Single and multi-wrap webbing anchors testing report

VERSION 1.0, 2022

Single and multi-wrap webbing anchors testing report

Version 1.0 , 2022

Author: Grant Prattley

Over The Edge Rescue
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Introduction

For back country rescue the aim is to use lighter weight gear balanced with functionality and performance. I have always thought that anchor rigging with 25mm was better than 16mm (tubular webbing).

My thinking went something like this:

> "The 25mm as it's wider and had more material it would be more robust around rocks especially on sharp edges."

There was actually no evidence from testing I had done to support this thought. What made me start questioning the validity of this thought was some testing of 25mm tubular webbing was ridiculously strong with the lowest value for a sling with a tape bend being 26kN. Also if there were sharp edges, would I not use a suitable protector?

So my question became:

> "Does the 16mm tubular have sufficient strength for use in anchor rigging as used in back country rescue?"

The question became a "why not" use 16mm webbing (based on testing) rather than "I would never" or "my preference is..." (based on opinion).

Note: This report is about technical rescue rigging. It relates to specific anchor rigging techniques that requires lots of practice to master and judgment to use in the right place. This article does not constitute training of any sort.

What we set out to do

Test and compare various single and multi-wrap anchor webbing rigging methods used around pins/carabiners, smooth rocks and sharp rocks for 16mm tubular webbing compared to 25mm tubular webbing as a baseline.

Note: The webbing uses a tape bend to join the ends and does not include any sewn products.

Variations tested include:

- Wrap 1, Pull 1
- Wrap 2, Pull 2
- Wrap 2, Pull 1
- Wrap 3, Pull 2.

Tested between:

- 12mm pin (or 12mm carabiner) and 30mm pin (16 and 25mm tubular webbing)
- Smooth rock and a 12mm pin (16mm tubular webbing)
- Sharp rock and a 12mm pin (16mm tubular webbing)
- Sharp rock + edge protection and a 12mm pin (16mm tubular webbing)

Methods and materials

Methods

Slow pull tests

- As each test destroyed the webbing, it was new for every test.
- Carabiners that were undamaged, were reused for multiple tests.
- All knots and bends had hand tension with all strands pulled tight.
- Each testing series records the slow pull tests set up (see Appendix 1-2).
- The slow pull testing was in one location.
  - Aspiring Safety, 1/6 Burdale Street, Riccarton, Christchurch, New Zealand.[1]
- 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

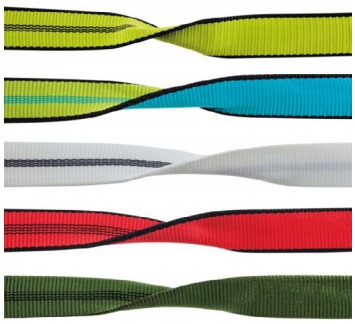
1 https://www.aspiring.co.nz

Materials

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

Edelrid X-Tube 25mm tubular webbing



- Width: 25mm, Weight: 43 g/m
- Breaking strength: 20kN
- Materials: Nylon
- Standards: Certified to EN 565
- Brand: Edelrid – https://edelrid.com[2]

Aspiring rope protector

- Hard wearing PVC rope protector
- 45mm internal flat webbing strip for durability.
- Velcro closure.
- 4mm prusik retaining cord.
- Brand: Aspiring – https://aspiring.co.nz

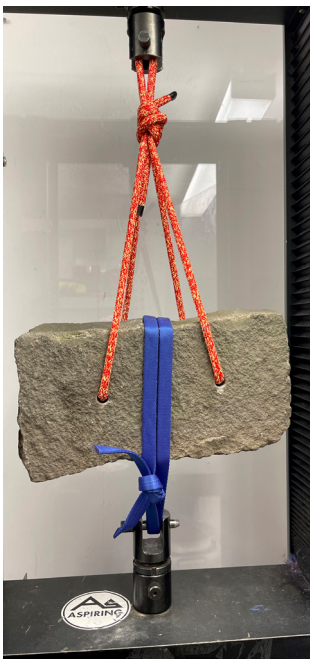
2 https://edelrid.com

Variations and types tested

Variations tested

Wrap 1 Pull 1

Wrap 2 Pull 2



Wrap 2 Pull 1

Wrap 3 Pull 2

Types tested

30mm pin

Smooth rock

Sharp rock

Edge protection

Slow pull test results

Edelrid X-Tube 25mm Tubular Webbing

Items tested	Avg. kN	%	#	Comment	Appx. 1
Between 30mm and 12mm pin (or 12mm carabiner)					
Wrap 1 Pull 1	27.98	70	3	Broke at the tape bend	pg. 12
Wrap 2 Pull 2	38.06	48	3	Broke at the carabiner inside strand	pg. 15
Wrap 2 Pull 1	33.36		3	Broke at the carabiner (2) or one side of 30mm pin (1)	pg. 18
Wrap 3 Pull 2	40.08		3	Broke at the carabiner inside strand	pg. 21

Aspiring 16mm Tubular Webbing

Items tested	Avg. kN	%	#	Comment	Appx. 2
Between 30mm and 12mm pin					
Wrap 1 Pull 1	20.16	81	3	Broke at the tape bend	pg. 24
Wrap 2 Pull 2	34.26	69	3	Broke at the 12mm pin inside strand	pg. 27
Wrap 2 Pull 1	20.80		3	Broke at one side of the 30mm pin	pg. 30
Wrap 3 Pull 2	36.62		3	Broke at the 12mm pin inside strand	pg. 33
Between Smooth Rock and 12mm pin					
Wrap 1 Pull 1	19.61	78	3	Broke at the tape bend	pg. 36
Wrap 2 Pull 2	29.69	59	3	Broke at the pin inside webbing	pg. 39
Wrap 2 Pull 1	18.31		3	Broke at one side of rock	pg. 42
Wrap 3 Pull 2	33.52		3	Broke at the pin inside webbing	pg. 45
Between Sharp Rock and 12mm pin					
Wrap 1 Pull 1	9.76	39	3	Broke at one side top edge of the block	pg. 47
Wrap 2 Pull 2	19.13	38	3	Broke at one side top edge of the block	pg. 50
Wrap 2 Pull 1	9.31		3	Broke at one side top edge of the block	pg. 53
Wrap 3 Pull 2	18.55		3	Broke at one side top edge of the block	pg. 56
Between Sharp Rock/Rope Protector and 12mm pin					
Wrap 1 Pull 1	18.73	75%	3	Broke at the tape bend	pg. 59
Wrap 2 Pull 2	35.09	70%	3	Broke at the pin inside webbing (1) or at one side top edge of the block (2)	pg. 62
Wrap 2 Pull 1	20.20		3	Broke at one side top edge of the block	pg. 65
Wrap 3 Pull 2	32.48		3	Broke at the pin inside webbing (2) or at one side top edge of the block (1)	pg. 68

Analysis of slow pull testing

Edelrid X-Tube 25mm Tubular Webbing

Between a 30mm and 12mm pin (or carabiner)

All the variations tested (W1P1, W2P2, W2P1, W3P2) are on average over 28kN.

- Recommended for all types of rescue.

Aspiring 16mm Tubular Webbing

Between a 30mm and 12mm pin

All the variations tested (W1P1, W2P2, W2P1, W3P2) are on average over 20kN.

- Recommended for lightweight rescue.

Between a Smooth Rock and 12mm pin

All the variations tested (W1P1, W2P2, W2P1, W3P2) are on average over 18kN. On average results were 2kN less than the testing 'Between a 30mm and 12mm pin'.

- Recommended for lightweight rescue rigging directly onto smooth rock.

Between a Sharp Rock and 12mm pin

Single strand variations (W1P1, W2P1) tested at around 9kN where two strand variations (W2P2, W3P2) tested on average over 18kN. On average the results were half the values from the testing 'Between a 30mm and 12mm pin'.

- Not recommended for lightweight rescue rigging directly onto sharp rock.

Between a Sharp Rock, Rope Protector and 12mm pin

All the variations tested (W1P1, W2P2, W2P2, W3P2) are on average over 18kN. Similar to results from the testing 'Between a 30mm and 12mm pin'.

- Recommended for lightweight rescue rigging onto sharp rock with a suitable rope protector.

Conclusions

For back country rescue the aim is to use lighter weight gear balanced with functionality and performance. I have always thought that anchor rigging with 25mm was better than 16mm (tubular webbing).

However, my question became "Does the 16mm tubular have sufficient strength for use in anchor rigging as used in back country rescue?"

The testing shows that the 16mm tubular webbing is suitable for light weight rescue as:

1. Single strand variations (W1P1, W2P1) break around the same minimum breaking strength as a 10mm static rope with a figure-8 on a bight (18kN)[3][4].
2. Two strand variations (W2P2, W3P2) break on average over 30kN which is greater than the aluminum carabiners we use. For example the Warlock HMS at 23kN[5].
3. Where sharp edges exist suitable edge protection needs to be used.

From a practical experience, we use the Aspiring 16mm webbing on a regular basis (30+ trips per year) for canyon rigging and exploring, in what can be some very unforgiving country. Its light weight to carry up a hill and we have had no issues when threaded behind a rock or in a pinch.

However, please consider the information presented here carefully and make your own judgment in the context of where you operate, the skill level of the team and if lighter weight webbing is the right way to go.

Note: This article is about technical rescue rigging. It relates to specific anchor rigging techniques that requires lots of practice to master and judgment to use in the right place. This report does not constitute training of any sort.

3 https://overtheedgerescue.com/rope-rescue/canyon-rescue-testing/
4 https://overtheedgerescue.com/rope-rescue/lets-lighten-the-load-update/
5 https://www.climbingtechnology.com/en/outdoor-en/carabiners/warlock2/warlock-hms

References

1. Aspiring. https://www.aspiring.co.nz
2. Edelrid. https://edelrid.com
3. Canyon Rescue Testing 2021. https://overtheedgerescue.com/rope-rescue/canyon-rescue-testing/
4. Lets lighten the load (update) 2021. https://overtheedgerescue.com/rope-rescue/lets-lighten-the-load-update/
5. Climbing Technology. https://www.climbingtechnology.com

Disclaimer

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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.

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.

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).

Appendix 1: Edelrid X-Tube webbing 25mm

Wrap 1 Pull 1 (loop) – 30mm pin 25mm

Materials

Webbing	– Edelrid X-Tube 25mm (20kN)

Test setup

Knots	– Tape bend
Wraps	– Wrap 1 Pull 1 Clip 1

Test parameters

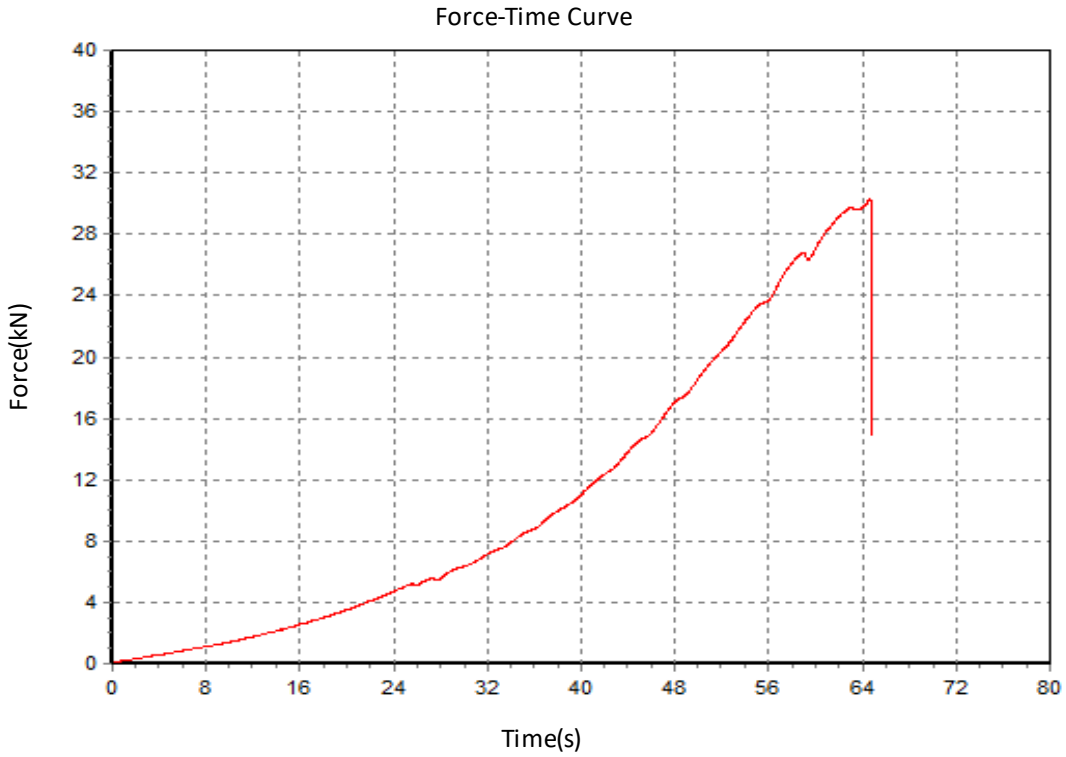
Speed	– Slow pull 100mm/minute
Tested between	– 30mm pin and 12mm pin

Results

Date	#	Max force (kN)	%	Comments
13/04/22	1*	30.30	76	Broke at tape bend
13/04/22	2	27.48	69	Broke at tape bend
13/04/22	3	26.16	65	Broke at tape bend
Average		**27.98**	**70**	

* Sample 13/04/22 #1 shown on the following pages.

Test Date:	Wednesday, 13 April 2022
Max Force (kN):	30.30
Product Name:	Wrap 1 Pull 1, tape bend, 30mm pin
Test #:	1
Material:	25mm Edelrid X-tube Webbing



Tested by: Grant Prattley

Signed:

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


#: 1 Date: 13/04/22
Test: Slow Pull 100mm/min
Type: Wrap 1 Pull 1
Webbing: 25mm Edelrid
Between: 12/30mm pins
Force: 30.30kN (76%)

Wrap 2 Pull 2 (double loop) – 30mm pin 25mm

Materials

Webbing	– Edelrid X-Tube 25mm (20kN)

Test setup

Knots	– Tape bend
Wraps	– Wrap 2 Pull 2 Clip 2

Test parameters

Speed	– Slow pull 100mm/minute
Tested between	– 30mm pin and 12mm carabiner

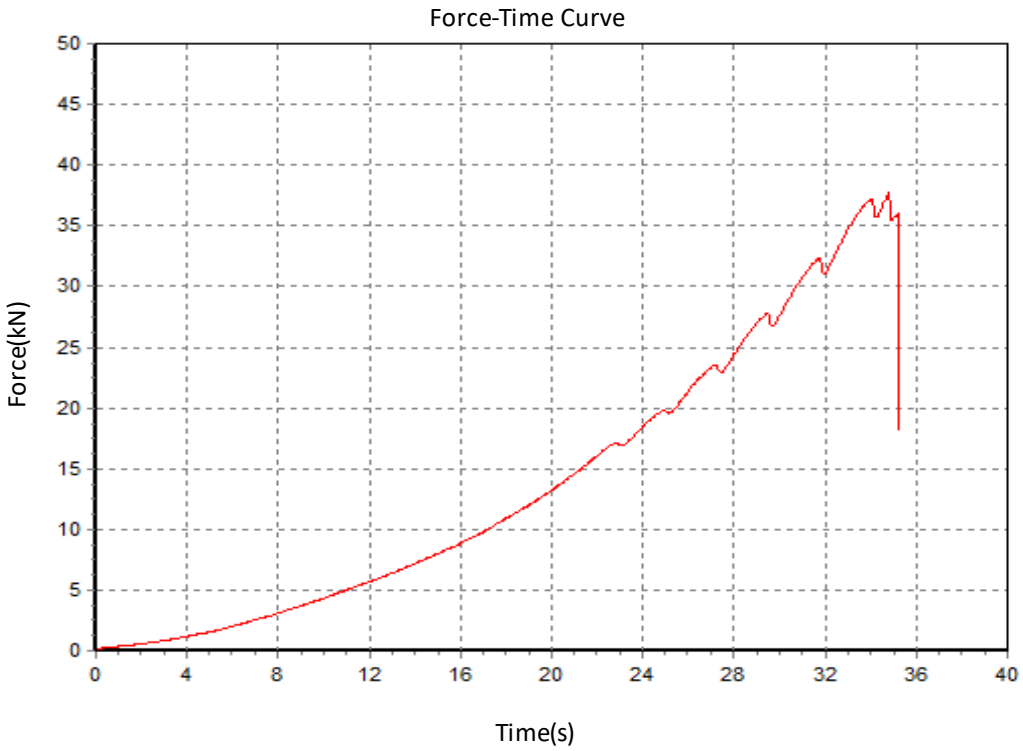
Results

Date	#	Max force (kN)	%	Comments
16/11/20	27*	37.79	47	Broke at carabiner inside strand
16/11/20	28	38.46	48	Broke at carabiner inside strand
16/11/20	29	37.94	47	Broke at carabiner inside strand
Average		**38.06**	**48**	

* Sample 16/11/20 #27 shown on the following pages.

ASPIRING

Test Date: Monday, 16 November 2020
Max Force (kN): 37.79
Product Name: W2P2 tape bend
Batch #: 27
Material: 25mm Edelrid Webbing



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Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 27 Date: 16/11/20
Test: Slow Pull 100mm/min
Type: W2P2 tape bend
Webbing: 25mm Edelrid
Force: 37.39kN

Wrap 2 Pull 1 (W2P1) – 30mm pin 25mm

Materials

Webbing	– Edelrid X-Tube 25mm (20kN)

Test setup

Knots	– Tape bend
Wraps	– Wrap 2 Pull 1 Clip 1

Test parameters

Speed	– Slow pull 100mm/minute
Tested between	– 0mm pin and 12mm carabiner

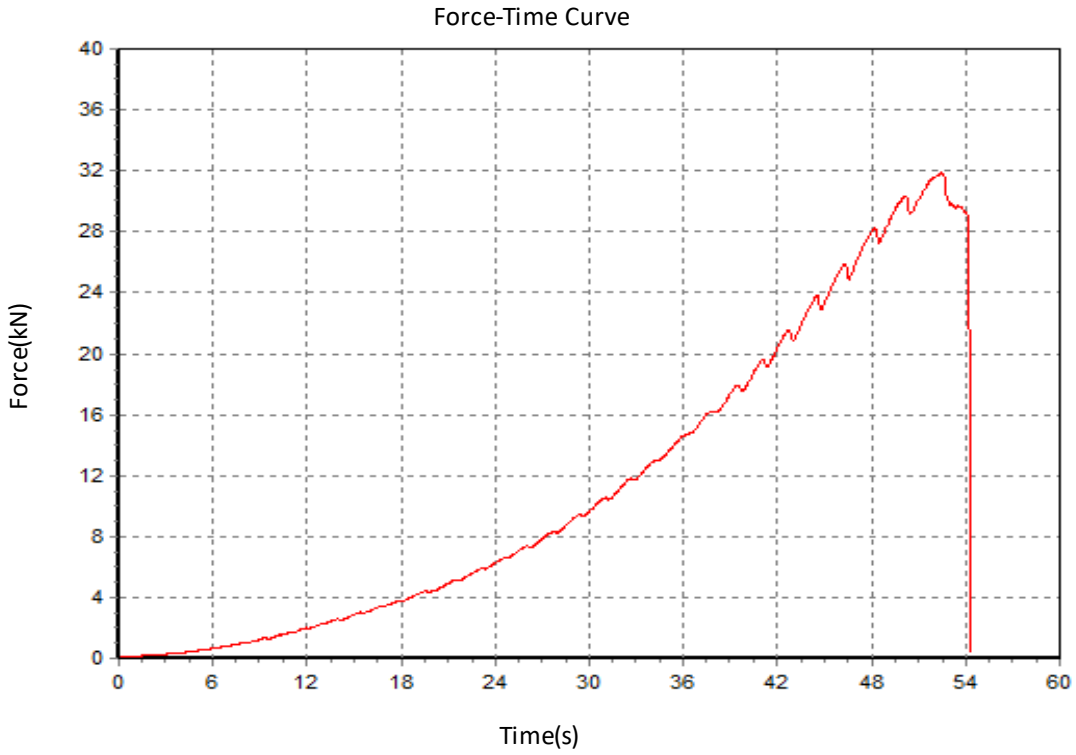
Results

Date	#	Max force (kN)	Comments
26/01/22	1*	31.85	Broke at one side of the 30mm pin
26/01/22	2	33.85	Broke at the carabiner
26/01/22	3	34.37	Broke at the carabiner
Average		**33.36**	

* Sample 26/01/22 #1 shown on the following pages.

ASPIRING

Test Date:	Wednesday, 26 January 2022
Max Force (kN):	31.85
Product Name:	Wrap 2 pull 1
Batch #:	1
Material:	25mm Edelrid webbing



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


#: 1 Date: 26/01/22
Test: Slow Pull 100mm/min
Type: Wrap 2 Pull 1
Webbing: 25mm Edelrid X-Tube
Pin: 30mm Ø
Force: 31.85kN

Wrap 3 Pull 2 (W3P2) – 30mm pin 25mm

Materials

Webbing	– Edelrid X-Tube 25mm (20kN)

Test setup

Knots	– Tape bend
Wraps	– Wrap 3 Pull 2 Clip 2

Test parameters

Speed	– Slow pull 100mm/minute
Tested between	– 30mm pin and 12mm carabiner

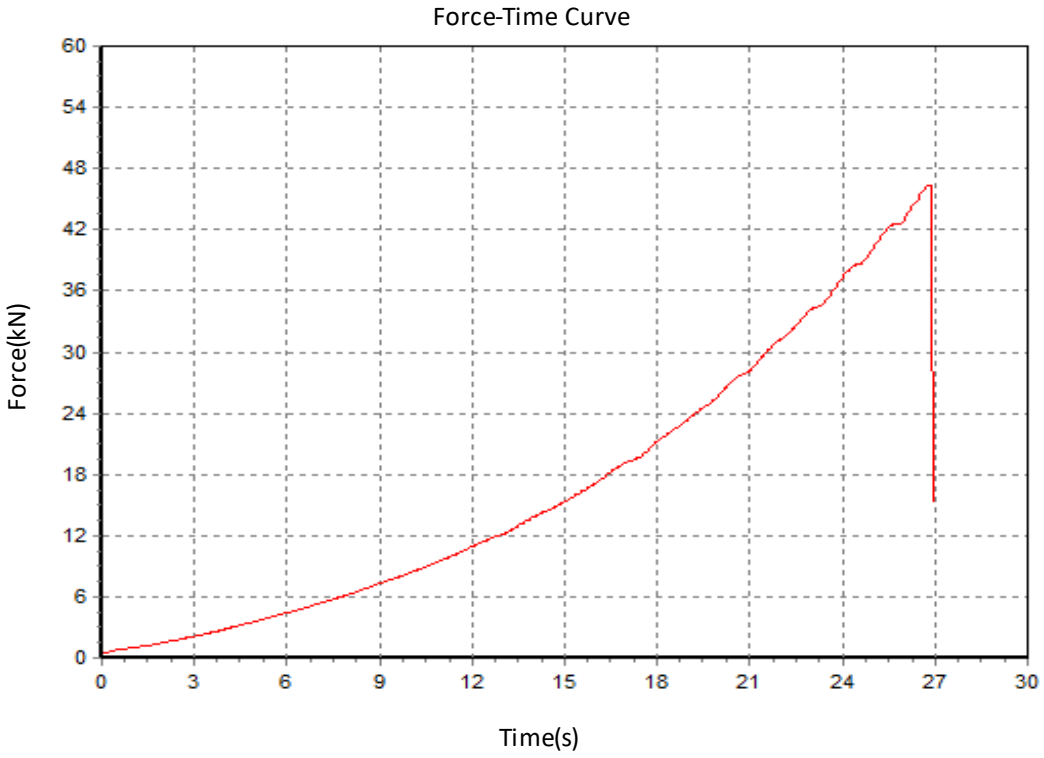
Results

Date	#	Max force (kN)	Comments
16/11/20	24*	46.36	Broke at carabiner inside strand
16/11/20	25	39.51	Broke at carabiner inside strand
16/11/20	26	34.37	Broke at carabiner inside strand
Average		**40.08**	

* Sample 16/11/20 #24 shown on the following pages.

ASPIRING

Test Date:	Monday, 16 November 2020
Max Force (kN):	46.36
Product Name:	W3P2 tape bend
Batch #:	24
Material:	25mm Edelrid Webbing



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Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 24 Date: 16/11/20
Test: Slow Pull 100mm/min
Type: W3P2 tape bend
Webbing: 25mm Edelrid
Force: 46.36kN

Appendix 2: Aspiring webbing 16mm

Wrap 1 Pull 1 (loop) – 30mm pin 16mm

Materials

Webbing	– Aspiring 16mm (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 1 Pull 1 Clip 1

Test parameters

Speed	– Slow pull 100mm/minute
Tested between	– 30mm pin and 12mm pin

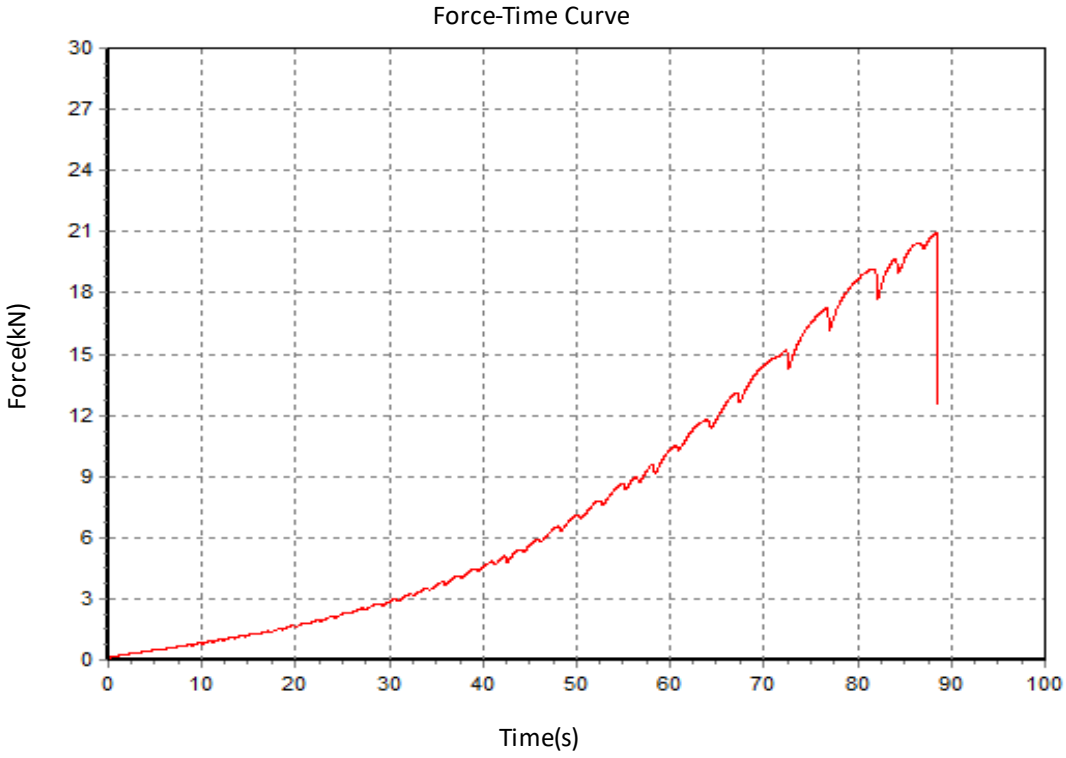
Results

Date	#	Max force (kN)	%	Comments
30/03/22	1*	20.96	84	Broke at the tape bend
30/03/22	2	20.51	82	Broke at the tape bend
30/03/22	3	19.01	76	Broke at the tape bend
Average		**20.16**	**81%**	

* Sample 30/03/22 #1 shown on the following pages.

ASPIRING

Test Date:	Wednesday, 30 March 2022
Max Force (kN):	20.96
Product Name:	Wrap 1 Pull 1 Tape Bend
Test #:	1
Material:	16mm Aspiring Webbing



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Tested by: Grant Prattley

Signed:

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#: 1 Date: 30/03/22
Test: Slow Pull 100mm/min
Type: Wrap 1 Pull 1
Webbing: 16mm Aspiring
Force: 20.96kN

Wrap 2 Pull 2 (double loop) – 30mm pin 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 2 (double loop) Pull 2 Clip 2

Test parameters

Speed	– Slow pull 100mm/minute
Tested between	– 30mm pin and 12mm pin

Results

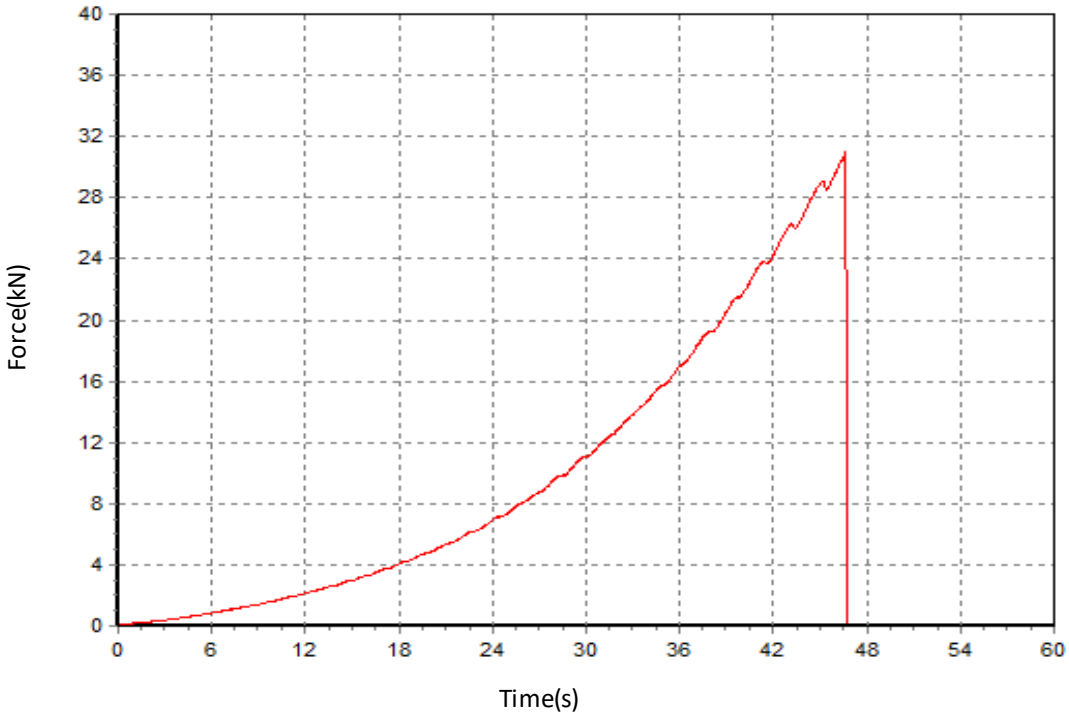
Date	**#**	**Max force (kN)**	**%**	**Comments**
13/04/22	4*	30.96	62	Broke at the 12mm pin inside strand
13/04/22	5	34.68	69	Broke at the 12mm pin inside strand
13/04/22	6	37.14	74	Broke at the 12mm pin inside strand
Average		**34.26**	**69**	

* Sample 13/04/22 #4 shown on the following pages

ASPIRING

Test Date:	Wednesday, 13 April 2022
Max Force (kN):	30.96
Product Name:	Wrap 2 Pull 2, tape bend, 30mm pin
Test #:	4
Material:	16mm Aspiring Webbing

Force-Time Curve



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Tested by: Grant Prattley

Signed:

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


#: 4 Date: 13/04/22
Test: Slow Pull 100mm/min
Type: Wrap 2 Pull 2
Webbing: 16mm Aspiring
Between: 12/30mm pins
Force: 30.96kN (62%)

Wrap 2 Pull 1 (W2P1) – 30mm pin 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 2 (double loop) Pull 1 Clip 1

Test parameters

Speed	– Slow pull 100mm/minute
Tested between	– 30mm pin and 12mm pin

Results

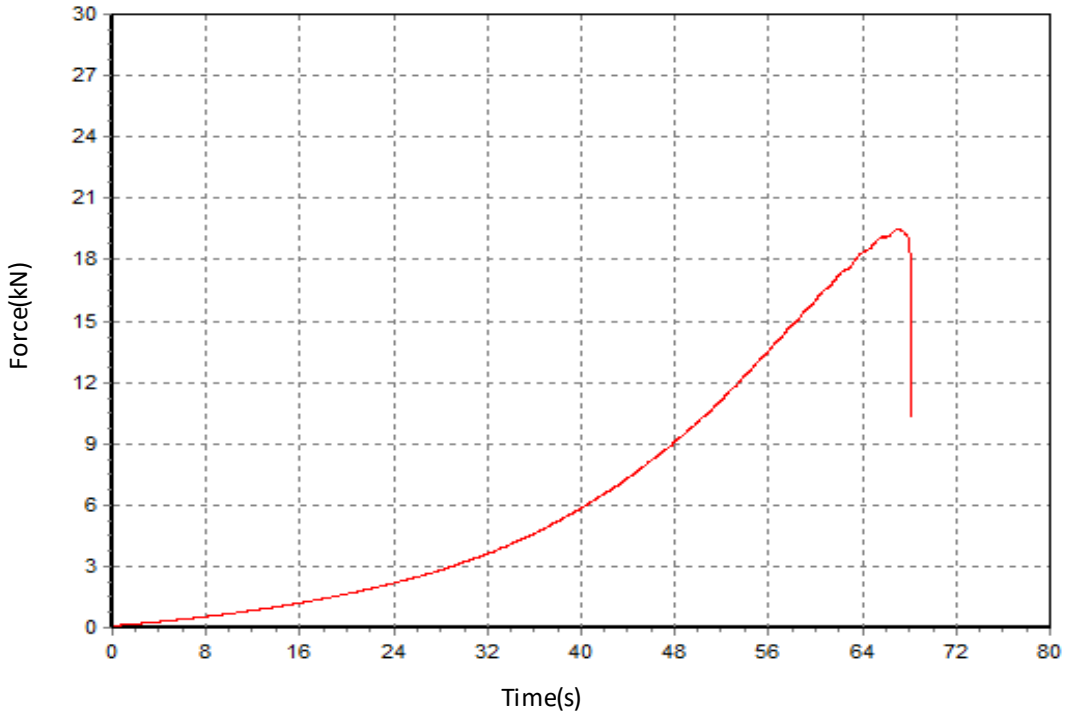
Date	#	Max force (kN)	Comments
13/04/22	7*	19.49	Broke at one side of the 30mm pin
13/04/22	8	21.64	Broke at one side of the 30mm pin
13/04/22	9	21.29	Broke at one side of the 30mm pin
Average		**20.80**	

* Sample 13/04/22 #7 shown on the following pages

ASPIRING

Test Date:	Wednesday, 13 April 2022
Max Force (kN):	19.49
Product Name:	Wrap 2 Pull 1, tape bend, 30mm pin
Test #:	7
Material:	16mm Aspiring Webbing

Force-Time Curve



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Tested by: Grant Prattley

Signed:

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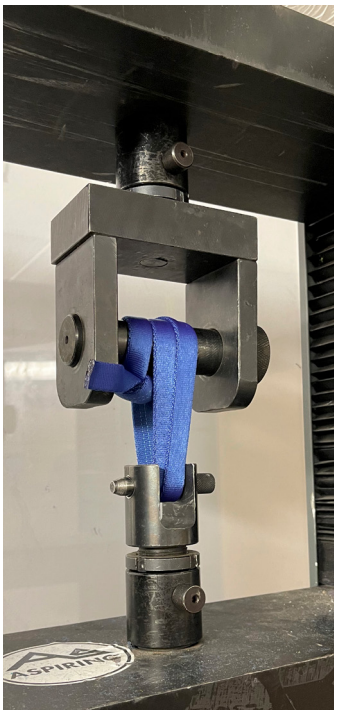
#: 7 Date: 13/04/22
Test: Slow Pull 100mm/min
Type: Wrap 2 Pull 1
Webbing: 16mm Aspiring
Between: 12/30mm pins
Force: 19.48kN

Wrap 3 Pull 2 (W3P2) – 30mm pin 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)



Test setup

Bend	– Tape bend
Wraps	– Wrap 3 Pull 2 Clip 2

Test parameters

Speed	– Slow pull 100mm/minute
Tested between	– 30mm pin and 12mm pin

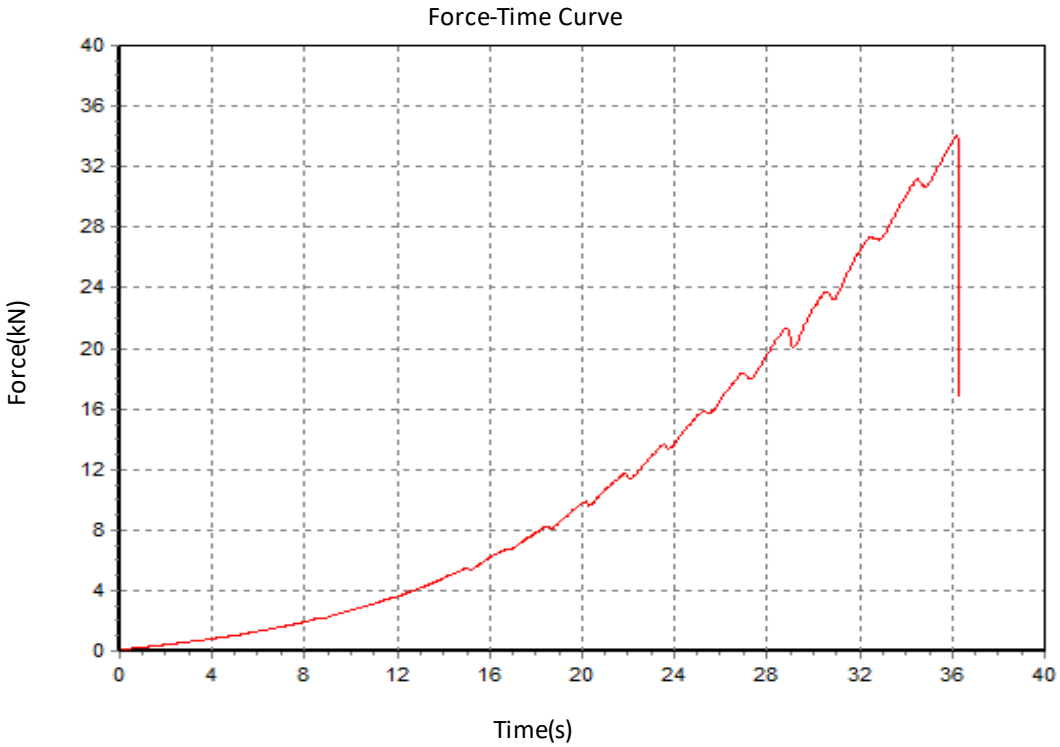
Results

Date	#	Max force (kN)	Comments
13/04/22	10	34.06	Broke at the 12mm pin inside strand
13/04/22	11	37.89	Broke at the 12mm pin inside strand
13/04/22	12	37.92	Broke at the 12mm pin inside strand
Average		**36.62**	

* Sample 13/04/22 #10 shown on the following pages

ASPIRING

Test Date:	Wednesday, 13 April 2022
Max Force (kN):	34.06
Product Name:	Wrap 3 Pull 2 tape bend 30mm pin
Test #:	10
Material:	16mm Aspiring Webbing



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Signed: Grant Prattley

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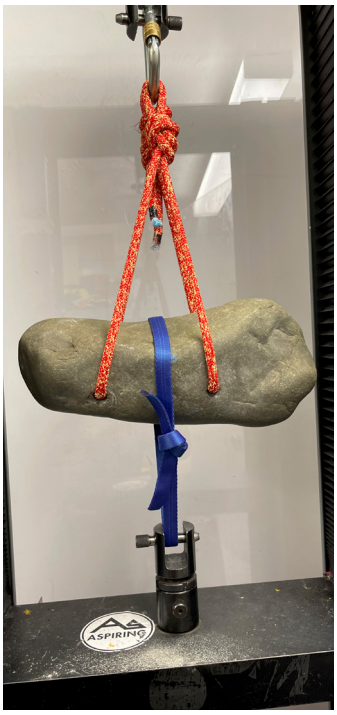
#: 10 Date: 13/04/22
Test: Slow Pull 100mm/min
Type: Wrap 3 Pull 2
Webbing: 16mm Aspiring
Between: 12/30mm pins
Force: 34.06kN

Wrap 1 Pull 1 (loop) – Smooth Rock 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)



Test setup

Bend	– Tape bend
Wraps	– Wrap 1 Pull 1 Clip 1
Rock	– Smooth 15cm diameter boulder

Test parameters

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

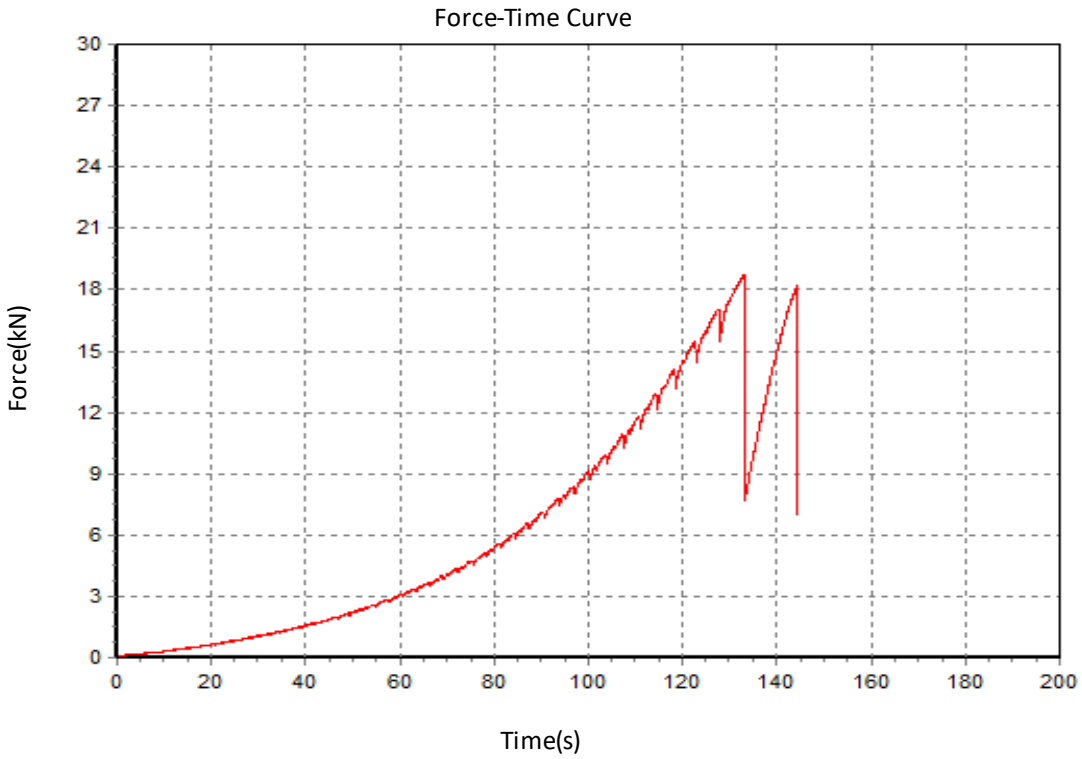
Results

Date	#	Max force (kN)	%	Comments
9/02/22	1*	18.73	75	Broke at the tape bend
9/02/22	2	19.13	77	Broke at the tape bend
9/02/22	3	20.98	84	Broke at the tape bend
Average		**19.61**	**78**	

* Sample 9/02/22 #1 shown on the following pages.

ASPIRING

Test Date:	Wednesday, 9 February 2022
Max Force (kN):	18.73
Product Name:	W1P1 (single loop) Smooth Rock
Test #:	1
Material:	16mm Aspiring Webbing



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


#: 1 Date: 09/02/22
Test: Slow Pull 100mm/min
Type: Wrap 1 Pull 1
Rope: 16mm Aspiring
Rock: Smooth 15cm Ø Boulder
Force: 18.73kN

Wrap 2 Pull 2 (double loop) – Smooth Rock 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 2 Pull 2 Clip 2
Rock	– Smooth 15cm diameter boulder

Test parameters

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

Results

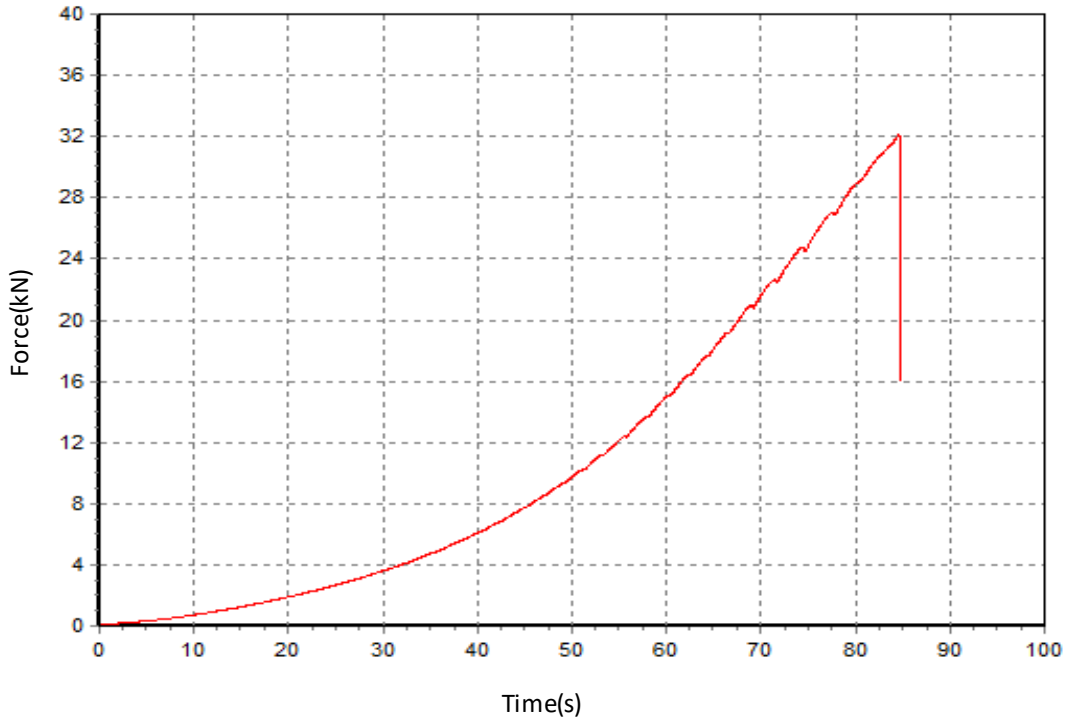
Date	#	Max force (kN)	%	Comments
9/02/22	4*	32.09	64	Broke at the pin inside strand
9/02/22	5	27.99	56	Broke at the pin inside strand
9/02/22	6	28.99	58	Broke at the pin inside strand
Average		**29.69**	**59**	

* Sample 9/02/22 #4 shown on the following pages

ASPIRING

Test Date:	Wednesday, 9 February 2022
Max Force (kN):	32.09
Product Name:	W2P2 (double loop) Smooth Rock
Test #:	4
Material:	16mm Aspiring Webbing

Force-Time Curve



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 4 Date: 09/02/22
Test: Slow Pull 100mm/min
Type: Wrap 2 Pull 2
Rope: 16mm Aspiring
Rock: Smooth 15cm Ø Boulder
Force: 32.09kN

Wrap 2 Pull 1 (W2P1) – Smooth Rock 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 2 Pull 1 Clip 1
Rock	– Smooth 15cm diameter boulder

Test parameters

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

Results

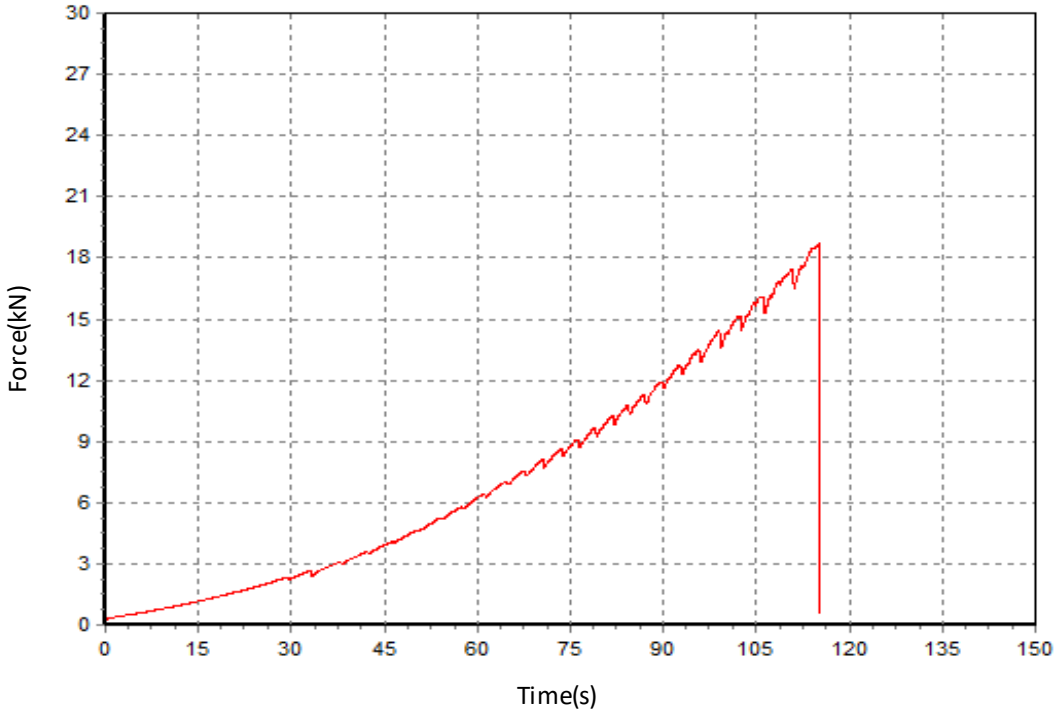
Date	**#**	**Max force (kN)**	**Comments**
9/02/22	7*	18.68	Broke at one side of rock pull strand
9/02/22	8	17.26	Broke at one side of rock pull strand
9/02/22	9	18.98	Broke at one side of rock pull strand
Average		**18.31**	

* Sample 9/02/22 #7 shown on the following pages

ASPIRING

Test Date:	Wednesday, 9 February 2022
Max Force (kN):	18.68
Product Name:	W2P1 Smooth Rock
Test #:	7
Material:	16mm Aspiring Webbing

Force-Time Curve



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 7 Date: 09/02/22
Test: Slow Pull 100mm/min
Type: Wrap 2 Pull 1
Rope: 16mm Aspiring
Rock: Smooth 15cm Ø Boulder
Force: 18.68kN

Wrap 3 Pull 2 (W3P2) – Smooth Rock 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 3 Pull 2 Clip 2
Rock	– Smooth 15cm diameter boulder

Test parameters

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

Results

Date	#	Max force (kN)	Comments
9/02/22	10*	32.55	Broke at the pin inside strand
9/02/22	11	32.86	Broke at the pin inside strand
9/02/22	12	35.16	Broke at the pin inside strand
Average		**33.52**	

* Sample 9/02/22 #10 shown on the following pages


#: 10 Date: 09/02/22
Test: Slow Pull 100mm/min
Type: Wrap 3 Pull 2
Rope: 16mm Aspiring
Rock: Smooth 15cm Ø Boulder
Force: 32.55kN

Wrap 1 Pull 1 (loop) – Sharp Rock 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 1 Pull 1 Clip 1
Rock	– Sharp 15x15cm block

Test parameters

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

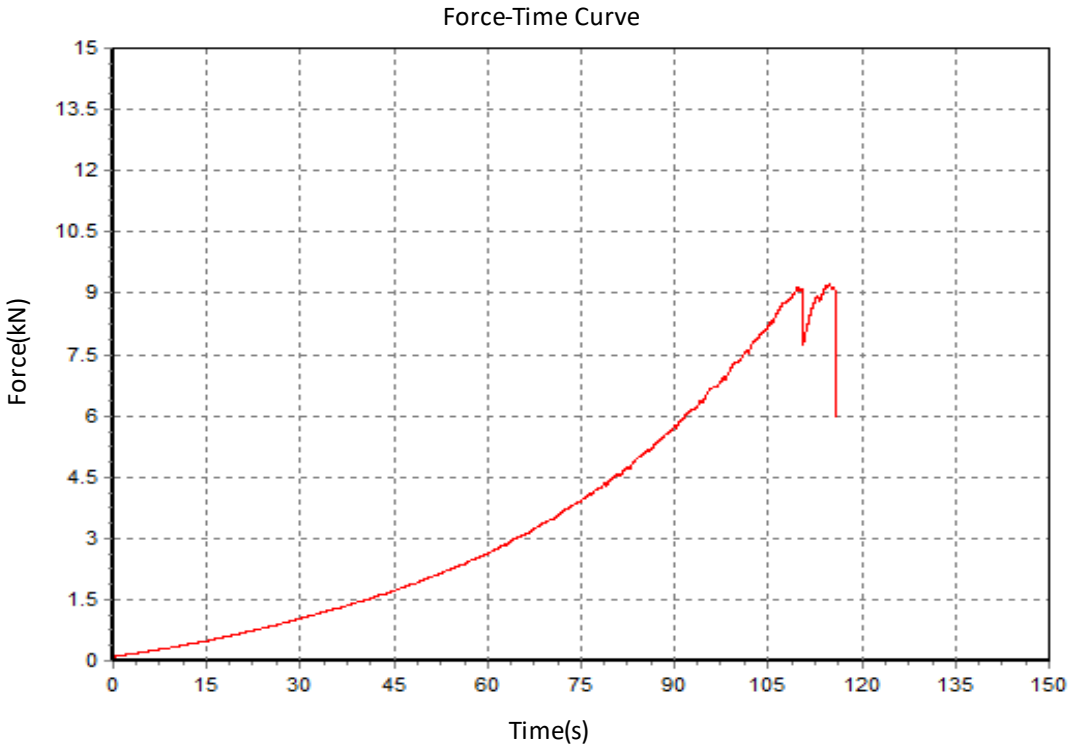
Results

Date	**#**	**Max force (kN)**	**%**	**Comments**
1/03/22	1	9.22	37	Broke at one side top edge of the block
1/03/22	2	10.49	42	Broke at one side top edge of the block
1/03/22	3	9.57	38	Broke at one side top edge of the block
Average		**9.76**	**39**	

* Sample 1/03/22 #1 shown on the following pages.

ASPIRING

Test Date:	Tuesday, 1 March 2022
Max Force (kN):	9.22
Product Name:	Wrap 1 Pull 1 Sharp Rock
Test #:	1
Material:	16mm Aspiring webbing



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 1 Date: 01/03/22
Test: Slow Pull 100mm/min
Type: Wrap 1 Pull 1
Webbing: 16mm Aspiring
Rock: Sharp 15x15cm Block
Force: 9.22kN

Wrap 2 Pull 2 (double loop) – Sharp Rock 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 2 Pull 2 Clip 2
Rock	– Sharp 15x15cm block

Test parameters

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

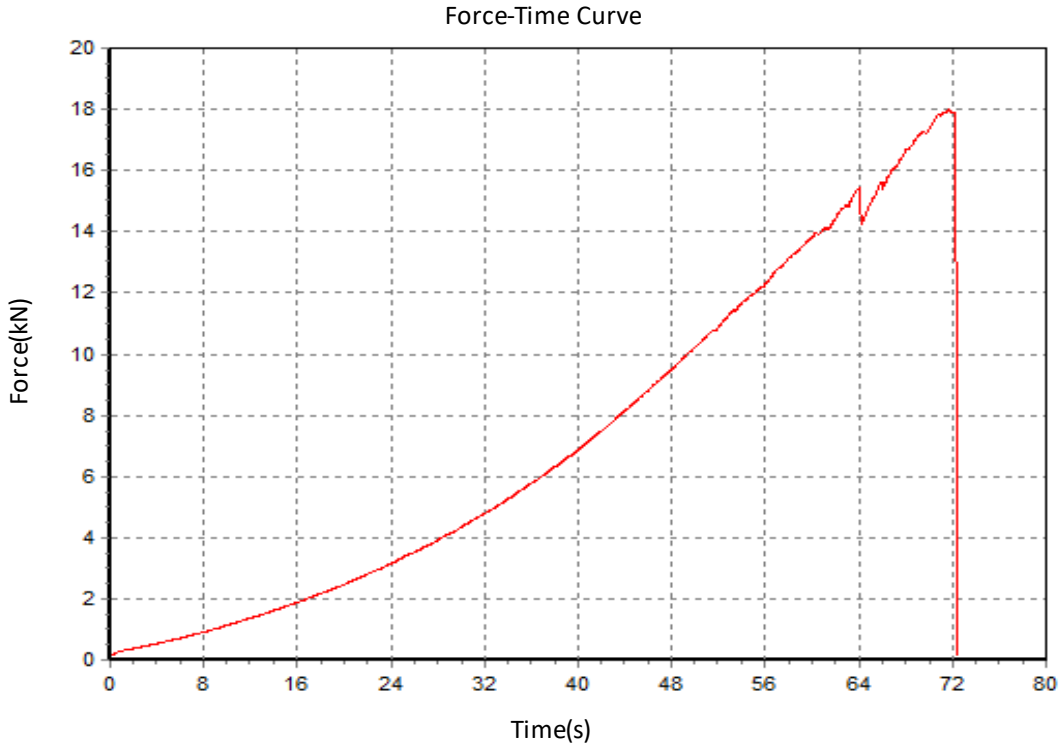
Results

Date	#	Max force (kN)	%	Comments
1/03/22	4*	17.98	36	Broke at one side top edge of the block
1/03/22	5	19.95	40	Broke at one side top edge of the block
1/03/22	6	19.47	39	Broke at one side top edge of the block
Average		**19.13**	**38**	

* Sample 1/03/22 #4 shown on the following pages

ASPIRING

Test Date:	Tuesday, 1 March 2022
Max Force (kN):	17.98
Product Name:	Wrap 2 Pull 2 Sharp Rock
Test #:	4
Material:	16mm Aspiring webbing



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


#: 4 Date: 01/03/22
Test: Slow Pull 100mm/min
Type: Wrap 2 Pull 2
Webbing: 16mm Aspiring
Rock: Sharp 15x15cm Block
Force: 17.98kN

Wrap 2 Pull 1 (W2P1) – Sharp Rock 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 2 Pull 1 Clip 1
Rock	– Sharp 15x15cm block

Test parameters

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

Results

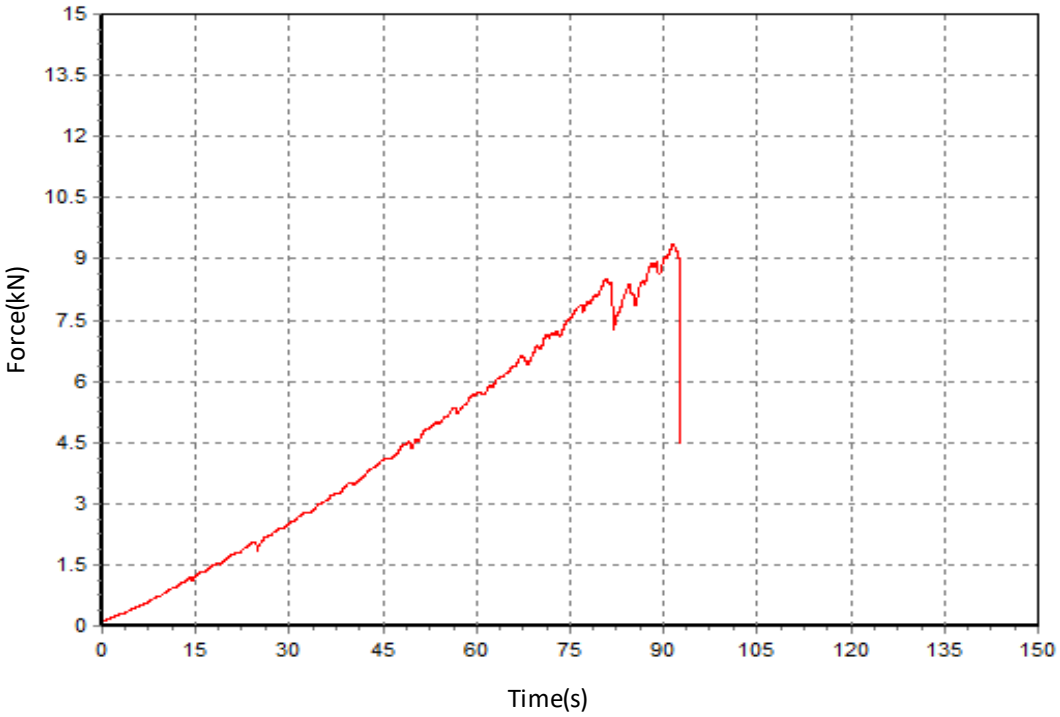
Date	**#**	**Max force (kN)**	**Comments**
1/03/22	7*	9.36	Broke at one side top edge of the block
1/03/22	8	9.44	Broke at one side top edge of the block
1/03/22	9	9.14	Broke at one side top edge of the block
Average		**9.31**	

* Sample 1/03/22 #7 shown on the following pages

ASPIRING

Test Date:	Tuesday, 1 March 2022
Max Force (kN):	9.36
Product Name:	Wrap 2 Pull 1 Sharp Rock
Test #:	7
Material:	16mm Aspiring webbing

Force-Time Curve



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


#: 7 Date: 01/03/22
Test: Slow Pull 100mm/min
Type: Wrap 2 Pull 1
Webbing: 16mm Aspiring
Rock: Sharp 15x15cm Block
Force: 9.36kN

Wrap 3 Pull 2 (W3P2) – Sharp Rock 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 3 Pull 2 Clip 2
Rock	– Sharp 15x15cm block

Test parameters

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

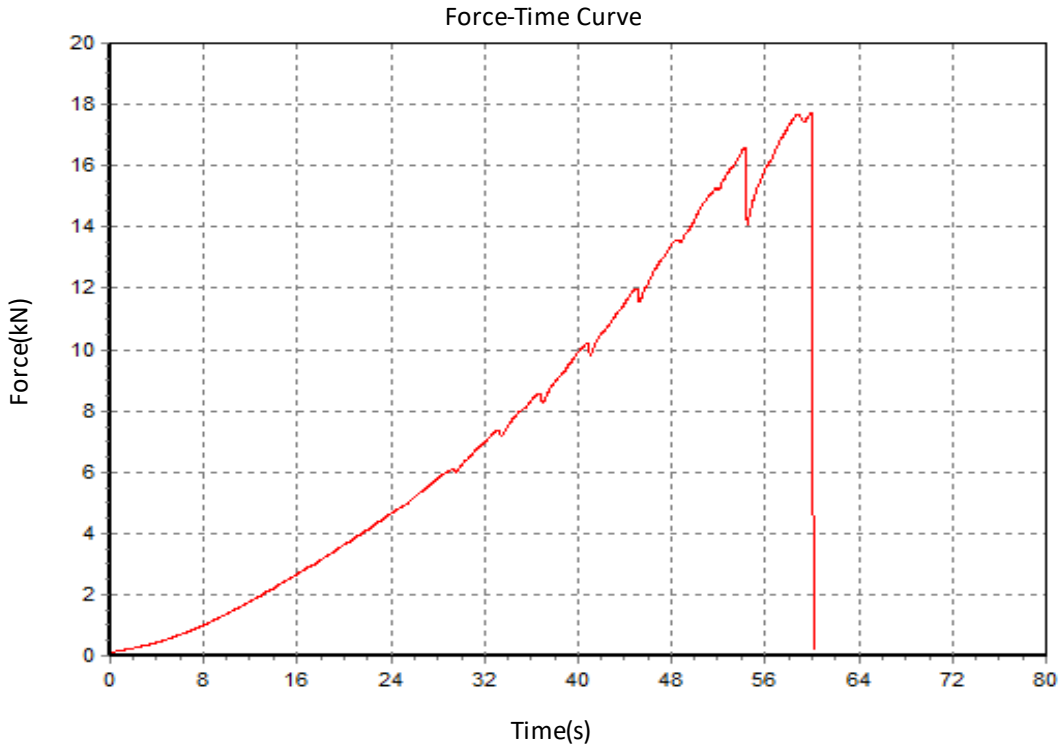
Results

Date	#	Max force (kN)	Comments
1/03/22	10*	17.73	Broke at one side top edge of the block
1/03/22	11	22.07	Broke at one side top edge of the block
1/03/22	12	15.84	Broke at one side top edge of the block
Average		**18.55**	

* Sample 1/03/22 #10 shown on the following pages

ASPIRING

Test Date:	Tuesday, 1 March 2022
Max Force (kN):	17.73
Product Name:	Wrap 3 Pull 2 Sharp Rock
Test #:	10
Material:	16mm Aspiring webbing



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


#: 10 Date: 01/03/22
Test: Slow Pull 100mm/min
Type: Wrap 3 Pull 2
Webbing: 16mm Aspiring
Rock: Sharp 15x15cm Block
Force: 17.73kN

Wrap 1 Pull 1 (loop) – Protector 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 1 Pull 1 Clip 1
Rock	– Sharp 15x15cm block
Protector	– Aspiring rope protector attached to rock

Test parameters

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

Results

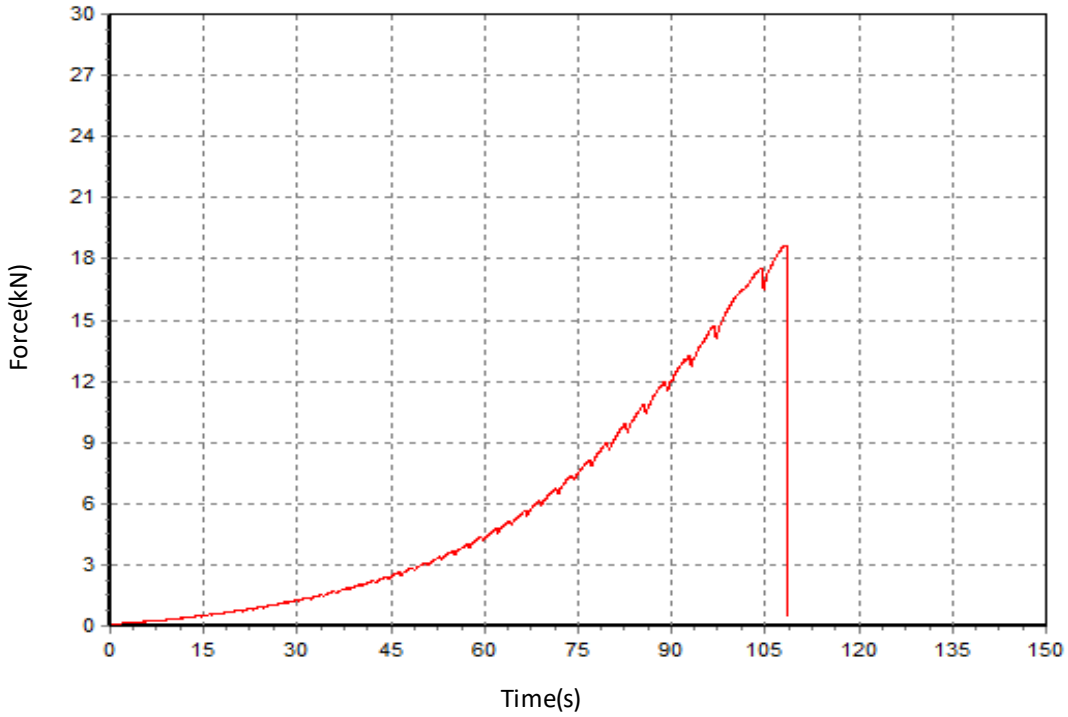
Date	#	Max force (kN)	%	Comments
6/04/22	1*	18.66	75	Broke at the bend
6/04/22	2	18.98	76	Broke at the bend
6/04/22	3	18.55	74	Broke at the bend
Average		**18.73**	**75**	

* Sample 6/04/22 #1 shown on the following pages.

ASPIRING

Test Date:	Wednesday, 6 April 2022
Max Force (kN):	18.66
Product Name:	W1P1 tape bend, sharp rock, edge pro
Test #:	1
Material:	16mm Aspiring Webbing

Force-Time Curve



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


#: 1 Date: 06/04/22
Test: Slow Pull 100mm/min
Type: Wrap 1 Pull 1
Rope: 16mm Aspiring
Rock: Sharp Boulder + Edge Pro
Force: 18.66kN

Wrap 2 Pull 2 (double loop) – Protector 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 2 Pull 2 Clip 2
Rock	– Sharp 15x15cm block
Protector	– Aspiring rope protector attached to rock

Test parameters

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

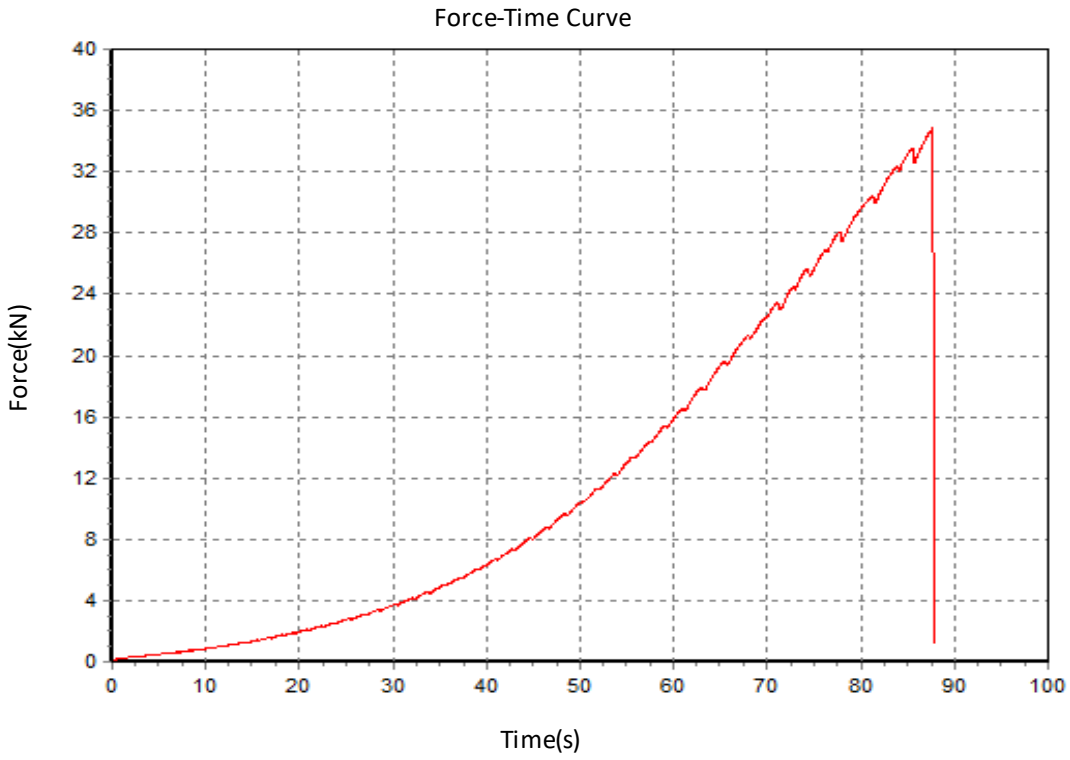
Results

Date	#	Max force (kN)	%	Comments
6/04/22	4*	34.90	70	Broke at the pin inside webbing
6/04/22	5	36.91	74	Broke at one side top edge of the block
6/04/22	6	33.47	67	Broke at one side top edge of the block
Average		**35.09**	**70**	

* Sample 6/04/22 #4 shown on the following pages

ASPIRING

Test Date:	Wednesday, 6 April 2022
Max Force (kN):	34.90
Product Name:	W2P2 tape bend, sharp rock, edge pro
Test #:	4
Material:	16mm Aspiring Webbing



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


#: 4 Date: 06/04/22
Test: Slow Pull 100mm/min
Type: Wrap 2 Pull 2
Rope: 16mm Aspiring
Rock: Sharp Boulder + Edge Pro
Force: 34.90kN

Wrap 2 Pull 1 (W2P1) Protector 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 2 Pull 1 Clip 1
Rock	– Sharp 15x15cm block
Protector	– Aspiring rope protector attached to rock

Test parameters

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

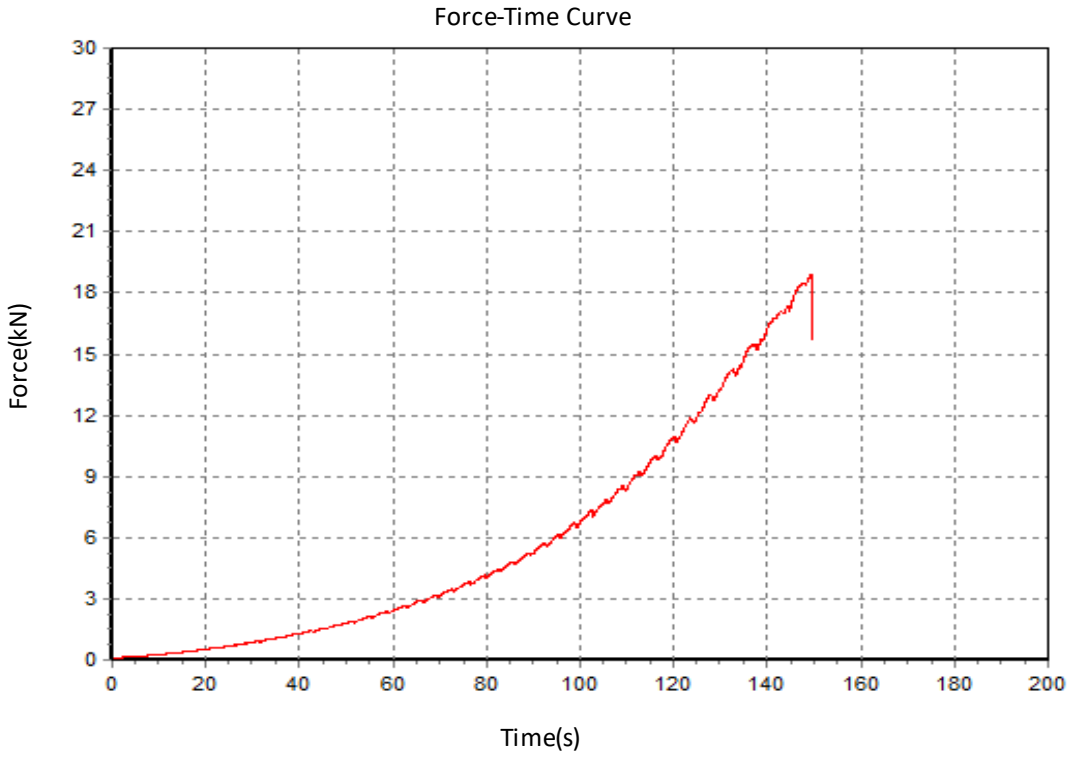
Results

Date	#	Max force (kN)	Comments
6/04/22	7*	18.89	Broke at one side top edge of the block
6/04/22	8	20.61	Broke at one side top edge of the block
6/04/22	9	21.09	Broke at one side top edge of the block
Average		**20.20**	

* Sample 6/04/22 #7 shown on the following pages

ASPIRING

Test Date:	Wednesday, 6 April 2022
Max Force (kN):	18.89
Product Name:	W2P1 tape bend, sharp rock, edge pro
Test #:	7
Material:	16mm Aspiring Webbing



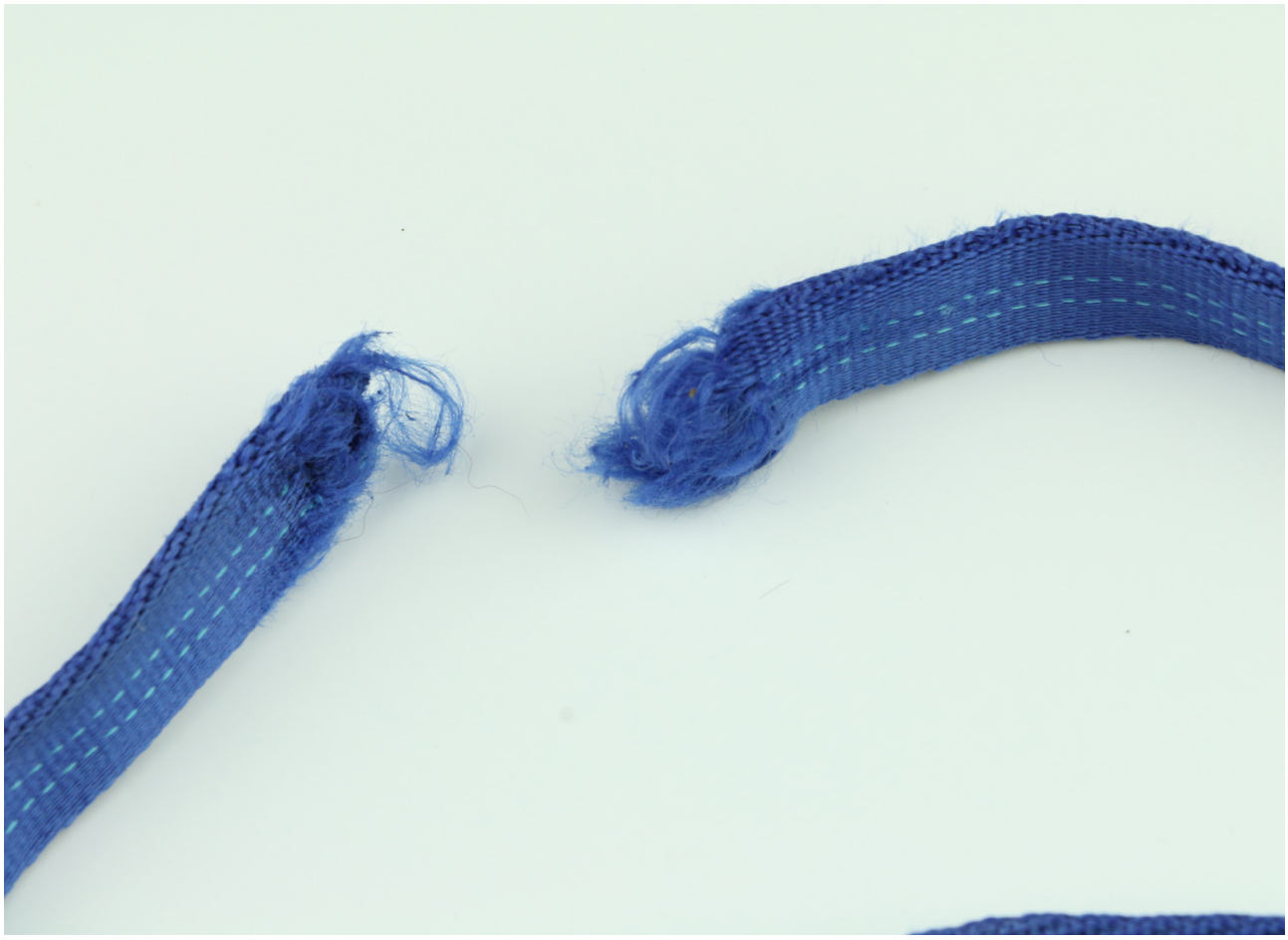
ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


#: 7 Date: 06/04/22
Test: Slow Pull 100mm/min
Type: Wrap 2 Pull 1
Rope: 16mm Aspiring
Rock: Sharp Boulder + Edge Pro
Force: 18.89kN



Wrap 3 Pull 2 (W3P2) – Protector 16mm

Materials

Webbing	– Aspiring webbing (12.5kN)

Test setup

Bend	– Tape bend
Wraps	– Wrap 3 Pull 2 Clip 2
Rock	– Sharp 15x15cm block
Protector	– Aspiring rope protector attached to rock

Test parameters

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

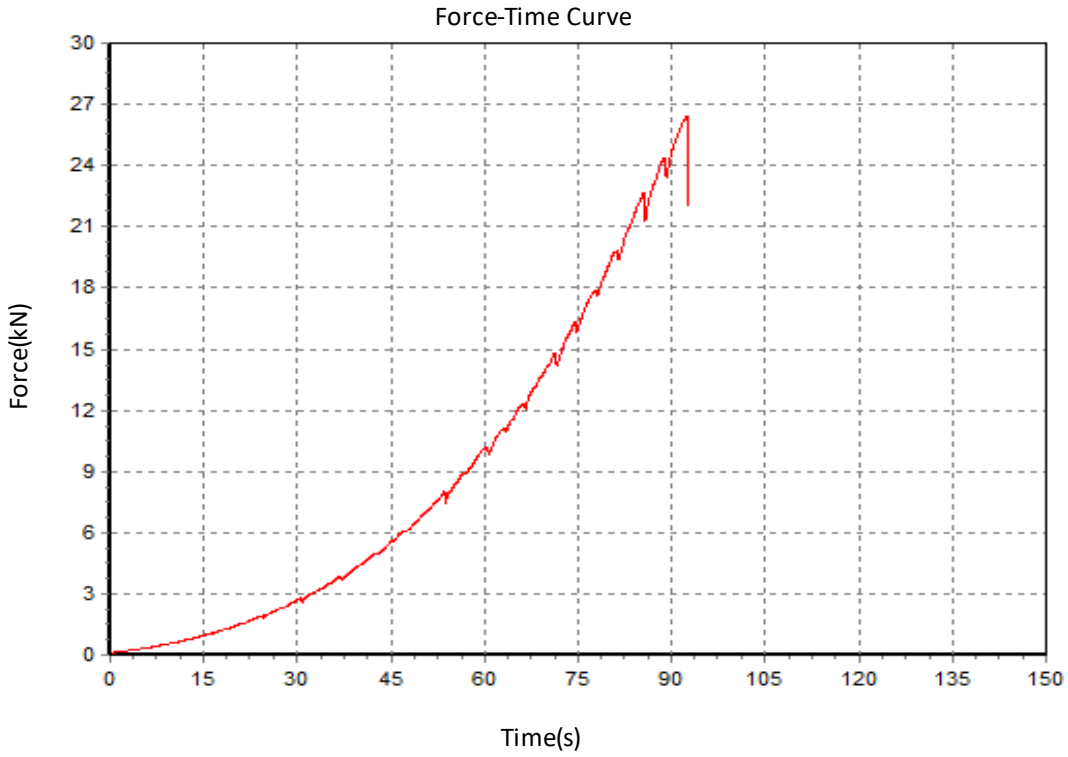
Results

Date	#	Max force (kN)	Comments
6/04/22	10*	26.40	Broke at one side top edge of the block
6/04/22	11	34.01	Broke at the pin inside webbing
6/04/22	12	37.03	Broke at the pin inside webbing
Average		**32.48**	

* Sample 6/04/22 #10 shown on the following pages

ASPIRING

Test Date:	Wednesday, 6 April 2022
Max Force (kN):	26.40
Product Name:	W3P2 tape bend, sharp rock, edge pro
Test #:	10
Material:	16mm Aspiring Webbing



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


#: 10 Date: 06/04/22
Test: Slow Pull 100mm/min
Type: Wrap 3 Pull 2
Rope: 16mm Aspiring
Rock: Sharp Boulder + Edge Pro
Force: 26.40kN