# Lightweight Jigger testing report VERSION 1.0, 2022







## Lightweight Jigger Testing Report

Version 1.0 , 2022

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## **Table of Contents**

Introduction	
<u>What we set out to do</u>	4
Methods and materials	5
<u>Slow pull test results</u>	7
Analysis of slow pull testing	8
Weight comparisons	9
Volume comparisons	10
<u>Conclusions</u>	11
References	12
Disclaimer	12
<u>Glossary of terms</u>	12
Appendix 1: Lightweight jigger testing details	



## Introduction

For backcountry rescue, the aim is to use lighter weight gear balanced with functionality and performance.

A couple of years ago, I made up a lighter weight jigger (4:1CD/5:1 pre-rigged pulley system) using a 6mm cord made with a Dyneema core with a polyester sheath.

Although we did some initial testing with a 5mm 4 on 1 Prusik and found it was suitable, we decided it was time to do more in-depth testing on all the components and the total jigger unit.

## What we set out to do

Test the various components used in the jigger.

Variations tested include:

- 5mm Prusik loop tied with a double fisherman's bend.
- 5mm Prusik on 6mm cord: 3 on 3 Prusik hitch and 4 on 2 Prusik hitch.
- 6mm cord tied with a scaffold hitch onto a pulley becket.
- Lightweight jigger complete.

Tested between:

- 12mm pins
- 12mm pins and 12mm carabiner
- 12mm pin and pulley becket
- 12mm carabiners and double pulleys





## **Methods and materials**

## Methods

## Slow pull tests

- As each test destroyed the cord, it was new for every test.
- Carabiners that were undamaged were reused for multiple tests.
- All knots, bends and hitches had hand tension with all strands.
- Each testing series records the slow pull tests set up (see App. 1).
- The slow pull testing was in one location.
  - Aspiring Safety, 1/6 Burdale Street, Riccarton, Christchurch, New Zealand.
- Vertical testbed 1.6m Electronic Universal Testing Machine, Model WDW-50
  - Maximum Test Force 50kN, sample rate 60 per second
  - Jinan Chuanbai Instrument Equipment Co Ltd







## **Testing Materials**

#### Nautilus 5mm Dyneema/Polyester cord

- Diameter: 5mm
- Weight: 19g/m
- Breaking strength: 9.8kN
- Materials: Dyneema core, Polyester sheath
- Manufacturer: Nautilus Braids nautilusbraids.co.nz

#### Nautilus 6mm Dyneema/Polyester cord

- Diameter: 6mm
- Weight: 26 g/m
- Breaking strength: 13.7kN
- Materials: Dyneema core, Polyester sheath
- Manufacturer: Nautilus Braids nautilusbraids.co.nz

#### SMC Micro PMP, Double Pulley

- Diameter: up to 13mm
- Weight: 136 g/m
- Rating: 40kN
- Material: Aluminium
- Type: Ball Bearing
- Sheave: 35mm
- Manufacturer: SMC https://smcgear.com

#### **CT Snappy Steel Screw Lock**

- Weight: 237 g
- Gate Opening: 22mm
- Material: Steel, Zinc Plated
- Rating: 40KN
- Standards CE 0333, EN 12275:2013-H, EN 362:2004-M
- Manufacturer: Climbing Technology

#### Aspiring 16mm tubular webbing

- Width: 16mm
- Weight: 34 g/m
- Breaking strength: 12.5kN
- Materials: Nylon
- Standards: Certified to EN 565
- Brand: Aspiring https://aspiring.co.nz















## Slow pull test results

#### Nautilus 5mm cord loop

Items tested	Avg. kN	%	#	Comment	Аррх. 1
				Between 12mm pins	
Loop double fisherman's	12.85	66	3	Broke at the bend, core slipped through sheath one tail, sheath broke on one side of bend	<u>pg. 13</u>

## Nautilus 5mm Prusik on 6mm Jigger cord

Items tested	Avg. kN	First slip	# tests	Comment	Аррх. 2
		Betwee	n 12mm p	in and 12mm carabiner	
3 on 3 Prusik	3.09	2.89	3	Kept on slipping	<u>pg. 16</u>
4 on 2 Prusik	6.86	5.42	3	Slipped initially then regripped. Stripped sheath of 6mm jigger cord.	<u>pg. 19</u>

## Nautilus 6mm cord Scaffold hitch on pulley becket

Items tested	Avg. kN # tests Comment		Аррх. 2	
Between 12mm pin and pulley becket				
Scaffold Hitch	8.49	3	Broke sheath at the double overhand on becket (1) and at the figure-8 on a bight (2)	<u>pg. 22</u>

## Lightweight Jigger complete

Items tested	Avg. kN	First slip	# tests	Comment	Аррх. 2
Between 12mm carabiners and double pulleys					
Jigger complete	21.62	16.97	3	Slipped initially then regripped. Stripped sheath of 6mm jigger cord.	<u>pg. 25</u>





## Analysis of slow pull testing

## Nautilus 5mm cord loop

The loop is suitable to use as it's over 12kN. As a component in the system, it has greater strength than the 4 on 2 Prusik.

• The loop tied with a double fisherman's is recommended for the lightweight jigger.

## Nautilus 5mm Prusik on 6mm Jigger cord

The 3 on 3 is not suitable for load capture on the third line as it keeps on slipping at 3kN.

The 4 on 2 is suitable for load capture on the third line as it breaks at nearly 7kN (6.86kN). In theory, the 4 on 2 Prusik would hold 1/3 of the load when rigged on the 3rd line. Therefore the estimated strength of the system would be 6.86kN x3 = 20.58kN

• The 4 on 2 Prusik is recommended for use in the lightweight jigger.

## Nautilus 6mm cord Scaffold hitch on pulley becket

The scaffold hitch with webbing edge protection is suitable as it's over 8kN. As a component in the system, holding 1/3 of the load, it has greater strength than the 4 on 2 Prusik.

• The scaffold hitch on the pulley becket is recommended for use in the lightweight jigger.

## Lightweight Jigger complete

The lightweight jigger complete with the Prusik loop tied with a double fisherman's, the 4 on 2 Prusik rigged on the 3rd line and a scaffold hitch tied on the pulley becket is over 20kN.

• The lightweight jigger is recommended for rescue.





## Weight comparisons

## Estimated

What the manufacturers record as the weights for the equipment.

ltem	Lightweight Jigger	Grams	Standard Jigger	Grams
Carabiners x 2	DMM PerfectO - Locksafe 66 gm	132	Edelrid HMS Strike Triple Locking 74 gm	148
Cord x 10m	Naulitus 6mm 26 g/m	260	Edelrid Powerloc 8mm 41 g/m	410
Small double pulleys x 2	Rock Exotica Double Six 1″ Pulley 93gms*	186	Rock Exotica 1.1″ Mini Double 141gm	282
Prusik x 1m	Naulitus 5mm 19 g/m	19	PMI 6mm Accessory Cord 26 g/m	26
	TOTALS	597		866

Difference: 866 - 597 = 269gm. The estimated saving is 31% in weight from the standard to the lightweight jigger.

\* Note: Rock Exotica no longer makes the double six 1" pulley

#### Actual

Actual weight with the testing photos side by side

Lightweight Jigger	0.56kg (560gms)
Standard Jigger	0.90kg (900 gms)

Difference: 900 - 560 = 340gm. The actual saving is 38% in weight from the standard to the lightweight jigger.





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## **Volume comparisons**

To get comparative volume comparisons, we put the respective jiggers in two different PVC bags, as shown in the following photos..

Lightweight Jigger	Standard Jigger
Height: 15cm	Height: 16cm
Diameter: 9cm	Diameter: 12cm
Volume: = Area of the base (Pi.r²) x height	Volume: Area of the base (Pi.r²) x height
= (3.14 × 4.5 <sup>2</sup> ) × 15	$= (3.14 \times 6^2) \times 16$
= 64 x 15	= 113 x 16
= 954 cm <sup>3</sup>	= 1809 cm <sup>3</sup>

Difference:  $1809 - 954 = 855 \text{ cm}^3$ 

Saving is 47% in volume from the standard to the lightweight jigger.









## Conclusions

For backcountry rescue, the aim is to use lighter weight gear balanced with functionality and performance.

- 1. The testing shows that the lightweight jigger is suitable for backcountry rescue as its overall strength is 20kN+.
- 2. The cord allowed the rigging to be smaller and lighter due to:
  - The greater strength of the Dyneema core (compared with nylon) while;
  - Retaining the performance benefits similar to nylon (higher melting point) with the polyester sheath – for the Prusik load capture.
- 3. The lightweight jigger saves one-third of the weight (300 grams) compared to a standard jigger in a side-by-side weight comparison.
- 4. The lightweight jigger saves half the volume (850 cm<sup>3</sup>) compared to a standard jigger in a side-by-side volume comparison.

## References

- 1. Aspiring. https://www.aspiring.co.nz
- 2. Edelrid. https://edelrid.com
- 3. Rock Exoctica. https://www.rockexotica.com
- 4. DMM. https://dmmwales.com
- 5. PMI. https://pmirope.com
- 6. Climbing Technology. https://www.climbingtechnology.com
- 7. Nautilus Braids <u>http://nautilusbraids.co.nz</u>
- 8. SMC https://smcgear.com
- 9. Jigger setup: troubleshooting. https://overtheedgerescue.com/rope-rescue/jigger-setup/
- 10. Progress capture testing for a jigger. <u>https://overtheedgerescue.com/rope-rescue/jigger-progress-capture-testing/</u>





## Disclaimer

- 1. Information contained in this test report is not an instructional guide—intended to supplement training from experienced and competent backcoutry rescue instructors.
- 2. Use at your own risk. The publisher and author assume no responsibility or liability for any accident, injury, loss or damage sustained while following any of the recommendations or techniques described.
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- 4. Testing was under controlled conditions with a limited set of equipment. Testing with different equipment or operating in different conditions may result in different outcomes.
- 5. The views, information, or opinions expressed in the test report are solely those of the author and do not necessarily represent those of other organisations or individuals listed.

## **Glossary of terms**

**Bend:** Where two pieces of rope or webbing are tied together usually at their ends, with both playing an integral part. The load is pulling in line through the bend. An example is a double fisherman's bend.

**Force (kN):** In physics, force is the push or pull on an object with mass that causes it to change velocity (to accelerate). Force represents as a vector, which means it has both magnitude and direction. The SI unit of force is the newton (N).

**Hitches:** Where a rope is tied to an object where if the object is removed the hitch falls apart. An example is the Italian/Munter hitch.

**Knots:** 'If it's not a bend or a hitch then it's a knot'. In the widest sense a generic name for all types of rope and cord entanglements but specifically where a connection is tied that is self-sustaining in rope or webbing.

**Maximum Force (kN):** Maximum amount of tensile stress that the material can withstand before failure (rupture), such as breaking or permanent deformation. Tensile strength specifies the point when a material goes from elastic to plastic deformation.

## OVER THE EDGE

## Appendix 1: Lightweight jigger testing details

## Loop double fisherman's

### Materials

Prusik cord	– Nautilus Polyester/Dyneema 5mm (9.8kN)		
Test setup			
Bend	– Double fisherman's		

#### **Test parameters**

Speed	– Slow pull 100mm/minute
Tested between	– 12mm pins

#### Results

Date	#	Max force (kN)	%	Comments
13/04/22	16*	13.06	67	Broke at the bend, core slipped through sheath one tail, sheath broke on one side of bend
13/04/22	17	12.30	63	Broke at the bend, core slipped through sheath one tail, sheath broke on one side of bend
13/04/22	18	13.20	67	Broke at the bend, core slipped through sheath one tail, sheath broke on one side of bend
Average		12.85	66	

\* Sample 13/04/22 #16 shown on the following pages.







Wednesday, 13 April 2022
13.06
Loop double fisherman's bend
16
5mm Nautilus Polyester/Dyneema Cord



Machine has a current calibration certificate. www.aspiring.co.nz

Q U A L I T Y MANAGEMENT



#### #: 16 Date: 13/04/22

Test: Slow Pull 100mm/min Type: Loop double fisherman's Cord: 5mm Nautilus poly/dyn Between: 12mm pins Force: 13.06kN





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## 3 on 3 Prusik

## Materials

Prusik cord	- Nautilus Polyester/Dyneema 5mm (9.8kN)		
Jigger cord	– Nautilus Polyester/Dyneema 6mm (13.7kN)		
Carabiner	<ul> <li>CT Snappy Steel Screw Lock (40kN)</li> </ul>		

### Test setup

Prusik bend – Double fisherman's	
Prusik tied	– 3 on 3
Jigger cord tied	– Figure 8 on a bight

#### **Test parameters**

Speed	– Slow pull 100mm/minute
Tested between	- 12mm pin and 12mm carabiner

#### Results

Date	#	First slip (kN)	Max force (kN)	Comments
13/04/22	19*	2.01	2.23	Kept on sliding
13/04/22	20	4.02	4.17	Kept on sliding
13/04/22	21	2.63	2.87	Kept on sliding
Average		2.89	3.09	









Test Date:	Wednesday, 13 April 2022		
Max Force (kN):	2.32		
Product Name:	3 on 3 Prusik		
Test #:	19		
Material:	5/6mm Nautilus Polyester/Dyneema Cord		





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## 4 on 2 Prusik

## Materials

Prusik cord	– Nautilus Polyester/Dyneema 5mm (9.8kN)	
Jigger cord	– Nautilus Polyester/Dyneema 6mm (13.7kN)	

#### Test setup

Prusik bend	– Double fisherman's		
Prusik tied	– 4 on 2		
Jigger cord tied	– Figure 8 on a bight		

## Test parameters

Speed	– Slow pull 100mm/minute	
Tested between	- 12mm pin and 12mm carabiner	

## Results

Date	#	First slip (kN)	Max force (kN)	Comments
13/04/22	22*	5.57	6.99	Slipped initially then regripped. Stripped sheath of 6mm.
13/04/22	23	5.33	7.42	Slipped initially then regripped. Stripped sheath of 6mm.
13/04/22	24	5.36	6.17	Slipped initially then regripped. Stripped sheath of 6mm.
Average		5.42	6.86	

\* Sample 13/04/22 #22 shown on the following pages.







Test Date:	Wednesday, 13 April 2022			
Max Force (kN):	6.99			
Product Name:	4 on 2 Prusik			
Test #:	22			
Material:	5/6mm Nautilus Polyester/Dyneema Cord			





 Tested by:
 Grant Prattley

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## Appendix 1: Lightweight jigger testing details







## Scaffold hitch on Becket

## Materials

Jigger pulley	- SMC Micro PMP, double pulley (40kN)		
Jigger cord	– Nautilus Polyester/Dyneema 6mm Cord (13.7kN)		
Webbing	<ul> <li>Aspiring 16mm tubular (edge protector)</li> </ul>		

#### Test setup

Becket hitch	- Scaffold
Jigger cord tied	– Figure 8 on a bight

#### Test parameters

Speed	– Slow pull 100mm/minute	
Tested between	- 12mm pins and 12mm carabiner	



## Results

Date	#	Max force (kN)	Comments	
13/04/22	25*	8.77	Broke sheath at the scaffold on becket	
13/04/22	26	8.47	Broke sheath and core at the figure-8 on a bight	
13/04/22	27	8.24	Broke sheath and core at the figure-8 on a bight	
Average		8.49		

\* Sample 13/04/22 #25 shown on the following pages.





8.77		
Scaffold hitch on becket		
ord		



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Q U A L I T Y MANAGEMENT













## Lightweight jigger setup

## Materials

Jigger pulley	- SMC Micro PMP, double pulley (40kN)		
Jigger cord	– Nautilus Polyester/Dyneema 6mm Cord (13.7kN)		
Webbing	<ul> <li>Aspiring 16mm tubular (edge protector)</li> </ul>		
Prusik Cord	– Nautilus Polyester/Dyneema 5mm (9.8kN)		

#### Test setup

Becket hitch	nitch – Scaffold	
Prusik bend	– Double fisherman's	
Prusik tied	– 4 on 2 on 3rd line	

#### **Test parameters**

Speed	– Slow pull 100mm/minute	
Tested between	- 12mm pins and 12mm carabiners	

## Results

Date	#	Max force (kN)	First slip (kN)	Comments
9/05/22	2	20.63	15.90	5mm Prusik hitch slipped initially then regripped. Stripped sheath of 6mm.
9/05/22	3	22.78	17.30	5mm Prusik hitch slipped initially then regripped. Stripped sheath of 6mm.
9/05/22	4	21.46	17.70	5mm Prusik hitch slipped initially then regripped. Stripped sheath of 6mm.
Average		21.62	16.97	

\* Sample 9/05/22 #2 shown on the following pages.









Test Date:Monday, 9 May 2022Max Force (kN):20.63Product Name:4:1 jigger Prusik 4on1 Prusik 3rd lineBatch #:2Material:Nautilus Polyester / Dyneema<br/>6mm Jigger Cord & 5mm Prusik Cord



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT Tested by: Grant Prattley

Signed:

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## Appendix 2: Aspiring webbing 16mm





