

## **The Boston Hitch**

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I would like to present a potentially new hitch that combines an exceptional ease of untying with a high degree of knot security. The quest for such a hitch led to Clifford Ashley's remarkable ABOK 1688, a hitch whose hallmark features are an ease of untying and a resistance to jamming even after heavy loading. Its drawback is its potential to become insecure under strenuous loading conditions. The proposed hitch, which I have called the "Boston Hitch" based on its geographical origin in New England's hub, represents the culmination of tests on many variants of ABOK 1688. It starts with two turns round the bar or post to which it is attached. Final wrapping turns are made around the crossing point of the two round turns in such a way that the first wrapping turn forms into a twisted loop through which the standing part of the line passes on route to its load. Subsequent optional wrapping turns increase the hitch's security in proportion to the number of extra turns made. The hallmark structural feature, the twisted loop, acts not only as a secure guide for the standing part of the line on route to its load but also as the trigger mechanism by which the hitch is untied after being unloaded.

The hitch is tied as follows:

### **Step 1**

While holding the standing part of the line in the left hand, pass the free end of the line front-to-back round the top of a horizontal bar, and pinch the descending line to the standing part with the left hand:

Figure 1

### **Step 2**

Pass the free end front-to-back round the top of the horizontal bar a second time to the right of the first turn:

Figure 2

### **Step 3**

Pass the free end front-to-back round the left side of the pinched lines:

Figure 3

### **Step 4**

Pass the free end front-to-back through the opening formed by the horizontal bar above, the two crossing lines below, and the descending lines on the left and right. Make this pass once, twice, or three times for a 1-, 2-, or 3-turn Boston Hitch, respectively:

Figure 4

Finishing, or dressing, the hitch is a two-step process:

### **Step 5**

While applying gentle traction on the free end with one hand, pull firmly on the standing part with the other hand until excess line material is taken up and the twisted loop forms. Steadying the free end prevents it from pulling through and the lines from becoming tangled during formation of the loop:

Figure 5

### Step 6

While maintaining traction on the standing part, pull on the free end in the direction of the loop until the final desired loop size is achieved. Sometimes, the loop is more easily finished with alternating back-and-forth pulls on the free end and standing part:

Figure 6

The finished hitch demonstrates the hallmark twisted loop through which the standing part of the line passes on route to its load:

Figure 7

One point to stress is that the loop size must be made large enough so that the standing part of the line passes through it with abundant clearance. This clearance allows the loop to slide freely along the standing part of the line when it comes time to untie the hitch. On the other hand, an excessively large loop size *may* mildly weaken its breaking strength and should *perhaps* be avoided (see below). I make the loop diameter about four to eight times the diameter of the line, depending on the thickness of the line and the bar or post to which it is fastened:

Figure 8

The close similarity between the Boston Hitch and ABOK 1688 is demonstrated by the fact that ABOK 1688 may be tied in a manner identical to that described for the *1-turn* Boston Hitch except that the free end is passed *back-to-front* rather than front-to-back round the left side of the pinched lines in Step 3. This one difference results in the key structural difference between the two hitches: the loop in the Boston Hitch has a 180° twist, whereas the loop in ABOK 1688 has no twist:

Figure 9

The 180° twist appears to be functionally important, as the Boston Hitch is substantially more secure than ABOK 1688 (see below).

A major goal was that the hitch should demonstrate a high degree of knot security. An informal security test was devised. A segment of braided 0.058" nylon mason twine (Home Depot, USA) was fastened at either end to two 1<sup>1</sup>/<sub>4</sub>" oak dowels with the hitch to be tested. The dowels were then manually snapped apart repeatedly to impart sudden high-intensity short-duration loads. Two hundred snaps were performed per test, or fewer if one of the hitches was about to become undone, and the amount of line slippage was recorded. Each test was repeated at least four times. This system was felt to represent a rigorous test of hitch security, because of both the slipperiness of the twine and the slippage-promoting nature of the loading conditions. The results are presented as (1) the median line slippage in millimeters per 100 snaps, and (2) a unit-less score of knot security using the following formula:

$$\text{Knot security score} = \text{Boom Hitch slippage per snap} / \text{test hitch slippage per snap}$$

The Boom Hitch (ABOK 1687) was chosen as the reference because of its status as a classic semi-permanent hitch. The knot security score of the Boom Hitch is, by definition, 1. A score greater than 1 indicates a more secure hitch than the Boom Hitch, and a score less than 1 a less secure hitch. The results are shown in the following table:

Figure 10

The same knot security scores are depicted graphically in the following chart:

Figure 11

As is seen, the 3-turn Boston Hitch demonstrates the greatest knot security of all the hitches tested, equaling that of the essentially "permanent" 2 Round Turns + 2 Half Hitches and exceeding that of two classic semi-permanent hitches, the Boom Hitch and the Ossel Knot. The 2-turn Boston Hitch achieves a lesser but still semi-permanent degree of knot security, approaching that of the Boom Hitch and the Ossel Knot and exceeding that of two hitches developed over the past 25 years specifically for their knot security, the Snuggle Hitch and the Vibration-Proof Hitch. The 1-turn Boston Hitch, although less secure than either the 2- or 3-turn version, nonetheless exceeds the security of many conventional hitches, including the Spar Hitch (ABOK 1187/1674), Picket Line/Ground Line Hitch, Ossel Hitch, and Clove Hitch. In comparison with the closely related ABOK 1688, the Boston Hitch is substantially more secure, consistently requiring one less wrapping turn to achieve a similar degree of knot security.

A second major goal was that the hitch should be both easy to untie and jam-proof. Provided that the loop is made adequately large (Figure 8), the Boston Hitch has been found to fulfill these goals. To date, it has never been observed to jam in a multitude of trials under a variety of loading conditions. Furthermore, it is untied with remarkable ease by simply (1) flicking the loop away from the bar or post with the fingertip, (2) pulling up on the loop to loosen the wrapping turns, then (3) pulling on the front strand where the loop strands cross to unwrap the turns:

Figure 12

The number of wrapping turns influences the ease of untying. Like ABOK 1688, the 1-turn Boston Hitch is trivially easy to untie. The 2- and 3-turn variants require unraveling of the wrapping turns, which adds only a minor extra effort. This ease of untying has been observed following even the heaviest loads and when the hitch is tied in wet cordage. In contrast, untying other semi-permanent hitches, including the Boom Hitch, Ossel Knot, and Round Turn + 2 Half Hitch variants, under those loading conditions can be difficult or even impossible (i.e., the hitch can become jammed).

An informal test was performed to compare the ease of untying of various semi-permanent and "permanent" hitches. Braided  $\frac{1}{8}$ " nylon/polypropylene cord (Home Depot, USA) was soaked in water, attached to a  $1\frac{1}{4}$ " oak dowel with the hitch to be tested, then subjected to five to six 150-lb pulls until the hitch could not be tightened further. A different person untied the hitch, and the untying time and a subjective measure of untying difficulty were recorded. A second test was performed in an identical manner, except that the cord was further subjected to a final progressive 200<sup>+</sup>-lb pull until the cord broke (always at the loop at the end that was being pulled rather than at the hitch) to mimic a worst-case loading scenario. The results are shown in the following table:

Figure 13

The same results are depicted graphically in the following two charts:

Figure 14

Figure 15

As is seen, the Boston Hitch variants are quick and easy to untie, bettering all the other semi-permanent and "permanent" hitches tested after both moderate and severe loading. This was true even though the conditions were strenuous enough that both the Boom Hitch and Ossel

**Knot jammed.** Another distinctive feature of the Boston Hitch is that it is nearly as easy to untie after a severe load as after a moderate load, in contrast with all the other hitches tested, which were consistently more difficult to untie after a severe load.

Provided that gentle traction is applied to the free end during initial loading (Step 5), the Boston Hitch will consistently dress to its proper finished configuration. Furthermore, it will accept a load before it is fully finished, in which case it may be finished unhurriedly by pulling on the free end until the desired loop size is achieved (Step 6). It is economical in line usage relative to its degree of knot security. The 3-turn Boston Hitch, the most secure of all hitches tested, uses 15% less line than the only hitch matching it in knot security, the 2 Round Turns + 2 Half Hitches. It uses fully  $\frac{1}{3}$  less line than the semi-permanent Boom Hitch (ABOK 1687) and Ossel Knot, both of which it exceeds in knot security by a substantial margin. The 2-turn Boston Hitch achieves a lesser but still semi-permanent degree of knot security with even better line economy: 25% less line than the 2 Round Turns + 2 Half Hitches and 40% less line than the Boom Hitch and Ossel Knot. Only the [one] Round Turn + 2 Half Hitches achieves a comparable degree of knot security with greater economy, using 20% less line than the 3-turn Boston Hitch and 10% less than the 2-turn Boston Hitch.

The Boston Hitch remains secure under a wide variety of conditions that are problematic for other hitches: (1) when tied with bungee or other slippery cordage; (2) when subjected to omnidirectional loading (a quality shared by few other hitches); (3) when subjected to high-intensity brief-duration loading (snapping), and (4) when tied to irregularly shaped objects. With regard to the latter case, the hitch will remain secure provided that the wrapping turns at the base of the loop remain pressed against the object's surface. Alternatively, the wrapping turns can be immobilized by securing the free end of the line with a couple of half hitches immediately adjacent to the wrapping turns. The hitch may then even be suspended in mid-air without loss of security. The 3-turn Boston Hitch, the most secure variant, should be used in this extreme circumstance:

Figure 16

Informal breaking strength tests were performed. A setup similar to that of the security tests was used. One end of a segment of braided 0.058" nylon mason twine was attached to a  $1\frac{1}{4}$ " oak dowel with a Boston Hitch, and the other end to a second  $1\frac{1}{4}$ " oak dowel with a comparison hitch. Progressively increasing distracting force was applied to the two dowels until the twine broke, always at one or the other hitch. The hitch with the fewer breaks on repeated testing was considered the stronger of the two hitches. The results are shown in the following table:

Figure 17

The following tentative conclusions can be drawn: (1) the breaking strength of the Boston Hitch approximates that of the Boom Hitch and does not seem to be greatly affected by the number of wrapping turns; (2) the Boston Hitch is stronger than the Clove Hitch, whose strength is known to be about 60-70% of the native strength of the line; and (3) a very large loop size *may* mildly diminish the breaking strength of the Boston Hitch and *perhaps* should be avoided.

Few disadvantages of the Boston Hitch have been identified thus far. While it can be tied under tension, some slippage will occur as the twisted loop forms. Whether a tying method can be devised that prevents this slippage remains to be seen. It should be noted that difficulty tying under tension is a feature shared by most hitches. While results from preliminary security and breaking strength tests are encouraging, formal testing still needs to be done.

In conclusion, a potentially new hitch is described with many appealing qualities: (1) easy to learn and easy to tie, (2) consistent in drawing up to its finished configuration, (3) free of significant slippage during finishing, (4) capable of handling a load before it is fully finished, (5) remarkably easy to untie and jam-proof even after heavy loading and when tied in wet cordage, (6) strong, (7) secure under a wide variety of challenging loading conditions, and (8) economical in line usage relative to the degree of security it achieves. The availability of three variants permits the Boston Hitch to be tailored to the task at hand: the 1-, 2-, or 3-turn hitch depending on whether the circumstances call for a temporary, semi-permanent, or "permanent" attachment, respectively. While a 1- or 2-turn hitch would probably suffice for most practical situations, the 3-turn Boston Hitch, by adding to the aforementioned features a virtually permanent degree of knot security, demonstrates a singularly broad spectrum of desirable qualities that would appear to make it as close to the "ideal" as any hitch yet described.

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