Worker Fatalities from being Caught in Machinery

Fatalities resulting from workers being caught in machinery reached a 6-year high in 1997. Half of the workers were performing service-related tasks at the time.

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In 1997, the overall number of deaths from work-related injuries (6,218) remained virtually the same as in 1996 (6,202). In contrast, deaths caused by workers being caught in machinery increased 29 percent, to 189. In the period 1992-96, the number of work-related deaths resulting from the same cause averaged almost 150 a year.[1] During this same period, serious nonfatal injuries resulting from workers being caught in machinery totaled 34,000 and were the leading cause of amputations among private industry wage and salary workers. (See table 1.) This article profiles these fatalities, describes related hazards, and discusses some injury prevention methods.[2]

TABLE 1. **Nonfatal injuries involving days away from work resulting from workers being caught in machinery, private industry, yearly average, 1992-96**

Nature of injury	Number	Percent
Total	34,350	100
Cuts, lacerations	11,177	32
Amputations	4,832	14
Fractures	4,376	13
Bruises, contusions	2,920	8
Multiple injuries	2,401	7
With fractures	1,018	3
With sprains	191	1
Sprains, strains	1,077	3
Soreness, pain	426	1
All other	7,129	21

Industry and equipment involved in fatal injuries

Manufacturing is considered relatively safe in terms of fatal work injuries. In 1997, it accounted for 12 percent of fatal work injuries, compared with its 16-percent share of total employment. Manufacturing is generally machine-intensive, and it accounted for the largest portion (41 percent) of the deaths resulting from workers being caught in operating machinery. (See table 2.) In addition, during 1996, almost 19,000 workers in manufacturing suffered injuries resulting in lost workdays because of such incidents.

In manufacturing, as well as in other industry divisions, the equipment associated with fatal injuries included material handling machinery (such as augers and other conveyors) and forklifts, in addition to machinery designed to perform specific industry-related tasks. (See table 3.) Material handling equipment accounted for about one-fifth of the worker fatalities in the study. Workers in manufacturing were also fatally crushed in debarkers and chippers, as well as in various mixers, presses, molders, and other metal and woodworking machines.

Agriculture, on the other hand, is considered relatively dangerous. In 1997, it accounted for 13 percent of the fatal work injuries, but comprised only 3 percent of total employment. Like manufacturing, agriculture is heavily mechanized. It accounted for one-fourth of the fatalities resulting from workers being caught in operating equipment in 1997. One-third of these fatalities involved balers, combines, and other harvesting and threshing machines. Power take-off units and driveshafts, used to transmit power from tractors to other farm machinery, accounted for about one-sixth of the fatalities.

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TABLE 2. **Worker fatalities from being caught in machinery by selected industry, 1997**

Industry	Number	Percent
Total	189	100
Agriculture, forestry, and fishing	50	26
Agricultural production, crops	30	16
Agricultural production, livestock	12	6
Agricultural services	5	3
Mining	11	6
Construction	17	9
Heavy construction, except building	10	5
Special trade contractors	6	3
Manufacturing	78	41
Food and kindred products	11	6
Lumber and wood products	11	6
Paper and allied products	8	4
Chemicals and allied products	4	2
Rubber and miscellaneous plastics products	5	3
Stone, clay, and glass products	9	5
Primary metal industries	9	5
Fabricated metal products	8	4
Industrial machinery and equipment	7	4
Transportation and public utilities	11	6
Trucking and warehousing	3	2
Electric, gas, and sanitary services	5	3
Refuse systems	5	3
Wholesale trade	11	6
Wholesale trade, durable goods	8	4
Scrap and waste materials	7	4
Wholesale trade, nondurable goods	3	2
Services	7	4

Mining and construction, which use some of the same types of equipment, together accounted for one-seventh of the fatalities studied. Various earthmoving and drilling machinery were primarily involved in these fatalities.

Refuse system and scrap waste material industries' equipment, associated with the "caught in" fatalities, included various trash compactors, balers, and shredders. These two industries together accounted for 7 percent of the fatalities in the study.

Circumstances surrounding fatal injuries[3]

Workers were performing a variety of machine-related tasks when they were fatally caught in equipment. (See table 4.) Slightly over half of the workers were reported as carrying out service- or maintenance-related tasks, that is, tasks other than the normal operating or feeding of the machine. One-fifth of the workers were performing general or unspecified repair or maintenance. Others were reported to have been unjamming, cleaning, adjusting, or inspecting the machine. Often these tasks were performed with the machine running. In other instances, workers had turned the machine off to work on it, but were killed when a coworker unknowingly turned the machine on when the workers were inside or near it. Others were killed when they bumped into or fell onto a switch or lever or activated a sensing mechanism. Several other workers were fatally injured when they stepped or reached over a running machine or piece of equipment.

Loose or tattered clothing also presented a hazard to workers operating or working near machines. Over one-fifth of the fatalities studied occurred after an article of clothing, such as a glove, pant leg, or shirt or coat sleeve, was

TABLE 3. **Selected machinery involved in fatalities resulting from workers being caught in machinery, 1997**

Type of machinery involved	Number	Percent
Total	189	100
Agricultural and garden machinery	28	15
Harvesting and threshing machinery	15	8
Balers	8	4
Harvesters, reapers	4	2
Mowing machinery	4	2
Construction, logging, and mining machinery	34	18
Excavating machinery	4	2
Loaders	4	2
Logging and wood processing machinery-specialized	7	4
Debarkers	3	2
Mining and drilling machinery	13	7
Drilling machines, drilling augers	7	4
Other construction, logging, and mining machinery	6	3
Agitators, mixers—earth, mineral	3	2
Compactors, crushers, pulverizers-earth, mineral	3	2
Material handling machinery	34	18
Conveyors-powered	23	12
Conveyors-belt	10	5
Conveyors-live roller	3	2
Conveyors-screw, auger	4	2
Cranes	5	3
Elevators	3	2
Metal, woodworking, and special material machinery	32	17
Bending, rolling, shaping machinery	3	2
Extruding, injecting, forming, molding machinery	11	6
Casting machinery	5	3
Plastic injection molding machinery	4	2
Lathes	3	2
Presses, except printing	4	2
Sawing machinery-stationary	6	3
Special process machinery	26	14
Food and beverage processing machinery-specialized	4	2
Packaging, bottling, wrapping machinery	7	4
Paper production machinery	4	2
Textile, apparel, leather production machinery	3	2
Other special process machinery	7	4
Pumps	4	2
Vehicles	18	9
Truck	6	3
Forklift	6	3
Tractor	5	3
Miscellaneous machinery	9	5
Trash compactors	5	3
Electronic doors, gates	3	2

TABLE 4. **Activity performed by workers fatally caught in machinery, 1997**

Worker activity	Number	Percent
Total	189	100
Operating machine	85	45
General (unspecified) repair or maintenance	37	20
Unjamming materials	19	10
Cleaning machine	14	7
Adjusting machine	8	4
Reaching or stepping over machine	7	4
Inspecting or checking machine	5	3
Other	14	7

caught in the machine. In fact, the 11 deaths involving power take-off equipment or driveshafts all occurred after the worker's clothing was caught in the equipment. (Workers' hair being entangled in equipment is a related hazard that can cause severe nonfatal injury, such as scalping and facial disfigurement.[4])

Falls into machinery accounted for almost one-tenth of the fatalities studied. Some of the deaths resulted when workers fell from the driver's seat into the working part of the backhoe or other earthmoving machinery after hitting rough terrain. Other deaths resulted when workers fell into the machine while performing various work tasks near it.

Safeguarding workers from being caught in machinery

The scenarios described above suggest that in many of the incidents proper guarding or maintenance procedures were not in place or not followed. Guarding refers to any means of effectively preventing personnel from coming in contact with moving parts of machinery or equipment that could cause physical harm. Contacting moving parts in two major areas can injure workers: the point of operation and the power transmission apparatus.

The *point of operation* is the area on the machine where work is actually performed on the material being processed, such as cutting, shaping, boring, or forming of stock. To be effective, point of operation guards must protect the worker against contact with dangerous moving parts while allowing the work to continue with minimal disruption of the production process. Workers—both machine operators and service personnel—faced with machine guards that are inconvenient may be tempted to remove them, thus, exposing themselves to hazards.[5]

Power transmission apparatus, such as gears, driveshafts, pulleys, belts, cranks, and power take-off units, transmit energy to the part of the machine performing the work. Because these parts do not have to be accessible during normal operation of the machine, they should be fully enclosed to prevent worker injury. Other moving parts, such as feed mechanisms, should be safeguarded to protect workers.

Safeguards. Barrier guarding is the most common method of machine safeguarding.[6] These guards are physical barriers that are mounted on or around a machine to prevent access to the moving parts. Today, machine manufacturers usually provide built-in guards that conform to the design and function of the machine.[7] Manufacturers may also provide guards for retrofitting older machinery without guards or for machinery whose guards have proven ineffective. However, evidence confirms the fact that all machines are not promptly retrofitted.[8]

Several other methods for safeguarding workers during machine operation exist, including devices that stop the machine if the worker's hand is placed in the danger area; devices requiring the operator to use both hands on the controls, thus keeping both hands out of danger; and feeding and ejection attachments that keep the worker's hands away from the point of operation.[9]

Safeguarding workers during servicing or maintenance of machinery presents employers with additional challenges. Servicing may require the worker to be near the machine's point of operation or power transmission without the usual guards in place. Moreover, certain machines must be running to be properly lubricated or adjusted. Workers faced with machine jams may be tempted to unjam the machine with the power on. Even after turning the power off, workers may be injured or killed if a coworker turns the machine on or if there is a release of residual energy.

A procedure, commonly referred to as "lockout/tagout," was developed to protect workers from the unexpected startup of equipment or release of hazardous energy while performing servicing or maintenance. In general, this process requires that energy sources for equipment be turned off or disconnected and that the switch either be locked or labeled with a warning tag, but preferably both. The person who applies the lock or tag should be the only one to remove it. This would ensure that a coworker does not energize the equipment thinking that the maintenance is done. In addition, stored or residual energy must be safely released or blocked so that its unexpected release will not injure the worker.[10]

Some repair and maintenance activities, such as cleaning, lubrication, and unjamming, take place during production. Machine operators, who may have to perform these tasks, may be unaware of the hazards involved.

Ten percent of the fatalities in the study occurred while the worker was unjamming a machine. Workers may be tempted to unjam a machine while it is still on, resulting in the worker being pulled in along with the jammed material. Besides turning the machine off and releasing stored energy, special tools may be available to retrieve materials from machines to avoid injury. Some machines today have reverser mechanisms to discharge clogs, thereby reducing the need for workers to get near the machine's point of op-

eration. Another method of avoiding injury is to prevent the jam itself. Using the machine at the correct speed, avoiding dust buildup, and ensuring that the machine is adjusted for the material's size can help forestall machine jams.[11]

Half of the fatalities involving machine jams occurred in agriculture. Because of this and other hazards associated with tractors powering farm equipment, farmers have been advised to disengage the power takeoff, shut off the tractor engine, wait for all parts to stop moving, and take the key before dismounting the tractor. This procedure protects against injury from contact with the rotating power shafts and the moving parts of the attached machine. It also prevents another person from turning the power on while the machine is being fixed.[12]

Machines with automatic or self-lubrication and adjustment permit these routine tasks to be performed without removal of safeguards.

Summary

To prevent further injury and death from being caught in running machinery, the Occupational Safety and Health Administration and other safety professionals recommend that workers and their employers:

- Safeguard against contact with moving machine parts;
- Shut off power, perform lockout/tagout, and release residual energy before unjamming, servicing, lubricating, or adjusting machinery (exceptions may apply for certain machinery);
- Avoid wearing jewelry and tattered or loose clothing around machinery, and wear hair short or tucked inside clothing;
- Avoid stepping or reaching across running equipment; and
- Replace guards after servicing equipment.

Because of the diversity in machinery used throughout industry, this discussion has been simplified. Employers and workers should follow manufacturers' instructions, applicable regulatory standards, current industry consensus standards, and other safety guidelines for operating, adjusting, unjamming, and repairing equipment.[13] ■

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[1] Other machine hazards include being struck by moving equipment or caught under overturning equipment, being struck by objects propelled by machinery, coming in contact with electric current, exposure to carbon monoxide or other substances emitted, and exposure to noise from running equipment.

[2] Data on nonfatal injuries are from the Bureau of Labor Statistics' Survey of Occupational Injuries and Illnesses (SOII). This program collects information from a random sample of about 200,000 establishments representing most private industry wage and salary workers, excluding workers on small farms. Worker and case characteristics are collected only for those workers sustaining injuries and illnesses that require days away from work to recuperate.

Data on fatal work injuries are from the Bureau's Census of Fatal Occupational Injuries (CFOI). CFOI data cover all fatal work injuries. This program, which has collected occupational fatality data nationwide since 1992, uses diverse data sources to identify, verify, and profile fatal work injuries. Information about each workplace fatality (industry and other worker characteristics, equipment involved, and circumstances of the event) is obtained by cross-referencing source documents, such as death certificates, workers' compensation records, and reports to Federal and State agencies. This method assures counts are as complete and accurate as possible. Because the scope and methodology of CFOI and SOII are slightly different, comparisons of fatal and nonfatal data are problematic. Additional information can be obtained from the Bureau of Labor Statistics Internet site at **http://stats.bls.gov/oshhome.htm** or via e-mail at **cfoistaff@bls.gov** or **oshstaff@bls.gov**

[3] Much of the information on the circumstances surrounding the incident was derived from a narrative description of how the incident occurred. In some cases, this narrative was compiled from numerous sources including investigation reports. In other instances, information available to the staff person summarizing the information was scant, particularly for fatalities that were unwitnessed or that were not investigated by a State or Federal agency. Although the reported data may vary from actual events, the information is still useful for analysis.

[4] "Scalping Incidents Involving Hay Balers—New York," *Morbidity and Mortality Weekly Report*, July 10, 1992, pp. 489-491.

[5] See *Concepts and Techniques of Machine Safeguarding*, Occupational Safety and Health Administration, OSHA 3067, *Washington, DC*, 1992 (Revised) for a more detailed discussion.

[6] Joy LePree, "Machine Guards Prevent Serious Injuries," July 1996 Staff Report, Cahners Business Information.

[7] *Accident Prevention Manual for Industrial Operations*, 9th Edition, National Safety Council, Chicago, 1988.

[8] "Scalping Incidents Involving Hay Balers—New York," pp. 489-491.

[9] *Concepts and Techniques of Machine Safeguarding*, OSHA 3067.

[10] See *Control of Hazardous Energy (Lockout/Tagout)*, OSHA 3120, 1997 (Revised) for a more detailed discussion.

[11] *Farm and Ranch Safety Management*, 4th Edition, Moline, Illinois: Deere and Company, 1994.

[12] *Ibid*.

[13] For instance, see *Concepts and Techniques of Machine Safeguarding*, OSHA 3067 for an explanation and list of applicable industry consensus standards.

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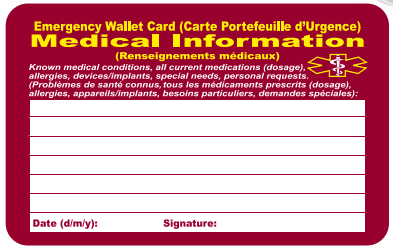

Back Side Information

Actual Size - 2.125" X 3.375"

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NEW

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- Recommended for workers with three (3) or more issues
- Seven lines for worker to fill in medical info including conditions, allergies, prescribed meds, etc.
- Comes with bull dog hole, compliant to ALL badge holders, incl. popular retractable clip holders, polypropylene neck wallets, vinyl badge holders, neck secure and breakaway lanyards.
- Larger size card makes emergency info easily visible (accessible) beneath badges, cards and passes by medics\doctors\nurses.

This Little Piggy...

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Have you ever noticed most accidents happen when you least expect them? Well, there I was, just coming in from a field training exercise (FTX) and about to perform a simple task when an accident happened to me. I certainly wasn't expecting to wind up in the hospital that January day.

I'm a Bradley systems maintainer and maintenance platoon sergeant for a forward-support company. We'd just completed the FTX in preparation for a deployment to the Joint Readiness Training Center and, after that, possibly Iraq. We were tired after spending 3 weeks in the field, but it was almost over—all we had left to do was clean our vehicles. At about 1700, the last of the vehicles were staged at the wash rack, so we went to work.

Everything about this day was relatively normal, with one notable exception: that morning, I'd taken my wedding ring off my dog tags and slipped it back on my left-hand ring finger. I figured since our training was over, wearing my ring was no big deal. I say this is notable because I always wear my ring around my dog tags when I'm on duty, especially in the motor pool or in the field. I'd spent a year in Iraq during Operation Iraqi Freedom II, and the only times I put on my ring were when I left for R & R leave and when my unit redeployed home. That system worked well, and thankfully I came home not only alive but with all 10 fingers!

I needed to get my wet-weather gear, which was in a shelter on the back of an LMTV trailer. I climbed on the trailer, got my things, and grabbed the right side rail for balance as I prepared to climb back down. Unfortunately, my foot slipped as I stepped on the lower bumper, and I began to fall. My hand slid down the rail as I moved toward the ground, and my ring caught in one of the U-shaped grooves used for securing canvas covers on the trailer.

I was horrified as I looked at my finger. The skin and most of the tissue on my ring finger was completely gone, and the bone from the first joint just above my fingernail was missing. I called out to the other guys and said, among other choice words, "Hey, get a medic, get the aid bag—I've lost my finger!"

Needless to say, I was in a lot of pain. Another Soldier got a combat lifesaver bag and pulled out a pressure bandage, which I wrapped around what was left of my finger. The commanding officer dialed 911 and had a pickup truck brought off the roadway so I could sit down and take off my helmet, weapon, and vest. We were only about 4 minutes from main post, so the ambulance arrived fairly quickly and took me to the emergency room at Darnell Army Community Hospital.

The doctors there told me the damage to my finger was so extensive they didn't know if any attempted repair would work. The tissue, nerves, and vessels were torn horizontally, and reattaching my finger would require 8 to 10 hours of surgery with no guarantee of success. In fact, there was only a 20-percent chance my finger wouldn't have to be amputated even with surgery due to the nerve and vessel damage, which reduced blood circulation in the injury to zero.

I faced a tough decision. The doctors told me my best course of action would be amputation because I would have a good chance of full recovery after rehabilitation. They let me decide, however, and after talking with my wife, I gave the doctors permission to amputate. They performed surgery that night, and my finger was amputated to the first joint—ironically, at the same place my wedding ring had rested just that morning.

It's been about 2 months since the accident, and I recently started rehab. I still feel a lot of pain, not just in my hand but all the way up my arm. The doctors explained some of the ligaments and tendons in my arm were pulled during the accident, and I'll experience phantom pain the rest of my life. I've lost about half the gripping power in my hand, which isn't good since I'm left-handed. I'll have to learn how to write and type again, but I can shoot right-handed—a definite plus for a Soldier. My long-term prognosis is pretty good, though; the doctors tell me that after about 4 months of occupational therapy I should be back to normal.

I share this story in the hope I'll open another Soldier's eyes and prevent them from making the same mistake. The doctors predict I'll be able to deploy back to theater with my unit later this year, but I could just as easily have lost my career that winter afternoon. Believe me, I'll do everything in my power to make sure I deploy with the Soldiers I've trained because I know they need me. I think it'll be a morale booster if my Soldiers can look at me and say, "If he lost a finger and is *still* here with us, we can do anything."

I'll be wearing my wedding ring on my right hand from now on, but I promise you this: I'll take it off whenever I put my uniform on, no matter what's planned that day. You never know what might happen. I survived a year in Iraq unharmed only to come home and lose my finger because I was tired and wasn't thinking straight. Stay alert and realize even the simplest of tasks can hurt you in a big way. If it can happen to me, it can happen to you too!

Editor's note: SFC Melancon would like to thank his team of doctors, led by LTC John J. Faillace at Darnell Army Community Hospital, for their outstanding care during his hospitalization and subsequent rehabilitation. He also would like to thank the Soldiers, NCOs, and officers of Delta Company, 215th BSB and 6th Squadron, 9th Cavalry for their continued support. "FIRST TEAM!"

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Giving the Finger

This soldier injured his pinky finger while serving in Iraq during the first year of conflict. The injury itself isn't very remarkable and he made a full recovery, but notice the ring next to the injured finger. It's never safe to wear rings or other jewelry in a field or combat environment. If the ring gets caught on something, you risk either a degloving injury (i.e., all the skin peeled off) or total amputation. Both injuries hurt a lot, so keep your ring in a safe place—not on your hand—when you're on duty.

Special thanks to LTC Roman Bilynsky, MD, who submitted this photo from his time with the 4th Infantry Division in Iraq.

A Finger or a Ring? The choice is Yours.