



Arnitel[®] TPC

Tubes & Hoses

For High-Performance Automotive and Industrial Applications

Tubes and Hoses

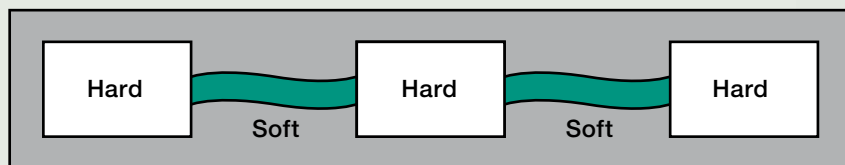
Summary

Arnitel® Thermoplastic Elastomer (TPC) offers a broad product portfolio of engineered materials that deliver high performance properties for automotive and industrial tube & hose applications. The list of benefits is extensive and includes:

- Superior flexibility across a wide temperature range (-40°C to 125°C) without using processing oils or plasticizers
- Excellent stiffness for certain applications even up to 170°C
- Excellent mechanical properties (creep, abrasion, dimension stability, fitting retention)
- Outstanding impact strength at low temperatures as low as -40°C
- Good resistance to chemicals and oil
- Easy and cost-efficient processing compared to conventional materials like rubber, PA11 and PA12
- Design flexibility allows single/multilayer concepts and reduced wall thickness designs

About Arnitel® TPC

Arnitel® TPC is a thermoplastic copolyester based elastomer (TPC-E or COPE), a unique material combining the strength and processing characteristics of engineering plastics with the flexibility of thermoset elastomers (rubbers). The material combines a hard segment of polyester (PBT) and a soft segment of polyethers or polyester, depending on grade.



Arnitel® composition

In comparison with other elastomers, Arnitel® offers highly consistent performance over a wide operating temperature range with very low variation in properties between low and high temperature extremes. As a high performance thermoplastic, Arnitel® does not require vulcanization to deliver optimal properties. This leads to substantial reductions in cycle time and component costs. Arnitel® provides advantages in processing and productivity.

Thanks to its outstanding characteristics, Arnitel® also enables exceptional flexibility in design, which gives the freedom to create innovative design concepts and thus adds value to your products.

For Tube & Hose Applications

Various Arnitel® grades are used in highly demanding tube and hose applications for automotive and industrial purposes, where flexibility, durability, and mechanical strength are required. Applications in these areas are, for example: vacuum brake tubing, air brake tubing, fuel tubing, convoluted tubing, hydraulic and pneumatic tubing. In rubber industry, mandrels consisting of Arnitel® are widely used for elastic hoses during the curing process in autoclaves.

Arnitel® provides an excellent combination of superior high and low temperature performance, flexibility and good chemical resistance. The outstanding processability of Arnitel® enables extrusion processes with higher line speeds and better dimensional control than competitive materials

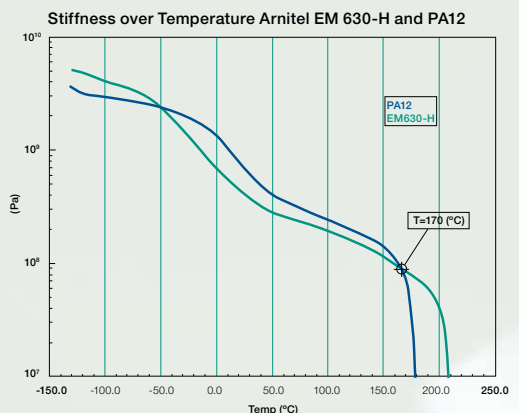
Automotive



In automotive applications, Arnitel® EM630-H grade has proven to be an ideal solution for safety components complying with strict automotive industry specifications. Arnitel® EM630-H is successfully applied in various vacuum brake tubing applications. Vacuum brake tubes, a vital part of brake boosters in today's cars, provide negative pressure from a fitting on an engine's intake system to a car's brake booster. The vacuum helps amplify braking forces when a driver steps on the brake pedal.

Compared with PA11 and PA12, vacuum brake tubes made from Arnitel® EM630-H remain stiff under ever-increasing engine compartment temperatures (up to 170°C), avoiding collapse, and without the need for additional heat shields or extra tube length with their additional part and labour costs. EM630-H fulfills the ozone requirements according to FMVSS No. 106 (100ppm 70h's). Also Arnitel® EM630-H has a better fitting retention and does not contain any plasticizers to keep its flexibility during its lifetime, unlike PA11 and PA12.

Arnitel® EM630-H remains stiff even up to 170°C



Industrial



In industrial applications, several Arnitel® grades such as PM381, PM581, PM650, EM550, EM630 and EM740, have proven to be the ideal solution for hydraulic hoses. Conventional hydraulic hoses have a rubber core braided with polymer fibers or metal wires as pressure reinforcement, mostly covered by an outer protective layer. Compared to nitrile rubber and other traditional materials, Arnitel® has many advantages in performance, production and handling.

Used as an outer layer, Arnitel® shows great impact resistance and excellent flexibility without use of processing oils or plasticizers. It also has a good resistance to chemicals. As an inner layer material, Arnitel® provides a smoother inner surface, superior flexibility and better hot oil resistance. This means that fluids are easier to pump while the hoses are easier to handle and have a longer service life. Inner layers made from Arnitel® can be manufactured to any length, including continuous production. With Arnitel® the hydraulic hose core can have thinner walls for a given pressure rating which makes the finished hose lighter and more flexible. Other properties which make Arnitel® ideal include low volumetric expansion under pressure, little oil absorption and low diffusion of gases.

Tubes & Hoses Applications at-a-glance

Automotive Applications



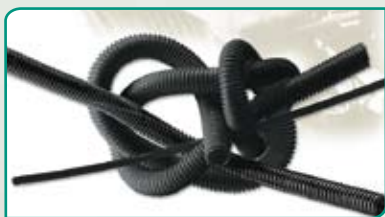
Vacuum Brake Tube

- Excellent heat resistance
- Remains stiff even up to 170°C
- Better fitting retention compared to plasticized PA11 and PA12
- Good oil resistance
- Competitive pricing
- Excellent heat forming properties
- Ozone resistant



Air Brake Tube

- Excellent high pressure resistance at highest temperature class (<125°C at 12 bar pressure)
- Design flexibility allows multilayer concepts
- Better fitting retention compared to PA12
- Contains no plasticizers and is environmentally friendly



Convoluting Tube

- Excellent heat resistance (CUT 175°C)
- Excellent chemical resistance
- Remains flexible at very low temperatures
- Good fatigue resistance in repetitive bending

Arnitel® has very good chemical resistance to automotive greases and fluids. This makes Arnitel® highly suitable for use in other automotive applications that are in contact with oils and ATF fluids at high temperatures. These include fuel tubes, grease distribution tubes, positive crankshaft ventilation hoses, transmission oil cooler hoses and power steering hoses.

Industrial Applications



Hydraulic Hose

- Low volumetric expansion under pressure
- Good chemical and (hot) oil resistance
- Outstanding impact resistance at low temperatures
- Smoother inner surface
- Superior flexibility at low temperatures
- Good abrasion resistance



Pneumatic Tube

- Excellent pressure resistance
- Excellent coil retention properties
- Superior creep properties
- Good chemical and oil resistance



Mandrels

- Extended service life: more than 10 vulcanization cycles
- Good chemical resistance
- No need for release agents
- High processing speed

Tubes and Hoses

Product Portfolio

The extended Arnitel® product portfolio offers a suitable solution for each tube and hose application. Arnitel® is available in four types of TPC-E, all designed specifically to meet the needs of extrusion processors.

- Arnitel® E is suitable for tubes and hoses applications demanding oil and chemical resistance
- Arnitel® P offers superior low temperature performance, flexural endurance and good mechanical properties
- Arnitel® U exhibits a high continuous use temperature (3000 hours at 150°C and peak temperatures up to 180°C). The material also provides outstanding resistance to chemicals, abrasion and copper. It provides an excellent solution for automotive convoluted tubes used as wire harness protection
- Arnitel® C, the newest development has the best high heat aging properties of all TPC-E, with continuous temperature of 3000 hours at 175°C, and is hydrolysis resistant (>150 days at 85°C in water).

Key Property Data

	EM550	EM630	EM630-H	EM740	PM381	PM581	PM650	UM552	CM622
Hardness (shore D)	53	60	63	72	33	55	63	55	62
Tensile modulus (MPa)	200	310	310	1000	60	300	520	250	280
MFI (cm³ /10 min)*	8	4	5	5	4	4	4	10	10
Melting point (°C)	207	212	212	221	212	218	221	195	220
Density (kg/m³)	1210	1240	1230	1290	1160	1230	1260	1260	1260

*at 230°C and 2.16 kg.

Green Solution

Arnitel® is an environmentally friendly solution; it is a thermoplastic material and thus recyclable:

- Lower waste rates, regrind is possible compared to cross-linked products like rubber
- Recycling after lifecycle or post-lifecycle recycling is possible compared to cross-linked products like rubber

Like any thermoplastic elastomer, Arnitel® can be processed through extrusion*. It needs no plasticizers, unlike PA11 and PA12. Plasticizers suspected of endangering health and environment like phthalates are not used. Waste is not harmful to the environment compared to competitive materials.

* Separate Arnitel® extrusion guide available

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