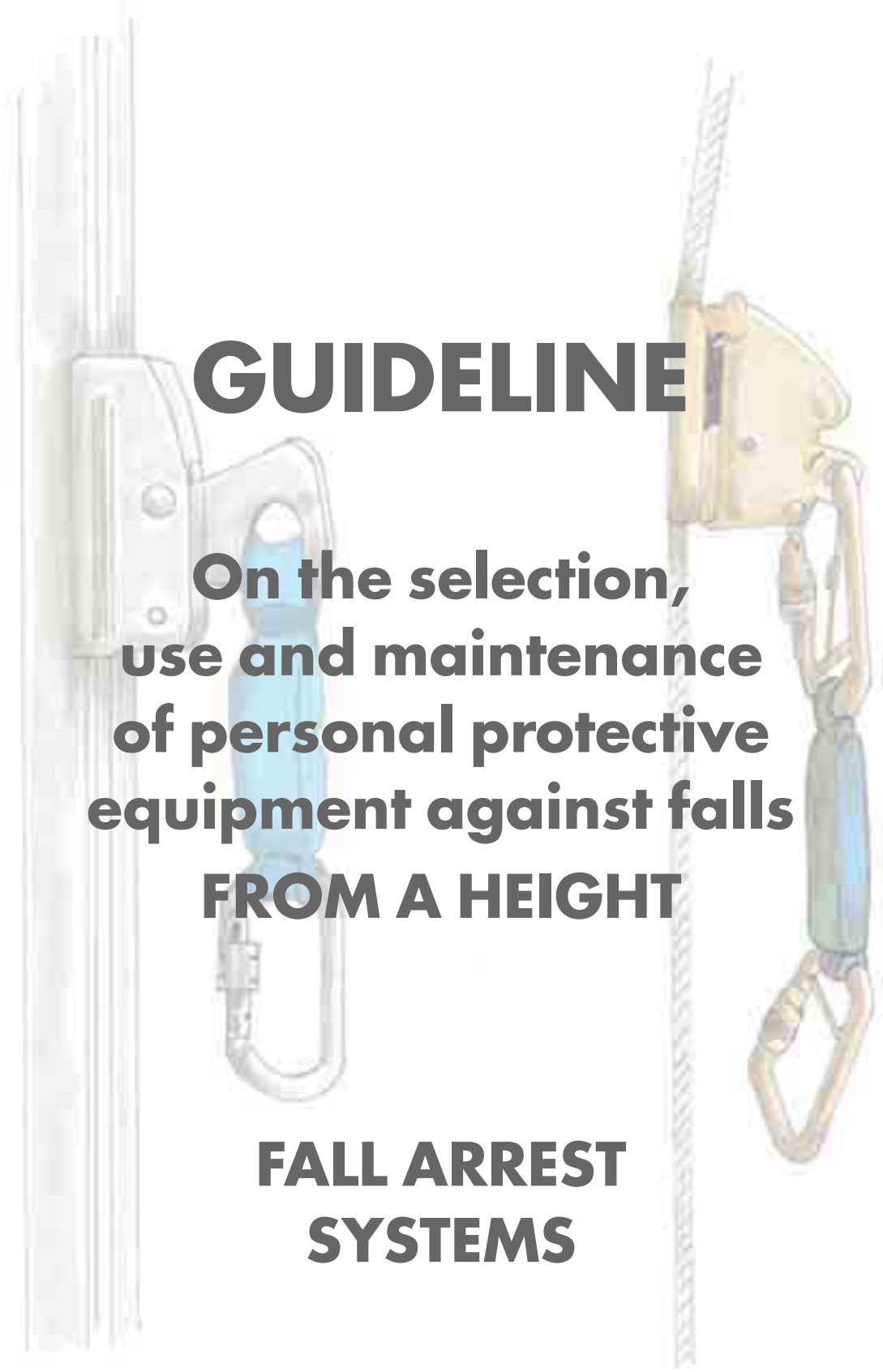

GUIDELINE

On the selection, use and maintenance of personal protective equipment against falls FROM A HEIGHT

FALL ARREST SYSTEMS

GUIDELINE

On the selection, use and maintenance of personal protective equipment against falls from a height

FALL ARREST SYSTEMS

Fogli d'Informazione ISPESL

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Introduction

Work at a height may expose workers to particularly severe risks to their health and safety, notably to the risks of falls from a height and other serious occupational accidents, which account for a large proportion of all accidents, especially of fatal accidents.

Improving safety, hygiene and health at the workplace is a basic goal to be achieved through European Directives and national current laws.

This guideline aims at contributing effectively to improving safety at work by giving employers and all the people involved with safety tasks, suggestions on the minimum content of the risk assessment document and on criteria to select and use Personal Protective Equipment (PPE) against falls from a height.

These PPEs, in compliance with Art. 41 of Legislative Decree 626/94 as amended "should be used when risks cannot be eliminated or reasonably minimised adopting technical prevention measures, collective protection devices, measures, methods or procedures to re-organize work duties".

The following areas have been examined: risk assessment for falls from a height, description, selection, use, inspection, maintenance, storage and shipment of fall arrest systems.

Ministry of Labour
Protection and Work Conditions
Division

Director General
Dr. Paolo Onelli

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for Health and Safety at Work

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Prof. Antonio Moccaldi

PREFACE

To meet the different demands and need of the world of work, ISPESL has to be a training body and a reference body to provide advice and assistance on prevention and protection of the workplace, and it must be ready to co-operate with other public and private bodies whose tasks include safety to achieve common goals such as the reduction in the number of work accidents and the protection of workers' health.

ISPESL, performing new tasks as public body, with by-laws related to the new regulation on research bodies and updated to take into account the principles and criteria from the new regulations on improving safety and health at work, may offer further and more effective type of actions in the field of research and transfer of results. These achievements are of paramount importance in performing its duties of assistance, advice, information and drafting of guidelines to support all sectors showing a high level of risk, such as construction, SMEs, agriculture and transportation.

Notably, good practices guidelines greatly contribute to improving health and safety at work.

This guideline provides indications on the minimum content of risk assessment document on the selection, use, maintenance of Personal Protective Equipment (PPE) against falls from a height, and fall arrest systems.

The indications in this guideline were drafted in compliance with current laws and regulation on the prevention of accidents and hygiene at work

Italian National Institute
for Health and Safety at Work

Director General
Dr. Umberto Sacerdote

TABLE OF CONTENTS

FOREWORD

When work at a height cannot be carried out safely and under appropriate ergonomic conditions from a suitable surface, the work equipment most suitable to ensure and maintain safe working conditions must be selected. Collective protection measures must be given priority over personal protection measures.

If above measures alone are not enough to avoid or minimise the risks to safety and health at work, with reference to the amount of residual risk that cannot be eliminated, the use of personal protective equipment becomes compulsory (PPE).

To select a suitable personal protective equipment it is necessary to define beforehand the type and amount of residual risks that cannot be eliminated from the workplace, with specific attention given to the following items: severity and probability of risk, types of possible hazards for workers, working conditions.

Since there are no personal protective equipment that can ensure a complete protection or at least in the large majority of work-related risks, the best solution offering a reasonable compromise between safety and comfort should be selected.

Obligations of the employer on the use of personal protective equipment are determined by Title IV of the Legislative Decree. 626/94, article 43 stating that:

"1) In order to select the personal protective equipment, the employer:

a) performs the analysis and assessment of risks that cannot be avoided using other means;

b) identify what personal protective equipment is suitable to the risks, taking into account any possible risk due to the use of the personal protective equipment;

c) assesses, using information provided with the personal protective equipment by its manufacturer and directions for use, the characteristics of PPEs available on the market and compares them with required characteristics;

d) updates selection made every time there is a meaningful change in the assessment elements.

2) The employer, even using directions provided by the manufacturer, identifies the working conditions in which every PPE should be used, especially length of use, depending on:

a) amount of risk;

b) frequency of risk exposure;

c) characteristics of the workplace of each worker;

d) PPE performance.

3) The employer supplies workers with PPE meeting the following requirements:
   a) PPEs should be compliant with standards established by Legislative Decree December 4, 1992, No. 475.
   b) Moreover, PPEs under a) should:
      - be suitable for risks to be prevented, without implying greater risks;
      - be suitable for current condition in the workplace;
      - take into account the ergonomic or health requirement of workers;
      - be suitable for workers and adjusted as required.
   c) In case of multiple risks requiring the concurrent use of several PPE, they should be compatible and such as to be still effective, even in concurrent use, against risk and related risks.

4) The employer:
   a) maintains the efficiency of PPEs and ensure their hygiene conditions, through required maintenance, repairs and replacements;
   b) ensures that PPEs are used only for their specific purpose, apart from specific and particular events, and in compliance with the instruction from the manufacturer;
   c) provides clear instruction to workers;
   d) assigns every PPE for personal use only and, if a PPE is to be used by more than one person, puts into place suitable measures so that its use does not represent sanitary or hygienic problems to the different operators;
   e) preliminarily informs workers on the risks against which the PPE is a protection from;
   f) lets suitable information on every PPE be available in the firm, or business unit;
   g) ensures adequate training and specific training sessions, if required, on the correct and actual use of PPEs.

5) In any case, training is essential and mandatory for:
   a) every PPE that, as stated by Legislative Decree 4 december, 1992, No. 475, belongs to the third category;
   b) omission."

"The duties of workers on the use of PPE are established by Title IV of the Legislative Decree 626/94, and article 44 states that:

1) Workers attend the training programme organised by the employer when necessary.

2) Workers use PPEs that are available to them following information and training received.

3) Workers:
a) take care of PPEs that are available to them;
b) do not alter them, unless such alterations are authorised.

4) After use, workers follow the undertaking procedures on how to return PPEs.

5) Workers immediately notify their employer or the relevant manager of any defect or problem they have detected while using the PPEs that are available to them."

Moreover, in the aforementioned Legislative Decree, article 40, paragraph 1, states that "a personal protective equipment is any equipment designed to be worn by the worker to protect him/her against one or more risks that may jeopardise his/her safety or health at work and any item or accessory designed for the same purpose" and article 43, paragraph 5, states that operators using PPE against falls from a height should be trained.

Personal protective equipment against falls from a height are classified as being Category III as defined by Legislative Decree 4 December, 1992, No. 475 (protection from fatal risks or serious and permanent injuries).

As to PPEs against falls from a height, a PPE includes not only the part of the equipment to be worn by the worker, but the entire fall arrest system, with every item and accessory (connection) to be secured to a safe anchor point.

1. Objective and scope

This guide, that is not binding, aims at providing indications to identify and use personal protective equipment against falls from a height named "fall arrest systems", that usually comprise a device to support the body and a connecting system that can be connected to a safe anchor point.

The necessary requirements of the safe anchor point, and of the minimum "free space" (minimum clearance for safe fall) required below the worker, the proper way to wear the device to support the body and to connect the connecting system to the safe anchor point, should be provided by the manufacturer of the fall arrest system in the information notice.

The content of this guide thus does not imply that comparing suggestions given with the actual working conditions and the protection requirements of each specific working environment is not needed.

This guideline does not apply to positioning equipment and descent equipment.

Below is a non comprehensive list of work where fall arrest systems are used:

- work on poles and lattice;
- work on gutters and eaves;
- work on roofs;
- work on ladders;
- work on building demolition;
- work on mobile elevated work platforms;
- work on suspended platforms;
- assembly of prefabricated elements;
- work on scaffolds;
- work on pylons;
- etc.

Moreover, the general purpose of this guideline is to provide a method for risk assessment of work at a height, where fall arrest systems are used against the risk of falling from a height.

2. STANDARD REFERENCES

The normative references used in this guideline are the Laws of the State on hygiene and health protection at work and on personal protective equipment.

2.1 Laws

Presidential Decree 27 April 1955, No. 547
Rules on accident prevention and hygiene at work.

Presidential Decree 7 January 1956, No. 164
Rules on the prevention of occupational accidents in construction.

Presidential Decree 19 March 1956, No. 303
General rules on hygiene at work.

Ministerial Decree 22 May 1992, No. 466
Regulation on the acknowledgement of the efficacy of an individual system to be used in the assembly and dismantling of metal scaffoldings.

Legislative Decree 4 December 1992, No. 475
Adoption of Directive 89/686/EEC of the Council of 21 December 1989, on the convergence of Laws of Member States on Personal protective equipment.

Legislative Decree. 19 September 1994, No. 626 as amended
Adoption of Directive 89/391/EEC, 89/654/EEC, 89/655/EEC, 89/656/EEC, 90/269/EEC, 90/270/EEC, 90/394/EEC, 90/679/EEC, 93/88/EEC, 95/63/EC, 97/42/EC, 98/24/EC, 99/38/EC, 2001/45/EC, 99/92/EC, on how to improve safety and health of workers at work.

Legislative Decree 14 August 1996, No. 494 as amended
Adoption of Directive 92/57/EEC.

Legislative Decree 2 January 1997, No. 10
Adoption of Directives 93/68/EEC, 93/95/EEC and 96/58/EEC on Personal Protective Equipment.

2.2 European standards

UNI EN 341	Personal protective equipment against falls from a height. Descender devices
UNI EN 353-1	Personal protective equipment against falls from a height - Guided type fall arresters including a rigid anchor line
UNI EN 353-2	Personal protective equipment against falls from a height - Guided type fall arresters including a flexible anchor line
UNI EN 354	Personal protective equipment against falls from a height - Lanyards
UNI EN 358	Personal protective equipment for work positioning and prevention of falls from a height - Belts for work positioning and restraint and work positioning lanyards
UNI EN 355	Personal protective equipment against falls from a height - Energy absorbers
UNI EN 360	Personal protective equipment against falls from a height - Retractable type fall arresters
UNI EN 361	Personal protective equipment against falls from a height - Full body harnesses
UNI EN 362	Personal protective equipment against falls from a height. Connectors
UNI EN 363	Personal protective equipment against falls from a height - Fall arrest systems
UNI EN 364	Personal protective equipment against falls from a height. Test methods
UNI EN 365	Personal protective equipment against falls from a height - General requirements for instructions for use and marking
UNI EN 795	Protection against falls from a height - Anchor devices - Requirements and testing

3. Definitions

The following terms are used in this guideline:

Energy absorber: any item or component of a fall arrest system designed to dissipate the kinetic energy developed during a fall from height.

Primary straps/secondary straps: primary straps for body harness are designed by manufacturers to support the body or exert pressure on it during a fall or after a fall arrest. All other straps are secondary straps.

Component: any part of a system sold by vendors and supplied with package, markings and information from the manufacturer. Body supports and lanyards are instances of system components.

Connector: connecting item or component in a fall arrest system.

Lanyard: connecting item or component in a fall arrest system. Lanyards can be made of a synthetic fiber rope, a metal rope, a strap or chain. In current laws it is also named as "arrest device".

Retractable lanyard: connecting item of a retractable type fall arrester. Retractable lanyards can be made of a metal rope, a belt or a synthetic fiber rope.

Guided type fall arrester: fall arrester equipped with a self-locking system and a guided system. The guided type fall arrester moves along an anchor line with the user without requiring manual adjustment when ascending or descending and, in case of fall, it automatically locks onto the anchor line.

Retractable type fall arrester: fall arrester equipped with a self-locking system and with an automatic system for tension and release of the lanyard, i.e. of the retractable lanyard. An energy dissipator can be integrated in the device itself or an energy absorber can be integrated in the retractable lanyard .

Guided type fall arrester including a flexible anchor line: a subsystem made of a flexible anchor line, self-locking guided type fall arrester including a flexible anchor line and a connector or a lanyard with a connector on one end. An energy dissipator can be placed between the fall arrester and the anchor line or an energy absorber can be integrated in the lanyard or on the anchor line.

Guided type fall arrester including a rigid anchor line: a subsystem made of a rigid anchor line, self-locking guided type fall arrester including a flexible anchor line and a connector or a lanyard with a connector on one end. An energy dissipator can be placed between the fall arrester and the anchor line or an energy absorber can be integrated in the lanyard or in the anchor line.

Anchor point: any element or series of component elements with one or more anchor points.

Body support device: see Body harness

Personal protective equipment (PPE) against falls from a height: Device to support a person onto a safe anchor point to safely prevent or arrest falls from a height.

Stoppage distance: the vertical distance H in meters, measured at the mobile load bearing point of the connecting sub-system (harness anchorage point) from the initial position (onset of the free fall) to the final position (equilibrium after arrest), excluding the displacements of the full body harness and its fastening component.

Element: part of a component or subsystem. Ropes, straps, attachment elements, accessories and anchor lines are instances of elements.

Energy dissipator element: element in a connecting subsystem to arrest falls. An energy dissipator element can be Integrated in fall arresters, in lanyards or in anchor lines.

Hook: connector with an automatic closing system and automatic or manual locking system.

Body harness: body support mainly to arrest falls, or a component of a fall arrest system. The body harness may include belts, accessories, buckles or other elements specifically arranged and assembled to restraint the body of an individual while falling and after fall arrest.

Work at height: any work exposing workers to the risk of a fall from a height greater than 2 metres from a stable surface (Legislative decree 235/2003 art. 4).

Flexible anchor line: specific connecting element for a subsystem with fall arrest. A flexible anchor line can be made of a synthetic fiber rope or a metal rope and is designed to be attached to an overhead anchor point.

Rigid anchor line: specific connecting element for a subsystem with fall arrest. A rigid anchor line can be made of a rail or metal rope and it is attached to a frame so that lateral movements of the line are limited.

Snap hook: a type of hook.

Attachment/detachment point: point along the anchor line where a guided type fall arrest can be attached or detached.

Fall arrest system: personal protective equipment including a body harness and a connecting subsystem to arrest falls.

Work positioning rope: a component around the body comprising elements that are arranged and fitted with a work positioning lanyard. It can support the user at a height so that he/she can work with free hands. It is not a component designed to arrest falls.

Work positioning lanyard: component used to connect a belt to an anchor point, or a framework, by surrounding It, and thus becoming a support. It is not a component designed to arrest falls.

Restraint belt: component surrounding the body comprising elements that, arranged and fitted with a restraint lanyard can limit the horizontal travel of user avoiding assuming positions that may entail the risk of falling from a height while working. It is not a component designed to arrest falls.

Subsystem: group of elements and/or components that are a unique part of a system from a vendor and supplied with package, markings and information from the manufacturer.

4. Risk assessment for falls from a height

This guide provides indications to be used when drafting the risk assessment document and the ensuing identification of prevention and protection measures and of personal protective equipment as established by Legislative decree 626/94 as amended, and Legislative decree 494/96 as amended.

4.1 Risk analysis for falls from a height

While carrying out work at height, where workers are exposed to great hazards for their health and safety, in particular the hazard of falls from a height, and where the difference in height exceeds current law requirement, collective protection measures should be adopted (guard rails, decks, safety nets, etc.). Any residual risk should be eliminated or minimised using positioning or fall arrest PPE.

4.1.1 Types of risks

When working at a height there are risks of falling from a height or strictly related to falling, and related to the specific work to be carried out, that may be fatal or cause body injuries or affect health.

The following types were identified:

a) the prevailing risk of falling after a fall from a height;

b) the risk following the fall flowing from:
- swinging of the body hitting obstacles ("pendulum effect");
- arrest of fall due to the stresses transmitted to the body by the harness;
- motionless suspension of the worker's body which stays hanging from the fall arrest equipment and time spent in such position;

c) risk related to the personal protective equipment against falls due to:
- personal protective equipment not fitting properly;
- personal protective equipment hindering free body movement;
- tripping over components of the personal protective equipment;

d) risk triggering falls due to:
- insufficient grip of footwear;
- fits of giddiness;
- eye-dazzling;
- lack of visibility;
- heatstroke or sunstroke;
- quick fall of temperature;

e) specific risk related to the kind of work:
- mechanical (sharp edges, sharp tools, fall of objects, etc.);
- thermal (sparks, free flame, etc.);

- chemical;
- electrical;

f) risk related to weather conditions:
   - wind, rain or ice over walkways, etc.

4.2 Risk exposure

In every moment, while working, risk exposure should be minimised, especially for those risks that can cause death or permanent injury and if they cannot be timely perceived by the worker before they occur. The importance of hanging motionlessy in state of uncounsciousness should not be undervalued, because it may lead to complications that could impair vital functions: in such conditions, hanging time, even less than thirty minutes, may cause serious illnesses due to the action exerted by the harness.

The risk assessment document and the operating plan shall provide for risks of falling from a height as well as the risk of hanging motionlessly and put into place emergency measures and procedures to reduce the time of hanging motionlessly to few minutes.

4.3 Minimising risks

In accident and heath risk prevention, great importance should be given to technical-organisational measures to eliminate or reasonably minimise hazards before they occur and safely protect workers using collective protection measures.

However, should these measures alone not be enough to avoid or reasonably minimise risks to safety and health at work, with reference to the amount of residual risk that cannot be eliminated, the use of personal protective equipment is mandatory.

Fig. 1 shows how to identify, eliminate and minimise specific work-related risks.

4.4 Emergency plan

Within risk assessment, an emergency procedure should be established to help workers who can be hanging from a fall arrest system and in need of assistance or help from other workers.

Therefore, when in working at a height a fall arrest systems should be used, workers with specific skills to ensure autonomous emergency help of the worker hanging from a fall arrest system should be included in the work unit.

If risk analysis and workplace compliance analysis show that such help cannot be autonomously given, a specific public help procedure is to be established.

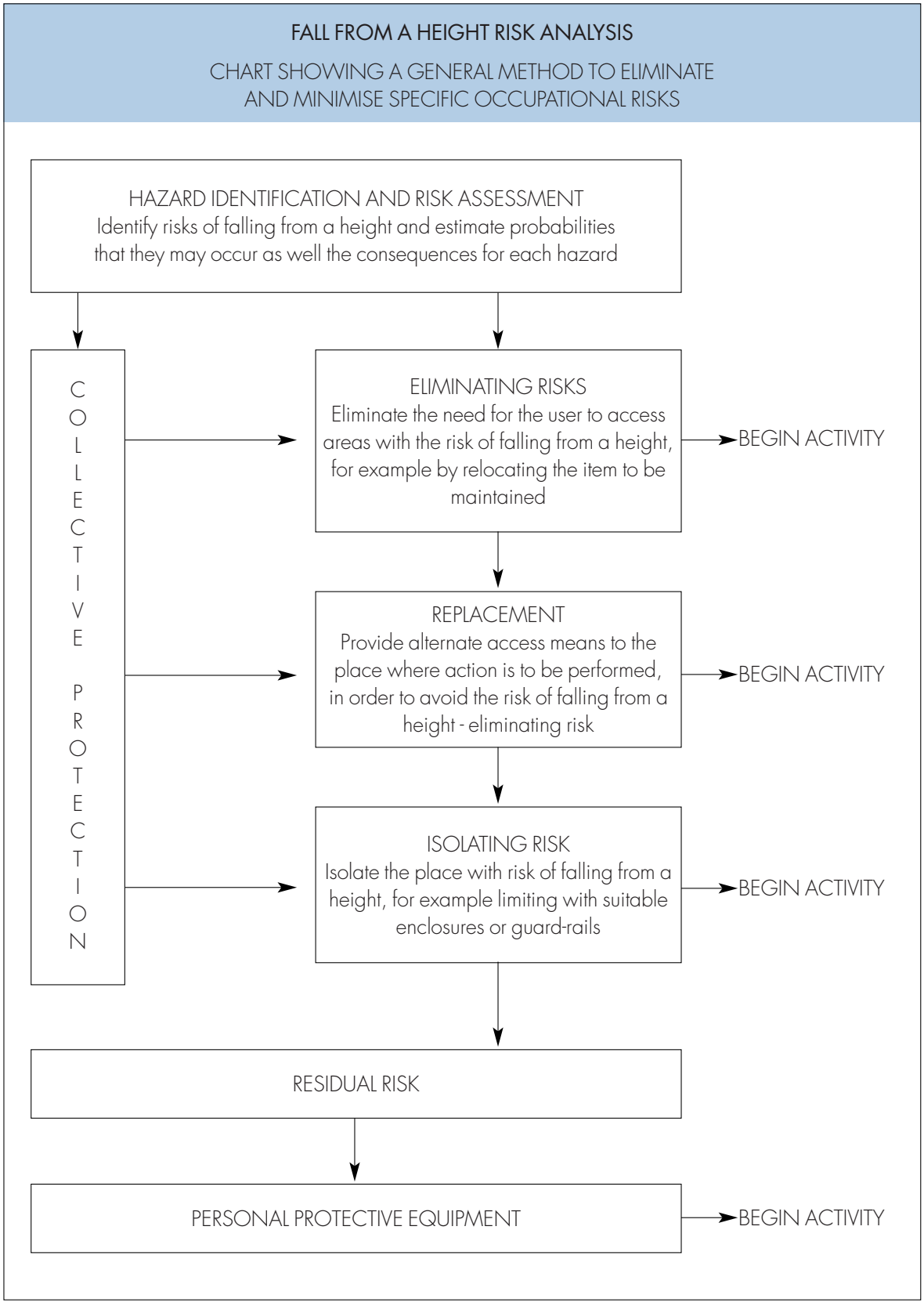


Fig. 1 - How to identify, eliminate and minimise specific work-related risks

5. CLASSIFICATION

Personal protective equipment to be used when carrying out work at a height where there is the risk of falling from a height can be classified as below (Fig. 2).

- Personal equipment to position and restraint workers in position and to prevent falling from a height.

  Work restraint systems are designed to support linesmen and other workers who work at a height on poles and other structures so that they can work with both hands free. Restraint systems are used to prevent falls from a height because they do not allow workers to reach areas where there is the risk of falling from a height. These systems are not designed to arrest falls.

- Personal protective equipment against falls from a height. Fall arrest.

  Equipment comprising a body harness, an energy absorber and a connecting system for an anchor point, they are designed to arrest falls.

  Such equipment should be anchored onto a fixed point.

- Personal protective equipment against falls from a height. Descender devices.

  These devices are used in emergency rescue and evacuation of individuals, a person may operate it or with another person to descend, at reduced speed, from a higher to a lower level.

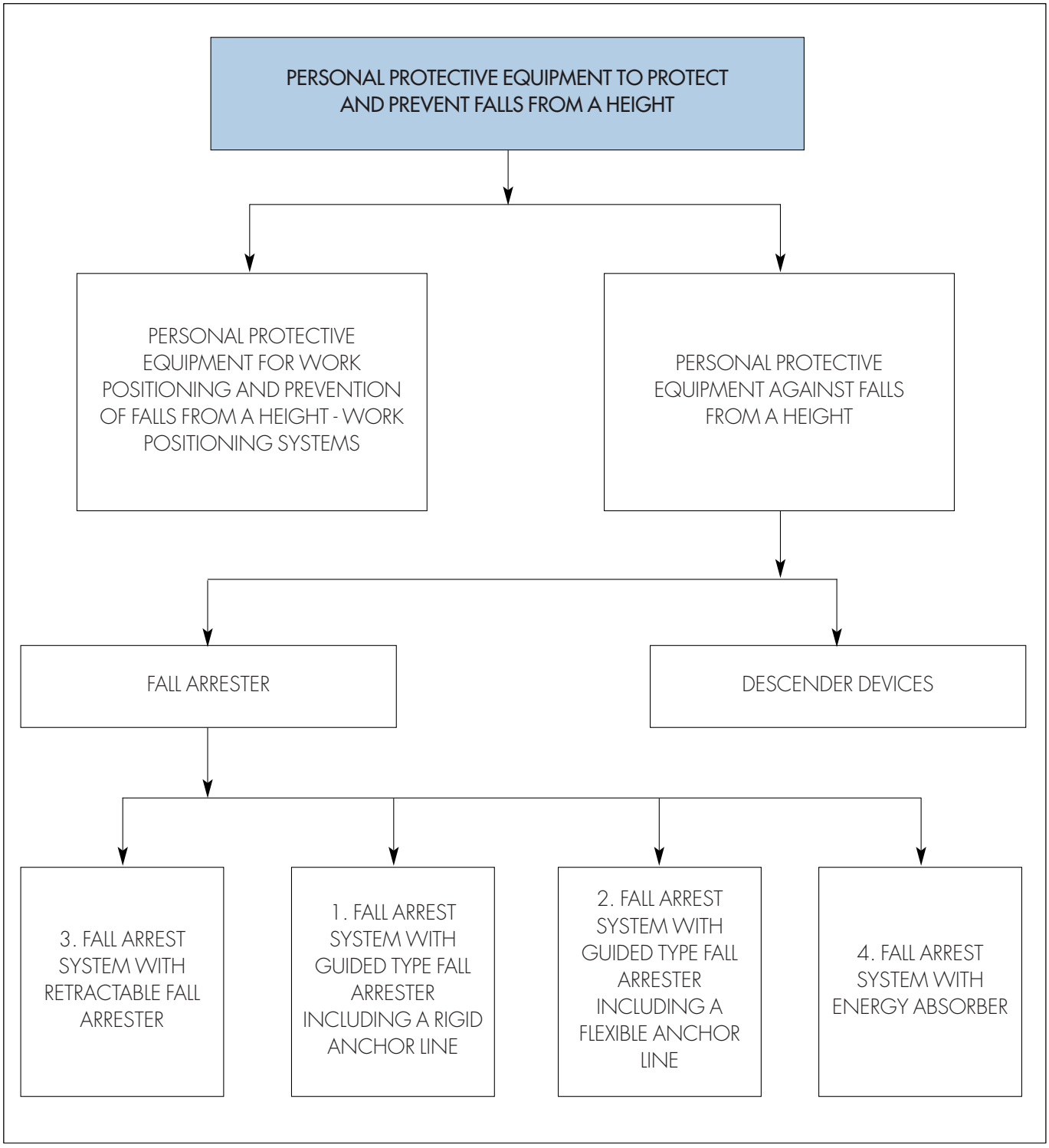


Fig. 2 - Classification of personal protective equipment

6. Description of systems, subsystems and components of personal protective equipment against falls from a height

6.1 Fall arrest systems

Fall arrest systems can be classified as below.

1) Fall arrest system with guided type fall arrester including a rigid anchor line:.

This system (figures 3 and 4) comprises a body harness and a subsystem with a rigid anchor line, self-locking guided type fall arrester including a flexible anchor line and a connector or a lanyard with a connector on one end. An energy dissipator can be placed between the fall arrester and the anchor line or an energy absorber can be integrated in the lanyard or in the anchor line.

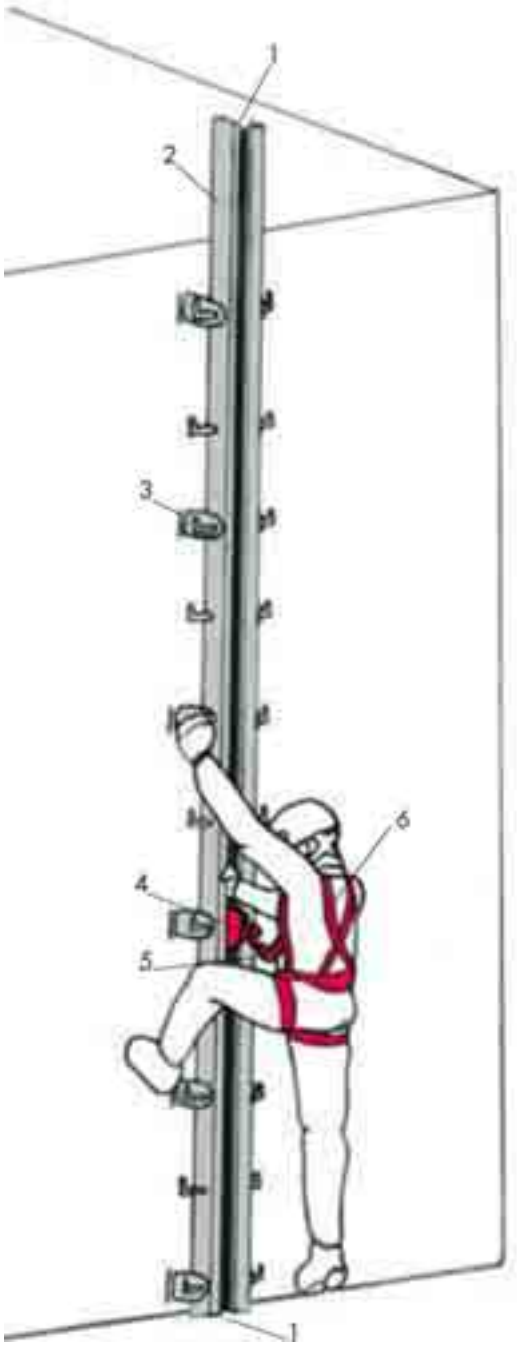
The guided type fall arrester (figures 5 and 6) travels along the anchor line, with the operator and no manual adjustment is required when ascending, and in some instances even when descending, and in case of falls, it self-locks on the anchor line.

A rigid anchor line can be made of a rail or metal rope and it is attached to a frame so that lateral movements of the line are limited

To limit lateral movements, the rigid anchor line should be secured to a framework at defined points, or the two ends of the metal rope should be secured to a framework and the metal rope should be stretched.

The anchor line is designed so that the guided fall arrester can travel only in the established directions and in such a way as to avoid the accidental detachment of the guided type fall arrester from the anchor.

All the attachment/detachment points of the anchor line are fitted with a stop to avoid that the guided type fall arrester is accidentally detached from the anchor line.



1. Attachment/detaqchment/stop point
2. Rigid anchor line
3. Bracket to secure to a suitable rigid structure
4. Guided type fall arrester with energy dissipator if necessary
5. Lanyard
6. Body harness with breastbone attachment for fall arrest

Fig. 3 - Example of a fall arrest system comprising a body harness connected by a short lanyard to a fall arrester on a rigid anchor line to climb poles, ladders and pylons

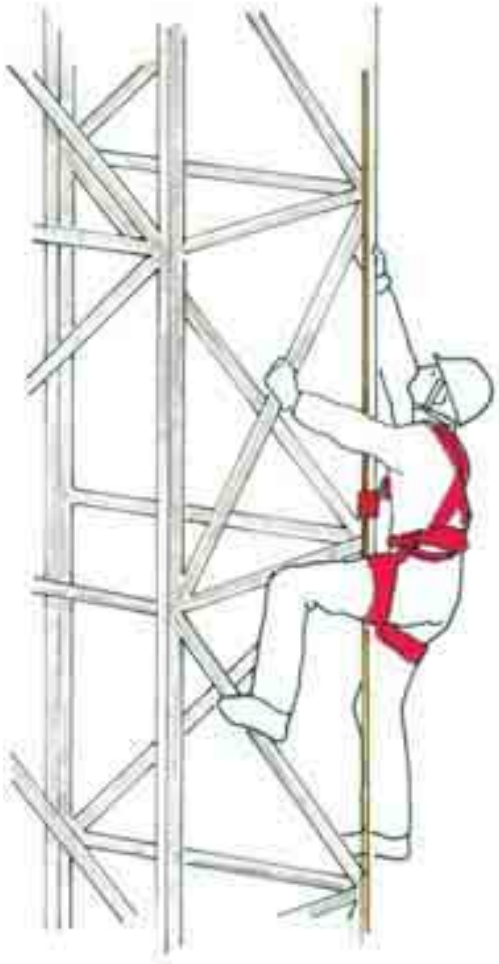


Fig. 4 - Example of climbing a pylon with a fall arrester with breastbone attachment

Lanyards can be made of a synthetic fiber rope, a metal rope, a strap or chain. The fall arrester should be fitted with a connector or of a connector on one end of a lanyard. If the fall arrester is only equipped with one connector, it can be permanently secured to the fall arrester or can be detachable. For fall arresters fitted with a lanyard, one end of the lanyard should be permanently connected to the device, while the other end should have a connector.

Manufacturer should specify the maximum length of the lanyard in the information provided with the product. If the guided type fall arrester is equipped with an opening device, the latter must be designed to be attached and detached by performing at least two manual voluntary consecutive actions.

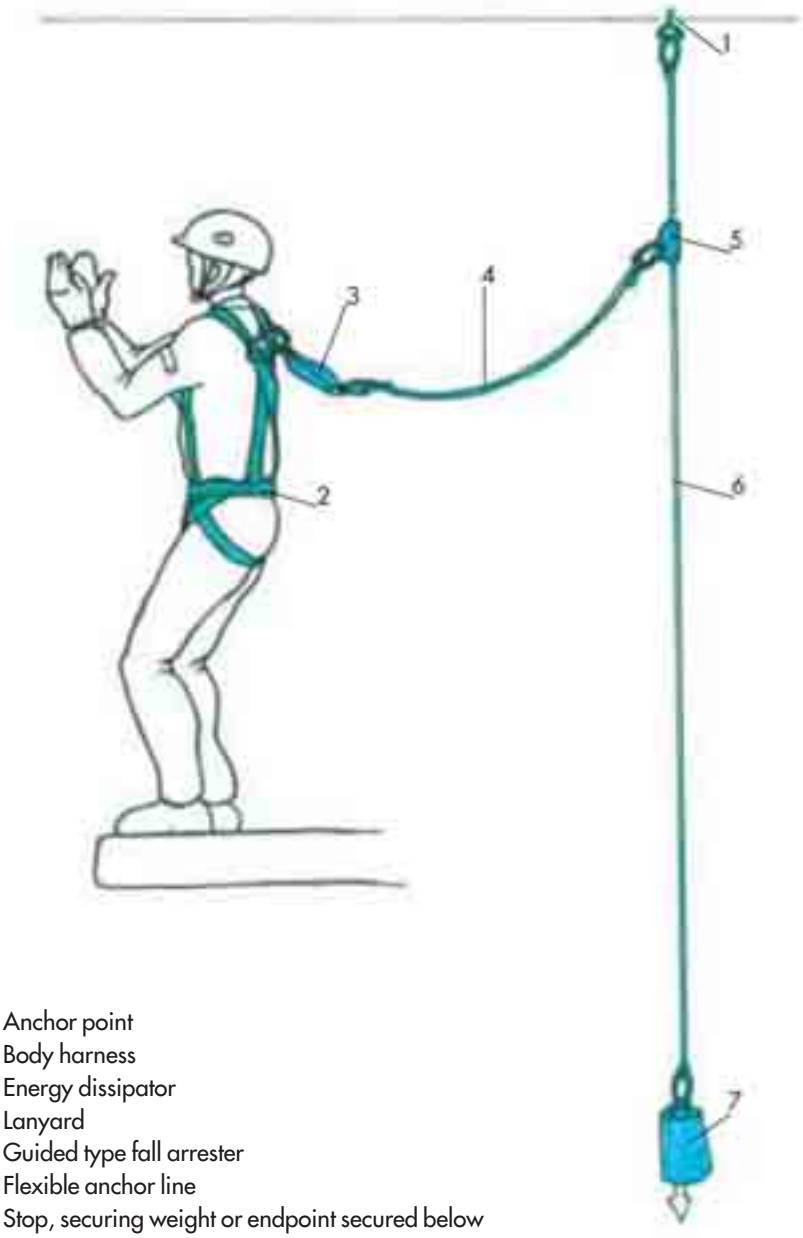
Fig. 5 - Fall arrester on Tee-rigid rail

Fig. 6 - Fall arrester on rigid rail with steel rope

2) Fall arrest system with guided type fall arrester including a flexible anchor line.

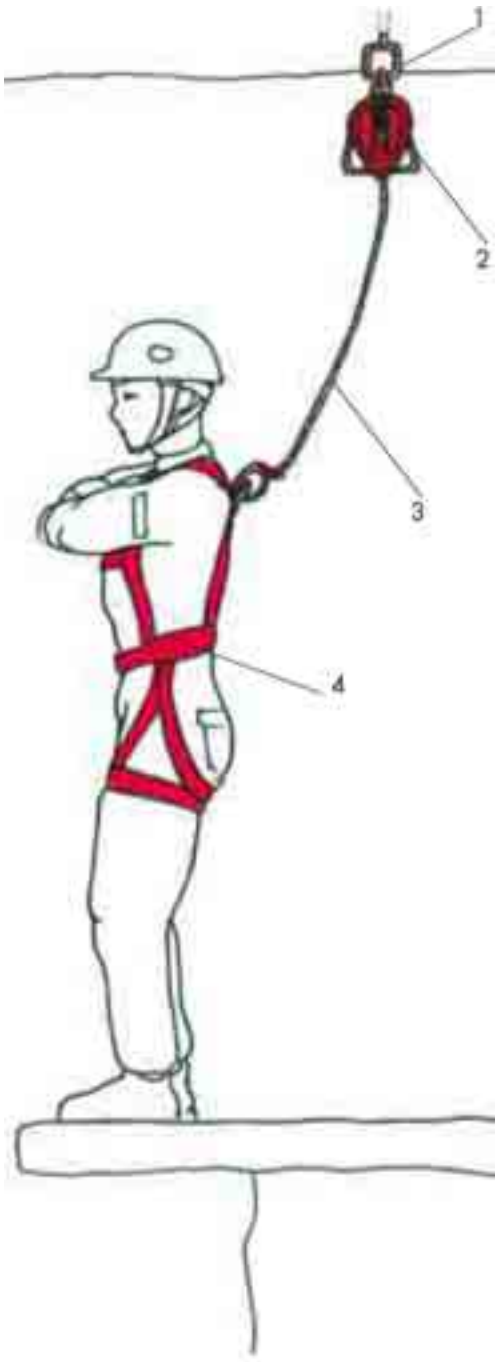
This system (Fig. 7) comprises a body harness and a subsystem made of a flexible anchor line, self-locking guided type fall arrester including a flexible anchor line and a connector or a lanyard with a connector on one end. An energy dissipator can be placed between the fall arrester and the anchor line or an energy absorber can be integrated guided type fall arrester in the lanyard or in the anchor line.

A flexible anchor line can be made of a synthetic fiber rope or a metal rope and is designed to be attached to an overhead anchor point.



1. Anchor point
2. Body harness
3. Energy dissipator
4. Lanyard
5. Guided type fall arrester
6. Flexible anchor line
7. Stop, securing weight or endpoint secured below

Fig. 7 - Example of fall arrest system comprising a body harness connected to guided type fall arrester including a flexible anchor line



1. Anchor point
2. Retractor
3. Retractable lanyard
4. Body harness

Note: The retractable fall arrester comprises a roller (2) and a retractable lanyard (3) that cannot be divided.

Flexible anchor lines are secured to overhead anchor points line and should be equipped with a stop, or designed in such a way that a stop can be fitted in, to avoid that the guided type fall arrester is accidentally detached from the anchor line.

Guided type fall arrester cannot be driven only by inertia. If the guided type fall arrester is equipped with a manual locking system, the lower end of the flexible anchor line is secured, for example, by a lower end attached to a weight.

Flexible metal anchor ropes are always fitted with a lower secured end or a weight.

Lanyards can be made of a synthetic fiber rope, a metal rope, a strap or chain. The fall arrester should be equipped with a connector or a connector on one end of the lanyard. If the fall arrester is only equipped with one connector, it can be permanently secured to the fall arrester or can be detachable. For fall arresters fitted with a lanyard, one end of the lanyard should be permanently connected to the device, while the other end should have a connector. The manufacturer should specify the length L_1 of the lanyard in the information provided with the product. The length of the lanyard, including the connector and the energy dissipator, should not exceed 1.0 m.

3) Retractable type fall arrester secured to a fixed anchor point.

This system (Fig. 8) comprises a body harness and a retractable type fall arrester (figures 9 and 10), secured to a fixed anchor point, that includes a self-locking retractor and a retractable lanyard. The length of the lanyard is automatically adjusted through an automatic tensioning system that pays out and retracts the lanyard, thus allowing the user to freely ascend and stop immediately in case of falls. The lanyard may be longer than 2 metres. An energy absorber may be integrated in the lanyard if the retractable type fall arrester does not include and energy dissipator.

Fig. 8 - Example of fall arrest system comprising a body harness and a retractable fall arrester

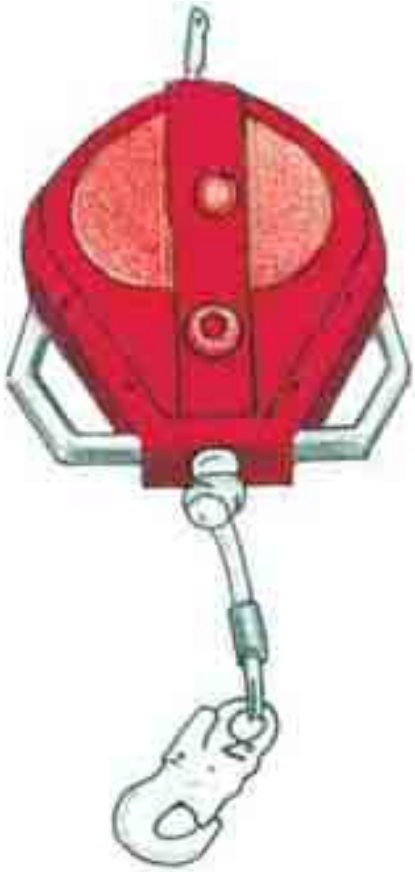


Fig. 9 - Retractable fall arrester

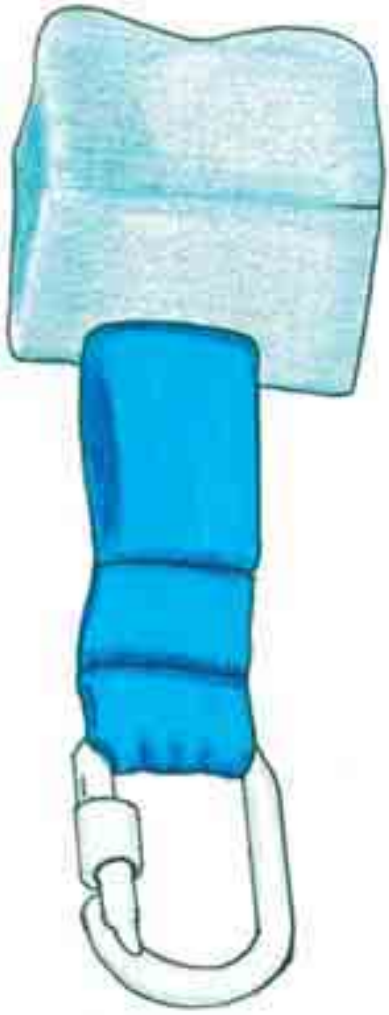
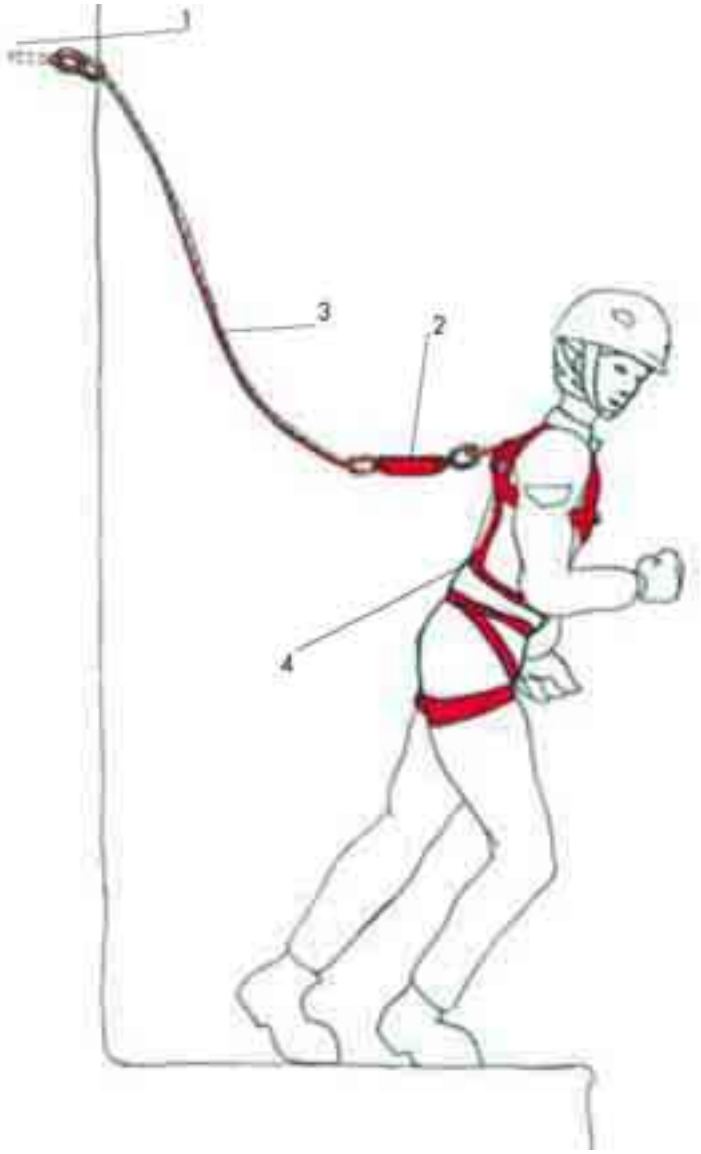


Fig. 10 - Retractable type strap fall arrester with energy absorber

4) Fall arrest system comprising a body harness, an energy absorber and a lanyard secured to a fixed anchor point.

This system (Fig. 11) comprises a device that is usually secured to a fixed anchor point with a fixed or adjustable length lanyard to which the body harness is secured. This system should integrate an energy absorber

Fig. 11 - Fall arrest system comprising a body harness, a lanyard and an energy absorber



1. Anchor point
2. Energy absorber
3. Lanyard
4. Body harness

6.2 Body harness

Body harnesses are meant to support the body and contribute to arrest falls. Body harnesses (figures 12 and 13) may comprises belts, accessories, buckles or other elements suitably arranged o or fitted to support the whole body of a person while falling and after fall arrest.

The primary straps of a body harness are meant to the body or exert pressure on it while falling and after fall arrest. All other straps are secondary straps. If correctly used, the body harness should perfectly fit the user by adjusting the specific means provided by the manufacturer and described in the user manual. A body harness perfectly fits the user when straps do not move or loosen.

The attachment item or items of the fall arrester can be positioned in such a way that, while using the body harness, they are in front of the chest (sternal attachment), above the centre of gravity, or on the shoulder or on the back of the user (back attachment).

The body harness can be integrated into garments. Even if the body harness is part of a garment, it should still be possible to perform a visual inspection of the harness.

A fixed or removable extension of the back attachment, to be used only with compatible components and systems can be used to facilitate connecting the other components of the fall arrest system.

Figures 14, 15 and 16 show other examples of body harness.

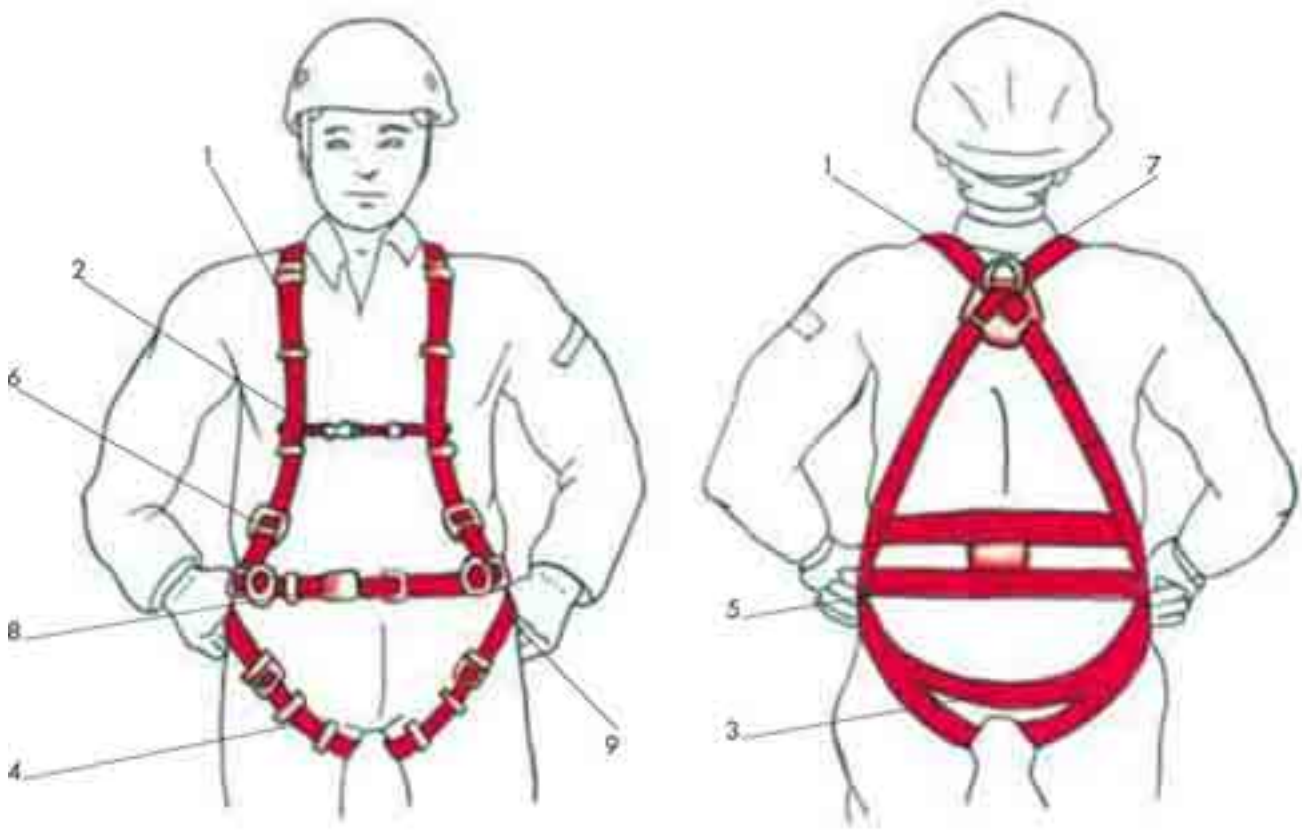
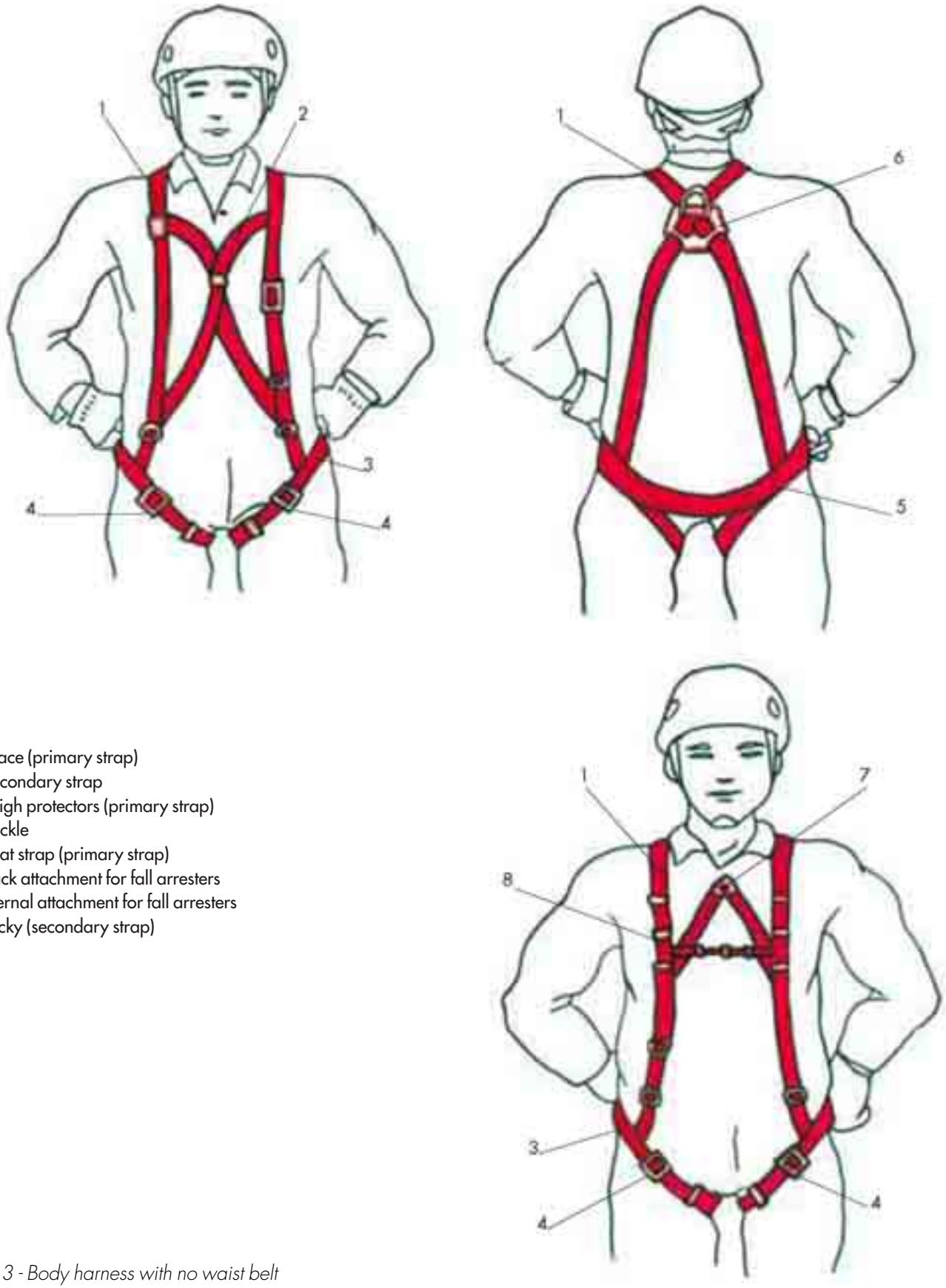


Fig. 12 - Body harness with waist belt

1. Brace (primary strap)
2. Dicky (secondary strap)
3. Seat strap (primary strap)
4. Thigh protector (primary strap)
5. Back support for work positioning (belt)
6. Adjustment
7. Attachment item for fall arresters
8. Buckle
9. Side attachment item to connect positioning or restraint lanyard. Not suitable against falls



1. Brace (primary strap)
2. Secondary strap
3. Thigh protectors (primary strap)
4. Buckle
5 Seat strap (primary strap)
6. Back attachment for fall arresters
7. Sternal attachment for fall arresters
8. Dicky (secondary strap)

Fig. 13 - Body harness with no waist belt

Fig. 14 - Body harness with integrated work positioning belt

Fig. 15 - Body harness with integrated work positioning belt and sternal attachment

Fig.16 - Body harness with integrated work positioning belt and back attachment

6.3 Lanyards and energy absorbers

Lanyards are elements connecting a body harness and an anchor point, both fixed or movable on rigid or flexible rails. Lanyards can be made of a synthetic fiber rope, a metal rope, a strap or chain.

An assembly (Fig. 17) comprising a lanyard (Fig. 18) and an energy absorber (Fig. 19) is used to limit to 6 kN the force on the attachment of a body harness in a fall arrest.

The maximum length of a fall arrest lanyard, including the energy absorber, ending sections and connectors, should not exceed 2 metres.

Figures 20, 21 and 22 show other examples of lanyards with energy absorbers.

The maximum extension of an energy absorber, under a dynamic load, should be less than 1.75 meters, because arrest distance H is to be $< 2L_t + 1.75$ m, depending on the total length L_t of the lanyard with the energy absorber (ref. EN 355:2002).

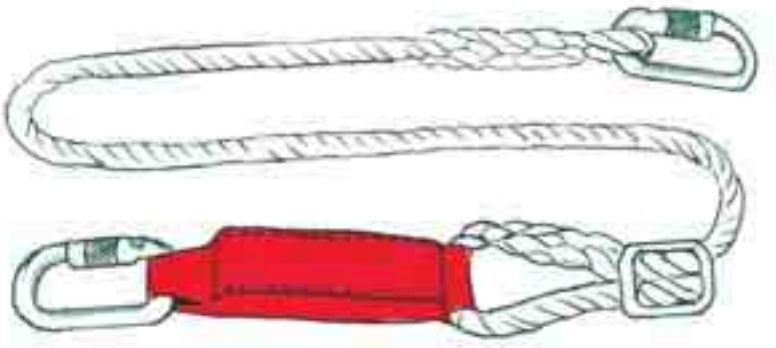


Fig. 17 - Adjustable lanyard with built-in energy absorber

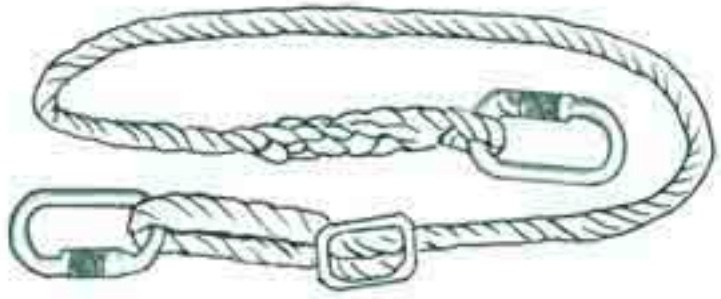


Fig. 18 - Adjustable lanyard without energy absorber

Fig. 19 - Energy absorber

Fig. 20 - Fixed band lanyard with energy absorber

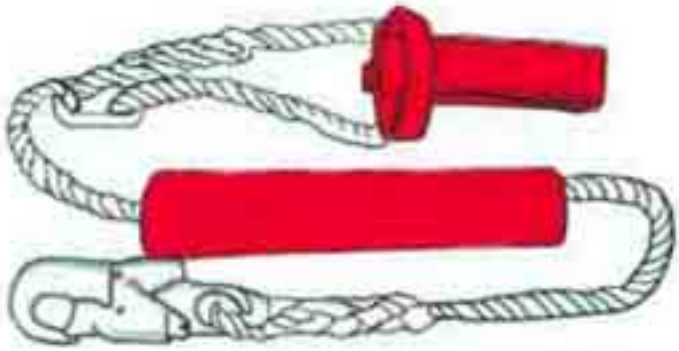


Fig. 21 - Adjustable lanyard with protection sleeve and energy absorber

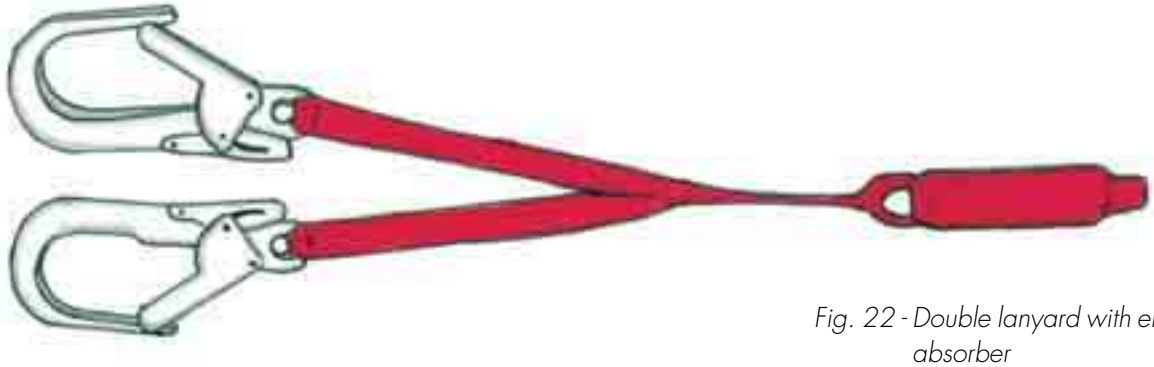


Fig. 22 - Double lanyard with energy absorber

6.4 Connectors

Connectors are connecting elements or components of a system. Snaphooks, hooks or pliers can be connectors.

Connectors should not have sharp or coarse edges that could cut, wear or otherwise damage ropes or belts or injure user.

To minimise the chances that hooks and snaphooks can be accidentally opened, they should feature automatic closure with manual or automatic locking. Connectors can be opened only by performing at least two manual voluntary consecutive actions.

Figures 23, 24, 25 and 26 show examples of connectors.

Fig. 23 - Triangle-shaped connector

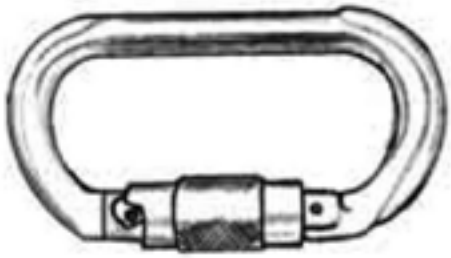


Fig. 24 - Oval connector

Fig. 25 - Plier connector

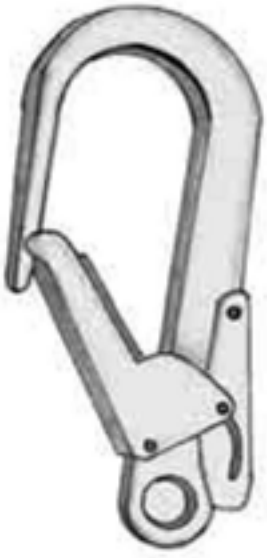


Fig. 26 - Wide opening connector

6.5 Work positioning and/or restraint lanyards and belts

Work positioning and/or restraint belts are usually made of a band (for the waist) with a back and two connecting elements to connect a work positioning and/or restraint lanyard that can be fixed or adjustable.

A work positioning belt can be used as restraint belt. Likewise, a positioning lanyard can be used as restraint lanyard.

Restraint and/or work positioning lanyards used with a restrint belt and limiting the horizontal movement of the worker from the anchor point, so that he/she may not reach a position from where he/she may fall from a height, should be used when movement is expected to take place over a horizontal surface or a slope with horizontal angle not exceeding 15°.

For restraint and/or positioning lanyards that can be adjusted, the maximum possible length should never allow worker to reach a position from where he/she may fall from a height under any working condition.

Work positioning and/or restraint lanyards and belts cannot be used as components of a fall arrest system.

7. General requirements of fall arrest systems

After having performed risk analysis, the employer selects and purchase PPEs.

PPEs should have the CE marking. The CE marking on PPEs certifies, on the manufacturer side, that the product complies with the basic safety requirements established by the Legislative Decree 475/92 as amended.

The employer should check that the PPE is supplied with an information notice, drafted and compulsorily issued by the manufacturer for all marketed PPE, beside name and address of manufacturer or of its agent within the Community, any useful information related to:

a) instruction on storage, use, cleaning, maintenance, service and disinfection;

b) performance achieved during technical tests performed to assess levels or protection classes of PPE;

c) accessories that can be used with PPE and characteristics of suitable replacement;

d) protection classes suitable for different levels of risk and related use limitations;

e) expiry data or term of PPE and of some of their components;

f) suitable packaging to handle PPE;

g) the meaning of marking;

h) if applicable, reference to applied directives;

i) name, address, identification number of notified bodies involved in the certification of the PPE.

The fall arrester PPE should include a body harness (body restraint device) and a connection system to be connected on a safe anchor point. They should be designed, manufactured and used so that the:

a) The braking power does not reach the threshold where:
- the user may suffer body injuries;
- components of the PPE may open or break and as a consequence the user falls.

b) the free fall travel of the worker from a working platform should be the least possible, after the intervention of the PPE.

c) the expected trajectory of the body while falling should be such as to avoid hitting obstructions.

Furthermore, they should guarantee that at the end of braking, user is in a correct position. The end position of the user should be such as to allow the user either to reach a safe place on his/her own or to wait for rescue with no further risks (see paragraph 4.2 and 4.3).

In the information notice, the manufacturer should specify useful data on:

- required characteristics of safe anchor point, as well as the minimun clearance for safe fall under the fall arrest system;
- how to wear the body restraint device (body harness) and how to connect it to the connecting system.

7.1 Types of falls

Before purchasing a fall arrest system, risks should have been assessed beforehand and how to eliminate or minimise them as shown in the flow chart in Fig. 1.

PPEs should be considered only after having assessed that collective protection measures cannot be used.

The following definitions for types of falls are used.

a) Free fall:
means the act of falling before the personal fall arrest system begins to apply force, it is greater than 600 mm in vertical direction and on a slope where it is not possible to walk without a handrail.

The maximum free fall displacement allowed is limited to 1500 mm, with the exception of workers employed in the assembly and dismantling of metal scaffolding, who use suitable "fall arresters", for which, displacement height may be extended to 4000 mm under conditions established by the Ministerial Decree 22 May 1992, No. 466 - Regulation on the effectiveness of a personal protective equipment for workers whose duty is to erect and dismantle metal scaffolding.

For example, the maximum arrest distance with 4 meter free fall and a fall arrest system comprising a body harness and a lanyard with integrated energy absorber, cannot exceed 5.75 meters (see for example the system shown in Fig. 30 a).

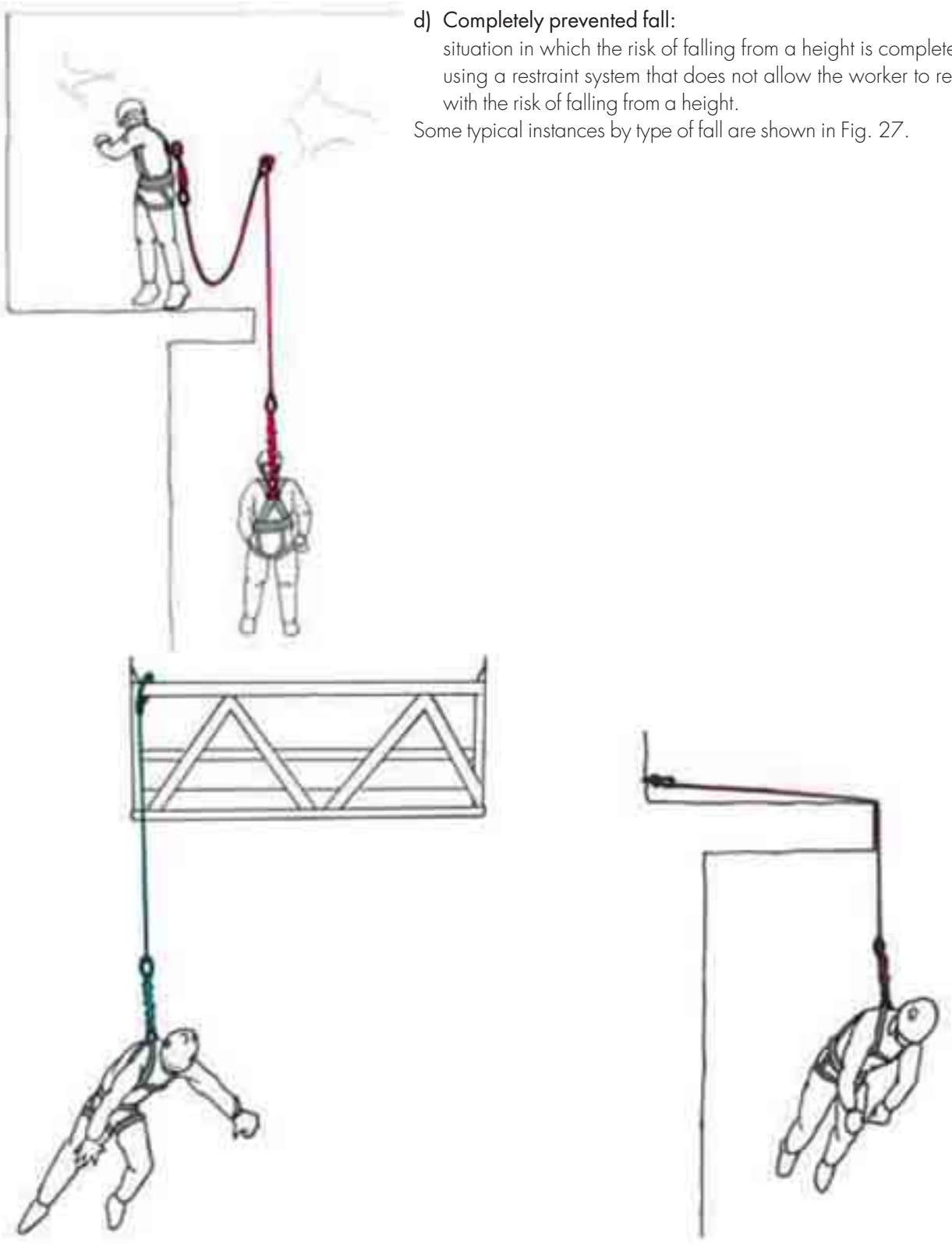
b) Limited free fall:
means the act of falling before the personal fall arrest system begins to apply force, it is equal to or less than 600 mm in a vertical direction and on a slope where It is not possible to walk without a handrail.

For example, the maximum arrest distance with a free fall equal to 0.6 meters and a fall arrest system comprising a body harness and a fall arrester on a rigid vertical line cannot exceed 1 meter.

c) Restraint fall:
means a fall where the person falling is restraint by the joined action of a suitable position of anchorage, length of the lanyard and fall restraint system. For this type of fall, the maximum arrest distance, under whatsoever condition, cannot be greater than 600 mm, both in a vertical direction and on a slope where it is possible to walk without the need of a handrail.

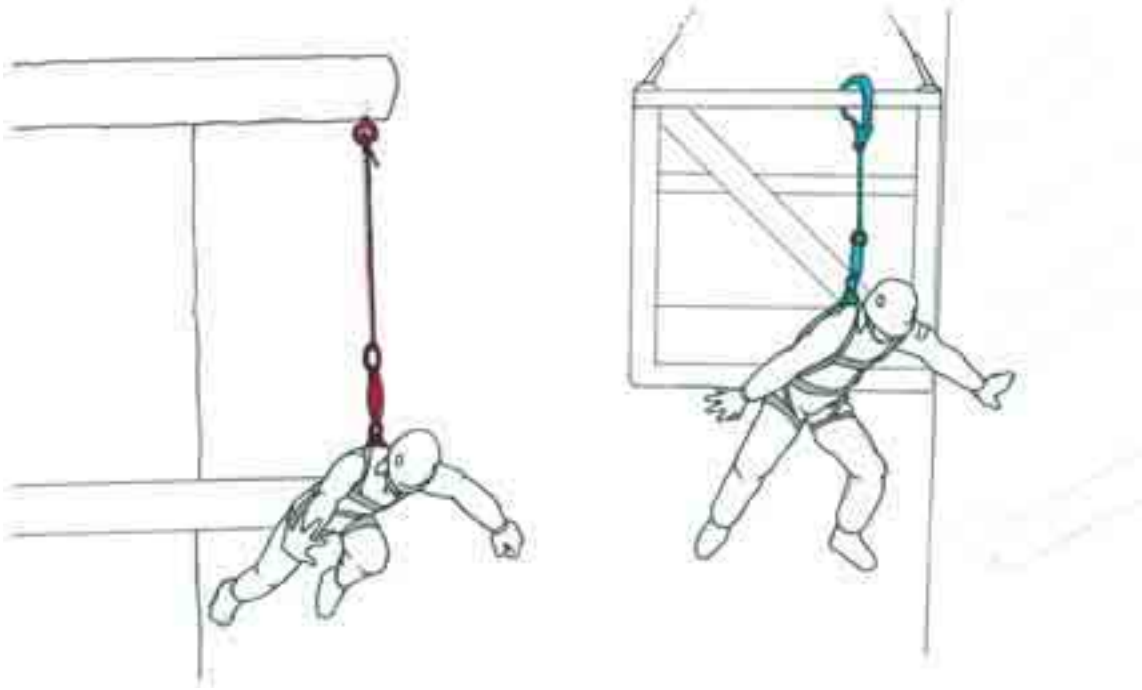
d) Completely prevented fall:
situation in which the risk of falling from a height is completely prevented using a restraint system that does not allow the worker to reach the area with the risk of falling from a height.

Some typical instances by type of fall are shown in Fig. 27.

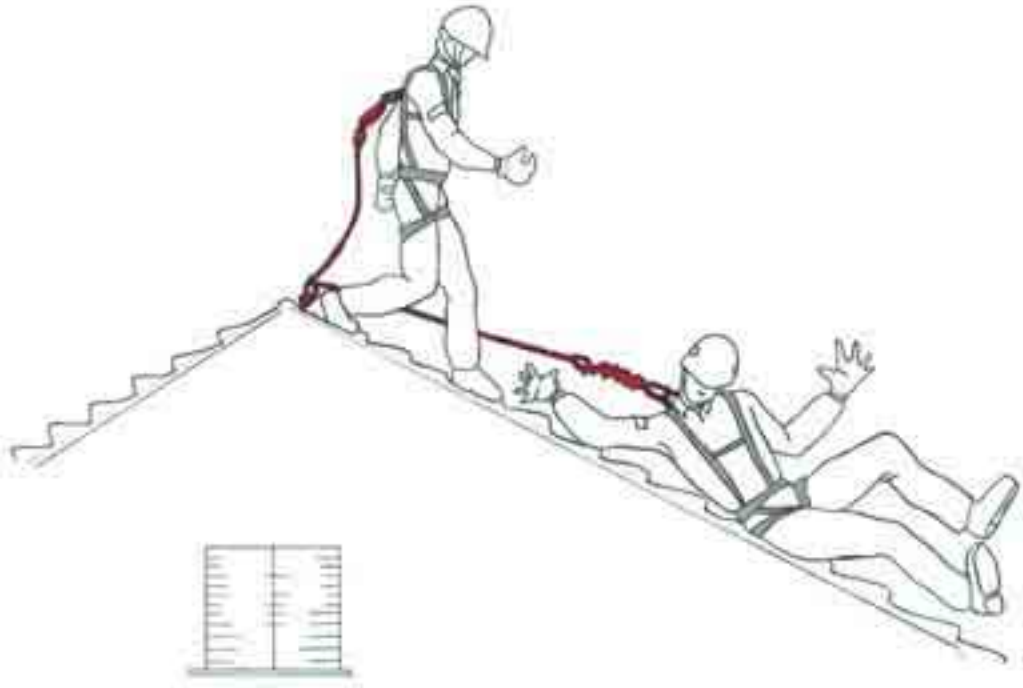


Free fall - free fall distance> 600mm

Fig. 27 - Typical instances by type of fall.

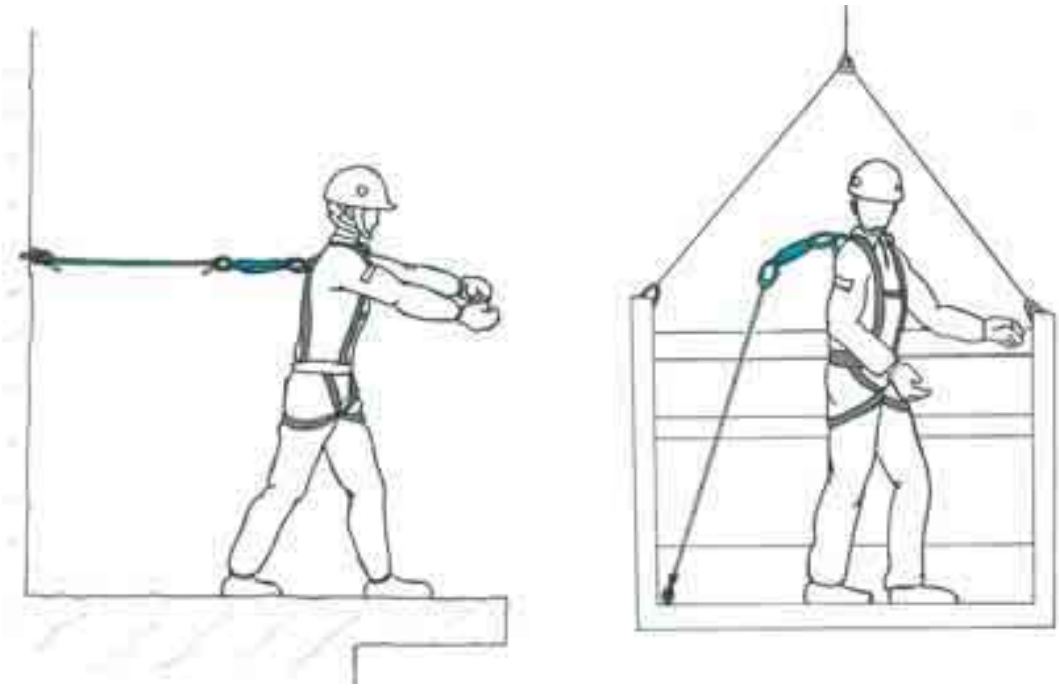


Limited free fall - free fall distance < 600mm



Restraint fall

Fig. 27 - Typical instances by type of fall.



Completely restrained fall - Impossible to fall

Fig. 27 - Typical instances by type of fall.

7.2 General selection criteria

7.2.1 Protection level priority

With reference to the protection level priority, selection should be made following the indications in the chart in Fig. 28.

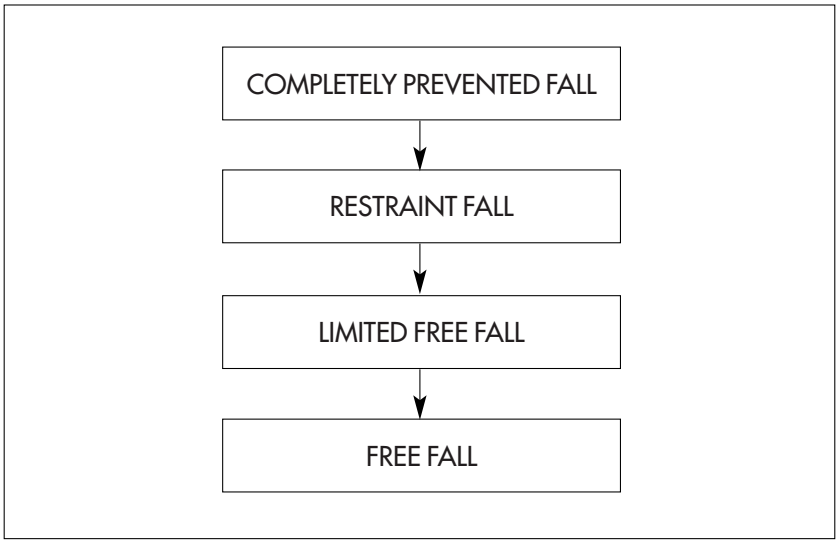


Fig. 28 - Protection level priority of falls from a height

7.2.2 General requirements in the selection of fall arrest systems against falls

When selecting a fall arrest system, the following elements should be taken into account:

1) Type of work

Amongst the types of work, the following should be considered:

- work on poles and lattice;
- work on gutters and eaves;
- work on roofs;
- work on ladders;
- work on building demolition;
- work on mobile elevated work platforms;
- work on suspended platforms;
- assembly of prefabricated elements;
- work on scaffolds;
- work on pylons.

2) Severity of fall

- free fall;
- limited free fall;
- restraint fall;
- completely prevented fall; impossible to fall.

3) Need for lateral movements, ascending movements, for the activity being considered

4) Limitation of the fall distance and clear distance both vertically as well as horizontally

5) Characteristics of systems and components of fall arrester and of anchor points

When selecting systems and components of fall arrester and of anchor points, with reference to safety, the following should be taken into account:

- ergonomics: wearability, adjustments, sensory features;
- restraint-free movement: suitable length of lanyards;
- association of systems with type of action;
- availability and suitability of anchor points (see 8.4).

6) Consequences of a possibile fall

In case of falls, the following injury sources should be avoided:

- impact with the ground;
- impact with obstructions below the working level, such as supporting structures;
- body harness, as a result of the fall arrest (e.g.: excessive pressure of the harness on the body or strangulation due to straps);
- impact with components of the fall arrest system.

When there is the risk of falling from a height (free, limited or restraint fall), workers should use a body harness with the related fall arrest system.

In no case the fall arrest system should release on the worker a strength greater than 6.0 kN.

7) effect of dangerous activities or unfavourable environmental conditions

When performing dangerous tasks or in case of unfavourable environmental conditions, such as those implying risks listed in paragraph 4.1.1 under e) and f), in selecting fall arrest systems the following should be taken into account:

- implementation of suitable working procedures;
- arrangement of suitable protection elements or systems;
- use of special equipment related to risks mentioned above.

If special equipment is to be used, contact the supplier of such equipment in order to make an appropriate selection.

7.2.3 Pendulum effect

When there is a risk of falling close to the extremity of flexible anchor line, it may occur that the mobile anchor device travels along the flexible line towards the centre of the line, dragging the worker with it.

The worker will then be subject to the so-called "pendulum effect" (Fig. 29).

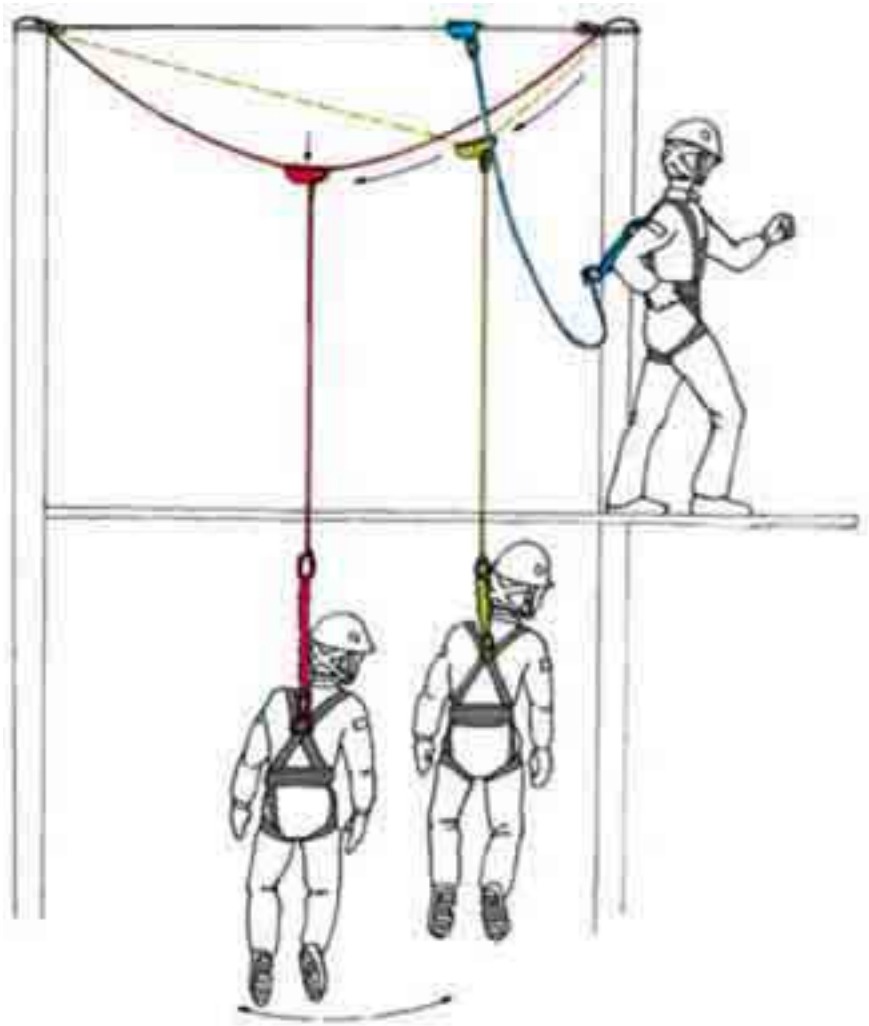


Fig. 29 - Pendulum effect

The impact of this effect will be related to the degree of friction between the mobile device and the anchor line, to the distance between anchor points of the line and to the type of rope.

If the worker is in danger of hitting obstructions while the pendulum effect is ongoing, a different layout for the anchor line should be provided for (e.g., a further anchor point above the obstacle) or an alternate system (e.g., a rigid guide).

7.2.4 Clear free fall space

In a fall arrest system, an important element to be assessed is the clear free fall space, under the arrest system, required to allow falling without hitting the ground or other similar obstacles.

The clear space required depends on the fall arrest system used.

7.2.4.1 Calculation and estimate of factors

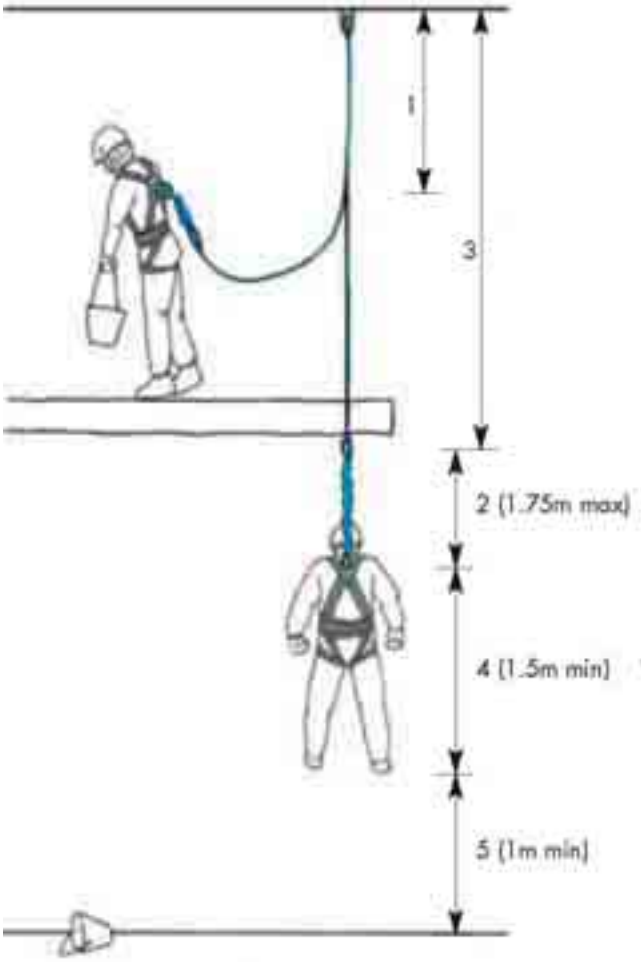
The factors to be taken into account in calculating the clear free fall space under the arrest system:

- bending of anchor points;
- static lenght of lanyard and extension when loaded;
- starting position of the fall arrest system;
- vertical travel or extension of the fall arrest system;
- height of the user;
- lateral displacement of the anchor point.

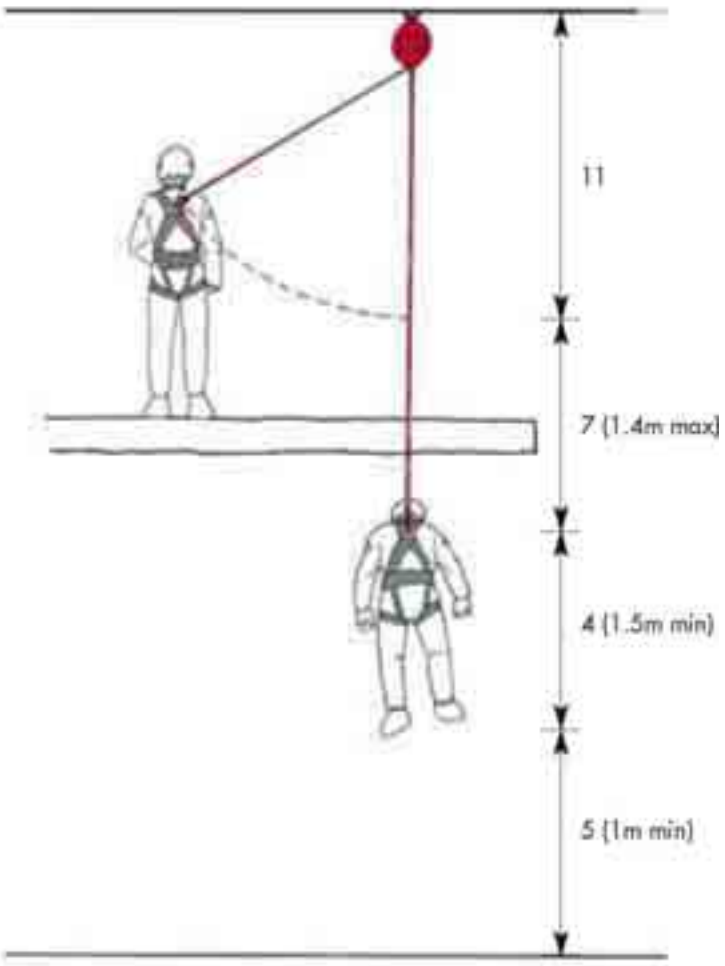
Note. Fig. 30 shows some examples of calculations and figures are shown only as example. Fall distance and residual clear space should be calculated taking into account the real use conditions of each fall arrest system and the type of anchor points used and instruction provided by the manufacturer of equipment.

1. **Bending of anchorages.**
   a) Single fixed anchor point. No anchorage displacement, unless the structure to which the anchorage is secured bends under the load resulting by the arrest of a fall.
   b) Horizontal or vertical rigid line.
   The same considerations apply as under 1 a).
   c) Horizontal or vertical rigid line. The maximum arrow of the anchor line is calculated with reference to the value of bending of the anchor line itself, as specified by the manufacturer.

2. **Static length of the lanyard and stretching when load is applied.**
   For a lanyard, or a lanyard with energy absorber, the length of the lanyard should be taken into account, adding the extended length of the energy absorber. The length of the connector should be added as well.



a) Single anchor point with lanyard - energy absorber



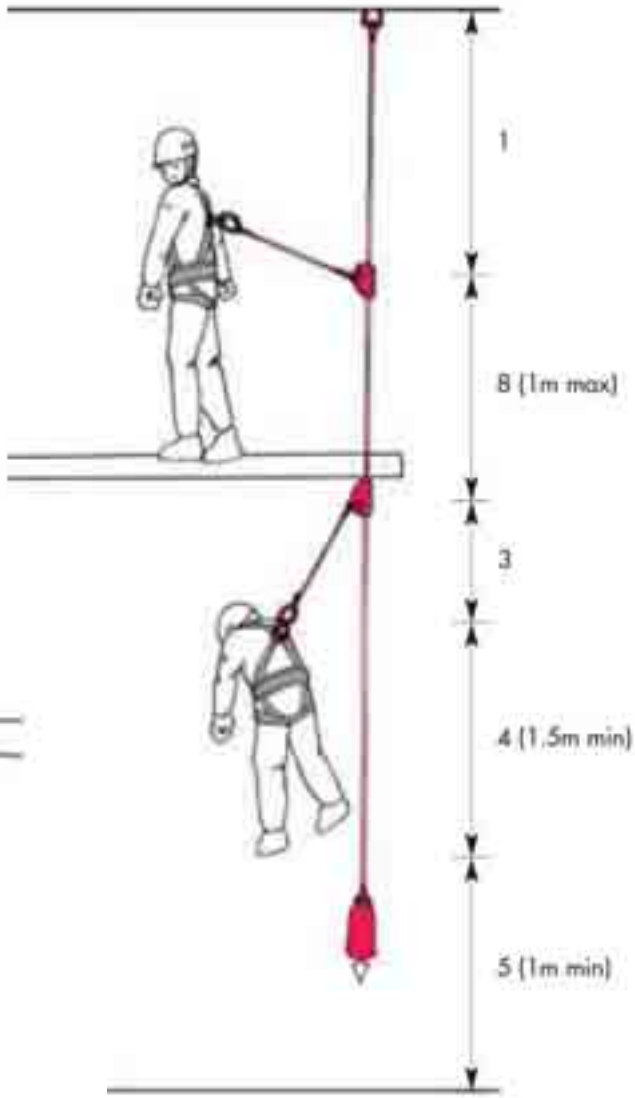
b) Retractable device

Fig. 30 - Example of how to define the minimum clear free fall space

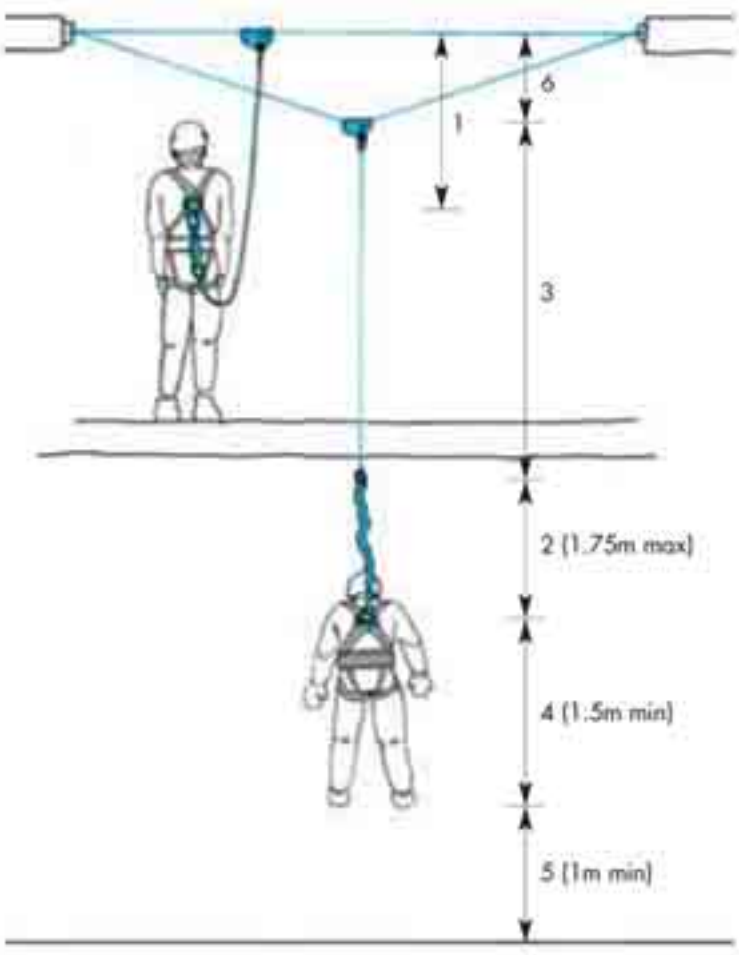
1. Starting distance
2. Stretching of the energy absorber, maximum = 1.75 meters
3. Length of the lanyard L (*)
4. Height of the body harness connection from the foot of person = 1.5 meters
5. Residual clear space, minimum = 1.0 meter
6. Arrow of the anchor line
7. Stretching of the retractable device, maximum = 1.4 meters
8. Travel of the device along the flexible vertical anchor line, maximum = 1.0 meter (**)
9. Travel of the device along the flexible vertical anchor line, 8 (1m max) HC maximum = (H – 2 L) (**)
10. Arrest distance H, maximum = 1.0 meter
11. Lowest starting distance for lateral displacement of the anchor point

* If for b), c) and e) an energy absorber is used, its stretching under dynamic load (as specified by the manufacturer) should be added to the length of the lanyard.

** Add any significant stretching or strain of the anchor line, under dynamic load, as specified by the manufacturer.



c) Fall arrester with flexible anchor line



d) Horizontal anchor line with lanyard - energy absorber

Fig. 30 - Example of how to define the minimum clear free fall space

1. Starting distance
2. Stretching of the energy absorber, maximum = 1,75 m
3. Length of the lanyard L (*)
4. Height of the body harness connection from the foot of person = 1,5 m
5. Residual clear space, minimum = 1,0 m
6. Arrow of the anchor line
7. Stretching of the retractable device, maximum = 1.4 meters
8. Travel of the device along the flexible vertical anchor line, maximum = 1.0 meter (**)
9. Travel of the device along the flexible vertical anchor line, HC maximum = (H – 2 L) (**)
10. Arrest distance H, maximum = 1.0 meter
11. Lowest starting distance for lateral displacement of the anchor point

* If for b), c) and e) an energy absorber is used, its stretching under dynamic load (as specified by the manufacturer) should be added to the length of the lanyard.

** Add any significant stretching or strain of the anchor line, under dynamic load, as specified by the manufacturer.

e) Fall arrester on rigid anchor line

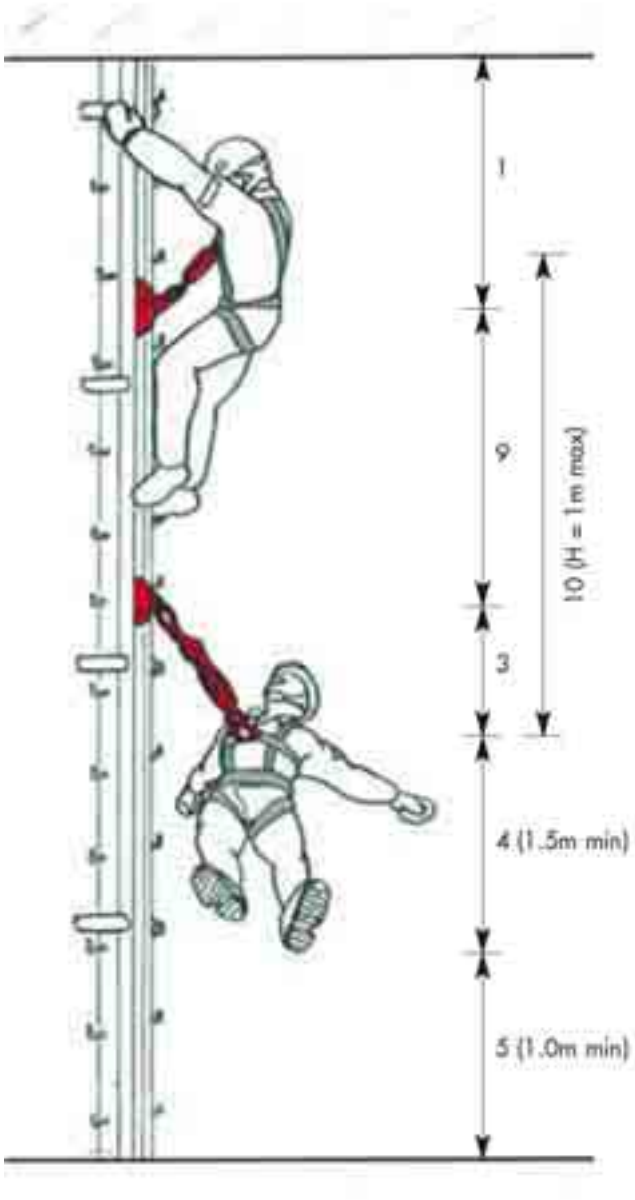


Fig. 30 - Example of how to define the minimum clear free fall space

3. Starting position of the fall arrester.

When establishing the starting position of the fall arrester, the vertical distance of the device from its anchor point must be considered, bearing in mind its least favourable position.

The starting position shall be:

a) the lowest point of the device, on the anchor line, when the user is located on the usual working level (Fig. 30 c, e);

b) the lowest point of the device, on the body harness of the worker, when he is on the usual working level (Fig. 30 a, b, d).

If more accurate estimates are lacking and in specific conditions, the position will be assumed to be on the same level of feet.

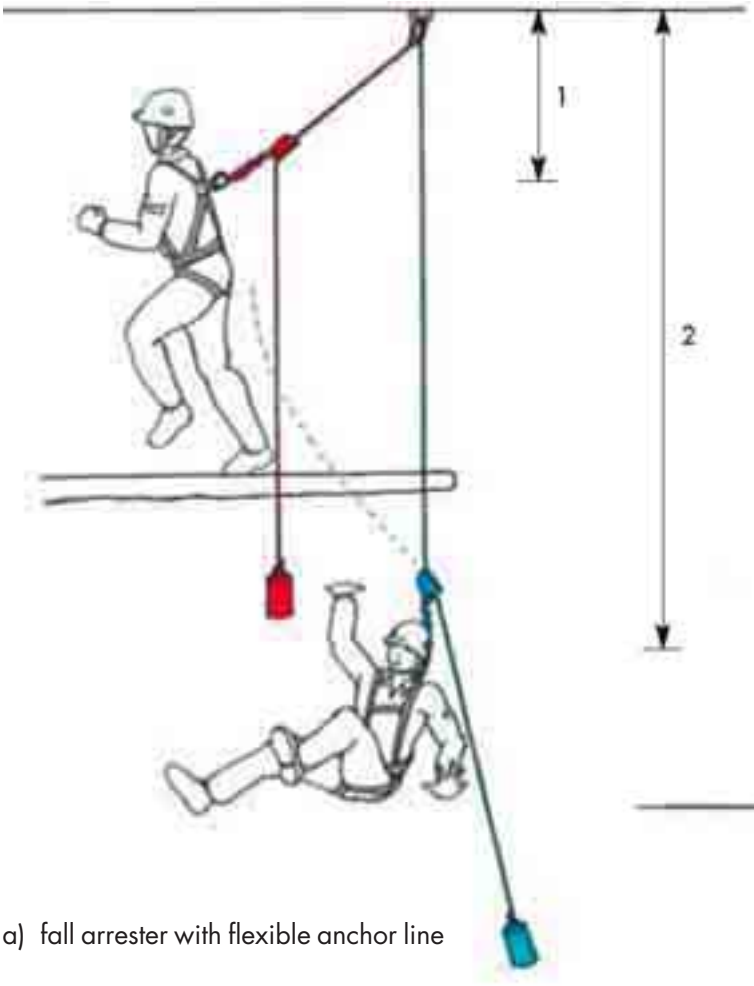
Note. Whenever possible, an anchor point located higher than the attachment point on the body harness should be used, to decrease as much as possible free fall distance.

4. Vertical displacement or stretching of the fall arrester.
   Where there is stretching or vertical displacement of the fall arrester, the following must be taken into account:
   a) fall arrest system with vertical flexible anchor line: maximum displacement 1.0 m, unless different directions certified by the manufacturer;
   b) fall arrest system with vertical anchor line: total maximum arrest distance 1.0 meter;
   c) fall arrest system with retractable type fall arrester: maximum travel 1.4 meters, unless different directions certified by the manufacturer;
   d) fall arrest system with lanyard and energy absorber: maximum stretching of the energy absorber 1.75 meters, unless different directions certified by the manufacturer;

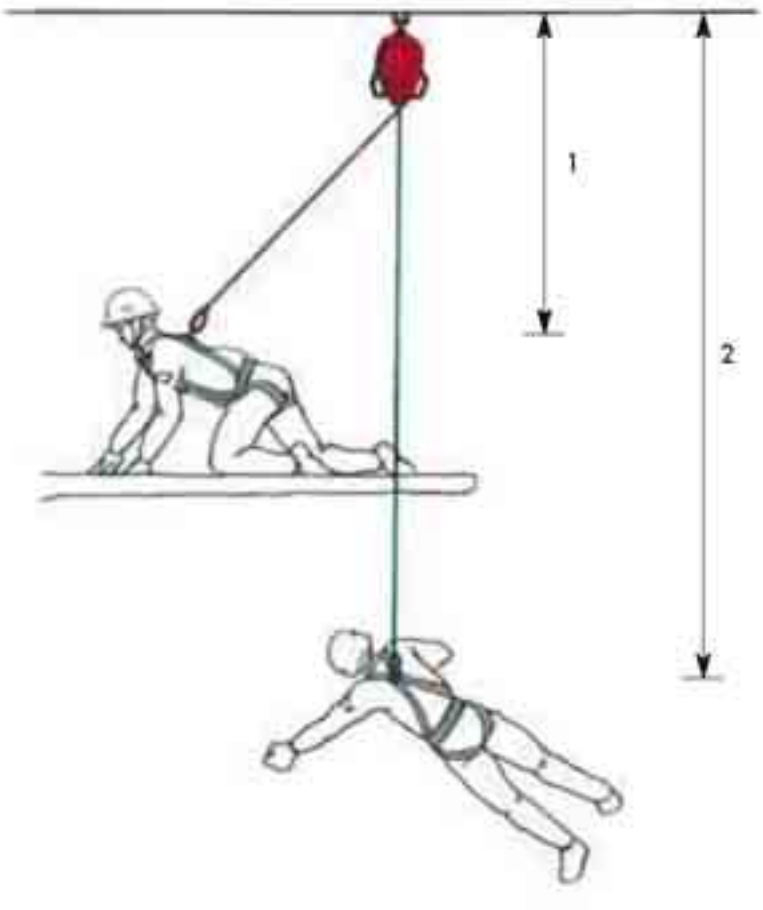
Note.
1) Any stretching or displacement of the fall arrester is always less than the total arrest distance.
2) Values shown in 4 a), 4 b) and 4 c) are only suggestions and are the output of calculations, under testing conditions in specific normative references.

5. Height of user.
   The height from feet of the attachment point on the body harness of the worker must always be considered. On the whole, a minimum distance of 1.5 is assumed to be suitable.

6. Lateral displacement from the anchor point.
   When the anchor point is displaced with reference to the expected fall position, the following must be taken into account:
   a) if the worker is using a lanyard such as the one shown in Fig. 30 a) and d), an additional distance will not be required;
   b) if the worker is using a fall arrester such as the one shown in Fig. 31, a lower starting position should be taken into account to consider maximum lateral distance from the anchor point (lateral misalignment of the anchor point – pendulum effect);



a) fall arrester with flexible anchor line



b) retractable type fall arrester

1) height of the starting position of the fall arrester before fall
2) height of the position (lowest) of the fall arrester, to calculate clear space, after fall

Fig. 31 - Effect of lateral misalignment in relation to the anchor point

7.2.5 Free fall distance

Fall arrest systems with lanyards equipped with energy absorbers, allows a free fall up to 4 m (for maximum free fall distance allowed, see paragraph 7.1 under a: Ministerial Decree 22 May 1992, No. 466), limiting deceleration and ensuing dynamic loads, during the fall arrest phase within tolerable limits without injury to the human body. In order to limit free fall within 4 m, the maximum length of the lanyard including the energy absorber and connectors is 2 m.

7.2.5.1 Calculating the free fall distance

When a fixed lanyard is used, free fall distance is calculated as shown below:

DCL = LC – DR + HA where:

DCL = free fall distance;

LC = lanyard length;

DR = Distance measured along a straight line between the fixed anchor point or position of mobile device connecting to a flexible or rigid horizontal line and position on the edge beyond which a fall may occur;

HA = 1.5 m, maximum height from feet, of the lanyard on the body harness, when the worker is in standing position.

Fig. 32 shows four instances.

Must there be a misalignment between the point at which the fall is possible and the lanyard connecting point (Fig. 33), the pendulum effect should also be taken into account.

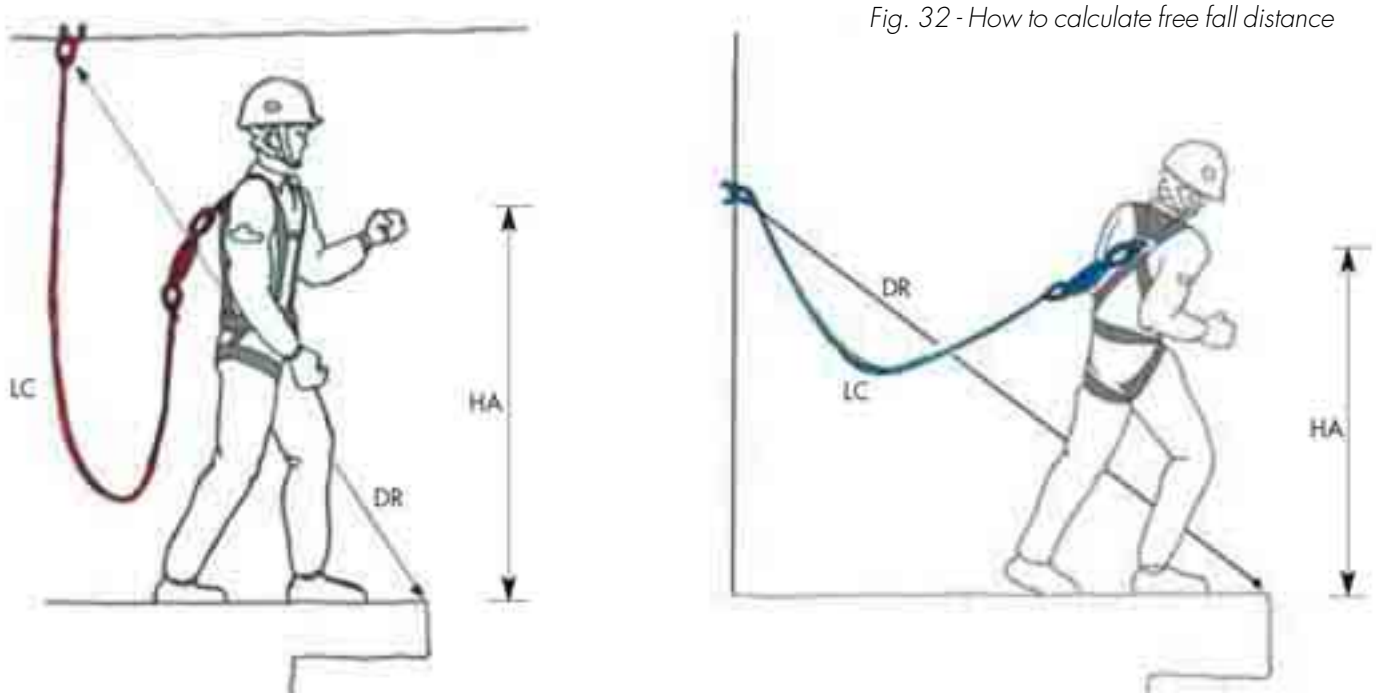


Fig. 32 - How to calculate free fall distance

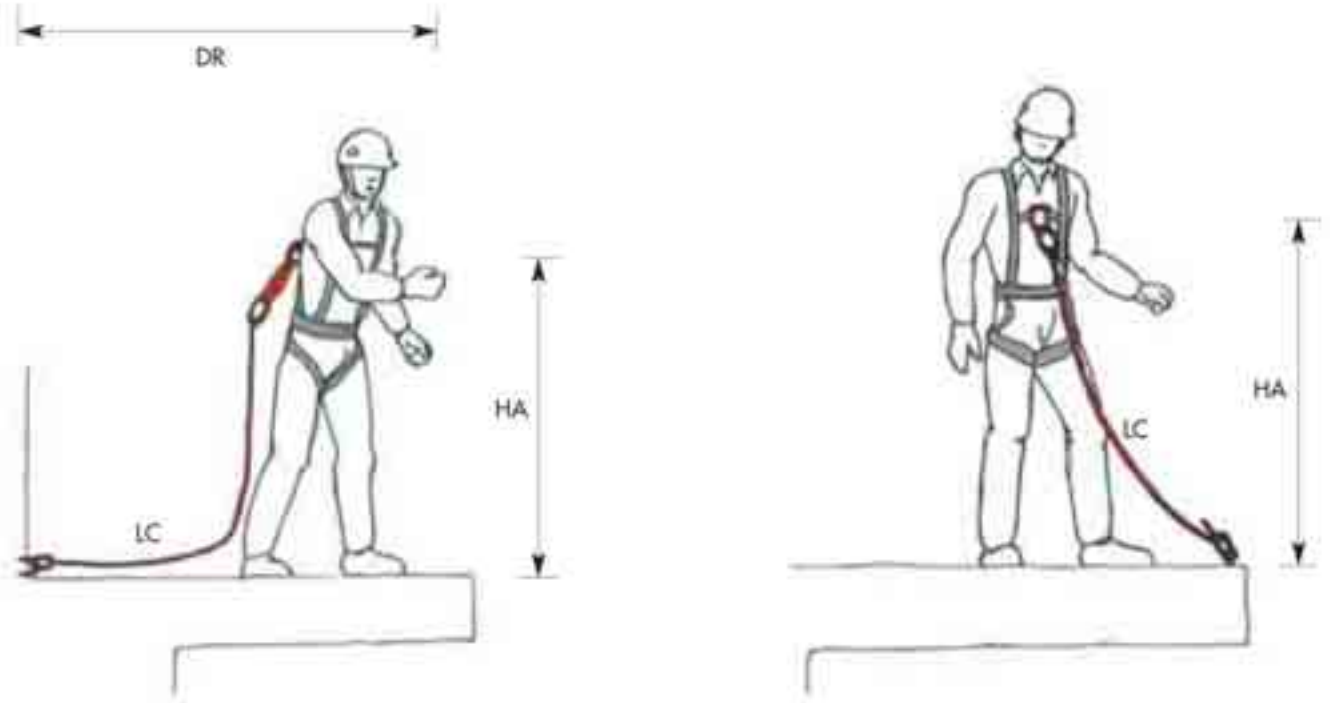


Fig. 32 - How to calculate free fall distance

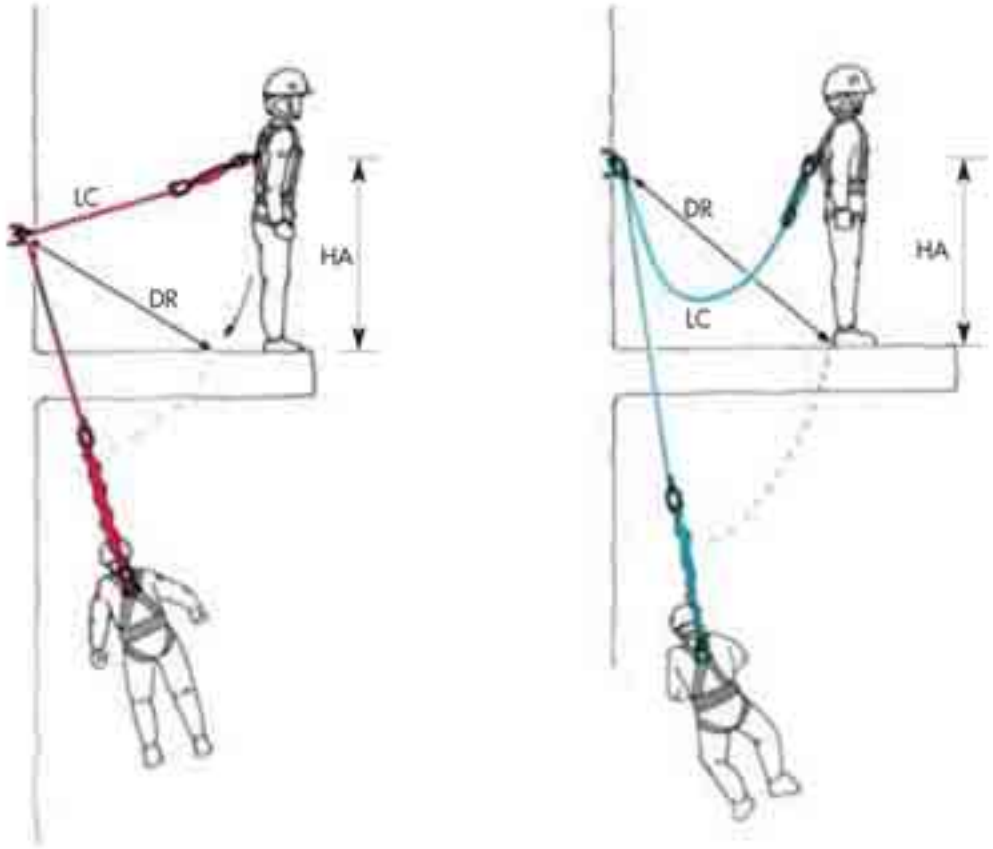


Fig. 33 - Example of misalignment between point of fall and connecting point

7.2.5.2 Acceptable free fall distance

Considering that the maximum free fall distance allowed is 1.5 m (4.0 m when the fall arrest system includes suitable energy absorbers, Ministerial Decree 22nd May 1992, No. 466 - Regulation on the acknowledgement of the efficacy of an individual system to be used in the assembly and dismantling of metal scaffoldings), the permissible free fall distance is the minimum possible distance that can be applied in a specific work condition.

7.2.5.3 Anchor point

In order to minimise the free fall distance, the anchor point must be located above the attachment point on the body harness and the lanyard should as short as possible, depending on the kind of task to be performed.

Anchor points located below the attachment on the body harness may result in too great free fall distances.

8. Selection of fall arrest systems

8.1 Selection of fall arresters

The typical applications of fall arresters are shown in figures 3, 4, 7, 8 and 11.

8.1.1 Selection criteria

- For all types:
  a) a worker can work at different heights and move up and down with an automatically operated device;
  b) the majority of devices, to activate the locking mechanism, require a certain amount of initial acceleration of worker while falling: therefore, some devices may not be suitable when fall occurs along a slope or on solid stuff made of small particles (e.g., sand, gravel, etc), where the velocity of fall does not activate the locking mechanism;
  c) fall arrest distance and distance from underneath obstacles, if any, should be assessed;
  d) compatibility of anchorage with the fall arrest system should be ensured;
  e) the compatibility of the different components of the fall arrester should be checked;
  f) directions for use and limitations of use specified by the manufacturer should be read and considered;
  g) a rescue procedure should be established before use, so that rescue can be completed before the health of worker is affected due to the suspended position after fall (see paragraph 4.3).
- For guided type fall arresters including a flexible or rigid anchor line:

  this device is not suitable to be used with an anchor line with an inclination from the horizontal plane lower than the minimum specified by the manufacturer (usually not lower than 45°) and required to activate the device.
- For retractable type fall arresters:
  a) this device is not suitable to be used when user is to assume an inclination of the lanyard greater than the maximum value specified by the manufacturer, and required to activate the device (usually 30°) (Fig. 34);
  b) this device is not suitable to be used on a slope with an inclination from the horizontal plan lower than the minimum value specified by the manufacturer, and required to activate the device (usually 60°);
  c) if the manufacturer has specified that the device may be anchored on an horizontal surface or on a vertical surface (Fig. 35), the user should check that:

- in the event of fall beyond an edge the device must operate effectively activating the locking mechanism with reference to manufacturer's directions on the inclination of the lanyard;
- the restraint rope must be able to withstand without breaking due to friction against the edge, taking into account its mechanical properties and the characteristics of the edge.

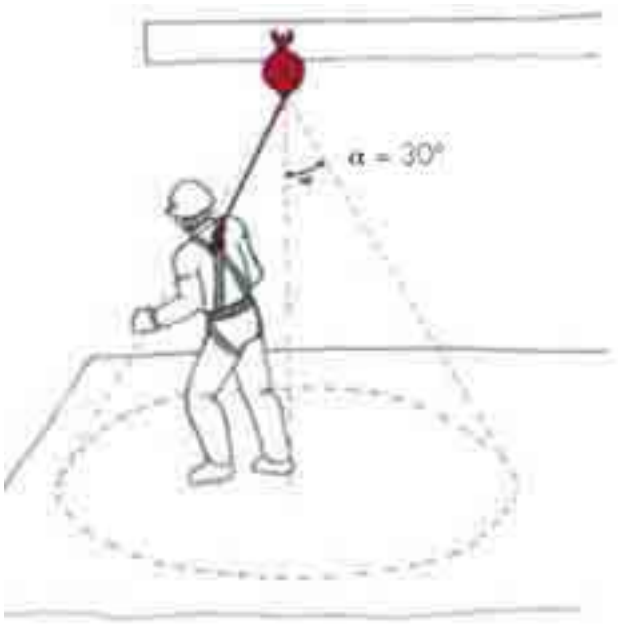


Fig. 34 - Operation limits of the retractable type fall arrester with anchorage above user

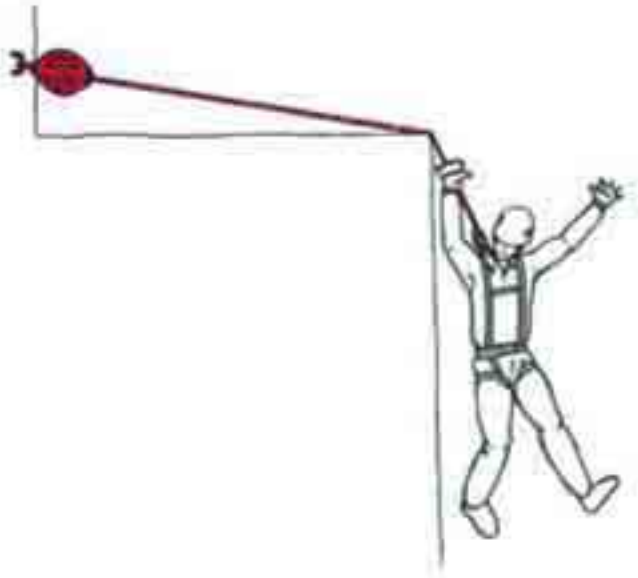


Fig. 35 - Operation limits of the retractable type fall arrester with anchorage onto a vertical surface

8.2 Selection of horizontal anchor lines

Horizontal anchor lines allow users to use a fall arrest system and to easily move sideways.

They can be divided into:

a) Rigid systems.
These systems comprise a rigid metal structure. Mobile attachments travel along the line and fall arresters are hooked onto it. The strength of guides and attachments should be determined using structural calculation.

b) Flexible systems.

These systems comprise a flexible rope with anchorages at the extremities and at any intermediate points if required. The mobile attachments travel along the line and fall arresters are hooked onto it. The mobile attachments should travel through the intermediate anchorages without being disconnected from the anchor line.

8.2.1 Selection criteria

Selection should be made, with reference to specific use, taking into account the following:

a) Of the type of guide.

➢ Rigid guide:

- for frequent use;
- suitable for being used by several workers at the same time;
- the intermediate anchorages do not hinder movement of the mobile attachments;
- for fall arrest the bending of the system can be neglected;
- where several workers are using the system at the same time, the person who falls exerts a lesser effect on the others.

➢ Flexible guide with rope:

- intended for non frequent use;
- more flexible layout;
- withstands greater distance between anchorages;
- are more easily installed in existing structures;
- may be used for anchor lines with height difference between anchorages and exceeding the edges of the building;
- energy absorbers can be used along the line.

b) The type of the anchorage structure.

The type of structure on which the system is to be anchored will determine the type of anchor line:

- some structures are more suitable to support vertical loads that are more common on rigid guide systems;
- some structures are more suitable to support heavy horizontal loads that are more common on the endpoint anchorages of flexible guides;
- architectural issues of the building may favour the selection of a system, but they should never jeopardise safety.

c) Instructions for use:

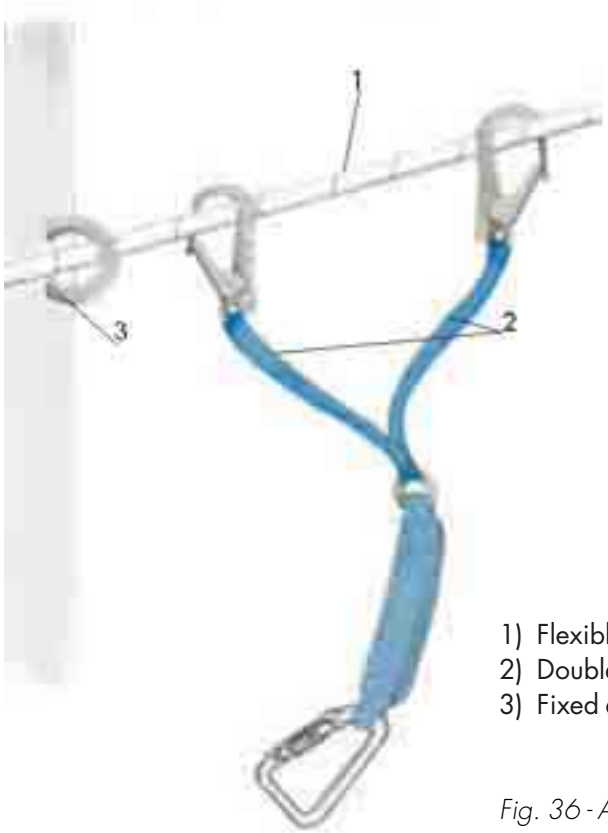
Beside the type of guide and the structure of the anchor line, the following should be taken into account when making the selection:

- the number of users that the system may withstand at the same time;
- the frequency of use and travel velocity along the lines;
- environmental conditions and their effects on performance and state of preservation;
- how easy is for the user to safely access the line from the different access points;

- the possibility to travel across the intermediate anchorages with no need to disconnect;
- the capability of the system to maintain the clear distance of free fall below the installation;
- easy check and maintenance of the system;

d) Auxiliary devices.
For mobile anchorages, when selecting auxiliary devices the following should be taken into account:

- in systems including a rigid guide, these devices are usually built-in the system and cannot be removed unless a specific restraint device is disconnected. When such mobile mobile devices are supplied as part of the system, alternate connection means cannot be used;
- in systems including a flexible guide, these devices are usually built-in the system and cannot be removed unless a specific restraint device is disconnected. These devices can be designed to travel across intermediate anchorages without being disconnected. Where the mobile attachment device is not built-in the system, attachments to be used should have a strength not less than the strength of items Integrated in the system;
- when the intermediate anchorages of the guides do not let the mobile attachment device go through, the anchorage system of the fall arrester should be complemented by two separate lanyards connected to two mobile anchor points, or by a connecting device that uses two mobile anchor points (Fig. 36).



1) Flexible anchor line
2) Double attachment device
3) Fixed anchorage (onto wall)

Fig. 36 - Attachment device with two mobile anchor points

8.3 Selection of body harnesses, belts, lanyards and accessories

Table 1 lists fall arrester and work positioning devices and components, specifying their main application and the type of falls for which they should be used.

Fall arresters and work positioning devices and components				
DEVICE/ COMPONENT	MAIN APPLICATION	APPLICABLE DEVICE TYPE OF FALL		
		FREE FALL	LIMITED FREE FALL	RESTRAINT FALL
Restraint and positioning belt Restraint and positioning lanyard	Item of the horizontal restraint and positioning system	NO	NO	NO
Body harness (against falls from a height)	Component of a fall arrest system	YES	YES	YES
Lanyard + energy dissipator	Component of a fall arrest system	YES	YES	YES
Fall arrester: a) retractable type b) guided type including flexible guide c) guided type including flexible guide	*Device to secure a person to an anchor point to completely prevent or arrest falls in safe conditions*	YES	YES	YES

Tab. 1 - Use of fall arresters and positioning devices

8.3.1 Body harnesses

Figures 12, 13, 14, 15 and 16 show typical instances of body harnesses to prevent falls.

Body harnesses should be used every time there is the risk of falls from a height, namely free fall, limited fall or restraint fall.

When selecting a suitable body harness the following should be taken into account:

- easy to wear and take out;
- if attachments are suitable for the kind of task/activity (sternal and/or back);
- possibility to adjust components so that they fit to the body.

Every time the type of task/work requires it, sternal attachment, suitably located on the body harness, should be used: for example, for workers who have to carry tools and instruments on their back or who should wear special garments to protect against cold weather or moist. In these cases body harnesses with a sternal attachment should be used.

8.3.2 Restraint and/or positioning belt

Restraint belts should be used as devices for horizontal restraint. They should not be used if there is the risk of free fall, limited free fall or restraint fall.

8.3.3 Restraint and/or positioning lanyard

Restraint and/or positioning lanyards should not be used if there is the risk of free fall, limited free fall and restraint fall.

8.3.4 Lanyard + energy dissipator

A lanyard is an item connecting the body harness with a suitable anchor point, either fixed or mobile along rigid or flexible guides.

A properly selected lanyard should:
- be easily assembled and adjusted;
- have suitable characteristics (length, with/without an energy absorber, type of connector, etc.) for the kind of task/work to be carried out and for the fall arrester being used.

A lanyard and energy dissipator assembly is used to limit to 6 kN the force on the attachment of a body harness while arresting a fall.

The energy dissipator can be neglected if:
- the material of the lanyard meets the requirement of the 6 kN limit;
- the fall arrest system to which it is connected can limit the force to 6 kN in case of fall arrest;
- fall distance is so short that arrest force cannot reach 6 kN.

If the lanyard can be exposed to free flame, heat, cut or abrasion, a metal rope or a chain should be used. In case of abrasion or cut, the lanyard can be protected using suitable protection sleeves.

8.3.5 Connectors

Connectors should be selected taking into account:

- size and type of anchorage to be used;
- frequency of hooking and un-hooking;
- frequency of movements of the worker.

Connectors should not have sharp or coarse edges that could cut, wear or otherwise damage ropes or straps or injure the user.

To minimise the chances that hooks and snaphooks can be accidentally opened, they should feature automatic closure with manual or automatic locking. Connectors can be opened only by performing at least two manual voluntary consecutive actions.

Depending on the type of work, they are divided into:

- hook connectors, used with fixed anchorages (wall eyebolt) or steel horizontal flexible anchor lines;
- oval connectors (snaphooks) used to directly connect with horizontal flexible anchor ropes ;
- plier connectors, used when there are structures with no anchor points ready to connect to oval connectors or hooks.

Oval connectors with locknut closure are suitable for tasks/work where hooking/unhooking are less frequent, whereas self-blocking devices are more suitable when hooking/unhooking are more frequent..

8.4 Selection of anchorages

The selection and position of anchorage depend on the type of task/work and structures where anchorage will be located.

If structures are not suitable for anchorages, other protection systems should be adopted after risk assessment.

Tables 2 and 3 show a summary of types of anchorages with related requirements, for further information see EN 795: 1996 + A1:2000 standard.

The strength of structure onto which anchorage is secured is specified in the user manual of the manufacturer of the anchorage.

	Class - purpose	Minimum strength of anchorage and structures in testing conditions - laboratory
Fixed system	• A A_1 Structure anchorages designed to be secured onto vertical, horizontal or sloped surfaces, such as columns, walls, lintels.	10 kN
	A_2 - Structure anchorages designed to be secured onto sloped roofs.	10 kN
	• B Temporary portable anchorages.	10 kN
Mobile system	• C Anchorages using horizontal flexible anchor lines. Horizontal flexible anchor line means a line diverting from the line of horizon not more than 15°. Max. number of users allowed: see manufacturer's directions.	One and a half time the force allowed by the manufacturer
	• D anchor devices using horizontal rigid anchorage rails. Max. number of users allowed: see manufacturer's directions.	10 kN + 1 kN for each additional person

Tab. 2 - Strength requirements of anchorages for fall arresters

	Class - type	Requirements
Dead-end	• E Dead-end anchorage to be used on horizontal surfaces. Horizontal surface means a surface diverting from the horizon line not more than 5°	Do not use in case of possible ice Distance from the roof edge not greater than 2500 mm.

Tab. 3 - Strength requirements for dead-end anchorages

8.4.1 Single point anchorage with fixed system

Some requirements and recommendations are listed below:

- The anchorage and the hosting structure should meet the requirements and minimum strength listed in tables 2 and 3.
- Structure strength assessment should be carried out by competent personnel.
- The anchorage required strength depending on the type of falls as defined in the chart in Fig. 28 should be assessed.
- Anchorages should be located in such a way to allow movements required to perform tasks, and to have minimum free fall.
- The position of anchorage should allow the worker to secure the lanyard to the anchorage before there is the risk of falling. Otherwise the worker should be already using another fall arrester so that he can safely connect to the new anchorage.
- Wear of anchorage should be taken into account, if so an anchorage made with suitable material should be selected.
- Every specific recommendation of the manufacturer should be met.

8.4.2 Tie anchorages

Some requirements and recommendations are listed below:

- All requirements and recommendations in paragraph 8.4.1 should be complied.
- The length of tie anchorages should be such as to allow, on the two sides of the anchor rope starting from the safety rope and surrounding the structure, the creation of an angle not exceeding 120° (Fig. 37).
- If the anchor structure has edged sides, protections for the areas touching the rope should be provided.

1. Anchor structure
2. Edge protection
3. Tie anchorage
4. Safety rope
5. Angle not exceeding 120°

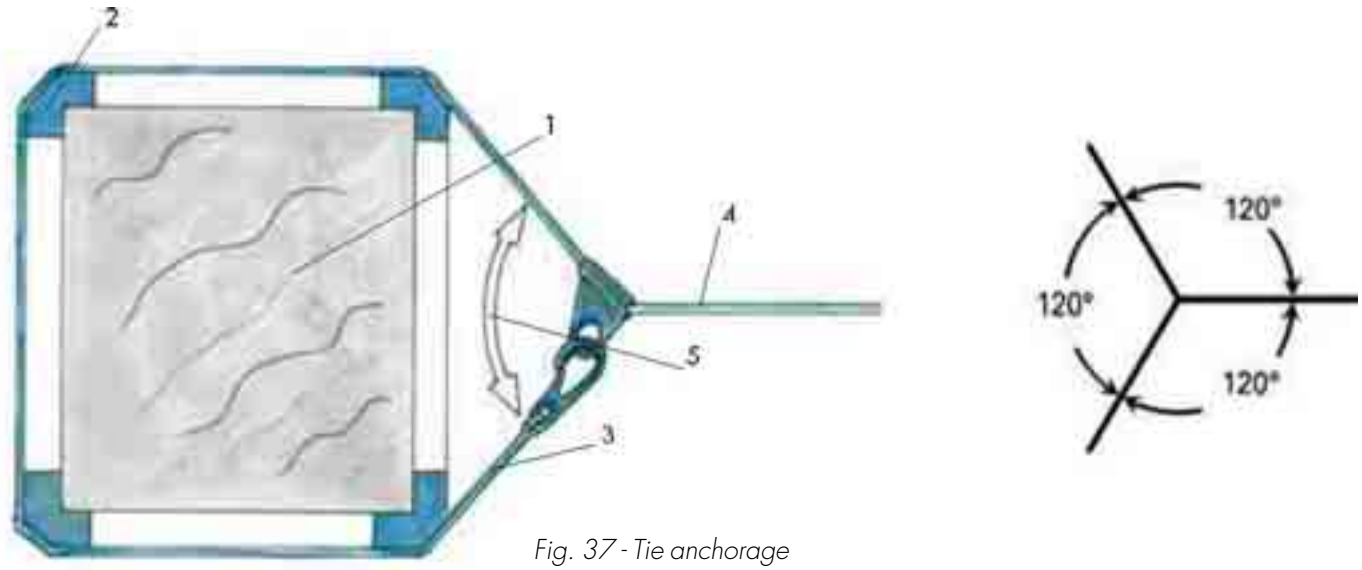


Fig. 37 - Tie anchorage

9. Use of fall arrest system

To use fall arrest systems, the following indications should always be taken into account:

- Fall arrest systems should be used only as expected and in compliance with directions provided by manufacturers.
- Fall arrest systems should be used with extreme care to avoid damages.
- Fall arrest systems should be maintained in an efficient state performing maintenance, repairing and replacement when required.
- Before using the device, workers should check that it is properly assembled and that latches and connectors are properly locked.
- Correctly store the device after use.
- When the system has been used for a fall arrest, it should be put out of service and prepared for inspection following instructions given in paragraph 10.2.4.
- Fall arrest systems should be only used by workers attending the education and training program organized by the employer.
- Fall arrest systems should be used by workers with extreme care and without altering devices and their combinations, as provided by manufacturers.

With reference to the use of fall arrest systems under specific conditions, the following further directions are provided. They do not cover all the operating conditions of the various activities and they should be accordingly assessed, from time to time.

9.1 Operation and specific situations

9.1.1 Activities on less easy walking surfaces

During the execution of activities on less easy walking surfaces, e.g. roofs, the possibility of fall both along the surface and beyond the edge should be considered. Thus, what follows should be taken into consideration:

- Potential fall distance.
  When using a fixed length lanyard the fall distance could be great enough when the fall starts nearby the anchor point. In such a situation a retractable type fall arrester should be used.
- Clear available space.
  Both along the surface and under the edge there should be no obstacles that could reduce the clear space available for the fall.

- Fall beyond the edge.
  Check that the area has no sharp corners that could obstruct or cut the lanyard or cause personal injury.
- Free swinging space.
  No side obstacles should be present along the clear free fall space if pendulum effect may occur.

If it is not possible to solve the above problems, it is essential to use a gangway with guard-rail.

9.1.2 Misaligned anchorage and falls beyond the edge with sharp corners

Falls beyond an edge with sharp corners can determine strains on the lanyards at the contact area as soon as they hit the edge. Since such situation can determine a loss of effectiveness of the fall arrest system and in extreme cases the lanyard breaking, anchorages and horizontal lines should be properly located.
Problems in case of misaligned anchorage at a certain distance from the potential fall point are likely to occur (Fig. 38):

- In case of edge with sharp corners:
  - a high friction factor between edge and restraint rope can be reached reducing the sensitivity of the braking device, and thus not allowing its operation;
  - the bending stress of the rope at the contact point with the edge could be high enough to cause the rope to break.
- In case of relatively sharp edge:
  - the restraint rope can keep running, even if at a reduced speed, so that it can not allow the activation of the device operating by inertial force.

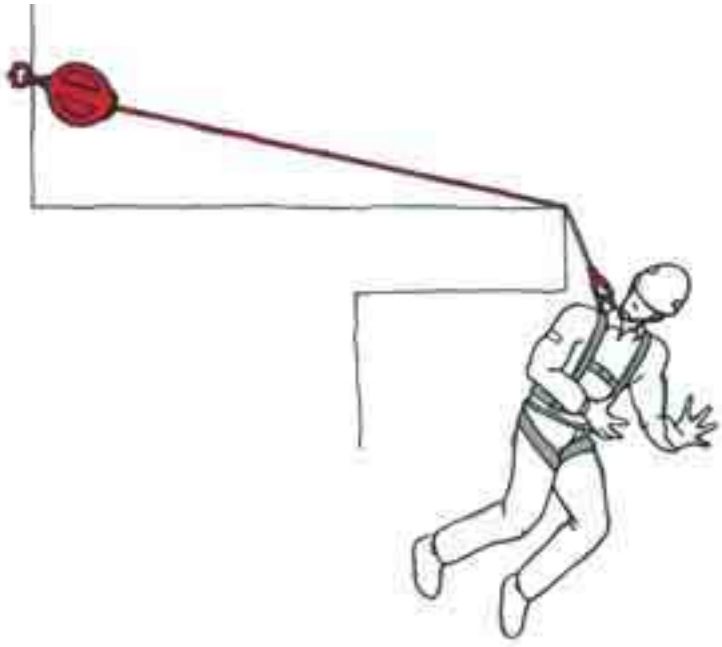


Fig. 38 - Misaligned anchorage from the point of fall

In case of displaced anchorage and possibility of fall beyond a border with smart corners or a partially connected border, it should be provided a new anchorage localized nearby the potential fall point.

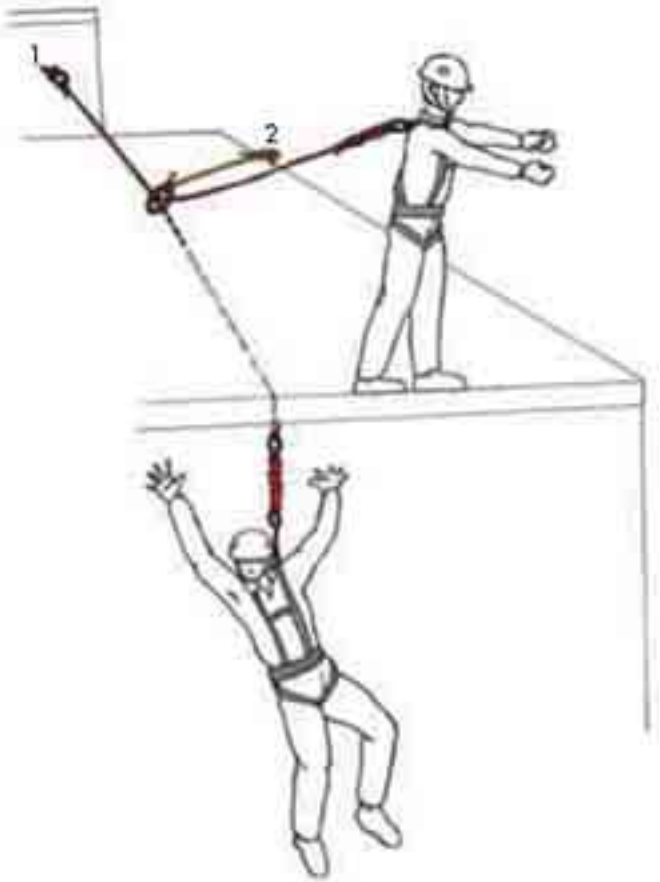
9.1.3 Pendulum effect

If lateral movements could occur during the fall, particular attention should be paid to the anchorages and horizontal lines position, to eliminate or minimise the consequent pendulum effect, and avoid that the worker hits obstacles during the fall.

The possibility of a pendulum effect during the fall is higher when the device is located at the end of the flexible anchor line, If compared with a fall arrester secured on a fixed anchorage.

To avoid the pendulum effect it is necessary to use a second anchor point with anchorage purposes to fasten a lanyard, or one intended as deflection of the restraint rope (deflection anchorage) as shown in Fig. 39.

use of two anchorages



joint use of a main anchorage and a deflection anchorage

1. main anchorage
2. deflection anchorage

Fig. 39 - Examples of how to use additional anchorages

9.1.4 Fall protection on mobile platforms

The user of mobile platforms may not easily find a proper anchorage for the fall arrester.

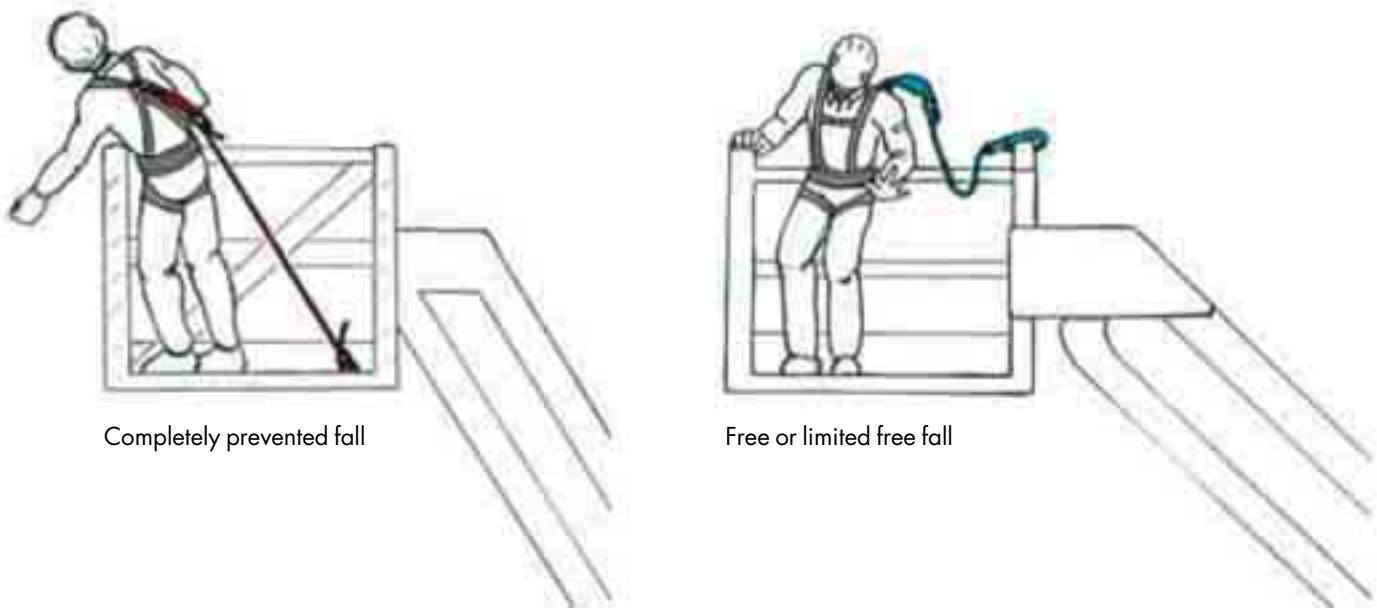
Assuming that for the anchorage the structure of the platform is used, the following specific directions are provided: for these activities only fall arresters that allow either a completely prevented fall or a restraint fall should be used. Limited fall or free fall devices should be allowed exclusively in exceptional cases after a proper assessment of the strength of the anchorage, and the effects of the dynamic stresses on the entire supporting system of the platform and of the other workers currently present.

Typical cases are illustrated in Fig. 40.

The truck crane and its all elements (stabilizers, truck, arm, terminal attachment equipment, electrical control devices), used to connect the fall arrester, is a connection subsystem that is part of the fall arrest system.

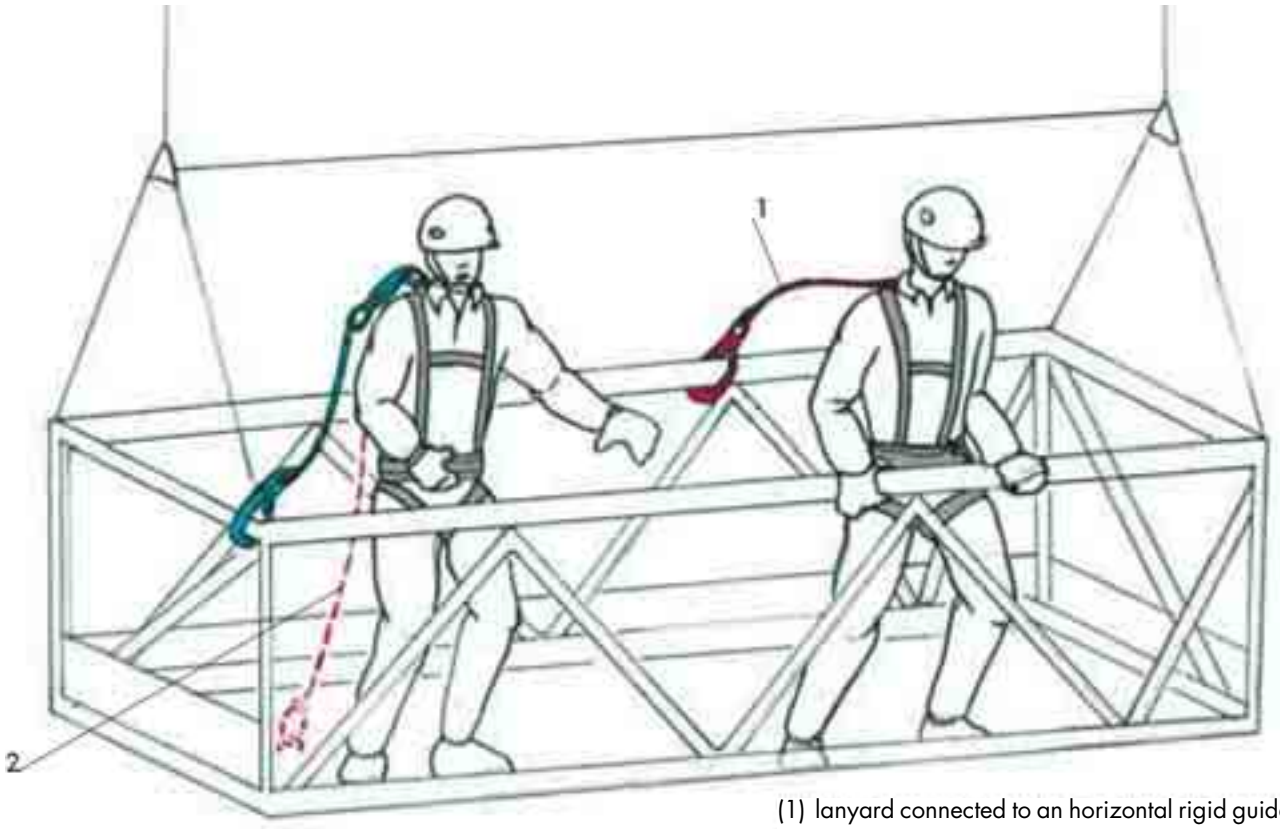
Thus, the truck crane is part of the overall fall arrest system that should be connected to a secure anchor point, that can be located, for example, on the ground.

Fig. 40 - Fall protection on mobile platforms

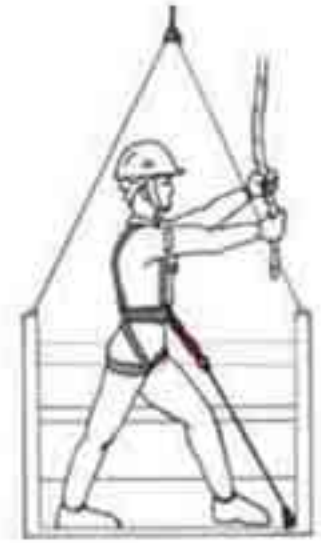


Completely prevented fall

Free or limited free fall

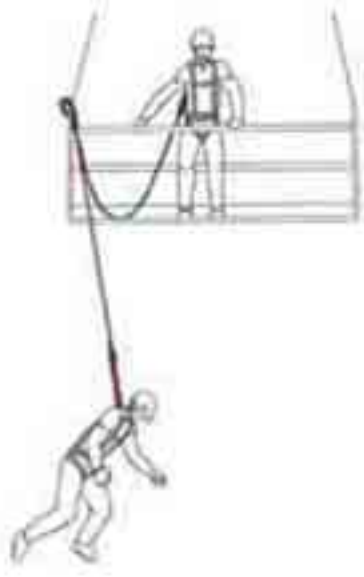


(1) lanyard connected to an horizontal rigid guide
(2) alternate restraint line



Completely prevented fall

Limited free fall < 600 mm



Free fall > 600 mm

Fig. 40 - Fall protection on mobile platforms

The truck crane, as part of a PPE (Personal Protective Equipment) intended to safeguard against falls from a height, belonging to the category III, is subjected to the provisions set in articles 8, 9 and 10 of Legislative Decree 475/92 as amended, as well as to the EC certification procedures in compliance with Art. 5 of the Decree itself, as applied to all the components of the fall arrest system.

9.2 Safe use of fall arresters

Below is a list of some general recommendations provided in order to safely use the fall arrester indicated in:

1. Figures 3 and 4: when the device is used to climb, for example, poles, 1 stile fixed metal ladders and trestles, using body harness equipped with sternal attachment point for the restraint lanyard, the length of the lanyard should be the one indicated by the device's manufacturer (usually up to 300 mm).
2. Figures 3 and 7: when the device is used on rigid inox steel cable lines or on a flexible anchor line, their ends should be equipped with an end lock.

Below is a list of some general recommendations provided in order to safely use the fall arrester indicated in Fig. 8:

1. This type of device, when not in use, should be left in retracted position in order to avoid the rope exposure to dirt and corrosion and to avoid leaving the spring under tension.
2. The device should not be used when lying on its side to ensure the proper recall mechanism operation.

Below it is reported a general recommendation in order to safely use the fall arrester shown in Fig. 11:

1. This type of device should be used without exposing the energy absorber to dirt or corrosives that could compromise its operation.

9.3 Safe use of anchor lines

Below is a list of some general recommendations provided in order to safely use security systems and devices:

1. Use a body harness compliant with the anchor line characteristics.
2. Use anchor lines not exceeding the maximum number of users set by manufacturers.
3. After a fall arrest, the anchor lines should be put out of service and serviced according to the directions provided by manufacturers.
4. An anchor line arranged for the connection of a fall arrest system should not be used as positioning system at work, unless expressly designed for such a purpose.
5. When it is necessary to switch from an anchor system to another one and there is the risk of fall from a height, the connection to both systems should be maintained during the transfer.
6. Check that all the connection systems are in lock position.
7. Check that the energy absorbers do not show stretching signs: if so, they should be replaced.
8. Anchor systems should be installed by competent people.
9. Nearby the access to the permanent anchor line, placards with the following information should be installed:
    - date of installation and name of installer and manufacturer;
    - system identification number;
    - compulsory usage of an energy absorber;
    - maximum number of simultaneous users allowed;
    - operating instructions (inspections and related dates);
    - dates in which the system has been put out of service;
    - a warning indicating that the system should be used only as connection line for the fall arrester.

9.4 Safe use of body harnesses, lanyards and attachment items

Only body harnesses should be used in case of potential falls.

The connection component of the fall arrest system should be exclusively connected to the sternal attachment (front) or the dorsal attachment (back) of the body harness.

The positioning belts should never be used whenever any fall could occur, that is a free fall, a limited free fall or a restraint fall.

9.4.1 Combinations of lanyards and body harnesses

Below is a list of some general recommendations provided in order to safely use lanyard/body harness matching:

1. The body harness should be worn as to fit the worker using its adjustment systems. Check that the adjustment and locking buckles are properly fitted.
2. The lanyard should be exclusively connected to the body harness on the attachments provided by manufacturers in order to support the fall arrest.
3. The lanyard should be used to minimise fall distance in case of falls.
4. The lanyard characteristics should ensure a clear free fall space as in paragraph 7.2.4.

Some situations may require the use of an additional lanyard in order to simultaneously connect to the anchor line while the primary lanyard can be used to overcome intermediate anchorages.

9.4.2 Connectors

Below is a list of some general recommendations provided in order to safely use the connectors:

1. Check that every coupler is compatible with the other, in order to avoid unvoluntary releases or element overload.
2. Check that upon PPE wearing and then periodically during its usage the primary and secondary locking devices are in safe position.
3. Avoid that attachment items are subjected to bending stresses (Fig. 41) as they could be designed not to withstand this kind of stress.
4. Avoid to stress the connector locking device with lateral loads.
5. Avoid loads non-axial to the plug (Fig. 42).
6. Avoid to use connectors with seats too small for the hosted ropes (Fig. 43).

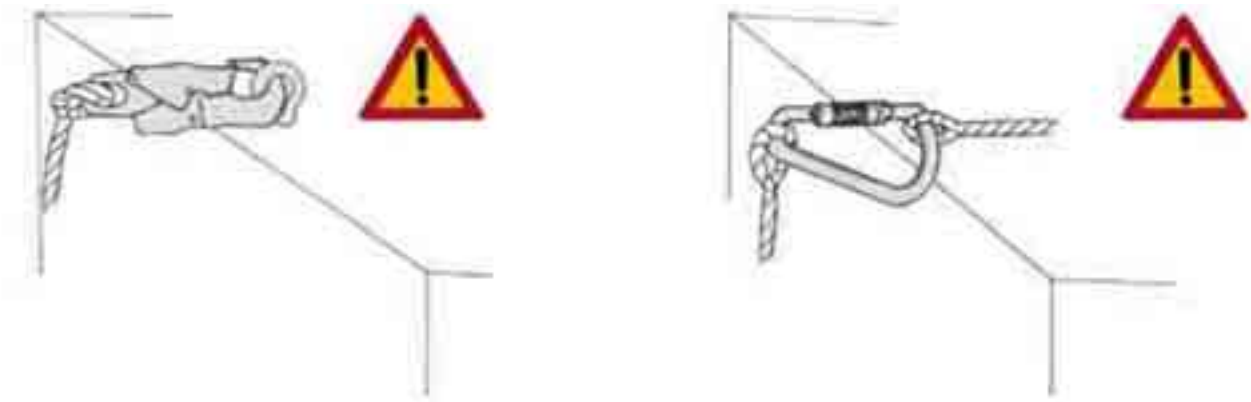


Fig. 41 - Wrong use of attachment items

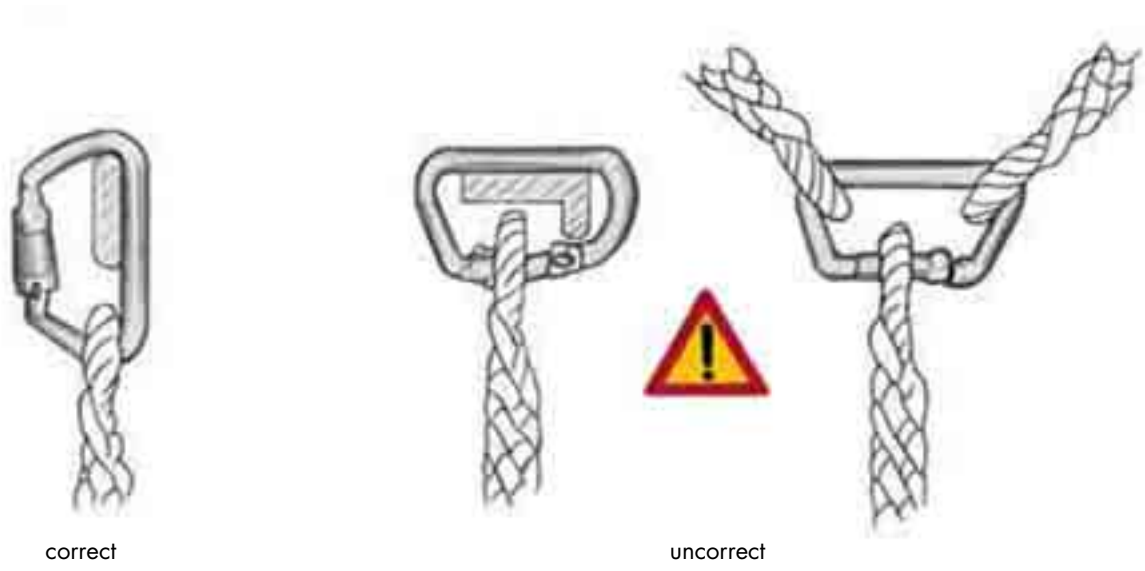


Fig. 42 - Loads non-axial to the plug

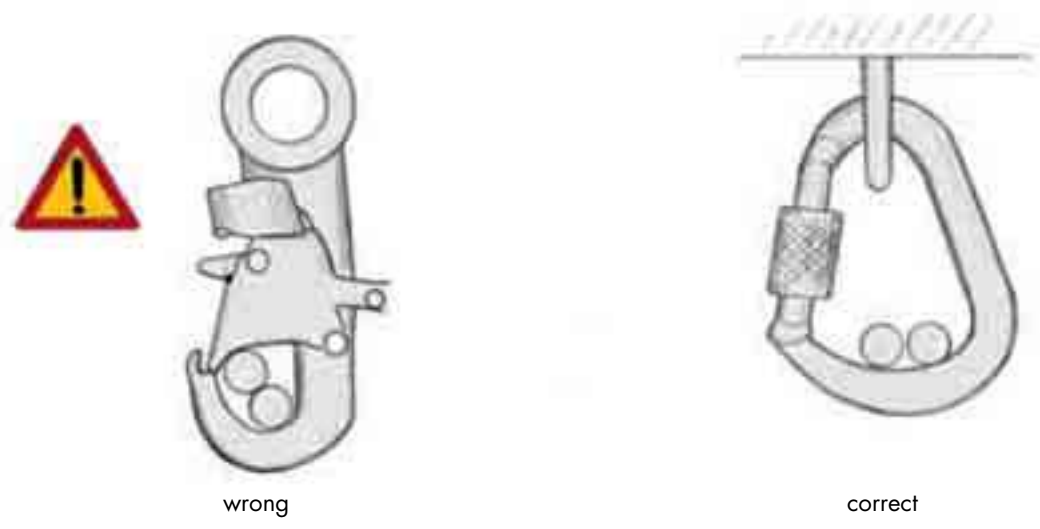


Fig. 43 - Connectors with seats too small for the hosted ropes

9.5 Safe use of anchorages

Below is a list of some general recommendations provided in order to safely use anchor systems and devices:

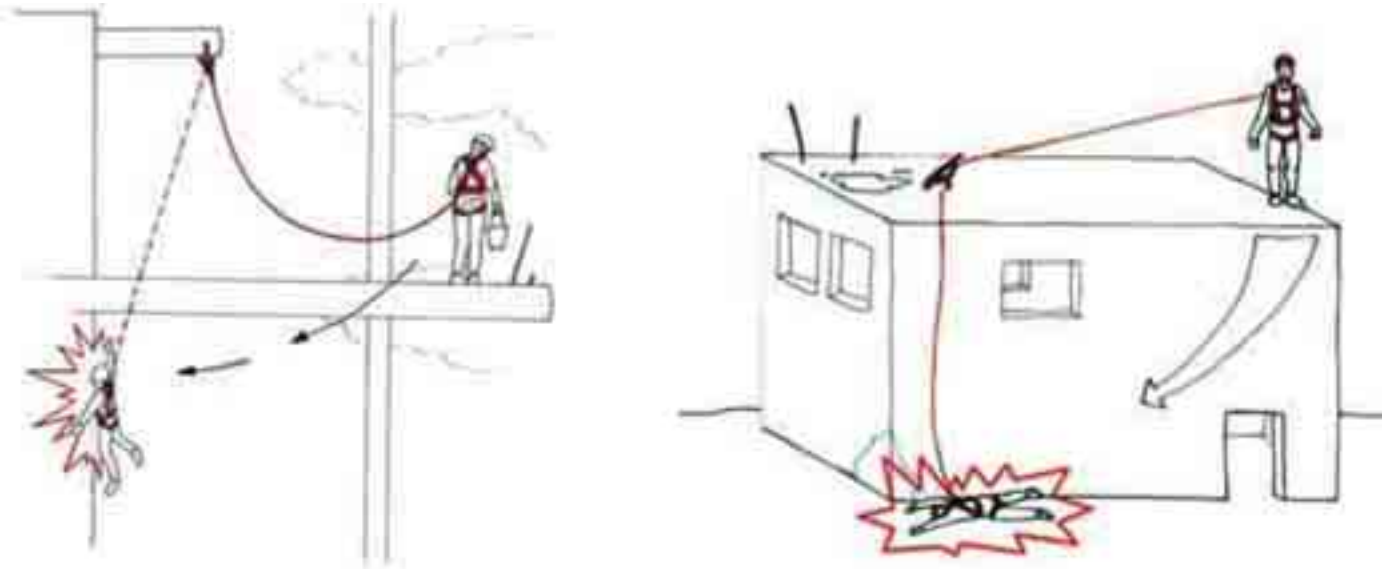
- Use a proper anchor point located as near as possible to the worker, on the vertical axis of the workplace to minimise the pendulum effect.
- Whenever possible, use an anchor point located higher than the attachment point on the body harness, in order to reduce the clear free fall space as much as possible.
- Use an anchor point that is located in position where it can ensure a proper safe clear space under the worker, depending on the type of fall arrester in use.
- Use anchorages that are strong enough according to tables 2 and 3.
- Arrange a safe access to the anchor point.

9.5.1 Pendulum effect

In case of lateral displacement between anchorage and potential fall point, the pendulum effect occurs during the fall.

In such a case two accidents could occur:

1. Simple pendulum effect with hitting against an obstacle (Fig. 44 a).
2. Pendulum effect with rope slipping along the edge and possible hitting against the ground when the rope length is greater than the section of the rope in contact with ground or a surface (Fig. 44 b).



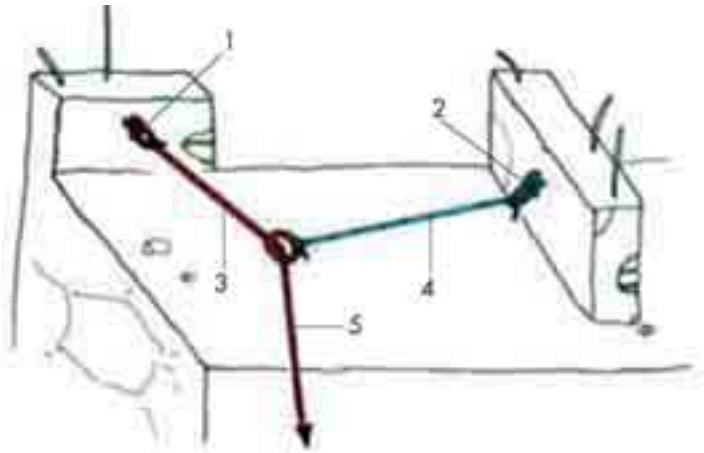
a) simple pendulum effect

b) pendulum effect with rope slipping along the edge

Fig. 44 - Pendulum effect

When it is not possible to completely avoid the pendulum effect, it is necessary to adopt one of the following methods:

1. Use an additional lanyard connected to a secondary anchorage in order to reduce the swinging (Fig. 39).
2. Use an additional deflection rope for the principal rope, connecting it to a second anchorage. (Fig. 45).
3. Apply latches on the edge (Fig. 46) at the workplace in order to limit the rope slipping from a latch to the next one.



1 Anchorage
2 Deflection anchorage
3 Primary rope
4 Deflection rope
5 Operator rope

Fig. 45 - Deflection anchorages

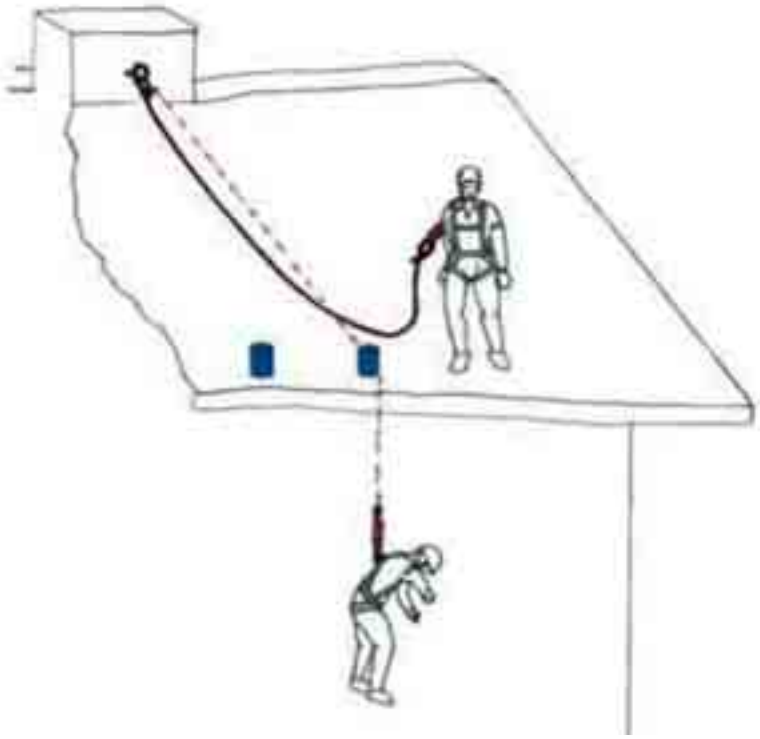


Fig. 46 - Latches on the edge

9.6 Safe use of tie anchorages

Below is a list of some general requirements for the usage of the tie anchorages (Fig. 37) located around a structure:

1. The strength of the structure should be compliant with the requirements in table 2.
2. The anchor rope sides, starting from the security rope and wrapping the structure, should form an angle of less than 120°.
3. Proper protections should be installed around the structure, at the contact areas with the anchor ropes, in order to avoid abrasions, cuts, excessive local strains.
4. Avoid anchor rope slipping around the structure.
5. For attachment elements to the security rope and anchor rope, requirements set in the sections 5 and 6 of paragraph 9.4.2 should be met.

10. Inspection

10.1 Type of inspection

Table 4 summarizes the general inspection requirements.

Type of inspection	Application	Mode
Before/after use inspection performed	personal equipment included body harnesses, lanyards, energy absorbers, lanyards with built-in energy absorbers, retractable type fall arresters, guided type fall arrester on flexible and rigid anchor lines	13.2.1
inspection performed by competent personnel	fall arrester - external check only	13.5.1
	body harnesses, lanyards, energy absorbers, lanyards with built-in energy absorbers, and related equipment	13.4
annual inspection performed by competent personnel	• permanently secured anchorages • fall arresters: complete revision • flexible and rigid anchor lines, including built-in components and mobile attachment devices	13.3 13.5.1 13.6
First use or reoperating inspection	all fall arresters or fall arrest system components	13.2.3
Inspection performed after a fall arrest and before reoperating	all components subjected to stresses due to a fall arrest	13.2.4

Tab. 4 - Summary of the inspection requirements

10.2 General inspections applied to fall arrest systems

For all components, check the presence and readability of the marking.

10.2.1 Fall arrest system inspection performed by workers

User should inspect, following the directions provided by manufacturers, through visual check, equipment before and after use, paying attention to every single component, e. g. body harnesses, lanyards, restraint ropes, energy absorbers, connectors.

In addition, worker should inspect the internal part of equipment whenever the access is allowed.

Worker should immediately report any fault or inconvenience detected during the inspection of every PPE included in the fall arrest system.

10.2.2 Periodical inspection

The periodical inspection should be performed following schedule and modes indicated in table 4, and in any case according to the directions provided by manufacturers.

10.2.3 First use or reoperating inspection

In addition to the conventional and periodical inspection, it is necessary to perform checks:

- upon reception of new equipment;
- before reoperating equipment after repair;
- before reoperating equipment when stored for an extended period of time or in conditions that could compromise its state of preservation;
- before reoperating a fixed installation, for a flexible anchor line not used for an extended period of time.

10.2.4 Inspection of a fall arrest system after a fall arrest or if faulty

After a fall arrest or if faulty, devices and equipment should be immediately put out of service and permanently marked with a label indicating their out of service conditions.

The equipment should be checked by competent personnel, according to the directions provided by manufacturers who should decide whether it can be put again in service, destroyed or repaired.

Repairs should be performed by the manufacturer or a competent person properly authorised by the manufacturer himself.

10.3 Body harnesses, lanyards and attachment elements inspection

In addition to what stated in paragraphs 10.2.1 and 10.2.3, every element should be inspected as scheduled by manufacturers, at least once a year.

The inspection should be performed by competent personnel as well as users.

Table 5 lists the checks to be performed on single components.

Component	Condition/fault to be checked
Straps	• cuts or tears • abrasions • excessive stretching • damage due to contact with heat, corrosives, or solvents • deterioration due to rotting, mildew, or ultraviolet exposure
Connectors	• distortion of hook or latch • cracks or forging folds • impediments to the free movement of the latch over its full travel • broken, weak or misplaced latch springs
D-rings	• strains • wearing • excessive play between ring's straps and base
Buckles and adjusters	• distortion or other physical damages • bent tongues
Sewing	• broken, cut or worn threads
Ropes	• cuts • abrasion or fraying • worn and broken threads • open wobblers • loosenings • damage due to contact with heat, corrosives, or solvents • deterioration due to ultraviolet light or mildew

Tab. 5 - Body harnesses inspection - checklist

10.4 Fall arrester inspection

In addition to what stated in section 10.2.1, devices as in par. 6.1 and anchor lines should be inspected by competent personnel following schedules and directions provided by manufacturers, and should be put out of service in case of faults. Whenever possible, they may be sent back to manufacturer for repair.

According to the directions provided by manufacturers, the following procedures should be performed:

- a complete and annual inspection, disassembling and assembling included, by competent personnel and according to the directions provided by manufacturers, and in any case after a fall arrest.

During every inspections, attention should be paid to:

- mechanical devices - perform an accurate cleaning of every single component, check the forging folds handling and the locking devices. Check for signs of corrosion;
- flexible anchor lines - check the state of lines with particular attention to wearing, cuts, tensioning, corrosion, terminals, rigidity, dirt;
- rigid guides - check that the rigid guides are free of dirt, visible signs of corrosions, and that the connections are properly secured.

Table 6 lists the checks to be performed on single components.

Component	Condition/fault to be checked
Ropes and straps with anchor lines included	• Cuts • Abrasions and fraying • Loosenings • Damage due to contact with heat, corrosives, or solvents • Excessive dirt or grease impregnation • Anchorages
Fall arrester body	1. rings - physical damages or wear 2. body - physical damages of the connecting elements to the body, strain, corrosion - hindering the free handling of the rope - loss of screws, nuts or similar elements 3. indicators - signals of fall arrest activation 4. labels - presence and readability
Locking mechanism	• Excessive wear • Efficiency of the security lock • No handle rope's freedom of run or losses of tension during the rewinding.
Snap hook	locking actions

Tab. 6 - Fall arresters inspection - checklist

10.5 Flexible and rigid anchor line inspection

Flexible lines and rigid anchor lines should be maintained by competent personnel following schedules and directions provided by manufacturers and at least once a year if regularly used or before using it again if not used for an extended period of time.

The following procedures should be performed:

- inspection of anchor points;
- checking tensioning of lines and of any energy absorber;
- checking the ending points / ends of lines;
- checking rigid rails and of their ends: permanent strains, corrosion due to rust and other pollutants, attachment of end points;
- checking mobile devices permanently installed on the anchor line;
- maintenance: mechanical devices should be maintained following the manufacturer's directions for use. Faulty products should be put out of service and, whenever possible, repaired by competent personnel.

Anchor lines with faulty or worn elements should be put out of service.

10.6 Inspection of anchor points

Permanently installed anchor points should be inspected by competent personnel, following the manufacturer's directions as to times and modes. Inspections should be recorded. It is recommended that the date of the latest inspection should be recorded not only on the inspection and maintenance card, but also on a label to be placed near the anchor point.

11. MAINTENANCE

Devices and equipment should be maintained following these indications:

- Mechanical devices. Maintenance following the manufacturer's directions for use. Dirt should be always removed, and, after cleaning, equipment should be dried using air at ambient temperature;
- Synthetic fabric. Usual cleaning for synthetic fabric and water and a mild detergent. If necessary, a more accurate cleaning should be performed. Manufacturer's directions for use should be followed.
- Flexible lines and rigid permanent anchor lines should be maintained by skilled personnel following times and directions provided by manufacturers and at least once a year if regularly used or before using it again if not used for an extended period of time.

Anchor lines with faulty or worn elements should be put out of service.

12. Log of inspections, of ordinary and extraordinary maintenance

Every fall arrest system should have its own maintenance card where actions and their results should be recorded, as shown in table 7.

The maintenance card should be available of users.

Item	Body Harness	Lanyards, energy absorbers	Arrest fall systems covered in paragraph 6.1, sections 1 and 2 including anchor lines	Arrest fall systems covered in paragraph 6.1, sections 3 and 4	Mobile attachment devices
Name and address of vendor / supplier	YES	YES	YES	YES	YES
Manufacturer lot number or serial number	YES	YES	YES	YES	YES
Year of manufacture	YES	YES	YES	YES	YES
Purchase date	YES	YES	YES	YES	YES
Date of first use	YES	YES	YES	YES	YES
Date and details of inspection and maintenance and related results	YES	YES	YES	YES	YES

Tab. 7 - Logbook data

13. Storage and handling

Storage and handling conditions should ensure that no part of the fall arrest system:

- is subject to unexpected stresses;
- is subject to excessive heat, moisture;
- comes into contact with sharp edges;
- comes into contact with corrosives that may cause damages.

If necessary, before storing equipment, dry them using air at ambient temperature.

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