F = M x A

FAQ: Climbing Physics - What's a Kilonewton (kN)?

Simple answer: **1 Kilonewton = 224.809 Pounds**
Smart ass answer - 1 Kilonewton = 1000 Newtons
Confusing answer - A Kilonewton is a measure of **force.** So is a **Pound.**

Here are the strengths for some commonly used cordages and webbing materials:

Nylon webbing and runners:

one inch climb-spec tubular webbing, bulk =19Kn
Metolius 18 mil sling =22Kn
Bluewater 1" tubular webbing = 19Kn
BD 18 mm nylon runner = 22Kn

Nylon cord :

Bluewater
6mil =7.7Kn
7 mil=11Kn
8mil =14Kn

Metolius 6mil = 11Kn

PMI
6mil = 6.8 Kn
7mil = 9.3 Kn

Spectra/Dyneema cord and runners:

Mammut 8mil dyneema sling =22kn
Bluwater titan/spectra 9/16" runner = 27 Kn
Titan cord 5.5 mil = 13.7 kn

UIAA limits for Climbing Gear:

Carabiners: 20 kN
Slings: 22 kN
Harnesses: 15 kN
Locking carabiner - 4,950 lbs.
Non-locking carabiner -4,500 lbs.
6 mm cord - 1,500 lbs.
7 mm cord - 2,090 lbs.
8 mm cord - 3,150 lbs.
5.5 mm spectra cord - 3,800 lbs.
19 mm climb spec webbing - 4,900 lbs.

9/16" climb spec runners - 2,250 lbs.
9/16" spectra runners - 6,075 lbs.
1" tubular webbing - 4,000 lbs.

22Kn = 4,950 lbs

Here are some hypothetical force calculations for some common climbing situations:

1. **Short top rope fall** - On an 82 foot wall , a climber ascends 20' and then falls one foot. The force on the anchor would be **634 lbs.**

2. **Longer top rope fall** more slack same climber falls 12' **1048 lbs on the anchor.**

3. **Lead climbing**. Leader ascends 130' he/she falls ten feet above last placement- falls 20 feet. This would be a fall factor of .14 and the force on the last piece of gear would be **1,131 lbs.**

4. **Lead climbing fall on the anchor** resulting in a factor 2 fall9worst case) would result in forces of **1967lbs.**

For full force calculations of these examples you can check out this web site:

http://www.southeastclimbing.com/faq/faq_kilonewton.htm

Nylon vs. spectra/dyneema/dynex

Nylon
PROS:
-Dynamic. Better for use in potential shock load situations. Think anchors. See attached Tom Moyer ITAR paper.
.
-Good gripping power for friction hitches.
-Slightly greater diameter means more resistance to abrasion/cutting.

CONS:
-Weakens with age, use and UV exposure.
-Slightly heavier than spectra.

Spectra/dyneema/dynex(all same- different names)
PROS:
-Super strong- spectra is the strongest fiber ever made. Dyneema is 15x stronger than steel.
-light

CONS:
-Static/No stretch!! Transfers more load to other parts of system!
-Up to 19% less resistant to UV damage than regular nylon

-Difficult to make friction hitches with due to slick material
-Weaker with repeated flexing under moderate loads than nylon(think top rope applications)
-LOW Melting Temp!!!--friction applications? Easily cut if rubbed by another rope.

*Cordage of this material should always be tied with triple fishermans. Testing reveals sheath failure under low loads with dbl fishermans- then the core slips through and unties!!

Some more info to process…

*Up to 50% decrease in strength with knots hitches. (John Sherman dyneema failure)

Additionally, climbers should be aware that all slings, whether skinny or fat, Dyneema/Spectra or Nylon, are susceptible to significant strength loss due to a girth hitch, and should use any
connecting knots with caution. While there may be some additional strength loss when connecting skinnier slings, this additional loss is only a few percent (the equivalent of perhaps 250 lbs out of 5000)--the additional strength loss is not enough to treat today's extremely thin slings any differently than fatter or nylon slings—all girth hitches must be treated with caution. The safest way to obtain a longer sling is to use a longer sling in the first place, rather than connecting them at all. If two slings must be joined, the strongest way to do so is with a carabiner.

Recent testing strongly suggests that old style nylon sling material and cordage is superior for general use in rock climbing. (from john longs "climbing anchors") The strengths of these materials are most important in dynamic situations where some stretch in the materials is of utmost importance. The super strong materials such as spectra, vectran and dyneema are static and as such translate direct forces to the carabiners and protection devices. Recent tests from several sources indicate that nylon webbing and cordage can absorb (without breaking) greater dynamic forces than high tensile strength cord and tech webbing.