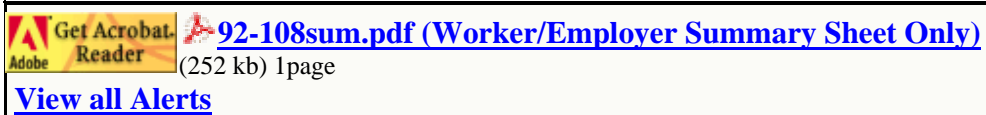


Request for Assistance in...

Preventing Worker Injuries and Deaths Caused by Falls From Suspension Scaffolds

NIOSH ALERT: August 1992

DHHS (NIOSH) Publication No. 92-108



WARNING!

Workers may die or be injured if scaffold equipment and fall protection systems are defective or misused.

The National Institute for Occupational Safety and Health (NIOSH) requests assistance in preventing worker injuries and deaths caused by falls from suspension scaffolds. "Suspension scaffold" means one or more working platforms suspended by ropes or other means from an overhead structure. Recent investigations by NIOSH suggest that fatal falls occur as a result of defective scaffold equipment, improper installation or operation, improper training of workers, or a failure to use appropriate personal fall protection equipment. This Alert describes five incidents resulting in six deaths caused by falls from suspension scaffolds.

Safety regulations of the Occupational Safety and Health Administration (OSHA) establish specific requirements for suspension scaffolds and their operation, including the use of fall protection systems (Figure 1) [\[see note 1\]](#). Every employer, supervisor, and worker involved in work from suspension scaffolds must comply with these regulations. NIOSH requests editors of trade journals, safety and health officials, and employers in the construction trades to bring the recommendations in this Alert to the attention of construction supervisors and workers.



Figure 1. Worker with fall protection systems in place.

BACKGROUND

Falls are a leading cause of traumatic occupational death. For the period 1980-85, the NIOSH National Traumatic Occupational fatalities (NTOF) database indicates that falls accounted for nearly 10% (3,491 of 36,210) of all traumatic occupational deaths for which a cause was identified [Bobick et al. 1990; NIOSH 1991a]. For 1986, the U.S. Department of Labor indicates that falls accounted for 8% (289 of 3,610) of all occupational fatalities from trauma [BLS 1988].

Fatal falls from scaffolds during the period 1980-85 accounted for 17% of all falls from elevations (461 of 2,705) and were second only to falls from buildings [Bobick 1988; NIOSH 1991a].

Falls from scaffolds accounted for 21% (82 of 386 incidents and 86 deaths) of fatal falls from working surfaces reported for the period 1974 to 1978 [OSHA 1979]. Suspension scaffolds were involved in 30% (25 of 82 incidents and 27 deaths) of the falls from scaffolds. Of the 25 falls from suspension scaffolds, 68% (17) involved scaffold equipment failure. Personal fall protection equipment was used in only three of these incidents, but it was used improperly in each case. In one incident, a worker fell out of his improperly fastened safety belt; in the other two incidents, excessively long lanyards broke or separated after victims fell 30 feet.

CURRENT AND PROPOSED OSHA REGULATIONS

OSHA regulations were promulgated in 1971 to protect workers from the hazards of working from scaffolds in both general industry [29 CFR 1910.28--[see note 2](#)] and the construction industry [29 CFR 1926.451]. However, falls from scaffolds continued to occur, and in 1986, OSHA proposed to revise the construction industry safety regulations addressing all types of scaffolds [51 Fed. Reg. 42680 (1986)--[see note 3](#)].

The proposed regulations would apply to the design, construction, and use of all scaffolds in construction. Instead of specification standards, the proposed regulations would use performance criteria to reduce the danger of slipping or falling from scaffolds.

The proposed regulations provide general requirements for all scaffolds regarding capacity, construction, access, use, and fall protection. In addition, they include provisions for the following:

- Use of a competent person (as defined in 29 CFR 1926.32) to inspect scaffolds and equipment before use
- Use of scaffold components capable of supporting proper loads
- Proper shielding of ropes from corrosive processes or heat
- Use of both guardrail systems and body belt or harness systems for work from suspension scaffolds

OSHA has scheduled final action on the proposed regulations for scaffolds and fall protection systems in 1992 [Occup Saf & Health Rep 1992].

CASE REPORTS

The NIOSH Fatal Accident Circumstances and Epidemiology (FACE) Program has been investigating fall-related fatalities among workers since October 1988. The following subsections present findings from five case reports of falls from suspension scaffolds that resulted in the deaths of six workers.

Case No. 1--Two Deaths

On November 15, 1988, a 53-year-old male painting foreman and a 28-year-old male painter died when the scaffold from which they were working collapsed, causing them to fall nearly 48 feet to the ground. The men were painting the exterior of a 48-foot-high, 56-foot-diameter storage tank. They were painting the side of the tank from a two-point suspension scaffold supported by two steel outriggers. The scaffold manufacturer specified 600 pounds of counterweight for this scaffold and load, but the painters had rigged the scaffold using only 200 pounds of counterweight (100 pounds per outrigger). The outriggers were not tied off or otherwise secured.

No personal fall protection equipment was being used by either worker. While the two men were working on the scaffold, their weight caused the outriggers to slip, and the scaffold, rigging, and victims fell to the ground [NIOSH 1989c].

Case No. 2--One Death

On December 19, 1988, a 27-year-old male cement finisher died when he fell from a suspension scaffold and his safety lanyard snapped. The victim and a coworker were dismantling suspended scaffolding at the 160-foot level inside a 172-foot-high, circular concrete silo. Both men were wearing safety belts with nylon rope lanyards secured to independent lifelines.

The accident occurred when the victim lost his balance and fell off an unguarded end of the scaffold. The coworker stated that he saw the victim fall and jerk upward as the lanyard caught him. When the victim's weight dropped back on the lanyard, it snapped, allowing him to fall onto a concrete floor.

Examination of the lanyard after the event showed burn damage at several places, including the point of failure. The employer did not control inspection or distribution of this fall protection equipment. Instead, the equipment was kept in a common supply bin where the workers could readily obtain it when needed and return it when work was completed. The lanyard had been returned to the storage bin even though it had probably been damaged earlier during cutting and welding operations [NIOSH 1989b].

Case No. 3--One Death

On March 15, 1989, a 33-year-old male caulking mechanic died when the scaffold on which he was working failed and caused him to fall 60 feet to the ground. The victim and a coworker were caulking the exterior skin plate joints and windows of a new seven-story building. Most of the work on the lower levels of the building had previously been completed using a personnel hoist. The upper floors of the building could not be reached with this device, so the crew brought a suspension scaffold to the site on the day of the incident.

Upon arrival, the crew found that workers from a window-washing firm had already rigged a two-point suspension scaffold on the building. An arrangement was made for one crew (containing one worker from each company) to work from the caulker's manlift while a second crew worked from the window washer's two-point suspension scaffold. The victim and one worker from the window-washing firm then ascended the building using the two-point suspension scaffold and began work at the sixth floor. Although the victim and his coworker had brought safety belts and lifelines to the site, this equipment had been left in the company truck, and none of the four workers were using any type of fall protection equipment.

When work was completed at the sixth floor, the men began their descent. Suddenly, the victim's end of the scaffold dropped to a vertical position. The victim fell from the scaffold to the ground 60 feet below. The second man on the scaffold (the window washer) managed to cling to the scaffold and a nearby window ledge until he could be rescued.

Inspection of the scaffold hoist revealed a defect in a centrifugal safety brake. This defect and the victim's possible failure to release the parking brake before beginning his descent caused one end of the scaffold to drop [NIOSH 1989a].

Case No. 4--One Death

On October 21, 1989, a 37-year-old male painter died when the platform he was working from fell 65 feet inside a municipal water storage tank. The victim was a member of a three-man crew that was using an improvised suspension scaffold to paint the interior of the 68-foot-tall, 32-foot-diameter water tank. The scaffold consisted of an aluminum ladder used as a platform and secured to steel "stirrups" made of steel bar stock bent into a box shape and attached to each end of the ladder. Wire cables from each stirrup ran to a common tie-off point. A cable from this common tie-off was rigged to a block and tackle

used from ground level to raise and lower the platform. The block and tackle supporting the system was secured to a vertical steel pipe on top of the tank with a cable that was fashioned into a loop by U-bolting the dead ends of a piece of wire rope.

The victim had been painting from one end of this scaffold while wearing a safety belt and lanyard attached to an independent lifeline. When the victim finished painting, he unhooked his lanyard from his lifeline and moved along the ladder platform to a position where he could hand his paint spray gun to the foreman (who was at the top of the tank). As the foreman took the spray gun, he heard a "pop" and saw the scaffold and the victim fall 65 feet to the floor of the tank.

Investigation of the incident revealed that the two U-bolts on the loop of cable supporting the block and tackle had loosened enough to allow the cable ends to slip through, causing the scaffold to fall. This particular rig had been used without incident every day for 2 weeks preceding this fatal fall [NIOSH 1990a].

Case No. 5--One Death

On November 20, 1989, a 39-year-old painter died after falling 40 feet when a scaffold suspension rope broke. This victim was a member of a three-man crew engaged in the abrasive blasting and painting of the interior of a 48-foot-high, 30-foot-diameter steel water tank.

Three separate two-point suspension scaffolds were used to reach the interior walls of the tank. The scaffolds abutted each other in a U-shaped configuration. The center scaffold platform was overlapped by one end of each of the other two scaffolds. Suspension ropes were located at each end of the center platform and at the outer ends of the two other platforms. The platform unit was raised by alternately raising each suspension point a few feet at a time.

Two men were involved in this operation when the incident occurred. The victim was standing on an outer end of the platform and was pulling on the suspension rope to raise that end of the scaffold. He fell when the rope broke and his end of the platform dropped to a vertical position. The victim was not using personal fall protection equipment although it was available and was being used by the second painter.

An investigation revealed that the 5/8-inch nylon hoist rope had broken at a point where it had been burned some time before the incident [NIOSH 1990b].

CONCLUSIONS

The fatal incidents reported here all involved violations of OSHA regulations for scaffolds. These regulations include the use of proper scaffold equipment, appropriate installation of equipment, use of proper operating procedures, use of prescribed personal fall protection equipment, and adequate training of workers.

None of the deaths described here would have occurred if the existing and proposed OSHA regulations for the safe use of scaffolds had been observed.

RECOMMENDATIONS

NIOSH recommends the following measures to prevent serious injuries and fatal falls while working from suspension scaffolds:

1. Comply with the current and proposed OSHA regulations for working with scaffolds.
2. Assure that design and construction of scaffolds conform with OSHA requirements.
3. Shield scaffold suspension ropes and body belt or harness system droplines (lifelines) from hot or corrosive processes, and protect them from sharp edges or abrasion.
4. Inspect all scaffolds, scaffold components, and personal fall protection equipment before each use.
5. Provide personal fall protection equipment and make sure that it is used by all workers on suspension scaffolds.
6. Use structurally sound portions of buildings or other structures to anchor droplines for body belt or harness systems and tiebacks for suspension scaffold support devices. Droplines and tiebacks should be secured to separate anchor points on structural members.
7. Provide proper training for all workers who use any type of suspension scaffold or fall protection equipment.
8. Follow scaffold manufacturers' guidance regarding the assembly, rigging, and use of scaffolds.

These recommendations are discussed briefly in the following subsections. Please note that an earlier NIOSH Alert [NIOSH 1991b] presents recommendations for preventing electrocutions during work with scaffolds near overhead power lines.

Compliance with OSHA regulations

Employers and workers must comply with the current OSHA regulations for working with scaffolds [29 CFR 1910.28, 1926.451]. Furthermore, they should

- consider all provisions of the OSHA proposed rulemaking for safe use of scaffolds in construction [51 Fed. Reg. 42680 (1986)], and
- incorporate additional safety provisions as appropriate to strengthen their safety programs.

Design and Construction of Scaffolds

The design and construction of scaffolds must conform with OSHA requirements concerning type of equipment, rated capacities, construction methods, and use. Each

scaffold and scaffold component must be capable of supporting its own weight plus at least four times the maximum intended load without failure. Each suspension rope must be capable of supporting at least six times the maximum intended load.

Shielding of Ropes

Suspension ropes and droplines for body belt or harness systems should be shielded from

- heat-producing processes such as welding,
- acids or other corrosive substances, and
- sharp edges or abrasions.

Such ropes should be made from material that is not adversely affected by heat or by acids or other corrosives.

Inspection

Employers should require a competent person to inspect all scaffolds and scaffold components for visible defects before use on each workshift. Scaffolds should be erected, moved, dismantled, or altered only under the supervision of a competent person.

All components of personal fall protection equipment (including body belts or harnesses, lanyards, droplines, trolley lines, and points of anchorage) should be inspected by a competent person before use. Any visibly damaged or worn equipment should be removed from service immediately.

Use of Fall Protection Equipment

Employers should provide appropriate fall protection systems and ensure their use by all workers on suspension scaffolds. Generally, these workers should be protected by a Type I guardrail system [\[see note 4\]](#) or a combination of body belt or harness system with a Type II guardrail system [\[see note 5\]](#).

However, when single-point and two-point adjustable suspension scaffolds are used, workers must be protected by both a body belt or harness system and a Type I or Type II guardrail system. Also, when boatswain chairs, catenary scaffolds, and float scaffolds are used, workers must be protected only by a body belt or harness system.

Use of Structural Members as Anchor Points

Structurally sound portions of buildings or other structures must be used to anchor droplines for body belt or harness systems and tiebacks for suspension scaffold support devices. Droplines and tiebacks should be secured to separate anchor points of structural members. Owners, architects, and engineers planning renovation or designing new facilities should incorporate strategically located anchor points on structural members of buildings for future exterior maintenance and repair work.

Proper Training of Workers

Employers should provide workers with proper training, including the manufacturers' recommendations for installing and operating suspended scaffold systems and for using personal fall protection equipment. Untrained personnel should never be permitted to work from any type of suspension scaffold.

ACKNOWLEDGMENTS

Dwayne Smith and Ronald Stanevich, Division of Safety Research, NIOSH, were the principal contributors to this Alert. Comments or questions concerning this Alert should be directed to Thomas R. Bender, M.D., Director, Division of Safety Research, National Institute for Occupational Safety and Health, 944 Chestnut Ridge Road, Morgantown, WV 26505-2888; telephone, (304) 291-4595.

We greatly appreciate your assistance, which is crucial to protecting the lives of American workers.

[signature]

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NOTES

1. Fall protection systems consist of body belt or harness systems (personal fall arrest systems) used independently or in combination with guardrail systems. [\[Return to main text\]](#)
 2. Code of Federal Regulations. See CFR in references. [\[Return to main text\]](#)
 3. Federal Register. See Fed. Reg. in references. [\[Return to main text\]](#)
 4. Type I guardrail systems are those capable of providing adequate fall protection without the use of body belts. [\[Return to main text\]](#)
 5. Type II guardrail systems are those that delineate the scaffold edge, restrain movement, provide handholds, and prevent misstepping. Type II systems must be supplemented by body belt or harness systems to provide adequate fall protection [51 Fed. Reg. 42680 (1986)]. [\[Return to main text\]](#)
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REFERENCES

Bobick TG, Schnitzer PG, Stanevich RL [1990]. Investigation of selected occupational fatalities caused by falls from elevations. In: Das B, ed. *Advances in industrial ergonomics and safety, II*. London, England: Taylor & Francis, pp. 527-534.

BLS [1988]. *Occupational injuries and illnesses in the United States by industry, 1986*. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Bulletin No. 2308.

CFR. *Code of Federal regulations*. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

51 Fed. Reg. 42680 [1986]. Occupational Safety and Health Administration: safety standards for scaffolds used in the construction industry; notice of proposed rulemaking. (To be codified at 20 CFR 1926).

NIOSH [1989a]. Fatal accident circumstances and epidemiology: caulking mechanic dies in fall when scaffold fails. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH FACE Report 89-29.

NIOSH [1989b]. Fatal accident circumstances and epidemiology: cement finisher dies after 160-foot fall from scaffold. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH FACE Report 89-21.

NIOSH [1989c]. Fatal accident circumstances and epidemiology: foreman and painter die in 48-foot fall when scaffold collapses. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH FACE Report 89-7.

NIOSH [1990a]. Fatal accident circumstances and epidemiology: painter dies when scaffold falls inside municipal water tank in Indiana. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH FACE Report 90-12.

NIOSH [1990b]. Fatal accident circumstances and epidemiology: painter dies following a 40-foot fall from scaffold inside water tank in Ohio. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, NIOSH FACE Report 90-16.

NIOSH [1991a]. National Traumatic Occupational Fatality (NTOF) database. Morgantown, WV: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Safety Research.

NIOSH [1991b]. NIOSH Alert: request for assistance in preventing electrocutions during work with scaffolds near overhead power lines. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 91-110.

OSHA [1979]. Occupational fatalities related to scaffolds as found in reports of OSHA fatality/catastrophe investigations. Washington, DC: U.S. Department of Labor, Occupational Safety and Health Administration, Office of Statistical Studies and Analysis.

Occup Saf & Health Rep [1992]. Sect. 1737, Fall protection (Part 1926), RIN 1218-AA37; Sect. 1738, Scaffolds (Part 1926), RIN 1218-AA40; Sect. 1739, Fall protection systems (personal protective equipment) (Part 1910), RIN 1218-AA48. Occupational Safety & Health Reporter, April 29.

This page was last updated: 1/10/97

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