Polyimide P84®
High-performance coatings

Technical brochure

EVONIK
Leading Beyond Chemistry

Polyimide P84®

Coatings beyond the limits: Polyimide P84®

- **No curing necessary**
  Polyimide P84® is a fully imidized polymer of a high molecular weight, thus showing excellent storage stability at room temperature and eliminating the need for a curing stage. The polyimide coating is fit for service after the solvent is evaporated.

- **Soluble Polyimide**
  Polyimide P84® is soluble in highly polar solvents like DMF, NMP, NEP and even non-CMR and low-tox solvents, making it easy to apply polyimide films with standard processing techniques.

- **High thermal stability**
  Polyimide P84® has a glass transition temperature well above 300°C, thus providing exceptional heat stability.

- **Excellent chemical resistance**
  Because of its chemical stability against organic solvents, oils and fuels, coatings with Polyimide P84® are the right choice for demanding applications.

- **Good adhesive strength**
  Polyimide P84® forms a strong bond on a variety of surfaces such as glass, metals, plastics and ceramics.

Why choosing Polyimide P84® coatings?

Polyimides, a material class with a success story

Evonik Fibres GmbH is an innovative Austrian company within Evonik, the technological leader in high-performance polymers. We supply Polyimide P84® as solution in organic solvents.

Polyimide P84® imparts excellent heat resistance to coatings. Polyimides are well known for their remarkable heat stability and creep resistance, even at elevated temperatures of 250°C or higher, so they are the right choice for commercial or technical applications and where demands on temperature resistance are high.

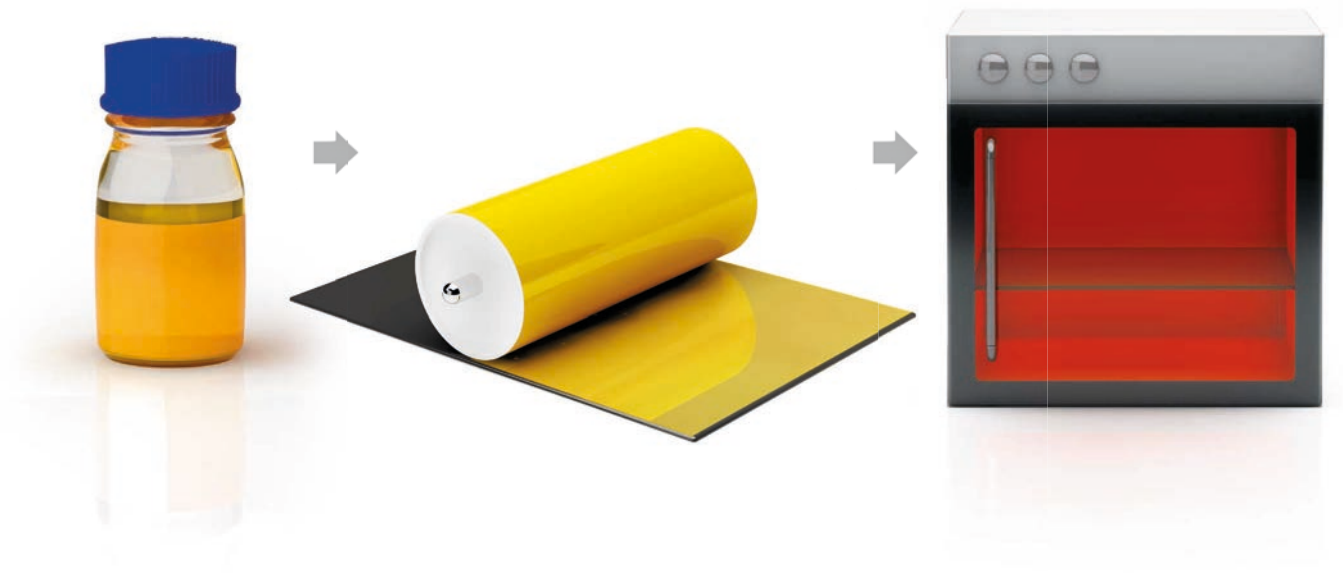
Solution for challenging demands

Polyimide P84® has availed itself in demanding electronic and semiconductor applications, where it serves as an insulating layer or chemical barrier.
Filled with solid lubricants such as graphite or molybdenum disulfide, Polyimide P84® films function as anti-friction coatings in bearings or guidances, such as are used in the automotive industry.
In engineering applications, coatings of Polyimide P84® are used for smoothening rough metal surfaces and preventing products from sticking on the rollers.
Given its high thermal stability, P84® coatings enable solder and laser technologies for coated components.

Simple processing, successful application

Processing and recommendations

Polyimide P84® is delivered as a viscous solution; it is easily dilutable to the appropriate viscosity with a solvent. In order to optimize particular processing requirements such as drying characteristics, it is also possible to partially replace solvents with more volatile non-solvents (e.g. hydrocarbons).
Application processes for P84® polyimide solutions include, among others, casting (doctor blade), dipping, spin-coating, spraying or roller-coating.
The exposure of freshly applied coatings to ambient air should be kept to a minimum, since the coating may become turbid. It is recommended to dry the coating at 80°C for up to 30 minutes to receive a dry coating before further handling.
For the removal of the residual solvent, a forced-air furnace is heated up to 250°C with a ramp of 1-5K/min. Heat-sensitive substrates can be dried at lower temperatures when assisted by vacuum or when drying times are increased.
The thorough removal of residual solvent is required to fully profit from the superior properties of P84®.



Dynamic viscosity as a function of concentration and temperature

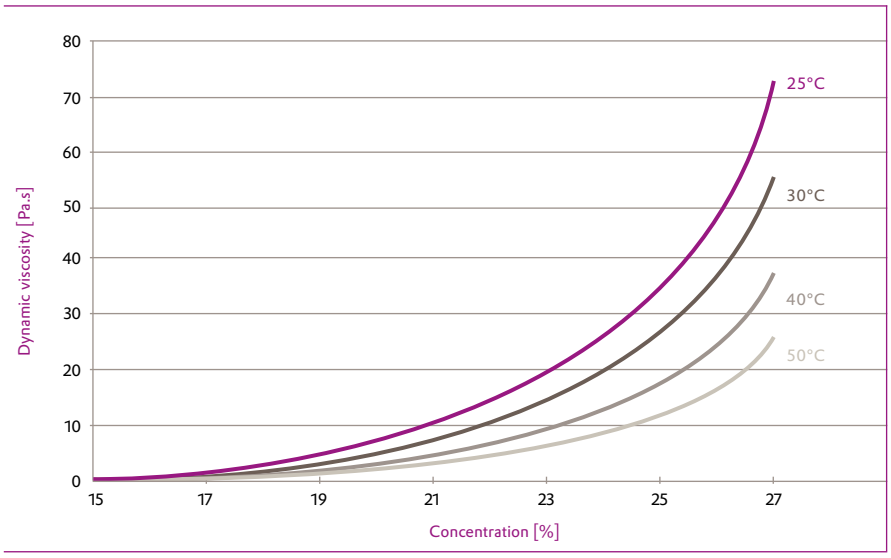


Chart 1
Dynamic viscosities of P84® solutions depend on concentration, temperature and solvent; here, examples for P84® in DMF are depicted.

Recommended drying cycle

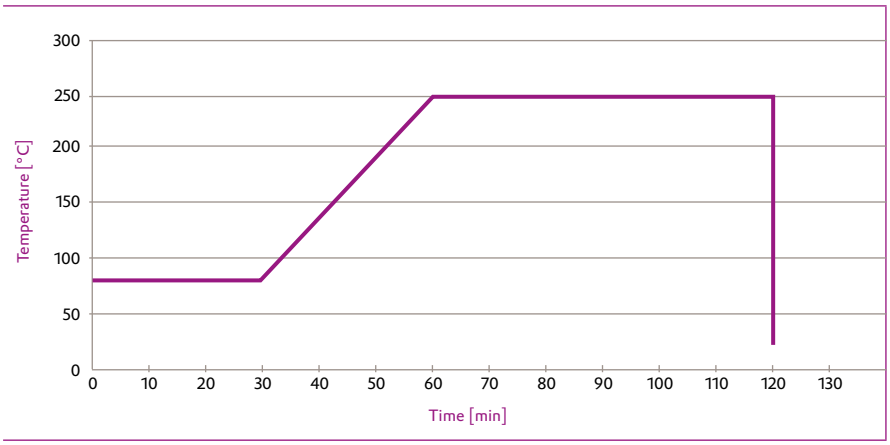


Chart 2
Temperature profile using a convection oven. P84® was applied as solution in DMF to form a film having approximately 10µm thickness. Procedure may have to be adapted to ensure complete removal of the solvent.

Where is Polyimide P84® applied successfully?

Semiconductor and electric industry

Polyimide P84® coatings as insulation layer protect valuable parts and components. PI coated wires are used in high temperature applications.
Modern communication and battery technologies benefit from P84® and its unique dielectric properties.

Automotive industry

Anti-friction coatings in bearings and guides made of P84® reduce friction, wear and noise.

Engineering applications

On rough metal parts, PI-coatings provide smooth and mechanically resistant surfaces for stable processes and easy cleaning properties.
Coatings with P84® protect from corrosion.

Benefitting from Polyimide P84® coatings

Outstanding properties

Polyimide P84® solution is provided in a variety of solvents including DMF (Dimethylformamide), NMP (N-Methylpyrrolidone), NEP (N-Ethylpyrrolidone). Low tox solvent mixtures based on DMSO (Dimethyl sulfoxide) available.

Selected properties

Property	Unit	Value
Maximum solid content	%	25
Viscosity | 25% polymer content	Pa·s	50-80
Molecular weight (Mw) | GPC (SEC), relative calibration, PS-standards	g/mol	> 125 000
Glass transition temperature (Tg)	°C	315
Decomposition temperature	°C	> 550
10% Weight loss | air	°C	525
10% Weight loss | nitrogen	°C	570
Melting point	°C	no
Limiting oxygen index (LOI) | ASTM D2863, 25µm film	% O_2	38
Dielectric strength | DC, Electrical properties tested on 50µm thick film	V/µm	415
Dielectric strength | AC, 50Hz	V/µm	172
Dielectric constant | AC, 1kHz, absolutely dry	-	3.5
Dissipation factor | AC, 1kHz	-	0.002
Volume resistivity | 500V	Ω·m	10^{14}
Refractive index | 650-770nm, DIN 53481 and DIN 53483	-	1.68

Thermogravimetric analysis

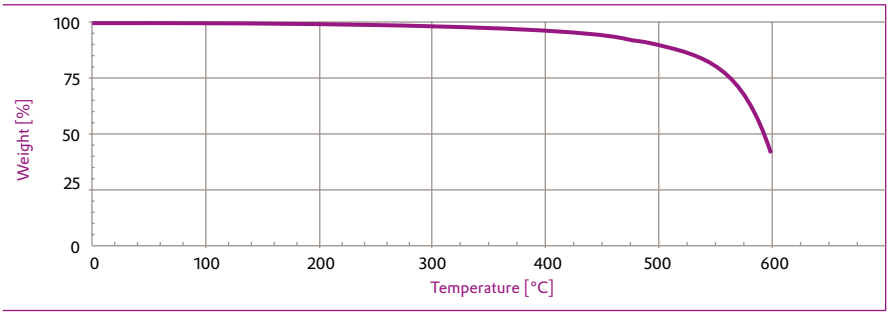


Chart 4
The excellent thermal stability of Polyimide P84® is demonstrated by means of TGA (thermogravimetric analysis, heat ramp: 20K/min, medium: air)

Excellent chemical resistance

List of tested substances

Organic chemicals		Stability
Aceton		●●●
Perchloric ethylene		●●●
Benzene		●●●
Benzine		●●●
Ethylene glycol		●●●
Acids		
Sulfuric acid	diluted, hot	●●○
	diluted, room temperature	●●●
	concentrated	●●○
Nitric acid		●●●
Hydrochloric acid	hot	●○○
	concentrated	●○○
Acetic acid		●●●
Oxalic acid		●●●
Bases, salts and other substances		
Sodium hypochlorite		●●●
Sodium chlorite		●●●
Sodium chlorate		●●●
Hydrogen peroxide		●●●
Sodium hydroxide		●○○
Ammonium hydroxide		●○○

Rating	●●● - Excellent	●●○ - Satisfying	●○○ - Poor
Description	No change, negligible change of mechanical properties	Moderate change, material with limited lifetime	Material decomposition within short time
Material class	Organic solvents, hydrocarbons, oil and grease, weak acids, salts, peroxides	Moderate acids and alkalines	Strong acids and alkalines

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