



## Processing Guidelines for Nanonylon 6

### 1. Pre-drying

Virgin resin such as A2600, A2800, NE2740, NF3020 and NF3040 is packaged dry in moisture-proof boxes and bags. Pre-drying should not be necessary unless package is damaged. Nylon6 has a high water-absorption rate. When resin absorbs water it causes hydrolysis during the injection molding process, resulting in degradation of properties and unsatisfactory molded parts. Therefore, pre-drying is essential prior to injection molding. Drying equipment may include a hot-air dryer or a dehumidified dryer, the latter being more efficient. The following table is the drying condition for virgin resin:

Time in Open Container	Drying Time (at 80°C)
0~4 hr	2 hr
4~24 hr	4 hr
1~5 days	24 hr
>5 days	48 hr

\*\* Dew point -18°C

Nylon will discolor on drying. The amount of color change depends on temperature and time. Normally, a dehumidified dryer operated 4 to 6 hours at a temperature of 75-85°C (167~185°F) will reduce water content to 0.1% or lower. For compounded nanonylon such as NE2740M3, NE2740M4, NE4023F, NE1063, NE2063 and NE6040ST, it must be pre-dried. The drying condition is 100~120 °C for 4 hours.

### 2. Injection Molding

#### 2-1 Selection of Injection Molding Machine

For molding PA6, a screw-type injection molding machine works best, with a minimum 20 L/D screw and a compression ratio of 3-4, and a chrome-plated nitrogenous steel base. As nylon 6 has such low viscosity when melted, compared with other resins, this may cause reverse flow of molten polymer. Therefore, the injection molding machine must be equipped with a screw head having a reverse-flow blocking valve. It is also advisable to use an intermittent nozzle to prevent nozzle drool.

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### 2-2 Temperatures of Cylinder and Nozzle

Resins are melted by the heater located inside the cylinder and by the shear stress generated between the screw and cylinder barrel. Generally, the bottom side of a hopper is sufficiently cool for smooth transportation of pellets. The melting zone is set at a temperature suitable for melting zone, thus preventing nozzle drool. If the temperature of the melting zone is too high, thermal degradation and substance volatility can occur, causing bubbles or silver streaks in the produced part. Conversely, if the temperature of the melting zone is too low, the flowability of the resin is reduced. This necessitates excessive injection pressure, thus degrading the properties of the produced part.

### 2-3 Mould Temperature

Mold temperature affects product appearance and the accuracy of product dimensions, and has a direct effect on productivity due to shortened cycles. If the mold temperature is too low, productivity increases due to faster cooling, but cosmetic and mechanical properties are degraded due to reduced material flow. It is essential to set the proper mold temperature necessary to maintain properties as required by the particular product specification, because PA6 is a crystalline polymer, and crystallization varies based on cooling speed. (Normally, the mold temperature of PA6 should be set at 60~80 °C (140~176 °F)). If the mold temperature is uneven over melting zones, product warpage can occur.

### 2-4 Injection pressure

Molten polymer flows through the mold cavity under the force of injection pressure, and a considerable amount of pressure is lost as material flows through the narrow sprue, runner, gate, etc. If injection pressure is too great, residual stress is increased due to over-charge that can cause horizontal strength degradation. If the pressure is too low, it can cause short shots, shrinkage, and bubbling. Also, in order to compensate for the 15~25% volume decrease incurred during material cool-off, a holding pressure of 30~80% of the initial injection pressure is required.

### 2-5 Molding Conditions.

The following are some typical conditions. The higher RV the more right side the condition is shifted.

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料品名稱 Item	A2600 A2800	NE2740 NF3020 NF3040	NE2740M3 NE2740M4 NE2740M5 NE4023F NE1063 NE2063 NE6040ST
乾燥條件(°C), Drying condition	See comment (4)	See comment(4)	100~120°C,4hr
料筒溫度(°C), Hopper Temperatures	RT~80°C	RT~80°C	RT~80°C
前段料管溫度 (°C) , Cylinder Temperature of Front	210~230	220~230	220~240
中段料管溫度 (°C) , Cylinder Temperature of Middle	220~240	230~250	230~250
後段料管溫度(°C) , Cylinder Temperature of Rear	230~250	230~250	240~260
射嘴溫度(°C) , Cylinder Temperature of Nozzle	230~250	230~250	240~260
模具溫度(°C) , Mold Temperature	60~80	60~80	60~80
射壓(錶),(kg/cm <sup>2</sup> ) Injection Pressure (gauge)	50~70	50~80	60~90
保壓(錶),(kg/cm <sup>2</sup> ) Hold Pressure (gauge)	30~60	40~60	40~70
射出時間 , Injection Time Sec.	4~15	4~15	5~15
保壓時間(Sec.),Hold Pressure Time	0~10	0~10	0~10
背壓,(kg/cm <sup>2</sup> ),Back Pressure	0~10	0~10	0~10
冷卻時間(Sec.), Cooling Time	10~25	10~25	15~30
儲料螺桿回轉數(rpm), Screw Speed at refill	50~200	50~200	50~150

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Comment :

- (1) Injection condition of ASTM specimen and for reference only.
- (2) Injection Machine Type HT-100, made by Fu Chun Shin
- (3) Screw diameter: 34mm
- (4) See 1. Pre-drying
- (5) Injection pressure (kgf/cm<sup>2</sup>) = 13.8 x gauge pressure
- (6) Max. specimen thickness=6.4mm