

Working Safely on the Roof

Complying with new OSHA fall-protection regulations takes more than the correct safety gear, it takes a commitment to using the gear correctly

by Howard Stein

On his way to a job one morning, a friend of mine stopped to watch a roofing crew climb a single ladder onto a 12-in-12 pitch, two-story roof. There were no scaffolds or roof jacks anywhere in sight. What caught his eye were the two uncovered foam-rubber sofa cushions each roofer carried with him onto the roof. What were the battered cushions for, he wondered? The answer came as he watched each roofer kneel on a cushion and get to work, leapfrogging from cushion to cushion as he shingled upward.

I've worked as a general contractor for nearly 15 years. And I've seen my share of poor safety practices and been guilty of a few myself. Although examples this extreme are rare, there's still plenty of unsafe building to go around. In 1991, for instance, 115,000 construction workers were injured and 158 died as a result of falls.

Although we use standard fall-protection measures such as scaffolds, guardrails on pump jacks and temporary plywood covers over stair and chimney openings in floors, I recently began investing in personal fall-protection equipment for myself and my employees. Before I wrote this article, I experimented with a variety of roof anchors; lifelines, which are safety lines that attach directly to a roof anchor; full-body harnesses; and lanyards, which are short lines that attach harnesses to the anchoring rope. I learned that some types of equipment are easier to use than others and that some are better-made than others. Although the price differences between low-end and better-quality safety equipment can be great, I found that the higher cost usually is worth the investment.

Ignorance of the law is no excuse—Although some contractors may be only vaguely aware of it, the Occupational Safety and Health Administration (OSHA) now monitors residential-construction sites to make sure workers are protected from falls. Changes in OSHA's fall-protection standards consolidate and update existing stan-



Free to concentrate. A secure roof anchor, a snug body harness and a good lifeline allow this roofer to concentrate on the job at hand.

dards and now also apply specifically to residential construction. Many roofers have complied by purchasing body harnesses, lanyards, rope lines and anchors, which as a group are called personal fall-arrest systems (photo above). However, general contractors, remodelers, framers and some of the other trades also are required to comply or face fines up to \$70,000, depending on the severity of the violation and the size of the company.

Most of these safety standards aren't new. Many have been in effect for almost 25 years for non-residential construction. What changed is the recognition that the percentage of homebuilders killed or injured in falls is just as high as that of other construction workers. Those who work in the hazardous construction industry know that falls are the number one cause of serious injury

and death. In fact, the revised OSHA rules were generated with the input and support of carpenters' and roofers' unions.

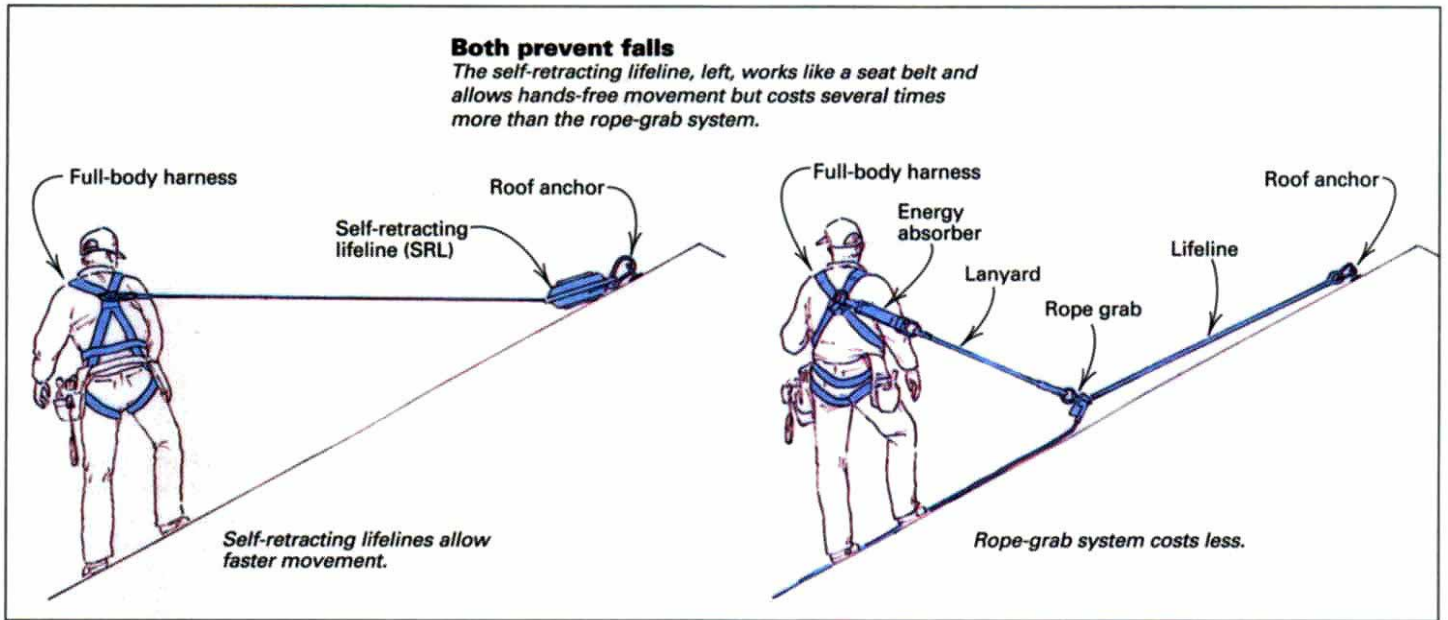
The new fall-protection standards encompass more than just fall-arrest systems. Beyond the scope of this article are other regulations for fall-safety protection, such as the requirement for a written safety plan. I urge you to read the regulations, which are available from OSHA (OSHA Publications, 200 Constitution Ave. N. W., Room N3101, Washington, D. C., 20210; 202-219-4667). Call your local OSHA office if you need more information.

The regulations are for anybody working 6 ft. or higher in the air—OSHA's Safety Standards for Fall Protection in the Construction Industry took effect in February 1995 and require some form of fall-protection system at any stage of residential construction where workers are subject to a fall of 6 ft. or more.

Wherever there is an unprotected side or edge at least 6 ft. above a lower level, employees must be protected from a fall by the use of a guardrail, a safety net or a personal fall-arrest system (PFAS). Work performed from ladders, scaffolds and pump jacks is subject to its own safety rules. Guardrails and safety-net systems weren't designed for sloped roofs or wood-frame construction.

Homebuilders need to become familiar with the body harnesses, lanyards, rope lines and anchors that make up personal fall-arrest systems. Manufacturers provide instructions on installation and inspection, cautions on safe use of components and systems, care and maintenance, and application limitations. Instructions are required reading for anyone using this gear.

Safety starts with a good anchor—Whether the following story is true, it illustrates the importance of properly anchoring your lifeline: Crew members working on a roof tie ropes around their waists and heave the lines over the peak of



A good anchor attaches snugly to the rafter. The author first removed a layer of shingles and drilled a hole in the roof to attach this roof anchor to a rafter. The L-shaped end of the anchor is fed through the hole and secured around the bottom of a rafter. A large wing nut on the threaded shaft is tightened down over a steel plate to fasten the anchor firmly to the roof.



It won't open accidentally. This self-locking snap hook, also called a carabiner, is used to attach a lifeline to an anchor and won't open unless two actions are executed.

the roof to an apprentice on the ground. The inexperienced lad ties off the ropes to the handiest dead weight around, which happens to be a car bumper. Trusting their anchor point, the crew members begin to work, thinking no more about their security until the car's owner, in a hurry and oblivious to the lifelines, drives away.

An improvement over car bumpers, roof anchors are attached to the uppermost part of a roof rafter or to the 2x ridge board (drawings p. 92). Manufacturers specify anchor placement about every 8 ft. to 10 ft. and about 6 ft. to 8 ft. from gable ends. These distances are to avoid what they call a swing fall, or "the pendulum effect." The user should be within a 30° arc on either side of the anchor point, which on most roofs is within 5 ft. or 6 ft. of the vertical fall line below the roof anchor. Many anchors require

that sheathing be in place to help spread the load to other rafters (photos left, center). Double-strap anchors straddle the ridge at any pitch and require filling the field of predrilled heavy-gauge metal straps or steel plates with a specified number of wood screws, nails or lag bolts. These anchors are designed to be attached to rafters through the sheathing, but never into sheathing alone. As a group, these anchors range in price from \$6 to \$65. The cheaper anchors are disposable or simply bent down and roofed over; the more expensive ones can be used over and over.

Another type of roof anchor can be installed without sheathing in place if 2x stock is nailed above and below the anchor to neighboring rafters. The first 2x is nailed to the top edge of the rafters near the ridge; the second is spiked to the underedges of the rafters below the roof an-

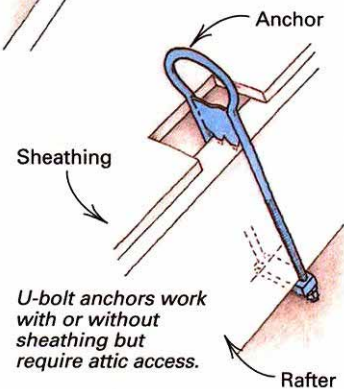
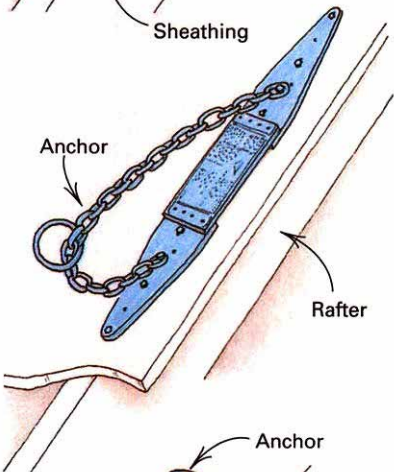
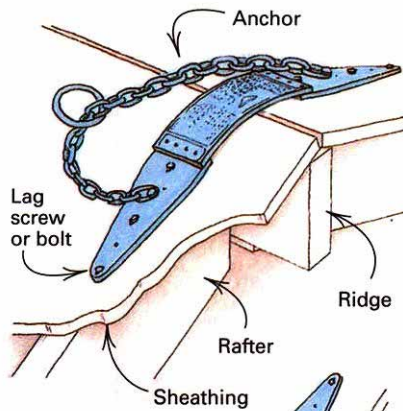
chor. Ranging in price from \$40 to \$80, these anchors engage the rafter or ridge by means of a U-bolt or a proprietary design that grabs around the underside of the 2x (drawing p. 92). Each type provides a rugged anchor point on which to connect a lifeline.

This kind of anchor can be used at the beginning of roof-sheathing installation. Personally, I wouldn't install them before this stage because until all of the rafters are in place, the roof system isn't stable enough to tie workers off to it and because raftering can be done safely otherwise. Roof anchors are all tested to meet a 5,000-lb. rating and are designed for one person each. The feeling of quality, the ease of use and the effort to set up and break down the roof anchors varies greatly. After trying out the major types available, I prefer the screw-type Universal Roof anchor

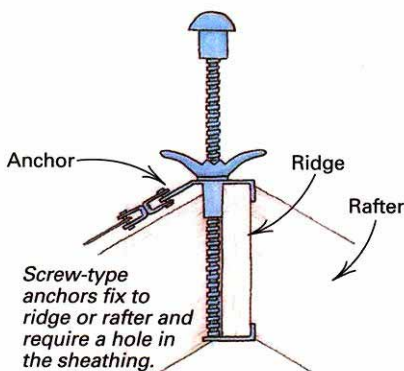
Three types of roof anchors

With any type of roof anchor, the main point is to secure the worker to the roof. These three types all do the job, but with more or less effort.

Double-strap anchors are versatile and don't require sheathing penetration.



U-bolt anchors work with or without sheathing but require attic access.



Screw-type anchors fix to ridge or rafter and require a hole in the sheathing.

from Leading Edge Safety Systems Inc. (500 Main St., P.O. Box 1019, Deep River, Conn. 06417; 800-241-7330) for temporary use on new work or remodeling and the L3670 stainless-steel, self-flashing anchor from DBI/SALA (3965 Pepin Ave., Red Wing, Minn. 55066; 800-328-6146).

Learning the ropes of fall-protection systems

A PFAS can include two types of rope restraints. Each restrains the worker in case of a fall; both connect directly to the roof anchor. The simpler, less expensive lifeline system starts typically with a 50-ft, 5/8-in. to 3/4-in. thick synthetic rope (also available in lengths of 30 ft. to 100 ft. or more). The less expensive lines are twisted three-strand rope. The very cheapest of these ropes are polypropylene (photo top left, facing page) and cost less than \$50 for a 60-ft. length. The longest lasting, highest cost lifelines have a braided exterior over a braided core and cost about \$135 for the same length. After trying several kinds, I prefer the better braided rope (photo top right, facing page). A three-strand twisted nylon lifeline (with an eye splice and hook at one end) costs about \$75 with a duffel bag for storage. The same in a polyester rope is about \$95.

Before I begin a deeper discussion of the various ropes and lines used in fall protection, I need to say something about hardware. A lifeline attaches to the anchor point by means of a self-locking snap hook or carabiner (photo right, p. 91). Nonlocking or single-action connector hardware is prohibited after 1997, so most manufacturers only send out hooks and carabiners that require two separate actions to open and that aren't subject to inadvertent rollout of the lifeline, which is when the twisting of the rope from below can cause the upper end to roll open the gate on a single-locking safety hook.

A counterweight of virtually any type on the untethered end of the lifeline maintains tension on the rope and allows a worker to slide his tether, or lanyard, up and down the line more easily.

A piece of stainless-steel hardware called a rope grab connects the lanyard to the lifeline (photo bottom left, facing page). On the other end, the lanyard attaches to a D-ring on the body harness with a double-locking hook or carabiner. All rope grabs automatically slide upward if the user ascends; some brands move more freely than others. My favorite rope grab is made by SURETY Manufacturing and Testing Ltd. (2115 91st Ave., Edmonton, Alberta, Canada T6P 1L1; 800-661-3013). To descend, the worker holds the locking mechanism lever in an upward position so that the cam lock rides freely as he lowers himself by holding the lifeline with his other hand. In case of a slip, the mechanism grabs the rope. The mechanism allows, on demand, a free-sliding up-and-down action for hands-free use. It costs about twice the average grab.

Rope grabs are tested for use with a particular lifeline and lanyard and shouldn't be mixed with components from other suppliers without first checking for compatibility.

Suiting up with full-body harnesses—At the opposite end of the lifeline from the anchor point is the full-body harness, worn by each worker as

part of the PFAS. Harnesses are available in all sizes and many styles, and they adjust by means of belt and buckle, parachute-type friction buckle or pass-through bar buckle. Some manufacturers offer only a universal size.

The D-ring on a fall-arrest harness is on the back, where the rear webbing crosses between the shoulder blades. Like all other components of the system, the D-ring is rated at 5,000 lb. All have straps that adjust around the thighs just below the buttocks to distribute the impact of a fall.

The harness should fit well and be adjusted properly for comfort and safety. Harness prices range from about \$60 to \$130. There are many good-quality harnesses in the \$65 to \$80 range.

The proper lanyard is no longer than 3 ft.—

The lanyard that connects the rope-grab mechanism to the lifeline is available in lengths from 12 in. to 36 in., but in no case should it be longer than that. Lanyards are made of synthetic webbing or rope and come with or without a built-in shock, or energy, absorber. The shock absorber is usually a sealed, rip-stitch section of folded webbing that gives up its slack when subjected to the stress of a fall.

On every piece of equipment I've tested, the lanyard is factory-attached to the rope grab, which means users have to reach over their backs to connect the lanyard to the D-ring on the back of the harness. This construction can be frustrating, especially if you're wearing gloves, because the double-locking snap hook or carabiner requires the two separate actions to engage or disengage.

I found the best combination to be a 1-ft. long shock absorber that's factory-connected to the harness, and a separate 1-ft. lanyard attached to the rope grab. The two hook together easily without requiring you to reach behind your back (bottom photos, facing page). For me, a lanyard of 18 in. to 24 in. is the most comfortable; a 36-in. lanyard requires a step up the slope to reach and maneuver the grab.

As a caution, there are systems on the market that come with a 6-ft. lanyard that meets standards for strength but that allows up to a 12-ft. fall if the user gets the full length of the lanyard above the rope grab and forgets to take up the slack. However, a 6-ft. lanyard with hook at each end is useful for working a single area near a roof anchor for tasks such as repointing a chimney. If this location is near an edge—less than 6 ft. from a gable end, for example—it should include an integral shock absorber.

Dennis Garafolo of Sinco Products Inc. (1 Sinco Place, P. O. Box 361, East Hampton, Conn. 06424-0361; 800-864-2699) warns that although his company sells many of the less expensive lifeline packages to contractors who want to get into quick compliance with the OSHA rules, most workers use rope-grab systems incorrectly. "A worker will snap onto an anchor at the ridge, walk down to the eave, lock on the grab, and then move up and down the roof without adjusting the rope grab to take up the slack as he moves around the roof. This can develop a 20-ft. lanyard, which is not user-friendly." In other words, it's dangerous.

Self-retracting lifelines are more expensive but easier to use

—A self-retracting lifeline (SRL) system automatically retracts or pays out cable from a metal or high-impact plastic housing as a worker moves toward or away from the unit (drawing left, p. 91). Inside is a speed-sensing brake, much as in a seat belt, that activates in a free-fall and cuts the impact force on the user.

SRLs are heavy, so they mount directly to the anchor point. A carabiner or hook at the end of the cable attaches to the harness. It's important to specify an SRL that's made to operate on a slope because some are designed for vertical use only and can bind when used on a roof pitch.

An SRL with 50 ft. of cable and a large carabiner costs about \$850. A cheaper SRL option has a thermoplastic housing and 20-ft., 1-in. wide synthetic webbing instead of cable. It costs about \$570. For comparison, a 50-ft. lifeline and rope grab with attached 18-in. or 24-in. lanyard cost from \$160 to \$300, depending on their features and quality.

The safety package you use may depend on your trade

—Just as a roofer uses a different type of hammer than a house framer or a finish carpenter, components of personal fall-arrest systems can vary from trade to trade. What works best for one trade might not be the best system for another.

A general contractor could supply roof anchors on a job, carrying the cost just as he does with a portable toilet or a job-site fire extinguisher. That way, all of the other trades could tie off their equipment to his anchors. (As a general contractor, I feel comfortable sharing roof anchors, but not lifelines and harnesses.)

· *Roofers move around faster than carpenters do.* To maintain production, many roofing contractors equip themselves with SRLs. Although more expensive, SRLs give quicker payback because they increase efficiency every day.

Some roofers' packages include a waist belt with a rope-grab lifeline system. Belts aren't acceptable after 1997, except on low-slope roofs (such as 4-in-12 pitch or less), because a free-fall in a belt can cause serious back injury. A majority of roofers have switched to full-body harnesses for that reason.

· *Carpenters spend less time on the roof as a percentage of total work and, when sheathing a roof, don't need to move horizontally or vertically as fast or as often as roofers.* For a two-person roof-sheathing crew aided by a cut person below, a combination of systems might be a good investment. The more experienced carpenter would use an SRL, which leaves no rope at his feet to trip on as he focuses on nailing off the ply. The other person is tied off on a less-expensive lifeline with rope grab. This system remains in place for trimming the roof eaves with fascia and soffit boards; the crew is tied off while working from planks on sidewall brackets at the second- and third-story level. If the roofing crew shares the roof anchors, only one setup is needed.

There's a bottom line to safe building—The time it takes to set up, use and break down PFASs could make a contractor slightly less competi-



You get the kind of rope you pay for. If the only concern is cost, a polypropylene rope (left) will do the job, although it's likely to kink up and cause problems. The braided polyester rope (right) costs a good bit more but will give good service for a lot longer than the cheaper rope.



Rope grabs slide freely but stop sliding under weight. The stainless-steel rope grab connects the lanyard to the lifeline and automatically slides upward when the user ascends. To descend, the worker holds the locking mechanism lever in an upward position so that the cam lock rides freely as he lowers himself. The mechanism grabs the rope if the user slips.



Here's a better way to hook lanyard to harness. It's always awkward and often difficult to reach behind the back and hook a lanyard to the D-ring that's attached to the body harness. This way works better. A 1-ft. lanyard that contains a shock absorber is factory-attached to the back of the harness, which can be swung around for attachment to a lanyard.

live against crews that don't comply with OSHA's regulations—unless the noncomplying crews get caught by OSHA. But when all contractors begin to comply with the rules, those builders who started early will already have a competitive edge.

For one thing, a good safety record keeps worker's compensation premiums lower. The mandatory accident report to the insurance company could trigger an investigation about whether fall protection was in use. Besides the obvious emotional issues involved, a serious injury or death could financially devastate a contractor. Accidents also disrupt work, and they can involve

the costs of both time and money to train replacement workers.

There are other benefits to using a PFAS. A one-person crew alone on a site is much safer using one of these systems. And some tasks are performed faster because the worker's efforts aren't focused on avoiding a fall. Also, on steeper roofs, lifelines are helpful in climbing. Finally, PFASs might restrict movement but can also be used for temporary positioning to avoid a lengthy setup for a short task. □

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