Skid-Steer Loader Hazards as Corroborated by NIOSH FACE (Fatality Assessment and Control Evaluation) Program Investigations in the United States, 1992-2005

Numerous publications contain warnings and educational information about the hazards of operating skid-steer loaders. A 1996 MMWR report [1] discussed work-related skid-steer loader fatalities from 1992 to 1995. NIOSH issued an Alert on skid-steer loader fatalities in 1998 [2]. In addition to case investigations, the Wisconsin, Nebraska, and Iowa FACE programs developed and placed skid-steer loader-related fact sheets or recommendations on their web pages. [3,4,5]. Universities and other organizations have issued skid-steer loader safety publications as well [6,7,8].

Primary hazards of skid-steer loaders include:

- being pinned or crushed in front of the loader by the bucket or other attachment
- being pinned or crushed at the side of the loader by the loader arms
- being pinned, crushed, or struck as a result of an overturn.

Additional hazards include:

- backing up and running over nearby workers or bystanders
- pinning nearby workers or bystanders between the loader and another object, such as when backing up
- turning quickly and striking others with the bucket

- traveling forward with reduced vision while carrying a bulky load up front and striking others
- being struck by items or materials falling from the bucket onto the operator or other people.

Between 1992 and 2005, the NIOSH FACE program conducted 43 federal or state-based investigations of occupational fatalities involving skid-steer loaders. This report describes the primary mechanical hazard in each of these investigations, without regard to operator or bystander behavior, training, industry, location, date, or other circumstances, in order to focus directly on the death-causing hazard itself, draw conclusions, and provide recommendations for dealing with these hazards. Investigations are listed below in chronological order by FACE report identification number.

1. 92MN009: Landscape worker (not the operator) was very close to the loader, slipped, and fell beneath the descending bucket.
2. 93MN066: Farm worker had removed the ROPS and side screens for access to low hog buildings, was using loader outside and got into a tight spot, tried exiting by climbing out the left side, hit a control, and was pinned by the descending loader arm.
3. 94WY018: Sawmill worker was moving logs with a reconditioned loader, put his head out the side, and was crushed by a loader arm. The loader had been in a fire, purchased and reconditioned by the sawmill, but the seat belt and side screens had been burnt or damaged and were not replaced.

4. 94MA014: Worker at landscape/lawn care/snow removal business started the loader after it had been out all night, requiring that he be seated with the safety restraint down. He left the operator station to clean snow out from around the pedals, which control the loader arms, apparently activated one of the pedals, and lowered the bucket onto himself. A locking device for the lift arms was optional on that model and was not present.
5. 95MN009: Owner of a tire repair business was removing snow from a parking lot, was found with his body still in the operator's station, in a squatting position, and his head pinned beneath the right loader arm. Apparently the loader had side screens; unclear how or why this happened.
6. 95IA001: Farmer was crouching beneath the raised bucket cleaning out the loader pedals, which had seized with frozen manure, ice, and snow. Apparently the controls had been frozen in the "up" position, and the arms raised after he started the machine. Because the loader was in a shed, the arms would not raise all the way, which was required to use the mechanical locking device on the arms. Apparently he loosened a pedal enough that the bucket descended and pinned him. A combination seat belt / lever interlock had been defeated by placing a glove beneath the raised lever.
7. 95NE025: Untrained carpenter stood in front of the unoccupied loader trying to figure out how to lower the arms, and was pinned by the descending bucket. The combination seat belt / lever interlock had been defeated by stuffing a rag beneath the lever.

8. 95CO032: Equipment maintenance worker was power washing the loader with the engine running, standing beneath the raised bucket; the engine stalled from getting wet, hydraulic pressure was lost, and he was pinned by the descending arms. Locking pins for the arms were present but not used.
9. 95NE034: Independent contractor doing demolition work was preparing to drive the loader onto a trailer, saw wire cable wrapped around the right front tire, leaned out the right side for a better look, and was pinned by the descending loader arm. No side screens were present; the loader had been manufactured with them, but they had been removed, possibly before this owner purchased the machine.
10. 96IA015: Farmer was using loader out in a field to move soil when the loader did a complete 360 degree rollover into a creek bed and ended up on its wheels. The farmer had had a local welder modify the ROPS to fit into low hog barns, and the lowered ROPS offered inadequate protection as well as less resistance to rollover. He was not wearing a seat belt and his head was crushed.
11. 96MO082: Landscaper backed the loader over a six-foot retaining wall, was not wearing a seat belt and came out of the seat, but stayed within the confines of the ROPS and side screens. He was found with his head and chest wedged between the seat and a side screen, and died of positional asphyxia.
12. 97IA031: Farmer was pulling a bush from a fence line using a chain attached to the bucket, leaned forward to adjust chain or was thrown forward by rough terrain, apparently hit a foot pedal which lowered the bucket and pinned him against the front of the loader. A seat belt presence-sensing interlock switch had been bypassed.

13. NIOSH 97-20: Worker for a tree-trimming company apparently leaned out the left side of the loader to see a hydraulic leak and inadvertently hit the foot pedal controlling the arms. His head was crushed by the descending arm. The side screens had been removed.
14. 97WI112: Farmer was using the loader to remove a part from an old manure spreader, exited the loader with the bucket raised and put the safety restraint bars back down, operated the loader arms while standing in front of the loader, and was found pinned between the bucket and the loader. He had selected this model loader because it did not have a seat presence-sensing switch.
15. 99IA007: Farmer leaned forward out of the loader with the bucket raised to close a gate, apparently bumped the lever controlling the loader arms, and was pinned against the front of the loader. A mechanical seat interlock intended to lock the control levers when the operator was off the seat apparently was quite worn and did not lock the levers if they were not exactly in neutral.
16. 99MN027: Farmer was using the loader to offload combine parts from a hay wagon when the loader controls jammed due to worn control linkages in the floor of the loader. The farmer exited the loader with the bucket raised and knelt in front of the loader to un-jam them, as she had been known to do, was initially pinned by her legs when the loader moved forward, and was found pinned by the loader arms against the front of the loader after the engine ran out of fuel and hydraulic pressure was lost.
17. 99NJ090: Landscape worker was showing a coworker how to operate the loader; the coworker was in the seat, and the experienced worker was facing him while

crouched on the loader arms. As he demonstrated the controls, he raised the loader arms (and himself) and hit his head on the front of the ROPS; he then lowered the arms, lost his footing, and was pinned against the front of the loader. The coworker panicked and could not lift the arms without assistance, and the trained worker died 18 days later.

18. NIOSH 2000-15: Plant production supervisor was standing beneath the raised arms of a newly-rented loader being operated by a maintenance supervisor, who was having difficulty operating it. Both had the received fundamental training. While reaching for a control, the supervisor inadvertently lowered the arms and was pinned beneath the left arm and the front of the loader.
19. 00WI037: Farmer was hauling stones to a pile at the edge of a field, exited the loader with the bucket raised, and either during the exit or reentry activated the controls and was pinned by the descending bucket.
20. 01MI001: Part-time worker clearing snow from a parking lot exited the loader with the bucket raised to clean snow from beneath the pedals, apparently activated the pedal that lowered the bucket, and was found pinned against the front of the loader.
21. 01IA004: Farmer using the loader to clean snow from hog pens was found in the seat and leaning out the left side, with his chest pinned by the left loader arm. The ROPS and side screens had been removed to access a low hog building. He may have had a medical problem before leaning out.
22. 01WI019: Farmer was driving the loader up an incline, bucket first, with the bucket full of stones and in the raised position. The loader overturned backwards,

the victim hit his head against the back crossbar of the ROPS, and died of positional asphyxia. He had the safety restraint bar down but the seat belt unfastened.

23. 01MI029: Farmer was loading manure, leaned out the left side of the loader to check a bad tire, and was pinned by the descending loader arm. The ROPS was present but the side screens had been removed.
24. 01AK015: Construction worker was close to a building preparing a form for a concrete slab and was guiding a loader toward him. The loader rolled forward into the depression around the form and pinned the worker against the building.
25. 01IA038: Hobby farmer, apparently with loader experience, was using a borrowed loader to move dirt, and had chained four 100-pound weights to the back of the loader to counterbalance overloaded buckets. The weights came off, the loader immediately tipped forward, and he was thrown out of the seat and pinned by the descending bucket. The bucket was large and designed for light materials like snow or grain, not dirt, and would not stay raised without constant control pressure, indicating an overload or leak.
26. 01IA042: Self-employed tree excavator was using a loader with a tree-shearing attachment to cut trees, and had sheared the trunks of a multi-trunk tree several feet off the ground. The loader was facing downhill to shear the last stump, and the incline plus the weight of the sheared tree caused the loader to tip forward onto the stump in such a way that the stump crushed the operator against the back of the ROPS.

27. 02WI054: Farmer was changing loader attachment and was outside the loader operating the controls from in front of the loader. He was found in the kneeling position, pinned by the loader arms against the front of the loader. The loader had a ROPS but did not come with interlocks.
28. 02IA057: Construction worker was standing between a truck and the rear of an operating loader, and was pinned against the truck tailgate when the loader backed into him.
29. 03MA001: Hospital buildings and grounds worker was using a loader to clear snow from a sidewalk when the loader fell through large ventilation grate in the sidewalk and dropped rear-first 20 feet. The impact caused the operator's head to strike the ROPS frame behind seat.
30. 03OR015: Construction worker was using a loader with forklift attachment, reached out for a short board that had been stabilizing the load, was unable to reach it, and lifted the safety restraint bar to reach further. He activated the loader arm control and was crushed by the descending forklift attachment. The controls were supposedly interlocked with the restraint bar and seat, and it is unknown why the interlock did not work.
31. 03WI050: Farmer using a borrowed loader was beneath the raised bucket, facing the loader, apparently doing troubleshooting or repair. He was found pinned by the bucket against the front of the loader.
32. 03IA054: Farmer using his loader near a grain dryer backed into an LP tank, knocked it off its foundation, and was repositioning the loader to reset it. He

exited the loader with the arms up, apparently activated the pedal that controlled the lift arms, and was crushed between the bucket and the front of the loader.

33. 03KY087: Construction worker installing a fence on a dairy farm exited beneath the raised bucket to shut a gate, and was found pinned between the loader arms and the loader. Loader had interlocks with weight-sensitive seat, and it is unknown why the loader arms descended.
34. NIOSH 2004-01: Worker at a rendering plant operating a loader with a scraper attachment in place of the bucket apparently raised unfastened his seat belt and raised the safety restraint to either lean forward or exit with the scraper raised, and was found pinned by the descending scraper. The loader was only two years old, and had interlocks to prevent the arms from moving when the restraint bar was raised. Further examination showed the interlock was out of adjustment, and that the loader arms would drop rapidly when the restraint bar was raised, without any control activation.
35. 03IA060: Farmer was using his loader to back wagons into a small shed by engaging the tongue with the loader bucket and steering the wagons in. He was found lying in the raised bucket, pinned against the door header, as if he had been in the bucket and was operating the controls from there when he raised the bucket and pinned himself. Loader did not have any interlocks.
36. 03WI080: Farmer operating his loader to smooth a dirt field road backed the loader over the edge of a ridge. The operator was ejected and hit by the loader as it overturned and tumbled down the ridge. The restraint bar was up and the seat belt unfastened.

37. 04MN002: Farmer was exiting his loader with the bucket raised to pick up a steel fence post, got the loader arm control lever caught in his coveralls, and was pinned by the descending bucket.
38. 04OR007: Nursery worker leaned forward out of the loader and was found with a severe head injury from striking his head on the left-front post of the ROPS. He had his coat lying in his lap, and it was found caught on the loader controls. The safety bar was in the lowered position.
39. 04MI066: Landscape worker was using a loader and chain to pull up a small tree, was unable to disconnect the chain from inside the loader, exited the loader with the bucket raised, and put the safety restraint bar back down so the controls would operate. As he adjusted the height of the loader arms to remove the chain, he was pinned between the arms and the front of the machine. The restraint bar interlock did work, which is why he lowered the bar after he exited..
40. 04IA036: Farmer and metalwork shop owner was repairing the loader in his shop, was standing beneath the raised bucket, had removed various parts of the operator station, and apparently was trying to free a control rod when he activated a control and was pinned by the descending loader arms. The safety lock for the loader arms was not used.
41. 04OK056: Heavy equipment operator who was operating a loader stood up and leaned forward to reinsert a loose bucket attachment pin. He raised the arms and pinned himself against the upper front crossbar of the ROPS.
42. 04MI176: Boy (age six) on farm was backed over by a loader operated by his brother (age nine) after going out in the field to feed cattle, as was normal

practice. A sister and the victim usually ran down the lane and opened the gate for the loader, which was carrying feed, and then rode back in the bucket. The brother operating the loader deviated from normal practice and the younger boy was approaching him to get a ride.

43. 05OK011: Plumber was standing in a shallow trench protecting a valve during backfilling, and was facing a loader approaching with the bucket raised. As the loader got to the trench, the ground shifted, the loader pitched forward, and the bucket struck the plumber in the head.

While these FACE investigations are not a statistical sample of skid-steer loader-related fatalities, they clearly corroborate the previous findings and recommendations regarding hazards. Of the 43 fatal incidents, 38 (88.4%) involved either the operator or another worker who was working with the loader in a maintenance/repair or instruction capacity. Only five (11.6%) involved other workers in the vicinity of an operating loader. Of the 38 incidents involving the operator or someone working with the loader, 25 (65.8%) occurred when the person was crushed or pinned at the front of the loader by the bucket/attachment or loader arms. Seven (18.4%) of the 38 occurred when the operator leaned out or exited the side of the loader and was pinned/crushed by the descending loader arm. Only three (7.9%) of the 38 incidents involved loader overturns. The final two (5.3%) incidents were quite unusual – tipping forward onto a stump, and falling through a sidewalk grate.

Fatalities involving bystanders or other workers in the vicinity depend on the behavior of the worker and operator. A skid-steer loader cannot prevent itself from running over someone, pinning someone against another object, or striking someone standing nearby. However, based on these investigations, fatalities to operators or other workers who are directly working with the loader are much more common and should be a primary target of intervention activities.

The *single most dangerous place* around a skid-steer loader is in front of the machine beneath a raised bucket/attachment or loader arms. This danger zone must be avoided at all times, with one exception: A person can enter this danger zone safely if the loader arms are mechanically locked or blocked to prevent them from suddenly dropping, as a result of control activation, loss of hydraulic pressure, or any other reason.

To protect operators during normal operation, it is essential that they stay in the safest place possible, which is on the seat, inside the zone of protection created by the ROPS and protective side screens. A seat belt should always be provided and used, because while a safety restraint bar may help prevent the operator from being thrown forward, it may not keep the operator in place during an overturn, particularly a violent one. Side screens are critically important to prevent heads or arms from protruding outside the zone of protection during an overturn, or more importantly, to keep operators from placing arms or heads out the side and being pinned/crushed by descending lift arms. Even a non-fatal injury of this type could involve an amputation. A skid-steer loader without a ROPS and side screens is a dangerous place for an operator, and those machines should

be retrofitted with a ROPS and screens (that meet applicable standards) if possible, or otherwise removed from the workplace.

When the operator must exit the loader, the loader arms and bucket/attachment must be fully lowered, unless the loader arms are raised and mechanically locked or blocked as mentioned previously. Mechanical locking or blocking devices for the lift arms have been standard equipment on skid-steer loaders for many years, although some require the operator to exit with the loader arms in the raised position in order to place the device, or else have another person do it. Some loaders have locking devices that can be positioned from inside the operator station, so that the loader arms are secured before the operator exits. On older loaders without locking devices, a length of heavy steel channel or angle iron may be carefully placed and secured onto the extended hydraulic cylinder to prevent it from retracting. Other means of blocking may be used depending on the situation and the devices available.

Another important safety device is the control interlock, which is designed to lock the controls when an operator leaves the seat or raises a safety restraint bar, or both. The intent is to prevent unintended descent of the bucket and lift arms if the operator leaves the loader with the arms raised. Some interlocks may require an operator to be on the seat or have the seat belt fastened before the engine can be started, to prevent operators from reaching in and starting the machine from the ground. However, interlocks are there as added protection and should not be considered the primary means of prevention. Operators should still only enter or exit the loader with the bucket down. Furthermore,

interlocks must be properly adjusted and maintained throughout the life of the machine, since breakage or wear and tear can render them ineffective. Interlocks should never be bypassed for convenience. Additionally, since there are still many older skid-steer loaders in use that were manufactured prior to control interlocks being made available, operators should not get in the habit of depending on interlocks to protect them.

If operators and others who are directly working with skid-steer loaders can keep their bodies, heads, and extremities out from beneath raised buckets and loader arms, simply by always lowering the bucket before exiting or mechanically blocking or locking the arms in the raised position, and by keeping side screens in place to prevent leaning out, the overwhelming majority of skid-steer loader fatalities can be prevented.

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