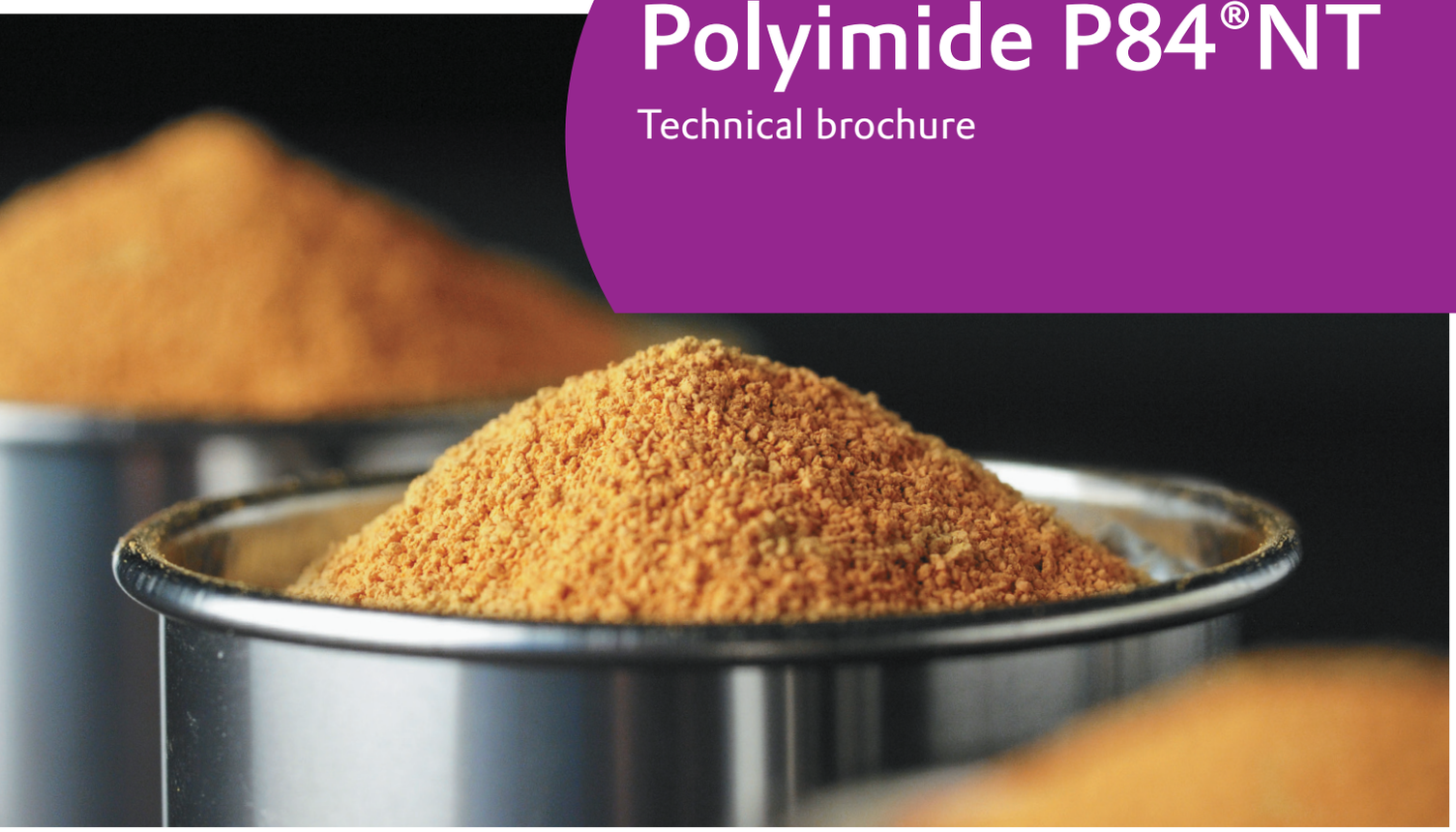
Polyimide P84®NT

Technical brochure



Evonik. Power to create.

Polyimide P84®NT

Introducing an outstanding high performance polymer:

Excellent performance at high temperatures
Polyimide P84®NT is used in applications where ordinary plastics would sooner melt or decompose.

High heat deflection temperature
Polyimide P84®NT guarantees very good creep resistance even at elevated temperatures.

High strength and excellent shape stability
Parts and components made of Polyimide P84®NT provide a rigid structure and can bear high mechanical stress and elongation.

Very good impact resistance
The high impact strength of Polyimide P84®NT ensures easy machinability with standard tools and good quality of edges and surfaces.

Processing by state-of-the art sinter technologies
Polyimide P84®NT is processable cost-efficiently by common sinter technologies such as hot compression moulding or direct forming.

Powder or granules are commercially available
Commercially available polyimide raw material enables plastics processors to develop proprietary polyimide parts and compounds.

Small particle size
Homogenous blending with functional fillers or other polymers can be achieved by employing powder grades with particle size less than 10µm.

Low wear and friction behaviour
Tribological compounds with solid lubricants provide dry-lubricated solutions for demanding applications.

Why choosing Polyimide P84®NT?

Demanding applications

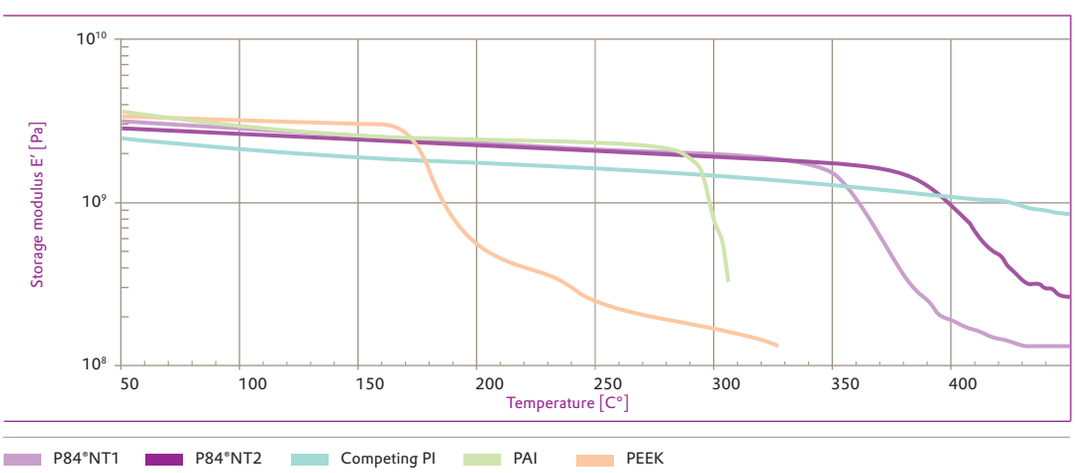
High temperatures or frictional wear at high speeds and loads often circumscribes the use of ordinary engineering plastics; hence, advanced high-performance polymers have taken their place in demanding applications. Plastics processors can use polyimides — which exhibit remarkable heat stability and creep resistance, even at elevated temperatures of 250°C or higher — where ordinary plastics would sooner melt or decompose.

Restrictions of conventional polyimides

Processing semi-finished parts made of polyimide is often a difficult undertaking, and the raw material is sometimes not available commercially, prompting some polyimide polymer producers to sell the machined parts at high prices, affordable in many cases only in niches.

In addition, some polyimides are known to be highly brittle and thus can not be used in applications that call for high quality of edges and surfaces and good impact strength.

Storage modulus in a three point bendig experiment at 1 Hz



Temperature ranges

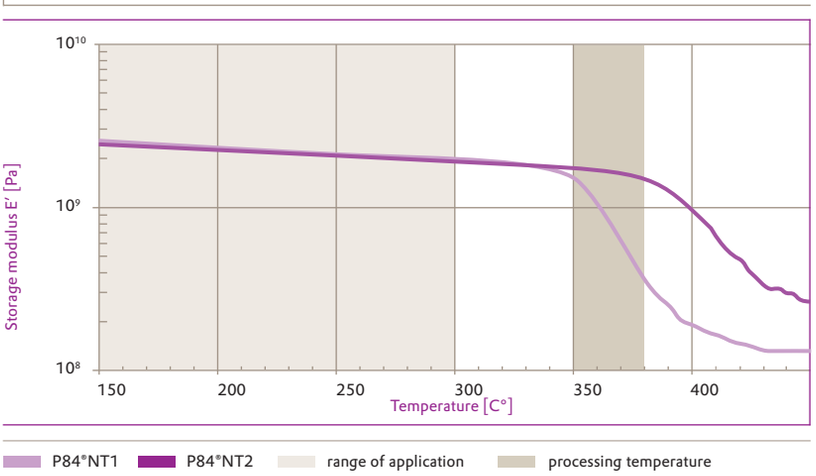


Chart 1-2
High Stiffness of Polyimide P84°NT even above 300°C, relatively simple and economical processing by sinter technologies above 350°C. P84°NT2 is the high temperature type of this material with glass transition temperature of 364°C

Developing a new polyimide material

Advantages of Polyimide P84®NT

To overcome the above-mentioned limitations, Evonik Fibres GmbH is now offering Polyimide P84®NT in powder or granulate form, which is processable by employing common sinter technologies such as hot compression moulding or direct forming. The high mechanical stability and the impact resistance of P84®NT parts ensure good machinability with standard tools.

Parts made of Polyimide P84®NT are excellent performers in thermally and mechanically stressed applications. This novel material features a high glass transition temperature of 337–364°C and a rigid structure (3705 MPa flexural modulus, 188 MPa strength in a three-point-bending experiment), combined with a high elongation at break of over 11 percent.

3-point-bending

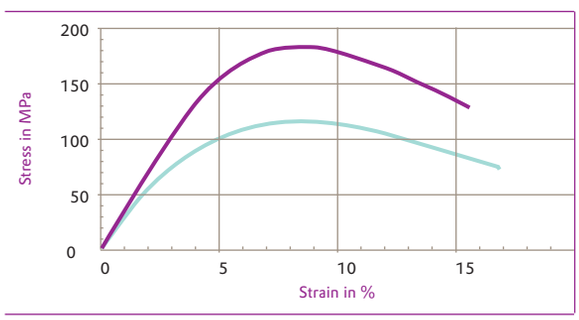


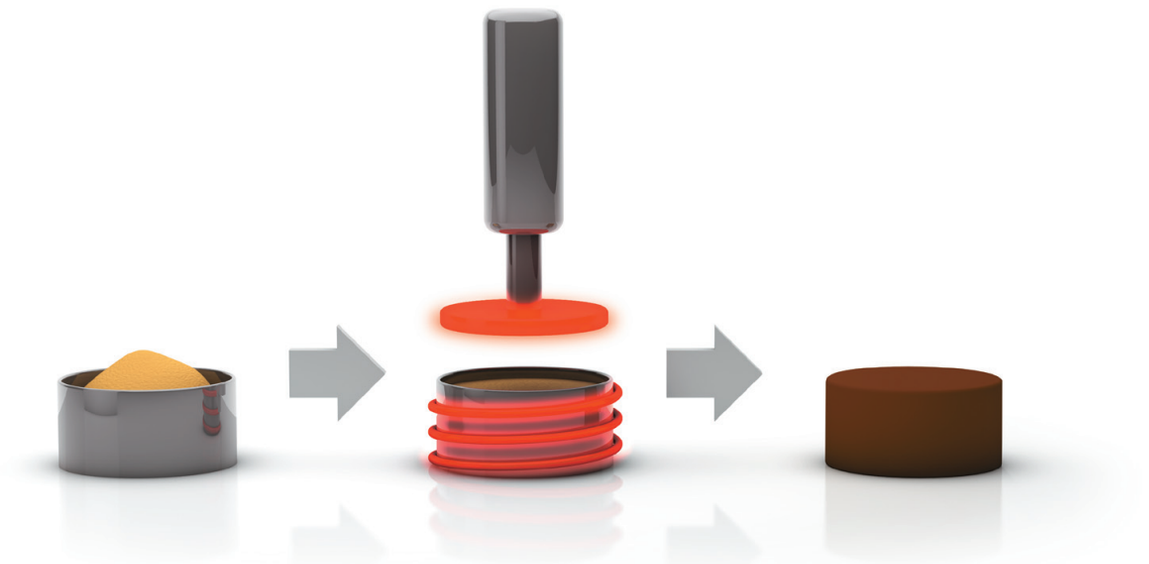
Chart 3
Comparison of stress-strain-curves in 3-point-bending experiment (ISO178). Polyimide P84®NT shows a wide area of elastic behaviour and high mechanical stability.

Selected properties

Property	Test method	Unit	P84®NT1	P84®NT1 15G*
Tensile strength	ISO 527	MPa	140	103
Tensile elongation at break	ISO 527	%	10	6
Tensile modulus	ISO 527	MPa	3581	3998
Compressive strength	ISO 604	MPa	470	269
Compressive modulus	ISO 604	%	1960	1878
Compression at break	ISO 604	MPa	58	41
Impact strength (Charpy)	ISO 179-1/1eA notched	$kJ.m^{-2}$	6	
	ISO 179-1/1eU unnotched	$kJ.m^{-2}$	40	
Heat deflection temperature	1,8 MPa Method Af	°C	319	335
	0,45MPa Method B	°C	343	345
Glass transition temperature Tg	DSC	°C	337	
Electric strength AC	ISO 60243-1	$kV.mm^{-1}$	22	

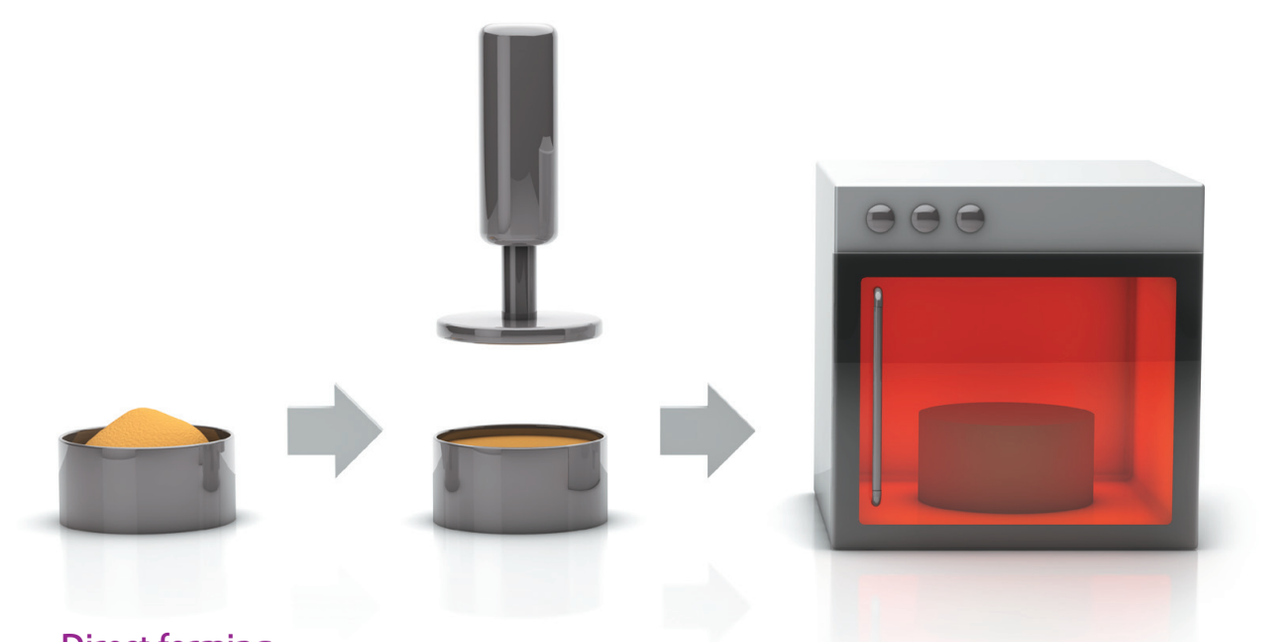
*P84®NT1 15G = Compound of P84 NT1 with 15% graphite

Simple processing of Polyimide P84®NT



Hot compression moulding

Big semi-finshed parts like plates, rods and tubes are produced by “Hot compression moulding” (HCM), applying high pressure and temperature above the glass transition point (Tg) for some hours. The manufacturing of precise components with high mechanical stability is done by machining these semi-finished parts. Processing parameters are 400kg/cm^2 pressure and 350-380°C temperature.



Direct forming

If a large quantity of small parts is to be produced cost efficiently and rapidly, Polyimide P84®NT powder can be processed by means of direct forming. This technology includes the production of “green parts” at extremely high pressure and ambient temperatures, with subsequent sintering in an external furnace. Processing is done at 3000kg/cm^2 pressure and 350-380°C temperature. The sintered parts can be manufactured with a high degree of precision and require little or no machining before they are used. High stroke rates of up to 40 parts per minute are possible.

Fillers adding function

Compounding

By blending it with functional fillers, plastics processors can adjust the properties of Polyimide P84®NT to meet specific requirements. Solid lubricants such as graphite, molybdenum disulfide, or PTFE make components self-lubricating. Moreover, fillers affect the electrical and thermal conductivity of polyimide compounds and have an impact on thermal expansion.

Carbon fibres increase the stiffness of polyimide parts. Polyimide is also used as matrix for abrasive material. Since Polyimide P84®NT is available as fine powder of 1-10 µm particle size, it can be used as functional filler itself, improving creep resistance at elevated temperatures or decreasing frictional wear.

Pin-on-disk experiment @ 20N load and 0.5m/s velocity on steel cronidur

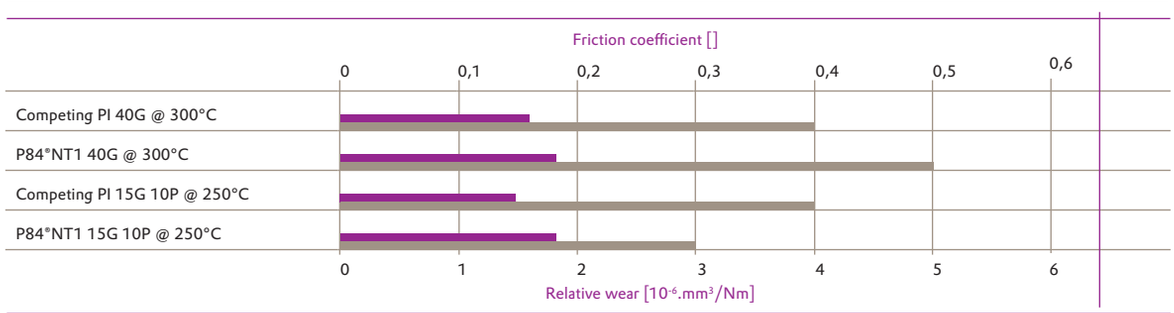
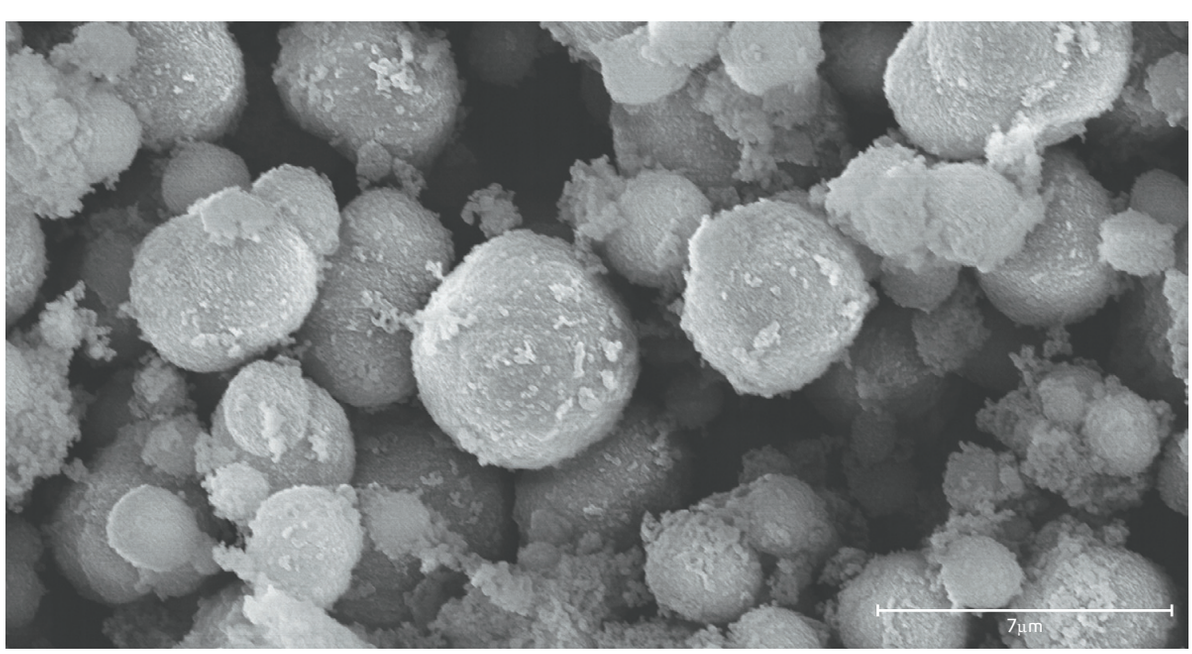


Chart 4
Comparable tribological behaviour of Polyimide P84 NT and other conventional polyimides. Tested compounds have been 40G (polyimide with 40% graphite) and 15G 10P (polyimide with 15% graphite and 10% PTFE).



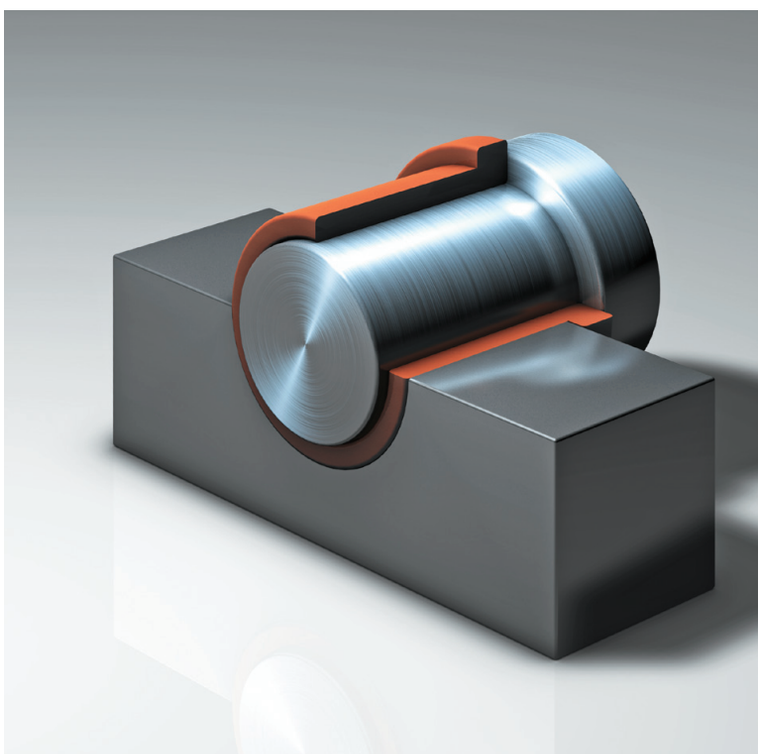
Scanning electron micrograph (SEM) at 4000× magnification. Spherical particles of Polyimide P84®NT with smooth surface.

Benefitting from Polyimide P84®NT

Applications

Given the variability of its properties, the simple processing of the raw material, and the good machinability of parts with standard tools, Polyimide P84®NT is the right choice for applications where plastics are used for commercial or technical reasons and demands on temperature stability are high.

For example, bushings made of a polyimide-graphite compound are used as bearings for windscreen wipers — for a lifetime of oil- and grease-free lubrication. Spacer discs in gear boxes can be made by direct forming, including all the necessary notches, thus minimizing post-processing and ensuring high-temperature stability and low wear. This new promising material is used in bushings, seals, bearings components, guides, gear wheels, and valve parts in the automotive and aerospace industries and in industrial equipment.



Product portfolio

Polyimide P84®NT is available as neat polymer as well as blended with functional fillers. Standard compounds contain 15% or 40% graphite, 15% MoS2 or 15% graphite combined with 10% PTFE. Moreover, developing custom-tailored solutions with proprietary formulations are possible.

Legal References

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EVONIK INDUSTRIES

Evonik Fibres GmbH
Gewerbepark 4
4861 Schörfling am Attersee
Austria

PHONE +43 7672 701-2867
FAX +43 7672 92046
www.p84nt.com

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