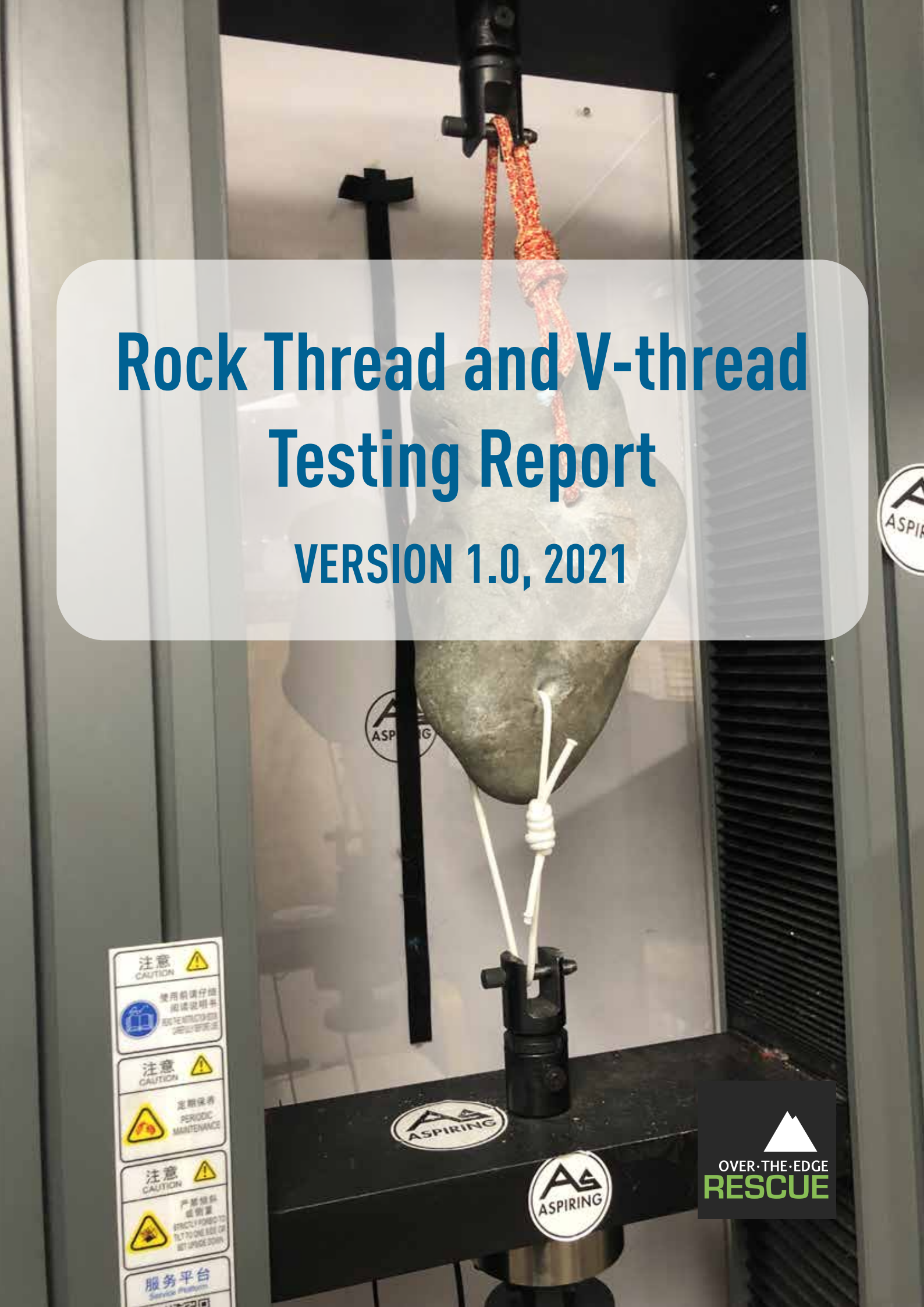

Rock Thread and V-thread Testing Report

VERSION 1.0, 2021

Rock Thread and V-thread Testing Report

Version 1.0 , 2021

Author: Grant Prattley

Over The Edge Rescue
https://overtheedgerescue.com

For the latest version and for referencing purposes use:

Prattley, Grant. **Rock thread and V-thread testing 2021.** Over the Edge Rescue. Version 1.0, 2021.
https://overtheedgerescue.com/canyoning/rock-thread-vthread-testing-2021/

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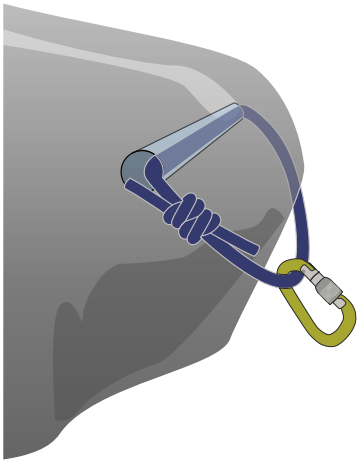
Introduction

A drilled thread in rock is a low-impact way to anchor for recreational and rescue purposes without leaving behind bolts.

The usual places for applying these anchors are caves and canyons; however, other rock-based disciplines could find this information equally applicable.

In a canyon, threads are a way to leave anchor rigging behind in a section affected by high flows and floods. The cord in a thread, if damaged, can be replaced. A bolt may be destroyed or completely broken off in a flood event. Additionally, threads are lighter weight for carrying up a hill to the start of the canyon, and you don't need to carry a drill each time you descend in the future.



Drilled thread

For rescues, threads allow us to put in additional anchors without leaving behind lots of bolts, just holes. Compared to removable bolts, threads are a cost-effective alternative, especially where you need lots of rigging, such as cave rescue.

In addition to rock threads, we undertook testing of rock V-threads. Where you have a blank face, could you drill a V in the rock much like you would in ice with ice screws (Ice V-thread equivalent = Abolokov). It is somewhat more difficult and time consuming to drill and thread, but it is possible.

Rock thread and V-thread anchors are part of the rigging toolbox for both recreational and rescue situations.

Standards and testing

The standard we are using for recreational is the New Zealand Canyoning Association Bolting Code of Practice. This standard states that 15kN should be a minimum construction standard for temporary anchors.

Rescue work system strength should be 20kN or more to give additional margin for higher potential forces.

Therefore, this testing aims to ascertain if the following meets or exceed the standards:

- Bends used to tie the loops,
- Cords used in the rock threads/V-threads,
- Rock strength of the threads/V-threads.

Methods and Materials

Methods

General setup methods

- New material was used for each test.
- Carabiners and rapides, where they were undamaged, were reused for multiple tests.
- All knots and bends had hand tension with all strands pulled tight.
- All tails were 4cm.

Slow pull tests

- Each testing series records the slow pull tests set up (see Appendix 1-3).
- The slow pull testing was in one location.
  - Aspiring Safety, 1/6 Burdale Street, Riccarton, Christchurch, New Zealand.
  - https://www.aspiring.co.nz/
- Vertical testbed 1.6m Electronic Universal Testing Machine, Model WDW-100
  - Maximum Test Force 100kN, sample rate 60 per second
  - Jinan Chuanbai Instrument Equipment Co Ltd

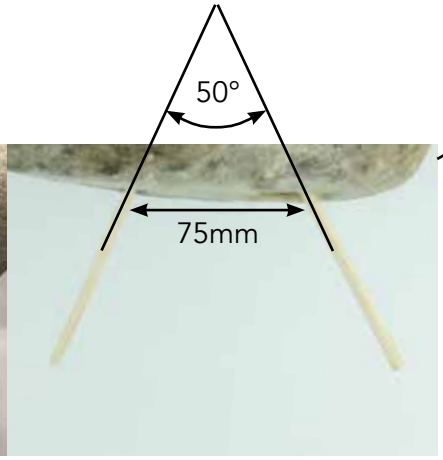
Rock boulder setup

- The top anchor thread in the rock (Greywacke river boulder) is Nautilus 8mm Dyneema/Polyester+Kevlar 30kN cord. The cord tied as a loop with a double fisherman's bend.
  The hole drilled is 12mm in diameter.

- The rock thread has a 12mm hole drilled 75mm long and 75mm from the front edge.

- The top anchor thread in the rock (Greywacke river boulder) is Nautilus 8mm Dyneema/Polyester+Kevlar 30kN cord. The cord is tied as a loop with a figure-8 rethread bend.
  The hole drilled is 12mm in diameter.

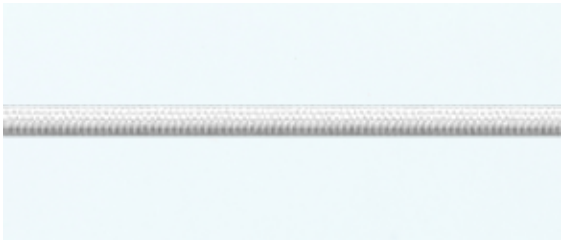
- The rock V-thread had a 12mm hole drilled at 75mm centres to form a V of 50 degrees (see below).



Materials

Beal 5mm Dyneema cord

- Diameter: 5mm, Weight: 23g/m
- Breaking strength: 15kN
- Materials: Dyneema core, Dyneema sheath
- Standards: EN 564
- Manufacturer: Beal – sport.beal-planet.com



Aspiring 5mm Dyneema cord

- Diameter: 5mm
- Breaking strength: 15kN
- Materials: Dyneema core, Dyneema sheath
- Supplier: Aspiring Safety – aspiring.co.nz

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

Beal 5.5mm Dyneema/Nylon cord

- Diameter: 5.5mm, Weight: 23g/m
- Breaking strength: 18kN
- Materials: Dyneema core, Nylon sheath
- Standards: EN 564
- Manufacturer: Beal – sport.beal-planet.com

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

PMI 7mm Nylon cord

- Diameter: 7mm, Weight: 33.2 g/m
- Breaking strength: 11.9kN
- Materials: Nylon core, Nylon sheath
- Standards: EN 564
- Brand: PMI – pmirope.com

PMI 8mm Nylon cord

- Diameter: 8mm, Weight: 42 g/m
- Breaking strength: 14.3kN
- Materials: Nylon core, Nylon sheath
- Standards: EN 564
- Brand: PMI – pmirope.com

Nautilus 8mm Aborist Prusik cord

- Diameter: 8mm
- Breaking strength: 30kN
- Materials: Dyneema core, Polyester+Kevlar sheath
- Manufacturer: Nautilus Braids – nautilusbraids.co.nz

PMI 10mm Classic Sport rope

- Diameter: 10mm, Weight: 66 g/m
- Breaking strength: 27kN
- Materials: Nylon core, Nylon sheath
- Standards: Cordage Institute 1801
- Brand: PMI – pmirope.com

Kordas 10mm Dana rope

- Diameter: 10mm, Weight: 68 g/m
- Breaking strength: 27kN
- Materials: Nylon core, Nylon sheath
- Standards: EN1891:1998 Type A
- Brand: Kordas – sacidkordas.com

Testing Results

Loop testing (Slow pull 100mm/minute)

Cord / Rope tested	Avg. kN 3 tests	Comment	Appx. 1
Beal 5mm Dyneema 15kN double fisherman's bend	12.74	Broke inside the bend, tails slipped through both sides	pg. 15
Beal 5mm Dyneema 15kN triple fisherman's bend	18.55	Broke at the pin, tails almost slipped through, most core strands left intact (1) and broke at the bend one side, a few core strands left intact (2)	pg. 18
Aspiring 5mm Dyneema 15kN double fisherman's bend	18.54	Broke at the bend, a few core strands left intact	pg. 21
Aspiring 5mm Dyneema 15kN triple fisherman's bend	21.31	Broke at the bend, core only, sheath remained intact (2) and core and sheath, a few core strands left intact (1)	pg. 24
Nautilus 5mm Dyneema/ Polyester 10kN double fisherman's bend	13.59	Broke at the bend core slipped through sheath on one tail, the sheath broke on one side of the bend	pg. 27
Nautilus 5mm Dyneema/ Polyester 10kN triple fisherman's bend	15.51	Broke at the bend core slipped through sheath one tail, the sheath broke on both sides of the bend	pg. 30
Beal 5.5mm Dyneema/Nylon 18kN double fisherman's bend	13.38	Broke at the bend core slipped through sheath both tails (2) and one tail (1)	pg. 33
Beal 5.5mm Dyneema/Nylon 18kN triple fisherman's bend	17.26	Broke at the bend core slipped through sheath one tail, sheath broke on one side of bend (2) and sheath remained intact, core slipped through sheath both tails (1)	pg. 36
Nautilus 6mm Dyneema/ Polyester 14kN double fisherman's bend	17.71	Broke at the bend core slipped through sheath one tail, the sheath broke on one side of the bend	pg. 39
PMI 7mm Nylon 11.9kN double fisherman's bend	18.86	Broke at the pin	pg. 42
PMI 8mm Nylon 14.3kN double fisherman's bend	23.82	Broke at the bend (1) and broke at the pin (2), core slipped through sheath one tail	pg. 45
PMI 8mm Nylon 14.3kN figure-8 rethread bend	20.34	Broke at the bend (1) and broke at the pin (2)	pg. 48
Nautilus 8mm Dyneema/ Polyester+Kevlar 30kN double fisherman's bend	34.23	Sheath broke one side of the bend (2) and stripped sheath at the pin (1), core slipped through sheath one tail	pg. 51
Nautilus 8mm Dyneema/ Polyester+Kevlar 30kN figure-8 rethread bend	33.44	Sheath broke one side of the bend, core slipped through sheath one tail	pg. 54
PMI 10mm Classic Sport Nylon 27kN double fisherman's bend	36.71	Broke at the bend (1) and broke at pin (2)	pg. 57
Kordas 10mm Dana Nylon 27kN double fisherman's bend	32.24	Broke at the pin	pg. 60

Rock thread testing (Slow pull 100mm/minute)

Items tested	Avg. kN 3 tests	Comment	Appx. 2
Beal 5mm Dyneema 15kN triple fisherman's bend	18.58	Broke at the bend (2) and at the pin (1), minor damage to cord at thread both sides	pg. 63
Aspiring 5mm Dyneema 15kN triple fisherman's bend	20.98	Broke at the bend, minor damage to the sheath both sides of the thread	pg. 66
Nautilus 5mm Dyneema/ Polyester 10kN triple fisherman's bend	12.90	Sheath broke on both sides of the bend, core slipped through sheath one tail (2/3), core shot damage to cord at thread one side, minor damage other side.	pg. 69
Beal 5.5mm Dyneema/Nylon 18kN triple fisherman's bend	16.95	Sheath broke on one side of bend (2/3), core slipped through sheath one tail, moderate damage to cord at thread both sides	pg. 72
Nautilus 6mm Dyneema/ Polyester 14kN double fisherman's bend	17.06	Sheath broke on one side of bend, core slipped through sheath one tail, core shot damage to cord at thread one side, minor damage other side	pg. 75
PMI 7mm Nylon 11.9kN double fisherman's bend	12.88	Broke at the thread one side, small damage to the other side. Significant damage at the pin (2/3)	pg. 78
PMI 8mm Nylon 14.3kN double fisherman's bend	17.41	Broke at the thread one side, small damage to the other side. Significant damage at the pin (2/3)	pg. 81
Nautilus 8mm Dyneema/ Polyester+Kevlar 30kN double fisherman's bend	33.78	Sheath broke one side of the bend, core shot damage to the sheath one side of the thread, minor damage the other side (2). Broke sheath and core one side of the thread, minor damage to the sheath other side of the thread (1)	pg. 84
Nautilus 8mm Dyneema/ Polyester+Kevlar 30kN double fisherman's bend test anchor	12-18kN	This cord was used as a thread to hold the rock in place for most of the testing. It underwent 18 tests with only moderate wear to the sheath.	pg. 88
PMI 10mm Classic Sport Nylon 27kN double fisherman's bend	26.78	Broke at rope exit of rock side opposite to bend, minor (1), moderate (1) and major (1) damage to the sheath other side	pg. 90
Kordas 10mm Dana Nylon 27kN double fisherman's bend	27.73	Broke at rope exit of rock side opposite to bend, moderate (1) and major (2) damage to the sheath other side	pg. 93

Rock V-thread testing

Slow pull tests (100mm/minute)

Items tested	Avg. kN 3 tests	Comment	Appx. 3
Beal 5mm Dyneema 15kN triple fisherman's bend	16.41	Broke as the loop exited the rock on bend side (2) and at the 10mm carabiner (1), minor damage to sheath of cord at the top of the V and other side.	pg. 96
Aspiring 5mm Dyneema 15kN triple fisherman's bend	20.18	Broke at the pin, minor damage to the sheath all 3 corners of the V-thread (2), broke at exit of rock same side as the bend, minor damage to sheath of cord at the top of the V and other side (1)	pg. 99

Analysis

Loop testing

- When joining the loops with a bend to get above 15kN for recreational use:
  - Triple fisherman's: Beal 5mm Dyneema, Nautilus 5mm Dyneema/Polyester, Beal 5.5mm Dyneema/Nylon
  - Double fisherman's: Aspiring 5mm Dyneema, Nautilus 6mm Dyneema/Polyester, PMI 7mm Nylon
- When joining the loops with a bend to get above 20kN for rescue use:
  - Triple fisherman's: Aspiring 5mm Dyneema/Polyester
  - Double fisherman's or figure-8 rethread: PMI 8mm Nylon, Nautilus 8mm Dyneema/Polyester+Kevlar
  - Double fisherman's: Kordas 10mm Dana Nylon, PMI 10mm Classic Sport Nylon

Rock thread testing

- The Beal 5mm Dyneema/Dyneema cord was over 18kN, and the Aspiring 5mm Dyneema/Dyneema cord was over 20kN on average. The Dyneema sheath had high resistance to abrasion during the tests, with only minor damage on all corners. Recommended as a rock thread.
- The Beal 5.5mm Dyneema/Nylon, Nautilus 6mm Dyneema/Polyester, and PMI 8mm Nylon/Nylon cords were over 15kN on average. The tests damaged the sheath, either a core shot or broke at the exit from the rock. Recommended as a rock thread for one-off use scenarios.
- The Nautilus 5mm Dyneema/Polyester and PMI 7mm Nylon/Nylon cords were under 15kN on average. The tests damaged the sheath with either a core shot or broke at the exit from the rock. Not recommended as a rock thread.
- The Nautilus 8mm Dyneema/Polyester+Kevlar cord was over 30kN on average. The tests caused moderate to major damage to the sheath with a core shot or broke at the exit from the rock. Recommended as a rock thread.
- The Nautilus 8mm Dyneema/Polyester+Kevlar cord was rigged as a thread to hold the test rock in place. One length underwent 18 tests ranging from 12-18kN with only moderate wear to the sheath. Recommended as a rock thread to be reused multiple times.
- The PMI and Kordas 10mm Nylon/Nylon ropes were over 25kN in average strength. All tests broke at the exit of the rock with minor to major damage to the sheath. If you don't have any suitable cord, the end of a rope will make an appropriate rock thread.

Rock V-thread testing

- The Beal 5mm Dyneema/Dyneema cord (average 16kN) and Aspiring 5mm Dyneema/Dyneema cord (average 20kN) when tested with a 50 degree drill angle on the V had sufficient strength for the rock type tested. Recommended as a rock V-thread.

Conclusions

1. As a preference, for better abrasion resistance, use cords with either Dyneema or Kevlar in the sheath.
2. Nylon or polyester sheathed cords (or ropes) are only recommended for one-off descents or other similar uses. As such, the cord may need to be replaced after every use. (Note: refer to the analysis for recommended cords – or ropes – to use)
3. When comparing similar materials, the thicker the cord or rope, the better the performance.
4. As you are working at the edges, the rock may be less robust. You are recommended to join together a minimum of two drilled threads to form an anchor.

Notes:

- *In the testing and analysis, we have only considered a single thread.*
- *When using two threads to form an anchor, you could argue that each loop would only take 50% of the force. If this were the case, each loop would only need to take 7.5kN (50% of the 15kN[1] anchor strength), and therefore it may be suitable to use alternate bends or cords.*

5. I recommend to keep it simple and always tie a full-strength loop of 15kN or more for a single thread as:
   - You may not be able to share the load between the two anchors equally.
   - If you choose to go down to one anchor, you know that the rigging is suitable.
   - It gives you and other subsequent users a reasonable margin.
6. The test rocks were weathered hard Greywacke river boulders.
   - The test rock had a 12mm hole drilled 75mm long and 75mm from the front edge. This rock held 24 tests ranging from 12-33kN. This rock type was sufficiently strong with these dimensions.
   - The V-thread rock had a 12mm hole drilled at 75mm centres to form a V of 50 degrees. This boulder held 6 tests ranging from 15-21kN. This rock type was sufficiently strong with these dimensions.
7. This report does not cover the safe placement of threads. Seek advice from an experienced person to guide you through the process.
8. Rock thread and V-thread anchors are part of the rigging toolbox for both recreational and rescue situations.

References

1. NZCA. **Bolting Code of Practice.** http://nzcanyoningassociation.org/resources/#boltingcode
2. PMI. https://pmirope.com
3. Beal. https://sport.beal-planet.com/
4. Aspiring Safety. https://www.aspiring.co.nz/
5. Nautilus Braids. http://nautilusbraids.co.nz
6. Prattley, Grant. **Webbing in Hangers.** Over the Edge Rescue. Version 1.0, 2021. https://overtheedgerescue.com/canyoning/webbing-in-hangers/
7. Prattley, Grant. **Rock thread and V-thread testing 2021.** Over the Edge Rescue. Version 1.0, 2021. https://overtheedgerescue.com/canyoning/rock-thread-vthread-testing-2021/

Glossary of terms

Bends: 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.

Max Force (kN): Maximum amount of tensile stress that the material can withstand before failure (rupture), such as breaking or permanent 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: Loop testing

Beal 5mm Dyneema loop (DF)

Materials

- Beal 5mm Dyneema/Dyneema cord (15kN)

Test setup

- Tied a double fisherman's bend to form a loop

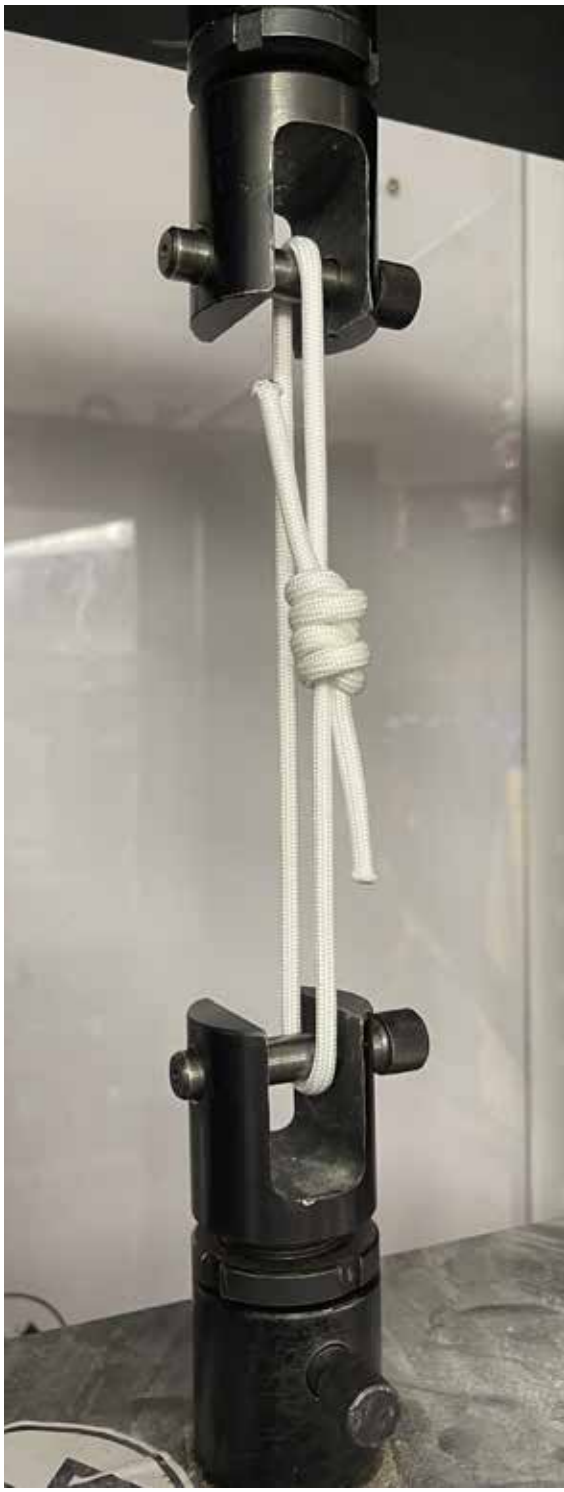
Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

Results

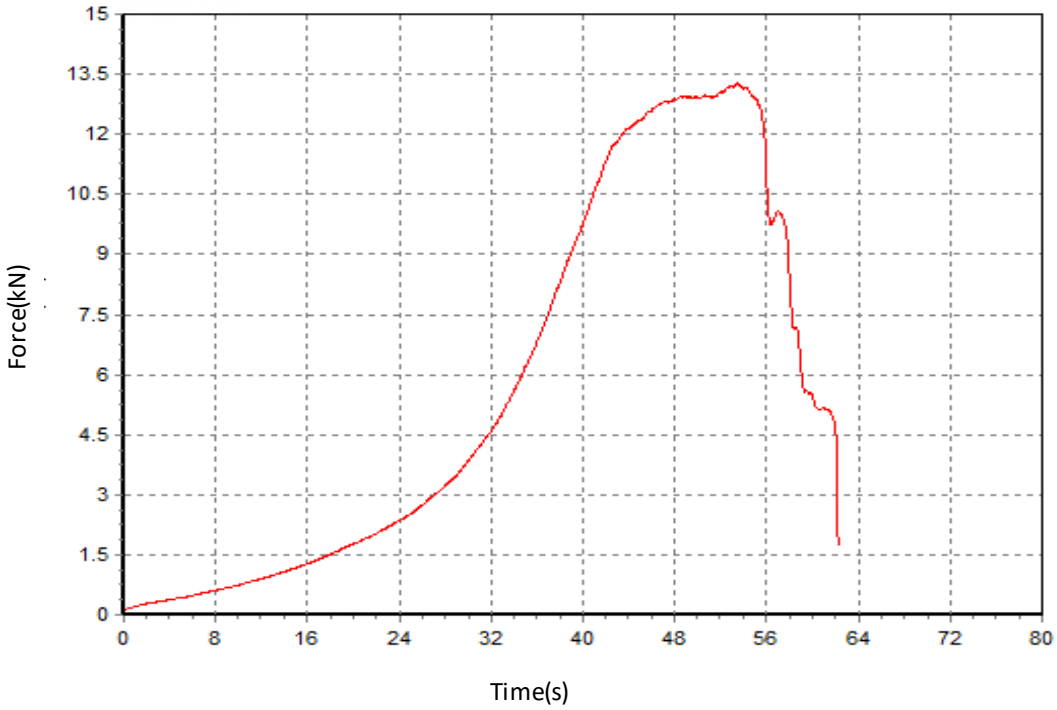
Date	#	Max force (kN)	Comments
16/04/21	4*	13.27	Broke inside bend, tails slipped through both sides
16/04/21	5	12.86	Broke inside bend, tails slipped through both sides
16/04/21	6	12.08	Broke inside bend, tails slipped through both sides
Average		**12.74**	

* Sample 16/04/21 #4 shown on the following pages.



Test Date:	Friday, 16 April 2021
Max Force (kN):	13.27
Product Name:	Loop double fisherman's
Batch #:	4
Material:	5mm Beal Dyneema

Force-Time Curve



Tested by: Grant Prattley

Signed:

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


#: 4 Date: 16/04/21
Test: Slow Pull 100mm/min
Product: Loop double fisherman's
Cord: 5mm Beal Dyneema
Force: 13.27kN

Beal 5mm Dyneema loop (TF)

Materials

- Beal 5mm Dyneema/Dyneema cord (15kN)

Test setup

- Tied a triple fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

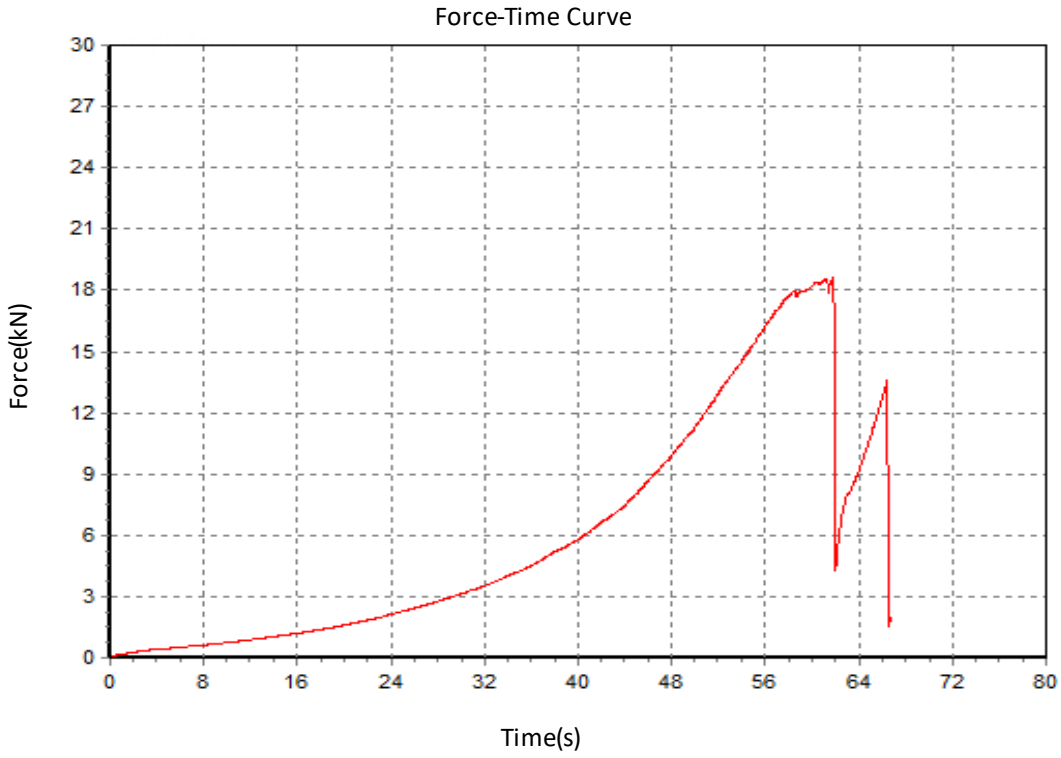
Results

Date	#	Max force (kN)	Comments
16/04/21	7*	18.61	Broke at the pin, tails almost slipped through, most core strands left intact
16/04/21	8	18.19	Broke at the bend one side, a few core strands left intact
16/04/21	9	18.86	Broke at the bend one side, a few core strands left intact
Average		**18.55**	

* Sample 16/04/21 #7 shown on the following pages.

ASPIRING

Test Date:	Friday, 16 April 2021
Max Force (kN):	18.61
Product Name:	Loop triple fisherman's
Batch #:	7
Material:	5mm Beal Dyneema



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: 16/04/21
Test: Slow Pull 100mm/min
Product: Loop triple fisherman's
Cord: 5mm Beal Dyneema
Force: 18.61kN

Aspiring 5mm Dyneema loop (DF)

Materials

- Aspiring 5mm Dyneema/Dyneema cord (15kN)

Test setup

- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

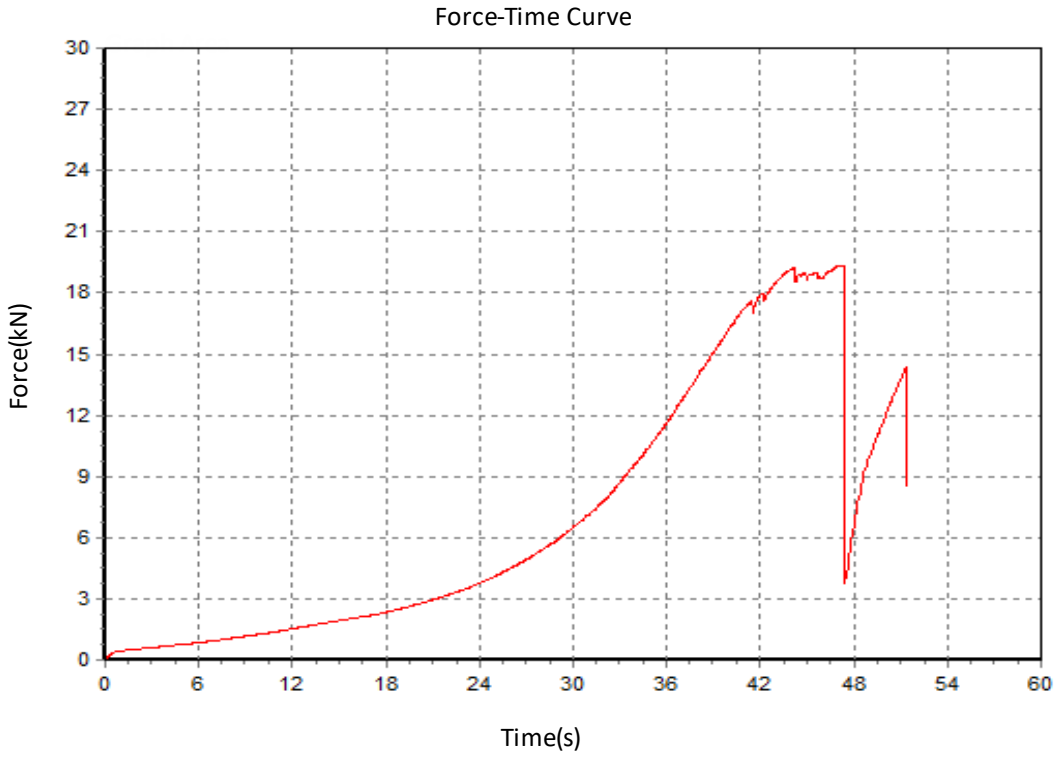
Results

Date	#	Max force (kN)	Comments
27/07/21	1*	19.35	Broke at the bend, core and sheath, a few strands left intact
27/07/21	2	17.69	Broke at the bend, core and sheath, a few strands left intact
27/07/21	3	18.58	Broke at the bend, core and sheath, a few strands left intact
Average		**18.54**	

* Sample 27/07/21 #1 shown on the following pages.

ASPIRING

Test Date:	Tuesday, 27 July 2021
Max Force (kN):	19.35
Product Name:	Loop double fishermans
Batch #:	1
Material:	5mm Aspiring Dyneema



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: 27/07/21
Test: Slow Pull 100mm/min
Type: Loop double fisherman's
Cord: 5mm Aspiring Dyneema
Force: 19.35kN

Aspiring 5mm Dyneema Loop (TF)

Materials

- Aspiring 5mm Dyneema/Dyneema cord (15kN)

Test setup

- Tied a triple fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

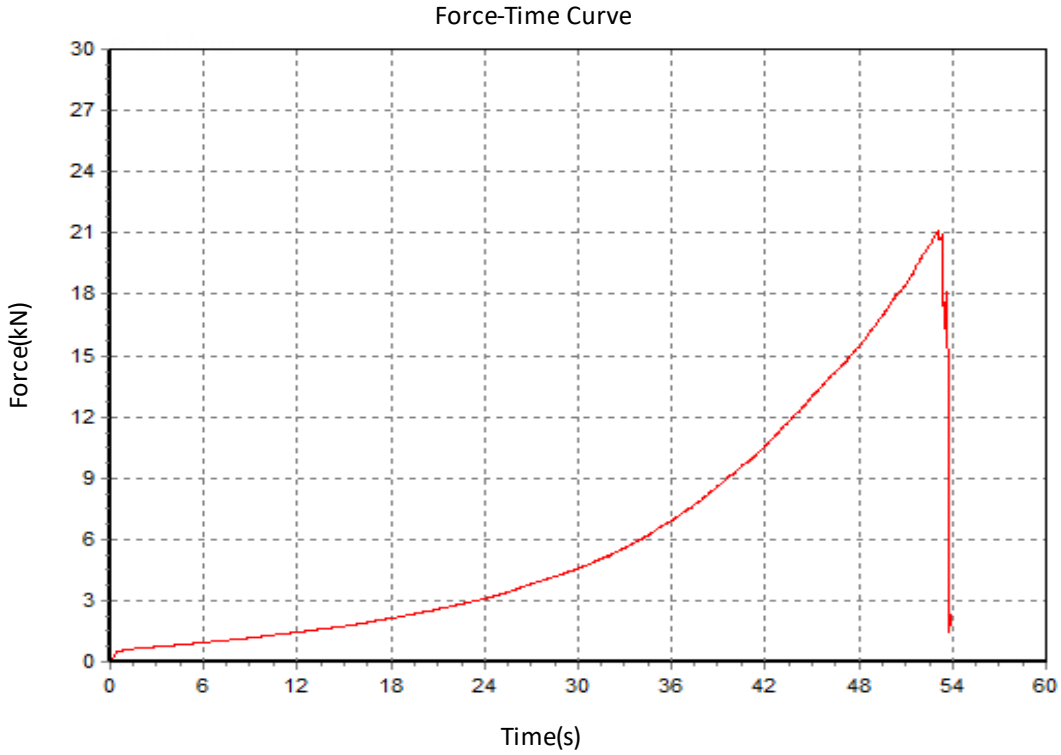
Results

Date	#	Max force (kN)	Comments
27/07/21	4*	21.09	Broke at the bend, core only, sheath remained intact
27/07/21	5	21.02	Broke at the bend, core only, sheath remained intact
27/07/21	6	21.82	Broke at the bend, core and sheath, a few strands left intact
Average		**21.31**	

* Sample 27/07/21 #4 shown on the following pages.

ASPIRING

Test Date:	Tuesday, 27 July 2021
Max Force (kN):	21.09
Product Name:	Loop triple fishermans
Batch #:	4
Material:	5mm Aspiring Dyneema



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: 27/07/21
Test: Slow Pull 100mm/min
Type: Loop triple fisherman's
Cord: 5mm Aspiring Dyneema
Force: 21.09kN

Nautilus 5mm Dyneema/Polyester loop (DF)

Materials

- Nautilus 5mm Dyneema/Polyester cord (10kN)

Test setup

- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

Results

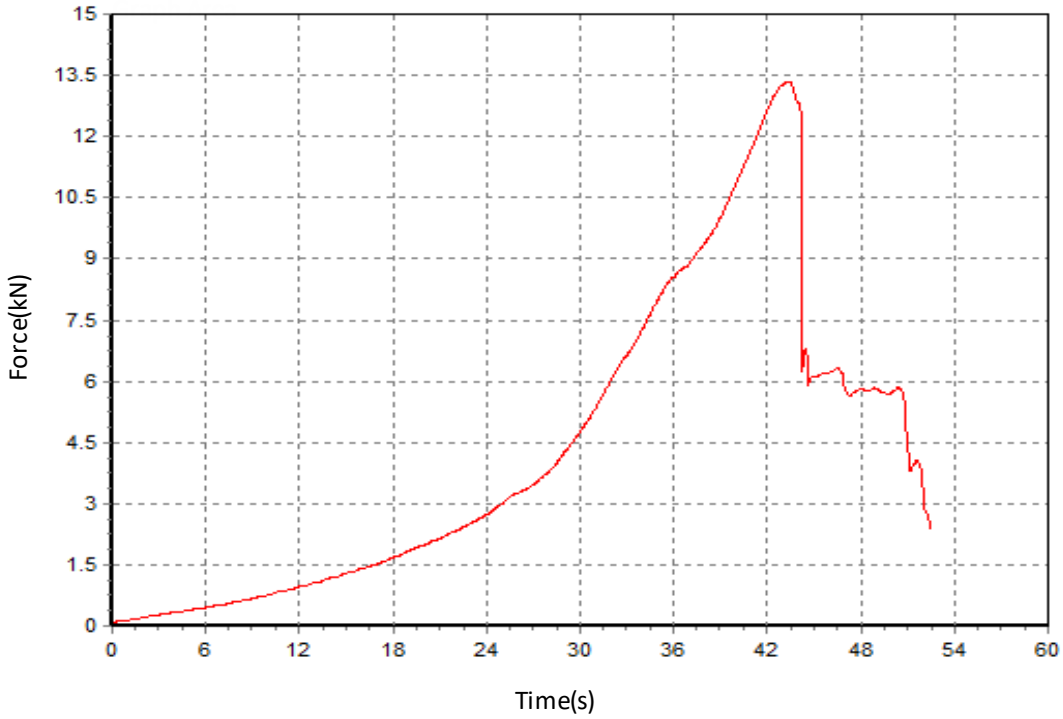
Date	#	Max force (kN)	Comments
14/08/20	13*	13.34	Broke at the bend, the core slipped through sheath one tail, the sheath broke on one side of bend
14/08/20	16	13.61	Broke at the bend, the core slipped through sheath one tail, the sheath broke on one side of bend
14/08/20	17	13.82	Broke at the bend, the core slipped through sheath one tail, the sheath broke on one side of bend
Average		**13.59**	

* Sample 14/08/20 #13 shown on the following pages.

ASPIRING

Test Date:	Friday, 14 August 2020
Max Force (kN):	13.34
Product Name:	Double fisherman's loop
Batch #:	13
Material:	5mm Nautilus Dyneema/Polyester

Force-Time Curve



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


#: 13 Date: 14/8/20
Test: Slow Pull 100mm/min
Type: Loop double fisherman's
Cord: 5mm Nautilus Dyneema / Polyester
Force: 13.34kN

Nautilus 5mm Dynnema/Polyester loop (TF)

Materials

- Nautilus 5mm Dyneema/Polyester cord (10kN)

Test setup

- Tied a triple fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

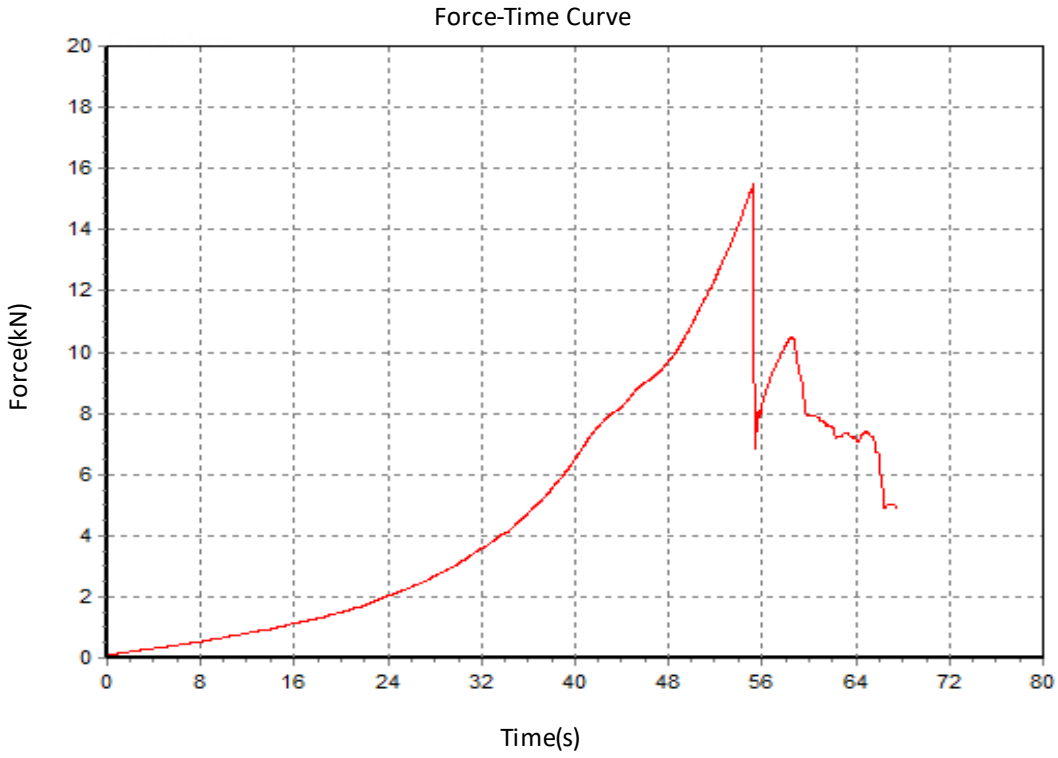
Results

Date	#	Max force (kN)	Comments
16/04/21	1*	15.49	Broke at the bend, core slipped through sheath one tail, sheath broke on both sides of bend
16/04/21	2	14.95	Broke at the bend, core slipped through sheath one tail, sheath broke on both sides of bend
16/04/21	3	16.09	Broke at the bend, core slipped through sheath one tail, sheath broke on both sides of bend
Average		**15.51**	

* Sample 16/04/21 #1 shown on the following pages.

ASPIRING

Test Date:	Friday, 16 April 2021
Max Force (kN):	15.49
Product Name:	Loop triple fisherman's
Batch #:	1
Material:	5mm Nautilus Dyneema/Polyester



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: 16/04/21
Test: Slow Pull 100mm/min
Product: Loop triple fisherman's
Cord: 5mm Nautilus Dyneema
Poylester
Force: 15.49kN

Beal 5.5mm Dynnema/Nylon loop (DF)

Materials

- Beal 5.5mm Dyneema/Nylon cord (18kN)

Test setup

- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

Results

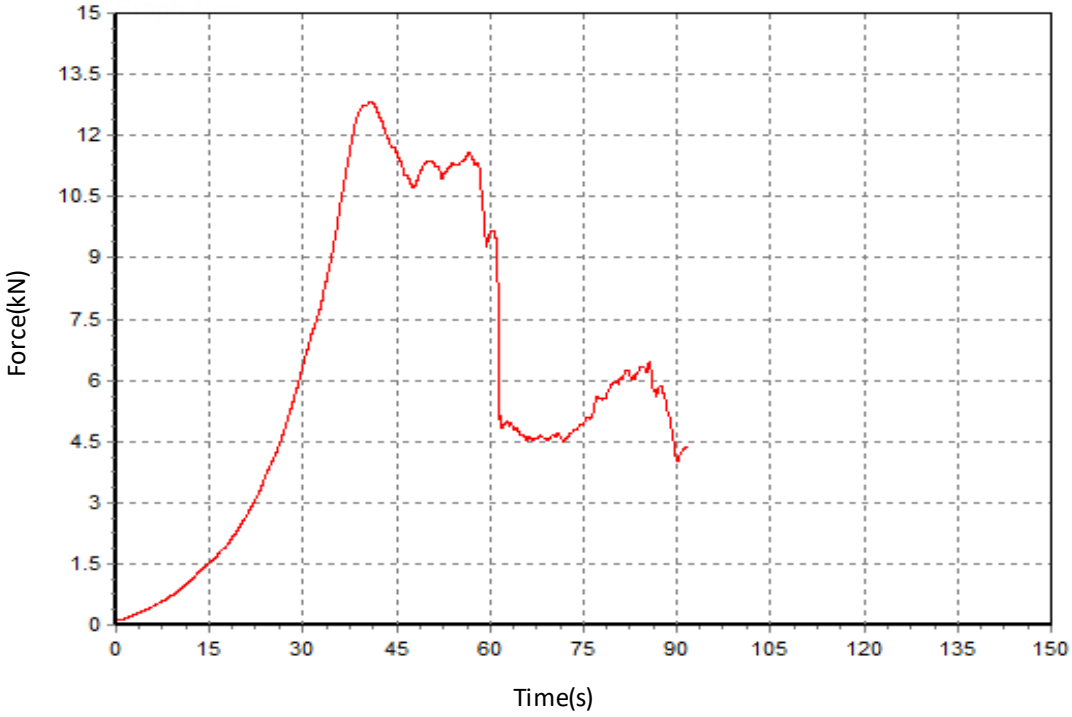
Date	#	Max force (kN)	Comments
14/08/20	6*	12.84	Broke at the bend, sheath remained intact, core slipped through sheath both tails
14/08/20	7	13.6	Broke at the bend, sheath remained intact, core slipped through sheath both tails
14/08/20	8	13.69	Broke at the bend, sheath remained intact, core slipped through sheath one tail
Average		**13.38**	

* Sample 14/08/20 #6 shown on the following pages.

ASPIRING

Test Date:	Friday, 14 August 2020
Max Force (kN):	12.84
Product Name:	Double Fisherman's Loop
Batch #:	6
Material:	5.5mm Beal Dyneema / Nylon

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


#: 6 Date: 14/8/20
Test: Slow Pull 100mm/min
Type: Loop double fisherman's
Cord: 5.5mm Beal Dyneema / Nylon
Force: 12.84kN

Beal 5.5mm Dynnema/Nylon Loop (TF)

Materials

- Beal 5.5mm Dyneema/Nylon cord (18kN)

Test setup

- Tied a triple fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

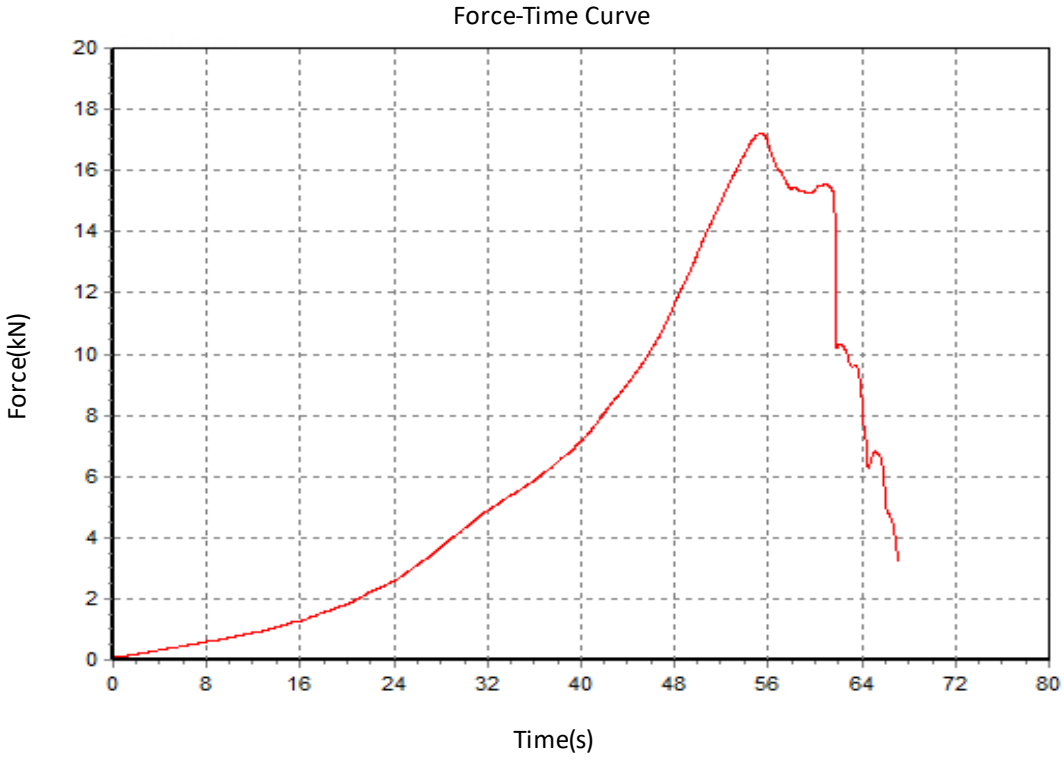
Results

Date	#	Max force (kN)	Comments
14/08/20	9*	17.22	Broke at the bend, core slipped through sheath one tail, sheath broke on one side of bend
14/08/20	10	17.31	Broke at the bend, sheath remained intact, core slipped through sheath both tails
14/08/20	11	17.24	Broke at the bend, core slipped through sheath one tail, sheath broke on one side of bend
Average		**17.26**	

* Sample 14/08/20 #9 shown on the following pages.

ASPIRING

Test Date:	Friday, 14 August 2020
Max Force (kN):	17.22
Product Name:	Triple fisherman's loop
Batch #:	9
Material:	5.5mm Beal Dyneema / Nylon



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 9 Date: 14/8/20
Test: Slow Pull 100mm/min
Type: Loop triple fisherman's
Cord: 5.5mm Beal Dyneema / Nylon
Force: 17.22kN

Nautilus 6mm Dynnema/Polyester loop

Materials

- Nautilus 6mm Dyneema/Polyester cord (13.7kN)

Test setup

- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

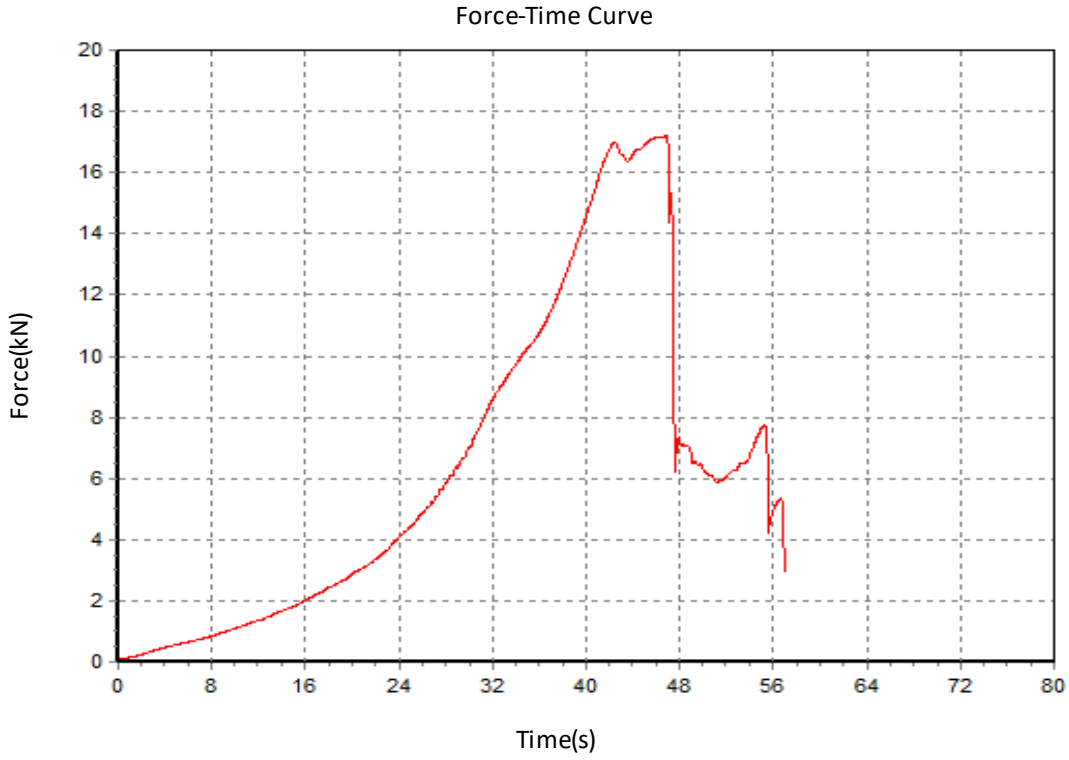
Results

Date	#	Max force (kN)	Comments
14/08/20	12*	17.20	Broke at the bend, core slipped through sheath one tail, sheath broke on one side of bend
14/08/20	14	17.95	Broke at the bend, core slipped through sheath one tail, sheath broke on one side of bend
14/08/20	15	17.98	Broke at the bend, core slipped through sheath one tail, sheath broke on one side of bend
Average		**17.71**	

* Sample 14/08/20 #12 shown on the following pages.

ASPIRING

Test Date:	Friday, 14 August 2020
Max Force (kN):	17.2
Product Name:	Double fisherman's loop
Batch #:	12
Material:	6mm Nautilus Dyneema / Polyester



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 12 Date: 14/8/20
Test: Slow Pull 100mm/min
Type: Loop double fisherman's
Cord: 6mm Nautilus Dyneema / Polyester
Force: 17.20kN

PMI 7mm Nylon loop

Materials

- PMI 7mm Nylon/Nylon cord (11.90kN)

Test setup

- Tied a double fisherman's bend to form a loop

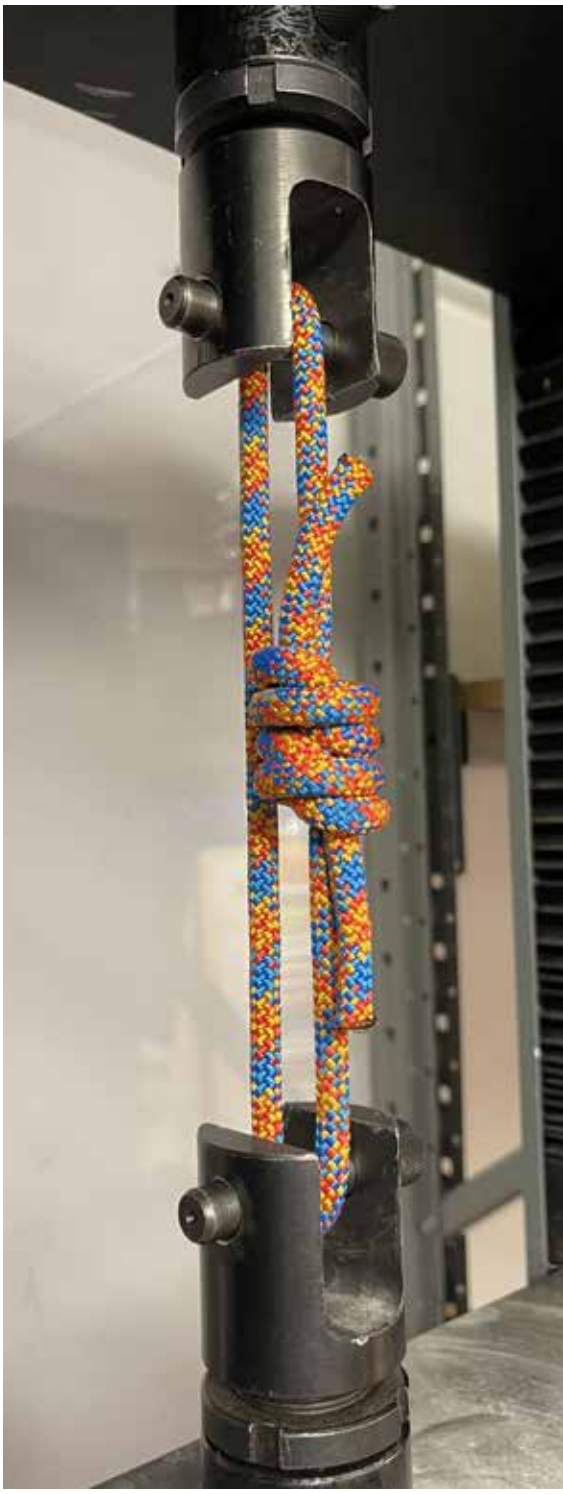
Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

Results

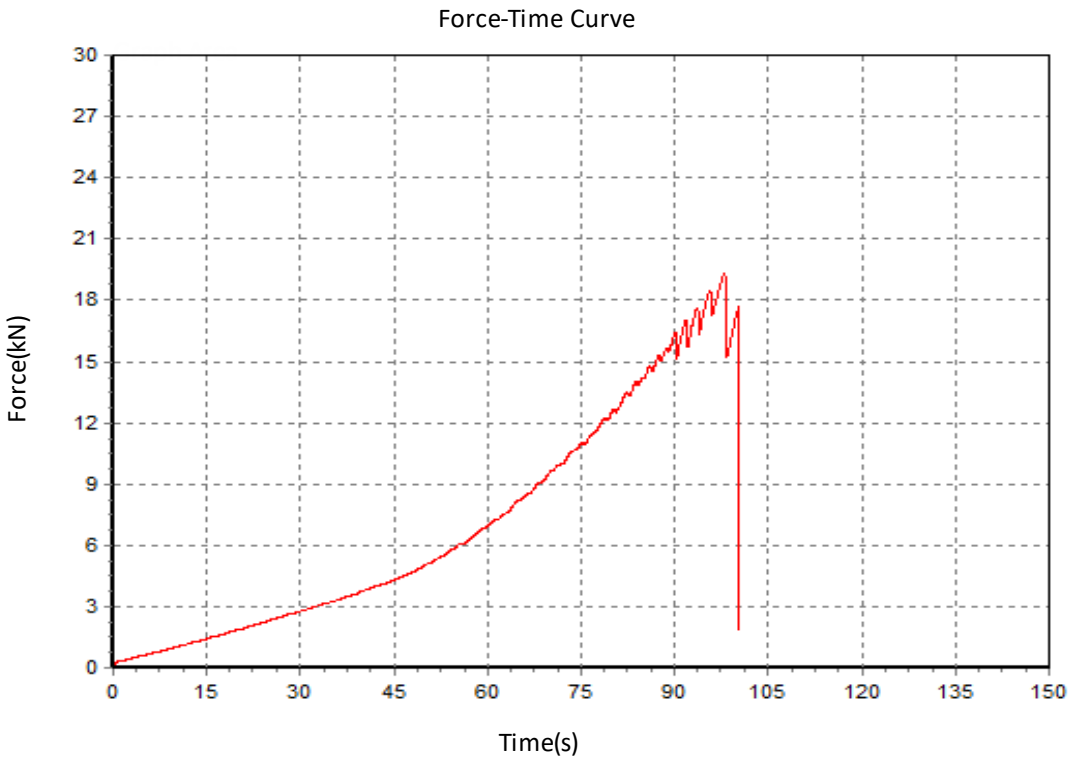
Date	#	Max force (kN)	Comments
14/08/20	21*	19.29	Broke at the pin
14/08/20	22	18.56	Broke at the pin
14/08/20	23	18.74	Broke at the pin
Average		**18.86**	

* Sample 14/08/20 #21 shown on the following pages.



ASPIRING

Test Date:	Friday, 14 August 2020
Max Force (kN):	19.29
Product Name:	Double fisherman's loop
Batch #:	21
Material:	7mm PMI Cord



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 21 Date: 14/8/20
Test: Slow Pull 100mm/min
Type: Loop double fisherman's
Cord: 7mm PMI Cord
Force: 19.29kN

PMI 8mm Nylon Loop (DF)

Materials

- PMI 8mm Nylon/Nylon cord (14.30kN)

Test setup

- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

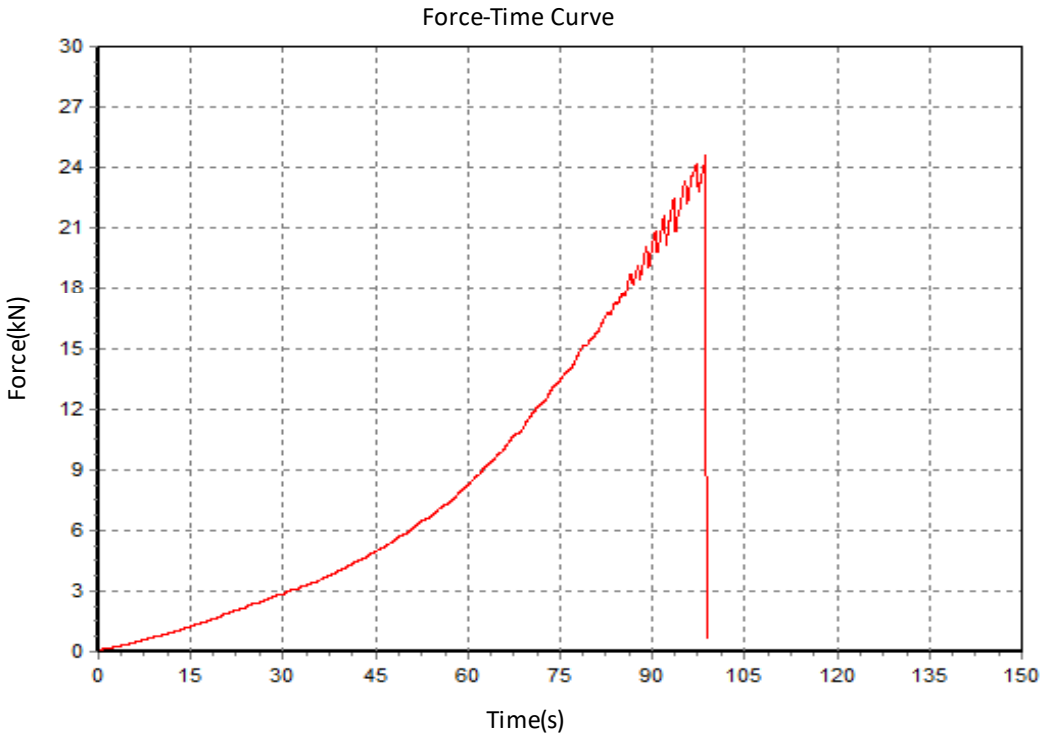
Results

Date	#	Max force (kN)	Comments
22/10/20	25	24.60	Broke at the pin
22/10/20	26	22.43	Broke at the pin
22/10/20	27	24.44	Broke at the bend
Average		**23.82**	

* Sample 22/10/20 #25 shown on the following pages.

ASPIRING

Test Date:	Thursday, 22 October, 2020
Max Force (kN):	24.6
Product Name:	Double Fisherman's Loop
Batch #:	25
Material:	8mm PMI cord



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 25 Date: 22/10/20
Test: Slow Pull 100mm/min
Type: Loop, double fisherman's
Rope: 8mm PMI Cord
Force: 24.60kN

PMI 8mm Nylon loop (F8RT)

Materials

- PMI 8mm Nylon/Nylon cord (14.30kN)

Test setup

- Tied a figure-8 rethread bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

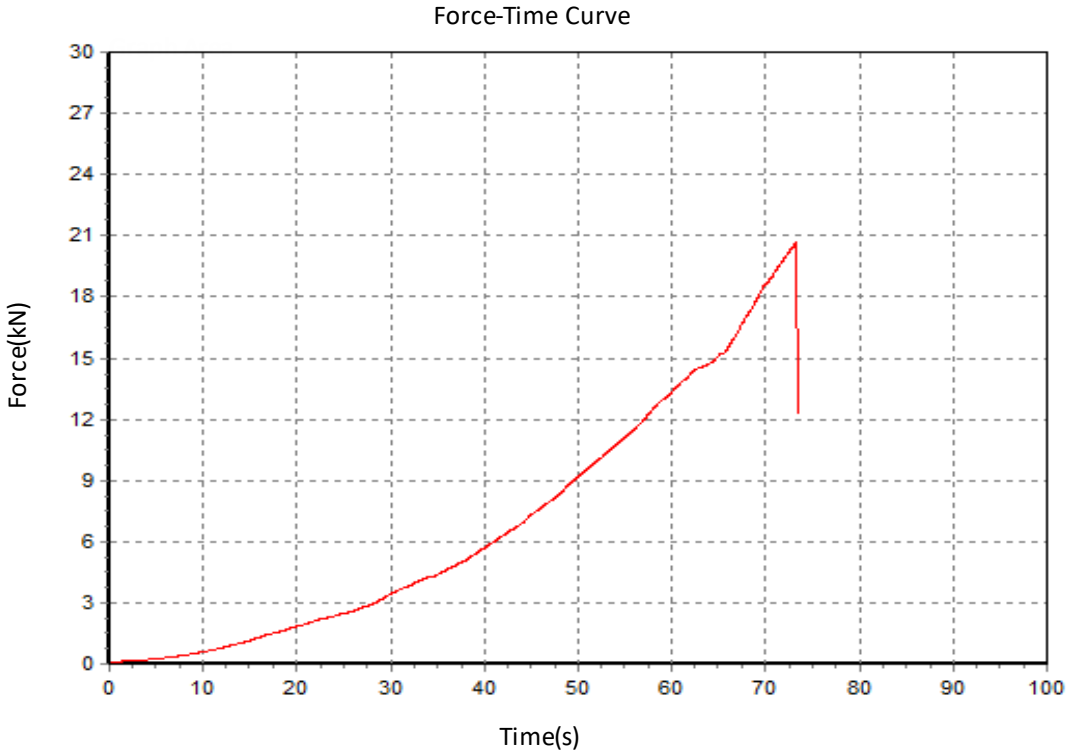
Results

Date	#	Max force (kN)	Comments
16/11/20	10*	20.68	Broke at the pin
16/11/20	11	19.91	Broke at the pin
16/11/20	12	20.43	Broke at the bend
Average		**20.34**	

* Sample 16/11/20 #10 shown on the following pages.

ASPIRING

Test Date:	Monday, 16 November 2020
Max Force (kN):	20.68
Product Name:	Fig-8 rethread bend loop
Batch #:	10
Material:	8mm PMI Accessory Cord



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 10 Date: 16/11/20
Test: Slow Pull 100mm/min
Type: Loop fig-8 rethread bend
Material: 8mm PMI cord
Force: 20.68kN

Nautilus 8mm Dyneema/Polyester+Kevlar loop (DF)

Materials

- Nautilus 8mm (Arborist Prusik) Dyneema/Polyester+Kevlar cord (30kN)

Test setup

- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

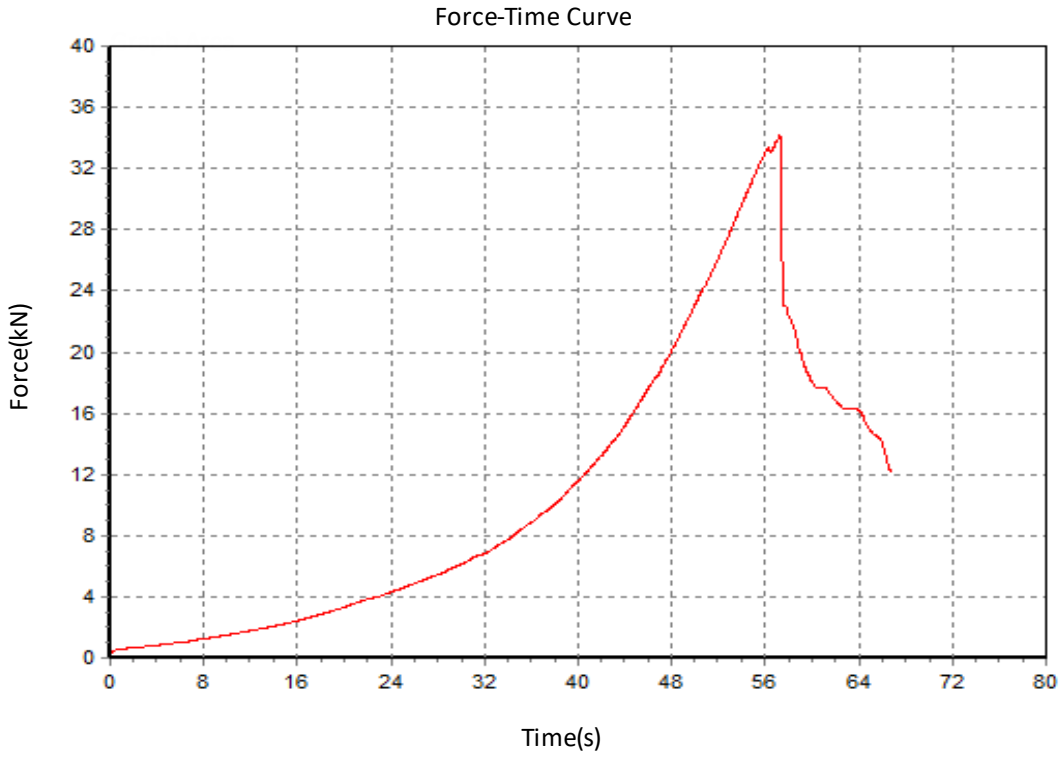
Results

Date	#	Max force (kN)	Comments
05/07/21	1*	34.24	Sheath broke one side of the bend, sheath continued to slip, core slipped through sheath one tail
05/07/21	2	34.55	Sheath started to break one side of the bend, stripped sheath at the pin, sheath continued to slip, core slipped through sheath one tail
05/07/21	3	33.89	Sheath broke one side of the bend, sheath continued to slip, core slipped through sheath one tail
Average		**34.23**	

* Sample 05/07/21 #1 shown on the following pages.

ASPIRING

Test Date:	Monday, 5 July 2021
Max Force (kN):	34.24
Product Name:	Loop double fisherman's bend
Batch #:	1
Material:	8mm Nautilus aborist prusik cord



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: 05/07/21
Test: Slow Pull 100mm/min
Type: Loop Double Fisherman's
Cord: 8mm Nautilus Dyneema /
Polyester+Kevlar
Force: 34.24kN

Nautilus 8mm Dyneema/Polyester+Kevlar loop (F8RT)

Slow Pull Test	~~Friction Test~~	~~Drop Test~~

Materials

- Nautilus 8mm (Arborist Prusik) Dyneema/Polyester+Kevlar cord (30kN)

Test setup

- Tied a figure-8 rethread bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

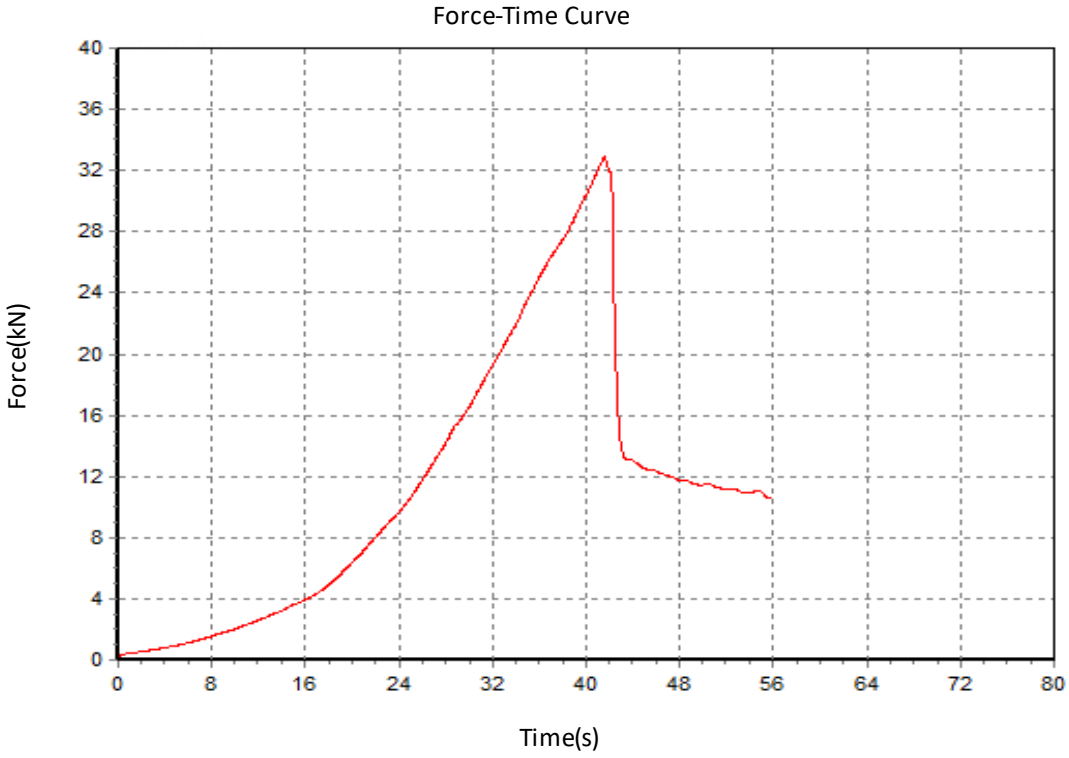
Results

Date	#	Max force (kN)	Comments
05/07/21	4*	32.91	Sheath broke one side of the bend, sheath continued to slip, core slipped through sheath one tail
05/07/21	5	33.69	Sheath broke one side of the bend, sheath continued to slip, core slipped through sheath one tail
05/07/21	6	33.73	Sheath broke one side of the bend, sheath continued to slip, core slipped through sheath one tail
Average		**33.44**	

* Sample 05/07/21 #4 shown on the following pages.

ASPIRING

Test Date:	Monday, 5 July 2021
Max Force (kN):	32.91
Product Name:	Loop figure-8 rethread bend
Batch #:	4
Material:	8mm Nautilus aborist prusik cord



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: 05/07/21
Test: Slow Pull 100mm/min
Type: Loop Figure-8 rethread
Cord: 8mm Nautilus Dyneema / Polyester+Kevlar
Force: 32.91kN

PMI 10mm Classic Sport Nylon loop

Materials

- PMI 10mm Classic Sport Nylon/Nylon rope (27kN)

Test setup

- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

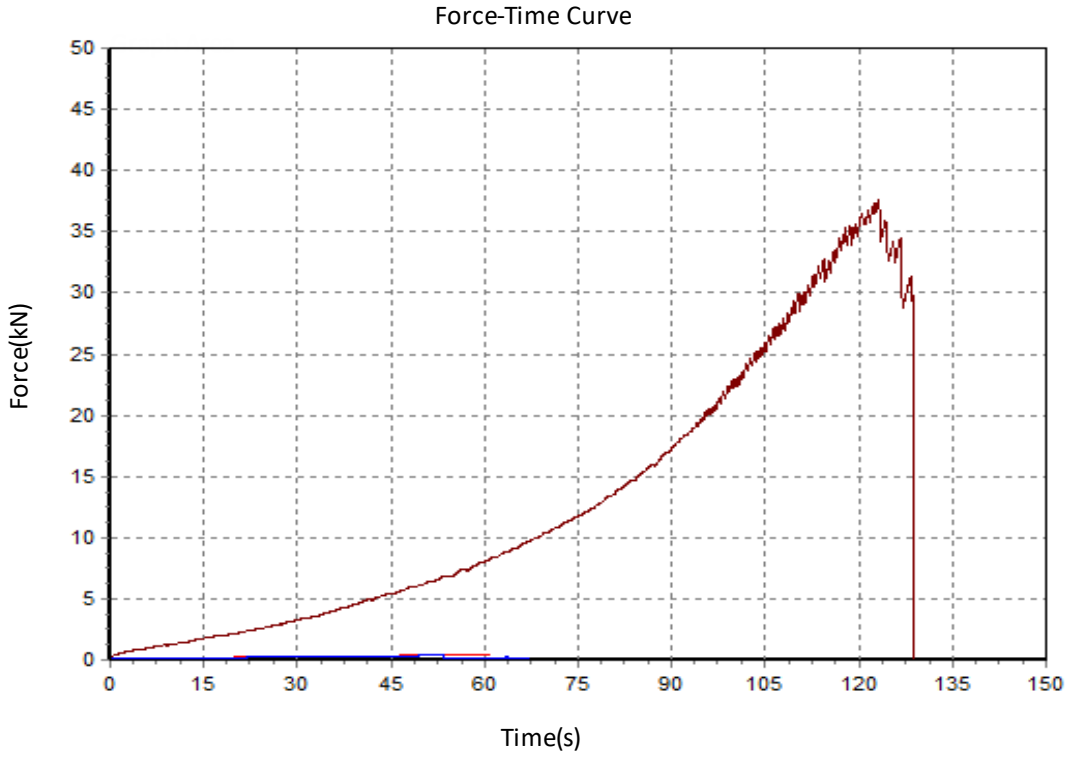
Results

Date	#	Max force (kN)	Comments
20/07/21	1*	37.57	Broke at the bend
20/07/21	2	35.88	Broke at the pin
20/07/21	3	36.69	Broke at the pin
Average		**36.71**	

* Sample 20/07/21 #1 shown on the following pages.

ASPIRING

Test Date:	Tuesday, 20 July 2021
Max Force (kN):	37.57
Product Name:	Loop double fisherman's bend
Batch #:	1
Material:	PMI 10mm Classic Sport



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: 20/07/21
Test: Slow Pull 100mm/min
Product: Loop double fisherman's
Rope: 10mm PMI Classic Sport
Force: 37.57kN

Kordas 10mm Dana Nylon loop

Materials

- Kordas 10mm Dana Nylon/Nylon rope (27kN)

Test setup

- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

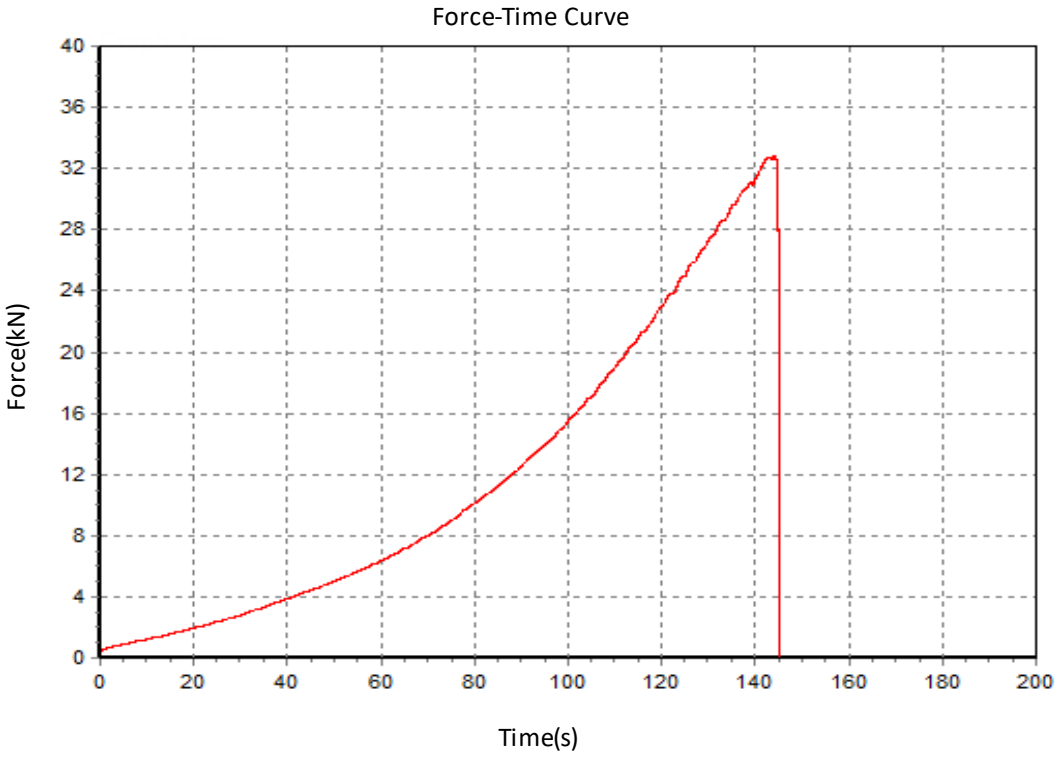
Results

Date	#	Max force (kN)	Comments
20/07/21	4*	32.87	Broke at the pin
20/07/21	5	31.33	Broke at the pin
20/07/21	6	32.51	Broke at the pin
Average		**32.24**	

* Sample 20/07/21 #4 shown on the following pages.

ASPIRING

Test Date:	Tuesday, 20 July 2021
Max Force (kN):	32.87
Product Name:	Loop double fisherman's bend
Batch #:	4
Material:	Kordas 10mm Dana



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: 20/07/21
Test: Slow Pull 100mm/min
Product: Loop double fisherman's
Rope: 10mm Kordas Dana
Force: 32.87kN

Appendix 2: Rock thread testing

Beal 5mm Dyneema rock thread

Materials

- Beal 5mm Dyneema/Dyneema cord (15kN)

Test setup

- Passed the cord through a 75mmx12mm rock thread
- Tied a triple fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

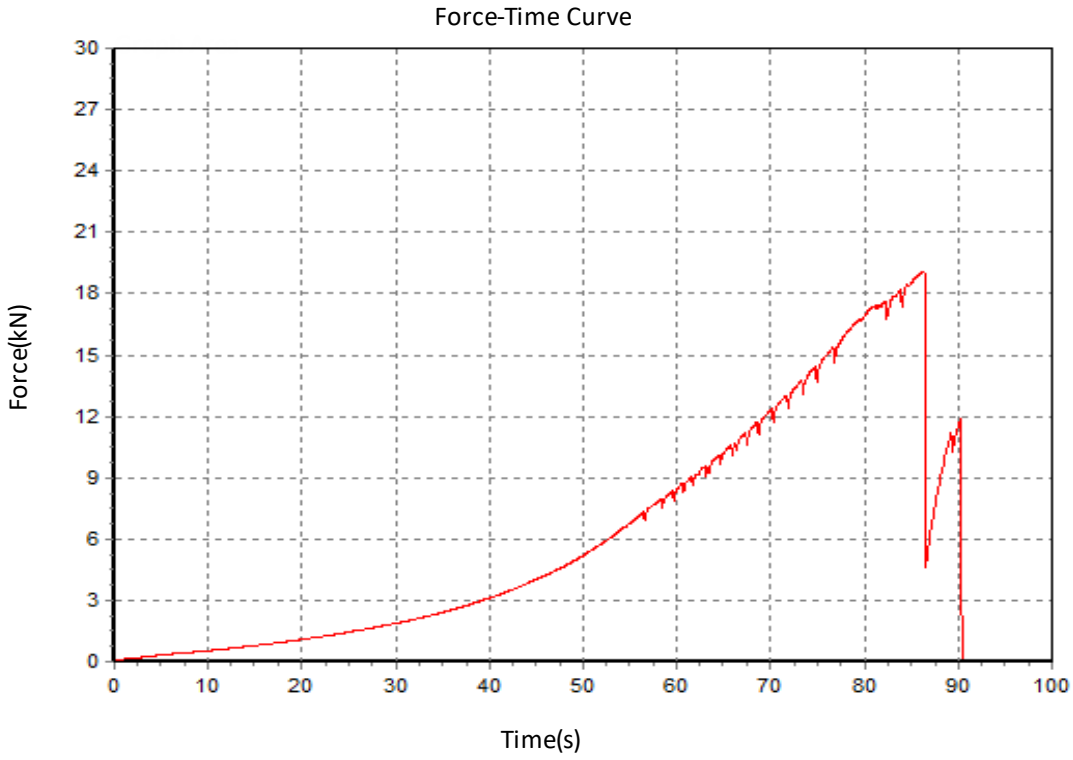
Results

Date	#	Max force (kN)	Comments
16/04/21	10*	19.06	Broke at the bend, minor damage to cord at thread both sides
16/04/21	11	18.07	Broke at the pin, minor damage to cord at thread both sides
16/04/21	12	18.6	Broke at the bend, minor damage to cord at thread both sides
Average		**18.58**	

* Sample 16/04/21 #10 shown on the following pages.

ASPIRING

Test Date:	Friday, 16 April 2021
Max Force (kN):	19.06
Product Name:	Loop triple fisherman's rock thread
Batch #:	10
Material:	5mm Beal Dyneema



ECAAS ISO 9001 CERTIFIED Quality Management

Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 10 Date: 16/04/21
Test: Slow Pull 100mm/min
Product: Loop thread in rock
triple fisherman's
Cord: 5mm Beal Dyneema
Force: 19.06kN

Aspiring 5mm Dyneema rock thread

Materials

- Aspiring 5mm Dyneema/Dyneema cord (15kN)

Test setup

- Passed the cord through a 75mmx12mm rock thread
- Tied a triple fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

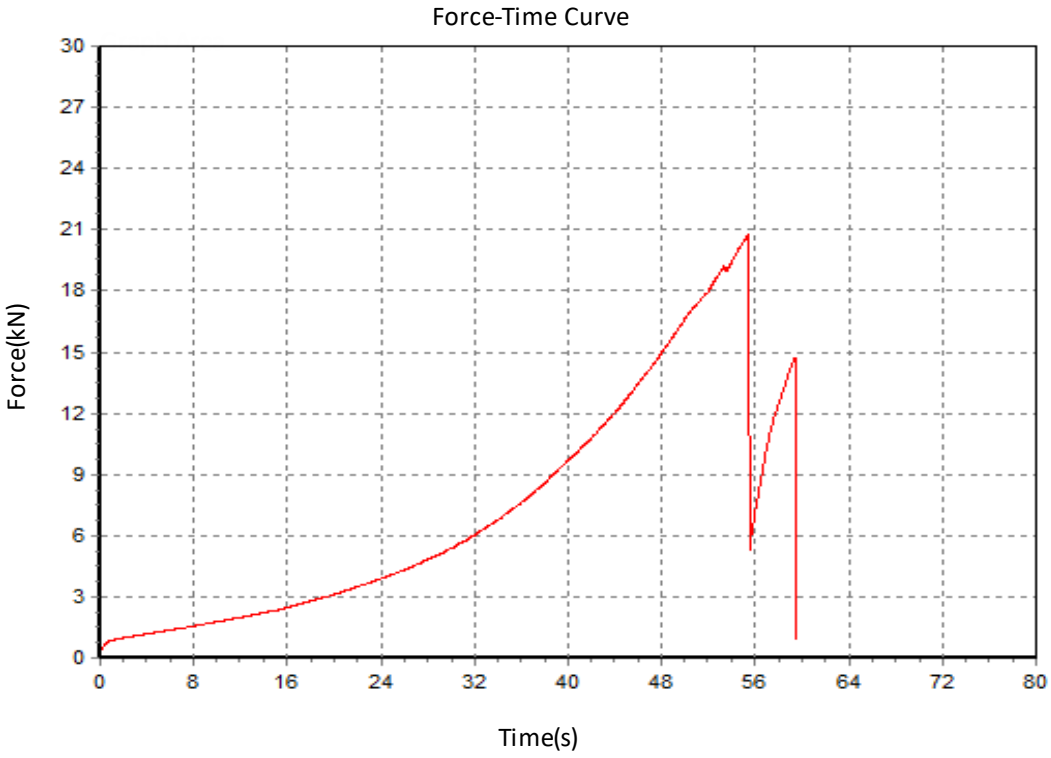
Results

Date	#	Max force (kN)	Comments
27/07/21	7	21.23	Broke at the bend, minor damage to the sheath both sides of the thread
27/07/21	8*	20.78	Broke at the bend, minor damage to the sheath both sides of the thread
27/07/21	9	20.94	Broke at the bend, minor damage to the sheath both sides of the thread
Average		**20.98**	

* Sample 27/07/21 #8 shown on the following pages.

ASPIRING

Test Date:	Tuesday, 27 July 2021
Max Force (kN):	20.78
Product Name:	Rock thread loop triple fishermans
Batch #:	8
Material:	5mm Aspiring Dyneema



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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


#: 8 Date: 27/07/21
Test: Slow Pull 100mm/min
Type: Rock thread, loop triple fisherman's
Cord: 5mm Aspiring Dyneema
Force: 20.78kN

Nautilus 5mm Dyneema/Polyester rock thread

Materials

- Nautilus 5mm Dyneema/Polyester cord (10kN)

Test setup

- Passed the cord through a 75mmx12mm rock thread
- Tied a triple fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

Results

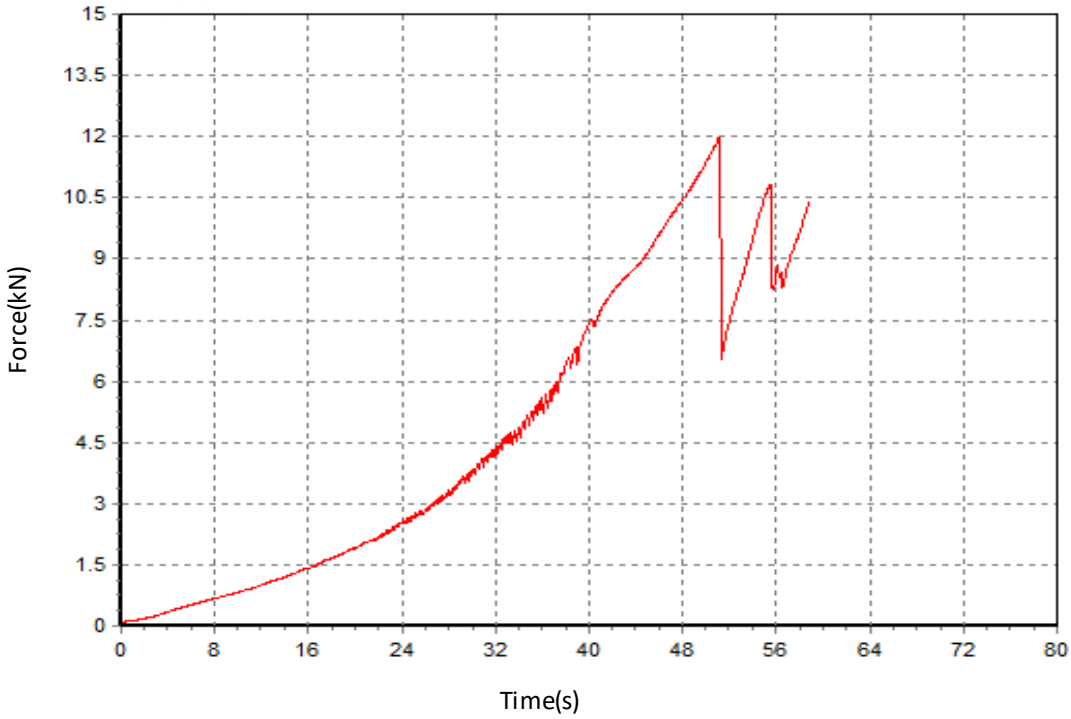
Date	#	Max force (kN)	Comments
16/04/21	13*	11.95	Sheath broke on both sides of the bend, core shot damage to cord at thread one side, minor damage other side
16/04/21	14	13.67	Sheath broke on both sides of the bend, core slipped through sheath one tail, core shot damage to cord at thread one side, minor damage other side.
16/04/21	15	13.07	Sheath broke on both sides of the bend, core slipped through sheath one tail, core shot damage to cord at thread one side, minor damage other side.
Average		**12.90**	

* Sample 16/04/21 #13 shown on the following pages.

ASPIRING

Test Date:	Friday, 16 April 2021
Max Force (kN):	11.95
Product Name:	Loop triple fisherman's rock thread
Batch #:	13
Material:	5mm Nautilus Dyneema/Polyester

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


Cut post testing to remove the cord from the rock
#: 13 Date: 16/04/21
Test: Slow Pull 100mm/min
Product: Loop thread in rock triple fisherman's
Cord: 5mm Nautilus Dyn/Poly
Force: 11.95kN

Beal 5.5mm Dyneema/Nylon rock thread

Materials

- Beal 5.5mm Dyneema/Nylon cord (18kN)

Test setup

- Passed the cord through a 75mmx12mm rock thread
- Tied a triple fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

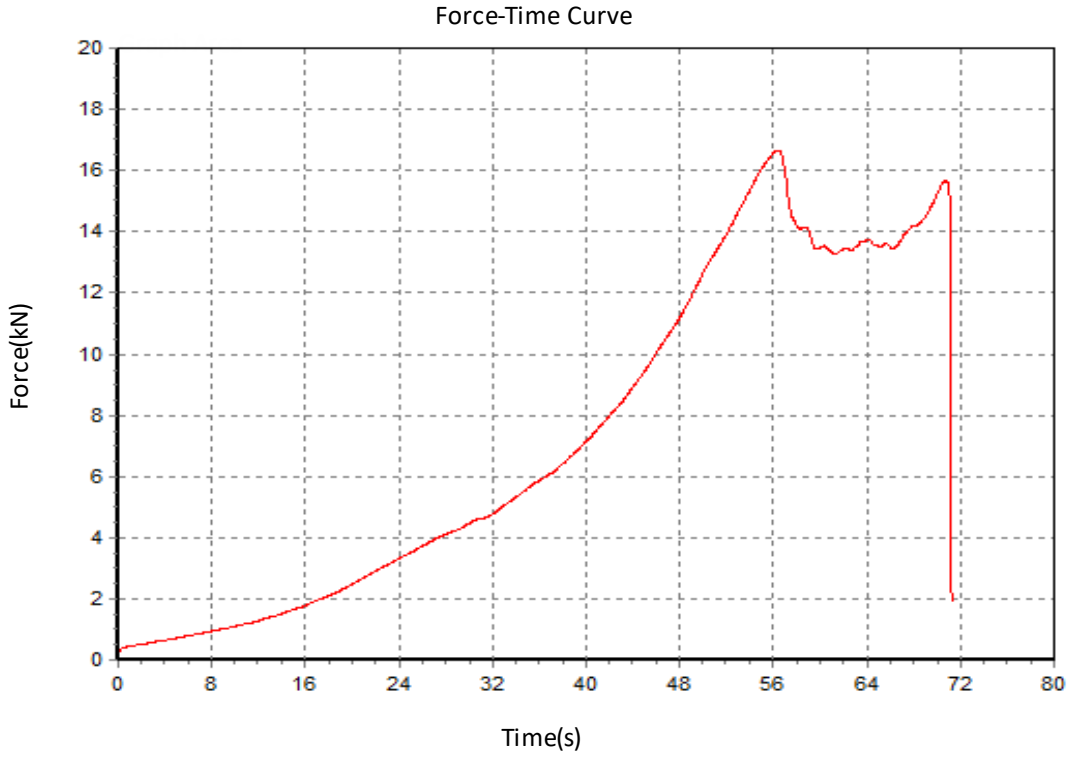
Results

Date	#	Max force (kN)	Comments
16/04/21	16*	16.66	Sheath broke on one side of bend, core slipped through sheath one tail, moderate damage to cord at thread both sides
16/04/21	17	17.10	Sheath remained intact, core slipped through sheath one tail, moderate damage to cord at thread both sides
16/04/21	18	17.10	Sheath broke on one side of bend, core slipped through sheath one tail, moderate damage to cord at thread both sides
Average		**16.95**	

* Sample 16/04/21 #16 shown on the following pages.

ASPIRING

Test Date:	Friday, 16 April 2021
Max Force (kN):	16.66
Product Name:	Loop triple fisherman's rock thread
Batch #:	16
Material:	5.5mm Beal Dyneema/Polyester



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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


Cut post testing to remove the cord from the rock
#: 16 Date: 16/04/21
Test: Slow Pull 100mm/min
Product: Loop thread in rock triple fisherman's
Cord: 5.5mm Beal Dyn/Nylon
Force: 16.66kN

Nautilus 6mm Dyneema/Polyester rock thread

Materials

- Nautilus 6mm Dyneema/Polyester cord (13.7kN)

Test setup

- Passed the cord through a 75mmx12mm rock thread
- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

Results

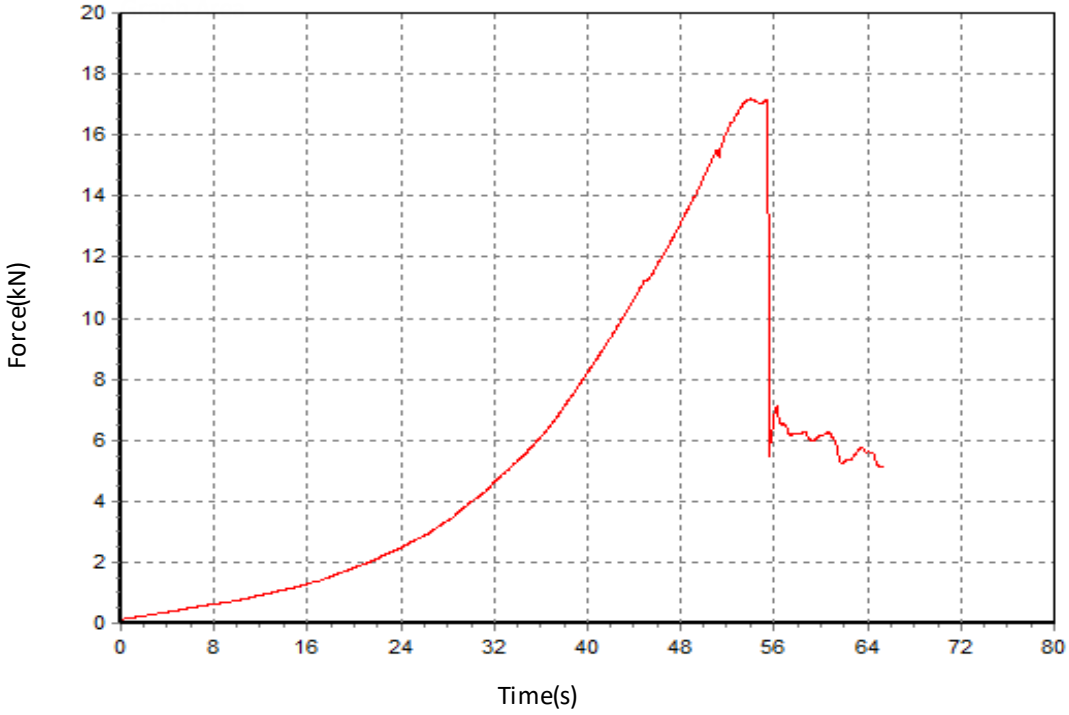
Date	#	Max force (kN)	Comments
16/04/21	19	17.58	Broke at the bend, core slipped through sheath one side, sheath broke on one side of bend, core shot damage to cord at thread one side
16/04/21	20	16.43	Broke at the bend, core slipped through sheath one side, sheath broke on one side of bend, core shot damage to cord at thread one side
16/04/21	21*	17.18	Broke at the bend, core slipped through sheath one side, sheath broke on one side of bend, core shot damage to cord at thread one side
Average		**17.06**	

* Sample 16/04/21 #21 shown on the following pages.

ASPIRING

Test Date:	Friday, 16 April 2021
Max Force (kN):	17.18
Product Name:	Loop double fisherman's rock thread
Batch #:	21
Material:	6mm Nautilus Dyneema/Polyester

Force-Time Curve



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed:

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


Cut post testing to remove the cord from the rock
#: 21 Date: 16/04/21
Test: Slow Pull 100mm/min
Product: Loop thread in rock triple fisherman's
Cord: 6mm Nautilus Dyn/Poly
Force: 17.18kN

PMI 7mm Nylon rock thread

Materials

- PMI 7mm Nylon/Nylon cord (11.9kN)

Test setup

- Passed the cord through a 75mmx12mm rock thread
- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins and a 10mm Maillon rapide

Results

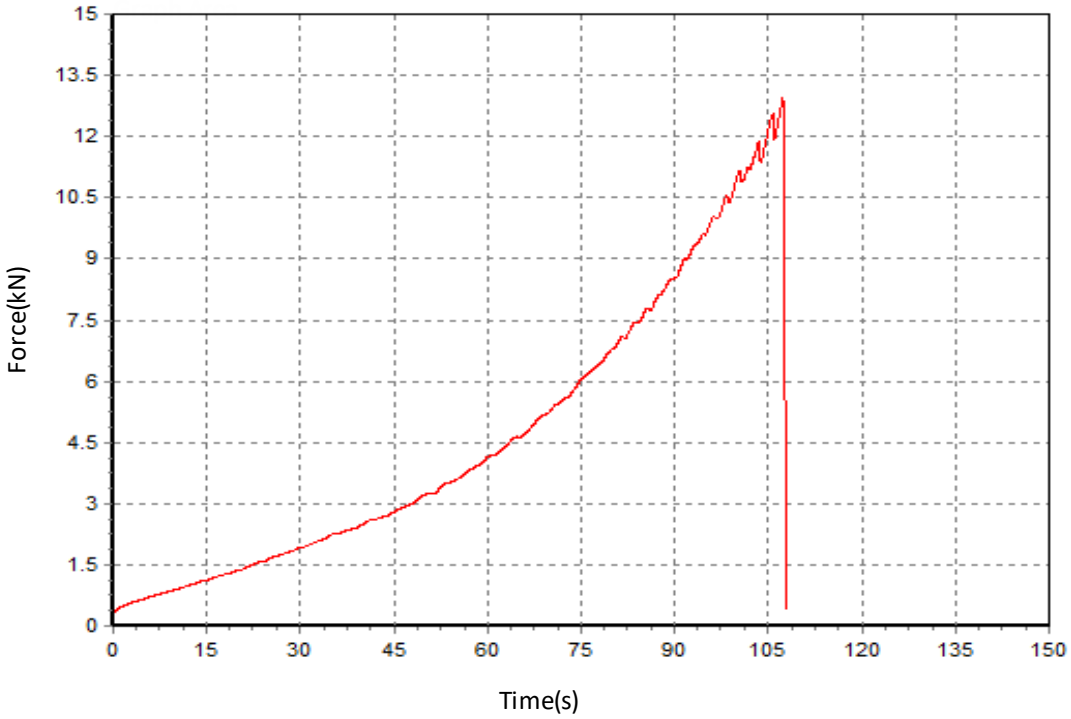
Date	#	Max force (kN)	Comments
16/04/21	22	12.87	Broke at the thread one side, small damage to other side
16/04/21	23*	12.93	Broke at the thread one side, small damage to other side, significant damage to cord at the rapide
16/04/21	24	12.85	Broke at the thread one side, small damage to other side, significant damage to cord at the rapide
Average		**12.88**	

* Sample 16/04/21 #23 shown on the following pages.

ASPIRING

Test Date:	Friday, 16 April 2021
Max Force (kN):	12.93
Product Name:	Loop double fisherman's rock thread
Batch #:	23
Material:	7mm PMI Nylon/Nylon cord

Force-Time Curve



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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#: 22 Date: 16/04/21
Test: Slow Pull 100mm/min
Product: Loop thread in rock double fisherman's
Cord: 7mm PMI Nylon
Force: 12.87kN

PMI 8mm Nylon rock thread

Materials

- PMI 8mm Nylon/Nylon cord (14.3kN)

Test setup

- Passed the cord through a 75mmx12mm rock thread
- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins and a 10mm Maillon rapide

Results

Date	#	Max force (kN)	Comments
16/04/21	25*	17.79	Broke at the thread one side, small damage to other side, small damage to cord at the rapide
16/04/21	26	17.8	Broke at the thread one side, small damage to other side, significant damage to cord at the rapide
16/04/21	27	16.65	Broke at the thread one side, small damage to other side, significant damage to cord at the rapide
Average		**17.41**	

* Sample 16/04/21 #25 shown on the following pages.

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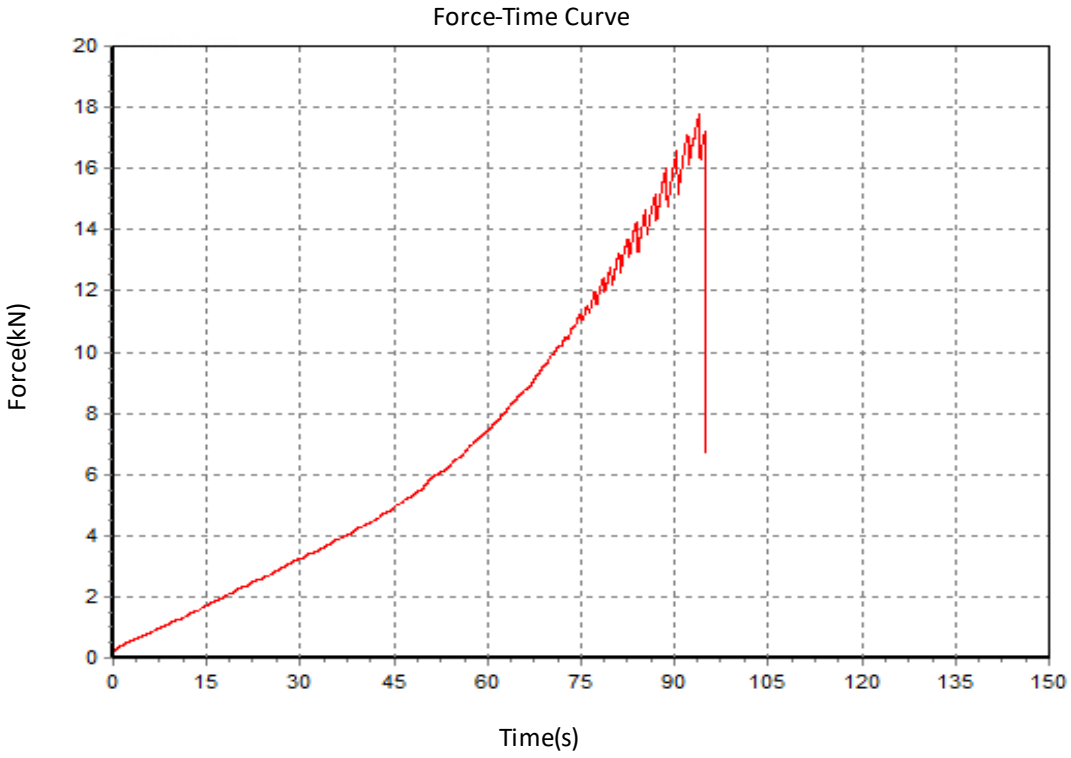
Test Date:	Friday, 16 April 2021
Max Force (kN):	17.79
Product Name:	Loop double fisherman's rock thread
Batch #:	25
Material:	8mm PMI Nylon/Nylon cord



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

Tested by: Grant Prattley

Signed: Grant Prattley

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#: 25 Date: 16/04/21
Test: Slow Pull 100mm/min
Product: Loop thread in rock
double fisherman's
Cord: 8mm PMI Nylon
Force: 17.79kN

Nautilus 8mm Dyneema/Polyester+Kevlar rock thread

Materials

- Nautilus 8mm (Arborist Prusik) Dyneema/Polyester+Kevlar cord (30kN)

Test setup

- Passed the cord through a 75mmx12mm rock thread
- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

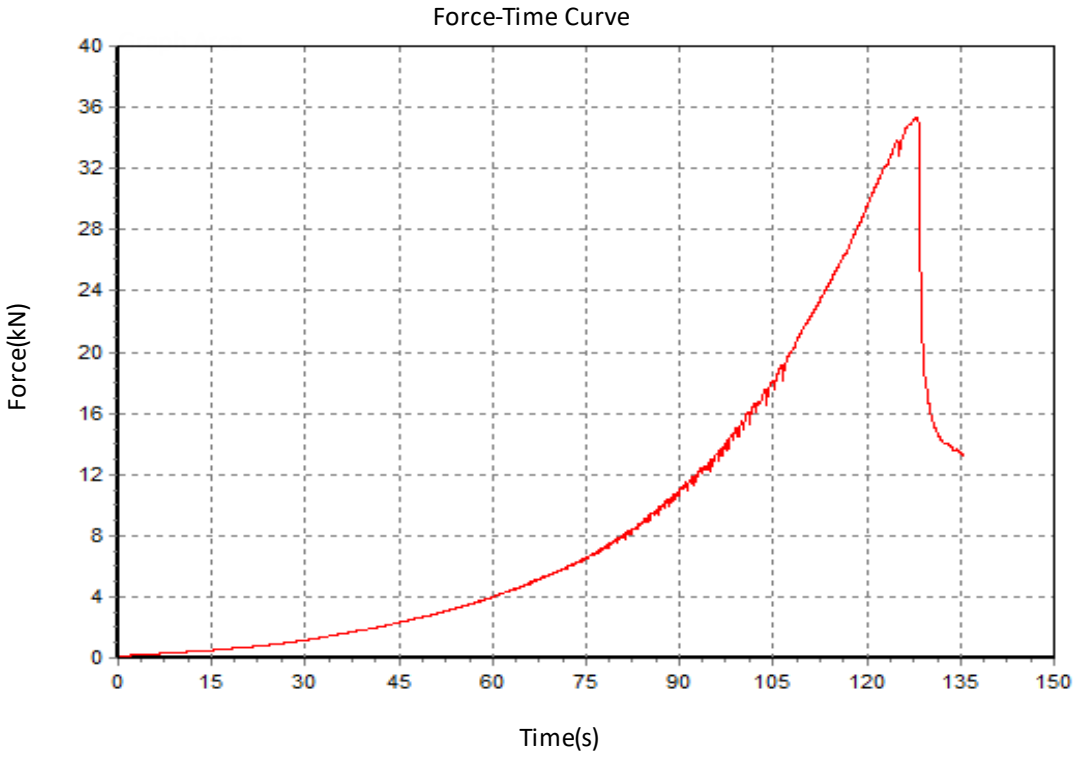
Results

Date	#	Max force (kN)	Comments
05/06/21	7*	35.37	Sheath broke one side of the bend, sheath continued to slip, moderate damage to sheath at the pin, moderate damage to the sheath one side of the thread, minor damage the other side
05/06/21	8	32.05	Broke sheath and core one side of the thread, minor damage to the other side
05/06/21	9	33.91	Sheath broke one side of the bend, sheath continued to slip, core shot damage to the sheath one side of the thread, minor damage the other side
Average		**33.78**	

* Sample 05/06/21 #7 shown on the following pages.

ASPIRING

Test Date:	Monday, 5 July 2021
Max Force (kN):	35.37
Product Name:	Rock thread loop double fisherman's bend
Batch #:	7
Material:	8mm Nautilus aborist prusik cord



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Tested by: Grant Prattley

Signed: Grant Prattley

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Cut post testing to remove the cord from the rock
#: 7 Date: 05/07/21
Test: Slow Pull 100mm/min
Type: Rock Thread Double Fish
Cord: 8mm Nautilus Dyneema / Polyester+Kevlar
Force: 35.37kN

Nautilus 8mm Dyneema/Polyester+Kevlar test anchor

Materials

- Nautilus 8mm (Arborist Prusik) Dyneema/Polyester+Kevlar cord (30kN)

Test setup

- Passed the cord through a 12mm rock thread
- Tied a double fisherman's bend to form a loop
- Use to anchor most of the rock thread tests (18)

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

Results

Date	#	Max force (kN)
16/04/21	10	19.06
16/04/21	11	18.07
16/04/21	12	18.6
16/04/21	13	11.95
16/04/21	14	13.67
16/04/21	15	13.07
16/04/21	16	16.66
16/04/21	17	17.10
16/04/21	18	17.10
16/04/21	19	17.58
16/04/21	20	16.43
16/04/21	21	17.18
16/04/21	22	12.87
16/04/21	23	12.93
16/04/21	24	12.85
16/04/21	25	17.79
16/04/21	26	17.8
16/04/21	27	16.65


Cut post testing to
remove the cord
from the rock

PMI 10mm Nylon rock thread

Materials

- PMI 10mm Classic Sport Nylon/Nylon rope (27kN)

Test setup

- Passed the rope through a 75mmx12mm rock thread
- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

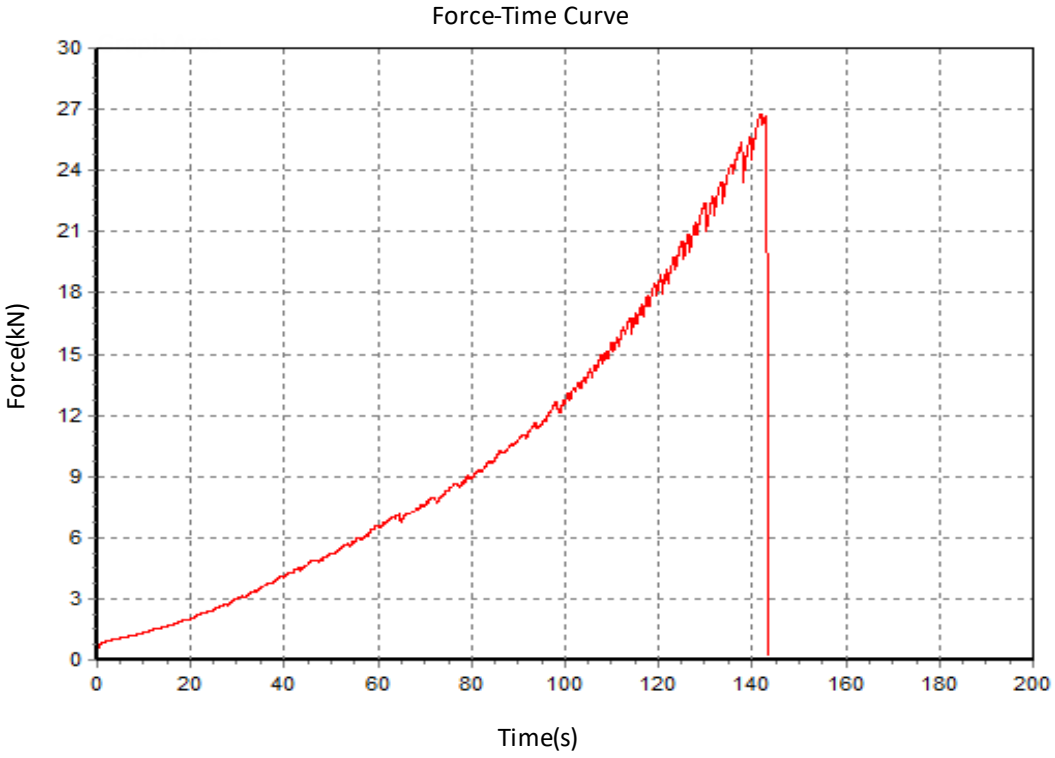
Results

Date	#	Max force (kN)	Comments
20/07/21	7*	26.79	Broke at rope exit of rock side opposite to bend, minor damage to the sheath other side
20/07/21	8	26.98	Broke at rope exit of rock side opposite to bend, moderate damage to the sheath other side
20/07/21	9	26.56	Broke at rope exit of rock side opposite to bend, major damage to the sheath other side
Average		**26.78**	

* Sample 20/07/21 #7 shown on the following pages.

ASPIRING

Test Date:	Tuesday, 20 July 2021
Max Force (kN):	26.79
Product Name:	Rock Thread Loop double fisherman's bend
Batch #:	7
Material:	PMI 10mm Classic Sport



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#: 7 Date: 20/07/21
Test: Slow Pull 100mm/min
Product: Rock thread, loop
double fisherman's
Rope: 10mm PMI Classic Sport
Force: 26.79kN

Kordas 10mm Nylon rock thread

Materials

- Kordas 10mm Dana Nylon/Nylon rope (27kN)

Test setup

- Passed the rope through a 75mmx12mm rock thread
- Tied a double fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins

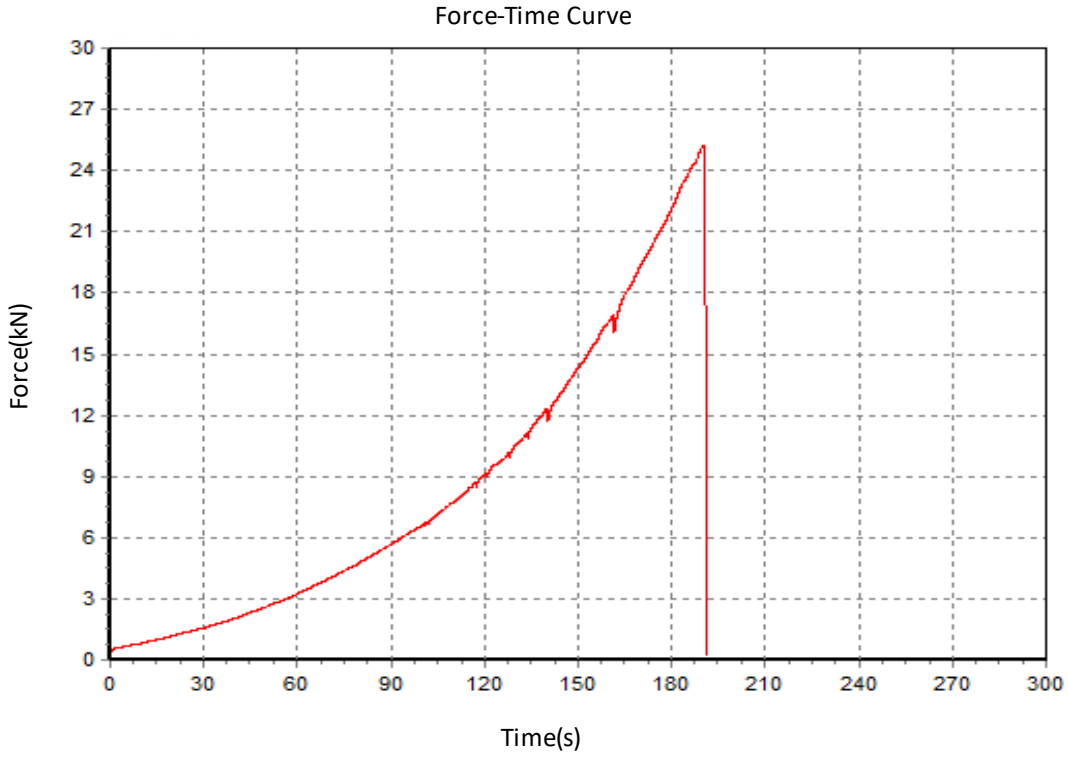
Results

Date	#	Max force (kN)	Comments
20/07/21	10*	25.22	Broke at rope exit of rock side opposite to bend, moderate damage to the sheath other side
20/07/21	11	28.91	Broke at rope exit of rock side opposite to bend, major damage to the sheath other side with core shot
20/07/21	12	29.06	Broke at rope exit of rock side opposite to bend, major damage to the sheath other side with core shot
Average		**27.73**	

* Sample 20/07/21 #10 shown on the following pages.

ASPIRING

Test Date:	Tuesday, 20 July 2021
Max Force (kN):	25.22
Product Name:	Rock Thread Loop double fisherman's bend
Batch #:	10
Material:	Kordas 10mm Dana



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#: 10 Date: 20/07/21
Test: Slow Pull 100mm/min
Product: Rock thread, loop
double fisherman's
Cord: 10mm Kordas Dana
Force: 25.22kN

Appendix 3: Rock V-thread testing

Beal 5mm Dyneema rock V-thread

Materials

- Beal 5mm Dyneema/Dyneema cord (15kN)

Test setup

- The drilled V-thread holes formed a 50 degree angle inside the rock
- Pulled the rope through the rock V-thread
- Tied a triple fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins and a 10mm steel carabiner.

Results

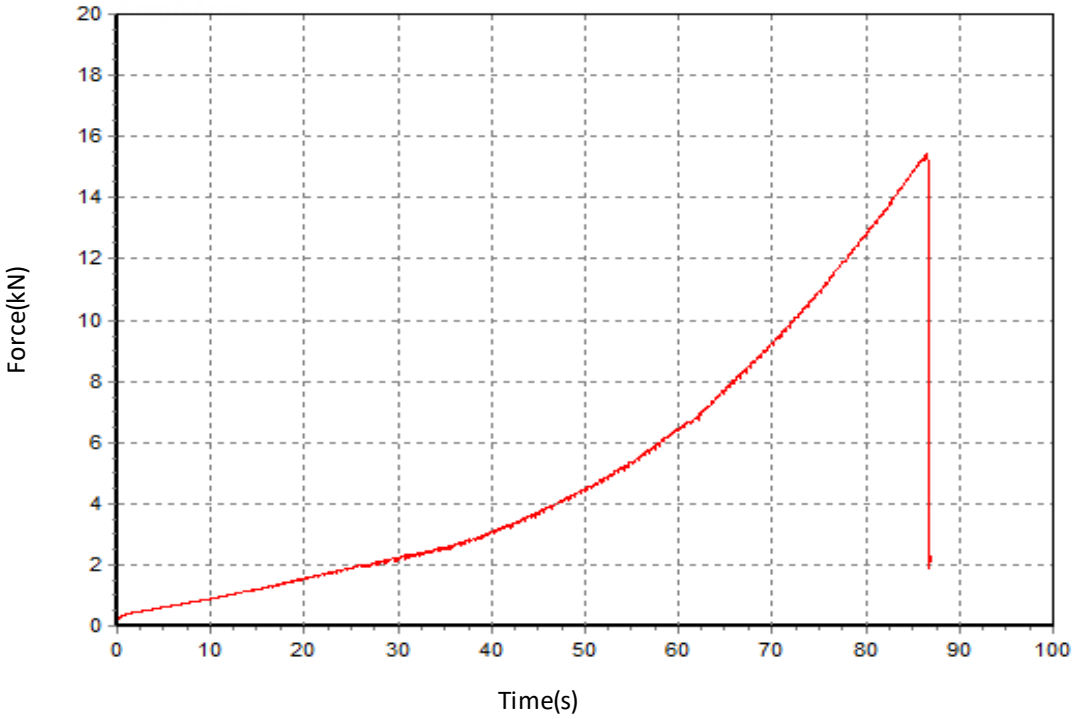
Date	#	Max force (kN)	Comments
16/06/21	1*	15.45	A small plate of rock on the bend side came off, broke the core of dyneema as the thread came out of the rock, significant damage to sheath, minor damage to sheath at the top of the V and other side exit
16/06/21	2	16.68	Cut completely the dyneema as the thread came out of the rock bend side, minor damage to sheath at the top of the V and other side exit
16/06/21	3	17.10	Broke at the 10mm steel carabiner, moderate damage to sheath bend side, minor damage to sheath at the top of the V and other side exit
Average		**16.41**	

* Sample 16/06/21 #1 shown on the following pages.

ASPIRING

Test Date:	Wednesday, 16 June 2021
Max Force (kN):	15.45
Product Name:	Rock V- thread loop triple fishermans
Batch #:	1
Material:	5mm Beal Dyneema

Force-Time Curve



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

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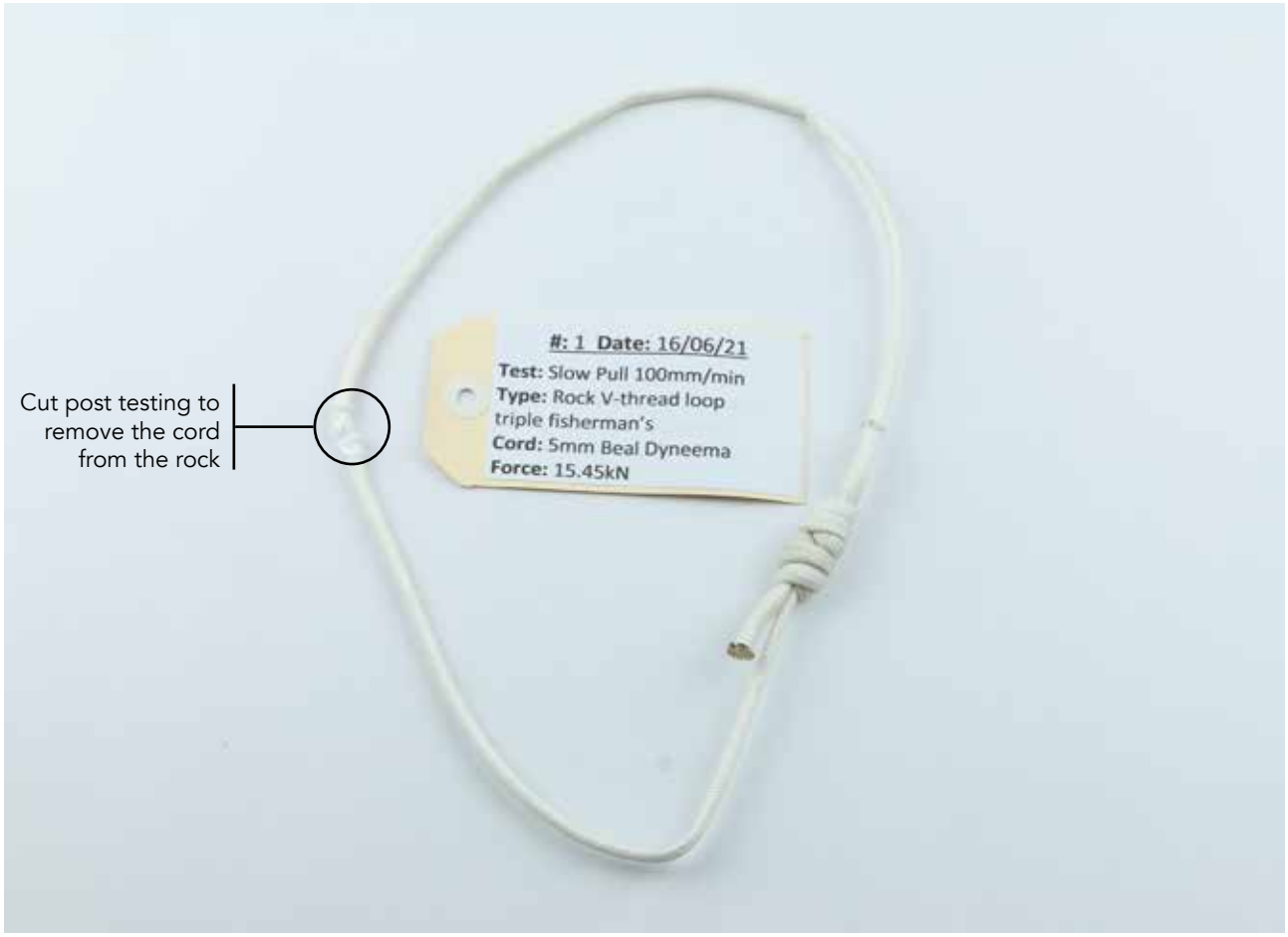

Cut post testing to remove the cord from the rock
#: 1 Date: 16/06/21
Test: Slow Pull 100mm/min
Type: Rock V-thread loop triple fisherman's
Cord: 5mm Beal Dyneema
Force: 15.45kN

Aspiring 5mm Dyneema rock V-thread

Materials

- Aspiring 5mm Dyneema/Dyneema cord (15kN)

Test setup

- The drilled V-thread holes formed a 50 degree angle inside the rock
- Pulled the rope through the rock V-thread
- Tied a triple fisherman's bend to form a loop

Test parameters

- Slow pull speed 100mm/minute
- Tested between 12mm pins and a 10mm steel carabiner.

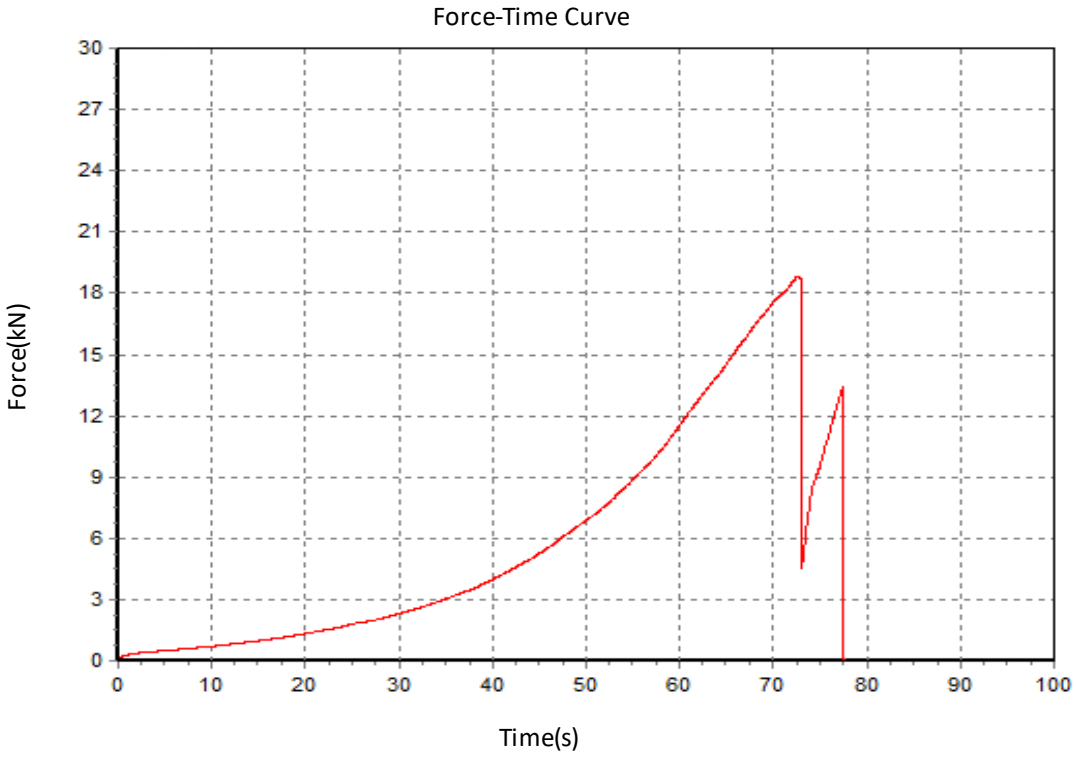
Results

Date	#	Max force (kN)	Comments
27/07/21	10*	18.84	Broke at the pin, minor damage to the sheath all 3 corners of the V-thread
27/07/21	11	21.61	Broke at the pin, minor damage to the sheath all 3 corners of the V-thread
27/07/21	12	20.09	Broke at exit of rock same side as bend, small surface slab of rock came free (80mmx40mmx7mm) minor damage to the sheath other 2 corners of the V-thread (this was the 6th test in the same V-thread)
Average		**20.18**	

* Sample 27/07/21 #10* shown on the following pages.

ASPIRING

Test Date:	Tuesday, 27 July 2021
Max Force (kN):	18.84
Product Name:	Rock V- thread loop triple fishermans
Batch #:	10
Material:	5mm Aspiring Dyneema



ECAAS ISO 9001 CERTIFIED QUALITY MANAGEMENT

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Signed: Grant Prattley

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#: 10 Date: 27/07/21
Test: Slow Pull 100mm/min
Type: Rock V-thread, loop triple fisherman's
Cord: 5mm Aspiring Dyneema
Force: 18.84kN