

Tech Tips

Advanced Tips and Tricks for the Mountaineering Community

Tech Tip #2

Tethering Systems: Spectra VS Nylon

During the last decade, Spectra slings (made of polyethylene, also known as Dynex or Dyneema) have become very popular due to their high strength to weight ratio, resistance to sharp edges and water resistance. Since they appeared on the market, climbing circles around the world have had spirited debates about the proper applications of this material compared to the 'old school' nylon slings (polyamide). Though this topic has spurred many debates encompassing many scenarios, we will focus on **how Spectra slings compare to nylon slings when used as tethers.**

The Scenario:

It's late January, about 35 degrees in the shade and you just topped out on the North Face of Castleton Tower. Your frozen hands have felt like blocks of wood for hours. You quickly sign into the summit register and head back to the edge of the tower where you left your rope rigged for a speedy rappel. Though the bolts are on the flat, horizontal part of the summit, the rappel chains extend well over the lip onto the vertical face. While sitting on the lip, you reach over the edge and clip the end of your tether to the bottom links of the chains. **The distance from your harness to the end of the tether below is about 4 feet (the full length of your 'double length sling').** You grab the chains up on the flats above and begin to lower yourself over the lip. Your frozen hands fail to securely grip the cold chains and you slip off the edge. **You fall about 8 feet before your tether gets weighted.** You just created a 'factor 2 fall' (F2F) on your tether and anchor. (FF = Distance of Fall/Length of the material that arrests the fall, such as a tether. In this case you fell 8 feet onto a 4 foot tether, thus, $8/4=F2F$).

Question #1) Will this F2F break a Spectra tether?

Question #2) Will this F2F break a nylon tether?

Question #3) How about if the slings an overhand knot in the middle?

Unfortunately, no one knows the answer to these questions because no one has volunteered to be the guinea pig that takes these traumatic, spleen-rupturing falls over and over again. So, we have to look at tests that have been done with 80kg weights on a 'drop tower' and make inferences from that. In this article we will be using data that came from DMM in Wales. You can watch them breaking Spectra and nylon slings on their website: <http://www.dmmclimbing.com/video.asp?id=5> Many other companies have done similar tests that show similar results. It's worth keeping in mind that the force that an 80kg weight creates in a factor fall is going to be quite a bit more than that of a human body. This is due to the fact that a human body would absorb some of the force as the harness compresses the flesh, when the body folds and rotates, etc. With this in mind, let's answer some questions....

Answer #1) Will a F2F break a Spectra tether? *Very likely....*

In the DMM tests, the F2F with an 80kg weight *was* enough to make the spectra sling fail in *every* test. The reason the Spectra broke was because it is a very static material and does not absorb energy when loaded. It's similar to shock-loading a steel cable- nothing gives. Because of the dynamic load on the static system, loads of about 20-22kN were generated and the slings ultimately snapped.

Answer #2) Will a F2F break a nylon tether? *Not likely.....*

In the DMM tests, the F2F with an 80kg weight was *not* enough to make the nylon sling fail in any of the tests. The loads produced were about 16.5-18.5kN, a much lower load due to the nylon's ability to absorb energy as it stretched.

Answer #3) Will a F2F break a Spectra and/or nylon tether with an overhand knot in the middle? *Very likely.....*

Both Spectra and nylon slings failed in all F2F tests when they had knots in them. In fact, the knotted Spectra sling failed in every test, even in F1F tests!

Discussion:

The simple take home message here is that it is quite dangerous to create slack in your tether.

It's quite apparent that the the nylon tethers fare *much better* than Spectra when shock loaded. If you put a knot in the nylon sling, you should be quite concerned about its strength and it would be best if you use such a system in scenarios where you won't have a chance of putting a high fall factor on it, especially a F2F!

If you are using a Spectra sling as a tether, you should be *very concerned* about creating any slack in it. If you are using the same sling with a knot in it, you should be *extremely concerned* about creating slack in it as the knot can reduce the strength by about half!

As climbers we do our best to follow rules of thumb. It would be easy to say to yourself, "Well, from now on I will never set myself up for an F2F on a Spectra tether!" But in the real world, sometimes we have to work with the materials we have left on our rack. And sometimes we have to expose ourselves to risks that might be the only choice due to the particular circumstances. However, knowledge is power and if we at least know what the risks are, we can make better, more educated decisions and hopefully reduce the risk of taking a big ride off something like Castleton Tower.

Drop Test Results From DMM:

	Length of Sling	Length of Fall	11mm Dyneema			16mm Nylon		
			1	2	3	1	2	3
FF1 Open Sling	120cm	120cm	23.2 kN	21.5 kN	22.9 kN	12.2 kN	13.1 kN	13.1 kN
FF1 Sling + Overhand Knot	120cm	120cm	11.5 kN	10.7 kN	-	10.5 kN	11.1 kN	11.4 kN
FF2 Open Sling	120cm	240cm	22.0 kN	20.4 kN	-	16.5 kN	18.5 kN	17.9 kN
FF2 Sling + Overhand Knot	120cm	240cm	12.4 kN	11.0 kN	-	13.9 kN	14.6 kN	-
FF1 Open Sling	60cm	60cm	16.7 kN					
FF1 Sling + Overhand Knot	60cm	60cm	10.2 kN					
FF1 30cm Quick Draw/2 Crabs	30cm	30cm	12.5 kN					

Failure

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