

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

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In one paragraph

Cotton is the fibre that grows on the seed of the cotton plant, *Gossypium*. Each fibre is a single cell, a hair on the seed coat, and when it dries it collapses into a flat, twisted ribbon of almost pure cellulose: about 95% at maturity and 99% after scouring and bleaching (Cotton Incorporated). That structure explains how cotton behaves. It is soft, absorbs moisture readily, takes dye well, and is stronger wet than dry, but it creases, shrinks unless finished, and burns easily. Its quality is judged by staple length, strength, fineness and colour, measured on every bale. It is the world’s main natural fibre: 24.5 million tonnes in 2023/24, about 19% of all fibre produced, according to Textile Exchange.

At a glance

Cotton vs polyester, linen and wool

	Cotton	Polyester	Linen	Wool
Source	Seed hair, cellulose	Synthetic polymer	Stem fibre, cellulose	Sheep’s fleece, protein
Tenacity, cN/tex	24-44	28-80, by grade	40-80	8-18
Elongation at break	4-10%	18-27% (apparel staple)	1.2-3.2%	25-40%
Commercial regain	7.0%	0.4%	12.0% (raw flax)	13.6%
Heat	Does not melt; ignites at about 255 °C	Melts at 250-260 °C	Does not melt	Does not melt; ignites at 570-600 °C
Limiting oxygen index	18-18.5	20-21	-	25.2
World production	24.5 million t, 19%	About 59% of all fibre	About 0.3%	Under 1%, with other animal fibres

Properties of cotton fibre

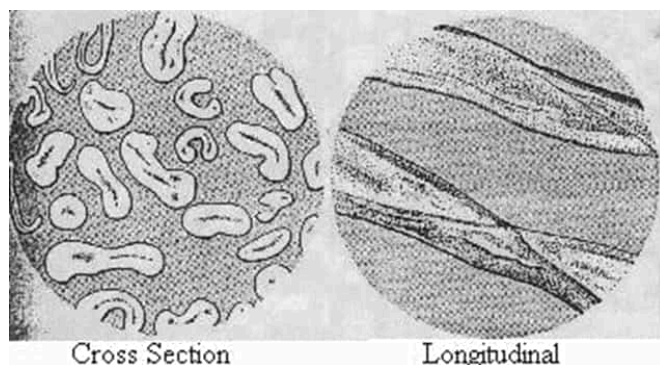
Property	Value	Source
Composition	90-95% cellulose at maturity; 99% after scouring and bleaching	Grover and colleagues (2025); Cotton Incorporated
Fibre length	US Upland 1.0-1.25 in (25-32 mm); Pima up to 1.6 in (41 mm); desi ½-1 in	Cotton Incorporated; USDA
Shape	Flat twisted ribbon, 50-100 convolutions per inch; bean-shaped section with a lumen	Cotton Incorporated; Haigler and colleagues (2012)
Specific gravity	1.54 g/cm³	Cotton Incorporated
Tenacity	27-45 g/tex dry; 30-54 g/tex wet (bleached fibre)	Cotton Incorporated
Elongation at break	3-9.5% dry	Cotton Incorporated
Moisture regain	7% at standard conditions (bleached); EU allowance 8.50%, mercerised 10.50%	Cotton Incorporated; Regulation 1007/2011

Property	Value	Source
Water holding, absorbent cotton	At least 23 g/g (Ph. Eur.); 24 times its weight (US)	Ph. Eur. 0036; Cotton Incorporated
Heat	Does not melt; decomposes gradually above 149 °C, rapidly above 246 °C; ignites at about 255 °C	Cotton Incorporated; Woolmark
Limiting oxygen index	18.4	Woolmark, citing CSIRO
Acids and alkalis	Destroyed by hot dilute and by concentrated acids; swells but is not damaged in sodium hydroxide above 18%	Cotton Incorporated

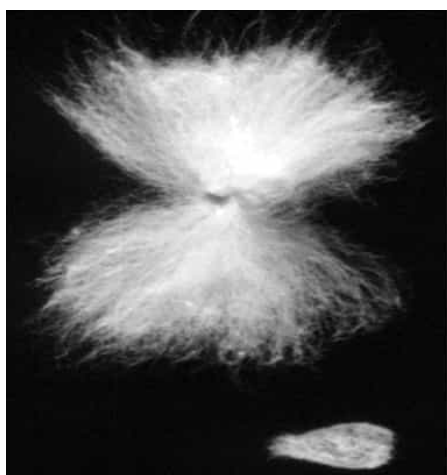
Key figures and their sources

- Upland, *G. hirsutum*, is about 95% of world production, chosen for its yield and adaptability (Grover and colleagues, BMC Genomics, 2025).
Source: Grover and colleagues, BMC Genomics, 2025 (pmc.ncbi.nlm.nih.gov)
- ELS and long-staple cotton together are “around 1% to 2% of total world production”, 390,000 tonnes in 2024/25, and the definitions are “not globally standardized” (ICAC, Specialty Cotton Report, 2025).
Source: ICAC, Specialty Cotton Report, 2025 (icac.org)
- The wax matters: it makes raw cotton water-repellent, which is why cotton is scoured before it is dyed or sold as absorbent cotton, and “After scouring and bleaching, cotton is 99% cellulose” (Cotton Incorporated).
Source: Cotton Incorporated (cottoninc.com)
- Cotton takes up moisture readily: its regain, the water it holds as a percentage of its dry weight, is 7% at standard conditions for bleached fibre (Cotton Incorporated), against 13.6% for wool and 0.4% for polyester (IS 13157).
Source: IS 13157 (archive.org)
- The EU’s agreed allowance, used for declaring fibre content, is 8.50%, and 10.50% for mercerised cotton (Regulation 1007/2011, Annex IX).
Source: Regulation 1007/2011, Annex IX (eur-lex.europa.eu)
- Cotton Incorporated gives bleached cotton fibre a strength of 27 to 45 g/tex dry and 30 to 54 g/tex wet, and notes that “the strength of cotton generally increases with increased moisture” (Cotton Incorporated, Table 3).
Source: Cotton Incorporated, Table 3 (cottoninc.com)
- Cotton ignites at about 255 °C and has a limiting oxygen index of 18.4, below the 21% of oxygen in air, so once lit it keeps burning; wool, for comparison, ignites at 570 to 600 °C with an index of 25.2 (Woolmark, citing CSIRO).
Source: Woolmark, citing CSIRO (woolmark.com)
- The layers follow the day: in laboratory-grown fibres a growth ring formed each time the temperature cycled down to 22 or 15 °C, and rings were rarely seen when nights stayed at 28 °C (Haigler and colleagues, Plant Physiology, 1991).
Source: Haigler and colleagues, Plant Physiology, 1991 (doi.org)

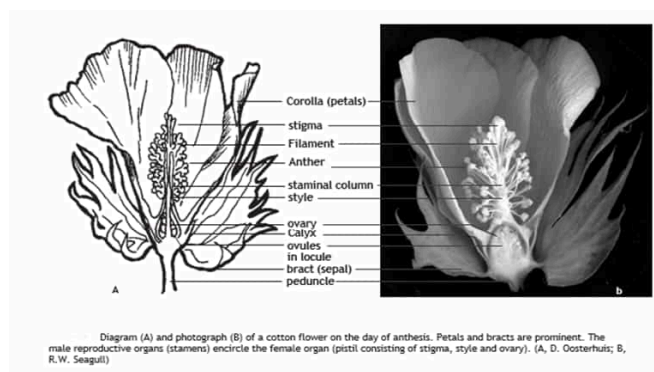
Diagrams



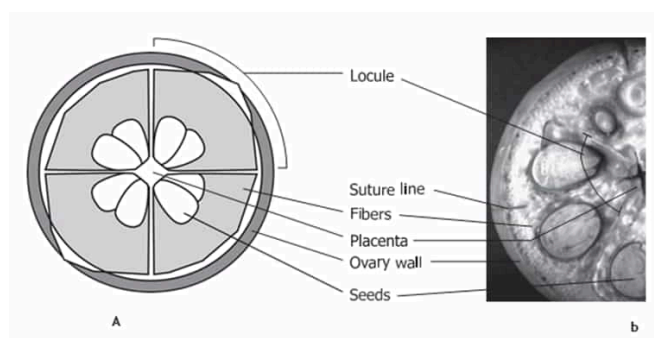
Cotton under the microscope: bean-shaped cross-sections (left) and twisted ribbons in the longitudinal view (right).



One seed and its fibres, combed out. Every fibre is a single cell of the seed coat.



A cotton flower on the day it opens, in diagram and in section.



A boll in cross-section: each locule holds seeds wrapped in fibre, and the boll splits along its sutures.

Revision questions

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

What is cotton?

EU labelling law defines cotton as “fibre obtained from the bolls of the cotton plant (*Gossypium*)” (Regulation (EU) No 1007/2011, Annex I). US law has no definition; “cotton” appears only as an example of a generic fibre name (16 CFR 303.6).

What is cotton made of?

Mature raw cotton is 90 to 95% cellulose (Grover and colleagues). The rest is the protein, pectin, wax, sugars and mineral matter of what was a living cell, most of it in the outer skin.

What does cotton look like under a microscope?

Along its length, “The cotton fiber, when observed in its entirety, is a flat, twisted ribbon, with 50 to 100 convolutions per inch” (Cotton Incorporated), about 20 to 39 twists a centimetre. In cross-section it is kidney- or bean-shaped, with a central canal, the lumen.

Is cotton absorbent and breathable?

Cotton takes up moisture readily: its regain, the water it holds as a percentage of its dry weight, is 7% at standard conditions for bleached fibre (Cotton Incorporated), against 13.6% for wool and 0.4% for polyester (IS 13157). The EU’s agreed allowance, used for declaring fibre content, is 8.50%, and 10.50% for mercerised cotton (Regulation 1007/2011, Annex IX).

Does cotton shrink?

Yes, unless it has been stabilised. Woven and knitted cotton is stretched as it is made and finished, and the strain is released the first time it is wetted and dried, so the fabric shrinks once, mostly in length.

Is cotton stronger wet or dry?

Wet. Cotton Incorporated gives bleached cotton fibre a strength of 27 to 45 g/tex dry and 30 to 54 g/tex wet, and notes that “the strength of cotton generally increases with increased moisture” (Cotton Incorporated, Table 3).

Is cotton flammable?

Yes. Cotton ignites at about 255 °C and has a limiting oxygen index of 18.4, below the 21% of oxygen in air, so once lit it keeps burning; wool, for comparison, ignites at 570 to 600 °C with an index of 25.2 (Woolmark, citing CSIRO).

Test yourself

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

1. Which cotton species makes up about 95% of world production?
2. How pure is cotton cellulose after scouring and bleaching?
3. What is the cross-sectional shape of a cotton fibre?
4. What is the EU agreed moisture allowance for cotton, and for mercerised cotton?
5. What is the dry and wet strength of bleached cotton fibre (Cotton Incorporated)?
6. Why does cotton keep burning once lit?
7. Which layer forms the main portion of a mature cotton fibre?
8. What does micronaire measure in cotton grading?
9. Why are extra-long staple cottons roller ginned rather than saw ginned?
10. Who developed mercerising, and in what year?

Answers

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

1. **Upland (G. hirsutum).**
See: What is cotton?
2. **99% cellulose.**
See: What is cotton made of?
3. **Kidney- or bean-shaped, with a central canal, the lumen.**
See: What does cotton look like under a microscope?
4. **8.50%, and 10.50% for mercerised cotton.**
See: Is cotton absorbent and breathable?
5. **27 to 45 g/tex dry and 30 to 54 g/tex wet.**
See: Is cotton stronger wet or dry?
6. **Its limiting oxygen index of 18.4 is below the 21% of oxygen in air.**
See: Is cotton flammable?
7. **The secondary wall (S2), concentric layers of cellulose.**
See: Structure of the cotton fibre
8. **Fibre fineness and maturity, by airflow through a constant mass of fibre compressed to a fixed volume.**
See: How cotton is graded: the HVI measurements
9. **Roller ginning at low speeds preserves fibre length and uniformity.**
See: Ginning: separating lint from seed
10. **John Mercer, in 1844.**
See: Chemical properties: acids, alkalis and mercerising

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