

Shop Floor Safety— Things to Think About

Charles M. Cooper

Ot should be a point of pride that the gear industry is actually safer than most other metalworking industries.

However, accidents do happen. A review of OSHA inspection reports for the gear manufacturing industry (SIC 3566) from January, 1990, through November, 1999, showed a total of 247 violations for which OSHA sought fines, including one fatality. These violations ranged from hazard communication and control of hazardous energy—lockout/tagout procedures at the high end (36 and 30 violations respectively) down to electrical training and arc welding and cutting procedures at the low end (1 violation each).

Because of the nature of the business, gear shops attract a higher caliber of skilled worker than other kinds of shops, and this goes a long way to creating a safe workplace. "From the shops that I have seen, they are very well set up," said John Coniglio, vice president of OSEA, the Occupational Safety and Environmental Association, Inc., an industrial safety consulting firm. "I find them in good order, neat and clean, with good accident records. If they have a problem, you normally see hand and finger injuries or eye injuries." These are things that the proper use of machine guards, lockout/tagout proce-

dures and personal protective equipment used as part of a company-wide safety program can effectively prevent.

A safety program can do other things for your business as well. Such a program can improve your bottom line by lowering the costs associated with health insurance and worker's compensation; by raising employee morale and productivity; and by reducing the scope and occurrence of regulatory fines and penalties.

What elements go into such a program? Shop floor safety arises from a combination of factors, all of which you can control—environment, equipment, training and supervision. When these factors are in place and working together properly, your shop floor will be a safe and productive place to work.

Safety from the Top Down

Safety in the workplace does not begin with technology, but rather with the mindset, participation and leadership of management determined to make safety part of their company's corporate culture. This is important, because without support from the leadership, no safety initiative will last.

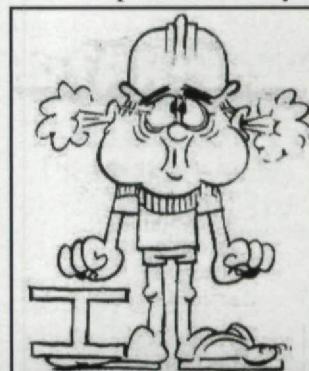
According to Coniglio, "Companies need to recognize, in a business sense, that safety is no more or less important than anything else that they do. They turn out a quality product. They turn out a product that's safe. They need to recognize that if

they have good safety people, they do because the safety person is looking at the cost per hour and the cost of goods impact that safety and health have. The best resource they have is the people who work in the plant, and that resource needs to be protected because of the return on investment." Coniglio then explained that companies need people in safety positions who can tell the board of directors what the cost impact is, not only in terms of losses, but also in terms of productivity and product improvement. These factors all tie together to improve the company's bottom line. "The company that has an effective safety and health program," said Coniglio, "will absolutely be better off than their competitors."

It is the job of management to develop the overall safety strategy for the company and to provide adequate training to both workers and supervisors. This strategy should tell management how and when to use engineering or administrative controls to limit worker exposure to hazards. It should also tell workers and their supervisors where hazards exist and how to implement these safety directives to abate them. The strategy should also include audits and surveys to allow management to track the success or failure of the program as well as a way for workers and supervisors to suggest

changes and improvements.

Environment, equipment, training and supervision are the factors that come together on the shop floor to create a safe work environment, and the strategy ought to reflect that. These broad categories include many obvious things like machine guarding, goggles and gloves, proper electrical maintenance, clean and dry floors and air quality. They also include obscure things—temperature, ergonomics, noise, the way storage areas are set up, stress, violence—the list goes on. It is up to you to go through your plant and try to see it as an OSHA inspector would. Try to



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**—JOHN CONIGLIO,
V.P., OSEA.**

see what kinds of hazards exist in your plant and figure out how to abate them.

Environmental Safety Issues

This covers your facility as a whole and includes air quality, temperature, noise, surface contamination, lighting, and building structures such as floors and stairs, railings, sprinkler systems and door signs. All of these factors must be taken into account, but a lot of it is just common sense. Floors must be kept clean and dry, walkways should be well marked and clear, and places where workers could fall should be guarded in some fashion. Any hazards in these areas should be either guarded or fixed. These guards and fixes don't have to be very complicated, either. It could be as simple as swapping out one kind of floor covering for another. "Sometimes the best results come from the simplest fixes," Coniglio says.

Other things to consider are that ladders should not be used where a permanent stair-

case would be appropriate, work areas should be well lit, sprinklers should function, exit doors should be well marked and open easily from the inside. Dealing with items such as these, which are covered under OSHA standards, would be a good start to any safety program. However, there are three shop floor environmental issues that should be looked at closely since they can have long term effects on your employees—fluids, temperature and noise.

Metalworking/Machining Fluids. Chemical contamination is becoming a major issue for American industry and labor. According to OSHA, millions of workers building automobiles, farm equipment, aircraft, heavy machinery, and other equipment are exposed to machining fluids. Studies have shown that occupational exposure to these fluids has resulted in cancers of the esophagus, stomach, pancreas, colon, rectum and other sites; respiratory problems ranging from respiratory irritation and asthma to bronchitis, lipoid pneumonia and hypersensitivity pneumonitis; and skin problems including irritation and dermatitis. There is evidence of impaired health at levels well below the Permissible Exposure Limit (PEL) for oil mists (5 mg/m³ time weighted average (TWA)) and the "nuisance dust" exposure limits applicable to all other machining fluids (15 mg/m³ TWA for total particulate).

Because of this evidence, there are those in industry who do not believe these standards go far enough. "The United Auto Workers are involved in looking at worker

exposure to oil mist in the air," said Coniglio. The UAW even had a hand in a 1992 report called "Health Effects of Exposure to Machining Fluids." According to the authors of the report, "Results from both the respiratory morbidity study and the mortality study suggest associations between machining fluid exposure and respiratory disease or cancer that are consistent with an interpretation of causality. Our initial dose-response analyses suggest that an exposure level of 0.5 mg/m³ would minimize any adverse health effect of worker exposure to machining fluids." This study and others have led to calls from both labor and business for a lowering of PELs for metalworking and machining fluids.

Because of these acknowledged health dangers, OSHA has designated metalworking and machining fluids to be a priority for comprehensive rulemaking. The agency is in the process of working with businesses and labor to develop these rules. In the meantime, some of the immediate steps you can take today to lower the risk associated with these fluids include protective clothing and equipment, mechanical splash guards and enclosures, local exhaust ventilation, marking any hand tools used in contaminated areas to prevent chemical contamination from spreading, and a good program of preventative maintenance.

Ambient Noise. Noise in the workplace is another environmental hazard that should be addressed. In high-noise environments, hearing can deteriorate over time, beginning in the higher frequency ranges and progressing down

into the low frequencies to deafness. OSHA regulations state that in work areas where the noise level is 85 dB(A) or above, hearing protection must be provided, but it is up to the worker to use it. At 90 dB(A) or higher, the use of such protection is mandatory.

Ambient noise issues can be addressed administratively or mechanically. Administrative controls can include restricting the amount of time a worker is exposed to the noise and/or mandating the use of personal protective equipment such as earplugs or muffs.

These devices carry noise reduction ratings (NR) that were developed by ANSI. The higher the rating, the more noise is muffled. Care should be taken to get the right NR rating for your work environment. For example, an NR rating of 6 or better is needed to cope with noise levels of 96 dB(A) or higher.

Mechanical methods of dealing with excessive noise include noise reducing baffles, compartmentalization, the use of noise reducing gears or the installation of rubber pads underneath machinery.

Heat. Temperature can be a problem when it leads to heat stress, a term that covers such disorders as heat stroke, which can lead to brain damage; heat exhaustion, which includes such symptoms as extreme weakness, fatigue, dizziness, nausea, headache, vomiting or unconsciousness; heat cramps, painful muscle spasms due to salt loss from sweating; fainting; or transient heat fatigue, which is a temporary state of discomfort and mental strain caused by prolonged exposure to heat.

DO NOT WEAR GLOVES WHEN GRINDING!

"SOMETIMES THE BEST RESULTS COME FROM THE SIMPLEST FIXES"

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Heat stress can be dealt with in a number of ways. Minimizing the heat within the workplace is one of the best ways to do this; however, there are circumstances where that is simply not practical. Giving workers time to gradually adjust to the heat, or lessening the amount of work and exposure by allowing adequate rest periods are other ways to fight heat stress.

You can also isolate the worker from the heat source by mechanizing some or all of the work procedures or providing heat shielding and ventilation. Protective clothing is also useful; however, it is necessary to know if the clothing will interfere with sweat evaporation.

Equipment

This is another broad category that covers a variety of items ranging from machine tools to fire extinguishers to ladders to personal protective equipment (PPE) such as hard hats, work gloves and boots. While fire extinguishers and ladders are among the many things looked at in an OSHA inspection, it is with machine tool safety and personal protective devices that most people on the shop floor are concerned.

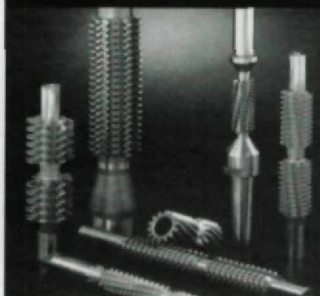
Machine Guarding. This refers to the mechanical means by which a worker is protected from the actions of the machine tool he is operating. The subject is covered in some depth in Subpart O of 29 CFR of the OSHA regulations. According to Part 212 of the regulations: "One or more methods of machine guarding shall be provided to protect the operator and other employees in the machine area from hazards such as those created by point of operation, ingoing nip points, rotating parts, flying

chips and sparks." The regulations require that manufacturers and owners of machine tools prevent you from putting your hand—or any other part of your body—where it might be injured or removed while the machine is in operation. Often, however, in shops where safety is not a big part of the corporate culture, these safeguards are bypassed or disabled.

"A company puts a light curtain on a machine because someone says they have to have a guard on that," said Coniglio. "They spend three-, four- or even five-thousand dollars to have it there. It looks good, but because it is, in somebody's mind, hindering their operations, instead of figuring it out, they just defeat the light curtain and take a chance. It's out of sight, out of mind. They say 'this guy knows how to do it, I'll just sit back and not look at it and hope nothing happens.' That's the reality of the situation."

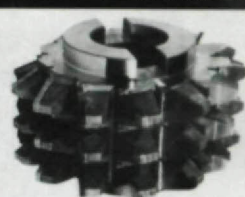
That is what happened at a major Illinois heavy vehicle and equipment manufacturer. Following a 1993 inspection of their facility, the Secretary of Labor cited the company with two violations of OSHA's machine guarding standard, one as willful and one as serious. A willful violation is one where the company has been cited before and has not abated the hazard, while a serious violation is a new one that could result in serious injury or death. In the case of the willful violation, workers were bypassing the guards on a 700-ton LVD hydraulic press. Employees were in the habit of disabling the light curtain, reaching into the machine's work area and manipulating the workpieces while the press was in opera-

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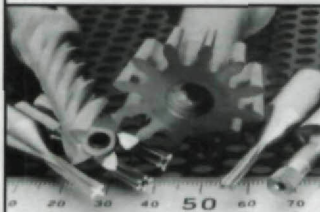
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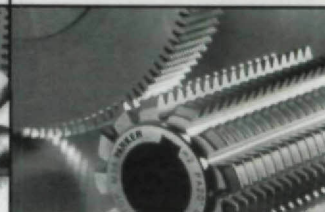
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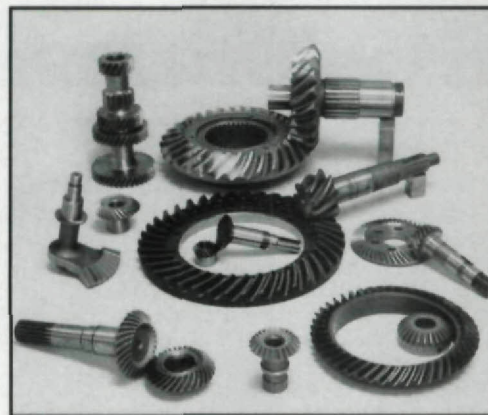
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MANAGEMENT MATTERS

tion. The second citation dealt with workers being able to load workpieces into a track press while the machine was indexing. This created a hazard by permitting workers to put their hands in the machine's work area while the machine was in operation.

By the time of the final hearing on the matter, this second hazard had been abated. These two violations cost this company \$22,000 in penalties and could have cost a machinist his hand, arm or life.

Lock-out/Tag-out. Sometimes it is necessary for an operator or some other trained individual to bypass the guards and get into the machine, usually when the machine needs to be serviced. When this happens, it is necessary to control the hazardous energy of the machine. This energy—mechanical, electrical, thermal, hydraulic, pneumatic, gravitational or chemical—can come from a variety of sources depending on the design and function of the machine. The key to controlling this energy is to properly shut down and fully deenergize the machine in question and to make sure that it stays that way until it can be returned to service. This is the purpose of a lockout/tagout program.

Once it has been determined that a machine should be locked or tagged out, all of the employees affected by this decision should be notified that the machine will be offline. This is followed by a normal shutdown of the machine. All of the controls and valves should then be placed in their off or closed positions. Place the lockout/tagout device, such as a breaker lock, hasp, chain or valve cover so that the controls

cannot be accessed. Now, release any stored energy from capacitors, springs, raised parts, rotating flywheels and hydraulic, air, gas or steam systems. This energy has to be released or restrained by grounding or repositioning. This is done blocking or bleeding the system. Verify that the equipment has been locked or tagged out and that it has been successfully isolated and de-energized by trying a normal startup. If this startup fails, you may now proceed with the work.

When you are done, inspect the work area for parts, tools, missing guards and make sure that the equipment is ready to operate. Clear the area and make sure everyone knows the machine is going to be restarted. Remove the locks and tags, and restart the machine.

The primary elements of a lockout/tagout program include documenting the program itself and developing procedures for each machine in the inventory, employee training and the distribution of standardized locks and tags to authorized personnel (the only employees permitted to lock or tagout a machine). These locks and tags should be dedicated to the lockout/tagout program, and they should identify the employee to whom they were issued. Only the person who placed the lock should be allowed to remove it.

Personal Protective Equipment (PPE). These are devices worn by the worker to protect him from hazards specific to the job he is doing when engineering controls such as machine guards are not practical or applicable. Depending on the job and the circum-

stances, these devices can include hard hats, eye protection, ear protection, boots and gloves, respirators, cool suits, and more. When it has been determined that the use of personal protective equipment is required, it should be provided by the company.

According to OSHA Section 1910.132 general requirements, the employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall:

- Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment.
- Communicate selection decisions to each affected employee.
- Select protective equipment that properly fits each affected employee.

In the general requirements, OSHA mentions four basic areas of personal protection—head, face/eye, hand and foot.

Head protection ranges from lightweight, minimally protective bump caps or skull guards, to various classes of helmets, which provide impact and penetration resistance. Class A and B helmets also offer protection from electricity. Class C helmets do not. Where falling object hazards are present, or if working on exposed, energized conductors, the appropriate helmet must be worn.

Face and eye protection includes a variety of spectacles, goggles, face shields and welding shields. The choice is

based on the nature of the hazard being faced (see tables).

Hand protection is needed when the worker's hands may be exposed to chemicals and other toxic substances, fire, extreme temperatures, cuts or lacerations, punctures or abrasions. There are gloves available that can protect against multiple hazards. However, a single type of glove cannot protect against all hazards. These hazards are classified under four broad categories: chemicals, abrasions, cutting and heat.

With chemicals, the chief concerns are chemical burns and the absorption of toxic substances through the skin. These can be minimized by using gloves made for this type of work, rinsing them before carefully removing them after use, and replacing

them regularly. Replacement is very important because all glove materials are eventually penetrated by chemicals. The rate of replacement is based on the application, the frequency of contact with the chemicals and the glove material.

Abrasion, heat (and cold), and cutting hazards also require the proper type of glove. They should be insulated for temperature extremes and made of tough, resilient materials to protect the hands from cuts, punctures and abrasions when handling sharp or rough objects.

One place where gloves are not recommended is around moving machinery, since the glove can actually make it easier for a worker's hand to be caught and injured. Here, protection is to be supplied by machine guards and

lockout/tagout procedures.

Foot protection is necessary when workers are in areas where their feet are exposed to falling, rolling, piercing or electrical hazards.

Safety shoes and boots are built to offer both impact and crush protection. Some also provide puncture protection as well while others offer electrical protection. The type of safety shoe or boot you need is based on the type of work you will be doing (see table).

PPE Training. OSHA rules also cover training standards for workers learning to use personal protective equipment. This includes new hires as well as established employees. According to Section 1910.132, employers are to train any employee whose job requires the use of personal

TABLE 1—FACE AND EYE PROTECTION BY HAZARD. SOURCE: OSHA.

SOURCE	HAZARD	PROTECTION
IMPACT—Chipping, grinding machining, masonry work, woodworking, sawing, drilling, chiseling, powered fastening, riveting, and sanding.	Flying fragments, objects, large chips, particles, sand, dirt, etc.	Spectacles with side protection, goggles, face shields. For severe exposure, use face shield.
HEAT—Furnace operations, pouring, casting, hot dipping, and welding.	Hot sparks, splash from molten metals, high temperatures.	Face shields, goggles, spectacles with side protection. For severe exposure use face shield. For splash from molten metals, use a face shield worn over goggles. For high temperature exposure, use screen face shields or reflective face shields.
CHEMICALS—Acid and chemicals handling, degreasing, plating.	Splash	Goggles, eyecup and cover types. For severe exposure, use face shield. For irritating mists, use special-purpose goggles.

TABLE 2—FACE AND EYE PROTECTION FOR LIGHT AND RADIATION HAZARDS. SOURCE: OSHA.

Welding: Electric arc	Optical radiation	Welding helmets or welding shields. Typical shades: 10-14.
Welding: Gas	Optical radiation	Welding goggles or welding face shield. Typical shades: • gas welding 4-8 • cutting 3-6, • brazing 3-4
Cutting, Torch brazing, Torch soldering	Optical radiation	Spectacles or welding face-shield. Typical shades: 1.5-3.
Glare	Poor vision	Spectacles with shaded or special-purpose lenses, as suitable.

TABLE 3—FOOT PROTECTION BY HAZARD. SOURCE: OSHA.

TYPE OF PROTECTION	HAZARD
Impact Protection	Carrying or handling materials such as parts or heavy tools, which could be dropped, and for other activities where objects might fall on the feet.
Crush Protection	Activities involving skid trucks, bulk rolls, heavy pipes or any heavy objects that could roll over a worker's feet.
Puncture Protection	Anywhere sharp objects such as metal scraps, nails, wire, etc. could be stepped on.

TO LEARN MORE

There are a number of places where employers and employees can go to learn more about workplace safety and health. Here are a few:

U.S. Government

ANSI American National Standards Institute
11 West 42nd Street, New York, New York 10036
Phone: (212) 642-4900, Fax: (212) 398-0023

FEMA Federal Emergency Management Agency
500 C Street, SW, Washington, D.C. 20472

NCIPC National Center for Injury Prevention and Control
Mailstop K65, 4770 Buford Highway NE, Atlanta, GA 30341-3724
Phone: (770) 488-1506, Email: OHCINFO@cdc.gov

NIOSH National Institute for Occupational Safety and Health
Hubert H. Humphrey Bldg., 200 Independence Ave., SW, Room 715H
Washington, DC 20201
Phone: (202) 401-6997
CDC Emergency Response Phone Number: (770) 488-7100
NIOSH Technical Inquiries 1-800-35-NIOSH (1-800-356-4674).

OSHA U.S. Department of Labor Occupational Safety & Health Administration

Office of Public Affairs - Room N3647
200 Constitution Avenue, Washington, D.C. 20210
Phone: (202) 693-1999

If you have an **EMERGENCY** and need to report a *fatality or imminent life threat* contact 1-800-321-OSHA (6742) immediately.

Associations

American Board of Industrial Hygiene
6015 West St. Joseph, Suite 102, Lansing, MI 48917-3980
Phone: (517) 321-2638, FAX: (517) 321-4624, E-mail: abih@abih.org

The American Society of Safety Engineers Customer Service
1800 E Oakton St, Des Plaines, IL 60018
e-mail: customerservice@asse.org
Phone: (847) 699-2929 between 8:30 to 5:00 CST
Fax: (847) 768-3434 24 Hours

ONLINE RESOURCES

www.abih.org

This is the Web site of the American Board of Industrial Hygiene. Offers industrial health and safety-related information as well as information about the Board's programs.

www.asse.org

The Web site of the American Society of Safety Engineers. Contains safety-related information as well as information on the Society, its aims and its programs.

www.cdc.gov/ncipc/ncicphm.htm

This is the official Web site for the National Center for Injury Prevention and Control. It contains information and statistics on injuries ranging from unintentional home accidents to workplace injuries to criminal violence.

www.niosh.gov

This is the official Web site for the National Institute for Occupational Safety and Health. It contains information on health and safety issues affecting American workers.

www.osha.gov

This is the official Web site for OSHA, containing information on standards, procedures, statistics (including findings on individual companies) and much more.

www.safetyinfo.com

This site is one of the most comprehensive safety resources available. It is a free service and is owned by: Safety Engineering, PO Box 477, Blount Avenue, Guntersville, Alabama, 35976
Phone: (256) 583-6321

protective equipment in the use of that equipment. That includes learning when PPE is to be used and what kind is necessary, how to properly put on, remove, adjust, and wear the equipment, its care and maintenance, the limitations of the equipment, its useful life and proper disposal. The trainee must be able to demonstrate that he understands these elements before being allowed to do work that would require the use of PPE.

Under the rules, those who cannot demonstrate such an understanding are to be retrained. Some of the circumstances where retraining is necessary include:

- Changes in the workplace render previous training obsolete.
- Changes in the types of PPE to be used render previous training obsolete.
- Inadequacies in an affected employee's knowledge or use of assigned PPE indicate that the employee has not retained the requisite understanding or skill.

Finally, the employer is to verify the training through a written certification, which should contain the name of each employee trained, the date(s) of training, and the subject of the certification.

The Role of the Supervisor

Once the program is in place, the engineering and administrative controls are working and the people on the floor are trained, then it is up to the supervisors to make sure that things go smoothly and according to plan. Like management, the supervisors are responsible for following all safety program requirements and making sure that their charges on the shop floor do

likewise. Would that company in Illinois have received the penalties it did if a supervisor had caught and corrected the press operator's mistake? Probably not.

OSHA has drawn up its own safety and health program, in which they have delineated the responsibilities of supervisory personnel.

According to the OSHA plan, the supervisor will be responsible for enforcing safety and health rules, regulations and standards. Supervisors are to instruct employees in safe practices and methods of operation and give full support to the Occupational Safety and Health Program. They are to conduct regular safety and health inspections, correct whatever unsafe and unhealthful conditions and practices are noted, obtain medical attention for injured or ill employees, and encourage and promote employee suggestions on how to improve safety and health. Finally, supervisors are to work with the Safety Officer in investigating accidents, completing appropriate compensation and accident prevention forms and submitting them through proper channels on a timely basis.

The roles assigned by OSHA to its own supervisory personnel are not too different from similar roles in companies across the country. All recognize that the supervisor is management's eyes and ears on the shop floor in many ways and for many initiatives, safety included. ⚙

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