Safety Handbook for

Plastics

A resource guide for the plastic industry

Ohio | Bureau of Workers' Compensation

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Introduction

Your employees are your organization's most valuable asset. By imporving safety and preventing accidents, you can protect your work force while reducing your workers' compensation costs. And the Ohio Bureau of Workers' Compensation's (BWC's) Division of Safety & Hygiene (DSH) is here to help.

This guide identifies and explains safety and health workplace concerns. It summarizes effective accident-prevention principles and techniques and provides management and employers with information to help them work safely. It also enables safety teams to meet their goals and obligations. Each section addresses a different concern and practical accident-prevention measures, as well as management's best practices.

This guide is not intended to be all encompassing, nor is it a document to provide compliance standards. Safety and health processes must be individualized to meet the needs of each workplace. The team who authored this guide developed it with the goal of making the plastics industry a safer and more healthy workplace.

However, safety isn't the only thing you can do to reduce your workers' compensation costs. You can also lower your premiums by proactively managing your workers' compensation claims. This includes incident investigation, early reporting of injuries and working with your employer services specialist and claims service specialist.

DSH has a long history of helping employers. BWC has assisted employers in the manufacturing industry since the 1920s. In fact, BWC has many experienced safety and health consultants that specialize in the plastics industry. Many are certified in safety and industrial hygiene, and several have more than 20 years of experience in the field of safety and health.

Safety works, and it can work for you and your employees. To learn more about BWC's other safety services, visit ohiobwc.com, or call 1-800-OHIOBWC, and request a safety services catalog.

Knowing you and your industry

Plastics are one of the most used and versatile materials in U.S. industrial and commercial markets. Plastics are integrated into the modern lifestyle. The plastics industry is in its second century. Most significant developments, however, have occurred since 1910. Phenolics were the first fully synthetic resins to become commercially successful. They evolved from the phenol-formaldehyde resins of the early 1900s.

The discovery of the thermosetting resins urea-formaldehyde and phenol-formaldehyde provided materials that could be molded into light-colored articles. Cellulose acetate, a thermoplastic introduced as a molding compound in 1927, developed concurrently with the urea-based resins and was safer to process and use.

The 1930s became the period of commercial development of the modern thermoplastics polyvinyl chloride, polyethylene, polystyrene and polymethyl methacrylate. Thermoplastics can be softened repeatedly by applying heat and thermosetting materials, then undergoing a chemical change when heated and shaped, so these materials cannot thereafter be reshaped by the application of heat.

Plastics were important to the war efforts of World War II when natural rubber supplies were in short supply. The chemistry of polymer formation began in the United States during this period, largely due to the broadening of the range of basic raw materials feeding it. The 1950s were the decade of developing polypropylene, high-density polyethylene and continued growth in the use of plastics.

Linear low-density polyethylene appeared in the late 1970s and large-scale production of plastics resulted in reduced costs. Plastics began to compete with traditional materials, such as wood, metal and glass. By adding alloys to tailor properties of the materials to specific needs, the demand for plastics increased even more.

Today, plastics are regarded as basic materials by engineers and designers, and are used in all industries.

Plastic processing

The plastics-processing industry converts bulk polymeric material into finished articles. Raw materials are generally received in the following forms:

- Fully compounded polymeric material directly fed the form of pellets, granules or powder;
- Uncompounded polymer, which must be compounded with additives before it is fed into machinery, in the form of granules or powder;
- Polymeric sheet, rod, foil and tube materials which are further processed;
- Miscellaneous material which can be fully polymerized matter in the forms of suspensions or emulsions (latices), or liquids or solids which can polymerize, or substances in an intermediate state between the reactive raw materials and the final polymer.

Compounding uses a variety of machinery. The most common additives known to the industry include:

- Plasticisers;
- Antioxidants;
- Stabilizers;
- Lubricants;
- Fillers;
- Colorants;
- Blowing agents.

Conversion processes

Conversion processes involve either:

- A polymer brought to a plastic state through heating at which point it is given a mechanical constriction leading to a form which it retains upon consolidation and cooling;
- A material totally polymerized by the action of heat, a catalyst or both, while under a mechanical constriction leading to a form it retains when fully polymerized and cooled.

Types of conversion processes

Compression molding

This process involves heating a plastic material, which can be in the form of granules or powder, in a mold that is held in a press. Pressure forces the material as it becomes plastic to conform to the mold's shape. Parts may be removed from the press either in a heated or cooled state, depending on the rate of hardening. Examples of articles made from this process are bottle tops, electric plugs and sockets, toilet seats and trays.

Transfer molding

In a modification of compression molding, the plastic is heated in a separate chamber and injected into a closed mold. It is preferable to normal compression molding when the final article has to carry delicate metallic inserts, or when, as in very thick objects, completion of the chemical reaction could not be obtained by normal compression molding. Transfer molding is normally restricted to thermosetting materials.

Injection molding

This process involves heating and homogenizing plastic granules in a cylinder with an in-line reciprocating screw and three barrel zones. The plastic is heated until sufficiently fluid to allow the pressure to inject the plastic into a cold mold, which lets the plastic take the mold's shape. This process is one of the most important in the plastics industry. Normally restricted to thermoplastics, it has been extensively developed and is capable of making articles of considerable complexity at very low cost.

Extrusion

The extrusion process is one by which plastic pellets or granules are fluidized, homogenized and continuously formed. Extrusion provides a continuous length assembly in making pipe.

Calendering

Plastic is masticated between two rolls that form the plastic into film. This process may be used to impregnate fabric or paper.

Blow molding

This process combines the extrusion and thermoforming processes. It is a process of forming a tube and introducing air and other gases to cause the tube to expand into a freeblown hollow object, or against a mold for forming a hollow object with a definite size and shape. Carbonated beverage bottles are formed by this method.

Rotational molding

This process is used for the production of molded articles by heating and cooling a hollow form, which is rotated. This enables gravity to distribute finely divided powder of liquid over the inner form's surface. Examples of articles produced by this method are footballs and dolls.

Film casting

Extruding a hot polymer onto a highly polished metal drum can form films. A solution of polymer also can be sprayed on to a moving belt. An important application of certain plastics is the coating of paper. Film casting paper and board are widely used in packaging.

Thermoforming

This is the process of taking plastic sheets and transforming them into parts through heat and pressure, either by pneumatics, compression or vacuum. Thermoforming is often used for small parts and is relatively inexpensive. Contact lenses, advertisements and directional road signs are among the products made by this process.

Vacuum forming

There are many processes that come under the vacuum-forming heading. They all include a sheet of plastic which is heated in a machine above a cavity, around the edge of which it is clamped, and when pliable, is forced by suction into the cavity, where it takes some specific form

and cools. In a subsequent operation, the article is trimmed free from the sheet.

Laminating

Two or more materials in the form of sheets are compressed to give a consolidated sheet or panel special properties.

Foamed processes

Foam is a major part of the plastics industry because it can be made from different types of materials. They range from soft and flexible to hard and rigid. The three types of cellular plastic are:

- Blown, such as in sponges;
- Syntactic, such as in microspheres;
- Structural, such as in parts with a foam core and a rigid exterior.

Resin technology processes (reinforced plastics)

These include plywood manufacturing, furniture manufacturing and the construction of large and elaborate articles, such as car bodies and boat hulls from glass fiber impregnated with polystyrene or epoxy resins. In all of these processes, heat or a catalyst consolidates a liquid resin and binds together discrete particles of fibers of mechanically-weak films or sheets, resulting in a strong panel of rigid construction. These resins can be applied by hand-layup techniques, such as brushing and dipping, or by spraying.

Finishing processes

Common to many industries, there are a number of specific techniques used for welding plastics. These include the use of solvents, such as chlorinated hydrocarbons, methyl ethyl ketone and toluene. They are used for bonding rigid plastic sheet for general fabrication, advertising display fixtures and similar items. Radio frequency radiation uses a combination of mechanical pressure and electromagnetic radiation with frequencies generally in the range of 10 to 100 megahertz. This method is commonly used to bond together flexible plastic material in the manufacturing of wallets, briefcases and children's carriers. Ultrasonic frequencies also can be used in combination with mechanical pressure for a similar application.

Industry statistics and trends

According to PolymerOhio, the state's polymer industry includes more than 2,800 facilities and 149,000 workers. It generates $49 billion in annual sales revenue and pays its workers $5.6 billion in wages. It is Ohio's largest industry.

Accidents in plastics product manufacturing remain above the average for all U.S. manufacturing. According to the Bureau of Labor Statistics (BLS) data, the rate of occupational injuries nationally was 37 percent higher for plastics processing in 2005 than for all U.S. manufacturing.

Injuries and illnesses in the plastics industry result from a multitude of inherent hazards. Due to the nature of the primary raw materials used the danger of fire and explosion is an important general hazard. Flammable gases or liquids may escape during reactions at temperatures above flash points. Adequate ventilation becomes crucial to the operations.

The majority of injuries in the plastics sector occur in plastics processing and depend almost entirely on the use of machinery. Adequate guarding is essential in compression, transfer, injection and blow-molding machines, as well as in in-running traps between rollers in processes involving plastic sheet. Many plastic-processing machines operate at high temperatures, and cause severe burns if parts of the body come into contact with hot metal or plastics. Waste plastic material reprocessed using granulators can pose contact hazard with the rotors through the discharge and feed openings. Again, guarding becomes important to prevent this.

Plastics are good electrical insulators. Static charges can build up on machinery on which sheet or film travels. Static eliminators should be used and metal parts properly grounded. Good housekeeping practices and adequate machine maintenance ensures a safe working environment.

Finally, a number of potential health hazards from the vapors of raw materials and additives are associated with plastics processing and thermoset resins, such as isocyanates. Dermatitis from skin exposures and noise from operating equipment pose additional concerns. All these issues are addressed in greater detail later in this guide.

Case studies

BWC works with many of the plastics manufacturers in the state. Successful cooperative strategies exist between employers and safety and health consultants. The following are a few examples of these strategies.

GI Plastek

This employer believed that incorporating behavior-based safety practices throughout its plants helped the company and its employees. Top management was in full support. This was an ongoing task to get buy-in and acknowledgement, but it increased the overall awareness of safety. BWC provided guidance to implement the behavior-based safety philosophy.

Circleville Plastics

This company's success came from implementing transitional work and rotating jobs, implementing ergonomic changes at workstations and an effective maintenance program. BWC provided consultation on the value of transitional work and ergonomics through several consultative efforts.

CW Ohio

Through a BWC consultant's encouragement, CW Ohio applied for and received a $40,000 safety grant for modifications to its polymer column line. The employer eliminated many of the manual material handling tasks by installing an automatic pumping station to fill molds for manufacturing columns used in commercial and residential construction. The use of the pumping station also eliminated excess materials spilling on the floor, saving on waste and eliminating a tripping hazard. The entire project cost $200,000. Production increased by up to 40 percent. The project is presently 75 percent completed. Material waste has decreased 15 percent. In addition, the company will eliminate a $50,000 annual expense for plastic buckets that manually carry raw product for the column molds. After the equipment was installed, accidents in this department dropped from 15 recordables to three.

Table 1.1 In Ohio, injuries and illnesses for fiscal year 2001, as logged in BWC data

Number of employers:	513
Number of claims:	Medical only 4,026 Lost time 588 Total = 4,614
Average filing lag per claim:	11.5 days
Average claims per employer:	9 claims

Data Source: Ohio BWC Data Warehouse

Identifying concerns

Assessing your company's current safety process

As a beginning step, consider asking yourself questions about present circumstances in your business. As you begin to assess your safety situationt, it may seem unfamiliar to ask yourself questions regarding the business and quality issues of your company. However, if you hold the business issues of quality, production and safety on an even plane (all core values of your organization, without any one being more important than the other), you will see the importance of the association. Depending upon the responder's level within the organization, the issues are the same, but take on a different significance or priority.

First, find yourself in the correct category below. Then, ask yourself questions to evaluate your present circumstances.

Strategic issues (for company president, top officers)

Current situation

What would you consider a quick overview of your situation?
What are your company's strengths?
What is your current situation with regard to safety?
Who has responsibility for safety?
Do you hold all those who report to you accountable for safety in your organization and, if so, what measurements are used to ensure that accountability?

Problem

What are your most pressing business concerns at this point? (labor, quality and production)
What are the economic consequences of these problems?
What are your goals for these areas this year?
Are you aware of your current safety-experience rating and its impact on your bottom line?
What do you think has contributed most to your safety performance?

Opportunity

What is your vision for the company? Where would you like it to be in four years? Could you describe the end result you would like to achieve?
If you could achieve that vision, what economic impact would that have on the business?
How does creating a safe work environment fit into your vision of the future?

Avoidance

From your past experience, is there anything you would want to avoid as you move forward?

Middle-management issues (for human resources, safety and operations)

Current situation

What is the overall emphasis of the entire management team for the business this year? (costs, profits and quality)
What does your safety process look like?
What are your responsibilities?
How are you held accountable for your safety performance and what measures are used?

Problem

What are your most pressing safety concerns at this point?
What do you think are the causes of your safety problems?
What are the economic consequences of those problems?
What are your goals for those areas this year?

Opportunity

What is the desired situation you would like to see the business achieve?
If you could achieve that vision, what economic impact would that have on the business?
What would a safe work environment look like in your business? What would be the economic impact?

Avoidance

From your past experience, is there anything you tried that didn't work for you?

End users' issues (for supervisors, team leaders and employees)

Current situation

What is the overall emphasis of the entire management team for the business this year? (costs, profits, quality)
What are your job responsibilities?
What do you enjoy the most about your job?
How are you held accountable for safety, and what measures are used?

Problem

What are your most pressing problems and concerns?
How do you view safety?
What do you think are the causes of your safety problems?
What are the economic consequences of those problems?

Opportunity

If you were the boss, what would you do differently?
What would a safe work environment look like in your business? What would be the economic impact?

Avoidance

From your past experience, is there anything you tried that didn't work for you?

Self-assessment for BWC's 10-Step Business Plan

Take time to thoroughly evaluate your specific safety programs and policies with the following assessment. Covering program and management issues, it is best used by a team of professionals (company president, safety director, environmental director, etc.). Your staff members and/or DSH can score and interpret results.

(The Tools section of this guide contains an action plan template. As you identify areas requiring action, make note of them in your own action plan.)

1. Visible, active senior management leadership

Visible senior management leadership promotes the belief that management of safety is an organizational value.

This requires the following:

- Authorizing the necessary resources to prevent accidents;
- Discussing safety processes and improvements regularly during staff or employee meetings;
- Ensuring you hold management accountable for accident-prevention activities and for managing accident-prevention processes;
- Assessing the success of the safety process annually by using perception surveys, personal interviews and/or behavior sampling;
- Encouraging employees to take an active part in maintaining a safe workplace.

Did your organization address each of the above requirements? Why or why not? Should the organization do more to promote the belief that safety is an organizational core value?

2. Employee involvement and recognition

Employee involvement and recognition affords employees the opportunity to participate in the safety-management process.

Employee participation opportunities include, but are not limited to the following:

- Safety and health involvement teams, focus groups or safety and health committees;
- Accident investigation analysis and assessment;
- Safety and health audits;
- Acting as instructors for safety and health training programs.

How do your employees participate in the safety-management process (in other words, how are they involved in decision making and problem solving), and how often do they meet with management to specifically discuss this process? There is no magic answer to this question. Employee involvement must fit within your organizational philosophy.

How do you recognize employees for their actions and efforts in bettering the safety-management process? For example, do you recognize employees for their contributions to decision making? Recognition includes establishing an ongoing process to identify and formally recognize employees for excellence in accident prevention.

3. Medical treatment and return-to-work practices

To help injured or ill employees obtain quality medical care and return to work, employers can establish a post-injury or disability-management policy and procedure consistent with the Ohio BWC Health Partnership Program.

Components of a disability-management procedure can include, at a minimum:

- Informing employees of the selected managed care organization (MCO);
- Informing employees of procedures identifying where they can obtain medical treatment;
- Providing employees with other supporting information or materials;
- Reporting immediatly accidents and illnesses to a supervisor;
- Regularly supervisory communications with off-work employees while they are convalescing;
- Investigating all accidents within 24 hours to identify system or process improvements so management can take corrective measures;
- When not prohibited by a labor agreement, a modifying duty or transitional-work program to allow employees to return to work in a productive capacity during the recuperative period.

Have you informed your employees of the MCO? _____

Do your employees know where they can obtain medical treatment? _____

Describe the accident-reporting process and the time frame in which this occurs. How and when do you communicate them to employees?

Describe your medical treatment, accident analysis and correction procedures.

Do your supervisors contact recuperating injured workers?

If a supervisor does not contact injured workers, who contacts them?

How often do you contact injured workers?

Do you have a modified duty or transitional-work policy? If no, why not? If yes, have you used it? How many times per year?

4. Communication

A program of regular communications on safety and health issues to keep all employees informed and to solicit feedback and suggestions.

How often do you advise employees of individual and organizational performance pertaining to safety performance?

How do you obtain suggestions, and how do you respond to these suggestions?

How do you communicate and ensure you inform all employees on safety matters?

5. Timely notification of claims
Employers must report claims immediately to BWC or its designee, i.e., the MCO, who in turn, must report them to BWC within 24 hours.

However, employers must ensure they report all cases involving lost time of more than seven days to BWC within 14 days of the date of injury, or one week after the impacted employee of the incident notifies the employer.

What is your process for reporting immediately injuries to BWC or your MCO?

Do you report claims within 14 days of the date of injury or seven days after notification from the impacted employee?

If the answer is no, what causes the delay?

What are you doing or what would you do to follow up with your MCO to ensure timely filing of a claim?

6. Safety- and health-process coordination
Assigning an individual the role of coordinating the company's safety efforts.

Duties must include:

- Helping everyone identify accident prevention and safety and health training needs (possibly through the use of perception surveys, interviews, behavior sampling or other methods);
- Helping supervisors make changes or develop strategies that improve the organization's safety systems and processes;

- Identifying and communicating new safety and health requirements;
- Compiling accident- or illness-related records;
- Tracking progress on safety- and health-related projects;
- Working with employees to optimize safe work practices;

What are the name(s) of your accident-prevention coordinator(s)? _____

How do/does your accident-prevention coordinator(s) perform the above duties?

_____

_____

_____

7. Orientation and training
Orientation and training for all employees.

Orientation must include:

- Presentation of the company safety and health policy;
- Employee responsibilities;
- Medical procedures such as how and when to report injuries or illnesses;
- Actions to take in case of emergency;
- How to report unsafe practices and conditions;
- Return-to-work procedures.

How does your organization accomplish the above orientation activities?

_____

_____

_____

Develop a written safety and health training process that documents specific training objectives and instruction processes.

At a minimum, training must cover procedures for the safe and efficient use of machinery and tools including:

- Ergonomic risk factors and the prevention of cumulative trauma disorders;
- Chemical hazards and how to prevent contact or exposure;
- If appropriate, procedures for lockout/tagout, hot-work permits and confined-space entry.

Do you survey your employees to determine their safety and health training needs? _____

What other methods do you use to determine your training needs?

Do you have a written training plan designed to meet the needs of your employees? _____

8. Written and communicated safe work practices
Publish safe work practices so employees have a clear understanding of how to safely accomplish their job requirements.

You must identify, document and make both general and job-specific safe work practices available.

Do you have written general safe-work practices?_____

Do you have written job-specific safe work practices?_____

What jobs still need written job-specific safe-work practices? As a guide, see the technical information as it pertains to training needs under the Occupational Safety and Health Administration (OSHA).

Do you require employees to sign a statement that they have read, understand and will follow the safe-work practices?_____

How do you plan inform your employees of these written practices?

9. Written safety and health policy
Your top executive must sign a safety and health policy document that all new hires receive. Communicate the policy to all employees, and then review it with them annually.

Do you display this policy on a bulletin board? If no, where is it posted?_____

Do you include it in an employee handbook?_____

If no to both B and C, where is it posted?_____

What other method do you use to inform employees that their safety and well-being is important to the senior officer of your organization?

How often do you review the safety policy with employees?

10. Recordkeeping and data analysis

Internal program verification to assess the success of the company's safety efforts by including audits, surveys and record analysis.

Compile injury- and illness-related data to:

- Identify safety and health process problems;
- Help manage the compensation process;
- Provide information necessary for developing solutions to problems.

What injury- and illness-related data does your organization record and compile?

Do you keep an OSHA 300 log? If not, how do you keep record of injuries?

How has recordkeeping and data analysis helped you identify problems, develop solutions and manage the compensation process?

Do you track near miss or close calls? If yes, what trends have you discovered and corrected?

Safety- and health-management assessment and action plan (Steps 1 and 2)

Please use the following template to document your plan for improving your safety- and health-management process. The assessment section helps you review and identify processes that may not exist or that need improvement. The plan is an effective way to list intended improvements, required action steps, who is responsible for completing each item and the deadline. Accountability is critical for effectively completing the performance goals. This type of action plan will help you hold employees accountable.

Step 1 Visible, active senior-management leadership	Plan of action (describe) a) Doing now	 b) Improvements to be made	Person responsible	Completion date
a) Authorizing necessary resources for accident prevention				
b) Discussing safety processes and improvements regularly during staff or employee meetings				
c) Ensuring management is held accountable for accident-prevention activities and for managing accident-prevention processes				
d) Assessing annually the success of the safety process by using surveys, personal interviews and/or behavior-sampling				
e) Encouraging employees to take an active part in maintaining a safe workplace				
BWC assessment			**Date**	**Meets** **Below**
Step 2 **Employee involvement and recognition**	**Plan of action (describe)** **a) Doing now**	 **b) Improvements to be made**	**Person responsible**	**Completion date**
a) Safety and health involvement teams, focus groups or safety and health committees				

Safety- and health-management assessment and action plan (Steps 2 and 3)

b) Accident-investigation analysis and assessment				
c) Safety and health audits				
d) Acting as instructors for safety and health training programs				
Recognition opportunities can include:				
a) Recognizing employees for excellence in accident prevention;				
b) Recognizing employees for consistently high contributions to safety and health;				
c) Recognizing employees for their contributions to continuous improvement through participation in problem solving, decision making or perception surveys;				
d) Recognizing employees who suggest safety and health improvements or complete safety and health projects.				
BWC assessment			**Date**	**Meets** **Below**
Step 3 **Medical treatment and return-to-work practices**	**Plan of action (describe)** **a) Doing now**	**b) Improvements to be made**	**Person responsible**	**Completion date**
a) Informing employees of procedures for obtaining medical treatment, including informing employees of the selected MCO				

Safety- and health-management assessment and action plan (Steps 3 and 4)

b) Immediate reporting of injuries and illnesses to a supervisor				
c) Regular communication with injured or ill employees who are off work				
d) Investigation of all injuries or illnesses within 24 hours to identify process and corrective measures				
e) When not prohibited by a labor agreement, a modified-duty or transitional-work program allowing employees to return to work in a productive capacity during the recuperative period				
BWC assessment			**Date**	**Meets** **Below**
Step 4 Communication	**Plan of action (describe)** **a) Doing now**	**b) Improvements to be made**	**Person responsible**	**Completion date**
a) Quarterly written and/or verbal feedback to all employees on their accident-prevention performance				
b) A process for upward communication and downward communication throughout the organization, including obtaining and responding to employee suggestions				
c) Communication can include memos, bulletin boards, staff and general meetings				
d) Feedback should include the organization's overall safety and health performance				

Safety- and health-management assessment and action plan (Steps 4, 5 and 6)

BWC assessment			Date	Meets / Below
Step 5 Timely notification of claims	**Plan of action (describe) a) Doing now**	**b) Improvements to be made**	**Person responsible**	**Completion date**
a) Claims are reported immediately to MCO				
b) MCO verifies and reports claim to BWC within 24 hours				
BWC assessment			**Date**	**Meets / Below**
Step 6 Safety- and health-process coordination	**Plan of action (describe) a) Doing now**	**b) Improvements to be made**	**Person responsible**	**Completion date**
a) Helping management and employees identify accident prevention and safety and health training needs through perception surveys, interviews, behavior sampling or other similar methods				
b) Helping supervisors make changes or develop strategies that improve the organization's safety systems and processes				
c) Identifying and communicating new safety and health requirements				
d) Compiling injury- and illness-related records				

Safety- and health-management assessment and action plan (Steps 6 and 7)

e) Tracking progress on safety- and health-related projects				
f) Working with employees to optimize safe work practices				
BWC assessment			**Date**	**Meets** **Below**
Step 7 **Written orientation and training plan**	**Plan of action (describe)** **a) Doing now**	**b) Improvements to be made**	**Person responsible**	**Completion date**
Safety and health written orientation and training plan will include:				
a) Company safety and health policy statement;				
b) Employee responsibilities;				
c) Medical procedures such as how and when to report injuries or illnesses;				
d) Actions to take in case of emergency;				
e) How to report unsafe practices and conditions;				
f) Return-to-work procedures.				

Safety- and health-management assessment and action plan (Step 7)

Safety and health training will include:				
a) Hazard communication;				
b) Bloodborne pathogens, if applicable;				
c) Specific job/task safe-work practices and hazard recognition;				
d) Recordkeeping of employee training and sign-off of training.				
At a minimum, training must cover:				
a) Procedures for safe and efficient use of machinery and tools;				
b) Ergonomic risk factors, including the prevention of cumulative trauma disorders;				
c) Chemical hazards and how to prevent contact or exposure;				
d) If appropriate, procedures for lock-out/tagout, hot-work permits and confined space entry.				
BWC assessment			**Date**	**Meets** **Below**

Safety- and health-management assessment and action plan (Steps 8 and 9)

Step 8 Written and communicated safe work practices	Plan of action (describe) a) Doing now	 b) Improvements to be made	Person responsible	Completion date
a) General safe-work practices				
b) Job-specific safe-work practices				
c) Employees sign statement that they understand and will follow safe work practices				
BWC assessment			**Date**	**Meets** **Below**
Step 9 **Written safety and health policy**	**Plan of action (describe)** **a) Doing now**	 **b) Improvements to be made**	**Person responsible**	**Completion date**
a) Chief executive officer's philosophy on safety and well-being of employees with his/her commitment to quality				
b) Managers, supervisors, team leaders and employees' responsibilities regarding the organization's commitment to workplace safety and health				
c) Commitment to returning injured or ill employees to work safely and quickly				
d) Communicated safety and health policies to employees verbally, posted on bulletin board, in employee handbook				
BWC assessment			**Date**	**Meets** **Below**

Safety- and health-management assessment and action plan (Step 10)

Step 10 Recordkeeping and data analysis	Plan of action (describe) a) Doing now	b) Improvements to be made	Person responsible	Completion date
a) Identify safety- and health-process problems				
b) Help manage the compensation process				
c) Provide information necessary for developing solutions				
d) Linkage between accident prevention and profitability				
e) Specific costs associated with safety and health problems and accidents				
BWC assessment			**Date**	**Meets** / **Below**

Best management practices

Real change starts at the top. The success of any safety effort depends on the commitment, involvement and support of the employer.

Management support and commitment

Best-practice employers are committed to treating employees as individuals, not as machines. One business owner provides the following comment: "These people are like family. I want to provide them with the safest work environment possible. They are my most valuable resource. I want them to be able to go home every day and see their wives and children in the same condition as when they left for work in the morning."

The businesses interviewed for this part of the guide value and support safety like all other business functions. They identify short- and long-term goals, and develop systems to track and measure results.

Designating an individual or group of individuals to coordinate the company's safety activities is clearly illustrative of senior management's support of and commitment to safety. This person or group is charged with developing and coordinating the firm's safety process. Employers hold front-line supervisors accountable for the implementation process.

Best-practice employers hold managers and supervisors accountable for safety, along with such business functions as quality, production, labor costs and waste. One method employers use to hold managers and supervisors accountable for safety is to include safety as an element of the employee's performance review. We recommend business leaders hold their supervisors and managers accountable for monthly reports regarding safety inspections, employee training, incident reports and safety meetings.

Another illustration of management's support and commitment to safety includes their involvement with safety meetings, facility audits and employee training. One company president personally provides training sessions for hourly staff on a monthly basis. In addition, the president participates in training classes provided by outside vendors.

Safety has no price tag for the majority of employers interviewed for this guide. They illustrate their commitment and dedication to safety by providing time and resources for their management team and hourly staff. This includes, but is not limited to, company-sponsored incentive programs, comprehensive employee-training programs, professional development for supervisory and hourly staff, equipment maintenance and modifications, and personal protective equipment.

The most critical element with all the employers is a proactive attitude in wanting to prevent their staff members from getting hurt. They show sincere care for their employees.

Because of market demand, all employers offer employees comprehensive benefit packages that include, but are not limited to above average wages, health insurance, vacations and 401k plans.

In addition, senior management's commitment to safety is illustrated by the use of time and financial resources. For example, one employer provides $30,000 for training on cranes and hoists for supervisors and equipment operators. Another employer provides safety training for all staff members on a weekly and monthly basis. Another employer spends $400 to $500 a month for new slings and material-moving supplies.

The majority of senior managers regularly attend professional safety and health seminars and workshops. These workshops include seminars provided by DSH and other private consulting and/or business associations.

Employers have developed a strong relationship with their local BWC customer service offices. The majority of employers interviewed take advantage of the DSH's training center, video library and reference library.

Keys to a safe workplace

Pre-employment screening

Employers who developed a comprehensive pre-employment screening and interview process have fewer accidents and workers' compensation claim costs. We encourage employers to conduct extensive background reviews of all potential employees. Generally, a member of senior management who is often part owner of the company, conducts initial interviews. Departmental managers, supervisors and group leaders conduct additional interviews. Although not all employers were involved in BWC's Drug-Free Workplace Program (DFWP), the majority implemented a pre-employment drug-screening program.

Drug and alcohol testing

Another key element that illustrates senior management's support for safety is the development and implementation of a drug and alcohol- testing program. Generally, this involves a process of testing employees prior to employment, after accidents and randomly throughout the year. In addition, employers provide training to staff on the effects of drugs and alcohol abuse associated with workplace accidents.

Accident analysis

Accident analysis investigation is a crucial element for any employer's safety process. Statements from several employers indicate that to truly determine the real cause of accidents, managers, supervisors and employees must be involved in the accident analysis/investigation process.

Senior management must be involved with this process, as well. In addition, employers must have front-line supervisors and employees report and follow up with incident reports. The majority of employers typically assign the coordination of this process to one or two key individuals within the company. However, they review and share reports with staff during weekly work-group meetings, monthly safety training and regular safety committee meetings. Many employers said the time and resources used for accident analysis and investigation is returned many times by the useful information identified and in preventing future accidents.

Claims management

In an effort to control and reduce the cost of workers' compensation claims and premiums, employers identify a person in senior management to coordinate these efforts. To manage existing claims, these coordinators work closely with their MCO, BWC claims service specialists and third-party administrators. Strategies, such as transitional and return-to-work programs, assist with keeping costs to a minimum. In addition, employers take advantage of BWC's settlement process to reduce and/or eliminate the high cost of claims. Employers that develop strong relationships with their BWC representatives and MCO tend to have fewer claim costs than other employers.

Employee issues

Training

Employee training is a key issue for all employers interviewed. As stated, senior managers take advantage of BWC's Ohio Center for Occupational Safety & Health (OCOSH) training center.

Aside from the OCOSH training center, many employers permit staff members to attend seminars and workshops provided by several employer associations. These associations include the Ohio Manufacturers Association, National Federation of Independent Businesses, American Society of Safety Engineers, National Safety Council, and local chapters of the National Tooling and Machining Association. Also, many employers provide hourly staff with OSHA's 30-hour and 10-hour training courses.

Proactive employers that value their staff and truly believe there is a cost benefit to safety, provide and support training for their associates that exceeds mandates from OSHA and other regulatory agencies.

Many employers provide staff training on a regular basis. A number of employers stated employee training is essential to keep their staff aware of safety concerns while performing their jobs. One method is to require front-line staff to conduct daily or weekly safety discussions with coworkers.

Employers should also develop written standard operating procedures for all company jobs and tasks. Specific safe-operating procedures comply with OSHA, as well as other safety and health requirements. These procedures serve as a valuable tool for training new or reassigned employees. Several employers developed placards with safe-operating procedures for illustration on machinery and equipment.

Employers should provide time and resources to educate employees on safety and health issues. In addition to the mandated training by federal standards, employers should provide comprehensive training for all staff members regarding job-specific standard-operating procedures.

Make qualified in-house or outside instructors available to provide training for employees.

Involvement

Employee involvement is illustrated through safety committees and work groups.

Safety committees or project teams focus their efforts on hazard correction and abatement, equipment modifications to improve safety and efficiency, and safety and health program review and development. These teams or work groups generally meet monthly for an hour at a time. Depending upon the circumstances, some focus groups meet weekly.

To promote employee involvement, several companies assign hourly staff to provide safety training for new employees (on-the-job training). To assure staff members are competent, management allocates time and resources for professional development. This is typically done by using local safety and health seminars and workshops. Also, employers provide hourly staff with opportunities to assist in departmental safety inspections.

Recognition

Employee recognition is illustrated through the use of company-sponsored luncheons, family dinners, holiday parties, flexible work schedules or gift certificates. Other illustrations of employee recognition include opportunities to attend the Ohio Safety Congress & Expo, year-end bonuses, employee-of-the-month plaques, and special recognition certificates provided when staff members assisted with special projects.

Employers with the greatest success primarily showed their associates they value them as individuals. Employers recognize staff through positive re-enforcement. Some employers feature staff members in monthly newsletters for achievements in their career and/or job performance.

Housekeeping

Hazard recognition and abatement

Safety audits or inspections are a critical element in a safety process. For the employers interviewed for this guide, the majority rely on the use of outside experts to assist them with annual safety audits. In addition to comprehensive annual inspections, employers generally require safety teams or departmental supervisors to conduct routine inspections of work areas. Again, with the most proactive employers, senior management is directly involved with this process. The business owner will assist the safety and health specialist during annual facility evaluations.

The most beneficial way to use safety inspections is for employers to prioritize items, assign responsibility to appropriate staff and hold employees accountable for corrective actions.

When using in-house staff to conduct safety audits, employee training is vital. Provide employees training on all applicable safety and

health standards, company standard operating procedures and industry guidelines. For example, maintenance staff should know and understand the National Electrical Code prior to conducting electrical safety inspections. Also, machine operators should know and understand OSHA and the American National Standards Institute's standards for equipment and machinery when performing machine guarding audits.

Written safety programs

Written safety programs are another key element to any organization's safety process. Review applicable state and federal safety requirements for written programs that apply to your business. Below is a brief summary of written programs that apply to most businesses in your industry:

- Accident investigation;
- Crane/hoist/sling;
- Confined space;
- Emergency action/fire prevention;
- First aid;
- Bloodborne pathogens;
- Hazard communication;
- Hearing conservation;
- Lockout/tagout;
- Personal protective equipment;
- Powered industrial trucks;
- Respiratory protection.

Industry standards typically help develope site-specific programs that comply with federal and state regulations.

Safety standards relative to the plastics industry

One of the most active standards organizations in the United States that coordinate the development and use of voluntary consenus standards for global use is the American National Standards Institute (ANSI). According to the organization's Web site, its library contains 854 standards that apply to the plastics industry, plastic materials, processing, systems and fabricating.

The goal of ANSI safety standards is to help designers avoid recognized hazards in their equipment designs, establish standard design procedures to safeguard equipment, and/or establish standard procedures to warn people who operate the equipment about the safety hazards associated with equipment. To ensure the American workers' safety, OSHA will reference ANSI standards in lieu of the general machining standard if an industry-specific recognized standard exists.

ANSI publishes its standards and offers them for sale in both electronic and paper forms. ANSI's Web site address is http://webstore.ansi.org/. Prices range from about $26 to $140.

Specific ANSI standards for the plastics industry

1. ANSI/SPI B151.1 - Horizontal Injection Molding Machines – Safety Requirements for Manufacture, Care and Use
2. ANSI/SPI B151.2 - Film Casting Machines – Construction, Care and Use
3. ANSI/SPI B151.4 - Blown Film Takeoff/Auxiliary Equipment – Construction Care and Use
4. ANSI/SPI B151.5 - Plastic Film and Sheet Winding Machinery – Manufacture, Care and Use
5. ANSI/SPI B151.15 - Extrusion Blow Molding Machines – Safety Requirements for Manufacture, Care and Use
6. ANSI/SPI B151.20 - Plastic Sheet Production Machinery – Manufacture, Care and Use
7. ANSI/SPI B151.21 - Injection Blow Molding Machines – Safety Requirements for Manufacture, Care and Use
8. ANSI B151.26 - Plastics Machinery – Dynamic Reaction – Injection Molding Machines – Safety Requirements for the Manufacture, Care and Use
9. ANSI/SPI B151.27 - Robots Used with Horizontal & Vertical Injection Molding Machines – Safety Requirements for the Integration, Care and Use
10. ANSI B151.28 - Plastics Machinery – Machines to Cut, Slit or Buff Plastic Foams – Safety Requirements for the Manufacture, Care and Use
11. ANSI/SPI B151.29 – Safety Requirements for the Manufacture, Care and Use of Vertical Clamp Injection Molding Machines

You can find European standards relative to the plastics industry at www.euromap.org.

Industrial hygiene concerns with plastics processing

The three main steps involved in the production of a commercial plastics product are polymerization (resin manufacturing), compounding (adding plasticizers, pigments and fillers) and processing (forming to a specific shape). The following discussion addresses the health of plastics processing. The health hazards associated with plastics processing depend upon the materials being processed, as well as the unit operations. However, there are common issues that recur in many of the specific operations.

Resin thermal decomposition

Polymerized resins are generally considered inert and do not present a risk. However, resins are shaped by a variety of processes, most of which involve heat. Much concern is often expressed

regarding exposure to thermal decomposition products.

All compounded resins have a temperature above which the product will degrade and form thermal decomposition products. These products are generally the source of employee complaints. The mechanisms of thermal decomposition are often complicated. The types and amounts of decomposition products vary widely, depending upon the process, temperatures and raw materials used.

Exposure to decomposition products is not a concern under normal operating conditions. Even slightly exceeding the upper temperature limit of a resin typically will not cause decomposition products to be emitted at high concentrations. However, problems may occur when the processing temperatures exceed the normal recommended range by a large margin such as with equipment malfunction or improper purging operations.

Below are examples of some common resins and reported thermal decomposition products:

- Polyolefin resins (polyethylene/polypropylene) — formaldehyde, acetaldehyde, acetone, formic acid and acetic acid;
- Polystyrene resins (ABS/SAN) — styrene monomer, benzaldehyde, acrolein and acrylonitile;
- Phenolic resins — phenol and formaldehyde;
- Amino resins — aldehydes and hydrogen cyanide.

Almost all fire and overheating situations with plastics will produce smoke, carbon dioxide and carbon monoxide. The listed resins and thermal decomposition products are not complete. So, it is important to be aware of the thermal decomposition products and potential health impacts that can be produced by overheating in your particular operation. It is always a good practice to read the resin's MSDS or consult with the resin supplier or an industrial hygienist.

If the generation of thermal decomposition products is a concern, then, depending upon the nature and type of emission, you can monitor exposures using a variety of sampling techniques. You can monitor most substances using sampling pumps and appropriate media. Direct-reading instruments may be necessary for some substances to monitor during peak exposure periods. Use local exhaust ventilation to control excessive emissions.

Noise

Noise and hearing loss represent a common health hazard in many plastics-processing operations. Typical operations of concern are those where large quantities of compressed air are used or scrap processing is performed.

You can measure noise exposure using sound-level meters and noise dosimeters, together with careful observation and documentation of worker duties. If eight-hour average exposures equal or exceed 85 decibels (dBA), A-weighted, then, make hearing protectors available and include affected employees in a hearing conservation program that includes annual audiometric testing, training and recordkeeping. When eight-hour average exposures exceed 90 dBA, you should evaluate engineering controls and make the use of hearing protection mandatory.

Where compressed air sources contribute to excessive exposures, you can often make noise reduction modifications. You can often reduce air-discharge noise on molding machines with the proper application and maintenance of mufflers, commercially available silencers. Properly directing the air blast can reduce air-ejection noise and using noise-reducing nozzles on compressed air hoses also can have a positive impact. You can reduce noise from scrap processing (grinders) with a good preventative maintenance program that includes procedures to:

- Maintain gears and bearings;
- Maintain sharpness of the cutting blades;
- Maintain integrity of the equipment covers and cleanout doors;

- Replace worn or damaged rubber flaps at feed openings;
- Repair sound-absorption material.

Many grinders have the feed opening at ear level, and you can fabricate or purchase a modified throat to redirect the feed upward or to the side. Another control measure is to replace grinders at individual molding machines with one large remotely located and enclosed grinder to handle the entire facility. A thorough engineering evaluation is advisable before you consider any major noise-control options. Noise reduction of three to five decibels is often achieved with very simple, inexpensive solutions.

Heat stress

Most plastics-processing operations involve heat, so heat stress is always a concern, especially during the year's warm months. The process heat, in combination with the air temperature, humidity, radiant heat (typically from the process) and air velocity affect the amount of stress the worker faces. Perhaps most important to the level of stress an individual faces are personal characteristics, such as age, weight, fitness, medical condition and heat acclimatization.

Common heat disorders (from most serious to least serious), their symptoms and first-aid include:

- Heat stroke — sweating stops and skin becomes hot, dry and flushed, confusion, delirium, loss of consciousness or coma. Heat stroke can be fatal. Seek medical attention immediately, then, if possible, move victim to a cool place and soak clothing in cool water, and fan the body;
- Heat exhaustion — sweating, clammy skin, pale or flushed complexion, weakness, dizziness and nausea. Rest in a cool place and drink cool water or other fluids. Seek medical attention if vomiting or loss of consciousness occurs;
- Heat cramps — painful spasms or cramps in muscles. This can occur during or after work. Massage the affected muscles and drink fluids that will replenish electrolytes;
- Heat rash — Also known as prickly heat, this is a rash that occurs when sweat is not easily removed from the skin by evaporation. You can prevent this by resting in a cool place and allowing the skin to dry.

You can prevent heat-related disorders with proper planning. Such planning should allow for employee education, plenty of easily accessible water, acclimatization to heat with short exposures initially followed by longer periods of exposure. Take plenty of rest breaks and schedule work during cooler parts of the day. Use engineering controls such as general ventilation, spot cooling and radiant heat shielding if feasible. Using personal cooling devices or protective clothing also can help reduce heat stress.

Dermatitis

Polymerized resins are generally not considered to be skin hazards. However, exposure to some resins, such as unsaturated polyesters can cause dermatitis. Dermatitis associated with plastics can be caused by primary irritation or by sensitizing agents.

A primary irritant causes a reaction by direct action on the skin if the concentration and time of exposure are sufficient. Strong acids, alkalis and solvents are examples of primary irritants.

A sensitizer may not show any dermatitis with initial contact. But the skin can become altered so that after a period of weeks or years subsequent, contact will cause an allergic reaction. Formaldehyde, isocyanates and organic amines are examples of sensitizers. Where dermatitis is an issue, completly eliminating skin contact with

the offending agent is the ideal preventative measure. Where some contact is unavoidable or where gloves are impractical, personal cleanliness is the next best protection method.

Robotics

Industrial robots are programmable multifunctional mechanical devices that move material, parts or tools through variable programmed motions to perform a variety of tasks. Robots are generally used to perform unsafe, hazardous, highly repetitive and unpleasant tasks. They have many different functions such as material handling, assembly, welding, machining, unloading, painting, spraying, etc.

With an estimated 100,000 robots used in North America's manufacturing plants, it is critical that companies understand robot safety. Studies indicate many robot accidents do not occur under normal operating conditions. Instead, they occur during programming, maintenance, repair, testing, setup or adjustment. During many of these operations, the operator, programmer or maintenance worker may temporarily be within the robot's working envelope where unintended operations could result in injuries.

ANSI, in cooperation with the Robotic Industries Association (RIA), has established requirements to enhance the safety of personnel using industrial robot systems. ANSI/RIA R15.06, Safety Requirements for Industrial Robots and Robot Systems addresses manufacturing and rebuilding, performance requirements, safeguarding, maintenance, testing, training and more.

Other standards, guidelines and organizations

National Institute for Occupational Safety and Health (NIOSH) Technical Report No. 88-108. Safe Maintenance Guidelines for Robotic Workstations. Available on their Web site: www.cdc.gov/niosh

OHSA Directive STD 01-12-002. Guidelines for Robotics Safety, 1987. Available on their Web site: www.osha.gov

OSHA Technical Manual (TED 01-00-015), Section IV, Chapter 4, Industrial Robots and Robot System Safety. Available on their Web site: www.osha.gov.

RIA, (734) 994-6088, www.roboticsonline.com

Ergonomics

The ergonomic approach to prevention

The most direct way to address job design and equipment problems is through engineering. Ergonomics focuses on permanent solutions in which safe work is the result of improved workplace designs and better work methods. Ergonomics' goal is to fit the job to the worker. You can accomplish control in the workplace by ergonomically reducing job demands of high force, repetition and awkward postures.

Extreme joint movement

You must design jobs well within a joint's range of motion. Any movement that overextends a joint can be harmful by overstretching tendons and ligaments. Additionally, muscles are weakest when fully extended or contracted. Work can be most efficiently performed in postures where joints are about at the midpoint of the range of movement because muscles are strongest in midflexion.

Job design should allow for the following work posture:

- Shoulders relaxed;
- Elbows close to the body;
- Elbows bent about 85 degrees to 120 degrees;
- Wrists aligned straight with the forearms.

Promote this minimally fatiguing posture by:

- Altering tools or controls;
- Moving parts;
- Changing the position of the worker.

Excessive force

You should design activities requiring excessive or prolonged muscle contractions so the worker need not exert more than 30 percent of his or her maximum force for a particular muscle. We recommend that any muscle contraction not exceed 50 percent of maximum strength capabilities. Design force requirements within these parameters for the weaker individuals expected to perform the job.

Corrective measures to reduce muscle effort include:

- Minimizing the force required;
- Spreading the force over a larger area;
- Providing better mechanical advantage.

Repetitiveness

Since repetitiveness is associated with a number of ergonomics problems, make an effort to limit the duration of continuous work. Alter work methods to reduce repetitive levels of work cycles. Levels of harmful repetition are not well defined. But, studies indicate jobs having a cycle time of less than 30 seconds, and a fundamental cycle that exceeds 50 percent of the total cycle time, should be considered an increased risk. Other sources suggest production standards exceeding 900 units per shift indicate high repetitiveness.

Reduce repetition by:

- Enlarging the task (that is, re-sequence or combine tasks);
- Mechanizing parts of the task;
- Automating the task.

Situations to avoid in job design

- The worker should not have to bend forward from the waist for extended periods of time.
- The worker should not have to twist the upper body or bend laterally while performing the task.
- The worker should not have to routinely or repeatedly kneel, stoop or squat.
- The worker should not have to tilt or turn the head excessively while performing the task.
- The arms should not have to be elevated or outstretched repetitively or for extended periods of time.
- The wrists should not have to be deviated excessively in any direction.
- The task should not require repetitive or sustained use of a pinch grip.
- The worker should not have to perform the same motions or motion pattern every few seconds for an extended period of time.
- Objects should not have to be held in the hands for extended periods of time.
- The worker should not have to stand or sit without moving for extended periods of time.
- The worker should not have to constantly use vibrating or impact tools.
- The worker should not have to use excessive force to move materials or to operate tools.

Commonly used ergonomic interventions

1. To reduce repetitiveness:
   - Provide mechanical aids for handling materials and for performing high-speed, repeated tasks;
   - Enlarge (expand) the work content to vary the task demands;
   - Rotate workers on repetitive tasks to distribute the risk and reduce individual exposure;
   - Increase the time allowance to complete the task; reduce forced work;
   - Spread the workload uniformly across the shift to reduce periods of excessively high production.

2. To reduce force requirements:
   - Minimize the weight of tools, containers and parts;
   - Provide handholds that increase the friction between the hand and the object;
   - Provide suitably-sized and shaped handles;
   - Provide gloves that minimize the negative effects on performance;
   - Provide well-balanced tools and containers;

- Replace manual tools with powered tools and devices;
- Use torque-control devices;
- Optimize the pace of the work to allow frequent rest pauses within the work cycle;
- Provide mechanical assists to reduce repetitive lifting and holding.

3. To reduce mechanical stresses:
   - Provide rounded corners and edges on worktables, handles and other objects where hands and arms make contact or rest;
   - Use padding and cushions to support arms and wrists from hard or cold surfaces;
     provide non-metallic handles or tool-handle wraps to reduce concentrated forces to the hand and fingers;
   - Keep the weights and sizes of materials, containers and parts well within the workers' strength capabilities;
   - Minimize arm and hand exposure to vibration.

4. To reduce awkward postures:
   - Locate work in front of the worker within easy reach;
   - Provide the work at an appropriate working height;
   - Arrange tools, materials, parts, fixtures, etc., in a logical, efficient orientation;
   - Provide tools and devices appropriately designed for the worker and the workstation configuration.

Guidelines for designing workstations

Working heights

One way to minimize stresses in the workplace is to provide appropriate working heights. Chairs, stools, workbenches, tables and equipment dictate what posture employees will assume while performing their jobs.

If the work is raised too high, the worker must compensate by lifting up the shoulders. This posture can lead to painful cramps at the shoulder-blade level and in the neck and shoulders. If the working height is too low, workers must work with a bent spine or extended forward tilting of the head that will lead to chronic neck and upper back pain. Thus, the working height must suit the person's height, whether sitting or standing at work.

Standing

Employees perform many jobs while standing, and, in some cases, for extended periods of time. Excessive stress and static loads are placed on the back and legs muscles, resulting in unnecessary fatigue and often pain. Reduced performance is the immediate result, with permanent damage to the body a long-term effect.

There are many alternatives available to lessen the physical stresses on such a worker. Allowing the employee to change postures and minimize static loading of muscles will greatly reduce stress and fatigue.

Providing a footrest or rail that allows the employee to stand with one foot up periodically will lessen static loads and stress. Alternating feet will provide further comfort. Resilient visco-elastic floor mats reduce static loading of leg muscles. Provide these wherever extensive standing is required, especially on concrete floors. In workplaces where floor mats are not practical, workers can use anti-fatigue shoe inserts to reduce static-muscle loading. Adjustable chairs or stools can offer periods of reduced stress on the legs. Many tasks that are performed when standing could be just as effectively done when seated.

Giving the employee several opportunities to change position by providing footrests, mats and the choice between sitting or standing will effectively reduce the risks of long-term standing.

Sitting

Sitting is often preferable to standing. However, chairs and stools must be correctly designed for the task, workplace and person. Poorly designed chairs can contribute to back problems, restrict circulation (especially at critical bending points, like the knees and waist), cause fatigue, breathing problems and pressure on nerves.

Even a well-designed chair can be the source of a problem if it is inappropriate for the requirements of the job. Different tasks will dictate the features required of a chair or stool. However, the chair, workstation or both should be adjustable to accommodate different sized workers.

The key chair components are the seat, backrest and armrests (if needed). They must be adjustable to fit body size, contours and personal work habits.

The backrest should provide a pivoting action to follow natural body movements and maintain lumbar support. It should be convex in shape from top to bottom and concave from side to side to conform with the contour of the back's lumbar area and to help keep the occupant centered in the chair.

The seat should slope slightly backward. This encourages the occupant to sit back in the chair and use the backrest for lumbar support. The seat's front should contour to avoid pressure on the back of the knee. Seat depth should be adjustable from front to rear in relation to the backrest position. The seat height should adjust so that the feet remain squarely on the floor. If this is not possible, a footrest is necessary.

Armrests should adjust front-to-back and side-to-side, and should remain parallel with the seat and floor. Proper placement of the armrests is necessary to reduce pressure on the seat surface and load on the spine. In some work settings, armrests can be obstacles.

Depending on the job and the worker, choose the chair's design on an individual basis. The chair must not restrict necessary productive movements. A backrest located too high and too large can produce bruises in various areas of the back and thorax. Also, an armrest supporting a moving elbow may lead to swelling and inflammation.

Other factors that you should consider when choosing the appropriate chair include frictional properties, softness, climatic comfort, number of feet and casters. Use casters when chair movements are often required. Five or more casters (or feet) are recommended over four to increase stability.

Worktables

Ideally, to provide a fully adjustable workplace, the tables and benches should also adjust to fit the worker and the task at hand. Proper height and tilt requirements can then be maintained. If adjustable benches are not economically feasible or the operating level at a machine cannot be varied, then design working heights to suit the tallest workers. You can give shorter persons something safe to stand on.

The most comfortable working height for manual materials handling is about 30 inches (knuckle height) for standing work. Keep in mind though that proper work height depends on the nature of the job. Bench work is usually much higher and can be determined by an individual's elbow height and the type of work. The elbow height is the distance from the floor to the underside of the elbow when it is bent at a right angle with the upper arm vertical. Generally, as work becomes heavier, requiring more physical strength, the worksurface should be lower. We recommend the following guidelines for determining bench heights for standing work:

- Precision work — about 2 to 4 inches above elbow height;
- Light work — about 4 to 6 inches below elbow height;
- Heavier work — about 6 to 16 inches below elbow height, depending on the task.

Recommended working heights for standing work are based on average body measurements, with no allowances for individual variances.

They only represent general guidelines.

Keep work materials and tools in a logical order and within easy reach of the worker (18 inches or less from point of operation, if possible). You can use small bins, trays and racks to store small parts to contain them and make them easily accessible.

Provide holders, racks or supports to facilitate storage and access to tools. Worktables and benches must provide adequate space for all tools, equipment, materials, fixtures and containers. Padded elbow supports are often advantageous in delicate work to reduce static loads in the back muscles and mechanical forces to soft tissues in the forearms. All edges of worksurfaces should minimally be rounded where elbows or forearms might make contact.

Ergonomic concerns specific to the plastics industry

- Manual materials handling – lifting, lowering, pushing, pulling, holding and carrying
- Handling raw materials
- Handling finished products
- Using tools
- Opening/closing safety gates
- Retrieving work in process (WIP)

Cumulative trauma disorders — caused by repetitive tasks, awkward postures and forceful exertions
- Parts trimming
- Packaging of parts

Ergonomic risk factors

High repetition
- Trimming parts – knives, gate cutters
- Materials handling
- Removing parts from machines

Forceful exertions
- Opening/closing safety gates and doors
- Trimming parts — knives and gate cutters
- Removing parts from machines
- Manual lifting — palletizing
- Manual lifting — raw materials
- Manual lifting — WIP

Awkward postures
- Trimming parts — knives and gate cutters
- Manual lifting — forward bending
- Opening/closing safety gates and doors — reaching
- Removing parts from machines — reaching

Mechanical pressure
- Trimming parts — knives and gate cutters
- Trimming parts — contact with sharp edges of worksurfaces
- Trimming parts — poorly designed seating

Static loading
- Prolonged standing
- Prolonged sitting
- Constant holding of tools
- Working heights — holding the arms up

Environmental stresses
- Exposures to heat
- Wearing of personal protective equipment (PPE)

Inadequate recovery time
- Work cycles with no rest pauses
- Overtime

You must provide sufficient clearances for legs and feet below the work surface. Seated workstations need considerably more leg space than standing workstations. There must be at least 7 inches for thigh clearance between the bottom of the work surface and the top of the seat pan. Footrests may be needed to support the legs and feet of smaller people to take the weight off the thighs.

Note: Working height is not always bench height. Instead, it is the height at which the work is done. Additional considerations are necessary for jigs, fixtures and product configurations, both for standing and sitting work postures.

Adjustability and anthropometry

Use anthropometric data to design worksta-

tions to accommodate different sized people. In general, a well-designed workstation will adjust to provide reasonable comfort for at least 90 percent of the workers. Workstation adjustability should focus on:

- Permitting several different working postures;
- Allowing hands to be comfortably placed in front of the body with elbows bent most of the time;
- Minimizing reaches for controls, tools and materials;
- Locating objects to be used between shoulder and knee height for material handling tasks.

The basic principles* of anthropometric design are below.

1. In general, don't design for the average.
   - When workstations are designed for the average-sized person, bigger and smaller people usually will not be accommodated.

2. Design for the extremes.
   - When designing for clearance, use the 95th percentile male measurements.
   - When designing for reach, use the 5th percentile female measurement.
   - When designing for safety, accommodate 100 percent of the population.

3. Design for a range.
   - Designing for low-stress lifting means placing pick-up and disposal points between the 95th percentile male-knee height and the 5th percentile female shoulder height.

4. Design for adjustability.
   - Whenever possible, a workstation should have elements that can be adjusted to the sizes and physical capabilities of the different people who use it.

* Taken from *Anthropometry Slide Guide*, a publication of the UAW-Ford National Joint Committee on Health and Safety.

Guidelines for designing work methods

Jigs and fixtures

Many jobs are designed such that the worker must use the non-preferred hand to hold the workpiece. This effort represents a static load on affected muscles and tendons, and often results in the sustaining of awkward arm/wrist/hand postures increasing the risk for cumulative trauma disorders (CTDs). Holding small objects in a pinch-grip posture increases the strength requirements of the task and accelerates the rate of fatigue that over time can contribute to CTDs. Therefore, we recommend to use jigs and fixtures whenever possible to hold the work.

Job re-sequencing

Job analysis often can identify elements in a job sequence where long static contractions occur or where frequent repetitions are performed. Rearranging the tasks can reduce or eliminate these undesirable task requirements. Often, you can more evenly distribute effort between both hands, or design the job to distribute the workload over different muscle groups and joints. Applying laws of motion economy also can improve productivity.

Combining jobs

You can often combine jobs with very short cycle times to provide the workers with more varied movements, reduce repetitiveness. Combining tasks also may reduce materials handling, storage for work-in-process and unpacking/repackaging of containers.

Research indicates that enlarging the job increases job satisfaction by instilling a sense of accomplishment because the worker has more personal control and responsibility for a finished product. This translates into improved worker productivity and quality. Combining jobs represents a viable alternative to worker rotation and may offer elements of job enrichment that worker rotation cannot.

Automation
Because of the work's complex nature, some jobs may be too difficult or costly to redesign to eliminate the biomechanical stresses associated with CTDs. In such cases, substitute automation or semi-automation to take over stressful, repetitive tasks that are high risks for CTDs. Workers can then perform as machine operators and perform less strenuous tasks.

Automation also can have a negative side. While reducing physical stresses, it also serves to simplify jobs, reducing them to single repeated acts. Automation can concentrate biomechanical forces on more vulnerable parts of the musculoskeletal system such as the hands and wrists.

Pace of work
Studies indicate that self-paced work is more desirable than paced work. Since workers are different, a forced pace is optimal for very few workers. A pace that is too slow will offer inadequate challenge, producing inattentive, unmotivated workers. A pace that is too fast may accelerate local muscle fatigue and increase the risk for CTDs. Alternatively, self-pacing makes it easier to find people willing to do the job and more likely that they will remain on the job.

Work hardening
New hires, transfers and employees returning from an extended absence due to an injury should start at a slower rate. This process of work hardening or conditioning helps the worker physically adjust to the job without experiencing soreness or injury. Soreness is in part associated with micro-tears in the connective tissues caused by forceful lengthening from unaccustomed repetitive exertions.

The amount of time needed to condition a worker will vary from individual to individual, but several weeks may be needed for a worker returning from an injury or CTD. Research indicates that workers introduced to the job at a slower pace develop better work practices and have less soreness.

Rest pauses
To provide recovery time for the forearm and hand muscles, design pauses into the work cycle. Insufficient recovery time will accelerate the rate of fatigue and increase the potential for CTDs. No clear-cut guidelines exist to accurately determine the amount and length of rest pauses within a work cycle. However, the required recovery time is a function of both the cycle time and the required effort used to perform the task. For example, higher effort would indicate more recovery time needed as would shorter cycle time. Work duration, rest breaks and production levels need to be derived directly at the work site for each job situation. Unfortunately, this is usually a process of trial and error.

Design guidelines for tools and chairs

Design guidelines for parts trimming knives
- Knife handles should be cylindrical or oval shaped.
- Knife handles should be at least 4 inches long. If gloves are worn, at least half inch should be added to the handle length.
- Knife handles should have a diameter of one inch to one and one-half inches. (one inch to one and one-quarter inches for smaller hands or gloved hands).
- The knife handle should be flanged at the front and back to reduce hand slippage.
- Knife handles should be covered with a textured rubber material, or made from wood or slightly compressible plastic or rubber. Textured surfaces are recommended because they aid in sensory feedback.
- To facilitate a straight-wrist posture, it may be desirable to bend the knife handle.
- The handle should not be form-fitted or have sharp edges or protrusions that may concentrate pressure on the hand's soft tissues.
- For repetitive tasks, a wrap-around handle can be provided that prevents the knife from slipping from the hand and allows the user to periodically reduce grip force and relax the hand.

- If a knife is used frequently, provide a belt-mounted sheathe or holder. This will reduce static loading of the hand and it will reduce misplacing the knife.
- Provide a variety of knife handles so workers can choose the style and size that best fits their hands.
- Keep knives clean so that grease, oil and other slippery substances do not accumulate on the handles. This makes them difficult to hold and control.
- Store knives and replacement blades in sleeves or protective holders when not being used. Never leave a knife laying on surfaces where they may not be seen.
- Institute a regular inspection, knife sharpening and blade-replacement program. A sharp knife requires less effort when performing a cut and, thus, reduces stresses to the hand and wrist. Train workers who routinely use knives to sharpen the blade or replace worn blades. Inspect knives on a regular basis. Replace a knife when it is no longer effective or when the handle is damaged or worn.
- Utility knives and box cutters should have retractable blades. Spring-loaded blades are desirable on tasks of short duration that are not highly repetitive because the blade automatically retracts when the blade selector is released. Frequently replace blades and have a supply readily available for the worker.
- Provide mesh gloves and mesh armcots for high-risk operations. Mesh gloves should be worn on the hand handling the part to prevent lacerations.
- In cold environments, give workers the opportunity to periodically warm their hands or provide them with gloves for thermal comfort. Cold reduces tactile feedback, causing excessive force to be applied when handling objects and using tools, and makes precision hand movements more difficult. Cold also reduces blood circulation and can accelerate fatigue. If gloves are provided, stock several sizes to comfortably accommodate differentsized hands.
- Sufficient lighting is necessary to facilitate vision when using knives. However, exercise caution when locating task lights to avoid glare.
- Provide large, unobstructed work surfaces so workers can use natural hand and arm postures. Cramping the arms and hands and forcing them into awkward postures reduce the workers' strength capabilities. Crowded conditions also invite neighbor cuts, resulting in injury to fellow employees.
- Consider providing a knife with a blade that swivels or a fixture that rotates the part to avoid awkward arm postures. This reduces bending and twisting of the wrist, forearm and elbow.
- Provide a knife safety-training program for all new workers who use knives on the job. Require workers who experience a knife injury to repeat the training. Instruct workers to perform cuts away from the body so that if the knife slips, it is less likely to cause a stab wound or laceration. Workers should not support objects with one hand and make cuts on the object with the other. Always place the object onto a secure surface before using the knife. When possible, workers should turn the object being trimmed or cut instead of compensating with the wrist and arm.
- Even with proper training in acceptable work methods and techniques, fatigue can reduce accuracy and increase the likelihood of error. Keep work schedules and pacing well within the workers' capabilities. A sense of urgency or hurry, especially combined with fatigue, will additionally contribute to errors and short cuts. During periods of high production, implement worker rotation to reduce fatigue.

Design guidelines for pliers

- If necessary to minimize wrist deviation, bend the pliers handles.
- Pliers handles should promote a comfortable power grasp using all of the fingers. You can achieve maximum strength capabilities when you distribute forces evenly through the whole hand.

- Handles should be rounded so that no sharp edges dig into the hand's soft tissues.
- Wider handle surfaces better distribute forces over a larger area of the hand and fingers, further reducing concentrated mechanical pressures.
- Handles should be non-metallic to reduce thermal conductivity.
- To comfortably accommodate a gloved hand, handles should be at least 4 inches long. To facilitate a comfortable power grasp, one-half inch should be added to the handle's length.
- The handle span of pliers should be between 2 inches and 2.7 inches. This span should accommodate maximal grip strength capabilities for most male and female workers.
- Spring-load the handles of pliers for repetitive jobs to enable the operator to use strong hand-closing muscles, rather than weak hand-opening muscles. This also will reduce trauma to the soft tissues on the back and sides of the hand and fingers.
- Cover handles with a slightly compressible rubber that provides a higher degree of friction. A textured surface can aid grip. However, avoid deep grooves, ridges and form-fitted handles.
- Remove from service any pliers with worn or damaged jaws that may increase the required hand forces needed to use the tool.
- Avoid designing jobs that require the frequent use of pliers and constant tool holding. Static loading of muscles and tendons can be relieved by allowing the worker to periodically release their grasp on the pliers. Provide a suitable place to store the pliers when not in use. This helps to prevent damage or contact with foreign materials that may affect the worker's ability to safely use the tool.

Design guidelines for production chairs and stools

- The seat pan should be height adjustable (preferably hydraulic or pneumatic cylinder type). We suggest that the seat surface be adjusted to 1 to 2 inches below the knee fold when the lower limb is vertical.
- The seat front should be rounded to relieve pressure in the popliteal area (behind the knee).
- The seat surface should slant slightly backward (3 to 5 degrees) to prevent sliding out of the seat pan and to encourage use of the backrest.
- The backrest should provide adjustable lumbar support both up-and-down and in-and-out. Additionally, adjust the backrest to avoid pressure to the back of the knee (the popliteal cavity) at the front edge of the seat pan.
- The backrest should be narrow enough to not interfere with the worker's arms and rib cage during the work cycle. Usually a kidney-shaped backrest positioned to clear the pelvis will ensure maximum mobility.
- To encourage workers to make adjustments to their chairs, have simple and easy to operate controls. Ideally, the user should be able to make adjustments while seated. No tools or special devices should be necessary to make the adjustments.
- Production chairs should generally not have armrests.
- The seat pan and backrest should be padded and upholstered with a breathable fabric. The covering should be textured to reduce sliding. Provide at least 2 inches of padding.
- The chair base should be wide to provide stability. Five legs are preferred to four with a minimum radius of 12 inches to prevent tipping, and a maximum radius of 14 inches to prevent tripping over the base. Production chairs and stools should generally not have casters unless frequent chair movements are necessary to perform the task.
- Provide an adjustable footrest at workstations where the worker's feet do not comfortably reach the floor. Position the footrest to take weight off of the thighs. The footrest should offer a large surface on which to comfortably place the feet. Footrests may be a part of the stool assembly, the worktable or an independent unit.

Additional workstation considerations for seated work

- Chair height should position the worker such that the work surface is at or slightly below elbow height. Providing height adjustable work surfaces with adjustable chairs and stools can facilitate fitting the workstation to the worker.
- Locate all materials, tools, controls and other objects within easy reach of the worker (18 inches or less). Frequently used objects should be within 10 inches, especially on light-assembly tasks. Avoid reaching below the work surface, to the floor and behind the worker.
- Provide ample leg and foot clearance underneath the work surface. The distance between the top of the seat and the bottom of the work surface should be between 7 inches and 11 inches.
- The work surface should be as thin as possible (about 1 inch to 2 inches thick).
- The edges of the work surface should be rounded where the worker commonly places his or her elbows and forearms. Padding the work surface's edge can further relieve pressure to the arms' soft tissue and nerves.
- It is sometimes advantageous to tilt the work surface toward the worker and/or provide holding fixtures to allow the worker to sit back in the chair and use the backrest for support.
- Suspend tools that weigh a few pounds or more over the work surface.
- Design workstations to allow for both standing and sitting postures. Alternating between sitting and standing can relieve the effects of static-muscle loading. A prop stool is an alternative to chairs in many sit/stand situations.
- If necessary, provide appropriate general lighting and suitable task lighting. Insufficient light can cause workers to lean forward and try to get close to their work, forcing a bent- spine posture and negating the backrest's effectiveness. Inappropriately directed lighting and glare can force workers into awkward sustained postures.

Manual lifting safe practices

Employees should practice the following concepts when manually handling objects:

- Lift comfortably. Choose the position that feels best, with or without a straight back;
- Avoid unnecessary bending. Do not place objects on the floor if they must be picked up again later. Try to keep loads between knuckle and shoulder levels. If removing objects from a container located on the floor, kneel down or squat instead of bending at the waist;
- Avoid twisting the torso. If possible, face the object and grasp it with both hands. Turn the feet, not the hips or shoulders. Leave enough room to shift the feet instead of twisting the body;
- Avoid reaching out. Handle heavy objects close to the body. Try not to lift or lower objects at arm's length;
- Avoid excessive weights. If the load is too heavy, get help or use a mechanical device if one is available;
- Lift gradually. Lift slowly, smoothly and without jerking;
- Use handles when they are provided;
- Handle smaller amounts. Remove some of the contents before handling a container or box;
- Avoid manual lifting. Slide objects when possible to avoid lifting them;
- Plan your lift and carrying route. Check the area for slipping and tripping hazards. Determine the best way to grasp the object, check the area and route for obstacles. Predetermine your destination so that a suitable place is available to put the object. Mental preparation can simplify the lift.

General considerations for manual materials handling

Despite great advances in modern technology, production processes in American industry still heavily rely on the manual handling of materials. Materials are handled between departments, divisions, and plants, and within every part of an operation — not just the warehouse or stockroom. Twenty percent to 25 percent of all

occupational injuries are associated with the material handling. Few advances in manual materials handling jobs have been made, and most efforts have proven ineffective. Much of this ineffectiveness is due to the emphasis on the worker's behavior and lifting techniques, and a lack of concern toward workplace design and work environment. Yet, the industrial worker routinely performs the task of manual materials handling as his/her sole duty or as part of his/her regular job.

Numerous types of injuries are associated with these operations of which the most debilitating and noteworthy involve the back. Back injuries in Ohio industry present staggering statistics. BWC reported approximately 23,000 back injuries during a recent reporting period. These claims represent approximately 20 percent of the total claims.

The average cost of a back injury claim is estimated at $25,000 or more. Past experience shows that these cost figures increase yearly.

As most safety professionals know, these are only the visible costs. Other losses to consider include lost production for employers, lost income to employees and a higher probability of accidents to replacement workers. The pain, suffering and lengthy disability not only affect the injured worker, but family, friends and co-workers.

Inadequate workplace design contributes to innumerable back injuries each year. Often, these injuries are caused by undesirable task requirements and/or awkward postures brought about by poorly designed workplaces.

Undesirable task requirements include:

- Repetitive load handling;
- Awkward postures while handling a load, such as bending and reaching out with a load;
- Handling excessively heavy and/or bulky loads;
- Twisting the torso while lifting;
- Repetitive or sustained bending;
- Demands of the job beyond the assigned worker's capabilities.

The past safety approach trains the workers in proper-lifting techniques. No current evidence is available to show these programs effectively reduce injuries. More often than not, workers find the demands of their jobs and the constraints within the work environment did not allow the application of proper-lifting concepts. The lesson to be learned is programs that teach employees proper lifting are not an effective substitute for a well-engineered workplace.

Through the use of computerized biomechanical models, research is suggesting that proper-lifting techniques are not as safe as has been previously assumed. These models indicate that loads, which can be lifted with the legs, can easily exceed the lower back's capacity.

Minimizing the weight, range of motion and frequency of the activity should be the objectives of materials-handling task design. Failure to do so, especially in repetitive lifting tasks, will increase the employee's vulnerability to injury. Also, management's vulnerability to injury claims involving the back increases, as can the cost of workers' compensation.

NIOSH addressed how to determine how heavy a load you can lift in the Work Practices Guide to Manual Lifting, 1981. Research has identified the following as primary variables in evaluating manual lifting tasks:

1. The horizontal distance from the load to the employee's spine;
2. The vertical distance through which the load is handled;
3. The frequency with which the load is handled.

Also, of importance, but rarely considered variables, include:

- Size of the load (bulk);
- Floor/shoe traction;
- Stability of the load;

- Adequacy of grip;
- Distance the load is carried;
- Space constraints;
- Rest time between lifts;
- Duration of the task;
- Environmental factors (for example, temperature, humidity, illumination and noise);
- Capacity of the employee;
- Employee's skill in handling loads;
- Employee's past injuries to muscles and skeletal structure.

The revised NIOSH Lifting Equation (1991) has incorporated an asymmetric factor (twisting) and a coupling factor (hand-to-load) to better define the lifting task and related risk factors. The equation has been further adjusted to better predict lifting strain by providing a safe lift zone. According to researchers, "Lifting tasks that exceed the predicted safe lift zone should be redesigned to eliminate or reduce the lifting demands of those tasks. For lifting tasks that do exceed the recommended weight limit engineering or ergonomic interventions should be implemented to reduce overexertion injuries."

All tasks involving lifting, lowering, pushing, pulling, carrying and twisting activities have a potential to cause back injury. Therefore, eliminate or at least minimize these tasks.

Principles of good basic design for manual material handling tasks are below.

1. Keep objects between shoulder and knuckle heights.
   Use platforms to store objects off the floor to eliminate the need for stooping and also keep the materials below shoulder height. Optimally, place heavy objects at knuckle height or about 30 inches. Deviating from this height increases stress on the back and promotes awkward postures.
2. Minimize the distance between the person and the object being handled.
   The farther away an object is from the person required to handle it, the more demanding the task becomes. A dense 15-pound load at arm's length is as stressful as 50 pounds held against the chest.
3. Eliminate unnecessary lifting and carrying.
   By providing shelves, supports, conveyors or rollers on which objects can slide or horizontally transported will reduce the need to lift and carry.
4. Eliminate reaching into bins or containers with the entire upper body.
   Unnecessary bending stress on the back can be excessive even with no external load on the body. Keeping the container off the floor and tilting it effectively reduces bending and eases the task of loading and unloading. Provide a powered assist to adjust the tilt angle. Also, use spring-loaded containers to lift parts up as they are unloaded. Equip containers with collapsible sides.
5. Minimize pushing and pulling objects.
   Proper equipment design and maintenance can reduce these problems. Pushing is better than pulling because it puts less strain on the back, but high strength requirements in either case are undesirable. Material handling equipment should have low-friction wheels and handles that can be easily grasped in an upright posture. Ideally, handles should be 1.5 inches in diameter. Design equipment to handle loads within the capabilities of most employees. Ensure that steep ramps and slippery floors are avoided.
6. Modify jobs containing repetitive or sustained twisting, stretching or leaning, especially with a heavy load.
   Eliminate these motions by repositioning containers, moving objects closer to the employee and providing adequate leg and foot clearances.
7. Design workbenches and workstation configurations for adjustability.
   Often, workers are forced to work with a bent spine or extended forward tilting of the head that lead to chronic neck and upper back pain. Corrective actions should allow the employee to remain in a relaxed, upright stance or a fully-supported, seated posture. Fully adjustable tables, chairs and fixtures are effective solutions.
8. Remove handling uncertainties.
   Choose obviously small containers that will

require manual handling. Use large containers where mechanical aids are necessary to move loads. Likewise, put handles on containers that are to be handled manually; do not put handles on large containers that are to be handled mechanically. This consistency will allow the employee to discriminate between manual versus mechanical handling of loads.

9. Eliminate combinations of back hazards with minimal corrective action.
   For example, loading a machine from a container on the floor combines sidestepping toward the parts container, twisting the back to one side, excessive reaching to pull parts close to the body and lifting from below the knees. Relocating the parts container at the proper height close to the machine or providing a parts feeding device to facilitate handling can eliminate all these undesirable demands.

Despite the ineffectiveness of training attempts in the past, there remains a need in the ergonomic philosophy for specific training of employees in the workplace. Provide appropriate design principles and adequate materials handling equipment. Then, provide workers specific training in the use of mechanical handling aids (they may not use them if they don't know how to or where to find them). Recognizing material handling problems and procedures prevent excessive manual handling of materials.

Machinery and machine guarding

Safeguards are essential to prevent injuries, such as crushed hands and arms, severed fingers and blindness. Guard or eliminate machine parts, functions or processes that may cause injury. Affix guards to the machine, where possible, and secure else where if attachment to the machine is not possible. Make sure the guard is not a hazard in itself.

Safeguarding the point of operation

Provide and ensure the use of point-of-operation guards or properly applied and adjusted point-of-operation devices on every operation performed on machinery and equipment. Guard the point of operation for every type of equipment — not just power presses.

Point-of-operation guards:

- Prevent hands or fingers from entering the point of operation by reaching through, over, under or around the guard;
- Do not create a hazard;
- Conform to the maximum permissible openings;
- Do not create pinch points between the guard and moving machine parts;
- Use fasteners not readily removable by the operator, so as to minimize the possibility of misuse or removal of essential parts;
- Facilitate inspection;
- Offer maximum visibility of the point of operation consistent with other requirements.

The point of operation is the area on a machine where employees perform work upon the material being processed. To prevent entry of hands or fingers into the point of operation by reaching through, over, under and around the guard, provide and ensure the use of point-of-operation guards or properly applied and adjusted point-of-operation devices.

Provide one or more methods of machine guarding (i.e., barrier guards, two-hand tripping devices, electronic safety devices, etc.). These help to protect the operator and other employees in the machine area from hazards, such as those created by point of operation, in-going nip points, rotating parts, flying chips and sparks.

Ensure the guarding device conforms to appropriate standards, or, if there are no specific standards, is designed and constructed to prevent the operator from having any body part in the danger zone during the operating cycle.

To permit easy handling of material without the operator placing a hand in the danger zone, use special hand tools for placing and removing material. Do not use these tools in place of

other required guarding, but only to supplement protection provided.

Point-of-operation devices protect the operator by:

- Preventing and/or stopping normal stroking of the press if the operator's hands are inadvertently placed in the point of operation;
- Preventing the operator from inadvertently reaching into the point of operation or withdrawing his or her hands if they are inadvertently located in the point of operation as the dies close;
- Preventing the operator from inadvertently reaching into the point of operation;
- Requiring application of both of the operator's hands to machine operating controls and locating the controls at such a safety distance from the point of operation that the slide completes the downward travel or stops before the operator can reach into the point of operation with his or her hands;
- Enclosing the point of operation before the operator can initiate a press stroke and maintaining this closed condition until the motion of the slide ceases;
- Enclosing the point of operation before the operator can initiate a press stroke to prevent him or her from reaching into the point of operation prior to die closure or prior to cessation of slide motion during the downward stroke.

Machines that usually require point-of-operation guarding include:

- Guillotine cutters;
- Shears;
- Alligator shears;
- Power presses;
- Milling machines;
- Power saws;
- Portable power tools;
- Forming rolls;
- Press brakes;
- Riveters.

Where mechanical hazards occur

Dangerous moving parts in three basic areas require safeguarding. These include:

- **Point of operation** — that point where work is performed on the material, such as cutting, shaping, boring or forming of stock;
- **Power transmission apparatus** — all mechanical-system components that transmit energy to the part of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks and gears;
- **Other moving parts** — all machine parts that move while the machine is working. These can include reciprocating, rotating and transverse moving parts, as well as feed mechanisms and auxiliary parts of the machine.

Guards

Guards are barriers that prevent access to danger areas. The four general types of guards include:

- **Fixed**: A permanent part of the machine. It is not dependent upon moving parts to perform its intended function. It may be constructed of sheet metal, screen, wire cloth, bars, plastic or any other material that is substantial enough to withstand impact and to endure prolonged use. This guard is usually preferable to all other types because of its relative simplicity and permanence. A fixed guard on a power press completely encloses the point of operation. The stock is fed through the side of the guard into the die area, with the scrap stock exiting on the opposite side;
- **Interlocked:** When this type of guard is opened or removed, the tripping mechanism and/or power automatically shuts off or disengages. The machine cannot cycle or be started until the guard is back in place. An interlocked guard may use electrical, mechanical, hydraulic or pneumatic power or any combination of these. If required, interlocks should not prevent inching by remote control. Replacing the guard should

not automatically restart the machine. To be effective, interlock all movable guards to prevent occupational hazards;
- **Adjustable:** Adjustable guards are useful because they allow flexibility in accommodating various sizes of stock;
- **Self-adjusting:** The movement of the stock determines the openings of these barriers. As the operator moves the stock into the danger area, the guard is pushed away, providing an opening that is only large enough to admit the stock. After the stock is removed, the guard returns to the rest position. This guard protects the operator by placing a barrier between the danger area and the operator. The guards may be constructed of plastic, metal or other substantial material. Self-adjusting guards offer different degrees of protection.

Devices

A safety device may perform one of several functions. It may:

- Stop the machine if a hand or any part of the body is inadvertently placed in the danger area;
- Restrain or withdraw the operator's hands from the danger area during operation;
- Require the operator to use both hands on machine controls, thus keeping both hands and body out of danger;
- Provide a synchronized barrier with the machine's operating cycle to prevent entry to the danger area during the hazardous part of the cycle.

Presence-sensing

The photoelectric (optical) presence-sensing device uses a system of light sources and controls that can interrupt the machine's operating cycle. If the light field is broken, the machine stops and will not cycle. You must only use this device on machines that you can stop before the worker can reach the danger area. The design and placement of the guard depends upon the time it takes to stop the mechanism and the speed at which the employee's hand can reach across the distance from the guard to the danger zone.

The radio frequency (capacitance) presence-sensing device uses a radio beam that is part of the machine control circuit. When the capacitance field is broken, the machine will stop or will not activate. Like the photoelectric device, only use this device on machines that you can stop before the worker can reach the danger area. This requires the machine to have a friction clutch or other reliable means for stopping. The design and placement of the guard depends upon the time it takes to stop the mechanism and the speed at which the employee's hand can reach across the distance from the guard to the danger zone.

The electromechanical sensing device has a probe or contact bar that descends to a predetermined distance when the operator initiates the machine cycle. If there is an obstruction preventing it from descending its full, predetermined distance, the control circuit does not actuate the machine cycle.

Pullback

Pullback devices use a series of cables attached to the operator's hands, wrists and/or arms. This type of device is primarily used on machines with stroking action. When the slide/ram is up between cycles, the operator is allowed access to the point of operation. When the slide/ram begins to cycle by starting its descent, a mechanical linkage automatically ensures withdrawal of the hands from the point of operation. Have the operator inspect all restraints and pullback devices prior to each equipment use. This includes prior to the beginning of each shift, after lunch and after breaks. Document each inspection and have a supervisor or member of management verify the inspections took place.

Restraint

The restraint (holdout) device uses cables or straps that are attached to the operator's hands at a fixed point. The operator must adjust the cables or straps to let his or her hands travel within a predetermined safe area. There is no extending or retracting action involved. Consequently, hand-feeding tools are often necessary if the operation involves placing material into the danger area.

Prior to each use of the equipment, have the operator inspect all restraints and pullback devices. This includes prior to the beginning of each shift, after lunch, after breaks, etc. Document each inspection and have a supervisor or member of management verify.

Gate guards

A gate is a movable barrier that protects the operator at the point of operation before the machine cycle can begin. In many instances, gates are designed to operate with each machine cycle.

A gate or movable barrier device protects the operator as follows:

- A Type A gate or movable barrier device protects the operator by enclosing the point of operation before a press stroke can be initiated and maintaining this closed condition until the motion of the slide has ceased;
- A Type B gate or movable barrier device protects the operator by enclosing the point of operation before a press stroke can be initiated, so an operator cannot reach into the point of operation prior to die closure or prior to cessation of slide motion during the downward stroke. Type B gates are not permitted on full-revolution clutch presses.

Put a system in place to properly inspect all machinery for appropriate point-of-operation guards. In addition, have a system in place to train machine operators and other personnel on the importance of machine guarding.

Training

Even the most elaborate guarding system cannot offer effective protection unless the worker knows how to use it and why. Specific and detailed training is a crucial part of any effort to provide guarding against machine-related hazards. Thorough operator training should involve instruction or hands-on training in the following:

- A description and identification of the hazards associated with particular machines;
- The guards themselves, how they provide protection and the hazards for which they are intended;
- How to use the guards and why;
- How and under what circumstances can employees remove guards and by whom (in most cases, repair or maintenance personnel only);
- What to do (such as, contact the supervisor) if a guard is damaged, missing or unable to provide adequate protection.

This safety training is necessary for new operators and maintenance or setup personnel when putting into service any new or altered safeguards, or when assigning workers to a new machine or operation.

References
29 Code of Federal Regulation (CFR)
1910.212 and .217
Ohio Administrative Code (OAC) 4121:1-5-10

General requirements

The employer will:

- Use dies and operating methods designed to control or eliminate hazards for operating personnel. Furnish and enforce the use of hand tools for freeing and removing stuck work or scrap pieces from the die, so that no employee reaches into the point of operation for such purpose;
- Supply the means for handling scrap from roll-feed or random-length stock operations;
- Scrap cutters used in conjunction with scrap handling systems must be safeguarded in accordance with 29 CFR 1910.219;
- Consider the hazard created by a guide post (when it is located in the immediate vicinity of the operator) when separated from its bushing by more than one-fourth inch as a point of operation hazard and be protected;
- Provide unitized tooling. If unitized tooling is used, safeguard the opening between the top of the punch holder and the face of the slide, or striking pad.

All dies will be:

- Stamped with the tonnage and stroke requirements, or have these characteristics recorded if these records are readily available to the die setter;
- Stamped to indicate upper die weight when necessary for air counterbalance pressure adjustment;
- Stamped to indicate complete die weight when handling equipment may become overloaded.

Die fastening

- Make provision in both the upper and lower shoes for securely mounting the die to the bolster and slide. Where clamp caps or set-screws are used in conjunction with punch stems, use additional means of securing the upper shoe to the slide.

Die handling

- Provide handling equipment attach points on all dies requiring mechanical handling.

Die setting

- The employer will establish a die-setting procedure that ensures compliance with OSHA standards.
- The employer will provide spring-loaded turnover bars for presses designed to accept these.
- The employer will provide die stops or other means to prevent losing control of the die while setting or removing dies in presses that are inclined.
- The employer will provide and enforce the use of safety blocks for use whenever dies are adjusted or repaired in the press.
- The employer will provide brushes, swabs, lubricating rolls, and automatic or manual pressure guns so that operators and die-setters will not have to reach into the point of operation or other hazard areas to lubricate.

Shears

Provide guards to protect against contact with the material hold-down devices and the blade on the feed side of the shear and blade protection on the discharge side. Use vacuum lifters (suction cups) or magnets to handle materials to be fed into the shear.

References
29 CFR 1910.212
OAC 4121:1-5-11-D-3
ANSI B11.4 Shears

Drill presses

- To prevent spinning, securely fasten work materials. Never use your hands to secure work materials.
- Use a center punch to score the material before drilling.
- Run the drill at the correct speed. Forcing or feeding too fast can break drill bits.
- Never attempt to loosen the chuck unless the power is off.
- Lower the spindle before removing a chuck.
- Never use a regular auger bit in a drill press.
- Frequently back the drill out of deep cuts to clean and cool the bit.
- Secure or anchor drill presses.
- Never wear gloves, loose clothing or jewelry when working with a drill press.
- Guard the point of operations on all drill presses. This includes the spindle, chuck, and belt and pulley system.

Reference
ANSI B11.8 Drilling, Milling and Boring Machines

Grinders

- Ensure that no combustible or flammable materials are nearby that sparks from the grinder wheel can ignite.
- Ensure that a guard covers at least 270 degrees of the grinding wheel on bench-mounted machines.
- Place the upper peripheral guard (tongue guard) not more than one-fourth inch above the grinding wheel for bench or pedestal grinders.
- Place the grinder tool rest at not more than one-eighth inch from the wheel and slightly above the centerline.

- Allow the grinder to reach full speed before stepping into the grinding position. Faulty wheels usually break at the start of an operation.
- Grind on the face of the wheel, unless otherwise designed.
- Use a vise-grip, pliers or clamp to hold small pieces.
- Slowly move work pieces across the face of the wheel in a uniform manner. This will keep the wheel sound.
- Do not grind non-ferrous materials.
- When mounting new grinder wheels, check them for soundness. Suspend the wheel on a string and tap it. If the wheel rings, it is probably sound.
- Check the revolutions per minute (RPM) of the grinder and the wheel to ensure that the grinder's RPM does not exceed the wheel's RPM rating.
- Replace immediately wheels that are badly worn, cracked or chipped.
- Never use a wheel that has been dropped or has received a heavy blow, even if there is no apparent damage.
- Before using a new wheel, let it a run a few seconds at full speed to make sure it is balanced.
- Secure or anchor in place pedestal or bench grinders.
- Never wear gloves, loose clothing, jewelry, etc., when working with grinders.
- Use a face shield in addition to eye protection when using a grinder for any operation.
- Never mount a stone without the blotters in place.

References
29 CFR 1910.215
OAC 4121:1-5-12
ANSI B7.1 Abrasive Wheels
ANSI B11.9 Grinding Machines

Metal lathes
- Make sure that all gear and belt guards are in place.
- Use a spring-loaded or self-ejecting chuck wrench on lathes with manually adjusted chucks.
- Keep your hands off chuck rims when a lathe is in operation.
- Do not attempt to screw the chuck onto the lathe spindle with the power on as it may get cross-threaded and cause injury. Stop the machine; place a board under the chuck and then screw it on by hand.
- Properly adjust steady rests to conform with the material being worked on.
- Always face the head stock and chuck when filing work in a lathe.
- See that tail stock, tool holder and work are properly clamped before turning the power on.
- Never attempt to adjust a tool while the lathe is running.
- Never wear gloves, loose clothing, jewelry, etc., when working with a lathe.
- Never apply a wrench to revolving work or parts.
- Always use a brush to remove chips, never your hands.
- Use pipe sleeves to cover work protruding from the end of the lathe when possible.
- Remove the tool bit before you remove your work from the lathe.
- Put chuck guards in place any time the lathe is operated with the jaws sticking out beyond the chuck.
- Use chip guards to prevent flying chips from hitting the operator and/or bystanders.

References
29 CFR 1910.212
OAC 4121:1-5-04
ANSI B11.6 Lathes

Pneumatic fastening tools
Nail guns and air guns are powered by compressed air. The main danger associated with pneumatic fastening tools is injury from one of the tool's attachments or fasteners.

- When not using pneumatic tools, disconnect them from the air supply.
- Ensure pneumatic tools that shoot nails, rivets or staples are equipped with a device

that keeps fasteners from ejecting, unless the muzzle is pressed against a firm surface.
- Never point a tool at items you do not want to fasten.
- Keep your finger off the trigger until you are ready to begin work. Most pneumatic tools have a hair-trigger that requires little pressure to activate the gun.
- Treat air hoses with the same care as an electrical cord.
- Do not drive fasteners into hard, brittle surfaces or areas where the fastener may pass through the material and protrude on the other side.
- Train all operators of pneumatic fastening tools according to the manufacturers' guidelines prior for operating the equipment.

References
29 CFR 1910.243 (b)
OAC 4121:1-5-07-L

Hand tools

Hand tools are non-powered tools, including wrenches, hammers, chisels and screwdrivers. While hand-tool injuries tend to be less severe than power-tool injuries, hand-tool injuries are more common.

The most common hand-tool accidents are caused by failure to:

- Use the right tool;
- Use a tool correctly;
- Keep edged tools sharp;
- Replace or repair a defective tool;
- Store tools safely.

Safety guidelines

- Wear safety glasses whenever you hammer or cut, especially when working with surfaces that chip or splinter. All persons in the area also should wear safety glasses also.
- Do not use a screwdriver as a chisel. The tool can slip and cause a deep-puncture wound.
- Do not use a chisel as a screwdriver. The tip of the chisel may break and cause an injury.
- Do not use a knife as a screwdriver. The blade can snap and injure an eye.
- Never carry a screwdriver or chisel in your pocket. If you fall, the tool can cause a serious injury. Instead, use a tool belt holder.
- Replace loose, splintered or cracked handles. Loose hammer, axe or maul heads can fly off defective handles.
- Use the proper wrench or socket to tighten or loosen nuts.
- Always chip or cut away from yourself when using a chisel. Use a soft-headed hammer or mallet to strike a wooden chisel handle. A metal hammer or mallet may cause the handle to split.
- Do not use a wrench if the jaws are sprung.
- If their heads are mushroomed shaped, do not use impact tools, such as chisels, wedges or drift pins. The heads may shatter upon impact.
- Direct saw blades, knives and other tools away from aisle areas and other employees.
- Keep knives and scissors sharp. Dull tools are more dangerous than sharp tools.
- Iron or steel hand tools may cause sparks and be hazardous around flammable substances. Use spark-resistant tools made from brass, plastic, aluminum or wood when working around flammable hazards.

Improper tool storage is responsible for many shop accidents, so:

- Have a specific place for each tool;
- Do not place unguarded cutting tools in a drawer;
- Store knives or chisels in their scabbards;
- Hang saws with the blades away from someone's reach;
- Provide sturdy hooks to hang (or storage area for tools) most tools on;
- Rack heavy tools, such as axes and sledges, with the heavy end down.

References
29 CFR 1910.242
OAC 4121:1-5-07

Compressed gas cylinders/compressed air

The in-plant handling, storage and use of all

compressed gases in cylinders, portable tanks, rail tank cars or motor vehicle cargo tanks will be in accordance with the Compressed Gas Association Pamphlet.

- Do not handle oxygen cylinders if your gloves are greasy or oily.
- Store all compressed gas cylinders in the upright position.
- Place valve-protection caps on compressed gas cylinders that are in storage or are not being used.
- Do not lift compressed gas cylinders by the valve-protection cap.
- Do not store compressed gas cylinders in areas where they can come in contact with chemicals labeled corrosive.
- Hoist compressed gas cylinders on the cradle, sling board, pallet or compressed gas cylinder basket.
- Do not place compressed gas cylinders against electrical panels or live electrical cords where the cylinder can become part of the circuit.

Compressed air used for cleaning

Do not use compressed air for cleaning equipment unless you reduce the pressure for the equipment to 30 pounds per square inch or less and proper protective equipment is in place. Never use compressed air to clean or blow debris from individuals.

References

29 CFR 1910.251 through 257
29 CFR 1910.242
OAC 4121:1-5-16

Flammable and combustible liquids

Statistics indicate that more than 21 percent of industrial fires and 15 percent of office fires start with the ignition of a flammable or combustible liquid. Contributing factors include:

- Lack of a fire prevention program;
- Improper container storage;
- No storage limits;
- Inadequate employee training;
- Inadequate bonding and grounding procedures;
- Lack of interaction with local emergency management agencies;
- No preventive-maintenance program for emergency equipment and devices;
- No procedures to control ignition sources during maintenance and contractor activities;
- No established hot work procedures and a no-smoking policy.

Flammable or combustible liquids are substances that catch fire and burn easily. Flammable liquids continue to burn even after ignition sources are removed from the source.

The flammability of a combustible liquid is determined by the following factors:

- Flash point — the lowest temperature at which vapors or gases will ignite;
- Fire point — the temperature at which a combustible liquid gives off vapors that will ignite;
- Minimum concentration of extinguishing agents needed to extinguish the fire;
- Combustion rate;
- Temperature increase during combustion.

Employees need to know the various sources that might ignite flammable liquid vapors. They include, but are not limited to, the following:

- Open flames;
- Electrical switches;
- Open motors;
- Static electricity;
- Smoking;
- Friction and mechanical sparks;
- Heat guns;
- Cutting and welding;
- Radiant heat.

Standard operating procedures should limit the amounts of any given flammable liquids stored on-site and in the work area. Develop storage strategies by considering daily usage requirements, storage capacity and delivery time. Permit only a limited amount of flammable liquids outside approved storage areas or con-

tainers. Limit the amount of flammable liquids outside an approved storage container or room to the following: 25 gallons of Class IA, 120 gallons of Class IB, IC, Class II or Class III. Permit no more than one day's supply of combustible/flammable liquids in spraying areas.

Only trained and authorized employees should handle and dispense flammable materials. Containers must be properly labeled, designed for flammable liquids and equipped with flame arresters. When dispensing flammable liquids from containers, bond and ground the containers. Place no-smoking signs where you use or store flammable liquids for operations.

Incorporate general exhaust ventilation for storage locations housed inside facilities. The ventilation system should include low-level venting, approximately 12 inches above the floor level. Federal safety standards require six room-air changes per hour.

References
29 CFR 1910.106 & .108
OAC 4121:1-5-07-M

Spray booths and spraying operations

Address the following issues for spray booths:

- Cover or contain light fixtures when mounted above an area where flammable vapors may be present;
- Provide sprinkler protection in a spray booth;
- Provide an audible or visual airflow monitoring system to assist in maintaining adequate airflow;
- Keep a clear space of not less than 3 feet on all sides free of storage or combustible material;
- Maintain the surfaces of the paint booth so they are smooth and easy to clean and/or use a non-combustible covering or strippable coating to facilitate the safe cleaning and removal of residues;
- OSHA standards require spark-producing equipment or any ignition source used within 20 feet of any spraying area (and not separated by a partition) must be designed for a Class I, Division 2 location.

Exhaust ventilation system

Make sure the system for removing contaminated air from a space comprises two or more of the following elements — enclosure or hood, duct work, dust-collecting equipment, exhauster and discharge stack. The construction, installation, inspection and maintenance of exhaust systems must conform to the principles and requirements in Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2, and National Fire Protection Agency (NFPA) 91.

References
29 CFR 1910.94
29 CFR 1910.107
ANSI Z9.2
NFPA 91

Hazard communication (HAZCOM)

OSHA's hazard communication requirements ensure that all employees who come in contact with chemicals are aware of the hazards associated with the substances.

According to the OSHA hazard communication standard, employers are to conduct an inventory of all chemicals in their facilities and obtain material safety data sheets (MSDSs) for each chemical identified. In addition, employers should develop written plans that identify specific standard procedures for handling chemicals, storage of chemicals and required protective equipment. Employers and employees should verify all containers are labeled properly. Employers must provide training for each employee regarding the safe handling of the chemicals in their work environments.

- Follow the instructions on the label and in the MSDSs for each chemical product used in your workplace.
- When using chemicals labeled flammable, corrosive, caustic or poisonous, use personal protective clothing or equipment, such as neoprene gloves, rubber boots, shoe cov-

ers, rubber aprons and protective eyewear.
- Do not use protective clothing or equipment that has split seams, pinholes, cuts, tears or other signs of visible damage.
- Always wash your hands with soap and water after using cutting fluids or solvents.
- Each time you use your gloves, wash your gloves before removing them. Use cold tap water and normal hand-washing motion. Always wash your hands after removing your gloves.
- Only dispense liquid labeled flammable from the bulk container located in areas posted flammable liquid storage.
- Do not use chemicals from unlabeled containers.

Written program
Identify responsibilities:
- Who is responsible for training?
- Who is responsible for ordering/maintaining MSDSs?

Container labeling
- Must be legible
- Identify chemical name
- Target organs specified
- Include manufacturer's name and address

MSDSs
- Where are they located?
- How may they be obtained?

Employee training
- Frequency
- Who conducts training?
- Who needs to be trained?

Chemical inventory
- What the company has on hand and what quantity?
- Where is it located?

Employee training
- New hires
- Transfers
- Temporaries
- New operations
- New products
- After accidents/incidents

Training topics
- Overview of HAZCOM requirements
- Chemicals present in workplace
- Location/availability of written program
- Health effects of chemicals
- How to lessen or prevent exposures
- Engineering controls the company is using

MSDSs
- Location
- How to read
- Labeling requirements

Contractors
- Notification procedures
- Training contractors of company hazards
- Training company employees on contractor hazards

References
29 CFR 1910.1200

PPE

Engineering controls that eliminate the hazard at the source offer the best and most reliable means of safeguarding. But whenever engineering controls are not available or fully capable of protecting them, employees **must** wear PPE. Employers must perform a PPE hazard assessment for their workplaces and determine if PPE is required. If PPE is required, employers will identify each type of PPE and the specific task or operations that require the use of PPE. The employer will certify and date the assessment. In addition, the employer must provide training to each employee on the specific type of PPE required in the work environment.

To provide adequate protection, protective clothing and equipment must always be:
- Appropriate for the particular hazards;
- Maintained in good condition;
- Properly stored when not in use to prevent damage or loss;
- Kept clean, fully functional and sanitary.

Eye protection

Make sure employees use appropriate eye or

face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation.

Ensure each affected employee uses eye protection that provides side shields when there is a hazard from flying objects. Detachable side protectors (clip-on or slide-on side shields) meeting the pertinent requirements are acceptable.

Employees who wear prescription lenses while engaged in operations involving eye hazards should wear eye protection that incorporates the prescription in its design, or wear eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses. Protective eye and face devices will comply with ANSI Z87.1.

Hearing protection

Administer a continuing, effective hearing conservation program whenever employee noise exposures equal or exceed an eight-hour time-weighted average sound level of 85 decibels (dB) measured on the A scale (slow response) or, equivalently, a dose of 50 percent. For purposes of the hearing conservation program, compute employee noise exposures in accordance with appropriate references, and without regard to any attenuation provided by the use of PPE.

Make hearing protectors available to all employees exposed to an eight-hour time-weighted average of 85 dB or greater at no cost to the employees. Replace hearing protectors as necessary.

Respiratory protection

The primary objective in controlling occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smoke, sprays or vapors is to prevent atmospheric contamination. Do this as far as feasible, by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while you are instituting them, use appropriate respirators.

Develop and implement a written respiratory protection program with required work site-specific procedures and elements for required respirator use. A suitably trained program administrator must administer the program. In addition, certain program elements are required for voluntary use of respirators to prevent hazards associated with respirator use. Requirements include fit testing, employee training, including maintenance, cleaning and care, respirator limitations, and verification that the respirator will protect against contaminant of concern.

Head protection

Ensure affected employees wear protective helmets when working in areas where there is a potential for injury to the head from falling objects. Make sure the helmet is designed to reduce electrical shock hazard when exposed to electrical conductors that could contact the head. It also should meet the requirements of ANSI Z89.1 for head protection.

Foot protection

Make sure employees use protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where employees' feet are exposed to electrical hazards. Mark protective footwear to indicate that they meet ANSI Z41 standard for protective footwear.

Hand and finger protection

Select and require employees to use appropriate hand protection when exposing their hands to hazards, such as those from skin absorption of harmful substances, severe cuts or lacerations, severe abrasions, punctures, chemical burns, thermal burns and harmful temperature extremes.

References
29 CFR 1910.132 through .140

OAC 4121:1-5-17
ANSI Z41 Protective Footwear
ANSI Z87.1 Eye & Face Protection
ANSI Z89.1 Protective Headwear - Industrial Workers

Emergency action and fire prevention plans

The emergency action plan should be in writing and cover designated actions employers and employees must take to ensure employee safety from fire and other emergencies.

Include these elements, at a minimum, in the plan:

- Emergency escape procedures and emergency escape route assignments;
- Procedures for employees to follow who remain to operate critical plant operations before they evacuate;
- Procedures to account for all employees after emergency evacuation has been completed;
- Rescue and medical duties for those employees who are to perform them;
- The preferred means of reporting fires and other emergencies;
- Names or regular job titles of persons or departments who can be contacted for further information or explanation of duties under the plan.

Establish an employee alarm system that complies with appropriate regulations. If you use the employee alarm system for alerting fire brigade members, or for other purposes, use a distinctive signal for each purpose.

Establish in the emergency action plan the types of evacuation to use in emergency circumstances. Before implementing the emergency action plan, designate and train a sufficient number of persons to assist in the safe and orderly emergency evacuation of employees.

Review the plan with each employee covered by the plan under the following circumstances:

- When the plan is developed;
- Whenever the employee's responsibilities or designated actions under the plan change;
- Whenever the plan is changed.

Review with employees upon initial assignment those parts of the plan that they must know to protect themselves in an emergency. Keep the written plan at the workplace and make it available for employee review. Employers with 10 or fewer employees may orally communicate the plan to employees.

Means of egress

- Identify all exits.
- Provide emergency lighting in accordance with local building codes.
- Never lock or block exit access and exits.
- Identify all non-exit doors.

Place lighting to reduce glare and prevent too much contrast between work areas and adjacent areas. Provide sufficient illumination for general safety and ordinary visual needs. Locate and guard lighting fixtures, so there will be no hazard to persons should accidental breakage of the lamp or fixture occur. Where failure of primary lighting can result in hazards to any person, provide emergency lighting.

Fire prevention plan

Maintain a written fire prevention plan and communicate the plan to employees.

Include these elements, at a minimum, in the fire prevention plan:

- A list of the major workplace fire hazards and proper handling and storage procedures, potential ignition sources (such as welding, smoking and others) and control procedures, and the type of fire protection equipment or systems that can control a fire;
- Names or regular job titles of personnel responsible for maintaing equipment and systems installed to prevent or control ignitions or fires;
- Names or regular job titles of personnel responsible for controlling fuel source hazards.

Control accumulations of flammable and combustible waste materials and residues so they do not contribute to a fire emergency. Include housekeeping procedures in the written fire prevention plan.

Inform employees of the fire hazards of the materials and processes to which they are exposed. Upon initial assignment, review with employees those parts of the fire prevention plan they must know to protect themselves in an emergency. Keep the written plan in the workplace and make it available for employee review.

According to established procedures, regularly and properly maintain, equipment and systems installed on heat producing equipment to prevent accidental ignition of combustible materials. Include maintenance procedures in the written fire prevention plan. Identify fire extinguishers and free them from obstruction. Inspect extinguishers visually in-house monthly and annually by an outside service company. Train any employee designated to use a fire extinguisher annually.

References
29 CFR 1910.35 through .40

Powered industrial trucks
All new powered industrial trucks must meet the design and construction requirements for powered industrial trucks established in ANSI B56.1. A label or other identifying mark on approved trucks must indicate approval by the testing laboratory.

Any modifications and additions that affect capacity and safe operation performed by the customer or user must have the manufacturer's prior written approval. Change capacity, operation and maintenance instruction plates, tags or decals, accordingly.

Do not use power-operated industrial trucks in atmospheres containing hazardous concentration of chemicals or dusts. Refer to appropriate standards for a specific list of hazards and for the types (designations) of powered industrial trucks that can be used.

Store and handle liquid fuels, such as gasoline and diesel fuel in accordance with NFPA No. 30 and liquefied petroleum gas fuel in accordance with NFPA No. 58.

Designate battery-charging installations in areas designed for that purpose. Provide facilities for flushing and neutralizing spilled electrolyte for fire protection, for protecting charging apparatus from damage by trucks and for adequate ventilation for dispersal of fumes from gassing batteries. Provide a conveyor, overhead hoist or equivalent material-handling equipment for handling batteries. Properly position and secure reinstalled batteries in the truck. Provide a carboy tilter or siphon for handling electrolyte. When charging batteries, pour acid into the water, not water into the acid.

Properly position trucks and apply brakes before attempting to change or charge batteries. Take care to ensure that vent caps are functioning. Open the battery (or compartment) cover(s) to dissipate heat. There is no smoking in the charging area.

Take precautions to prevent open flames, sparks or electric arcs in battery-charging areas. Keep tools and other metallic objects away from the top of uncovered batteries.

Provide adequate lighting on the truck.

Make sure concentration levels of carbon monoxide gas created by powered industrial truck operations do not exceed the specified levels.

Set the hightway truck's brakes and place wheel chocks under the rear wheels to prevent the trucks from rolling during the loading. Fixed jacks may be necessary to support a semi-trailer and prevent upending during the loading or unloading when the trailer is not coupled to a tractor.

Provide wheel stops or other recognized positive protection to prevent railroad cars from moving during loading or unloading operations. Provide

protection to prevent railroad cars from being moved while dock boards or bridge plates are in position.

As demonstrated by completing training and evaluations, operators must be competent to safely operate a powered industrial truck.

Trainees may operate a powered industrial truck only:

- Under the direct supervision of persons who have the knowledge, training and experience to train operators and evaluate their competence;
- Where such operation does not endanger the trainee or other employees.

Training consists of a combination of formal instruction (lecture, discussion, interactive computer learning, videotape, written material); practical training (demonstrations the trainer performs and practical exercises trainees perform); and evaluation of the operator's performance in the workplace. Persons who have the knowledge, training and experience to train powered industrial truck operators and evaluate their competence, conduct all operator training and evaluation.

Powered industrial truck operators receive initial training in truck-related topics and workplace-related topics, except in topics the employer can demonstrate are not applicable to safe-truck operation in the employer's workplace.

Truck-related topics include:

- Operating instructions, warnings and precautions for the truck types the operator will be authorized to operate;
- Differences between the truck and the automobile;
- Where truck controls and instrumentation are located, what they do and how they work;
- Engine or motor operation;
- Steering and maneuvering;
- Visibility, including restrictions due to loading;
- Fork and attachment adaptation, operation and use limitations;
- Vehicle capacity and stability;
- Any vehicle inspection and maintenance that the operator will be required to perform;
- Refueling and/or charging and recharging of batteries;
- Operating limitations;
- Any other operating instructions, warnings or precautions listed in the operator's manual for the types of vehicle the employee is being trained to operate.

Workplace-related topics include:

- Surface conditions where you will operate the vehicle;
- Load composition and load stability;
- Load manipulation, stacking and unstacking;
- Pedestrian traffic in areas where you will operate the vehicle;
- Narrow aisles and other restricted places where you will operate the vehicle;
- Hazardous locations where you will operate the vehicle;
- Ramps and other sloped surfaces that could affect the vehicle's stability;
- Closed environments and other areas where insufficient ventilation or poor vehicle maintenance can cause a buildup of carbon monoxide or diesel exhaust;
- Other unique or potentially hazardous environmental conditions in the workplace that might affect safe operation.

Conduct refresher training, including an evaluation of the training's effectiveness to ensure that the operator has the knowledge and skills needed to safely operate the powered industrial truck.

Provide refresher training in relevant topics when:

- The operator is observed operating the vehicle in an unsafe manner;
- The operator is involved in an accident or near-miss incident;
- The operator receives an evaluation that reveals he or she is not operating the truck safely;
- The operator is assigned to drive a different type of truck;
- A workplace condition changes in a manner that could affect safe operation of the truck.

Conduct an evaluation of each powered industrial truck operator's performance at least once every three years, or if an employee is involved in an accident or a near miss.

If an operator has already received training in a topic previously specified, and the training is appropriate to the truck and working conditions encountered, no additional training in that topic is required. But the operator should be evaluated and be competent to operate the truck safely.

Employers certify each operator is trained and evaluated as required. The certification includes the name of the operator, date of training, date of evaluation and identity of the person(s) performing training or evaluation.

General rules

- Do not drive trucks up to anyone standing in front of a bench or other fixed object.
- Do not allow anyone to stand or pass under the elevated portion of any truck, whether loaded or empty.
- Do not permit unauthorized personnel to ride on powered industrial trucks. Provide a safe place to ride where riding of trucks is authorized.
- Keep arms or legs from between the uprights of the mast or outside the truck's running lines.

When a powered industrial truck is left unattended, fully lower load-engaging means, neutralize controls, shut off power and set brakes. Block the wheels if the truck is parked on an incline. A powered industrial truck is unattended when the operator is more than 25 feet away from the vehicle, but remains in his view, or whenever the operator leaves the vehicle and it is not in his or her view.

Maintain a safe distance from the edge of ramps or platforms while on any elevated dock, platform or freight car. Do not use trucks for opening or closing freight doors.

Set brakes and put wheel blocks in place to prevent trucks, trailers or railroad cars from moving while loading or unloading. Fixed jacks may be necessary to support a semi-trailer during loading or unloading when the trailer is not coupled to a tractor. Check the flooring of trucks, trailers, and railroad cars for breaks and weakness before entering with a powered industrial truck.

Ensure there is sufficient headroom under overhead installations, lights, pipes, sprinkler system and other overhead obstructions.

Use an overhead guard as protection against falling objects. This guard offers protection from the impact of small packages, boxes, bagged material and other objects the operator might encounter, but not the impact of a falling capacity load.

Use a load backrest extension whenever necessary to minimize the possibility of the load or part of it from falling rearward.

Use only approved industrial trucks in hazardous locations.

Whenever a truck is equipped with vertical only, or vertical and horizontal controls that you can elevate with the lifting carriage or forks for lifting personnel, take the following additional precautions for the protection of personnel being elevated:

- Use a safety platform firmly secured to the lifting carriage and/or forks;
- Provide means to allow personnel on the platform to shut off power to the truck;
- Provide protection from falling objects as indicated as necessary by the operating conditions.

Keep fire aisles, access to stairways and fire equipment clear.

Observe all traffic regulations, including authorized plant speed limits. Maintain a safe distance, approximately three truck lengths from the truck ahead and keep the truck under control at all times.

Yield the right of way to ambulances, fire trucks or other vehicles in emergency situations. Do not pass other trucks traveling in the same direction at intersections, blind spots or other dangerous locations. Slow down and sound the horn at cross aisles and other locations where vision is obstructed. If the load being carried obstructs forward view, travel with the load trailing.

Cross railroad tracks diagonally wherever possible. Do not park closer than 8 feet from the center of railroad tracks.

Look in the direction of and keep a clear view of the path of travel. Ascend or descend grades slowly. When ascending or descending grades in excess of 10 percent, drive loaded trucks with the load upgrade. Tilt back the load and load-engaging means on all grades if applicable and raise the load only as far as necessary to clear the road surface.

Under all travel conditions, operate the truck at a speed that will permit it to stop safely. Slow down for wet and slippery floors.

Properly secure dock boards or bridge plates before driving over them. Slowly and carefully drive over dock boards and bridge plates and do not exceed the rated capacity. Slowly approach elevators and, then, enter squarely after the elevator car is properly leveled. Once on the elevator, neutralize the controls, shut off the power and set the brakes. Enter elevators or other confined areas with motorized hand trucks with load end forward. Avoid running over loose objects on the roadway surface.

Reduce speed to a safe level while negotiating turns by turning the hand steering wheel in a smooth, sweeping motion. Except when maneuvering at a very low speed, turn the hand steering wheel at a moderate, even rate. Handle only stable or safely arranged loads. Exercise caution when handling off-center loads that you cannot center. Handle only loads within the truck's rated capacity. Adjust the long or high, including multiple-tiered loads that may affect capacity. Operate trucks equipped with attachments as partially loaded trucks when not handling a load.

Place a load-engaging means under the load as far as possible. Carefully tilt the mast backward to stabilize the load.

Use extreme care when tilting the load forward or backward, particularly when high tiering. Do not tilt load forward with load-engaging means elevated, except to pick up a load. Do not tilt an elevated load forward, except when the load is in a deposit position over a rack or stack. When stacking or tiering, use only enough backward tilt to stabilize the load.

If a powered industrial truck needs repair, is defective or in any way unsafe, take it out of service until it has been restored to a safe operating condition.

Turn the engine off while filling fuel tanks. Avoid spillage, but if any fuel or oil is spilled, carefully wash it away or make sure it has completely evaporated. Replace the fuel tank cap before restarting the engine. Do not operate a truck until any leaks in the fuel system are repaired. Do not use open flames to check the electrolyte level in storage batteries or gasoline level in fuel tanks.

Remove from service any power-operated industrial truck in unsafe operating condition.

Have authorized personnel make all repairs. Repair problems with the fuel and ignition systems of industrial trucks that involve fire hazards only in locations designated for such repairs. If a truck needs repairs to the electrical system, disconnect the battery prior to making repairs.

Replace all parts of any industrial truck requiring replacement only with parts equivalent to those used in the original design. Do not alter industrial trucks so the relative positions of various parts are different from when originally received from the manufacturer. Do not add extra parts not provided by the manufacturer or eliminate parts, except as provided in the appropriate standard. Do not add counterweights to fork trucks unless approved by the truck manufacturer.

Examine industrial trucks before placing them in service. If the examination shows any condition affecting the vehicle's safety, keep the vehicle out of service. Make these examinations at least daily. If you use industrial trucks on a round-the-clock basis, examine them after each shift. Immediately report and correct any defects.

Materials handling and storage

If using mechanical handling equipment, allow sufficient safe clearances for aisles, at loading docks, through doorways and wherever turns or passage must be made. Keep aisles and passageways clear and in good repair, with no obstruction across or in aisles that could create a hazard. Appropriately mark permanent aisles and passageways.

Do not allow storage of material to create a hazard. If you stock bags, bundles and other containers, stack, block and interlock in tiers with limited height so they are stable and secure against sliding or collapsing.

Keep storage areas free from accumulation of materials that are hazards from tripping, fire, explosion or pest refuge. Control vegetation when necessary.

Provide signs to warn of clearance limits.

Provide derail and/or bumper blocks on spur railroad tracks. This is where a rolling car can contact other cars being worked on, or when entering a building, work or traffic area.

Provide covers and/or guardrails to protect personnel from the hazards of open pits, tanks, vats, ditches and other hazards.

References
29 CFR 1910.178
OAC 4121:1-5-13
ANSI B56.1 Low Lift and High Lift Trucks

Overhead and gantry cranes

A crane is a machine for lifting and lowering a load and moving it horizontally with a hoisting mechanism being an integral machine part. Cranes, whether fixed or mobile, are driven manually or by power. An overhead crane has a movable bridge carrying a movable or fixed-hoisting mechanism and travels on an overhead fixed-runway structure. A hoist is an apparatus that may be a part of a crane. It exerts a force for lifting or lowering. Rope refers to wire rope, unless otherwise specified.

All new overhead and gantry cranes have to meet the design specifications of the American National Standard Safety Code for Overhead and Gantry Cranes, ANSI B30.2.

If a qualified engineer or the equipment manufacturer thoroughly checks the modifications and the supporting structure for the new rated load, you may modify and re-rate cranes. Test the crane in accordance with appropriate standards. Typically, the crane must be load tested at 125 percent of its designed capacity after modifications are completed on the equipment.

Plainly mark the crane's rated load on each side of the crane and, if the crane has more than one hoisting unit, have its rated load marked on each hoist or its load block. Make sure this marking is clearly legible from the ground or floor.

Maintain a minimum clearance of 3 inches overhead and 2 inches laterally between crane

and obstructions in conformity with the Crane Manufacturers' Association of America Inc.'s Specification No. 61.

Inspect all cranes on a regular basis. Prior to initial use, inspect all new and altered cranes to ensure compliance with federal provisions and state safety requirements. Primarily, there are two types of inspections: frequent and periodic.

Perform frequent inspections on a daily to monthly basis. Inspect for defects, and carefully examine all deficiencies and determine whether they constitute a safety hazard. You should:

- Inspect all functional operating mechanisms for maladjustments interfering with proper operation daily;
- Inspect deterioration or leakage in lines, tanks, valves, drain pumps and other parts of air or hydraulic systems daily;
- Visually inspect hooks with deformation or cracks on a daily basis. Perform a documented monthly inspection;
- Visually inspect hoist chains and wire ropes on a daily basis. Perform a documented monthly inspection.

Conduct periodic inspections on one-to-12 month intervals. The periodic inspection should include all items identified in the frequent inspection as well as checking for:

- Deformed, cracked or corroded members;
- Loose bolts or rivets;
- Cracked or worn sheaves and drums;
- Worn, cracked or distorted parts, such as pins, bearings, shafts, gears, locking and clamping devices;
- Excessive wear on brake system parts, linings, pawls and ratchets;
- Load, wind and other indicators over full range for any significant inaccuracies;
- Gasoline, diesel, electrical or other power plants for improper performance or noncompliance with applicable safety requirements;
- Excessive wear of chain-drive sprockets and excessive chain stretch.

Allow only designated personnel to operate a crane. Locate all operating handles within convenient reach of the operator when he or she is facing the area to be served by the load hook or while facing the direction the cab is travelling. The operator needs a full view of the load hook in all positions and should see clearly enough to perform his or her work with light within the cab. Locate the cab to afford a minimum of three-inches clearance from all fixed structures within its area of possible movement.

Use a conveniently placed fixed ladder, stairs or platform requiring no steps over any gap exceeding 12 inches to access the cab and/or bridge walkway. Make sure fixed ladders conform to ANSI A14.3.

If sufficient headroom (a minimum of 48 inches) is available on cab-operated cranes, provide a foot walk on the drive side and along the entire length of the bridge. This is for all cranes having the trolley running on the top of the girders.

Make sure you design foot walks to sustain a distributed load of at least 50 pounds per square foot and have an anti-slip walking surface. Toe boards and handrails should be in compliance with appropriate standards.

Gantry cranes require ladders or stairways extending from the ground to the foot walk or cab platform. Stairways must be equipped with rigid and substantial metal handrails and anti-slip walking surfaces. Ladders must be permanently and securely fastened in place and comply with standards.

Provide cranes with bumpers or other automatic means with equivalent effect, unless the crane:

- Travels at a slow rate of speed and has a faster deceleration rate sleeve bearings;
- Is not operated near the ends of bridge and trolley travel;
- Is restricted to a limited distance by the nature of the crane operation and there is no hazard of striking any object in this limited

distance;
- Is used in similar operating conditions.

Mount the bumper so there is no direct shear on bolts and design. Install the bumpers to minimize parts falling from the crane in case of breakage.

Provide trolleys with bumpers or other automatic means of equivalent effect, unless the trolley:

- Travels at a slow rate of speed;
- Is not operated near the ends of bridge and trolley travel;
- Is restricted to a limited distance of the runway and there is no hazard of striking any object in this limited distance;
- Is used in similar operating conditions.

When operating more than one trolley on the same bridge, equip each with bumpers or the equivalent on the adjacent ends. In case of age, design and install bumpers or equivalent to minimize parts falling from the trolley.

Equip bridge trucks with sweeps extending below the top of the rail and projecting in front of the truck wheels.

If hoisting ropes run near enough to other parts to make fouling or chafing possible, install guards to prevent this. Provide a guard to prevent contact between bridge conductors and hoisting ropes if they come into contact.

Guard exposed moving parts, such as gears, setscrews, projecting keys, chains, chain sprockets and reciprocating components that can constitute a hazard under normal operating conditions. Securely fasten the guards. Guards should support without permanent distortion the weight of a 200-pound person, unless the guard is located where it is impossible for a person to step on it.

Equip each independent hoisting unit of a crane with at least one self-setting brake or holding brake applied directly to the motor shaft or some part of the gear train. In addition, outfit each independent hoisting unit of a crane with control braking means to prevent speeding. An exception is worm-geared hoists, the angle of whose worm is such that it prevents the load from accelerating in the lowering direction.

Make sure holding brakes for hoist motors have not less than the following percentage of the full-load hoisting torque at the point where the brake is applied:

- 125 percent when used with a control braking means other than mechanical;
- 100 percent when used in conjunction with a mechanical control braking means;
- 100 percent each if two holding brakes are provided.

References
29 CFR 1910.179
ANSI B30.2 Overhead & Gantry Cranes

Slings
A sling is an assembly that connects the load to the material-handling equipment. Whenever any sling is used, observe these practices:

- Do not use damaged or defective slings;
- Do not shorten slings with knots or bolts or other makeshift devices;
- Do not kink sling legs;
- Do not load slings in excess of rated capacities;
- Balance the loads to prevent slippage when slings are used in a basket hitch;
- Securely attach slings to the loads;
- Pad or protect slings from the sharp edges of the loads;
- Keep suspended loads clear of all obstructions;
- Keep all employees clear of loads about to be lifted and of suspended loads;
- Do not place hands or fingers between the sling and its load while the sling is being tightened around the load;
- Do not perform shock loading;
- Do not pull a sling from under a load when the load is resting on the sling.

Each day before using a sling, have a competent person designated by the employer inspect it and all fastenings and attachments for damage or defects. Perform additional inspections during sling use, where service conditions warrant. Immediately remove damaged or defective slings from service.

Permanently affix durable identification stating size, grade, rated capacity and reach on alloy steel chain slings.

Make sure hooks, rings, oblong links, pear-shaped links, welded or mechanical coupling links or other attachments have a rated capacity at least equal to that of the alloy steel chain with which they are used. Do not use the sling in excess of the rated capacity of the weakest component.

Do not use makeshift links or fasteners formed from bolts or rods, or other such attachments.

In addition to the required inspection, make a thorough periodic inspection of alloy steel chain slings in use on a regular basis. Base the timetable on frequency of sling use, severity of service conditions, nature of lifts being made, and experience gained on the service life of slings used in similar circumstances. Make inspection intervals no longer than once every 12 months.

Maintain a record of the most recent month in which each alloy steel chain sling was thoroughly inspected and have the record available for examination.

Make sure you designate a competent person to perform a thorough inspection of alloy steel chain slings, including wear, defective welds, deformation and increase in length. If defects or deterioration are present, immediately remove the sling from service.

Ensure before use, the sling manufacturer or equivalent entity proofs each new, repaired or reconditioned alloy steel chain sling, including all welded components in the sling assembly, in accordance with paragraph 5.2 of the American Society of Testing and Materials Specification A391.

Do not use alloy steel chain slings with loads in excess of the rated capacities prescribed. Use slings not included in tables only in accordance with the manufacturer's recommendations.

Permanently remove alloy steel chain slings from service if they are heated above 1,000 degrees Fahrenheit (F). When the slings are exposed to service temperatures in excess of 600 degrees F, reduce the maximum working load limits permitted in accordance with the chain or sling manufacturer's recommendations.

Do not use worn or damaged alloy steel chain slings or attachments. When welding or heat testing is performed, do not use slings unless repaired, reconditioned and proof tested by the sling manufacturer or an equivalent entity.

Do not use mechanical coupling links or low carbon steel repair links to repair broken lengths of chain.

If the chain size at any point of any link is less than that stated in appropriate tables, remove the sling from service.

Remove from service alloy steel chain slings with cracked or deformed master links, coupling links or other components.

Immediately remove wire rope slings from service if any of these conditions are present:

- Five broken wires in one strand in one rope lay or 10 randomly distributed broken wires in one rope lay;
- Wear or scraping of one-third the original diameter of outside individual wires;
- Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure;
- Evidence of heat damage;
- Cracked, deformed or worn end attach-

ments;
- Hooks that have been opened more than 15 percent of the normal throat opening, measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook;
- Corrosion of the rope or end attachments.

Metal mesh slings

Permanently affix to each metal mesh sling a durable marking or tag stating the rated capacity for both the vertical basket hitch and choker hitch loads.

Make sure handles have a rated capacity at least equal to the metal fabric and exhibit no deformation after proof testing.

Join the fabric and handles so that:

- The rated capacity of the sling is not reduced;
- The load is evenly distributed across the width of the fabric;
- Sharp edges will not damage the fabric.

Do not apply coatings that diminish the rated capacity of the sling.

Do not use new and repaired metal mesh slings, including handles, unless proof tested by the manufacturer or equivalent entity at a minimum of one and one-half times the rated capacity. Proof test elastomer impregnated slings before coating.

Do not use metal mesh slings to lift loads in excess of the rated capacities. Use slings not included in tables only in accordance with the manufacturer's recommendations.

You may use metal mesh slings not impregnated with elastomers in a temperature range from minus 20 degrees to plus 550 degrees without decreasing the working-load limit. You may use metal mesh slings impregnated with polyvinyl chloride or neoprene in a temperature range from zero degrees to plus 200 degrees. For operations outside these temperature ranges or for metal mesh slings impregnated with other materials, follow the sling manufacturer's recommendations.

Do not use repaired metal mesh slings unless a metal mesh sling manufacturer or an equivalent entity repairs them. Once repaired, permanently mark or tag each sling, or maintain a written record to indicate the date and nature of the repairs and the person or organization that performed the repairs. Make records of repairs available for examination.

Immediately remove metal mesh slings from service if any of these conditions are present:

- A weld or brazed joint is broken along the sling edge;
- A reduction in wire diameter of 25 percent due to abrasion or 15 percent due to corrosion;
- A lack of flexibility due to distortion of fabric;
- A distortion of the female handle so that the depth of the slot is increased more than 10 percent;
- A distortion of either handle so that the width of the eye is decreased more than 10 percent;
- A 15-percent reduction of the original cross sectional area of metal at any point around the handle eye;
- A distortion of either handle out of its plane.

Natural and synthetic fiber rope slings

Do not use fiber rope slings made from conventional three-strand construction fiber rope with loads in excess of the rated capacities prescribed. Fiber rope slings require a diameter of curvature meeting at least the minimums specified. Use slings not included in tables only in accordance with the manufacturer's recommendations.

You may use natural and synthetic fiber rope slings, except for wet frozen slings, in a temperature range from minus 20 degrees to 180 degrees without decreasing the working load limit. For operations outside this temperature range, and for wet frozen slings, follow the sling

manufacturer's recommendations.

Do not use spliced fiber rope slings unless they have been spliced in accordance with the following minimum requirements and in accordance with any additional recommendations of the manufacturer:

- In manila rope, eye splices consist of at least three full tucks, and short splices consist of at least six full tucks, three on each side of the splice center line;
- In synthetic fiber rope, eye splices consist of at least four full tucks, and short splices consist of at least eight full tucks, four on each side of the centerline.

Do not trim strand end tails flush with the surface of the rope immediately adjacent to the full tucks. This applies to all types of fiber rope and both eye and short splices. For fiber rope less than one inch in diameter, make sure the tail projects at least six rope diameters beyond the last full tuck. For fiber rope one inch in diameter and larger, make sure the tail projects at least six inches beyond the last full tuck. If a projecting tail interferes with the use of the sling, taper the tail and splice it into the body of the rope using at least two additional tucks (which will require a tail length of approximately six rope diameters beyond the last full tuck).

Fiber rope slings need a minimum clear length of rope between eye splices equal to 10 times the rope diameter.

Do not use knots in place of splices. For splicing, use clamps designed specifically for fiber ropes. For all eye splices, make sure the eye provides an included angle of not greater than 60 degrees at the splice when the eye is placed over the load or support.

Do not use fiber rope slings if end attachments in contact with the rope have sharp edges or projections.

Immediately remove natural and synthetic fiber rope slings from service if any of these conditions are present:

- Abnormal wear;
- Powdered fiber between strands;
- Broken or cut fibers;
- Variations in the size or roundness of strands;
- Discoloration or rotting;
- Distortion of hardware in the sling.

Use only fiber rope slings made from new rope. Do not use repaired or reconditioned fiber rope slings.

Synthetic web slings

Mark or code each sling to show the rated capacities for each type of hitch and type of synthetic web material.

Make sure synthetic webbing is of uniform thickness and width, and selvage edges are not split from the webbing's width.

Make sure fittings have a minimum breaking strength equal to that of the sling and are free of all sharp edges that could in any way damage the webbing.

The only method to attach end fittings to webbing and to form eyes is stitching. Make sure the thread is in an even pattern and contains a sufficient number of stitches to develop the full breaking strength of the sling.

Do not use synthetic web slings with loads in excess of the rated capacities. If slings are not listed in rating charts or tables, use them only in accordance with the manufacturer's recommendations.

When using synthetic web slings, do not use:

- Nylon web slings where fumes, vapors, sprays, mists or liquids of acids or phenolics are present;

- Polyester and polypropylene web slings where fumes, vapors, sprays, mists or liquids of caustics are present;
- Web slings with aluminum fittings where fumes, vapors, sprays, mists or liquids of caustics are present.

Do not use synthetic web slings of polyester and nylon at temperatures in excess of 180 degrees or polypropylene web slings at temperatures in excess of 200 degrees.

Do not use repaired synthetic web slings unless repaired by a sling manufacturer or an equivalent entity. The manufacturer or equivalent entity should proof test each repaired sling to twice the rated capacity prior to its return to service. Retain a certificate of the proof test and make it available for examination. Do not use slings, including webbing and fittings, that have been repaired in a temporary manner.

Immediately remove synthetic web slings from service if any of these conditions are present:

- Acid or caustic burns;
- Melting or charring of any part of the sling surface;
- Snags, punctures, tears or cuts;
- Broken or worn stitches;
- Distortion of fittings.

References
29 CFR 1910.184
OAC 4121:1-5-15
ANSI B30.9 Slings

Portable ladders

Ladders come in different styles, including step, straight and extension. They also vary in construction and may consist of wood, aluminum or fiberglass. Choose the correct type and size ladder for the job. Type I or IA ladders are required in the work environment.

All ladders sold within the United States are rated as:

- Type I or IA: Heavy-duty industrial ladder rated to hold up to 250 or 300 pounds, respectively;
- Type II: Medium-duty commercial ladder rated to hold up to 225 pounds;
- Type III: Light-duty household ladder rated to hold up to 200 pounds.

Safety guidelines

- Always inspect a ladder before you climb it. Make sure the steps are sturdy and the locking mechanisms are functional.
- Carry ladders horizontally with the front end slightly higher than the back end.
- To open a stepladder, make sure the spreader is locked and the pail shelf is in position. To open an extension ladder, brace the bottom end and push the rungs or rails out.
- Place ladders on a solid, level surface to ensure safety.
- Watch for overhead obstructions and power lines.
- To prevent ladders from sinking into soft ground, use a large board under the feet of the ladder.
- Position a straight or extension ladder so that the base of the ladder is 1 foot away from the vertical support for every 4 feet of working ladder height. For example, if you are working with 8 feet of ladder, place the base of the ladder 2 feet from the wall.
- Do not place the top of a ladder against a window or an uneven surface.
- Tie the top of a straight or extension ladder to supports when possible. Stake and tie the feet of the ladder.
- An extension ladder used for access to a roof must extend at least 3 feet beyond the support point.
- Use a wooden or fiberglass ladder if you must work near electrical sources.
- Do not place a ladder in front of a door unless you lock and barricade the door and post a warning sign on the opposite side of the door.
- Use good judgment when climbing or working on ladders.
- Wear shoes with slip-resistant soles and make sure they are dry before climbing.
- Never allow more than one person on a ladder.

- Face the ladder and firmly grip the rails, not the rungs, with both hands when climbing or descending.
- Keep your body between the rails at all times. Do not shift your weight to one side.
- Have someone steady the ladder if it cannot be secured otherwise.
- Do not stand on the top four rungs of an extension ladder or the top two rungs of a stepladder.
- Keep two feet and one hand on the ladder at all times when working on a ladder.
- Do not stand on the bucket shelf of a ladder.
- Carry small tools on a tool belt when working on a ladder. Use a rope to raise and lower heavy tools.
- Never leave a raised or open ladder unattended.
- Store ladders away from heat and moisture. Destroy damaged or unsafe ladders.

References
29 CFR 1910.25 through 27
OAC 4121:1-5-03
ANSI A14.1 Ladders – Wood
ANSI A14.2 Portable Metal Ladders
ANSI A14.3 Fixed Ladders
ANSI A14.5 Portable Reinforced Plastic Ladders

Recommended and required written and training programs

Training is an important part of any good safety program. It also is an area that most employers have trouble maintaining. This chapter includes key points to consider in training your employees, as well as a sample form that you can use to document training. One of the areas that employers fail at when it comes to keeping up with training is that they do not maintain records. No matter what type of training you conduct in your facility, it is a good idea to properly document it. The list below gives you key points to consider when training.

- Develop training outlines covering what is to be communicated to employees.
- Have sign-in sheets for all training. If you can't provide sign-in sheets, you haven't done training.
- Compile files of sign-in sheets and outlines for each training class conducted.
- Develop a training schedule to ensure all required training is done during the time period required.
- Annually review training schedules for any changes that might be needed.
- Document training of new employees.
- Make a check list of training and other topics for new employees to ensure that everything gets covered.

Below is a list of programs and safety issues an employer may have to address. These programs should be site-specific. Prior chapters have covered many of these and some are highlighted below. To help assist employers with the development of these programs, BWC provides on-site program evaluation. Also, the OCOSH training center offers many of these classes.

- Lockout/tagout program
- Electrical safe work practices
- Hot work permits
- Hazard communications program
- Personal protective equipment
- Respiratory protection program
- Hearing conservation program
- Emergency action plans
- Fire prevention plans
- Powered industrial trucks/forklifts
- Cranes/hoist inspection program
- Sling inspection program
- Housekeeping
- First-aid training
- Confined space entry program
- OSHA log
- Accident reporting
- Safety committees/work teams
- Bloodborne pathogens
- Transitional work program
- Spill response plans

Housekeeping

Keep all places of employment, passageways, storerooms and service rooms clean and orderly and in a sanitary condition. Maintain every work-

room floor in a clean and, so far as possible, dry condition. Where wet processes are used, maintain drainage and provide false floors, platforms, mats or other dry standing places, where practicable. To facilitate cleaning, keep every floor, working place and passageway free from protruding nails, splinters, holes or loose boards. Where mechanical handling equipment is used, allow sufficient safe clearances (a minimum of three feet) for aisles, at loading docks, through doorways and wherever turns or passages must be made. Keep aisles and passageways clear and in good repairs, with no obstruction across or in aisles. Appropriately mark permanent aisles and passageways. Provide covers and/or guardrails to protect personnel from the hazards of open pits, tanks, vats, ditches, etc.

References
29 CFR 1910.22, .23 & .176

First-aid equipment

Make first-aid equipment available at all times. Report all injuries as soon as possible for medical attention. Provide first aid until medical attention can be provided. A first-aid responder should be on site unless the company is within close proximity to emergency medical facilities. You can define close proximity as those facilities that can respond to an incident that requires medical treatment.

References
29 CFR 1910.151

Confined space entry

Consider the following items as part of your written confined space program and training of your staff members.

- Post a sign. For example, "Danger — Permit Required Confined Space. Do Not Enter" by the confined space, or inform all employees by an equally effective means, such as written communication of the existence and location of the dangers posed by the permit-required confined space.
- Post the completed permit at the entry portal or inform all authorized entrants by an equally effective manner. For example, hold a meeting with all authorized entrants before entry, and review the completed permit with them.
- Ensure that the entry permits contain the 15 required elements:
  - Permit space to be entered;
  - Purpose of the entry;
  - Date and authorized duration of the permit;
  - Names of all authorized entrants in the space;
  - Names of the attendants;
  - Name of entry supervisor and signature or initials of person who originally authorized the entry;
  - Hazards of the permit space;
  - Specific measures used to isolate the permit space and to control or eliminate the hazards before entry;
  - Acceptable entry conditions;
  - Results of initial and periodic tests with times and name or initials of tester;
  - Available rescue and emergency services and how to notify these services;
  - Communication procedures used between entrants and attendants;
  - Required confined space equipment;
  - Additional needed information based on the permit space;
  - Any additional permits needed (e.g., hot work);
  - All employees entering or acting as standbys should be properly trained on confined space entry.

References
29 CFR 1910.146
OAC 4121:1-5-22

OSHA recordkeeping

You must maintain OSHA logs for each calendar year for five full years, plus the current year. Post the summary each year on Feb. 1 where employees normally see postings. You must log all work-related injuries/illnesses on the log that are considered OSHA recordable within six days

of receiving notice. For assistance in completing the form, refer to the instructions on the back of the OSHA log form. To obtain a copy of the form and/or the instruction booklet, visit OSHA's Web site, **www.osha.gov**.

References
29 CFR 1904 &1910.1920

Accident reporting
A supplementary record (OSHA Accident Report form, BWC First Report of an Injury, Occupational Disease or Death or other acceptable reports such as accident investigation reports) is required and must be available for inspection within six working days of a recordable illness or injury. You can obtain OSHA forms from your local OSHA office or by visiting OSHA's Web site, **www.osha.gov**.

References
29 CFR 1904

Safety committees/work teams
The safety committee provides an important method for employee participation in the safety program. Employees can share their knowledge and experience to correct potential workplace hazards, find ways to eliminate or reduce those hazards and monitor shop safety rules which, if not followed, may contribute to an accident. Safety committees encourage a closer relationship and understanding between employees and management relating to on-the-job safety by providing the opportunity for members to bring their ideas to management. A successful safety committee must encourage each employee to willingly accept responsibility for his/her own safety.

Bloodborne pathogens
A written bloodborne pathogens program should identify those persons at risk of exposure, as well as what means they should use to protect themselves. Provide annual training to all at-risk employees on how to identify bloodborne pathogens and their associated risks. Offer those who are at risk, the hepatitis B vaccine at no cost.

References
29 CFR 1910.1030

Transitional work program
A transitional work program uses real job duties to accommodate an injured worker's medical restrictions for a specific time period to gradually return the injured worker to the worker's original job. Injured workers may recover more quickly and participate in work activities as soon as they're medically able. In spite of their medical conditions, they also may experience a smoother transition back to regular duty and have improved self-esteem.

Spill response plans
Put a written plan in place to assist your employees with handling chemical spills. This plan should cover required equipment, PPE and all procedures that employees should follow to clean up any spilled hazardous material.

References
29 CFR 1910.120

Power tools, machinery and equipment
Common accidents associated with power tools include abrasions, cuts, lacerations, amputations, burns, electrocution and broken bones. These accidents are often caused by:

- Touching the cutting, drilling or grinding components;
- Getting caught in moving parts;
- Suffering electrical shock due to improper grounding, equipment defects or operator misuse;
- Being struck by particles that normally eject during operation;
- Touching hot tools or work pieces;
- Slips, trips and falls in the work area;
- Being struck by falling tools.

Safety guidelines
- Use the correct tool for the job. Do not use a tool or attachment for something it was not designed to do.

- Refer to the operator's manual or safety instructions provided with the equipment.
- Wear the appropriate PPE for the job.
- Select the correct bit, blade, cutter or grinder wheel for the material at hand. This precaution will reduce the chance for an accident and improve the quality of your work.
- Keep all guards in place. Cover exposed belts, pulleys, gears and shafts that can cause injury.
- Always operate tools at the correct speed for the job at hand. Working too slowly can cause an accident just as easily as working too fast.
- Watch your work when operating power tools. Stop working if something distracts you.
- Do not rely on strength to perform an operation. The correct tool, blade and method should not require excessive strength. If you have to use undue force, you may be using the wrong tool or have a dull blade.
- Disconnect from the power source before clearing jams or blockages on power tools. Do not use your hand to clear jams or blockages, use an appropriate tool.
- Never reach over equipment while it is running.
- Never disable or tamper with safety releases or other automatic switches.
- Use a push stick to move material through a machine when the chance for operator injury is great.
- Disconnect power tools before performing maintenance or changing components.
- Remove chuck keys or adjusting tools prior to operation.
- Keep bystanders away from moving machinery.
- Do not operate power tools when you are sick, fatigued or taking strong medication.
- Secure work pieces with a clamp or vise to free your hands and minimize the chance of injury when possible. Use a jig for pieces that are unstable or do not lie flat.
- Never wear gloves, loose clothing or jewelry when working with power tools.

References

29 CFR 1910.242
OAC 4121:1-5-07

Lockout/tagout
Employers are required to develop and implement an effective isolation and control program for hazardous energy when maintenance and/or service is performed for machinery. Employers are required to develop specific procedures to isolate and control all energy sources for each piece of equipment in the workplace. In addition, employers are required to identify specific employees who are authorized to perform machine lockout/tagout. The following outline identifies the requirements of an effective lockout/tagout program.

Purpose
To protect employees from unexpected release of stored energy, including:

- Mechanical;
- Hydraulic;
- Chemical;
- Gravity;
- Electrical;
- Pneumatic;
- Thermal;
- Any other sources of stored energy.

Written program
- Identify all sources of energy for each piece of equipment.
- Provide each employee with his or her own locks and keys. The supervisor may have a second key, but well-established procedures must be in place for when the supervisor can use the second key.
- Verify if an employee is not at the facility.
- Make a reasonable effort to inform the employee that the lock has been removed.
- Ensure that the employee is informed about the action before he or she returns to work.
- Annually review procedures (not by one performing lockout/tagout).
- Notify outside contractors of the program.

Employee training
- Methods of identifying energy sources

Resources

Plastics industry organizations and Web sites

PolymerOhio

PolymerOhio represents Ohio's processors, material suppliers, machinery and equipment manufacturers, mold builders and all organizations that support the industry. PolymerOhio is a consortium of partners dedicated to the exchange of information and services.

PolymerOhio, P.O. Box 2098,
Westerville, OH 43086
Phone: (614) 212-5366
E-mail: info@polymerohio.org
Web address: www.polymerohio.org

Society of Plastics Engineers

The Society of Plastics Engineers is a network of plastics professionals around the world that promote the knowledge and education of plastics and polymers. There are local sections in Ohio.

Web address: www.4spe.org

Society of the Plastics Industry

This organization is forming unique partnerships in safety with MIOSHA, and OSHA. The goal of these partnerships is to focus on the importance of providing a safe workplace for all workers in the plastics processing industry through specific safety training programs, and education and outreach efforts.

Web address: www.socplas.org

Manufacturing organizations

National Association of Manufacturers

www.nam.org

The Ohio Manufacturers Association is a member association of the National Association of Manufacturers.

33 N. High St.
Columbus, OH 43215
(614) 224-5111
(800) 662-4463
E-mail: oma@ohiomfg.com
Web address: www.ohiomfg.com

Best practices information

Best Manufacturing Practices

Through its surveys, Best Manufacturing Practices identifies and documents best practices in industry, government and academia; encourages the sharing of information through technology transfer efforts; and helps strengthen the global competitiveness of the U.S. industrial base.

Web address: www.bmpcoe.org/bestpractices

The Benchmarking Exchange (TBE)

TBE's BenchNet is a comprehensive and very user friendly electronic communication and information system designed specifically for use by individuals and organizations involved in benchmarking and process improvement. (There is a charge for this service.)

Web address: www.benchnet.com

Tools

Calculating incident, frequency and severity rates

Incident rate:

$$\frac{\text{Number of recordable injuries and illnesses x 200,000}}{\text{Number of hours worked by all employees}}$$

Lost day incident rate:

$$\frac{\text{Number of recordable injuries and illnesses involving lost or restricted days x 200,000}}{\text{Number of hours worked by all employees}}$$

Frequency rate:

$$\frac{\text{Number of claims x 1 million}}{\text{\$ Payroll}}$$

Severity rate:

$$\frac{\text{Number of lost and restricted work days x 200,000}}{\text{Number of hours worked by all employees}}$$

The incident and severity rates represent a time-weighted average based on 100 full-time employees working 2,000 hours each (thus the 200,000 hour constant in each formula). These rates should be calculated for each month and year-to-date running total.

Recordable incident:_____

Lost workdays:_____

Restricted workdays: _____

Action plan

Those items not checked off as satisfactory become those with which to start system improvements. The first step of system improvements is to form an action plan. Consider the form below.

Action item	Responsible party	Start date	Completion date	Complete
Example: Assess personal protective equipment needs	Line supervisors/ safety director	Jan. 1	Feb. 1	✔

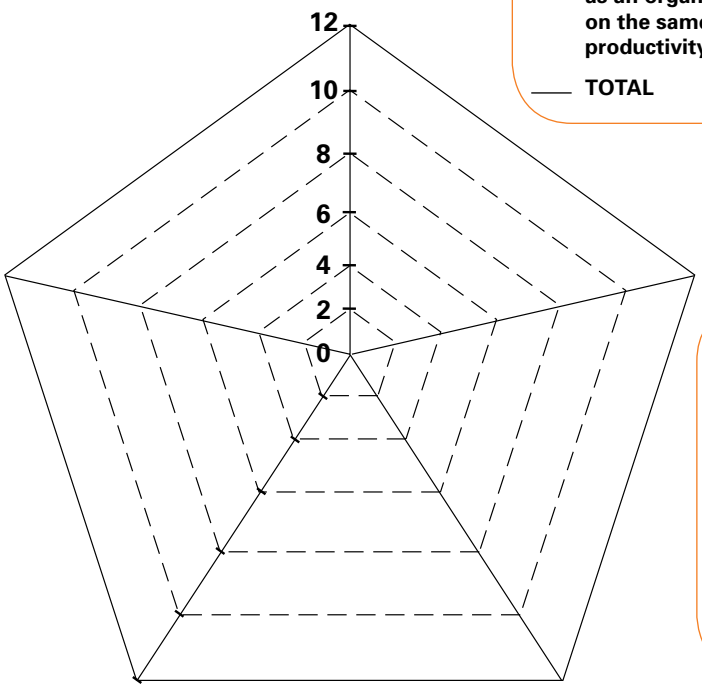
Safety culture wheel

Instructions

(1) Consider the questions in each category.
(2) Rate your company on a scale from 0 to 3.
    0 = Weakness
    1 = Some aspects covered
    2 = Could be improved
    3 = Strength
(3) Total the points under each category.
(4) Plot the totals onto the corresponding axis.
(5) Connect the plotted points from axis to adjacent axis.

Leadership

- ___ **Leadership commitment to safety is active, visible and lively.**
- ___ **A clear and inspiring vision has been established for safe performance.**
- ___ **Safety is viewed and treated as a line management responsibility.**
- ___ **Safety is clearly perceived as an organizational value on the same level with productivity and quality.**
- ___ **TOTAL**



Measurement & accountability

- ___ **All levels of the organization have safety goals and process responsibilities clearly defined.**
- ___ **The process of achieving results is a key safety measure.**
- ___ **Performance reviews include accountability for safe performance at all levels.**
- ___ **Supervision is accountable to perform safety observations and feedback.**
- ___ **TOTAL**

Systems & processes

- ___ **Trust and openness are the norm.**
- ___ **Positive reinforcement is used regularly.**
- ___ **Bureaucratic obstacles are removed.**
- ___ **There is formal and informal recognition for great performance at all levels.**
- ___ **TOTAL**

Organizational style

- ___ **Supervisors and workers partner to find**
- ___ **and correct systems causes of incidents.**
- ___ **Communication systems are abundant, effective and flow well in all directions.**
- ___ **Training systems deliberately and systematically create competency for the right people at the right time.**
- ___ **Safe operating procedures and policies are clearly defined and communicated.**
- ___ **TOTAL**

Involvement

- ___ **Workers are skilled at problem solving and decision making.**
- ___ **Labor and management work together to address safety systems issues.**
- ___ **Team orientation achieves involvement and cooperation.**
- ___ **Innovation, participation and suggestions are encouraged at all levels.**
- ___ **TOTAL**

Training log

Training topic: _____

Key points covered: _____

Outline or other handout material attached: **Yes** **or** **No**

Instructor: _____ **Date:** _____

Name printed or typed	Signature	Date

Notes