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FINAL REPORT: Safe Working Load of Clixmate Part Number:
CLI005, Yellow Clips (Ref: 201812)
CLI015, Green Clips (Ref: 201907)
CLI014, White Clips (Ref: 201907)

Client: Frank Casey, Golstone Pty Ltd

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Summary

Golstone Pty Ltd contracted QUT to perform tensile testing to determine the Safe Working Load (SWL) of Clixmate Part Number CLI005 Yellow Clips, CLI015 Green Clips and CLI014 White Clips.
In this case the SWL is defined to be the Mean Maximum Load – 3 Standard Deviations calculated from tensile 20 tests.

The following is a summary of the Safe Working Load (SWL) with Safety Factor (SF) for all the clips tested.

Table 8: Safe Working Load with Safety Factor (kg)

		Safety Factor				
	SWL	1.5	2	2.5	3	4
CLI005 Yellow Clip	20.4	13.6	10.2	8.1	6.8	5.1
CLI015 Green Clip	19.2	12.8	9.6	7.7	6.4	4.8
CLI014 White Clip	4.3	2.9	2.2	1.7	1.4	1.1

Materials and Method

The Clixmate Part Number CLI005 Yellow Clips, CLI015 Green Clips and CLI014 White Clips were provided by Golstone Pty Ltd. The clips were tested on an Instron 5566RH1968 universal testing machine with a 10kN load cell. A total of 20 clips were tested of each type. The load train shown in Figure 1b used 316 stainless steel chain with two progressively smaller D shackles to provide a radial contact that matched the curvature of the clip. Tests were performed under standard laboratory conditions of 23°C.

The clips were pre-stressed to 10N to account for the self-weight of the load train and provide tension and alignment through the load train. A strain rate of 5mm/min was applied to represent the expected in-service conditions of static loading. The test was ended when the D shackle slipped from its original position in the curved top or bottom of the clip, representing when a cable would no longer be held in position by the clip.

The load-strain data was recorded on Instron Bluehill with a load error of (+/- 0.005) N.

a) b)

Figure 1: Sample and Test Setup;
a) Clixmate Part Number CLI005, CLI015 & CLI014 provided by Golstone Pty Ltd, and,
b) Instron 5566RHL1968 testing load train

Results: CLI005 Yellow Clips

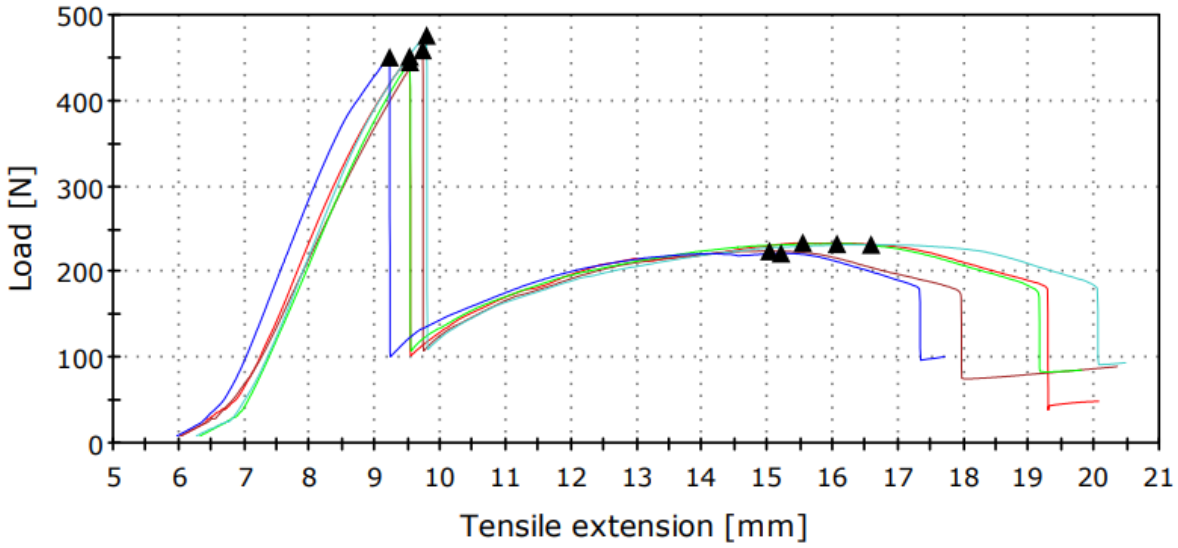
Figure 2 shows the load-strain response of the clip under tensile loading. The graphs show an initial curve where the clip bends until the clasp teeth meet (0-50N). This is followed by a roughly linear region until the clasp of the clip opens (50-400N). The load significantly drops. A lower load curved region is then seen where the load is held by the open clip. This region ends when the shackle slips or falls off the clip. Once unloaded, although some damage was observed, none of the clips experienced catastrophic failure in the form of fracture.

Table 1 shows the maximum load results for the 20 samples when the clip is clasped and unclasped (open).

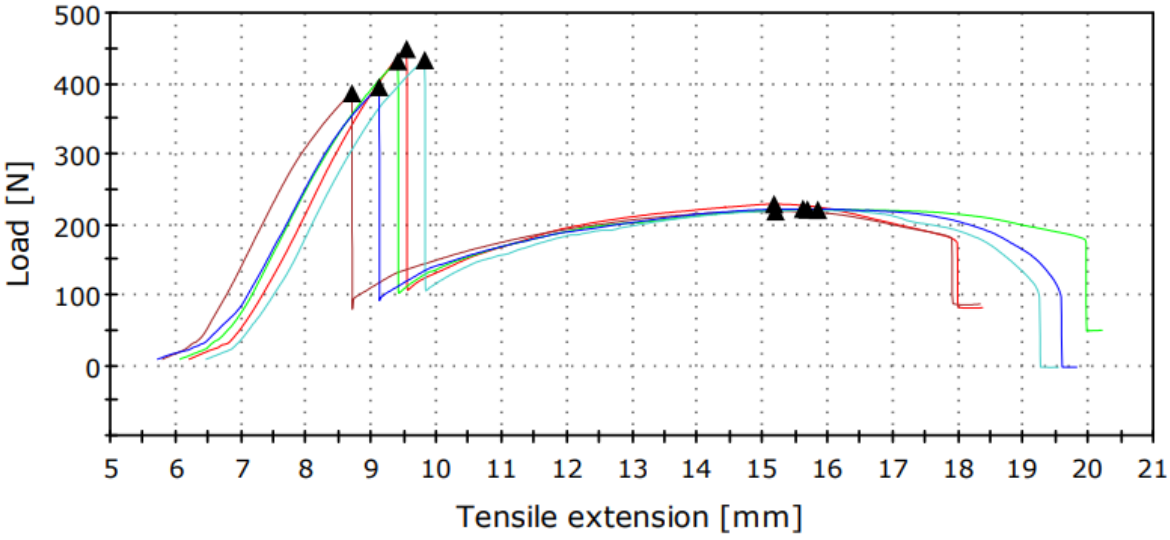
Table 1: Results of Tensile Testing CLI005 Yellow Clips

Sample Number	Maximum Load (N): Clasped	Load Maximum Load (N): Unclasped
1	451.57	234.67
2	459.3	225.13
3	445.19	233.67
4	476.11	232.57
5	450.51	222.54
6	448.9	229.45
7	386.22	219.41
8	431.71	221.96
9	433.43	221.39
10	394.95	222.64
11	441.99	220.58
12	403.2	217.48
13	419.81	216.8
14	416.67	219.25
15	402.51	215.5
16	419.78	219.4
17	421.83	214.03
18	396.12	210.24
19	424.72	211.7
20	439.44	212.98

Specimen 1 to 5



Specimen 6 to 10



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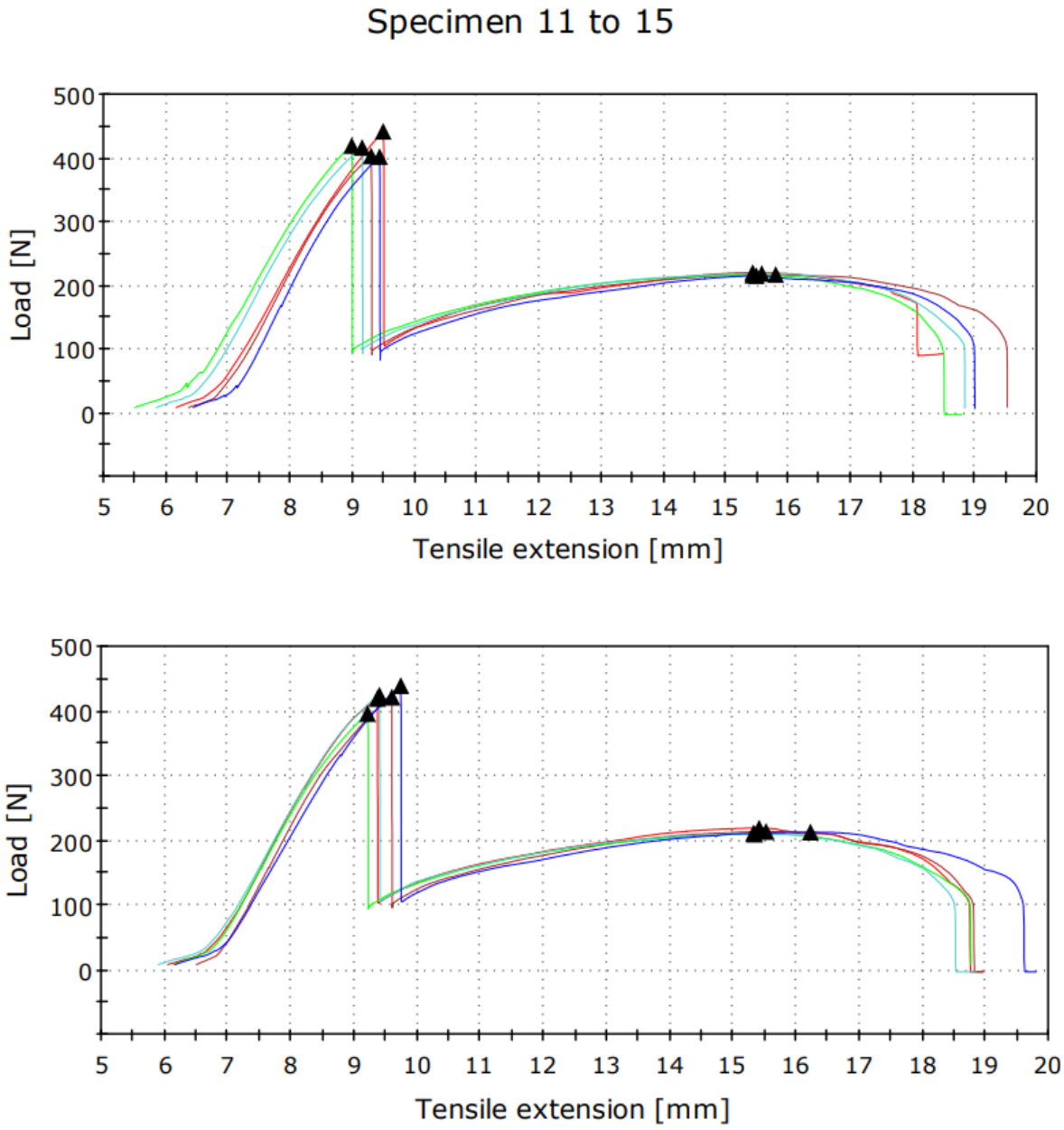
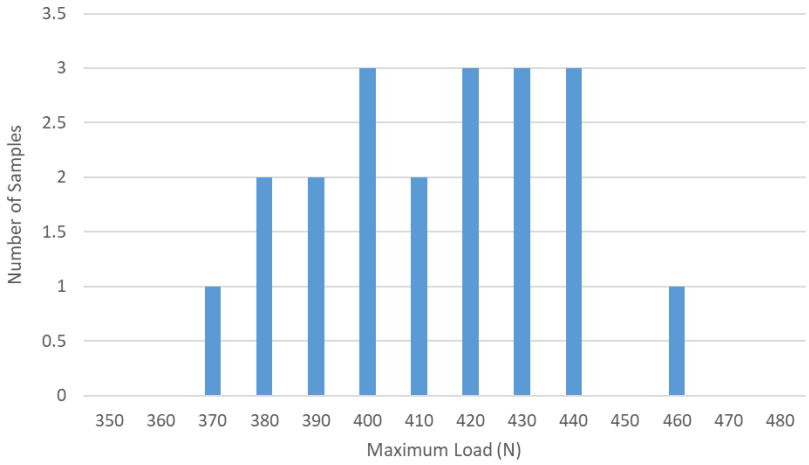


Figure 2: Tensile Load-Strain of Clixmate Part Number CLI005 Yellow Clips

Figure 3 shows a graph of the results in Table 1. Analysing these results the mean stress and standard deviation was calculated and is shown in Table 2. For the maximum load of the clasped clip, recorded results were within 3 standard deviations.

a)



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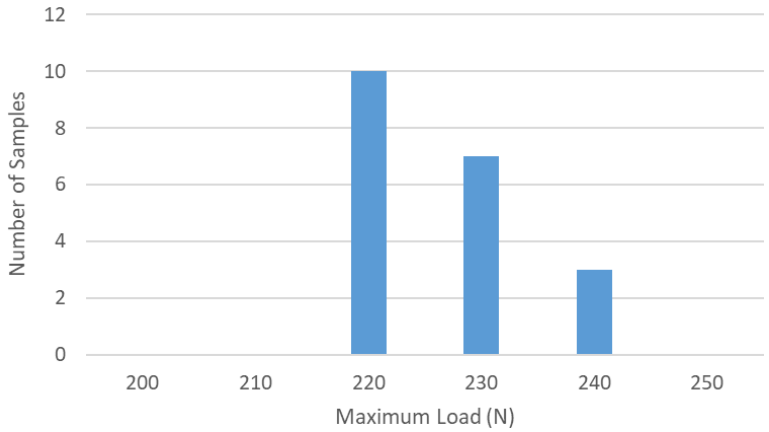


Figure 3: Maximum Load; a) clasped, and, b) unclasped

Table 2: Mean and Standard Deviation of Results CLI005 Yellow Clips

	Maximum Load (N): Clasped	**Load Maximum Load (N): Unclasped**
Mean - 3 SD	**356.38**	**199.75**
Mean	**428.20**	**221.07**
Mean + 3 SD	**500.01**	**242.39**

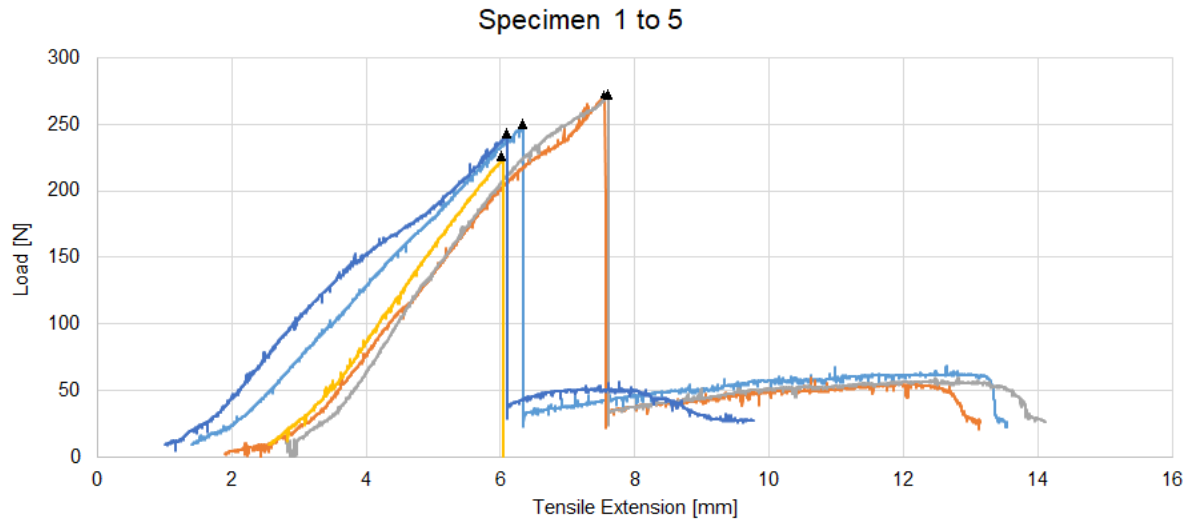
Results: CLI015 Green Clips

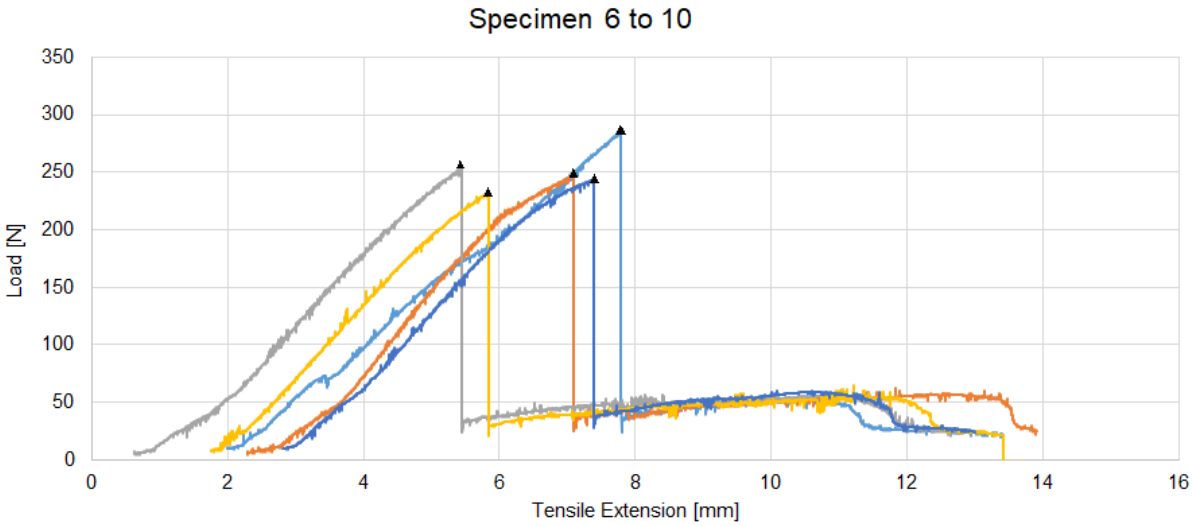
Figure 4 shows the load-strain response of the clip under tensile loading. The noise in the graph comes from the use of the 20kN load cell as low loads. The graphs show an initial curve where the clip bends until the clasp teeth meet (0-50N). This is followed by a roughly linear region until the clasp of the clip opens (50-300N). The load significantly drops to a lower load region where the load is held by the open clip. This region ends when the shackle slips or falls off the clip. Once unloaded, although some damage was observed, only one clip experienced catastrophic failure in the form of fracture.

Table 3 shows the maximum load results for the 20 samples when the clip is clasped. The unclasped clip strength is not shown for this case as once the clip was unclasped it was not unable to withstand any significant increase in strength i.e. a defined second peak in strength was not observed.

Table 3: Results of Tensile Testing CLI015 Green Clips

Sample Number	Maximum Load (N): Clasped
1	248.2
2	270.7
3	270.5
4	223.7
5	241.6
6	287.6
7	249.3
8	252.8
9	232.3
10	246.8
11	304.4
12	252.8
13	223.0
14	240.8
15	244.0
16	243.7
17	236.4
18	237.8
19	275.6
20	276.4





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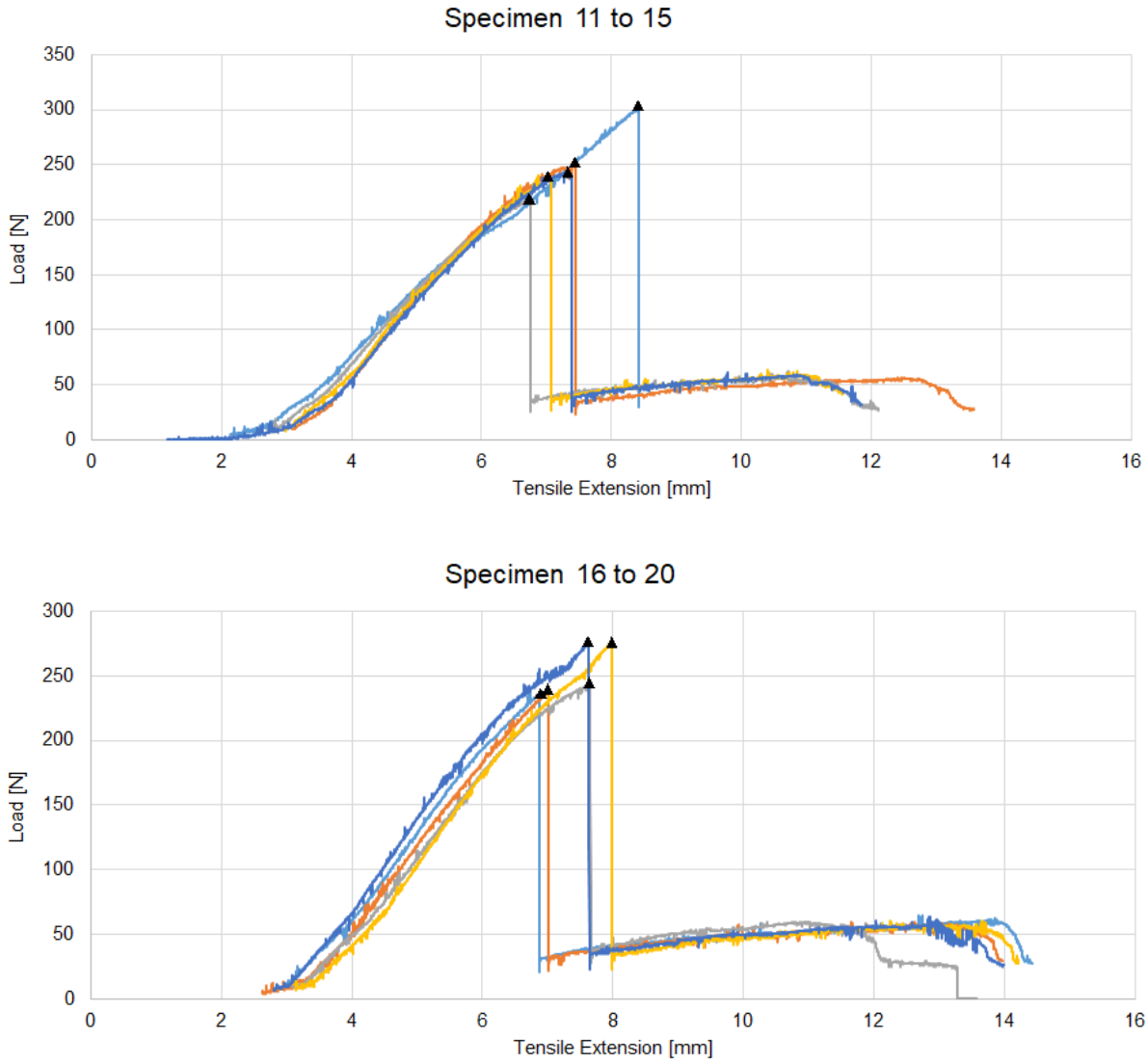

Figure 4: Tensile Load-Strain of Clixmate Part Number CLI015 Green Clips

Table 4: Mean and Standard Deviation of Results CLI015 Green Clips

	Maximum Load (N): Clasped
Mean - 3 SD	**188.6**
Mean	**252.9**
Mean + 3 SD	**317.2**

Results: CLI014 White Clips

Figure 5 shows the load-strain response of the clip under tensile loading. As the clip has no clasp and the plastic more brittle a 500N load cell was used in the setup shown in Figure 1b. The graphs show a roughly linear region where the load is held by the open clip. This region shows some jagged features as a result of slipping of the clip when loaded. The test ends when the shackle slips or falls off the clip. Once unloaded, although some damage was observed, only one clip experienced catastrophic failure in the form of fracture.

Table 5 shows the maximum load results for the 20 samples when the clip is clasped.

Table 5: Results of Tensile Testing CLI014 White Clips

Sample Number	Maximum Load (N): Clasped
1	46.2
2	46.6
3	44.2
4	46.8
5	45.7
6	44.4
7	47.5
8	46.1
9	44.6
10	44.8
11	47.2
12	45.7
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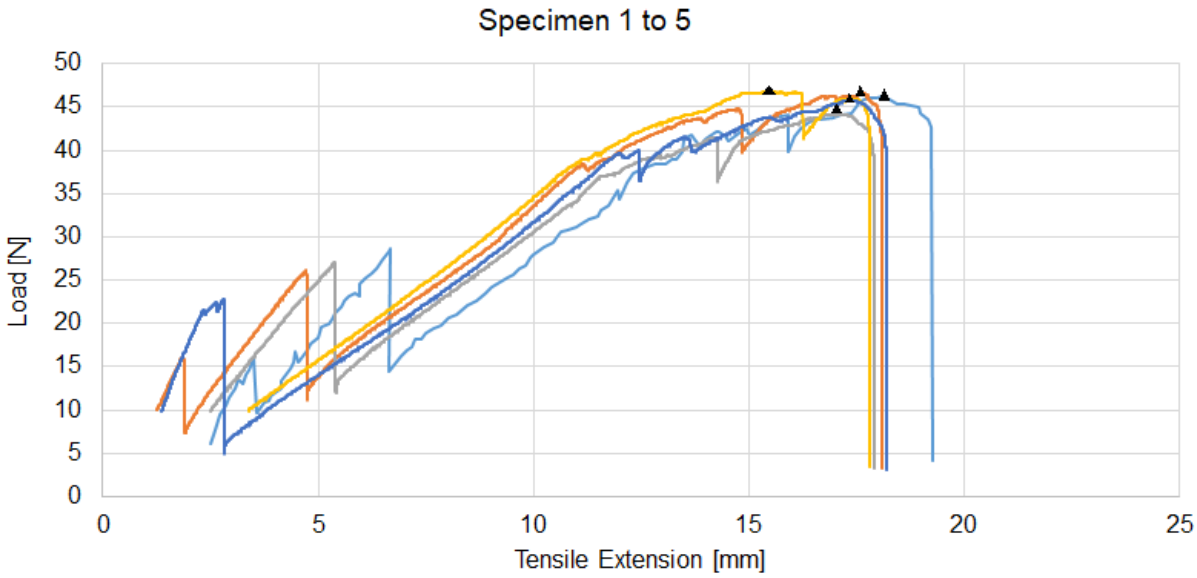
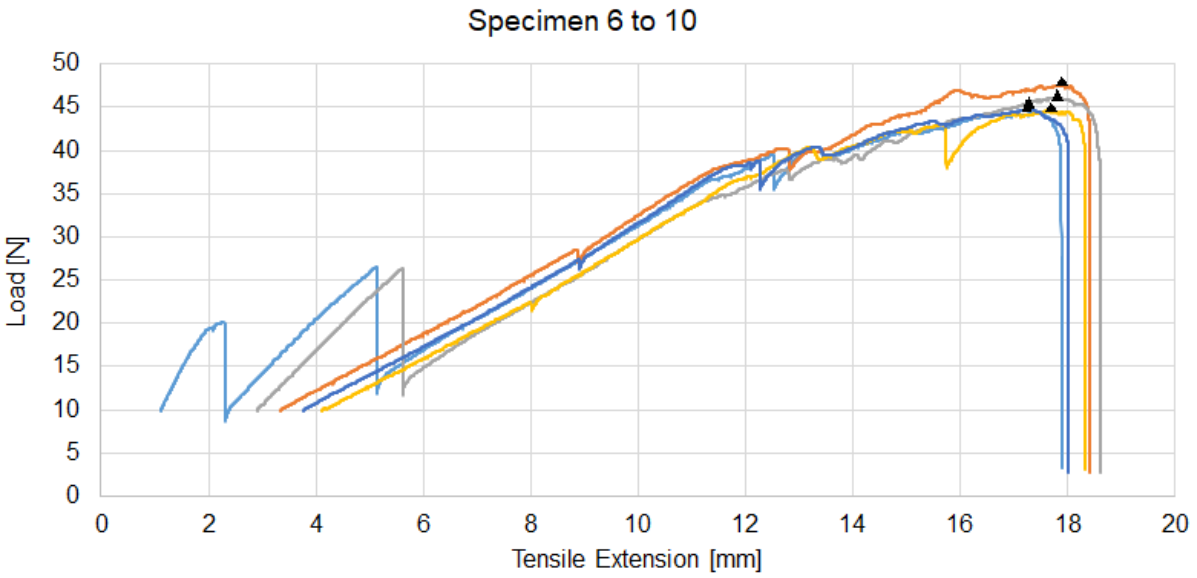
15	46.6
16	45.0
17	47.1
18	45.4
19	44.8
20	44.5





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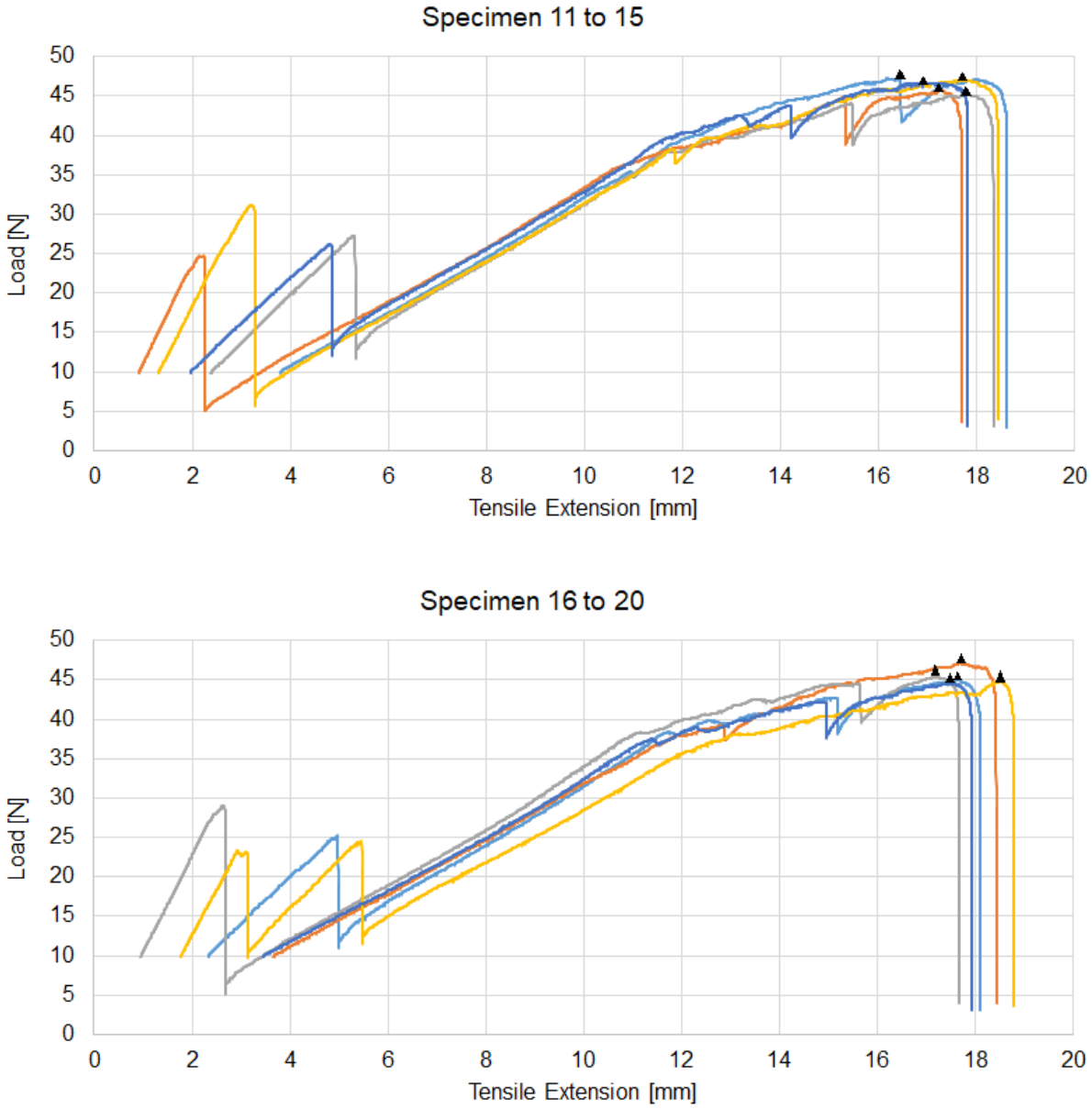

Figure 5: Tensile Load-Strain of Clixmate Part Number CLI014 White Clips

Table 6: Mean and Standard Deviation of Results CLI014 White Clips

	Maximum Load (N): Clasped
Mean - 3 SD	**42.6**
Mean	**45.8**
Mean + 3 SD	**48.9**

Conclusion: Safe Working Load

As requested by Goldstone the following is a summary of the Safe Working Load (SWL) with Safety Factor (SF) for all the clips tested.

In this case the SWL is defined to be the Mean Maximum Load – 3 Standard Deviations.

Table 7: Safe Working Load with Safety Factor (N)

		Safety Factor				
	SWL	1.5	2	2.5	3	4
CLI005 Yellow Clip	199.8	133.2	99.9	79.9	66.6	49.9
CLI015 Green Clip	188.6	125.7	94.3	75.4	62.9	47.2
CLI014 White Clip	42.6	28.4	21.3	17.0	14.2	10.7

Table 8: Safe Working Load with Safety Factor (kg)

		Safety Factor				
	SWL	1.5	2	2.5	3	4
CLI005 Yellow Clip	20.4	13.6	10.2	8.1	6.8	5.1
CLI015 Green Clip	19.2	12.8	9.6	7.7	6.4	4.8
CLI014 White Clip	4.3	2.9	2.2	1.7	1.4	1.1

QUT would like to thank you for engaging them on this project.

This report was prepared and issued by

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