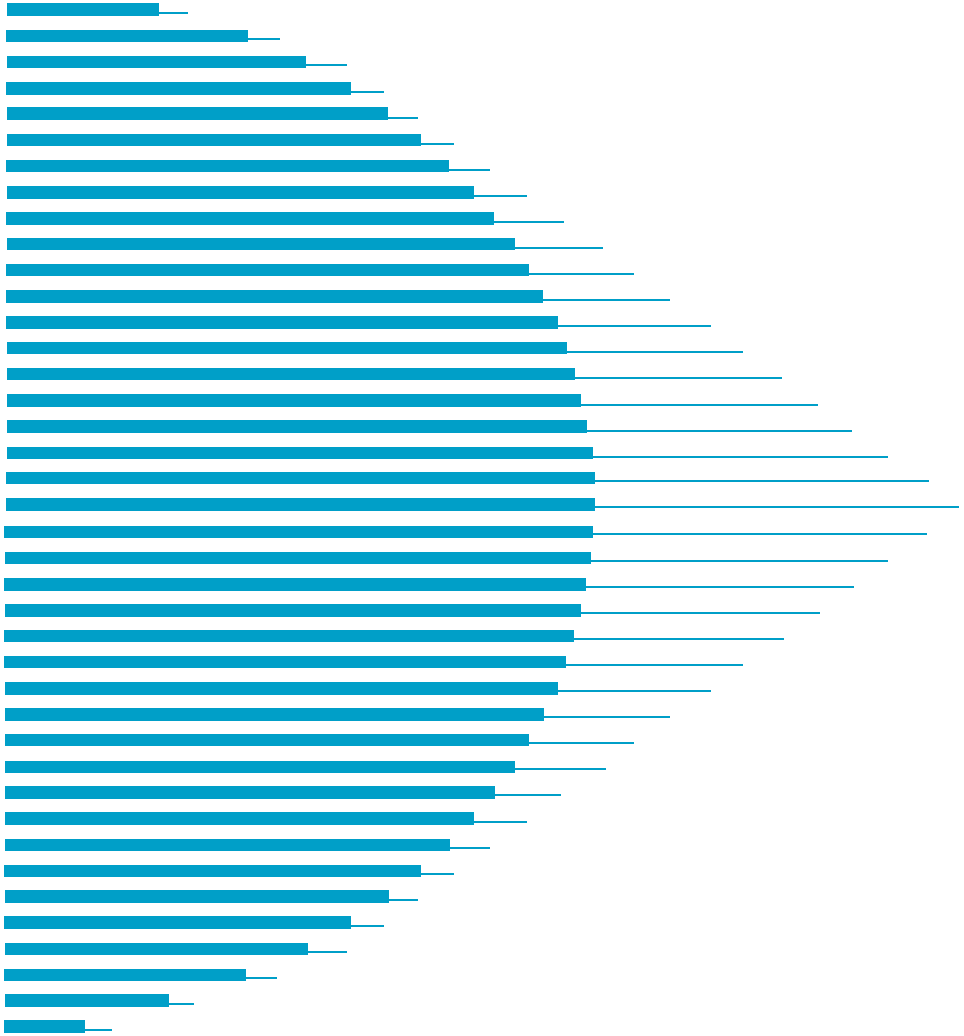
Reny®



High Performance Polyamide

Reny®

Mitsubishi Engineering-Plastics Corporation

Introduction

Reny is a proprietary molding compound based on mainly polyamide MXD6 that has been reinforced with glass fiber, carbon fiber or special minerals.

Reny generally has superior mechanical strength and modulus compared with other engineering plastics.

Thus, Reny is suitable as a metal substitute in many applications, including automobiles, electronics, electrical appliances, machinery and construction.

Special features

- Excellent mechanical strength and modulus over a wide range of temperatures
- Superior to commodity polyamides in dimensional stability and mechanical strength due to low water absorption
- Low thermal expansion coefficient, equivalent to that of metal alloys
- Highly resistant to oils and organic solvents
- Low mold shrinkage and low warpage
- Good surface finish even in highly filled grades

Comparison of Properties of PAMXD6 and Conventional Polyamides

Properties	Units	Condition	PAMXD6	PA6	PA66
Density		20℃	1.21	1.14	1.14
Water Absorption	%	Immersion at 20℃	5.8	11.5	9.9
Moisture Regain	%	65% RH	3.1	6.5	5.7
Deflection Temperature Under Load	℃	1820kPa	96	57	60
Melting point	℃		243	225	268
Glass Transition Temperature	℃	DSC*	75	48	50
Thermal Expansion	10^{-5}cm/cm℃		5.1	8	10
Tensile Strength	MPa		99.0	61.8	76.5
Elongation	%		2.3	200	60
Tensile Modulus	GPa		4.7	2.5	3.1
Flexuel Strength	MPa		157	123	127
Flexuel Modulus	GPa		4.4	2.4	2.9
Izot Impact, Notched	J/m		20	59	39
Rockwell Hardness		M scale	108	85	89

*DSC : Differential Scanning Calorimeter

PAMXD6 $H-(NH-CH_2-C_6H_4-CH_2-NHCO-C_4H_8-CO)_n-OH$

PA6 $H-(NH-CH_5H_{10}-CO)_n-OH$

PA66 $H-(NH-CH_6H_{12}-NHCO-C_4H_8-CO)_n-OH$

Applications

E&E,OA	Smart phones and mobile phones - frame, chassis, Laptop PC - housings, PC - mechanical parts, Printers - guide rollers, mechanical parts, Copy machines - toner screws, gears, rail platens, Cash dispensers - housings, rollers, mechanical parts, Bar-code reader parts, Card reader parts, Handy camera – hinge base, grips, Electronic musical instruments - insulators, Motor stator cores, Receptacle frames, Cable connectors, Coil bobbins, Carbon resistor bases, Rotary switch parts, Pulleys, Timing-belt pulleys, Auto-switch parts, Connectors, Connector insulators, Switches, Timer cases, Steam iron parts, Fans for home saunas, Heater rotary-switch parts, Refrigerator hinges, Shaver parts, Spotlight parts, Down-light switches, Flanges, Semiconductor insulators, IC pallets, IC insulators ... etc.
Vehicles	Door mirror stays, Inner mirror stays, Flywheel magnets, Shift lever parts, Shift lock releases, Fog lamp louvers, Lamp reflectors, Cylinder head covers, Engine mount parts, Motorcycle fuel pump caps, Gears for automobile seats, Rolling dumpers, Stud pins, Bearing parts, Halogen lamp insulator holders, Ducts for superchargers, Steering lock body parts, ABS sensors, Table arms for bullet trains, Motorcycle seat lock parts, Bicycle saddle-posts, Motorboat screws ... etc
Machinery	Waterproof watch cases, Camera gears, Camera flash furnishing plates, Measuring - instrument parts, Micro-gears for watches, Hearing-aid parts, Solar battery pallets, Lithium battery pallets, Welding parts, Printing machine gears, Spinning machine parts, Oil pressure tanks, Robot parts ... etc
Sports Equipment and Miscellaneous	Windsurfer buckles, Ski goggles, Fishing reels, Radio controlled helicopters - housing mechanical parts, Hand dynamometers, Kettle parts, High-pressure pan parts, Scissor blades, Hole-punch parts, Fire extinguisher nozzles, Fasteners, Bed parts ... etc
Civil Engineering And Construction	Screws, Nuts and bolts, Core ties for civil engineering uses, Step for use in utility holes, Door handles and hinges, Handrail parts, Window fence parts, Lock holder covers, Door latches, Carport parts, Branch cocks, Gas stopcock joints ... etc

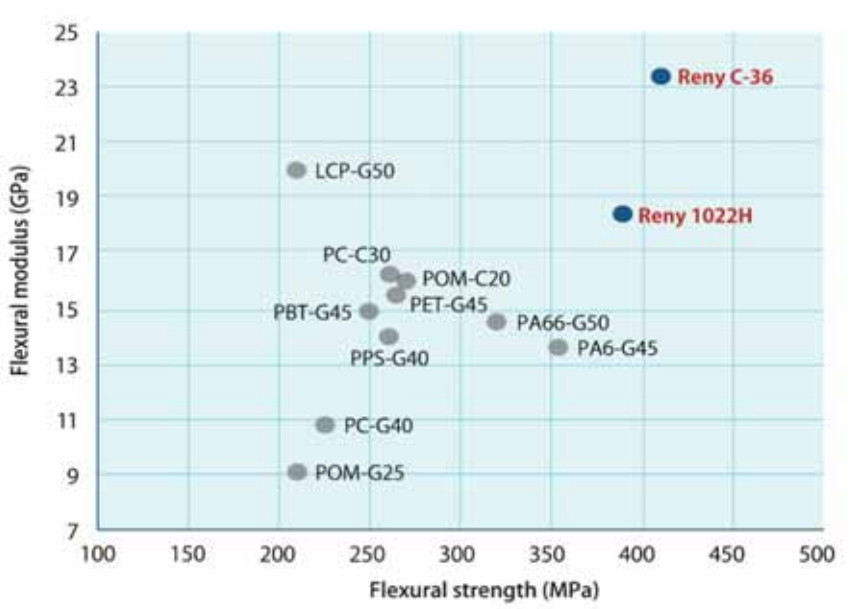
Features

Reny typically containing around 50% glass fiber of filler reinforcement has high strength and rigidity.
Even with high glass loadings, molded parts have excellent smooth surface finish that is ideal for painting or metallization.

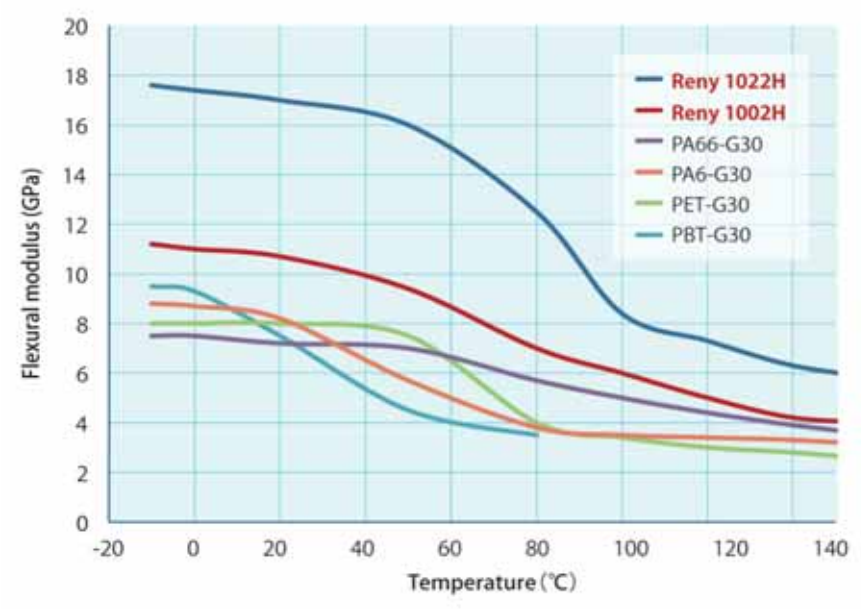
Reny provides resistance to bending.

Reny has high strength and modulus comparable to some cast metals and alloys. Reny has higher strength and modulus compared to various engineering plastics. Moreover, Reny has excellent flexural modulus over a wide range of temperature.

■ **Flexural strength and modulus**



■ **Temperature dependence of flexural modulus**

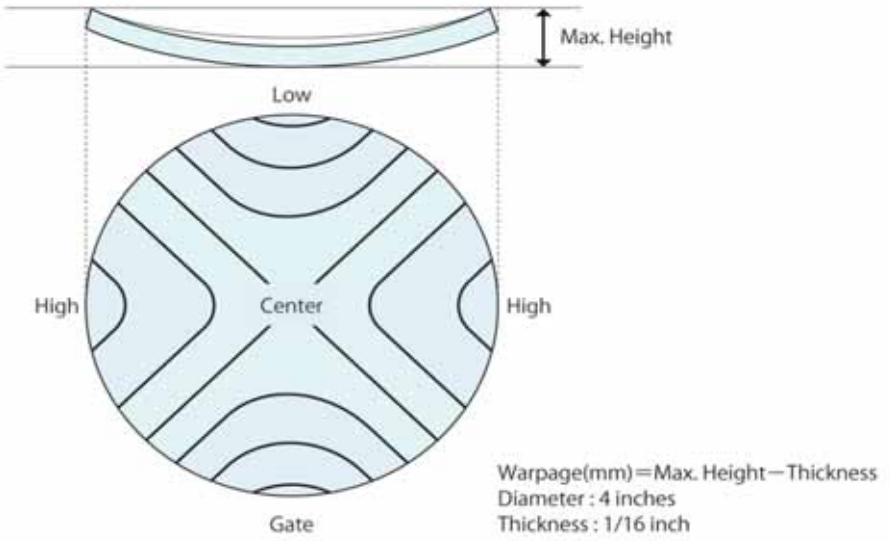


Reny provides excellent resistance to warping.

Reny has lower warpage compared to other crystalline polymer-based FRTPs.

■ **Warpage**

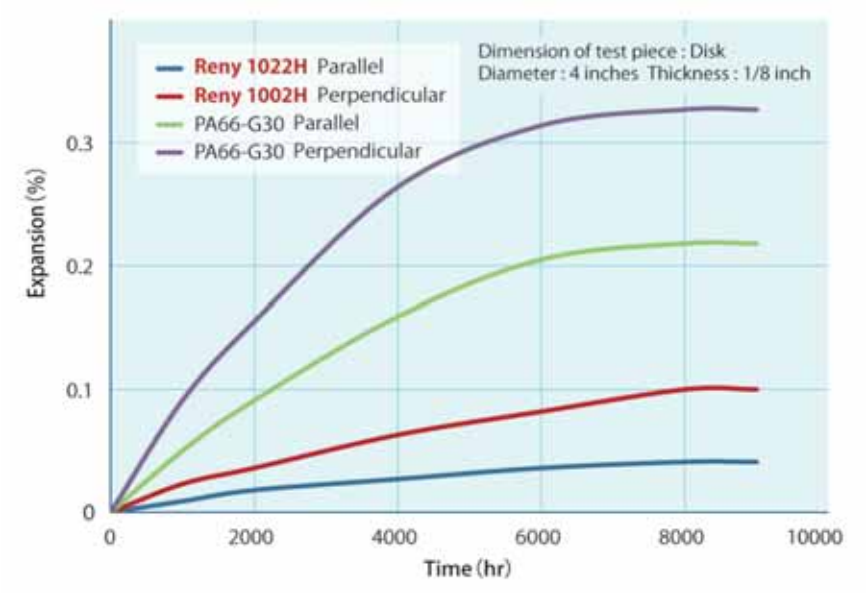
Materials	Warpage (mm) at specific mold temp.	
	75℃	130℃
Reny 1002H	–	**3.98 mm**
Reny 1022H	–	**3.74 mm**
Reny 2620	–	**0.31 mm**
Reny 2502AH	–	**0.26 mm**
PA66-G30	5.75 mm	8.31 mm
PET-G30	–	5.65 mm
PBT-G30	8.17 mm	–
PBT Low Warpage Grade	3.11 mm	–
PPS-G40	–	2.60 mm



Reny offers low water absorption.

Owing to its low water absorption, Reny has better dimensional stability than typical polyamides.

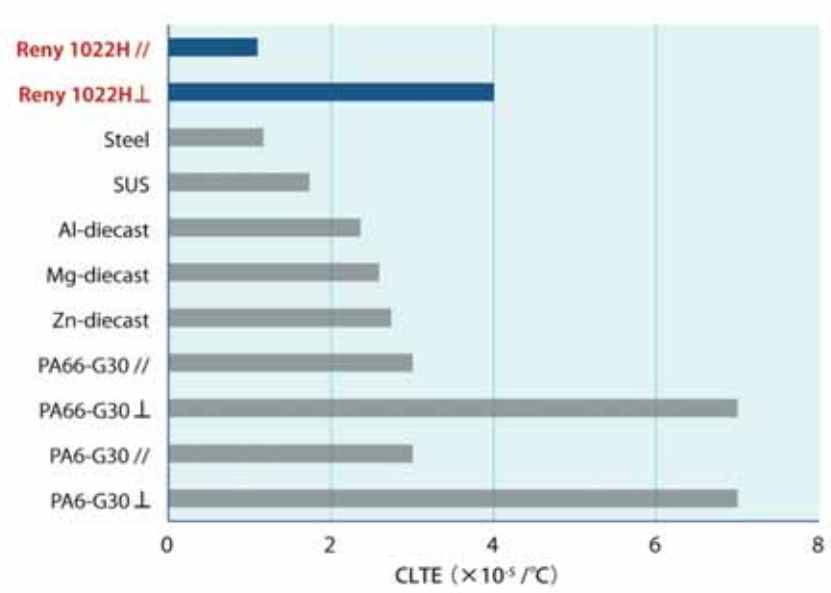
■ **Dimensional changes at 20°C, 65%RH**



Reny can be used in high temperature.

Reny has low coefficient of linear thermal expansion (CLTE) similar to that of metals or metal alloys.

■ **CLTE comparison**



Reny is highly chemical-resistant.

Reny has superb resistance against gasoline, lubricant, organic chemicals containing chlorine and other chemicals.

■ **Chemical resistance**

Weight increase (%) / Loss of tensile strength (%)

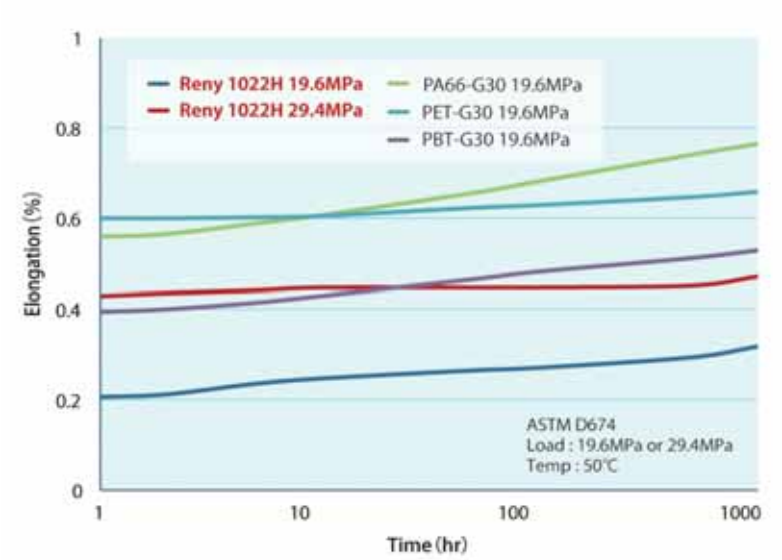
Chemicals	Reny 1002H	PA66-G30	PA6-G30	PET-G30	PBT-G30
water	0/5	2/6	2/27	0/2	0/1
NaOH aq. 10%	0/0	0/0	2/13	–12/100	–1/92
H_2SO_4 aq. 30%	0/7	7/17	23/65	0/0	0/0
Phenol 5%	9/39	9/38	16/63	0/2	0/4
Acetic acid	0/0	2/0	4/9	0/0	0/0
Methanol	1/6	3/30	4/44	0/0	0/0
Ethylacetate	0/0	0/0	0/0	0/0	0/0
Acetone	0/0	0/0	0/0	0/0	0/0
Toluene	0/0	0/2	0/0	0/1	0/0
Gasoline	0/0	0/0	0/0	0/0	0/0
Engine oil	0/0	0/0	0/0	0/0	0/0
Trichloroethylene	0/0	0/0	0/0	0/0	0/0
Lubricant	0/0	0/0	0/0	0/0	0/0

(Immersed for 7 days at atmospheric temperature)

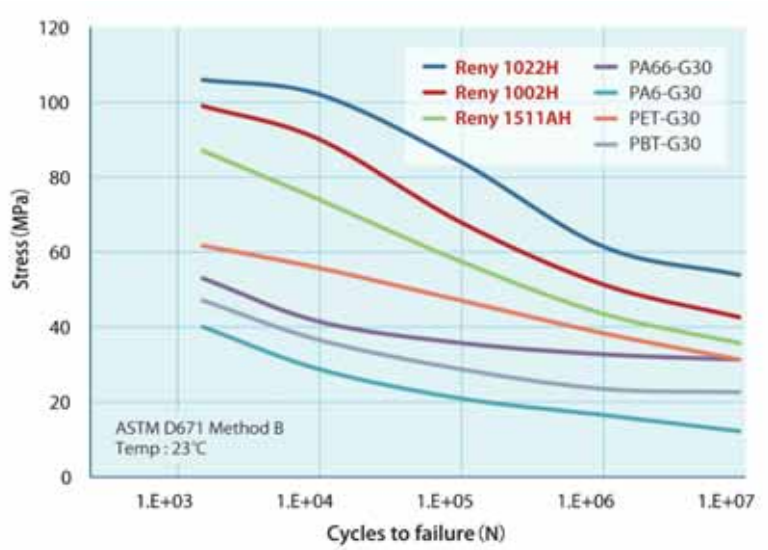
Reny is extremely resistant to creep and fatigue.

Reny demonstrates superior creep resistance against high loads.

■ **Tensile creep**



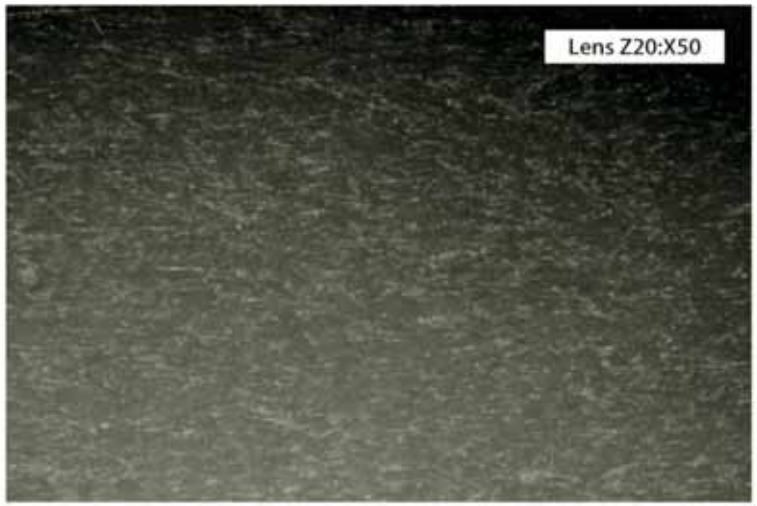
■ **Flexural fatigue**



Reny offers good surface finish.

Even with high glass loadings, molded parts have excellent smooth surface.

▲ Reny 1022H



▲ PA66-G50

Processing information

Predrying

Reny is supplied in a special bag that prevents moisture absorption during storage and transportation.
Basically, predrying is not necessary prior to molding if the bag has just been opened.
However, Reny absorbs moisture gradually when exposed to air, so the predrying process should be applied to pellets that have been left unused at least one hour after opening the bag.
A hopper-dryer is recommended during the molding process.

■ **Typcical drying conditions are as follows :**

Drying Method	Temperature	Time	Note
Trays in drying ovens	80℃	At least 12 hrs.	30mm maximum depth of pellets

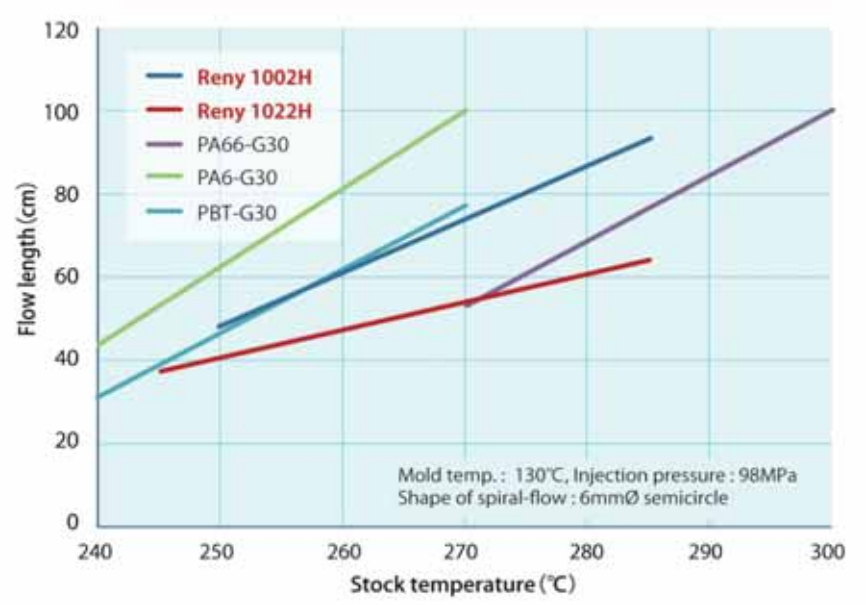
Processing conditions

The standard processing temperature range of Reny is 250°C to 280°C. The temperature of the resin must be adjusted to produce proper filling in the mold but should not exceed 300°C to prevent thermal decomposition.
The standard surface temperature of the mold is 120°C to 140°C to achieve sufficient crystallinity.
That will assure good surface finish, good dimensional stability, full mechanical properties and low moisture absorption.
However, when the wall thickness of the molded parts is less than 1mm, its crystallinity may be insufficient. In that case, the molded parts should be annealed for at least one hour at 130°C in an air oven. Besides, we prepare special grades for thin-wall or small parts.

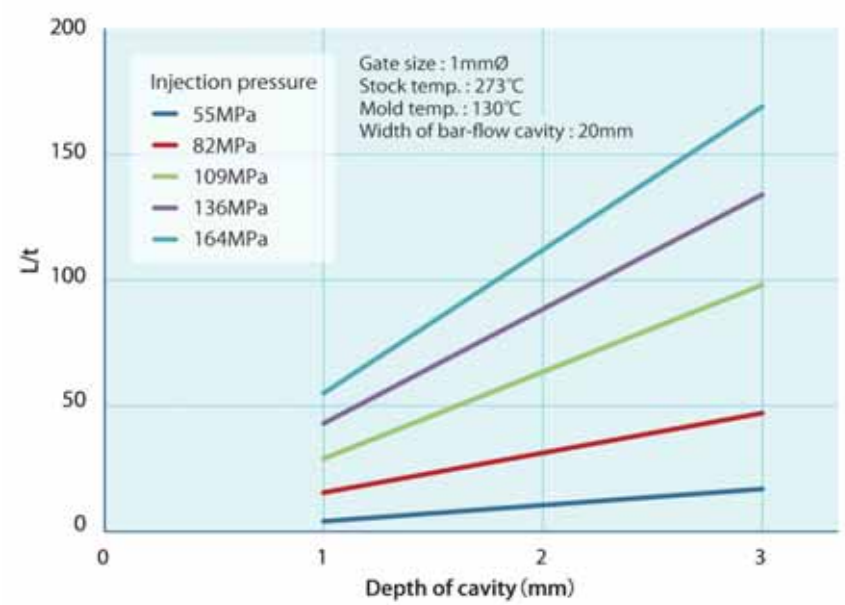
Flowability

The following graphs show the dependence of spiral-flow length on stock temperature and the relationship between bar-flow length (L/t) and depth of cavity.

■ **Temperature dependence of spiral-flow**



■ **Relationship between bar-flow length (L/t) and depth of cavity of Reny 1022H**



Comparison table with other Engineering Plastics

Properties	Test Methhod	Terms	Units	Polyamide MXD6		PA6-G	PA66-G	PBT-G	PET-G	POM-G	PPS-G
				Reny 1002H	Reny 1022H						
				G	G	G	G	G	G	G	G
				30%	50%	30%	30%	30%	30%	25%	40%
				dry(50%RH)	dry(50%RH)	dry(50%RH)	dry(50%RH)	dry	dry	dry	dry
Physical properties											
Density	ISO 1183	–	g/cm³	1.46	1.65	1.37	1.37	1.52	1.59	1.59	1.67
Water absorption		23℃, 50%RH	%	1.5	1.1	2.4	2.0	–	–	–	–
		23℃, Underwater		0.20	0.14	–	–	0.07	0.08	0.20	0.02
Rheological properties											
Melt Mass-flow Rate	ISO 1133	Temperature	g/10min	40.9	8.3	10	19	20	13	9	13
Melt Volume-flow Rate			cm³/10min	31.0	3.4	8	15	15	9	6.3	8
			℃	275	275	250	280	250	280	190	310
		Load	kg	2.16	2.16	2.16	2.16	2.16	2.16	2.16	2.16
Molding Shrinkage	–	–	%	0.5	0.4	0.7	0.8	0.7	0.6	0.6	0.45
Mechanical properties											
Tensile modulus	ISO 527-1 ,527-2		MPa	12100 (11100)	20400 (19300)	9600 (5700)	9700 (6300)	9500	11300	10000	14000
Stress at break			MPa	181 (148)	260 (214)	170 (110)	170 (120)	130	150	140	150
Strain at break			%	1.7 (1.8)	2.0 (2.1)	3.3 (5.6)	2.6 (4.1)	2.7	2.1	3.0	1.3
Flexural strength	ISO 178	–	MPa	286 (265)	390 (318)	262 (167)	267 (199)	210	230	210	220
Flexural modulus				11600 (10700)	18400 (15100)	9200 (5600)	8300 (6500)	8900	11000	9100	15000
Charpy impact strength	ISO 179-1 ,179-2	23℃	kJ/m²	35 (33)	72 (58)	81 (92)	110 (84)	59	56	60	37
Charpy notched impact strength		23℃	kJ/m²	6.3 (6.2)	11.3 (12.2)	12 (19)	11 (13)	10	8	9	9

Properties	Test Methhod	Terms	Units	Polyamide MXD6		PA6-G	PA66-G	PBT-G	PET-G	POM-G	PPS-G
				Reny 1002H	Reny 1022H						
				G	G	G	G	G	G	G	G
				30%	50%	30%	30%	30%	30%	25%	40%
				dry(50%RH)	dry(50%RH)	dry(50%RH)	dry(50%RH)	dry	dry	dry	dry
Thermal properties											
Melting temperature	ISO 11357-3		℃	–	–	–	–	224	254	166	280
Glass transition temperature	ISO 11357-2		℃	–	–	–	–	–	–	–	–
Deflection temperature under Load	ISO 75-1 ,75-2	1.80MPa 0.45MPa	℃	224 (212) 237 (232)	230 (223) 238 (233)	205 220	244 260	202 220	226 246	162 164	260 273
Vicat softening temperature	ISO 306	–	℃	–	–	–	–	–	–	–	–
Coefficient of Linear thermal expansion	ISO 11359-2	MD TD	1/℃	2E–5 5E–5	1E–5 4E–5	3E–5 7E–5	3E–5 7E–5	3E–5 6.5E–5	3.2E–5 5.5E–5	3E–5 11E–5	1E–5 4E–5
Flammability	UL94	–	–	–	–	–	–	–	–	–	–
Flammability	UL94	1.6mmt	–	HB	HB	HB	HB	HB	HB	HB	V–0
Electrical properties											
Relative permittivity	IEC 60250	100Hz 1MHz	– –	(5) (4)	5 (5) 5 (5)	4 4	4 4	– 3	– –	4.1 4.1	– 28
Dissipation factor	IEC 60250	100Hz 1MHz	– –	(0.020) (0.016)	0.007 (0.020) 0.008 (0.017)	0.014 0.021	0.009 0.019	– 0.016	– –	0.003 0.008	– 0.020
Volume resistivity	IEC 60093	–	Ω・m	1E+14 (2E+13)	2E+14 (1E+13)	2E+13	3E+13	1E+14	–	1E+12	1E+14
Surface resistivity	IEC 60093	–	Ω	7E+14 (2E+14)	1E+16 (8E+14)	2E+14	4E+14	1E+15	–	1E+16	1E+15
Electric strength	IEC 60243-1	1mmt 2mmt 3mmt	MV/m	31 (29) 27 (22) –	27 (25) – –	27 – –	26 – –	25 – –	– – –	25 16 –	22 17 –
Comparative tracking index	IEC 60112	–	–	525 (550)	575 (550)	475	550	–	–	600	–
	UL746A	–	–	–	–	–	–	–	–	–	–

The listed properties are portrayed as general information only and are not product specifications.
Mitsubishi Engineering-Plastics disclaims any liability in connection with the use of the information in this table.

Note

- The values described are typical values only.
- The usage examples indicated here do not guarantee results applicable to relevant uses of the products.
- It is the users' responsibility to investigate industrial property rights and the terms of use related to the uses and applications indicated here.
- For the handling (transport, storage, forming, disposal, etc.) of the products, it is advisable to refer to technical documents and the Safety Data Sheet (SDS) of the proper materials and grades. Please contact us for consultations when the products are used for the purpose of food containers and packaging, medical parts, safety equipment, and toys for children.
- In Japan, the colored products of each grade may contain chemicals subject to reporting requirements under the applicable law provided in Appendix 9 of Article 18-2 of the Enforcement Order, under Article 57-2 of the Industrial Safety and Health Act. For details, please contact us.
- For the export of our products and products incorporated with our products, please comply with the relevant laws and regulations, such as the Foreign Exchange and Foreign Trade Law.
- Please note that because of the chemical substance management systems in each country, the chemicals used in our products are subject to control, and separate applications might be required or are banned from imports and exports. It is advisable to inquire about the status of regulations in the relevant countries if you are exporting or importing our products.