

Types of Textile Fibres: Classification and Property Table

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In one paragraph

Textile fibres are classified first by where they come from. Natural fibres grow as fibres: plants give cellulose fibres such as cotton, flax and jute, animals give protein fibres such as wool and silk, and a group of minerals, asbestos, gives fibres now known to cause cancer. Manufactured fibres, also called man-made fibres, are spun in a factory from a polymer or a melt: from a natural polymer, as viscose, lyocell and acetate are made from wood cellulose; from a synthetic polymer, as polyester, nylon and acrylic are; or from an inorganic material such as glass, basalt or carbon. This page sets out that classification, then compares 34 fibres in one table of density, strength, stretch, moisture, heat and flammability, with a named source for every figure. Below the table, each fibre links to the site's own article on it and to the calculators that use these numbers.

At a glance

Properties of 34 textile fibres

Fibre	Class	Density, g/cm ³	Tenacity, cN/tex, dry	Elongation at break, %	Commercial moisture regain, %	EU agreed allowance, %	Effect of heat, °C	LOI, %
Cotton	Plant, seed	1.50–1.56 [LB, ZK]	24–44 [LB, CI]	4–10 [BK, SS]	7.0 raw and yarn; 8.5 mercerised yarn [IS]	8.5; mercerised 10.5 [EU]	Does not melt; decomposes slowly above 149, rapidly above 246 [CI]	18–18.5 [BJ, KK]
Kapok	Plant, fruit	0.37–0.38 with the hollow centre; cell wall 1.47 [SS, ZK]	—	1.2 [SS]	—	10.9 [EU]	—	—
Flax (linen)	Plant, bast	1.50–1.54 [ZK, BK]	40–80 [ZK, SS]	1.2–3.2 [PK, SS]	12.0 raw flax; 8.75 linen [IS]	12 [EU]	Does not melt; main decomposition begins at 296–300 (TGA, nitrogen) [RZ]	—
Hemp	Plant, bast	1.48–1.50 [ZK, BK]	47–80 [ZK, SS]	1.5–1.6 [SS, PK]	12.0 [IS]	12 [EU]	Does not melt; main decomposition begins at 290–300 (TGA, nitrogen) [RZ]	—
Jute	Plant, bast	1.44–1.50 [ZK, BK]	24–45 [ZK, SS]	1–2 [SS]	13.75 [IS]	17 [EU]	—	—
Ramie	Plant, bast	1.50–1.55 [BK, ZK]	45–88 [SS, ZK]	2–7 [PK, SS]	—	8.5 (bleached) [EU]	—	—

Fibre	Class	Density, g/cm ³	Tenacity, cN/tex, dry	Elongation at break, %	Commercial moisture regain, %	EU agreed allowance, %	Effect of heat, °C	LOI, %
Sisal	Plant, leaf	1.3–1.5 [PK]	36–61 [PK, ZK]	2.0–2.5 [PK]	—	14 [EU]	—	—
Abaca	Plant, leaf	1.5 [ZK]	—	—	—	14 [EU]	—	—
Coir	Plant, fruit	1.2 [PK]	11–18 [PK]	15–30 [PK]	—	13 [EU]	—	—
Wool	Animal	1.30–1.31 [ZK, BK]	8–18 [ZK, BK]	25–40 [BK]	13.6 [IS]	17 carded; 18.25 combed [EU]	Does not melt; chars at about 300; ignites at 570–600 [ZK, IW]	23.6–25 [KK, BJ]
Silk (mulberry)	Animal	1.34–1.37 [BK, ZK]	27–40 [ZK, BK]	—	11.0 [IS]	11 [EU]	Does not melt; stable to about 150 [ZK]	23.6 (fabric) [KK]
Viscose (rayon)	Regenerated cellulose	1.52–1.54 [LB]	24–26 [LB]	17–25 [ZH]	11.0 (as rayon) [IS]	13 [EU]	Does not melt; pyrolysis at about 350 [BJ, KK]	18.9 [BJ, KK]
Modal	Regenerated cellulose	1.52–1.54 [LB]	34–36 [LB]	—	11.0 (as rayon) [IS]	13 [EU]	—	—
Lyocell	Regenerated cellulose	1.50 [LB]	40–42 [LB, ZH]	11–16 [ZH]	11.0 (as rayon) [IS]	13 [EU]	Does not melt; stable to about 250, rapid mass loss above 300 (TGA, nitrogen) [RJ]	—
Acetate	Cellulose ester	—	—	—	6.5 [IS]	9 [EU]	Melts at about 250 [CF]	—
Triacetate	Cellulose ester	—	—	—	3.5 [IS]	7 [EU]	Melts at 290–300 [BJ, CF]	18.4 [BJ]
Polyester (PET)	Synthetic	1.36–1.41 [LB, MF]	28–80, by grade [LB, IR, MF]	18–27 (apparel staple) [IR]	0.4 [IS]	1.5 [EU]	Melts at 250–260 [LB, BJ]	20–21 [BJ, KK]
Nylon 6	Synthetic	—	—	—	4.5 [IS]	6.25 staple; 5.75 filament [EU]	Melts at about 215 [BJ, KK]	20–21.5 [BJ, KK]
Nylon 6,6	Synthetic	1.14 [MF]	20–82, by grade [MF]	—	4.5 [IS]	6.25 staple; 5.75 filament [EU]	Melts at 255–265 [MF, BJ]	20–21.5 [BJ]
Acrylic	Synthetic	—	—	—	1.5 [IS]	2 [EU]	Glass transition about 100; pyrolysis about 290 [BJ]	18.2 [BJ, KK]
Modacrylic	Synthetic	1.20–1.35 [MF]	23–34 [KA]	21–29 [KA]	0.4–3.0, by class [IS]	2 [EU]	Softens at 120–125; decomposes from 247–277 [MF, RJ]	26–32 [KA, BJ]
Polypropylene	Synthetic	0.90–0.92 [LB, MF]	25–60 [LB]	—	0 (as olefin) [IS]	2 [EU]	Melts at 160–175 [LB, MF]	18.6 [BJ, KK]

Fibre	Class	Density, g/cm ³	Tenacity, cN/tex, dry	Elongation at break, %	Commercial moisture regain, %	EU agreed allowance, %	Effect of heat, °C	LOI, %
UHMW polyethylene	Synthetic	0.97–0.98 [SP, MF]	282–327 (Spectra S1000) [SP]	3.0–3.5 [SP]	0 (as olefin) [IS]	1.5 (as polyethylene) [EU]	Melts at about 144–152 [MF, KV]	—
Elastane (spandex)	Synthetic	—	—	300–700 [AS]	1.3 [IS]	1.5 [EU]	—	—
PLA (polylactide)	Synthetic, bio-based	1.24–1.25 (polymer) [NW, LB]	26–53 [NW, LB]	10–70 [NW]	—	1.5 [EU]	Melts at 165–180 [NW]	—
Chlorofibre (PVC)	Synthetic	—	—	—	0 (as vinyon) [IS]	2 [EU]	Softens and shrinks at about 150 [BJ]	37–39 [BJ]
Vinylal (PVA)	Synthetic	—	86–100 (industrial filament) [KU]	6–7.5 [KU]	4.5 (as vinal) [IS]	5 [EU]	—	—
Fluorofibre (PTFE)	Synthetic	2.3 [TF]	12–18 [TF]	15–100 [TF]	0 (as fluorocarbon) [IS]	0 [EU]	Melts at 327 [TF, BJ]	65 (brown) to above 95 (white) [TF]
Meta-aramid (Nomex)	Synthetic	1.37–1.38 [NX]	23–44 [NX]	19–31 [NX]	4.5 (safety apparel) [IS, NX]	8 (as aramid) [EU]	Does not melt; carbonises above about 427 [NX]	About 28 [NX]
Para-aramid (Kevlar 29)	Synthetic	1.44 [KV]	203 [KV]	3.6 [KV]	3.5–7.0, by end use [IS]	8 (as aramid) [EU]	Does not melt; decomposes at 427–482 in air [KV]	29 [KV]
PBI	Synthetic	—	—	—	—	—	Does not melt; decomposition reported from 450 to 704, by method [R], PB]	40–42 [BJ]
Glass (E-glass)	Inorganic	2.6 [NB]	123 (unsized virgin fibre) [NB]	4.8 [NB]	0 [IS]	2; 3 if 5 µm or finer [EU]	Softens at 844–920 [NB, KM]	—
Carbon (Toray T300)	Inorganic	1.76 [TC]	201 [TC]	1.5 [TC]	—	—	—	—
Basalt	Inorganic	About 2.7 [DB]	111–148 [DB]	—	—	—	Softens at 1,060; melts at 1,250 [KM]	—

Key figures and their sources

- **DB:** Deutsche Basalt Faser, Basalt roving; tenacity converted from 3,000 to 4,000 MPa.
Source: Basalt roving (deutsche-basalt-faser.de)
- **IR:** Indo Rama Synthetics, polyester staple fibre grades, 1.0 to 1.7 denier.
Source: polyester staple fibre grades (indoramaindia.com)

- IS: Bureau of Indian Standards, IS 13157:1991, Textile fibres, commercial moisture regains, Table 1, with Amendment No.
Source: IS 13157:1991, Textile fibres, commercial moisture regains (archive.org)
- KA: Kaneka, Protex modacrylic product list; tenacity converted from 2.3 to 3.4 cN/dtex.
Source: Protex modacrylic product list (modacrylic.com)
- NB: Nittobo, Composition and characteristics of glass fiber; tenacity converted from the 3.2 GPa strength of unsized virgin fibre.
Source: Composition and characteristics of glass fiber (nittobo.co.jp)
- NX: DuPont, Technical guide for Nomex fiber, 2019, Table II-1 and text; the regain of 5 to 5.5% measured on Nomex IIIA fabric is in the text.
Source: Technical guide for Nomex fiber (arcflashwear.com)
- PB: PBI Performance Products, About PBI; 1,300 °F converted to 704 °C.
Source: About PBI (pbiproducts.com)
- SP: Solstice Advanced Materials, Spectra S1000 fiber for industrial applications; tenacity converted from 32 to 37 g/den.
Source: Spectra S1000 fiber for industrial applications (solstice.com)

Test yourself

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

1. Which international standards give the generic names for natural fibres and for man-made fibres?
2. Which natural fibre is the exception to natural fibres being staple fibres, and why?
3. What is tenacity, and why is it used to compare textile fibres?
4. How many cN/tex is 1 g/den?
5. How does wet strength differ between cotton and regenerated cellulose fibres?
6. What is moisture regain?
7. Why is the EU agreed allowance for a man-made fibre usually higher than its commercial moisture regain?
8. Why does a hot iron glaze polyester?
9. According to Kakar and colleagues, above what limiting oxygen index is a textile generally considered flame retardant?
10. What proportion of acrylonitrile by mass distinguishes acrylic from modacrylic?

Answers

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

1. ISO 6938 for natural fibres and ISO 2076 for man-made fibres.

See: How textile fibres are classified

2. Silk, which is reeled from the cocoon as a continuous filament.

See: How textile fibres are classified

3. Breaking force divided by linear density; it lets fibres of different fineness be compared.

See: Reading the table › Density, tenacity and elongation

4. 8.83 cN/tex.

See: Reading the table › Density, tenacity and elongation

5. Cotton is stronger wet than dry, while regenerated cellulose weakens when wet.

See: Reading the table › Density, tenacity and elongation

6. The water a fibre holds, as a percentage of its oven-dry mass.

See: Reading the table › Moisture regain: the commercial figure and the EU allowance

7. It includes the moisture content and substances removable during analysis, such as spin finish.

See: Reading the table › Moisture regain: the commercial figure and the EU allowance

8. Polyester is thermoplastic: it softens and then melts.

See: Reading the table › Heat

9. Above 27.

See: Reading the table › Limiting oxygen index (LOI)

10. Acrylic is at least 85% acrylonitrile; modacrylic has more than 50% and less than 85%.

See: The fibres, one by one › Manufactured fibres from synthetic polymers

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