

Personal Fall Protection Equipment (PFPE)



Basic information for
employers and employees
Status 2022-01 (V 3.0)



Foreword

Every year in Switzerland, 9,000 accidents occur involving a fall from height, of which approximately 22 are fatal and 280 result in life-long disabilities. It is reported that the fall height generally starts at approximately 50cm.

It is not always technically possible to secure a work site solely through collective safety installations (scaffolding, safety nets, railings, etc.). In these instances, it is necessary to implement personal fall protection equipment (PFPE).

Working at height with PFPE is a challenging task, which is never risk-free, and often quite demanding. In addition to the minimum physical and mental requirements, (e.g., fitness, agility, and a head for heights) this type of work demands a serious, professional education.

To correctly implement PFPE, every member of the involved team must be aware of his/her responsibility and must be properly trained.

When each person involved recognizes their responsibility, together we can reduce the number of fall accidents considerably.

This document illustrates the most important points for the safe training and implementation of PFPE. However, this document will also point out that PFPE is not always the best solution.

For the use of PFPE in intervention operations (Police, Fire brigade, Army, Disaster control, Alpine rescue, etc.), the rules and regulations of the organisations concerned must be observed. The PFPE course offers a good basis.

SUPPORT

Since August 2014 absturzrisiko.ch has been run by an Association. These training principles were developed by a group in which SUVA, the «Schweizerische Höhenarbeiten und Riggingverband» SHRV and the «Schweizer Bergführerverband» (SBV) are represented.

Contents

1	Legal Basics/references	4
2	Reducing risk when working at height	5
3	Collective protection	6
4	Lifting platforms	7
5	Working with Mobile Scaffolds	8
6	Ladders	9
7	Training to work with PFPE	11
8	Know when to say «STOP»!	12
9	Fall Arrest Force	13
10	Slack Rope – a high risk	14
11	Required fall area	15
12	Pendulum Fall Risk	16
13	System Priority	17
14	Visual inspection of PFPE	18
15	Before each use	19
16	PFPE components	20
17	The Harness	21
18	Helmet	22
19	Anchor Points	23
20	Carabiners	24
21	Lanyards	25
22	Textile connectors, ropes	26
23	Fall Arrest Devices	28
24	Knots	30
25	Suspension syndrome	31
26	Rescue	32
27	Simple Rescue System	33
28	PFPE Maintenance	34
29	Checklist	36
30	Limitations: Working with PFPE and working on a suspended rope	37
31	Further background knowledge	39

Legal Basics / references

GESETZLICHE GRUNDLAGEN

- **UVG** Unfallversicherungsgesetz (Accident Insurance Act)

- **VUV** Verordnung über die Unfallverhütung (Accident Insurance Ordinance)

- **BauAV** Bauarbeitenverordnung (Construction Labour Ordinance)

- **KranV** Kranverordnung (Crane Ordinance)

- **StGB** Strafgesetzbuch (Criminal Code)

LEGAL BASICS SUMMARY

- Work at height must be properly planned.

- Fall protection measures must be implemented from 2.0m and higher.

- When working at a height of 3.0m and more, façade scaffolding, catch scaffold, surface scaffold or safety nets are mandatory.

- Floor and roof openings must be secured, regardless of the fall height.

- Fall arrest measures must be implemented from a fall height of 2.0m above fragile roof surfaces.

- Exceptions to the above: work on roofs of short duration (max. 2 person working days), on roofs (from 3.0m) and on mobile ladders

- Collective protection (e.g., scaffold) and technical solutions (e.g., lifting platforms) are preferable to PFPE

- PFPE should only be used when other collective safety measures are technically unfeasible or proven to be more dangerous

- If the use of PFPE is necessary, a written safety and rescue concept for PFPE must be drawn up in consultation with an Occupational Safety specialist.

- Work with personal fall protection equipment can only be carried out by properly trained personnel

- Working alone with PFPE is not permitted.

- On-site rescue must be always possible, within 10-20 minutes, with means available on site (permanent physical injury can occur within 10 minutes)

The written rescue concept must be discussed before work is undertaken!

2 Reducing risk when working at height

GOOD WORK PREPARATION SIGNIFICANTLY REDUCES RISKS.

Declared objective: Reduce exposure time by all means! Always ask the following questions before work begins:

Situation		Measure Taken	Legal Reference
Work preparation completed?	No → Yes ↓	Planning processes, material requirements and qualifications of personnel defined	UVG Art. 82 BauAV Art. 3
Fall height > 2.0m?	Yes → No ↓	Meet fall protection measures	BauAV Art. 22-29
Is it possible to avoid working at height?	Yes → No ↓	Preliminary work on floor, etc.	BauAV Art. 3 Abs. 1
Technical resources available to reach workplace situated at height?	Yes → No ↓	Lifting platforms, suspended scaffold, work platforms	VUV Art. 5 BauAV Art. 29
Collective protection applicable?	Yes → No ↓	Large work decks, façade scaffold, railings, safety nets, work platforms, reduce access to danger zones	VUV Art. 5 BauAV Art. 27, 35
Use of PFPE is necessary		Preparation of written safety and PFPE rescue concept in consultation with an Occupational Safety specialist	VUV Art. 11a BauAV Art. 29
PFPE Restraint device applicable?	Yes → No ↓	Deploy personnel with fall protection training	VUV Art. 5, 8 BauAV Art. 29
PFPE Positioning system applicable?	Yes → No ↓	In case of slip, fall height cannot exceed 10cm	VUV Art. 5, 8 BauAV Art. 29
Fall arrest system applicable?	Yes → No ↓	Correctly! Is there adequate free fall space?	VUV Art. 5, 8 BauAV Art. 29
On-site rescue with the available equipment and personnel within 10-20 min. guaranteed?	Yes → No ↓	Instruct personnel and supervise the implementation	VUV Art. 3, 7, 11 BauAV Art. 8
Rescue not guaranteed?		Employ rope access technicians ≥L2 → www.absturzisiko.ch	VUV Art. 11a

Collective protection

Collective protection = side protection, façade scaffolding, safety nets, etc.

Human behaviour is susceptible to many constantly changing factors. Protective equipment is most effective when it can function independently of an individual's behaviour.

THE ADVANTAGE OF COLLECTIVE SAFETY MEASURES:

- They protect all workers simultaneously
- They function independent of daily conditions and time constraints

CAUTION:

- Fall arrest nets should be installed so that persons cannot fall more than 3.0m or from a height of more than 3.0m.
- Safety gear must be installed so that persons, objects, and materials cannot fall more than 2.0m, or fall to a depth of more than 2.0m.



Lifting platforms

Lifting platforms are technical aids which can help to significantly reduce exposure to danger

Technical solutions such as lifting platforms drastically simplify work at height. However, with incorrect handling, new dangers can arise.

TRAINING AND INSTRUCTION:

Operators of aerial work platforms must be trained for the respective category of working platforms. The training comprises a theoretical and a practical part and is completed with an examination. Operators must be carefully selected and be up to date with new situations or equipment.

RESTRAINT SYSTEM ON LIFTING PLATFORMS

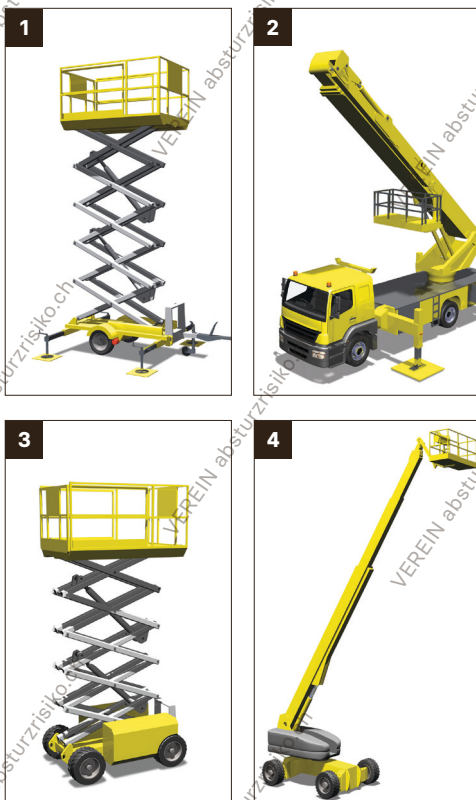
- minimal instruction required
- must be used in accordance with the working platform instructions
- is generally mandatory on a boom-type platform (type 1b/3b)
- should be attached to the designated anchor points
- A height safety device is recommended for lifting platforms
- maximum length of connecting device $\leq 1.8\text{m}$
- with safety harness EN361
- only use with suitable energy absorber (load capacity)

ATTENTION

The anchor point in the baskets is often only 3.0 kN, not 12 kN!



Always secure yourself to the basket with a harness (EN361) when working with a cherry picker



- 1 Static vertical
- 2 Static outrigger
- 3 Mobile vertical
- 4 Mobile outrigger

Working with mobile scaffolds

Mobile scaffolds are practical, lightweight, quick to set up – with correct expertise – and are ideal for interior spaces

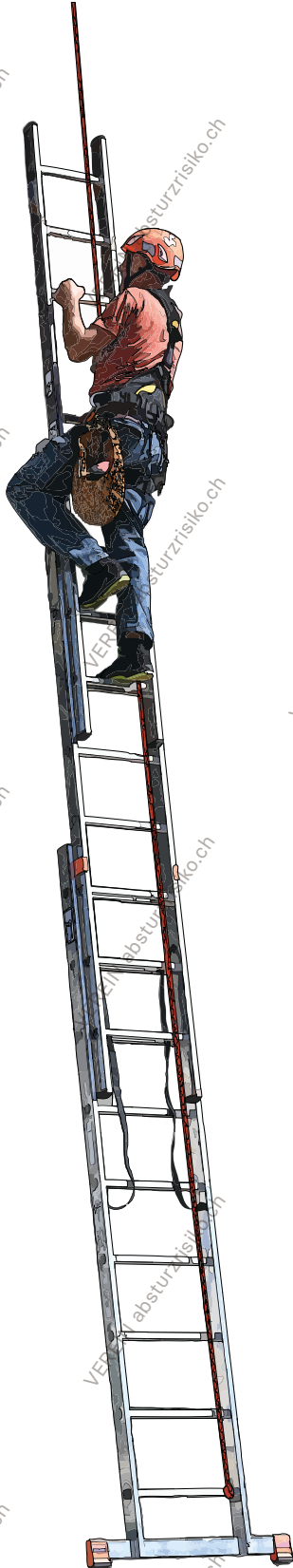
A SUMMARY OF THE BASICS

- Mobile scaffold must comply with SN EN 1004-1/-2
 - older models usually have to be retrofitted.
- The scaffold must be set up, utilized, and taken down according to the manufacturer's advice.
- There must be safe access to the working levels such as ladders or steps.
- A standing surface is necessary every 2.0m.
- A staggered arrangement of the scaffold decking is not permitted.
- From a fall height of 2.0m, a three-part side guard must always be fitted.
- **Working platforms are preferable to rolling scaffolds, where possible.**



Safe rolling scaffold erection, with each standing surface installed before the next level.

Ladders



A quarter of all falling accidents involve a ladder.

- A ladder is itself not a workplace, but primarily an access tool
- Portable ladders should only be used if other more suitable equipment is not available
- When carrying out work on ladders from a fall height of 2.0m from the standing surface, measures must be taken to avoid fall (e.g., use PPE)
- Leaning/Tressle ladders are often not suitable equipment. Lifting platforms, working platforms or platform ladders or mobile scaffold are better suited.
- Adjustable ladders should be set at an angle of approx. 70° inclination
- Ladders should always be secured against accidental slippage, rotation, and tipping
- Only ladders in sound physical condition should be used

ART. 20 BAUAV: REQUIREMENTS

1. Only ladders may be used which are:
 - a. suitable for the intended use regarding load-bearing capacity and stability
 - b. undamaged.
2. Ladders must be placed on a stable surface and secured against slipping, rotating, and tipping.
3. The location of placement must be chosen in such a way that there is no danger of falling objects or materials.
4. The top three rungs of ladders may only be climbed if they are leading out onto a platform and a retaining device is available.
5. The top two rungs of stepladders may not be climbed. Stepladders may only be mounted and exited from the foot of the ladder.

ART. 21 BAUAV: WORKING FROM PORTABLE LADDERS

1. Work from portable ladders may only be carried out if no other work equipment available is better suited in terms of safety.
2. From a fall height of more than 2.0m, work from portable ladders may only be of short duration and fall protection measures must be taken.

LADDERS AS A MEANS OF ACCESS

- Stepladders must not be used as a means of access.
- The top three rungs of stepladders may only be climbed if a platform and a retaining device are provided at the exit.
- Climbing over roofs and levels must be done securely from 3.0 m upwards. A secured access is recommended. If the ladder cannot be technically secured, it must be held by a person.

SECURING ON FIXED LADDERS

- Mechanical installations: from 3.0 m use fall arrest system/safety cage
- Structural installations: from 5.0 m, fall arrest system/safety cage (recommended from 3.0 m and above)
- Shaft ladders: from 5.0 m, Fall arrest system



Training to work with PFPE

Working with PFPE can be an especially dangerous job. (VUV Art. 8) Work involving exceptional risks may only be carried out by personnel with the proper training.

GOALS FOR TRAINEES

- To have a sufficient basic knowledge of PFPE
- To know the importance of a properly planned rescue concept
- To know when and where to implement PFPE
- To plan simple work tasks using PFPE
- To know the specific dangers of working with PFPE
- To know the forces that can act upon the body in the event of a fall

WHO NEEDS TRAINING?

- Employees who need to work with PFPE
- Employees who plan, organize, or supervise work with PFPE (site managers and safety supervisors)

INSTRUCTORS

- PFPE Instructors certified by absturzrisiko.ch (e.g., Rope access technician level 3 or level 2, with in-depth specialist knowledge and training adapted from the PFPE training safety and training concept)

TRAINING LENGTH

- An appropriate training for people with limited experience should last **a full work day**. This should include training in a standard rescue technique, lowering a person with a rescue apparatus.
- Special rescue techniques, e.g., without prefabricated equipment, are to be taught separately.
- In-depth specialist knowledge for checking and maintenance of PFPE must be taught separately (e.g., Training of PFPE experts according to DGUV G 312-906).

Know when to say «STOP»!

We know that most accidents don't simply happen. They are often the result of unsafe handling, deliberately tolerated by supervisors.

HIGH RISKS OCCUR

- through **neglecting to perform tasks**
- by **ignoring** relevant regulations
- by **underestimating** the risk, and overestimating one's own abilities (e.g., where an employee overestimates their lengthy experience)
- due to **inadequate preparation**
- by tolerating unsafe actions

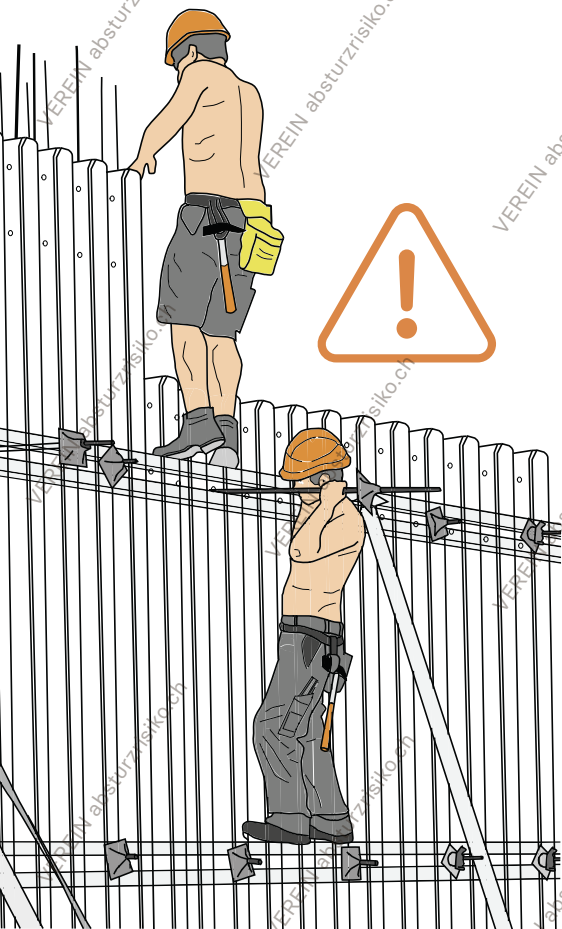
PARTICULARLY WHERE

- the personnel are **poorly trained**
- the personnel are **poorly equipped**
- work must be carried out in **unfavourable weather** conditions (ice, snow, wet, heat)
- employees must work under **financial stress and time constraints to meet deadlines**
- a job must be 'improvised' due to **inadequate work preparations**

DUTIES OF THE EMPLOYEE (VUV ART. 11)

- follow the employer's instructions
- stick to the approved safety regulations
- do not disturb the functionality of safety installations
- report or fix any observed deficiencies in the safety installations

DUTIES OF THE EMPLOYER (SEE VUV ART. 3-10)



Fall Arrest Force

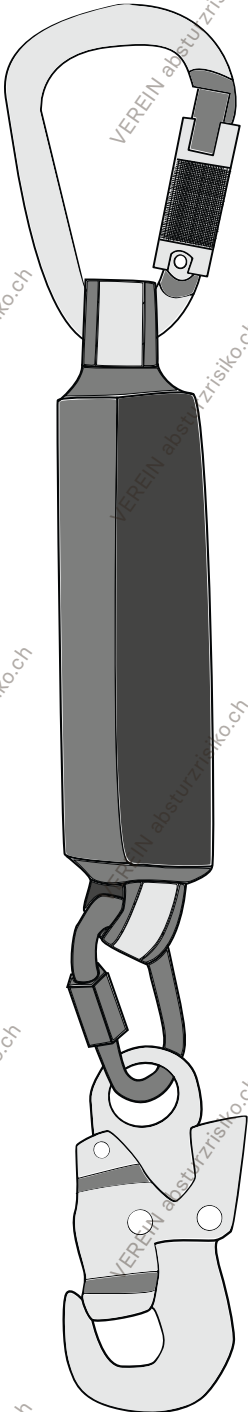
Fall arrest force or impact force is the force exerted on the person and the harness/equipment components during a fall.
 → An impact force of ca. 3,0 kN (~300 kg) can be enough to cause permanent injury, depending on the position of the body.

The Fall arrest force is dependent on many different factors (freefall height, elasticity of the rope, knots, harness, etc.) and can only be determined through direct measurement.

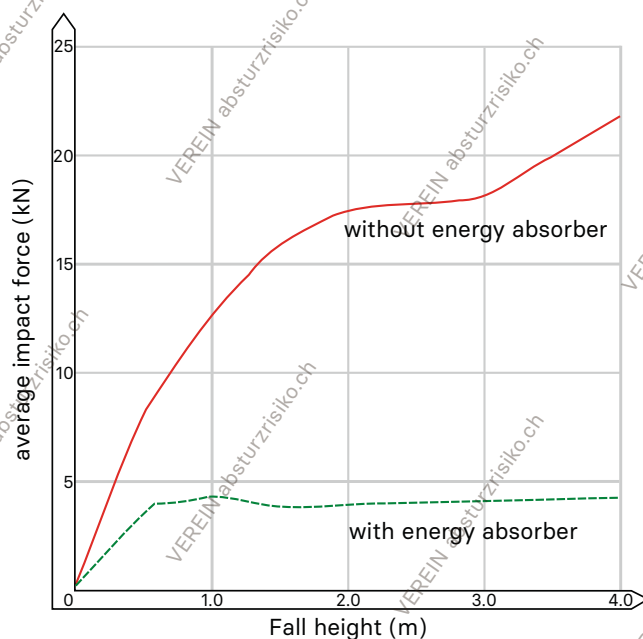
ENERGY ABSORBER (EN 355)

An energy absorber helps to guarantee the fall arrest force on a body does not exceed 6 kN.

An energy absorber has the same damping effect as an airbag in a car. The fall is decelerated by the prolonged opening or tearing of the energy absorber. The standard maximum tear-off length is 1,75 m. This value can be lowered by a lower fall factor and an adapted length lanyard. The acting acceleration forces are limited.



Short coupling with an energy absorber



An energy absorber reduces the force acting upon the human body to 400-600kg (4-6kN)

Slack Rope – a high risk

In certain safety systems, the rope can become slack without the user even noticing, which can be very hazardous.

- Every centimeter of slack rope increases the distance of the free fall
- A longer fall increases the resulting impact force exponentially!
- Even a freefall of 50 cm can cause permanent injury if the safety equipment is used improperly
- A slack rope is a backbreaker!

PREVENTION

- Use a retention or fixed positioning system
- Work with height safety devices (HSG) at high lying anchor points. Caution: → Increased risk of pendulum fall with single anchor point

POORLY ADJUSTED FASTENER

- too much slack rope
- large free fall distance
- larger impact force
- higher risk of injury



Required fall area

Is there enough space to fall?

When working with PFPE, the following must be considered: Depending on the components used, a fall space must be ensured. An impact during the fall and arrest must be prevented! If the fall space is too small, restraint or positioning systems must be used.

EXAMPLE CALCULATION OF A PROPER FALL ZONE

+ Length of connecting aid ¹	= 2,00 m
+ Energy absorber extension ²	= 1,75 m
+ Distance between attachment point and worker's foot sole	= 1,50 m
+ Safety reserve	≥ 1,00 m
Total necessary fall zone	≥ 6,25 m

¹The length of the lanyard depends on the selected system

²The tear length of the energy absorber depends on the product and is max. 1.75m according to EN 355

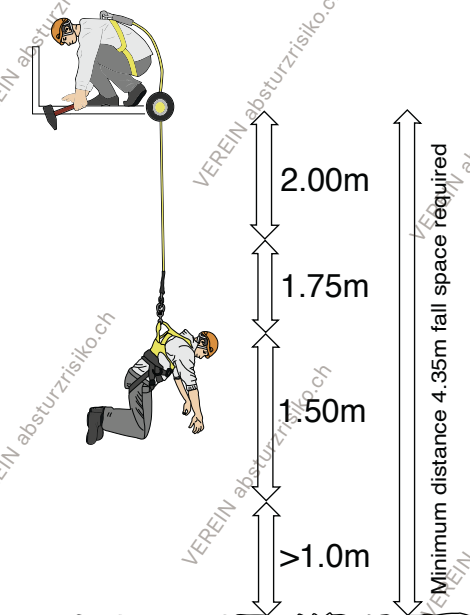
If possible, an anchor point directly above the person and as little slack as possible in the lanyard = short fall distance = low fall energy = energy absorber tears open less far.

IMPORTANT FACTORS

- Placement of the anchors (directly above the worker, and above head height wherever possible)
- Possible deformation of the anchor device
- Total length of the lanyard incl. energy absorber
- Extension of the energy absorber
- Stretching of the distance between fall arrest eyelet and foot sole, due to the impact force
- A safety reserve of 1m (for system elasticity, etc.)

HINT

In the example on the left, the illustration shows that the fall space requirement can be reduced by more than 1 metre, by moving the anchor point inwards or overhead.



Example of calculating fall area



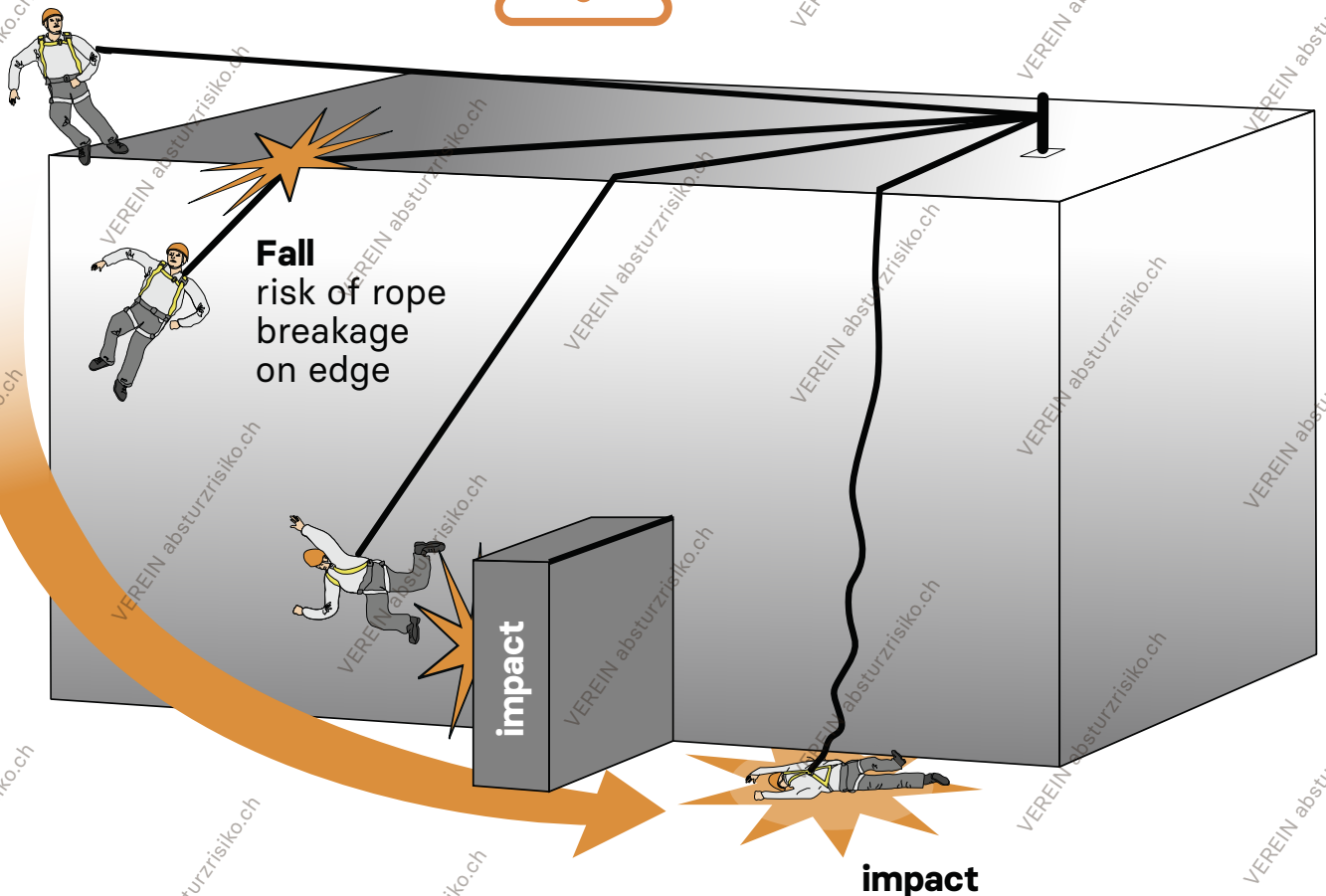
Depending on the selected system components and the position of the anchor point, the required fall space can be up to 10 m or more.

Pendulum Fall Risk

The risk of a pendulum fall is always present when working with personal fall protection.

- A pendulum fall over an edge can tear even a 4 mm steel cable through the combination of whiplash and friction!
- To actively avoid pendulum fall risk install deflection/intermediate anchors, and restraint points.
- Caution in critical situations! Only certain fall arresters and lanyards are adequately resistant to such situations
- Always use material tested against sharp edges
- Request a test certificate from the manufacturer
- eliminate or cover sharp edges

Pendulum fall risk



System Priority

The residual risk in working with PFPE is minimized by an informed choice of safety systems.

PRIORITY 1 — RESTRAINT SYSTEM

- Keeps the user away from potential fall-risk areas
- Ideally does not require adjustment.
- The risk of injury from falling is excluded.

PRIORITY 2 — POSITIONING SYSTEM

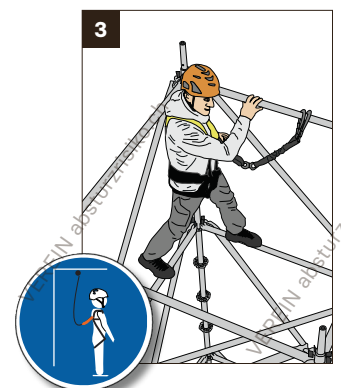
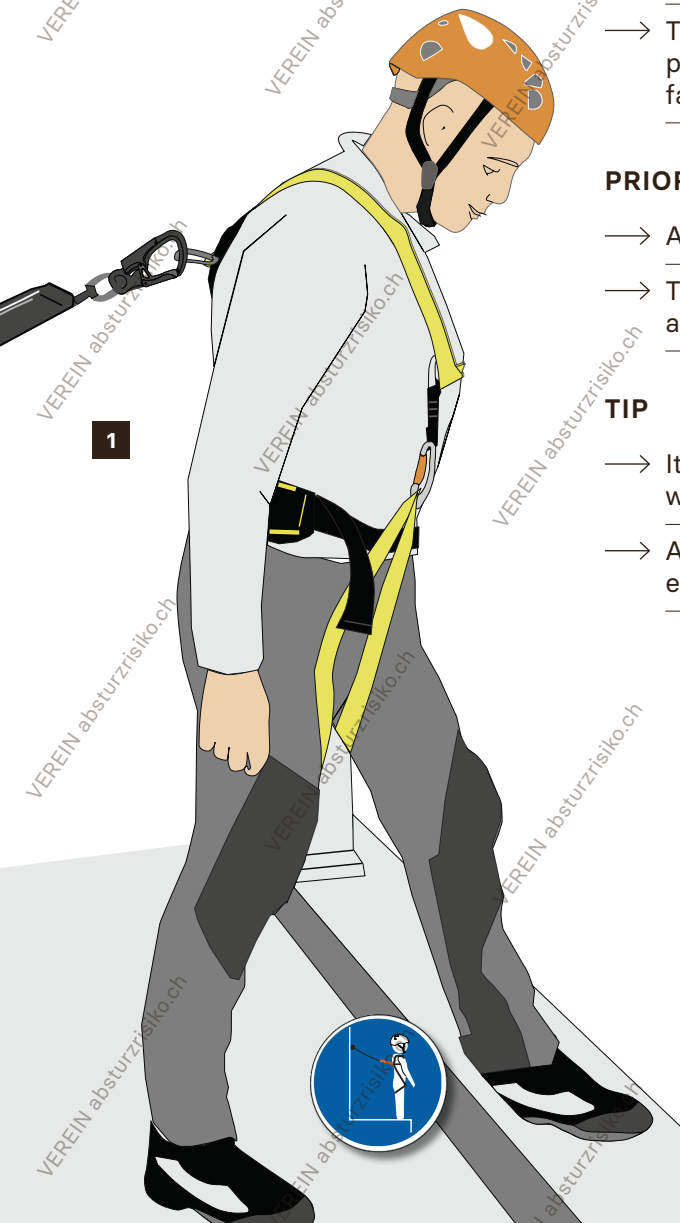
- Positions the user at the work area. An anchor point on a structure prevents a free fall.
- The risk of injury is kept low.
- To be used in combination with a fall arrest system or collective protection (=redundancy) in the event of the positioning system failure resulting in a fall.

PRIORITY 3 — FALL ARREST SYSTEM

- Arrests the user's fall. Impact force is limited
- The risk of injury is present but can be reduced by using a high anchor point and shortest possible lanyards.

TIP

- It is recommended to change the positioning system at the workplace.
- A fall arrest system stops a free free fall and limits the impact exerted on the body of the user.



Visual inspection of PFPE

Safety equipment must be visually inspected for the following defects before every use:

- Visible damage? _____
- Worn-through areas? _____
- Defective or torn seams? _____
- Corrosion, cracks, or deformations in metal parts? _____
- Contamination by any harmful substances (acids, alkalis, cement milk)? _____
- Functional capability of lanyards (carry out a manual function test?) _____

Before each use

Prior to working with PFPE, the following must be clarified:

1. Do the anchor/securing points have adequate **load bearing strength**?
2. Is the **proper use** of the equipment/tools guaranteed?
3. **Endangered third parties:**
→ Is there someone working below me?
→ Is a barrier necessary? (Public safety?)
4. Are **permits**, exemptions or supervisory staff needed?
5. Can a **rescue** be guaranteed at any time with the available equipment?
6. Safety regulations available, read and understood by all workers?



PFPE components

Personal safety equipment can be divided into four parts:

- Harness (SN EN361)

- Helmet with **chinstrap** (SN EN12492/SN EN 397/SN EN 14052)

- Lanyards (energy absorbers, carabiners, retention devices, etc.)
 - SN EN354 Lanyards
 - SN EN355 Energy absorbers
 - SN EN358 Harnesses and lanyards
 - SN EN360 Height restraint devices
 - SN EN362 Connection devices (carabiners)
 - SN EN1891 Kernmantle rope

- Load bearing anchor
 - SN EN 795 Anchor point/Structure: R>1 to/10 kN

IMPORTANT

- Only tested PFPE equipment may be used (CE-certification)

- Retain instruction manual, study it, and follow it!

- Request a declaration of conformity when buying

- Have the equipment inspected at least once a year, by a PFPE specialist (e.g. DGUV-I 312-906).

- Shorter inspection intervals can result from the hazard assessment (e.g., due to abrasion, chemical abrasion, chemical stress)

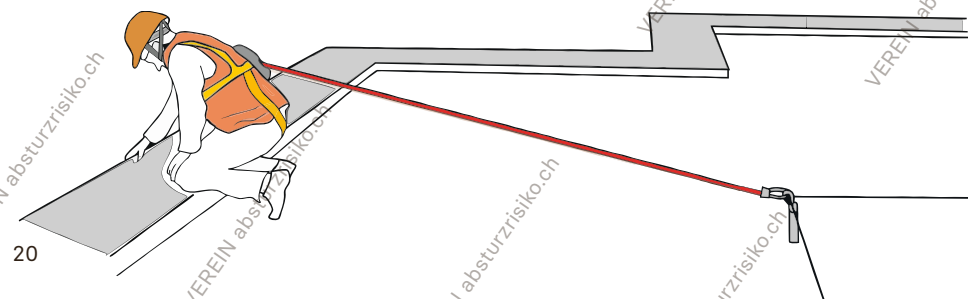
CAUTION

- A helmet without a chinstrap can fall off
 - risk of cranial injury

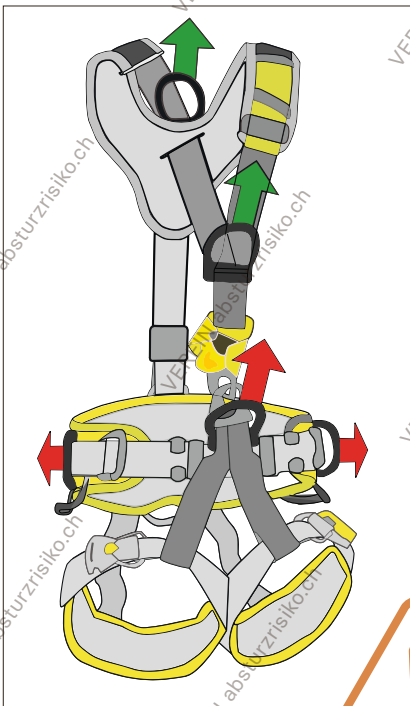
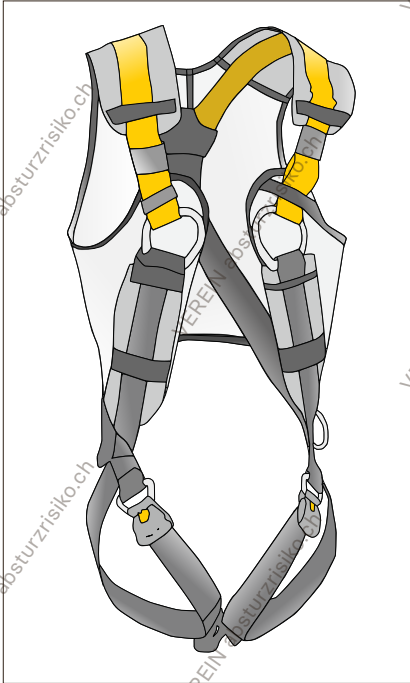
- Sport climbing harness may not be used!
 - risk of neck and back injury!

GENERAL RULE:

Take more care of your PFPE than you would your Smartphone – it saves your life



Person with harness and lanyard secured on an anchor point EN795



Caution:

Fall arrest and restraint harnesses (EN361 & EN358) Lateral EN 358 harness eyelets and central abseiling eyelet must be used as a fall arrest eyelet.

Harnesses must comply with SN EN361

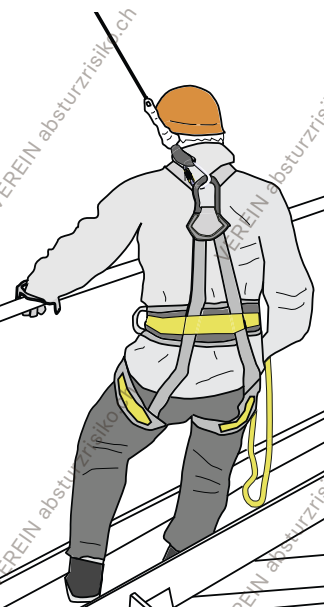
- Attachment points (back and/or chest eyelets) are adjustable and must be above the body's center of gravity
 - Back eyelet > between shoulder blades
 - Chest eyelet at the sternum
- Attachment eyelets are marked with A, two-part eyelets for example, with A/2
- Webbing that is too long should be looped back through the buckle and fastened
- The belt and webbing should lay tight to the body, but not restrictive
- The shoulder harness should be pulled on so that the upper body can move freely in an upright position

TEST:

You should be able to just barely push one hand between the leg loop and the thigh

CORRECT SITUATION:

- High anchor point is above the worker (<30° deviation from perpendicular)
- The back eyelet is at shoulder blade height



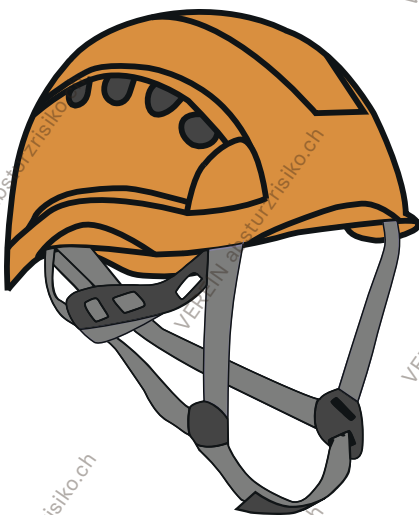
Helmet

When working with PFPE always wear a helmet with chin strap! A normal helmet would fall off during a fall, resulting in an extremely high risk of head injury from impact.

- Helmet must always be worn with the strap closed.
- Only use the (tested) chin strap belonging to the helmet.
- Two-point chin straps and such elastic material straps are not suitable.
- Adjust the fit before use. It should neither be restrictive nor easily slip around on your head
- Take care when using paint or insect spray or stickers on the helmet (chemical reactions can erode the plastic).
- Certain mountaineering helmets are made from less robust materials and must be replaced frequently.

TEST:

- **Put on the helmet and adjust it properly to your head. Open the chin strap and tilt your head all the way forward. The helmet should stay on your head**



'Mountaineering helmet' with 3-point chin strap and closable vents

Suitable helmet types	Mountaineering helmet ¹	Industrial safety helmet	High performance industrial safety helmet
Norm	SN EN 12492	SN EN 397	SN EN 14052
Chinstrap strength	(+) >50 daN ¹	(-) 15–25 daN ²	(-) 15–25 daN ²
Electric insulation	(-)	(+) ³	(+) ³
Ventilation	(+)	(±/-)	(-)

¹ Recommended for work with PFPE (safety helmet stays on the head in a fall)

² Protection against strangulation (e.g., working in pipelines)

³ Optional features: electrical insulation, protection against molten metal

- **The risk assessment of the operation shows whether the optional requirements of EN 397 and EN 14052 have to be complied with and to what extent the resistance of the chinstrap is relevant.**

Anchor Points

- Always choose the highest possible anchor point. The chosen anchor point should keep the fall distance as short as possible and prevent a pendulum fall.

- Use only anchors or installations that comply with e.g., **SN EN 795**
 → **Observe manufacturer's instructions!**

- One anchor point in the support structure must hold 12 kN (~1,2 t).

- In case of uncertainty about anchor points consult a Level 3 qualified height worker.

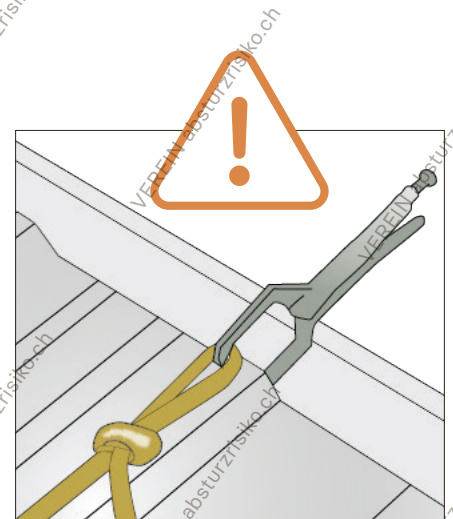
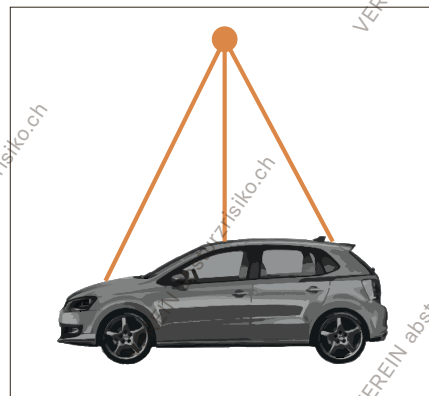
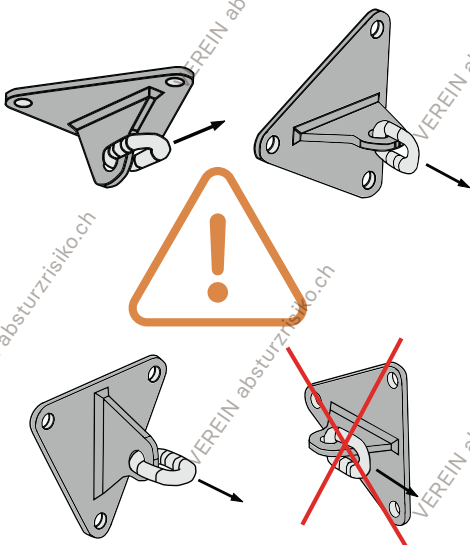
- Fixed mounted anchor devices: Installation in accordance with manufacturer's instructions must be documented (installation report in accordance with SN EN 795)!

- Only use approved anchor systems.
 → no homemade constructions!

- Rope systems and anchorage supports must be tested as a system and must be installed strictly in accordance with the manufacturer's instructions.

- Chimneys, ventilations pipes, and snow catchers are not anchor points!

- Roof hooks are not always load bearing in all directions.



Caution:

The entire safety system and even your life is dependent on the integrity of the anchor point

A simple rule of thumb:

Only anchor yourself to an object that you would hang your car on as well!

Caution:

Some certified anchor points and roof hooks (EN 517 Typ-A) must not be loaded in all directions!

Carabiners

Only use carabiners that conform to the norm, as connecting devices!

STATE OF THE TECHNOLOGY

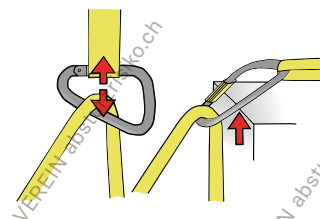
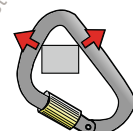
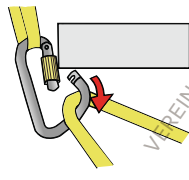
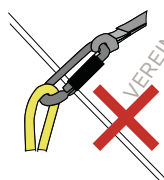
- Automatic locking carabiners (i.e., Trilock) are preferred to screw lock carabiners.
 - Users tend to forget to screw the carabiner to lock, and they can open themselves
- Steel Trilock carabiners are the safest!
- Carabiners must be maintained according to manufacturer's instructions.

RECOMMENDED ARE STEEL OR ALUMINIUM CARABINERS

- When attaching the carabiner directly into anchor points and when working with steel ropes, it is best to use steel carabiners!
- In most cases: use aluminium for carabiners attached onto body, otherwise steel.

PAY ATTENTION TO INCORRECT LOADING

- Carabiners quickly lose their load bearing strength when incorrectly loaded and can break.
- Be careful how you use your carabiner!
- With a two-piece chest eyelet (A/2) always use a steel carabiner or special half-round/heart-shaped carabiner.



Examples of **how carabiners should never be loaded**. Higher falling forces could cause a carabiner to break

Lanyards

Lanyards can be defined as all components between the harness and anchor points

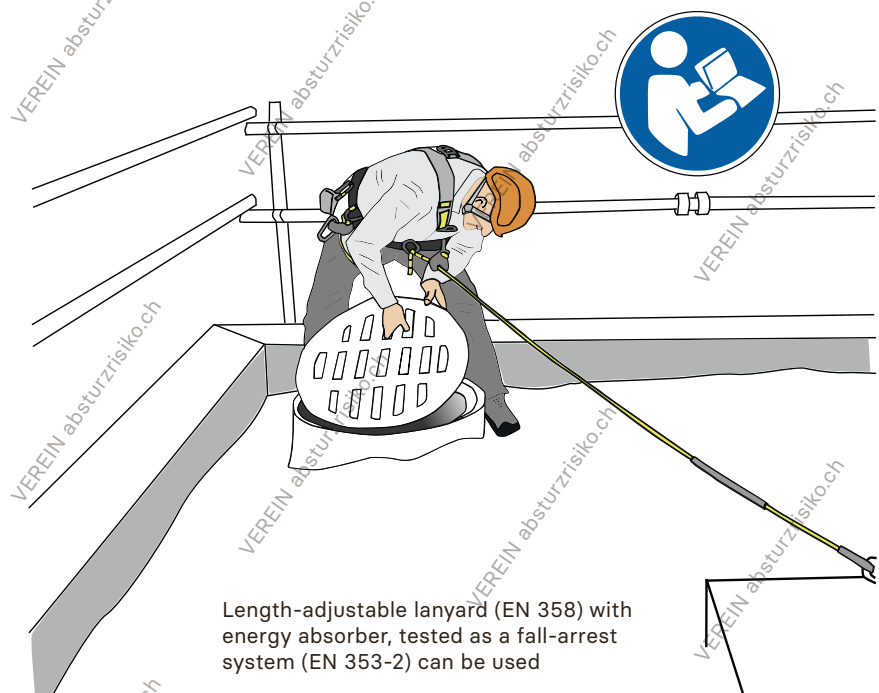
CHOICE OF LANYARDS

- The lanyards must be adjusted according to the specific situation: sharp edges etc.
- Check your choice of safety system: The fall zone must be free of obstacles.
- Only use approved components.
- Recommendation for restraint system: Only use systems with an **energy absorber** (there is often an unnoticed risk of falling, due to different distances from an edge)

ADJUSTABLE-LENGTH LANYARDS (EN 358)

- Ensure simplified workplace positioning according to the relevant **manufacturer's instructions**.
- Only adjust the lanyard at a safe platform. Otherwise, there is a fall risk.
- Never use where there is a risk of falling or only in combination with a fall arrest system (=system redundancy)

An adjustable lanyard for work positioning



Length-adjustable lanyard (EN 358) with energy absorber, tested as a fall-arrest system (EN 353-2) can be used

Textile connectors, ropes

Semi-static kernmantle ropes with low elongation are used for PFPE. (Static or semi-static ropes)

MECHANICAL INJURIES

- Protect connecting means/rope against sharp edges
→ use rope edge protector or protected sling.
- Do not stand on the rope or drive over it with a vehicle.
- Do not provoke pendulum movements on edges.

CHEMICAL DAMAGE

- Avoid contact with acids, bases, cement milk, and oils!

HEAT DAMAGE

- Ropes are usually not heat resistant!
Careful when working around hot elements, cutting torches, grinders, etc.!
- There are special fireproof ropes available

FRICTION DAMAGE

- Never let a load-bearing rope slide over an edge without protection.
- Never pull rope on rope under load

DRYING, STORAGE, AND CLEANING (SEE PARA. 29)

- Protect the ropes from dirt, and clean them regularly

WET ROPES

- Wet ropes are more vulnerable to damage and lose their strength
- Pay careful attention to completely soaked ropes

CEMENT MILK, BOJAKE

- Cement slurry can get sucked into the rope core, hardens, and can make the core fibres brittle

- A rope that has been damaged like this can seem in perfect condition but has lost most of its load bearing strength. This is a danger for all fabric elements (i.e., webbing, harnesses, etc.).

- When in doubt, dispose of it.

ROPE ENDS

- Always **knot the end of rope ends** without stitched eyelets. This avoids falling with adjustable length devices and mobile fall arrest devices.

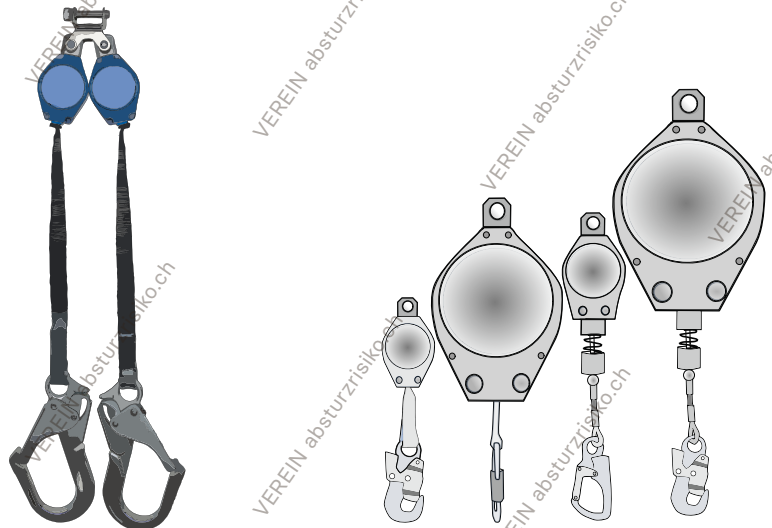
- always follow **manufacturer's instructions.**

Fall Arrest Devices

With all types of fall arrest devices:
There should be no further lengthening between the device and the attachment point on the harness
→ manufacturer's instructions.

RETRACTABLE FALL ARREST DEVICE HSG (EN 360)

- Functionally, they all work similarly: if the rope is pulled too fast through the device, it blocks the rope
→ even a short fall of 20cm will be immediately blocked.
- Anchor points should always, where possible, be above the user
- An HSG (EN 360) device has an integrated energy absorber.
- If a fall arrest device is used horizontally, it must be specified by the manufacturer.
- This device should not be used when working with a risk of sinking, sliding etc. (e.g., on water, silos etc.)
- On sloping surfaces, it should be noted that the device only blocks at a certain rate of acceleration.
- When used on horizontal cable systems, the manufacturer's instructions for the rope system and HSG must be observed!
A restraint system is preferable, as a HSG does not prevent a fall.
- If there is danger of edge loading of lanyards, edge-proof tested devices must be used and manufacturer's instructions observed.



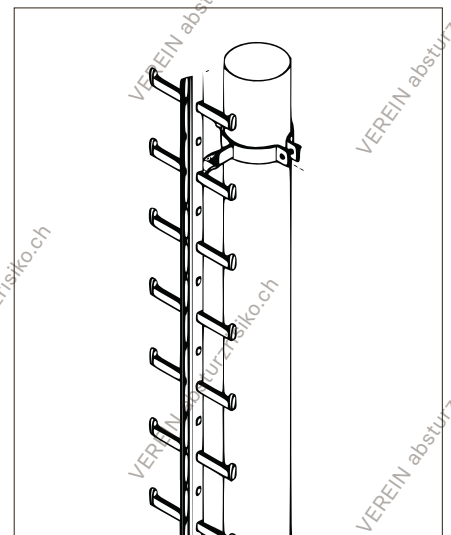
Retractable type fall arresters with external external energy absorber in Y-connectors installed to prevent slack rope

MOBILE (SLIDING) FALL ARRESTERS (EN 353-2)

- Fall arrest device with an automatic blocking function on a moveable textile or steel rope.
- Attention to energy absorption.
- Ideal for vertical climbing on ladders, scaffolding, etc.
- For horizontal or use on sloping surfaces, the device must be approved by the manufacturer.
- Avoid a slack rope wherever possible.
- Not all products are suitable for working where there is danger of sinking (e.g., in water/fluid, soil etc.).

CLIMBING PROTECTION SYSTEM (EN353-1)

- Mostly permanently installed ascending/climbing protection system e.g., rail-guided along ladders or a tensioned, metal rope fixed at both ends.
- Not to be used as a positioning system!
- Do not lean out of the side.
- Only use the mobile device on the system provided
- Attach the mobile device in the climbing protection eyelet or in the chest eyelet of the harness
- A second safety system should be used in conjunction with the climbing protection system (2 safe contact points attached to the structure!).



Knots

There have been countless books written on knotting technique.

It is best to use preassembled products, which eliminate the need for knots. However, where this is not possible, there are a few practical knots that can be mastered any time.

BEFORE YOU START TYING UP, ASK YOURSELF:

- Do I have to use knots, or would it be safer to use **standard lanyards**?
- Have I mastered the required knots?
- Am I sure that this is the correct knot to use?

A FIGURE-8 IS THE MOST COMMONLY USED KNOT

- It is simple to check
- It is relatively easy to undo after bearing a load.
- It reduces the rope load capacity to a much lesser extent than most other knots.
- The rope strands should be placed parallel to each other to simplify an inspection

IMPORTANT TO KNOW

- Different knots reduce the load strength of a rope differently
- Knots can reduce the nominal breaking load of a rope by up to 50%

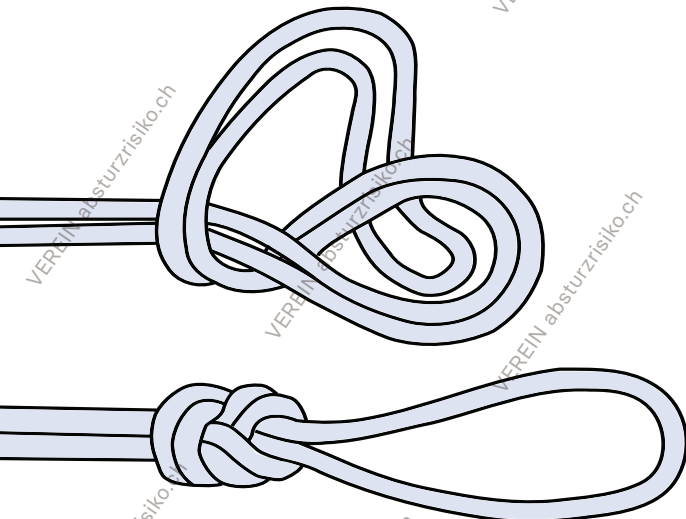


Figure 8 knot

Suspension syndrome

Suspension syndrome (also known as suspension intoxication or orthostatic intolerance) is a potentially life-threatening condition, caused by hanging motionless (e.g., immediately following an injury) for an extended period in a harness.

CAUSES

- In humans, blood is pumped through the body by movement and the resulting pressure of the muscles on the veins (skeletal-muscle pump), back to the heart.
- While hanging motionless in a harness, blood can 'pool' in the arms and legs. The muscle pump doesn't work, and this can lead to serious circulatory problems and a lack of oxygen to the brain.

THE CLOCK IS TICKING!

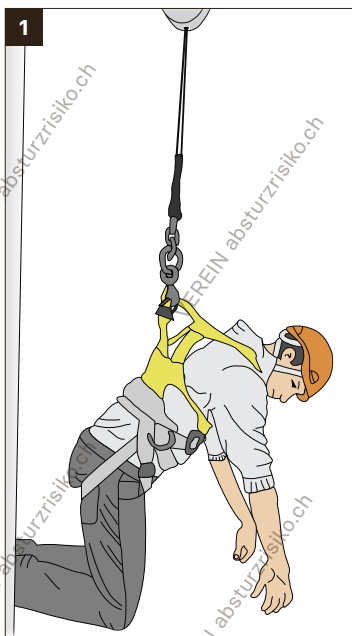
- It should be assumed that by motionless hanging, permanent damage can occur even after only **10 minutes**.
- A person must be released from the hanging position (carefully) within max. **20 minutes**.

IMPORTANT

Rescue personnel should be notified of a possible suspension syndrome and alerted to the possibility of recovering a fatality.

AID/RESCUE

- When the vital functions of the casualty allow, keep the upper body elevated.



- 1 Suspension syndrome casualty hanging motionless in a harness
- 2 Self-help: The muscle pump can be reactivated by pressing your feet into a standing-loop

Rescue

A rescue must always be possible with the equipment on-site.

RESCUE COORDINATION

- Before work begins, formulate a rescue protocol!

- Consider the rescue possibilities and equipment before even putting a harness on

- The rescue tactics and techniques should be clear to all personnel on-site

- The relevant equipment should be easily accessible and ready for use at the work site or integrated into the system.

GOALS

- Evacuate the casualty to a secure area, so that further emergency care can be carried out.

- The casualty and rescuer should be protected from any further risk or injury

WORK FAST – BUT REMAIN ATTENTIVE!

- A rescue must be carried out within 10-20 minutes (See suspension syndrome on previous page)

BASIC LEGALITIES:

- Rescue/Evacuation must be always possible (BauAV Art. 8, VUV Art. 3)

- Stop hazardous work immediately if emergency communication with a doctor or hospital cannot be established, and a helicopter deployment is not possible (BauAV ART. 39)

ACCIDENT: WHAT TO DO

1. Try to remain **calm** and secure yourself and others.

2. Establish **contact** with the casualty.

3. **Call** a medic

4. Begin **rescue measures**

5. Give **first aid**, BLS-AED (Basic Life Support and Automated External Defibrillation) Even if the casualty appears to be well, accompany them to a check-up.

Caution: This is only a guideline, and the protocol is dependent upon the nature of the worksite and accident.

Simple Rescue System

Abseiling of a casualty together with a rescuer is rarely the appropriate rescue method. This should be left to height rescue specialists or personnel trained in rope access.

TRAINING

- A PFPE training session must include instruction in a simple rescue with a rescue system.
- Advanced, complex rescue tactics should be taught in a separate, technical course!
- A proper rescue training session lasts usually ½-1 day.

RESCUE SYSTEMS

- The chosen system should be easy to use, and quick to implement in any situation.
- Rig for Rescue: With the construction of detachable systems (e.g., abseil device with rope reserve at anchor point) the rescue can be made easier.
- A system that is appropriate for vertical rescue situations can be unsuitable for horizontal situation (e.g., inclined shafts).
- In practicing rescue, always also use a redundant system.

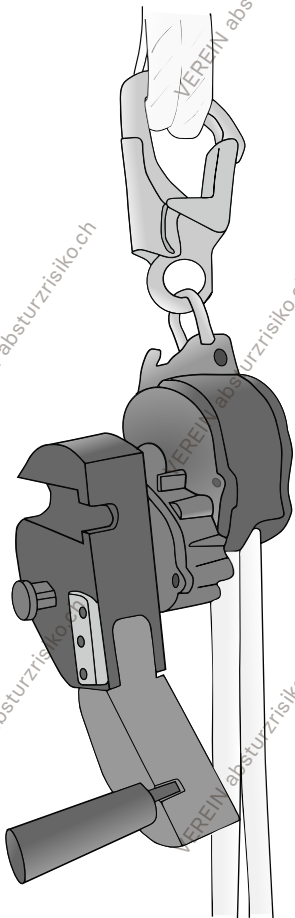
Frequent rescue practice is mandatory!

A SIMPLE RESCUE WITH A RESCUE ABSEIL DEVICE

- Mount the rescue device above the casualty
- The casualty must be freed of his fall arrest system. Most systems have an integrated feature to lift or unload a casualty.
- Lower the victim with an abseil device. For devices with a built-in brake, the abseil speed is limited to ~0.8 m/s regardless of weight.

CAUTION IS ADVISED

Additional risks for rescuers and casualties must be prevented at all costs → Where it is technically and timewise possible, install a redundant safety system.



A simple rescue device with an integrated crank to unload the casualty from the fall arrest system. (The entire system should always be preassembled and ready in a rescue bag).

PFPE Maintenance

Valuable lives depend on PFPE - careful and conscientious handling should therefore be a matter of course.

BEFORE EVERY USE

- The correct functionality of fall arrest harnesses, height safety, length adjustment, fall arrest and restraining devices, etc. must be ensured before every use

- Inspect all equipment for faults visually before every use

REGULAR INSPECTIONS

- In addition to visual site inspections, equipment should be tested when necessary, or at least once a year according to the manufacturer's recommendations

- Be careful with height safety and rescue devices
 - Follow the manufacturer's instructions

STORAGE

- Fall protection equipment must be stored in a dry, well-ventilated area

- Wet equipment? Hang the equipment like clothes, loosely to dry – but not too close to a heating source!

- Protect the equipment from direct sunlight. UV rays can accelerate the aging process

CLEANING

- Clean according to the Manufacturer's instructions
 - for information contact the manufacturer

- Washing the equipment with lukewarm water is usually acceptable

DANGEROUS SUBSTANCES

- Avoid contact with acids, bases, oils, and cement milk.

- Careful of sparks when working with cutting torches and grinders!
 - Fireproof harnesses and webbing are available on the market.



DAMAGED MATERIAL?

→ Defective material or material that was involved in a fall i.e., harness, rope, carabiner, must be replaced.

EMPLOYER'S RESPONSIBILITIES

→ Providing the suitable PFPE

→ Ensuring and regulating equipment maintenance

→ Ensuring correct use of PFPE (according to the manufacturer's instructions)

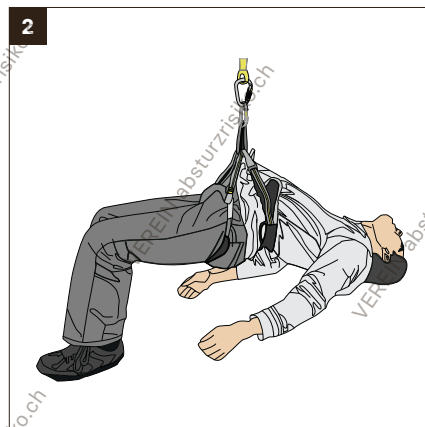
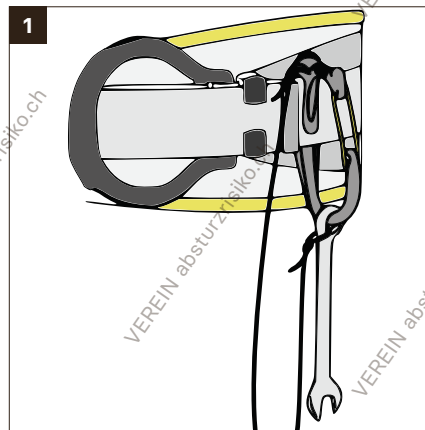
MARKING

→ Use designated areas for labelling

→ When labelling take care not to cover parts of the equipment relevant to safety.

Checklist

- ✓ Are the PFPE users demonstrably instructed and trained by a certified instructor?
- ✓ Is working alone excluded?
- ✓ Are all the workers assigned to a team?
- ✓ Is the equipment properly labelled? (i.e., manufacturer, model year, etc.)?
- ✓ Is the equipment approved for use? (i.e., after annual inspection by a competent person)
- ✓ Has the user inspected their equipment before every use?
- ✓ Are only locking carabiners being used? Are they all screwed securely?
- ✓ Are the appropriate carabiners attached to the anchor points? → steel carabiners
- ✓ Are the correct eyelet/loops being used on their harnesses? → i.e., no lanyards attached to material loops.
- ✓ Are the harnesses correctly worn and adjusted?
- ✓ Are the anchor points above head height where possible?
- ✓ Will the user be supported by their restraint system in each situation?
- ✓ Has the fastest rescue tactic been planned and practiced?
- ✓ Only the proper equipment in use? (No alpine climbing gear)
- ✓ Are all tools secured to the harness or wrist?¹
- ✓ Only full-body harnesses in use?²
- ✓ Do all helmets have chinstraps?³



Limitations: Working with PFPE and working on a suspended rope

Carrying out work on a suspended rope (Rope access and positioning technique) requires specialist training (BauAV ART. 118, see www.suva.ch/seil)

WORKING WITH PFPE

- Working with PFPE is work with rope protection, to protect against a fall.
- Lowering a casualty with a lanyard/rope is part of the basic knowledge for working with PFPE.
- Rescue exercises must always be carried out with a secondary safety system (redundant system)
- Positioning at the work site, without moving on/with the rope or lanyard is not considered to be 'working on a suspended rope'.
- If a system failure during worksite positioning inevitably leads to a fall, an additional fall arrest system with energy absorber must be used.

Fall protection with PFPE

Restraining system



Prevents a fall

System is only used for fall protection or positioning. Controlled movement without a rope is possible.

Basic course min. 1 day

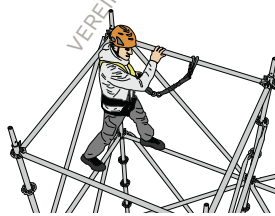
www.suva.ch/psaga

Work site positioning



Positioning at work-site (with redundant system)

Arresting system



Controlled fall arrest

Rope access and positioning

Ascending/descending positioning on a taut working rope



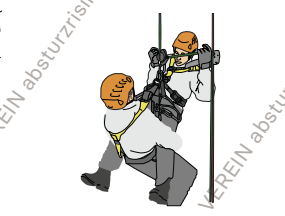
System failure without safety rope leads to a fall.

Training working at height Level 1-3

www.suva.ch/seil

Rope assisted rescue

Rescue with rope assistance hanging on the rope



System failure without safety rope leads to a fall

In-depth specialist training in rescue techniques

WORKING ON SUSPENDED ROPE

- Working on suspended rope or working with rope supported access and positioning techniques are activities in which a person is stabilised with a taut rope without secure footing on a structure. A system failure without a safety rope will inevitably result in a fall.

- The above techniques are procedures in which users, among other things, use ropes or lanyards, redundantly secured, and position themselves horizontally or vertically.

- Art. 118 of the BauAV must be observed when working on a suspended rope.

- The Construction Work Ordinance (or country-relevant body) must be adhered to during all maintenance and inspection work around structures and rock clearing work sites.

- Only workers who have the appropriate training and are qualified to work on a suspended rope (min. Level 1 or 2) may undertake such work.

- Further info: www.suva.ch/seil

ROPE ASSISTED TREE CLIMBING TECHNIQUES

- This is a rope technique used in forestry and the tree care industry which goes beyond purely tree climbing. The methodology includes climbing and rigging techniques, professional use of the chainsaw on the tree, special timber salvaging and logging techniques and safety measures.

- Further info www.suva.ch/forst

ROPE ASSISTED RESCUE

- Rope assisted rescue is a procedure in which the rescuer(s) move on or with the rope, vertically or horizontally.

- Practice and training of rope rescue techniques in the context of a professional activity, requires in-depth experience from the instructors. They must be carried out and supervised by an appropriately instructor (e.g., Height Worker Level 3, Instructor height rescue).



Further background knowledge

AT WWW.ABSTURZRISIKO.CH YOU WILL FIND A WIDE RANGE OF RESOURCES:

- Training materials (basic module)
- Industry-related in-depth training for PFPE (possibly subject to a charge)
- Training offers
- Tools for training providers
- Services for working at height
- Graphics for own work
- PFPE - video sequences
- Tips & tricks
- New or unknown products
- Field reports
- Fall risk: best practice

... and much more

