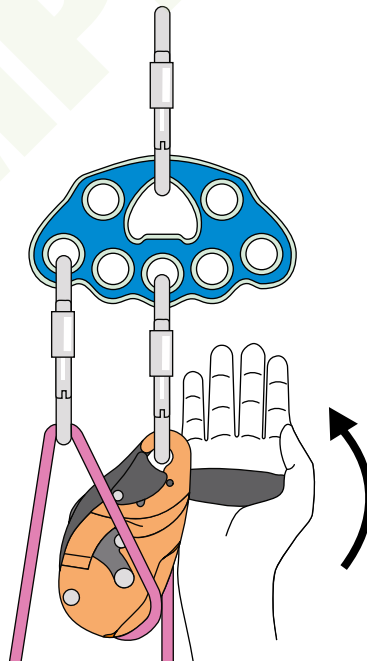


3 Improved rescue techniques

ALPINE RESCUE MANUAL



ALPINE RESCUE MANUAL

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3.1. Introduction

We speak about improvised rescue techniques when circumstances (bad weather, time) will not permit heavy rescue gear, such as winches or a tripod, to be brought to the accident site. In situations like this, improvisation is called for in an organised rescue operation too. The rescue equipment must be compact and lightweight and also capable of being used efficiently. Rescuers should only use equipment that they are familiar with and know how to use.

3.2 Pulley systems

3.2.1 General information

Pulley systems are used to lift loads. They are made up of fixed and movable sheaves over which ropes are run. The efficiency of a pulley system depends on its mechanical advantage and the friction. By using sheaves mounted on ball bearings and ensuring the least possible contact with whatever is underneath (rock, snow, soil, trees), the amount of friction can be reduced, the efficiency of the pulley system increased, and the load on the attachment points (anchors) reduced. When using pulley systems, it is important to give consideration not only to the friction but also to the rope length, the weight of the load, the lifting speed and the team size.

Fig. 3.01 Direction change angle

When a direction change is performed over a fixed pulley (a) it should be borne in mind that the force (F) is only equal to the load (P) if the pull is parallel to the load. Friction can generally be neglected. We thus endeavour to install the attachment points and direction changes as high up as possible.

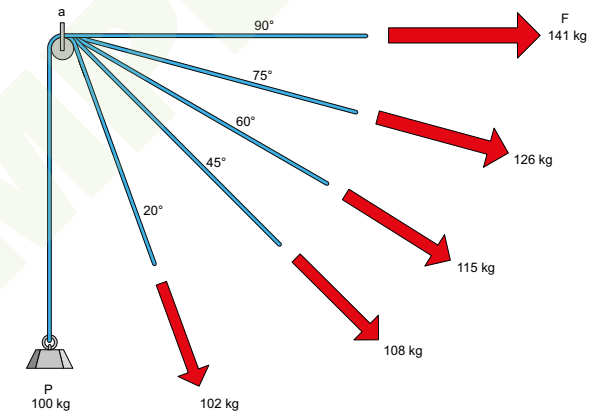
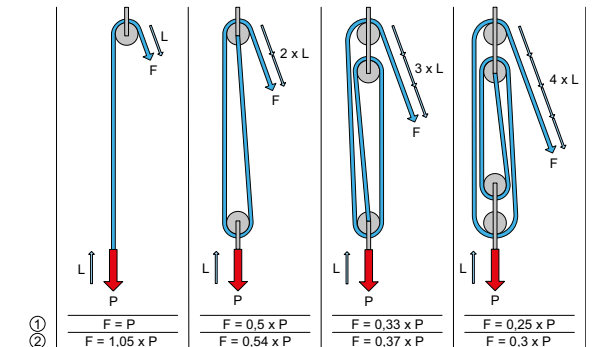


Fig. 3.02 Efficiency

P = load
F = tractive force
L = distance/displacement
① = theoretical tractive force
② = tractive force in practice



3.2.2 Pulley systems with a single rope and technical aids

3.2.2.1 Single pulley system

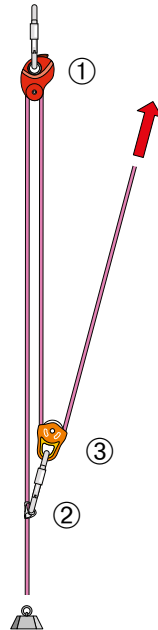
Setup

- ▷ Secure the load (it must always be possible to detach it again) using a Munter hitch and blocking knot
- ▷ Attach a progress capture pulley (Mini Traxion, Pro Traxion, I'D S) directly to the loaded rope
- ▷ Place the rope clamp on the loaded rope
- ▷ Affix the standard pulley to the rope clamp
- ▷ Thread the traction rope through the standard pulley
- ▷ Check the installation of the progress capture pulley
- ▷ Transfer the load to the progress capture pulley
- ▷ Raise the load

Fig. 3.03 Single pulley system

- ① Progress capture pulley
- ② Rope clamp
- ③ Standard pulley

Mechanical advantage:
In theory 1:3
In practice 1:2.25



Advantages: Rapid and straightforward setup, big lifting displacement.

Drawbacks: Requires a great deal of effort.

3.2.2.2 Double pulley system (Swiss pulley system)

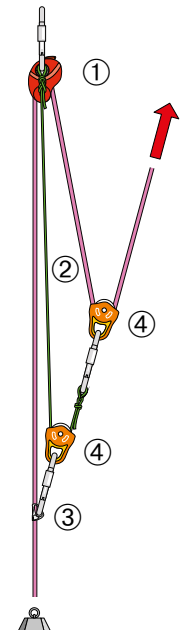
Setup

- ▷ Secure the load (it must always be possible to detach it again) using a Munter hitch and blocking knot
- ▷ Attach a progress capture pulley (Mini Traxion, Pro Traxion, I'D S) directly to the loaded rope
- ▷ Attach the accessory cord to the anchor (or to the rope end)
- ▷ Place the rope clamp on the loaded rope
- ▷ Affix the standard pulley to the rope clamp
- ▷ Place the accessory cord in the lower standard pulley
- ▷ Affix a further standard pulley to the accessory cord with a carabiner
- ▷ Thread the traction rope through the standard pulley
- ▷ Check the installation of the progress capture pulley
- ▷ Transfer the load to the progress capture pulley
- ▷ Raise the load

Fig. 3.04 Double pulley system (Swiss pulley system)

- ① Progress capture pulley
- ② Accessory cord
- ③ Rope clamp
- ④ Standard pulleys

Mechanical advantage:
In theory 1:5
In practice 1:3



Advantages: Simple and straightforward conversion from a single to a double pulley system; less effort required.

Drawbacks: Less lifting displacement than a single pulley system.

3.2.2.3 Other pulley systems

The following pulley systems are recommended where there is not much space (rock, glacier, tripod, etc.)

Fig. 3.05 Reversible pulley system

Mechanical advantage:

In theory 1:3

In practice 1:1.25

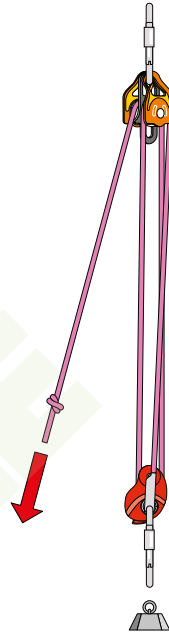
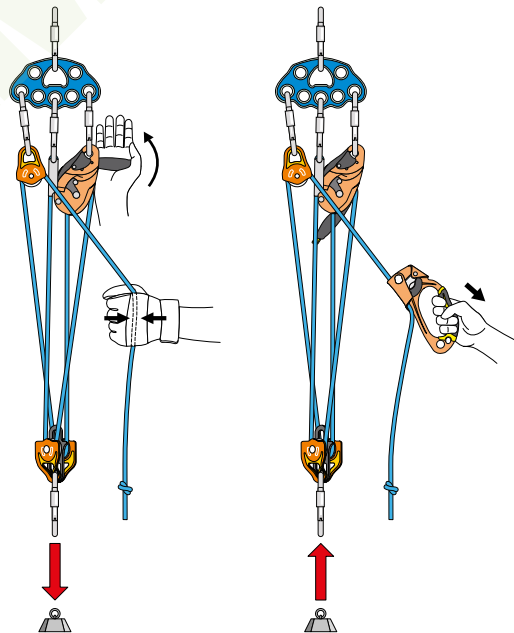


Fig. 3.06 Combined raising and lowering system

Mechanical advantage:

In theory 1:4

In practice 1:3



Advantage: Permits a rapid switch between lowering and raising.

Drawback: Rope is four times the length of the distance to be covered.

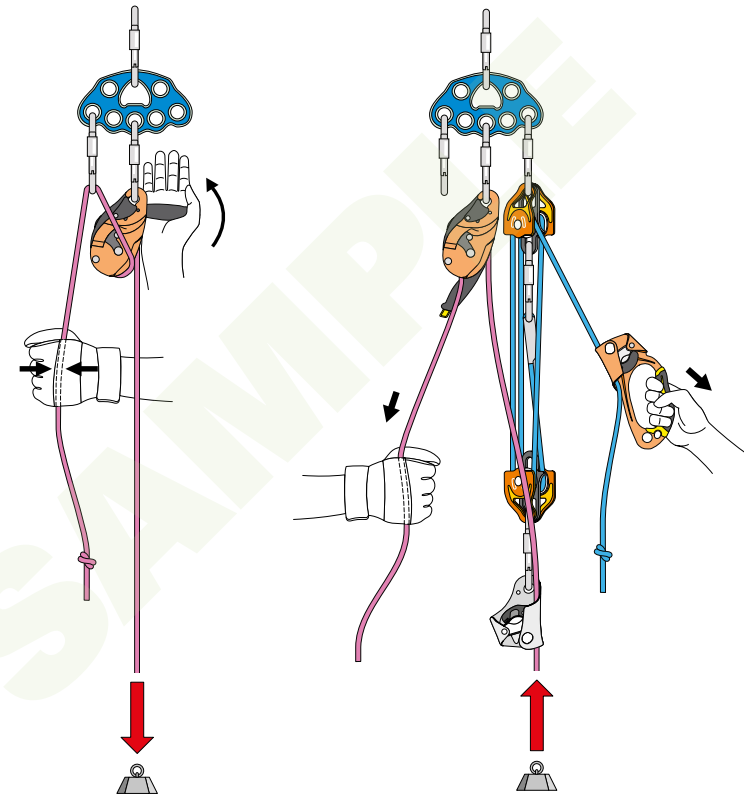
Fig. 3.07 Independent system for raising and lowering

For raising, the "Canadian pulley" with double sheaves is used.

Mechanical advantage:

In theory 1:4

In practice 1:3



Advantage: Rope length is equal to the distance to be covered.

Drawback: Switching between lowering and raising is complicated.

The Canadian pulley with a double sheave is reversible. If there is sufficient space available, the double-sheave structure of the pulley should be inserted in such a way that it is possible to pull against the anchoring, so that the load is taken off it.

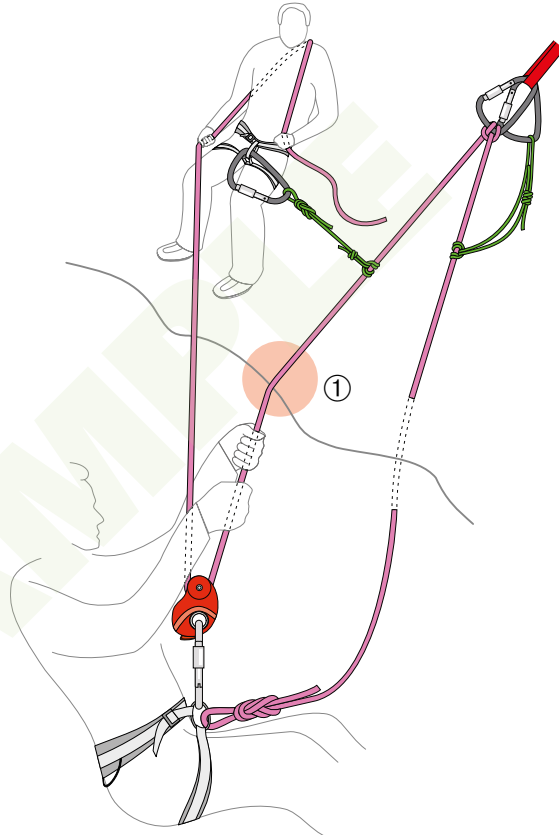
3.2.2.4 Austrian pulley system

This pulley can only be used if the victim is capable of assisting in their rescue and if sufficient rope is available. It can be used on rocks and glaciers.

Fig. 3.08 Austrian pulley system

① To prevent the rope from cutting into the snow, an object should be placed beneath it (such as a secured ice axe or a rucksack).

Mechanical advantage:
In theory 1:2
In practice 1:1.9



Advantages: Highly efficient pulley system with a single sheave, little equipment required.

Drawbacks: *Caution(!)* Rope reserves are necessary.

3.2.3 Pulley systems with a double rope and technical aids

3.2.3.1 Single pulley system with a double rope

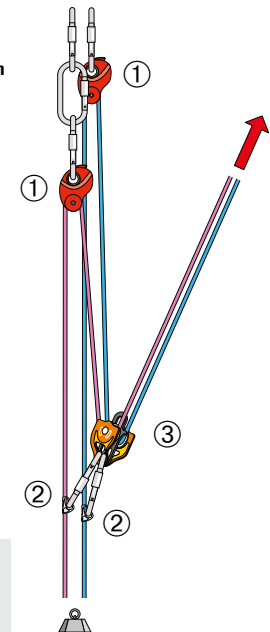
Setup

- ▷ Secure the load (it must always be possible to detach it again) using a Munter hitch and blocking knot
- ▷ Attach a progress capture pulley (Mini Traxion, Pro Traxion, I'D S) directly to each of the loaded ropes
- ▷ Run each rope separately with a progress capture pulley
- ▷ Clip a rope clamp to each of the loaded ropes (e.g. a Shunt, or a Tibloc on each of them)
- ▷ Attach a double pulley to the rope clamps
- ▷ Thread the traction rope through the pulley
- ▷ Check the installation of the progress capture pulley
- ▷ Transfer the load to the progress capture pulley
- ▷ Raise the load, always pull in both ropes simultaneously and keep them taut

Fig. 3.09 Single pulley system with a double rope

- ① Progress capture pulleys, staggered
- ② Rope clamps
- ③ Double pulley

Mechanical advantage:
In theory 1:3
In practice 1:2.25



Advantages: Rapid and straightforward to set up, big lifting displacement.

Drawbacks: Requires a great deal of effort.