

What is PA 6 FR black

PA 6 FR black

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

PA 6 FR black is the flame-retardant grade of polyamide 6 in a through-coloured black version. Through a halogen- and phosphorus-free flame-retardant system it achieves UL 94 V-0 and is certified to EN 45545-2 – for components with fire-protection requirements that additionally call for a uniformly dark appearance.

Classification and basic character

PA 6 FR is a semi-crystalline engineering thermoplastic from 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. The black version is coloured throughout, not coated: scratches and machined surfaces remain visually inconspicuous. Like all polyamides, PA 6 FR absorbs moisture. Due to the flame retardant the elongation at break is considerably lower than with standard PA 6, so 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 ensures that the material is flame retardant and self-extinguishing and achieves the highest UL 94 class V-0 at 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 development.

Why black

The black colouring is more than appearance. It simplifies identification and grade separation in the warehouse, disguises operational soiling on visible and operating parts, and improves resistance to visible yellowing under light exposure. Please note that the electrical properties were determined on natural material – pigmentation can change volume and surface resistivity. For electrically critical applications we clarify the values with the supplier in advance.

Mechanical and physical properties

PA 6 FR reaches a yield stress of around 82 MPa with a tensile modulus of about 3,800 MPa and a density of approximately 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. Colouring does not significantly change these values.

Chemical, thermal and moisture resistance

Chemically PA 6 FR behaves like PA 6: good resistance to fuels, oils, greases and many solvents, no resistance to strong acids and – over longer periods – to hot water (hydrolysis). The service temperature ranges from about -20 °C to a continuous +85 °C, short-term 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 black is the right choice

Whenever typical polyamide 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
- Visible and operating parts calling for a uniformly dark appearance
- Guide and sliding parts in railway, transport and factory equipment
- Applications requiring UL 94 V-0 and low smoke development

When PA 6 FR black is not the right choice

The limits of the material matter just as much:

- Food contact – the FR grade is not intended for this; please use standard PA 6 or POM
- Applications with high impact or shock loads – elongation at break is low due to the flame retardant
- Electrically critical applications without prior clarification of the values for the coloured grade
- Permanent contact with hot water/steam or strong acids (hydrolysis/attack)
- Where no fire protection is required – standard PA 6 is more economical

What does PA 6 FR black cost

PA 6 FR is considerably more expensive than standard PA 6, as the flame-retardant system and the approvals raise the material cost; the colouring adds little on top. As a rough, non-binding guide, semi-finished prices are in the range of around 15–30 €/kg. The component price is determined mainly by the form and dimensions of the semi-finished product, material utilisation, 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 all work cleanly. Because of the lower toughness we use sharp tools and adapted cutting parameters to avoid break-outs. We take moisture absorption and thermal expansion into account for tight tolerances and condition the semi-finished product where required. This is how we reliably manufacture precision parts – from one-offs 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 (rail fire protection)
- High hardness, strength and stiffness
- Coloured throughout – scratches and machined surfaces stay inconspicuous

Disadvantages

- Low elongation at break – more brittle, sensitive to impact and shock
- Not intended for food contact
- Absorbs moisture – changes in dimensions and properties
- Electrical values of the coloured grade to be clarified case by case
- Lower heat deflection temperature (HDT approx. 65 °C) and higher price

Typical Properties

- Flame retardant / self-extinguishing (UL 94 V-0)
- Halogen- and phosphorus-free flame-retardant system

Product Examples

- Components for rail vehicles (EN 45545-2)
- Insulators and electrical/electronic components

Typical Industries

- Railway technology and rail vehicles
- Automotive engineering
- Public transport

- Certified to EN 45545-2
- Coloured black throughout
- High hardness and strength
- Good sliding, abrasion and wear resistance
- Not intended for food contact
- Holders, housings and covers
- Visible and operating parts in public transport
- Guide and sliding parts in railway and transport
- Wear parts with fire-protection requirements
- 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
Water absorption	DIN EN ISO 62	%	3.0
Flammability (thickness 3 mm / 6 mm)	UL 94		VO / VO
Colour			black
Mechanical Properties			
Yield stress	DIN EN ISO 527	MPa	82
Elongation at break	DIN EN ISO 527	%	3
Tensile modulus of elasticity	DIN EN ISO 527	MPa	3800
Shore hardness	DIN EN ISO 868	scale D	83
Thermal Properties			
Melting temperature	ISO 11357-3	°C	222
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 stated are typical average values for the PA 6 FR grade; they serve as an aid to material selection and are not a legally binding assurance of specific properties. The electrical properties were measured on natural material and may deviate for black-coloured material. PA 6 FR contains a flame-retardant system and is not intended for food contact. Polyamides absorb moisture – this changes mechanical properties and dimensions; the values apply to dry material. Price information is a rough, non-binding guide.