The Shorter Practical ABOK

This book is based on *The Ashley Book of Knots (ABOK)* (Ashley, 1944). It is shorter because:

(1) It is practical. It omits all the wonderful decorative knots whose practical purposes (other than decoration) can be served by simpler practical knots. Perhaps the often-beautiful decorative knots will be treated elsewhere.

(2) It defines a knot 'species' based on structure.

> Ashley wrote that "*either a different form, a different way of tying, or a different use constitute a different knot*" and widely useful structures were presented repeatedly in *ABOK*. Not so here.
>
> Here, a stable and unique nub structure alone defines a knot. Slip and chiral forms are classified as the same knot species. Forms that differ only outside the nub (*eg* for added security) are sub-species.

(3) It omits all of Ashley's wonderful introductory chapter, the fascinating account of knot use in various occupations, and all of the items other than knots that were (by 1944) used with rope. Consult *ABOK* for these things and for Ashley's descriptions of knot species listed with *ABOK* #s.

(4) Some structures described in *ABOK* are considered to be used rarely, and are omitted here or given only in summary lists.

This book follows a hierarchical classification of knots (Birch, 2025a). In many ways the classification is the same as that implicit in the Chapter arrangement and text of Ashley (1944). It is a degenerate classification in the sense that one structure may have various uses (which define higher taxa). But each knot is given one reference (from *ABOK* where possible) as a 'type specimen'. The clearest and fullest description is generally selected for this purpose. For structures that are not present in *ABOK*, new numbers will be needed (Appendix B). Rules of nomenclature for such a classification will also be needed. They should be set by international consensus among those interested in knot systematics. In the meantime, each 'knot species' is given a unique name (reflecting traditional usage in English where that is possible without creating confusion or ambiguity). Name is given here in **SMALL CAPS** for the primary listing of a knot. Most illustrations are from *ABOK*. As it is more than 80 years since Ashley wrote, this book serves also as an update where necessary; including some insights from other giants of the knotting literature: Day (1935, 1947, 1967) and Warner (1992) .

The hierarchical classification used here places knots within the broader category of human inventions. It uses functional criteria at higher levels, but species are distinguished primarily on structure in the tightened nub. This document is mainly concerned with layers Order, Family, Genus and Species:

Domain, *functional* (Mechanics: devices that transmit force, usually to induce or impede motion)
Kingdom, *functional* (Ties: devices that connect objects or hold them together)
Phylum, *primarily functional* (Knots: structures formed in cordage, ie pliable, elongated material)
Class, *functional* (Practical or Decorative)
Order, *primarily functional*, suffix -ales
Family, *primarily structural,* suffix -aceae
Genus, *structural*
Species, *structural*
Sub-species, *anything*

When Ashley wrote, synthetic-fibre ropes had barely been invented, and were not yet in wide use. The diversity of cordage constructions has multiplied since then, and knots that were secure in traditional natural-fibre cordage may be insecure in stiffer, springier or slipperier synthetic-fibre cordage. The challenge varies in degree. Some staple-fibre synthetic ropes perform well with traditional knots. Other synthetic ropes are untrustworthy with most traditional knots. It is perhaps a testament to the ingenuity of our predecessors that very few wholly new structures have been developed or required to meet this challenge: mostly it has been met by adding an extra turn or so to traditional knots, to increase the amount of friction that they apply.

Knots hold by friction. Resistance to sliding of a flexible rope around a turn increases exponentially with the coefficient of friction and the angle of contact in the turn. (The idealized formula; ignoring effects such as rope stiffness, flattening under load and surface irregularity; is $R = e^{\mu\theta}$ where R is resistance to sliding, *e* is a constant, μ is the coefficient of kinetic friction and θ is the wrap angle.) Therefore, fewer extra turns may be needed than first thought: there is truth in the old saying that "there's a lot of virtue in a round turn". However, environmental factors such as ice or mud on a rope can decrease surface friction. Furthermore, some synthetic fibres (*eg* HMWPE) are so strong and so slippery (low μ: see Appendix A) that most knots fail because the tail crawls back through the nub under a heavy load on the stand. Ropes of these fibres must be sheathed in higher-friction material for knotting, or used with splices that are specially designed for the particular construction.

All knots weaken the cordage in which they are tied. The amount of weakening varies between knots and cordages, but it is often at least 50%. The weakening may be permanent if cordage fibres have been damaged. Cordage may also weaken over time through exposure to effects such as sunlight, chemicals or biological attack. These effects are not always obvious. Therefore cordage for critical use is typically selected with a large 'safety factor' intended to allow for foreseeable weakening. It is stored to minimize damage, and retired after any potentially damaging event, or after a specified period since manufacture. Before any critical use of an unfamiliar rope, the knotter must inspect the rope and test an intended knot under a high load and the worst foreseeable environmental conditions.

Over longer time periods, most cordage (including all natural-fibre cordage) is ephemeral. There are perhaps a half dozen examples of knots in cordage more than a few thousand years old (Turner & van de Griend, 1996). Yet there is evidence (such a holes in amulets and the activities of cultures that were stone-age in technology) that cordage and knots were among the earliest human inventions. Most practical knots have been independently invented many times, and there is no basis for an expectation to discover the original developers. There is no basis for a claim to have (first) invented a new species, but (as in biology,) it is a privilege to describe one unambiguously for the first time in archival media.

Only in recent times (since about 1740 CE) has it become possible to describe and illustrate knots in printed or electronic media that are suitable for both mass distribution and archiving (Birch, 2020a). Since then, thousands of knots have been described or illustrated in such media for the first time, and copied (often uncritically, without credit, and/or with errors) into subsequent compilations. The "law of the simplest" (van de Griend, 1992) continues to apply. Cultural issues aside, in knotting humans tend to use the simplest structure (to tie and usually to untie) that serves the function.

Terminology about Cordage and Structures Used in Knotting

Most terms are used as defined in the Glossary for Practical Knot Tyers, which may be consulted for more detail.

Cordage is used here as a collective term for flexible, elongated materials (*eg* ropes). Cordage is sometimes regarded as essentially linear, and in this sense a **line** is a length of cordage.

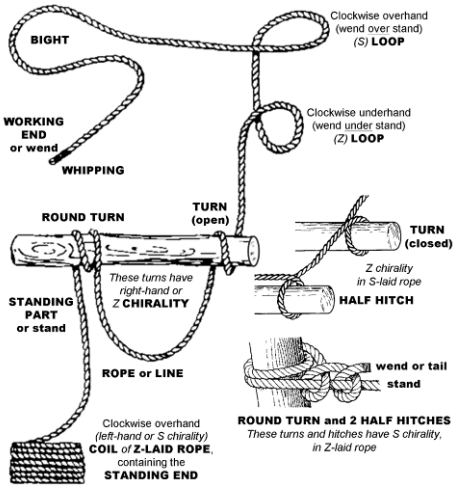
A **knot** is any useful complication in a length of cordage. To be useful, a knot must generally hold its shape against a small force such as that from the weight of the structure itself, even when neither end is loaded. This distinguishes knots from temporary complications of cordage. In many cases, a stable knot is comprised of multiple components that are not stable alone. Some of these are described below.

Narrower usages of 'knot', *eg* limited to knob and eye structures, are not followed here. Structures that rely on seizing for practical utility generally are not included here. Exception is made for some knots such as 'Single Carricks' that historically were used frequently, always with seizings. A well-made seizing is secure and gentle on rope (*ABOK* #534), but they are rarely used today, probably because of the extra materials and time required.

Broader usages of "knot"; *eg* certain Celtic and Heraldic 'knot designs' that can be imagined or illustrated, but not tied as stable structures in tangible cordage; are also excluded here.

An **end** is either extremity of a line. Some knots are tiable in the bight (**TIB**) without using either end.

The standing end (sometimes abbreviated as **stend**) of a line being knotted is the end which need not be accessed to make the knot. It may be fixed to some large structure, or distant from the knot.



The standing part (**stand**) is the part of a line between the standing end and a knot. The term is commonly used in reference to the region just before the line enters the knot, but it may also refer to part of a line a short distance inside the nub (*eg* "the wend is nipped under the stand").

The working end (**wend**) is the end of a line used during the making of a knot. In a strict sense, the wend is ephemeral (existing only during the tying of a knot). On completion, the wend becomes the tail. In practice, the term is often used to refer to parts of a line after knot completion, including parts just outside the nub (towards the tail end) and parts that were traced by the wend (*sensu stricto*) and which on completion of the knot are a short distance inside the nub (*eg* "the wend is nipped under the stand").

A **tail** is a working end (or region of line) that protrudes on completion of a knot. Most knots are designed to receive a **load** (tension) on the stand(s), but many are not designed to be tail loaded. A few knots are either-end loadable (**EEL**), and some are designed to be loaded simultaneously on both ends. If a tail crawls completely back through a knot, typically it will untie or **spill**.

The **nub** or core of a knot is the region in which friction exists that is relevant to the security of the knot. In many cases, this is the entire knot; but in eye knots the nub may be distinguished from the eye that emerges from it.

Nip is pressure exerted by a line on itself or on another solid with which the line intersects (resulting in friction between these components).

In context of knotting, **structure (or similitude)** is the arrangement of cordage in the nub, allowing uniform scaling, rotation, reflection, different degrees of tightening, and differing sizes and shapes of lines, eyes, and underlying solids. (Some of these are distinguished by mathematicians as separate geometric properties.) The relevant structure exists after a knot is **threaded** (or woven) adjusted into shape (or **dressed**) and drawn hand-tight in the expected direction(s) of load (**packed** or set). All knots should be dressed and packed before use.

For **identification** of a knot, the structure typically is discerned at several stages, usually looser than the loaded nub. To reveal their structure, including the relationship between stand and tail, knots commonly are illustrated somewhat loose, with tails much shorter than needed for security in use.

Capsize is a change in structure (as defined above), which in extreme cases may spill a knot.

Chirality means having one of two mirror-image forms (like human hands or gloves). Chiral forms are treated here as the same knot species, although they may have slightly different behaviour in chiral (laid) cordage.

A **bight** is a curved length of line. It may be a closed bight (if the two arms of the bight touch each other without crossing), or an open bight (if the two arms of the bight do not touch each other). If the line crosses itself, the bight becomes a loop.

A **loop** is a structure in which a line crosses once over itself.

A **U-turn** (half turn) is a bight of cordage around a solid. The arc of contact between the line and the solid is about 180º. The stand and the wend are on the same side of the solid, and approximately antiparallel (at about 360º). Tight turns of low diameter weaken most ropes. This affects choice of diameters for substrates, but susceptibility varies between rope compositions and constructions.

A **turn** (full turn) is a single loop of cordage around a solid. The underlying solid may include *eg* a pole, a spar, a ring, a hook, or a line; even the same line. The arc of contact between the line and the solid is about 360º. The stand and the wend will lie at an angle to each other of about 90º to 180º (they may lie on opposite sides of the solid).

A **round turn** comprises about 1.5 consecutive turns. There are two passages of the line over the underlying solid, and the arc of contact between the line and the solid is about 540º. The stand and the wend are on the same side of the solid, and approximately antiparallel (at about 360º). The traditional terminology with additional turns can be very confusing.

A **half hitch** is a (full) turn of cordage around a solid, with the line arranged to confer some nip on itself. The underlying solid may be another region of the same line. (Ashley, 1944 proposed a different definition to distinguish a half hitch from a single hitch. That proposal is not followed here.)

If the arms of a bight are fixed while the tip of the bight is turned through 180º (*ie* twisted once) a loop is obtained. More **twists** will result in a series from figure-eight forms to a **helix** of the arms around each other (as in a **laid** rope). The same helix can be envisaged as a series of turns of one arm over the other (especially if one arm is pulled tighter).

Another common component of more complex knots is the **Thumb Knot**, sometimes in **half knot** form (see below).

A knot is **slippery** (or a **slip**/**slipped** knot) when the tail is passed back through the nub in such a way that a sufficient pull on the tail will cause the knot to simplify or fall apart. Slippery forms commonly are tied for quick release or resistance to jamming after a heavy load. They are treated here as sub-species, although they may differ from the parent species in properties that are relevant to primary knot function (*eg* width of stopper knots).

A knot is **TIB (tiable in the bight** or on the bight**)** if it can be made without use of the ends.

An eye knot is **PET (post eye tiable)** if it can be made with the eye around a post, without accessing either end of the post and without needing to form a preliminary knot before passing the line around.

cis and ***trans*** terms have been borrowed from chemistry as less ambiguous than the terms **direct** and **oblique** sometimes used in knotting. The terms are usually applied to the tails of bends, in a projection of the loose knot onto a plane. In that case *cis* (direct) means on the same side of the nub, whereas *trans* (oblique) means on opposite sides of the nub. This can become confusing, as the geometry of a knot may change during dressing, packing and heavy loading, such that tails that were *cis* when woven become *trans* when loaded.

Security of a knot is the resistance of the knot to slippage under load, to changing shape (capsizing) into a form more prone to slippage, and to loosening (or eventually coming apart) under adverse conditions that may be encountered in the intended use of the knot. When confronted with a claim for increased security, an experienced knotter will ask: “Secure in what, against what, and at what cost?”

Strength of a knot can be expressed as a percentage of the breaking strain of the cordage in which it is made. Difficulties arise because of inherent variability between replicates, and because results depend on precise conditions of the test. Cordage should therefore be used well within its **safe working load**, which for new cordage is commonly taken to be between 1/5 and 1/10 of the minimum breaking strain.

Single-stranded Stopper Knots

Order Stopales (single-stranded knots that can be tied in a single line to form a knob)

The single-stranded stopper knots include some of the simplest and most versatile structures in knotting. They are used: as a temporary measure to prevent raveling of an end, to increase size (so the line will not pass through an aperture), to increase weight (for heaving), in combination with other knots to increase friction (as tail 'locks'), and as foundation structures for many other knots.

To prevent passage through an aperture, slippery forms (with the tail passed back through the nub) can have the advantage of increased effective knot diameter.

In Ashley's experience, seizings or stops (temporary seizings) were commonly used to secure tails. Today 'locks' to tails frequently are made with the knotted line itself. Security increases in the order: no lock < half hitch < thumb knot < grapevine stopper knot (strangle) around another region of the line. In this use, the stopper knot forms an added hitch (Phillips, 2014). The increase in friction depends on contact geometry in the knot, and surface lubricity of the cordage. Where a half hitch traditionally was used for tail security in natural-fibre ropes, a grapevine double fisherman (strangle) stopper knot around another part of the rope might be recommended today (*eg* in synthetic-fibre kernmantle climbing and rescue ropes). The added friction may be essential, or insufficient, for security with some modern cordage. Ashley appears not to have anticipated this use for stopper knots. He does show stopper knots tied in the tail(s), to increase security by preventing the tail from crawling back through the nub (*eg ABOK* #1403). However, of structures formed around a line, he shows only half hitches and bowline knots to increase tail security when seizings are inappropriate (*eg ABOK* #497, 1404, 1724, 1726).

Traditionally, a 'stopper knot', a 'stopper' and a 'stop' were different. This taxon includes only 'stopper knots'. 'Stoppers' are multi-turn structures used to hold a larger line such as an anchor cable: order Coilales. 'Stopper' has another use in climbing equipment. 'Stops' are binding hitches used as temporary seizings, whippings or lashings: order Hitchales. "Stop the end" is therefore ambiguous, but it was sometimes used to mean "Tie a stopper knot in the end". Such ambiguity is best avoided.

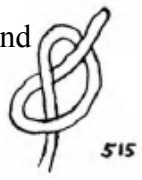
Family Simplaceae (wend passes through a single aperture in a looped or twisted line)

All the knots in this Family, and many of the knots based on them, are prone to jam after a heavy load. This tendency may be reduced by additional twists or turns in the nub structure, or by the insertion of other components such as toggles.

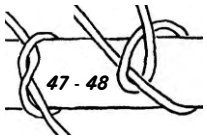
Genus <u>Overhand</u> (single loop through which passes the wend, forming a turn)

The word overhand is commonly used in the context of knots in this genus, although the initial loop can equally be underhand (Warner #6, 7). The genus name 'Overhand' is suggested here to retain a historical connection while avoiding use of terms derived from 'Thumb Knot' at both genus and species levels.

THUMB KNOT *ABOK* #<u>515</u> (When tied around a solid, it may form a 'half hitch around the stand' [*ABOK* #48]; or it may be dressed as a 'half knot' [*ABOK* #47], especially when formed between two lines rather than two regions from one line in a loop.)



In the form usually called a 'Thumb Knot', this structure comprises a single loop, through which the wend passes once to form a turn in the line. It is the simplest, the smallest, and probably the oldest knot. Fishermen call it the wind knot, and no doubt it has formed this way since the first uses of lines. It

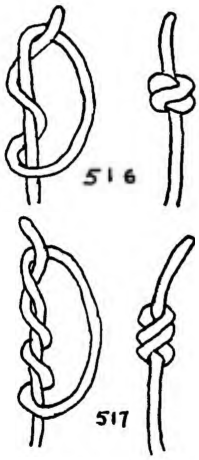


can be tied (as a skilled trick) by twirling and flicking a suitable length of line. To tie it without great skill or wind assistance, small stuff usually is rolled between a thumb and forefinger, intermediate-sized rope is cast over the hand, and heavier ropes probably were woven on deck. It was named in print the Thumb Knot (Emmerson, 1754) several decades before the name Overhand Knot first appeared (Lescallier, 1777). There may be older names.

Asher (1983) gave a useful terminology for parts of the knot in Open Form, including the spine, the belly and three spaces in the lumen.

Ashley (1944) distinguished the Thumb (or Overhand) Knot as tied with one end, versus the half knot tied with two ends around a solid (*ABOK* #46, 47); but that is not always the case. Warner (1992) wrote that they can be obtained from the same structure, woven and dressed in one line, by tightening between an end and the nub (for a Thumb Knot), or between the ends (for a half knot); but that is also problematic. Pettigrew (2013) reinforced that with a large solid through the ***c*** space, a Thumb Knot will typically yield the half-knot form; whereas a large solid through the ***r*** or ***s*** space will yield the half-hitch form. In summary, the form obtained depends on the directions of force in the nub (including interaction with any enclosed solid) and on the ends. There are many intermediates, but at the extremes the loaded nubs are very different in form: a near-linear helix in the spine of a 'half knot' versus a tight arc in the turn of a 'half hitch around the stand'. Under changed load directions, they can interchange.

MULTIPLE THUMB KNOTS *ABOK* #516, 517, 566; Warner #62, 63



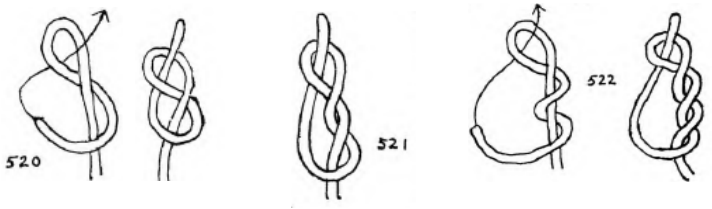
If the wend is passed more than once through a loop, a Multiple Thumb Knot will result. Double, Triple and higher multiples are common. Depending how these are dressed and tightened, two distinct forms can be obtained: an **Open Form** that shows the original belly outside the turns; and a **Grapevine Form** that transfers the turns over the original belly which thus disappears into the core of the nub (*ABOK* #566; Warner #62, 63). The distinction from half knots becomes more challenging in Multiple Thumb Knots, and the designation of chirality becomes tricky in the Grapevine Form. The various multiples and forms have different structures. They are separate 'knot species'.

As an example of multiple uses of the same structure, the Grapevine Form of the **DOUBLE THUMB KNOT** *aka* Strangle Knot (*ABOK* #409, 516, 1239, 1415, 3100) is used as a stopper (in pull cords), a stop (temporary whipping, near the end of a larger rope), a tail lock (for another knot such as a Bowline), around the stand (as a noose or hitch), around another line (as half of a Double Fisherman's Bend), or around another solid (*eg* as a sack knot, or an emergency clamp). Triple forms have comparable uses, and higher multiples have various decorative uses.

Genus Twisted (the nub comprises multiple loops or twists, but not more complex structures such as Thumb Knots, before the final passage of the wend through an aperture in the nub)

This genus includes some of the knots most used in climbing and vertical rescue, because the twists are easy to make, result in knots that have distinctive shapes for visual verification, use minimal cordage to provide added friction, and are slightly more jam-resistant (relative to a Thumb Knot). They are also fairly strong and secure in the (stiff) kernmantle ropes currently used for such activities. The figure-eight form in particular has been widely elaborated in fixed-eye knots, nooses and bends, as well as stopper knots (*eg* Merchant, 2007). Figure-nine variants are among the strongest knots for synthetic-filament fishing lines (*eg* Barnes, 1951).

FIGURE EIGHT KNOT *ABOK* #520
FIGURE NINE KNOT *ABOK* #521
STEVEDORE KNOT *ABOK* #522



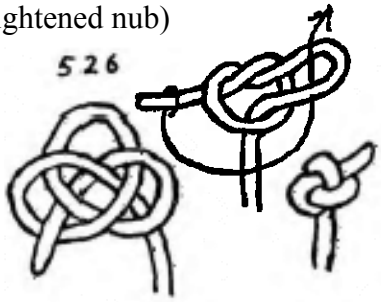
If a closed bight is twisted through 180º while the arms are fixed, a loop will result. Then if the lower arm is passed over the other and down through the aperture of the loop, a Thumb Knot will result. If more twists are made before the lower arm is passed through the aperture, the results will be Figure Eight-, Figure Nine-, Stevedore-, *etc*- Knots. These knots are generally tied in other ways, but the example serves to illustrate a structural relationship between bights, twists, loops, turns, and a series of knots. Multiple forms of the Thumb Knot and Figure Eight Knot have been applied widely as nooses and hitches (*eg* Merchant, 2007 p. 59; Svensson, 1940 pp. 65-66).

Family Complaceae (the nub involves one or more Thumb Knots before final passage of the wend)

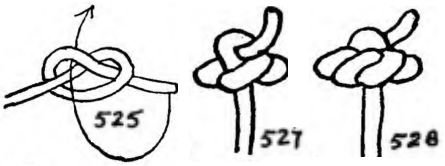
The stopper knots in this Family are generally wider, but slower to tie, than those in the Simplaceae. They can be quite decorative, but they also provide the simplest knots for practical purposes including (i) terminating a line at an wide aperture and (ii) adding weight to a line for heaving.

Genus Lobed (providing multiple lobes around the stand in the tightened nub)

Ashley presented a series of stopper knots that gained width through additional lobes or 'rims' around the stand. Of these, the **OYSTERMAN'S STOPPER** (*ABOK* #526) is the most practical compromise between the desired function and tying difficulty.



TWEENIE *ABOK* #525
QUATREFOIL *ABOK* #527
CINQUEFOIL *ABOK* #528

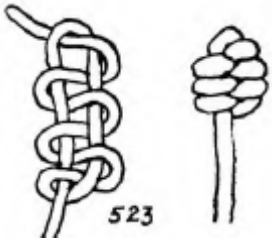


Other weavings are also possible (KM 37, 21) but *ABOK* #526 has not yet been bettered. A figure-eight start is arguably an improvement to *ABOK* #525, but little is gained by complicating the start of *ABOK* #526 (KM 24, 13-14). Other knots fitting this Genus description (*eg ABOK* #545-554, 577-578) are too challenging to tie to be considered practical.

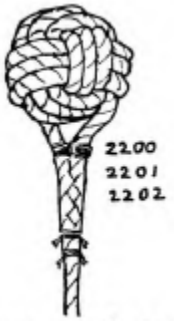
Genus Heaved (with multiple turns that increase weight at the end of a line for heaving)

The knots shown below have fewer than four turns around any axis. This distinction is somewhat arbitrary, as other coiled heaving line knots (*ABOK* #535-544) may be included in this Order as well as Coilales. If available, a small sandbag is generally a better option.

RACKED STOPPER *ABOK* #523



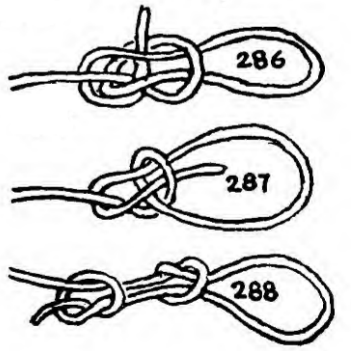
MONKEY'S FIST *ABOK* #542, 2200-2202



Fixed Eye Knots

Order Fieyales (Provide one or more loops or bights of cordage [the eyes] outside the nub of the knot, without separating the cordage into parts. The eye[s] will not slip material to the stand or tail in normal usage.)

As pointed out by Ashley (1944) single and multiple eye knots have been greatly elaborated, sometimes to decorative effect. Many such knots have subtle advantages for particular applications; but many practical knotters will have one preference in each of the terminal, in-line and multiple eye-knot categories, to suit many uses. While it is convenient to think of these categories when selecting a knot to tie, they are not suitable for classification and identification of fixed eye knots, for several reasons. An in-line knot can always be tied near an end, and TIB knots used in practice at the terminus can also be tied in-line. There is no guarantee that a knot found mid-line was not tied using an end. It can be difficult to discern whether a complex nub is TIB, and difficult or impossible to develop a practical method of tying such a knot in the bight. The fact that a knot can be tied in-line or near a terminus does not indicate whether it has a suitable lead or stability for an intended practical use in that location. The classification is therefore based on structural features that can be observed when the knot is encountered (provided it can be loosened enough to observe these structural features).



The Families in this Order are distinguished primarily by eyes based on bights (*eg ABOK* #286), loops (*eg ABOK* #287), or running eyes that can be 'locked' in at least one direction at a desired size (*eg ABOK* #288). A secondary distinction in the case of eyes based on loops is made on the nature of any nipping structure and collar. These Families include knots with a single eye and multiple eyes of the same type.

Any stopper knot that is tied with a bight (as distinct from a slipped tail) will yield a fixed-eye knot. This is generally too cumbersome to be undertaken with complex stopper knots. It is commonly undertaken with the Simple Family of stopper knots, especially using string and other small stuff when the knotter is not concerned that the knot will jam after a load.

The nub of a fixed eye knot can also be envisaged as a bend involving its own stand. Any bend will yield a fixed-eye knot if its tails are joined. However these often are not practical eye knots, because they are cumbersome to tie and/or are likely to be loaded in a way that makes the nub prone to capsize (Asher, 1989 pp. 81-82). Sometimes one of the stands may be joined to a tail to better effect, as in the structural relationship between a sheet bend and a common bowline knot (Warner #521).

Fixed eye knots, especially bowline knots, provide a good example of how tail security may be improved not only by addition of stopper knots but also by additional weaving of the tail through the original nub. The latter can be effective, and such knots have been called "inherently secure". But it can also disrupt nub structure and friction unexpectedly, or require careful dressing to avoid a potential slip knot or noose structure (*eg* to avoid a mis-tightened Alston tuck [*ABOK* #1015] or Yosemite tuck), which would be inherently insecure. Or it may cause the knot to jam under load. To avoid such mistakes, a simple, well-conceived and well-tested weaving pattern is best. Although the two approaches are treated differently in this classification, neither is inherently more secure. Knots that combine security with ease of untying are appreciated in some recreations like sport climbing; but in other recreations like sport fishing, strength is appreciated while ease of untying is barely relevant. Riggers working with heavier weights, those in vertical rescue and those in yacht racing may all have different priorities. Knotters must consider the nuances of usage.

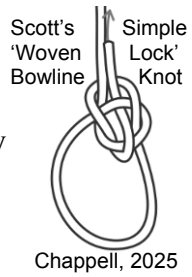
Family Bowlaceae (Eyes based on loops - the two arms of each eye enter the nub through different apertures and/or in different directions. The core nub comprises [i] a TIB structure that nips

multiple lines, and [ii] a collar that passes around a line from the nipping structure, with arms through that nipping structure.)

This Family includes the bowline knots and the less-common myrtle knots. The nub of a bowline knot commonly is a Sheet- or Lapp-Bend structure in which the tail becomes an arm of the eye. Some knotters object to comparing these nubs (because of different design loadings). More complex TIB nipping structures are also used. In all cases: (i) the collar and the nipping structure transition to different arms of the eye(s), and (ii) they stabilize each other in the nub. The bowline eye (based on a loop) is chiral. In the Common Bowline Knot, examining the first crossing of the loop-eye shows that the chirality of the eye matches that of the nipping turn. Some of the flagstaff knots (*ABOK* #1987-1989) form bowline-like structures on completion, but the loading (and thus the nip) is so different that they may be excluded from this Family.

Genus <u>Qallunaat Bowline</u> (single eye from a nub with a collar passing around the stand; both arms of the collar pass in one direction through the nipping structure)

This genus includes the bowline knots used in European maritime tradition. The name is suggested to contrast with the European designation of 'Inuit Bowline Knots'. Multiple fast tying methods have been devised (*eg* Day, 1947).



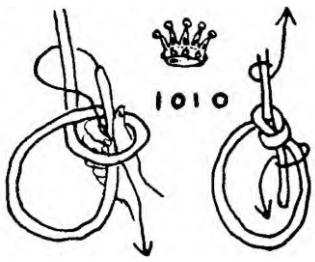
Chappell, 2025

Bowline eye knots have many valued functional properties (Birch, 2024). However, with aberrant loading and especially in slippery or springy cordage they can be insecure. Therefore bowline knots should have tails locked for any critical use. Scott Safier's Simple **WOVEN LOCK** is an excellent example. Anyone concerned about 'bight snagging' can add a further grapevine (strangle) lock around the stand, at the cost of greater difficulty in untying.

Possibly because of their valued functional properties, bowline eye knots have been greatly explored and elaborated in efforts to overcome their limitations for specific applications. Only a few foundational species are mentioned here, and users may consult the literature in their own fields of interest for other examples. With emphasis on climbing, Gommers (2016) compiled many eye knots that may now be difficult to find in original IGKT forum postings. Winton-Jones (2024) is interesting for a caving perspective. Other examples include Toss (1990) and Compton (2013) for yachters, Barnes (1951) and Wilson (2007) for fishers, and Grog (2025) for various interests.

A TIB nipping structure is not sufficient to ensure that the knot is PET, or that it will not jam after a heavy load (though these features are often sought in practical bowline knots, and associated with the simplest TIB nipping structures). Single eye bowline knots are PET, but some multi-eye forms are not.

COMMON BOWLINE KNOT (tail inside the eye) *ABOK* #71, 287, <u>1010</u>, 1011



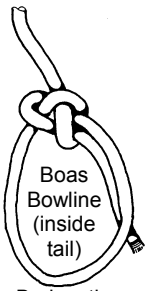
This knot has also been called the 'Sailor's Bowline' among other names (Birch, 2020b). The nub can be envisaged as a *cis* Sheet Bend, with nip from the stand coming directly onto the tail. As in the *cis* Sheet Bend, this nip tends to move the tail across and out of the eye under heavy loading. Under design loading, about half of the force on the eye is transmitted to the nipping turn, which grips both arms from the collar, adding to security in a way not usually seen in a Sheet Bend. Under ring loading, nip from the stand on the tail is reduced, and tail slippage followed by spill of the knot may result (particularly with cyclic ring loading). Well-designed tail locks reduce this insecurity.

There are many variant species, some with nubs based on various Sheet Bends. The form with a round-turn nipping structure (Day ,1947 #65) is perhaps more easily tied by the climber's half-knot (Day #61S-T) or noose (Day #61M-O) methods. Dressing of the nub as in *ABOK* #488 is not recommended. The form with a clove-hitch nipping structure (Day #66) is more easily tied by sailor's hitch-transfer methods (Day #61A-B or J-K). Both have higher security than *ABOK* #1010.

OUTSIDE-TAIL BOWLINE KNOT (tail outside the eye) *ABOK* #1034½

This knot has (in various times and places) been called the 'Turned-out, Left-handed, Cowboy or Dutch Merchant-naval Bowline'. The nub can be envisaged as a *trans* Sheet Bend, but under design loading a substantial proportion of the force on the eye is transmitted to the nipping turn. This puts direct nip on the tail, contributing to security. Under ring loading, this direct nip of the turn on the tail, confers more security than the inside-tail knot. But there is a perhaps more likelihood of tail slippage when load falls only on the arm of the eye that transitions to the collar and tail. There are variant species as discussed for the Common Bowline Knot. Scott's Simple Woven Lock greatly improves the security of bowline knots with either tail orientation, against various types of aberrant loading and tail snagging.

Genus Inuit Bowline (single eye from a nub with a collar passing around the line that transitions between nipping structure and eye; both arms of that collar pass in one direction through the nipping structure) KM 67, 14-15



Budworth, 2000

Knots in this genus were first reported in print by Franz Boas in a 1907 report on "*The Eskimo of Baffin Land and Hudson Bay*". van de Griend (1996) explored their ancient history. They have been variously called 'Boas-, Eskimo-, Inuit-, Cossack-, Mongolian-, Panama- and Anti-Bowline' Knots. Apparently not used in European marine tradition, they are absent from *ABOK*. Although Day discusses them in 1967, they are absent from his 1947 compilation. They are interesting among bowline knots because under design loading their nubs resemble Lapp Bends rather than Sheet Bends. The nub is compact and tri-lobed from the 'front'. Two species are analogous to Qualunaat Bowlines above, but unlike them the chirality of the loop-eye differs between inside-tail (more secure) and outside-tail forms. This knot is (arguably) more secure than the Common Bowline against some forms of aberrant loading. However, it is much harder to untie after a heavy load. This may explain the popularity in some localities of the slipped-tail (**KALMYK-**) form (Wikipedia, 2025a).

To tie the basic form of **BOAS BOWLINE**, pass the end of a long tail through the bight of a Slip Knot (*ABOK* #44). This is the same as passing the end of a long stand through the bight of a Simple Noose (*ABOK* #43). Then capsize into the desired form. The long part forms the eye. If you pass the end of a tail through the bight of a noose (or the end of a stand through the bight of a slip knot) you will instead obtain a Common Bowline Knot. The direction of passage of the end through the bight determines whether the resulting bowline knot will be inside- or outside-tail. To make the slipped form, the final tail must be passed back through the nub appropriately (or a different 'fingertip' method applied to the whole tying process).

Other species can be envisaged. For example, starting with a slipped Figure Eight (*ABOK* #530) instead of Thumb Knot, gives an Inuit Bowline with collars around both the stand and the line that transitions between nipping structure and eye. The Inuit Bowline tail can be 'locked' in various ways. Weaving (analogous to Scott Safier's Simple Lock) to emerge beside the arm from the nipping turn has the added benefit of reduced jamming between U-turn collar and nipping turn after a heavy load (Smith, 1992).

Genus <u>Myrtle</u> (single eye from a nub with arms of the collar passing in opposite directions through the nipping structure)

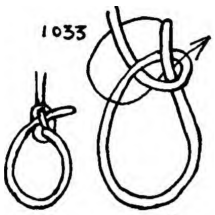
In some cases the Granny-like passage of the arms through the nipping structure creates a danger that the knot will slip or spill, so it is best to avoid this form entirely unless you have thoroughly tested the exact structure, and can reliably distinguish it from all lesser structures, under the proposed conditions of use. The name arose in an IGKT forum that may no longer be available.

Some multi-collar knots can be designed with collar arms passed in both bowline and myrtle fashion (*eg* 'Ampersand Bowlines'). They may be considered as a form of locked bowline, but this form is rarely used in practice.

TREE-SURGEON'S EYE KNOT *ABOK* #<u>482</u>

This knot is interesting because it includes a crossing-knot that provides both a collar around the stand and a primary nipping structure, plus a turn that transitions from the returning arm of the eye and (i) stabilizes the incoming arm of the eye, (ii) has a myrtle-like passage through the primary nipping structure and (iii) provides a secondary nipping structure. It is a complex dressing of an eye knot from 'Single Carrick' bend *ABOK* #1444. The knot requires careful dressing to attain the security implied by the name, and seems to be rarely used in practice today.

SINGLE CARRICK EYE KNOT *ABOK* #<u>1033</u>

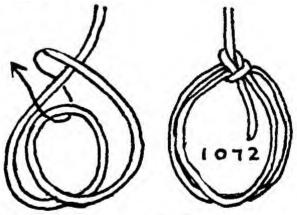


This is a simple dressing of an eye knot from 'Single Carrick' bend *ABOK* #1443. The (non-myrtle) eye knot derived similarly from the 'Full Carrick' bend *ABOK* #1439 is difficult to dress and pack securely. Common Bowline Knots have a faster tying method, and absence of slippery close relatives. These factors ensure strong preference for the Common Bowline Knot.

Genus <u>Multi-eye</u> (more than one eye, all of the structure that defines the Family of which this Genus is a member)

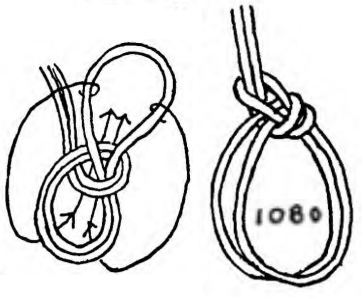
The PET status of multiple-eye bowlines is variable. Those based on the Portuguese Bowline structure (ABOK #1072) are PET, though the lock in Warner #444 is not.

PORTUGUESE BOWLINE *ABOK* #<u>1072</u>



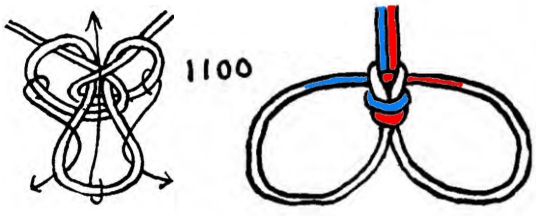
This knot (sometimes called the 'French Bowline') can be tied several ways, but in any case it requires care in use because cordage can slip easily between the eyes unless an appropriate 'lock' is added.

BOWLINE ON A BIGHT *ABOK* #<u>1080</u>



The form of 'Bowline on a Bight' (BOAB) shown as *ABOK* #1080 is TIB but not PET. In other cases (like the version of 'Bowline on a Bight' used for a climber's tie-in, Warner #437D) the first eye is PET and any subsequent eye is rewoven. The need to tie the first eye knot before passage of a subsequent eye 'around the post' makes the overall knot non-PET. It can also slip unless loaded on both stands, or loaded on both eyes. To ensure the former, if one end is short it is commonly joined to the stand using a Common Bowline Knot (*ABOK* #1075).

SPLAYED DOUBLE BUTTERFLY KNOT *ABOK* #1100

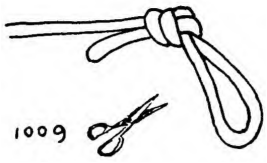


This dual eye knot is formed from the single-eye Lineman's (or 'True Alpine Butterfly') Eye Knot (*ABOK* #1053) and a very similar structure can be formed from the 'False Alpine Butterfly' dressing of the Englishman's Eye Knot (*ABOK* #1038). In either case, it is interesting that a double-eye knot which complies with the bowline definition can be obtained from a knot which is clearly not a bowline, but rather a typical member of Family Bightaceae. If relaxation of the nipping turn when load is removed from the eye(s) is considered important, the complex nubs might exclude these knots from Family Bowlaceae, but that property is difficult to define and test without ambiguity. As with BOAB, it is TIB but not PET. It is wise to load both stands, or if used as a terminal knot, the tail should be appropriately locked (*eg* by a strangle knot or bowline knot to the stand).

Family Bightaceae (eyes based on bights - the two arms of each eye enter the nub through the same aperture and in the same direction)

Knots in this Family are commonly TIB, but not PET. They can be formed with one arm of the eye through an object like a closed ring, but this requires that a foundation knot (such as a Thumb Knot or Figure Eight Knot) be tied first, then rewoven after passage of the wend through the ring. A single Genus (**Bighted**) may suffice.

OVERHAND EYE KNOT *ABOK* #1009

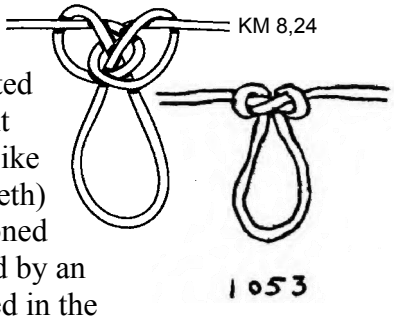


Widely used in small stuff, this knot is less often used in rope, because it jams after a heavy load.

FIGURE EIGHT EYE KNOT *ABOK* #1047

This knot requires a greater load to jam than the Overhand Eye. It is strong, secure, and easy to tie and recognize, so it is widely used in applications where resistance to jamming after a heavy load is a lesser priority. It also tests poorly-conceived definitions of bowline knots, as it can be envisaged to comprise a TIB nipping turn around the arms of the eye and a collar around the stand. The nipping turn must be bi-loaded under some conditions (to jam the knot as observed). Other structural features must be used in the definition of the Bowlaceae. Hopefully those provided above are sufficient. Knots that can be envisaged as partially rewoven Figure Eights have also been developed (*eg ABOK* #1043≈1057, 1058). Figure Nine species can also be tied, and may be stronger (Barnes, 1951; Merchant, 2007).

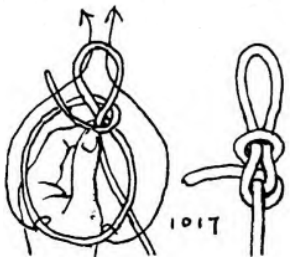
LINEMAN'S EYE KNOT *ABOK* #1053



This TIB knot (also called the "True Alpine Butterfly') is well suited to loads from different directions on the stands, so it is an excellent mid-line eye knot, in contrast with the Figure Eight Eye Knot. Unlike the Common Bowline, two hands (and for some people also the teeth) are required for tying. Security as a terminal knot has been questioned because of possible capsize and tail slippage, but may be improved by an effective lock. The arms of the eye sometimes are shown as crossed in the nub. This tends to arise after tying by 'twisted bight' methods, whereas arms usually are not crossed after 'across the palm' methods. A separate (and essential) cross-over in the nub of lines from the stands can occur anywhere from just inside the entry points of the stands

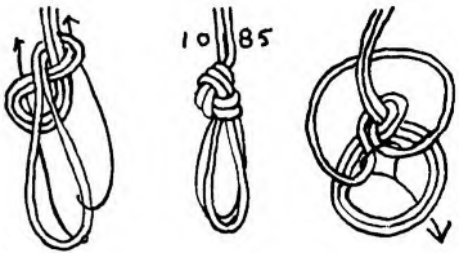
(preferred against jamming) to the opposite side of the knot. All variations can be interchanged by dressing, but most knots are left 'as woven', so substantially different structural forms may result. Whether these have different performance has not adequately been tested. For now, they are accepted with caution as sub-species. Other variations on tying methods (Grog, 2025; Lee, 2022) yield forms with double eyes that are parallel (dressed several ways; Gautman, 2025), counter (Nots, 2022), or splayed (*ABOK* #1100), and a bend, all reputedly excellent for their purposes. It can be tied (using an end; Masterson, 2023) through a ring or around a post (not PET), but the tying method is more error-prone. Lesser mid-line eye knots have also been developed (*eg ABOK* #1049-1052, 1054-1056, 1059-1061).

ANGLER'S EYE KNOT *ABOK* #1017, 1035



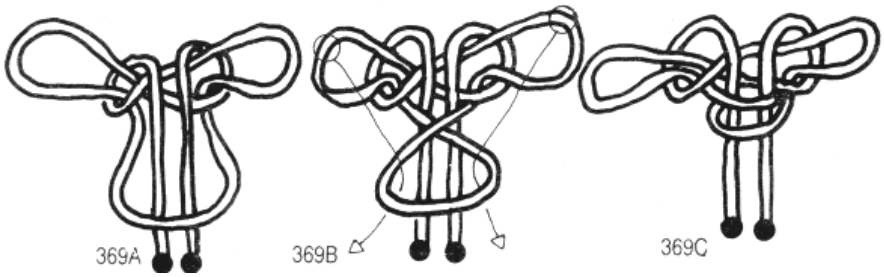
This TIB knot (also called the 'Perfection Knot') has stood the test of time better than most. It even holds securely in springy bungee cord and in slippery monofilament fishing line (though it has not enough friction to be safe in unsheathed HWMPE). It is good for straight lead of the stand into the eye in small stuff, when jamming is unimportant; but as a fisherman's eye knot it is probably inferior to the Figure Nine Eye (Barnes, 1951). One limitation is that this eye is hard to tie through a ring. Knots with some similarities have been developed (*eg* Double Dragons; Root, 2005), without compelling evidence of superiority, but possibly with increased friction and jam-resistance relative to the Angler's Eye Knot.

DOUBLE FIGURE EIGHT EYE KNOT *ABOK* #1085



It is hard to beat this knot (also called 'Bunny Ears') for two nearly parallel eyes that will not slip in most rope types, provided the stands are not to be splayed. It can be tied using a BOAB-like maneuver on an almost-completed Figure Eight Eye. If jamming is a problem, try a Splayed Double Butterfly.

SPANISH EYES KNOT *ABOK* #1087, Warner #368



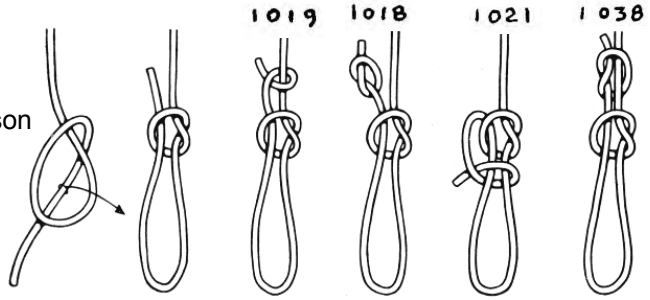
Once commonly called a bowline (which by the current definition it is not) this knot provides double splayed eyes. It can be tied by several methods (all of which are more difficult to remember than BOAB or Double Butterfly Eye Knots). An advantage is that it is less affected by unevenly loaded stands. It by can be 'locked' as in Warner #369 to reduce the problem of slippage between the eyes. The Sheepshank Eyes Knot (*ABOK* #1088) locked the same way must be dressed carefully, and probably remains less secure. Ashley explored many other multi-eye knots (Chapter 12), without indicating a clear preference.

Family Adjuaceae (eyes based on bights and directly adjustable in size through a lockable tail)

Svensson (1940) Fig. 46 showed how sailors used structures derived from a slipped Thumb Knot as adjustable 'standing eyes'. The foundation structure can be a Figure Eight Knot (eg Shaw, 1933 p. 102, *ABOK* #1042, Warner #286-288). Although the approach can be extended to nooses, this is

rarely used because security is low (Warner #290). The same forms are used by anglers and various others on land. After formation of the final stopper knot in the tail, the eye becomes fixed in size, in at least one direction. The eye may be passed around another solid to provide an open hitch, or a loose hitch if carefully adjusted. A single Genus (**Tailock**) may suffice.

STORE KNOTS (several species)
ABOK #1018-1021



from Svensson

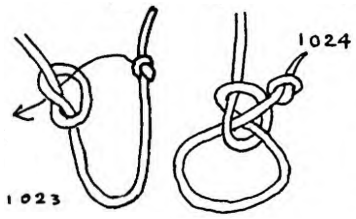
ENGLISHMAN'S EYE KNOTS
ABOK #1022, 1038, 1039

Possibly because of the engaging hitches, these knots have also been called 'True Lover's Knots' (a name given to various other knots). *ABOK* # 1038 can be dressed in various forms, one of which (also called a 'False Alpine Butterfly') resembles the Linemen's Eye Knot, but is inferior because it lacks the cross-over in the nub of lines from the stands. In consequence, it can too easily capsize into a weaker and less secure form (KM 96, 45-46).

Family Larmaceae (Eyes based on loops. The nub lacks a collar with arms that pass through a TIB nipping structure.)

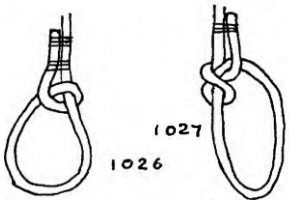
Several simple adjustable eyes fall in this Family, as does the Midshipman's Hitch when it is seized as a fixed eye. Some knotters may argue that Flagstaff Knots (*ABOK* #1987-1989) and capsizing nooses (*ABOK* #1991,1992) belong here because of their unusual loading. Other knots in this Family have been illustrated and probably tied (in error, or with blind faith in published illustrations). As an example, tie a rewoven Figure Eight Eye Knot, in which the re-weaving commences at the side of the foundation knot and finishes at the base (instead of commencing there). The reduced friction relative to a fully rewoven knot may be important in slippery cordage. Such errors may be dangerous if the inferior structures that result are not recognized on initial inspection. There is also a curious historical connection. A single Genus (**Loopeye**) may suffice.

HALTER AND BOWSTRING KNOTS *ABOK* #1023-1025



These adjustable loop eyes are a little harder to tie than the slip-bights in the Adjuaceae, but they have the advantage that the eye can not be lost by pulling it back into the nub. The choice of which space in the foundation knot to use for passage of the rethreaded tail may alter the resulting eye shape. Friction of the single tail is not so noticeably influenced by chirality as in the Granny Knot. Unless jammed in small stuff, adjustable eyes (in Family Adjuaceae or Larmaceae) are generally used temporarily and under supervision, because security depends entirely on the stopper knot in the tail. *ABOK* #1024 has also been used in lariats and called a 'Honda Knot'.

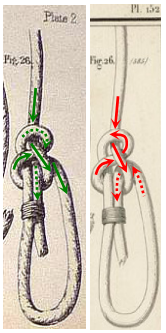
SEIZED EYE KNOTS *ABOK* #1026, 1027



TRUE BOWLINE?

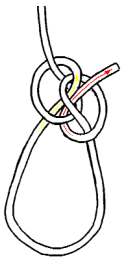
The illustration shown below first appeared in Émy (1842) Pl.152 as "*Nœud d'agui à étalingue servant hisser un home dans les manœuvres*". It was copied ambiguously in Bowling (1866) Plate 2 as "Bowline knot, for a man to sit in at his work"; questioned by Burgess (1884) with "This can hardly be called the true 'bowline' knot"; but called by Graumont and Hensel (1939-1952) "The True Bowline" albeit "not recommended". Blandford (1980) postulated it was

"likely ... used at the bow until it was superseded by the knot we now know". It is an insult to able seamen to suggest that they used such a knot for those purposes. They avoided forms like the Figure Eight Knot that would jam after a heavy load in rope, and are unlikely to have entrusted such critical work to a seizing with so little additional friction. The structure is not mentioned in any of the Seamanship manuals of the late 1800's, or by Haslope (1891), Shaw (1933), Svensson (1940), Day (1947), Warner (1992) or Turner & van de Griend (1996). Ashley (1944) dismissed it as an unnecessary complication of the Bowstring Knot (*ABOK* #1025). It is perhaps ironic that the Common Bowline Knot was probably used as a bowstring knot before adoption by sailors for ropes (Leslie, 1890).


Misdrawn Bowlines?

ZEPPELIN EYE KNOTS

There are multiple fixed eye knots with a nub structure like the Zeppelin Bend, but all are somewhat difficult to tie without mistakes. The most commonly cited example (Roo, 2015a) fits in this Family.

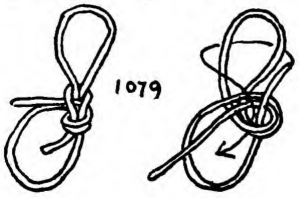

Zeppelin Eye

Family Heteraceae (multiple eyes of different structure as used to define other Families in this Order)

Because multi-eye knots can have several different eye types, a Family is provided for such heterologous structures, though they could also be considered to exist in several Families in a degenerate classification. A single Genus (**Hetereye**) may suffice.

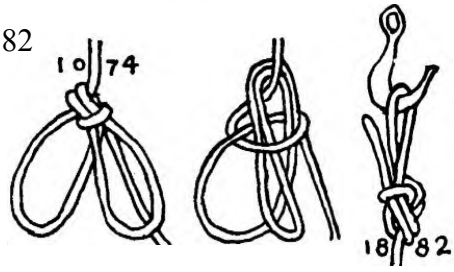
SISTER EYES *ABOK* #1079

Sometimes regarded as a curiosity with few practical applications, this knot does illustrate how easily a structure with two different eye structures may be formed.



BOWLINE WITH A BIGHT *ABOK* #1016, 1074, 1150, 1882

One form of *ABOK* #1074 has two eyes of different structure. But if the tail bight is ignored (or used in a lock), there is a single-loop-eye bowline. If the loop is drawn tight around the nub there is a single-bight-eye structure (*ABOK* #1882). There is some debate about whether the heterologous-eye or single-bight-eye form is better suited to the stated historical purpose of a knot to use on a hook when a heavy load is to be carried on the stand.



TRIPLE BOWLINE Warner #435

This may also be envisaged as a bowline tied entirely with a bight. If the tail bight is excluded from consideration, this seems to be the only bowline that is simultaneously TIB and PET. If it is not loaded on both 'stands', one should be secured to the other for safety. The tail may be locked as in a Common Bowline Knot; or advantage may be taken of the bight in the tail by locking it as shown in Warner #436 (not PET) or using another solid such as a carabiner (Cox and Fulsaas, 2003). Finally, the tail bight may also be used as a third (heterologous) eye. No eye knot can be simultaneously TIB and PET for all eyes.


435. Triple Bowline

436. Locked Bowline

Nooses

Order Noosales (eye knots that will slide along the loaded stand, changing the eye size)

A noose is a hitch around the stand, providing an adjustable eye. If a stand is folded into a bight before weaving of the wend around the stand, and provided the passage of the stand into that bight remains fairly straight, the result is a noose. A pull on the stand will reduce the size of the eye, and (if nothing is trapped) may either simplify / spill the knot (*eg ABOK* #1116 / 1118), or merely tighten the eye onto a part of the nub (*ABOK* #1124), depending on the pattern of weaving used to form the knot.

The eye of a noose may be passed around a solid to form a hitch (*eg ABOK* #1711). Some nooses are constructed so that they can be capsized (usually by a pull on the tail) into a fixed eye knot (*eg ABOK* #1831, 1987-1992). The reverse also applies: aberrant loading of some fixed eye knots can cause capsize into a noose (*eg ABOK* #1010). Because it is generally intended that a knot tied as a fixed eye should not slip, this is avoided by careful attention to loading directions or addition of locks that make the knot resistant to such capsize.

Practical nooses are intended to trap a solid in a shrinking eye, in use as a hitch or as a snare in hunting. This requires not too much friction between the nub and the running stand, or the eye will not shrink under reasonable load on the stand. However, the intended load may vary widely (*eg* a snare *vs* a gallows knot). A fixed eye knot the slides when capsized may be said to have "become a noose".

Any fixed eye knot or eye splice can form a noose (without capsize or slip in the nub) if the stand is passed though it as a bight (forming the eye of the noose) (*eg ABOK* #1117). It may be argued that this is a stacking of structures, because the nub of the fixed eye knot is not altered in the process. The Family is included here because it is one of the most common ways to form a structure with the function of a noose (and this order is defined primarily on function).

If the wend is folded into a bight just before final passage through the nub of a knot, the result is a slippery form of a knot (classified here as a sub-species of that knot). A pull on the tail to withdraw the bight will simplify the nub (*eg ABOK* # 1712), and may entirely spill a simple knot (*eg ABOK* #529). In some cases the knot is complicated to prevent an unintended spill (*eg ABOK* #243), but such complications inevitably interfere with the defining function of a slippery tail. Nooses and slippery forms of knots differ in whether the stand or tail leads directly to the 'running' eye. This has immense implications for knot function. Nooses tighten onto an underlying solid under a load on the stand. Slippery knots spill under a load on the tail.

A slippery knot should be used carefully to avoid unintended trapping of any solid when the tail is pulled. Sometimes it is difficult to distinguish between a tail and a stand. In such cases, it may be equally difficult to distinguish between a slippery knot and a noose. Both are sometimes called 'running knots'. A noose may also be formed with a slippery tail (*eg ABOK* #1115) for fast release, or with a stopper knot in the tail for increased security.

The multi-turn 'Hangman's Noose' is considered under the Order Coilales.

Family Homogenaceae (single stand emerges directly from the nub)

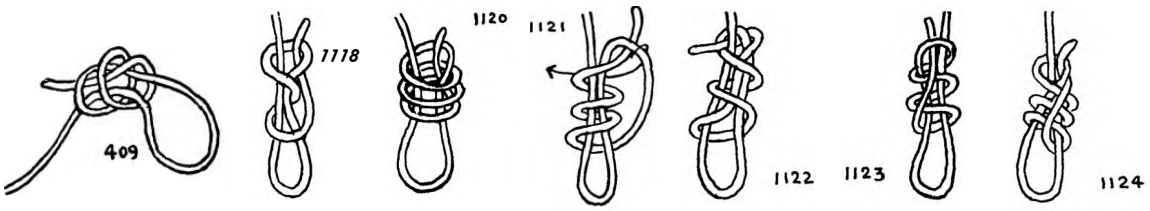
Genus <u>One-pass</u> (nub shows one pass of the line over the running stand)

OVERHAND NOOSE *ABOK* #<u>1114</u>

Genus <u>Few-pass</u> (nub shows two or three passes over the running stand)

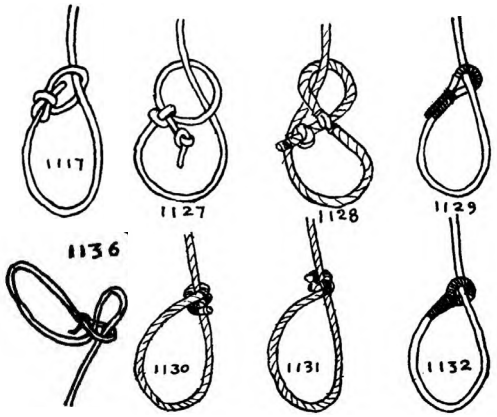
FIGURE EIGHT, POACHER'S, GIBBET, ICHABOD, GALLOWS, AND SCAFFOLD NOOSES
ABOK #<u>1116</u>, <u>409</u>, <u>1118</u>, <u>1120-1124</u>

These knots vary in the details by which turns are taken around the running stand, and whether the knot will spill if no other solid is trapped in the eye. The number of turns is variable, even for knots given the same name. It may be observed that the Scaffold Noose (*ABOK* #1120) is simply the triple form of the Poacher's Noose (*ABOK* #409).



Family Bieyaceae (single stand emerges through an eye knot: bight and eye)

Any eye (a fixed eye knot, another noose, a spliced or seized eye) may be employed as the base for a noose in this Family. A single Genus (**<u>Reeved</u>**) may suffice.



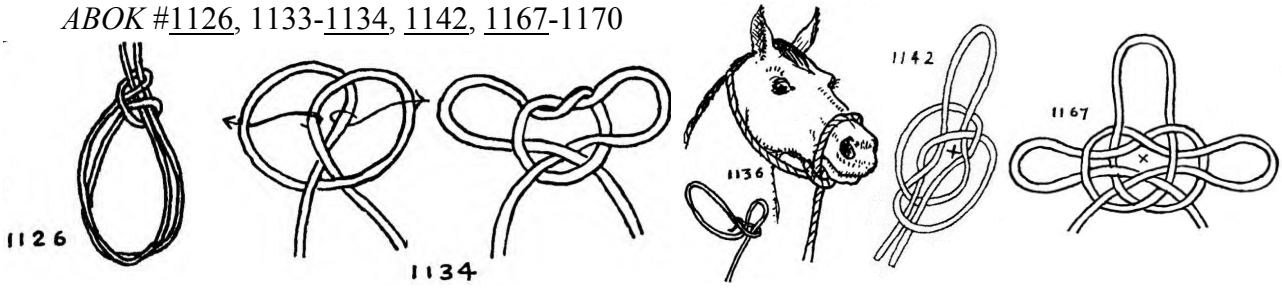
eg **RUNNING BOWLINE, LARIAT** and **CLINCHES**
ABOK #<u>1117</u>, <u>1127-1132</u>

Nooses are often useful as hitches, and the outside clinch probably tightens closer onto the underlying solid than any other hitch. It is the 'Bouline Knot', used this way on bowline ropes in the age of sail.

Family Munooaceae (multiple stands and eyes)

Practical nooses with multiple eyes generally have homogenous nubs, though the eyes may have diverse structures. The stands of Jug Sling and Masthead knots commonly are joined to make another eye; after which these knots may be regarded as providing adjustable eyes of fixed total length. They serve perhaps more often as tying challenges than as practical knots. With minor tweaks to the classification, most multi-eye nooses could be lumped into the Genera above, but many practical users probably think first about the number of eyes needed to solve a particular problem, so a separate Family is used here. There are various ways to obtain multiple noose eyes, but only a few are in practical use and a single Genus (**<u>Plurinoose</u>**) may suffice.

eg **GIRTH**, **HANDCUFF**, **JUG SLING** and **MASTHEAD NOOSES**
ABOK #<u>1126</u>, 1133-<u>1134</u>, <u>1142</u>, <u>1167</u>-1170



The **HALTER NOOSE** (*ABOK* #1136) is unusual in deriving from the Bieyaceae. It is shown here for comparison with *ABOK* #1142, said to be useful as a hackamore with two reins.

Bends

Order Bendales (joining two or more lines or regions of a line; provided that this requires a structure such as a bight or loop in each)

Bends involve intact cordage, whereas shroud knots and splices (which are generally more secure, and often intended to be more permanent) involve separation of multiple cordage parts before lines or regions are joined. Ashley (1944) equivocated in several distinctions: he included among bends various interesting 'joining' structures that required the separation of cordage components (*eg ABOK* #1480-85, 1489, 1491); multiple turns like lashings (*eg ABOK* #1486, 1487, 1512, 1513); and devices that are not knots (*eg ABOK* #1525-1528, 1531-1537, 1540, 1542-43).

Bends provide many examples of the design of knots for particular uses. It is common to find that lines must be joined to provide the required length of cordage, or to complete a binding. So ease of tying is generally appreciated, but other (sometimes competing) demands arise in particular circumstances. For example: is the cordage stiff or brittle? Must the bend pass through an aperture, over other rigging or over a ledge? Will the bend be subject to heavy or cyclic loading? Are critical loads to be supported or secured? Is the bend to be untied for re-use of the cordage? Except in small stuff, bends typically are intended to be untied, so structures that jam under load are avoided.

Modern knotters too often forget that tails traditionally were seized to stands, or to arms in eye knots, to improve security (*eg ABOK* #1011, 1461). A few tucks sometimes were used after or instead of a bend (*ABOK* #1485). Stopper knots are commonly added today (instead of seizings) as 'locks' to add friction and improve tail security.

Many bends are less secure if the joined lines differ in diameter or other properties. When in doubt, it may be preferable to join disparate lines by interlaced eyes, provided these eyes will not slip. Such interlaced eyes may be considered as a stacking of knots without an alteration to nub structure. They are included here because this is one of the best ways to join lines of very different diameter.

There are data-free observations that chirality can affect both the strength and security of some knots in laid ropes, but sometimes these are contradictory (*eg* Bushby, 1902-26; Ashley, 1944, Day, 1947; Admiralty, 1951; Chisnall, 1995; reviewed by Warner, 1996). In the few cases with any reported quantification, the effect was around 20%. Usage of 'lay' (and twist) as a direction in ropes varies between languages, and may have been 'lost in translation' (Svensson, 1940, pp. 22, 26, 48, 52). Sometimes the meaning can be understood from illustrations, but these are rarely provided. Too often, the 3D chirality of loops/turns/helices in rope is confused with the 2D chirality of the clock face. With loops, we must specify 'clockwise underhand' (= Z or RH) or 'clockwise overhand' (= S or LH) to reveal chirality and whether this is with (matching) or against (opposite in chirality to) the lay of the strands in the rope. Until there are compelling data in various rope types, or a trend that supports a tested hypothesis about mechanism, the uncertainty remains. It is part of the reason that prudent knotters use long secured tails and large safety factors (if bends must be used) in the many locations around the world where laid ropes are still used in critical applications.

Interlocked bights, loops and thumb knots are common core structures in bends. The lines in a bend must interlock, so 'bight' in this context is taken to include a U-turn around either line, and 'loop' is taken to include a (full) turn around either line.

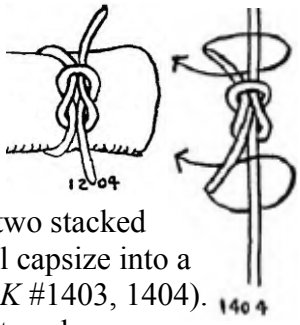
Carrick Diagram

Family Cardiaceae (including a core structure in which lines can be represented as only simple loops/turns or bights/U-turns, able to be projected as a 'Carrick Diagram')

Many of the knots that can be tied on a 'Carrick Diagram' change to a different form when tightened. The 'Carrick' form is useful for classification, because it is easily

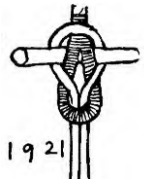
established when the nub is loosened slightly. The reference to a 'core structure' allows elaborations such as Double Sheet Bends and Simple Simons to be included in this family, which aligns with the way knotters typically view such knots (*eg* "Sheet Bend variants"). But the original 'core structure' may be hard to discern after sufficient elaboration (*eg* Vice Versa bends); and the distinction may become a matter of judgment, combined with other features including pattern and length, in plaited bends.

Genus Bighted Carrick (at least one line in the core structure can be arranged as a bight)



REEF KNOT (two bights interlocked with the arms of each bight passing in the same direction through the aperture of the other bight, and with tails, if present, *cis* -- on the same side) *ABOK* #1204, 1402

Also called the 'Square, Flat or Sailor's Knot', this has been used widely as a binding hitch (*ABOK* #1204) rather than a bend. It is tied as two stacked half knots of opposite chirality. If one bight is straightened, the other will capsize into a Girth Hitch. For use as a bend, the tails should be seized or locked (*ABOK* #1403, 1404). Unlike many others in this Family, the Reef Knot remains flat when tightened.

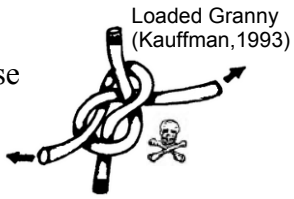


A form with bights provided by one or more straps or slings has been called an **EYE TO EYE BEND**, and may be toggled for ease of tying or release (*ABOK* #1493, 1494, 1495, 1921, 1923, 1924). Eye-to-eye connections can be very secure as neither line has a tail that can slip through.

THIEF KNOT (two bights interlocked with the arms of each bight passing in the same direction through the aperture of the other bight, and with tails *trans* -- on opposite sides) *ABOK* #1207

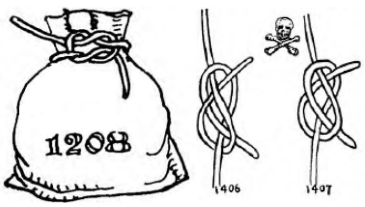
Obviously related to a Reef Knot, but harder to tie and more prone to slip, so rarely used in practice as a binding hitch; and hopefully never as a practical bend. Thief and Reef forms cannot be distinguished if the stands and wends are not distinguishable from each other, as in netting knots.

GRANNY KNOT (two bights interlocked with the arms of each bight passing in opposite directions through the aperture of the other bight, and with tails *cis* in flat form) *ABOK* #1206, 1405



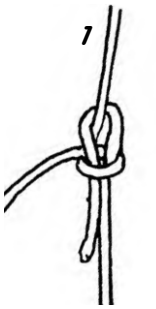
Less reliable than a Reef Knot, and often tied in error (by failing to reverse the chirality of the stacked half knots). The Granny (or Lubber's) Knot is often illustrated as a flat knot with interlocked bights and *cis* tails, but under a load (if it does not slip apart) it twists into a knob with interlocked loops at an angle that can give the appearance of *trans* tails. It is prone to slip or jam under load, especially in laid rope, depending on chirality. This is because chiral variants in directions of the loops and the helix of the laid cordage influence friction at cross-overs.

WHATNOT (two bights interlocked with the arms of each bight passing in opposite directions through the aperture of the other bight, and with tails *trans* in flat form) *ABOK* #1208, 1406

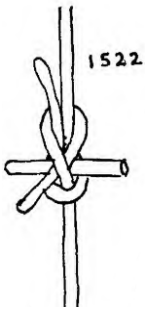


Like the Granny Knot, the Whatnot capsizes under load, and it is even more treacherous as a bend. Especially when tied with short tails, the ends are prone to be twisted or capsized into a form (sometimes called Whatnot 2 or **GRIEF KNOT**, *ABOK* #1407) that slips under load. The two 'Whatnots', having different structures (and forces under load) in the nub, are separate species. Neither is considered practical in cylindrical cordage, but see Grass Knot.

SHEET BEND (single bight and single loop/turn interlocked, with the stand of the turn component passing through the bight) *ABOK* #1, 1431



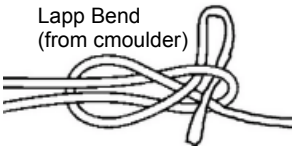
The loop passes around the arms of the bight, and thus becomes a turn arranged into a half hitch. This is the most common asymmetric core structure in knotting. It is used frequently in weaving (*ABOK* #2, 1418), but the friction is insufficient to be trusted alone in synthetic rope (Birch, 2020c). Provided the cordage is not slippery, it can be used with thicker cordage in the bight component. Unless seized, a bight that is too thick or springy can straighten, flipping the turn into a half knot around its own stand, and spilling the knot. When one line is springy, or if lines vary substantially in diameter (as in use of a 'messenger' to haul a heavier line), it is safer to use a Racking Bend or interlocked eye knots that are themselves secure in the cordage.



Two forms, with *cis* (direct, *ABOK* #1431) *vs trans* (oblique, *ABOK* #1432) tail orientations can be differentiated as sub-species. This alignment affects whether the load from the stand of the turn falls first on the stand or tail of the bight. Although *cis* tails are generally preferred, the advantage seems to depend on the composition of the cordage, and tail orientation may have less effect on function than in Reef Knot relatives or the Carrick Bend. Under load, the tail of the bight moves across the front of its stand in the *cis* but not the *trans* Sheet Bend. Both orientations tend to jam after a heavy load, unless toggled (*eg ABOK* #1522).

If the bight component is an eye splice or fixed eye, the knot may be known as a **BECKET HITCH** (*ABOK* #1900). This is more secure as the bight has no tail that can slip through the knot. The distinction becomes tenuous when the bight is seized (*ABOK* #1434). The T-Bend (Warner #403) is loaded on both ends of the turn. When the stands and wends cannot be distinguished on either line, the Sheet Bend becomes the most widely used Mesh Knot or Net Knot (*ABOK* #402). It is also possible to multiply the bight line (or the loop/hitch line) to form Multiple Sheet Bends (*eg ABOK* #1497, 1499, 1501) or Swab Hitches (*ABOK* #1901). It can be formed as a Short-End Bend (*ABOK* #1473, 2005, 2562) or a Flagstaff Knot (*ABOK* #1988). It is the nub of the Common Bowline Knot (*ABOK* #1010). On a hook it is called a Blackwall Hitch (*ABOK* #1875) or Bill Hitch (*ABOK* #1879), though these are unstable unless loaded.

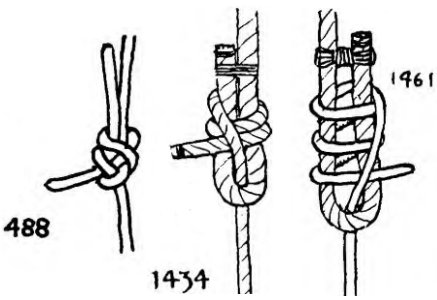
LAPP BENDS (sheet bend structures with the load placed on what is normally the tail of the loop/turn, thus serving as the stand) *KM* 38, 23; *KM* 101, 14-15; Warner #427



Another way to state this is that only the tail of the turn passes through the aperture of the bight. Typically this form is used with a slipped tail for fast and complete release. If not tied on an eye, the loaded parts (stands) in flat form should be *cis* (as will be the tails). This puts maximum nip from the loaded turn on the tail of the bight. Multiple turns may increase security. They have also been known as 'Girdle Knots'.

Haslope #38 may be viewed as a complicated weaving derived from a modified Lapp Knot or Sheet Bend structure. It is secure, but too complicated for common use. *ABOK* #493=1419 has a Granny-like passage of the turn.

Various **MULTIPLE SHEET BENDS** (sheet bends with loop/turn extended in extra twists, or turns in helix or grapevine form, around the arms of the bight) *ABOK* #488, 489, 491, 1434, 1435, 1436, 1438, 1461; Warner #419, 422



Several weaver's knots are related to this group, or to Enhanced Sheet Bends. These include dressing variants and forms with different weaving of the lines. A case can be made that each has a distinct structure and should be distinguished as a separate species, or that some are subspecies that may interchange under a load. **DOUBLE SHEET BENDS** are more secure, and better with ropes of uneven diameter, then their single cousins, but still to low in friction to be trusted in many synthetic-fibre rope constructions.

SIMPLE SIMON BENDS (reef knot with additional turns around the arms of one bight) *KM* 6, 15; *KM* 131, 17-18; Asher #79, 80


Simple Simon from Asher (KM 6)

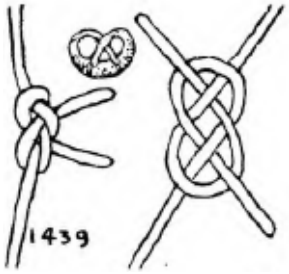
Originally described along with Vice Versa bends as "decorative", they are rarely used in traditional cordage but may be useful because of greater friction in some synthetic cordage.

Genus Looped Carrick (both lines in the core structure are constrained into loops/turns)


1446

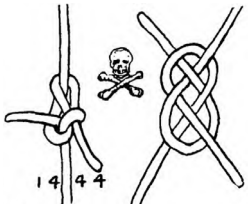
Whereas the tails of the Reef Knot, Granny Knot and Sheet Bend can be arranged to give the appearance of loops in a Carrick Diagram (*ABOK* #1440-1442), the tails of a (full) Carrick Bend are constrained by weaving from moving into the appearance of a bight.

CARRICK BENDS (two loops interlocked with alternating over and under weaving throughout) *ABOK* #1439


1439

Two forms, with *cis* (*ABOK* #1428) *vs trans* (*ABOK* #1439) tail orientations in the flat form of the knot can be distinguished only if the stands are distinguishable from the wends. They may be differentiated as separate species (**JOSEPHINE KNOT** vs **FULL CARRICK BEND**) or as sub-species. This alignment has less effect on function as a bend than in Reef Knot relatives, but more than in the Sheet Bend. Seizing into the flat form substantially improves the strength of the knot in ropes of large diameter, and may be called a **HAWSER BEND** (*ABOK* #1446). Especially in smaller ropes, the knot may be used without seizing, in which case it will draw up into a more compact but secure and fairly jam-resistant form after a little slippage.

The confusingly-named **OPEN CARRICK BEND** (*ABOK* #1448) is a different knot sometimes illustrated for use on hawsers. Some related knots (*ABOK* #1450-1453) also pull up into 'easy loops' suited to large hawsers, and one (*ABOK* #1451) has been dubbed the 'Corrick Bend' (see below). None of these knots fits a Carrick Diagram.


1444

Various knots comprising interlocked turns, with at least one deviation from alternating over and under weaving, that can be drawn onto a Carrick Diagram have been called **SINGLE CARRICK BENDS** (*ABOK* #1443-1445). Some of these can be dressed with the appearance of one bight (which would formally place them in the previous genus). They have various weaving patterns and loop/turn chiralities, resulting in different structures (and forces under load) in the nub. All should be avoided. There are several different species of such 'Single Carrick Bends', but none is considered practical unless seizings are added.

ENHANCED SHEET BENDS (twin loop derivatives of Sheet Bends) *ABOK* #486, Warner #422

If the bight of a sheet bend is twisted, it forms a loop; which becomes an added turn when threaded by the stand in an "Enhanced" Sheet Bend. As only the bight component is altered, there are as many "Enhanced" species as there are Sheet Bend variants.

VICE VERSA BENDS (twin loop derivatives of Simple Simons) *KM* 6, 15; Asher #84

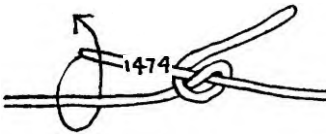
Vice Versa Bends are symmetrical derivatives of Simon Bends. *ABOK* #1450 is related. Several different species may be of interest for jam-resistance or greater friction in some synthetic cordage.

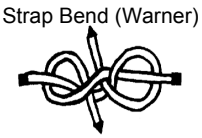

Vice Versa from Asher (KM 6)

Family Crossaceae (lines wound around each other in simple crossing knot and/or half hitch formations only, and not fitting a Carrick Diagram)

A single Genus (**Noncar**) may suffice, or the family may be split into several Genera based on the structures formed by each line.

PARCEL and **HARNESS BENDS**
ABOK #1227, 1420, 1421, 1474; Warner # 48



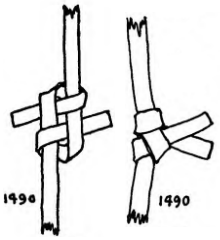

Strap Bend (Warner)

These knots are convenient for tying parcels and the like because they can be made under tension. They are secure in small stuff; but they tend to jam. Other stacked knots can be used similarly (eg *ABOK* #1475-1477). Warner remarks that the version based on a crossing knot and half hitch is well suited to flat or stiff materials, so he calls it the 'Strap Bend'.

REEVING-LINE BENDS *ABOK* #1459, 1460

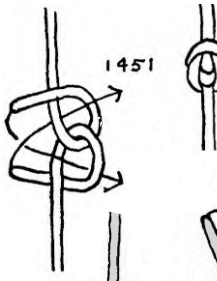
These knots rely on seizings for security, but they are of interest because they gain strength from the half hitches, while remaining slim enough to pass through hawse pipes. Many other 'hawser bends' also rely on seizings for security (see *ABOK* #1447-1449, 1456-1458).

GRASS BEND *ABOK* #1490



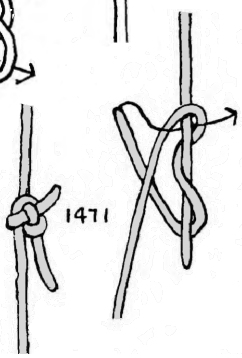
Cordage improvised from grasses or canes may be flat, stiff, and brittle if folded too tight. Some materials can be softened (*eg* by soaking or steaming) to allow simple knots without breaking. The Whatnot (*ABOK* #1406) finds a use as a knot for flat material. Although the 'Carrick' form of *ABOK* #1406 is obvious in rope, it is not obvious (or tied this way) in flat material. Nor are the ends likely to change spontaneously to the dangerous form of *ABOK* #1407 in flat material, but caution is still warranted. Thus a Tape Knot (*ABOK* #1412) may be safer if the material will tolerate it.

CORRICK BEND *ABOK* #1451



Perhaps more of a curiosity than a practical structure, it tends to slip until drawn into correct form as an interlocked turn and crossing knot.

CAPSIZED BENDS (Bends initially tied with one line [as hitches], then drawn tight to capsize and involve the other) *eg ABOK* #1471



Depending how it is drawn up, *ABOK* #1471 may remain as a hitch around a straight line. This provides substantial friction but may pull under load. Bends in some other Families can also be threaded initially as hitches (*eg ABOK* #1473). Formation by capsize makes not a separate family.

Family Snakaceae (at least one line wound in a repeating 'under and over' pattern around the other, nub too complex to fit a 'Carrick Diagram')

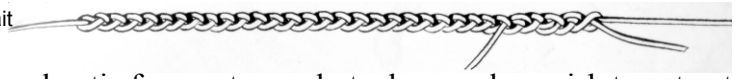
Genus Racked (lines of substantially different size, with the smaller line wound in a 'figure eight' pattern around the other)

RACKING BEND (one line can be arranged as a simple bight) *ABOK* #1462

When a 'messenger line' of small diameter must be used to haul a line of much larger diameter (such as a hawser or lifeline) the bend that joins them must be quick to apply and remove, and secure for the duration of the operation, in lines with very different properties. Most bends are unsuitable, because the larger line tends to spring open, pushing the turns of the smaller line back onto its own stand. The racking bend draws closed the bight in the heavier line, and resists slippage while remaining easy to untie. It is the best knot for the purpose, especially if the tail of the smaller line is further secured to the stand of the heavier line.

Öhrvall's Heaving-Line Bend, *ABOK* #1463, has been proposed as an alternative (and would be classified in Family Crossaceae), but it is harder to remember the weaving.

Genus Plaited (lines of similar size woven in a repeating pattern, nub elongated with turns near each end)

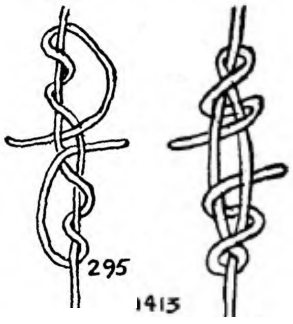


These knots are too unwieldy to tie and untie for most uses, but when anglers wish to extract the maximum possible breaking strength from lines (and pass through a runner) they may use a long plaited bend. A similar approach has been used to join laid rope to chain (*ABOK* #1517). The length at which these structures cease to be regarded as bends (but rather as braids, plaits, sinnets, splices or lashings) varies with the application (*cf ABOK* #572, 1430). Structures in rope with more than three turns around one axis fit, in this classification, in Order Coilales. Shorter versions have been tied as Sennit knots in rope (Wright & Magowan, 1928; Root, 2010) with a structural relationship to the Vice Versa bend that is not obvious when tightened. Extended (decorative) forms of the Carrick Diagram have also been used (*eg ABOK* #1429, #1548).

Family Muturaceae (each line forms multiple turns, with tails emerging from a central aperture)

A single Genus (**Stomoura**) may suffice.

CHAYTOR BLOOD BENDS (each line forms multiple turns around the other) *ABOK* #295, 1413



This is the strongest bend other than a plait that has been developed for joining lines of small stuff including fishing line. When the tails are trimmed short it is streamlined through the water. It is seldom used in rope, possibly because the stand is more prone to damage during tightening in rope, which removes the strength advantage (Barnes, 1951). There are many variations on this structure, including the number of turns made in each line, the chirality of the turns in each line, and whether the wends cross before becoming the tails. Knots made by 'outcoiling' (*eg ABOK* #295) or 'incoiling' (*eg ABOK* #1413) are equivalent in structure when set in slippery cordage. In nylon monofilament at least, providing care is taken not to damage the line before the knot is set, there appears to be little difference between them in performance (Barnes, 1951).

Historical Aside

Ashley (1944) wrote that the term Blood Knot applied to Multiple Thumb Knots in the thong of a whip (*ABOK* #508) and he used the name Barrel Knot for #295 and #1413.

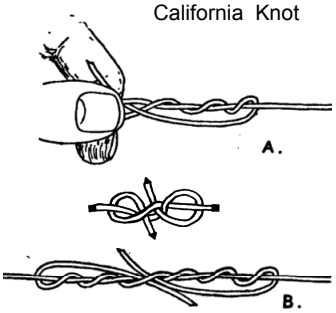
Barnes (1951) observed that for hundreds of years (multiple) Thumb and Figure Eight knots tied in whip thongs had been called 'Blood Knots'.

As noted above, these stopper knots also make effective hitches, especially in small stuff. It is probably no surprise that some anglers knew these hitches (through a ring or the eye of a fish-hook) as 'Blood Knots'.

First publication of the line-joining bend sometimes called a 'Blood Knot' is usually attributed to Chaytor (1910), but it was shown earlier by Church (1907) as the 'California Knot', and used much earlier (*Fishing Gazette* 55, 220).

California Knot

Chaytor imagined it as being based on interlocked multiple Figure Eight knots (with one more twist than a Stevedore knot), and he called it a 'Double Blood Knot' shortened to 'Blood Knot'. *ABOK* #295 is illustrated with one less twist, so it might be imagined as interlocked Stevedor knots.

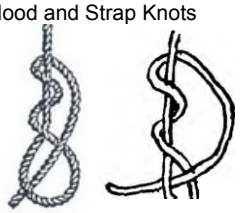


Resemblance between Blood and Strap Knots

Warner (#48-49) formed a clearer picture how the lines interlocked, noting that the Chaytor Blood Knot is an extended Strap Bend.

In any case, Chaytor called it a Blood Knot, and the name caught on, at least in Britain.

So anglers now called their hitches (like the unnamed *ABOK* #300) 'Half Blood Knots'. But for some variants (*eg* those with two turns through the eye) they reverted to 'Blood Knot' (Wilson, 1990). American anglers were inclined to call these 'Clinches', though that name had long been taken by sailors for seized turns (*ABOK* #1130, 1131).



Resemblance between Blood and Stevedor's Knots

The name 'Barrel Knot' (which Ashley used for Chaytor's Blood Knot) was used by Barnes (1951) for the Grapevine Double Fisherman's Bend, and by Merchant (2007) for a double overhand noose, which Ashley called a 'Poachers Knot'(*ABOK* #409). Currently 'Barrel Knot' is sometimes applied to the Triple Fisherman's Bend, or to any stopper knot based on Multiple Thumb Knots, or even to the half-knot arranged to hoist a barrel (*ABOK* #2176).

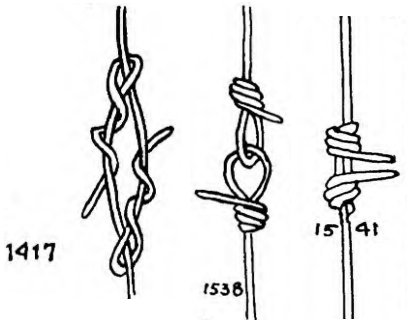
To complicate matters, Ashley (1944) called the Grapevine Double Fisherman's Bend a 'Grapevine or Double English Knot'(*ABOK* #1415). Ashley did not show the open form of this knot, which Barnes (an Englishman) distinguished from the grapevine (Barrel) form as the 'Double Fisherman's Knot' (Barnes, 1951 p. 229) and Warner (an Australian) called the 'Wolf Knot' (Warner #110). Others have equivocated (Blandford, 1980 pp. 62 *vs* 213).

If you are not confused by all this, you probably do not agree that there is a need to agree on a unique name for each knot species, and above all to avoid the situation where the same name is used for different knot species.

Those needs are fundamental to the present work.

WIRE BENDS (each line forms multiple turns around itself)

INTERLOCKED TIMBER HITCHES *ABOK* #1417



This bend is useful in flexible cordage and in light-gauge wire.

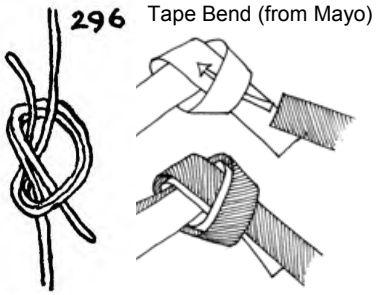
For joins (perhaps not knots) used in heavier wire, where ends need not be constrained but riding turns are typically added, see *ABOK* #1538,1541.

Family Thumbaceae (each line forms a Thumb Knot or Figure Eight Knot)

Genus Ring (nubs rewoven with stands opposite for inline forms, or with ends laid together and tied as one for offset forms)

Rescue agencies will not use any knot from this Genus in rescue ropes, which are strong but often stiffer and slipperier than traditional cordage, and sometimes used to suspend heavy critical loads.

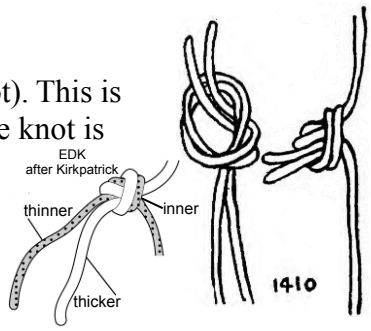
RING BEND *ABOK* #296, 1412



Also called a 'Water Knot' (one of several knots known by this name). Although it is a little cumbersome to tie as a re-threaded Thumb Knot, this structure has found a new use as the **TAPE BEND**. It has been used to make a sling from a length of flat or tubular nylon webbing. The knot should then be dressed carefully so that all parts are flat, and tightened with long tails. This will be weaker than a professionally-sewn sling, and unsuitable for lower-friction materials. It should not be tied in ends of different size or composition. The knot is likely to jam after a heavy load.

Some fishermen (but not surgeons) use the name 'Surgeon's Knot' for the version based on doubled Thumb Knots (not *ABOK* #463). There are other ways to rethread single and multiple Thumb Knots, but most are more decorative than practical (*eg ABOK* #1426, 1427). Some climbers prefer dual EDKs in tape.

OFFSET OVERHAND BEND *ABOK* #1410



Also known by some climbers as the **EDK** (European Death Knot). This is the knot tied by most binding machines. Easliy tied, but weak, the knot is nevertheless appreciated by some abseilers (rapellers) for ease of retrieval over ledges. Various modifications have been proposed for this application, including use of a Grapevine-form Double Thumb Knot, backup by a second Thumb Knot, or an added turn of the one or both lines through the nub. If used at all, the knot should be carefully dressed, with long (30 cm) tails. If one line is slightly thinner it must lie 'inner' (closer to the stands).

It is interesting that Ashley reported that this knot in laid mohair yarn was 50% more secure against jerks when the chirality of the spine in the Thumb Knot matched that of the laid yarn (tied with the lay, *ABOK* #1558). In contrast, Svensson (1940, p52) appears to prefer opposite chirality (as in coiling rope, and as in the more reliably jamming Granny knot). It probably matters not in achiral rope, but reminds us to question: "Security in what, against what, ... ?"

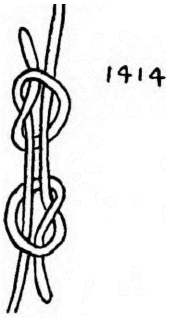
FIGURE EIGHT FORMS

The Figure Eight form provides more friction than the Thumb Knot. It is a little harder to tie, but it can be a little easier to untie after a moderate load. When used as an inline bend, the Figure Eight form is sometimes called the **FLEMISH BEND** (*ABOK* #1411), but there are many subtle variants (Xarax, 2010). A DF may be slightly stronger and is generally preferred in critical applications.

The Offset Figure Eight Bend can flip repeatedly under load, rapidly consuming even long tails. It should never be used.

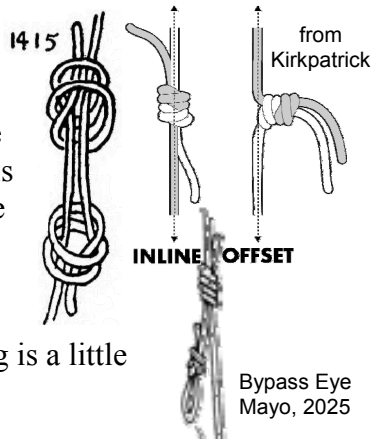
Genus Fisherman's (Bends tied in each line around the stand of the other for inline forms, or with ends laid together then stacked knots tied using each line around the end of the other for offset forms. Who can say if a fisherman invented them?)

FISHERMAN'S BEND *ABOK* #1414 (not hitch *ABOK* #24)



The (single) Fisherman's Bend (SF) has many names from a long history of use in natural-fibre cordage. It has too little friction to be reliable in more slippery cordage, but remains of interest as the basic member of a series that includes structures which remain useful. It consists of a Thumb Knot tied by each line around the stand of the other. The two Thumb knots should be tied with the same chirality so that they will 'stack' snugly under load. Day (1947) reported that the bend was 20% stronger against steadily increasing pull when the Thumb Knots were tied against the lay in ~1/2" manilla yacht rope.

DOUBLE FISHERMAN'S BEND *ABOK* #1415



The Double Fisherman's Bend (DF) tied in Open Form leaves the belly outside the nub and exposed to excessive wear, so the knot is almost always tied in Grapevine Form. This is a strong and secure bend, preferred in rescue work where these virtues outweigh the difficulty of untying, and the tendency to jam after a heavy load. Tails may be taped to pass through a rescue pulley, or used for a bypass eye. The knot can also be used in offset form, though tying is a little more difficult and strength is much lower than the inline form.

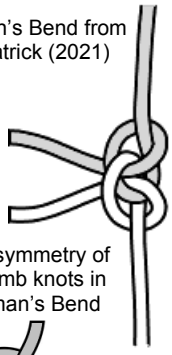
There is also a triple form (TF), sometimes used if ropes are slippery or slightly different in diameter. A Figure Eight version (*ABOK* #1416), has no advantage under most circumstances.

Genus Interlock (Thumb Knots interwoven through one or more of their lumenal spaces)

Ashley explored bends based on interlocked Thumb Knots (*ABOK* #1408, 1409, 1426, 1452,1453) and another form was added in the corrections (*ABOK* #1425A), but the two best forms were missed. In 'the best' cases, at least one wend interlocks through the ***s*** and/or ***r*** space of the opposing Thumb Knot (though this may not be obvious during tying).

A problem for this whole genus is that there are so many permutations of Thumb Knot chiralities, apertures and directions to thread. In some cases there are alternative (stable) dressings. It is easy to make a mistake. Some of the results look 'right' at a glance, but are inferior or downright dangerous. The Lineman's bend tied by an eye method is probably the least error-prone, though a risk still exists in at least some eye methods. As Ashley warned in *ABOK* #1424 "*Unless a bend, requiring (this) many crossings ... possesses some particularly desirable feature beyond other bends, it is of interest only if it is decorative*".

LINEMAN'S BEND Day, 1947 p. 56; KM 37, 22; Toss, 2016 pp. 74-75

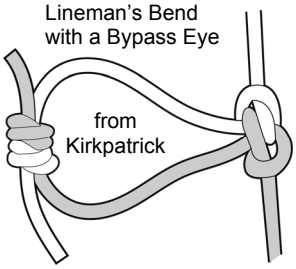

Lineman's Bend from Kirkpatrick (2021)

This asymmetric knot has also been named the '(Alpine) Butterfly Bend' and the 'Strait Bend' (by Brion Toss, who published it after Cyrus Day and Phil Smith). Those who have learned to tie the Lineman's Eye Knot (*ABOK* #1053) readily can use the same method to tie the bend. In fact, if the ends of the lines to be united are first joined (even temporarily), subsequent tying of the Lineman's Bend by an eye method (Grog, 2025) will reduce the possibility of mis-tying an inferior knot due to confusion when threading free ends.

The unusual asymmetry of interlocked thumb knots in a (loose) Lineman's Bend

For inline use, the result is a little less strong than a DF, but without retying it works like an offset bend, where it is stronger than the DF. It is also much easier to untie after a load. The tails should be long to ensure security, and joined by an additional knot if the ropes are slippery. In climbing or rescue work, an eye is often provided at any bend (to clip into during bypass of the bend). The knotter must assume that any eye might be used to clip in, so it must be safe for this purpose. A Lineman's Bend tied with a DF near the ends will meet both needs.

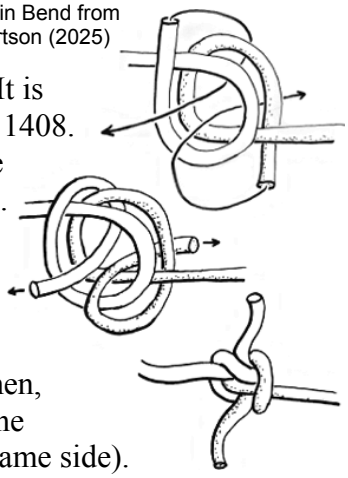
Lineman's Bend with a Bypass Eye from Kirkpatrick



Overall, perhaps the most versatile of secure bends.

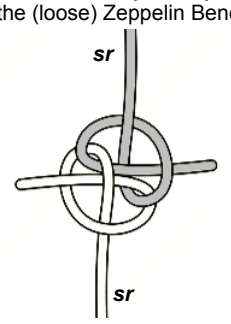
ZEPPELIN BEND Wikipedia (2025b); KM 51, 6-7

Zeppelin Bend from Robertson (2025)



This knot was also presented by Desmond Mandeville as the 'Poor Man's Pride' and by Bob Thrun as an 'Easily Untied Bend'. It is not in *ABOK*, though some people see similarities in #582, 1062 or 1408. Many people find it hard to learn or remember without frequent use (so it may fail the first requirement of a widely-used practical knot). It must also be tightened in a sequence (Birch, 2020c), but it may be worth the effort. The two interlocked Thumb Knots have different chiralities (which may help to remember the '69' or 'bq' tying method). There is a variant in which the wends cross before emerging as tails. Structure, including the passages through the lumen, differs from similar but lesser bends. Beware the mistake of tying the inferior 'False Zeppelin Bend' (same chirality start, collars on the same side). Alas, the 'false' method is sometimes taught as the 'Zeppelin Bend'.

The unusual symmetry of the (loose) Zeppelin Bend



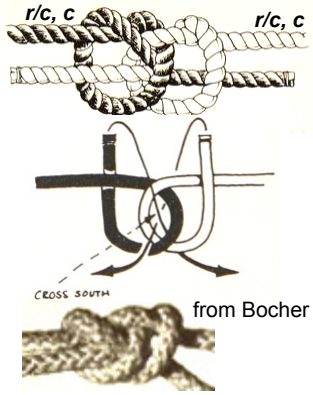
The Zeppelin Bend is very secure. It resists the effects of slack shaking, tail loading and cyclic loading. It works in stiff and springy cordage, in most slippery modern synthetics (though not in unsheathed HMWPE), and even to join lines with moderately different diameters. With training, the knot is easy to recognize when tightened. It is also very resistant to jamming, remaining easy to untie by rolling the collars away from the nub, even after a heavy load. Although it is rarely an issue given a preference for long tails, the length of line consumed in the nub is remarkably short for so much friction. Possible disadvantages include knot diameter greater than a DF (so it may not pass a rescue pully). There is no offset form, so retrieval over ledges may be problematic.

Double and eye forms are also reported to be very secure; though the eye knots have different tying complexities, and in practical use most are neither PET nor TIB (Wikipedia, 2025b).

Overall, this may be the best bend you have ever forgotten how to tie.

SHAKE HANDS Asher #93

Shake Hands Bend
from Asher (1989)

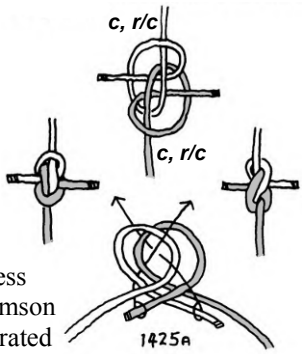


from Bocher

Derived by Asher (1989) from decorative eye knot *ABOK* #1031, 1048 (from *Noeud Moroasiro*, p. 202 in Bocher, 1914). If dressed with tails beside stands, it interlocks through the ***r*** spaces, and tails emerge through the ***c*** spaces of opposing Thumb Knots (but these spaces can connect in some dressings). Claimed by Asher to be both secure and jam-resistant. It would be useful to have results on strength, security, jamming and knot diameter versus the DF. All published methods seem to have a danger of mis-threading/dressing.

RIGGERS or **RIGGER'S BEND** Smith, 1953; *ABOK* #1425A

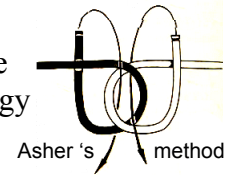
Also called 'Hunter's Bend' (after one of its re-discoverers), this is perhaps the best of the bends in which thumb knots are interlocked through their central spaces. Some users claim that this structure is more resistant to loosening by jiggling than those given above. On the other hand, it is much more prone to jam after a heavy load. The unusual (alpha-numeric) *ABOK* # was added by the publishers after Ashley's death. It remains in the "corrected" edition of 1993.



There is a slick (but error-prone) tying method (as illustrated):

(i) Overlap the ends to be joined in antiparallel direction.
(ii) Throw a twin loop in the region of overlap.
(iii) Thread the ends through the loop from opposite sides.
(iv) Dress and tighten carefully (pull mainly on the stands).

Avoid a helix in step (i) to avoid difficulties later. Dress the twin loops cleanly in step (ii). Unfortunately, if the loops are superposed wrongly the result may be a 'False Zeppelin Bend', which looks similar at first glance (especially from the 'top'), but is less stable under a load. Even Blandford (1980 and KM 8, 22) made this error. Ettrick Thomson showed the difference in KM 5, 15. Even with loops arranged correctly, only the illustrated direction of passage in step (iii) will form the desired bend. The 'wrong way' will collapse, or capsize into something dangerous. Provided the cautions common to this genus are taken, Asher's method may be safer.



from Bocher

Jamming is generally more problematic in lines of smaller diameter. Crossing the wends just before they emerge as tails is reported to reduce jamming. There are various ways to "cross" these wends. The simplest stable version (by analogy with Shake Hands) is a bend from the decorative eye *Nœud superposé 8 fois*, p. 188 in Bocher, 1914 (with dressing variants, at least some of which jam). Others (including so-called "Rigger X") are obtained more easily by trambling than use of Asher's method. Ashley's warning should be heeded.

Family Ieyeaceae (interlocked eye knots)

Although this Family might be excluded from the classification on the grounds that it is composed of stacked eye knots with unaltered nubs, it provides one of the most reliable ways to join lines of different diameter and/or composition. The eyes may either be interlocked while tying, or joined after tying using a device such as a locking carabiner (or even a toggle in some circumstances). Any two eye knots may be used. Strength and security will depend on the choice of eye knots, cordage, and any other components in the system. Sometimes, hitches to a ring are used instead of eye knots. A single Genus (**Stacked**), and a single example with eye knots may suffice.

BOWLINE BEND *ABOK* #1455

If time permits and security is important, locked bowlines may be better.

Hitches

Order Hitchales (a structure including one or more turns of a line around a solid, that functions to connect the line to the solid)

The turns may be U-turns or full turns. The underlying solid may be another region of the same line. When the solid is a line, the hitch should be made entirely by one line or region thereof, with the other serving only as a solid around which the hitch is made. This helps to distinguish bends from hitches as functional Orders of knots. In this definition, 'a solid' may be a group of solids that are bound by the same turns of a line. Some hitches (like the Girth Hitch, *ABOK* #1673) will spill completely if the underlying solid is removed, but many will not. Often there are complications of the line beyond the turns around the underlying solid, *eg* half hitches around the stand, to increase the security of the hitch. The insertion of a toggle into a knot is not considered as a hitch. Ashley (1944) equivocated: he included several hitches as bends (*eg ABOK* #1465-1470, 1488). A knot usually formed with more than 3-4 turns of a natural-fibre line around a solid may be classified in Order Coilales; but the distinction has become less simple because more turns are used in hitches formed in modern synthetic-fibre ropes of lower surface friction.

This is the most common order of knots, with many variations in structure that sometimes correspond with particular functions. For example, binding hitches may have no apparent stand and short tails; anchor hitches may have a long stand to the object being anchored; a Timber Hitch may be used to haul a single log or a bundle of sticks using a long stand after an accessory half hitch in the stand, around the solid(s); and a fixed eye like a Bowline Knot may be used as an open hitch that can rise or fall on a pile with changes in the tide. There are so many hitches that only a small fraction of them can be listed or illustrated in a 'shorter' work. Even *ABOK* has only a subset, with preference for (past) use at sea. As with eye knots, most knotters have a few favourite hitches for their particular suite of applications. Those shown here may reflect my personal preferences and some historical controversies.

The shape of the solid can affect security (particularly for snug hitches). Generally a rounded solid is preferable, though a few hitches depend on sharp angles in the underlying solid (*eg ABOK* #1604).

Chirality affects some hitches, especially when the underlying solid is a laid rope. Typically, the Timber Hitch and dogging of tail blocks and stoppers is made with the lay (for more friction). In knotting, the wend is usually kept free so that it can rotate (unnoticed) to avoid adding torque while each turn is made. For example, the Rolling Hitch (*ABOK* #1729) has tight turns when made around the stand of the same rope, but the wend rotates during tying to make either chirality effective. When tight, the nub bites; and when loose it sits upon the underlying lay (facilitating adjustment); with little effect of chirality. Right handers tend to throw clockwise loops for convenience. Some authors have been confused about chirality or the meaning of "with the lay" (for a summary see Warner, 1996).

Some interactions between a line and a solid do not make a knot. The Ashley Single (*ABOK* #49), Balancing (*ABOK* #218) and Crossing (*ABOK* #1818) Hitches might be considered to reside at the interface: they will not retain a useful form for long without a load on at least one end of the line.

The definitions or meanings of "snug hitch" and even "hitch" varied through *ABOK* (*cf* pp. 12, 13, 14, 289, *etc*) so an attempt has been made here at a consistent definition and usage. Hopefully the definitions used here reflect the broad sense of usage in ABOK. Ashley sometimes distinguished "working" and "standing" ends of a line (*eg ABOK* #128), but when used he used "end" without qualification, he generally meant 'wend' or 'tail' (*cf ABOK* #27, 28, 33, 45, 48, 71-73, 289, *etc*).

Some respected authors seem not to understand the implications of the capstan equation (as explained *eg* by Merchant, 2007 p. 65). It is a common misconception that a larger-diameter substrate (*eg* winch drum) will confer more friction in a turn of line (*eg* Toss, 2016 p. 44). Using supple rope, friction increases (exponentially) with the number of turns, but not at all with diameter of the underlying solid.

Family Lineaceae (used to secure a line to a solid, not only to bind a solid)

Genus Snug (line wrapped tight around the solid, with the wend secured between a turn in the line and the underlying solid, though it may be further fastened to the stand)

ASHLEY SINGLE HITCH? (a single turn around a solid, with the wend laid under the stand to create nip between the stand, the solid and the wend between them)

This function requires careful dressing, packing and loading of the stand. It often relies on the structure of the underlying solid to help trap the wend (*ABOK* #49, 1594-1603, 1613, 1614). If the load on the stand is not maintained, and more so if the line is 'flirted', this hitch will not be secure, even in a line with low surface lubricity.

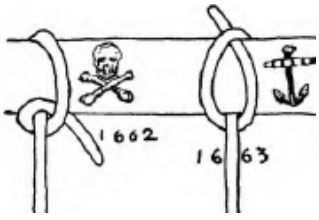
If the solid does not have a suitable shoulder, one may be provided by other ropework, such as a lashing (Warner #10). In other cases, sufficient nip is obtained by the use of multiple turns (*ABOK* #1604) crossed turns (*ABOK* #1674, 1676) a U-turn around the stand (*ABOK* #1663,1877) or the structure is used (as a binding) in a series that secures both ends (*ABOK* #2074, 2076). Some forms are close to a U-turn and Half Hitch in structure (*ABOK* #1821), and the two sources of nip can be combined (*ABOK* #218, 1607). Security may be further increased (with additional resistance to capsize by 'flirting') by additional interactions between the parts of the line, and/or between the line and the solid (*ABOK* #216, 217, 1812, 1813).

Ashley (1944) used the term "single hitch" with several meanings (*eg* pp 14, 74, 283, 284, 288, 298, 299, 302, 328, 336, 518). As precedent, he cited Luce (1862) who used the phrase once only, in describing reefing, and specified "with the bight made around the standing-part". Luce probably meant one hitch there, as he did when he wrote of a "single" ... anchor, block, spoke, strap, knot, rope, *etc*. In the section on knots, he illustrated as a "half-hitch" the structure that Ashley called a "single hitch". The phrase "single hitch" was not used in Luce *et al.* (1884). Ashley sometimes called the structure a half hitch (*eg* #271, 1012, 1147, 1152, 1459, 1474, 1477, 1516, 1733, 3450); or he used hitch, single hitch and half hitch interchangeably (#1985-86). He conceded that usage is vexed (#1748). Day (1947) noted that it is impossible under some common conditions to distinguish between single hitches and half hitches as defined by Ashley. This has caused confusion and avoidance of the term (Warner #10).

On balance, it seems best to apply the term 'single hitch' only to variants of the half hitch (see **Terminology** section), under circumstances in which the nip from the stand pressing the wend against an underlying solid is sufficient to hold against a substantial pull on the standing part, in the absence of other complications involving the stand or the wend (Birch, 2019b).

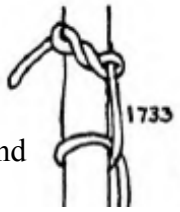
Ashley (1944) proposed similarly interesting and problematic distinctions between (i) a clove hitch and two half hitches (*ABOK* #48; perhaps from Dana, 1841) and (ii) midshipman's and rolling hitches (*cf. ABOK* #1230, 1729). The same distinction was not always applied to other structures (*eg. ABOK* #1862). That distinction is not followed here.

U-TURN AND (one or more direct or reversed chirality) **HALF HITCHES AROUND THE STAND**
ABOK #1662, 1707, 1710, 1713, 1727, 1780, 1781, 1786



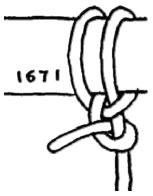
A U-turn with single half hitch around the stand (one of the forms called a 'half hitch' in Ashley, 1944) is rarely secure, depending on the surface lubricity of both the solid and the cordage. But the half hitch can arguably be arranged as a 'single hitch' (with the stand nipping the tail more firmly against the solid to confer security under sustained load). Half hitches are used in combination with many other structures in knotting to increase friction.

TIMBER HITCHES *ABOK* #1665, 1666, 1668, 1733



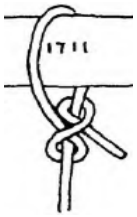
The wend is nipped between stand and underlying solid so these may be envisaged as higher orders of the half hitch with the special dressing that defines the 'single hitch'. But they also achieve substantial nip from multiple turns of wend around stand. Timber hitches may be used with more turns in slippery cordage. They are often are used with an accessory half hitch in the stand, around the solid (*ABOK* #271, 1733), for increased friction and to control direction of the solid while hauling.

SECURED CLOVE HITCH *ABOK* #1670, 1671, 1773, 1814, 1887



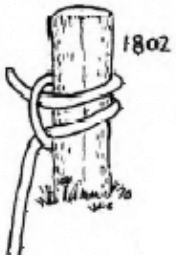
The Clove Hitch is properly a crossing or binding hitch, because it is not always secure when one end is loaded. However, when the tail is secured to the stand, the clove hitch becomes reliable as a line hitch (with load on the stand), though it may jam under a heavy load.

BUNTLINE AND LOBSTER BUOY HITCHES *ABOK* #1711, 1838, 1847; 1714, 1839

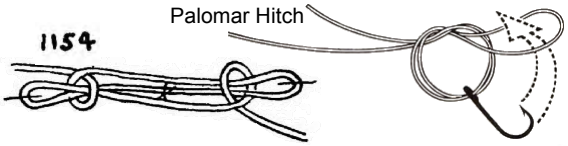


The Buntline and Lobster Buoy Hitches gain security by nipping against the underlying solid a (second) half hitch formed around the stand. They jam after a heavy load. but this may be reduced by dissipating load in multiple turns around the solid, as in Fisherman's Anchor Hitches.

GIRTH HITCHES *ABOK* #1673, 1683, 1694, 1763, 1802, 1816, 1859, 1890

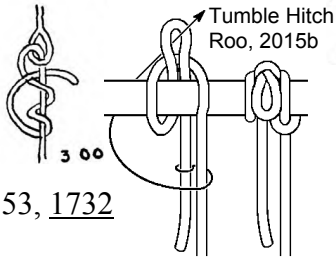


Also known by many other names including 'Larks Head, Cow Hitch, Bale Sling Hitch, and Strap Hitch'; the reverse half hitches are not very secure with a free tail, but the structure can be simple and secure when tied in a sling (or luggage tag), if the ends are prevented from slipping back to spill the knot. They never jam.



SHEEPSHANKS *ABOK* #1152-1166
AXLE HITCHES *ABOK* #160-162
CAMEL HITCH *ABOK* #215, 741
PICKET-LINE or **GROUND-LINE HITCHES** *ABOK* #1674, 1676, 1680

SINNET HITCHES *ABOK* #1684, 1685, 1686
BOOM HITCH *ABOK* #1687
HALYARD HITCHES *ABOK* #1675, 1677, 1678, 1679
SLINGSTONE HITCH *ABOK* #1697
SNUG BACKHAND HITCHES and **TENSION HITCHES** *ABOK* #1688-1693, 1725, 1731, 1796, 1797, 1851, 1853, 1732
PILE HITCH *ABOK* #1815, 1886
Some **FISHING HITCHES** ABOK #300; Wilson 'Blood' & 'Palomar' hitches
Some **QUICK-RELEASE HITCHES** *ABOK* #396, 1810, Lehman 'Tumble Hitch', ...
FISHERMAN'S ANCHOR HITCHES *ABOK* #24, 1722, 1723, 1724, 1840-1843, 1885



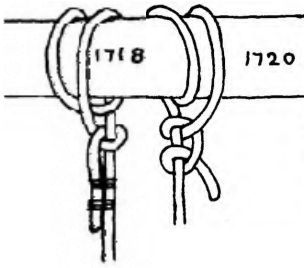
Genus Loose (line passed in one or more turns that do not trap the wend against the solid, then having the wend or tail secured to the stand)

This name is derived from a traditional usage, but it can be misleading: some 'loose hitches' can be very tight! In many cases they create nip through one or more half hitches around the stand (those after the first may be envisaged as single hitches). Any 'snug hitch' could be tied around the stand after turns around another solid to create a 'loose hitch', but this is generally too much trouble for any advantage over simpler structures.

Loose hitches comprise several knot elements. Turns around the underlying solid dissipate load, and thereby contribute greatly to the strength and jam-resistance of the overall structure (Wikipedia, 2025c). They are part of hitch structure, so hitches with a U-turn around a solid are separate species from those made with one or more full turns; even if they use the same finish around the stand. Riding turns have a different structure, which affects overall friction in various directions of load, and tail security, depending on configuration (Krauel, 2005). The number or orientation of half hitches can greatly influence hitch security and jam-resistance. Those integral to the hitch are part of the species definition, and added complications can be considered as sub-species. However, the boundary between species and sub-species may become arguable with different cordage types (friction with the underlying solid or the stand).

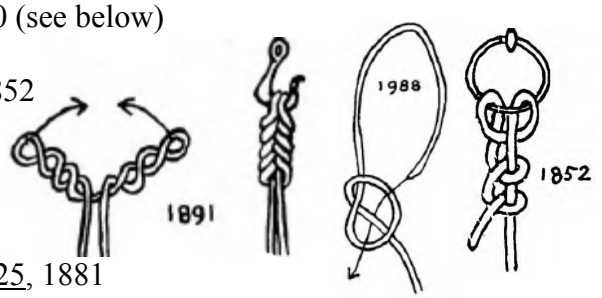
Any noose may be tightened onto an underlying solid. Many of the 'loose hitches' can be envisaged as nooses, even if they are primarily used as hitches (*eg ABOK* #1711, 1714). Loose hitches with round turns will generally not hold all of their characteristic form without an underlying solid.

ROUND TURN AND (one or more, direct or reversed) **HALF HITCHES**
ABOK #1718, 1720, 1784, 1834-1837, 1883

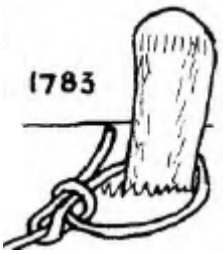


While this structure is obviously related to the U-Turn and Half Hitches Around the Stand, the Buntline Hitch and the Fisherman's Anchor Hitch, it does not rely on trapping the wend against the underlying solid. Instead it uses a round turn (around the solid) and half hitches (around the stand) to achieve enough friction for security. While there is resonance in the sayings that "There's a lot of virtue in a round turn" and "Two half hitches saved a Queens's ship", the fact remains that the Round Turn and Two Half Hitches was generally seized for longer security in the age of sail (*ABOK* #1719, 1835). It was often tied with an extra turn for strength and jam resistance (*ABOK* #1721, 1836). In synthetic cordage today it may be essential to use extra turns and/or half hitches for security.

GRAPPLE and **SLIP & NIP HITCHES** *ABOK* 1231; Birch, 2022
MIDSHIPMAN HITCHES *ABOK* #1727, 1729, 1730 (see below)
HALTER HITCH *ABOK* #1804, 1826
LOOSE BACKHANDED HITCHES *ABOK* #1795, 1852
NON-SLIP HITCH *ABOK* #1829
HAMMOCK HITCHES *ABOK* #1832, 1833
DOUBLE GIRTH HITCH *ABOK* #1695, 1862
CAT'S PAWS *ABOK* #1888, 1891, 1892
NOOSE HITCHES *eg ABOK* #409, 1114, 1803, 1825, 1881
CAPSTAN, CRABBER'S EYE, FLAGSTAFF HITCHES *ABOK* #1831, 1987-1992
Some **FISHING HITCHES** Wilson 'Centauri', 'Uni' nooses
Some **HIGH POST AND DRAW HITCHES** *ABOK* #398, 399, 1809, ...



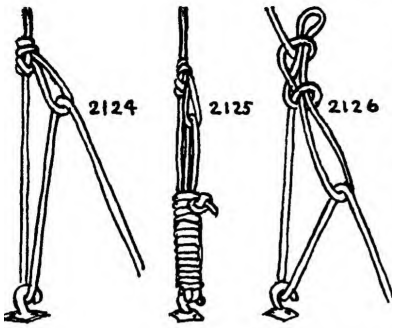
Genus Open (with multiple lines or regions of a line running from the underlying solid to a fixed nub that is separated from the solid)



Any eye knot that can be passed over a pile, cleat or bollard may serve as a hitch. A fixed eye will be Open unless the size of the eye is adjusted carefully to the diameter of the pile. Bowline knots are commonly used this way (ABOK #1716, 1783, 1787, 1788). Nooses are typically tightened onto the underlying solid as Loose Hitches, but some may remain Open if friction is high. Sliding hitches are commonly Open if tied around the stand of

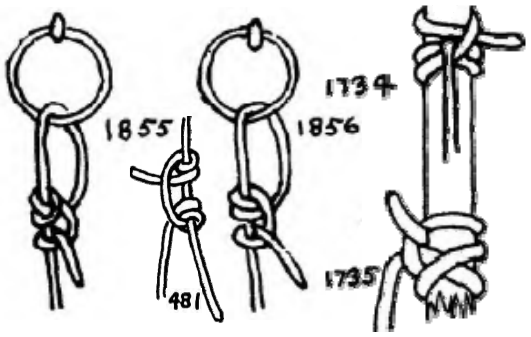
the same line, but they are classified separately here (with a moveable nub) because of their convenience of adjustment.

TRUCKIES HITCHES
ABOK #2124-2126, 2119-2121; Warner # 362, 559, ...



There are many alternative names, and many variations on the way to form an eye for use in this rope tackle. In some forms, it might be classified elsewhere. Possibly because of the wear and loss of mechanical advantage through rope-on-rope friction, it has largely been superseded today by the ratchet strap; but such knots remain useful to consider in an emergency.

Genus Sliding (tolerate a pull in at least one direction along the underlying solid, without slipping; but are readily adjusted by sliding manually along that solid).



These knots may be tied around a separate solid such as a spar, or tied around the stand (sometimes after one or more turns around a separate solid). **MAGNUS, MIDSHIPMAN'S** or **ROLLING HITCHES** (*ABOK* #1027, 1729, 1730, 1734, 1735, 1799, 1800, 1855, 1856) and related '**PRUSIK**' **HITCHES** (*ABOK* #481, 1763) are examples (Birch, 2025c). Climbers use slings in variations. More turns are typically required on low-friction (*eg* synthetic-rope) substrates, challenging the distinction between knots and lashings.

All that I have seen in practical use are snug (provided it is understood that an underlying solid can be the stand of the same line), but their distinguishing feature is that they are designed to grip automatically when tight but slide along the underlying solid when loosened slightly. Sliding hitches tied around the stand are also technically nooses, but to tolerate a pull along the stand they all have too much friction to serve usefully as practical nooses. Indeed, they are often called 'friction hitches'. Other nooses may behave similarly depending on friction, but are less reliable.

Be careful about sliding structures (*eg ABOK* #1472) under high loads in synthetic cordage: the heat generated on slippage can soften or melt the cordage.

Family Bindaceae (used to bind one or more solids, or keep such substrates furled; with no substantial load to be carried on either end after tightening)

While Ashley (1944) distinguishes crossing knots (whose ends are further employed) from binding knots, it is not clear that there is any practical crossing knot that can not be classified elsewhere. Crossing knots that may not hold their form for long when the ends are not 'further employed' are not included here, beyond the Crossing Knot and Marling (Marlin/e) Hitch provided as examples. In practice, these two forms are typically secured using other knots. Some of the crossing knots that Ashley describes are quite decorative, but simpler hitches serve the non-decorative practical function.

On a substrate with low surface lubricity, and low forces acting to open it, even a half knot (*ABOK* #122, 1203) or a multiple thumb knot in open form (*eg* in *ABOK* #1209) may serve as a useful (if temporary) binding knot. For longer-term use, a greater complication of cordage providing

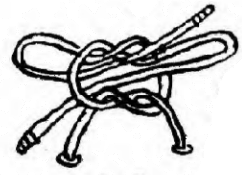
increased nip is required. Many binding hitches are snug, but their primary purpose is to bind their substrate rather than connect a line to it (as in the Snug Line Hitches).

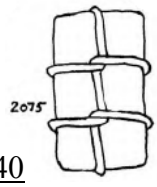
Nooses can be tightened onto a solid to bind it, but they are designed to withstand a substantial load on one end, so they are better considered in other taxa.

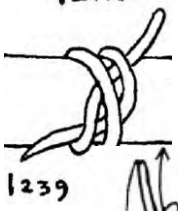
The binding hitches emphasize one of the key observations in practical knotting: some core structures are useful across functional groups. Reef knots traditionally were used on temporarily furled sails; because they are fairly secure as binding knots, but easily capsized by hand into girth hitches around the stand, then spilled. With added tail security, they serve as useful bends. Any bend in which one line can be arranged as a TIB structure (*eg* a bight or loop) can be capsized into a hitch around that line, but this hitch is not always practical (try it with a Carrick Bend). Bends based on non-TIB structures (*eg* Thumb Knots in Zeppelin Bends) cannot be capsized this way. As noted below, any bend can yield various eye knots if various pairs of ends are imagined as joined. In reverse, fixed eye knots when cut in the eye yield bends, but it matters which line from the cut eye is taken as a stand. Any simple stopper knot can be tied around a solid to form a hitch, though some will not be secure. Two hitches around opposed stands may be drawn together as a bend, though it may jam under heavy load. A snug or loose hitch can be tied around the stand to form a noose, though the result may have an impractical lead or friction. Any noose when cut in the eye will yield a hitch that slides, but most have too little friction to serve as useful sliding hitches as classified here. It might be interesting to make a (non-degenerate) classification of core structures in knots, but such a classification would not reflect the uses that have generally driven the invention of practical knots.

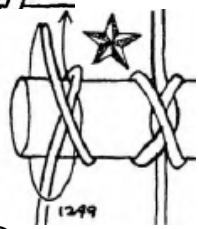
One Genus (**Binding**).

This may be the most-used category of knots. Many people tie several each day, in their shoe laces, pajama cords or parcels. Some typically are used only in particular occupations. Many have traditionally been called “knots”, even some used only as binding hitches. Perhaps it is time to use “hitch” in all such cases, for consistency.

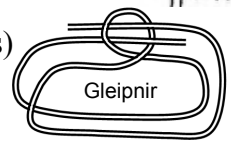








REEF KNOT and Derivatives *ABOK* #1204, 1210-1222
Lesser Relatives of the Reef Knot: **GRANNY, THIEF, WHATNOT** *ABOK* #1206-1208
LIGATURE / SURGEONS KNOT *ABOK* #1209
PARCEL KNOT *ABOK* #1227
TWISTS *ABOK* #1235, 1237, 1258-1261
STRANGLE / SNUGGLE KNOTS *ABOK* #1239, 1240
MILLER’S KNOTS *ABOK* #1241-1243, 1253
NET LINE HITCHES *ABOK* #1246, 1247
CLOVE HITCH *ABOK* #1245
CONSTRICTOR KNOTS *ABOK* #1249-1252, 1255
ROBAND HITCHES *ABOK* #1268, 1262-1277
MARLING (MARLIN/E) HITCH? *ABOK* #2075
CROSSING KNOT AND DERIVATIVES? *ABOK* #1171-1175, 2077, 2078
GLEIPNIR HITCHES (Gleipnir, 2009 ...)
STOPS (temporary lashings, whippings or seizings, with ≤3 turns) *eg ABOK* #1181, 2096-97, 3439-41



Multi-Stranded Knots

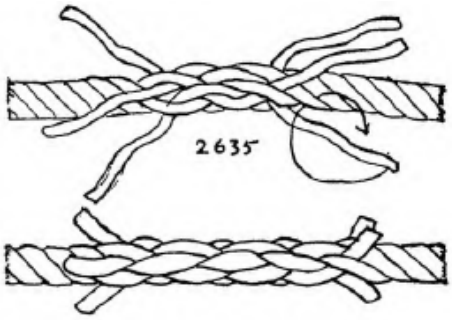
Order Mustrales (using multiple strands or components of cordage, commonly strands of a laid rope or layers from a braided rope)

This is one of the two orders in this classification that are defined on primarily structural criteria. The possibility to use the strands separately was developed to a high degree in laid, multi-stranded ropes. The same principles have been applied to laid wire ropes, though the stiffness of wire demands a different technique. Splicing by different techniques has proven useful in some braided ropes, and is not used in some kernmantles.

It is perhaps ironic that strands or components are first separated (which reduces strength) when the goal is to increase strength of the resulting structure. Yarns also may be joined this way (*ABOK* #1480-1484, 2688-2691).

Family Splicaceae (one or more components of a rope are tucked into the structure of the same or another rope)

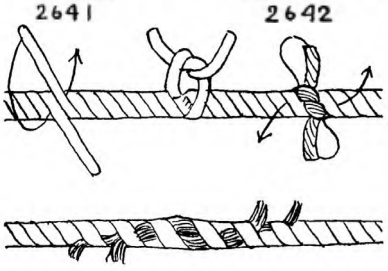
Well-made splices are substantially higher in both strength and security than bends and eye knots, but slower to tie and rarely untied. In some cordage (such as braided HMWPE) surface lubricity is so high that most common knots are insecure, but some specialized splices are effective. Stiff materials (including most wire 'ropes') tolerate (often specialized) splices, but not other knots. However, some rope constructions (notably most kernmantles) are unsuited for splices as they do not separate easily into components suitable for splicing. For the diversity of splices in laid rope, see *ABOK* Chapter 34-36. For tying instructions in laid ropes and popular early braids see also Toss (2016). For splices suited to particular modern rope constructions, see the manufacturers (*eg* Samson, 2025).

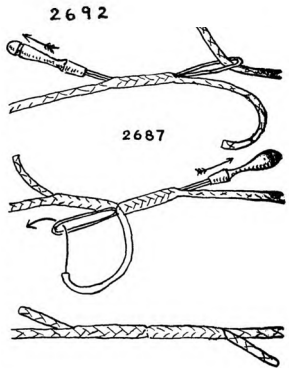


Genus Wend-joining (joining the wends of two lines)

Although the **SAILOR'S SHORT SPLICE** (*ABOK* #2635) is widely known, many variations in detail are described in *ABOK* Chapter 34. Short splices should be tapered for maximum strength (*ABOK* #2641, 2642), and they may be seized for greater longevity (*ABOK* #2638, 2639).

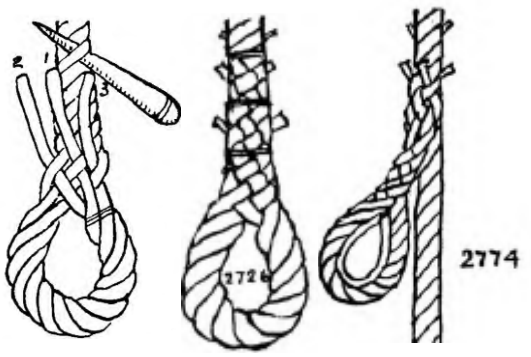
The main distinction of a **LONG SPLICE** is that it does not appreciably increase the joined line diameter, because strands are relaid then joined at separate locations (*ABOK* #2692). But it consumes more rope than a shroud knot or short splice, and it takes more time to complete with minimal loss of rope strength. Either short or long splices can be adapted for wire splices (*ABOK* #2716-2719) and for grommet formation (*ABOK* #2861-2867).



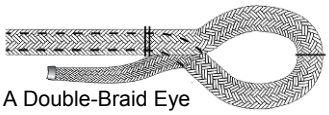


Tubular braided ropes had begun to appear in Ashley's time, and he showed how they were joined by splicing (*ABOK* #2687). He even showed a method that might be adapted to parallel-fibre core kernmantle ropes (*ABOK* #2675) though splicing of such ropes is not recommended. Several methods were used to join ropes of very different composition (*ABOK* #2720-2724). It is best to check the method recommended by the manufacturer of a specific modern rope.

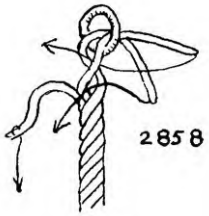
Genus <u>Aperture-forming</u> (forming an eye or aperture by use of one or more lines; or joining one line to another at a position other than an end)



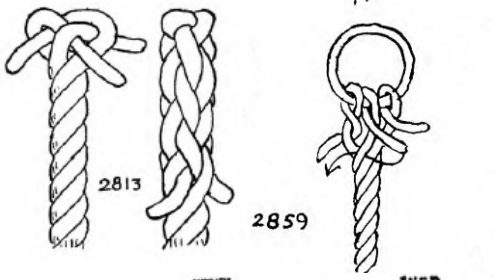
Eye splices (like short splices) should be tapered for maximum strength, and they may be seized for greater longevity. Those looking into *ABOK* for the first time will be amazed at the diversity of eye splices, but for most practical purposes in laid rope variations on the **SAILOR'S EYE SPLICE** will suffice (*ABOK* #<u>2725</u>-2733). The starting tucks can be tricky, then the pattern is as for a Short Splice. A thimble may be incorporated, and various aperture shapes and side splices can be achieved (*ABOK* #2774, 2832-2857). Ashley also showed a few ways to splice an eye in tubular braids (*ABOK* # 2791-2797), sinnets (*ABOK* #2798-2802) and wire ropes (*ABOK* #2805-2812). Variations have been developed to suit modern braided rope compositions and constructions. It is best to check the method recommended by the manufacturer of a specific rope.


A Double-Braid Eye
Samson, 2025

Genus **<u>Terminal</u>** (tucking strands into the same rope to form a thicker wend with no aperture, or to join a rope to a ring, chain or shackle)

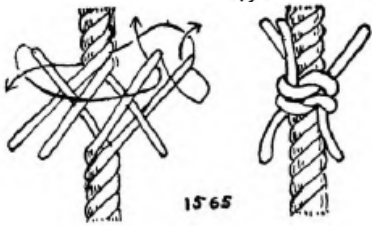


A **BACK SPLICE** (*ABOK* #<u>2813</u>) should only be used if you want a thicker region at the end of a rope. A whipping is better to prevent raveling without increasing line diameter, and a single-stranded or multi-stranded stopper knot is better to prevent unreeving. But various techniques of splicing find application in the making of spliced joins between laid rope and a chain or shackle (*ABOK* #2679, 2858-2860).



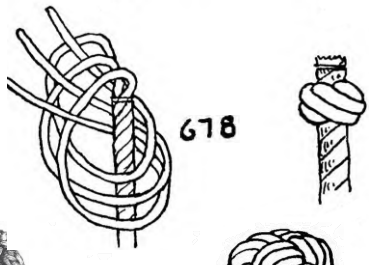
Family Shroudaceae (multi-strand bends)

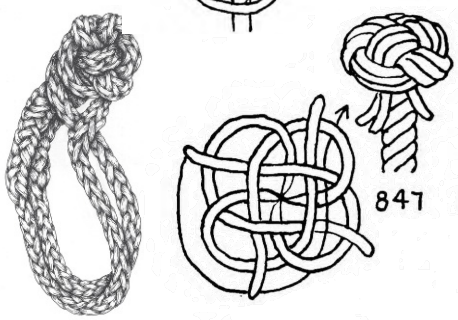
Genus <u>Shroud Knot</u> (*ABOK* Chapter 19). Substantially higher in both strength and security than single-stranded bends. They were important when standing rigging of tall ships was assaulted by cannon balls, but are seldom seen in practical use today.



Family Mustopaceae (stopper knots made with multiple strands)

Genus <u>Multi-stop</u>: may serve both a decorative and practical purpose. They can be very useful as stoppers to prevent unreeving of a long-serving tackle. There are many variants (*ABOK* Chapters 6-10). For a smaller selection of those most useful in practice, see Warner (1992 #231-233 and 239-244) or Toss (2016, Figure 4-6 and 4-7). For an in-line knot, a **MATTHEW WALKER** (*ABOK* #<u>678</u>-683) is most common. Some combination of **CROWN** and **WALL** knots is perhaps the best terminal stopper, as in the **MANROPE KNOTS** (eg *ABOK* #<u>845</u>-850, 878-880). Combining a Manrope Knot with a simple tuck in strong braided rope creates a useful **SOFT SHACKLE** (Toss, 2016 Appendix).





A Soft Shackle (Toss)

Structures with Many Loops or Turns

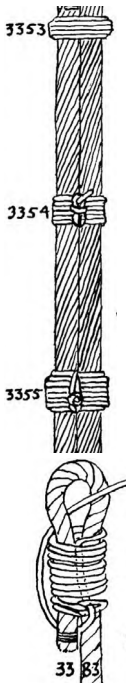
Order Coilales (with multiple [usually more than three in natural-fibre ropes] loops or turns around one axis)

More judgment is needed here (or the classification may be increasingly challenged) with increasing diversity of cordage. In traditional cordage, it is rare for a practical knot (in rope) in any other Order to have more than three turns around one axis. But more turns may be needed for friction and security in cordage made from synthetic fibres with lower surface lubricity. Fishermen routinely use knots with more turns in slippery braids and monofilaments, especially lines of low diameter. Examples in synthetic cordage include the added turns in multiple Fisherman's Bends (*ABOK* #1415) and 'Prusik' friction hitches, Tensionless Hitches (*ABOK* #1732), and Timber Hitches (*ABOK* #1665). Many of the 'hitches' used to withstand a pull along a slippery substrate use multiple turns for friction (*eg ABOK* Chapter 22; Icicle Hitch from Smith, 1990), but they also may be considered as lashings. Exceptions may also be made for those who follow the maxim "If you can't tie a knot, tie a lot."

Allowing for such judgment, the structures included in this taxon are: seizings (*ABOK* #1512,1513, 3303-3306, 3353-3430), whippings (*ABOK* #3442-3462), lashings (*ABOK* #2102-2117, 2131-2145, 3432), mousings (*ABOK* #3267-3271), wormings (*ABOK* #3336-3341), servings (*ABOK* #3342-3350), gammoning (*ABOK* #3432), marling (marlin/e)- and half-hitching (*ABOK* #2074, 2075, 3114-3116), keckling (*ABOK* #3117), nippering (*ABOK* #1770, 3118-3121), snaking (*ABOK* #3122-3124), stoppers (*ABOK* #1765-1769), heaving-line knobs (*ABOK* #535-544), open coils of cordage (*ABOK* #3083-3101) and others. Many such structures are described in *ABOK* Chapters 40-41. Some are rarely seen today. Others remain common and important. Multiple turns are common in knots tied for decorative effect (*eg* Capuchin, Lanyard, Button and Turk's Head Knots). Even quipus, once used in Inca accounting, are now primarily decorative.

Only the most common and practical categories are considered here. The boundaries between various types of multi-turn bindings sometimes are indistinct. It may be argued that some of these structures should be excluded as knots because they will not hold the desired form without either a load or an accessory structure, such as a hitch or a tuck through the substrate, at one or both ends.

Family Solid-core (bindings that enclose one or more solids)



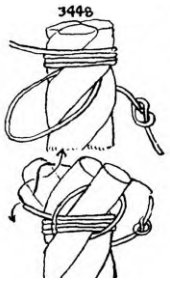
Genus Seizing (a binding, made of small stuff, that holds together multiple lines or parts of the same line)

A seizing typically has more than three turns, in a helical binding about as long as the diameter of the bound line(s). If there are few turns, the temporary seizing may be called a stop. Lashings made with small stuff around a spar or solid other than a line are sometimes called seizings *(eg ABOK* #3125, 3424). **MOUSING** *(ABOK* #3267-3270) is a special example used to reduce the risk that a rope will come out of a hook, though it is better to employ a hook with a suitable safety latch.

Ashley illustrated many seizings, with a confusing variety of names (*ABOK* #3353-3144). It seems that usage varied substantially, even between contemporaneous mariners (*eg* Svensson, 1940 pp. 134-139). For non-seafarers, a **COMMON SEIZING** (Warner #17) or a **FRAPPED FLAT SEIZING** (*ABOK* #3354, 3383) serve multiple purposes.

Genus Whipping (a seizing [or for temporary purposes a stop] applied near the end of a line to prevent it from raveling)

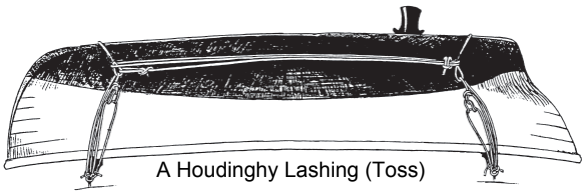
Even with a melting synthetic-fibre rope, a whipping made with small stuff is generally preferable for long-term use to the fusion of fibres achieved using a hot knife or flame. One advantage of a well-made '**BUTANE WHIPPING**' is that the end can be tapered (Blandford, 1980 pp. 19-20), much more easily than traditional **POINTING** *(ABOK* #3549-3570).



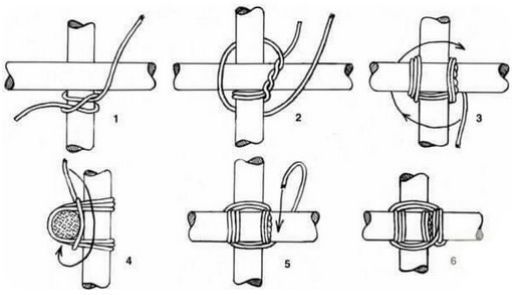
Ashley illustrated many forms of whipping to suit various circumstances *(ABOK* #3442-#3462). The most secure forms are applied towards the end, against the lay of the rope, and interlaced with the rope structure to prevent sliding off. With a laid rope, this can be done without tools using a **SAILMAKER'S WHIPPING** *(ABOK* #3448, Svensson Fig. 32).

Genus Lashing (a binding that holds enclosed objects firmly together, typically made of rope with more than three turns of natural-fibre cordage, and excluding seizings)

At the extremes, a lashing is very different from a hitch. For example, a rope may connect a dingy to a yacht railing by hitches, for easy transport in harbour; but the dinghy may be lashed to the yacht deck while sailing between ports. But there are many intermediates, with no clear boundary. For example, a lashing can join flexible stay or guy lines (*ABOK* #1512, 1513, 3304-3306, 3311-3313), or today it may join a strong synthetic hammock line to tree-hugger webbing (**HAMMOCK LASHING**; Hennessy, 2016). A substantial object today can be secured with only few passes of strong webbing. Ratchet straps, cam buckles or cable ties perform many tasks that once demanded a lashing or seizing. The diversity of structures sometimes called lashings can be appreciated from *ABOK* Chapter 28 (for a much more restricted usage see Warner Chapter 24).


A Houdinghy Lashing (Toss)

In pioneering (Sweet, 1974) it is still useful to distinguish between types of lashing used to secure spars (though there are variations on each):
SQUARE *eg ABOK* #2114, and see Warner #534
DIAGONAL *eg ABOK* #2115, but see Warner #537
SHEER *eg ABOK* #2102, 2104
POLE *eg ABOK* #2103
TRIPOD *eg ABOK* #2105, 2107



A Square Lashing (after Sweet)

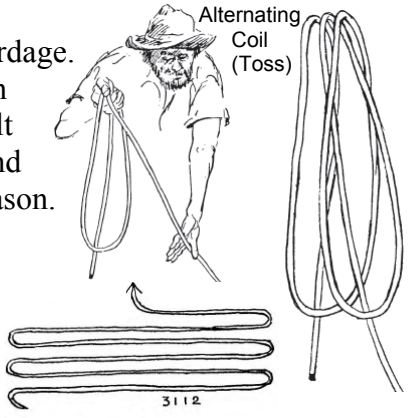
In yachting, a sail may be seized, bent, laced or lashed to a mast, boom or stay by various means including **HELICAL**, **HALF-HITCHED** or **MARLING-HITCHED** lashings (*ABOK* #3125-3146; Toss, 2016 Figure 1-22). Some **BELAYS** are also made with multiple turns for greater strength, long-term use, or to compact excess rope (*ABOK* Chapter 20).

Family Line-Shortening (any arrangement that serves to make a line more compact for deployment, storage or transport)

Although cordage in use is often essentially linear, transport and storage generally require a more compact configuration, typically a coil but sometimes a folded, **CHAINED** (*ABOK* #1114; Warner # 29) or hybrid configuration. Small stuff is often wound onto a solid (*eg* a spool, reel or netting needle), but rope is usually coiled or folded without any substrate. The Family could be divided into Genera on such structural grounds, if this were justified by the number of structures in practical use. For now, one genus (**Coil**) may suffice.

If a line is short, an open coil made for storage may have fewer than three loops or turns, but most knotters would recognize that the intention was a coil. Coiling towards a belayed (fastened) end can add torque, and eventually kinks that will damage a rope under strain (Birch, 2025b). Rope is thus coiled towards an open end where possible, so that the end can rotate while each turn is made.

Many different coils have been developed to suit the various needs of mountaineers (Cox and Fulsaas 2003), firemen (*ABOK* #3094), heavers of messenger lines (Toss, 2016 Figure 3-37; Sweet, 1974 pp. 94-99; ABOK #3107, 3108) and assorted mariners (*ABOK* #3094-3106). Z-laid rope is usually coiled S (in a clockwise overhand helix), so that when it is drawn off in a hurry the twists introduced during coiling can be absorbed by slight loosening of the lay (Toss, 2016 p. 2). But repeated coiling, especially of long ropes, can be a problem unless twists are shaken out.



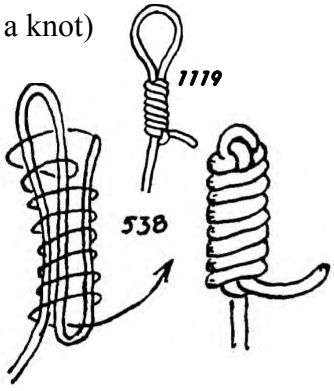
The problem is sometimes amplified with amphichiral (braided) cordage. An **ALTERNATING COIL** (Warner # 23; Toss, 2016 Figure 1-3) with long ends may be slightly harder to make, but it will generally result in fewer kinks. This also works well with hoses, electrical cables and other kinds of achiral materials that must be coiled for whatever reason.

A heaving line must generally be gathered in before it can be redeployed. When time is short and there is no other equipment, a lifeline is generally coiled then thrown from the hip. For a chance that a messenger line will run free (without tangles or kinks), arrange a coil on a smooth surface with the stand up. Better, if time permits before heaving, arrange the line into flakes (preferably non-overlapping as in a **LONG FLAKE**, *ABOK* #3111, 3112) on the smooth surface. Even random folds in a wide-mouthed box will run more reliably than a coil for most cordage, hence the popularity of rope bags among arborists, climbers and rescue technicians.

Bight-hitched Coil
(Toss)

If the ends are to be employed after uncoiling, it is best to avoid memory effects that can linger if an end is used to secure the coil. This can be done by using a turn away from either end to make a **BIGHT HITCH** around the coil (Toss, 2016 Figure 1-5). If the line is to be used doubled, store it that way; either by chaining (*ABOK* #1144) or by coiling from the paired ends and making a bight hitch from the final coil.

Family Heaving (multiple turns used to add weight or control the lead of a knot)



The Family could be divided into Genera on either functional or structural grounds, if this were justified by the number of structures in practical use. For now, one genus (**Multi-pass**) may suffice.

The only knots traditionally made with more that three turns in natural-fibre cordage (other than fishing lines) were the **HEAVING LINE KNOTS** where the added turns also added weight (*ABOK* #535-544), and their cousin the **HANGMAN'S NOOSE** where the added turns may have served to preserve the lead of the stand into the noose under a substantial load (*ABOK* #1119). As noted above, if a small sandbag is available it is generally more practical than a Heaving Line knot. Happily the gallows have largely been outlawed on humane grounds, but the historically-named Hangman's knot remains useful as a noose that will hold its form for a long time without a trapped solid. It may deserve a new name. There is too much friction for some purposes.

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Often unnecessarily argumentative, rambling, and replete with opinions presented as facts, the IGKT forum was not designed as an archival source. Nevertheless, postings there have included a lot of original thinking about knots. Unfortunately, IGKT changed URLs for original forum postings, and many early image attachments seem to have been lost. Although this makes historical research and fair citation difficult, much of the key information is available in secondary sources. Where possible, links that were active at time of writing have been provided above.

Appendix A: Properties of Cordage Fibres (footnotes)

* All entries are approximate averages. Results differ between manufacturers, and are modified by additives in many products. Other fibres (like Vinylon) are also used. Ropes have further modifications such as:

(i) structural effects on stretch (which tends to decrease from laid ropes to braided and parallel-filament constructions) and on friction;

(ii) mixture of polymers before and after extrusion, fibre length if cut, use of different polymers in core and jacket, weaving pattern in the jacket, and additives. These are often proprietary (secret), evolving, and can markedly affect properties like knot holding (stiffness and friction), flammability, abrasion and UV resistance of cordage.

In some contexts, other properties may be of greater importance: water-absorption and effect on length and strength; stiffness; creep; strength loss in tight turns; susceptibility to microbial degradation. See manufacturer websites and also CI-2003 from the cordage institute, samsonrope.com/resources/commercial-marine/rope-manual, tensiontech.cn/tools-guides/fibres-guide, animatedknots.com/rope-materials and youtube.com/watch?v=sLbsgNpF4Ts.

Density: most relevant because ropes below 1 g/cm^3 will float in water.

Break Tenacity in grams per denier is a measure of breaking stress: the ratio of force to mass per unit length.

Stretch at break (%) of fibres is complicated in rope by structural and pre-treatment effects.

μ is generally estimated as a coefficient of static friction on a steel cylinder, and reports are subject to many variations and errors. Resistance to slippage ideally increases exponentially with μ.

Critical temperature (CT, always below melting point MP, but by an amount that varies between fibres) is the temperature at which degradation is caused. Fibres weaken at lower temperatures (*eg* from 80 ºC for Manila).

Susceptibility of fibres to abrasion, UV and tight turns are not necessarily matched in rope, depending on additives and construction methods.

Burn tests for rope fibre identification involve observation during and after application of a clean heat source. After removal of the heat source: F=flame, M=melt, S=smell, R=residue. Results are confused by multiple fibres.

Appendix A: Properties of Cordage Fibres*

Common or Trade Name	Chemical Name	Density (g/cm^3)	Break Tenacity (gpd)	Stretch (%)	μ	CT MP (ºC)	Abrasion resist	UV resist	Burn Test
Manila	Lignocellulose	1.4	5	10	.5	150 --- chars 177	Fair	Good	F: bright M: no S: burnt paper R: grey ash
Polypro PP	Polypropylene (an olefin)	0.9	6.5	20	.2	120 165	Poor	Poor	F: shrinks / burns or extinguishes M: droplets S: tar / parrafin R: brown bead
Nylon Perlon	Aliphatic Polyamide	1.1	9	25	.1	165 230	Fair	Fair	F: extinguishes M: droplets S: celery/ fish / burnt plastic R: brown / grey bead, will pull threads
Polythene Silver, Tanikalon PE, LDPE, HDPE, (depends on MW: see also HMWPE)	Polyethylene (an olefin)	0.95	6	20	.2	80 110	Fair	Poor	F: shrinks / burns M: droplets S: paraffin (candle) R: waxy, crushable
Dacron Terylene PET PES HTP	Polyester Polyethylene terephthalate	1.3	8	15	.1	177 255	Good	VG	F: sooty, black smoke usually extinguishes M: droplets S: sweet / chemical R: brittle dark bead, won't pull threads
Vectran	LCAP (Aromatic Polyester)	1.4	24	3.3	.1	145 330	VG	Fair	Usually will not melt in burn test; chars above 400 ºC
Kevlar Technora Twaron	Aramid (Aromatic Polyamide)	1.4	28	4.6	.1	270 ---	VG	Poor	Hard to burn, degrades without melting to black fibres at 500 ºC
Spectra Dyneema	HMWPE†	0.97	40	3.6	.05	65 145	Fair	Good	Shrinks and melts fibres, candle smell
Zylon	PBO	1.6	35	3	.2	330 ---	Fair	Poor	Will not burn or melt, decomposes at 650 ºC

† HMWPE (high molecular weight polyethylene) is also known an HMPE (high modulus polyethylene). Although it is very strong when fibres are straight, it suffers much strength loss in tight turns or compression. Low stretch reduces the snap-back hazard, but increases the risk of damage from shock-loading.

Other fibres with relatively high break tenacity (> 20 gpd?) are also called "high modulus".

* See the previous page for other footnotes to this table.

Appendix B: Suggested Method to Extend *ABOK* #s for Additional Practical Knots

Ashley reached number 3584, mostly for illustrations, in his encyclopaedic *ABOK*. These *ABOK* # have subsequently been used as knot identifiers, which seems appropriate given the quality of his descriptions (typically suitable as type specimens) and his expressed aim to "write an accessible comprehensive and orderly book on applied knots".

However, additional practical knots have been described in the (more than 80) years since Ashley wrote. If we are to use numbers that somehow follow from Ashley in reference to these additional knots, we must develop a system to extend the numbers given in *ABOK*. A suggestion is offered that suits the hierarchical classification of knots used here. Simply commence numbering of additional knots with a preceding digit that matches the Order of the knot. Thus the first added knot in each Order would be:

Order	**First ext-*ABOK* #**
Stopales	10001
Fieyeales	20001
Noosales	30001
Bendales	40001
Hitchales	50001
Muturales	60001
Coilales	70001

As mentioned elsewhere (Birch, 2025a), if a hierarchical classification is adopted, rules of nomenclature should be set by international consensus among those interested in knot systematics. The rules should include a minimum standard for the enabling description of additional practical knots (Appendix C), and permissible archival locations. (If IGKT agreed to take the responsibility, this could include at least a reference in *Knotting Matters*, as a means to ensure that the description is indeed enabling and accessible to all knotters, and also to keep order in assigned numbers).

International consensus should also be reached on a body authorized to evaluate proposed additional knot descriptions, and to issue a unique ext-*ABOK* # where this is warranted.

A knot that achieves a marked improvement in practical function over any previously described knot, while remaining practical to tie, is most likely to warrant an additional ext-*ABOK* #. Descriptions that add (i) methods of tying, or (ii) turns to an existing structure, or (iii) slight variations to dressing of existing structures, without a marked difference in a useful function (other than increased friction suited to ropes of lower lubricity), are unlikely to warrant a new ext-*ABOK* #. They may nevertheless serve as important additions to the descriptions of existing knots and their variants. Many important contributions to the body of knowledge about knotting will not require the issue of a new ext-*ABOK* #.

Appendix C: Suggested Components of an Enabling Description of a Practical Knot

1. One or more illustrations that together with the text allow a person of ‘ordinary skill in the art’ to tie the structure without guesswork*.

2. Description of the structure in text if needed to elaborate on the illustration(s).

3. At least one efficient tying method.

4. Practical uses for the structure, and improvements in practical function over previously described knots if relevant.

5. Any cautions relating to practical use of the structure.

6. Any similar previously-documented structure(s) and how they may be distinguished from the described structure.

7. A suggested name for the structure that is consistent with the international rules of nomenclature in knot systematics.

8. Optionally, structures that may be added to increase the long-term security of the knot (used to indicate suggested sub-species).

9. Optionally, a suggested location for the knot within a published hierarchical classification.

The enabling description must be published in an accessible archival medium (with at least a note referring to the description published in the IGKT magazine *Knotting Matters*, if IGKT is agreeable). On acceptance as an enabling description of an additional practical knot, an ext-*ABOK* # will be assigned by the authorised body, and the description should serve as a type specimen of the knot.

* A person of ‘ordinary skill in the art’ will have substantial experience in the tying of knots, but need have no prior experience of the described knot.