

Aarnitel® Extrusion Grades

TPC

GRADE CODING

Aarnitel® Extrusion 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. Allow the material that has been stored elsewhere to adapt to the temperature in the processing room while keeping the bag closed.

Packaging

Aarnitel® Extrusion grades are supplied in airtight, moisture-proof packaging.

Moisture content as delivered

Aarnitel® Extrusion grades are packaged at a moisture level ≤ 0.05 w%.

Conditioning before extrusion

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

Moisture content before extrusion

Since Aarnitel® Extrusion grades are delivered at molding moisture specification (≤ 0.05 w%), the resin can be extruded 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 evaporation methods or manometric methods (ISO 15512).

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Drying

Arnitel® Extrusion 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 / -22 and -40°F. Vacuum driers with N₂ purge can also be used. Hot air ovens or hopper driers are not suitable for pre-drying Arnitel® Extrusion grades; the use of such driers may result in non-optimum performance. Table 1 enlists the preferred drying conditions, depending on moisture content, for Arnitel® Extrusion grades. Be aware that granules typically require a heat up time of 1 h during the first stage of drying. Arnitel® Extrusion grades are preferably dried at 80°C, the material should not be dried at temperatures above 110°C.

Table 1. Preferred drying conditions for Arnitel® Extrusion grades.

Moisture content [%]	Time [h]	Temperature	
		[°C]	[°F]
Arnitel® Extrusion grades < 0.05 as delivered	4-8	80	176
Arnitel® Extrusion grades (open bag) > 0.05-0.2	16	80	176
Arnitel® VT Highly Breathable Extrusion grades (open bag) 0.05 - 10	24	100	212
Arnitel® VT Highly Breathable Extrusion grades (open bag) > 10	72	100	212

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Arnitel[®] Extrusion Grades

MACHINERY

Conventional single screw extruders can be used for the extrusion processing of Arnitel[®].

Extruder barrel

Extruder barrels for polyamide, polyester and polyolefins are usually suitable for Arnitel[®]. Barrels with axial grooves and intense cooling of the intake zone require special attention during startup and cooling should be avoided.

Screw design

Good melt quality can be obtained with conventional single screw extruders equipped with a 3-zone screw as shown in the figure below. However well-designed barrier screw achieves the best results in terms of melt quality without any possibility of any part of unmolten polymer. Also a mixing device at the end of the metering section enforces a homogenous melt temperature.

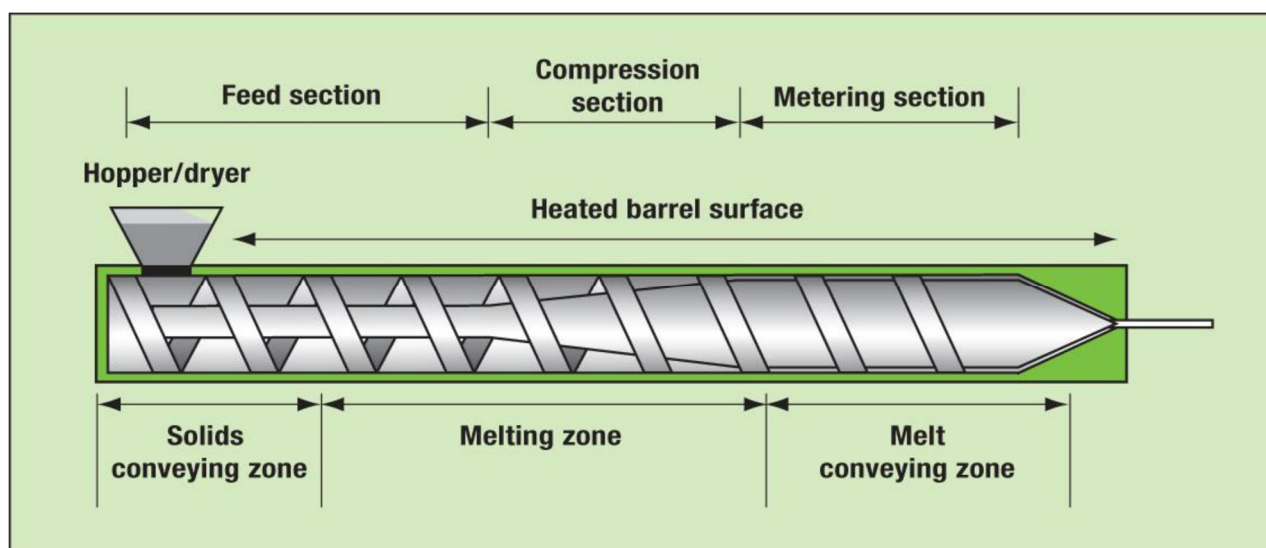


Figure 1. Typical setup of an extrusion machine with indication of the temperature zones.

Length to diameter ratios of 25 or higher provides the best melt quality. The clearance between screw flights and barrel should be small:

- 0.08-0.10 mm for extruders up to 45 mm in screw diameter
- 0.1-0.15 mm for larger extruders

The compression ratios should be between 2.4 and 3.2, determined by the depth of the feed section divided by the depth of the metering section. For continuous extrusion a ratio of 3 is preferred.

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The channel depth of both the feed and metering section is important. If the feed channel is too deep and not long enough, particularly with large diameter screws, poor feeding and loss of output can be the result.

If the metering channel is too deep, insufficient pressure will be built up resulting in irregular output, particularly with low viscosity grades. A metering channel, which is too shallow can result in overheating of the melt due to high shear, particularly with high-viscosity types.

Table 2. Typical characteristics of machines with several extruder diameters.

Characteristic design parameters 3-zone screw					
Screw length		25 - 30			
Pitch		1D			
Extruder diameter	mm	30	45	60	90
Length section					
Feed section	D	7 - 10	7 - 10	7 - 10	7 - 10
Compression section	D	4 - 6	4 - 6	4 - 6	4 - 6
Metering section	D	8 - 11	8 - 11	8 - 11	8 - 11
Channel depth					
Feed section	mm	6	7	11	17
Metering section	mm	2	2.5	4	5

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Arnitel[®] Extrusion Grades

PROCESSING TEMPERATURES

Typical processing temperatures of Arnitel[®] Extrusion grades can be found by using the flow chart below. Answer the questions applicable to the Arnitel Extrusion grade to determine the category of the zone temperature setpoints.

START HERE

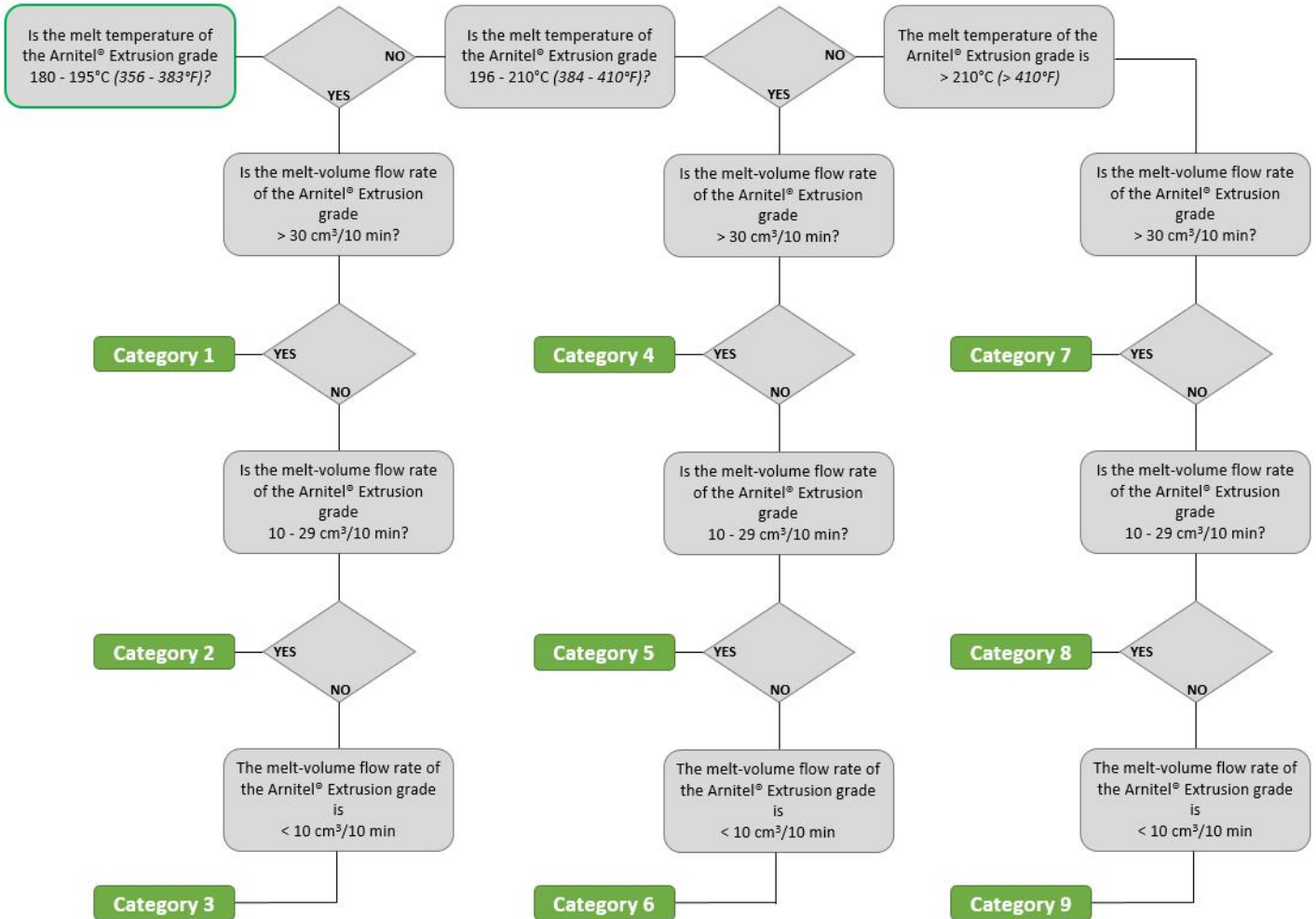


Figure 2. Flow chart to determine the category of the zone temperature setpoints.

After the determination of the category of the zone temperature setpoints, the table on the next page (table 3) can be used to find the temperature setpoints to each zone belonging to the found category from figure 2.

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Table 3. Typical temperature setpoints for each category, based on melting temperature and viscosity (MVR) of the Arnitel® Extrusion grade, as derived from figure 4.

Category	Zone 1 setpoint [°C] [(°F)]	Zone 2 setpoint [°C] [(°F)]	Zone 3 setpoint [°C] [(°F)]	Zone 4 setpoint [°C] [(°F)]	Head setpoint [°C] [(°F)]	Die setpoint [°C] [(°F)]	Die tip setpoint [°C] [(°F)]
1	160-180 (320-356)	180-200 (356-392)	200-220 (392-428)	210-225 (410-439)	225 (439)	220 (428)	215 (419)
2	160-180 (320-356)	180-200 (356-392)	200-220 (392-428)	210-225 (410-439)	225 (439)	220 (428)	215 (419)
3	160-180 (320-356)	190-210 (374-410)	210-230 (410-446)	215-230 (419-439)	230 (446)	225 (439)	215 (419)
4	200-210 (392-410)	210-220 (410-428)	220-230 (428-446)	220-230 (428-446)	230 (446)	230 (446)	220 (428)
5	200-210 (392-410)	210-220 (428-428)	220-235 (428-455)	220-235 (428-455)	235 (455)	230 (446)	220 (428)
6	200-210 (392-410)	215-225 (419-439)	220-240 (428-464)	220-240 (428-464)	235 (455)	230 (446)	220 (428)
7	205-215 (401-419)	215-225 (419-439)	225-235 (439-455)	225-235 (439-455)	230 (446)	225 (439)	225 (439)
8	200-210 (392-410)	215-225 (419-439)	230-240 (446-464)	230-240 (446-464)	230 (446)	230 (446)	225 (439)
9	200-210 (392-410)	215-225 (419-439)	230-240 (446-464)	230-240 (446-464)	235 (455)	235 (455)	225 (439)

Remark

If the power of the machine reaches the maximum power of the extruder:
Increase overall barrel temperature or shift from an increasing barrel temperature profile to a decreasing temperature profile (when having a grooved intake zone) by increasing the temperature at the intake/feed zone(s) → inverse/reverse temperature profile.

Melt temperature

It is advised to frequently measure the melt temperature by inserting a thermocouple into the melt (handheld) to avoid that only the temperature of the extruder will be measured via the installed device. The set barrel temperature strongly influences this temperature.

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Recommendations for Extrusion

Arnitel[®] Extrusion Grades

SAFETY

For the safety properties of the material, we refer to our SDS which can be ordered at our sales offices. During practical operation, it is recommended 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 all Arnitel[®] Extrusion grades, applicable cleaning agents or HDPE.

PRODUCTION BREAKS

During production breaks longer than a few minutes, we advise emptying the barrel. The temperature of the barrel should be reduced to a level far enough below the melting point of the compound in order to stop decomposition of the compound. Always wear personal safety protections for hand/eye/body.

TROUBLESHOOTING

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

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