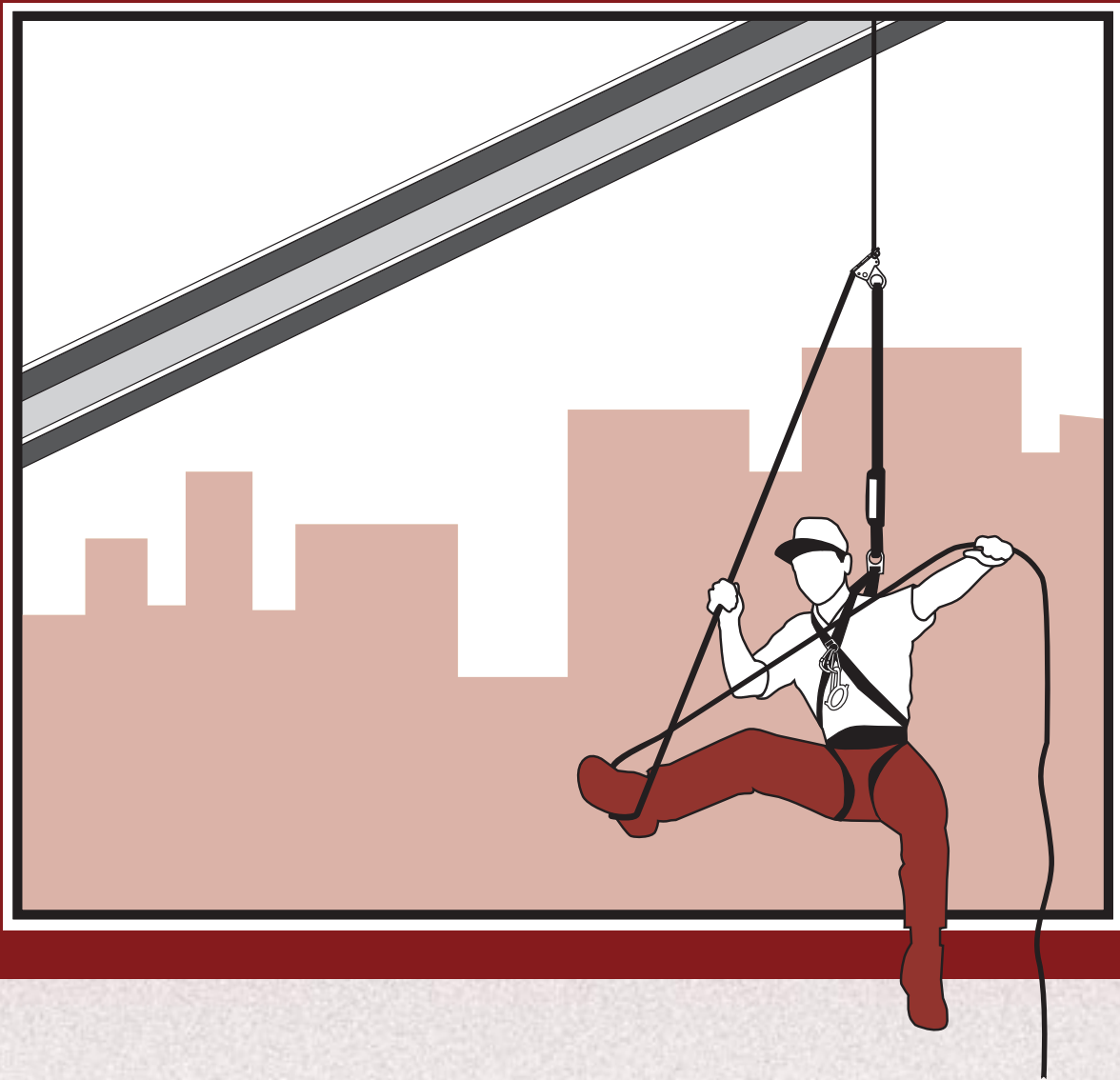


FALL PROTECTION RESPONDING TO EMERGENCIES



*Oregon Occupational Safety
& Health Division (OR-OSHA)*





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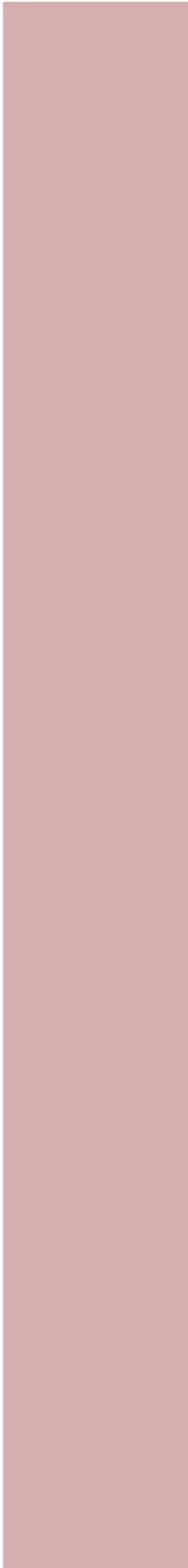
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Introduction

If you or your employees work from exposed, elevated surfaces, you're probably familiar with the personal fall-arrest system and you know that it can save your life if you use it properly. A personal fall-arrest system will stop your fall, but what do you do *after* it stops your fall? Unless someone can rescue you — or you can rescue yourself — a personal fall-arrest system will leave you hanging in space, sometimes a long way from a safe level.

The important point is this: If a fall leaves you suspended in a personal fall-arrest system, you must know how to rescue yourself or someone else must know how to rescue you **PROMPTLY**. The reason? The pressure that results from hanging in a body harness can constrict blood flow between your lower extremities and your heart. If you can't reduce the pressure promptly, you could lose consciousness within minutes. A prompt rescue can mean the difference between life and death.

Obviously, you should try to prevent emergencies so that you don't have to respond to them. Emergencies happen unexpectedly but you can prevent most of them by identifying and then eliminating or controlling the hazards that cause them. If an emergency does happen, you need a strategy for responding to it promptly. The best way to develop such a strategy is through a written emergency-response plan.

The purpose of this guide

If you're an employer or an employee who works from exposed, elevated surfaces, this guide will help you learn the following:

- What you can do to prevent fall-related emergencies
- How you can respond promptly to fall-related emergencies

Keep in mind: If you are an employer, you must provide for the prompt rescue of employees suspended from personal fall-arrest systems, or you must ensure that the employees know how to rescue themselves. ORS 1926.502(d)(20)

What you can do to prevent emergencies

Identify the hazards that cause emergencies

The first thing you should do is look for fall hazards in the tasks that workers do and the areas in which they work. Examples of hazardous tasks include placing rebar, connecting steel beams, conducting exterior building maintenance, and working on roofs. Hazardous areas include holes in roofs and floors, hoist areas, unprotected roof edges, and slippery or unstable surfaces (including ladders and scaffolds).

Eliminate or control the hazards

After you identify fall hazards, you need to eliminate or control them so that they won't cause an emergency. For example, you can eliminate many workplace fall hazards by placing rigid covers over holes, installing guardrails around unprotected roof edges, keeping walkways clean and slip-free, and making sure that workers use ladders and scaffolds that will support them *and* their equipment. Examples of methods for controlling task-related fall hazards include warning lines, safety nets, positioning devices, roof brackets with slide guards, and personal fall-arrest systems.

How you can respond promptly if an emergency occurs

The best way to ensure prompt, effective rescues is to develop a written *emergency-response plan*. This is *your* strategy for responding to fall-related emergencies. It doesn't need to be a massive document; however, it should show that you've thought about how to eliminate or control fall hazards and to ensure that workers will know how to respond promptly if something goes wrong. At a minimum, your plan should do the following:

- Establish emergency-response procedures
- Establish a chain of command
- Identify critical resources, including first responders, medical supplies, and rescue equipment
- Require emergency-response training for those affected by an emergency

Establish emergency-response procedures

Every emergency-response plan should have specific procedures — preferably, in writing — that describe what people must know and do to ensure a fallen worker receives prompt attention. These procedures include the following:

- Reporting an emergency
- Rescuing a suspended worker
- Providing medical and first aid
- Evaluating what caused the emergency

Establish a chain of command

All employees should know their roles and responsibilities during an emergency; however, one person must be responsible for managing the emergency, i.e., assessing its scope and directing the efforts of others. Make sure back-up personnel can take over for key players when they are absent.

Identify critical resources

Prompt rescues won't happen without trained first responders, medical supplies, and appropriate equipment. First responders include those who perform rescues and provide medical services. They must understand the procedures in your emergency plan, know how to administer first aid, and use rescue equipment.

Every worksite needs medical supplies for likely injuries. What medical supplies are available for emergencies at your site? Are they appropriate for injuries that are likely to occur? Be sure to store the supplies in clearly-marked, protective containers and make them available to all shifts.

Identify on-site equipment that responders can use to rescue a suspended worker. Examples include extension ladders and mobile lifts. Technical rescue equipment — such as pulleys, winches, or brake tubes — may be necessary at some sites.

Always determine where and how each type of equipment would be effective in a rescue effort. Make sure the equipment will permit rescuers to reach a fall victim, that it's available when rescuers need it, and that rescuers know how to use it. For

example, will the longest available ladder reach a suspended worker? If not, what equipment will reach the worker? When equipment is needed for a rescue, will workers who know how to use it be available? Also, think about how seasonal and environmental conditions will affect rescue equipment and those who use it: Equipment that works well during the summer may not work during the winter.

Require emergency-response training

An effective emergency-response plan ensures that on-site workers know emergency procedures, know how to use available rescue equipment, and — if necessary — know how to contact off-site responders. Workers who use personal fall-arrest systems and who work alone must know how to rescue themselves. Those who work at a remote site may need a higher level of emergency training than those who work near a trauma center or a fire department.

Responding to an emergency

A checklist for rescuing a suspended worker

When an emergency occurs

- If a suspended worker can't perform a self-rescue, call the on-site emergency-response team and get the appropriate rescue equipment.
- First responders should clear a path to the victim. Others should direct emergency personnel to the scene.
- Prohibit all nonessential personnel from the rescue scene.
- Talk to the worker and try to determine the worker's condition.
- If the worker is accessible, provide comfort and check vital signs. If necessary, administer CPR and attempt to stop bleeding.
- If the worker's injuries are minor, proceed with the rescue. Only trained responders should attempt a technical rescue.
- If the worker has severe injuries, contact emergency medical responders. Remember, 911 responders may not be able to accomplish prompt rescues.

After any emergency

- Report fatalities and catastrophes to OR-OSHA within eight hours. Report injuries requiring overnight hospitalization and medical treatment other than first aid to OR-OSHA within 24 hours.
- Document what went wrong, step by step.
- Identify all equipment that may have contributed to the emergency. Let a *qualified person* — one who has the knowledge, the experience, and the demonstrated ability to resolve fall-protection and rescue problems — examine the equipment. If the equipment was damaged, repair or replace it. If the equipment contributed to the emergency, determine why and how.
- Determine what caused the emergency. Be as specific as possible. Include dates, times, environmental conditions, work processes, and persons involved.
- Review the emergency-response plan. Determine what procedures should be added or changed to prevent similar emergencies. Revise the plan accordingly.

Techniques for rescuing a suspended worker

If you use a personal fall-arrest system and are suspended as the result of a fall, you must know how to rescue yourself or you must be rescued promptly. Self-rescue methods include the *foot wrap* and the *rappel*. An aided rescue involves at least one trained responder and equipment appropriate for the nature of the rescue.

A word of caution. If you use them properly, the rescue methods described below may save your life. But you must first learn them and practice them under the supervision of an experienced fall-rescue instructor.

Where do I find an experienced fall-rescue instructor?

Because we're a government agency, we can't recommend for-profit organizations that offer fall-rescue instruction.

However, we can suggest you do one of the following:

- Ask your insurance carrier for recommendations.
- Ask for suggestions from a safety equipment supplier.
- Check community college course offerings.
- Search the World Wide Web.

What you should know about 911

If you're working in a 911 service area, you can use this number to request medical and other emergency services. Keep in mind, however, that most 911 responders are not trained to rescue a suspended worker. Calling 911, therefore, does not ensure a prompt rescue.

Self rescue

A personal fall-arrest system can save your life if you fall, but your harness won't hold you comfortably while you're suspended. If you can't relieve the pressure it exerts on your legs, which constricts blood flowing back to your heart, you could lose consciousness. The first thing you should do is relieve the harness pressure; the *foot wrap* will relieve the pressure and allow you to climb up or down for short distances. You should learn the foot wrap if you use a personal fall-arrest system *and* if a fall could leave you suspended more than 35 feet above a lower level. See *How to do a foot wrap*, Page 8.

You can use a foot wrap to lower yourself short distances. However, if you're suspended more than 35 feet and you need to descend quickly, the *rappel* is the more effective method. See *How to do a rappel*, Page 9.

Aided rescue

Anyone who is suspended from a lifeline and can't perform a self rescue will need help from trained rescuers. Consider, for example, the worker who has a heart attack and falls or a suspended worker who is injured as a

Self-rescue methods include the foot wrap and the rappel.

Aided-rescue methods include pulley systems, brake-tube systems, and winch systems.

result of the fall. Aided rescues involve trained rescuers and *appropriate* equipment. Keep in mind the following in deciding what equipment is appropriate:

- Can you use extension ladders, forklifts, or elevating platforms to perform aided rescues — or do you need technical rescue equipment?
- Will the equipment be available and ready to use when you need it?
- Can rescuers always reach a suspended worker with the equipment?
- Do rescuers know how to use the equipment?

If possible, use on-site equipment such as extension ladders, forklifts, or elevating platforms for aided rescues. Only if this equipment isn't available or isn't appropriate should you consider using technical rescue equipment.

Technical equipment appropriate for aided rescues includes pulley systems, brake-tube systems, and winch systems. Each has advantages and disadvantages.

Pulley systems

Pulley systems have been used for centuries to move heavy loads, so it's not surprising to find them used in rescue work. A properly rigged 4:1 system, for example, takes about 60 pounds of force to raise a 200-pound person — a task that one adult can accomplish easily. Pulley systems are safe, inexpensive, easy to rig, and can raise or lower a suspended worker from any height. However, you'll need a long rope to make the system an efficient one. For example, lowering a person 50 feet with a 4:1 system requires a 240-foot rope — four times 50 feet plus 40 feet as a safety margin. See *How to use a pulley system*, Page 13.

Brake-tube systems

A brake tube uses rope friction — the rope wraps around the brake tube — to lower a suspended worker. Brake-tube systems are inexpensive (\$100 - \$200) and easy to set up. A brake-tube system will lower a suspended worker from any height. It has no moving parts and lowers faster than winch or pulley systems. Because they're small and inexpensive, you can set up brake-tube systems for more than one worker at a site. A brake-tube system requires a rope twice as long as the working height plus 20 feet as a safety margin. See *How to use a brake-tube system*, Page 14.

Winch systems

Winch systems have also been around a long time. Small gears provide the mechanical advantage for these systems. Winch systems are easy to operate, will raise or lower a suspended worker, and require little physical effort. A manual winch with 20:1 gearing takes about 12 pounds of turning force to raise a 200-pound worker — a task that one adult can accomplish easily. However, an appropriately geared manual winch requires many turns of a crank to lower a victim more than a few feet. Winch systems designed for rescues are also expensive (\$700 - \$1,000), and aren't practical if the rescue distance is greater than 100 feet.

How to do a foot wrap

Necessary equipment

- A personal fall-arrest system (including *body harness*, *connectors*, *secure anchor*, *vertical lifeline*, *lanyard*, and a *rope grab*).

See Definitions, Page 17 for an explanation of terms in italic.

Fig. 1

Grasp the lifeline hanging below you (that's the trailing end). Wrap it once under your right foot starting from the inside, then loop it over the top of the foot.

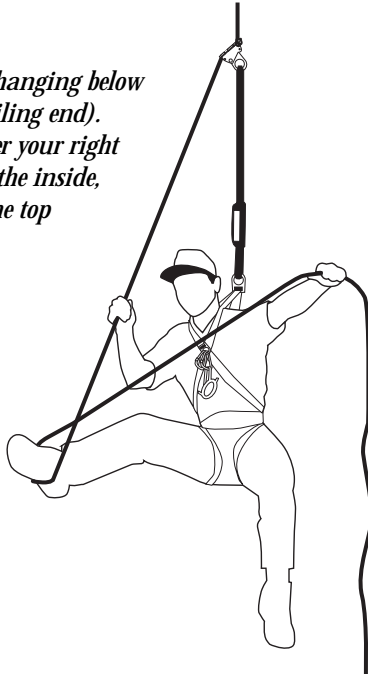


Fig. 2

Stretch the lifeline out horizontally and step into it with your left foot.

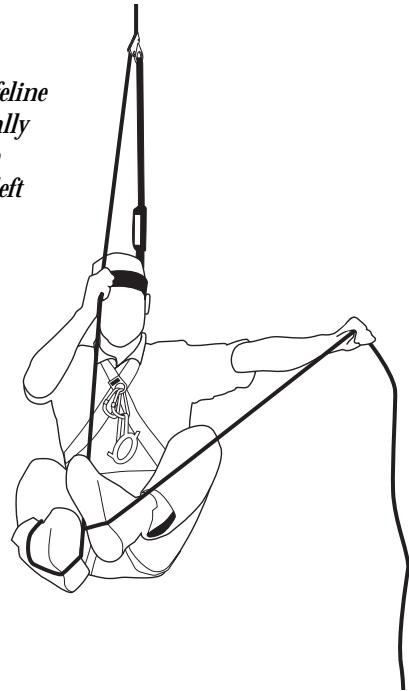


Fig. 3

Raise the trailing end of the lifeline and bring both parts together. You have now created a loop that will allow you to stand.

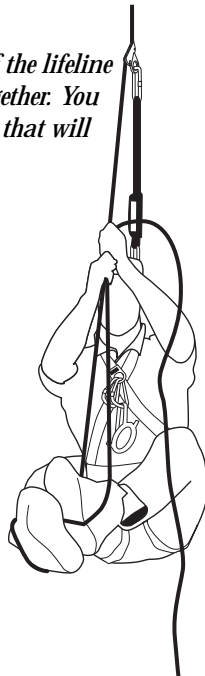
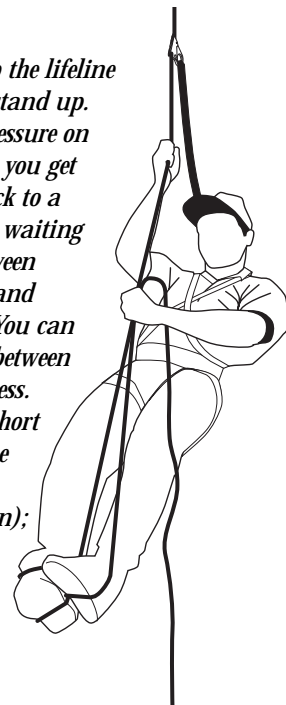


Fig. 4

Continue to hold on to the lifeline with both hands and stand up. This will relieve the pressure on your upper legs. When you get tired, you can shift back to a sitting position. While waiting for help, alternate between sitting in the harness and standing in the loop. You can also distribute weight between your feet and the harness. To climb up or down short distances, slide the rope grab up (to climb up) or down (to climb down); sit back down, grasp another bite of rope, then repeat the process.



How to do a rappel

Necessary equipment

- A *personal fall-arrest system*, including *body harness, connectors, secure anchor, lifeline, lanyard*, and a *rope grab*
- Two *carabiners*
- Two eight-millimeter *prussik loops*
- A figure-eight *descender* compatible with the diameter of the lifeline

See *Definitions*, Page 17 for an explanation of terms in italic.

Fig. 1

Take one of the two prussik loops and spread it horizontally across the lifeline.

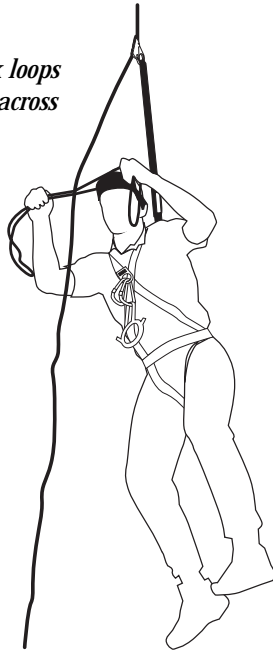


Fig. 2

Make a three-wrap prussik knot as follows: Take the end of the loop in your right hand and push it through the eye of the loop in your left hand. Do this three more times, then pull the tail of the loop down firmly to tighten the knot.

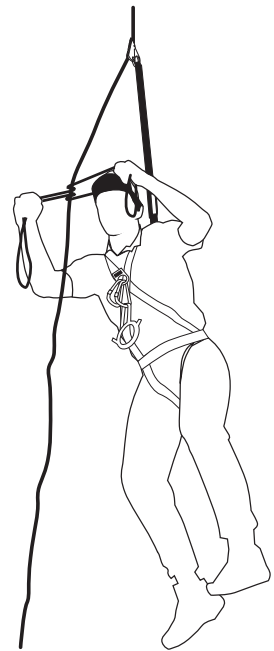


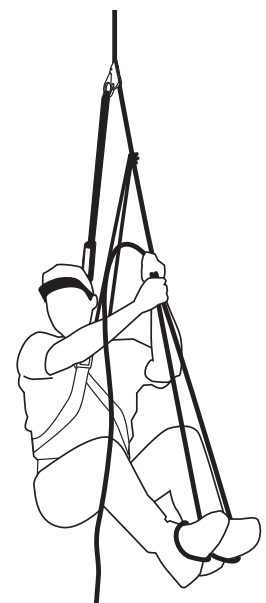
Fig. 3

Clip a carabiner into the tail of the prussik loop and into the rappelling attachment on your harness. Slide the prussik knot up the lifeline toward the rope grab to remove any slack in the prussik loop.



Fig. 4

Grasp the lifeline hanging below you (the trailing end) and do a foot wrap. (See How to do a foot wrap, Page 8.)



How to do a rappel, *continued*

Fig. 5

Stand up in the lifeline. Slide the prussik knot up the lifeline so that it touches the rope grab. If the knot doesn't reach the rope grab, you will have to sit down in the harness, do another foot wrap, then stand up again so that you are closer to the rope grab.

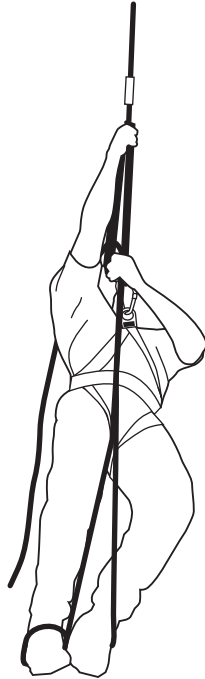


Fig. 6

When you have reached the rope grab, attach your descender to the lifeline. Grab the lifeline and bring it together so that it forms a loop at approximately shoulder level. Feed the lifeline loop through the larger eye of the descender.

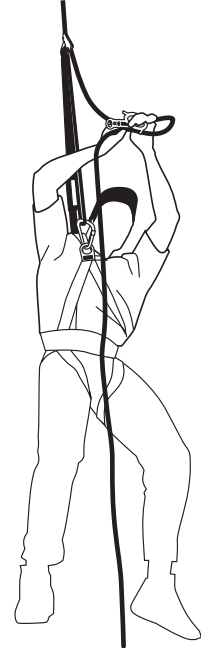


Fig. 7

Slip the loop over the smaller eye of the descender. (Make sure the smaller eye is pointing toward the ground.) The loop will ride up against the base of the larger eye.

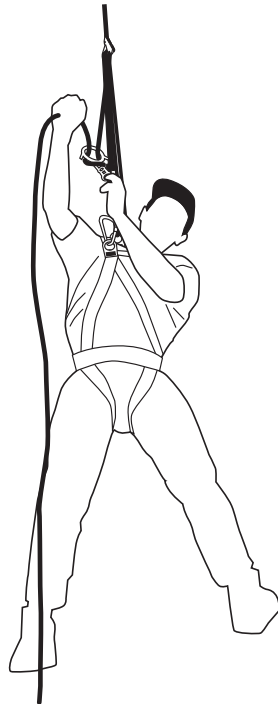


Fig. 8

Clip a carabiner to your rappel attachment and through the small eye of your descender. Lock off the descender as shown in Fig. 9



How to do a rappel, *continued*

Fig. 9.

Lock off the descender by grasping the trailing end of the rope and sliding it between the leading end of the rope and the large eye of the descender.

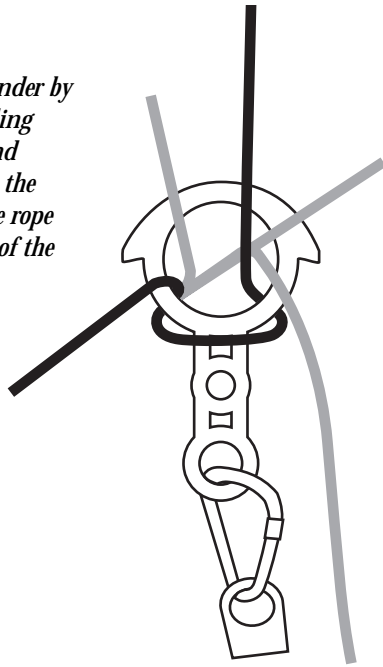


Fig. 10

Do a foot wrap. (See How to do a foot wrap.)

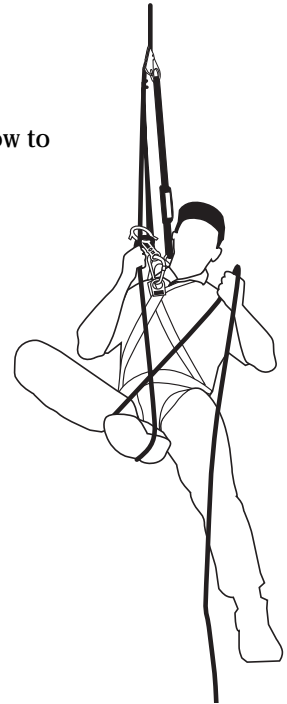


Fig. 11

Stand up in the lifeline and grasp the prussik knot (you will be transferring your body weight to the descender).

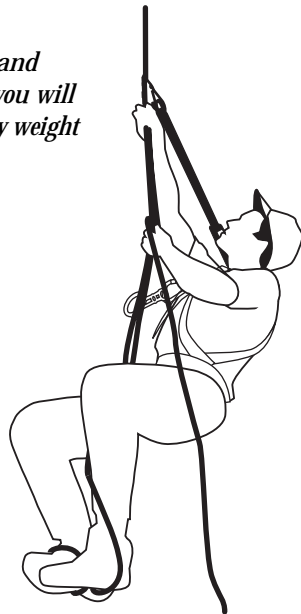
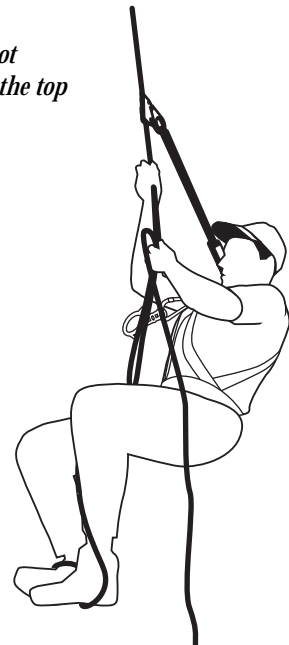


Fig. 12

Slide the prussik knot down the lifeline to the top of the descender.



How to do a rappel, *continued*

Fig. 13

Slide the rope grab down to the top of the descender. Sit down again. Your weight will be off the prussik loop. Unclip the prussik loop and remove it.



Fig. 14

The full weight of your body is now transferred to the descender. Undo the foot wrap.

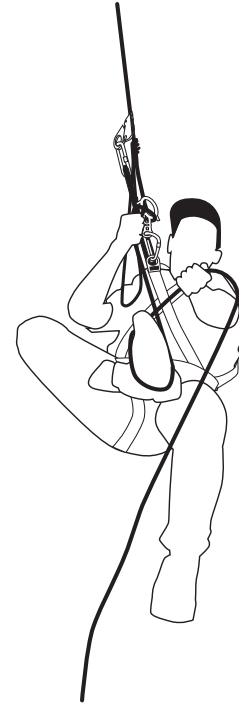


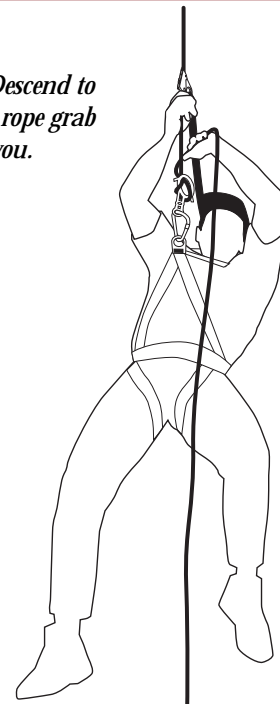
Fig. 15

Remove the prussik loop from the lifeline.



Fig. 16

Unlock the descender. Descend to a safe area, sliding the rope grab down the lifeline with you.



How to use a pulley system

Necessary equipment

(Make sure the equipment is rated for rescue work and has at least a 5,000-pound load capacity.)

- A large pad to protect the rope and to reduce friction over an unprotected edge
- Two pulleys
- Two *carabiners*
- A rope long enough to accomplish the rescue, plus additional length as a safety factor

See *Definitions*, Page 17 for an explanation of terms in *italic*.

Fig. 1

Connect the leading end of the pulley system to an anchor with at least a 5,000-pound load capacity. Be sure to place the rope pad under the ropes; the pad protects the ropes and reduces friction. Lower the trailing end of the system to the suspended worker:

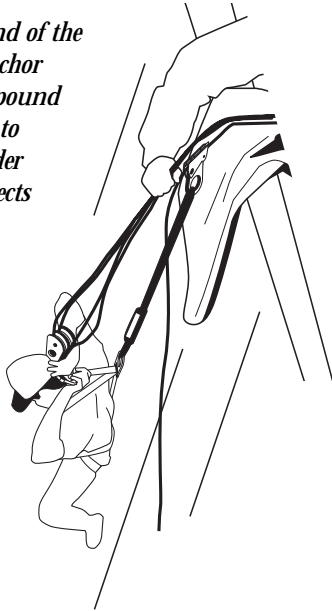


Fig. 2

Attach the pulley carabiner on the trailing end of the system to the D-ring on the body harness. (Here the worker attaches it to the D-ring connector on his back. You can also attach the trailing end to the rappel attachment on the front of a body harness.)

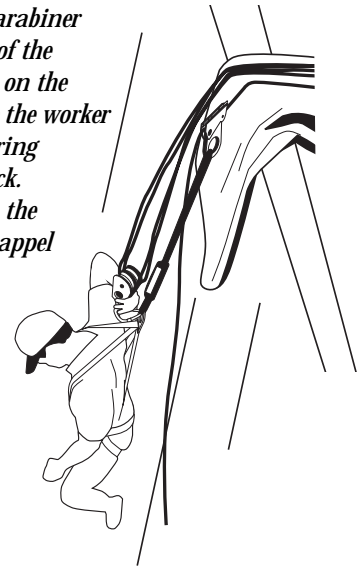


Fig. 3

Begin raising the worker until he can reach and unlock the rope grab on the fall-arrest system.

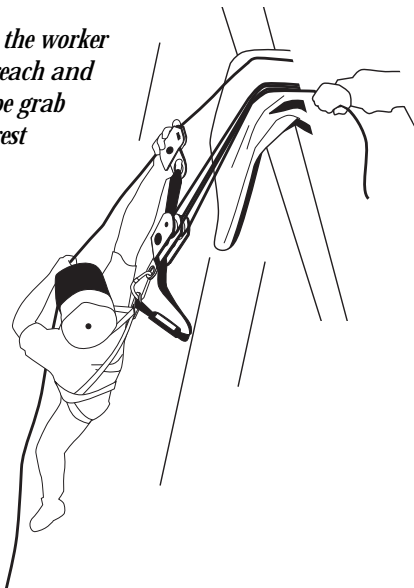
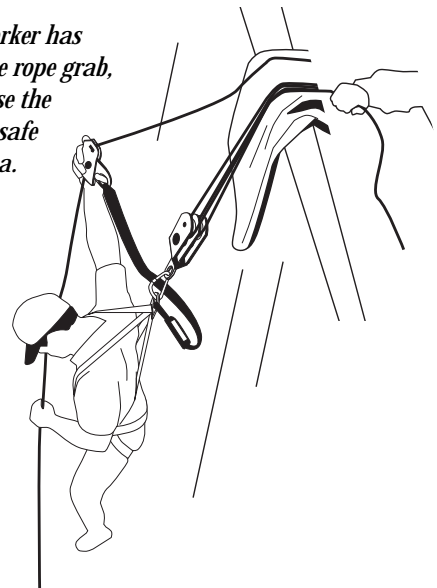


Fig. 4

After the worker has unlocked the rope grab, lower or raise the worker to a safe landing area.



How to use a brake-tube system

Necessary equipment

- A *brake tube* and a *connector* (that will connect the brake tube to a secure *anchor*)
- A *personal fall-arrest system* (including *body harness*, *rope grab*, and a *lifeline*). Make sure the lifeline is at least twice as long as the distance from the anchor to the landing area plus an extra 20 feet.

See *Definitions*, Page 17 for an explanation of terms in *italic*.

Fig. 1

Locate an appropriate anchor. It must support at least 5,000 pounds and it must be directly above the suspended worker.

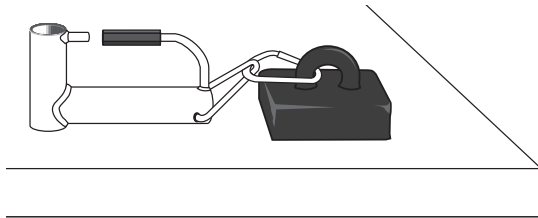


Fig. 2

Turn the locking sleeve on the brake tube counterclockwise to unlock it. Slip the leading edge of the rope through the opening and lay it over the top of the shorter tube and under the longer tube.

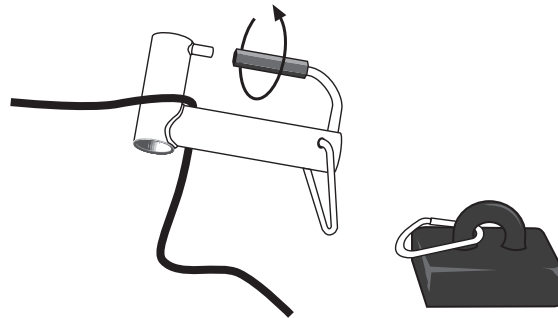


Fig. 3

Begin wrapping the rope around the longer tube.

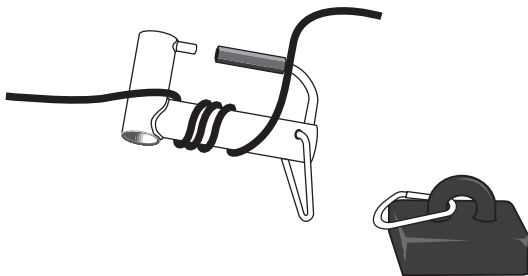
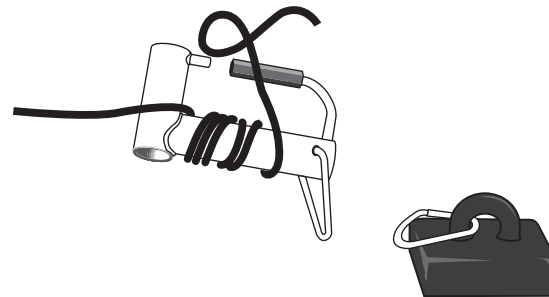


Fig. 4

Wrap at least 6 wraps of rope around the longer tube, then tie a half hitch around the smaller tube.



How to use a brake-tube system, *continued*

Fig. 5

Add another half hitch around the smaller tube.

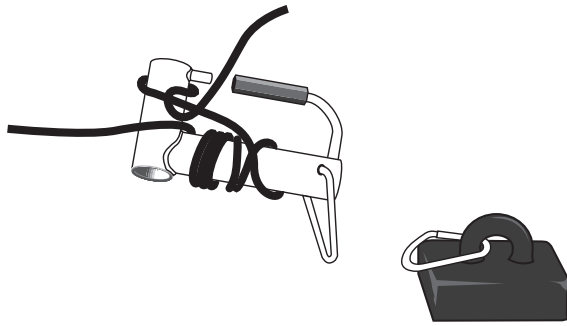


Fig. 6

Push the locking sleeve forward and screw it clockwise into the threaded member until it is tight.

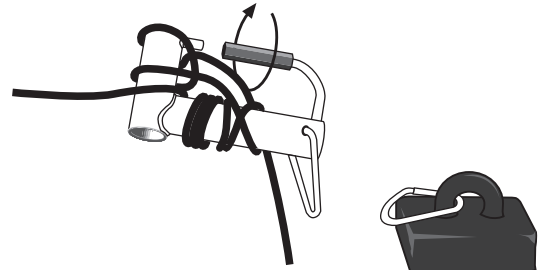


Fig. 7

The brake tube is ready to connect to an appropriate anchor. You can use the leading end of the rope as the lifeline component of a personal fall-arrest system. If a worker falls, the rope grab will arrest the fall as if the lifeline were attached directly to a standard anchor; the worker can then be lowered to a safe landing.

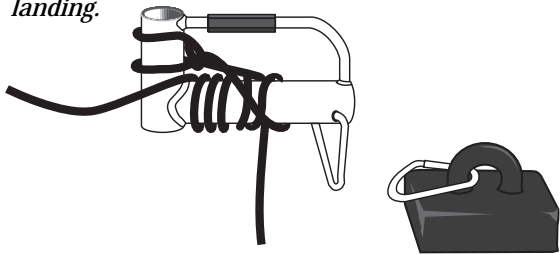
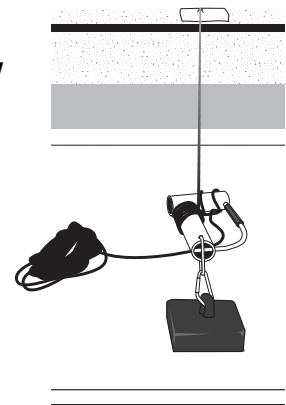


Fig. 8

Brake-tube system supporting a suspended worker. (The worker isn't shown in this illustration.) Be sure to place a pad between the roof edge and the lifeline to protect the lifeline from abrasion and to reduce rope friction.



How to use a brake-tube system, *continued*

Fig. 9

Once a fall has been arrested, another worker must lower the suspended worker to a safe area. First, unscrew the locking sleeve completely and begin unwrapping the half hitches. Keep a firm grip on the trailing end of the rope at all times. After you have removed the half hitches, lock the sleeve again.

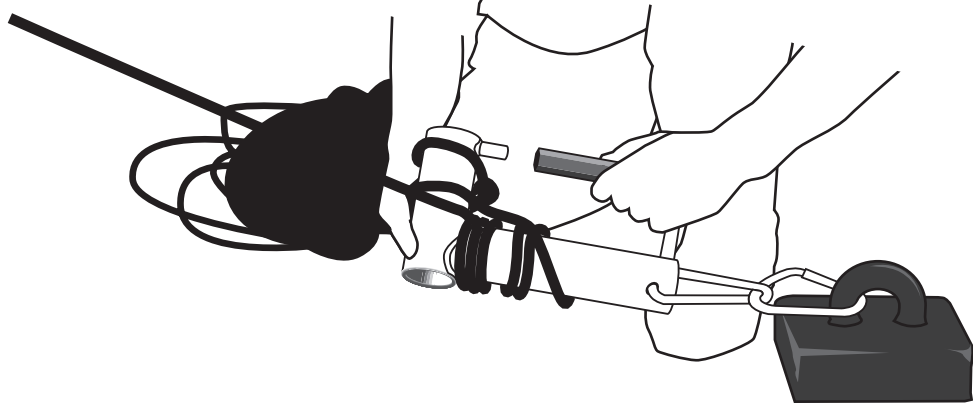
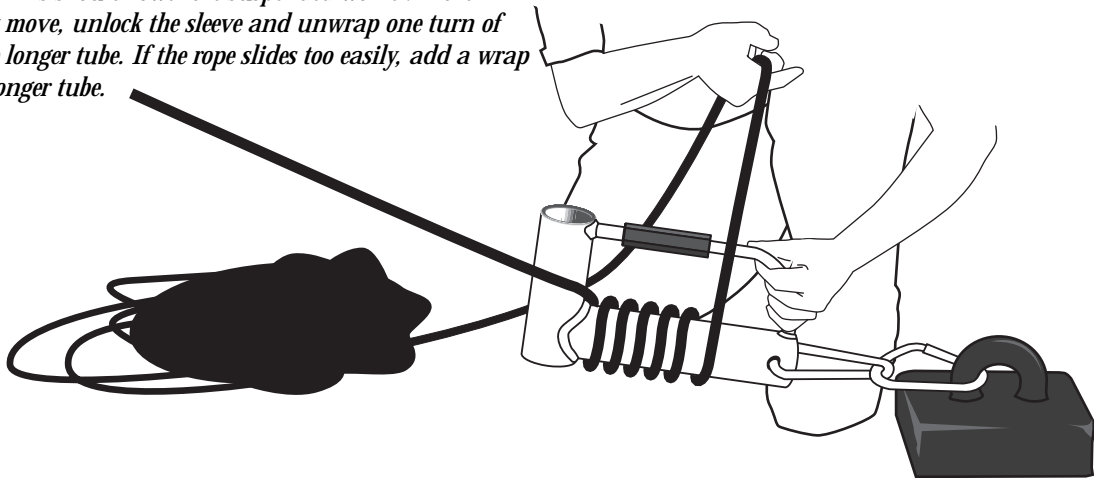


Fig. 10

Slowly release the trailing end of the rope by letting it slip through your fingers. This should lower the suspended worker. If the rope does not move, unlock the sleeve and unwrap one turn of rope from the longer tube. If the rope slides too easily, add a wrap around the longer tube.



Definitions

Aided rescue

Rescue work that requires one or more trained responders and appropriate equipment to retrieve a suspended worker. The type of equipment depends on the nature of the rescue. Equipment ranges from ladders and lifts to pulley, brake-tube, and winch systems.

Anchor

A secure point of attachment for lifelines, lanyards, or deceleration devices. Anchors must be capable of supporting a minimum load of 5,000 pounds per worker (or designed, installed, and used under the supervision of a qualified person).

Body harness

Straps that one wears to distribute fall-arresting forces over the thighs, waist, chest, shoulders, and pelvis. Attaches to other components of a personal fall-arrest system.

Brake-tube system

An aided-rescue system that uses rope friction to lower a suspended worker. The brake tube is easy to set up and is relatively inexpensive (\$100 - \$200). A suspended worker can be lowered from almost any height, and the device has no moving parts. Brake-tube systems are effective only for lowering and require a rope twice as long as the working height plus an extra 20 feet as a safety margin.

Carabiner

A type of connecting component.

Connectors

Devices that couple (connect) components of a personal fall-arrest system.

D-ring

A type of connector; usually an attachment point on a body harness.

Descender

A device for rappelling that controls one's descent along a lifeline.

Emergency-response plan

An employer's strategy for dealing with fall-related emergencies. It establishes that an employer has evaluated fall hazards, developed procedures to treat an injured worker or rescue a suspended worker, acquired appropriate supplies and equipment, and trained workers appropriately.

Foot wrap

A self-rescue method that will relieve harness pressure on a suspended worker.

Lanyard

A flexible rope, strap, or webbing that connects a body harness to a deceleration device, lifeline, or anchor.

Lifeline (vertical)

A flexible line that attaches directly to person's body harness, lanyard, or deceleration device at one end and to an anchor at the other end.

Personal fall-arrest system

A system designed to stop a single worker from free falling to a lower level. System components include an anchor, connectors, a body harness, and may include a lanyard, deceleration device, or lifeline.

Prussik knot

A type of sliding hitch knot tied with a short loop of rope.

Prussik loop

A short loop of rope that is attached to a lifeline with a prussik knot.

Pulley system

A technical aided-rescue system that will raise or lower a suspended worker. Pulley systems are inexpensive, easy to rig, and safe to use. But they require a long rope to be most efficient.

Qualified person

One who has a recognized degree, certificate, or professional standing, or who has successfully demonstrated the ability to resolve fall-protection and rescue problems.

Qualified first-aid person

One who has current first-aid training by the American Red Cross or an equivalent provider.

Rope grab

A deceleration device that moves along a vertical lifeline. The device automatically engages and locks on the lifeline when a worker falls.

Rappel

A self-rescue method that one can use to descend a fixed rope.

Self-rescue

Methods that a suspended worker can use to reach a safe level without assistance or to relieve pressure from a body harness.

Winch system

A technical aided-rescue system that will raise or lower a suspended worker. Winch systems are easy to operate and require minimum physical effort to raise or lower a suspended worker.

OR-OSHA services

OR-OSHA offers a wide variety of safety and health services to employers and employees:

Consultative Services

- Offers no-cost on-site safety and health assistance to Oregon employers for help in recognizing and correcting safety and health problems in their workplaces.
- Provides consultations in the areas of safety, industrial hygiene, ergonomics, occupational safety and health programs, new business assistance, and the Safety and Health Achievement Recognition Program (SHARP).

Enforcement

- Offers pre-job conferences for mobile employers in industries such as logging and construction.
- Provides abatement assistance to employers who have received citations and provides compliance and technical assistance by phone.
- Inspects places of employment for occupational safety and health rule violations and investigates workplace safety and health complaints and accidents.

Standard & Technical Resources

- Develops, interprets, and provides technical advice on safety and health standards.
- Provides copies of all OR-OSHA occupational safety and health standards.
- Publishes booklets, pamphlets, and other materials to assist in the implementation of safety and health standards and programs.
- Operates a Resource Center containing books, topical files, technical periodicals, a video and film lending library, and more than 200 databases.
- Manages the Worksite Redesign Grant Program, which awards grants to develop and implement solutions to workplace safety, health, and ergonomic problems.

Public Education & Conferences

- Conducts conferences, seminars, workshops, and rule forums.
- Coordinates and provides technical training on topics like confined space, ergonomics, lockout/tagout, and excavations.
- Provides workshops covering basic safety and health program management, safety committees, accident investigation, and job safety analysis.
- Manages the Voluntary Protection Program and the Safety and Health Education and Training Grant Program, which awards grants to industrial and labor groups to develop occupational safety and health training materials for Oregon workers.

***For more information, call the OR-OSHA office nearest you.
(All phone numbers are voice and TTY.)***

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