NIOSH

ALERT

Preventing Injuries and Deaths from Skid-Steer Loaders

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

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NIOSH ALERT

Preventing Injuries and Deaths from Skid-Steer Loaders

WARNING!

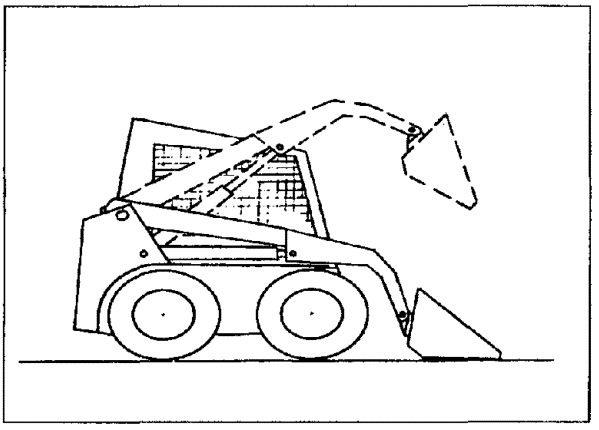
Workers who operate or work near skid-steer loaders may be crushed or caught by the machine or its parts.

If you operate or work near skid-steer loaders, take these steps to protect yourself.

1. **Follow safe operating procedures:**
   - Operate the loader from the operator's compartment—never from the outside.
   - Stay seated when operating the loader controls.
   - Work with the seat belt fastened and the restraint bar in place.
   - Keep your arms, legs, and head inside the cab while operating the loader.
   - Load, unload, and turn on level ground when possible.
   - Travel and turn with the bucket in the lowest position possible.
   - Operate on stable surfaces only.
   - Do not travel across slopes. Travel straight up or down, with the heavy end of the machine pointed uphill.
   - Keep bystanders away from the work area.
   - Never disable safety devices.

2. **Enter and exit from the loader safely:**
   - Enter the loader only when the bucket is flat on the ground—or when the lift-arm supports are in place.
   - When entering the loader, face the seat and keep a three-point contact with handholds and steps.
   - Never use foot or hand controls for steps or handholds.
   - Keep all walking and working surfaces clean and clear.
   - Before leaving the operator's seat,
     — lower the bucket flat to the ground,
     — set the parking brake, and
     — turn off the engine.

3. **Maintain the machine in safe operating condition:**
   - Follow the manufacturer's instructions.
   - Keep the foot controls free of mud, ice, snow, and debris.
   - Regularly inspect and maintain
     — Interlocked controls
     — Safety belts
     — Restraint bars
     — Side screens
     — Rollover protective structures (ROPS)
   - ***NEVER*** modify or bypass safety devices.
   - If you must perform service under a raised bucket, use the lift-arm supports.



Please tear out and post. Distribute copies to workers.

See back of sheet to order complete Alert.

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Warning!

Workers who operate or work near skid-steer loaders may be crushed or caught by the machine or its parts.

The National Institute for Occupational Safety and Health (NIOSH) requests help in preventing injuries and deaths among workers who operate, service, or work near skid-steer loaders. This type of loader is commonly used in agriculture, construction, and general industry for materials handling and excavating.

Recent NIOSH studies suggest that employers, supervisors, and workers may not appreciate the hazards of operating or working near skid-steer loaders; or they may not follow safe work procedures for controlling these hazards. This Alert describes six deaths involving skid-steer loaders and recommends methods for preventing similar incidents.

BACKGROUND

Risk of Injury

Skid-steer loaders put workers at risk of rollover and runover incidents. But they also have features that expose workers to other risks of injury.

For example, the operator's seat and controls are between the lift arms and in front of the lift-arm pivot points. Thus operators of skid-steer loaders must enter and exit from the loader through the front of the machine and over the bucket. If the worker does not exit or enter properly, a foot or hand control may be activated and may cause movement of the lift arms, bucket, or other attachment. Such an incident could cause death or serious injury.

Also, the machine is very compact and places the operator close to the zone of movement for the lift arms (see Figure 1).

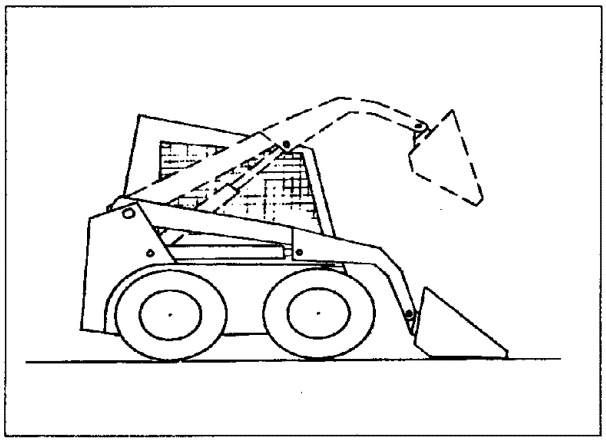

Figure 1. Skid-steer loader.

Current Safeguards

Interlocking—To keep workers from unintentionally activating controls, manufacturers of skid-steer loaders began to equip them with interlocked control systems in the early 1980s. These interlocked controls require that a nonoperational control or fixture (such as a seat belt or restraint bar) be secured or activated before operational controls can function. Some machines connect the lift-arm control to the seat belt to prevent movement of the lift arm unless the seat belt is fastened. Other machines connect the lift-arm control to a bar that must be lowered in front of the operator or to a pressure switch in the seat. Manufacturers have recently introduced electronic systems to perform the interlocking function.

Rollover Protective Structures—Skid-steer loaders now come equipped with rollover protective structures (ROPS), side screens, and seat belts to protect the operator if the machine turns over. The side screens keep the operator from coming into contact with moving lift arms.

Fatality Data

Several databases identify work-related fatalities in the United States:

- **NTOF**—The NIOSH National Traumatic Occupational Fatalities Surveillance System
- **FACE**—The NIOSH Fatality Assessment and Control Evaluation Program
- **CFOI**—The Census of Fatal Occupational Injuries of the Bureau of Labor Statistics

The following subsections summarize the data on fatalities involving skid-steer loaders.

NTOF—During the period 1980–92, the NTOF Surveillance System used death certificate data to identify 54 work-related fatalities involving skid-steer loaders [NIOSH 1997b]. These fatalities resulted from the following types of incidents:

	Number of victims	
Pinning between the bucket and frame of the machine or between the lift arms and frame	25	(46%)
Crushing incidents for which no further information was provided	15	
Rollovers	11	
Pinning between the loader and another object	2	
Being run over	1	

An additional 65 fatalities were attributed to *pinning between the bucket and frame or between the loader lift arms and frame*, but no loader type was identified. A number of these fatalities may have involved skid-steer loaders. The NTOF data probably underestimate the number of fatalities involving skid-steer loaders because death certificates do not identify all work-related fatalities [Russell and Conroy 1991; Stout and Bell 1991].

FACE—During the period 1992–97, the NIOSH FACE program identified 37 work-related fatalities involving skid-steer loaders. These fatalities resulted from the following types of incidents:

	Number of victims	
Pinning between the bucket and frame of the machine or between the lift arms and frame	29	(78%)
Rollovers	6	
Other/unknown	2	

The 29 fatalities involving pinning between the bucket and frame or between the lift arms and frame resulted from the following activities:

	Number of victims
Working or standing under a raised loader bucket	10
Leaning out of the operator's compartment into the path of the moving lift arms (pinned against frame)	8
Entering or exiting (pinned between bucket and frame)	5
Unknown (pinned between bucket and frame)	6

CFOI—During the period 1992–94, the CFOI identified 20 work-related fatalities involving skid-steer loaders. Of these 20 fatalities, 14 (70%) involved *pinning between the loader bucket and frame or between the lift arms and frame*. The CFOI uses multiple sources of information to identify work-related fatalities.

CURRENT STANDARDS

OSHA Regulations

The current Occupational Safety and Health Administration (OSHA) regulations for the construction industry do not specifically address skid-steer loaders. However, they require employers to protect workers from several hazards associated with operating and maintaining these machines.

The OSHA regulations apply to motor vehicles, mechanized equipment, and marine operations. They address operator restraints, operating procedures, rollover protection, machine guarding, and maintenance procedures. The OSHA regulations that apply to skid-steer loaders are summarized as follows:

- Seat belts shall be provided, and they shall meet the requirements of the Society of Automotive Engineers (SAE) standard, *Seat Belts for Construction Equipment* (J386-1969) [29 CFR* 1926.602(a)(2)].

- All bidirectional machines shall be equipped with a horn, distinguishable from the surrounding noise level, which shall be operated as needed when the machine is moving in either direction [29 CFR 1926.602(a)(9)(i)].

- Scissors points on all front-end loaders, which constitute a hazard to the operator during normal operation, shall be guarded [29 CFR 1926.602(a)(10)].

- End-loader buckets and similar equipment shall be either fully lowered or blocked when being repaired or when not in use. All controls shall be in a neutral position, with the motors stopped and the brakes set, unless work being performed requires otherwise [29 CFR 1926.600(a)(3)(i)].

**Code of Federal Regulations.* See CFR in references.

- Equipment manufactured on or after September 1, 1972, shall be equipped with ROPS which meet the minimum performance standards prescribed in 29 CFR 1926.1001 and 1926.1002 or shall be designed, fabricated, and installed in a manner which will support, based on the ultimate strength of the metal, at least two times the weight of the equipment applied at the point of impact [29 CFR 1926.1000(b) and 1926.1000(c)(2)].

- No modifications or additions which affect the capacity or safe operation of the equipment shall be made without the manufacturer's written approval. If such modifications or changes are made, the capacity, operation, and maintenance instruction plates, tags, or decals shall be changed accordingly [29 CFR 1926.602(c)(ii)].

ANSI/SAE Standard

The SAE has developed a standard for the American National Standards Institute (ANSI) addressing skid-steer loaders. The SAE standard SAE J1388 (June 1985) contains design guidelines that address machine rollovers and the hazards of pinning between the lift arms and frame and between the bucket and frame [ANSI/SAE 1985]. To conform with this recommended practice, manufacturers must do the following:

- Provide warnings, operator instructions, and service procedures

- Equip the machine with seat belts

- Provide a means to prevent the lift arm from lowering when the operator is entering or exiting from the machine

- Provide handholds and steps to facilitate entry and exit from the loader

- Provide ROPS with side screens

- Provide two openings for emergency exit

- Provide safety signs and instructions to warn of hazards during normal operations and servicing

CASE REPORTS

The cases presented here were investigated by the FACE Program between 1992 and 1997.

Case No. 1—Defeat of Interlocked Controls

On February 7, 1995, a 37-year-old male farmer died after he was struck by the falling bucket of a skid-steer loader. The incident occurred after the victim used the loader for chores and parked it in an open garage without cleaning accumulated mud, snow, and manure from the foot-operated lift-arm and bucket controls. When the victim shut down the machine and exited from it, he stepped on the lift-arm control, moving it to the lift position. The debris then froze, locking the controls in place. After about an hour, the victim returned, entered the loader, and started the engine. The lift arms rose until the bucket contacted the header over the open garage door. The victim shut down the machine, dismounted, knelt on the ground under the raised bucket in front of the machine, and began cleaning the frozen controls with a pry bar. While cleaning, he unintentionally moved the lift-arm foot pedal control to the down position. The lift arms suddenly moved down, pinning the

victim between the bucket and frame of the machine. The victim was discovered by his wife, who immediately boarded the machine, started the engine, and attempted to raise the bucket. However, the controls had frozen again, and she was not able to activate the lift-control pedal. A farm employee unsuccessfully tried to raise the bucket with a jack. The victim was freed by a local fire department. Resuscitation efforts began at the scene and continued during transport of the victim to a local hospital, but they were unsuccessful. The victim was pronounced dead at the hospital emergency room [University of Iowa 1995].

Although several factors contributed to the injury, two factors were critical:

1. The interlock system for the lift-arm control had been defeated by a glove that was jammed into the linkage connected to the seat belt. A working interlock system would have prevented the lift-arms from rising when the victim started the engine.

2. The clearance inside the garage was low and prevented the lift arms from rising enough to use the lift-arm supports (sliding pins) mounted near the top of the ROPS.

Case No. 2—Improper Exit

On October 29, 1993, a 26-year-old male hog farmer was fatally injured when he was caught between the frame of a skid-steer loader and the lift-arm hydraulic cylinder. The victim was working alone, using the loader to pile manure in one corner of a hog containment building. The loader's protective cage (ROPS) had been removed to permit operation under the 6- to 6½-foot ceiling of the building. The lift-arm support could be used only when the lift arms were fully raised. The loader stalled in front of and facing the manure pile with the bucket raised, preventing the victim from dismounting through the front of the machine. As he attempted to climb over the side of the machine, he unintentionally hit the lift-arm control lever, causing the lift arms to drop and crush him against the frame. A family member called 911, and first responders released the victim using a large front-end loader and chain. The victim was transported to a hospital where he was pronounced dead on arrival as a result of respiratory arrest after a crush injury to the chest wall [Minnesota Department of Health 1994].

Case No. 3—Unsupported Bucket

On March 4, 1994, a 24-year-old male landscaping worker died from injuries sustained while cleaning snow from the operating pedals of a skid-steer loader. Using the loader and a pickup truck equipped with a snow plow, the victim and a coworker had begun clearing snow from the parking lot and walkways of a condominium complex. On arrival at the jobsite the morning of the incident, the victim borrowed a snow brush/scraper from his coworker to clear snow from the loader. This machine was equipped with control interlocks connected to a safety bar that had to be lowered over the operator before the engine could be started or the foot-operated lift-arm controls would work. The victim started the machine, raised the bucket, and dismounted by wriggling under or climbing over the safety bar. When the coworker plowing snow with the pickup truck made a pass through the area, he observed the victim standing under the raised bucket, leaning into the operator's compartment. Returning for a second pass, the coworker saw the victim pinned between the bucket and frame. While cleaning the

snow from the foot wells of the operator's compartment, the victim had activated the lift-arm control. The bucket moved down and crushed the victim against the frame of the machine. The emergency medical service responded minutes later and freed the victim. He was transported to a regional hospital where he was pronounced dead from blunt chest trauma. Although the equipment manufacturer sold a lift-arm support designed for this machine, it was not available at the jobsite [Massachusetts Department of Public Health 1994].

Case No. 4—Working Near a Raised Bucket

On July 16, 1992, a 16-year-old male landscaping worker died as a result of traumatic injuries from being struck by the bucket of a skid-steer loader. The victim and two coworkers were removing a fence that surrounded a housing development drainage pond. The fence had been hung on 1- by 2-inch wooden stakes near the bottom of the pond's bank, which had a 20% slope. The loader was being used to pull up the stakes, since overgrowth around the pond made it difficult to remove them by hand. The worker operating the loader positioned it about midway from the top of the bank, facing down the slope with the bucket lowered. The victim and the other coworker stood near the bottom of the bank and wound the fence around the loader bucket. The loader operator pulled the stake by raising the lift arms. He then moved the machine to the next stake and lowered the bucket to repeat the process. As the operator was raising the lift arms to pull the third stake, the loader tipped forward. To stabilize the machine, the operator lowered the bucket. At the same time, the victim (who had been standing in front and to the side of the loader) slipped and fell beneath the bucket. The bucket struck him in the chest and he died shortly after from traumatic chest injuries [Minnesota Department of Health 1992].

Case No. 5—Improper Backing Procedures

On September 20, 1996, a 43-year-old landscaping worker died after he backed a skid-steer loader over a 6-foot concrete retaining wall. At the time of the incident, the victim was spreading topsoil to prepare for grass seeding. He performed the task by driving toward the wall with a fresh load of topsoil in the bucket, depositing the soil near the wall, then backing up and dragging the bucket to spread the soil more evenly. The incident occurred as the victim finished dumping a load of topsoil and before he began to back up. As he approached the edge of the work area, he turned the loader around and backed toward the wall, dragging the bucket on the ground. The left rear tire of the machine went over the wall followed by the right rear tire. The machine struck the ground rear end first, coming to rest on its left side. The victim, who was not wearing a seat belt, remained inside the cab but came out of the operator's seat. He was knocked unconscious, with his head and chest wedged between the seat and the side screen. The event was unwitnessed, but several coworkers heard the impact and came immediately to the victim's aid. Emergency personnel were unable to find a pulse, and the victim was pronounced dead at the scene by the medical examiner. The cause of death was asphyxiation due to occlusion of the airway [Missouri Department of Health 1996].

Case No. 6—Removed Side Screens

On July 6, 1997, a 25-year-old male worker for a tree-trimming service was fatally injured when he was caught by the descending lift arm of an operating skid-steer loader.

At the time of the incident, he was using the loader to pick up brush and stumps in a residential area. The side screens on the machine had been removed. Following a lunch break, the victim resumed operating the loader to gather yard debris and deposit it in a dump truck. As he was loading a log into the truck, he placed his head outside the operator's compartment in the path of the lift arm. The lift arm moved down when the victim unintentionally stepped on the foot-operated lift control or when hydraulic pressure was lost because of a ruptured line. A passing homeowner noticed hydraulic fluid spraying from the machine and alerted one of the victim's coworkers, who found the victim sitting in the operator's seat with his head crushed by the lift arm. The cause of death was recorded as a crushed cranium due to a heavy equipment accident. Emergency personnel at the scene noted that the left main pivot pin connecting the lift arm to the frame was missing. Investigators concluded that the pin might have disengaged while the lift arm was down in the carry position, resulting in dislocation of the lift arm and rupture of the hydraulic line [NIOSH 1997a].

CONCLUSIONS

These fatal incidents suggest that employers and workers may not fully appreciate the hazards associated with operating or working near skid-steer loaders, the need to follow safe work procedures, or the consequences of bypassing interlocks and other safety features.

RECOMMENDATIONS

NIOSH recommends that employers and workers comply with OSHA regulations, maintain equipment in accordance with ANSI/SAE standards, and take the following measures to prevent injury when operating or working near skid-steer loaders:

- Always use and maintain the safety devices provided by manufacturers:
  - — Lift-arm supports
  - — Interlocked controls
  - — Seat belts
  - — ROPS
- Follow safe operating procedures.
- Follow safe mounting and dismounting procedures.
- Follow proper maintenance procedures.
- Train workers to read and follow the manufacturer's procedures for operating and servicing skid-steer loaders.

The following subsections discuss these recommendations in detail.

Using and Maintaining Safety Devices Provided by Manufacturers

Regularly inspect and maintain all safety devices provided by manufacturers.

Lift-arm supports—Use the lift-arm supports provided by or recommended by the manufacturer when it is necessary to work or move around the machine with the bucket in a raised position while the controls are unattended. Machines now being manufactured have either the pin-type supports (which can be operated from inside the operator's cab) or the strut-type supports (which may also be operated from inside the cab or may require the help

of a coworker). If the machine is not equipped with lift-arm supports, contact the equipment dealer or manufacturer's representative for help in selecting proper support procedures. ***Never*** use concrete blocks as supports. They can collapse under even light loads. Hoists and jacks used for support must be free of defects such as bent, cracked, or twisted parts or pinched, frayed, or twisted cable. They must also be capable of supporting the load.

Interlocked controls—Regularly inspect and maintain interlocked controls in proper operating condition. These systems require the operator to be properly positioned and restrained before the loader can be used. Never bypass or defeat interlocked controls. Make sure that the seat belt is always securely fastened around the operator when the loader is in operation. Always use restraint bars if they are provided. Although workers and employers may perceive safety features such as interlocked controls and seat belts as obstacles to efficient machine operation, bypassing these devices increases the risk of death or serious injury.

Seat belts—Make sure that the seat belt is secured around the operator whenever the seat is occupied. The seat belt protects the operator in several ways. If seat belts are part of the interlocked control system, they protect workers from being caught and crushed between the lift arms and frame. During rollovers, the seat belt maintains the operator within the protective envelope of the ROPS. The seat belt can also protect the operator from leaning or being jostled into the operating zone of the lift arms and bucket.

Retrofit packages—If side screens, interlocks, ROPS, and seat belts are not present, contact the equipment dealer or manufacturer's representative about the availability of retrofit packages or replacement parts.

Operating Safely

If you are an employer, make sure that your workers understand all manufacturers' warnings and instructions before they operate skid-steer loaders. Train workers to use the following safe operating procedures:

- Operate the loader from the operator's compartment—never from the outside.
- Stay seated when operating the loader controls.
- Work with the seat belt fastened and the restraint bar in place.
- Keep your arms, legs, and head inside the cab while operating the loader.
- When possible, plan to load, unload, and turn on level ground.
- For maximum stability, travel and turn with the bucket in the lowest position possible.
- Never exceed the manufacturer's recommended load capacity for the machine.
- Operate on stable surfaces only.
- Avoid traveling across slopes; travel straight up or down with the heavy end of the machine pointed uphill.
- Always face the direction of travel.
- Keep bystanders away from the work area.

- ***NEVER*** modify or bypass safety devices.

Entering and Exiting from the Loader Safely

- Enter only when the bucket or other attachment is flat on the ground—or when the lift-arm supports are in place. Use supports supplied or recommended by the manufacturer.

- When entering the loader, face the seat and keep a three-point contact with handholds and steps.

- Never use foot or hand controls for steps or handholds.

- Keep all walking and working surfaces clean and clear of debris.

- Before leaving the operator's seat,

  — lower the bucket or other attachment flat to the ground,

  — set the parking brake, and

  — turn off the engine.

- If you are unable to exit through the front of the machine, use the emergency exit through the roof or across the back.

Maintaining the Loader in Safe Operating Condition

- Follow the manufacturer's instructions for maintaining the loader.

- Keep the foot controls and the operator's compartment free of mud, ice, snow, and debris.

- Before servicing the loader,

  — set the parking brake,

  — lower the bucket or other attachment flat to the ground,

  — turn off the engine, and

  — remove the key from the switch.

- If the machine cannot be serviced with the bucket on the ground, use the lift-arm supports recommended or provided by the manufacturer. If the machine is not equipped with lift-arm supports, contact the equipment dealer or manufacturer's representative for help in selecting proper supports.

- Never work on the machine with the engine running unless directed to do so by the operator's manual. Follow the manufacturer's safety recommendations to complete the task. If the adjustments require that the engine be in operation, use two persons to perform the task.

Training

Train operators and workers who service the loaders to read and follow the manufacturer's operating and service procedures given in the operator's manuals and on the loader's warning signs. For help with such training, contact the equipment manufacturer. Obtain manuals, instructional videos, and operator training courses from the equipment dealer or manufacturer.

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We greatly appreciate your help in protecting the safety and health of U.S. workers.

Linda Rosenstock, M.D., M.P.H.
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