

Wool Fibre: What Wool Is, Its Properties, Structure and How It Is Made

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In one paragraph

Wool is the fibre that grows as the fleece of the domestic sheep, *Ovis aries*. It is a protein fibre: about 97% protein, chiefly keratin, the protein of hair and horn, with 2 to 3% lipid (Woolmark). Two features explain most of how it behaves. Each fibre is crimped, so wool is bulky for its weight and springs back when it is crushed. And its surface is covered with overlapping scales, which is why wool felts and shrinks when it is washed warm and rubbed. Wool can take up about a third of its own weight in water vapour, does not melt, and is hard to ignite. Fine Merino wool, around 20 microns across, is soft enough to wear next to the skin; coarser wool goes into tweeds, blankets and carpets. By volume it is a small fibre: wool, mohair, cashmere and alpaca together made up less than 1% of the world's fibre output in 2024, according to Textile Exchange.

At a glance

Source: Woolmark, What is the wool fibre? The IWTO's statistics use broader bands: fine up to 24.5 µm, medium 24.6–32.5 µm, coarse over 32.5 µm.

Mean fibre diameter	Typical use
Under 19.5 µm	Base layers, underwear, fine knitwear
19.5–22 µm	Apparel, knitwear
22–24 µm	Outerwear
Over 24 µm	Carpets and interiors

Properties of wool fibre

Property	Value	Source
Composition	About 97% protein (keratin), 2–3% lipid; sulphur 3.08–3.92% in Merino, mean 3.43%	Woolmark; Reis and colleagues (1967)
Fibre diameter	Merino under 17.5 to about 24 µm; British breeds 29–42 µm	Woolmark; British Wool
Staple length	Australian clip average 87.3 mm (2025/26); British longwools 15–30 cm	AWI; British Wool
Cross-section	Slightly elliptical; ratio of diameters 1.08 in Merino	Wang and colleagues
Crimp	About 20 per inch at 20 µm; about 4 per inch at 40 µm	NMSU Extension
Density	1.30–1.31 g/cm ³	Zimniewska and Kicińska-Jakubowska; Beckman and colleagues
Tenacity	8–18 cN/tex	Zimniewska and Kicińska-Jakubowska; Beckman and colleagues
Elongation at break	25–40%; slightly weaker and more extensible when wet	Beckman and colleagues; Khan and Khan (1970)

Property	Value	Source
Commercial moisture regain	13.6%	IS 13157:1991
EU agreed allowance	17.00% carded, 18.25% combed	Regulation 1007/2011, Annex IX
Regain in saturated air	33–34%	Menkart and colleagues (1966)
Heat	Does not melt; ignites at 570–600 °C	IWTO
Limiting oxygen index	25.2 (IWTO); 23.6–25 in two reviews	IWTO; Bajaj (1992); Kakar and colleagues (2023)
Heat of combustion	4.9 kcal/g	IWTO
Clean yield of greasy wool	63.6%, Australian average 2025/26	AWI

Key figures and their sources

- In one CSIRO study of Merino wool, sulphur made up a mean 3.43% of the fibre, with a range of 3.08 to 3.92% (Reis and colleagues, 1967).
Source: Reis and colleagues, 1967 (connectsci.au)
- What is left is the clean yield: 63.6% on average for the Australian clip in the 2025/26 season (Australian Wool Innovation).
Source: Australian Wool Innovation (wool.com)
- Fine wools carry more grease and yield less: a South Dakota State extension guide gives 40 to 68% for fine wool against 55 to 75% for the coarser grades (SDSU Extension).
Source: SDSU Extension (extension.sdstate.edu)
- At ordinary room conditions the agreed commercial figure for wool is 13.6%, against 11.0% for viscose, 7.0% for raw cotton and 0.4% for polyester (IS 13157:1991, which is built on ASTM D1909-1985).
Source: IS 13157:1991 (archive.org)
- In saturated air wool reaches a regain of 33 to 34%, about a third of its own weight (Menkart, Wolfram and Mao, 1966).
Source: Menkart, Wolfram and Mao, 1966 (library.scconline.org)
- Woolmark says wool “can absorb up to 35% of its weight before feeling wet and clinging to the skin”.
Source: Woolmark (woolmark.com)
- The industry bodies differ on the comparison with cotton: Woolmark says wool absorbs “twice as much as cotton”, the IWTO says “50% more” (IWTO, Wool and Skin).
Source: IWTO, Wool and Skin (iwto.org)
- The same moisture helps with odour: Woolmark reports a New Zealand panel study in which wool fabrics “retained 66 per cent less body odour intensity than polyester fabrics and 28 per cent less than cotton fabrics” (Woolmark).
Source: Woolmark (woolmark.com)

Diagrams



Raw fleeces, rolled and labelled, waiting to be sold or scoured. Photo: Jessica Lewis, Pexels.

Revision questions

The questions readers ask most, with the article's own answer.

What is wool?

In everyday use, wool means sheep's wool. The law draws the line a little wider, and differently on each side of the Atlantic.

What is wool made of?

Clean wool is keratin, a family of proteins rich in the sulphur-containing amino acid cystine, whose disulphide bonds tie the protein chains together. In one CSIRO study of Merino wool, sulphur made up a mean 3.43% of the fibre, with a range of 3.08 to 3.92% (Reis and colleagues, 1967).

What does wool look like under a microscope?

Along its length, a wool fibre shows a rough, scaly outline. The scales "are distinctly visible under an ordinary light microscope.

Why is wool warm?

Mostly because of crimp. A wool fibre's cortex is built from two kinds of cell, and in Woolmark's words they "grow side by side, but at different rates, to create a natural bend in the fibre known as crimp" (Woolmark).

Why does wool shrink and felt?

Wool can shrink in two quite different ways. Relaxation shrinkage happens to fabric of any fibre the first time it is wetted: strains set into the yarn and cloth during spinning, knitting and finishing are released, once.

Why does some wool itch? Is it an allergy?

The prickle is mechanical, not allergic.

Is wool flammable?

Wool will burn in a strong enough flame, but it is the hardest of the common apparel fibres to ignite and it does not melt.

Is wool sustainable?

Wool grows back each year and it rots. Woolmark, citing a 2023 soil-burial study, says "100% Merino wool fabrics can biodegrade by 95% after 15 weeks of burial in soil, but the rate varies

with soil, climate and wool characteristics” (Woolmark); the IWTO puts it at “almost completely degraded after six months in the ground” under ideal conditions (IWTO).

Test yourself

Ten questions on this topic. Answer them without looking, then check on the last page.

1. What is wool chiefly composed of, and in what proportions?
2. What is the agreed commercial moisture regain of wool at ordinary room conditions?
3. Why do wool fibres migrate and felt when a wet wool fabric is squeezed and released?
4. Above what fibre diameter do fibre ends cause the prickle of wool against the skin?
5. At what temperature does wool ignite, according to the IWTO, and what is its limiting oxygen index?
6. Which of the two cell types of the wool cortex carries more sulphur?
7. In the spinning count system of wool grading, how long is a hank?
8. Which acid is used to carbonise wool, and above what level of vegetable matter?
9. Which wool processing system includes top-making: woollen or worsted?
10. Chemically, is lanolin from wool scouring a fat or a wax?

Answers

Each answer is stated in the article; the section to read again is named after it.

1. **About 97% protein, chiefly keratin, with 2 to 3% lipid (Woolmark).**
See: Opening
2. **13.6%**
See: Does wool keep you dry? Moisture and breathability
3. **Their scales give a higher friction when the fibre moves tip forward than in the reverse direction.**
See: Why does wool shrink and felt?
4. **Coarser than approximately 30-32 μm .**
See: Why does some wool itch? Is it an allergy?
5. **570 to 600 °C; limiting oxygen index 25.2%.**
See: Is wool flammable?
6. **The paracortex.**
See: Structure of the wool fibre: cuticle, cortex and medulla
7. **560 yards.**
See: How wool is graded and measured
8. **Sulphuric acid, when vegetable matter exceeds 5% of the wool's weight.**
See: Chemical properties: acids, alkalis and bleach
9. **Worsted only; it is not carried out in the woollen system.**
See: How wool is made: from fleece to fabric › Carding and combing: woollen and worsted
10. **A wax, not a fat.**
See: How wool is made: from fleece to fabric › Scouring, and lanolin

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