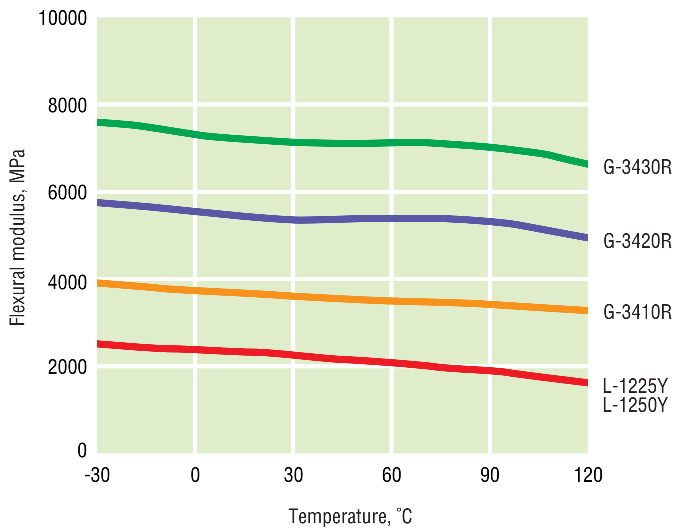


Fig. 4 Flexural modulus of Panlite vs. temperature

Impact characteristics

Panlite has outstanding impact characteristics.
For example, it shows a high Charpy impact value (notched) of 67 KJ/m² or more at room temperature.
At temperatures below -20˚C or -30˚C, although ductile fracture characteristics change to brittle fracture, the material shows a high value compared with other plastic materials (Figure 5).
If the designed product is unnotched and without sharp corners, stable impact characteristics are obtained over a wide temperature range, as brittle fracture at low temperature is eliminated.
It should be noted that the impact value is affected by the average molecular weight (Fig. 6).
The impact value of Panlite G increases as the glass fiber content is increased (Fig. 7).

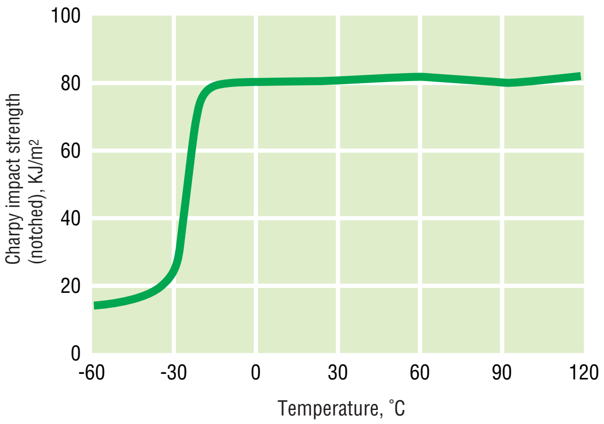


Fig. 5 Impact Strength of Panlite vs. Temperature (General PC)

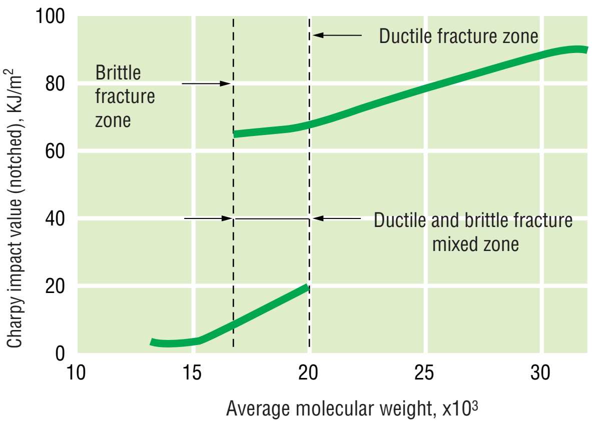


Fig. 6 Molecular Weight vs. Impact Strength of Panlite

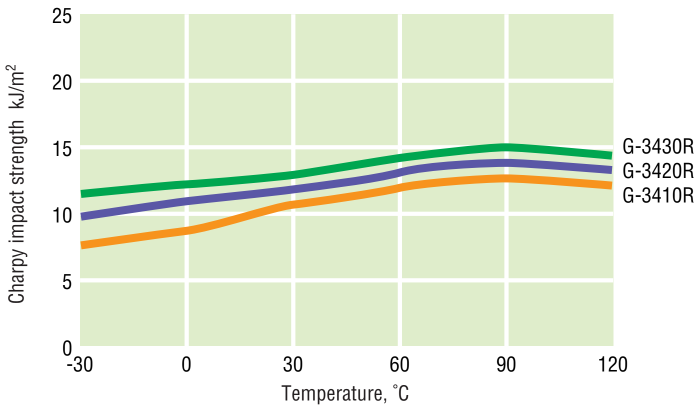


Fig. 7 Impact value of Panlite vs. temperature (PCG)

Creep characteristics

Creep is a phenomenon that is characterized by an increase in the deformation of the material with time when a certain stress is given to the material. Creep is related to both the temperature and the stress.
Panlite has outstanding creep characteristics (Fig. 8).
In the cases of Panlite and Panlite G, the apparent flexural modulus varies respectively due to the creep (Fig. 9).
As for the relationship between creep deformation of Panlite and the designed stress, for example, when the material is subjected to the stress of 12.7 MPa at 20˚C, the deformation after 20 years is 0.7% (Fig. 10).

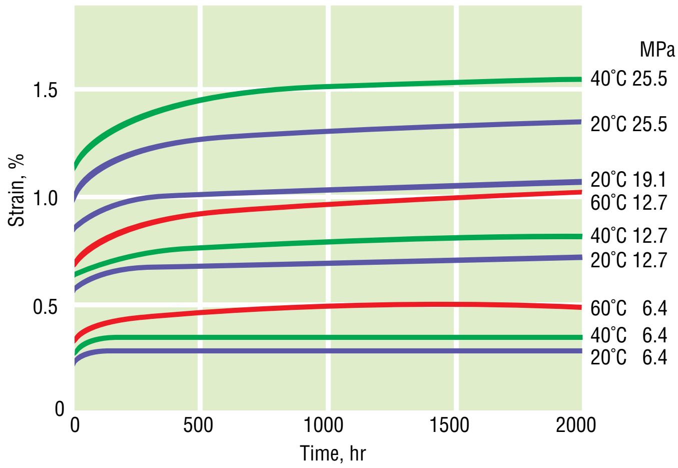


Fig. 8 Creep Characteristics of Panlite

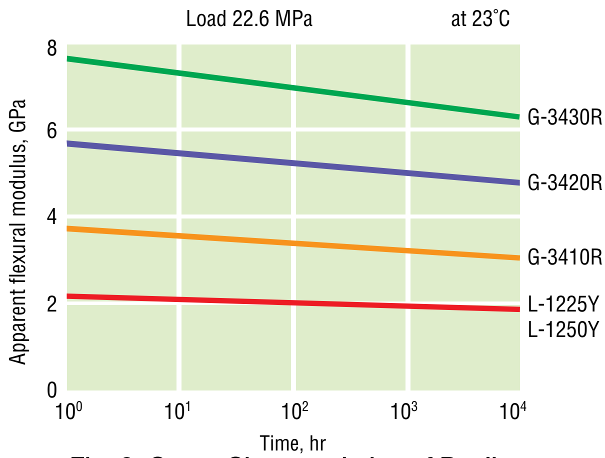


Fig. 9 Creep Characteristics of Panlite (Apparent flexural modulus)

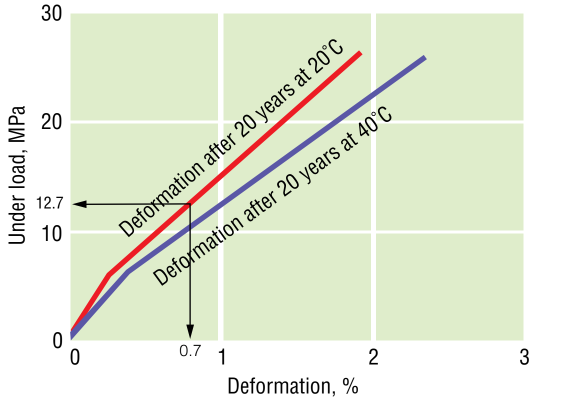


Fig. 10 Creep Deformation vs. Stress of Panlite

Repeated fatigue characteristics

The rupture of material due to repeated fatigue occurs even when the stress is lower than its flexural strength.
The curve drawn by plotting the values of repeated stress and the number of times of repetition of the stress until the rupture occurs is called the S-N curve. The repeated fatigue characteristics of Panlite can be improved largely by increasing the glass fiber content (Fig. 11).

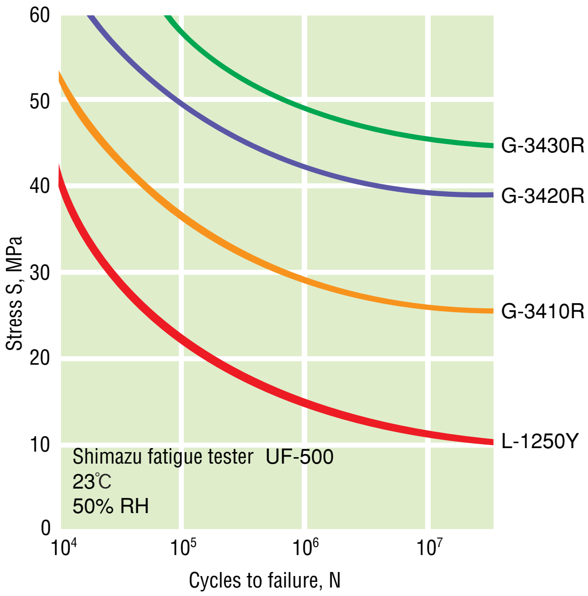


Fig. 11 Repeated Fatigue Characteristics of Panlite

Allowable stress

When a plastic part has been used for a long period of time under stress, crazing or cracking sometimes occurs. The maximum stress at which neither crazing or cracking occurs is called allowable stress, and it varies depending on the operating temperature. The allowable stress is the greatest stress under which a material is believed to be safe in actual use, and may also be called design stress. Allowable stress varies according to the type of stress, but in all cases it has been determined after material testing, by service conditions and experiences (Table 1).
Since allowable stress is a maximum value, a safety allowance must be added when assuming the stress in service conditions.

Table 1 Allowable Stresses of Panlite and Panlite G

Static load: MPa

Grade \ Temp, ℃	−20	0	20	50	100
L-1250Y	15.7	14.7	13.7	11.3	2.9
G-3410R	20.6	19.6	18.6	13.7	3.9
G-3420R	27.5	24.5	23.0	17.7	5.9
G-3430R	32.4	29.4	27.5	22.6	8.3

Thermal Properties

Panlite's secondary transition point is between 145-150℃ and its heat distortion temperature between 123-132℃, both of which place it within the higher categories among thermoplastics. As for its low-temperature characteristics, the brittle temperature is lower than -100℃ -extremely low- and thus Panlite has stable mechanical and electrical properties over a wide temperature range.

Flame resistance

Panlite has excellent flame resistance compared with other thermoplastic resins.

Table 2 Flash temperature and auto-ignition temperature of Panlite

Item	Test method	Characteristic value
Flash temperature	ASTM D1929	480℃
Auto-ignition temperature	ASTM D1929	580℃

Table 3 UL94 flame class and oxygen index of Panlite

Grade	UL94 flame class (thickness 1.5mm)	Oxygen index (O.I.)
L-1250Y	94HB	25~26
LV-2225Y	94V-2	29~30
LV-2250Y	94V-2	29~30
LN-1250G	94V-0	31~32
G-3410R	94V-2	33~34
G-3430R	94V-2	34~35
GN-3410R	94V-2	41~42
GN-3430R	94V-0	42~43
GV-3410R	94V-0	42~43
GV-3430R	94V-0	44~45

* Oxygen index (O.I.) test method: ASTM D2863

Continuous service temperature

According to UL 746B, the temperature at which the initial strength of the material is reduced to a half is defined as the long term continuous service temperature (temperature index). Each grade of Panlite is approved as a material having a higher temperature index than that of other materials (Table 4).

Table 4 Temperature Index of UL (UL746B, Thickness: 1.47 mm)

(℃)

Grade	Electric	Mechanical	
		Impact	Non-impact
L-1225Y	125	115	125
L-1250Y	125	115	125
K-1300Y	125	115	125
LN-1250G	125	115	125
G-3410R	130	120	130
G-3430R	130	125	130
GN-3410R	130	120	130
GN-3430R	130	120	130

Ball pressure temperature

For plastics, ball pressure temperature is specified by IEC Publication 335-1, UL746C and Electric Appliances Control Law (regulations concerning technical standards).
The ball pressure temperature of Panlite is on the higher side of all thermoplastics (Table 5).

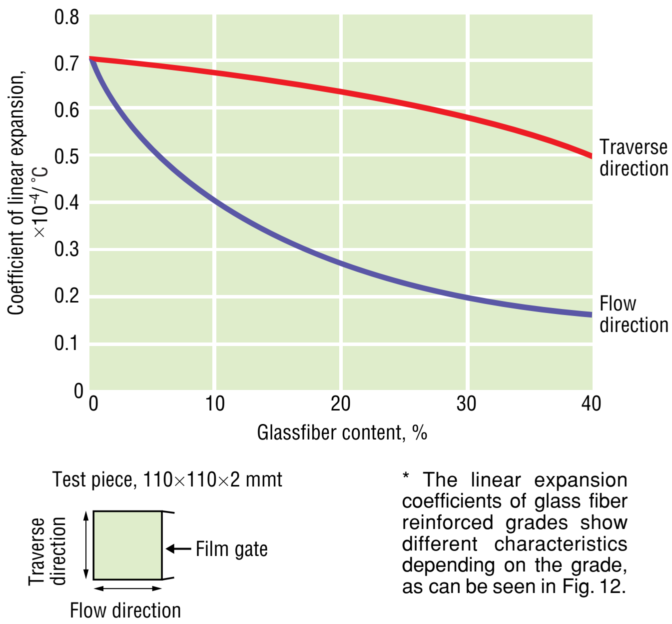
Table 5 Ball Pressure Temperature of Panlite

(℃)

Grade	Ball pressure temp., ℃
L-1225Y	130
L-1250Y	130
K-1300Y	135
LN-1250G	130
G-3410R	135
G-3430R	135
GN-3410R	135
GN-3430R	135

Coefficient of linear expansion

Panlite G-3430R has a low coefficient of linear expansion, nearly equal to that of die-cast aluminum (Fig. 12). However, there are differences between the flow direction and traverse direction due to glass fiber orientation. This must be taken into consideration when designing a product.



* The linear expansion coefficients of glass fiber reinforced grades show different characteristics depending on the grade, as can be seen in Fig. 12.

Fig. 12 Coefficient of Linear Expansion of Panlite

Melting point and decomposition temperature

As Panlite is an amorphous plastic, it does not show a definite melting point, but is roughly 230-240°C. Also, the decomposition temperature is over 340°C (Fig. 13).

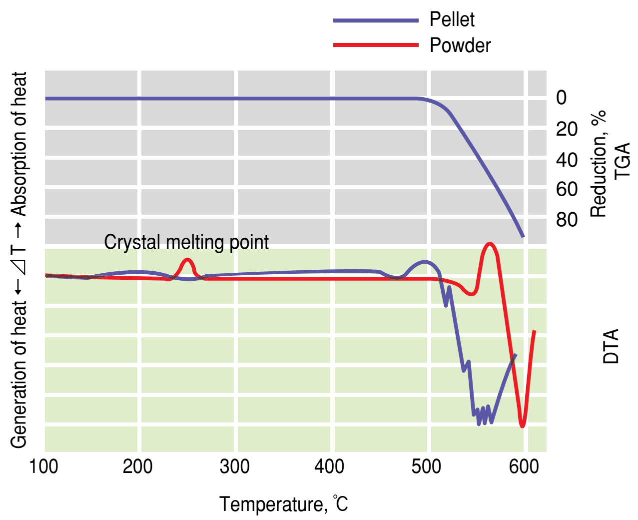


Fig. 13 TGA-DTA Curve of Panlite

Electrical Properties

Panlite is an insulating material with excellent electric characteristics compared with other plastic materials. Panlite features not only high dielectric breakdown strength and high volume resistivity but also stable dielectric constant and stable dielectric loss tangent in a wide range of temperatures and frequencies (Fig. 14-19).

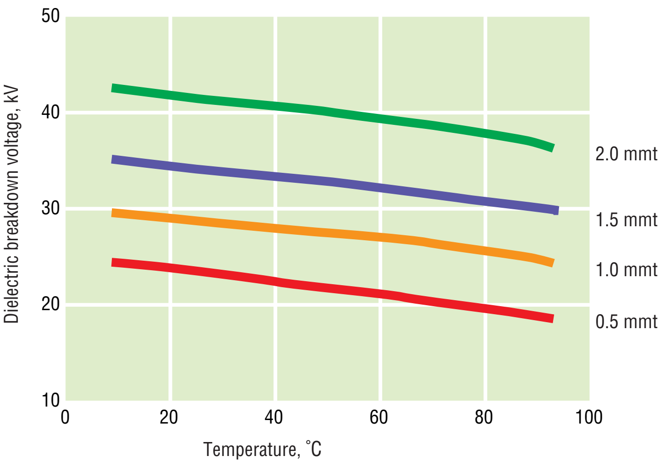


Fig. 14 Dielectric Breakdown Strength of Panlite vs. Temperature

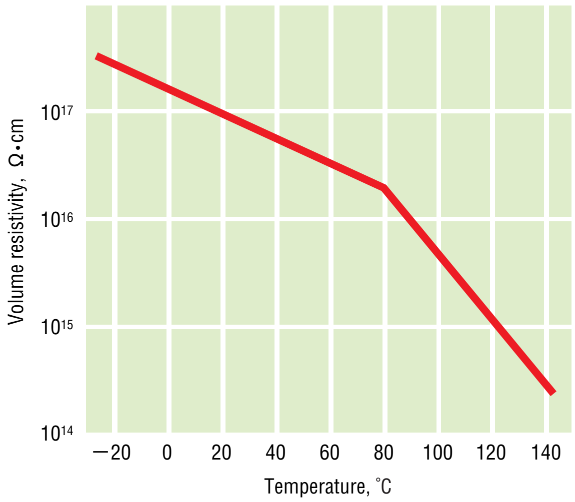


Fig. 15 Volume Resistivity of Panlite vs. Temperature

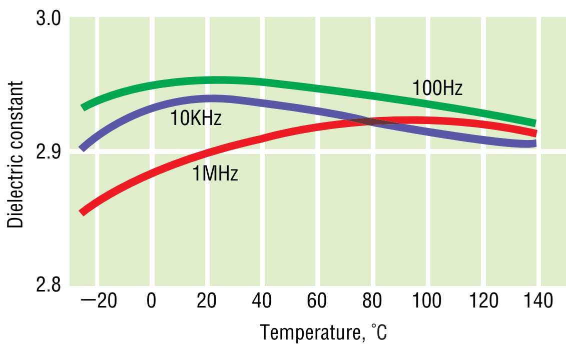


Fig. 16 Dielectric Constant of Panlite vs. Temperature

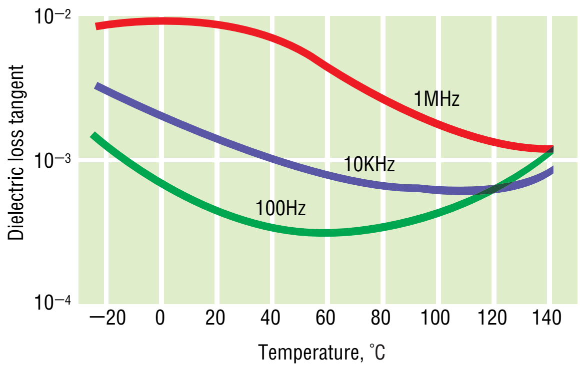


Fig. 17 Dielectric Loss Tangent of Panlite vs. Temperature

(at 23˚C)

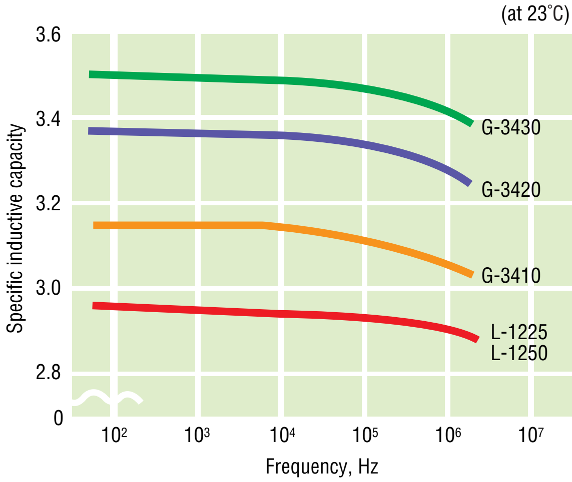


Fig. 18 Dielectric Constant of Panlite vs. Frequency

(at 23˚C)

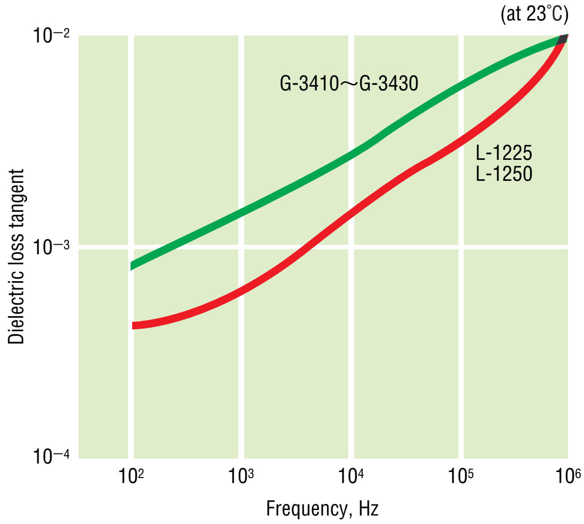


Fig. 19 Dielectric Loss Tangent of Panlite vs. Frequency

Chemical Properties

In general, Panlite is stable in water, alcohol, oil, salts and weak acids, but adequate care should be taken as it becomes cloudy, swells or dissolves in alkali, aromatic hydrocarbons, halogenated hydrocarbons, etc.

Critical stress

Even when the stress acting on the plastic material is less than the allowable stress, it can cause crazing or cracking of the material when it is in contact with a chemical, though it depends on the kind of chemical. Such a phenomenon is called solvent cracking, and the minimum stress at which the solvent crack occurs is called the critical stress. Panlite can be left in contact with the chemicals whose critical stress values are over 13.7 MPa, but adequate care should be taken in cases where the critical stress values are less than 13.7 MPa (Table 6).

Table 6 Chemicals Resistance (Critical stress) of Panlite

Chemicals	23˚C	70˚C
Inorganic chemicals		
Hydrochloric acid 10%	○	×
Sulfuric acid 10%	○	○
Nitric acid 10%	○	×
Caustic soda 10%	△	×
Phosporic acid 1%	○	×
Potassium chloride*	○	○
Sodium chloride*	○	○
Aluminum chloride*	○	×
Soda carbonate*	△	△
Soda sulfide*	×	×
Ammonium chloride*	×	×
Organic chemicals		
Acetic acid 10%	○	
Acetic acid 100%	×	×
Formic acid 100%	△	
Methanol	△	×
Ethanol	○	△
Ethyl ether	×	×
Acetone	×	×
Ethyl acetate	×	×
Carbon tetrachloride	×	×
Benzene	×	×
Petroleum benzine	△	
Chloroform	×	×
Dichloroethane	×	×
Dioxane	×	×
Dimethylformamide	×	×
Tetrahydrofuran	×	×
Toluene	×	×
Phenol solvent 5%	×	×
Metacresol	×	×

*: 23˚C saturated solution

Chemicals	23˚C	70˚C
Oil products		
Gasoline	×	×
Kerosene	○~△	×
Gas oil	○~△	×
Spindle oil 60 (Shell)	○	△
Open gear oil No. 1 (Daphne, Idemitsu)	○	△
Mechanic 56 (Daphne, Idemitsu)	○	○
Swalube RO-10 (Maruzen)	△	△
Swalube RO-100 (Maruzen)	○	○
Hydraulic L-150 (Kyodo oil)	○	○
Mobil Super 10W50 (Mobil)	○	○
Special-A Turbine oil (Maruzen)	○	○
Grease		
Moricoat 44 grease M (Dow-Corning)	○	○
Silicone KS64 grease (Shin-Etsu)	○	○
Silicone YG3058 (Toshiba)	○	○
Showa Cup Class-1 No. 3 (Showa)	○	△
Grease Max No. 2 (Maruzen)	○	○
Albania Grease No. 3 (Shell)	○	×
Grease Darina 2 (Shell)	○	○
Gold No. 2 (Nippon Grease)	○	○
Cutting oils		
Neocool AP-Cut (Matsumura Yushi)	○	△
Diatool A-4 (Daido Kagaku)	○	○
Shimiron M (Modification No. 2) (Daido)	○	×
Silicone TSM631 (Toshiba)	○	×
Silicone KM780 (Shin-Etsu)	○	×
Silicone YF3842 (Toshiba)	○	×
Rust preventatives		
Rustfighter (Nippon Grease)	○	△~×
Nonruster (Yushiro Kagaku)	○	△~×
RP-6 (Shin Nippu Kagaku)	○	○

Chemicals	23˚C	70˚C
Antistatic agents		
Hotac	○	○
Antista ADS	○	○
Elecnon OR-S	○	○
Disinfectants		
Decahydronaphthalene	○	×
Osban (Aqueous solution of 500 times)	○	○
Hibiten (Aqueous solution of 500 times)	○	○
Detergents		
Alkali detergent (pH 11)	△	×
Invert soap	○	△
Mypet (Undiluted solution) (Kao)	○	○
Magiclean (Undiluted solution)	×	×
Bluedia (Lion)	○	○
Cosmetics		
MG-5 hair tonic	○	○
MG-5 hair liquid	○	○
Eroica hair liquid	○	×
Foods		
Whisky	○	○
Japanese Sake	○	○
Wine	○	○
Sesame oil	○	△
Salad oil	○	△
Butter	○	△

○: Items usable: Critical stress is over 13.7 MPa
△: Items requiring care in use: Critical stress is 9.8-13.7 MPa
×: Items not usable: Critical stress is less than 9.8 MPa

Caution: Above ○ marked items are considered as usable for the present, but it is required to conduct an experiment before use under the actual use condition.

Hot water resistance

Panlite has carbonate bond. When it is soaked in hot water of 80°C or above for a long period of time, it is hydrolyzed and the physical properties decline gradually. Therefore, in designing the product, due consideration should be given to its specifications.

Sanitary properties

A number of Panlite grades have been approved by the sanitation test of the Ministry of Health and Welfare notification No. 18 of the year 1994 . There are also grades that meet the Japan Hygienic Olefin And Styrene Plastics Association´s Self-restrictive Requirements on Food-contacting Articles Made of Polyolefins and Certain Polymers, and the sanitation standards of the FDA (Food and Drug Administration) in the US.
Panlite is also approved as No. 7-738, one of the existing chemical products falling under the categories prescribed by the law concerning the examination and control of the manufacture of chemical products.

Optical Properties

Transparency

Panlite has excellent light transmission of about 90% per 2 mm thickness (Fig. 22)

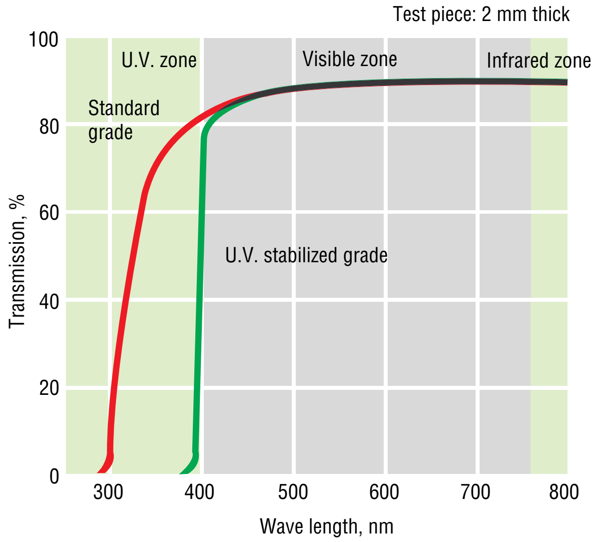


Fig. 22 Light Transmission

Refractive index

Panlite has as high a refractive index as 1.585 (nd) at normal temperatures. In Fig. 23, the temperature dependence of refractive index is shown.

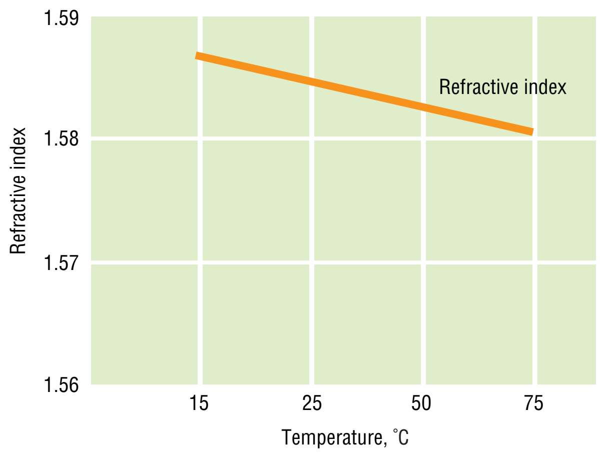


Fig. 23 Temperature Dependence of Refractive Index

Abbe number

The Abbe number of Panlite is 30.

Weather Resistance

Panlite has outstanding weather resistance characteristics.
The weather resistant grade is an improved version in which both mechanical property degradation and changes in hue have been further decreased (Fig. 24-30).

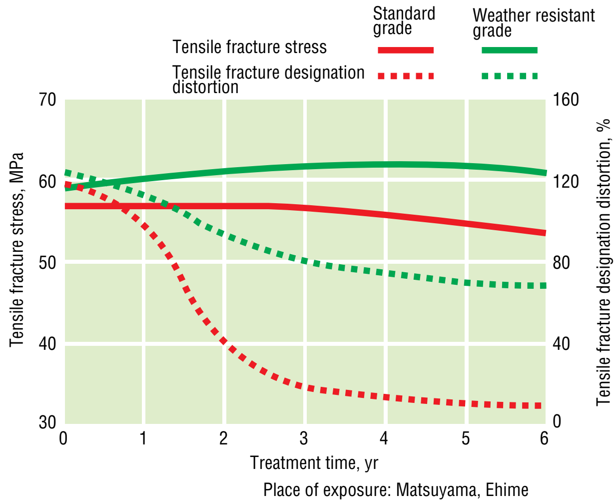


Fig. 24 Outdoor exposure test (tensile property) of Panlite

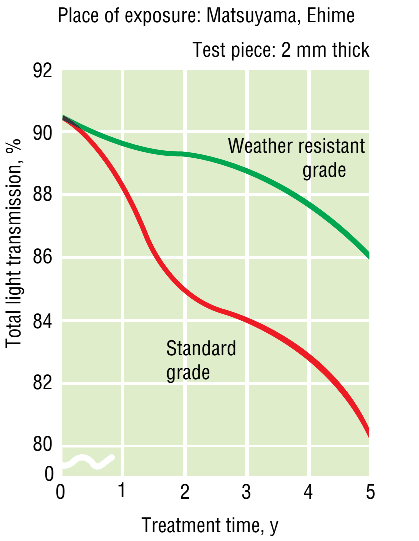


Fig. 25 Outdoor Exposure Test (Total light transmission)

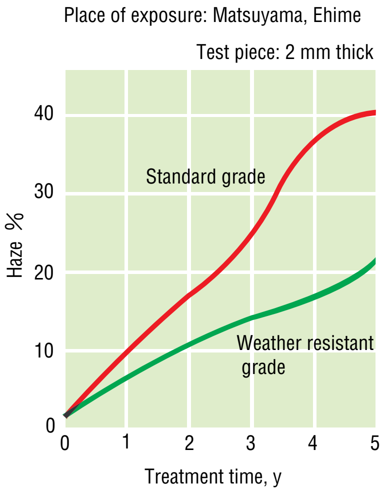
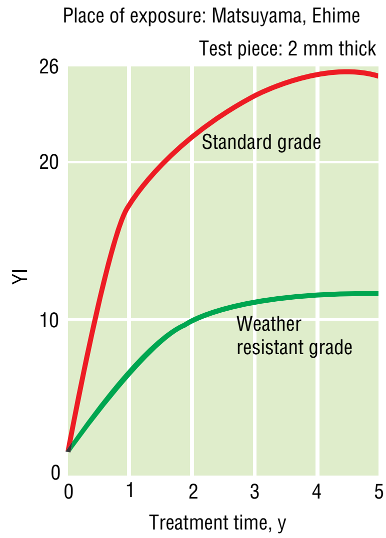


Fig. 26 Outdoor Exposure Test (Haze)



Note: Yellow index is measured by the transmission method using a light source C.

Fig. 27 Outdoor Exposure Test (YI: Yellow index)

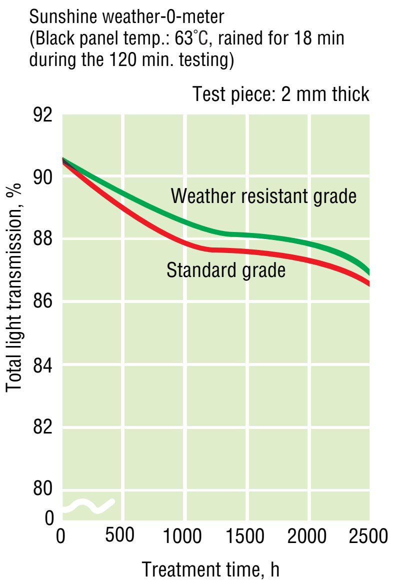


Fig. 28 Accelerated Weather Resistant Test (Total light transmission)

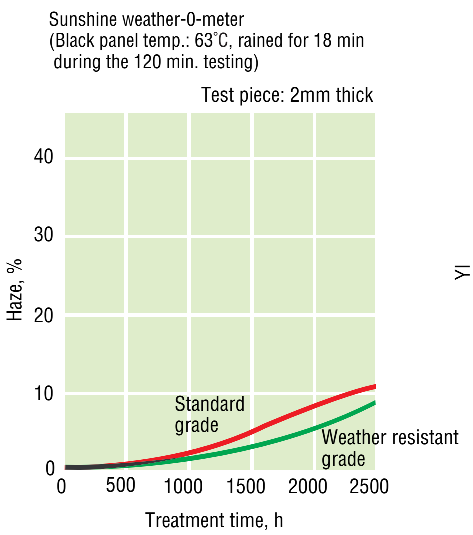
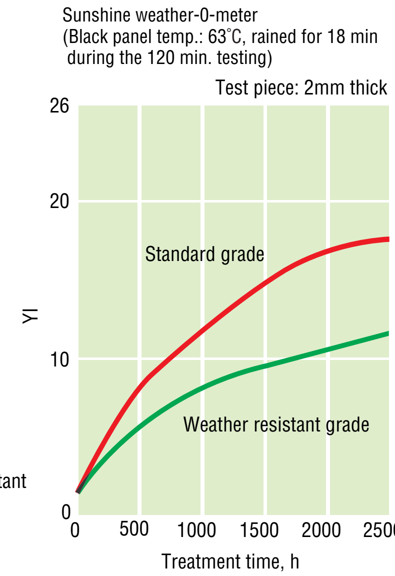


Fig. 29 Accelerated Weather Resistant Test (Haze)



Note: Yellow index is measured by the transmission method using a light source C.

Fig. 30 Accelerated Weather Resistant Test (YI: Yellow Index)

Product Design

Panlite is a widely accepted engineering plastic because of its fine mechanical characteristics, wide range of temperature adaptability, and good dimensional stability. The following are typical examples of applications for practical design utilizing Panlite.

Product thickness

The thickness of molded products is usually 1-4 mm. If there is, however, any irregular wall thickness, the thick wall section sometimes sinks and bubbles are apt to show up in the center. It is therefore recommended that the rib construction should be adopted to the thick wall section. Also drastic changes of thickness should be avoided and uniformity in thickness should be maintained (Fig. 31).

Main considerations for thickness in designing are as follows.

(1) Maintain thickness as uniform as possible.
(2) Avoid drastic changes in thickness.
(3) Adopt rib construction to the thick wall section.

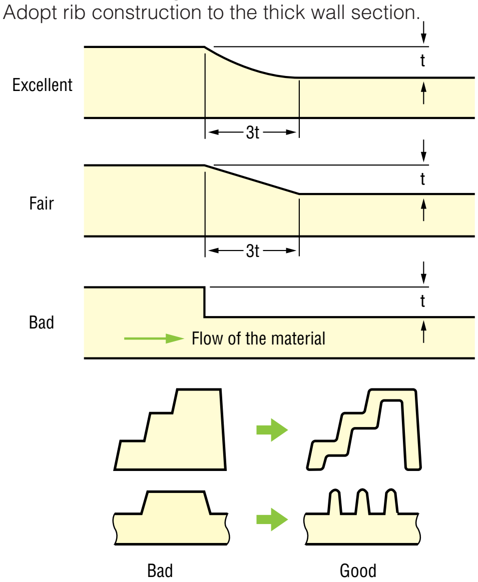
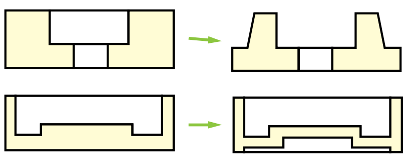


Fig. 31 Wall Thickness Change



Corner R/T

Since stress is concentrated around the corners, avoid designing sharp corners and increase the corner R/T to above 0.3R/T, or preferably above 0.5R/T.

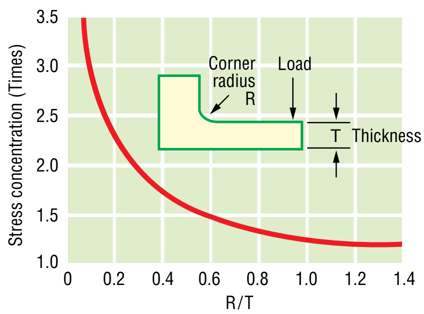


Fig. 32 Stress Concentration at the Corner Part

Rib

To reduce thickness of the designed product, rib construction is recommended as an efficient method of product reinforcement. The main considerations for rib construction design are as follows.

(1) Construction of two or more smaller ribs as opposed to a single independent rib.
(2) Lattice structure to increase strength.
(3) Reduce rib thickness to below that of the base material.
(4) R reinforcement at the foot of the rib.

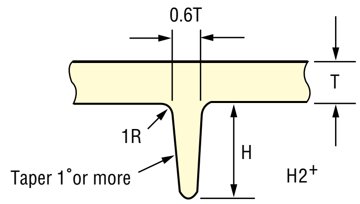
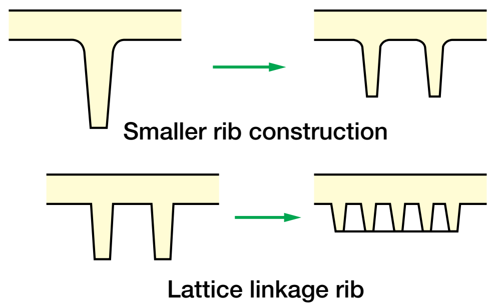


Fig. 33 Standard rib



Boss design (Press-in)

Since residual stress when molded, load, and difference of thermal expansion coefficient are centered onto the screw boss and insert boss, sufficient material thickness is required when designing.

For screw bosses, it is recommended that the design inside diameter of the boss should be the effective diameter of the screw. For an insert boss, the value of the outside diameter of the insert metal "d" should be used.

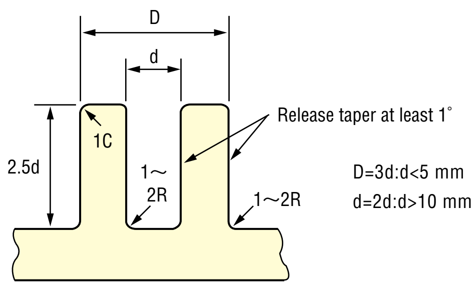


Fig. 34 Screw Boss Radius

Mold release taper

Since the mold shrinkage rate of Panlite is as low as 0.5-0.7%, sufficient mold release taper is required.
The standard taper on one side is about 1/100 (Fig. 35)
For embossing molds, a larger taper may be required depending on the roughness of the embossing.

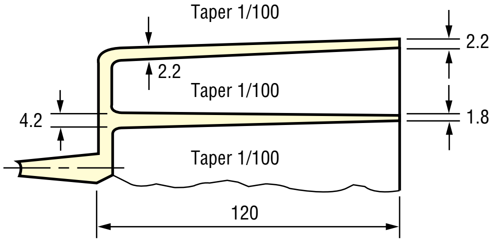


Fig. 35 Standard Mold Release Taper

Sprue

Sprue shape varies with the size of molded products and the molding machine used. Illustrated in the drawings here are standard shape.

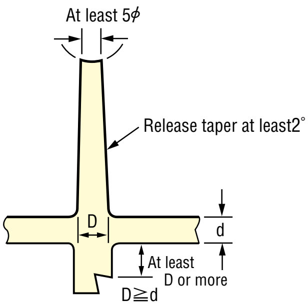
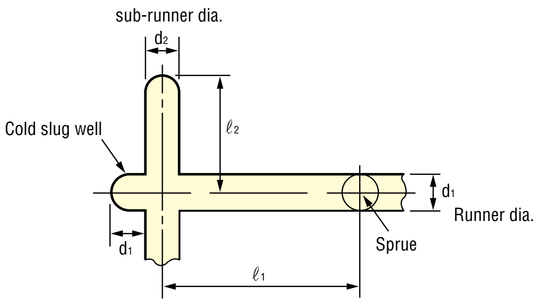


Fig. 36 Standard Sprue and Runner

Runner

Runner shape varies with the size of the molded products and the type of molding machine. The length of the runner should be kept as short as possible. In case the runner has branches, the balance of the runner should be maintained. A cold-slug well should be provided at branches and bent sections.



The runner and sub-runner should be designed in diameter and length, as recommended below. Cold-slug well should be provided at the bent section.
(mm)

Runner length ℓ_1	Runner dia d_1
less than 70	6
70～200	8
more than 200	more than 10

Sub-runner length ℓ_2	Sub-runner dia d_2
less than 70	6

Fig. 37 Standard Runner Shape

Gate

With regard to shapes and locations of the gate, consider how the resin fills, how the molded products can be easily detached, and how finishing can be facilitated without difficulty. The following are examples of typical gate shapes and designs used for Panlite.

● Tab gate
This reduces haze around the gate, jetting and residual stress.

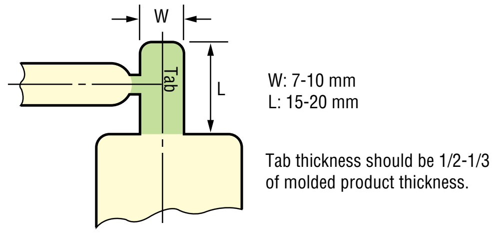


Fig. 38 Example of Standard Tab Gate

● Fan gate
This eliminates jetting.

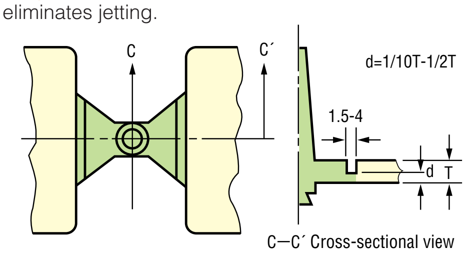
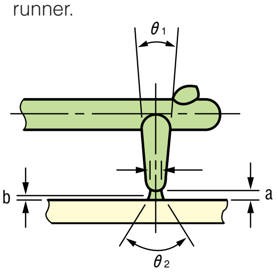


Fig. 39 Example of Standard Fan Gate

● Pin-point and submarine gates
These can detach the molded product automatically from the runner.



Symbol \ Molded product	Small product	Large product
θ_1 °	20～30	20～30
θ_2 °	90	60
a mm	0.6～1	1～3
b mm	0.3～0.5	0.5～2
d mm	1.0～2.0	more than 2.5

Fig. 40 Example of Standard Pin-point Gate

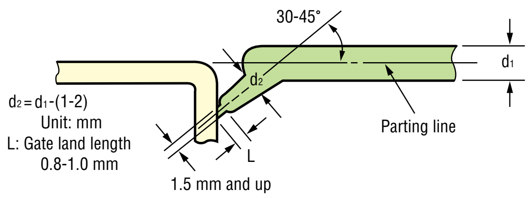


Fig. 41 Example of Standard Submarine Gate

● Ring and diaphragm gates
These eliminate the weld around the cylinder.

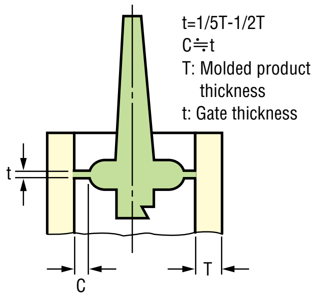


Fig. 42 Example of Standard Ring Gate

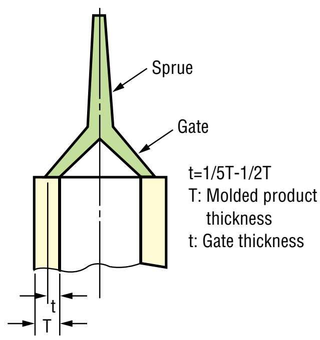


Fig. 43 Example of Standard Diaphragm Gate

Ejection

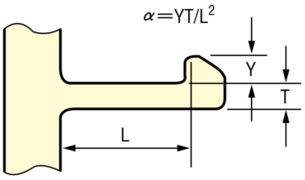
Since Panlite has a high load-deflection temperature and strength, ejection can be easily accomplished. However, when the ejection is made by force, it may cause internal distortion problems. In this case, it is recommended that the position and the number of ejector pins should be set to allow uniform ejection of the molded products.

Air vent (degassing)

Ensure the inclusion of air vents (degassing) to avoid short shot and gas burns.
Air vents should be provided at locations where the gas finally escapes, runner end, or where short shot or air pockets may easily appear.
The depth of the vent should be 0.03mm - 0.05mm. When it is included on a parting line, the width is usually 5mm - 10mm.

Design standards of snap fit parts

Bring deformation after assembly to nearly nothing (zero) so that the coefficient of strain (α) by the deformation (Y) on assembly may become lower than values shown here. The coefficient of strain (α) by the deformation on assembly can be obtained from the structure calculating formula of cantilever beam (Fig. 44). Each corner must be rounded enough to prevent cracking caused by stress concentration. If loads are applied repeatedly to these parts, use data of repeated fatigue (bending) instead of the coefficient of strain (α).



Grade	Coefficient of strain α
L-1225Y	0.020
G-3410R	0.016
G-3420R	0.012
G-3430R	0.011

Y: deflection (cm)
T: thickness (cm)
L: length (cm)

Fig. 44 A Standard Snap-fit Joint

Insert

Panlite enables the insertion of very strong metals. However, since the thermal expansion coefficient of metals differs from that of Panlite, distortion may occur due to differences in cooling shrinkage, causing cracks around the insert.
In case a metal piece is inserted in molding with Panlite, if the metals are heated to about 200˚C, the difference in cooling shrinkage is reduced and cracks can be prevented. In designing insert bosses the value of the outside diameter of the insert metal "d" should be used (Figure 45).

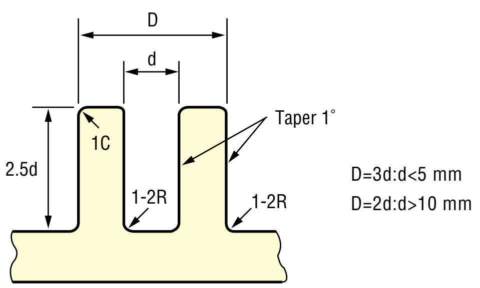


Fig. 45 Standard Insert Boss

Molding

Panlite is suitable for such processing techniques as injection molding, extruding, blow molding and injection-blow molding.

Predrying

The water content of Panlite is about 0.2% at room temperature. In order to obtain good molding results, reduce the product moisture content to 0.02% or below. This will also avoid problems with deterioration in physical properties, foaming and silver streaking caused by hydrolysis.

Predrying conditions

Type of drying machine	box type hot blast drying machine	hopper dryer
Drying temperature	120˚C	120˚C
Drying time	5 hours or more	5 hours or more
Remark	The thickness of the pellet layer should be 3 cm or less. The hopper of the molding machine should be heated to maintain the pellet temperature between 100˚C and 120˚C, and to avoid moisture absorption.	For continuous molding, use a machine with a continuous molding capacity of 5 hours or more. If a dehumidifying type machine is used, more efficient drying will be performed.

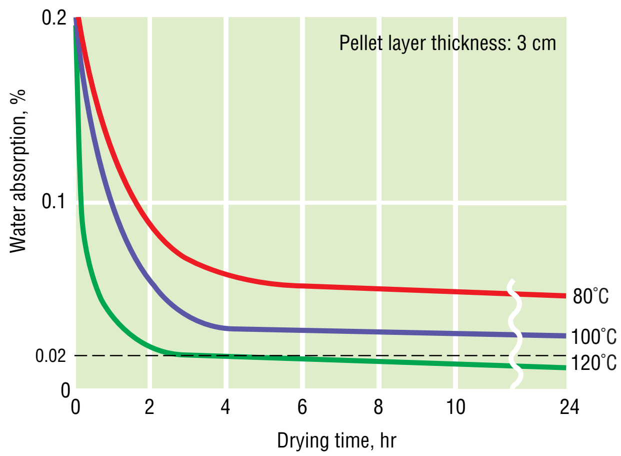


Fig. 46 Drying Curve of Panlite

Injection molding

● Molding condition

Standard injection molding conditions of Panlite are shown in the following tables.

● Flow characteristics

Since flowability of Panlite is greatly influenced by the grade, wall thickness of product, resin temperature, injection pressure, etc., attention should be paid in designing products to the spiral flow and bar flow lengths (Fig. 47 and 48).

Table of Standard injection conditions

Predrying		120°C×5 hours or more. Ensure thorough drying to reduce the moisture content to 0.02% or below
Injection molding machine		Select a molding machine with a shot capacity of 1.5-3 times as that of the weight of the molded product.
Molding condition	Molding temperature	270-320°C
	Mold temperature	80-120°C
	Screw revolution	40-100rpm
	Injection speed	medium - high
	Injection pressure	98.1MPa - 147.1MPa
	Back pressure	10MPa or less

Injection Molding Machine: 65 ton clamp
Inj. pressure: 117.7 MPa (1,200 kgf/cm^2)
Mold temp.: 90°C
(Archimedean spiral flow mold)

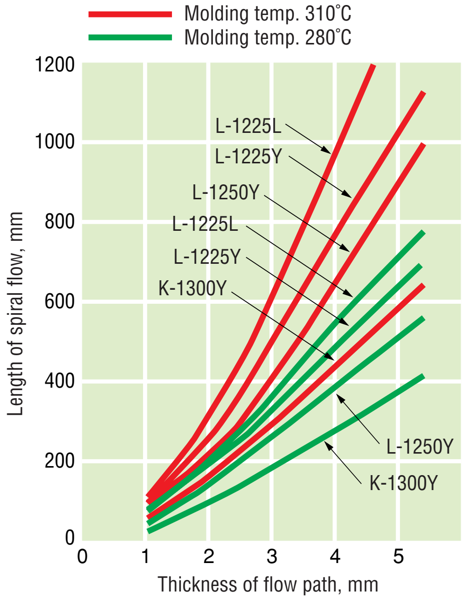


Fig. 47-1 Flowability (Spiral Flow) of Panlite (Thickness of flow path 1-5mm)

Injection Molding Machine: 150 ton clamp
Inj. pressure: 127.5 MPa (1,300 kgf/cm^2)
Mold temp.: 100°C
(Archimedean spiral flow mold)

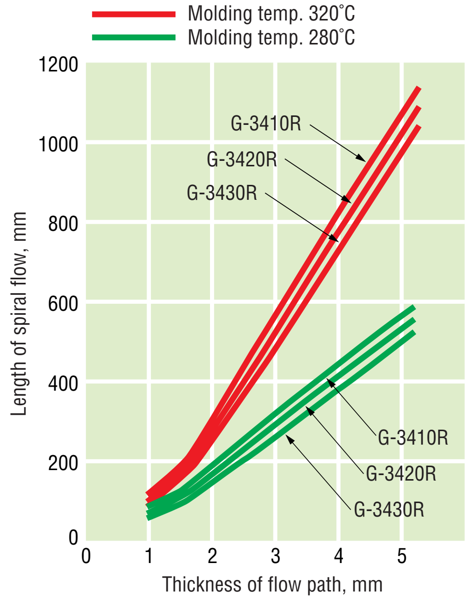


Fig. 48-1 Flowability (Spiral Flow) of Panlite G (Thickness of flow path 1-5mm)

Injection Molding Machine: 90 ton clamp
Inj. pressure: 147.1 MPa (1,500 kgf/cm^2)
Mold temp.: 100°C (Bar flow mold width 6 mm)

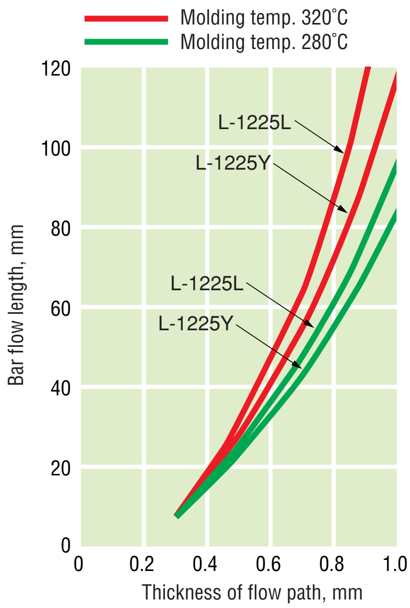


Fig. 47-2 Flowability (Bar Flow) of Panlite (Thickness of flow path 0.3-1.0 mm)

Injection Molding Machine: 90 ton clamp
Inj. pressure: 147.1 MPa (1,500 kgf/cm^2)
Mold temp.: 100°C (Bar flow mold width 6 mm)

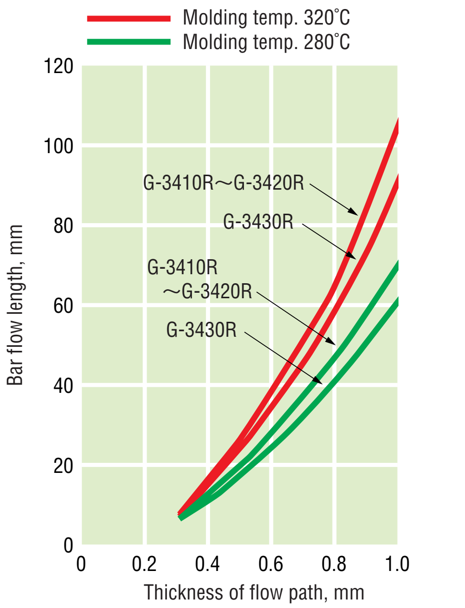


Fig. 48-2 Flowability (Bar Flow) of Panlite G (Thickness of flow path 0.3-1.0 mm)

● Mold shrinkage rate

Mold shrinkage rate of Panlite is as low as 0.5-0.7%. It becomes lower if it is reinforced with glass fiber. Panlite G has a slightly different mold shrinkage rate depending upon whether shrinkage follows the direction of the flow or the traverse direction, therefore care should be taken in designing mold to the shape, position, etc. of the gate (Fig. 49).

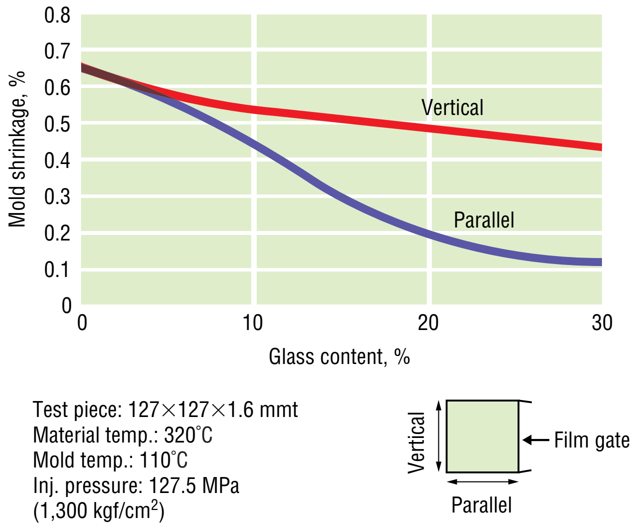


Fig. 49 Mold Shrinkage

※ Mold shrinkage rate of each GF reinforced grade may show different characteristics from Fig. 49.

● Mold temperature

Since mold temperature greatly influences the appearance of molded products and molding strain, a heating unit to control the mold temperature at 80-120˚C should be attached.

● Purging agent

Regarding purging agent for Panlite, a heat foaming mechanical type is more suitable than a heat decomposing solvent type.
See the instruction manual of the manufacturer for use.

● Residual stress and annealing

With molded products of Panlite residual stress often results, because shearing stress is apt to be placed or cooling shrinkage is liable to occur during the molding and fabricating quite the same as in the case of other resins.
If the residual stress of molded products is too great, crazing, cracking or deformation may result in the application. Therefore, such products should be molded under the allowable strain or wherever possible below 7.8-9.8 MPa.
Cracking may also be resulted from the use of solvent when coating, bonding or machining such products.
Although residual stresses can be eased by annealing, similar to other thermoplastic resins, care should be exercised in designing products/molds and in molding.

Annealing condition (target)
120˚C 1 hour

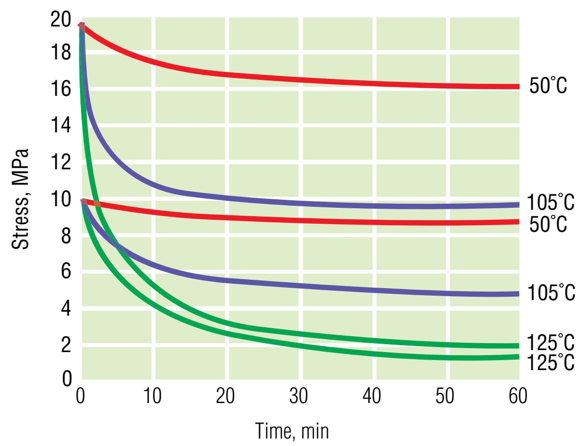


Fig. 50 Stress Relaxation of Tensile Strength of Panlite vs. Temperature

●Common defects when injection molding & countermeasures

Main causes of defects and corrective measures are described in the following table. (Table 7)

Appearance	Cause	Countermeasures
Deformation by water content	• Decomposition by insufficient drying of pellet	• Sufficient predrying • Maintain temperature of hopper
Vacuum foam	• Insufficient capacity from the lack of shrinkage caused by quenching around thick wall section • Unsuitable mold temperature • Unsuitable cylinder temperature • Insufficient injection pressure and pressure keeping	• Eliminate thickness deviation • Modify gate position to meet at right angles at thick wall section • Raise mold temperature • Lower cylinder temperature • Raise injection pressure and pressure keeping
Weld mark	• Unsuitable cylinder temperature • Lack of injection pressure • Unsuitable mold temperature • Lack of degassing in the cavity	• Raise cylinder temperature • Raise injection pressure • Raise mold temperature • Add airrent
Sink mark	• Caused by the shrinkage that results from slow cooling of the surface of thick wall parts (unsuitable thickness) • Insufficient injection pressure • Insufficient injection capacity • Mold temperature is too high or lack of cooling • Insufficient pressure maintained • Insufficient gate dimension	• Reduce thickness deviation • Raise injection pressure • Increase injection capacity • Increase cooling time if mold temperature is suitable • Extend holding time • Increase gate dimension
Burning (whole or partial change in color)	• Unsuitable cylinder temperature • Retention occurs partially in cylinder • Seepage into the screw joint between cylinder and nozzle • In case of using check valve and ring • Decomposition from insufficient pellet drying • Excessive capacity of molding machine	• Lower the cylinder temperature • Eliminate dead corners • Eliminate gap around screw joint • Eliminate the material retention • Provide predrying as recommended • Change to a suitable capacity machine
Silver streak	• Unsuitable cylinder temperature • Long retention time • Unsuitable injection speed • Unsuitable gate dimension • Insufficient pellet drying • Unsuitable injection pressure	• Lower cylinder temperature • Eliminate retention • Slow injection speed • Enlarge the gate size • Provide predrying as recommended • Reduce injection pressure
Wave around gate (devitrifying)	• Unsuitable injection speed • Unsuitable pressure holding time • Unsuitable mold temperature • Unsuitable gate dimension	• Slow injection speed • Shorten pressure holding time to avoid the presence of molten materials in the cavity after filling • Raise mold temperature • Enlarge the gate size
Jetting and flow marks	• Unsuitable mold temperature • Unsuitable injection pressure • Unsuitable gate dimension	• Raise temperature • Reduce injection pressure • Enlarge the gate size
Defective ejection (defective mold release)	• Lack of gradient in core and cavity • Unsuitable cycle • Unsuitable cylinder temperature • Unsuitable position and number of knock pins • Vacuum with molded products in mold release from core • Unsuitable mold temperature • Unjection pressure is too high and filling capacity is too large	• Add a draft • Cooling time is too short or extremely long • Lower molding temperature to reasonable value • Examine reasonable position and number • Often occurs when the surface of the core is smooth. Eject with plate not with pin, and add vent pin. • Lower the mold temperature and lengthen the cycle • Reduce injection pressure and reduce weight of materials
Brittleness of molded products	• Unsufficient drying • Mold temperature is too low • Injection pressure and pressure holding are excessive, occurrence of inside stresses caused by thickness deviation and defective mold release • Notch effective • Heat decomposition • Contamination by foreign material	• Maintenance of drying machine and hopper • Select suitable conditions • Eliminate thickness deviation • Eliminate sharp corners, modify position of gate • Lower the cylinder temperature • Eliminate the material retention • Cleaning of hopper and cylinder

Extrusion

●Molding condition

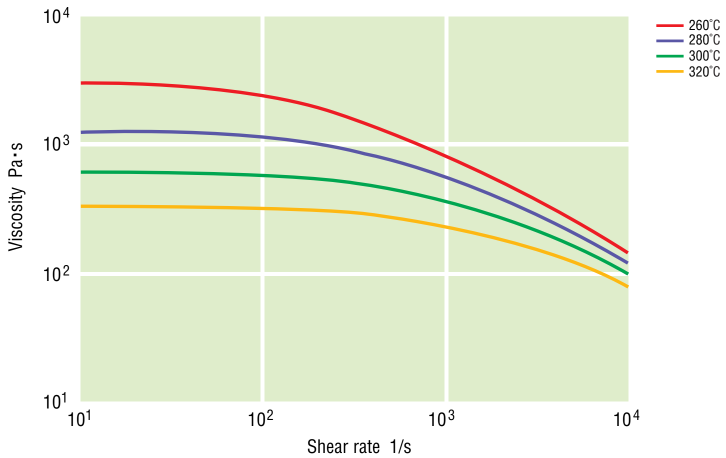
Standard conditions for extrusion of Panlite are shown in Table 8.

Table 8 Standard conditions for extrusion

Predrying		Drying is necessary when a non-vent type extruder is used. 120℃×5 hours or more, Dry to reduce the pellet water content to 0.02 % or below.
Extruder		Both non-vent type and vent-type are available. The following range of screw L/D and compression ratio are recommended. screw L/D non-vent type 20-26 compression ratio pellet CR=CR=2.0-3.0 vent type 24-32 powder CR=3.0-4.0
Molding condition	Cylinder temperature	at the bottom of hopper 240-270℃ cylinder 260-300℃ adapter 260-300℃
	Die temperature	250-290℃
	Screw revolution	20-100rpm
	Back pressure	5MPa-30MPa
	Roll temperature	110-135℃

●Melting characteristics

Melt viscosity vs. shear rate
Grade : Panlite L-1250ZW



●Extrusion defects & countermeasures

Main causes of defective extrusion and corrective measures are described in the following table. (Table 9)

Appearance	Cause	Appearance	Cause
Fluctuation of sheet width	Change of extrusion output, Unsuitable screw shape, fluctuation in screw revolution, fluctuation in cylinder and die temperature, fluctuation in dryness of materials, fluctuation in extrusion output relative to the molecular weight	Hue coloration	Defectiveness of material hue Decomposition caused by excessive cylinder and die temperatures
Dispersion of sheet thickness	Fluctuation in extrusion output Ununiformity of flow due to insufficient kneading Dispersion of die temperature Ununiformity of receive speed Incomplete adjastment of lip clearance	Vertical line of surface	Adhesion of decomposition debris at die outlet Insufficient kneading Unsuitable die structure Streak inside die Lack of cleaning of extrusion and die Streak in lip edge
Contamination of foam	Insufficient drying Insufficient back pressure Contamination of cracked gas caused by extremely high temperature	Surface wave	Fluctuation of flow rate Unsuitable cooling temperature for polishing rol
Contamination of debris	Contamination of debris in material Contamination of debris caused by harsh environment in sheet production Appearance of decomposition products in cylinder or die Insufficient cleaning of the extruder	Irregular surface	Insufficient length for die land Insufficient back pressure Insufficient kneading Excessive lubricant Extremely high temperature
Fish eye	Insufficient kneading Insufficient back pressure Non-plasticity caused by extremely low cylinder temperature Unsuitable screw shape	Spots in surface	Ununiformity of die temperature Misalignment of crimping for polishing roll Welding polishing roll at extremely high temperature

Secondary Processing

Machining

For Panlite, machining is possible with metal working tools, such as cutting, drilling, machining, etc.
Panlite has excellent stiffness and strength. Also its softening point is high, therefore, the machining surface is not easily softened or chipped, and gives a beautiful finish.
During machining, the workpiece may be whitened by the frictional heat or cracked by occurring the great residual stress and physical properties may be deteriorated. Therefore, the machining speed must be adjusted properly and cutting tools must be cooled without fail.

When cutting oil is used, choose the most proper one for Panlite (See P. 23, Table 6).
As cutting oil, neutral detergent solution, silicone of emulsion type, etc. are usually used.
When load is applied after machining or residual stress is great, annealing treatment should be given.

Mutual bonding of Panlite

Panlite can be bonded with adhesives, solvent, ultrasonic waves, etc.

● Bonding by Adhesives and solvents

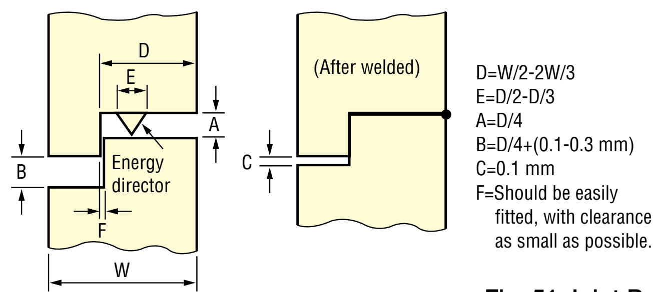
As pretreatment, bonding surface should be cleaned by detergent or alcohol and be sandpapered. After that, the pieces should be bonded. Introduced in the table below are examples of mutual bonding by typical adhesives and solvents. Almost all the adhesives have a low critical stress value, therefore bonding should be made after the molded product is annealed when residual stress is great (Table 7).

Table 10 Adhesives suitable for Panlite

Type	Adhesive	Manufacturer	Tensile shearing strength MPa	Critical stress 23°C×24 hr MPa	Remark
Epoxy type	Cemedine 1500	Cemedine	4.4	61.8 and up	Cure agent: Polyamide, Pot life: 60 min (20°C)
	Bond E Set M	Konishi	3.4	61.8 and up	Cure agent: Modified polyamide, Pot life: 60 min (20°C)
	Bond Quick Set	Konishi	2.0	61.8 and up	Cure agent: Modified polyamide, Pot life: 4 min (20°C)
Urethane type	Bond KU-661/KU-662	Konishi	3.9	21.6	KU-661: Polyester polyol, KU-662: Polyisocyanate
α-cyano acrylate type (Instantaneous adhesives)	Aron Alpha #201	Toagosei Co., Ltd.	10.8	6.9	Viscosity: 2-6 (CPS)
	Three Bond 1770	Three Bond	9.8	6.9	Viscosity: 2-5 (CPS)
	Cemedine 3000	Cemedine	8.3	6.9	Viscosity: 2-5 (CPS)
	Loctite 495	Japan Loctite	10.8	6.9	Viscosity: 40 (CPS)
Solvent type	Bond VP-2000	Konishi	10.3	7.8	Main component: Acrylics, Solvent: MEK
Solvent	Methylene chloride	-	10.8	-	

● Ultrasonic welding of Panlite

Since ultrasonic welding needs only a very short time of less than one second for welding and is very easy to handle, this method is becoming more and more popular. In order to obtain good bonding results, an energy director should be provided at the jointing parts of the workpiece (Fig. 51).
After bonding, annealing treatment should be given and residual stress relaxed. Clearance is as smalle as possible, and should be easily fitted.



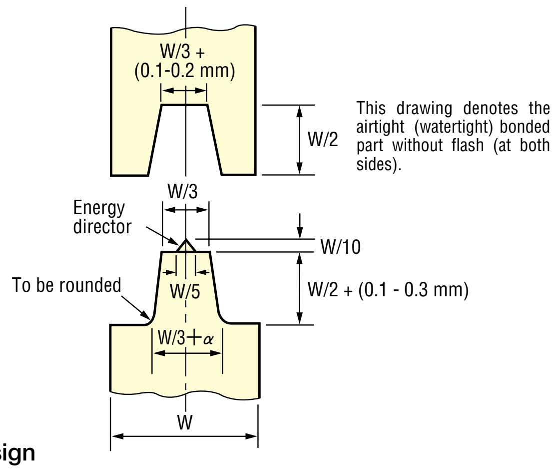


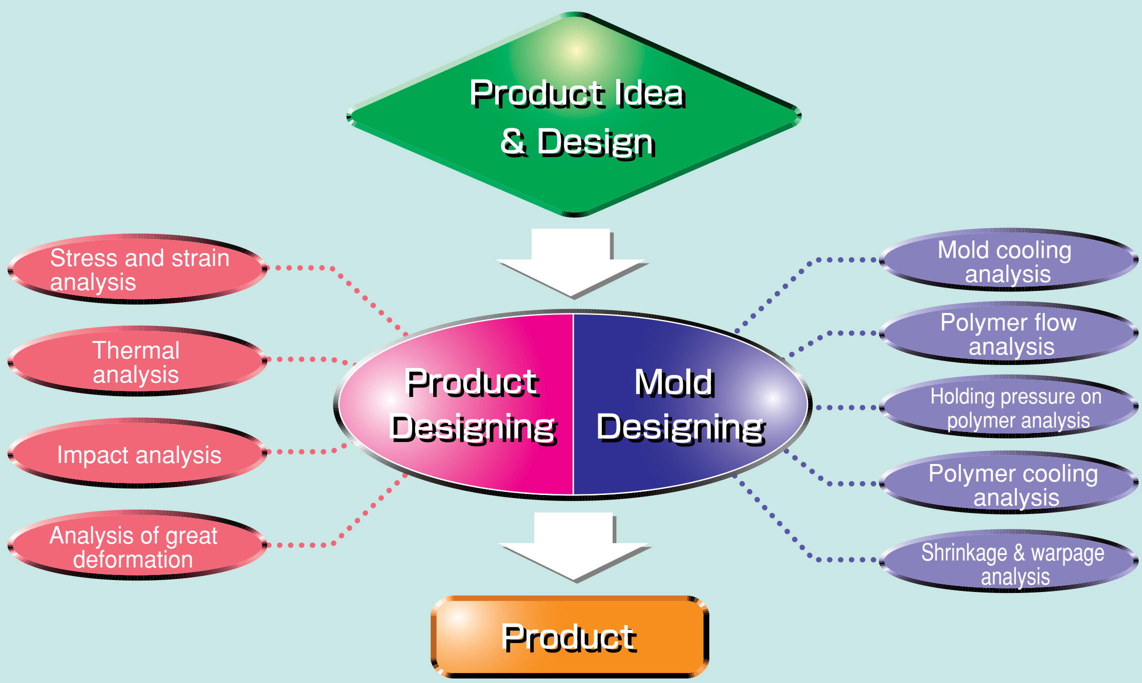
Fig. 51 Joint Parts Design

Technical Service - CAE

< To Support Product Development for Higher Quality >

Quality demands for plastics products result in ever higher standards being achieved. Lighter in weight, stronger and more beautiful are all typical demands. A wide product range and small lots of production are resulting from public preference of product identity.
As a result, product life cycles are becoming shorter.
Teijin Chemicals Ltd. continues its tireless efforts for the development of materials to meet these needs, and as part of such R&D work, we have CAE (Computer Aided Engineering,) services to support users who are engaged in the development of low cost and high quality goods in a short period of time.

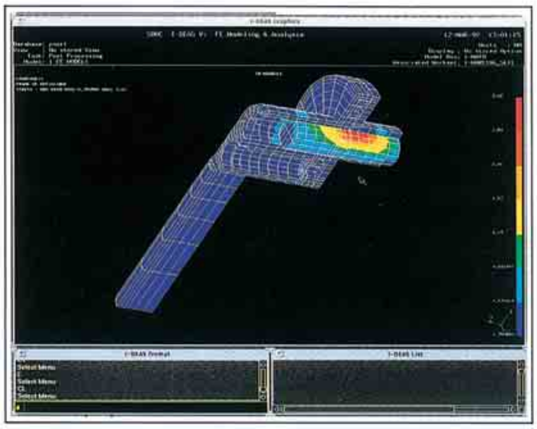
Strength estimation of product, and mold designs which used to depend on experience and a sixth sense can be pre-checked and studied through computer simulation. No doubt, this will reduce the commercialization cost of product and shorten the time for development.
Furthermore, CAE is proving itself to be quite useful tool for studying design and reliability limits and also for higher functional product design. Based on our depth of experience and data base of polymers built up after many years of material development, Teijin Chemicals Ltd. is able to render extensive services utilizing CAE to support customers in product development.



(An approach utilizing CAE from product design to production)

Structural Analysis of Molded Product

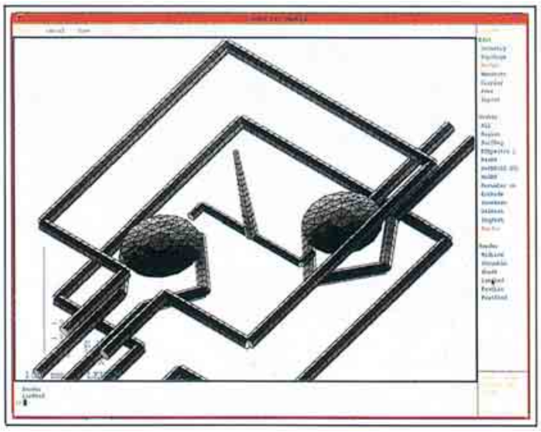
Strength of a molded part enough to meet functional requirements of product is estimated while considering repeated fatigue, creep deformation and fiber orientation, which is then used for study on the best suitable material to be selected, then wall thickness and necessity of reinforcing ribs.



Stress distribution of door handle

Mold Cooling Analysis

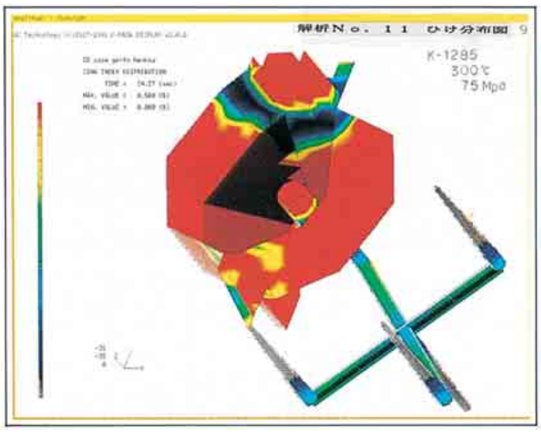
Uneven mold cooling results in warpage and deformation of molded parts. A cooling circuit necessary for uniform cooling is designed, followed by the study on possible reduction of injection molding cycle.



Cooling pipe arrangement of spectacles lenses

Holding Pressure on Polymer and Cooling Analysis

Holding pressure on polymer and cooling during injection molding are simulated by following the PVT curve. Assuming the point of sinking caused by polymer shrinkage and gate sealing time, optimization of the holding pressure and cooling time is studied.



Sink distribution of a mechanical part

Polymer Flow Analysis

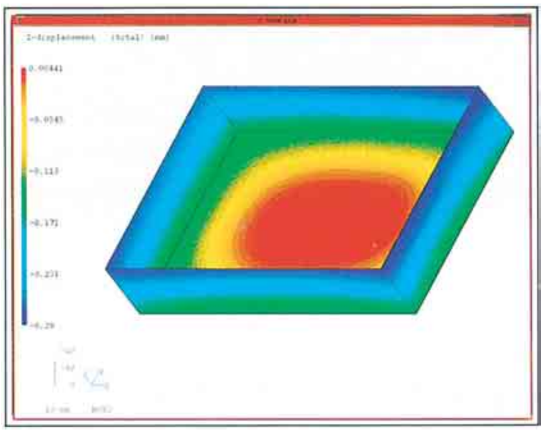
Assuming the polymer flow-in process during injection, it is also possible to assume the gate position suitable for simultaneous charging, temperature and pressure at the time of flow-in, weld line resulting point and the suitable molding machine to be adopted.
In addition, study of wall thickness reduction will also become possible.

Meter visor molding

Filling pattern for meter visor

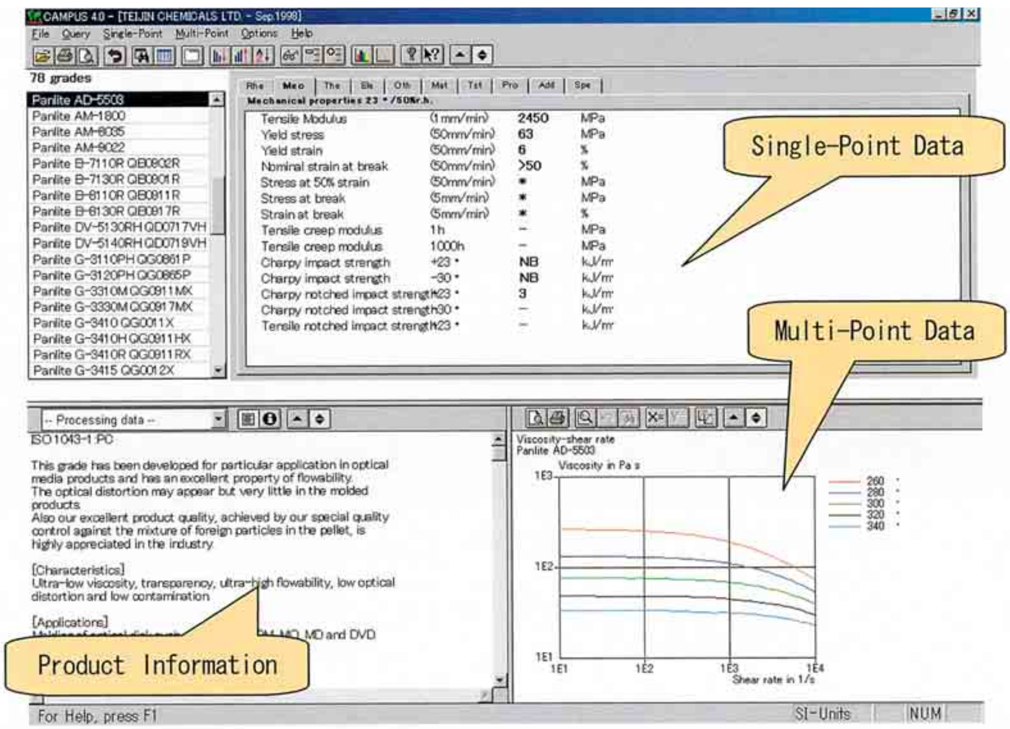
Shrinkage and Warpage Analysis

Warpage and deformation of a molded part are assumed resulting from uneven mold cooling and the difference in shrinkage rates between pressure holding and cooling stages. Dimensional errors of a molded part from the design dimensions and such data are fed back to the mold designing stage.



Distribution of displacement in "Z" direction in a box model

CAMPUS, the abbreviation for Computer Aided Material Preselection by Uniform Standards, is a computer database service designed to help users select suitable plastic materials based on their requirements.
CAMPUS is offered by more than 50 plastic resin suppliers around the world. By simply installing CAMPUS on your computer, you can build up a reliable, international plastics database that is based on ISO standards. Since the shape of specimens, test items, measurement conditions and representation of data are standardized, it is possible to compare the resins or materials of different suppliers, easing material selection.



CAMPUS screen

Activities on CAMPUS

Teijin Chemicals sees CAMPUS as an integral part of its global and technical support service program set up to aid users with resin selection, and so has acquired CAMPUS licensing. The company currently leads the establishment of a system for acquiring plastics data under ISO standards.

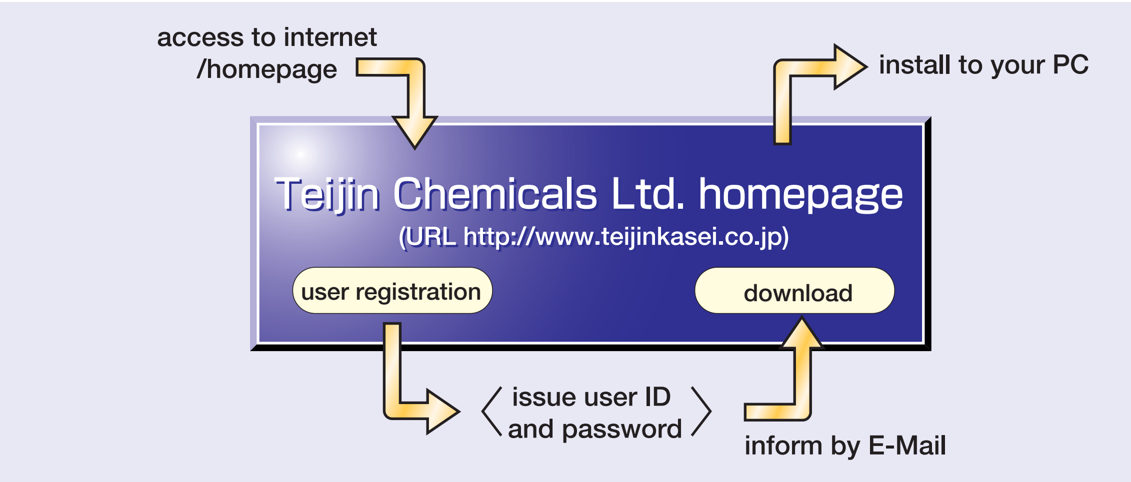
Teijin Chemicals became the first plastics manufacturer in Japan to freely distribute the CAMPUS service to customers.

CAMPUS/Teijin Chemicals version contains data for Panlite and Multilon, based on ISO standards. You can search and compare Teijin plastics grades that meet your requirements easily and rapidly.

Panlite®	Polycarbonate resin	PC
	Reinforced polycarbonate resin	PC+GF
	PC/Pes type polymer alloy	PC+PET
		PC+PBT
Multilon®	PC/ABS type polymer alloy	PC+ABS

Acquisition of CAMPUS/Teijin Chemicals version

Teijin Chemicals distributes its data via internet by the following procedure. (See the chart below)



Required system

●Basic software	Microsoft Windows 3.1* or higher that runs on the mainframe
●Mainframe	Personal computer with i486TM or higher
●Memory	8MB or more (12MB or higher is preferable)
●Hard disk	At least 10MB of hard disk space
●Display	VGA or higher graphics adapter
●Others	E-mail Box, Internet environment, CD-ROM, FDD, etc.

Physical properties-general grades

Property	Unit	Test method	Measurement condition	Standard (mold release/bluing)				
				L-1225LM	L-1225L	L-1225Y	L-1250Y	K-1300Y
Melt volume flow rate	cm^3/10min	ISO 1133	300℃ load1.2kgf	24	18	11	8	2.8
Density	kg/m^3	ISO 1183	—	1200	1200	1200	1200	1200
Water absorption rate	%	ISO 62	in water 23℃ 24h	0.2	0.2	0.2	0.2	0.2
Light transmission	%	ASTM D1003	thickness 3mm	88	88	88	88	88
Refractive index	—	ASTM D542	—	1.585	1.585	1.585	1.585	1.585
Tensile modulus	MPa	ISO 527−1 and ISO 527−2	1mm/min	2400	2400	2400	2400	2350
Tensile yield stress	MPa		50mm/min	62	61	62	61	60
Tensile yield distortion	%		50mm/min	6	6	6	6	6
Tensile fracture designation distortion	%		50mm/min	>50	>50	>50	>50	>50
Tensile fracture stress	MPa		50mm/min	—	—	—	—	—
Tensile fracture distortion	%		50mm/min	—	—	—	—	—
Flexural modulus	MPa	ISO 178	2mm/min	2400	2350	2350	2300	2200
Flexural strength	MPa		2mm/min	94	93	92	91	90
Charpy impact strength	kJ/m^2	ISO 179	unnotched	NB	NB	NB	NB	NB
			notched	58	67	71	76	89
Load-deflection temperature	℃	ISO 75−1 and ISO 75−2	1.80MPa	125	126	128	129	132
			0.45MPa	138	139	141	142	145
Vicat softening temperature	℃	ISO 306	50℃/h 50N	142	146	148	149	151
Mold shrinkage	%	In - house method	parallel (4mmt)	0.5~0.7	0.5~0.7	0.5~0.7	0.5~0.7	0.5~0.7
			vertical (4mmt)	0.5~0.7	0.5~0.7	0.5~0.7	0.5~0.7	0.5~0.7
Coefficient of linear expansion	$\times10^{-4}$/℃	ISO 11359−2	parallel	0.7	0.7	0.7	0.7	0.7
			vertical	0.7	0.7	0.7	0.7	0.7
Specific inductive capacity	—	IEC 60250	100Hz	3.1	3.1	3.1	3.1	3.1
	—		1MHz	3	3	3	3	3
Dielectric loss tangent	$\times10^{-4}$	IEC 60250	100Hz	10	10	10	10	10
	$\times10^{-4}$		1MHz	90	90	90	90	90
Volume resistivity	Ω・m	IEC 60093	—	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$
Surface resistivity	Ω	IEC 60093	—	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$
Withstand voltage	MV/m	IEC 60243−1	short time test	30	30	30	30	30
Tracking resistance	—	IEC 60112	—	225	250	250	250	250
Flammability	—	UL 94	—	V-2 (0.40mm) HB (2.1mm)	V-2 (0.40mm) HB (1.9mm)	V-2 (0.40mm) HB (1.9mm)	V-2 (0.40mm) HB (1.5mm)	HB (0.38mm)
Temperature index	℃	UL 746B	electric 1.5mmt	125	125	125	125	125
			impact 1.5mmt	115	115	115	115	115
			non-impact 1.5mmt	125	125	125	125	125

The values listed are specification values, not certified values.

Standard (mold release/bluing)			Weather resistant grade (acquired SAE standard)				Weather resistant grade		Extrusion
LV-2225L	LV-2225Y	LV-2250Y	L-1225ZL 100	L-1225Z 100M	L-1225Z 100	L-1250Z 100	LV-2225Z	LV-2250Z	L-1250ZW
18	11	8	25	19	12	8	11	8	6
1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
88	88	88	88	88	88	88	88	88	88
1.585	1.585	1.585	1.585	1.585	1.585	1.585	1.585	1.585	1.585
2400	2400	2400	2400	2400	2400	2400	2400	2400	2400
61	61	61	62	62	61	61	61	61	62
6	6	6	6	6	6	6	6	6	6
＞50	＞50	＞50	＞50	＞50	＞50	＞50	＞50	＞50	＞50
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
2350	2350	2300	2400	2400	2400	2350	2400	2350	2350
93	92	91	95	95	94	93	94	93	93
NB	NB	NB	NB	NB	NB	NB	NB	NB	NB
67	71	76	13	62	71	76	71	76	70
126	128	129	123	125	128	129	128	129	129
139	141	142	136	138	141	142	141	142	142
146	148	149	142	144	148	149	148	149	147
0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7
0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7	0.5～0.7
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
3	3	3	3	3	3	3	3	3	3
10	10	10	10	10	10	10	10	10	10
90	90	90	90	90	90	90	90	90	90
＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}
＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}
30	30	30	30	30	30	30	30	30	30
250	250	250	250	250	250	250	225	225	225
V-2 (0.40mm) V-2 (1.5mm) V-2 (3.0mm)	V-2 (0.40mm) V-2 (1.5mm) V-2 (3.0mm)	V-2 (0.40mm) V-2 (1.5mm) V-2 (3.0mm)	V-2 (0.40mm) HB (2.1mm)	V-2 (0.40mm) HB (1.9mm)	V-2 (0.40mm) HB (1.9mm)	V-2 (0.40mm) HB (1.5mm)	V-2 (0.40mm) V-2 (1.5mm) V-2 (3.0mm)	V-2 (0.40mm) V-2 (1.5mm) V-2 (3.0mm)	V-2 (0.40mm) HB (1.5mm)
125	125	125	125	125	125	125	125	125	125
115	115	115	115	115	115	115	115	115	115
125	125	125	125	125	125	125	125	125	125

Physical properties-general grades

Property	Unit	Test method	Measurement condition	Optical grade	Flame resistant grade				
					Standard	Bluing	Weather resistant grade	Non-bromine/ non-phosphor type	
				AD-5503	LN-1250G	LN-2250Y	LN-2250Z	LN-2520	LN-2520A
Melt volume flow rate	cm^3/10min	ISO 1133	300℃ load1.2kgf	54	11	11	11	18	18
Density	kg/m^3	ISO 1183	—	1200	1220	1200	1200	1200	1200
Water absorption rate	%	ISO 62	in water 23℃ 24h	0.2	0.2	0.2	0.2	0.2	0.2
Light transmission	%	ASTM D1003	thickness 3mm	89	Translucent	88	88	Translucent	Translucent
Refractive index	—	ASTM D542	—	1.585	—	1.585	1.585	—	—
Tensile modulus	MPa	ISO 527−1 and ISO 527−2	1mm/min	2450	2400	2400	2400	2400	2400
Tensile yield stress	MPa		50mm/min	63	62	61	61	64	64
Tensile yield distortion	%		50mm/min	6	6	6	6	7	7
Tensile fracture designation distortion	%		50mm/min	>50	>50	>50	>50	>50	>50
Tensile fracture stress	MPa		50mm/min	—	—	—	—	—	—
Tensile fracture distortion	%		50mm/min	—	—	—	—	—	—
Flexural modulus	MPa	ISO 178	2mm/min	2400	2200	2350	2350	2280	2280
Flexural strength	MPa		2mm/min	96	90	92	92	98	98
Charpy impact strength	kJ/m^2	ISO 179	unnotched	NB	NB	NB	NB	NB	NB
			notched	3	12	76	76	11	13
Load-deflection temperature	℃	ISO 75−1 and ISO 75−2	1.80MPa	124	129	128	128	127	127
			0.45MPa	138	141	141	141	141	141
Vicat softening temperature	℃	ISO 306	50℃/h 50N	143	148	148	148	148	148
Mold shrinkage	%	In - house method	parallel (4mmt)	0.5〜0.7	0.5〜0.7	0.5〜0.7	0.5〜0.7	0.5〜0.7	0.5〜0.7
			vertical (4mmt)	0.5〜0.7	0.5〜0.7	0.5〜0.7	0.5〜0.7	0.5〜0.7	0.5〜0.7
Coefficient of linear expansion	$\times10^{-4}$/℃	ISO 11359−2	parallel	0.7	0.7	0.7	0.7	0.7	0.7
			vertical	0.7	0.7	0.7	0.7	0.7	0.7
Specific inductive capacity	—	IEC 60250	100Hz	3.1	3.1	3.1	3.1	3.1	3.1
	—		1MHz	3	3	3	3	3	3
Dielectric loss tangent	$\times10^{-4}$	IEC 60250	100Hz	10	10	10	10	10	10
	$\times10^{-4}$		1MHz	90	90	90	90	90	90
Volume resistivity	Ω･m	IEC 60093	—	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$
Surface resistivity	Ω	IEC 60093	—	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$
Withstand voltage	MV/m	IEC 60243−1	short time test	30	30	32	32	32	32
Tracking resistance	—	IEC 60112	—	250	275	225	225	250	250
Flammability	—	UL 94	—	—	V-0 (1.0mm)	V-2 (0.43mm)	V-2 (0.43mm)	V-0 (1.0mm)	V-0 (1.0mm)
						V-0 (3.0mm)	V-0 (3.0mm)	5VB (2.0mm)	5VB (2.0mm)
Temperature index	℃	UL 746B	electric 1.5mmt	—	125	125	125	130	130
			impact 1.5mmt	—	115	115	115	125	125
			non-impact 1.5mmt	—	125	125	125	130	130

 The values listed are specification values, not certified values. Notes:*Anti-environmental pollution type (Non-bromine/non-phosphor type) 1) Temperature index of LN-2250Y and LN-2250Z is provided

Frictional wear resistant grade	High light reflection grade				Light diffusion		
	Anti-environmental pollution type*		Phosphor type flame resistant grade	Halogen type flame resistant grade	High light transmission	Standard	High light diffusion
	Standard grade	Flame resistant grade					
LS-2250	LD-1000RM	LN-3010RM	LN-3000RM	LN-1010RM	ML-1102	ML-1103	ML-1105
—	—	—	—	—	—	—	—
1260	1280	1280	1290	1330	1200	1200	1200
0.17	0.20	0.20	0.20	0.20	0.20	0.20	0.20
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
2400	2600	2650	3000	2500	2400	2400	2400
50	60	60	55	54	61	61	61
6	6	6	6	6	6	6	6
—	—	—	—	—	＞50	＞50	＞50
50	60	54	60	50	66	66	66
110	110	100	110	110	120	120	120
2200	2400	2430	2700	2300	2300	2300	2300
80	95	92	93	91	96	96	96
NB	NB	NB	NB	NB	NB	NB	NB
25	40	12	60	25	30	25	20
130	128	125	92	125	129	129	129
139	137	134	98	137	141	141	141
141	139	138	100	139	148	148	148
0.5～0.7	0.4～0.6	0.4～0.6	0.4～0.6	0.4～0.6	0.5～0.7	0.5～0.7	0.5～0.7
0.5～0.7	0.4～0.6	0.4～0.6	0.4～0.6	0.4～0.6	0.5～0.7	0.5～0.7	0.5～0.7
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
3.0	3.4	3.4	3.4	3.4	—	—	—
3.0	3.4	3.4	3.4	3.4	—	—	—
10	11	—	55	27	—	—	—
90	90	—	100	100	—	—	—
＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}	＞1×10^{13}
＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}	＞1×10^{15}
32	32	32	32	32	—	—	—
300	250	250	250	250	—	—	—
V-2（1.5mm）	☆V-2（0.44mm）	☆V-2（0.40mm） ☆V-0（1.6mm）	☆V-2（0.40mm） ☆V-0（0.80mm）	☆V-0（0.38mm）	—	—	—
115	125	80	80	80	—	—	—
105	115	80	80	80	—	—	—
105	125	80	80	80	—	—	—

under the thickness of 3.0mm. 2) Temperature index of LN-1010RM is provided under the thickness of 0.38mm. 3) LN-2250Y and LN-2250Z are not available inside EU. ☆＝White

Physical properties-glass fiber reinforced grades

Property	Unit	Test method	Measurement condition	Standard				Low anisotropy grade		
				G-3410R	G-3415R	G-3420R	G-3430R	G-3410H	G-3420H	G-3430H
Melt volume flow rate	cm^3/10min	ISO 1133	300℃ load1.2kgf	—	—	—	—	—	—	—
Density	kg/m^3	ISO 1183	—	1270	1300	1340	1430	1270	1340	1430
Water absorption rate	%	ISO 62	in water 23℃ 24h	0.16	0.15	0.14	0.12	0.16	0.14	0.12
Tensile modulus	MPa	ISO 527−1 and ISO 527−2	1mm/min	3700	5000	6100	8000	3300	5000	6700
Tensile yield stress	MPa		5mm/min	—	—	—	—	—	—	—
Tensile yield distortion	%		5mm/min	—	—	—	—	—	—	—
Tensile fracture designation distortion	%		5mm/min	—	—	—	—	—	—	—
Tensile fracture stress	MPa		5mm/min	70	85	90	105	70	85	100
Tensile fracture distortion	%		5mm/min	3.5	3.0	2.5	2.0	4.0	3.0	2.0
Flexural modulus	MPa	ISO 178	2mm/min	3600	4400	5400	7100	3400	5000	6600
Flexural strength	MPa		2mm/min	120	130	140	160	115	135	155
Charpy impact strength	kJ/m^2	ISO 179	unnotched	55	50	40	35	70	58	45
			notched	10	10	11	12	8	9	10
Load-deflection temperature	℃	ISO 75−1 and ISO 75−2	1.80MPa	144	147	147	148	135	137	139
			0.45MPa	149	150	150	151	142	143	143
Vicat softening temperature	℃	ISO 306	50℃/h 50N	151	152	152	153	145	146	146
Mold shrinkage	%	In - house method	parallel (4mmt)	0.3〜0.5	0.2〜0.4	0.1〜0.3	0.02〜0.2	0.3〜0.5	0.2〜0.4	0.1〜0.3
			vertical (4mmt)	0.4〜0.6	0.4〜0.6	0.4〜0.6	0.3〜0.5	0.4〜0.6	0.4〜0.6	0.3〜0.5
Coefficient of linear expansion	$\times10^{-4}$/℃	ISO 11359−2	parallel	0.4	0.3	0.3	0.2	0.5	0.4	0.3
			vertical	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Specific inductive capacity	—	IEC 60250	100Hz	3.2	3.3	3.4	3.5	3.2	3.4	3.5
	—		1MHz	3.2	3.3	3.4	3.5	3.2	3.4	3.5
Dielectric loss tangent	$\times10^{-4}$	IEC 60250	100Hz	10	10	10	10	10	10	10
	$\times10^{-4}$		1MHz	90	90	90	90	90	90	90
Volume resistivity	Ω・m	IEC 60093	—	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$
Surface resistivity	Ω	IEC 60093	—	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$
Withstand voltage	MV/m	IEC 60243−1	short time test	35	35	35	35	35	35	35
Tracking resistance	—	IEC 60112	—	175	175	175	175	175	175	175
Flammability	—	UL 94	—	HB (0.43mm) V-2 (0.80mm) V-1 (3.0mm)	HB (0.43mm) V-2 (0.80mm) V-1 (3.0mm)	HB (0.43mm) V-2 (0.80mm) V-1 (3.0mm)	HB (0.43mm) V-2 (0.80mm) V-1 (3.0mm)	HB (0.43mm) V-2 (0.80mm) V-1 (3.0mm)	HB (0.43mm) V-2 (0.80mm) V-1 (3.0mm)	HB (0.43mm) V-2 (0.80mm) V-1 (3.0mm)
Temperature index	℃	UL 746B	electric 1.5mmt	130	130	130	130	130	130	130
			impact 1.5mmt	120	125	125	125	120	125	125
			non-impact 1.5mmt	130	130	130	130	130	130	130

The values listed are specification values, not certified values.

Isotropy grade			Flame resistant grade			Flame resistant grade (Non-bromine/non-phosphor type)			High flame resistant grade		
G-3310M	G-3320M	G-3330M	GN-3410R	GN-3420R	GN-3430R	GN-3610L	GN-3620L	GN-3630H	GV-3410R	GV-3420R	GV-3430R
—	—	—	—	—	—	—	—	—	—	—	—
1280	1360	1440	1280	1360	1440	1270	1340	1430	1290	1380	1470
0.16	0.14	0.12	0.16	0.14	0.12	0.16	0.14	0.12	0.16	0.14	0.12
2700	3250	3800	3700	5950	8200	3800	6100	6800	3900	6200	8500
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
55	55	55	75	90	105	70	82	85	75	90	105
60	30	3.5	3.5	3.0	2.0	2.0	1.0	1.0	3.5	3.0	2.0
2600	3200	3800	3600	5450	7300	3600	5600	6500	3800	5700	7600
90	93	95	125	140	155	115	138	142	125	140	155
NB	60	40	45	40	35	45	40	35	40	35	30
8	6	4	9	9	10	7	7	7	8	8	9
124	127	129	144	146	148	140	140	140	144	146	148
135	137	138	147	149	151	143	145	143	147	149	151
140	141	142	149	151	153	146	147	146	149	151	153
0.5~0.7	0.4~0.6	0.3~0.5	0.3~0.5	0.1~0.3	0.02~0.2	0.3~0.5	0.1~0.3	0.1~0.3	0.3~0.5	0.1~0.3	0.02~0.2
0.5~0.7	0.4~0.6	0.3~0.5	0.4~0.6	0.4~0.6	0.3~0.5	0.4~0.6	0.4~0.6	0.3~0.5	0.4~0.6	0.4~0.6	0.3~0.5
0.6	0.6	0.5	0.4	0.3	0.2	0.4	0.3	0.3	0.4	0.3	0.2
0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
3.2	3.4	3.5	3.2	3.4	3.5	3.2	3.4	3.5	3.2	3.4	3.5
3.2	3.4	3.5	3.2	3.4	3.5	3.2	3.4	3.5	3.2	3.4	3.5
10	10	10	10	10	10	10	10	10	10	10	10
90	90	90	90	90	90	90	90	90	90	90	90
$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$
$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$
35	35	35	35	35	35	35	35	35	35	35	35
175	175	175	175	175	175	175	175	175	175	175	175
V-2 (0.80mm)	V-2 (0.80mm)	V-2 (0.80mm)	V-2 (0.43mm) V-0 (1.5mm)	V-2 (0.43mm) V-0 (1.5mm)	V-2 (0.43mm) V-0 (1.5mm)	V-2 (0.40mm) V-0 (1.6mm)	V-2 (0.40mm) V-0 (1.6mm)	V-2 (0.40mm) V-1 (1.0mm) V-0 (1.6mm)	V-2 (0.40mm) V-0 (0.75mm) 5VA (2.5mm)	V-2 (0.40mm) V-0 (0.75mm) 5VA (2.5mm)	V-2 (0.40mm) V-0 (0.75mm) 5VA (2.5mm)
130	130	130	130	130	130	80	80	80	130	130	130
120	125	125	120	120	120	80	80	80	120	120	120
130	130	130	130	130	130	80	80	80	130	130	130

Physical properties-glass fiber reinforced grades

Property	Unit	Test method	Measurement condition	Frictional wear resistant grade			High-appearance camera grade		
				GS-3410	GS-3420	GS-3430	G-3110PH	G-3120PH	G-3130PH
Melt volume flow rate	cm^3/10min	ISO 1133	300℃ load1.2kgf	—	—	—	—	—	—
Density	kg/m^3	ISO 1183	—	1340	1380	1520	1270	1340	1430
Water absorption rate	%	ISO 62	in water 23℃ 24h	0.14	0.12	0.10	0.16	0.14	0.12
Tensile modulus	MPa	ISO 527−1 and ISO 527−2	1mm/min	4000	6000	8000	3000	4000	5000
Tensile yield stress	MPa		5mm/min	—	—	—	—	—	—
Tensile yield distortion	%		5mm/min	—	—	—	—	—	—
Tensile fracture designation distortion	%		5mm/min	—	—	—	—	—	—
Tensile fracture stress	MPa		5mm/min	70	85	100	65	65	86
Tensile fracture distortion	%		5mm/min	3.5	3.0	2.5	5.0	3.0	2.0
Flexural modulus	MPa	ISO 178	2mm/min	3700	5500	7300	3100	4400	6000
Flexural strength	MPa		2mm/min	110	133	155	110	110	135
Charpy impact strength	kJ/m^2	ISO 179	unnotched	46	43	40	55	40	38
			notched	12	12	12	6	8	10
Load-deflection temperature	℃	ISO 75−1 and ISO 75−2	1.80MPa	144	146	148	123	123	126
			0.45MPa	148	149	150	130	131	134
Vicat softening temperature	℃	ISO 306	50℃/h 50N	151	152	152	134	135	138
Mold shrinkage	%	In - house method	parallel (4mmt)	0.3〜0.5	0.1〜0.3	0.02〜0.2	0.35〜0.55	0.2〜0.4	0.1〜0.3
			vertical (4mmt)	0.4〜0.6	0.4〜0.6	0.3〜0.5	0.4〜0.6	0.4〜0.6	0.3〜0.5
Coefficient of linear expansion	$\times10^{-4}$/℃	ISO 11359−2	parallel	0.4	0.3	0.2	0.5	0.4	0.3
			vertical	0.6	0.6	0.6	0.6	0.6	0.6
Specific inductive capacity	—	IEC 60250	100Hz	3.2	3.4	3.5	3.2	3.4	3.5
	—		1MHz	3.2	3.4	3.5	3.2	3.4	3.5
Dielectric loss tangent	$\times10^{-4}$	IEC 60250	100Hz	10	10	10	10	10	10
	$\times10^{-4}$		1MHz	90	90	90	90	90	90
Volume resistivity	Ω・m	IEC 60093	—	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$	$>1\times10^{13}$
Surface resistivity	Ω	IEC 60093	—	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$
Withstand voltage	MV/m	IEC 60243−1	short time test	35	35	35	35	35	35
Tracking resistance	—	IEC 60112	—	175	175	175	175	175	175
Flammability	—	UL 94	—	V-2 (0.38mm) V-1 (3.0mm)	V-2 (0.38mm) V-1 (3.0mm)	V-2 (0.38mm) V-1 (3.0mm)	V-2 (1.7mm) HB (0.40mm)	V-2 (1.7mm) HB (0.40mm)	V-2 (1.7mm)
Temperature index	℃	UL 746B	electric 1.5mmt	130	130	130	80	80	80
			impact 1.5mmt	120	120	120	80	80	80
			non-impact 1.5mmt	130	130	130	80	80	80

The values listed are specification values, not certified values.

Physical properties-carbon fiber reinforced grades

Property	Unit	Test method	Measurement condition	Standard			Flame resistant	
				B-8110R	B-8120R	B-8130R	BN-8110R	BN-8120R
Melt volume flow rate	cm³/10min	ISO 1133	300℃ load1.2kgf	—	—	—	—	—
Density	kg/m³	ISO 1183	—	1240	1290	1340	1260	1310
Water absorption rate	%	ISO 62	in water 23℃ 24h	0.16	0.14	0.12	0.16	0.14
Tensile modulus	MPa	ISO 527−1 and ISO 527−2	1mm/min	7700	13600	18100	7500	13000
Tensile yield stress	MPa		5mm/min	—	—	—	—	—
Tensile yield distortion	%			—	—	—	—	—
Tensile fracture designation distortion	%			—	—	—	—	—
Tensile fracture stress	MPa			110	130	135	115	135
Tensile fracture distortion	%			2.5	1.5	1.0	2.5	1.5
Flexural modulus	MPa	ISO 178	2mm/min	7400	12000	16000	7200	11500
Flexural strength	MPa		2mm/min	165	185	195	170	185
Charpy impact strength	kJ/m²	ISO 179	unnotched	35	25	20	30	23
			notched	8	7	6	7	7
Load-deflection temperature	℃	ISO 75−1 and ISO 75−2	1.80MPa	146	147	147	146	147
			0.45MPa	149	149	149	149	149
Vicat softening temperature	℃	ISO 306	50℃/h 50N	152	152	153	152	151
Mold shrinkage	%	In - house method	parallel (4mmt)	0.1〜0.3	0.02〜0.2	0.01〜0.15	0.1〜0.3	0.02〜0.2
			vertical (4mmt)	0.4〜0.6	0.3〜0.5	0.3〜0.5	0.4〜0.6	0.3〜0.5
Coefficient of linear expansion	$\times10^{-4}$/℃	ISO 11359−2	parallel	0.3	0.2	0.1	0.3	0.2
			vertical	0.6	0.6	0.5	0.6	0.6
Specific inductive capacity	—	IEC 60250	100Hz	—	—	—	—	—
	—		1MHz	—	—	—	—	—
Dielectric loss tangent	$\times10^{-4}$	IEC 60250	100Hz	—	—	—	—	—
	$\times10^{-4}$		1MHz	—	—	—	—	—
Volume resistivity	Ω·m	IEC 60093	—	10^{0}〜10^{2}	10^{-1}〜10^{1}	10^{-2}〜10^{0}	10^{0}〜10^{2}	10^{-1}〜10^{1}
Surface resistivity	Ω	IEC 60093	—	10^{1}〜10^{3}	10^{0}〜10^{2}	10^{0}〜10^{1}	10^{1}〜10^{3}	10^{0}〜10^{2}
Withstand voltage	MV/m	IEC 60243−1	short time test	—	—	—	—	—
Tracking resistance	—	IEC 60112	—	—	—	—	—	—
Flammability	—	UL 94	—	V-2 (0.75mm) V-1 (3.0mm)	V-2 (0.75mm) V-1 (3.0mm)	V-2 (0.75mm) V-1 (3.0mm)	V-2 (0.75mm) V-0 (1.5mm)	V-2 (0.75mm) V-0 (1.5mm)
Temperature index	℃	UL 746B	electric 1.5mmt	80	80	80	80	80
			impact 1.5mmt	80	80	80	80	80
			non-impact 1.5mmt	80	80	80	80	80

The values listed are specification values, not certified values.

Physical properties-carbon fiber reinforced grades

Property	Unit	Test method	Measurement condition	Non-bromine/non-phosphor type flame resistant grade			Frictional wear resistant grade		EMI shield (phosphor type flame resistance)		
				B-4110R	B-4120R	B-4130R	BS-8110R	BS-8120R	E-8715	EN-8515N	EN-8615N
Melt volume flow rate	cm³/10min	ISO 1133	300℃ load1.2kgf	—	—	—	—	—	—	—	—
Density	kg/m³	ISO 1183	—	1230	1280	1330	1290	1360	1305	1305	1305
Water absorption rate	%	ISO 62	in water 23℃ 24h	0.16	0.14	0.12	0.16	0.14	0.15	0.15	0.15
Tensile modulus	MPa	ISO 527−1 and ISO 527−2	1mm/min	7700	13600	18200	7800	13600	7700	8100	8100
Tensile yield stress	MPa		5mm/min	—	—	—	—	—	—	—	—
Tensile yield distortion	%			—	—	—	—	—	—	—	—
Tensile fracture designation distortion	%			—	—	—	—	—	—	—	—
Tensile fracture stress	MPa			105	125	130	110	120	63	60	70
Tensile fracture distortion	%			2.5	1.5	1.0	2.0	1.5	3.0	3.0	5.0
Flexural modulus	MPa	ISO 178	2mm/min	7500	12000	16000	7500	12000	7300	7600	7600
Flexural strength	MPa		2mm/min	160	185	195	160	170	105	100	110
Charpy impact strength	kJ/m²	ISO 179	unnotched	32	28	24	27	25	45	25	22
			notched	8	8	8	8	7	15	10	8
Load-deflection temperature	℃	ISO 75−1 and ISO 75−2	1.80MPa	146	147	147	147	147	115	100	110
			0.45MPa	148	149	149	150	150	125	108	118
Vicat softening temperature	℃	ISO 306	50℃/h 50N	151	152	152	152	152	128	111	124
Mold shrinkage	%	In - house method	parallel (4mmt)	0.1〜0.3	0.02〜0.2	0.01〜0.15	0.1〜0.3	0.02〜0.2	0.11〜0.31	0.05〜0.25	0.07〜0.27
			vertical (4mmt)	0.4〜0.6	0.3〜0.5	0.3〜0.5	0.4〜0.6	0.4〜0.6	0.36〜0.56	0.25〜0.45	0.28〜0.48
Coefficient of linear expansion	$\times 10^{-4}$/℃	ISO 11359−2	parallel	0.3	0.2	0.1	0.3	0.2	0.2	0.2	0.2
			vertical	0.6	0.6	0.5	0.6	0.6	0.8	0.8	0.8
Specific inductive capacity	—	IEC 60250	100Hz	—	—	—	—	—	—	—	—
	—		1MHz	—	—	—	—	—	—	—	—
Dielectric loss tangent	$\times 10^{-4}$	IEC 60250	100Hz	—	—	—	—	—	—	—	—
	$\times 10^{-4}$		1MHz	—	—	—	—	—	—	—	—
Volume resistivity	Ω·m	IEC 60093	—	10^{0}〜10^{2}	10^{-1}〜10^{1}	10^{-2}〜10^{0}	10^{0}〜10^{2}	10^{-1}〜10^{1}	6×10^{-3}	5×10^{-3}	5×10^{-3}
Surface resistivity	Ω	IEC 60093	—	10^{1}〜10^{3}	10^{0}〜10^{2}	10^{0}〜10^{1}	10^{1}〜10^{3}	10^{0}〜10^{2}	7×10^{0}	6×10^{0}	6×10^{0}
Withstand voltage	MV/m	IEC 60243−1	short time test	—	—	—	—	—	—	—	—
Tracking resistance	—	IEC 60112	—	—	—	—	—	—	—	—	—
Flammability	—	UL 94	—	V-2 (0.80mm)	V-2 (0.80mm)	V-2 (0.80mm)	V-2 (0.75mm) V-1 (1.5mm)	V-2 (0.75mm) V-1 (1.5mm)	V-2 (0.75mm) V-1 (3.0mm)	V-0 (0.75mm) 5VA (2.0mm)	V-2 (0.75mm) V-0 (1.5mm)
Temperature index	℃	UL 746B	electric 1.5mmt	80	80	80	80	80	80	80	80
			impact 1.5mmt	80	80	80	80	80	80	80	80
			non-impact 1.5mmt	80	80	80	80	80	80	80	80

The values listed are specification values, not certified values.

1) Temperature index of B-4110R, B-4120R & B-4130R is provided under the thickness of 0.8mm.
2) Volume resistivity and surface resistivity of E-8715, EN-8515N & EN-8615N are measured on our own standard.
3) Mold shrinkage of E-8715, EN-8515N & EN-8615N at thickness 1.5mmt.
4) E-8715, EN-8515N & EN-8615N are not available inside EU.

Physical properties-PC alloy grades

Property	Unit	Test method	Measurement condition	Standard			Flame resistant		Fiber reinforced grade	
				AM-1800	AM-8030	AM-9022	MN-3600H	MN-3705	AM-9020F	GM-9315
Melt volume flow rate	cm^3/10min	ISO 1133	280℃ load2.16kgf	14	10	9	17	27	—	—
Density	kg/m^3	ISO 1183	—	1180	1240	1220	1190	1190	1290	1330
Water absorption rate	%	ISO 62	in water 23℃ 24h	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Tensile modulus	MPa	ISO 527−1 and ISO 527−2	1mm/min	2250	2350	2250	2350	2450	3400	4600
Tensile yield stress	MPa		50mm/min ＊5mm/min	60	62	56	60	60	58	—
Tensile yield distortion	%			5	4	4	7	7	4	—
Tensile fracture stress	MPa			68	62	62	50	50	51	＊93
Tensile fracture distortion	%			140	100	120	100	110	100	＊3
Flexural modulus	MPa	ISO 178	2mm/min	2200	2300	2200	2300	2300	3300	4500
Flexural strength	MPa		2mm/min	85	88	85	95	95	88	139
Charpy impact strength	kJ/m^2	ISO 179	unnotched	NB	NB	NB	NB	NB	NB	35
			notched	72	53	74	45	50	15	8
Load-deflection temperature	℃	ISO 75−1 and ISO 75−2	1.80MPa	123	104	109	112	95	102	134
			0.45MPa	132	123	134	125	108	128	145
Mold shrinkage	%	In - house method	parallel (4mmt)	0.5〜0.7	0.7〜1.0	0.7〜1.0	0.5〜0.7	0.5〜0.7	0.4〜0.6	0.3〜0.5
			vertical (4mmt)	0.5〜0.7	0.8〜1.1	0.8〜1.1	0.5〜0.7	0.5〜0.7	0.5〜0.7	0.5〜0.7
Coefficient of linear expansion	$\times10^{-4}$/℃	ISO 11359−2	parallel	0.7	0.8	0.8	0.7	0.7	0.5	0.3
			vertical	0.7	0.8	0.8	0.7	0.7	0.8	0.7
Surface resistivity	Ω	IEC 60093	—	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$	$>1\times10^{15}$
Flammability	—	UL 94	—	—	—	—	HB (0.45mm) V-1 (1.0mm) V-0 (1.5mm) 5VB (2.0mm) 5VA (3.0mm)	V-2 (0.40mm) V-0 (0.80mm) V-0 (3.0mm)	—	—
Temperature index	℃	UL 746B	electric 1.5mmt	—	—	—	95	80	—	—
			impact 1.5mmt	—	—	—	95	80	—	—
			non-impact 1.5mmt	—	—	—	95	80	—	—

The values listed are specification values, not certified values.

Physical properties of other plastics

Properties		Unit	Panlite L-1250Y	PMMA	ABS	Modified PPE		PBT		POM		Nylon6 (absolute dry)	
				non-reinforced	non-reinforced	non-reinforced	GF30%	non-reinforced	GF30%	non-reinforced	GF25%	non-reinforced	GF30%
Density		kg/m^3	1,200	1,190	1,040	1,060	1,300	1,310	1,520	1,410	1,590	1,130	1,360
Water absorption	In water 23℃, 24hr	%	0.2	0.3	0.3	0.10	0.06	0.10	0.07	0.22	0.20	3.0	2.1
	saturation		0.4	2.0	—	—	—	—	—	1.0	—	8.0	—
Tensile fracture designation distortion		%	>50	6	>50	30	2	90	2.7	30	3.0	>50	3.5
Charpy impact strength	notched	kJ/m^2	76	1.4	30	20	8	3	10	7	9	9	15
Load-deflection temperature	load 1.80MPa	℃	129	100	85	105	139	54	202	105	162	65	210
Coefficient of linear expansion	parallel	$\times 10^{-4}$/℃	0.70	0.60	0.80	0.75	0.30	1.10	0.65	1.10	0.30	0.85	0.23
	vertical		0.70	0.60	0.80	0.75	0.70	1.10	0.30	1.10	1.10	0.85	0.65

The values listed are quoted from catalogs and literature published by respective makers.

Conversion Table of SI/CGS Units

Item	Current unit	Conversion rate	SI unit to be used
Load	kgf	9.80665	N
Stress	kgf/cm^2	0.0980665	MPa、(N/mm^2)
Modulus of elasticity	kgf/cm^2	0.0980665	MPa
Impact strength	kgf・cm/cm	9.80665	J/m
Torque	kgf・cm	0.0980665	N・m
Viscosity	poise	0.1	Pa・s
Pressure	atm	101.325	kPa
Calorie	kcal	4.18605	kJ
Thermal conductivity	$\frac{kcal}{m \cdot h \cdot ℃}$	1.16279	$\frac{W}{m \cdot ℃}$
Linear expansion	$\frac{cm}{cm \cdot ℃}$	—	1/℃
Volume resistivity	Ω・cm	0.01	Ω・m
Dielectric breakdown strength	kV/mm	—	MV/m

-: no conversion necessary

⚠ Caution

- The figures listed in this catalogue are typical values obtained under standard test methods, and may not be applicable for products that are used under different application condition.
- The combustion figures listed in this catalogue are from small-scale test and may not be applicable for hazards during a major fire.
- Please refer to us for an advice regarding the application conditions for medical equipment, food service applications, and toys.
- When any kind of additives (such as anti-bacterial agents, stabilizers and flame retardants) or coloring agents are to be added to this resin, please be sure to consult with Teijin Chemicals Ltd., in advance.
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- The property values of other plastics have been quoted from pertinent catalogues and literature.
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- The contents of this catalogue may be changed without prior notice.
- Please refer to the Material Safety Data Sheet (MSDS) before use for other warnings in detail.
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