AN ANALYSIS OF BOWLINES

Bowlines have received (undeserved) bad press within the climbing and rescue community. It is true that ABoK #1010 in its basic form and structure is insecure and roping and knot technicians have understood and tried to overcome this.

In life support applications of a mission critical nature, ABoK #1047 (figure 8 loop) has wide support and is taught in virtually all entry-level roping courses. Its popularity is linked to the fact that it is easy to tie and easy to learn – and it is both *secure* and *stable*.

However, the figure 8 loop can be somewhat difficult to untie after high loading events – and it is this point that makes it unpopular amongst some climbers. It is also worth noting that in order to tie a figure 8 loop through a climbing harness or around a tree, a *two stage* process is required.

The bowline has the property of being easy to untie – even after high loading. This is why it remains the knot of choice for riggers and doggers (cranes/lifting/construction industry).

The Holy Grail for the climbing and rescue community is to find the 'ideal' knot that has the properties of a bowline (easy to untie after loading events and a one stage tying process) and the security and stability of a figure 8 loop.

Efforts have traditionally focused on ways to improve the security and stability of the bowline. A popular variation is the so-called *Yosemite Bowline (see Fig 6)*.

Other variations have been devised in a continuing effort to find the 'ideal' knot.

No peer reviewed (reproducible) technical data is available for the properties of the various knots illustrated. Behaviour under static and dynamic loading and raw strength are generally poorly documented or of dubious origin. It is the view of this author that strength is not the most important characteristic of a knot. Of greater importance are the properties of *security* and *stability*.

Since this paper was originally published in Jan 2009, I have found *what I believe* is the ideal Bowline for climbing and indeed rope rescue purposes. (see figure 26 & 27)

Mark Gommers

23 June 2011 (Originally published in January 2009)

The Anatomy of a Knot

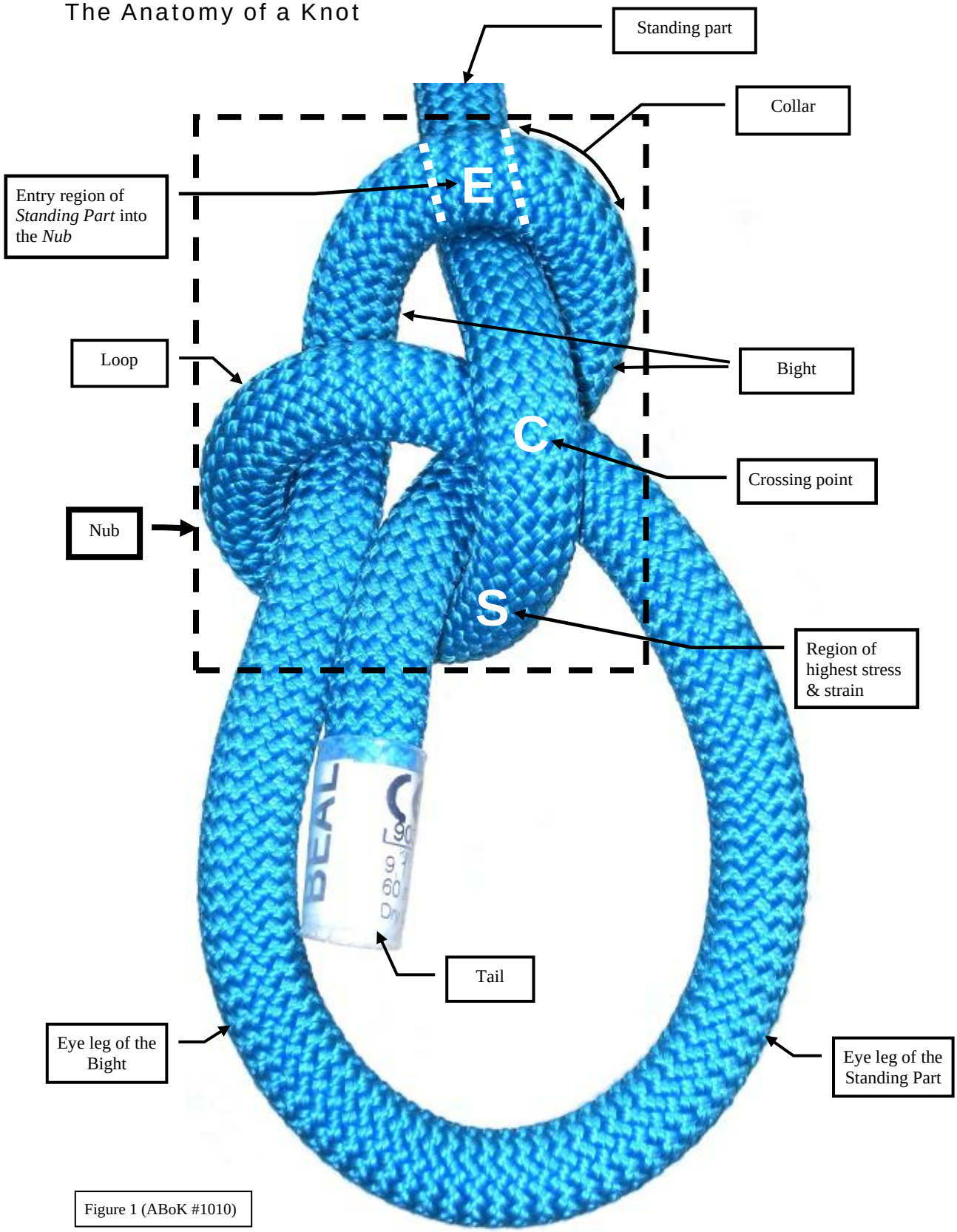
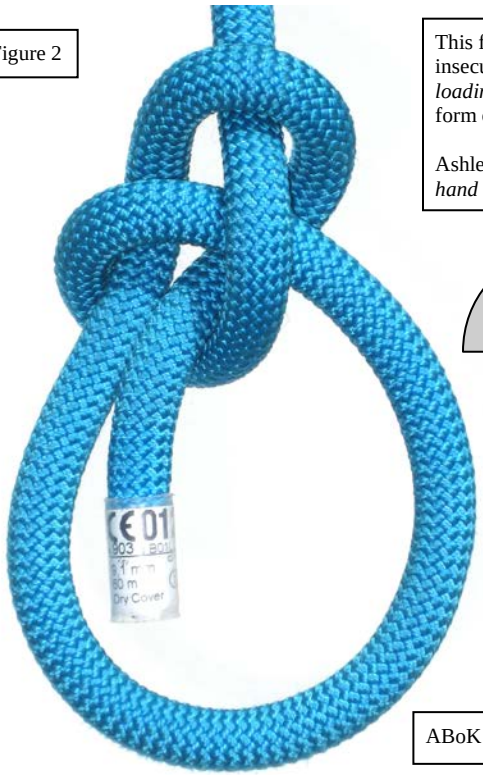


Figure 1 (ABoK #1010)

Figure 2



ABoK #1010 (Front)

This form of the Bowline is insecure and vulnerable to '*ring loading*'. It is the least secure form of all the Bowlines.

Ashley referred to it as a '*right hand bowline*'.

Figure 3

ABoK #1010 (Rear)

Figure 4

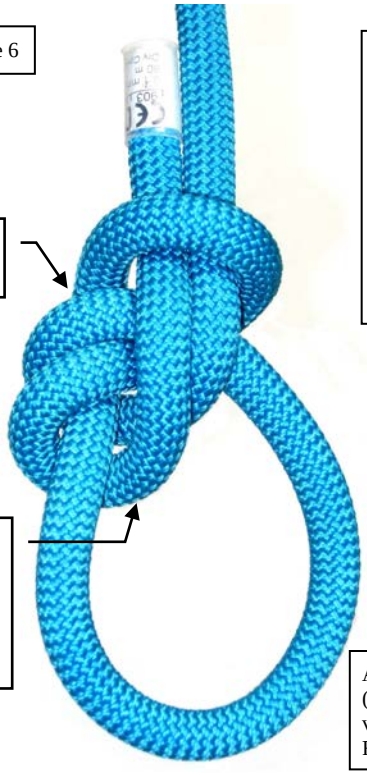
ABoK #1034.5 (Front)

This form of the Bowline is resistant to ring loading but is still not suitable for mission critical applications. Ashley referred to this form as a '*Left Hand Bowline*.' Also referred to as a 'Cowboy Bowline'.

Figure 5

ABoK #1034.5 (Rear)

Figure 6



Note the figure 8 form.

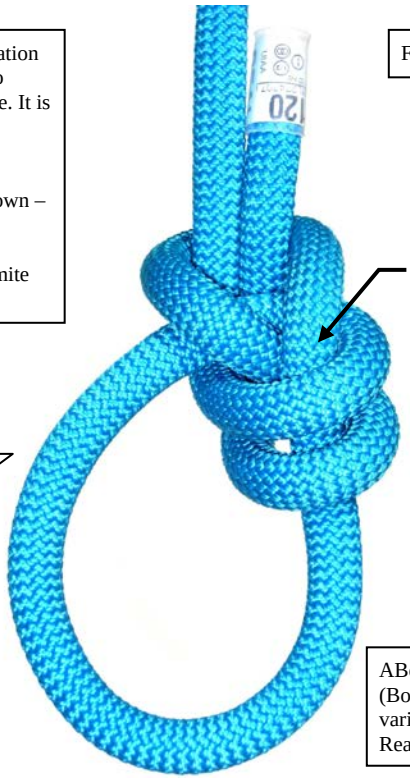
Tail wraps around eye leg, then tucks through collar to finish.

ABoK #1010
(Bowline: Yosemite variant)
Front view

The so-called 'Yosemite' variation of the Bowline is an attempt to make the structure more secure. It is widely used in the USA for climbing applications.

[ ] History/first use data unknown – although the name suggests development and subsequent popularity originated in Yosemite valley USA.

Figure 7



2 rope diameters encircled and gripped by the nipping loop

ABoK #1010
(Bowline: Yosemite variant)
Rear view

Figure 8

Another variation – this time a simpler 'Yosemite finish'.

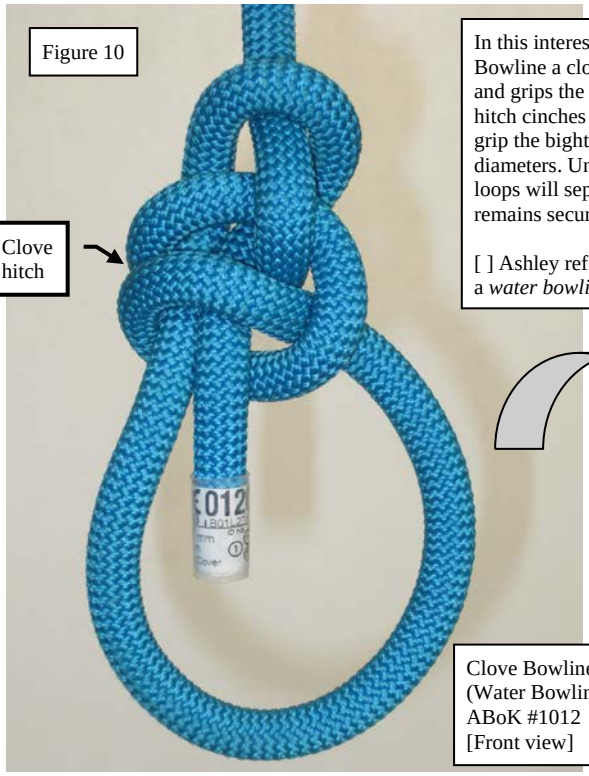
[ ] Suggested by Dan Lehman as an alternative method of tucking and 'securing' the tail.

ABoK #1010
(Bowline variant)
Front view

Figure 9

ABoK #1010
(Bowline variant)
Rear view

Figure 10



Clove Bowline (Water Bowline) ABoK #1012 [Front view]

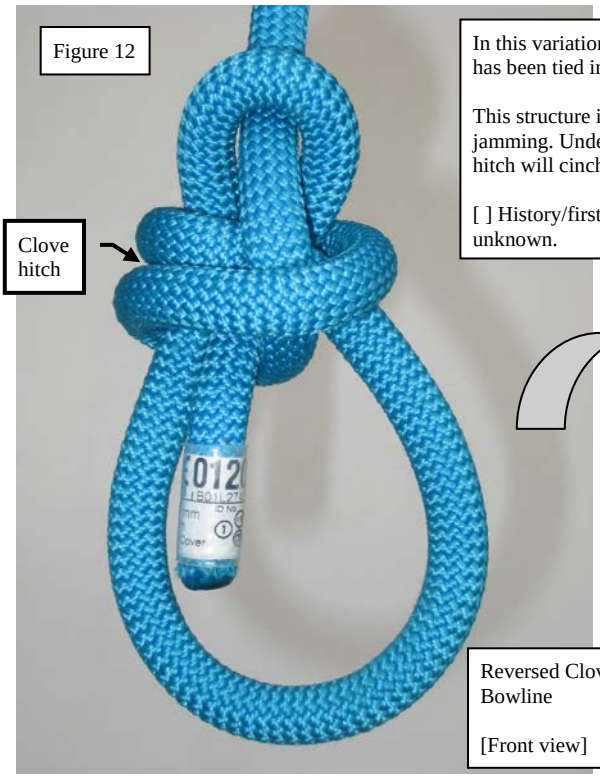
In this interesting version of the Bowline a clove hitch encircles and grips the bight. The clove hitch cinches tight and acts to grip the bight with its dual rope diameters. Under load, the 2 loops will separate but the knot remains secure.

[ ] Ashley referred to this form as a *water bowline* (#1012).

Figure 11

Clove Bowline (Water Bowline) ABoK #1012 [Rear view]

Figure 12



Reversed Clove Bowline

[Front view]

In this variation, the clove hitch has been tied in reverse.

This structure is prone to jamming. Under load, the clove hitch will cinch tight.

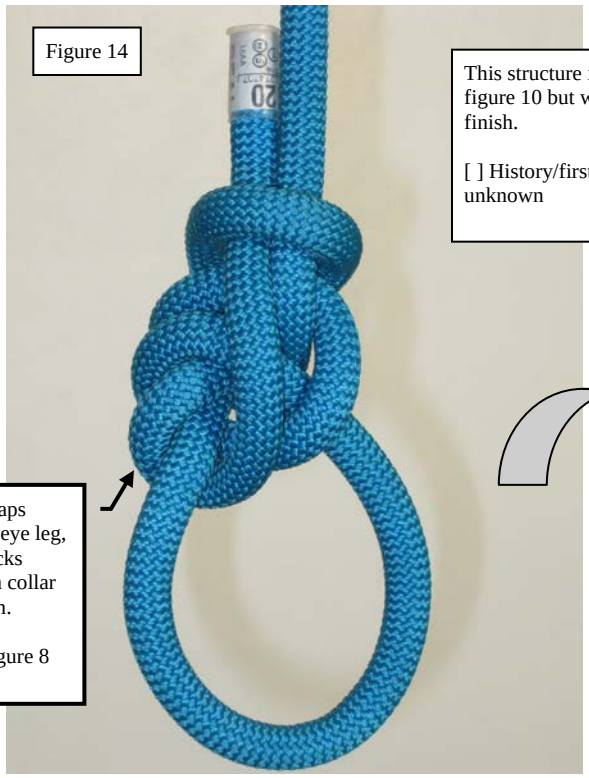
[ ] History/first use data unknown.

Figure 13

Reversed Clove Bowline

[Rear view]

Figure 14



Tail wraps around eye leg, then tucks through collar to finish.

Note figure 8 form.

This structure is the same as figure 10 but with a 'Yosemite' finish.

[ ] History/first use data unknown

Figure 15

Figure 16

Constrictor hitch

Constrictor Bowline

[Front view]

In this variation, a constrictor hitch (ABoK #1249) is used instead of the clove hitch.

[ ] History: The first known description of the Constrictor hitch occurs in Tom Bowling's 1866 work, *The Book of Knots* where it was called the "Gunner's knot".

Figure 17

Awaiting image

Constrictor Bowline

[Rear view]

Figure 18

Double loops increase the overall surface area acting to grip and hold the bight.

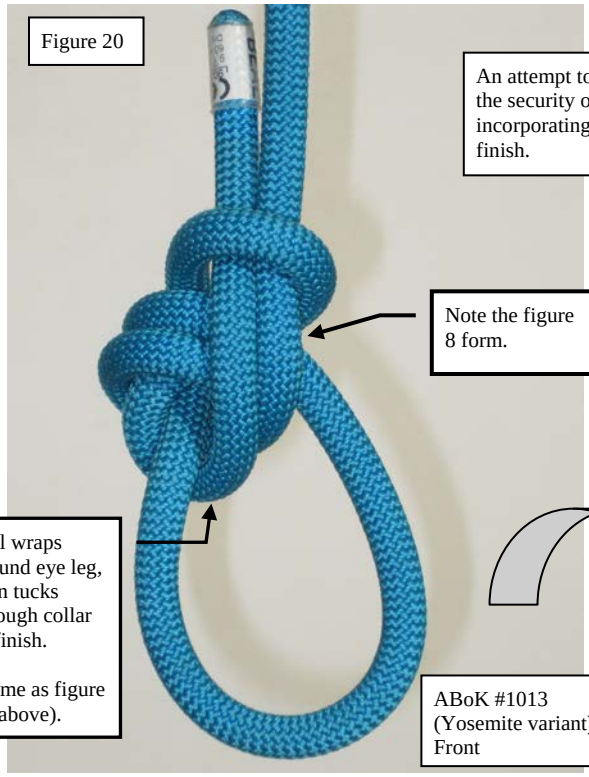
ABoK #1013 (front)

Clifford Ashley reported that this form "*…holds the bowline together in such a way as to lessen the danger of it capsizing, which is liable to occur when a single bowline is carelessly drawn up.*"

Figure 19

ABoK #1013 (rear)

Figure 20



An attempt to further improve the security of #1013 by incorporating a 'Yosemite' finish.

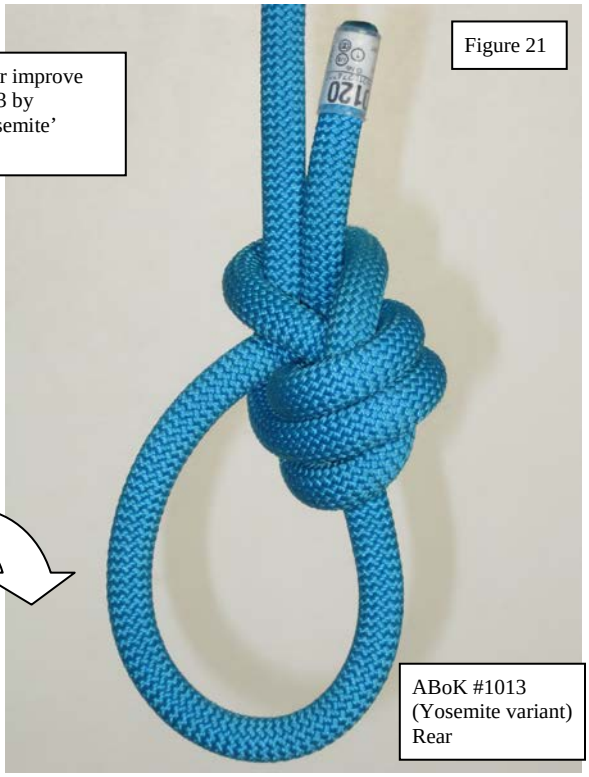
Note the figure 8 form.

Tail wraps around eye leg, then tucks through collar to finish.

(Same as figure 14 above).

ABoK #1013 (Yosemite variant) Front

Figure 21



ABoK #1013 (Yosemite variant) Rear

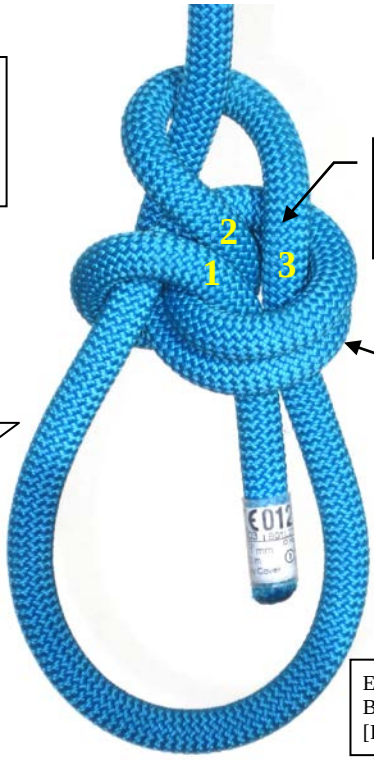
Figure 22

End Bound Double Bowline (EBDB). [Front view]

A clever improvement of ABoK #1013 devised by Dan Lehman.

Discovery date unknown

Figure 23

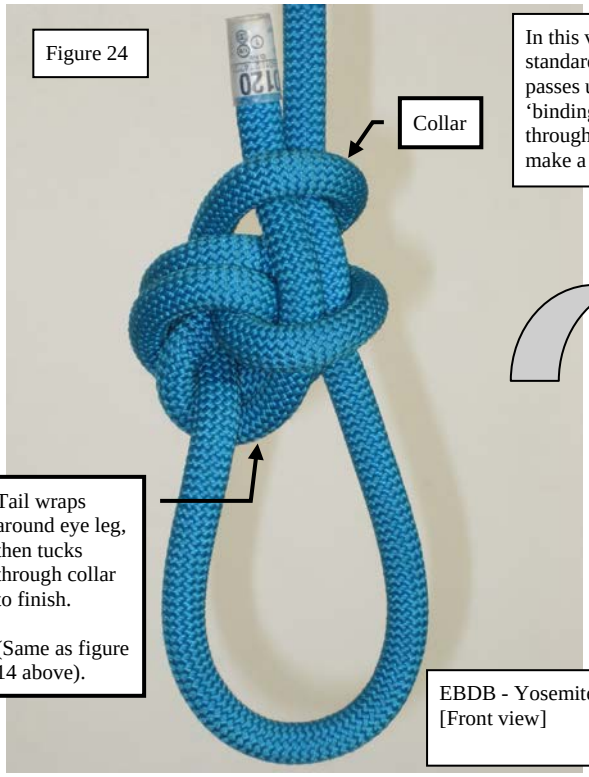


3 rope diameters encircled and gripped by double loops

Double loops

End Bound Double Bowline (EBDB). [Rear view]

Figure 24



Collar

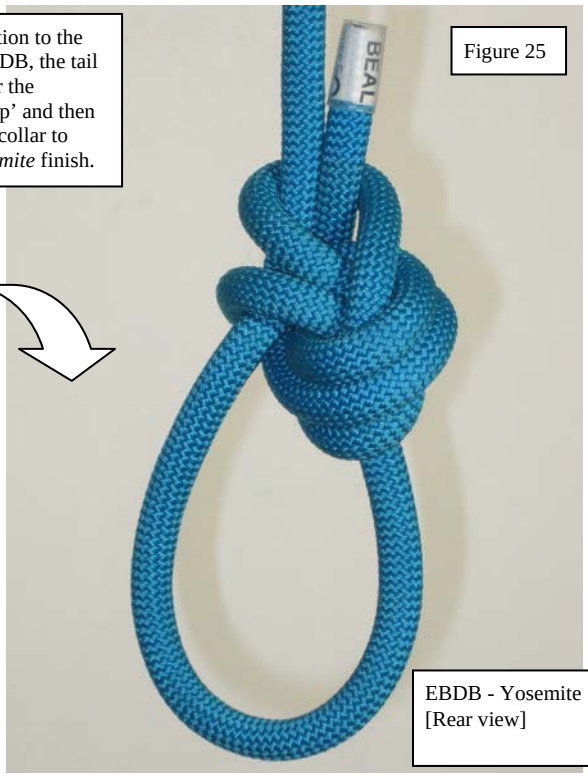
In this variation to the standard EBDB, the tail passes under the 'binding loop' and then through the collar to make a *yosemite* finish.

Tail wraps around eye leg, then tucks through collar to finish.

(Same as figure 14 above).

EBDB - Yosemite [Front view]

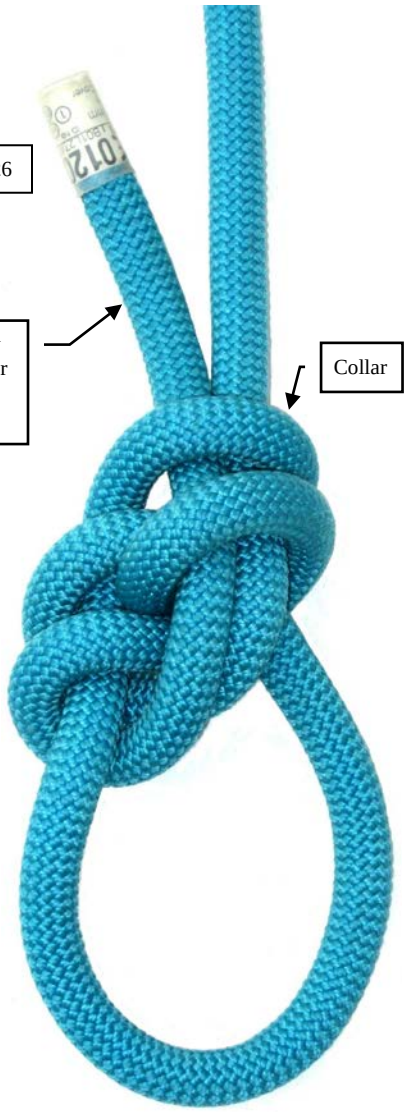
Figure 25



EBDB - Yosemite [Rear view]

EBSB Bowline variant

Figure 26



Tail securely held by collar and binding loop.

Collar

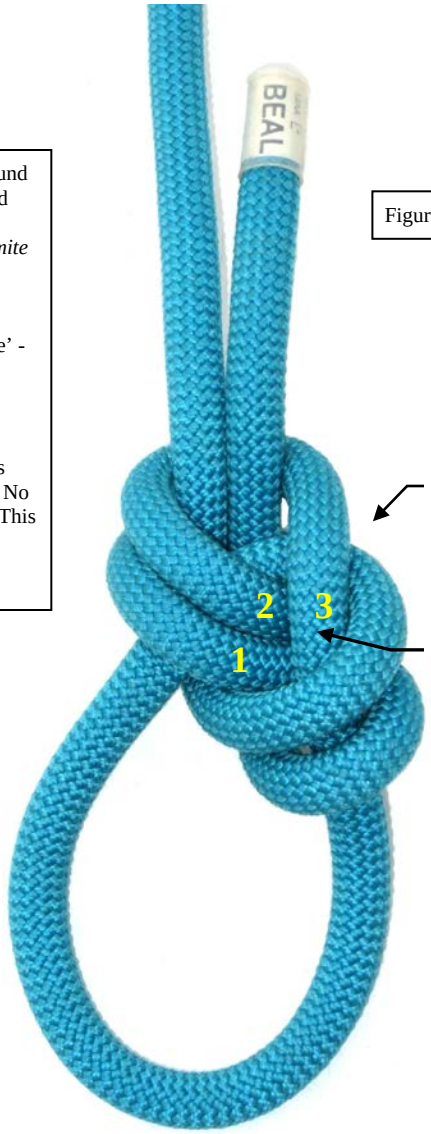
EBSB - Bowline [Front view]

This variation is an End Bound Single Bowline (EBSB), and combines elements of the original *EBDB* with a *Yosemite* finish.

Compare this form to the standard 'Yosemite Bowline' - see figure 6 & 7 p4.

History: Mark Gommers suggested this form as an alternative to Dan Lehman's EBDB (fig 22) in Jan 2009. No other published info exists. This form of the Bowline is well suited as a tie-in knot for climbing applications.

Figure 27



Note the figure 8 form.

3 rope diameters encircled and gripped by a single loop.

EBSB - Bowline [Rear view]

Test data: Tested by Mark Gommers

Cord batch coding: A050AS0100 Lot #R6-092507KT (purchased 02 Jan 2009).
Test method: Static load test using 5 Ton dynafor tension load cell. Slow pull using hand operated winch, peak load recorded at failure. Knots were cinched tight by hand strength – same degree of effort used to cinch all 3 knot specimens.

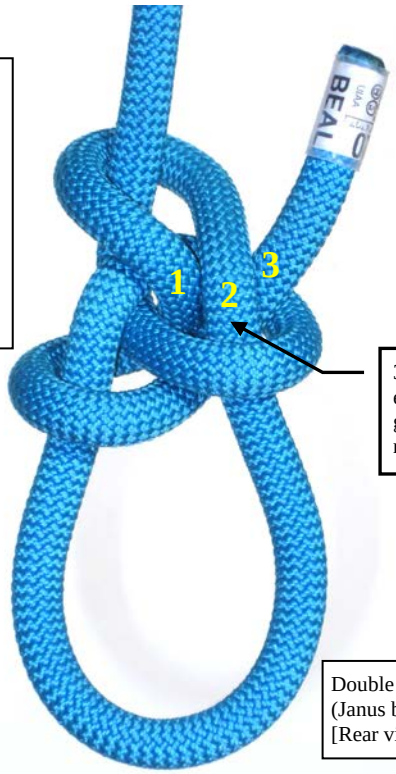
EBSB	Cord diameter	Cord material	Certification	Manufacturer	End fixing anchor pin diameters	Test date	Minimum Breaking Strength (Sterling)	Peak load at failure	% strength remaining relative to MBS
Test 1	5.0mm	Nylon	EN 564	Sterling USA	10.0mm	14 Jan 2009	5.2 kN	3.84 kN	73%
Test 2	5.0mm	Nylon	EN 564	Sterling USA	10.0mm	14 Jan 2009	5.2 kN	4.02 kN	77%
Test 3	5.0mm	Nylon	EN 564	Sterling USA	10.0mm	14 Jan 2009	5.2 kN	3.96 kN	76%

Figure 28

The version of the Bowline is attributed to Heinz Prohaska and has two collars. Prohaska referred to it as a *'Double Bight Bowline'*. It also has 3 rope diameters which are encircled and gripped by the loop. Dan Lehman refers to this form as a *'Janus Bowline'*.

Double Bight Bowline (Janus bowline) [Front view]

Figure 29



3 rope diameters encircled and gripped by the nipping loop.

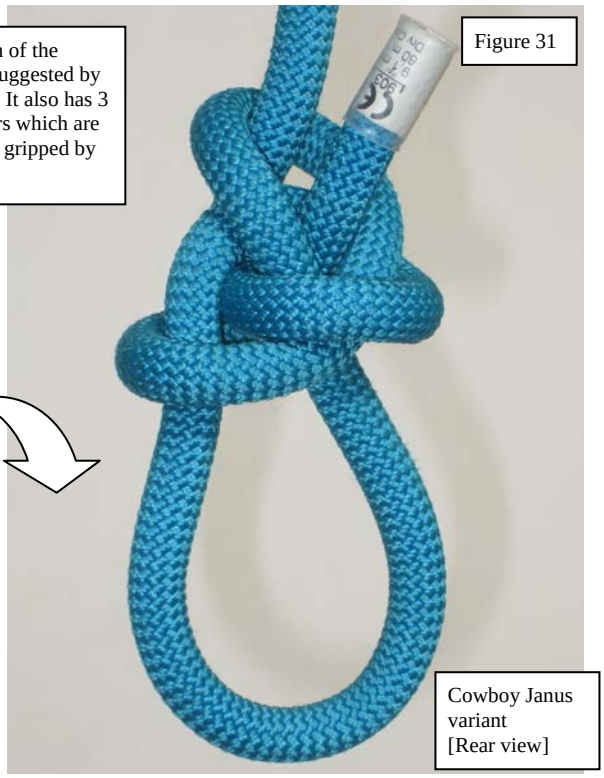
Double Bight Bowline (Janus bowline) [Rear view]

Figure 30

This variation of the 'Janus' was suggested by Dan Lehman. It also has 3 rope diameters which are encircled and gripped by the loop.

Cowboy Janus variant [Front view]

Figure 31



Cowboy Janus variant [Rear view]

Figure 32

Girthed hitched bowline
[Front view]

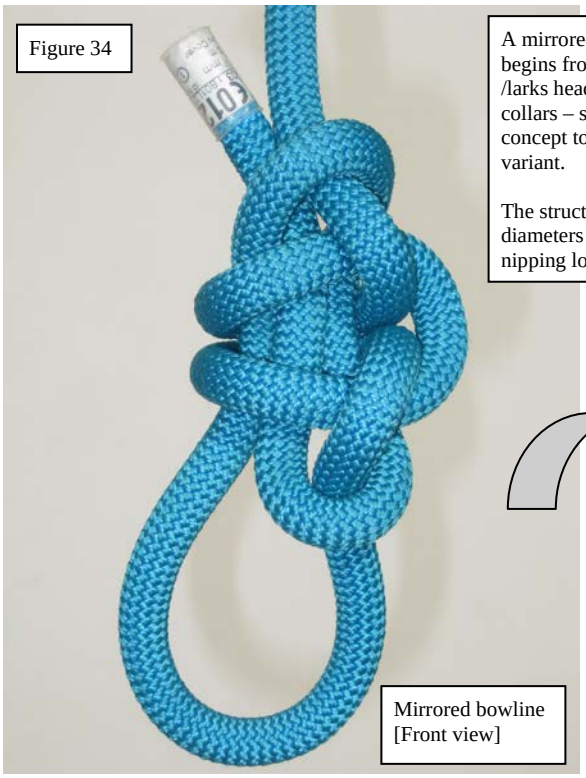
A girth hitched Bowline. It begins from a girth hitch /larks head. Compare its structure to the clove bowline at figure 10.

The girth hitch is also the base structure for tying *mirrored* Bowlines (see fig 38).

Figure 33

Girthed hitched bowline
[Rear view]

Figure 34



Mirrored bowline
[Front view]

A mirrored Bowline. It begins from a girth hitch /larks head. There are 2 collars – similar in concept to the Janus variant.

The structure has 3 rope diameters inside each nipping loop.

Figure 35

Mirrored bowline
[Rear view]