MA FACE
Occupational Fatality Report

Tree Service Foreman Fatally Injured While Repairing a Skid-steer Loader – Massachusetts

Summary
On January 23, 2015 a 38-year-old male foreman for a tree service company (victim) was fatally injured while repairing a skid-steer loader with the lift arm and bucket attachment in the raised position. The victim was standing in front of the skid-steer under the raised lift arm and bucket while performing the repair that involved removing one of the loader’s high pressure hydraulic lines. Once the hydraulic line was removed, the victim was crushed against the loader’s frame when the lift arm and bucket came down. The victim’s employer arrived on site and found the victim. A call was immediately placed for emergency medical services (EMS). EMS and local police arrived within minutes. The Jaws of Life were used to free the victim. The victim was pronounced dead at the incident location.

Contributing factors identified in this investigation were working under an unsupported raised load, lift arm support device not engaged to prevent the lift arm from lowering, and lack of a safety and health program and lockout/tagout procedures.

The Massachusetts FACE Program concluded that to prevent similar occurrences in the future, employers should:

- Ensure that skid-steer loader lift arm locks are engaged prior to beginning maintenance tasks that require lift arms in the raised;
- Develop, implement and enforce lockout/tagout procedures for skid-steer loaders that include the use of lift arm support devices during maintenance tasks;
- Provide training on maintenance tasks employees will be performing and ensure that only trained employees perform maintenance tasks; and
- Develop, implement, and enforce a safety and health program that addresses hazard recognition and avoidance of unsafe conditions.

In addition, forklift manufacturers should:

- Manufacturers of skid-steer loaders should adopt and implement the concept of Prevention through Design (PtD) and design skid-steers to eliminate known hazards.
INTRODUCTION
The Massachusetts FACE Program was alerted by the local media that during the previous month a male tree service worker had died from injuries sustained when he was repairing a skid-steer loader. On April 30, 2015, a representative from the Massachusetts FACE Program traveled to the company location and met with the company owner to discuss the incident. The police report, death certificate and other documents were reviewed during the course of the investigation.

EMPLOYER
The employer was a full-service tree and landscaping company that had been in business for about 30 years. Tree services included pruning, cabling and bracing, fertilization, insect and disease control, removal, and stump grinding. Landscape services included all phases of landscape construction and maintenance, and lawn services. In the winter months, the company also provided snow plowing and sanding services. The number of company employees varied depending on the season. There were about three employees in the winter months and seven employees in the warmer months.

The victim was employed as a foreman with the company and he also performed equipment maintenance tasks. A typical work day for the victim started around 6:30 a.m. and went until 3:00 p.m. or later depending on the job. On the day of the incident, the victim went from his house straight to the job site to start troubleshooting and then repair the skid-steer loader. Employees did not have union representation.

WRITTEN SAFETY PROGRAMS AND TRAINING
At the time of the incident, the company had neither a written safety and health program nor a hazardous energy control (lockout/tagout) program. The company owner did have a horticultural certification and a Massachusetts pesticide applicators license. All new hires were provided with on-the-job training, along with a review of how to use equipment needed to complete tasks. New hires were only allowed to operate equipment with experienced employees present until proficiency was demonstrated. Regularly scheduled preventive maintenance for equipment, including the skid-steer loader, was performed in-house by the victim and the company owner, and other maintenance tasks were performed when a repair was needed. At the time of the incident, none of the employees had the Massachusetts Department of Public Safety hoisting license, which is required to operate skid-steer loaders in Massachusetts. Since the incident, workers who operate the skid-steer loader have obtained the state-issued hoisting license.

VICTIM
The victim was a 38-year-old male foreman for the tree and landscape service company. The victim had been employed at the company for about 19 years. The victim performed many tasks including, but not limited to, tree work, landscaping, snow removal, and equipment maintenance tasks. The day of the incident, a Friday, the victim arrived at the work site around 6:30 a.m. and was scheduled to work a full day. The incident occurred somewhere between 10:30 a.m. and 11:30 a.m., approximately 4.5 hours into his shift.
INCIDENT LOCATION
The incident occurred at a garage location that was owned by a friend of the victim. The garage owner had a welding fabrication and service shop in the garage. It was reported that the main reasons the repair was being performed at the friend’s garage location was that the garage had space to perform the repair, it was heated and it was equipped with tools. The garage was a located a few miles from the company and was in a rural residential area.

EQUIPMENT
The equipment involved in the incident was a skid-steer loader (Figure 1) that was manufactured and purchased in 1997 by the company. The loader was equipped with a four cylinder turbocharged diesel engine and four rubber tires. The approximate dimensions of the skid-steer loader, with the bucket attachment, were 127 inches long, 75 inches high, 65 inches wide, with a 42-inch wheelbase. The loader had a three-sided enclosed operator’s cab, which was accessed through the open front and one seat for the operator (Figure 2). The back of the cab could also be used as an emergency exit.

Inside the enclosed cab on either side of the operator’s seat there were two levers that controlled the loader’s steering, direction of travel, and travel speed. The lever on the left side of the operator’s seat controlled the wheels on the left side of the loader and the lift arm. The lever on the right side controlled the right wheels and the loader’s attachment. When both levers were pushed forward the loader moved forward in a straight line and when both levers were pulled back the loader moved in reverse. When only the loader’s right lever was pushed in the forward direction, the right wheel would drive and the loader would turn to the right. When only the right lever was pulled back the loader turned to the left in reverse. The opposite was true when only the left lever was pushed forward or pulled back.

There were also two pivoting foot pedals that controlled the position of the loader’s hydraulic-based lift arm (boom) and attachment. The left foot pedal controlled the loader’s lift arm. Pivoting the left foot pedal back would raise the loader’s arm and pivoting the pedal forward would lower the loader’s arm. The right foot pedal controlled the tilt of the bucket. Pivoting the right foot pedal back would roll the bucket back towards the loader’s cab. Pivoting the right foot pedal forward would roll the bucket forward and dump the bucket.

Two of the loader’s safety features associated with the lift arm were a mechanical lift arm lock and interlocks connected to the operator seatbelt and seat (pressure switch). To trigger the interlocks, the seatbelt would need to be unlatched, the operator would have to leave the loader’s seat, or the ignition key would have to be turned off. When triggered, the interlocks would lock the lift arm and attachments controls in neutral, preventing any movement of these components.

The loader’s lift arm was designed to wrap around the front of the machine where the attachment would connect to the lift arm. The lift arm was raised and lowered by two hydraulic cylinders located on either side of the loader. The manufacturer equipped mechanical lift arm lock would prevent the lift arm from being lowered to the ground when it was properly engaged (Figure 3).
A manual lever to engage the mechanical lift arm lock was located inside the cab next to the right rear side of the operator’s seat (Figure 2). To engage the lift arm lock, the lift arm must first be in the raised position, and then the lock can be manually engaged, which extends the lift arm lock pins. The lift arm is then lowered onto the pins. These pins prevent the lift arm from being able to be lowered any further, either intentionally, or unintentionally, such as by an unexpected activation of the controls or by hydraulic failure. The mechanical lift arm lock must only be engaged while the operator was seated inside the loader’s cab, allowing the operator to engage the lift arm lock and then safely exit the cab. The manufacturer had applied multiple decals on the loader to warn of hazards, including the need to use the lift arm lock pins to prevent a crushing between the lift arm and loader frame.

The incident occurred on a Friday morning in January and the temperature was 30 degrees Fahrenheit with partly cloudy skies. There was a 5 mile per hour wind making it feel about 26 degrees Fahrenheit outdoors. The victim and the company owner had previously discussed repairing the loader, which had a hydraulic leak. The weather forecast was for a blizzard in the next few days and they would need the loader to help clear snow. It was decided to perform the repair at the heated garage owned by a friend. This friend also owned the house located next to the garage, and, at the time of the incident, a resident of the house was home. The skid-steer loader had been brought to the garage location the night before the incident.

The victim drove straight to the garage from his home on the morning of the incident, arriving between 6:30 a.m. and 7:00 a.m. The victim and the company owner, who was also at the garage to help with the repair, started to troubleshoot the hydraulic leak. They placed the loader’s front tires up on ramps to get a better view of the hydraulic system and the undercarriage. The lift arm was in the raised position and it was reported that the mechanical lift arm lock was engaged. Next the loader’s belly pan, a metal shield designed to prevent damage to the undercarriage of the equipment when being operated on rough terrain, was removed. Due to grease and dirt buildup, it was difficult to observe the location of the hydraulic leak.

At this point, the employer left the garage area to pick up some parts for the loader, and the victim moved the loader outside of the garage. The victim then pressure washed the loader so he could find the hydraulic leak. While the company owner was still away, the victim finished pressure washing the undercarriage and then moved the loader back into the garage. The loader’s front tires were placed back up onto the ramps and the lift arms were raised, but the mechanical lift arm lock was not reengaged. It appears that next the victim exited the loader’s cab and found the leak in the hydraulic system, which was in a low pressure line. The location of the leak was difficult to access even with the loader up on the ramps.

Then it appears that the victim removed the loader’s seat providing access to the top section of the loader’s undercarriage through the floor of the cab. To access the leaking low pressure hydraulic line, the victim would have had to first remove a high pressure hydraulic line. It appears that while accessing the high pressure hydraulic line, the victim was standing in front of the machine, underneath the raised lift arms, leaning over and into the cab. Once the high pressure hydraulic line was removed, the raised lift arm and bucket attachment came crashing down, crushing the victim between the lift arm and the front of the loader.
At approximately 11:30 a.m. the company owner returned to the garage location and found the victim. The company owner immediately had the resident of the house place a call for emergency medical services (EMS). Within minutes EMS arrived at the garage location. The Jaws of Life were used to free the victim. The victim was pronounced dead at the incident location.

CONTRIBUTING FACTORS
Occupational injuries and fatalities are often the result of one or more contributing factors or key events in a larger sequence of events that ultimately result in the injury or fatality. The Massachusetts FACE team identified the following contributing factors in this incident:

- Working under an unsupported raised load.
- Lift arm support device not engaged.
- No lockout/tagout procedures.
- No safety and health program.

CAUSE OF DEATH
The medical examiner listed the cause of death as multiple blunt force injuries.

RECOMMENDATIONS/DISCUSSION
Recommendation #1: Employers should ensure that skid-steer loader lift arm locks are engaged prior to beginning maintenance tasks that require lift arms in the raised.

Discussion: Hydraulic systems need to be pressurized to have controlled movement of the hydraulic powered object, in this case the lift arm. Prior to working on any component of a hydraulic system, one of the first steps should be to implement a hazardous energy control program’s lockout/tagout procedures (Recommendation #2). Implementing these procedures would help ensure that any movable parts are blocked and secured. Once movable parts have been secured, the troubleshooting and maintenance tasks requiring the lift arm to be in the raised position can be performed safely.

During normal operation of a skid-steer loader, the loader’s operator should never exit or place any part of their body outside of the cab without lowering the lift arm to the ground first. This incident occurred not during normal operation of the loader, but during maintenance of the hydraulic system for which the victim needed the loader’s lift arm to remain in the raised position. At the time of the incident, the loader’s lift arm was in the raised position without the lift arm lock engaged, and the victim was outside of the cab underneath the raised lift arm working on the skid-steer’s hydraulic system. Not having the lift arm lock engaged, which can be done before exiting the cab, contributed to the event that lead to the fatal injury.

It was reported that earlier in the morning the lift arm lock was being used and it was unclear why the lock was not in use at the time of the incident. If the lift arm lock had been engaged
when the skid-steer was brought back inside the garage, there would have been safe access to the
cab and the area underneath the raised arm and the lift arm would not have come crashing down
when the hydraulic line was removed.¹

**Recommendation #2:** Employers should develop, implement and enforce lockout/tagout
procedures for skid-steer loaders that include the use of lift arm
support devices during maintenance tasks.

**Discussion:** OSHA regulation 29 CFR 1910.147, *The control of hazardous energy
(lockout/tagout)* requires that employers establish procedures for isolating machines and
equipment during servicing and maintenance from the input of energy by affixing appropriate
locks or tags to energy isolating devices and then blocking and securing any movable part and
training employees on these procedures.²,³ Lockout/tagout is performed to prevent any
unexpected energization, start-up or release of stored energy, such as an unintentional engaging
of a control lever or an unexpected hydraulic system failure, that could injure workers during
servicing and maintenance of machines and equipment. All forms of energy must be considered,
including electrical, hydraulic, pneumatic and mechanical.⁴ Therefore, individual lockout/tagout
procedures are needed for each piece of equipment that specify the requirements to properly
perform lockout/tagout on that machine or piece of equipment, as well as when lockout/tagout
should be implemented.

Specific lockout/tagout programs should be documented in writing and include, but not be
limited to:

- Identifying and labeling of all hazardous energy sources
- Developing procedures to de-energize, isolate, block, and/or dissipate all forms of
  hazardous energy, and verify by tests or observations that all energy sources are de-
  energized before work begins
- Requiring workers who will perform the tasks to secure the machines’ energy control
devices
- Inspecting repair work before reactivating the equipment
- Ensuring that all workers are clear of danger points before re-energizing the system
- Reviewing energy control procedures on a routine basis update these procedures as
  needed

Involving employees in developing and updating the hazardous energy control program and
training is important. The employer should seek input from employees by having employees
evaluate the effectiveness and limitations of the hazardous energy control program. Employers
should ask employees about techniques involved in completing tasks that require them to expose
any part of their bodies to machine and equipment hazards, especially maintenance activities and
common procedures that are not typically thought of as part of the everyday operation.
Employees who spend the majority of their time operating and performing maintenance tasks on
machines and equipment will be able to contribute valuable information that otherwise be
overlooked, and these employees will likely be able to contribute the most information about the
effectiveness and limitations of the hazardous energy control program. A hazardous energy
control program with logout/tagout procedures should be part of a more comprehensive safety
and health program that addresses the full range of potential hazards employees are exposed to while at work.

In this case, the employer did not have a hazardous energy control program, and therefore did not have procedures for lockout/tagout. A specific lockout/tagout procedure should be developed for skid-steer loaders that specifies when lockout/tagout should be implemented and the requirements to properly perform lockout/tagout on each machine. The lockout/tagout procedure for skid-steer loaders should include the use of the manufacturer-provided lift arm lock (Recommendation #1).

**Recommendation #3: Employers should provide training on maintenance tasks employees will be performing and ensure that only trained employees perform maintenance tasks.**

**Discussion:** In this incident, the victim had many years of experience performing tree and landscaping tasks and performing maintenance on all types of machinery, including skid-steer loaders. It was unclear what training related to maintenance tasks, including hydraulic work that the victim might have received over the years. It is important that workers who will be performing maintenance on machinery and equipment are provided training on these tasks, especially when the repair requires work involving hydraulic systems and other energy sources.

Machinery and equipment maintenance training should be performed at the same time as lockout/tagout training (Recommendation #2), because lockout/tagout is a crucial component of most repairs. Maintenance training should include specifics about the machinery and equipment owned by the company. Refresher training should be routinely provided and all trainings should be documented. In addition, for some more advanced repairs, the employer should contact the machine or equipment manufacturer to perform the repair or to help find a qualified mechanic to hire for the repair.

**Recommendation #4: Employers should develop, implement, and enforce a safety and health program that addresses hazard recognition and avoidance of unsafe conditions.**

**Discussion:** A safety and health program should include the systematic identification, evaluation and prevention or control of general workplace hazards and the hazards of specific jobs and tasks. The major elements of an effective program are management leadership, worker participation, hazard identification and assessment, hazard prevention and control, education and training, and program evaluation and improvement.5

The program should also include an explanation of the workers’ rights to protection in the workplace, and outline safe work practices workers are expected to adhere to, specific safety protection for all tasks workers perform, how workers can identify and avoid hazards, and who workers should contact when safety and health issues or questions arise.
When developing a safety and health program, employers should start by performing a hazard analysis of all routine tasks performed by employees for potential hazards and incorporate information about these identified hazards and their controls into the program. When determining potential hazards associated with equipment, the manufacturer’s operator’s manual and the equipment’s warning decals should be reviewed and incorporated into the safety and health program procedures. Equipment-specific lockout/tagout procedures (Recommendation #2) should be included in the control of hazardous energy section of the safety and health program.

Employers should also use their employees’ expertise throughout the program development process by seeking employee input. Once the program is developed, employers should continue to seek employees’ input during the routine updating of the program. The program should be updated when safety concerns arise and when new equipment, tasks and chemicals are introduced into the workplace. In addition, for industries where work sites change with each job, the safety and health program should also require that a hazard analysis be performed for each job site before work begins to ensure that the required tools and personal protective equipment (PPE) needed to complete the tasks are available.

Employers should ensure that they have fully and effectively implemented their safety and health program by routinely performing assessments of tasks and immediately addressing any observed unsafe conditions. As part of the program’s implementation, training should be provided to all employees on the program’s topics and procedures, and should also include hazard recognition and the avoidance of unsafe conditions. All training provided to employees should be documented.

Although not factors that contributed to this incident, here are three additional common hazards that should be addressed by landscape companies are:

- **Hydraulic fluid.** A failure in a hydraulic system can release hydraulic fluid with enough pressure to easily penetrate clothing, skin and eyes. Hydraulic fluid can irritate skin and if hydraulic fluid penetrates skin, even the smallest amount, it will immediately begin to kill tissue. If not treated immediately gangrene can set in quickly and there is also a risk of blood poisoning. The appropriate personal protective equipment (PPE), including gloves and face shields should always be worn when working with hydraulics.

- **Silica.** Sand and stone materials, such as granite and pavers, contain silica. When cutting and buffing stone materials, employees can inhale dust containing silica. Exposure to silica can increase the risk of lung cancer and causes the lung disease silicosis, which is an incurable, debilitating, and sometimes fatal disease. Employers should provide and ensure the use of engineering controls (exhaust ventilation, dust collection systems, water sprays) to eliminate or reduce the amount of silica in the air and train workers on silica hazards.

- **Fall protection.** Employers must provide fall protection to employees who are working from a height of at least four feet (six feet for construction-related work). In addition, whenever work is being performed from a raised aerial lift, employees must be provided with and wear fall protection in the form of either a fall restraint system (recommended) or a fall arrest system.
The Massachusetts Department of Labor Standards (DLS) offers free consultation services to help small employers improve their safety and health programs, identify hazards, and train employees. DLS can be contacted at 978-242-1351. More information about DLS can be found on their Web site at www.mass.gov/dos/consult.

The Massachusetts Department of Industrial Accidents (DIA) has grants available for providing workplace health and safety training to employers and employees. Any company covered by the Massachusetts Workers’ Compensation Insurance Law is eligible to apply for these grants. More information about these DIA grants can be found on their Web site at www.mass.gov/dia/safety.

**Recommendation #5: Manufacturers of skid-steer loaders should adopt and implement the concept of Prevention through Design (PtD) and design skid-steers to eliminate known hazards.**

**Discussion:** The concept of Prevention through Design (PtD), as it would relate to machine manufacturers, is addressing safety and health needs during the design process to prevent or minimize hazards that could result in injuries, illnesses and fatalities to machine operators and others. Applying PtD during the design phase of a machine would initiate the process of thinking about how the machine functions in relation to the individuals who would operate, maintain, come in contact with, or interact with the machine. The goal is to identify potential hazards during these interactions. Once hazards are identified, the machine design can be altered to eliminate or control these hazards.

In this case, a late model conventional skid-steer loader was being repaired when the incident occurred. Like other conventional skid-steer loaders, cab access was through the front of the cab and the cab tilted back to access the engine compartment. Conventional skid-steer loaders are associated with several known design-related hazards and serve as an excellent example of the potential for eliminating or minimizing injury risks through PtD. One of the known design-related hazards of conventional skid-steer loaders includes a tripping hazard when climbing over the loader’s attachment and the front of the lift arm to access the cab. Another is that the design routinely brings workers underneath the raised lift arms during maintenance of the skid-steer and requires manually engaging the lift arm lock to protect the worker.

Some manufacturers have recently altered their skid-steer loader design. The manufacturer of the loader involved in this incident now design their skid-steer loaders with a cab that tilts forward, rather than back for easier maintenance access. However, to tilt the cab, the design still requires the lift arm to be raised and the lift arm lock to be manually engaged. This design does not eliminate the possibility of being crushed between the lift arm and the loader. A couple other manufacturers have also altered their skid-steer loader design and incorporated a number of changes: cab access located on the left side of the loader, a single lift arm on the right side, and a cab that tilts to the front for maintenance access (Figure 4). Cab access on the loader’s left side combined with the single lift arm on the right side does eliminate the tripping hazard of climbing over the front of the loader. The single lift arm on the right side combined with a cab that tilts to the front reduces, but does not eliminate, the time a worker could potentially be underneath a
raised lift arm because to tilt the cab the lift arm still has to be in the raised position. Optimally to reduce the tripping and crushing hazards described above, skid-steer loaders could be designed with a single lift arm on one side, access to the cab on the opposite side of the lift arm, and a cab that can be tilted while the lift arm remain completely lowered to the ground.

REFERENCES


7. Equipment World. Focus on these skid steer brand differences to choose the best loader for your needs. January 18, 2016. 2002]. www.equipmentworld.com/focus-on-these-skid-steer-brand-differences-to-choose-the-best-loader-for-your-needs/
Figure 1 – Similar skid-steer as the one involved in the incident

Figure 2 – Cab of similar skid-steer as the one involved in the incident
Figure 3 – Skid-steer with lift arm raised and mechanical lift arm lock engaged

Figure 4 – Newer style skid-steer loaders with cab access on the left side, cabs that tilt forward and single lift arm design
FATALITY ASSESSMENT AND CONTROL EVALUATION PROGRAM

The Massachusetts Department of Public Health, in cooperation with the National Institute for Occupational Safety and Health (NIOSH), conducts investigations on the causes of work-related fatalities. The goal of this program, known as Massachusetts Fatality Assessment and Control Evaluation (Massachusetts FACE) is to prevent future fatal workplace injuries. Massachusetts FACE aims to achieve this goal by identifying and studying the risk factors that contribute to workplace fatalities, by recommending intervention strategies, and by disseminating prevention information to employers and employees.

Massachusetts FACE also collaborates with engineering and work environment faculty at the University of Massachusetts at Lowell to identify technological solutions to the hazards associated with workplace fatalities.

NIOSH funded state-based FACE Programs currently include: California, Kentucky, Massachusetts, Michigan, New York, Oregon, and Washington.

Additional information regarding this report is available from:

Occupational Health Surveillance Program
Massachusetts Department of Public Health
250 Washington Street, 4th floor
Boston, Massachusetts 02108-4619
(617) 624-5627

Evaluate this report

We would appreciate your feedback on these reports so we may continue to improve the MA FACE project and our investigation reports. A feedback form can be found at: www.mass.gov/eohhs/docs/dph/occupational-health/report-evaluation.doc

The completed form may be returned by fax to (617) 624-5676, by mail to FACE, 250 Washington Street, 4th Floor, Boston, MA 02108, or by email to ma.face@state.ma.us.