Recommendations for injection molding Stanyl® ForTii™ halogen-free FR

GRADE CODING

Stanyl® ForTii™ glass fiber reinforced and halogen-free flame retardant injection molding grades.

MATERIAL HANDLING

Storage

In order to prevent moisture pick up and contamination, supplied packaging should be kept closed and undamaged. For the same reason, partial bags should be sealed before re-storage.
We advise storage at room temperature.

Packaging

Stanyl® ForTii™ grades are supplied in airtight, moisture-proof packaging.

Moisture content as delivered

Stanyl® ForTii™ grades are packaged at a moisture level equal to or less than 0.1w%

Conditioning before molding

To prevent moisture condensing on granules, bring cold granules up to ambient temperature in the molding shop while keeping the packaging closed.

Moisture content before molding

Since Stanyl® ForTii™ is delivered at molding moisture specification (≤ 0.1w%), the resin can be molded without pre-drying. However, to overcome the fluctuation from package to package we advise to pre-dry (see drying section below). Furthermore, pre-drying is required in case the material is exposed to moisture before molding (package damage or open for longer period of time). Moisture content can be checked by water evaporization methods or manometric methods (ISO 15512).

Drying

Stanyl® ForTii™ grades are hygroscopic and absorb moisture from the air relatively quickly. Preferred driers are de-humidified driers with dew points maintained between -30 and -40 °C. Vacuum driers with N_2 purge can also be used. Hot air ovens or hopper driers are not suitable for pre-drying Stanyl® ForTii™ grades; the use of such driers may result in non-optimum performance.

Moisture content	Time	Temperature
0.1-0.2% and as delivered	2 h	100 °C
0.2-0.5%	4 – 8 h	100 °C
> 0.5%	< 100 h	100 °C
	or 24 h	110 °C
	or 4 h	120 °C

Regrind

Regrind (level is dependent on the specific grade, please check the UL 94 Yellow Card, but minimal 25%) can be used taking into account that this regrind must be clean/low dust content/not thermally degraded/dry and of same composition as the original material.

MACHINERY

General

Stanyl® ForTii™ grades can be processed on general injection molding machines.

Screw geometry

Typically 3-zone screw designs with volumetric compression ratios of approximately 2.5 work fine.

Steel type
Corrosive- and abrasive-resistant steel types which are generally used for glass fibre reinforced, halogen-free FR, high temperature, polyamide materials are also to be used for the Stanyl® ForTii™ grades in tools, nozzles and screws. Failing to do so may result in wear and/or corrosion, especially of the screw/barrel (due to the high temperatures involved there), which can lead to decreasing processing performance.

Suitable corrosive- and abrasive-resistant steel types are generally powder metallurgical steels containing typically more than 13% of chrome and a HRC value of 55 or higher. Furthermore, a carbide or other type of protective coating is often applied. Examples of suitable steel types for Stanyl® ForTii™ grades are Böhler M390 or CPM 420V/590V. Injection molding equipment suppliers will also have their own codings for suitable steel types. It is recommended in all cases to contact the technical service department of your injection molding equipment supplier for their specific steel type coding, using the steel requirements mentioned above.

Nozzle temperature control
Due to the combination of the typical high melting temperature of Stanyl® ForTii™ and consequently its high processing temperature, it is necessary to have a good temperature control for the nozzle. The use of an open nozzle or, even better, a “reversed tapered nozzle” with good temperature control and an indepedantly-controlled thermocouple nearby the tip and heater bands with sufficient output, is recommended. The nozzle temperature should be set as high as possible to prevent a cold slug, yet low enough to prevent excessive drool.

Venting design
A good venting design is crucial for good molding behavior (easy filling) and low outgassing/mold deposit. Blocked vents can lead to incomplete parts and/or burning at the end of the flow path (diesel effect). It is recommended to use venting on all inserts (explosive venting) and also on the runner system. Use decreased injection speeds during filling in order to make the venting as effective as possible.

Hot runner layout
The fast crystallization of Stanyl® ForTii™ asks for specific hot runner design rules. Try to achieve a close contact with your hot runner supplier and DSM as the material supplier, to be sure that the right hot runner system is chosen.

When processing Stanyl® ForTii™ with hot runners, keep in mind these basic rules:

- Central bushing heated separately
- Only use external heated system
- Manifold heated from both sides
- Tip with thermocouple in front (near gate)
- Very accurate temperature control in the gate area

For more details, there is also a special hot runner flyer available for Stanyl® and Stanyl® ForTii™. Please contact your DSM sales or check our website.

TEMPERATURE SETTINGS

Mold temperature
Stanyl® ForTii™ can be used with a wide range of tool temperatures (100 - 140 ºC). However, to achieve optimal mechanical properties and stable dimensional parts, it is recommended to apply a tooling temperature above the glass transition temperature (Tg) of Stanyl® ForTii™ (125 ºC). For obtaining the best surface quality in thin wall applications, tooling temperatures close to Tg should be avoided; either tooling temperatures sufficiently below Tg (e.g. 100ºC) or above Tg (e.g. 140ºC) can be used in this case.

Barrel temperature
Due to the high melting point of Stanyl® ForTii™ this temperature should be set high enough to provide a homogeneous melt without getting too near to the degradation temperature of 350ºC. A rising temperature profile is recommended. Optimal settings are governed by the barrel size and residence time.

Nozzle	Front	Center	Rear
330 – 335ºC	330 – 335ºC	325 – 335ºC	320 – 330ºC

Melt temperature
To generate a good and homogeneous melt, the melt temperature should always be above 330°C. Optimal mechanical properties will be achieved at melt temperatures between 330-340°C. Melt temperatures on the low side of this window (330-335ºC) are recommended to minimize the risk of mold deposit and corrosion.
We advise to frequently measure the melt temperature by purging the melt in a Teflon cup and inserting a thermo probe into the melt.

Residence time
Melt residence time for Stanyl® ForTii™ in general should not exceed 4 minutes; preferably, melt residence time for Stanyl® ForTii™ is < 2 minutes. See also the separate section on residence time below.

Hot runner temperature
A hot runner temperature set to the same level as the nozzle temperature should work fine and not lead to excessive overheat of the Stanyl® ForTii™ grade. When starting up, an increased tip temperature may be necessary to overcome a frozen nozzle.

GENERAL PROCESSING SETTINGS

Screw rotation speed
To realize a good and homogeneous melt, it is advised to set a screw rotation speed resulting in a plasticizing time that is just within the cooling time.
The rotational speed of the screw should not exceed 6500/D RPM (where D is the screw diameter in mm).

Back pressure
Back pressure should be between 5-30 bars effective. Keep it low in order to prevent nozzle-drooling, discoloration and long plasticizing times.

Injection speed
Moderate to high injection speeds are required in order to prevent premature crystallization in the mold during injection phase and to obtain a better surface finish. The recommended injection speed profile goes from fast (for sprue and runner filling) to medium (for part filling) to avoid excessive shear heating and allow air to escape from the mold. Adequate mold venting is required to avoid burning at the end of the flow path (due to diesel effect).

Injection pressure
Injection pressure should be high enough to maintain the set injection speed (use set injection pressure higher than the peak pressure if possible). Tooling air vents must be effective to allow optimum filling pressure and prevent burn marks.

Holding time
Due to its fast solidification, holding time for Stanyl® ForTii™ is short compared to other engineering plastics. Effective holding time is determined by part thickness and gate size.

Holding pressure
The most adequate holding pressure is the level whereby no sinkmarks or flash are visible. A too high holding pressure can lead to stresses in the part.

Cooling time
Due to the fast crystallization of Stanyl® ForTii™, a short cooling time is possible. Actual cooling time will depend on part geometry and dimensional quality requirements as well as the tool design (gate size).

RESIDENCE TIME

Melt residence time (MRT) for Stanyl® ForTii™ in general should not exceed 4 minutes with preferably at least 50% of the maximal shot volume used. A formula to estimate this MRT is described below.

$$MRT = \frac{\pi D^3 \rho}{m} * \frac{t}{60}$$

Whereas:

MRT	= Melt Residence Time	[minutes]
D	= Screw Diameter	[cm]
ρ	= Melt Density (for Stanyl® ForTii™ = 1.2)	[g/cm3]
m	= Shot Weight (only plastic + runner)	[g]
t	= Cycle Time	[s]

Optimal melt residence time for Stanyl® ForTii™ is < 2 minutes.

SAFETY

For the safety properties of the material, we refer to our MSDS which can be ordered at our sales offices. During practical operation we advise to wear personal safety protections for hand/eye/body.

STARTUP/SHUT DOWN/CLEANING

Production has to be started and stopped with a clean machine. Cleaning can be done with PA6-GF, applicable cleaning agents or HDPE. Hot runners can also be cleaned and put out of production cleaning them with PA66-GF.

PRODUCTION BREAKS

During production breaks longer than a few minutes, we advise emptying the barrel and lowering the barrel and hot runner [if applicable] temperature to 250ºC. This in order to stop decomposition of the compound.

TROUBLE SHOOTING

See our trouble shooting guide lines on the internet.