

## Load Testing

### NSW SES Vertical Rescue Professional Development Workshop

#### *Wellington NSW*

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Acknowledgements to all participants of the workshop who participated fully in the load testing session as observers, data recorders, riggers, etc.



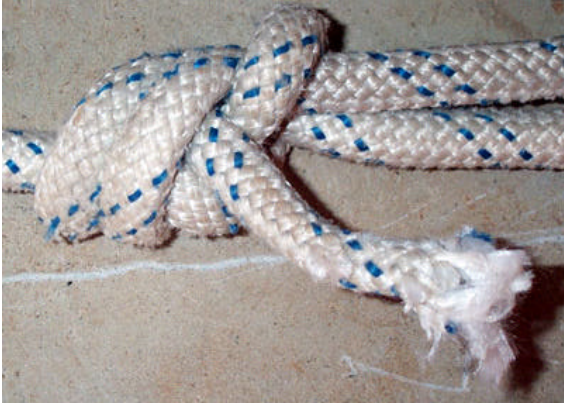

The tests were conducted as an opportunity to demonstrate the failure modes, relative strengths and behaviour under load of a wide range of vertical rescue equipment and methods. Not all methods tested are approved for use in vertical rescue. Some are in use in recreational circles, while others were tested for purely speculative reasons.

The test rig was set up inside Wellington SES's Shed. The load cell, a Straightpoint NIP/5t 5 tonne load cell with remote display, was anchored to the base of one of the columns of the shed. A 1.5 tonne tirfor hand winch was anchored to another column and rigged through a pulley to provide a 2:1 mechanical advantage. The test pieces were rigged between the load cell and the pulley on the tirfor winch.


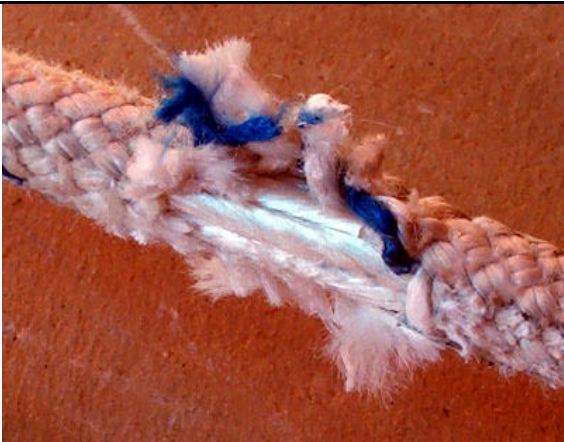

Calibration data for the load cell shows it to be accurate to +/- 2kgs over the full range of the load cell.




Comments	Load at "Failure"	Photo
6mm double wrap prusik loop on 13mm static life rescue line .	300 kgs	



Comments	Load at "Failure"	Photo
<p><b>6mm triple wrap prusik loop on 13mm static life rescue line .</b></p> <p>Minor slipping at 650 kgs. At 1083 kgs both strands of the loop failed simultaneously at the prusik knot.</p>	<p>Began slipping at 650 kgs. Failed at 1083 kgs.</p>	
<p><b>Figure 8 loop.</b></p> <p>This loop was used to anchor the 13mm rope for the previous prusik tests. While this knot has not failed, this is how it looked after being loaded to 1083 kgs.</p>	<p>1083 kgs.</p>	
<p><b>Figure 8 v Figure 9 Loop.</b></p> <p>The previous figure eight loop (loaded to 1083 kgs) was tested against a newly tied figure 9 loop in the other end of the 13mm rope.</p> <p>The figure eight failed at 2074 kgs on the outside bend of the knot.</p>	<p>2074 kgs</p>	 <p>The figure 9 after loading to 2074 kgs.</p>

Comments	Load at "Failure"	Photo
		 <p>The figure 8 at failure.</p>
<p><b>Figure 8 v Figure 9 loops.</b></p> <p>The figure eight was tested again against the figure 9.</p> <p>At a load of approximately 2000kgs, the knots and rope started to audibly "crack". Again the figure 8 failed at 2190 kgs, with the rope between the knots stretching from 2.27 metres at no load to 3.4 metres at failure (50% stretch!).</p>	2190 kgs	 <p>The figure 9 after loading.</p>  <p>The failed figure eight.</p>
<p><b>Tape sling, single strand, approx. 10 years old.</b></p> <p>Tape was reportedly 1800 kg MBL Edelrid 25mm tube tape tied with a tape knot loop at each end. The tape failed at the tape knot. It was</p>	551 kgs.	








Comments	Load at "Failure"	Photo
noted that the outside bend of the tape knot failed.		
<p><b>Tape sling, single strand, &gt;10 Y.O.</b></p> <p>Tape was reportedly Bluewater mil-spec 25mm tube tape with an MBL of 2050 kgs. Once again the tape failed in the outside bend of the tape knot.</p>	758 kgs.	
<p><b>CMI Ascender on 13mm rope, and Munter Hitch.</b></p> <p>The 13mm rope was anchored with a locked-off munter hitch.</p> <p>Munter hitch started slipping at 300 kgs, at about 450 it tightened significantly and slipping reduced dramatically.</p> <p>The ascender tore a chunk out of the sheath of the rope at 799 kgs and re-gripped the rope. It slipped again at 827 kgs the continued to slip.</p> <p>The munter hitch was still good.</p>	<p>Ascender: 799 kgs, and 827 kgs</p> <p>Munter Hitch slipping at 300 kgs.</p>	 <p>A chunk of sheath torn out...</p>  <p>The clogged teeth of the ascender cam.</p>

Comments	Load at “Failure”	Photo
		 <p>The locked off Munter (Italian) Hitch after loading.</p>
<p><b>SRT A4 Ascender on 13mm rope.</b></p> <p>The previously loaded Munter hitch began slipping at 800 kgs.</p> <p>The SRT ascender completely severed the sheath at 848 kgs.</p> <p>The Munter hitch was still good.</p>	848 kgs	 <p>The SRT ascender completely severed the sheath.</p>
<p><b>25mm tube tape both knots tied so inside bend of the knot is loaded.</b></p> <p>Compare 927 kgs with 758 kgs for outside bend in same tape.</p>	927 kgs	
<p><b>4 wrap Klemheist Knot in 25mm tube tape (new) on 13mm rope.</b></p> <p>At 600 kgs the tape began audibly creaking.</p>	<p>Slipped 870 kgs.</p> <p>Tape failed at 950 kgs</p>	No photo available



Comments	Load at “Failure”	Photo
<p>At 870 kgs the knot slipped and then retensioned at 708 kgs. It continued slipping, and the rope began to coil like a snake.</p> <p>Tape broke at 950 kgs at the Lark’s head formed at the exit to the Klemheist knot.</p>		
<p><b>4 Wrap Klemheist Knot in 8mm cord on a 13mm rope.</b></p> <p>Rope began twisting at 400 kgs. At 1160 kgs the knot slipped, and again at 1570 kgs. Finally at 1744 kgs the cord snapped inside the wraps (not at the exit loop).</p>	1744 kgs	 <p>Note the twisting of the rope!</p>
<p><b>“Bloodknot” – single marlon spike / double marlon spike – tied in 8mm cord.</b></p> <p>Failed in the “single marlon spike” or overhand knot – the sheath severed and a length of core pulled through.</p>	893 kgs	 <p>The knot before loading...</p> <p>... and after.</p>


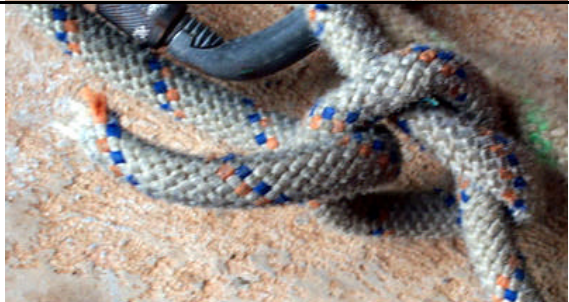


Comments	Load at “Failure”	Photo
<p><b>Bowline with a half hitch keeper vs a Double Fisherman’s Loop in 13mm static life rescue line.</b></p> <p>Failed at 1879 kgs at a lark’s head formed in the bowline.</p>	1879 kgs	 <p>The failed bowline.</p>  <p>The double fisherman’s after loading.</p>
<p><b>Triple wrap Prusik knot tied in 25mm tube tape on 13mm static life rescue line.</b></p> <p>This was a curiosity test to compare with a klemheist in tape. It is obvious why a prusik knot isn’t used in tape! Slipped at 30 kgs.</p>	30 kgs	No photo available

Comments	Load at “Failure”	Photo
<p><b>Double wrap Prusik knot tied in 25mm tube tape on 13mm static life rescue line.</b></p> <p>Slipped at 50 kgs.</p>	50 kgs	
<p><b>Single wrap Prusik Knot (Lark’s Head) in 25mm tube tape on 13mm static life rescue line.</b></p> <p>Slipped at just 3 kgs!</p>	3kgs	No photo available.
<p><b>Figure eight loop vs Double Fisherman’s knot vs Figure 10 (Stevedore’s) knot in 13mm static life rescue line.</b></p> <p>Failed at the double fisherman’s at 2116 kgs. Close observation showed the sheath failed momentarily before the core.</p>	2116 kgs	
<p><b>Portuguese Bowline vs Buntline Hitch on the Bight.</b></p> <p>Portuguese Bowline failed at 1100 kgs.</p>	1100 kgs	



Comments	Load at “Failure”	Photo
<p><b>Clove Hitch vs Bowline in 11mm static life rescue line.</b></p> <p>Clove hitch rolled at 898 kgs, and failed at 1081 kgs just outside the knot.</p> <p>There was some conjecture that the cove hitch was not dressed in a natural form so this test was repeated as part of the following test.</p>	898 kgs	
<p><b>Bowline vs Alpine Butterfly vs Clove Hitch in 11mm static life rescue line.</b></p> <p>The clove hitch was dressed in it's natural form compared to the previous test. It visibly performed better.</p>	<p>Clove hitch rolled at 1047 kgs.</p> <p>Alpine Butterfly Failed at 1121 kgs.</p>	

Comments	Load at “Failure”	Photo
		
<b>Alpine Butterfly vs Alpine Clutch.</b>  Alpine Butterfly failed at 1065 kgs.	1065 kgs	

#### Disclaimer

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