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Wool and Flame Resistance

Fact Sheet

Key Points

- Wool has a complex composition that is based on a unique cell structure
- Wool's high nitrogen and water content makes it naturally flame resistant
- Wool does not ignite easily and will often self-extinguish
- Should wool burn it does not melt while burning
- Wool produces less smoke and toxic fumes during combustion than synthetic fibres, making it a far safer choice for interiors such as carpets and bedding

Why is flame resistance important?

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.

In 2011-12 there were 380 fire-related deaths in Britain. Three-quarters of these were dwelling fires. When a fire started in a bedroom or living room/dining room, where soft furnishings are the norm, fatality occurred in that same room more often than when the fire started in any other room. Gas, smoke or toxic fumes was the most common cause of death and contributed to the cause of death in more than half of all dwelling fire fatalities. One quarter of fatalities were due to severe burns. In addition, there were 11,300 non-fatal fire-related casualties.

What factors influence flammability?

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 fibre type.

How does wool's flammability compare to other fibres?

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:

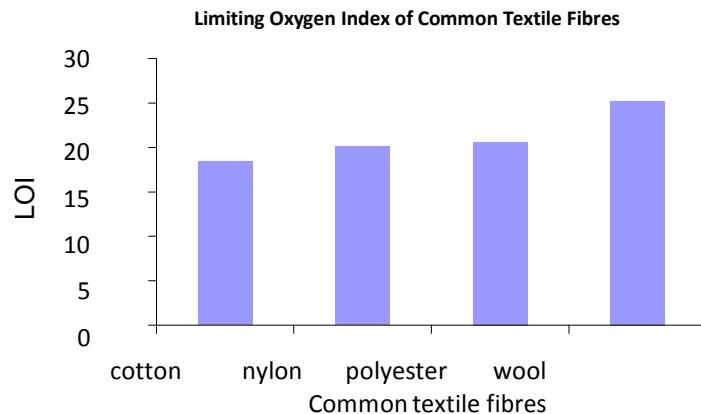
- A very high ignition temperature – 570-600° C
- A high Limiting Oxygen Index (LOI). This is the measure of the amount of oxygen needed to sustain combustion
- A low heat of combustion – the measure of the amount of heat energy released in the burning process
- Does not melt or stick
- Self-extinguishing

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. This mechanism also means that wool produces less smoke and toxic gas than synthetic fibres.

How is the flammability of fibres determined?

The Limiting Oxygen Index test is used for ranking the flammability of materials. The higher the value, the less flammable the material.

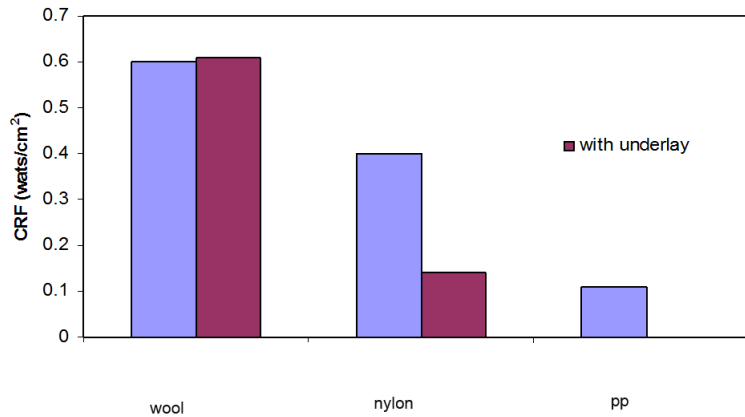


Wool has the highest LOI of the commonly used textile fibres.

What are the advantages for 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.

NBS Radiant Panel Test
(Saxony carpets 1500 g/m² spw)
(underlay: waffle rubber)



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. Smoke creation levels are around 10 times higher for nylon carpet than wool, and around 80 times higher for polypropylene carpets.

What about bedding? How can wool help when bed linens are made of cotton and polyester?

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 fairly frightening fire will develop within three-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.

Where can I learn more?

Contact IWTO for more information on wool and its natural technical properties:

Elisabeth van Delden

International Wool Textile Organisation

Rue de l'Industrie 1, 1000 Brussels, Belgium

+32 493 18 68 54

+32 2 505 4010

E-mail: vandelden@iwto.org



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About IWTO

The International Wool Textile Organisation (IWTO) is an independent non-profit organisation representing the wool industry at the international level. Our mission is to connect all parts of the wool supply chain in order to strengthen wool's credentials as the world's leading sustainable fibre.

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