



Chatham Rope Company

Rope walks were very long sheds, or even open areas, where fibres were laid and then woven into rope

# The amazing history of rope

Do you know your hemp from your manila and the surprising qualities of Dyneema? Roger Hughes untangles the mysteries of rope

**W**hile I was looking into buying some new running rigging recently for my schooner, *Britannia*, I started to consider some of the newer ropes which are now available. Some of these, such as Dyneema, can handle unbelievable loads which conjure up absurd scenarios. *Britannia* weighs about 44,000lb (20 tonnes), so theoretically a single 3/4in diameter 12-strand Dyneema (about as thick as a finger, rated at 58,000lb), could lift the whole boat!

I'm not thinking of putting this to the test, but it serves to illustrate the advancement of modern ropes.

Yet rope is one of the oldest of human tools, used long before recorded history. Drawings in Egyptian tombs from 6,000 years ago show rope that would have been used to haul the massive blocks that went into every pyramid. And evidence of rope goes back a lot further even than the

Egyptians. Fossil fragments have been found in caves; carbon dated from 17,000 years ago. If you killed a large deer, which then needed two men to lug it back to your cave, you might tie its legs to a strong tree limb and carry it between you. 'Tie' being the operative word here, probably with some tree creeper or fibrous grass. Individually this might not be strong enough, but it could be made stronger by simply winding two or three strands together, and you'd have a rope. Originally, this was exactly how ropes were made, by intertwining various plant fibres. The Chinese were the first to perfect the superior hemp fibres to make rope, around 2,800BC.

Hemp is a rapid-growing fibrous plant, a species of the abacá banana family, but not to be confused with its marijuana cousin. The long stem is flayed to remove fibrous membranes which are then dried and woven into rope. Manila rope is also

made of hemp, but so named because Manila, in the Philippines, was a major growing, manufacturing and shipping port. Ropes were also made from coir fibre, from the outer fibres of coconuts because it's waterproof and one of the few natural fibres resistant to saltwater. Sisal rope is also a plant fibre, from the agave plant, which has long leaves from which the fibres are extracted.

The actual construction of rope hardly changed over these millennia. Even as late as the 18th century, the same base fibres were still being laid-up along 'rope walks.' These were often simply a long open lane, but which might also have a covered roof.

Individual thin fibres were staggered, then intertwined. Multiple fibres were twisted into yarns, then yarns were intertwined in the opposite direction to form strands. Traditionally three strands were then wound the opposite way to form 'Hawser-laid rope'. This process is called counter twisting, and prevents the

## ABOUT THE AUTHOR

Roger Hughes is an Englishman living near Orlando, Florida, USA. He has been sailing for nearly half a century as a professional captain, charterer and restorer of boats. He has just completed a five year restoration of his Down East 45 *Britannia*.

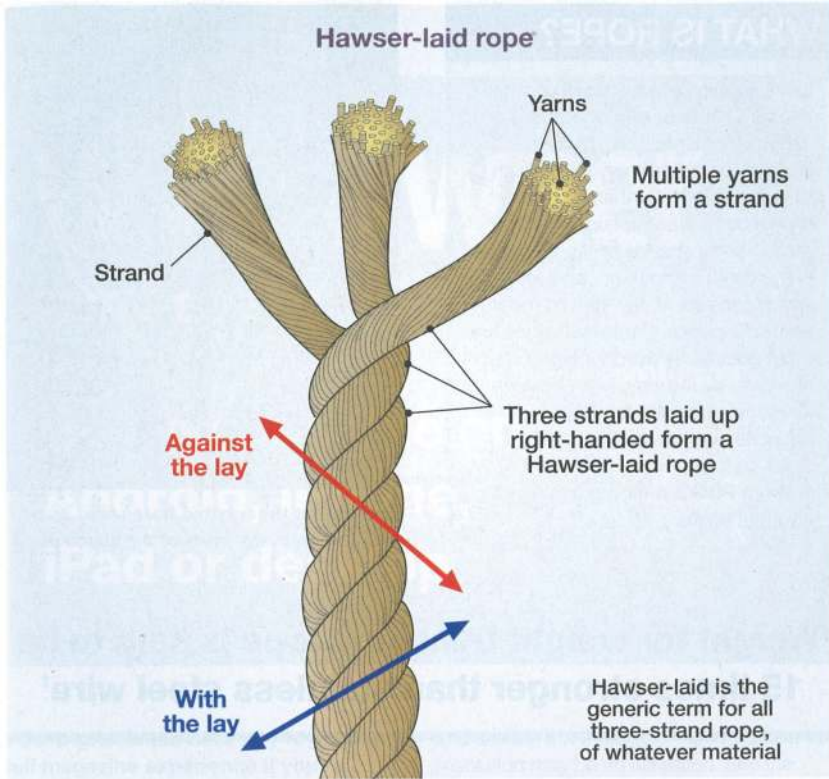


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rope unwinding.

For heavier duty rope, like anchor cable, three or more hawser-laid ropes would be intertwined to form 'cable-laid'. Historic Chatham Dockyard in Kent, where many famous ships of war were made, including HMS *Victory*, still has a working rope-walk. It's 1,135ft long and took a 200-man workforce to make a 1,000ft anchor cable – all by hand.

The strength of these ropes was very much dependent upon the closeness of the intertwined organic fibres. But on February 28, 1935, everything about rope changed. On this day nylon fibres were perfected by a chemist, WH Carothers at DuPont's research facility at Wilmington, Delaware. Not only were these individual synthetic yarns stronger and lighter than anything previously available, but they could be produced continuously, so there was no need to overlap them to make rope. Consequently, any length could be made and the rope-walk suddenly became redundant.



Sisal is very similar to abacá but is made from the leaves of the plant

However marvellous nylon was for other uses, conspicuously for women's stockings, it has limitations on boats. Even though it was stronger than any other rope, it also stretched under load and absorbed water, causing it to become heavier and some 10-15% weaker. Sailing vessels do not generally need stretchy rope, except maybe for mooring lines, where some 'give' is desirable.

Some people refer to their running rigging as rope, but the correct term is line. While they are both physically the same, a rope becomes a line when it is designated for a specific purpose on a vessel. A halyard is a line (made of rope) but an unused coil on deck is rope.

The advent of polyester braided rope overcame the deficiencies of nylon, and because of how it is constructed it produces stronger rope.

Instead of twisting three strands together, eight thinner strands are interwoven or plaited together to form an outer cover. Inside this is a core, which



An example of a modern Nylon rope, hawser-laid

## TYPES OF ROPE



### HEMP ROPE

Hemp rope is one of the original rope materials, being made from a fast-growing plant



### VINTAGE 3 STRAND

This rope of modern fibres is patterned after the hemp three-strand hawser laid rope of old, yet three times the strength for the size



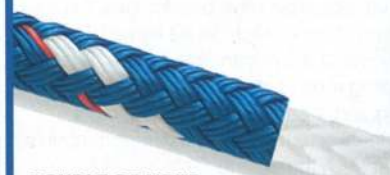
### MANILA LAID ROPE

Another traditional rope of hemp fibres, named after Manila in the Philippines where it was made



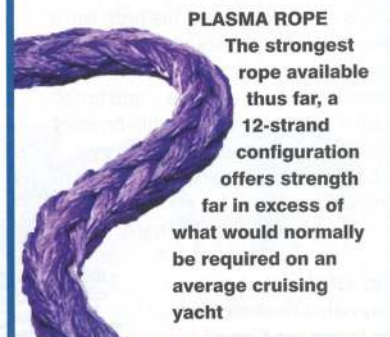
### DYNEEMA

Constructed of super-strong manmade fibres, Dyneema is available in many different configurations, including braided and hawser-laid



### DOUBLE-BRAIDED

An inner core and outer covering work together when the rope is under load, but give great flexibility when loose



### PLASMA ROPE

The strongest rope available thus far, a 12-strand configuration offers strength far in excess of what would normally be required on an average cruising yacht



is also plaited. Each is actually a separate rope, but they work in tandem when a load is applied. This type of construction is generically called braided rope. It is immensely strong for its thickness, enabling much thinner lines to be used than old hawser-laid. This in turn reduces windage and weight overall.

This rope is easier on the hands than the old coarse materials and very flexible, passing easily round blocks. It hardly stretches at all and is made in many different colours, which helps with identification on a rope-strewn deck or cockpit.

There are basically three types of braided rope, which are made using various materials such as polyester and polyethylene, etc.

**Hollow braided** rope is created by plaiting groups of fibres together to create a tight tube, with a hollow centre.

**Solid braid** has a solid inner core, giving it more strength than a hollow braided rope.

**Double-braid** has a braided outer cover, and an inner core and is by far the stronger of the three.

Nowadays, double-braided rope is the most commonly used of the braided styles on a modern yacht.

### Dyneema

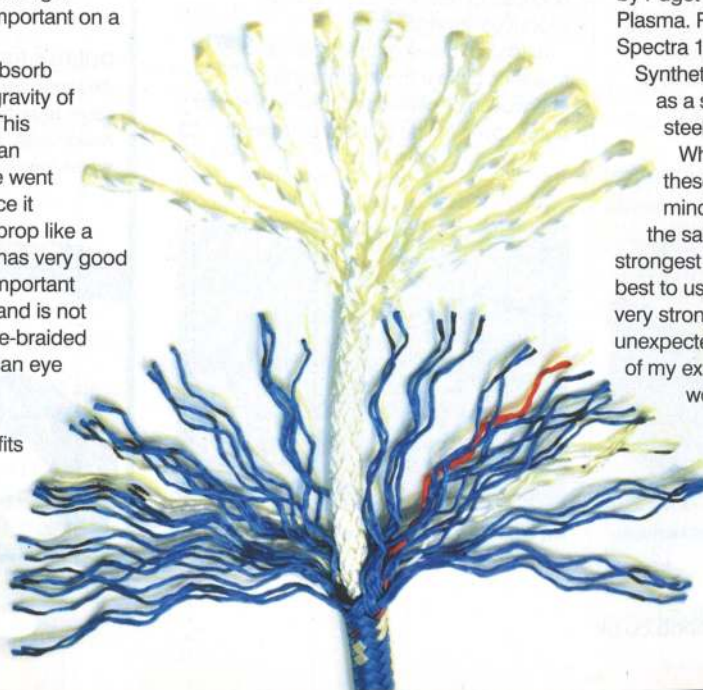
Over the past 30 years or so, another material has been developed. This is quite a mouthful to name, with an acronym as awkward. It is called Ultra-High Molecular Weight Polyethylene Fibre, (UHMWPF). It was developed by a Dutch company and is reputed to be the strongest and lightest rope in the world. They called it Dyneema and it is now made into rope for boats by all the leading manufacturers. So what makes Dyneema so special for our boats?

Weight for weight Dyneema rope is said to be 15 times stronger than 7x19 stainless steel wire! Size for size, it is reputed to be eight times lighter! This presents the remarkable possibility of using rope in place of wire for standing rigging, offering a significant weight reduction where it is most important on a yacht, in the rigging.

Dyneema rope does not absorb water, and it has a specific gravity of 0.97 which means it floats. This would certainly prove to be an advantage if a Dyneema line went overboard under power, since it would not sink and foul the prop like a heavier line surely would. It has very good resistance to sunlight – an important consideration for cruisers – and is not such a tight weave as double-braided line. The method of splicing an eye is considerably easier than braided rope.

These are significant benefits

**A double braided rope unravelled to show how the layers are formed**



### WHAT IS ROPE?

Lines, sheets, guys, ties, strings that can be of fibre or of wire. Rope is of various 'constructions', plaited, braided, or the ordinary laid (which means twisted). Furthermore, laid rope may be hawser-laid, which means three strands twisted together in the usual manner, or cable-laid, which consists of hawser-laid ropes twisted together. Cable-laid ropes are most commonly used for big hawsers, by the way, while hawser-laid ropes are used for sheets, halyards and the mooring lines of small craft.

■ From PBO's online glossary of nautical terms



This shows the way the fibres are stripped from the stem of the abacá plant

## 'Weight for weight Dyneema rope is said to be 15 times stronger than stainless steel wire'

for Dyneema on yachts. But as one might expect, there is a significant disadvantage as well. From a scan of the major discount outlets on the web, Dyneema rope is between three to four times the price of double-braided of the same thickness. This might explain why there are not so many cruising boats around with Dyneema lines or rigging. I made a quick back-of-an-envelope estimate that it would cost about \$2,400 (£1,805) to change just the running rigging on *Britannia* – not even including the standing rigging. But that would be infinitesimal compared to the cost of re-rigging an older, more famous *Britannia*. The 100-gun, first rate ship-of-the-line, which fought at Trafalgar in 1805 had 43 miles of hemp line, weighing 79 tons. Imagine the weight saving and reduced windage if they could

have used Dyneema!

Indeed, rope making has come a long way in the past 100 years.

Manufacturers continue to combine the benefits of modern fibres to produce different ropes for various marine uses. In the US, where I live, The New England Rope company even make a three-strand polyester hawser-laid rope, in the traditional brown hemp colour. They call it Vintage-3-strand, and it looks just like the real thing. The big difference is: ½in diameter Vintage-3-strand is rated at 6,200lb (2,800kg), whereas the same size in Manila will only carry about 2,000lb (900kg).

Spectra is another comparatively new synthetic fibre, from Honeywell Industries, which is reputed to be even stronger than Dyneema. It is formed into 12-strand rope by Puget Sound Ropes, which they call Plasma. Pelican Ropes also offer a Spectra 12-strand rope, which they call Synthetic Stainless Rope, suggesting it as a specific substitute for stainless steel wire standing rigging.

When considering the strengths of these ropes, it's worthwhile to remain mindful of their purpose, if only for the sake of your bank balance. The strongest rope may not always be the best to use for some lines on a yacht. A very strong williwaw once hit me unexpectedly and wrenched the clew out of my expensive multi-coloured Genoa. It

would have been much cheaper if the sheet had snapped instead. Three-strand nylon, or even manilla, is still perfectly satisfactory to use as mooring line and is cheap to replace.

