Multilon®

PC/ABS Polymer Alloy

TEIJIN

Human Chemistry, Human Solutions

Multilon is a PC/ABS polymer alloy originally developed by Teijin Limited. Combining the many excellent characteristics of both polycarbonate (PC) and ABS, Multilon is used in a variety of products, such as electric & electronic appliance parts, office automation equipment, lighting fixtures, automobile parts, houseware and many other areas.

Multilon®

Multilon®

Contents

Multilon® Lineup

Series	Types	Grade
Standard series	General purpose	T−3750 (UL94 HB)
		TN−3000V (UL94 V-0)
		TN−3411V (UL94 V-0)
	Antistatic	T−3615Q (UL94 HB)
		TN−3616Q (UL94 V-0)
Automotive series	General purpose	T−2711J (General purpose・High impact property・High heat resistance)
		T−2754 (High flowability・High impact property)
	Plating	MK−1000A (UL94 HB plating property)
Non-halogen type flame resistant series	Housing applications: General purpose	TN−7000 (UL94 V-0)
	Housing applications: High flowability	TN−7500 (UL94 V-0)
	Housing applications: High rigidity	TN−7000F (UL94 V-0)
		TN−7100F (UL94 V-0)
		TN−3712B (UL94 V-0)
		TN−3713B (UL94 V-0)
		TN−3715B (UL94 V-0)
	Housing applications: High flowability・High rigidity	TN−7500F (UL94 V-0)
	Housing applications: Filler reinforced	DN−3710F (UL94 V-0 10% filler reinforced)
		DN−3720F (UL94 V-0 20% filler reinforced)
	Chassis applications: Filler reinforced	DN−7720D (UL94 V-1 20% filler reinforced)
		DN−7730M (UL94 V-1 30% filler reinforced)

Multilon® Standard Series

Multilon standard series have been listed under UL94 HB or UL94 V-0 rating. A halogen flame retardant is used for the V-0 grade to make it flame resistant. An antimony compound is added as a flame retardant auxiliary to TN-3000V and TN-3616Q.

General Purpose Type

PC/ABS polymer alloy suitable for general purpose use. The balance between heat resistance and impact property is superior compared to the heat resistance of ABS or modified PPE. The flow property is higher than heat-resistant ABS.

Grades	Characteristics
T-3750	UL-94 HB
TN-3000V	UL-94 V-0
TN-3411V	UL-94 V-0

Antistatic Type

Antistatic type grade with an antistatic polymer.
The value of surface resistance is 10^{10}-$10^{11}\Omega$, delivering excellent antistatic performance. The antistatic effect is maintained even after wiping with cloth or washing.

Grades	Characteristics
T-3615Q	UL-94 HB
TN-3616Q	UL-94 V-0

Multilon® Automotive series

PC/ABS polymer alloy developed for automotive use.
It shows excellent heat resistance, impact properties, light resistance and flowability.

General Purpose Type

Standard grade with excellent heat resistance, impact resistance, and light resistance.
Standard grade exhibits excellent heat resistance performance compared to the heat-resistance ABS, ensuring high impact resistance even at temperatures below −30℃.

Grades	Characteristics
T-2711J	High impact property, high heat resistance
T-2754	High flowability, high impact property

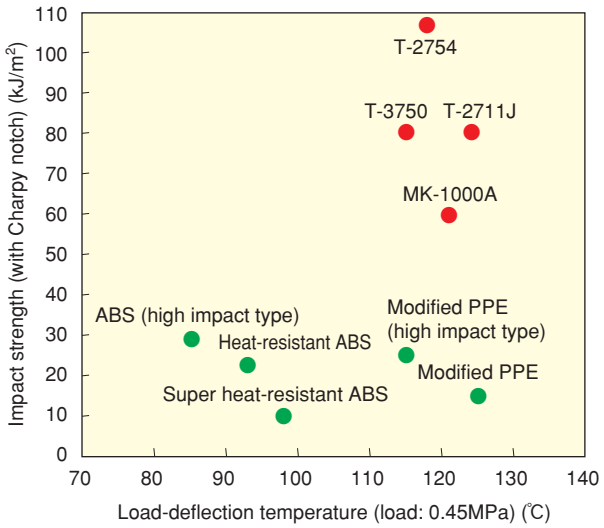
Plating type

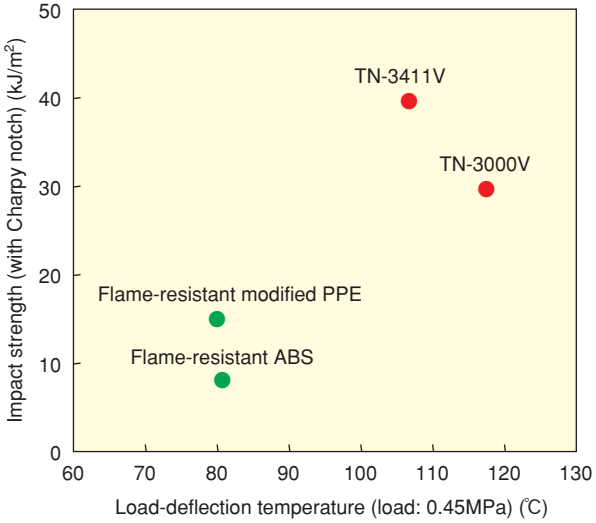
Plating grade with excellent heat resistance, impact resistance, fatigue property, and dimensional stability. This type is widely used for outer and inner door handles, as well as panels and other plated decorations.
Plating is possible during the ABS plating process.

Grades	Characteristics
MK-1000A	UL-94 HB

Heat resistance and impact strength

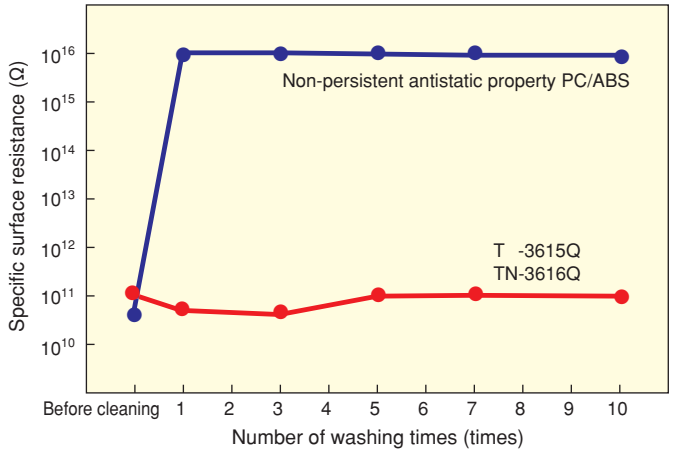
Multilon has stronger impact strength than the equivalent ABS and modified PPE.





Antistatic properties

The antistatic effect of T-3615Q and TN-3616Q lasts long even if they are wiped with cloth or washed.

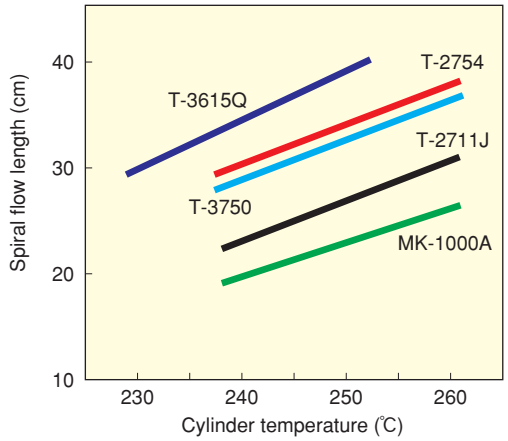


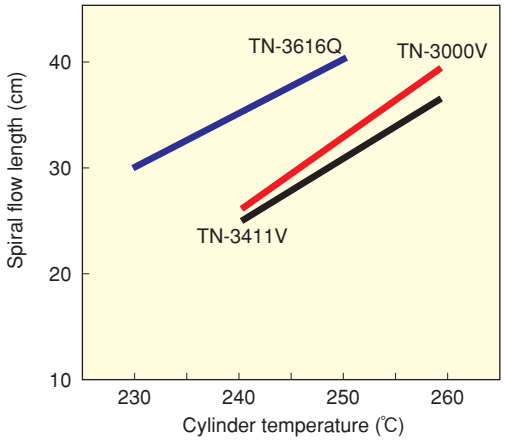
Measuring conditions

① Molded test piece are under the condition of (23℃; 50 %RH) for more than 24 hours.
② Measurement of specific surface resistance.
③ After dipping in water for one hour, molded test piece are wiped with cloth to remove water.

Flow property (spiral flow length)

Molding machine: Sumitomo SG150U
Injection pressure: 98.1 MPa
Mold temperature: 70° C
Flow path thickness: 2 mm
Flow path width: 8 mm





Multilon®
Non-halogen type flame resistant series

These series are flame resistant grade using Non-halogen type flame retardant additive which is UL94V-0 and 5V rated. It has excellent impact properties and moldability, along with resistance to hydrolysis and excellent recycling efficiency.

Housing applications

General purpose type

Standard grade has excellent impact strength, heat resistance and moldability.

Grades	Characteristics
TN-7000	UL-94 V-0/5V

High flowability type

This type features especially reliable flowability. It is particularly suited to housing of office automation devices.

Grades	Characteristics
TN-7500	UL-94 V-0/5V

High rigidity type

High rigidity grade makes possible the molding of thin wall office automation device housings. In addition, TN-7100F has the superior impact strength.

Grades	Characteristics
TN-7000F	UL-94 V-0/5V
TN-7100F	UL-94 V-0/5V
TN-3712B	UL-94 V-0/5V
TN-3713B	UL-94 V-0/5V
TN-3715B	UL-94 V-0/5V

High flowability/high rigidity type

High flowability and rigidity grade makes possible the molding of thin wall office automation device housings.

Grades	Characteristics
TN-7500F	UL-94 V-0/5V

Filler reinforced type

Rigidity is improved by adding inorganic fillers.
High rigidity and flowability properties makes possible the molding of thin wall office automation device housings.

Grades	Characteristics
DN-3710F	UL-94 V-0/5V 10% filler reinforced
DN-3720F	UL-94 V-0/5V 20% filler reinforced

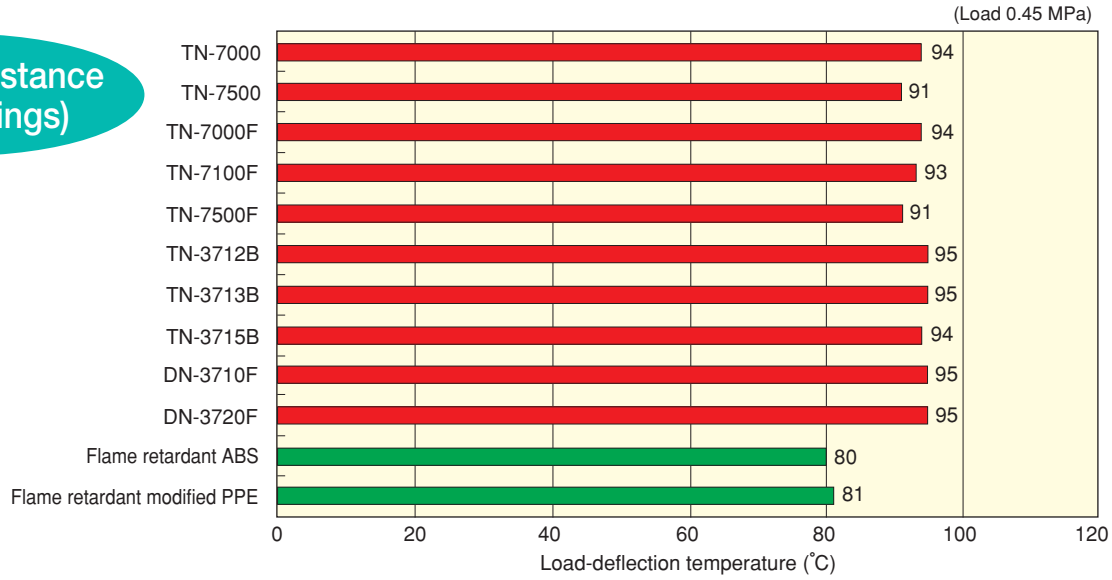
Chassis applications

Filler reinforced type

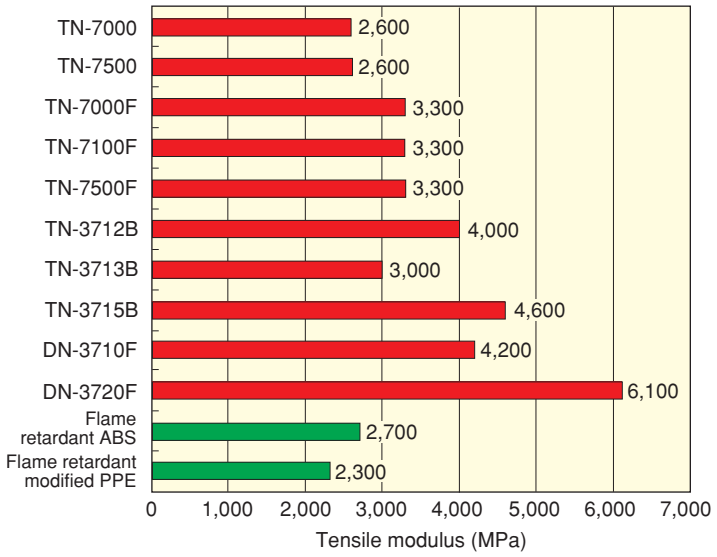
Rigidity is improved by adding inorganic fillers.
Molding anisotropy and dimensional stability have been improved for optical chassis applications, which require high dimensional accuracy.

Grades	Characteristics
DN-7720D	UL-94 V-1/5V 20% filler reinforced
DN-7730M	UL-94 V-1/5V 30% filler reinforced

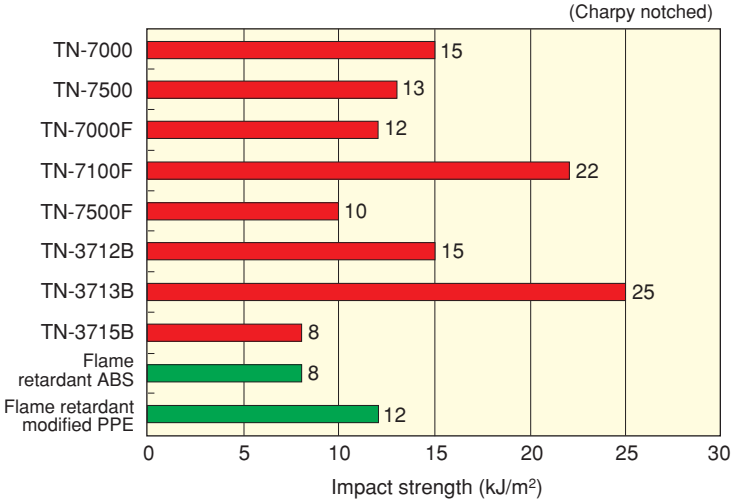
Heat resistance (for housings)



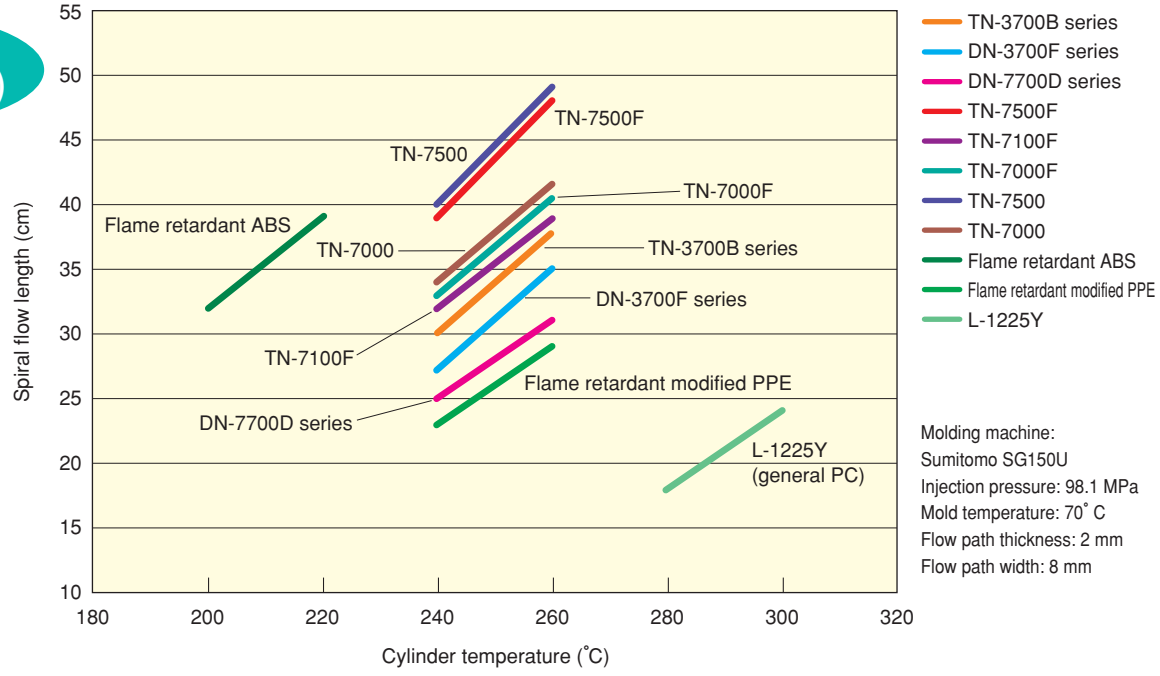
Rigidity (for housings)



Impact strength (for housings)



Flowability (spiral flow length)



Molding machine:
Sumitomo SG150U
Injection pressure: 98.1 MPa
Mold temperature: 70˚ C
Flow path thickness: 2 mm
Flow path width: 8 mm

Multilon® Physical Properties

Property	Unit	Test method	Measurement condition	Standard series					Automotive series		
				T-3750 (general)	TN-3000V (General flame resistance)	TN-3411V (General flame resistance)	T-3615Q (Persistent antistatic property)	TN-3616Q (Flame-resistant persistent antistatic property)	T-2711J (general)	T-2754 (high flowability)	MK-1000A (Plating)
Density	kg/m³	ISO 1183	—	1,130	1,190	1,180	1,130	1,210	1,140	1,110	1,120
Tensile modulus	MPa	ISO 527–1 and ISO 527–2	1mm/min	2,250	2,550	2,650	1,760	1,760	2,250	2,150	2,050
Tensile stress at yield	MPa		50mm/min *5mm/min	55	60	65	45	45	56	54	50
Tensile stress at break	MPa			50	50	50	50	45	48	48	42
Tensile strain at yield	%			5	2	3	3	3	3	3	3
Tensile strain at break	%			80	75	110	120	120	110	130	110
Flexural modulus	MPa	ISO 178	2mm/min	2,300	2,600	2,800	1,800	1,800	2,300	2,200	2,100
Flexural strength	MPa		2mm/min	83	95	95	70	74	85	78	75
Charpy impact strength	kJ/m²	ISO 179	unnotched	NB	NB	NB	NB	NB	NB	NB	NB
			notched	80	30	40	80	55	80	107	60
Load-deflection temperature	℃	ISO 75–1 and ISO 75–2	1.80MPa	100	103	93	93	97	104	95	97
			0.45MPa	115	118	107	107	112	124	118	121
Vicat softening temperature	℃	ISO 306	50℃/h 50N	114	119	109	109	112	122	114	116
Molding 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	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	0.5～0.7	0.5～0.7
Coefficient of linear expansion	$\times 10^{-4}$/℃	ISO 11359–2	parallel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
			vertical	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Surface specific resistance	Ω	IEC 60093	—	10^{16}	10^{16}	10^{16}	10^{10}～10^{11}	10^{10}～10^{11}	10^{16}	10^{16}	10^{16}
Flammability	—	UL 94	—	HB (0.75mm)	V-2 (0.75mm) V-0 (1.5mm)	V-0 (1.5mm) 5VB (2.5mm)	HB (1.5mm)	V-0 (1.5mm)	—	—	HB (1.5mm)

* The figures shown above are representative: They are not guarantees of individual results.
* Mold shrinkage at thickness 4mm.
* Molding shrinkage of Multilon will vary depending on its application thickness. Send any inquiry to the Headquarters of Polycarbonate Resin Sales, Teijin Limited, for detailed technical information.

	Non-halogen type flame resistant series											
	Housing applications										Chassis applications	
	TN-7000 (general)	TN-7500 (high flowability)	TN-7000F (high rigidity)	TN-7100F (high rigidity)	TN-7500F (high flowability・high rigidity)	TN-3712B (high rigidity)	TN-3713B (high rigidity)	TN-3715B (high rigidity)	DN-3710F (filler reinforced)	DN-3720F (filler reinforced)	DN-7720D (filler reinforced)	DN-7730M (filler reinforced)
	1,180	1,180	1,220	1,210	1,210	1,250	1,210	1,300	1,260	1,340	1,350	1,400
	2,600	2,600	3,300	3,300	3,300	4,100	3,050	4,700	4,200	6,100	6,500	9,000
	63	63	63	62	62	＊62	63	＊70	＊61	—	＊74	—
	48	47	46	46	48	＊45	50	＊50	＊48	＊60	＊70	＊66
	3	3	2	2	2	＊2	3	＊2	＊3	—	＊2	—
	80	50	20	50	30	＊30	100	＊20	＊35	＊5	＊3	＊2
	2,600	2,600	3,200	3,200	3,200	4,000	3,000	4,600	4,100	5,400	6,200	8,000
	95	95	96	94	96	90	90	105	94	100	115	100
	NB	NB	NB	NB	NB	NB	NB	NB	NB	60	40	18
	15	13	12	22	10	15	25	8	13	4	4	3
	84	80	84	83	80	85	84	85	83	83	110	108
	94	91	94	93	91	95	94	95	95	95	122	120
	97	94	97	96	94	98	97	98	98	98	124	122
	0.5～0.7	0.5～0.7	0.4～0.6	0.4～0.6	0.4～0.6	0.4～0.6	0.45～0.65	0.35～0.55	0.4～0.6	0.2～0.4	0.2～0.4	0.1～0.3
	0.5～0.7	0.5～0.7	0.4～0.6	0.4～0.6	0.4～0.6	0.4～0.6	0.45～0.65	0.35～0.55	0.5～0.7	0.3～0.5	0.3～0.5	0.2～0.4
	0.8	0.8	0.6	0.6	0.6	0.55	0.65	0.50	0.45	0.30	0.40	0.30
	0.8	0.8	0.7	0.7	0.7	0.55	0.65	0.50	0.70	0.65	0.48	0.35
	10^{16}	10^{16}	10^{16}	10^{16}	10^{16}	10^{16}	10^{16}	10^{16}	10^{16}	10^{16}	10^{16}	10^{16}
	V-2 (0.70mm) V-1 (1.2mm) V-0 (1.5mm) 5VB (2.0mm)	HB (0.45mm) V-2 (0.8mm) V-1 (1.2mm) V-0 (1.5mm) 5VB (2.0mm)	V-0 (1.2mm) 5VB (1.8mm)	V-2 (0.75mm) V-1 (1.0mm) V-0 (1.5mm) 5VB (1.8mm)	V-0 (1.2mm) 5VB (1.8mm)	V-1 (1.0mm) V-0 (1.5mm) 5VB (2.0mm)	V-1 (1.0mm) V-0 (1.5mm) 5VB (2.0mm)	V-2 (0.75mm) V-1 (1.0mm) V-0 (1.2mm) 5VB (2.0mm)	V-1 (1.0mm) V-0 (1.3mm) 5VB (1.8mm)	V-1 (1.0mm) V-0 (1.3mm) 5VB (1.8mm)	◎V-1 (1.5mm) ◎5VB (2.0mm)	◎V-1 (1.5mm) ◎5VB (2.0mm)

◎＝Black

Multilon®
Applications

Mobile phone

Digital video camera

CD changer

Smoke detector

Copier

Digital audio player

Lap-top PC enclosure

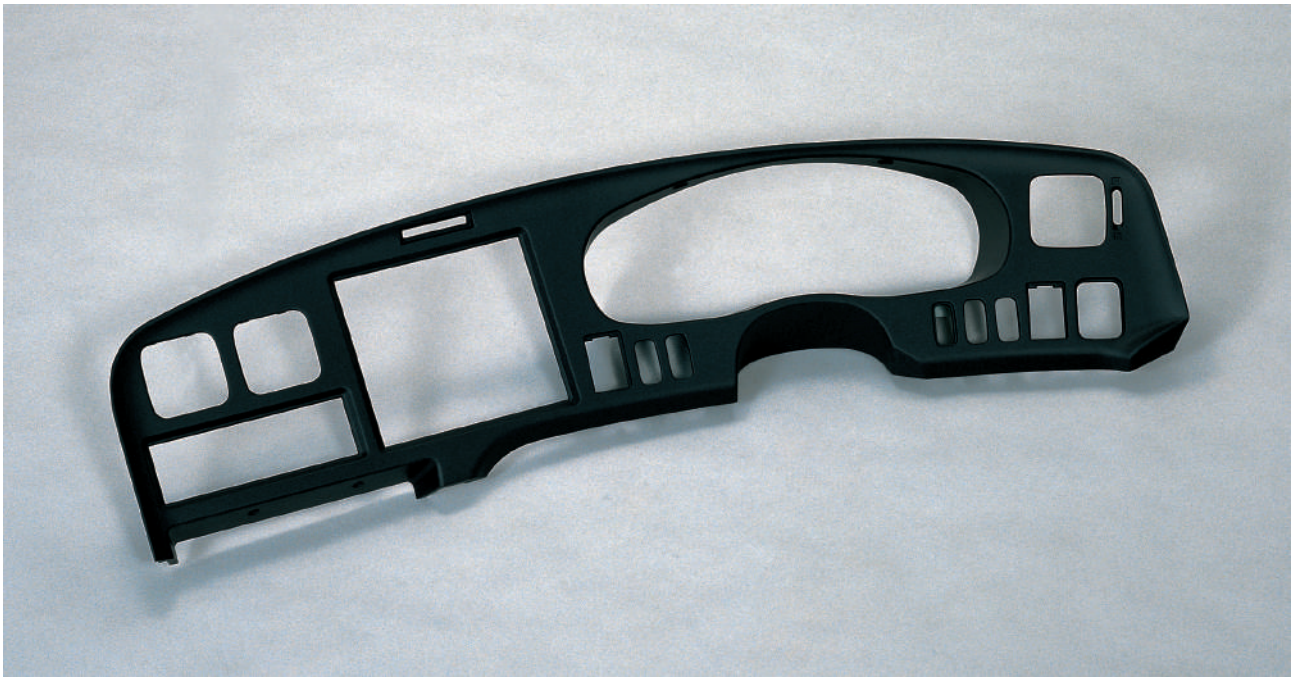
Multilon®
Applications

Center panel

Glove box knob

Audio panel

Outer handle



Cluster

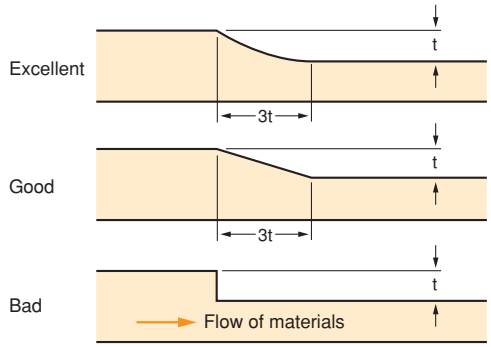
Multilon® Product Design

Multilon is used in a wide variety of fields. The following are some examples of applications, and recommendations for designs using Multilon.

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 sink, 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.

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 for thick section.



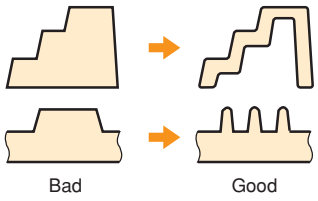
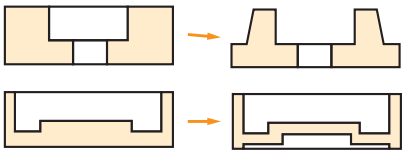


Fig.1 Wall thickness variation



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.

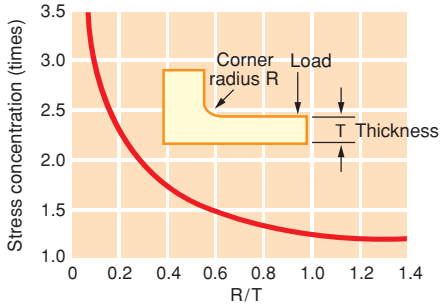


Fig.2 Stress concentration at corners

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 thick 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

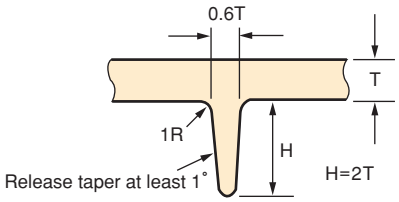
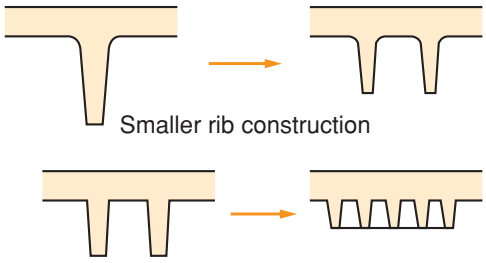


Fig.3 Standard rib



Boss

Since residual stress when molded, load, and difference of thermal expansion coefficient with metal are centered onto the screw boss and insert boss, sufficient material thickness is required when designing.
For the screw boss, the inner diameter of the boss should be designed to be the pitch diameter of the screw.

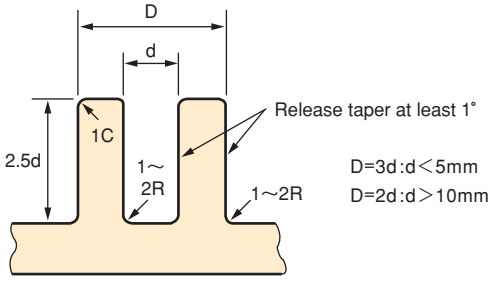


Fig.4 Standard screw boss diameter

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. 5).
For embossing molds, a larger release taper may be required, depending on the roughness of the embossing.

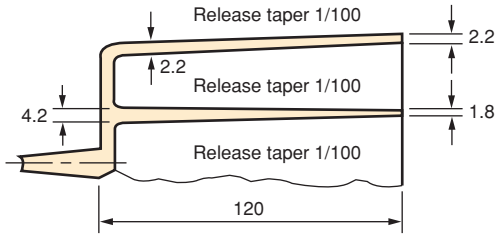


Fig.5 Standard Mold Release Taper

Sprue

Sprue shape varies with the size of molded products and the molding machine to be used. Illustrated in Figure 6 is a standard sprue shape.

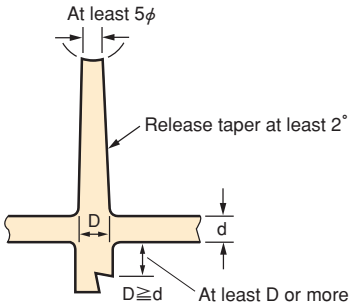
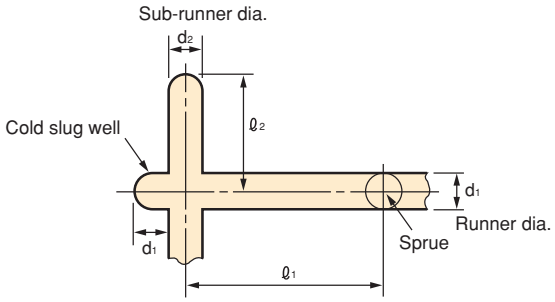


Fig.6 Standard Runner

Runner

Runner shape varies with the size of molded products and the molding machine to be used. The length of the runner should be kept as short as possible. Branched runners should be balanced. A cold-slug well should be provided for the branch and the bent section of the runner.



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.7 Standard Runner Shape

Gate

With regard to shapes and position of the gate, careful consideration should be given so that a sufficient amount of resin may be filled, molded products may be easily detached, and finishing may be done without any difficulty. The following are examples of typical gate shapes and designs used for Multilon.

● Tab gate

This reduces haze around the gate section, jetting and residual stress (Fig.8).

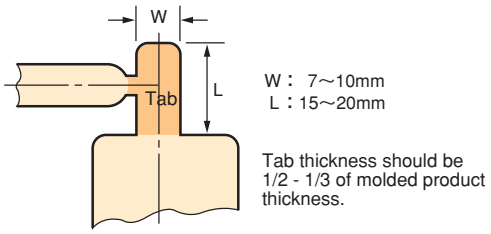


Fig.8 Example of Standard Tab Gate

● Fan gate

This eliminates jetting (Fig.9)

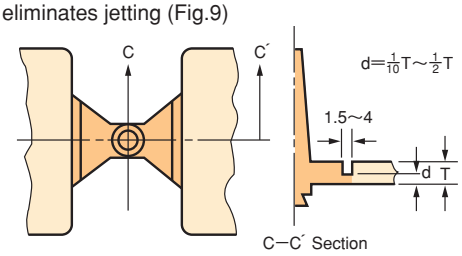
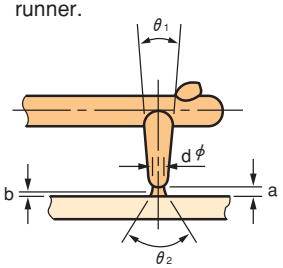


Fig.9 Example of Standard Fan Gate

● Pin-point and submarine gates

These can detach automatically molded product from the runner.



Molded product / Symbol	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.10 Example of Standard Pin-point Gate

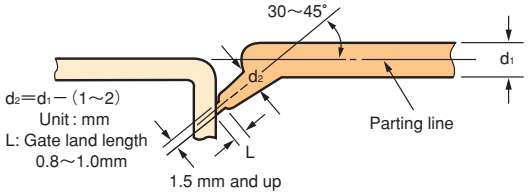


Fig.11 Example of Standard Submarine Gate

● Ring and diaphragm gates

These eliminate weld around the cylinder.

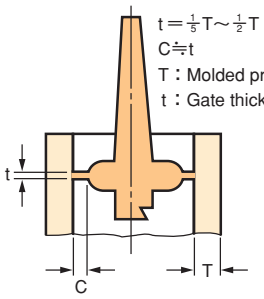


Fig.12 Example of Standard Ring Gate

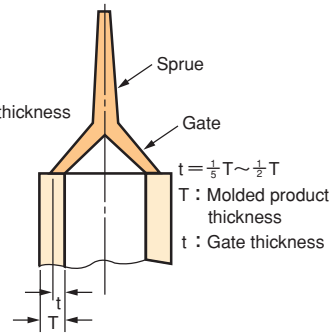


Fig.13 Example of Standard Diaphragm Gate

Ejection

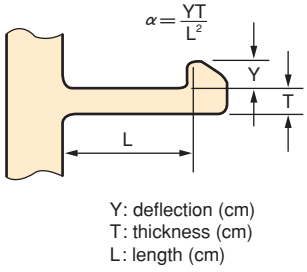
Multilon exhibits a high heat distortion temperature and strength, aiding ejection. However, when ejection is made under force, internal distortions may occur. In this case, it is recommended that the position and the number of ejector pins should be reconsidered to facilitate uniform molding ejection.

Air vent (venting)

An air vent must be provided in order to prevent short shots and gas burns. The vent should be provided at the point at which where the gas is last pressured, such as the runner terminal or the point where the short shot or air-pocket is apt to occur.
The vent depth is 0.03mm - 0.05mm, and the width usually ranges from 5 - 10mm when provided at the parting line. Please also provide a vent near the insertion pin and ejector pin.

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 strain coefficient α relating to deformation on assembly can be obtained from the structural formula for a cantilever beam (Fig.14). 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.



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

Grades	Strain coefficient α
T-3750 TN-3000V TN-3411V T-2711J	0.020
T-2754 MK-1000A	0.021
T-3615Q TN-3616Q	0.019
TN-7000 TN-7500	0.018
TN-7000F TN-7100F TN-7500F TN-3713B	0.016
TN-3712B DN-3710F	0.012
TN-3715B	0.011
DN-3720F DN-7720D	0.010
DN-7730M	0.008

Fig.14 A Standard Snap-fit Joint

Insert

Multilon enables the insertion of very strong metals. However, as thermal expansion coefficient of metals differs from that of Multilon, distortions may occur due to the difference in cooling shrinkage, causing cracks around insert part.
For resins with lower cold flow like polycarbonates, distortions create large stresses that produce cracks. If the metals are heated to about 200˚C, the difference in cooling shrinkage is reduced and cracks can be prevented. In designing insert boss, the outside diameter of the insert metal should be "d". (Fig.15)

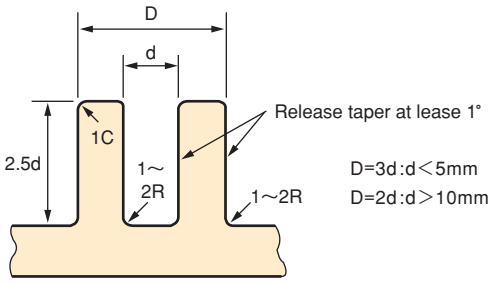


Fig.15 Standard screw boss diameter

Ultrasonic welding

Ultrasonic welding needs only a very short time of less than one second for welding and is very easy to handle. As a result, 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.16). After bonding, annealing treatment should be given and residual stress be relaxed.

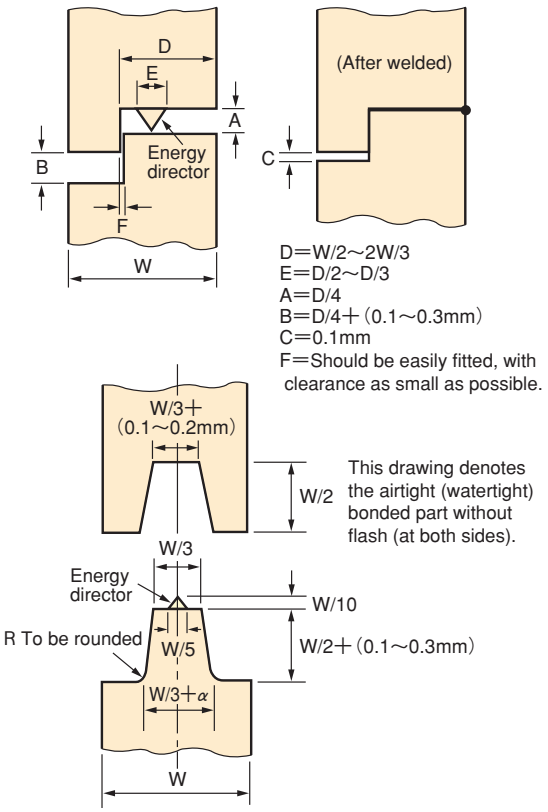


Fig.16 Joint Parts Design

Multilon® Injection Molding

1. Predrying

In order to obtain good moldings with Multilon, it is necessary to predry the polymer under the conditions listed below. These conditions will allow to avoid problems with deterioration in physical properties, foaming and silver streaking caused by hydrolysis. If the drying time exceeds 8 hours, reduce the temperatures of drying machine and hopper dryer to 10°C Lower than those shown in the following condition table, to avoid discoloration of pellet.

2. Injection Molding

It is recommended that the shot capacity of the injection molding machine be about 1.5-3 times the weight of the molded product. It is also recommended that molding be performed according to the molding conditions as described in the table below. Upon setting the molding conditions, start from a low injection speed. A hight injection speed from the start causes the resin to flow through narrow areas such as the nozzle and gates at a high speed, resulting in material burns from shear heat or gas burns at the weld area.

Multilon standard molding conditions

Grades \ Conditions	Predrying		Molding temperature	Mold temperature	Injection pressure
	Temp.	Time			
T-3750 TN-3000V TN-3411V T-3615Q TN-3616Q	110℃	4~8h	230~260℃	50~70℃	59~147 MPa
T-2711J MK-1000A T-2754	110℃	4~8h	240~270℃	50~70℃	59~147 MPa
TN-7000 TN-7000F TN-7100F TN-3712B TN-3713B TN-3715B DN-3710F DN-3720F	80℃	5~8h	230~270℃	50~70℃	59~147 MPa
TN-7500 TN-7500F	80℃	5~8h	230~270℃	50~60℃	59~147 MPa
DN-7720D	110℃	4~8h	240~280℃	50~80℃	59~147 MPa
DN-7730M	100℃	4~8h	240~280℃	50~80℃	59~147 MPa

●Common defects when injection molding & countermeasures

Appearance	Cause	Countermeasures
Bubbles caused by water content	・Decomposition by insufficient drying of pellets	・Sufficient predrying ・Maintain temperature of hopper
Weld mark	・Unsuitable cylinder temperature ・Insufficient injection pressure ・Unsuitable mold temperature ・No venting in the cavity	・Raise cylinder temperature ・Increase injection pressure ・Raise mold temperature ・Include venting
Sink mark	・Caused by shrinkage from slow cooling surface of thick wall section (unsuitable wall thickness) ・Insufficient injection pressure ・Insufficient shot capacity ・Mold temperature is too high or insufficient cooling ・Insufficient pressure maintained ・Insufficient gate dimension	・Reduce thickness deviation ・Increase injection pressure ・Increase shot capacity ・Increase cooling time if mold temperature is suitable ・Extend pressure holding time ・Increase gate dimension, especially thickness
Burning (whole or partial discoloration)	・Unsuitable cylinder temperature ・Partial retention occurs in the cylinder ・Seepage into the screw joint between cylinder and nozzle or other parts ・In case of using check valve and ring ・Decomposition by insufficient drying of pellets ・Excessive capacity of molding machine	・Lower the cylinder temperature ・Eliminate dead corners ・Eliminate gap around screw joint ・Eliminate the material retention ・Perform 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 the cylinder temperature ・Eliminate retention ・Slow injection speed ・Enlarge the gate size ・Perform 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
Ejection problems (defective mold release)	・Insufficient taper 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 ・Injection pressure is too high and filling capacity is too large	・Add release taper ・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 raw materials
Brittleness of molded products	・Insufficient drying ・Mold temperature is too low, injection pressure and pressure holding are excessive ・Occurrence of inside stress caused by thickness deviation and defective mold release ・Notch effect ・Heat decomposition ・Contamination by foreign material	・Maintenance of drying machine and hopper ・Select suitable conditions ・Eliminate thickness deviation ・Eliminate sharp corners, Modify gate position ・Lower cylinder temperature ・Eliminate the material retention ・Cleaning of hopper and cylinder

⚠ 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 conditions.
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