



Sustainable Material Guide // 06 Wool

Created by **supply**Compass &  **THE
WOOLMARK
COMPANY**

Wool

Credit: The Woolmark Company



Material properties of Merino wool

Natural Fibre – Animal Fibre



Super soft

Merino wool is finer than human hair, can be softer than cashmere and gentle on even the most sensitive skin.



Lower energy and water use

Wool uses 18% less energy than polyester and nearly 70% less water than cotton to produce 100 sweaters.



Sheds no microplastics

Wool is 100% biodegradable so does not contribute to microplastic pollution in our oceans or land.



Breathable and non-allergenic

An active fibre, Merino wool is thermoregulatory, keeping you cool when it's hot and warm when it's cool.



The most reused and recycled fibre

100% natural and renewable, wool is the most reused and recyclable apparel fibre on the planet.

Introducing Wool



Wool is a 100% natural, renewable and biodegradable fibre and commonly refers to those fibres produced by sheep. However, not all wool is the same. There are more than 1,000 breeds of sheep across the world which produce different types of wool, used for various purposes.

Australia is the largest producer of Merino wool in the world, with a total of 68 million sheep and 60,000+ woolgrowers producing 90% of the world's wool used for fine apparel. With a commitment to responsible practices and animal welfare, Australia is also the largest producer of non-mulesed wool in the world. Wool makes up only 1.2% of the global apparel market by volume, but makes up 8% of its value, reaffirming wool as a luxury fibre.

Australian Merino wool is much more complex than any of the synthetic fibres and most other natural fibres. A relatively new type of wool known for its superior softness, Australian Merino wool is eagerly sought by the world's textile trade. It is this complexity that provides wool with the unique set of benefits which cannot be matched by any other fibre—natural or man-made.



Other types of wool

Wool is most commonly referred to fibres derived from sheep but is just one of many animal fibres used for textile production. The list of animals that produce hair used as a textile fibre is quite long and includes:



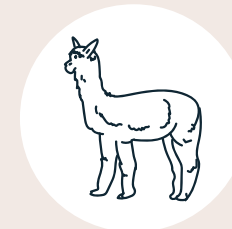
Yak

Yaks produce two types of fibre: guard hair and down. Only the down is used in apparel applications.



Goat

Cashmere, mohair and angora are all fibres produced by different breeds of goat.



Camelid

Vicuna, alpaca, llama, guanaco and other camelids produce fibre used in textiles.



Rabbit

Angora is also used to describe the fibre produced by Angora rabbits.

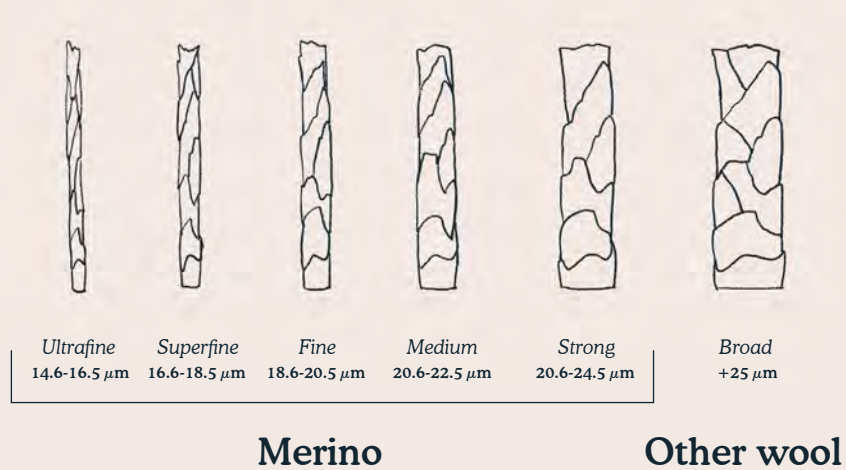


Possum

Possum hair is sometimes blended with other animal fibres for textiles.

Merino vs other wool

Wool from different sheep breeds is divided into three main categories (fine, medium and broad) based on the diameter of the wool fibre, which is measured in microns (one micron equals one millionth of a metre). As can be seen below, Merino wool is the finest and loved for next-to-skin apparel.

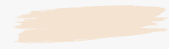


Woolen vs Worsted

Woolen yarn is spun from shorter fibres and is bulkier, softer, fuzzier, more insulating and used for items such as sweaters and carpets. Worsted yarn is spun from longer fibres and is finer, lighter and smoother, holding crease and shape well and used for items such as fine suitings and athleticwear.



The wool production process



1

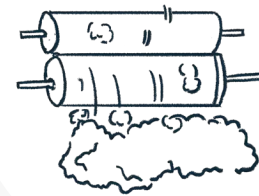
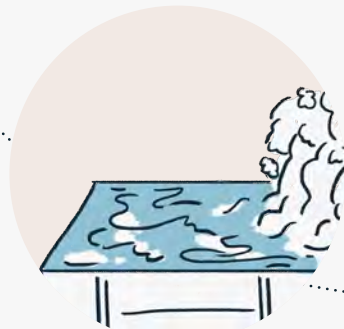
Shearing

A key responsibility in caring for healthy and happy sheep involves shearing their fleece; if not done, the fleece can become overgrown and impact the animals. Once the greasy/raw wool is harvested it is then classed (graded) based on fibre diameter, plant matter, staple strength, staple length, colour and potential yield.

Scouring

Before wool can be processed to yarn, it must be washed (scoured) to remove the bulk of contaminants (like dirt, sweat and plant matter) from the raw fibre. Wool is passed through a series of bowls containing water and detergent. Excess dirty water is squeezed from the fibre before several rinses. After drying, the wools are conditioned, ready for the next stages of processing.

2



Carding

Carding removes the knots and tangles from the clean wool by gently teasing them apart using wire-covered rollers. Yarn can either then be made using woollen processes, where the wool leaves the card as slubbing ready for spinning, or worsted processes, where the wool leaves as a continuous length of card sliver.

3

Gilling for Worsted

The card sliver needs to be 'gilled' to straighten the fibres, making them more parallel and ready for combing. This is done by pulling the fibres through metal pins in a process similar to combing wet hair after a shower. Card sliver is commonly gilled about five times before moving onto the comb.

4



5

Combing/Top-making for Worsted

The combing process removes plant matter, tangled and short fibres (noil). After combing, the sliver is re-gilled two to three times. The sliver is now known as 'top'.



7

Spinning

During spinning, twist is inserted into the relatively weak roving/slubbing which binds the fibres closer together, increasing inter-fibre friction and imparting strength to the yarn. Yarns can also be twisted together to further increase strength.



Dyeing

Colour is applied and fully absorbed into the wool fibre by dyeing in hot water and this process can be carried out at almost any stage, from loose wool, top, yarn, fabric and even at the garment stage. Wool naturally takes and holds dye very well.



8

Drawing for Worsted

Before the newly-formed top can enter the spinning stage it has to be made some 40 times thinner by drawing it down into a fine sliver, called a roving.

6



Finishing

Merino fabrics and garments are finished by washing, to clean and soften, drying and then pressing to remove creases and stabilise the fibre ready to be made into garments or end-products during making-up and sewing.

9



Wool accounts for 1.2% of the global apparel market by volume, but 8% by value.



Key types of sheep



Border Leicester

Origin // England and Scotland

Wool type // Broad

Use // Border Leicester is mainly used for crossbreeding with Merinos, to produce a first-cross animal. First-cross ewes (female sheep) produce lambs for meat. Border Leicester wool is used for upholstery and carpets.



Dorper

Origin // South Africa

Wool type // Fleece (a combination of wool and coarse hair)

Use // Dorper is a 'shedding' breed used to produce meat. Dorper skins can also be used for hides and leather.

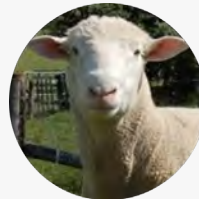


Polwarth

Origin // Australia

Wool type // Medium - broad

Use // Polwarth is a dual-purpose breed and produces both wool and meat. Polwarth wool is often used for interior textiles and some forms of outerwear apparel.



Poll Dorset

Origin // Australia

Wool type // Broad

Use // Poll Dorset is mainly used to produce fast-growing meat lambs, but the wool can be used for interior furnishings such as pillows, comforters or duvets as well as bulky sweaters and coats.



Australian Merino

Origin // Australia

Wool type // Ultrafine - medium

Use // Finer wool categories in this group are used for specialty apparel, such as fine knitwear and underwear, high-quality suits, luxury fashion and performance-wear.



Corriedale (Lincoln x Merino)

Origin // Australia and New Zealand

Wool type // Medium - broad

Use // Corriedale is a dual-purpose breed and produces both wool and meat. This wool is suitable for interior textiles such as comforters or duvets.



The social, animal and environmental impact of wool

Wool is a natural, renewable and an easily recycled fibre, that has the ability to be sustainable when produced and processed properly. Wool grown around the world, can vary from small to large free-range farms in different environments, leading to differences in production.

Life Cycle Assessment (LCA) scores for wool are low, ranking it lower than synthetic materials like polyester. These current LCA methodologies take a cradle-to-gate rather than a cradle-to-cradle approach, failing to take into account the consumer use and disposal of wool products. In the Material Circularity Indicator by the Ellen MacArthur Foundation, wool gets the highest score possible just like other renewable fibres.

The following key areas detail the impact of wool, on animals, people and planet.



1 / Grazing

Sheep for wool are generally raised on rangelands that are most suited for livestock and not for arable crops. However, farmers need to be careful about overgrazing as it can lead to top-soil erosion, destroying the ability of the land to retain water and sequester carbon. Woolgrowers can implement regenerative agricultural farming practices to holistically manage their land and support healthy ecosystem functioning.



2 / Chemical use

Veterinary registered chemicals that kill external and internal parasites of sheep are used as spray or as an oral dose. If not used according to the manufacturer's

Credit: The Woolmark Company



directions, some of these chemicals could impact the surrounding environment or affect farm workers' health. However, an increasing number of farmers are growing phosphorus-efficient pasture legume species that not only reduce the reliance on fertiliser applications, but fix nitrogen in the soil and provide extensive ground cover reducing top soil erosion, and have the ability to reduce methane emissions as they are easily digestible by sheep.



3 / Mulesing

Mulesing is a quick, one-off surgical procedure to protect sheep from breech flystrike. It removes excess skin from the breech – the area around the tail – of the sheep. Mulesing can be a painful procedure but the majority of procedures in Australia are performed with anaesthesia and analgesia. Mulesing minimises the risk of the devastating welfare issue of flystrike

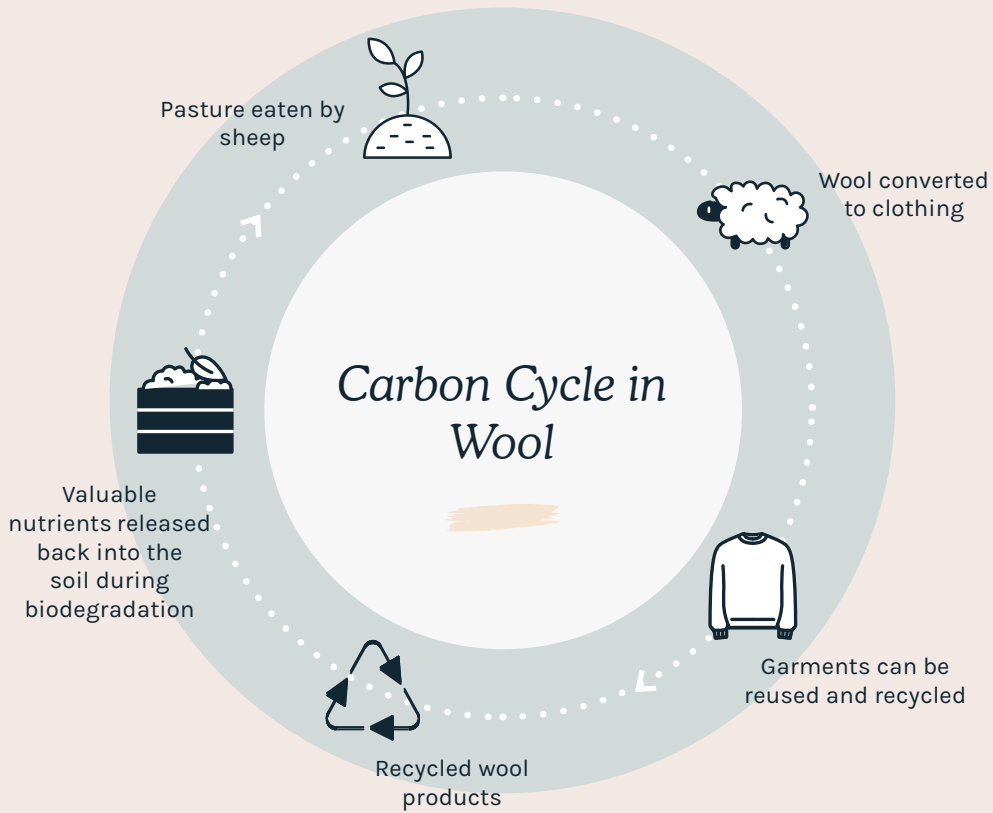
by reducing the opportunity for blowflies to lay eggs in the wet wool area of the breech. Since mulesing can have impacts on the wellbeing of sheep, it is being phased out and Australia is now the largest producer of non-mulesed wool. Flystrike is increasingly controlled by regular removal of wool, breeding wrinkle-free sheep and proper management of grazing and insecticides.



4 / Methane emissions

Apart from emissions from energy use during wool processing like other fibres, methane is emitted during the cultivation process. When sheep digest pasture, they convert atmospheric carbon into the GHG methane. 4.5-6.5% of the energy can be lost as methane, which is belched out. This can be reduced and offset by woolgrowers through flock productivity, planting trees as shelterbelts and improving soil management to increase carbon storage.

Wool and the Carbon Cycle



Wool forms a part of the natural carbon cycle. By storing the greenhouse gas carbon dioxide (CO₂), wool prevents the stored gas from contributing to climate change for the time the garment is in use. All this CO₂ is removed from the atmosphere for the fibre's life – from when it is used by the grass during growth, to when it is converted into wool on the sheep, through the wool product's use phase – until it is disposed of and biodegrades. For many wool garments, this period is greatly extended because wool is used or recycled in a variety of textiles.

Wool and circularity

Circular and sustainable design integrates transparency from the beginning; where a garment has a meaningful positive impact throughout its entire lifecycle. Here's why wool is, by nature, a circular fibre.

Properties	Aim	Barriers
Renewable in annual regrowth cycles. Part of the atmospheric carbon cycle, made of 40% carbon.	 <i>Use renewable resources</i>	Synthetic blends and trims limit the recycling and biodegrading possibilities of wool products.
Can regenerate natural systems and help build soil carbon. Sheep live on land that is not used for growing food, and maintain biodiversity and landscaping.	 <i>Regenerate natural systems</i>	Over-grazing can contribute to desertification.
Organic wool and cradle-to-cradle wool is clean.	 <i>Remove Pollution</i>	The industrial cycle conventionally contains many pollutants such as superwash, dyestuff, finishings, detergents as well as water and energy use.
Wool is typically kept longer than other garments and is often easy to repair. High heritage and second-hand value. Less laundry is needed.	 <i>Keep materials and products in use for a long time</i>	Products are not designed for long lifetime, repair or for disassembly for recycling purposes.
Easy to recycle, and biodegrades, releasing valuable nutrients to soil.	 <i>Make fit for technical &/or biological cycles</i>	Lack of global collection and sorting systems at scale, and the related recycling industries.

Designing a collection with wool?

Here are 3 aspects to consider.



Credit: The Woolmark Company



1 / Transparency and traceability

Aim for full supply chain transparency, tracing wool back to the farm where it was grown. Ensure responsible sourcing and production through certified sources and responsible farming practices that address sheep, land and environment.



2 / Use

A [world-first LCA study](#) calculated the lifetime impacts of the garment per single wear event and found the duration of garment lifetime was the most influential factor determining the impact of woollen garments. The total number of wears was estimated to be 109. However, if this garment was disposed of after 15 uses, this would result in a 5.8 to 6.8-fold increase in impact and resource use. Increasing the total number of wears to 400 reduced environmental impacts by 49 to 68%.

Wool's natural resistance to odour, stains and wrinkles means wool clothes require less washing and preserves the as-new look and feel of the garment. According to a [global wardrobe audit](#) conducted by The Nielsen Company on behalf of The Woolmark Company, the average lifetime of wool garments was more than

50% longer than cotton garments. Hence it is important to design for longevity, communicate good garment care practices to consumers and establish mediums for easy repair.



3 / Closed-looped process

According to the International Wool Textile Organisation (IWTO), up to 5% by weight of the total clothing donated by consumers for recycling and re-use is wool, though it only makes up 1.2% of the virgin fibre supply. Look for recycled wool that re-engineers pre or post consumer wool into new yarn.

Wool is also biodegradable, releasing natural nutrients back into the soil and does not release microplastics in water. In a [latest study](#) by The Woolmark Company and AgResearch, researchers compared the biodegradability of two types of Merino wool in sea water to that of viscose rayon, polyester, nylon and polypropylene. The study shows that even machine-washable wool (treated with Hercosett resin) was found to fully biodegrade in marine environments. However, avoid synthetic blends and trims as this can hamper wool's biodegradability and recyclability.

Innovations in wool

Think you know wool? Think again. These innovative product developments will change the way you work with wool.



Credit: Merino wool faux fur, The Woolmark Company



1 / Wind and water-resistant wool fabric

Merino wool tops are stretched, but not set, during what is known as Optim™ processing, constructing the fabric at a very high level of thread density in warp and weft. It is only when the fabric is wet finished that the stretch is released, causing the yarns to contract, and the creation of the immensely dense fabric. Advancements using Optim™ processing and stretch technology have led to double-faced fabrics, luxurious drape fabrics, and soft hand-feel qualities.



2 / Wool faux fur

An increasing number of brands continue to remove traditional fur from their collections. Merino wool presents a natural alternative to animal hide and synthetics. Innovatively knitted from Merino wool yarn, wool faux fur fabrics are cropped and brushed to replicate a traditional fur or shearling look and feel. Garments created

with wool faux fur have the added natural benefits of thermoregulation, breathability, odour resistance and the peace of mind that the fabric comes with a less impactful environmental solution than synthetic faux fur.



3 / Seamless knitwear

Engineering a garment with seamless knitting technology enhances wool's performance benefits to create garments which are flexible, diverse, visually appealing and comfortable. Seamless knit and flat-knit technology from Santoni, STOLL, Shima Seiki and Karl Mayer is revolutionising the use of Merino wool for seamless apparel and whole-garment constructions for base-, mid- and outer-layers. By engineering a garment to have features such as compression and breathability points on a single surface, it allows for greater structure diversity and comfort. What's so unique about seamless apparel is that it allows for a combination of different patterns and knit stitches in different colours on the one piece of fabric.



Credit: Seamless Knitwear, The Woolmark Company



4 / Digital printing

Digital printing has paved the way for near-photographic printing on wool. Counter to traditional print methods, digital printing is quick and personalised, using direct-to-fabric machines minimising the investment in screens, print tables and additional washing equipment.

Similar to a home inkjet printer, fabric is passed under the head of the printer allowing for printing on smaller lengths of fabric, lessening its demand for water, chemicals and textile waste. Chemicals and water usage are significantly reduced when choosing digital printing, and inks

can be recycled to minimise environmental impact.



5 / Wool velvet

Velvet, or velour when knitted, is a fabric prevalent in textile history and synonymous with luxury. The addition of wool elevates the already premium velvet fabric features whilst also adding an elegant drape, improved stain resistance and most importantly warmth and insulation to the end use product. Manufacturing both traditional velour and velvet includes a shaving or thread cutting process which results in fibre

shredding – wool's natural properties mitigate excessive landfill contribution whilst avoiding chemical waste generation associated with synthetic velvet.



6 / Wool wadding (wool filling)

Wool offers a natural alternative to traditional synthetics or down used in quilted garments, outdoor sleepwear or outerwear. Wool's natural stretch and crimp creates insulating air pockets, offering superior protection from the cold. In fact, wool fill offers warmth with 25% less weight compared to polyester filling and because of the fibre's breathability, it also creates a drier, more comfortable microclimate within garments. Wool wadding is created with layers of carded

wool batts, that range from 85gsm to 250gsm. The innovation of wool filling replaces down or feathers with small wool balls called wool nepps or wool noils.



7 / Wool footwear

Advancements in knitting technology have facilitated the use of wool in footwear. Combining wool with different yarns in a shoe upper draws on wool's natural properties to promote dryness, breathability, freshness (anti-odour), comfort and warmth. With fully fashioned knitwear uppers, waste is reduced by directly mounting the shaped piece onto the sole of the shoe. Filament-wrapped wool yarns add strength and resistance to abrasion, extending the wear of the shoe.

Credit: Wool footwear, The Woolmark Company



Woolmark and the UN SDGs

The Sustainable Development Goals, launched by the United Nations in 2015, are a collection of 17 interconnected goals and act as a blueprint to address the most pressing problems of the world.



Credit: The Woolmark Company



1 / Renewability

Wool is a 100% renewable resource, grown by the simple blend of sunshine, fresh air, grass and water.



2 / Processing

The Woolmark Company works with industry partners—from early-stage processors through to end garment makers—to adopt innovative processes and technologies to ensure best practice across the supply chain.



Industrial Processing: Innovation in processes including garment construction, seamless, flat-knit and whole-garment knitting for reduced yarn and fabric waste.

Dyeing, printing and finishing: More environmental and sustainable processes such as waterless dyeing, natural dyes, new print technologies and alternatives to finishing processes.



1 / Longevity

A wool fibre can be bent up to 20,000 times before breaking. This makes wool garments highly durable, allowing them to retain their as-new look and feel.



2 / Garment Care

Wool garments are easy to care for. The fibre is naturally resistant to stains, odours and creases, meaning you don't have to wash wool clothing as often as clothes made from other fibres, saving you time and money on energy and water bills.

3 / Biodegradability

Wool fibres are 100% biodegradable in both land and marine environments, offering a more impactful solution.



1 / Soil

The Woolmark Company provides valuable resources and workshops to



run projects dedicated to environmental health, including improving soil quality and enhancing biodiversity. By providing woolgrowers with better options to improve their soil nutrition, producers will be able to make better use of previously unproductive land through holistic management and regenerative agriculture.

2 / Water

The Woolmark Company invests in research into more effective ways to manage water and nutrient resources on wool-growing properties. On-farm water allocations are in place to prevent over usage and improve land management. In the supply chain, more environmental and sustainable processes such as waterless dyeing, natural dyes, new print technologies and alternatives to finishing processes are implemented.



3 / Other

By working directly with Australia's 60,000+ woolgrowers, The Woolmark Company is able to promote responsible and sustainable farming practices and build consumer trust by connecting woolgrower responsibility to a quality end product.



1 / Animal Welfare

The health and happiness of woolgrowers is inextricably linked to the health and happiness of the sheep under their care. Since 2001, Australian woolgrowers, through The Woolmark Company's parent body, have invested AU\$74.5 million into research and development that focuses on the health and welfare of their sheep.

Five Welfare Domains: Australian woolgrowers work to ensure their sheep are cared for in a way that meets these Five Welfare Domains and constantly look for improvements to be included in their management practices. The Five Domains are defined as Nutrition, Environment, Health, Behaviour and Mental state.

Flystrike: Australian woolgrowers have been proactive in collaborating with researchers and industry to protect Australian sheep against this condition. To date, Australian woolgrowers, via The Woolmark Company's parent body, have invested AU\$40 million to combat flystrike.

Shearing: The Woolmark Company's research and development arm works to better the lives of Australian shearers and wool handlers by providing free training for novice, improver and advanced

shearers and wool handlers through regional coaching programs. Since 2015, The Woolmark Company has facilitated close to 4000 shearer and wool handler training days to 17,000 people, delivered through The Woolmark Company-funded programs.



2 / Social Welfare

Worker Welfare: Woolmark's core values are reflected by those with whom we

partner. Woolmark licensees and partners are responsible for abiding by ethical labour practices in the manufacture of Woolmark-certified products. Woolmark's partners sign up to their licensee agreement, requiring them to comply to the requirements set by the International Labour Organization and United Nations. Licensees must also comply with the environmental laws of where their product is made and sold.

Credit: The Woolmark Company





The Woolmark Quality Assurance Symbol

For more than 50 years, we've certified more than 5 billion wool apparel and wool care products, guaranteeing durability, performance and quality. The Woolmark logo is the world's best-known textile quality fibre brand, representing a long-term commitment between woolgrowers, mills, brands and consumers. It also gives confidence that the certified product, garment or care product has been authenticated and meets The Woolmark Company's exacting standards, which are independently tested against five core categories.

Wool Content: We assess the wool's purity, to verify the product is 100% what it claims to be.

Colourfastness to Light: We expose this wool to the harshest light—for up to 10

hours—to assure its colours are lasting.

Durability: We subject this wool to extreme pressures—we push, pull and stretch it to its physical limits—to measure its strength.

Wash Testing: We wash this wool in hard, unforgiving machines to ensure no shrinkage and no loss of shape.

Colourfastness to Liquid: Finally, we take this wool and test it, intensely, against the very liquids it would normally meet throughout its lifetime.



Benefits of Woolmark Certification for your brand

1 / Customer satisfaction

85% of consumers agree the Woolmark symbol ensures quality. Leverage the reputation and authority of the iconic Woolmark symbol to build consumer confidence.

2 / Independent quality assurance and authentication

We guarantee the fibre composition of wool garments and wool products with testing at independent laboratories.

3 / Building a traceable supply chain

Trace the origin of your wool fabrics through the supply chain when sourcing from Woolmark licensees.

4 / Technical support

Utilise the Woolmark Technical Team for on-demand technical support and product development.

5 / Staff development and training

Tailor-made training days, webinar participation and free educational resources on the Woolmark Learning Centre.

Other Key Certifications and Organizations



IWTO



RWS



GOTS



ZQ



GRS

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