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# Wool & Fire

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## Fabrics & Flames

Flammability is the ability of a substance to burn or ignite, causing fire or combustion. Burns from clothing fires are a significant cause of injury and death. While most fabrics used in clothing can burn, some are much more flammable than others. In some applications – children’s sleepwear, work wear for emergency services and military personnel, and in situations where there is potential exposure to open flame or extreme heat – it is crucial for apparel and other textiles to provide a level of safety from the risk of burns, smoke and fume inhalation.

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When a fire starts in a bedroom or living room/dining room, where soft furnishings are the norm, fatality occurs in that same room more often than when the fire starts in any other room. Gas, smoke or toxic fumes are the most common cause of fatalities due to fires in home dwellings.

Given the right conditions, all fabrics will burn.  
There are four key aspects to burning behaviour:

- 1 Propensity for ignition.
- 2 Smoke density.
- 3 Toxicity of products evolved from burning.
- 4 Speed of flame spread.

Many factors influence how easily a textile will ignite, the manner in which it will burn, and the products of its combustion. These include the source of ignition and conditions such as airflow and surrounding materials. But the most important parameter in assessing the flammability of a textile is the fibre type.

# Flame Retardancy

Wool's inherent chemical structure makes wool naturally flame resistant. It is a highly trusted natural fibre in public areas such as hotels, aircraft, hospitals and theatres. Wool is harder to ignite than many common textile fibres. Whilst cotton catches alight at 255°C, the temperature must reach 570-600°C before wool will ignite. Polyester melts at 252-292°C and nylon succumbs at an even lower 160-260°C, but wool does not melt, so it cannot stick to the skin like synthetics do. Of the commonly used textile fibres (cotton, rayon, polyester, acrylic and nylon), wool is widely recognised as the most flame resistant. Wool's fire resistant attributes include:

- A very high ignition temperature of 570-600°C
- A high Limiting Oxygen Index (LOI). This is the measure of the amount of oxygen needed to sustain combustion
- A low heat of combustion – the measure of the amount of heat energy released in the burning process
- Does not melt or stick
- Self-extinguishing

Wool's inherent fire resistance comes from its naturally high nitrogen and water content. Because of this, wool requires higher levels of oxygen in the surrounding environment in order to burn. Wool may be ignited if subjected to a significantly powerful heat source but does not normally support flame, and smouldering usually continues only for a short time. In addition, wool's highly cross-linked cell membrane structure will swell when heated to the point of combustion, forming an insulating layer that prevents the spread of flame.

## Living With Wool Carpets

Wool's superiority in carpets is due not only to its inherently lower flammability, but its tendency to char on the surface pile. The charred layer protects the carpet's lower pile, backing, and underlay. The protective effect of wool pile can be seen in the unchanged Critical Radiant Flux (CRF), which is the minimum radiant energy a fire needs to sustain burning. The lower the CRF the greater the tendency of the material to spread flame. Even with a non-wool underlay, wool maintains its CRF. In contrast the CRF of nylon and polypropylene carpets drop significantly as they begin to melt and involve the underlay in the fire. This also results in greater smoke levels.

## Wool in the Bedroom

There are major advantages in incorporating a wool component into a bedding system. Even when other fibres are present in the form of sheets and bed linens, wool significantly reduces the rate of fire development and flame spread and consequently provides a much longer potential escape period. For example, with a polyester duvet, a fire will develop three to four minutes after ignition, and four minutes later, the fire will be difficult to extinguish with a hand-held extinguisher. In contrast, a wool blanket or wool duvet allows only a slow spread of flame, low heat output and relatively little smoke even over a much longer period.

## About IWTO

With a world-wide membership encompassing the wool pipeline from sheep to shop, the International Wool Textile Organisation (IWTO) represents the interests of the global wool trade. By facilitating research and development and maintaining textile industry standards, IWTO ensures a sustainable future for wool. To learn more about IWTO and its activities, visit [www.iwto.org](http://www.iwto.org).

