

# Scaffolding



An estimated 2.3 million construction workers, or 65 percent of the construction industry, work on scaffolds frequently. Protecting these workers from scaffold-related accidents would prevent 4,500 injuries and 50 deaths every year, at a saving for American employers of \$90 million dollars in workdays not lost.

## **1926.450 - Scope, Application**

- Covers all scaffolds used in workplaces
- Does not apply to crane or derrick suspended personnel platforms, which are covered by 1926.550(g)
- Aerial lifts are covered exclusively by 1926.453

## **1926.450 – Purpose**

- Updates existing standard to include types of scaffolds such as catenary and step trestle
- Allows flexibility in the use of fall protection systems to protect employees
- Simplifies language, eliminates duplicative outdated provisions, consolidates overlapping requirements
- Allows employers compliance flexibility

## **Organization of Standard**

- 1926.450 Scope, application and definitions applicable to this subpart
- 1926.451 General requirements
- 1926.452 Additional requirements applicable to specific types of scaffolds
- 1926.453 Aerial lifts
- 1926.454 Training

## **Organization of Standard (cont'd)**

- Appendix A – Scaffold specification
- Appendix B – (Reserved) Criteria for determining the feasibility of providing safe access and fall protection for scaffold erectors and dismantlers
- Appendix C – List of National Consensus Standards
- Appendix D – List of Training Topics for Scaffold Erectors and Dismantlers
- Appendix E – Drawing and Illustrations

## **1926.450 – Effective Dates**

- Effective on November 29, 1996, except for 1926.453(a)(2)
- Paragraphs (e)(9) and (g)(2) for 1926.451 which address safe access and fall protection for employees erecting and dismantling supported scaffolds is effective September 2, 1997

## **1926.450 – Major Points**

- 10 foot trigger height for fall protection on scaffolds
- 36 inch minimum guardrail height where fall arrest systems are primary fall protection
- 38 inch minimum guardrail height where guardrail is primary fall protection
- Provides for use of cross-bracing as guardrail under certain conditions, in lieu of either a mid-rail or a top-rail
- Requires after 1 year, that competent person determines feasibility of providing fall protection for built-up scaffold erectors and dismantlers

## **Scaffold Definition**

Means any temporary elevated platform (supported or suspended) and its supporting structure (including points of anchorage), used for supporting employees or materials or both.



# Competent person

- Inspect scaffolding and components prior to each work shift
- Determine feasibility of providing fall protection and access
- Evaluate connections to support load and prevent swaying
- Determine structural soundness when intermixing components manufacturer
- Train erectors and dismantlers to recognize work hazards



**Hazard:** Employees working on improperly constructed scaffolding system.

**Corrective Action:** Install proper scaffold system

## 1926.451(a) Capacity

- Non-Adjustable
  - Support its own weight and 4 x maximum intended load
  - Suspension rope and connecting hardware support 6 x maximum intended load
- Adjustable
  - Stall load of scaffold hoist not to exceed 3 x rated load
  - Designed by a qualified person and built to loaded design



**Hazard:** Employees working on an improperly constructed scaffold.

## 1926.451(b) Platform construction

- Fully planked and decked
  - No more than 1” gap between adjacent units and platform and uprights
  - Max openings between platform and uprights 9 -1/2”
  - Platform and walkways at least 18” wide



**Description:** (1) Platform consists of only one plank; (2) Plank is supported by another plank that is supported by a window sill; (3) No fall protection.

**Corrective Action:** Provide adequate support for planks. Fully plank Platform. Provide fall protection

## 1926.451(b) Platform construction (cont'd)

- Each abutted end shall rest on a separate support surface
- Overlap platforms not be less than 12" only over supports unless restrained to prevent movement
- On direction changes, platforms that rests on a bearer at an angle other than a right angle must be laid first
- Platforms that rest at right angles over the same bearer laid second



## **1926.451(b) Platform construction**

**(cont'd)**

- Front edge of all platforms
  - No more than 14" from face of work
  - 3" from face for outrigger scaffolds
  - 18" from face for plastering and lathing operations
- Platforms 10' and less to extend at least 6" but not more than 12" past support
- Platforms greater than 10' nor more than 18" past support unless

## 1926.451(b) Platform construction (cont'd)

- Fully planked and decked
  - Ladder jack, top plate bracket, roof bracket, and pump jack scaffold at least 12" wide
  - Guardrails and/or personal fall arrest systems for platforms and runways not 18' wide



## 1926.451(b) Platform construction (cont'd)

- No paint on wood platforms, except edges that may be marked for identification
- Fully planked between from upright and guardrail
- No mixed components, unless compatible and integrity maintained
- No modification of mixed components unless approved by competent person
- No components or dissimilar metals unless competent person determines galvanic action will not reduce strength



## 1926.451(c) Supported scaffolds

- Restrained from tipping by guys, ties, or equivalent when higher than 4:1 ratio
- Support installed per recommendations or at closest horizontal member to the 4:1 height



When working on scaffolding at heights of 6 feet or more above a lower level, guardrails must be installed. The guardrails will provide a physical barrier to prevent you from falling. The guardrail system must be installed along all open sides and ends of the platforms.

The guardrail system must be installed before the scaffold can be used by workers.



## 1926.451(c) Supported scaffolds (cont'd)

- Never use scaffolds that do not have proper guardrails installed



Guardrails are required for your protection. Never use a scaffold that does not have proper guardrails installed. Many workers will use a scaffold without guardrails because they think nothing will happen to them and the guardrails are not really needed. The guardrails may be the only thing between you and a fall to your death.

In this photograph the worker is on the third level of the scaffold and working unsafely. There are no guardrails in place to prevent him from falling.

## 1926.451(c) Supported scaffolds (cont'd)

- Scaffold platforms must be fully planked



Scaffold platforms must be fully and properly planked. The planks must fully cover the platform to create a safe working surface. Gaps between the planks and the uprights must not be greater than 1 inch wide.

Additionally, scaffolding planks must be maintained in good condition. They must not be broken, cracked, warped or painted.

This photograph shows scaffolding 3 sections high that is not fully planked on the lower 2 sections.

## 1926.451(c) Supported scaffolds (cont'd)

- Must bear on adequate foundations
- Unstable objects will not be used as working platforms
- Plumbed and braced



To avoid falls and other hazardous conditions, you should only work from scaffolds that are properly constructed and supported. If the scaffold does not have a stable foundation, then the scaffold may move or shift causing either the scaffold or you to fall.

This scaffold has a base plate but it is not resting on a firm foundation. The base plate is resting on blocks, uneven timbers and planking over uneven ground.

## 1926.451(d) Suspension scaffolds

- Support devices must support 4 x imposed load
- Outrigger beams, metal or equivalent material, and restrained
- Outrigger beams stabilized to floor or roof deck
- Direct connection evaluated by competent person



**Anchor point for lifeline rope not evaluated prior to use**

## 1926.451(d) Suspension scaffolds (cont'd)

- Counterweights made of non-flowable material, sand, gravel, etc.
- Counterweights secured, and not removed until scaffold disassembled
- Tiebacks secured to sound anchorage on the building or structure
- Single tiebacks installed at angle prohibited



**Description:** Photo shows tie-backs not at 90 degrees

**Corrective Action:** Tie-backs corrected to 90 degrees

## **1926.451(d) Suspension scaffolds (cont'd)**

- Minimum lengths for suspension ropes on hoists
- No repaired wire rope
- Proper sized eye splice thimbles
- Ropes inspected by competent person
- No swaged attachment unless approved

## **1926.451(d) Suspension scaffolds (cont'd)**

- No gasoline powered equipment or hoist
- Automatic brakes on powered and manual hoists
- Positive crank force to descend
- Tied to prevent swaying
- Safety devices not used as platforms

## 1926.451(e) Access

- Must have safe access
- Cross-braces prohibited as means of access
- Bottom rung no more than 24' high
- Rest platforms required at 35' intervals
- Slip-resistant treads on all steps and landings
- September 2, 1997, sets access for erectors and dismantlers
- Can use end frames for access





## 1926.451(e) Access (cont'd)

- Hook-on attachable ladders
  - Specifically designed for type of scaffold
  - Lowest rung no more than 24 inches above level on which scaffold is supported
  - Rest platforms at 35 foot intervals when more than 35 feet high
  - Maximum rung length 11 ½ inches, and a maximum space between rungs 16 ¾ inches



When scaffold platforms are more than 2 feet above or below a point of access, portable ladders, hook-on ladders, attachable ladders, or other means of safe access must be provided. Other types of access may include stair towers, ramps, or walkways.

When using portable hook-on ladders, they must be positioned so they do not tip the scaffold over.

Additionally, the spacing of the ladder rungs must be 16 ¾ inches or less and have a minimum length of 11 ½ inches.

Following these guidelines will allow you to safely access scaffolding and reduce your risk of falls.

## 1926.451(f) Use

- Never overloaded
- Erected, moved, dismantled and altered near power lines
- Repair in place or replace damaged components
- Restrict horizontal movement with employees unless designed by registered P.E.
- Prohibit work activities during high winds unless authorized by C.P.
- Remove whole scaffold from service until repaired



**Description:** This scaffold was within 10 feet of the overhead power line with 300 volts to 50KV.

**Corrective Action:** The scaffold should not be erected, dismantled, used or altered near energized power lines.

## 1926.451(f) Use (cont'd)

Proper clearance near overhead lines



Keep 10 foot minimum unless de-energized,  
Relocated, or installed protective covering installed!

**Description:** This scaffold was within 10 feet of the overhead power line with 300 volts to 50KV.

**Corrective Action:** The scaffold should not be erected, dismantled, used or altered near energized power lines.

## 1926.451(f) Use (cont'd)

- No work on snow, or ice covered platforms
- No barrels, boxes or ladders on top of scaffolds



## 1926.451(g) Fall protection (PFAS or guardrails)

- Required at 10'
- May be used in lieu of guardrails on some scaffolds
- PFAS and guardrails on suspension scaffolds
- Required for erectors and dismantlers after September 2, 1997 if feasible and no greater hazard
- Top-rails after 1-1-2000, 38" to 45" high
- In some cases, may use cross bracing in lieu of top-rail or mid-rail



## 1926.451(h) Falling object protection

- Hardhats required for employee
- Protect employees below from falling objects
  - Toe-boards
  - Canopies
  - Barricades



## 29 CFR 1926.452 - Supported scaffolds

- Supported scaffolds consist of one or more platforms supported by outrigger beams, brackets, poles, legs, uprights, posts, frames, or similar rigid support



# Pole

- Restrict movement of existing platform until bearers are set, and braced
- Couplers have to be made of structural steel
- The use of couplers made from gray cast iron is prohibited
- Designed by P.E. when more than 125 feet
- Transverse bracing form an “X” across width of the scaffold must be installed at scaffold ends



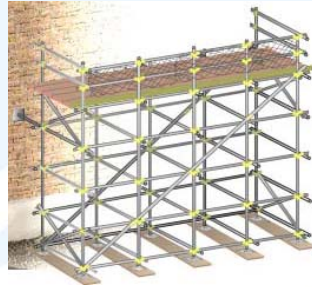
Pole scaffolds are a type of supported scaffold in which every structural component, from uprights to braces to platforms, is made of wood. OSHA has standards for two kinds: single-pole, which are supported on their interior side by a structure or wall, and double-pole, which are supported by double uprights independent of any structure.

Because they have to be built from scratch and cannot easily be reused, pole scaffolds are considered old-fashioned and are rarely used today.



# Tube and Coupler

- When platforms are being moved to the next level, the existing platform must be left undisturbed until the new bearers have been braced and set in place
- Couplers must be made of a structural metal
- Couplers made from gray cast iron is prohibited
- Designed by P.E. if over 125 feet



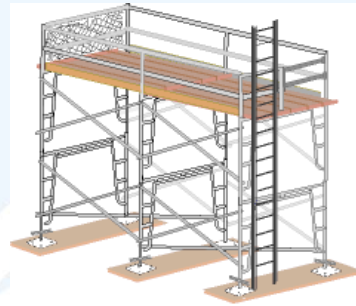
Tube and coupler scaffolds are so-named because they are built from tubing connected by coupling devices. Due to their strength, they are frequently used where heavy loads need to be carried, or where multiple platforms must reach several stories high. Their versatility, which enables them to be assembled in multiple directions in a variety of settings, also makes them hard to build correctly.

## Tube and Coupler (cont'd)

- Transverse bracing forming an "X" across the width of the scaffold must be installed at the scaffold ends, and at least at:
  - Every third set of posts horizontally (measured from only one end)
  - Every fourth runner vertically
- Bracing must extend upward diagonally to opposite sides of the scaffold
- Where length is *greater* than their height, longitudinal bracing must be repeated beginning at least at every fifth post
- On outside posts, tube and coupler guardrails and midrails may be used in lieu of outside runners

## Fabricated frame

- Existing platforms remain until the frames are set / braced
  - Joined with stack pin
- Must be designed by registered engineer when over 125 ft.



Fabricated frame scaffolds are the most common type of scaffold because they are versatile, economical, and easy to use. They are frequently used in one or two tiers by residential contractors, painters, etc., but their modular frames can also be stacked several stories high for use on large-scale construction jobs.

## Mobile

- Plumb, level and squared
- Braced to prevent collapse
- Casters and wheels locked to prevent movement while in a stationary position
- Platforms must not extend beyond the base supports of the scaffold, unless stability is ensured



Mobile scaffolds are a type of supported scaffold set on wheels or casters. They are designed to be easily moved and are commonly used for things like painting and plastering, where workers must frequently change position.

## **Mobile (cont'd)**

- Not allowed to ride on scaffolds unless the following exist
  - Surface on which scaffold is being moved is within 3 degrees of level, and free of pits, holes and obstructions
  - Height to base width ratio during movement is 2:1 or less
  - Outrigger frames, when used, are installed on both sides of the scaffold
- When power systems are used, the propelling force is:
  - Applied directly to the wheels
  - Does not produce a speed in excess of 1 foot per second
- No employee is on any part of the scaffold that extends beyond the wheels, casters, or other supports

# Pump jack

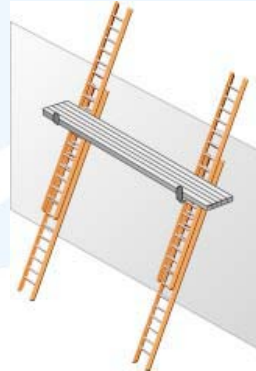
- Brackets, braces must be fabricated from metal plates and angles
- Each bracket must have two positive gripping mechanisms
- Workbench may be used as a top-rail when guardrails used for fall protection
- Work benches must not be used as scaffold platforms
- Poles must be secured to structure by rigid triangular bracing, or equivalent



Pump jacks are a uniquely designed scaffold consisting of a platform supported by moveable brackets on vertical poles. The brackets are designed to be raised and lowered in a manner similar to an automobile jack. Pump jacks are appealing for certain applications because they are easily adjusted to variable heights, and are relatively inexpensive.

# Ladder jack

- Must meet requirements of subpart “X”, stairways and ladders
  - Exception: Job-made ladders must not be used to support ladder jack scaffolds
- Ladder jacks must be designed and constructed to bear on:
  - Side rails and ladder rungs, or
  - Ladder rungs alone
- Ladders used to support ladder jack scaffolds must be:
  - Placed and fastened to prevent slipping



A ladder jack scaffold is a simple device consisting of a platform resting on brackets attached to a ladder. Ladder jacks are primarily used in light applications because of their portability and cost effectiveness.

Platforms should not **be placed higher than 20 feet from the supported base.**

Scaffold platforms must not be **bridged together.**

# Suspended scaffolds

- Suspended scaffolds are platforms suspended by ropes, or other non-rigid means, from an overhead structure





## Two point swing stage

- Platform limited to 36”
- Platform securely fastened to hangars
- Platforms must be of ladder, plank or beam type
- Must not be bridged together unless bridge and hoist is appropriately sized



Two-point adjustable suspension scaffolds, also known as swing-stage scaffolds, are perhaps the most common type of suspended scaffold. Hung by ropes or cables connected to stirrups at each end of the platform, they are typically used by window washers on skyscrapers, but play a prominent role in high-rise construction as well.

## Single-point adjustable

- Supporting rope between scaffold and the suspension device must be kept vertical unless:
  - Rigging has been designed by a qualified person
  - Scaffold is accessible to rescuers
  - Support rope is protected from rubbing during direction changes, and
  - Scaffold is positioned so swinging cannot bring it into contact with other surfaces



A single-point adjustable scaffold consists of a platform suspended by one rope from an overhead support and equipped with means to permit the movement of the platform to desired work levels. The most common among these is the scaffold used by window washers to clean the outside of a skyscraper (also known as a boatswain's chair).

## Multi-level

- Must be equipped with additional independent support lines that are:
  - Equal in number to number of points supported
  - Equal in strength to the suspension ropes
  - Rigged to support scaffold if the suspension ropes fail
- Independent support lines and suspension ropes must not be anchored to the same points
- Supports for platforms must be attached directly to support stirrups (not to other platforms)



A multi-level scaffold is a two-point or multi-point adjustable suspension scaffold with a series of platforms at various levels resting on common stirrups.

## 1926.453 - Aerial lifts

- Must meet ANSI criteria
- Secured to lower traveling position by a locking device before moving
- Ensure proper fall protection prior to using
  - Includes use of guardrails
- Lifts must allow you to access heights and work from a protected area



Always make sure you have proper fall protection and training before using a powered platform. Proper fall protection includes the use of guardrails. Lifts must have mid rails and top rails on all sides including the point of access.

Workers must use a fall restraint system while working in an aerial platform. This will prevent you from falling outside the lift while working.

The brakes of these lifts must be set when used and workers must not move the lifts while they are in use. You should not move an aerial lift while in use, unless it is specifically designed for that purpose.

## Aerial lifts (cont'd)

- Requires use of body belt or harness and lanyard
- Worker must stand on floor of basket
- Never exceed load capacity
- Do not move lift truck with workers in basket unless adequately designed (upper controls – personnel carriers)
- Brakes set for outrigger use (wheels chocked)



This photograph shows a worker who is standing on the mid rail and leaning over the edge. This worker could easily lose his balance and fall out of the platform.

## Aerial lifts (cont'd)

- Vehicle-mounted or self-propelled elevating work platforms – training is required!



All pneumatic and hydraulic components must comply with ANSI A92.2.1969 and non-critical parts must have a burst factor of 2:1

Only use equipment that is designed for lifting people. Never improvise and build your own lifting platform.

This slide shows both a good and a bad example of a “personnel lift”. The photograph on the left shows the bad example. This is not a powered work platform. This is a wooden pallet being lifted with a forklift. There are no guardrails, the worker is not tied off, and the platform was not designed for lifting workers. This is very dangerous and should never be attempted.

The photograph on the right is the good example. This lift is specifically designed to carry workers. The employees are protected by a complete set of guardrails and the workers are tied off.

Never allow yourself to be lifted in an unsafe work platform and never lift anyone else.

## 1926.454 Training

- Employees must receive training from qualified person that covers:
  - Nature of hazards, electrical, falls, and falling items
  - Use of scaffold / handling
  - Maximum intended load and load carrying capabilities of scaffold
  - Procedures for setup, dismantling or moving the system
  - Requirements of subpart “L”

# Retraining

- When the employer has reason to believe an employee lacks the skill or understanding needed for safe work involving scaffolds, retraining shall be performed until proficiency is established
- Retraining is also required when:
  - Additional or new hazards exists
  - Changes occur in the type of scaffold and fall protection exist
  - Where there are inadequacies in an employee's work



## **Common OSHA Citations**

- 451(g)(1) Fall protection at 10 feet
- 453(b)(2)(v) Aerial lifts – Body belt and lanyard
- 451(e)(1) Scaffold access
- 451(b)(1) Scaffold platform construction
- 454(a) Scaffold user training

# Resources

- [www.osha.gov](http://www.osha.gov)
  - 29 CFR 1926.451
  - NSHA-OSHA Job Site Safety Handbook
- <http://www.osha.gov/publications/osha2202.html>
  - Construction Industry Digest
  - Scaffolding Industry Association
- <http://www.scaffold.org>
  - American National Standards Institute
  - A92 (SIA): Scaffolds and other elevating devices