(Appendix 1) Load upon pitons and other anchors

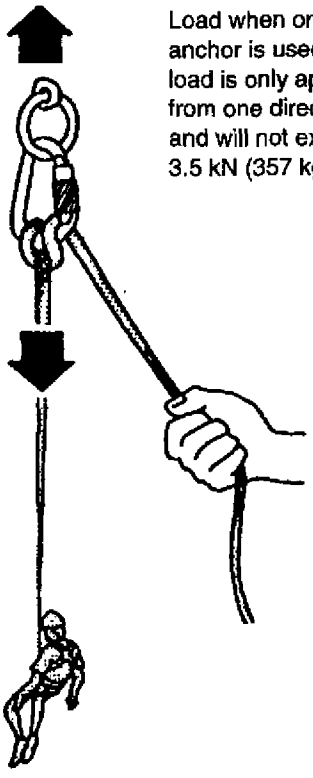
The load upon an anchor varies depending on many different factors. Was it the leader or a follower who fell? Was a top rope being used? Was it a vertical fall? All these variables affect the load. In general, however, the load can be described as follows.

* When only a top anchor is used, the force of a fall is only applied to the anchor from one direction, thus a load capacity of 3.5 kN (357 kgf) is sufficient. Using today's anchoring methods, this is the maximum capacity of anchors, and it is very rare that a fall should generate this great a load. The load is increased when there is little or no slack available, but this is an extremely unusual situation, and even then the load will not exceed 7 kN (714 kgf).

* When the top anchor is supplemented by an intermediate anchor, however, the force of a fall is applied to the top anchor from two directions, which doubles the load. Short falls usually generate a greater load than what has been estimated in mountain climbing literature, while long falls generate less than the literature predicts. This statement only holds true, however, as long as there is ample slack and the force of the fall can be mitigated (i.e., the fall is a short one, and/or there is friction between the rope and the intermediate anchor and/or rock face). Various loading conditions are listed in the table below.

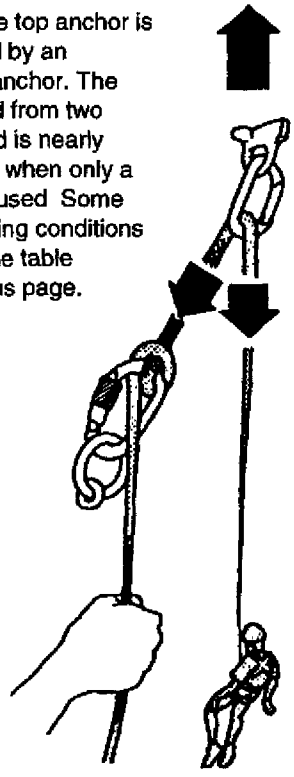
Height of fall	Distance above intermediate anchor from which fall occurred	Load upon intermediate anchor (assuming the climber weighs 80 kg)
1 m	0.3 m	4.0 kN (408 kgf)
3 m	1 0 m	5.0 kN (510 kgf)
5 m	1.7 m	6 0 kN (612 kgf)
10 m	3.8 m	8.0 kN (816 kgf)*
20 m	7.5 m	10 0 kN (1020 kgf)*
30 m	12.5 m	12.0 kN (1224 kgf)*

* Load figures include friction between the rope and the intermediate anchor and/or rock face.

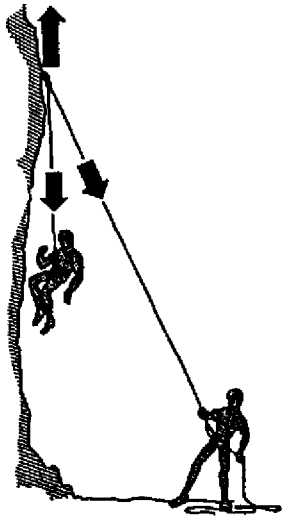


Load when only a top anchor is used. The load is only applied from one direction, and will not exceed 3.5 kN (357 kgf).

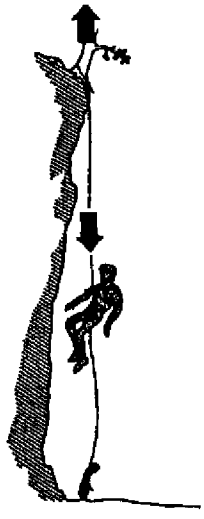
Load when the top anchor is supplemented by an intermediate anchor. The load is applied from two directions, and is nearly twice the load when only a top anchor is used Some standard loading conditions are listed in the table on the previous page.



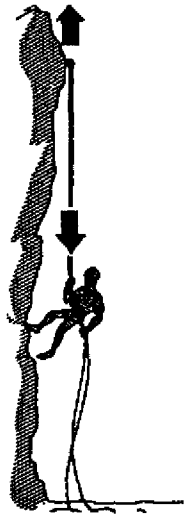
* When a top rope is used, the end anchor is subject to a maximum load of 2 kN (204 kgf), including the weight of the rope itself.
* When belaying is accomplished using a fixed rope and an ascender, the ascender is subject to a maximum load of 1.5 kN (153 kgf), including the weight of the weight of the fixed rope itself.
* During rappelling, the anchor is subject to a load equivalent to twice the weight of the rappeller, i.e., 1.5 kN (153 kgf). Even in the unlikely event that the rope is subject to a sudden increase in load during the rappelling procedure, the load will not exceed three times the weight of the rappeller. If two people rappel at the same time, the load is doubled.



Top-rope climbing
2kN (204kgf)



Unassisted belay, done using an ascender
1.5kN (153kgf)



Rappelling
1.5kN (153kgf)

(Appendix 2) Equipment

[Sit harness]

The sit harness is a very important device for connecting the rope to the rescuer. It prevents the harness from interfering with the rescue work or hindering movement.

A sit harness chosen to fit the body of the rescuer will minimize the impact on the body generated by a fall by distributing the person's weight. The harness is meant to hold the body and is not a shock absorber.

* To choose the right size, squat down and make sure that the harness does not tighten around the thighs.

[Evacuation triangle]

This type of harness is designed to quickly and easily tie in the victim. It can be used for children as well as adults.

The triangle has a shoulder strap to give firm support even when the accident victim is upside down.

[Sling]

A short length of rope (diameter 6-8 mm) or webbing (width 15-25 mm) tied in a loop, used for connecting carabiners or as an anchor. Has many uses depending on the thickness.

Sewn slings are sold commercially, or you can tie webbing to make a sling as needed.

[Carabiners]

Types of carabiners:

oval, D, asymmetric D, and pear or Munter biner.

* The gate is largest for the asymmetric D, D, and oval carabiners in descending order.

(As protective devices or if used to prevent a fall, always use locking versions.)

Carabiner strength:

A "(22kN)" stamped into the spine of the carabiner indicates the strength to withstand a dead load of approximately 2200 kg, but this is only for major axis stress, locked. The carabiner will break with less stress if cross-loaded on the minor axis.

The gate lock of the carabiner can break easily if it catches on the bolt hole or if the spine gets pressed against a rock edge.

* Even if the strength rating is sufficient, improper use will degrade the performance.

[Descenders/rappel devices]

Types of descenders and rappel devices: figure 8, A.T.C, Grigri, stop

Grigri: A rappel device with a built-in locking mechanism. The self-braking mechanism can be used if necessary in a descent. The Grigri works somewhat like an automobile seat belt: when movements are slow, the rope runs freely through the device; when there is a shock load, the GRIGRI locks, jamming the rope with a cam. A handle releases the cam; it can be used also to pause and resume a descent.

Stop descender:

A self-braking rappel device designed for use with a single rope. It automatically stops the descent when the handle is released. Holding the handle releases the brake; the "braking hand" on the rope end controls your rate of descent. The stop can be put on or taken off the rope without detaching from the harness.

* Braking is done with the right hand on the free end of the rope. The handle is not the brake and must be released to stop the descent.

[Ascenders]

Ascension:

A rope blocker for self-belaying on a fixed rope; the hand grip insulates the hand from the metal in cold conditions.

[Pulleys]

Types of pulleys:

for single rope or double rope; with sliding or non-sliding side plates; large and small sheave diameters; it is necessary to choose the right type for the specific use

[Other]

Rope protection

- Roll module edge roller: multifunctional; the four "modules" are linked together with screw links that twist and turn to conform to uneven surfaces, allowing your rope to roll smoothly.
- Rope pad: A lightweight protector made of Protec that opens and closes using velcro, it protects a fixed rope or anchor webbing.