

# FALL PROTECTION

## REBAR AND CONCRETE FORMWORK



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



# Contents

**Introduction** ..... 2

    OR-OSHA's Fall Protection Requirements for  
    Construction Work: 1926 Subdivision M ..... 2

**Fall protection requirements for rebar and  
concrete formwork** ..... 3

    Personal fall-arrest systems ..... 3

    Safety-net systems ..... 3

    Positioning-device systems ..... 4

    Climbing rebar ..... 5

    Capping rebar ..... 6

    Standard formwork ..... 6

    Slipforms ..... 7

    Tilt-up work ..... 7

    Precast concrete ..... 7

    Exterior building work ..... 8

    Ladders ..... 8

    Protective equipment ..... 8

**Training** ..... 9

    Retraining ..... 9

    Training records ..... 10

**Emergencies** ..... 11

    Responding to emergencies ..... 12

    Investigating accidents ..... 12

**Definitions of selected terms** ..... 13

**OR-OSHA services** ..... 16

# Introduction

Fall protection is a concept that describes behaviors, systems, processes, procedures, equipment, and rules intended to protect workers from fall hazards. Fall protection doesn't mean bulky or cumbersome equipment. It doesn't interfere with work tasks and it doesn't get in the way of coworkers if you understand the concept and apply it appropriately. That's the purpose of this manual: to help you use appropriate fall protection for rebar and concrete formwork.

## *OR-OSHA's fall protection requirements for construction work: 1926 Subdivision M*

OR-OSHA's fall protection requirements for the construction industry are included in OAR 437, Division 3, Subdivision M, of the Oregon construction safety and health code. The requirements apply to virtually all walking and working surfaces in construction workplaces.

### ***Subdivision M specifies:***

- Where fall protection is required.
- What fall protection systems and methods are appropriate to use.
- Correct construction and installation practices for fall protection.
- Supervision requirements for workers using fall-protection.
- Safe-work procedures and requirements with fall-protection systems.
- Training requirements for workers using fall protection.

# Fall-protection requirements for rebar and concrete formwork

Division 3, Subdivision M, requires workers on the face of formwork or reinforcing steel to use fall protection if they are six feet or more above a lower level. Workers and employers can choose from among the following types of fall protection: personal fall-arrest systems, safety nets, or positioning-device systems.

## *Personal fall-arrest systems*

Personal fall-arrest systems are designed to stop a worker from free falling to a lower level. A personal fall-arrest system consists of an anchorage, connectors, and a full body harness.

Other system components may include a lanyard, a lifeline, and a deceleration device. These components must be used only for fall protection and not for any other purpose. If the system, or any system component, is subjected to a fall, it must be immediately removed from service and cannot be used again until a *competent person* determines it is undamaged.

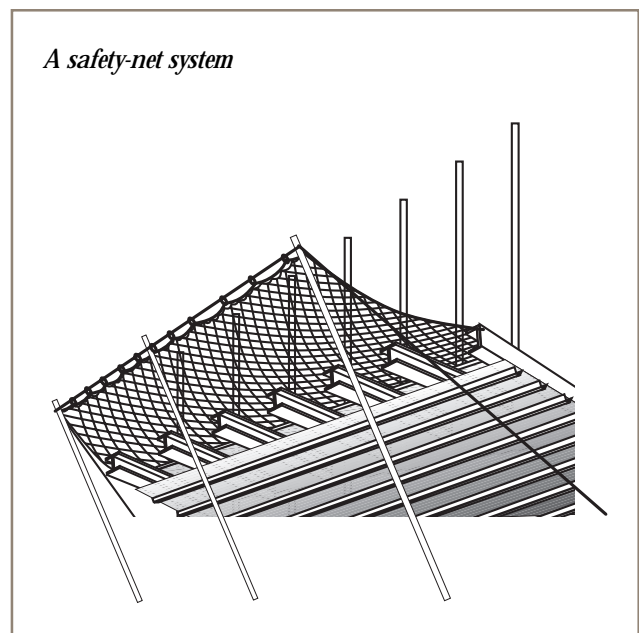
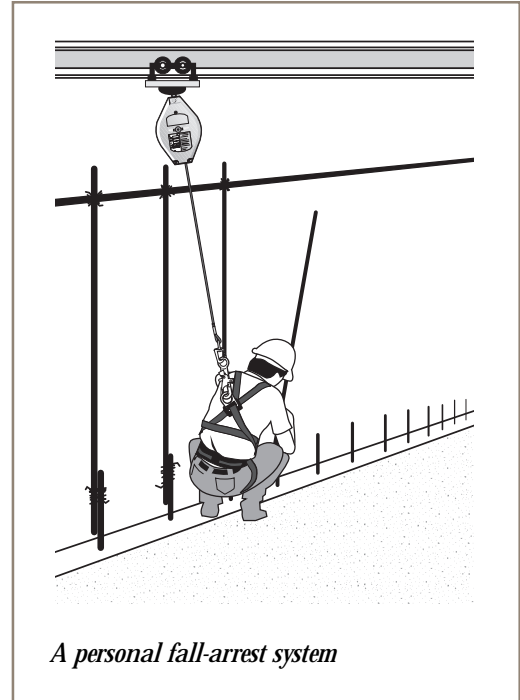
### *Who is a competent person?*

OR-OSHA defines a competent person as one who is capable of identifying existing and predictable hazards in the work environment and who has authorization to take prompt measures to eliminate the hazards.

Use a personal fall-arrest system as fall protection when you are constructing standard forms or doing dismantling work, exterior building work, or erecting precast concrete members.

## *Safety-net systems*

Safety-net systems consist of mesh nets, panels, connectors, and other impact-absorbing components. Use safety nets as fall protection for doing standard formwork, slipform work, and erecting precast concrete members.





### *Positioning-device systems*

Positioning-device systems are the most appropriate type of personal fall-protection for working on and placing rebar. A positioning-device system enables one person to work on a vertical surface with both hands free and it limits free-fall distance to two feet or less. The difference between a positioning device system and a personal fall-arrest system is that a positioning-device system supports a worker on an elevated surface and limits a fall to two feet. A personal fall arrest system, on the other hand, prevents a worker from free falling more than six feet.

The major components of a positioning-device system are:

**Body support** — a body belt or full body harness.

**Connectors and connecting assemblies** — a chain/web rebar assembly or rope/web lanyard, snaphooks, and D-rings.

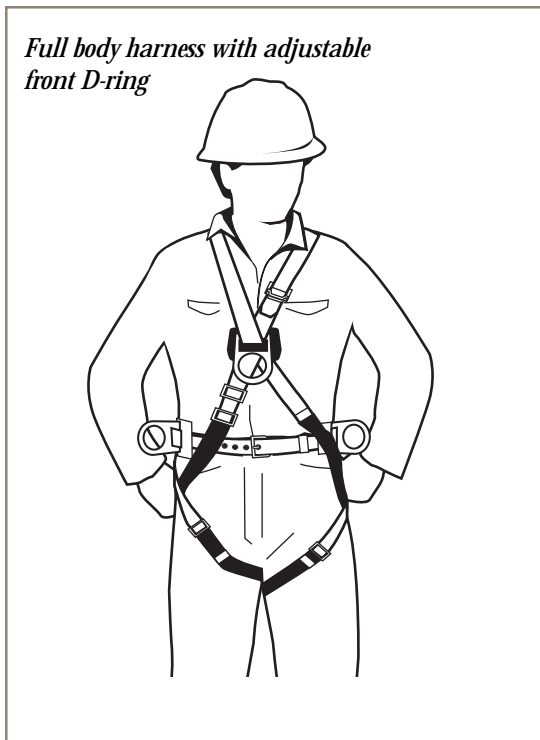
**Anchorage connector** — a carabiner or snaphook.

**Anchorage** — a rebar or other support structure.

Positioning-device systems must meet the following requirements:

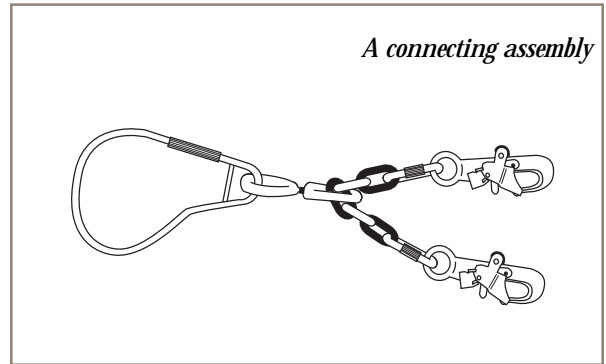
#### *Body support*

A body belt must limit the maximum arrest force on a worker to 900 pounds and can't be used for any purpose other than personal fall protection. A body harness must limit the maximum arrest force to 1,800 pounds and must be used only for fall protection. Make sure the body belt or harness has side D-rings, or a single front D-ring for positioning. (Rear D-rings are for fall arrest only.) Finally, use a body belt or full body harness that is properly fitted; belts and harnesses come in different sizes. Body belts must not ride up and compress the rib cage.



*Connectors and connecting assemblies*

Connecting assemblies must have a minimum tensile strength of 5,000 pounds. Snaphooks and D-rings must be proof-tested to a minimum tensile load of 3,600 pounds without cracking, deforming, or breaking. They must be made of drop-forged steel or equivalent materials, the finish must be corrosion-resistant, and the surfaces smooth. The dimensions of snaphooks must be compatible with the members to which they are connected or the snaphooks must be of the double-locking type to prevent roll out.



*Anchorage*

Positioning-device systems must be secured to an anchorage that can support at least twice the potential impact load of a worker's fall or 3,000 pounds, whichever is greater.

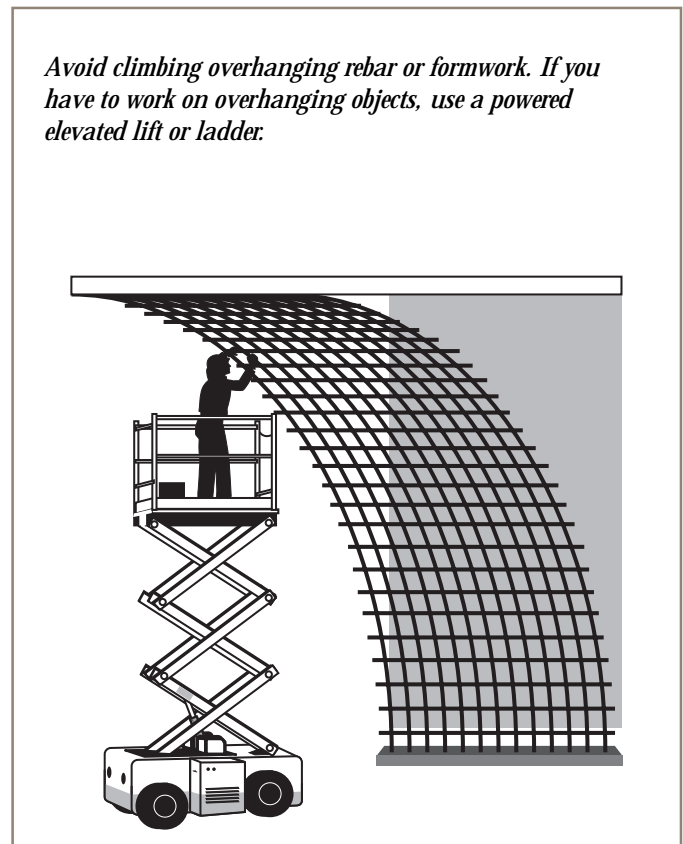
Be sure to inspect positioning device systems for wear, damage, or deterioration before using them. Remove defective components from service.

*Climbing rebar*

OR-OSHA permits you to free-climb concrete forms and rebar to reach work areas. The maximum free-climbing height is 24 feet. The horizontal bars must be spaced not less than six inches, or more than 16 inches on center. When rebar spacing is more than 16 inches on center, use a ladder or lift to reach work areas. Upon reaching a work area, you must use a personal fall-arrest system, safety net, or positioning-device system for fall protection.

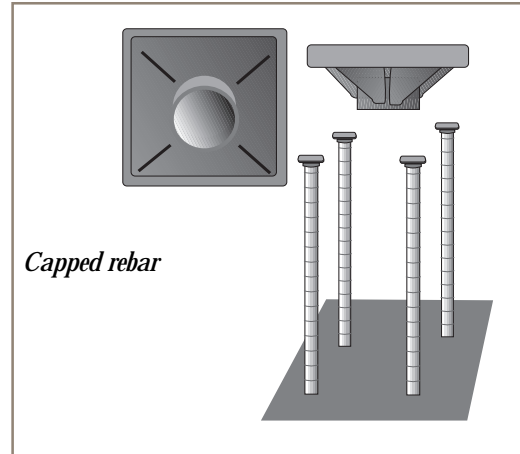
Check the rebar's rigidity before climbing it. If it's not rigid, brace it to meet the required 3,000-pound anchor-load requirement.

Avoid climbing overhanging rebar or forms (see the figure at right). This type of climbing increases your risk of falling and overexerting your muscles and joints.



### Capping rebar

Whenever you work above rebar that protrudes from the floor, cover the rebar with protective caps that will prevent you from being impaled if you fall. Cap rebar protruding horizontally to prevent scrapes, cuts, or eye injuries.



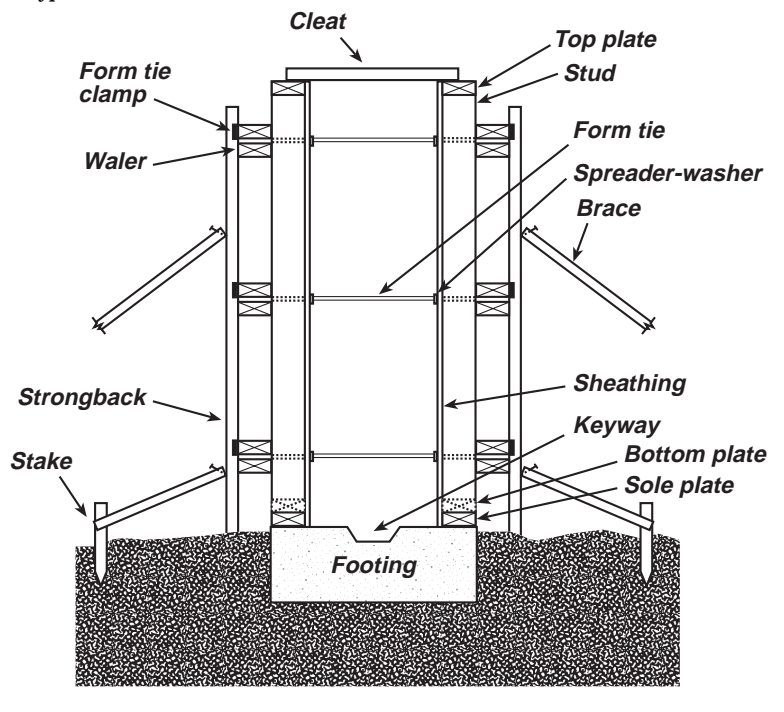
### Standard formwork

When you work on standard forms more than six feet above a lower level, you must use appropriate fall protection (personal fall-arrest, safety-net, or positioning-device systems) or work from a platform such as a carpenter bracket scaffold. Railings on work platforms must be 42±3 inches high. Include midrails and toeboards if people are working below.

When you climb standard forms with walers or cross-ties to gain access to a work area, make sure the climbing members are no more than 16 inches apart. Use a ladder or lift to reach the work area if the climbing members are spaced more than 16 inches apart. Ladder rungs must offer reliable footing. Tie off an unstable ladder so that it is anchored at the access to the work area and at the ladder's base.

Note: Walers have depths ranging from 1 ½ inches to 3 ½ inches. The smaller walers do not offer much toehold. Use caution when you climb walers with narrow depths.

A typical standard form



If you are doing dismantling or erecting work outside protective guardrails, you must use a personal fall-arrest system.

When rebar protrudes from wall forms that you are dismantling, you may tie off to the exposed rebar if it's strong enough and if you can't slide off the end. A number three, grade 60, bar (0.375-inches diameter) has ultimate shear strength of about 6,000 pounds. A number-four grade 60 bar (0.500 in diam.) has a shear strength of 8,000 pounds.

Do not walk, sit, or stand on top of wall forms.

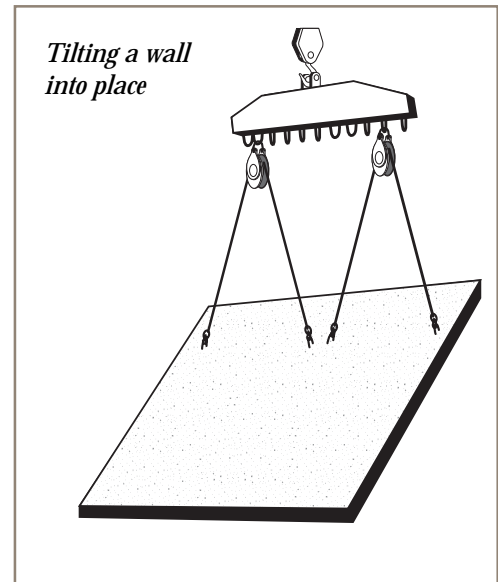
## Slipforms

Workers using slipforms are usually protected from falls by safety-net systems or catch platforms attached to the forms by carpenter brackets. Special hooks that anchor directly to slipforms are available, too. Follow the manufacturer's recommendations and instructions if you use these hooks.

## Tilt-up work

When doing tilt-up work:

- Make sure wall anchors are cast in the wall when it is formed on the ground.
- Attach braces to the wall before the lift.
- Install appropriately sized bolts and shackles to do the lift.
- After the wall is tilted into place, secure the braces at an appropriate angle before the lifting cables are released.
- Stand clear of the wall and out of its drop zone until it is securely braced.
- Use appropriate fall-protection equipment to walk or straddle upper wall areas.
- Use ladders to gain access to the upper wall area.

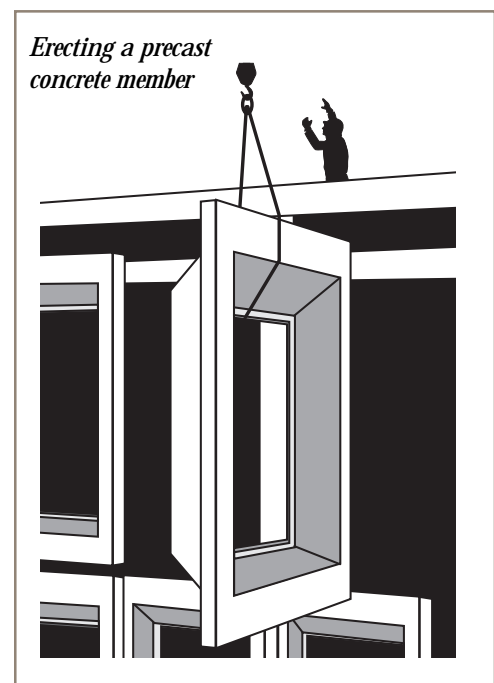


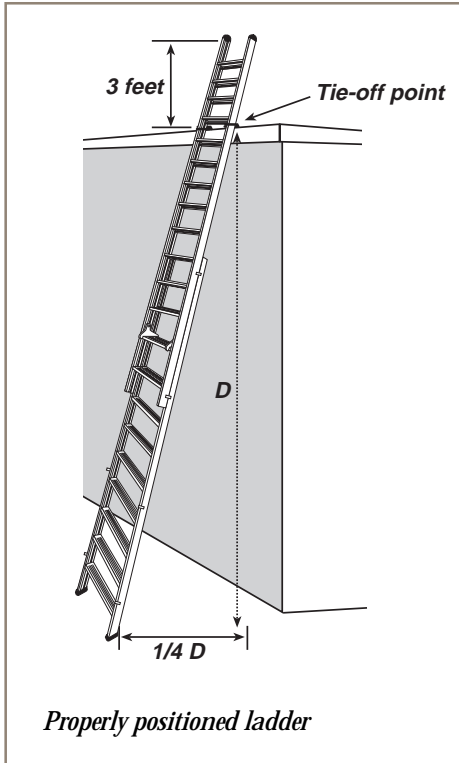
## Precast concrete

When you erect precast concrete members such as wall panels and columns, or do related work such as grouting precast members — and you are six feet or more above a lower level — you must be protected from falling by one of the following methods:

- Guardrail systems
- Safety-net systems
- Personal fall-arrest systems
- A written fall protection plan and a controlled-access zone.

A fall protection plan allows workers doing precast concrete erection work to use alternative fall-protection systems or methods when conventional systems are infeasible. However, the employer must be able to show that conventional systems aren't practical or that they pose a greater safety hazard to workers than other alternatives. Employers must make sure these plans meet other requirements as well. See Division 3, Subdivision M, 1926.502(k) for the complete requirements. A controlled-access zone is created by erecting a control line, or lines, to restrict access to a work area. The control line warns others that access to the zone is limited to authorized workers. You must have a safety monitor to warn workers of fall hazards within the controlled-access zone.





### Exterior building work

If you work on an unguarded surface or an exterior wall six or more feet above a lower level, you must use ladders, lifts, or appropriate fall protection (such as a personal fall-arrest system, safety-net system, or positioning-device system).

### Ladders

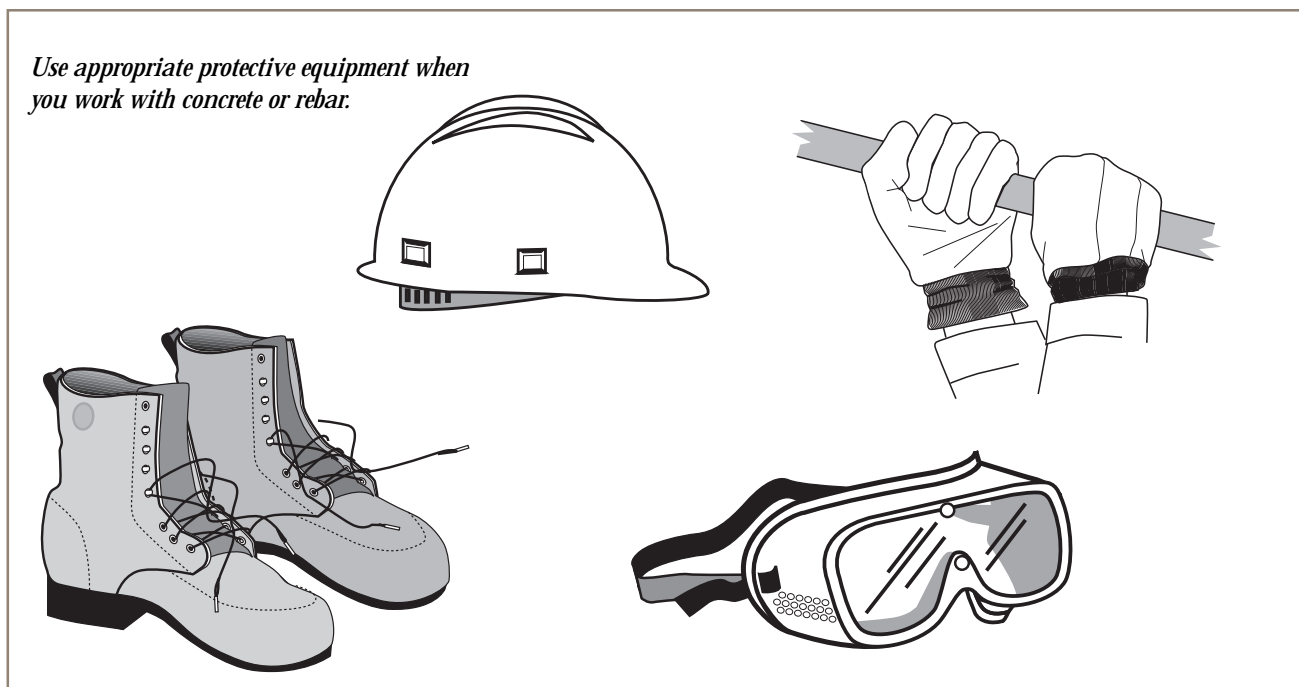
Falls from ladders occur frequently among workers doing rebar and exterior building work. Most ladder falls involve portable ladders that move, tilt, or shift while a worker is climbing or descending.

Keep in mind the following points when using a ladder:

- If the ladder is not stable, tie it off (at the top and bottom) before climbing it.
- Stay within the side rails when climbing or working from a ladder. You can reach out from a ladder, but your torso must remain within the side rails.
- Face the ladder when climbing or descending it. Don't try to carry objects that could cause you to lose your balance. Keep hands free to grasp the ladder.

### Protective equipment

When working with concrete, wear protective clothing and equipment appropriate for the task. Important items are gloves, safety glasses, leather work shoes, and a hard hat.



# Training

Employers must be aware of workplace fall hazards and take appropriate action to eliminate or minimize those hazards. They should select appropriate fall protection for a particular area or operation and train workers to use it correctly. Subdivision M, Section 1926.503 requires employers to provide training for all workers exposed to fall hazards. The training must be provided by a competent person and should ensure that workers can:

- Recognize fall hazards in their work area.
- Use appropriate procedures to minimize their exposure to fall hazards.

Workers who use or intend to use a personal fall-arrest system also should know:

- How to inspect the equipment before they use it.
- How to wear the equipment.
- Proper hook-up and attachment methods for the equipment.
- Anchoring and tie-off techniques appropriate for the work.
- How to estimate free-fall distances.
- Equipment care and storage procedures.
- Rescue procedures and techniques.

## *Retraining*

Workers who do not recognize fall hazards at a particular work area must be retrained. Other reasons workers may need retraining include changes at a worksite that make earlier training obsolete, changes in the types of fall-protection equipment used, and failure to demonstrate skills for using fall-protection equipment effectively.



# Emergencies

Fall-protection systems are designed to minimize workers' exposure to fall hazards and to reduce their risk of injury if they do fall. However, employers are responsible for establishing procedures to ensure that workers who do fall receive prompt emergency and medical attention. Emergency procedures should identify key rescue and medical personnel, equipment available for rescue, emergency communications procedures, retrieval methods, and primary first-aid requirements. Employers should also establish rescue procedures for personal fall-arrest systems before workers use the systems.

**NOTE:** Workers in 9-1-1 service areas can use the 9-1-1 number for ambulance service; however, most 9-1-1 responders are not trained to rescue an injured worker suspended in a personal fall-arrest system. Rescue procedures must assure prompt rescue of a suspended worker. The 9-1-1 number does not ensure prompt rescue.

Use the guidelines below to develop your own emergency-response procedures.

## *Before on-site work begins*

- Make fire department or emergency-response units aware of the job specifications at the site and any factors that may slow response time.
- Document the rescue plan and make sure it's posted at the worksite.
- Post emergency responder phone numbers and addresses at the worksite.
- Mark the worksite with signs and note the easiest access routes in and out of the site.
- Make sure you have quick access to rescue and retrieval equipment, such as lifts and ladders.

## *As on-site work progresses*

- Identify on-site equipment that can be used for rescue and retrieval. Examples: lifts and ladders.
- Maintain a current equipment inventory at the worksite. Equipment may change frequently as the job progresses.
- Reevaluate and update the emergency-response plan if on-site work tasks change.

### *Responding to emergencies*

If the worker is injured, call 9-1-1 or other emergency numbers indicated on the emergency-response plan for ambulance service. Remember, 9-1-1 responders are not trained to rescue an injured worker suspended in a personal fall-arrest system. First responders should clear a path to the victim. Others should be sent to direct emergency personnel to the scene.

- Make sure only qualified personnel attempt a technical rescue.
- Prohibit all nonessential personnel from the fall/rescue site.
- Talk to the fall victim.
- Determine the victim's condition if possible.
- If the victim is accessible, provide comfort and check vital signs.
- If necessary, administer CPR, and attempt to stop bleeding.

### *Investigating accidents*

- Report fatalities and catastrophes to OR-OSHA within eight hours. Report injuries requiring overnight hospitalization and medical treatment other than first aid within 24 hours.
- Identify all equipment associated with the accident and place it out of service until the accident investigation is complete.
- Document step by step what went wrong and what went right.
- Review the fall-protection plan. Determine how the plan could be changed to prevent similar accidents. Revise the plan accordingly.
- Have a competent person examine equipment associated with the accident. If it contributed to the accident, determine how and why. Replace it if necessary.

# Definitions of selected terms

## *Anchorage*

A secure point of attachment for workers' lifelines, lanyards, or deceleration devices. Anchorages for personal fall-arrest systems must be capable of supporting a minimum load of 5,000 pounds per worker (or be designed, installed, and used under the supervision of a qualified person, as part of a complete personal fall-arrest system that maintains a safety factor of at least two). Anchorages for positioning-device systems must be capable of supporting a minimum load of 3,000 pounds per worker.

## *Body belt (safety belt)*

A strap that cinches around a person's waist and attaches to a lanyard, lifeline, or deceleration device. The maximum permissible arresting force for a body belt is 900 pounds. The use of a body belt in a positioning-device system is acceptable and is regulated under section 1926.502, paragraph (e) of Subdivision M.

## *Body harness*

Straps that an individual wears to distribute fall-arresting forces over the thighs, waist, chest, shoulders, and pelvis. Attaches to other components of a personal fall-arrest system. The maximum permissible arresting force for a body harness is 1,800 pounds.

## *Carpenter bracket scaffold*

A scaffold consisting of wood or metal brackets supporting a platform.

## *Competent person*

A person who is capable of identifying existing and predictable hazards in the work environment and who has authorization to take prompt measures to eliminate the hazards.

## *Connector*

A device used to couple (connect) components of a personal fall protection system or positioning-device system. The connector may be an independent component (such as a carabiner) or an integral component (such as a buckle or D-ring sewn into a body belt) of the system. Connectors must be made of drop forged steel or equivalent material and proof-tested to a minimum tensile load of 3,600 pounds; they must have a corrosion-resistant finish and all surfaces and edges must be smooth to prevent damage to other parts of the system.

## *Controlled-access zone (CAZ)*

An area designated for overhand bricklaying operations or leading edge construction, or as required in a fall-protection plan. Conventional fall protection systems — guardrail systems, personal fall-arrest systems, or safety-net systems — are not required in the area; access is permitted only to workers performing overhand bricklaying and leading edge construction tasks.

### *Conventional fall protection*

A guardrail system, safety-net system, or personal fall-arrest system.

### *Deceleration device*

A mechanism that dissipates or limits energy imposed on a person during fall arrest. Examples include rope grabs, rip-stitch lanyards, special woven lanyards, and automatic self-retracting lifelines.

### *D-rings*

Attachment points on a body belt or harness for deceleration devices or lanyards. D-rings must have a minimum strength of 5,000 pounds and must be proof-tested to a minimum tensile load of 3,600 pounds.

### *Formwork*

The total system of support for freshly placed or partially cured concrete, including the mold or sheeting (form) that is in contact with the concrete, as well as all supporting members including shores, reshores, braces, and related hardware.

### *Free fall*

Falling before fall protection begins to arrest the fall.

### *Guardrail system*

Vertical barriers erected to prevent workers from falling to a lower level.

### *Lanyard*

A flexible rope, strap, or webbing that connects a body belt or harness to a deceleration device, lifeline, or anchor. Lanyards that tie-off one worker must have a minimum breaking strength of 5,000 pounds. Lanyards that automatically limit free-fall distance to two feet or less must have components capable of sustaining a minimum static tensile load of 3,000 pounds with the lanyard in the fully extended position.

### *Lifeline*

A flexible line that attaches directly to a person's body belt, harness, lanyard, or deceleration device at one end and to an anchor at the other end. A lifeline that hangs vertically and is connected to one anchor is a vertical lifeline. A lifeline that stretches horizontally between two anchors is a horizontal lifeline. All lifelines must be protected against cuts or abrasions; they cannot be made of natural fiber rope.

### *Personal fall-arrest system*

A conventional fall-protection system designed to stop a single worker from free falling to a lower level. Components include an anchorage, connectors, a body belt, or body harness and may include a lanyard, deceleration device, or lifeline.

*Positioning-device system*

A type of personal fall protection system that supports a person who needs to work with both hands free on surfaces, such as walls or window sills. Also, used for formwork construction and concrete rebar placement.

*Precast concrete*

Concrete members (such as walls, panels, slabs, columns, and beams) that have been formed, cast, and cured prior to final placement in a structure.

*Qualified person*

A person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to resolve problems relating to a specific subject, operation, or project.

*Safety-net system*

A fall-arrest system of mesh nets including panels, connectors, and other impact-absorbing components.

*Slipform*

A form that is pulled or raised as concrete is placed.

*Snaphook*

A connector consisting of a hook-shaped member and a keeper. It can be opened to receive an object and, when released, automatically closes to retain the object. There are two types of snaphooks — locking and non-locking.

*Tilt-up work*

A method of concrete construction in which members are cast horizontally at a location adjacent to their eventual position and tilted into place after forms are removed.

*Waler*

A horizontal timber or steel member used for bracing vertical members.

## 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.



In compliance with the *Americans With Disabilities Act* (ADA), this publication is available in alternative formats. Call the OR-OSHA public relations manager, (503) 378-3272 (V/TTY).

Materials contained in this publication are in the public domain and may be copied and distributed without permission from Oregon OSHA.

## *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.)*

### **Salem Central Office**

350 Winter St. NE, Rm. 430  
Salem, OR 97301-3882  
Phone: (503) 378-3272  
Toll free: (800) 922-2689  
Fax: (503) 947-7461

### **Portland**

1750 NW Naito Parkway, Ste. 112  
Portland, OR 97209-2533  
(503) 229-5910  
*Consultation: (503) 229-6193*

### **Salem**

DAS Bldg. 1st Floor  
1225 Ferry St. SE  
Salem, OR 97310-1330  
(503) 378-3274  
*Consultation: (503) 373-7819*

### **Eugene**

1140 Willagillespie, Ste. 42  
Eugene, OR 97401-2101  
(541) 686-7562  
*Consultation: (541) 686-7913*

### **Bend**

Red Oaks Square  
1230 NE Third St., Ste. A-115  
Bend, OR 97701-4374  
(541) 388-6066  
*Consultation: (541) 388-6068*

### **Medford**

1840 Barnett Rd., Ste. D  
Medford, OR 97504-8250  
(541) 776-6030  
*Consultation: (541) 776-6016*

### **Pendleton**

721 SE Third St., Ste. 306  
Pendleton, OR 97801-3056  
(541) 276-9175  
*Consultation: (541) 276-2353*

