SAFE

I often hear contractors complain that they can't afford to build scaffolding that meets Occupational Safety and Health Administration (OSHA) safety requirements. But improperly erected scaffolding can cost you an arm and a leg — literally. As a scaffolding consultant, I design and supervise the erection of scaffolding systems that meet OSHA regulations. In this article, I'll cover a number of scaffolding systems and some of the regulations for each.

Frame Scaffolding

Sometimes referred to as "pipe scaffold" (OSHA refers to it as "tubular welded-frame scaffold"), these steel frames are easily connected into complex scaffolding arrangements. When assembling a frame scaffold system, it's important to establish a level base and use proper bracing and planking.

A Level Playing Field

A firm and level base is a must (see "General Guidelines for Safe Scaffolds," page 32). The legs of the base frames should always rest on a steel base plate and wood sills (see Figure 1). The minimum size sill I'd recommend is an 2x10 that's 18 inches

SCAFFOLDING OPTIONS

by Jay Klein

A firm base, proper bracing, and fall protection measures are the keys to OSHA-approved staging

Figure 1. *Always set tubular steel scaffolding on a steel base plate on top of level wood sills. Tack the bases to the wooden sills with 10d nails.*

Figure 2. *When tying scaffolding to masonry structures, use a tubular tie-in in conjunction with an eyebolt. The author recommends a vertical tie-in spacing of no more than four times the smallest base dimension.*

Figure 3. *Manufactured platforms are available with hatches that allow workers to reach the work area from within the scaffold framing system.*

long. Adjustable bases are used to level the first "course" of frames, and these levelers should always be tacked to the sills using 10d common nails.

It's easy to understand that sills prevent tubular legs from sinking into soft soil, but sills are also required when setting frames on asphalt or concrete. Frames can slowly "push" their way into sun-warmed asphalt, and the point loads created by the small cross-section of a tubular leg can crack concrete.

Succeeding courses of frames are placed over the connecting pins inserted in the top of the first-course frames. Once the frame is in place, a scaffold hinge pin should be inserted through both the leg of the upper frame and the pin of the lower frame. These locking pins prevent the upper frame from lifting off the lower frame. Don't omit these pins: Not long ago, the entire upper level of an 80-foot scaffold system erected by one of our competitors lifted off the lower portion when a high wind blew through. Workers had inadvertently failed to install the lock pins on an entire course. Fortunately, the accident happened after hours.

Tying Off

As the height of a frame scaffold assembly increases, it becomes necessary to tie the assembly to the building. OSHA's minimum requirements call for tie-ins every 26 feet vertically and every 30 feet horizontally, but many manufacturers prefer a tie-in spacing of no more than four times the smallest base dimension. So, for example, a 5-foot-wide scaffolding frame would be tied in every 20 feet in both directions. The number of tie-ins will need to increase for heavy loads, or when the scaffold is wrapped with a poly enclosure (an enclosed scaffold will catch wind like a sail). When erecting an enclosed scaffolding system, tie-in spacing requirements should be provided by the manufacturer's representative or by an engineer.

Scaffolding must be restrained from moving towards or away from the building, so it's important that tie-ins provide bracing in both directions. We use tubular tie-ins to secure frames to the structure. We often tie in to masonry structures by drilling and inserting an eyebolt in the mortar joint, and wiring it to the scaffold frame with #9 form wire (Figure 2). The wire keeps the scaffold from pulling away from the building, while the tubular tie-in acts as a compressive brace to prevent the scaffolding from moving towards the building.

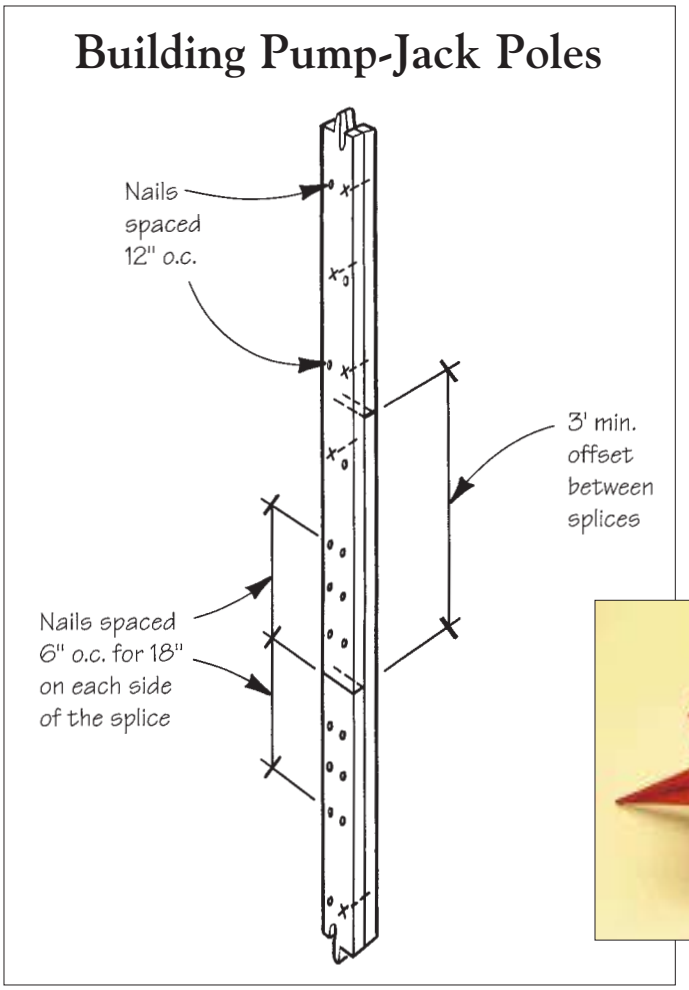
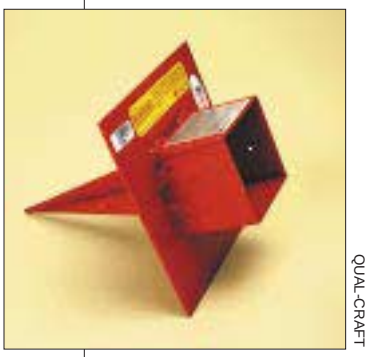


Figure 4. *When building pump-jack poles, use a pair of 10d common nails driven from opposite sides every 12 inches. At splices, increase nailing to every 6 inches for a distance of 18 inches on each side of the splice. Splices on opposite sides of the pole must be offset by at least 3 feet. For a secure footing, manufactured steel bases that drive into the ground are also available (inset photo).*



QUAL-CRAFT

General Guidelines for Safe Scaffolds

Where scaffolding is concerned, common sense is a valuable tool. Below are some items that should always be considered when building a scaffold.

- All scaffolding should be on a firm surface capable of supporting all intended loads. Make sure that any floor or roof systems can support the additional weight that any loaded scaffolding will introduce.
- All scaffolding should bear on and be fastened to an acceptable sill.
- Scaffolding should always be constructed plumb, level, and square.
- Proper access must be supplied to all scaffolding. Use gates or hatch platforms to access staging platforms, and to avoid having to climb over guardrails.
- Fall protection will always need to be provided when scaffolds exceed 10 feet in height. The three most common forms of fall protection are guardrail systems, lifeline systems, and safety-net systems.
- All guardrail systems should have a top rail, midrail, and toeboard. The top rail must be at least a 2x4. It must be placed between 36 and 42 inches high and it must be capable of withstanding a 200-pound force applied in any direction. Midrails should be a 1x6 or equivalent, and the toeboard should be a minimum of 4 inches tall. Debris screening is required whenever there will be activity below the scaffold.
- Scaffold erection and dismantling must be performed or supervised by a competent person who understands the regulations and has the authority to make proper changes.
- All scaffolding must be braced properly and have proper decking.

— *J.K.*

Planking

Wood walkways should always be constructed out of certified scaffold planking (see "All Planks Are Not Created Equal"). The planking should overlap the "head bar" (the uppermost horizontal bar) by at least 6 inches, but not more than 12 inches, and should be tied down with #9 form wire or tie wire and nailed together in situations where uplift may occur (anytime the planking is located outside).

Manufactured platforms are available that consist of an aluminum frame covered by an aluminum or plywood deck. These platforms have "hooks" at their ends that slip over the head bar of the scaffold frames, and are available with hatch doors to allow proper access to the work area (Figure 3).

Pump Jacks

Pump jacks have a lot going for them: They're inexpensive, erect very quickly, and are easily adjustable once in place. But with few exceptions, the pump-jack scaffolds I've seen in my travels would have an OSHA inspector reaching for his pen. Pump-jack scaffolds *can* meet OSHA requirements, however, when erected properly.

Start With the Poles

Probably the most misunderstood part of a pump-jack scaffold is the requirement for the lumber used for the poles. OSHA requires that the 2x4s used to assemble the poles "be knot- and defect-free construction-grade lumber with an extreme fiber stress in bending value of at least 1,500 psi."

The bad news is that you may spend the rest of your life searching in a lumberyard for 2x4s that are "knot- and defect-free." The good news is that 2x4s that meet the OSHA requirements can be ordered from your lumberyard or scaffolding supplier.

Assembling the poles is the next issue. Poles should be nailed using pairs of 10d common nails spaced a maximum of 12 inches on-center, and staggered uniformly from opposite outside edges. Splice joints must be offset by at least 3 feet, and nails should be spaced a minimum of 6 inches on-center for a distance of 18 inches on each side of the splice (Figure 4).

The poles must be set on an ade-

quate base (I recommend using, at minimum, a 2x10 that's 18 inches long), and should be toe-nailed to the base with two or three 10d common nails. Or, you can use a fabricated steel base, available from Qual-Craft (see "Sources of Supply," page 35), which is driven into the ground and provides a secure seat for the bottom of the pole.

Pump-jack poles must be plumb. Many carpenters like to lean them towards the building, but an out-of-plumb pole is subject to increased bending stresses — stresses not accounted for in pump-jack design loadings.

The poles act as long, thin columns, and need to be restrained from swaying or, worse, buckling. The 2x4 X-bracing that I often see nailed on the back of pump-jack poles only stiffens the poles side to side; it won't keep the posts from bowing towards or away from the building. OSHA calls for intermediate bracing at 10-foot intervals, a requirement that can easily be met by installing standard pump-jack brackets (Figure 5). Of course, intermediate braces get in the way when pumping the jacks up or down. To bypass an intermediate pole brace, install an extra brace 4 feet above the brace to be passed. Unfasten the connecting bracket from the pole and let the brace swing down against the work wall (don't remove the brace from the wall). After pumping past the disconnected brace, reconnect it to the pole and remove the extra brace.

Maximum pole length is 30 feet, so at most you'll only need two additional brackets for each pole (plus an extra one for bypassing a brace).

Guardrails

Pump-jack scaffolding that exceeds 10 feet in height is required to have a guardrail system in place on all open sides and ends. There are work-table brackets available for pump jacks that can serve as the top rail in a guardrail system, providing they meet guardrail specifications.

Planking

Working platforms over 10 feet high must be at least 20 inches wide. Two "scaffold grade" planks are acceptable as long as pole spacing doesn't exceed

Figure 5. *Pump-jack poles require intermediate bracing every 10 feet. Installing an additional pole bracket is the easiest way to provide this bracing.*

All Planks Are Not Created Equal

You should be careful about what you call a scaffold plank. OSHA requires that *all* planking be "scaffold grades or equivalent as recognized by approved grading rules for the species of wood used." Two-inch nominal-thickness certified scaffold planks can be used, but only to span 8 feet. Only a full 2-inch-thick scaffold plank can be used to span up to 10 feet, and only when the loading will not exceed 25 pounds per square foot (see chart, below). These planking requirements apply to all types of scaffold, including roof and wall brackets.

We use 10-inch-wide laminated scaffold planks with our scaffolding systems (see photo, right). They're a little pricey (around $50 for a 16 footer), but they will not split or check like sawn lumber, and can be used to span up to 10 feet.

Scaffold planks should always extend over end supports by at least 6 inches but not more than 12 inches and should overlap other planking by at least 12 inches. Planking should always be tied down in situations where uplift may occur. Wind-caused uplift can occur anytime a plank is used outdoors, so we tie down all our outdoor planking with #9 form wire or tie wire.

— *J.K.*

TRUS JOIST MACMILLAN

Permitted Spans for Planking

	Full-thickness undressed lumber			Nominal-thickness lumber*	
Working load (psf)	25	50	75	25	50
Permissible span (ft.)	10	8	6	8	6

* Nominal-thickness lumber is not recommended for heavy-duty use.

Figure 6. *Ladder jacks are inexpensive and easy to erect. Like any system, ladder jacks require fall protection, which is most easily provided with a lifeline system.*

10 feet. An aluminum "walking plank" can be used as long as the 20-inch minimum width is satisfied. There are guardrail systems that can be attached to aluminum staging planks, but these depend on the aluminum staging being securely fastened to the pump-jack bracket to prevent overturning of the plank. OSHA offers no guidelines on how to secure the plank, but specifies that the top guard must be capable of withstanding a 200-pound force in any direction.

When determining pole spacing, keep in mind that you should never exceed a working load of 25 pounds per square foot of planking, or exceed a 500-pound maximum working load between each pole. This includes the weight of platforms, guardrail systems, materials, tools, and people.

The Alum-A-Pole System

Alum-A-Pole manufactures what could be described as the Cadillac of pump-jack systems. The aluminum poles are approved for working heights up to 50 feet, and the system's staging platform and work table are connected by a fiberglass netting, producing an approved guardrail system.

Other Systems

Ladder Jacks

Ladder jacks are one of the least expensive scaffolding systems available. All a carpenter need do is toss up a couple of ladders and run a plank between the ladder jacks (Figure 6). There are important rules, however, that need to be followed.

When using certified wood scaffold planks, ladder spacing should not exceed 10 feet, and the platform must be at least 18 inches wide. Manufactured planks (an aluminum walking plank, for example) must be at least 12 inches wide. According to the American National Standard Institute (ANSI), no more than two people are permitted on a plank supported by ladder jacks, with only one person standing on each half of the plank's span. According to this requirement, the only way you can pass tools or material back and forth is if both people meet in the middle of the plank. This rule apparently stems from the fact that most ladder jacks are rated for a 250-pound maximum load, including planking — a weight that is easy to exceed. And don't forget that the rating of the ladders used must equal or exceed the ladder-jack rating, and must be installed to OSHA specs.

The trickiest part of using ladder jacks is providing the required fall protection above 10-foot heights. A lifeline system is about the only practical way of meeting this requirement.

Roof Brackets

To meet the current OSHA regulations, contractors who use roof brackets must also provide fall protection. An elaborate catch platform can be constructed below the eaves, but this is gen-

Figure 7. *E-Z Rail roof brackets are designed to provide an OSHA-approved guardrail system.*

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Figure 8. *Wall brackets are bolted to wall framing members, and should be spaced no more than 8 feet apart. A railing system or other fall protection is required when the brackets are higher than 10 feet.*

erally an expensive proposition. A complete lifeline system for each worker will satisfy the regulations (workers in harnesses are connected by the lifeline to brackets fastened at the roof peak).

There is a roof bracket available that can meet OSHA fall-protection standards (Figure 7). E-Z Rail roof brackets have a steel sleeve welded to each roof jack that accepts a No. 1 southern pine 2x4 upright (included with each roof bracket). Metal clips on each upright support 2x4s for toeboard, midrail, and top rail.

Wall Brackets

Wall brackets are generally through-bolted to the framed wall. OSHA requires that the bolts be at least 5/8 inch in diameter (Figure 8). The brackets should be spaced a maximum of 8 feet apart, with no more than two people and 75 pounds of tools and material occupying each 8-foot section.

Fall protection is required when heights exceed 10 feet, and as with many other types of scaffolding, this is often the most difficult requirement to meet. Most wall brackets have flanges to which guardrail uprights can be fastened. As with any guardrail system, the top rail must be capable of withstanding a 200-pound force applied in any direction.

Ridge Hooks

When fastened to a ladder, a ridge hook provides a quick and easy way to access areas on a steep roof. The supplemental fall protection that is required is generally most easily met using a lifeline system. Ridge hooks should always be secured to ladders following the manufacturer's specs, and should never be loaded beyond the rating of either the ridge hook or the ladder, whichever is lowest.

A "ladderless" ridge hook, available from Ultimate Ridgehooks, bolts onto a 2x8, and a pair of these ridge hooks provide a stable base for constructing scaffolding (Figure 9). According to the manufacturer, a pair of these heavy-duty ridge hooks will support up to 1,750 pounds when used on a 12/12 pitched roof, and eliminate the need to puncture the roof system with fasteners.


DEER HILL ENTERPRISES

Figure 9. *The Ultimate Ridgehook provides a 2x8 base for fastening chimney scaffolding, without puncturing the roofing.*

Safety First and Last

For those of you that think the OSHA scaffolding regulations are overly burdensome, it's important to recognize that they were put in place to reduce the number of fall-related injuries. The next time you hear somebody grumbling about OSHA being a four-letter word, remember: It only takes one serious fall to end a career. ■

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Sources of Supply

Alum-A-Pole Corporation
1011 Capouse Ave.
Scranton, PA 18509
800/421-2586
Pump-jack system

ASC Plus
P.O. Box 388059
Cincinnati, OH 45238
800/585-5641
E-Z Rail Safety System

Truss Joist MacMillan Industrial Group
2600 East Amity Road
Boise, ID 83705
208/364-3600
Microllam scaffold planking

Universal Scaffolding
550 W. New Castle St.
Zelienople, PA 16063
412/452-8300
Frame scaffolding and accessories

DBI/Sala
3965 Pepin Ave.
Red Wing, MN 55066
612/388-8282
Lifeline systems

Qual-Craft
P.O. Box 559
Stoughton, MA 02072
617/344-1000
Pump-jack system, wall brackets, roof brackets

Ultimate Ridgehooks
Deer Hill Enterprises
224 West St.
Cummington, MA 01026
800/588-9660
Ladderless ridge hook

Werner Co.
93 Werner Rd.
Greenville, PA 16125
412/588-8600
Ladder jacks, aluminum staging for frame scaffolding