ARMADILLO
MERINO

PROTECTION

FIRE RETARDANT

This fact sheet covers the intrinsic flame-resist performance of ZQ Merino

made from

ZQ™
MERINO FIBRE
zqmerino.com

FLAMMABILITY

INTRODUCTION

The propensity for textiles to catch fire, and the manner in which they burn, is a key consideration for many apparel products. Some applications where this is particularly important include children's nightwear, workwear, and apparel for emergency services and military personnel.

All fabrics will burn given the right conditions, however some are more difficult to ignite, burn more slowly, are easier to extinguish, and combust at a higher (or lower) temperature. (Ingham, 1983).

The difficulty of ignition, rate of burning, fumes associated with combustion and temperature of combustion are critical elements in assessing the suitability of fabrics for specific end uses, and are the subject of numerous international standards. Wool provides a high level of fire safety naturally with no additional chemical treatment, making it ideal for a range of apparel and textile uses where flame resistance is a critical determinant of product suitability

WHY FLAME RESISTANCE IS IMPORTANT

In some textile applications it is highly desirable for apparel and other textiles to impart a level of safety from the risk of burns, smoke and fume inhalation. This is particularly the case in children's nightwear, work and sports wear in situations where there is potential exposure to naked flame or extreme heat is likely for example, metal workers, gas and petroleum workers, and for professional risk takers such as emergency services and military personnel.

Burns from clothing fires are a significant cause of serious injury and death. While most fabrics used in clothing can burn, some materials are much more flammable than others. Statistically in;

AUSTRALIA

- 12 deaths resulted from clothing fires between 2000 and 2006.

USA

- An average of 120 people died in the USA each year from clothing thermal burns between 1999 and 2004.
- The annual USA average from 1997 to 2006 for clothing-related burn injuries treated in emergency departments was 4321. Of these:
    - 3 205 related to daywear
    - 1 175 related to daywear worn by people aged 25 to 64
    - 801 related to daywear worn by people aged 14 to 24 (USA National Electronic Injury Surveillance System (NEISS)

BRITAIN

- Around 80 people in Britain are killed each year after their clothing catches on fire.

(Source. Australian Competition and Consumer Commission)

PREVIOUS OPTIONS

(LIMITATIONS OF OTHER FIBRES)

There are a multitude of factors that dictate how easily a textile will ignite, and even more that influence the manner in which it will burn and the by products of its combustion (Ingham et al., 1983). Some of the more important ones are:

- Fibre type
- Yarn composition/construction
- Fabric construction
- Garment design
- Ignition source
- Fabric orientation
- Environmental conditions (airflow, surrounding materials, etc)

Numerous standards for measuring the flammability and/or thermal protective performance of textiles exist – the choice being dependent very much on the application intended for the textile. In addition, standards exist to measure such things as evolution of heat and fumes during burning of textiles, and around the care of fire resistant textiles. Several commonly used standards are listed below, by way of example:

- ISO 6941:2003 – Textile fabrics. Burning behaviour. Measurement of flame spread properties of vertically oriented specimens.
- ISO 15025:2000 – Protective clothing. Protection against heat and flame. Method of test for limited flame spread.
- ASTM D 4108-87 – For determining the thermal protective performance of clothing materials when exposed to flame.
- ASTM F1891-98 – For arc and flame resistant rainwear materials.
- ASTM F106-98 – For flame resistance of electric workers clothing.
- AS/NZS 1249 – For children's nightwear.
- AS1530.2 – For determining vertical flame spread.
- ISO 9239 – Radiant panel test
- NFPA 2112 – Flame resistant garments for protection of industrial personnel against flash.

NB. ASTM = American Society for Testing of Materials; NFPA = National Fire Protection Association.
AS/NZS = Australian/New Zealand Standard; ISO = International Standards Organisation

Common textile fibres such as nylon, cotton, polyester and rayon, all have relatively low ignition temperatures, and in some cases, will also melt prior to ignition (nylon and polyester).

Technology has been developed to artificially impart flame resistance to apparel fabrics using chemical treatments, during fibre manufacture, or as a treatment to the fibre, yarn or finished fabric. In contrast, wool provides a high level of flame resistance naturally as a feature of its complex and unique internal structure and chemistry. If an even higher level of safety is required, wool can also be chemically treated in a similar manner to other textile fibres and fabrics.

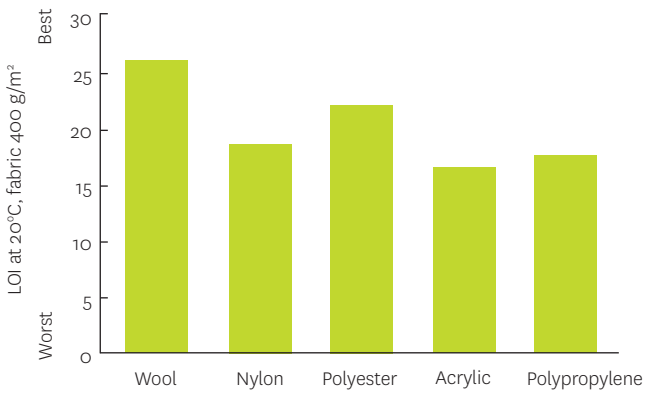

Figure 1. Limiting Oxygen Index (LOI) of common textile fibres (Source: Collie and Johnson, 1998)

MERINO WOOL SOLUTION

Wool is naturally flame resistant, and its performance exceeds that of all other commonly encountered textile fibres. This flame retardancy arises from the unique chemical structure of Merino (for example, its high nitrogen content (14%) and high relative moisture content), which confers the following beneficial properties and behaviours:

- A very high ignition temperature (570-600˚C)
- A high Limiting Oxygen Index (20- 25%) – with the LOI being a measure of the minimum % of oxygen required to sustain combustion.
- A low heat of combustion
- A low rate of heat release
- Doesn't melt or stick upon burning
- Self extinguishing
- Formation of an insulating char when it burns
- Evolution of less smoke and toxic gases than formed during combustion of most synthetic fibres

Table 1, Figure 1 and Figure 2 afford a comparison of wool with other important textile fibres, demonstrating superior performance across virtually all parameters measured.

Table 1. Key measures of flammability for common textile fibres.

Fibre	Limiting Oxygen Index (%)	Heat of combustion (Kcal/g)	Ignition temp (°C)	Melting temp (°C)
Wool	25.2	4.9	570-600	Does not melt
Cotton	18.4	3.9	255	Does not melt
Nylon	20.1	7.9	485-575	160-260
Polyes.	20.6	5.7	485-560	252-292
Rayon	19.7	3.9	420	Does not melt

Source: CSIRO

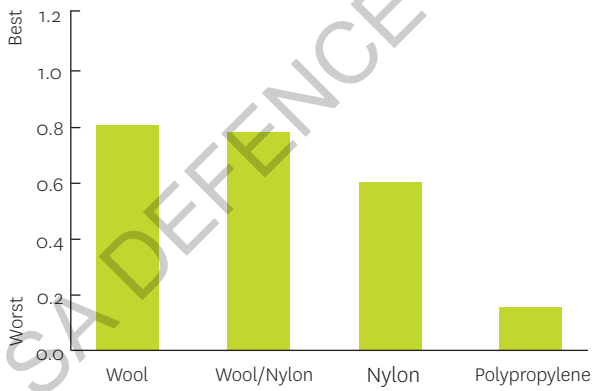

Figure 2. Energy (Radiant Panel Test) required to ignite carpets (Source: Wools of New Zealand)

The performance of wool can be improved even further by the addition of a flame retardant treatment such as Zirpro, which has been shown to raise the LOI to between 27 and 33%.

SUMMARY

Merino is naturally flame resistant, and its performance exceeds that of all other commonly encountered textile fibres.

Merino has a low heat of combustion and a low rate of heat release.

If Merino comes into direct contact with another burning surface, it won't melt or stick.

Merino is self extinguishing once the initial ignition source is removed.

Merino forms an insulating char when it burns and evolves less smoke and toxic gases than formed during combustion of most synthetic fibres

REFERENCES

Australian Competition & Consumer Safety; Product Safety Australia, http://www.productsafety.gov.au/content/index.phtml/itemId/975156

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CONTACT

ARMADILLO
MERINO

Armadillo Merino®
5 Nether Close
Duffield
Derbyshire
DE56 4DR
U.K.

+44 (845) 4 637466
+44 (845) 4 MERINO
hello@armadillomerino.com
www.armadillomerino.com