

# **POLYAMIDES**

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# MEANING

- Nylons, or Polyamides (PA), are high-performance semi-crystalline thermoplastics. They may be amorphous, semi-crystalline and of greater or lesser crystalline.
- Polyamides (PAs) are produced either by the reaction of a diacid with a diamine or by ring-opening polymerization of lactams(cyclic amides).
- The two most important polyamides are poly(hexamethylene adipamide) (Nylon 6,6) and polycaprolactam (Nylon 6).  
The other polyamides, are *aramid, Kevlar and nomex*.
- **Nylon** is a generic designation for a family of [synthetic polymers](#), wherein monomers may be [aliphatic](#) or [semi-aromatic](#) or aromatic [polyamides](#).

# DEFINITION AND CHEMICAL COMPOSITION

- Nylon is a manufactured fiber in which the fiber-forming substance is a long-chain, synthetic polyamide in which less than 85% of the amide linkages are attached directly to two aromatic rings.



- The recurring amide group contains elements as carbon, oxygen, nitrogen and hydrogen.
- Molecular chain of nylon is long, and straight of variable length with no side chains or cross linkages. Nylons often have high crystallinity.

# MICROSCOPIC APPEARANCE OF POLYAMIDES

- Cross-Sectional View- Circular or multilobal
- Longitudinal View- Structureless, transparent, uniform diameter, fine, glass rod-like appearance.



# PROPERTIES

- **Strength:** Nylon has good tenacity and outstanding strength which is not affected with age. Strength is due to strong hydrogen bonds that form between the molecular chains. It is one of the lightest textile fibres is at the same time also one of the strongest, that's why, added at the points of wear such as knees and seats of jeans and toes and heels of socks. Wet strength is 80-90% of dry strength. Little swelling occurs when polyamide is wet. Nylon has excellent abrasion resistance. That means high tenacity polyamides are more crystalline and oriented. Tenacity: 4-9 gm/den (dry), in wet 90% of dry.
- **Elasticity:** Nylon has good elasticity. The amorphous regions contribute elasticity. If stretched too much, it will not completely recover its shape. The high elongation and excellent elastic recovery of nylon contributes to the outstanding performance in hosiery. Nylon hosiery recovers to its original shape at knees and ankles instead of bagging. Breaking extension is 20-40%.  
Fabrics of nylon filament yarn have excellent draping qualities.

**Resiliency:** Nylon fabrics have excellent resilience. Nylon does not wrinkle much in use and retains its shape well during use.

**Absorbency:** Nylon has low absorbency. It dries quickly as water remains on the surface of the fabrics and runs off. This property makes the nylon fabrics suitable for raincoats and shower curtains. Nylon's low absorbency has a disadvantage in that the fabric feels clammy and uncomfortable in warm, humid weather. polyamide is [hygroscopic](#). The absorption of water will change some of the material's properties such as its [electrical resistance](#). Nylon is less absorbent than wool or cotton. Moisture regain: 3.5-5%; (not absorbent due to crystallinity).

**Washability:** Polyamides are smooth, non-absorbent and dry quickly. Dirt doesn't cling to this smooth fibre, which can be washed easily or can be even cleaned by using a damp cloth. Nylon whites are commonly referred as colour scavengers and should be washed separately to avoid greying. They easily pick up colour and dirt from the wash water. Nylons, washed with other fabrics pick up colour (even from the palest pastels) and develop a dingy grey appearance that is extremely difficult to remove. In addition to retaining their appearance during wear, garments made from nylon fabrics retain their appearance and shape after washing. Hot water should be avoided during washing as the hot water may cause wrinkling in some fabric constructions.

**Effect of Heat:** On heating, polyamides melt and drip. They do not burn. Some flame is carried down with the drip. Odor is celery tar and gives white smoke. After burning it turns into tan coloured bead. Melting point: Nylon 6,6 – 252°C, Nylon 6 – 215°C. Aromatic polyamides melt at 500°C. On burning aramid does not melt but forms thick char thus acts as barrier between skin and heat thus providing flame resistancy.

Heat causes hydrogen bonds to weaken and if the fibers are bent while hot, bonds will break and form new bonds and shapes permanently on cooling. Thus, it is easy to change its molecular arrangement by heat treatment to give permanent “set” to creases in trousers, pleats in skirts, shape to stockings etc.

Nylon should be pressed or ironed at 132°C -149°C. Nylon should always be ironed at low temperatures. Using hot iron will result in glazing and then melting of the fabric.

**Shrinkage:** Nylon fabrics retain their shape and appearance after washing. It has good stability and does not shrink.

**Resistance to Perspiration:** Nylon fabrics are resistant to perspiration.

**Effect of Light:** Nylon fabrics have low resistance to sun light. They are not suitable for curtains or draperies as it is weakened by the exposure to sun light.

# CHEMICAL PROPERTIES

**Reaction to Acids:** Nylon 6,6 is attacked by mineral acids is disintegrated or dissolved almost. But is inert to dilute acetate acid and formic acids even of the boil. It is dissolved in the concentrated formic acid. Nylon 6 is attacked by mineral acid but resistant to dilute boiling organic acid. Certain acids when printed causes shrinkage that creates a puckered damasque effect. Sulphur containing soot from industries on damp day combines with moisture to form acid and results in epidemics of run in stockings. It dissolve in formic acid and phenols.

**Reaction to Alkalis:** Nylon has excellent resistance to alkali's but the frequent and prolonged exposures to alkalis will weaken the fiber.

**Effect of Bleaches:** Polyamides are resistant to bleaches. Not attacked by oxidizing and reducing bleaches but may be harmed by chlorine and strong oxidizing bleaches.  
Prolonged use of chlorine bleach may cause yellowing on white nylon.

**Affinity for Dyes:** Polyamides can be easily dyed with a wider range of dyes. They takes deeper hands. The dyed fabrics retain their colour and have good resistance to fading.

**Resistance to Mildew:** Nylon fabrics have absolute resistance to the development of mildew.

**Resistance to Insects:** Nylon is resistance to the moths and fungi.



