

# ForTii® Ace MX53

## PPA-GF50

50% Glass Reinforced, PA4T, Heat Stabilized, for Automotive applications

Print Date: 2019-10-19

### **GRADE CODING**

ForTii® Ace glass fiber reinforced 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. Advisable is storage at room temperature.

#### **Packaging**

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

#### **Moisture content as delivered**

ForTii® Ace MX53 is packaged at a moisture level  $\leq 0.1$  w%.

#### **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 ForTii® Ace MX53 is delivered at molding moisture specification ( $\leq 0.1$  w%), the resin can be molded without pre-drying. However, to overcome the fluctuation from package to package we advise to pre-dry to a maximum level of 0.05% (see drying section below). Furthermore, pre-drying is required in case the material is exposed to moisture before molding (prolonged storage or open/damaged packaging).

Moisture content can be checked by water evaporation methods or manometric methods (ISO 15512).

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## Recommendations for injection molding

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### Drying

ForTii<sup>®</sup> Ace grades are hygroscopic and absorb moisture from the air relatively quickly. Moisture absorption is fully reversible under the following drying conditions without compromising material quality. Preferred driers are dehumidified driers with dew points maintained between -30 and -40°C / -22 and -40°F. Vacuum driers with N<sub>2</sub> purge can also be used. Hot air ovens or hopper driers are not suitable for pre-drying ForTii<sup>®</sup> Ace grades; the use of such driers may result in non-optimum performance.

Moisture content	Time	Temperature	
[%]	[h]	[°C]	[°F]
0.1 - 0.2 and as delivered	2 - 4	100 - 130	212 - 266

### Regrind

Regrind can be used taking into account that this regrind must be clean/low dust content/not thermally degraded/dry, of same composition and similar particle size as the original material. The acceptable level of regrind depends on the application requirements (e.g. UL Yellow Card). Be aware that regrind can cause some small color deviations.

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### MACHINERY

ForTii<sup>®</sup> Ace 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

Abrasive resistant tool steels which are normally used for glass and/or mineral reinforced materials are also to be used for ForTii<sup>®</sup> Ace polymers in tools, nozzles and screws.

#### Nozzle temperature control

Due to the combination of the typical high melting temperature of ForTii<sup>®</sup> Ace 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 independently-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.

#### Hot runner layout

The fast crystallization of ForTii<sup>®</sup> Ace asks for specific hot runner design rules. For more details, there is also a special hot runner flyer available for all ForTii<sup>®</sup> Ace grades. Please contact your DSM sales or check our websites.

Try to achieve a close contact with your hot runner supplier and DSM as the material supplier, to ensure that the right hot runner system is chosen.

When processing ForTii<sup>®</sup> Ace 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

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# ForTii<sup>®</sup> Ace MX53

## TEMPERATURE SETTINGS

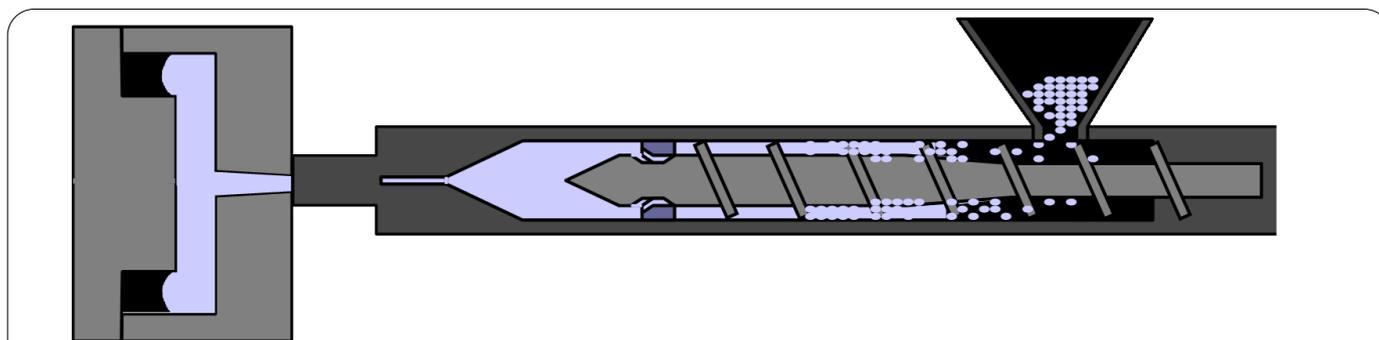
### Mold temperature

ForTii<sup>®</sup> Ace can be used with a wide range of tool temperatures (80 - 200°C / 176 - 392°F). Structural parts can be molded with a mold temperature, starting from 80°C (176°F). The preferable tool temperatures can be found in the table below:

<i>Recommendation</i>	Optimum balance of mechanical, chemical and aesthetic properties	Enhanced surface aesthetics
<i>Temperature</i>	120 - 160°C (248 - 320°F)	160 - 200°C (320 - 392°F)

### Barrel temperature

Due to the high melting point of ForTii<sup>®</sup> Ace this temperature should be set high enough to provide a homogeneous melt without getting too near to the degradation temperature of 370°C / 698°F. A flat or rising temperature profile is recommended. Optimal settings are governed by barrel size and residence time.



Mold	Melt	Nozzle	Front	Center	Rear
80 - 200°C 176 - 392°F	350-370°C 662-698°F	340-370°C 644-698°F	340-350°C 644-662°F	340-350°C 644-662°F	330-340°C 626-644°F

### Melt temperature

To generate a good and homogeneous melt, the melt temperature should always be above 350°C / 662°F. Optimal mechanical properties will be achieved at melt temperatures between 350-370°C / 662-698°F. Melt temperatures on the low side of this window are recommended to minimize the risk of mold deposit. The advise is to frequently measure the melt temperature by pouring the melt in a Teflon cup and inserting a thermo probe into the melt.

### 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 ForTii<sup>®</sup> Ace grade. When starting up, an increased tip temperature may be necessary to overcome a frozen nozzle.

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## 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, excessive shear heating and long plasticizing times.

### Decompression:

In order to prevent nozzle drool after plasticizing and retracting the nozzle from the mold, a short decompression stroke can be used. However, to prevent oxidation of the melt, which may result in surface defects on the parts, it is recommended to keep this as short as possible.

### 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

The real injection pressure is the result of the flowability of the material (crystallization rate, flow length, wall thickness, filling speed). The set 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

Effective holding time is determined by part thickness and gate size. Holding time should be maintained until a constant product weight is achieved. Due to its fast solidification, holding time for ForTii<sup>®</sup> Ace is short compared to other engineering plastics.

### 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

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

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## RESIDENCE TIME

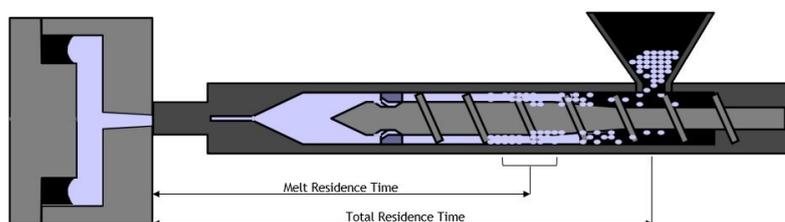
The Total Residence Time (TRT) is the time difference between the compound fed into the throat of the barrel and the melt leaving the machine via the nozzle (and hotrunner if applicable).

The Melt Residence Time (MRT) is the time difference between the melt-front of the compound in the barrel and the melt leaving the machine via the nozzle (and hotrunner if applicable).

Generally the TRT is about 2 - 2.5 x MRT.

The recommended maximum MRT for ForTii<sup>®</sup> Ace MX53 is ≤ 6 minutes, valid for mid-range temperatures. A formula to estimate the MRT is described below:

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



Whereas:

MRT	= Melt Residence Time	[minutes]
D	= Screw Diameter	[cm]
ρ	= Melt Density	[g/cm <sup>3</sup> ]
m	= Shot Weight	[g]
t	= Cycle Time	[s]

*Please note: In the calculation above, the hotrunner volume has not been taken into account. When a hotrunner is part of the setup, please add the hotrunner volume to the calculation.*

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### SAFETY

For the safety properties of the material, we refer to our SDS 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 or PA66-GF, applicable cleaning agents or HDPE. Hot runners can also be cleaned and put out of production cleaning them with PA6-GF or PA66-GF.

### PRODUCTION BREAKS

During production breaks longer than a few minutes, we advise emptying the barrel. The temperature of the barrel and the hot runner [if applicable] should be reduced to a level far enough below the melting point of the compound in order to stop decomposition of the compound.

When the hot runner, nozzle, or even the screw is blocked, be aware that under these conditions a sudden outburst of molten material can take place. Always wear personal safety protections for hand/eye/body.

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### TROUBLESHOOTING

#### Overall assessment of good molding practice

An effective assessment for good molding practice (that shows limited degradation of the polymer) is to measure the reduction in Viscosity Number (VN) from granules to molded part according to ISO 307. Good molding practice is characterized by a VN reduction up to 5% of the VN of the material. A reduction of 5% - 10% is very commonly achieved in the industry. Anywhere between 10% and 15% reduction is an indication that the molding process could be improved from the combination of moisture content, melt temperature and residence time perspective. Beyond 15% VN reduction is a very strong indication that optimization of processing parameters is needed. With excessive thermal degradation one should anticipate the possibility of loss of functional robustness of the molded parts.

Contact DSM in case more information is required from the aspect of material or processing.

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