

What is PA 6 FR EN

PA 6 FR

PA 6 FR (flame-retardant polyamide 6) – semi-crystalline engineering thermoplastic, halogen- and phosphorus-free

PA 6 FR is the flame-retardant grade of polyamide 6. Through a halogen- and phosphorus-free flame-retardant system it achieves UL 94 V-0 and is certified to EN 45545-2 (fire protection in rail vehicles) – ideal for components with fire-protection requirements in railways, transport and electronics.

Classification and basic character

PA 6 FR is a semi-crystalline engineering thermoplastic of the polyamide family – chemically a PA 6 equipped with a halogen- and phosphorus-free flame-retardant system. This makes it flame retardant and self-extinguishing (UL 94 V-0) and at the same time hard, strong and dimensionally stable. Like all polyamides, PA 6 FR absorbs moisture. Due to the flame retardant, the elongation at break is significantly lower than standard PA 6, i.e. the material is more brittle.

Flame retardancy and approvals

The special feature of PA 6 FR is its integrated fire protection: a halogen- and phosphorus-free flame-retardant system makes the material flame retardant and self-extinguishing and achieves the highest UL 94 rating V-0 in 3 mm and 6 mm thickness. In addition, PA 6 FR is certified to EN 45545-2 – the European standard for the fire behaviour of materials in rail vehicles. This makes the material suitable for applications requiring fire protection and low smoke generation.

How PA 6 FR is produced and processed

PA 6 FR is produced like standard PA 6 by polymerisation of caprolactam, with a flame-retardant system incorporated. We machine precision parts from the extruded semi-finished stock (rods, plates). Because of the moisture absorption, for tight tolerances we take the swelling behaviour into account and condition the stock if required. Due to the lower toughness, sharp tools and adapted cutting parameters are important.

Mechanical and physical properties

PA 6 FR reaches a yield stress of around 82 MPa at a modulus of about 3,800 MPa and a density of roughly 1.17 g/cm³ – it is stiffer and harder than standard PA 6. Due to the flame retardant, the elongation at break is only about 3 %, so the material is less tough and rather brittle. It offers good sliding, abrasion and wear properties as well as good dimensional stability.

Chemical, thermal and moisture resistance

Chemically, PA 6 FR behaves like PA 6: well resistant to fuels, oils, greases and many solvents, not resistant to strong acids and – over longer periods – hot water (hydrolysis). The service temperature ranges from about -20 °C to a continuous +85 °C, briefly up to around 160 °C; the heat deflection temperature is lower due to the flame retardant (HDT approx. 65 °C). Like all polyamides, PA 6 FR absorbs moisture, which increases toughness, reduces stiffness and causes dimensional changes.

When PA 6 FR is the right choice

PA 6 FR pays off whenever PA-typical properties have to be combined with fire protection – for example:

- Components for rail vehicles with EN 45545-2 requirements
- Insulators and electrical/electronic components with fire protection
- Holders, housings and covers in public transport
- Guide and sliding parts in railway, transport and factory equipment
- Applications requiring UL 94 V-0 and low smoke generation

When PA 6 FR is NOT the right choice

Just as important are the limits of the material:

- Food contact – the FR grade is not intended for the food sector; use standard PA 6 or POM here
- Applications with high impact/shock loading – the elongation at break is low due to the flame retardant (more brittle)
- Highest dimensional accuracy under changing humidity – then POM
- Permanent contact with hot water/steam or strong acids (hydrolysis/attack)
- When no fire protection is required – standard PA 6 is more economical

What does PA 6 FR cost?

PA 6 FR is significantly more expensive than standard PA 6, as the flame-retardant system and the approvals increase the material cost. As a rough guide, semi-finished stock ranges from about 15–30 €/kg. The part price is mainly determined by stock form and dimension, material utilisation (waste), machining effort and batch size. We are happy to quote binding prices on request based on your drawing.

Machining at Liedtke

PA 6 FR machines well – turning, milling, drilling and sawing produce clean results. Because of the lower toughness (brittleness) we use sharp tools and adapted cutting parameters to avoid chipping. We take moisture absorption and thermal expansion into account for tight tolerances and condition the stock if required. This lets us reliably produce precision parts – from single parts to series production.

Advantages and disadvantages at a glance

An honest assessment – and how the disadvantages can be mitigated in practice:

Advantages

- Flame retardant and self-extinguishing (UL 94 V-0)
- Halogen- and phosphorus-free flame-retardant system
- Certified to EN 45545-2 (railway fire protection)
- High hardness, strength and stiffness
- Good sliding, abrasion and wear properties

Disadvantages

- Low elongation at break – more brittle, sensitive to impact/shock
- Not intended for food contact
- Absorbs moisture – dimensional and property changes
- Lower heat deflection temperature (HDT approx. 65 °C) and higher price

Practical tip: PA 6 FR shows its strengths wherever fire protection is mandatory – e.g. in rail transport to EN 45545-2. If no flame retardancy is needed, we recommend the tougher and cheaper standard PA 6; for food contact use standard PA 6 or POM.

Typical Properties

- Flame retardant / self-extinguishing (UL 94 V-0)
- Halogen- and phosphorus-free flame-retardant system
- Certified to EN 45545-2
- High hardness and strength
- Good sliding properties
- Good abrasion and wear resistance
- Good machinability and dimensional stability
- Not intended for food contact

Product Examples

- Components for rail vehicles (EN 45545-2)
- Insulators and electrical/electronic components
- Holders, housings and covers
- Guide and sliding parts in railway and transport
- Wear parts with fire-protection requirements
- Components for factory equipment and semiconductor industry

Typical Industries

- Railway technology and rail vehicles
- Automotive engineering
- Public transport
- Electronics and electrical engineering
- Semiconductor industry
- Factory equipment

	Test Method	Unit	Value
General Properties			
Density	DIN EN ISO 1183-1	g / cm ³	1.17
Moisture absorption	DIN EN ISO 62	%	3.0
Flammability (thickness 3 mm / 6 mm)	UL 94		V0 / V0
Mechanical Properties			
Yield stress	DIN EN ISO 527	MPa	82
Elongation at break	DIN EN ISO 527	%	3
Tensile modulus	DIN EN ISO 527	MPa	3800
Shore hardness	DIN EN ISO 868	scale D	83
Thermal Properties			
Melting temperature	ISO 11357-3	°C	222
Specific heat capacity	DIN 52612	kJ / (kg * K)	1.70
Coefficient of linear thermal expansion	DIN 53752	10 ⁻⁶ / K	90
Service temperature, long-term	Average	°C	-20 ... 85
Service temperature, short-term (max.)	Average	°C	160
Heat deflection temperature	DIN EN ISO 75, method A, HDT	°C	65
Electrical Properties			
Volume resistivity	DIN EN 62631-3-1	Ω * cm	10 ¹³
Surface resistivity	DIN EN 62631-3-2	Ω	10 ¹⁶

The values given are typical average values for PA 6 FR natural; they serve as an aid to material selection and are not a legally binding warranty of specific properties. PA 6 FR contains a flame-retardant system and is not intended for food contact. Polyamides absorb moisture, which changes mechanical properties and dimensions; the values apply to dry material. Price figures are rough, non-binding guide values and may vary depending on market situation, grade, dimension and quantity.