The Wonderful World of Wicks

Wicks are an essential component of any fire prop. The better quality your wicks are, the longer they'll last and the safer they'll be - you still need to take proper care of your wicks though! With so many options for wicks out there, it can be hard to know what's what.

All the science and tech behind wicking material is pretty complicated stuff and we (not scientists) have tried our best to make this article as simple and as accurate as possible, but we admit we're not perfect so we apologise if something is not quite right.

All wicks are Kevlar, right?

While most wicks are made from Kevlar, or a Kevlar blend (more on this shortly), this is not true of all wicks. Kevlar is actually the brand name of a DuPont product - a flame resistant, synthetic aramid fibre. Kevlar was created by Stephanie Kwolek, a pioneer in polymer research who was employed by DuPont. Most people refer to any type of aramid fibre used for wicks as Kevlar simply because it's more recognised than the term 'aramid fibre'.
Other products which have a similar composition, though generally not used for wicks, are Nomex (also by DuPont) and Technora (by Teijin Aramid).

This type of product is commercially known as aramid braided rope, which in the fire spinning world is generally used for knots such as the monkey fist, or aramid flat tape, which can be used for such wicks as the sushi roll on the ends of a staff.

Kevlar blends

Kevlar wicking, as manufactured by DuPont, does not come in a 100% pure aramid form. Authentic DuPont Kevlar is a blend of Kevlar and other synthetic fibres. There are two main types, both of which are similar but are better suited to slightly different uses.

K1 (as it's known in the fire spinning world) Kevlar is a blend of Kevlar, Nomex and other aramid fibres with fibreglass. Fibreglass has a higher heat resistance than aramids alone - the fibreglass threads start to degrade at around 537°C. This is the most common type of Kevlar used for wicking fire props, it's been around in Aotearoa for yonks, and it's the wick we prefer for our fire props. This blend is well suited to most props as it's easy to work with, relatively durable, and has a respectable level of fuel absorption.

K2 is blended in a similar way to K1, but with more fibreglass, making it thicker, more spongy, and more absorbent - this is why it's preferred for eating torches. The downside is that it's more susceptible to fraying and it doesn't hold its form as well as K1, making it less ideal for props that spin and may get dropped often.

Puro 'Kevlar' (not actually Kevlar but a pure aramid fibre) is relatively new and is becoming pretty popular in Europe. This stuff is a bit more expensive than the blended Kevlar and it's also more rigid. The rigidity of Puro means it can be hard on the hands and a bit tricky to work with, especially for tying knots, but it does make it extremely durable and able to handle drops and scrapes with minimal edge fraying.

Ultimately, the wick you choose will come down to personal preference, price point, and what you plan on using the wick for (and what's available, of course). Our preferred wick is the K1 blend - it's easy to work with and has proven itself over the years. Regardless of which wick you choose, wick care is important in ensuring your fire props have a long and safe life.

Time for some science!

The term 'aramid' is short for aromatic polyamide. Here, aromatic does not mean a fragrant scent. Instead, it refers to - and here's where we start to get sciency - the presence of aromatic rings of six carbon atoms. Basically, ring-shaped, flat molecular structures with a specific type of bond that gives increased stability.

A polyamide is a polymer with units (sometimes known as a 'mer' from the Greek word meros, which means 'a part') that repeat themselves and are linked by amide bonds (a rather complicated type of bond that is easily formed and gives structural rigidity, or toughness).

The term polymer means 'many mers' or many units. Polymers are a substance or material that have very large molecules which are made up of many repeating subunits. These subunits repeat themselves by linking together in a chain, kind of like a necklace, producing a strong complete chain.

Polymers can be synthetic or naturally occurring. Some examples of synthetic polymers are nylon, polystyrene, polyester, and epoxy. Naturally occurring polymers include silk, wool, and DNA.

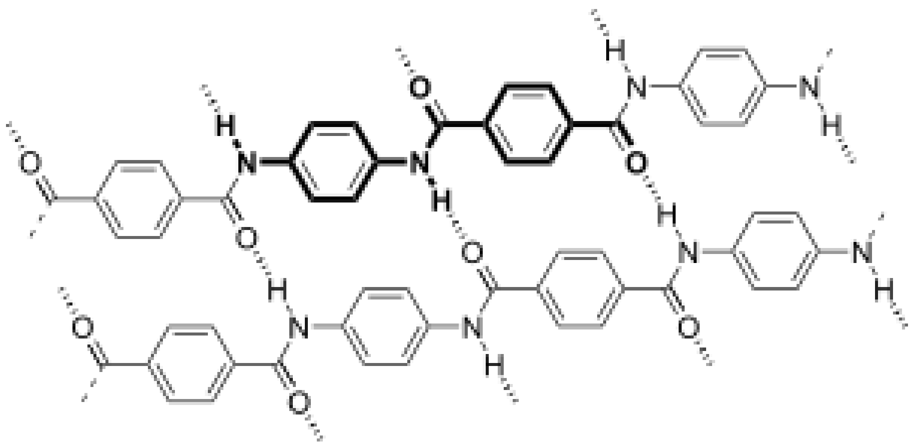
Aramid fibres

The aramid fibre is a class of heat-resistant, strong, synthetic fibres that are related to nylon, but are much more rigid and durable. Aside from being used for wicks, this type of fibre is often used in the aerospace industry, in the military, and for ballistic rated body armour (e.g. bullet proof vests), among many other applications.

In order to meet the US Federal Trade Commission's definition of an aramid, no less than 85% of the subunit links must be attached to two aromatic rings. Aramid fibres are divided into two main types depending on where the links attach to the aromatic rings. The two types of aramid fibres are meta-aramid and para-aramid.

The first commercially introduced aramid fibre was from DuPont in the early 1960's. They created a meta-aramid fibre originally known as HT-1, which then became Nomex. This type of fibre handles in a similar way to textile fibres (cotton, polyester, silk, wool) but has an incredible resistance to heat and doesn't melt, drip, or ignite in normal oxygen levels. Similar products were also produced by other manufacturers under various different names.

Para-aramid fibres were developed in the 1960's and 1970's, and have all the excellent qualities of a meta-aramid, with a higher tenacity, or strength, and a higher elastic modulus - the measurement of how much a substance will deform when stress is applied to it. The first commercial introduction of a para-aramid fibre was from DuPont and they called it… yep, you guessed it… Kevlar. Kevlar is made up of rigid molecules which form mostly planar (flat and level) sheet-like structures similar to that of silk - one of the strongest natural fibres on the planet.



Molecular structure of Kevlar:
bold represents a monomer unit, dashed lines indicate hydrogen bonds.

Kevlar's chemical structure is made up of several repeating inter-chain bonds which are cross linked with hydrogen bonds - this is what gives Kevlar its strength. The fibres in Kevlar are so tightly spun that it's almost impossible to separate them. This tight spinning is what makes Kevlar an ideal choice for ballistic rated body armour. When a high velocity projectile hits Kevlar, the fibres basically catch it while absorbing and dissipating its energy.

Technora is also a para-aramid fibre that was first commercially produced in 1987, with a polymer that is closely related to Kevlar. NASA has made use of the abrasion resistance, chemical stability, temperature resistance, and superior fatigue resistant performance of Technora, employing it to suspend the Mars rover, Opportunity, from its descent parachute in 2004. NASA also used Technora, combined with nylon and Kevlar, to make the parachute used for the Mars landing of the Perseverance rover in 2021.

Kevlar vs Nomex vs Technora

There is a reason that Kevlar is the industry standard when it comes to fire spinning. The combination of high strength, high heat-resistance, and high absorption ability make it the most ideal material for use as wicks. With time and use, Kevlar will still degrade, but it is by far the best option currently available.

When the fibres used for Kevlar are spun, the result is an impressive tensile strength of around 525,000psi (pounds per square inch - a common measurement of pressure). Kevlar retains its strength and flexibility down to −196°C and is actually slightly stronger at low temperatures. Kevlar can handle the heat, up to about 340°C, although its tensile strength is progressively reduced the longer it's exposed to high temperatures. For example, if you expose Kevlar to 160°C for 500 hours, its strength is reduced by about 10%. Exposing it to 260°C for 70 hours reduces its strength by about 50% - nothing to worry about with 5 minute burns!

Nomex can handle temperatures up to 370°C and has incredible thermal, chemical, and radiation resistance - probably why it's commonly used in PPE (personal protective equipment) for fire fighters! However the strands of Nomex cannot align in the same way as those in Kevlar, meaning it only has a tensile strength of around 49,000psi.

Technora is pretty impressive stuff with no melting point, and it only begins to degrade once it reaches around 500°C. It also maintains its mechanical properties all the way down to -200°C. Additionally, Technora has a high LOI (limiting oxygen index) - this is the amount of oxygen that will support combustion, or burning, of a polymer - which means it stops burning as soon as it is no longer exposed to a flame. The tensile strength of Technora ranges from around 464,000 to 507,000psi.

While Technora seems like it would be the better choice for wicks given its higher temperature resistance, there are a couple of factors which make it less than ideal. Technora does not have very good fuel absorption, which is something that's kinda crucial for fire spinning. The less absorption, the less burn time! Currently, Technora is only available in rope form, not the flat wicking we see from Kevlar, which is essential for many wick types. This is why Technora is generally used for leashes rather than wicks.

	KEVLAR	NOMEX	TECHNORA
Type of Aramid	Para	Meta	Para
Tensile Strength (approx. psi)	525,000	49,000	464,000 - 507,000
Low Temp (approx.)	-195°C	-195°C	-200°C
High Temp (approx.)	420°C	370°C	500°C
Common Uses	Ballistic rated body armour	Fire-fighter clothing, PPE	Aerospace

For comparison, steel has a tensile strength ranging from around 42,000 to 348,000psi, depending on composition and heat treatment.

If you made it this far, well done!

We hope this has provided some insight into Kevlar, and wicking materials for fire props in general.