

# WHICH BEND FOR JOINING ROPES?

Testing and analysis of flat bends used for rope retrieval.

BY GRANT PRATTLE, OVER THE EDGE RESCUE, JUNE 2016 (VERSION 2.0)

## The question:

Is there a bend that is easy to tie, easy to undo after normal loading, has a snag free surface while having reasonable strength?

## Materials used

- 9mm nylon Dana rope manufactured by Kordas.
- Breaking strength of 21.15kN.
- Meets standard EN 1891B.
- Observation: the rope was stiff and did not easily fold in half.



## Introduction

As part of writing the [Canyoning Technical Manual](#), I needed to find out more about flat bends. For my own piece of mind, I had to make sure what I was putting in the book was suitable.

In canyoning, as well as other disciplines, you often need to join 2 ropes for retrieval during a pull through descent. For long pitches in aquatic canyons, the bend can take a single person load ( $\approx 100\text{kg}$ ). For example, when you have a releasable system in place above the bend.

For many years, the flat overhand has been used. This is often known as the European Death Knot (EDK). The flat overhand is popular as it is easy to tie, easy to undo after normal loading and provides a flat snag free surface when retrieving. The main concern however with the flat overhand is the failure by rolling. A combination of stiff ropes, poor dressing/setting, and short tails are likely to be contributing factors to failure in the field.

Five flat bend variations were tested (August 2015) for ease of tying and strength. This included the flat overhand, overhand 1.5, stacked overhand, double overhand and triple fisherman's.

## Testing procedure

A repeatable test procedure was set up.

- A 20t test bed was used at the Chainman Ltd, 1 Cass Street, Sydenham, Christchurch.
- New rope was used for testing. It was important not to use unreliable, unknown strength of old or retired rope and to use rope of the same diameter and type used in canyoning.
- All tests used a figure-8 knot on the bight on both ends.
- 20cm tails were used as the standard.
- A control set was tested without bends and using a figure-8 knot on the bight on both ends.
- All knots and bends were hand tensioned.

# Flat bend variations tested

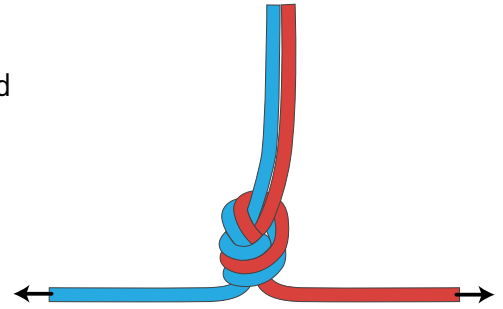
## Flat Overhand

With both strands wrap once around and thread through.

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## Overhand 1.5

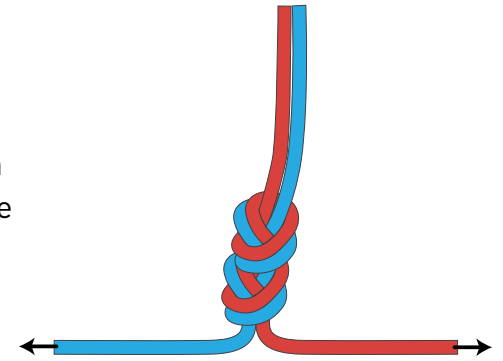
With both strands wrap around and thread through. Take the inside strand and wrap/thread a second time.



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## Stacked Overhand

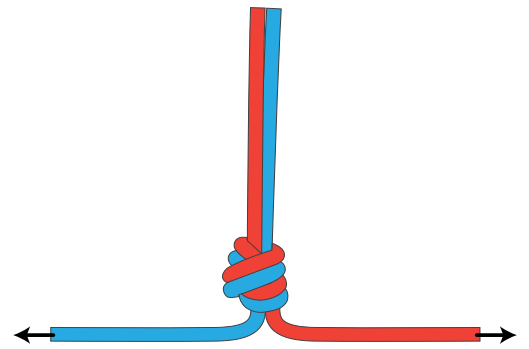
Tie one flat overhand and then tie a second on top in the same direction.



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## Double Overhand

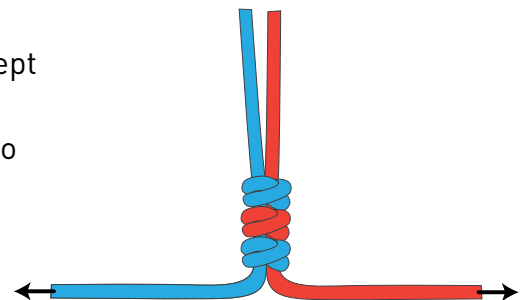
With both strands wrap two times around and thread through as you would for a double fisherman's.



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## Triple (T) Fisherman's

Tie a double fisherman's except with the tails coming out the same side. Choose a strand to tie another fisherman's.



## Test data

#	Test Type	Peak kN	Average kN	Break % 22.15kN	Failure	Comments
1	Control Fig8 knots	15.05			Broke at fig-8 knot	NA
2		15.56				NA
3		15.18	15.27	0.69		NA
1	Flat Overhand	7.85			Did not break	Kept rolling
2		7.72				Kept rolling
3		7.66	7.74	0.35		Kept rolling
1	Stacked Overhand	9.89			Broke at bend	Rolled 1 time
2		9.27				Rolled 3 times
3		11.27	10.14	0.46		Rolled 1 time
1	1.5 Overhand	10.82			Broke at bend	Rolled 1 time
2		10.06				Rolled 2 times
3		9.40	10.09	0.46		Rolled 2 times
1	Double Overhand	11.63			Broke at bend	Did not roll
2		11.53				Did not roll
3		13.25	12.14	0.55		Did not roll
1	T-Fishermans	12.69			Broke at bend	Did not roll
2		13.08				Did not roll
3		12.92	12.90	0.58		Did not roll

## Analysis

An overview of the testing.

- 1. Flat Overhand:** easy to tie, strength is below 40% and failed with the bend rolling.
- 2. Stacked Overhand:** a little harder to tie (compared to the flat overhand), strength is between 40-50%, rolled 1-3 times and then failed by breaking the rope at the bend.
- 3. Overhand 1.5:** much more difficult to tie, strength is between 40-50%, rolled 1-2 times and then failed by breaking the rope at the bend.
- 4. Double Overhand:** a little harder to tie, strength is between 50-60%, did not roll and failed by breaking the rope at the bend.
- 5. T-Fisherman's:** strength is between 50-60%, did not roll and failed by breaking the rope at the bend

## Conclusions

The Double Overhand has the best all round performance. Another good option is the T-fisherman's. These two bends made it into the Canyoning Technical Manual.

The performance of the Flat Overhand can easily be improved. For example, tying a second overhand on top (stacked overhand) improves the strength from 7 to 10kN and changes the failure method from rolling to breaking the rope.

## Testing limitations

- We tested a sample size of 3 per bend variation.
- The rope tested is designed for canyoning.
- We did not test how easy the bends were to undo after normal loading.

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