

Arnitel® E & P Tube Manufacturing

TPC

Print date: 2024-03-12



Drying

Arnitel® is supplied pre-dried, in moisture proof bags. The moisture content is low enough to permit immediate extrusion for most applications but pre-drying will improve the performance of the final polymer even more.

Moisture absorption: When exposed to air, Arnitel thermoplastic copolyester absorbs moisture. Small quantities of absorbed moisture in the Arnitel granules may cause degradation during processing. This results in varying molecular weights, possibly leading to a decrease in mechanical performance and to irregular throughput.

Take the following precautions:

- allow material that has been stored in a relatively cold room to adapt slowly to the temperature in the processing room - do not open the packaging until the extruder is heated and ready for production
- always feed the entire contents of one or more bags into the hopper and close the hopper tightly
- do not refill the hopper until there is room for the entire contents of a bag
- always try to refill the hopper to the top
- ensure the hopper size is adapted to the consumption in order to limit residence time of the material

For vacuum calibrating tubes with small tolerances it is recommended to dry the granulate in a desiccant dryer to assure a constant low moisture level [below 500 ppm]. The hopper of the dryer should preferably be mounted directly on the extruder. The granulate must be dried for at least 3 hours prior to processing at 90°C to 105°C. In cases where bags have been exposed to the ambient air for a long period it is advised to dry the material for 8 hours at 110 °C.

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MACHINERY

Single screw extruders can be equipped with either a grooved or a smooth barrel in the feed zone. Both can be used for the extrusion processing of Arnitel. We do recommend different temperature profiles for each one as given in the following tables.

Table 1. Temperature settings for smooth barrel extruders

Arnitel® Grade	MVR (2.16 kg, 230°C) [cc/600s]	TM [°C]	Zone 1 [°C]	Zone 2 [°C]	Zone 3 [°C]	Zone 4 [°C]	Head [°C]	Die [°C]	Tip [°C]
EM630-H	4	212	210	220	235	235	230	230	220
EM361-H	4	212	210	220	235	235	230	230	220
EM631-HB	4	212	210	220	235	235	230	230	220
PM581	4	218	215	225	235	235	230	230	220
L-X07075	12	207	210	225	230	230	230	230	220
L-X07367	4	213	210	220-240	240	240	240	240	230
L-X07368	4	213	210	220-240	240	240	240	240	230
L-X07369	4	209	210	220-240	240	240	240	240	230
L-X07370	4	209	210	220-240	240	240	240	240	230
EM740	5	221	210	220-250	240	240	240	240	230
EM740-H	5	221	210	220-250	240	240	240	240	230

Table 1. Temperature settings for grooved barrel extruders

Arnitel® Grade	MVR (2.16 kg, 230°C) [cc/600s]	TM [°C]	Zone 1 [°C]	Zone 2 [°C]	Zone 3 [°C]	Zone 4 [°C]	Head [°C]	Die [°C]	Tip [°C]
EM630-H	4	212	220	220	235	235	230	230	220
EM361-H	4	212	220	220	235	235	230	230	220
EM631-HB	4	212	220	220	235	235	230	230	220
PM581	4	218	225	235	235	235	230	225	225
L-X07075	12	207	240	240	240	240	220	220	230
L-X07367	4	213	240	240	240	240	220	220	230
L-X07368	4	213	240	240	240	240	220	220	230
L-X07369	4	209	240	240	240	240	220	220	230
L-X07370	4	209	240	240	240	240	220	220	230
EM740	5	221	240	240	240	240	220	220	230
EM740-H	5	221	240	240	240	240	220	220	230

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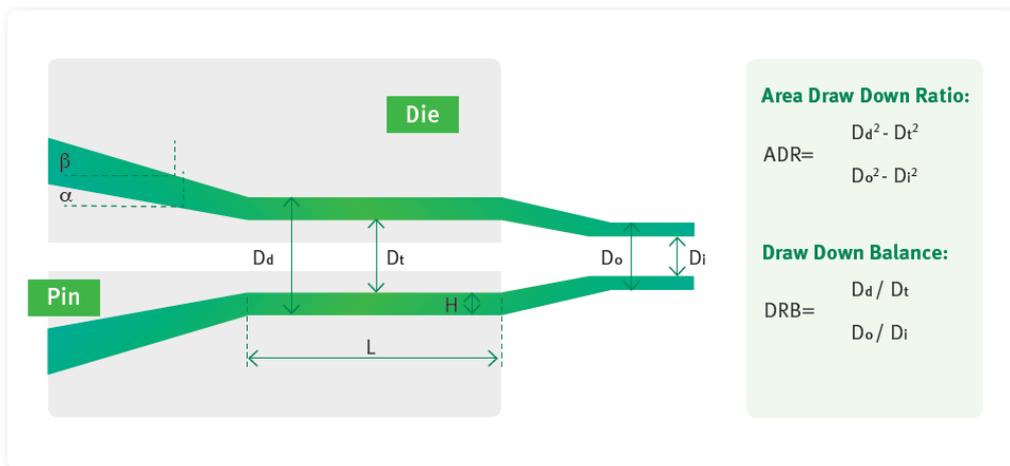
Die design

The preferred tube die design is given by the dimensions of the pin and the die;

- The tube die should be between 1.5 and 3 times the required tube outside diameter. For tubes larger than 18 mm. outside diameter, the die should be between 1.5 and 2 times the tube outside diameter.
- The tube pin should be larger than the inside diameter of the final tube by a slightly lower factor than what is used to determine die outside diameter.

The result of the above mentioned guidelines is expressed by the Area Draw Down Ratio (ADR). The ADR is the cross sectional surface area of the die opening to the cross sectional area of the finished tube. For Arnitel the optimal ADR is between 2,5 and 9.

In order to draw the cross section of the tube correctly from the die, the Draw Ratio Balance (DRB) should be between 1,0 and 1,1.



Tube dimensions tube	Tube dimensions		Die dimensions		Landlength	ADR	DRB
	D_o	D_i	D_d	D_t	L		
6 x 1	6	4	9 - 18	6 - 12	20 - 40	2,5 - 9	1,0 - 1,1
8 x 1	8	6	12 - 24	9 - 18	20 - 40	2,5 - 9	1,0 - 1,1
12 x 1,5	12	9	15 - 36	13 - 27	30 - 60	2,5 - 9	1,0 - 1,1
16 x 2	16	12	24 - 40	18 - 30	30 - 80	2,5 - 6	1,0 - 1,1
20 x 2	20	16	30 - 40	24 - 32	30 - 80	2,5 - 4	1,0 - 1,1

Taper angle: $20^\circ < \alpha < 45^\circ$; $25^\circ < \beta < 50^\circ$ ($\beta \geq \alpha$). (depending on extruder size)

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Cooling

Cooling water temperature is preferably between 15°C and 35°C. The calibrator dimension is 1.07 x the final tube diameter (eg. For a 12 x 9 tube; a 12,85 mm. calibrator is advised).

Heat forming (e.g. vacuum brake tubes)

In order to form the tube into its final shape a heat forming step is necessary. The tube should be heated up to 20 °C below the material melting point (T_m) for minimum 10 minutes. After the forming step quick cooling is advised, preferably with water.

Fittings

should be fitted dry or lubricated by water. If any lubrication oils or greases are to be used please contact an Envalior specialist to confirm compatibility.

Coiling (e.g. Airbrake tubes)

Best coiling conditions are achieved at 200°C for 50 minutes in a hot air oven. Immediate cooling in cold water is advised. It is important to prevent overshoot in temperature as this will lead to melting of the tube surface. When using lower temperatures or shorter time cycles, the coils might show a spring effect leading to diameter change and to “open coils”.

Coiling of multilayer tubes requires optimizing the temperature profile to avoid melting at the surface versus good coil dimension and shape stability. It is advised to optimize the coiling process by lowering the temperature and extending the time.



Safety & RoHS

Please handle the material with care following all the guidelines on the SDS. Arnitel® E & P are fully compliant with all RoHS requirements.

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