

Nylons (Polyamides) PA

INTRODUCTION

The name “nylons” refers to the group of plastics known as polyamides. Nylons are typified by amide groups (CONH) and encompass a range of material types (e.g. Nylon 6,6; Nylon 6,12; Nylon 4,6; Nylon 6; Nylon 12 etc.), providing an extremely broad range of available properties. Nylon is used in the production of film and fibre, but is also available as a moulding compound.

Nylon is formed by two methods. Dual numbers arise from the first, a condensation reaction between diamines and dibasic acids produces a nylon salt. The first number of the nylon type refers to the number of carbon atoms in the diamine, the second number is the quantity in the acid (e.g. nylon 6,12 or nylon 6,6).

The second process involves opening up a monomer containing both amine and acid groups known as a lactam ring. The nylon identity is based on the number of atoms in the lactam monomer (e.g. nylon 6 or nylon 12 etc).

PROPERTIES

The majority of nylons tend to be semi-crystalline and are generally very tough materials with good thermal and chemical resistance. The different types give a wide range of properties with specific gravity, melting point and moisture content tending to reduce as the nylon number increases.

Nylons tend to absorb moisture from their surroundings. This absorption continues until equilibrium is reached and can have a negative effect on dimensional stability. In general, the impact resistance and flexibility of nylon tends to increase with moisture content, while the strength and stiffness below the glass transition temperature (< 50-80 oC) decrease. The extent of moisture content is dependent on temperature, crystallinity and part thickness. Preconditioning can be adopted to prevent negative effects of moisture absorption during service.

Nylons tend to provide good resistance to most chemicals, however can be attacked by strong acids, alcohol's and alkalis.

Nylons can be used in high temperature environments. Heat stabilised systems allow sustained performance at temperatures up to 185 oC (for reinforced systems).

Grades Available (Suggest TYPES rather than Grades.)

There are many types of nylon available (e.g. Nylon 6 nylon 66, nylon 6/6-6, nylon 6/9, nylon 6/10, nylon 6/12, nylon 11, nylon 12). The material is available as a homopolymer, co-polymer or reinforced. Nylons may also be blended with other engineering plastics to improve certain aspects of performance. Nylon is available for processing via injection moulding, rotational moulding, casting or extrusion into film or fibre.



Patterson & Rothwell Ltd. Mount Pleasant St.
Mount Pleasant Industrial Estate, Oldham OL4 1HH

Tel: **0161 621 5000**

email: sales@patterson-rothwell.co.uk

www.patterson-rothwell.co.uk



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Physical Properties: NB The lower figure is typical for unreinforced Nylon, and the higher figure typical for 30% glass filled.

PHYSICAL PROPERTIES

Tensile Strength	90 - 185	N/mm ²
Notched Impact Strength	5.0 - 13	Kj/m ²
Thermal Coefficient of expansion	90 - 20/70	x 10 ⁻⁶
Max Cont Use Temp	150 - 185	oC
Density	1.13 - 1.35/1.41	g/cm ³

RESISTANCE TO CHEMICALS

Dilute Acid	*
Dilute Alkalis	***
Oils and Greases	****
Aliphatic Hydrocarbons	****
Aromatic Hydrocarbons	****
Halogenated Hydrocarbons	***(variable)
Alcohols	*

KEY

*poor ** moderate *** good **** very good



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APPLICATIONS

Nylon fibres are used in textiles, fishing line and carpets. Nylon films is used for food packaging, offering toughness and low gas permeability, and coupled with its temperature resistance, for boil-in-the-bag food packaging.

Moulding and extrusion compounds find many applications as replacements for metal parts, for instance in car engine components. Intake manifolds in nylon are tough, corrosion resistant, lighter and cheaper than aluminium (once tooling costs are covered) and offer better airflow due to a smooth internal bore instead of a rough cast one. Its self-lubricating properties make it useful for gears and bearings.

Electrical insulation, corrosion resistance and toughness make nylon a good choice for high load parts in electrical applications as insulators, switch housings and the ubiquitous cable ties. Another major application is for power tool housings.

HISTORY

Carothers discovered polyamides in 1931. On the 28th October 1938 commercial production of nylon 6,6 began. Polyamides were first introduced as fibre forming polymers). The first commercial application was the Bristles on Dr West's Miracle Tuft toothbrush. In the following year nylon stockings became available and, in 1941, nylon moulding powders began commercial production. Nylon 6 was developed in the 1940's (largely as a consequence of the patent that existed on Nylon 6,6). Nylon mouldings were not widely used until the 1950's.