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.

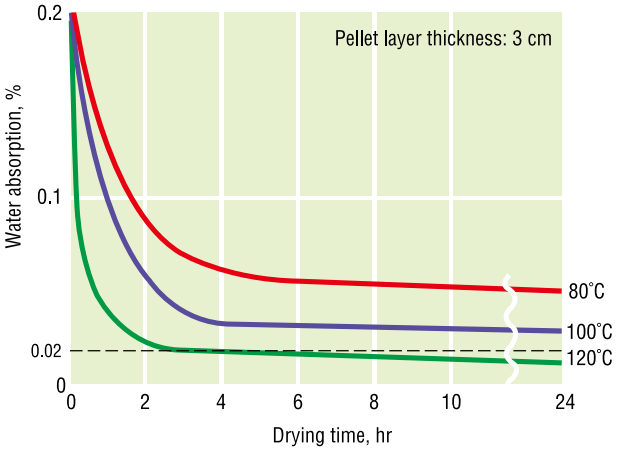


Fig. 46 Drying Curve of Panlite

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

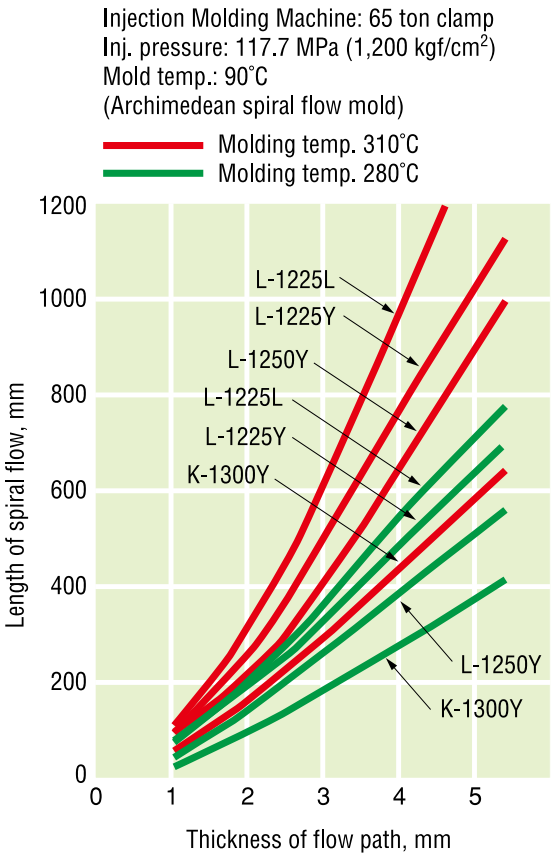


Fig. 47-1 Flowability (Spiral Flow) of Panlite (Thickness of flow path 1-5mm)

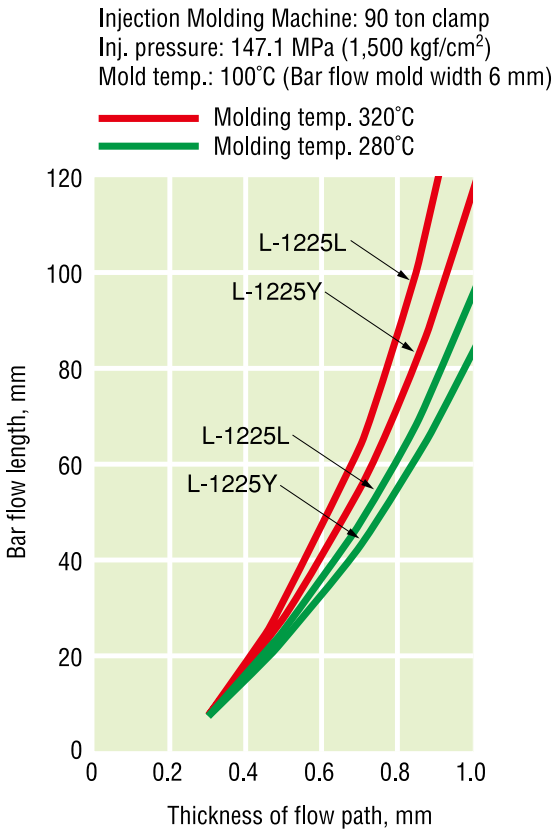


Fig. 47-2 Flowability (Bar Flow) of Panlite (Thickness of flow path 0.3-1.0 mm)

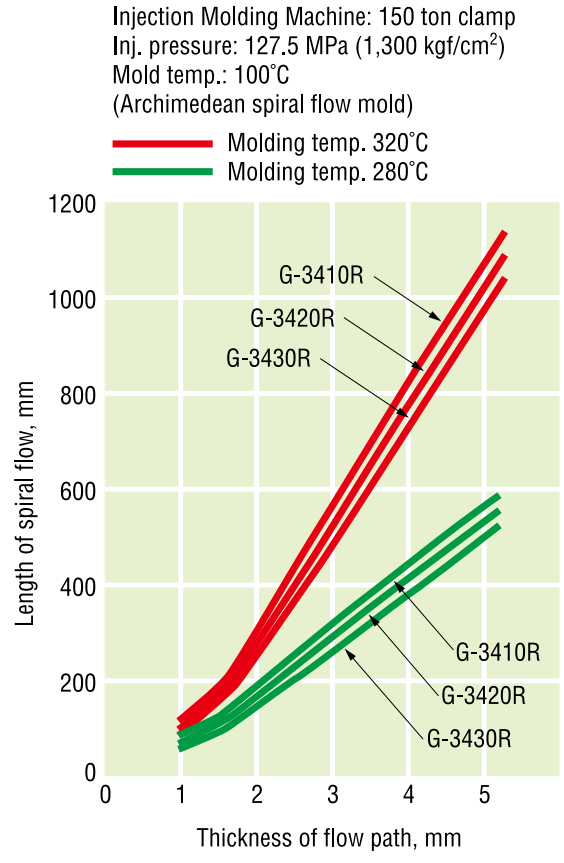


Fig. 48-1 Flowability (Spiral Flow) of Panlite G (Thickness of flow path 1-5mm)

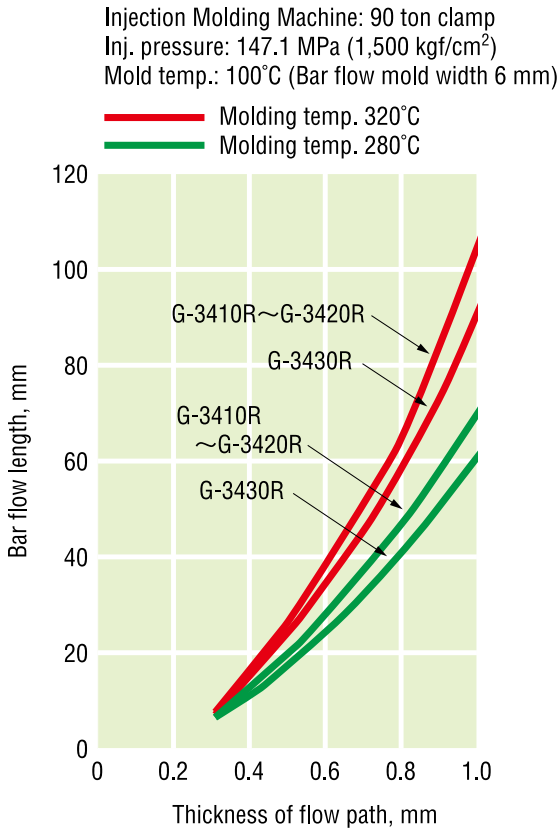
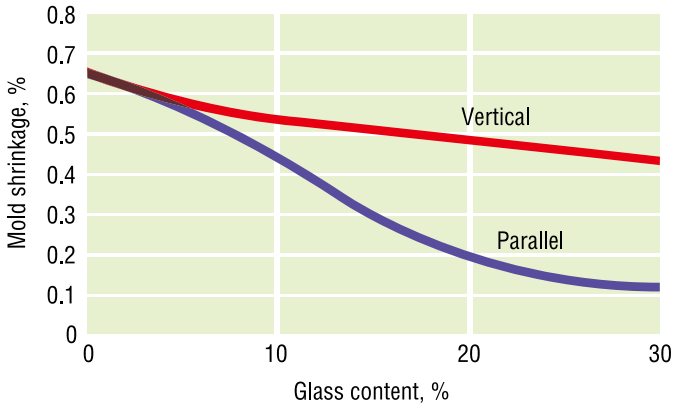


Fig. 48-2 Flowability (Bar Flow) of Panlite G (Thickness of flow path 0.3-1.0 mm)

● 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).



Test piece: 127×127×1.6 mmt
Material temp.: 320˚C
Mold temp.: 110˚C
Inj. pressure: 127.5 MPa
(1,300 kgf/cm^2)

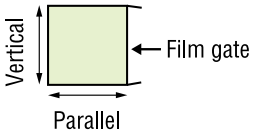


Fig. 49 Mold Shrinkage

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

● 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.

● 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.

● 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.

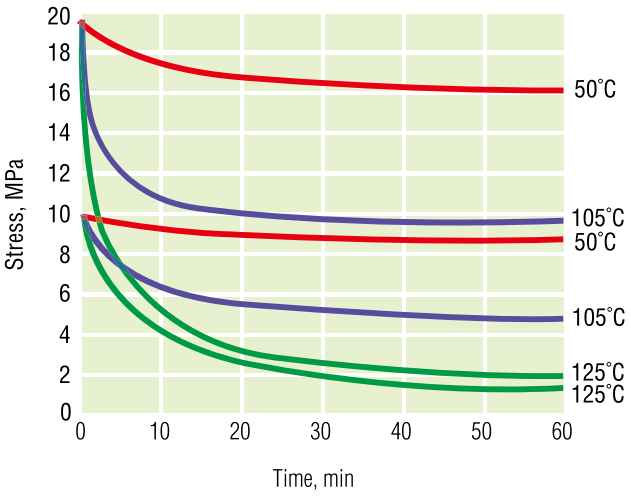


Fig. 50 Stress Relaxation of Tensile Strength of Panlite vs. Temperature

Extrusion

●Molding condition

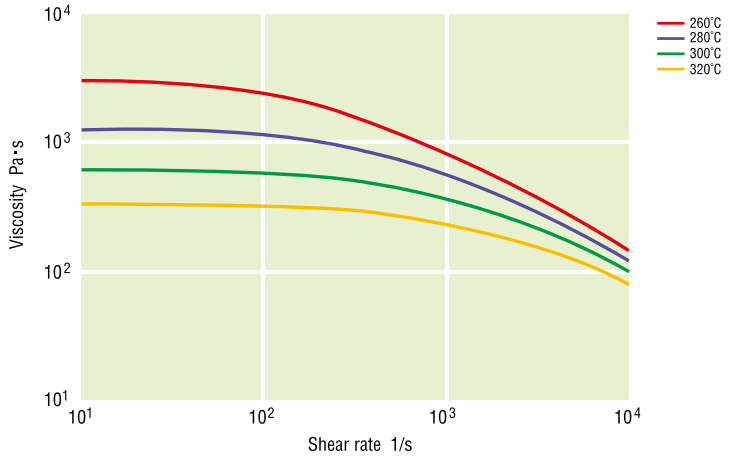
Standard conditions for extrusion of Panlite are shown in Table 8.

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