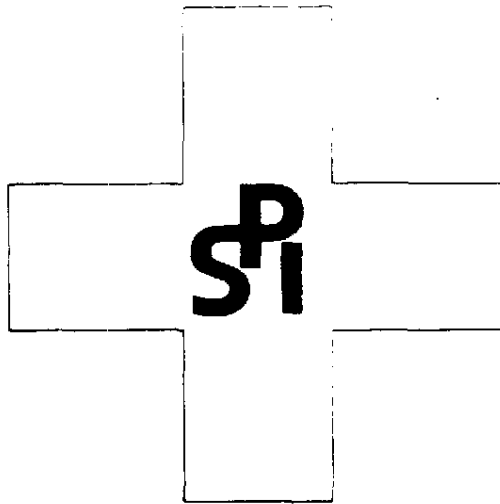




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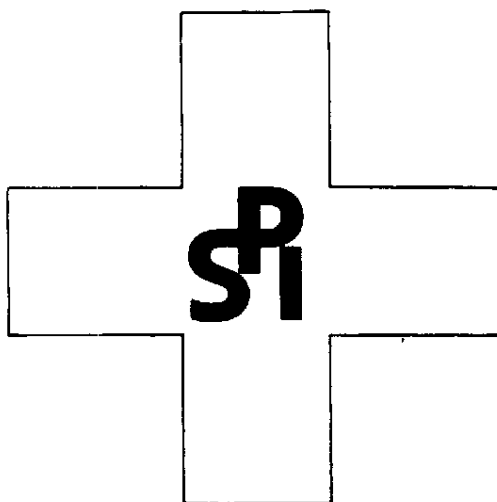
***Plastics Training and Information
to Promote Safety***

The Safety and Health Reference Guide for the Plastics Processor



The Society of the Plastics Industry, Inc.

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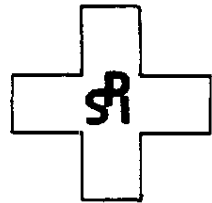
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**THE SAFETY AND HEALTH REFERENCE GUIDE
FOR THE PLASTICS PROCESSOR**

**PUBLISHED BY
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PlasTIPS

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SECTION II—MACHINERY SAFETY

SECTION III—SAFE MATERIALS HANDLING PROCEDURES

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DISCLAIMER

This Safety and Health Reference Guide is intended to be a general management tool that plastics processors may find helpful in building a sound safety program. As a management tool, it highlights important safety requirements and suggests possible compliance strategies. This manual is meant to be used in conjunction with applicable rules and regulations and not as a substitute for those rules, or for an employer's specific responsibility to provide a safe working environment.

Safety practices discussed in this Guide have been found helpful in some situations; where provided, safety precautions provided by a manufacturer should be followed. In specific cases, additional precautions may be necessary and/or the suggested safety procedures outlined in this Guide may be inappropriate, ineffective, or unnecessary.

This material has been funded in part by funds from The Occupational Safety and Health Administration, U.S. Department of Labor, under grant number E9FOD273. These materials do not necessarily reflect the views or policies of the U.S. Department of Labor. Mention of trade names, commercial products, or organizations does not imply endorsement by the U.S. Government.

FOREWORD

The Safety and Health Reference Guide for the Plastics Processor is a primary component of the PlasTIPS (Plastics Training and Information to Promote Safety) program which has been funded jointly by The Society of the Plastics Industry, Inc. and the U.S. Occupational Safety and Health Administration. Federal funds involved were provided under the New Directions program.

In addition to this Safety and Health Reference Guide, the PlasTIPS program includes the following:

- 1) Audio/visual programs addressing safety matters of concern to the plastics industry; PlasTIPS currently includes eight completed audio/visual programs with selected support materials. Additional programs are in various stages of development.
- 2) Safety/Health Bulletins designed to alert SPI members to important issues in the area of occupational safety and health. SPI Safety/Health Bulletins address issues of importance to the general SPI membership while technical assistance and counsel are available to individual company members at all times from SPI staff specialists in safety and industrial hygiene.
- 3) Instructional seminars to help train supervisory personnel in conducting effective safety programs.
- 4) SPI's annual statistics and awards program which collects data on occupational illness and injury from member firms for purposes of monitoring the progress of safety programs in the plastics industry and, at the same time, to provide appropriate recognition for those organizations which have demonstrated meaningful progress toward providing a safe workplace.

PlasTIPS is an important, continuing project for SPI. Introduction of this Safety and Health Reference Guide for the Plastics Processor is a significant

achievement in SPI's on-going effort to provide members with tools necessary to develop effective occupational safety and health programs.

This project could not have been completed without generous contributions in the form of expert counsel and use of facilities on the part of many individuals from a number of SPI member firms.

A handwritten signature in black ink, reading "G.R. Munger". The signature is fluid and cursive, with the first letters of each name being capitalized and prominent.

G.R. Munger

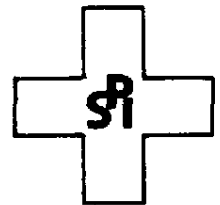
President

The Society of the Plastics Industry, Inc.

EXHIBIT REPRINT PERMISSIONS

Permission has been granted in writing by the following organizations to reproduce illustrations or data used as exhibits in this report.

Exhibit	Page	Permission Given By
1-1	1-2	National Safety Council
1-2	1-8	National Safety Council
2-1	2-7	American National Standards Institute (ANSI)
3-1	3-2	National Safety Council
3-2	3-4	National Safety Council
3-3	3-18	National Safety Council
3-4	3-24	American Society of Mechanical Engineers
3-5	3-34	National Safety Council
3-6	3-35	American National Standards Institute (ANSI)
4-3	4-32	American Conference of Government Industrial Hygienists - Committee on Industrial Ventilation
4-4	4-39	Mine Safety Appliances Co. •
4-8	4-71	Institute of Electrical and Electronics Engineers, Inc. and Patty's Industrial Hygiene and Toxicology - John Wiley and Sons
5-1	5-5	National Safety Council
5-4	5-29	National Safety Council
5-5	5-30	National Fire Protection Association



PlasTIPS

SECTION I

FUNDAMENTALS OF SAFETY AND HEALTH

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SECTION I - FUNDAMENTALS OF SAFETY AND HEALTH

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SECTION I - FUNDAMENTALS OF SAFETY AND HEALTH

Many companies, small and large -- processors, material suppliers, and machinery builders -- have recognized the need to approach safety on an integrated basis. These efforts must encompass all aspects of plastics processing operations. The objective, of course, is to improve the industry's safety performance. Furthermore, *additional benefits may be derived by maximizing efficiency and improving productivity.*

Toward this end, The Society of the Plastics Industry, Inc. (SPI) continues to develop resource material for training in safety and health practices in plastics processing. It is the intention of SPI to assist management by presenting some proven methods developed by the industry over a period of years that can increase the effectiveness and usefulness of a safety and health program. This guide provides general principles for developing safe work practices in plastics processing operations. It does not represent an interpretation of laws or specific regulations dealing with worker safety.

The development of these materials is consistent with the intent and philosophy of SPI as stated in its Policy on Safety and Health in the Workplace. (See Exhibit I-1). This policy, which was adopted by the operating units of SPI, gives direction and focus to the efforts of all concerned for health and safety in the plastics industry.

I.0 SAFETY PROGRAM

Productivity, quality control, and safety are interrelated aspects of a good management system. Safety activities should be considered an integral part of production so that safety is built into all work procedures, from equipment selection to training in the proper use of equipment. Favorable trends in quality control and scheduling, improved morale, lack of absenteeism and turnover, and other operational goals can occur concurrently with improved safety records.

The fundamentals of safety management are, in fact, no different from those of production management. First, top management establishes a policy and sets goals that are realistic and achievable, then assigns responsibility for meeting safety goals to those who are in direct supervisory roles. If safety is considered an integral part

1-2
Exhibit 1-1

SPI Safety Policy
Safety and Health in the Workplace

The production of plastics and plastics products, like the production of all other materials and products, involves the potential for exposure of personnel to industrial risks. The degree of these risks can be minimized by the application of sound industrial safety and health practices.

To assist its members in the continued development of constantly improving industrial safety and health practices in the plastics industry, The Society of the Plastics Industry, Inc. urges all of its operating units to recognize and to continue to communicate to their members the constant need for joint management-employee cooperation to maintain a safe and healthful workplace. The operating units also are requested to assist in developing and implementing effective workplace practices designed to ensure that employees are free from unreasonable safety and health risks. These practices will apply to the manufacture and use of plastics and plastics constituents, and the use of plastics processing machinery.

INDUSTRY ACTIONS

Through the activities of SPI's Committee on Occupational Safety and Health, SPI will assist members in meeting the requirements of current OSHA and related governmental regulations in the area of safety and health. Likewise, SPI will participate in the development of new or modified OSHA or related governmental safety and health regulations which may affect the plastics industry. SPI will represent its members' interests before government agencies where it is ascertained that regulations are unreasonable or inappropriate.

Concurrent with the development of industry safety and health practices and supporting the intent and purpose of OSHA and related regulations, SPI will continue to endorse reasonable means to improve accident prevention and healthful working conditions. To do this it will encourage:

1. Cooperative participation in the development of reasonable and effective health and safety standards.

2. Collection of industrial accident data to use in evaluation of working conditions.
3. Development and implementation of accident prevention programs and personnel training in safety practices and procedures.
4. Development of appropriate industrial safety and health practices and procedures for the workplace.

MEMBER ACTIONS

SPI will encourage all members to work toward the reduction of workplace accidents by the following actions:

1. All SPI units will be urged to assume a leadership role by advising their members to adopt or continue to follow workplace safety programs through
 - a. Education related to the management of safety and health responsibilities.
 - b. Increasing awareness of applicable safety standards.
 - c. Maintenance of working conditions which are free from unreasonable risks.
 - d. Employee education and training in safety practices.
 - e. Maintenance of medical and first aid system.
 - f. Maintenance of an accident reporting system.
 - g. Development of an overall employee safety record-keeping system.
2. The Committee on Occupational Safety and Health working under the direction of the Public Affairs Committee will be charged with the following responsibilities:
 - a. Assisting SPI operating units in the establishment of workplace safety programs.
 - b. Periodically reviewing safety programs to ascertain whether any additional areas may require attention; and
 - c. Ensuring that SPI's safety and health programs are made available to all members.

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of every job and poor safety performance is penalized in the same way as is poor performance in other areas of responsibility, all employees, from the top manager to the newest employee, will develop a strong commitment to safety.

Basic Elements of a Safety and Health Program

A successful program for safety starts from the top, with management expressing its commitment through the adoption of a safety policy. The policy sets the tone for encouraging safe production and states that the company is committed to:

1. Establishing objectives for a Safety and Health Program
2. Establishing accountability in reaching these objectives
3. Periodically reviewing the performance of the Safety and Health Program.

A safety policy provides the direction. Thereafter, it is the task of the operating units to implement the goals established in the policy.

1. Establishing objectives for a Safety and Health Program

Examples of realistic annual objectives are:

- the identification of training needs and development of a specific program to meet these needs
- reducing the incidence of accidents or injuries
- improving the facilities, or equipment
- improving work procedures and housekeeping
- establishing formal training procedures.

2. Establishing accountability for reaching these objectives

Assigning accountability involves more than a management review of the accident rate. Leadership, creativity, persistence and the ability to accomplish set objectives should also be evaluated at all levels of the company. A commitment to safety should be required of top management, supervisors and individual employees.

One means of assigning accountability for the safety program is to emphasize the supervisor's role in safety activities. Supervisors should be recognized for their participation in such activities as:

- attending safety meetings
- providing one-on-one coaching or training
- giving pep talks
- making safety inspections
- being involved in equipment maintenance
- writing reports (accidents, unsafe conditions, etc.)
- spotting and correcting unsafe conditions promptly
- special supervision of unusual conditions and practices
- monitoring employees' use of personal protective equipment
- achieving a reduction in the accident rate

3. Periodically reviewing the performance of the Safety and Health Program

After accountability for the safety program has been established, it is important to ensure its continued implementation. Management must verify that unsafe conditions are spotted and corrected immediately. The primary responsibility for identifying and correcting unsafe conditions lies with first-line supervisors, but a team approach among all departments is needed to obtain the best results. Some companies have adopted the policy of giving highest priority to maintenance projects necessary to correct unsafe conditions. Special funds need to be budgeted for maintaining safe equipment and repairs.

Safety Committee

Another facet of implementation of a safety program is through the establishment of a safety committee. The safety committee does not relieve management or supervisors of the responsibility for safety, but it can serve as an advisory body by:

- pointing out safety activities of special importance to the company
- auditing conditions on a plant-wide basis and reporting on the status of corrective actions
- recommending policies and actions to improve overall safety and health conditions
- assisting in the coordination of safety and health activities among departments
- investigating accidents

Many companies have a safety committee. The type and extent of the responsibilities of such committees differs widely according to the concerns of management, the size of the company, and the type of plant involved. To be effective, the safety committee should have strong leadership. Top management should take an active role in giving the committee the needed backing and authority to get things done. Ideally the highest ranking official at the facility should chair the safety committee. The decision as to who should serve on the committee will depend on several factors including the type of operations and facilities involved. In unionized plants, safety committee membership and responsibilities may be written into a negotiated contract. In such cases, both management and the union may choose their own representatives or the representatives may be elected by the employees.

Among the guiding principles to employ in committee membership are:

- insuring that some of the representatives are knowledgeable in safety and health

- having representatives who have direct knowledge of the operations and their hazards
- including a representative who can be responsible for seeing that safety work orders have been completed
- selecting employees who will express concern and offer observations on behalf of their co-workers

The safety committee, once formed, can be made responsible for:

- advising on or setting safety policy
- reviewing accidents or incidents
- reviewing new operations before they are brought on line for their compliance with safety and health requirements
- reviewing major expenditures for their inclusion of new safety and health controls
- promoting interest in safety through competition and other means
- educating others in safety and health
- inspecting workplace conditions or reviewing reports of previous inspections
- initiating special committees to carry out specific assignments
- assisting in the formulation of safety training programs

Good safety committee meetings require planning and effort. Notice of a meeting, accompanied by an agenda, should be sent to each committee member, rather than announcing a meeting by placing a general notice on the bulletin board or notifying members verbally.

An initial inspection of the entire plant should be made by a group composed of production representatives, maintenance personnel and a safety professional. If a safety professional is not on the company staff, the insurance carrier, state consultant, or a private consultant should be contacted.

The importance of the first inspection cannot be overemphasized. This activity gives the workers their first specific indication of management's sincere interest in accident prevention. It helps to persuade the workers that they should practice personal safety, since the company itself is authorizing the expenditure of time and money to create a safe workplace.

Various types of inspection forms can be used to record observations (Exhibit 1-2 is an example of an inspection form). When completed, these forms provide a record of the plant's condition and simplify the listing of recommendations for action. They provide management with a means for determining what recommendations were made and whether they were implemented.

It is the responsibility of each employee to report any unsafe acts or conditions to the supervisor so that corrective action may be made as soon as possible.

A daily checklist for machine operators, supervisors, and maintenance personnel can encourage employees to look for unsafe conditions and practice safety on a daily basis. Short checklists are most valuable because they are used most easily. Supervisors should review the checklists periodically with the employees to make certain that the lists address the most important safety issues.

Some types of equipment should be checked on a regular basis. Regular inspections of boilers, elevators, unfired pressure vessels, cranes, power presses, respirators, sprinkler systems and fire extinguishers are recommended.

Before they are operated, new machines and equipment should be inspected to ensure that they meet pertinent safety and health standards. Pilot runs with extra emphasis on safety precautions are commonly used when debugging new operations. Once the equipment is placed in production, close supervision is still needed until its safe operation is confirmed.

Detailed Inspection Checklist Helps Inspector Find Unsafe Acts and Hazards Before They Can Trigger an Accident

SAFETY INSPECTION CHECKLIST	
Plant or Department _____ Date _____	
This list is intended only as a reminder. Look for other unsafe acts and conditions, and then report them so that corrective action can be taken. Note particularly whether unsafe acts or conditions that have caused accidents have been corrected. Note also whether potential accident causes, marked "X" on previous inspection, have been corrected. (V) indicates Satisfactory (X) indicates Unsatisfactory	
1. FIRE PROTECTION Extinguishing equipment ☐ Standpipes, hoses, sprinkler heads and valves ☐ Exits, stairs and signs ☐ Storage of flammable material ☐	4. BULLETIN BOARDS Neat and attractive ☐ Display changed regularly ☐ Well illuminated ☐
2. HOUSEKEEPING Aisles, stairs and floors ☐ Storage and piling of material ☐ Wash and locker rooms ☐ Light and ventilation ☐ Disposal of waste ☐ Yards and parking lots ☐	7. MACHINERY Point of operation guards ☐ Belts, pulleys, gears, shafts, etc. ☐ Oiling, cleaning and adjusting ☐ Maintenance and oil leakage ☐
3. TOOLS Power tools, wiring ☐ Hand tools ☐ Use and storage of tools ☐	8. PRESSURE EQUIPMENT Steam equipment ☐ Air receivers and compressors ☐ Gas cylinders and hoses ☐
4. PERSONAL PROTECTIVE EQUIPMENT Goggles or face shields ☐ Safety shoes ☐ Gloves ☐ Respirators or gas masks ☐ Protective clothing ☐	9. UNSAFE PRACTICES Excessive speed of vehicles ☐ Improper lifting ☐ Smoking in danger areas ☐ Horseplay ☐ Running in aisles or on stairs ☐ Improper use of air hoses ☐ Removing machine or other guards ☐ Work on unguarded moving machinery ☐
5. MATERIAL HANDLING EQUIPMENT Power trucks, hand trucks ☐ Elevators ☐ Cranes and hoists ☐ Conveyors ☐ Cables, ropes, chains, slings ☐	10. FIRST AID First aid kits and rooms ☐ Stretchers and fire blankets ☐ Emergency showers ☐ All injuries reported ☐
	11. MISCELLANEOUS Acids and caustics ☐ New processes, chemicals and solvents ☐ Dusts, vapors, or fumes ☐ Ladders and scaffolds ☐
Signed _____	
USE REVERSE SIDE FOR DETAILED COMMENTS OR RECOMMENDATIONS REP 100-AD-1081 PRINTED U.S.A. STOCK NO. 120-10	

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A spot inspection, unscheduled and unannounced, may be effective in focusing on operations or machines with high risk potential. Such inspections are not designed to assign fault, but to demonstrate management's concern for the detection of any unsafe conditions in the particular operations involved.

All facilities and operations should be inspected at least once a year by personnel working outside the department. The inspections should cover all areas of the plant. Checklists that are tailored to plant facilities can expedite an inspection as well as provide continuity between inspections. The checklist can have three basic headings: physical facilities (structures, machinery, equipment, materials, and so on); methods of operation (including work practices); and plans and specifications (for instruction, installation of machinery and equipment, seasonal or occasional jobs, and for purchase orders for material and equipment).

Once a basic "checklist" system has been introduced a complete tabulation of all items and operations to be inspected should be established. This comprehensive master list for future inspections can be very effective in minimizing duplications and in verifying that all appropriate areas and procedures are periodically inspected.

The inspector or inspection team should report to supervisors of the area that is to be inspected and invite them to participate in the inspection. Inspectors should be careful not to undermine the authority of the line supervisors. It should be clear that the responsibility for accident prevention remains with the supervisor.

The inspectors should be curious and not hesitate to question a condition or operation even if they do not know what specific corrective measures to suggest. Inspectors should demonstrate their sincerity and desire to help by being open, honest, and inquisitive.

Before leaving an area, inspectors should discuss with the supervisor any questionable work practices and conditions observed during the visit. Inspection reports should suggest specific corrective action for any unsafe practices or conditions noted. Each recommendation should positively identify or locate the unsafe practice. It is helpful if the recommendations are arrayed so that the the most serious problems can be addressed first.

The recommendations should be numbered and should indicate the exact location and condition to which each refers. The recommendations should then be passed to someone with the authority to decide whether each is to be approved, disapproved or held for further investigation.

Recommendations that are approved should be acted on quickly. All approved recommendations should be followed up to verify that they have been carried out. Recommendations marked for further investigation should be assigned to the person best qualified for such a study.

Recommendations that are disapproved should be recorded with the reason for the disapproval indicated. The person or group who made the recommendation which was not approved should be informed of the reasons for the disapproval. Periodic reports should be issued covering the number of recommendations submitted during the specified time, the number implemented, the number pending and the number disapproved. Copies of the reports should be given to safety committee members and to company officials.

Periodic inspections should not obscure the fact that safety is a continuous activity.

Maintaining Interest in Safety

Employees sustain an interest in safety when a sense of pride and accomplishment in their safety activities is cultivated. The safety program can be sold with the same ingenuity as any sales program.

Employees can be encouraged to participate directly in safety activities through establishment of a company-wide campaign that focuses on such specific goals as:

- development of safe work habits or attitudes
- reduction of the frequency of accidents
- improved communications among management, supervisors, and operators

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A safety campaign should not be seen as a substitute for training or a remedial measure to compensate for unsafe conditions. It should be a calculated effort to reduce injuries by motivating employees to observe safe practices.

A contest is one of the oldest promotional tools used in American industry. Friendly competition can be used to bolster interest and enthusiasm in a safety program. It can provide common ground for talking about safety and bringing the efforts of management and the employees together. Because contests involve much time and effort, it is wise to design the contest carefully to include as many people as possible, to keep awards within reach of all participants, and to generate maximum interest.

Each contest should be announced well ahead of time. All participants should know the ground rules before the contest begins. The simpler the contest, the better. Complicated rules may discourage or confuse participants.

The most common safety contest is the one that awards employees for being part of a group whose efforts resulted in a favorable safety record. The winners could be the group with:

- the safety record that improved to the greatest extent
- a certain number of hours without a lost-time accident
- the best safety record (providing the conditions are similar)

Where departments are very dissimilar, safety contests which measure the standings of the various departments against their own records or which involve competition among the different workshifts are more equitable.

2.0 SUPERVISOR'S COMMITMENT TO SAFETY

In developing an effective safety program it is essential to understand that the ultimate responsibility for safety lies with both management and labor. The key is joint responsibility.

Supervisors, for their part, should know which procedures are safe and be able to explain them to the employees. But more than this, they should make certain that safe procedures are followed. To do so, they should apply their supervisory ability toward meeting safety goals in the same way they would toward meeting production goals. All the principles in training and motivating employees for production are applicable to safety. Supervisors should know the jobs, how to work with people and, most of all, should assume the responsibility for seeing that the job is done safely.

Safety is an essential part of effective supervision. Supervisors' safety records should be a part of their overall performance appraisal.

Supervisor's Role

Supervisors' roles in the safety program should include:

- familiarizing themselves with the company policy and program
- making sure that each employee is acquainted with the safe operating procedures for equipment and facilities
- investigating all accidents promptly and thoroughly, and following up to correct causes of accidents
- working responsibly with other departments to coordinate plant-wide safety practices
- forbidding maintenance personnel, contractors or others from working in the area until assured that all safe operating procedures will be followed
- inspecting the work area daily for unsafe conditions or actions
- preventing the starting of new equipment or procedures without first instituting appropriate safety and health procedures

- insisting that all employees maintain proper safeguards and wear suitable protective equipment
- correcting unsafe conditions or actions, in a timely fashion, with all work followed up with on-the-spot inspection
- encouraging all employees to be responsible for their own safety, and to report any hazardous condition, injury or near-injury
- setting an example by following all safe operating procedures

Some common techniques used successfully by supervisors in dealing with safety procedures are:

- explaining the operation fully to employees so they understand the consequences of their actions
- mentioning safety frequently -- every day, if necessary (one company which had an excellent safety record attributed it in part to the plant manager who greeted everyone each day with "Are you going to do it safely?")
- being creative (each individual will have prior safety experience and training so different approaches may be effective in transferring that training to the present job)
- not personalizing any admonitions given to employees on safety

Job Safety Analysis

Before supervisors can oversee an operation's safety, they should understand thoroughly each job in their department. To do so, they can examine a job by breaking it down into its components and then analyzing its safety. It should then be apparent how each step can be made safer and more efficient.

Job safety analysis is the technique for breaking down any given work assignment into its basic steps, studying each for inherent or potential hazards, and developing specific work procedures that will eliminate or control each potential hazard. Job safety analysis is especially important for operations with:

- poor safety records (as evidenced by the accident records)
- greater need for employee education or training (which can be made simpler and easier after job safety analysis)
- new processes, locations, or machinery where hazards have not been identified
- safety engineering deficiencies (which can be corrected through controls suggested by the job safety analysis)

There are four basic steps in job safety analysis:

1. Select a job or jobs for analysis. Priorities should be established; the jobs with the highest risk potential should be studied first. After a safety program is initiated, all new or revised jobs can be analyzed and the unchanged jobs reviewed on a regular basis for revisions.
2. Break the job down into successive steps narrow enough that any unsafe conditions may be detected.

Careful observation and common sense are the essential components of job safety analysis. Supervisors should try to put themselves in the operator's place and ask themselves the questions:

- Are there any sharp or protruding objects nearby?
- Could I be caught between two things (such as calender rolls)?
- Could I strain my back by pushing or lifting?

- Are there any potential health hazards such as toxic chemicals, noise, heat stress or radiation present in my work environment?

It is important that the successive steps of the job be reviewed with the operator, especially "near misses."

3. Act to eliminate or offset unsafe conditions. Once these are identified for each step, ways to offset or avoid them should be evident, such as:

- finding a new way to perform that step in the job
- changing materials, tools, equipment, or location
- modifying the job procedure to eliminate the specific hazard
- reducing the frequency of the procedure
- adding protective equipment

Many benefits can accrue from the conscientious application of these principles. The techniques will:

- uncover previously overlooked unsafe conditions
- assist in training new employees in safety
- promote interest in safety
- increase the supervisor's understanding of safety
- aid in the review of job procedures and in the determination of the causes of accidents
- target the need for monetary appropriations for safety

New Employee Safety

New employees' first impressions of a company's safety program will influence their attitudes toward safety for the rest of their employment. From the beginning new employees should know:

- management is serious about safety
- their jobs are considered safe but there is always a chance of injury
- safety is a team effort
- they should not operate any machinery without direct authorization and proper instruction
- they should report any unsafe practices and all injuries to their supervisor
- protective equipment is available and must be used when and where it is required

Since safety is a joint effort, the responsibility to inform new employees about job safety may lie with a number of persons. The personnel director or safety manager can set the tone, but the supervisors should impress new employees with their responsibility for safety. The importance of safety should be evident in the on-the-job training given to new employees. It can be reinforced through:

- a checklist of rules, regulations, and policies for each job
- an introductory audiovisual on health and safety
- short in-house safety training classes followed by discussion and a written or oral examination
- periodic conferences with employees to reinforce attitudes about safety
- specific safety retraining programs

Job Instruction Training

The supervisor should repeat and re-emphasize the safety rules along with the other job fundamentals so that new employees will be convinced that the company truly cares about their safety, and that safe work practices are mandatory.

Informal job training may not be sufficient to ensure that the job is being done safely. Planned, well-organized training can reduce the possibility of a serious accident.

The National Safety Council has prepared a five-step job instruction training program:

Step 1. Prepare equipment ahead of time so that the student can start in immediately. Put all students at ease. Attach importance to the job and stimulate interest. Do some initial probing to see what experience and skills each student brings to the job. Give a broad overview of the job and its importance.

Step 2. Present no more than five or six key points at any one time. If there are more than six points, divide the training into two sessions. Perform the operation for the students several times. Break the job into steps. Be careful to name parts, tools, and processes very accurately as you go through each step. Assume the students do not understand, even though they may shake their heads in agreement.

Step 3. Observe each student/employee performing the operation. Frequently ask whether he or she understands. Make sure the student verbalizes the names and uses of the parts, processes or tools. If the employee cannot proceed unaided, go back to Step 2.

Step 4. Test the student. After the student can perform the job satisfactorily, the instructor should check the quality of work and ask the student to repeat what has been learned.

Step 5. Follow-up with on the job audits to assure that the correct procedures are being used.

The instructor must be thorough, knowledgeable and committed to "safe production." Remember, a student usually mimics the instructor.

3.0 OFF-THE-JOB SAFETY

The main objective of both off-the-job safety and on-the-job safety is the same -- to protect the worker from injury. Safety principles practiced on the job can influence an employee's behavior off the job as well.

People typically spend less than a third of their time each week on the job. Records compiled by some companies have shown the number of off-the-job injuries sustained by their employees to be amazingly high - often many times the number of in-plant injuries for the same periods.

Surveys made by these companies have indicated that operating costs are directly affected by the off-the-job injuries suffered by their employees. Possible costs may be for:

- wages for relief personnel
- training of substitute employees
- equipment damaged and product spoiled by less experienced replacement personnel
- additional work loads placed on supervision
- injured employees on their return to work not performing at peak efficiency for a period of time
- disability payments
- insurance payments - for accident and health insurance, group life insurance, or hospital and surgical insurance

The supervisor can promote off-the-job safety by taking an interest in the off-hour welfare of the workers. In personal contacts and safety meetings the supervisor can talk about off-the-job safety.

Off-the-job safety can cover items such as environmental stresses. Loud noises from the use of chain saws, snowmobiles, and motorcycles may damage an employee's hearing ability. Impaired hearing may diminish the employee's ability to work safely on the job. If employees have recreational exposures to loud noises, they should be encouraged to wear hearing protection while involved in such activity.

Other off-the-job safety items commonly addressed are smoking, handling chemicals, and electrical safety.

Management can help prevent off-the-job accidents by:

- planning and supporting off-the-job safety programs for all employees
- discussing off-the-job safety, either in special meetings or as part of the regular safety work
- providing protective equipment (safe glasses, safety shoes, ear plugs) and encouraging its use in off-the-job situations where such protection is desirable - e.g. ear plugs for chain saw operators, safety shoes for lawn mowing
- collecting, analyzing, then publicizing off-the-job safety data
- budgeting for the promotion of off-the-job safety

4.0 ACCIDENT RECORDS AND STATISTICS

The Occupational Safety and Health Administration (OSHA) and most states require recording of injuries or illnesses occurring on the plant premises or because of work-related functions which require treatment beyond first aid. These records which are required by law are the minimum which should be done. Incident reports that show

near misses, property damage and cases where simple first aid was needed may not be required by law, but they give much needed information. A near miss may differ from a severe, disabling accident by a fraction of an inch. Records of such incidents can prompt the implementation of control measures before a serious accident occurs.

Accidents happen because of unsafe conditions or unsafe acts. The person compiling the accident report should carefully seek out the causes for both conditions and acts. To do so, all relevant details should be recorded including:

- any defects in plant equipment or design
- any unusual production demands
- instructions or training given to the operator prior to the accident
- condition of floors, lighting, ventilation
- position of guards, interlocks and other safety devices
- positions and behavior of witnesses prior to the accident
- whether personnel protective equipment was used and what its condition was

The extra time needed to investigate and document the causes of the accident and then to initiate a remedy will be small in relation to the benefits. Corrective actions should be based on sound data; in many cases capital expenditures may be required for corrective actions.

Accident Investigations

An accident may involve many different causes such as:

- insufficient training of employees

- a lack of concentration
- the disregarding of instructions
- the lack of proper lighting
- poorly designed guards
- defective equipment
- poor housekeeping
- inadequate personal protective equipment

If an accident investigation shows the cause of injury to be an unsafe act such as "lifting while off balance" or "poor grip on object," the supervisor should explain to the injured employee and other employees the correct way to do the job. If the cause was an unsafe condition, it is management's responsibility to have the condition corrected at once. No investigation should be conducted to find fault - the accident has occurred - the investigation is to find out why it happened and what can be done to prevent another such accident.

A company may want to determine the cost of each accident. If it does, the accident report should include a statement of direct injury expense, such as compensation and medical or hospital costs and the indirect costs, such as spoilage of material, damage to the equipment, and loss of production time. Such indirect costs may exceed by several times the direct compensation and medical costs.

A company should retain in its files all medical records as well as all records dealing with their employees' exposure to toxic substances or harmful physical agents. The records should be made accessible to the employees, their designated representatives and to OSHA. The requirements for retaining these records and making them available to certain parties are spelled out in an OSHA Standard: Access to Employee Exposure and Medical Records (29 CFR 1910).

Injury and Illness Statistics

Statistics on occupational injuries and illnesses utilize standardized methods of reporting occupational injuries and illnesses. OSHA requires all companies with more than ten employees to record occupationally related injuries and illnesses which require treatment beyond first aid. Other organizations such as the Workmen's Compensation Board, insurance companies, state agencies, and the National Safety Council, also gather accident statistics. The reporting method may or may not use the same definitions as OSHA.

Since most employers are required, as a minimum, to keep their reporting in accordance with OSHA methods, the following explanation of injury and illness rates is limited to reporting requirements specified in OSHA Form 200, the standard occupational injury/illness reporting form. (See Exhibit I-3.)

OSHA's Form 200 and record keeping requirements (as revised in 1978) employ the following terms:

- Occupational injury -- any injury such as a cut, fracture, sprain, or amputation, that results from a work-related accident or from exposure to a hazard in the work environment.
- Occupational illness of an employee -- any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. This includes acute and chronic illnesses, or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with chemical, physical or biological agents in the work environment.
- Lost workdays -- those days lost because of occupational injury or illness. The number includes all days (consecutive or not) that the employee, because of an occupational injury or illness, could not work, was assigned to a temporary job, worked at a permanent job less than full time, or worked at a permanently assigned job but could not perform all duties normally connected with it.

Bureau of Labor Statistics
Log and Summary of Occupational
Injuries and Illnesses



SPI-24646

Bureau of Labor Statistics
Log and Summary of Occupational
Injuries and Illnesses

NOTE: This form is required by Public Law 91-358 and must be kept in the establishment for 5 years. Failure to maintain and post can result in the issuance of citations and assessment of penalties. (See posting requirements on the other side of form.)

RECORDABLE CASES: You are required to record information about every occupational death, every nonfatal occupational illness, and those nonfatal occupational injuries which involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid). *(See definitions on the other side of form.)*

[illegible]

Certification of Annual Summary Totals By _____ Title _____ Date _____

- Recordable cases -- incidents involving an occupational injury or occupational illness, including deaths. Not recordable are first aid cases that involve one-time treatment and no subsequent observation (minor scratches, cuts, burns, splinters), or that do not ordinarily require medical care, even though such treatment was provided by a physician or registered professional personnel.
- Non-fatal cases without lost workdays -- cases of occupational injury or illness that did not involve fatalities or lost workdays but did result in transfer of employee permanently to another job or termination of employment, medical treatment (other than first aid), diagnosis of occupational illness, loss of consciousness, or restriction of work or motion.

Using the OSHA Form 200 plus data on the number of employee hours worked, a company can calculate incidence rates to show the relative ranking of its injury and illness experience. These incidence rates are useful for comparing the frequency of accidents and their severity (such as number of lost workdays). The rates are calculated on the basis of 100 full time employees (200,000 employee hours of exposure time). Incidence rates can be calculated using the following equation: Incidence Rate = total recordable cases or lost workday cases or lost workdays x 200,000 divided by the total hours worked by employees during the period covered.

Each year The Society of the Plastics Industry, Inc. tabulates the incidence rates of member companies. A company can then compare its incidence rates with others in the industry.

5.0 OCCUPATIONAL SAFETY AND HEALTH ACT

On December 29, 1970 the Occupational Safety and Health Act was signed into law. The Act itself was landmark legislation to create a uniform, standardized safety and health law that would apply to workplaces across the nation. The purpose of the Act was "to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources."

OSHA and NIOSH

The Occupational Safety and Health Act authorized the creation of the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH). OSHA, under the Department of Labor, has the *responsibility for:*

- enforcing standards by investigating complaints, inspecting workplaces, and proposing penalties
- collecting data and information to target inspections and compliance efforts in a worthwhile manner
- proposing and promulgating new standards that address hazards not specifically covered in the previous standards
- providing training and assistance to employers and employees in the areas of compliance with safety and health regulations

NIOSH, which is a part of the Department of Health and Human Services, does not have any direct enforcement responsibility. Its work is directed toward:

- developing and recommending to OSHA occupational safety and health standards
- conducting research, experiments, and demonstrations relating to occupational safety and health
- conducting educational programs for occupational safety and health professionals

OSHA and/or NIOSH offer:

- publications, pamphlets, training materials for evaluating worker safety and health (OSHA and NIOSH) (See Bibliography, Section VII)

- on-site consultations (OSHA Consultative Program)
- health hazard evaluations (NIOSH)
- training courses (OSHA and NIOSH)

OSHA Standards Setting Responsibility

OSHA was given the responsibility for promulgating and enforcing occupational safety and health standards. General industry standards contained in 29 Code of Federal Regulations, 1910 (copies available from OSHA) were, for the most part, adopted from consensus standards previously developed by industry. Sources of these general consensus standards include:

American National Standards Institute (ANSI)

American Society for Testing and Materials (ASTM)

American Conference of Governmental Industrial Hygienists (ACGIH)

National Fire Protection Association (NFPA)

Enforcement Programs

OSHA is responsible for enforcement of those rules and regulations which it has issued.

In executing its enforcement responsibilities, OSHA coordinates its compliance programs through more than seventy Area Offices located throughout the country. Each Area Office is headed by an Area Director who has the responsibility for issuing citations and proposing penalties. Each Area Director, in turn, reports to one of the ten Regional Offices in the country.

OSHA also relies upon individual state enforcement programs; these have to be approved by OSHA before they can be implemented. Approximately half of the individual states have established such OSHA-approved state programs, which largely incorporate the Federal requirements.

OSHA also offers consulting services, either through area offices or through state programs. These services are free of charge and do not trigger compliance inspections as long as all conditions deemed serious violations are corrected.

Employer and Employees Rights and Responsibilities

Each employer covered under the Occupational Safety and Health Act is required to follow the standards promulgated under the Act and to maintain a work environment free from recognized hazards. In addition, the employer must:

- report to the Area Director a fatal or catastrophic event (five or more employees hospitalized or any employee death) within 48 hours of its occurrence
- keep records on hand and available to employees and government representatives (OSHA Form 200, Occupational Injuries and Illnesses)
- post permanently, in a conspicuous location, an OSHA poster
- make accurate and correct statements, representations, or certifications in any application, record, report, plan or document to be maintained pursuant to the Act or disclosed to any authorized government representative
- not discriminate against employees who properly exercise their rights under the Act
- between February 1 and March 1 post, in a conspicuous location, the OSHA 200 form for the previous year
- post citations and variances in the work area involved

In addition to these responsibilities, employers have the right to:

- comment on standards and regulations
- apply for a variance from a standard (temporary or permanent)
- be represented on walk-arounds in an OSHA inspection
- appeal enforcement actions (contest citations)
- have confidentiality maintained
- obtain financial assistance in compliance effort from the Small Business Administration
- request on-site consultation

Employees are to:

- comply with standards and regulations
- make accurate statements
- cooperate in inspection
- work safely
- report unsafe conditions to the supervisor
- report job-related injuries or illnesses to their employer

Employees have the right to:

- a safe and healthful workplace
- have complaints acted upon confidentially

- comment on standards
- inspect citations and certain records maintained by employers
- be represented at inspections in unionized plants
- contest the abatement period for a citation
- be free from discrimination in any manner for exercising rights under the OSHA Act
- review copies of appropriate OSHA standards, rules, regulations, and requirements
- be notified of variances

Under the Occupational Safety and Health Act, the employer has the responsibility "to furnish each employee with employment and a place of employment which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to their employees." Commonly called Section 5 or the General Duty Clause, this obligation of the Act is a means of enforcing workplace safety and health practices that are not covered by a standard. Various interpretations have been made as to the meaning of recognized hazards. As a minimal criterion, the hazards to be "recognized" have to be generally recognized as serious hazards within the industry in which they occur and must be detectable by means of the human senses or by means of accepted tests known in the industry to determine their existence (which should make their presence known to the employer).

When new standards are proposed by OSHA, they are published in the Federal Register. After their publication, the proposed standards are open for comment by interested groups or individuals for at least 30 days. After the close of the comment period a hearing is frequently scheduled where testimony can be solicited from key individuals. OSHA will review and answer the objections, may make changes in the proposed standard, and promulgate a permanent standard by publishing it in the Federal Register. Once the new standard is published, a court review can be requested by any person adversely affected by the implementation of the standard.

OSHA can promulgate Emergency Temporary Standards where an imminent hazard exists and it is necessary to immediately institute protective measures in order to protect potentially affected workers. Once published in the Federal Register, such standards become effective immediately. A Permanent Standard is subsequently prepared and promulgated through the previously discussed standard rulemaking procedure.

Variances

OSHA grants variances to employers who, for primarily technical reasons, cannot meet certain standards. The employer can petition if there is evidence that the proposed conditions represent safe and healthful working conditions which are equivalent to those required by the standards but which, because of a technicality, may not necessarily meet the letter of the law. Variances can be granted on a temporary basis (up to a year) or on a permanent basis.

The grounds for a variance cannot be based on economic hardship since employees are not expected to be placed in hazardous situations under any condition including economic disaster for a particular company. The Small Business Administration has loans available for companies whose compliance costs could jeopardize their economic survival. Applications for SBA loans are available at the OSHA regional offices.

An OSHA Inspection

There are two general types of OSHA inspections: safety, and health (industrial hygiene). The safety inspection looks at machine guarding, fire protection, materials handling techniques, and other plant procedures and conditions which may present a risk of injury to an employee. The health inspection concentrates on environmental exposures such as chemicals, noise, radiation, and other stresses that could impair the health of the employee and cause illness.

With proper identification, an OSHA compliance officer, under the direction of the Area Director, can enter any establishment covered by the Occupational Safety and Health Act at any reasonable time of the day. It is against the law for that compliance

officer to give any advance notice of the inspection except under special, authorized, conditions where an inspection effort would be impeded without such notice. A company may require OSHA to produce a court warrant before a compliance officer is allowed on the premises.

In considering potential OSHA inspections, it is important to recognize that these are often the result of specific employee requests. Under Section 8 (f) of the Act, OSHA is obligated to respond to employees' written complaints alleging that a hazard exists and that a violation of the Act has been committed. The names of employees who have initiated an OSHA inspection through the complaint procedure are kept confidential if the employee so wishes.

After compliance officers have entered the facilities, contacted the person in charge, and presented their credentials, they then proceed with the opening conference.

At the opening conference, the compliance officer will:

- describe the nature of the inspection (complaint, accident, general inspection)
- provide copies of standards, forms, or other informational booklets
- inform the employer and employee representative of their rights and responsibilities
- ask questions as to the nature of the production process, the extent of the plant facilities, and the scope of the company's safety program

Also, during the course of the opening conference or during the inspection itself, the compliance officer may review records such as:

- accident records (OSHA 200) and first report of injury, subject to subpoena or warrant requirements
- safety policy and procedures
- inspection check lists (respirators, cranes, etc.)

After the opening conference, the compliance officer will enter the workplace for inspection of certain work areas or of the entire facility, depending on the scope of the inspection set forth by the Area Director. Employers or their representatives should accompany the compliance officer for the entire inspection. An employee union representative will be given an opportunity to be included in all key aspects of the OSHA visit.

During the inspection the compliance officer will make notes of apparent violations. Documentation of the apparent violations by the compliance officer is made through employer and employee statements, observation of conditions, and environmental testing. The evidence is gathered so that the Area Director can judge the seriousness and extent of the hazard.

If the inspection is for occupational health hazards, an industrial hygienist may test for air contaminants, noise, or radiation. Many of these tests require that samples be collected during an entire shift and consequently often necessitate the compliance officer's returning at a later date. The employer should document the testing equipment and procedures used.

After compliance officers have completed their inspection, they will request a closing conference.

The points covered in a closing conference may include:

- apparent violations and their locations
- time necessary for corrections of the apparent violations (abatement period)
- appeal procedures
- employer rights and responsibilities
- availability of SBA loans

After the closing conference, the Area Director may issue a citation if apparent violations were found during the inspection. If companies, after reviewing the citation, disagree with any part, then a letter of contest must be sent to the Area Director. This

review and notice of contest should be completed within 15 working days of receipt of the citation.

Employers can contest any or all of the citation, including:

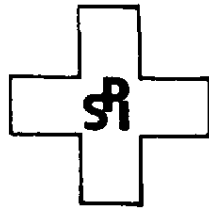
- whether the violation occurred
- the seriousness of the violation
- the proposed penalty
- the abatement period

There are two types of violations according to OSHA.

1. The serious violation alleges a hazardous condition with reasonable probability that serious bodily harm can result if the situation is not corrected.
2. All other violations are considered other than serious violations.

If employers or their representatives willfully violate the Occupational Safety and Health Act and an employee death results therefrom, or if employers make false statements or falsify documents, or if they assault a representative of the Government, or forcibly impede an inspection, they could be subject to criminal penalties under the Act.

Under the Occupational Safety and Health Act, employers have the right to protect their trade secrets and other confidential information. Guaranteeing confidentiality is a difficult task for government as well as for industry. OSHA's need to document hazardous areas and conditions may involve exposure of company confidential information. Counsel and the OSHA Area Director should be prewarned as to potential conflicts with proprietary information. The company's requiring of a warrant may be appropriate.



PlasTIPS

SECTION II

MACHINERY SAFETY

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SECTION II - MACHINERY SAFETY

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SECTION II - MACHINERY SAFETY

This section covers key points of a general machine safety and maintenance program, safety features of plastics processing machinery and practical means to reduce the risk of physical injury during the operation of machinery.

1.0 GENERAL MACHINERY SAFETY

The risk of physical injury in a manufacturing operation can be reduced through installation and maintenance of machinery safeguards and instruction of employees in the correct operating methods for each machine.

Principles of Safeguarding

Safeguards in and around machinery reduce the risk of employee injury from both operator error and machinery failure. Machinery safeguards are a part of good machine design which provides an extra level of protection over and above that imparted through good machine design, safety training programs and operator experience.

Safeguarding a machine should be more than simply installing guards to prevent direct contact with the hazardous areas of the machinery. It should include consideration for material handling hazards, operating requirements (correct operating temperatures, pressures, etc.) and preventive maintenance procedures. Safeguarding can help to prevent injuries from:

- direct contact with exposed moving parts of a machine including points-of-operation (clamping, cutting, etc.) or power transmitting mechanisms (gears, pulley, slides or couplings)
- machine failure from overloading, metal fatigue or improper use
- contact with materials in process such as hot molten plastic in molding operations or flash from trimming operations
- operator error

- direct contact with hazards such as electricity from unguarded electrical terminals or "hot" improperly grounded machines

A fundamental requirement in developing and implementing a machinery safety program is a thorough knowledge of the machinery, its safety devices and controls. When new equipment is installed, the operating manual provided by the manufacturer should be studied carefully; it provides operating instructions and describes safety features of the equipment. To insure continued operating safety, all the safety devices installed by the manufacturer should be identified and left in place during normal use. Any alterations or repairs to the machinery should be made in such a way that they will not reduce the safety features provided in the original installation. The operating manual should be retained in a place readily accessible to the operator.

Whether the safeguards are part of the original equipment, are built by the user, or are provided by the machine manufacturer, they should meet certain minimum standards for performance. Some important standards for their performance may include:

- 1) conformance to Federal requirements such as the OSHA machine guarding requirements in CFR 1910, Subpart O
- 2) conformance to specifications and guidelines adopted by the American National Standards Institute (ANSI) (See Section VII for a list of proposed and adopted ANSI standards for plastics processing machinery.)
- 3) provision for convenient access by authorized personnel for lubrication, inspection, adjustment, and repairs; restricted access to other personnel
- 4) minimization of hazards from the safeguards themselves
- 5) protection provided to the operator, maintenance person, passers-by, or others working in the surrounding area
- 6) prevention of access during the cycle to a danger zone beyond the point of operation

- 7) maintenance of structural integrity of the machine
- 8) sufficient strength to resist normal wear and shock, and sufficient durability to serve over a long period with normal scheduled maintenance
- 9) proper attention to environmental concerns such as noise, air contaminants, radiation, heat and other potential health hazards
- 10) provision of ample room and lighting for operation and maintenance, and housekeeping

Machinery manufacturers and equipment suppliers are good sources of information, providing instructional materials and other aids for safeguarding. In addition, they may be able to supply guards or retrofit kits conforming to the machine's specifications.

Additional advice on machine safeguarding can be obtained from safety experts employed by consulting firms, insurance carriers, trade associations such as The Society of the Plastics Industry, Inc. or professional groups such as the National Safety Council and the American Society of Safety Engineers. (See Section VII.)

The effect of changing the design or materials used in the construction of safety devices should be considered in light of its impact on the entire operation. Seemingly minor alterations may impose unexpected and unacceptable risks.

Once safeguards are in place, supervisors, operators, and maintenance personnel share the responsibility for keeping them functional. The machine should not be run unless the safeguards are in place and in good condition. Operators should report defective guards to the supervisor immediately. If a guard has to be removed for maintenance, the machine should be shut down and locked out. All guards removed should be replaced in the same manner as originally installed.

Some common operations that need some form of guarding in plastics processing includes:

- clamping actions created by two objects coming together such as platens in a mold area
- nip points created by having two parallel objects rotating close together such as in calenders, conveyors, belts and pulleys, rolling mills, and roll stacks downstream from sheet extruders
- cutting or shearing actions from sawing or trimming

Common types of point-of-operation safeguards include:

- enclosures and barriers
- automatic and semi-automatic feed devices
- two-handed controls or other hand removal devices

The fixed guard acts as a barrier or enclosure of the point of operation and cannot be easily removed by operating personnel. It is an effective way to prevent operators and passers-by from contacting the moving parts of a machine during operation. Fixed safeguards may be adjustable to accommodate different sets of tools or various kinds of work. Some fixed barriers can be installed at a distance from the point of operation in association with remote feeding arrangements.

An acceptable alternative to a fixed barrier or safeguard is a guard which is interlocked with the operation of the machine so that the operator cannot remove the guard when a hazard is present at the point of operation. Removal of the guard will automatically disengage the power and prevent the machine from operating. In plastics processing, the enclosures or guards are interlocked with the electrical, the hydraulic system and mechanical interference bars. Interlocking guards are found on injection molding machines where the operator has to remove the finished piece from the mold area.

In types of machinery where it is not feasible to provide enclosures or barriers around the point of operation, several types of devices can be used to insure that employees hands are kept away from the point of operation while there is a hazard.

One such device is a loader board or loading device that eliminates the introduction of the operator's hands into the molding area. The preferred device is the two-handed control which requires that control circuits be simultaneously operated by two hands until the hazardous condition does not exist. The separate hand controls should be far enough apart that one hand cannot operate both. The controls should also be installed in a series type electrical circuit with an anti-repeat so that an employee cannot block or tie down one control and operate the other with only one hand. For machines with two operators, a four-handed control in series is appropriate. Two-handed control devices are often used on compression molding machines. Other guarding devices developed to fit unique operating requirements include electronic eyes, automatic stock loading, and special tools. Requirements for such controls are fully described in ANSI Standards.

Electrical Safeguarding

Safeguarding workers from electrical hazards associated with machinery will prevent injuries from electrical shock or burn. An electrical safety program for machinery should include:

- 1) design and installation of equipment in accordance with standard specifications such as those in the NFPA-70, National Electrical Code
- 2) establishment of procedures for working safely around electrical equipment and machinery, and the training of personnel in these procedures
- 3) checking the equipment and reviewing procedures to ensure that the equipment functions with minimum risk from electrical hazards
- 4) labeling of each circuit breaker to identify the machine(s) it controls

Common means of reducing electrical hazards include:

- effective grounding
- guarding of live electrical parts

- using equipment only within its rated electrical capacity
- de-energizing parts before working on them
- positively locking out power before servicing equipment
- careful design and placement of electrical controls to preclude accidental operation
- properly labeling all control buttons, switches, and power disconnects
- providing protection from the possibility of the machine restarting automatically after power failure

Warning Signs

Signs and nameplates are affixed to machinery to warn of potential hazards as well as to indicate the need for safe operating procedures. These signs should be specific, positive, and easy to understand. Standard warning signs are specified for many types of plastics processing machinery, but the signs should not be a substitute for effective safeguards (Exhibits 2-1 and 2-2).

Machinery components should be color-coded to specify the nature and degree of potential hazard associated with a particular component. For example, yellow cautions against physical hazards such as components that might strike operators. The color codes can also be used to alert personnel to dangerous areas and specific emergency controls. For example, the color red is normally used to identify emergency stop buttons or bars.

Preventive Maintenance

A positive preventive maintenance program is an essential component of any comprehensive machine safeguarding program. To reduce the possibility of injury from machine failure or the malfunction of safety devices, a planned series of repairs, adjustments, and replacement of worn parts should be established for each piece of

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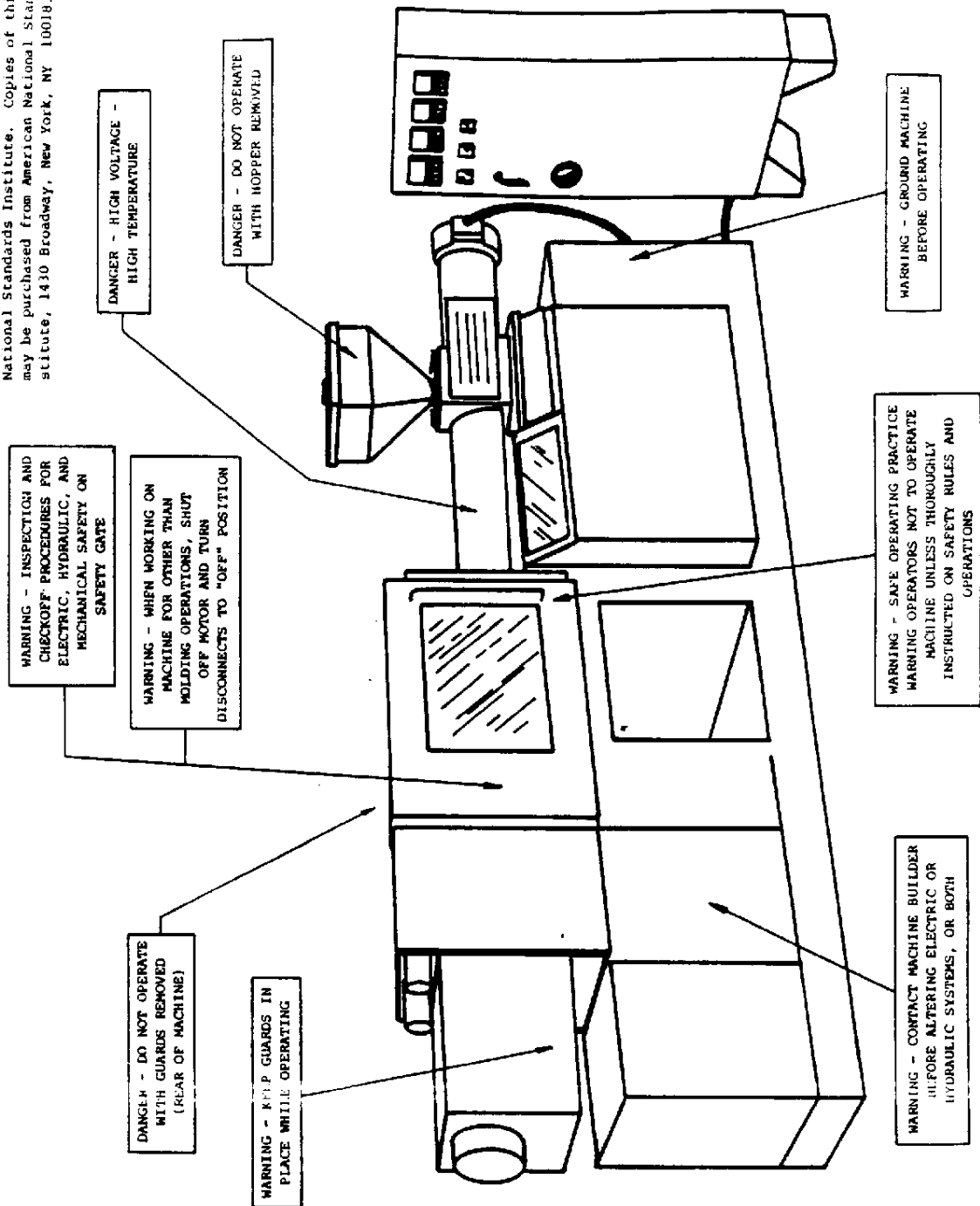
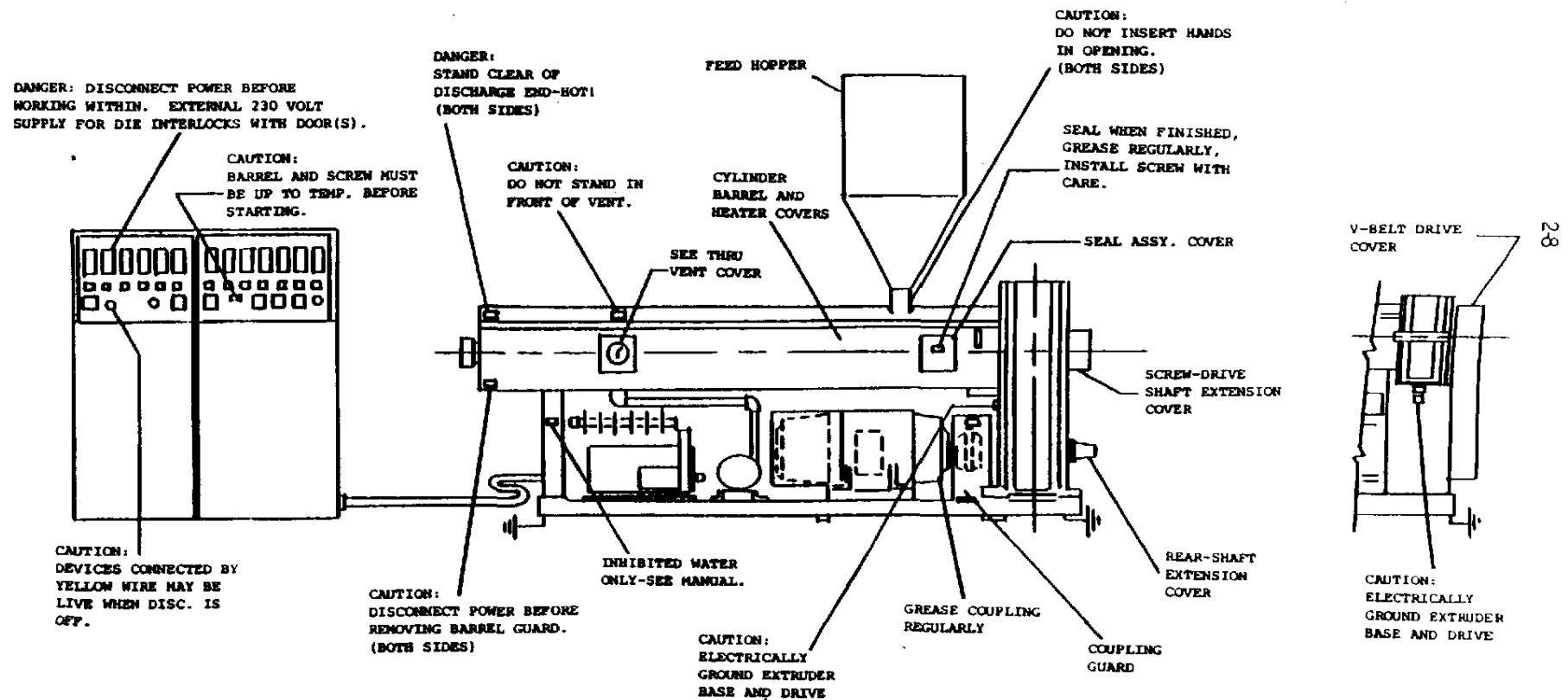


Exhibit 2-1
Typical Warning Signs for Injection Molding Machines

Exhibit 2-2
Plastics Extrusion Machine Typical
Warning Signs Location and Guards



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equipment. The manufacturer's suggested maintenance schedule should be followed and all new equipment should be installed according to manufacturer's specifications. Documented machinery inspections should be conducted on a scheduled basis to ensure that the equipment is functioning properly and that all safeguards are in proper working order.

When performing alterations, repairs, adjustments or maintenance on machinery, personnel should have a positive means to prevent someone else from accidentally starting the machine. One such method is called "lockout and tag." Persons doing the non-routine work put their individual padlock on the electrical power source that feeds the machinery and place a properly completed "Do Not Operate" tag on the machine. Machinery actuation switches should be tested after locking out to ensure that the equipment is inoperable. These tags should be signed and dated by the person locking out the equipment. A lock can be removed only by the person who placed it on the electrical switch.

Safe Working Procedures

A machinery safety program should anticipate the possibility that employees will engage in unsafe acts because they:

- are unaware that what they are doing is wrong
- misunderstand instructions that are given
- do not consider the instructions to be important
- are not given specific instructions
- find it awkward to follow instructions
- deliberately disregard instructions
- are distracted from the job at hand

Machine safeguarding by itself cannot eliminate the possibility of human error. An effective safety program should include:

- 1) rules for safe operation of machinery
- 2) provisions for monitoring the operation to make sure that these rules and procedures are consistently used and

- 3) training in proper operating procedures

The establishment of strict safe working procedures requires that the machine instruction manual and the specifications of the materials being molded be followed closely. Both sets of information should be updated periodically by consultation with the machinery manufacturer and the material supplier.

TYPICAL RECOMMENDATIONS FOR SAFELY OPERATING PLASTICS PROCESSING MACHINERY INCLUDE:

- 1) permitting only qualified personnel to perform machine maintenance and set up
- 2) grounding the machine per applicable electrical codes before initial operation and checking ground connections frequently
- 3) not altering mechanical, electrical, or hydraulic systems or circuits without the concurrence of machine manufacturers and documented approval by certified personnel
- 4) performing set-up or maintenance on the machine only when there is a positive means to ensure the machine will not start up accidentally (that is, lock out)
- 5) not disconnecting or bypassing machine safety devices on systems during operation, set-up, or maintenance
- 6) checking machine safety devices and systems before each machine start-up and at shift change to insure that they function properly and reporting malfunctions
- 7) not operating a machine if any of the safety interlocks are functioning improperly
- 8) keeping the interlocked front gate and guard, rear sliding guards and all other guards and covers free of obstructions

- 9) keeping guard viewing windows clean and secured in place
- 10) not attempting to service or repair machine unless qualified to do so
- 11) not attempting to correct a machine operation or maintenance problem without the assistance of experienced supervisors or qualified maintenance support
- 12) not exposing any part of the body to any reciprocating, rotating or clamping action or to any heated machine parts. It is important that all employees understand the hazards of loose clothing and long hair around machinery
- 13) not operating a machine while the hopper is removed
- 14) using wooden or plastic tools where applicable to remove plastic spillage
- 15) not using machinery as a substitute for ladders (only approved ladders should be employed)
- 16) wearing any recommended eye protection and protective clothing during machine operation, set-up and maintenance
- 17) keeping the machine working area clean and free from obstruction
- 18) standing clear of all plastic purging areas (molds, dies, heads, etc.) until plastic flow is established
- 19) limiting unauthorized personnel in the machine operating area

A SUPERVISOR'S RESPONSIBILITY FOR MACHINE SAFETY SHOULD INCLUDE:

- maintaining equipment in safe working order

- establishing safe work methods and procedures
- instructing/training operators in safe procedures with periodic follow-up to see that the training has been successful
- supervising/monitoring the workplace for unsafe conditions and taking steps to eliminate them
- maintaining order and enforcing all company safety rules and regulations

Safe machine operation requires that operators wear appropriate clothing and where necessary, suitable personal protective equipment. All work clothes should fit snugly particularly around the neck, wrists, and ankles to prevent clothing from becoming caught in the machine. Long hair and rings, chains and neckties, or any other items of apparel which could easily be caught should not be worn around machinery.

When positive protection from hazards cannot be provided by other methods such as engineering controls, appropriate personal protective equipment should be worn. Personal protective equipment includes gloves, hardhats, safety shoes, goggles, glasses, aprons, respirators, hearing protectors, and faceshields. Employees should be trained in its proper use and have access to an ample supply of clean equipment in good repair.

Machinery Standards

Industry safety standards for the construction, care and use of plastics processing equipment and machines are initiated under the auspices of the Machinery Division and the various processors divisions of The Society of the Plastics Industry, Inc. (SPI). The primary objective of these standards is to minimize accidents and injuries associated with machine operations.

To accomplish this objective, the problem of machine safety is approached from two directions:

- 1) eliminating, by design, certain recognized construction hazards and establishing standard approaches to design so that machines available from various manufacturers will have similar operational characteristics
- 2) safeguarding the point of operation to protect the operator from recognized hazards

Any standard covering the construction, care and use of plastics processing equipment and machines is generally complicated by the wide variety of types and sizes of machines manufactured, by the virtually infinite combinations of parts being produced, the production methods used, and the operating conditions that exist in industry today.

Therefore these standards address only the fundamental aspects of good machine design and safe operation. Responsibilities for understanding and implementing these requirements are assigned to the builder, the rebuilder, the modifier, and the user.

Standards issued by the American National Standards Institute, Inc. (ANSI) are consensus standards which are intended to be used as guides to aid the manufacturer, consumer, and the general public. The existence of an ANSI Standard does not preclude anyone, whether or not they have approved the standard, from actually manufacturing, marketing, purchasing, or using products, processes, or procedures that do not conform to the standard since the standards are voluntary. However, they do have wide recognition and acceptance within industry in general and within the plastics industry in particular. They are subject to periodic review, revision and updating. Users are cautioned to obtain and use the latest edition of any given standard.

These standards may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers may receive current information on all standards by calling or writing the American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018. The telephone number is (212) 354-3300.

American National Standards Institute (ANSI) standards for plastics processing equipment that have been issued or are now being processed are:

ANSI B151.1-1976, Horizontal Injection Molding Machines

ANSI B28.1-1967 (R1972), Mills and Calenders in the Rubber and Plastics Industries

Proposed ANSI, Vertical Injection Molding Machines

Proposed ANSI, Extrusion Machines

Proposed ANSI, Screen Changers - (Extruders)

Proposed ANSI, Plastic Film and Sheet Winding Equipment - (Extruders)

Proposed ANSI, Slit Tape and Monofilament Post-Extrusion Equipment

Proposed ANSI, Blown Film Take-Off and Auxiliary Equipment

Proposed ANSI, Film Casting Machines - (Extrusion)

Proposed ANSI, Rotational Molding Machines

Proposed ANSI, Blow Molding Machines

Proposed ANSI, Knife Type Cutters Used for the Size Reduction of Plastics and Other Materials

Proposed ANSI, Machines to Cut Plastic Forms and Related Materials

Proposed ANSI, Mold Temperature Control and Chilling Units

Proposed ANSI, Thermoforming Machines

Proposed ANSI, Horizontal Expandable Polystyrene Shape Molding Machines

Proposed ANSI, Granulators, Pelletizers, and Dicers Used for the Size Reduction of Plastics

Proposed ANSI, Vertical Clamp Compression Transfer Molding Machines

2.0 INJECTION MOLDING MACHINES

Injection molding machines use heat and pressure to melt plastic molding material in a barrel and force it into the mold cavity. Extremely high clamping pressures are required to hold the melt in the mold cavity. This section reviews safety aspects of the injection molding of thermoplastics. (Some safety procedures are slightly different for injection molding of thermosets because different operating conditions are required. For example, thermoset injection molding uses a cooler barrel and a hotter mold.)

ANSI Standard B151.1 aids the user and manufacturer in understanding safety requirements for the construction, care and use of horizontal injection molding machines.

Safeguards are used to reduce the possibility of injury due to human error, mechanical failure, electrical failure and limitations in machinery design.

A safety gate, usually with a window, is provided as a barrier to keep an operator away from moving parts and the mold while the machine is operating. The safety gate should be in a fully closed position before the clamp can be operated. It should also be interlocked with the operation of the machine so that when the gate is opened the clamp stops or opens. There are three safety interlocks, one for the electrical system, one for the hydraulic system and one for the mechanical system. The electrical interlock is normally an electrical switch which allows the molding cycle to continue when the safety gate is closed. The hydraulic interlock controls the hydraulic fluid flow so that the hydraulic pressure cannot be used to close the clamp.

On injection molding machines built since January 1, 1976, an auxiliary mechanical safety device is also installed. This device is usually a bar which will physically block the clamps from closing while the safety gate is open. The safety bars should be adjusted for the clamp stroke, the mold height, and the clearance between the platens in the open position.

All interlocks and safety devices connected with the safety gate should be checked regularly, including after setup and at the beginning of each shift. The gate should be intact, operate freely on its rails, and yet be firmly attached to the machine.

The rear of the machine should be enclosed with a rear guard with an electrical interlock. On low machines, the top should be covered with an electrically interlocked guard. If either of these interlocked guards is removed, the machine should shut down, and not be restartable until the guards are replaced.

Fixed guards cover danger points such as the clamping mechanisms, the hot barrel and any electrical contacts. The machine should be locked out before any fixed guards are removed.

All feed openings should be guarded to prevent employees from accidentally inserting their hands in them during the machine operation. When the injection molding machine is purged, care should be taken to avoid being splashed by the hot melt. A purging shield reduces this hazard. It has a safety glazed window in it for viewing

the purging area and is interlocked to prevent purging when the shield is not in position. Personal protective equipment such as face shields and gloves should also be used.

Signs affixed to the equipment should point out operating procedures for the machine. The design of the machine will dictate the wording required for each sign. Specific signs are described in ANSI standards.

THE FOLLOWING ARE POINTS TO BE NOTED IN THE OPERATION OF INJECTION MOLDING MACHINES:

- 1) When starting up a cold machine, the operator should check that the plasticating barrel has reached the required operating temperature before molding is begun.
- 2) Molding materials should be purged from the plasticating barrel and the mold cavity before a machine is shut down.
- 3) After an operation is completed, the electrical switches and valves should be left in the position designated in the operating instructions.
- 4) Established lockout procedures should be followed during maintenance, repair or machine alterations.
- 5) Access to a platform adjacent to the hopper at the rear of the machine should be provided.
- 6) Whenever charging materials to the machine hopper by pneumatic transfer conveyor equipment or when the machine hopper is opened for inspection, the eyes should be protected from flying pellets.
- 7) If the plasticating barrel is overheated or the nozzle is plugged, hot materials may be expelled forcefully from the nozzle when it becomes activated.
- 8) When the nozzle is retracted from the mold for cleaning or repairing, operators should use extreme caution. (Nozzle tips should be wiped clean

before moving them back into contact with molds, using where practical, a long-handled wiper of soft metal material.) Purging procedure should require that operators wear a face shield or safety glasses.

- 9) Fingers, sticks, or tools should not be poked into the feed throat. Specific instructions for clearing feed throat blockages should be developed. Employees should be aware that gases in the barrel may be released when removing the obstacle in the feed throat.
- 10) Personnel should not reach over, under or around any guard.
- 11) Caution should be exercised in viewing part ejection, mold actions, or core actions when the mold is opening.
- 12) The machine should not be operated with guards removed or interlocks bypassed.

Consult the machine instruction manual and the manufacturer for additional information concerning the injection molding machine.

3.0 EXTRUSION MACHINES

In extrusion machinery, plastic materials are melted by heat and pressure in the extruder barrel and then are continuously forced out through a die. Products produced are sheet, film, pipe, rod, profile shapes, filament, wire/cable coating, and other shapes. Extruded stock is often cut into sections convenient for conveying, batching and storing. Chopping or slitting equipment often is an integral part of the extrusion operation.

The barrel of the extrusion machine and the material in it are heated either electrically or by circulating a heat-transfer medium through a jacket on the barrel. When the operator opens the head to change or clean dies or screens, residual pressure in the barrel may cause hot material to blow out forcibly or superheated vapor may be vented. Other hazards include the possibility of fire from the venting of superheated vapor. Caution should be exercised in opening the head to remove dies even when the

machine is not running. An approved unbolting or unclamping procedure, which allows any residual pressure to vent down and away from the operator should be followed. It should be standard operating procedure to stand clear of the head when relieving jammed stock or preparing to open the head to clean the die.

Chilled water lines and steam lines serving the extruder should be marked so that they can be readily identified. Tags, different shaped valve controls, or other devices can be used.

Hot metal parts should be shielded by expanded metal or other suitable materials. A polished metal hood over the large heating cylinder of an extruder will protect the operator from contacting the cylinder and may make the work station cooler by acting as a radiant heat shield.

If plastic material being extruded becomes frothy, bubbly, popping, and has the odor of decomposing material, or if there is difficulty in maintaining feed to the screw, avoid looking into the hopper or standing in front of dies. A supervised safety check should be initiated. This may include steps to reduce heat, to keep the screw turning as long as resin in the extruder is free to exit from the die, to check the thermocouples, to make sure the heater bands and adapters are tight, and to make sure that all controls are properly seated.

Guarding is needed in the feed area, the drive, the barrel heaters, the electrical terminals and the blower inlets and outlets. A disconnect switch with lockout should be installed on the control panel. To guard against electrical shock all metal equipment, auxiliary equipment receptacles, guards, floor grids, and auxiliary equipment should be properly grounded. Safety features in the machine can consist of pressure relief systems and shear bolts that are actuated if dangerous pressures build up behind the die. Caution should be exercised in screen or die changing. The water trough, if used to cool the product coming out of the die, should be rigidly secured so that accidental bumping does not splash water on the hot die. Auxiliary equipment should have guards or alternate protection for in-running nips, cutting blades, and the power transmission train.

Operator clothing should fit snugly to prevent its being caught in equipment. Face protection should always be used during purging and at start-up of

extrusion. Any maintenance, repair or alterations to the equipment should be preceded by positively locking out at the main switch.

Proposed ANSI Standard B151.7 is a proposed standard for extrusion machinery and is being reviewed for adoption. It provides a voluntary guide to aid the user and manufacturer in safety requirements for the construction, care, and use of extruders.

Parallel proposed standards in the B151 series include downstream equipment used with the basic extruder:

- (1) screen changers
- (2) underwater pelletizers
- (3) blown film machinery
- (4) film casting machinery
- (5) slit tape and monofilament machinery
- (6) film and sheet winders

Potential hazards in plastics extrusion operation include:

- (1) contact with the revolving screw
- (2) contact with cutoff knives
- (3) injury from pinch points on conveying systems
- (4) burns from contact with hot stock, heater plates, dies, screens, extruder barrels, blow back of steam or stock, and threading polymer
- (5) fires caused when air comes into contact with hot stock and when polymer leaks onto the heaters

- (6) strains caused by trying to open stuck extruder heads or by material handling problems
- (7) slipping on loose pellets underfoot
- (8) extrusion delay when the heat is on and the screw is not turning
- (9) high temperatures caused by malfunctioning of controllers or thermocouples
- (10) heater bands being burned out or loose
- (11) electrical shock from contact with electric heater elements on the extruder head
- (12) water, oil or feedstock spills causing slippery floors or increased hazards from electrical shock
- (13) die assembly shearing due to excessive buildup of melt pressure in the barrel

A good extruder safety program should include:

- (1) initial and continuing operator training
- (2) inspection, testing, and maintenance of machine safety features and maintenance of a clean machine and work area
- (3) the correction of any hazards before machinery is operated
- (4) effective guarding of the feed area
- (5) effective guarding of the drive
- (6) head pressure relief or limit systems

- (7) fixed covers on electrical terminals
- (8) sufficient operational clearances
- (9) guarding of blower inlets and outlets
- (10) a disconnect switch, with lock-out, on the control panel(s)
- (11) rotationally restrained rotary unions
- (12) proper grounding of the extruder and electrically powered auxiliaries

Every extruder installation should have guards, interlocks and emergency stop devices tailored to the physical surroundings and particular operation. An emergency stop device is any trip rod, cord, button or electronic device which, when actuated, will disconnect the power to the machine and stop the rotation of the screw(s).

All operators should be able to read and understand instruction on the safe operation and use of the equipment. They should not tamper with emergency stop devices or remove a guard or operate the machine with a guard removed. Mechanics should lock out and tag the machine electrical power before making adjustments or repairs on the equipment. Upon completing maintenance or repairs they should replace guards before turning the machine back to the production operator.

In addition to the information presented in the section on Signs, suggested wording for extruders includes:

DANGER - disconnect power supply(ies) before working inside

DANGER - stand clear of discharge end - HOT

CAUTION - do not insert hands in feed opening or operate extruder
without barrier guard

CAUTION - electrically ground extruder base and drive

CAUTION - devices connected by yellow wire may be live when disconnect is off

CAUTION - do not insert hands in opening

CAUTION - disconnect power before removing barrel guard

CAUTION - barrel and screw should be up to temperature before starting

Because of the wide variety of extruder designs, locations will vary. Signs should be located as close as possible to the potential hazard.

For operating extruder and auxiliary equipment, a uniform written checklist should be followed. Among the necessary considerations are that:

- (1) operator attire is not hazardous (no loose fitting clothes, jewelry, neck ties)
- (2) cleanliness is maintained for the feed hopper, ventilation ports to extruder drive, power and control cables to heaters and instruments, guide rails, limit switches, payoff and windup reels cutting devices, safety gates, and floor (pellets)
- (3) dies are properly aligned and clamped
- (4) main electric switch, stop buttons and safety gates are effective in cutting off power
- (5) heat is applied to extruder-die first, then applied progressively up to feed end of barrel, to insure that material at the exit end is thoroughly fluid
- (6) proper material is being fed for purge and production
- (7) as dictated by setup, hand pyrometer checks may be made of temperature of the barrel and of molten plastic

- (8) records should be kept of time required to reach operating temperature
- (9) while cleaning molten plastic from a die with soft metal or cotton cloth, the operator should wear gloves, and should stand away from the opening of the die
- (10) extruder and auxiliary equipment is adjusted as needed for good production. As screw speed is increased, temperature of heater bands will need adjustment.

Safety features are also appropriate for auxiliary equipment used in extrusion operations.

- (1) Take-off equipment: (Auxiliary equipment used to pull or support extrudate as it leaves the die.) This may be a simple conveyor belt or elaborate devices to reshape, cool and cut the plastic. Jets of air or water may be applied to accelerate cooling, to preserve shape and permit windup without deformation. Safety eyeglasses with side shields or safety goggles should be worn when air jets are in use.

Uniform speed of withdrawal of extrudate is often maintained by a driven pair of caterpillar belts, or sheaves that match the extrudate profile. The upstream end of such take-off presents pinch points and the pinch points should be effectively guarded.

- (2) Water trough: When the extrudate is thick or is produced at a high rate it is often drawn through a trough of cooling water located between the extrusion die and the pulling device. If the water trough is brought too close to the die, steam may be produced which presents a burn hazard to the employees in the work area, or proximity of the water trough may cool the die enough that the plastic solidifies in the die, resulting in a dangerous pressure build-up within the extruder. Slippery floors and increased electrical shock hazards may also result from water spills.
- (3) Material conveyors: Conveyors that feed stock into the extruding machine (or take products from it) should be interlocked so that they

stop when the machine stops. They should be provided with covers when they are located where the operator might reach, step, or fall into them.

If open conveyors are overhead, there should be a guard to catch material that falls from them. Before starting a conveyor the operator should first make sure that other employees are standing clear. When pneumatic feed lines are used to supply extruders, the entire system and extruder feed should be tightly closed. If the extruding machine is fed by a conveyor any shafts, sprockets, or pinch point hazards should be guarded.

- (4) Screen changer: This device contains a filter or filters which removes foreign particles from the molten plastic. A power unit, usually hydraulic, moves the filter. Fixed and movable guards protect against all moving or rotating parts such as gears, sheaves, belts, chains, shafts, and drive couplings. Operators should be properly positioned so as to avoid risk of injury.

Extrusion Blow Molding Machines

ANSI Standard B151.15 is a proposed standard for extrusion blow molding machinery and is being reviewed for adoption. It provides a voluntary guide to aid the user and manufacturer in safety requirements for the construction, care and use of extrusion blow molding machines. Highlights of the proposed standard include the following recommendations:

- Managers of blow molding operations need to establish and maintain a program of periodic and regular inspection of blow molding machines to make certain that safeguards are in good operating condition and properly adjusted. A visual inspection of operations and safeguards should be made at least once per shift. At least monthly, each machine should be examined and the findings of the examination recorded. Some features of the machine may require more frequent attention.

- A safety gate, guards, or a combination of safety gates and guards should be provided to protect the operator from the point of operation while the machine is operating. If a window is used, the window material must meet standard safety performance specifications. The safety gate must be in a fully closed position before the clamp is operated, either manually or automatically. Interlocks should be used to cause the clamp to stop or open when the gate is opened a maximum distance of 2 inches.
- At least one electrical interlock should be provided. The interlock should be positioned so that it cannot be easily or accidentally tripped by the operator. When the safety gate is closed, the interlock should be actuated.
- At least one emergency stop button should be provided at the operator control station, which, when pressed, causes the clamp or clamps to stop.
- Fixed and/or movable guards should be installed over hazardous areas normally accessible to operators.
- Guards should be provided at feed openings for plastics materials. When this is not feasible, caution signs should be placed in this area.
- Electrical systems should be installed according to the requirements of the National Electrical Code at the time the blow molding machine is shipped.

4.0 CALENDERS AND ROLL MILLS

Safe operation of roll mills and calenders requires that appropriate provisions be made to protect against hazards associated with stock feeding and removal, and blending equipment. Requirements for work space, braking, safety stopping switches and actuating devices, lighting, ventilation, and emergency release provisions should also be defined.

ANSI Standard B28.1 provides a voluntary guide to aid the user and manufacturer in safety requirements for the construction, care, and use of calenders (and mills).

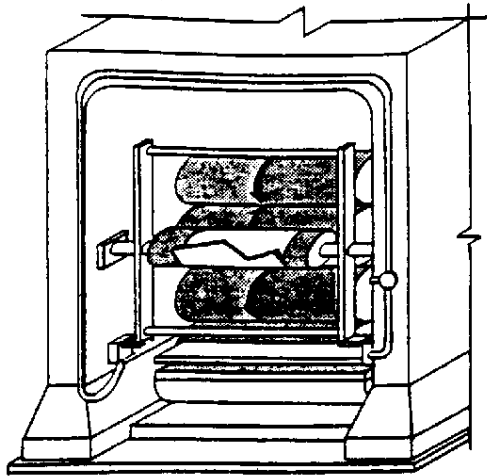
Safeguards are used in calenders and calender lines to reduce the possibility of injuries resulting from human error, mechanical failure, electrical failure and limitations in machinery design. Exhibit 2-3 shows examples of guarding for calenders.

Calender roll bite (the nip point between any two or more metal rolls) poses a hazard because the two in-running surfaces create a pinch point or bite which can trap hands or clothing. The taper of the steel bite can grab and pull in making it progressively difficult, if not impossible, for the victim to get free. Plastic stickiness can increase the grabbing and holding power. Calender, roll and mill machines should have guards or safety trips located at each pair of in-running rolls. The most reliable protection against calender bite accidents is a device which will operate automatically and be effective regardless of the reaction of the victim, stopping the calender rolls whether the person "freezes" or struggles instinctively to get free.

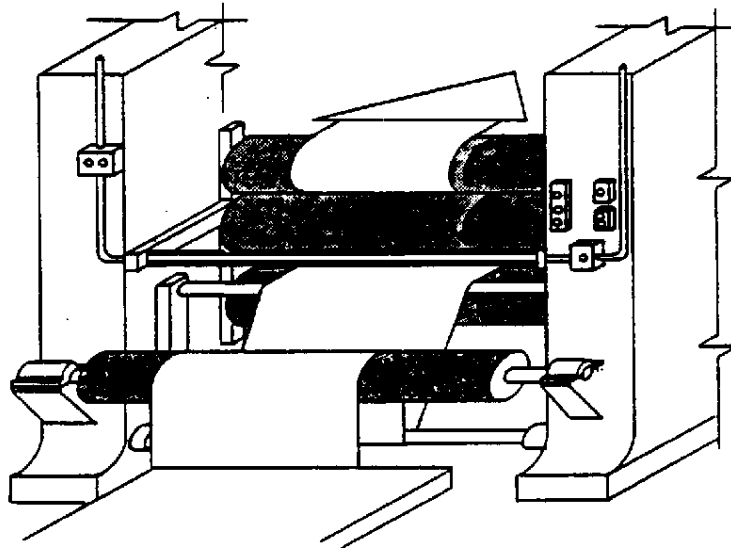
For calenders with speeds in excess of 125 feet per minute, an automatic gate should be provided to completely shield the bite while the calender is operating at the higher speeds. The gate should be so located in front of the bite that in the raised position, it will not interfere with operations and in the closed position, it will prevent an operator from reaching into the bite. The gate should be actuated by any increase in speed above 125 feet per minute. This gate is an addition to, and not a substitution for, interlocked finger trip bars.

In the early 1970's, OSHA adopted Standard B28.1 safety requirements for mills and calenders used in the plastics industry. OSHA requires trip cables, wire-centered cords, or trip rods along the face and both sides of the calender rolls. The only exception to this rule is where fixed barriers prevent contact with the roll bite. A performance check of the effectiveness of the safety trips should be made routinely at the beginning of each shift and before starting operations. On all plastics processing equipment, there are to be at least two of the three types of interlocked safety guards: mechanical, electrical, or hydraulic. OSHA has specific maximum stopping distances that must not be exceeded. Sec. 29 CFR 1910.212.

2-27
Exhibit 2-3
Example of Guarding for Calenders



Interlocked barrier offering protection at both upper and lower inrunning bites on a three roll vertical calender.



Interlocked barrier for guarding a calender roll bite. The guard is actuated by being pushed either up or down. Functioning of either of the two switches will stop the calender.

Source: Springborn Laboratories, Inc.

SPI-24687

An interlocked finger trip barrier, which will actuate a switch and stop the calender when pushed either up or down, is an alternative to a solid barrier. When any object, particularly the operator's fingers, starts to get caught between the moving surface of the calender roll and the barrier, the calender will stop automatically. Openings that provide visibility should be small enough to prevent the operator from reaching through to the bite. Two limit switches are used with each of the interlocked barriers. There is one on each side so that if one fails, the second will operate. The actuating switches are also designed to prevent the calender from operating when the barrier is removed.

Partial protection can be afforded by an interlocked barrier bar, installed approximately 30 inches from the feed bite and on a level with it. Under most operating conditions, this bar will always be between the operator's chest and the bite. The bar is designed to trip by either forward or backward pressure. Any slight motion or involuntary jerk toward the danger zone will automatically shut down the calender.

Safety trip cables or wire-centered cords, mounted just inside the calender frame may provide less protection than a suitably placed rigid trip bar because their effectiveness is contingent upon the operator's response to a situation and not an automatic system.

A semiautomatic feeding device reduces the handling of stock at the in-running stock feed bites, and will greatly reduce the hazard of operation, but it may not operate as efficiently as an automatic interlocked safety barrier.

For feeding stock into the bite, air- or hydraulic-operated cylinders may be used. If a mechanized pusher is not practical, a blunt wooden pusher at least two (2) feet long can be used. Under no circumstances should operators be permitted to push stock into the bite with their hands.

Fixed barriers or stationary bite guards can be placed at points of operation where the operator is not required to do work within the reach of the bite itself. If the work must be observed behind the guard, openings may be made in the guard. The barrier should be located so that a clearance of no more than one-half inch is provided between the barrier and the in-running side of the calender bite. The barrier should be rigid and solidly attached so that it cannot be easily bent or tampered with.

Many different auxiliary machines are used with calenders such as mixers, blenders, feed conveyors, granulators, storage silos, roll temperature control and chilling units, conveyors, etc. All auxiliary equipment should be located so that it will not interfere with access to and operation of safety trips and other safety devices.

The following points should be included in a safe practice program for calenders:

- (1) All parts of the calender train should be linked by adequate communications devices which may include telephones, speaking tubes, signal bells, or horns. A clear warning signal should always be sounded before a calender is started. A suitable alarm should be provided to signal for assistance in case of accident.
- (2) Lockout stop buttons and places for safety padlocks on disconnect switches are needed for the equipment and feeding devices during maintenance, repair, or machine alteration. There should be only one starting button station on the calender. Feeding devices should be stopped and locked out when the calender is being serviced.
- (3) Overhead mirrors and/or TV viewers may be needed to check upper feed points.
- (4) Fixed ladders and catwalks with standard rails and toeboards should be provided where access to elevated parts of the equipment is required.
- (5) The proper functioning of all controls is essential to the safe operation of the machine. When the machine is shut down, all controls should be in the "OFF" position with the power disconnected and locked out, and the machine tagged.
- (6) Good preventive maintenance and housekeeping are important for safe operation of the equipment.
- (7) Operators should be instructed in the safety features and hazards of the bite points.

- (8) Tools or loose items of any kind should be stored properly and not left on top of hoods or calender housings.

Common sense rules:

- (1) Do not touch any machine part which may be hot, unless adequately protected.
- (2) Do not reach or lean into the machine during operation.
- (3) Do not allow foreign objects to fall into the rolls.
- (4) Do not exceed established rating speeds and capacities.
- (5) Do not remove or alter coupling and gear guards unless the machine is completely shut down and locked out. Replace these items before resuming operations.
- (6) Keep machine area clean, uncluttered and well lighted.
- (7) Before working on the calender rolls or drive eliminate all possible sources of accidental activation of machine components.

5.0 COMPRESSION AND TRANSFER MOLDING MACHINES

Closing dies, flash, hot equipment, points of operation, flying particles, and excessive heat in a plastic melt area are some of the potential hazards in compression and transfer molding.

Some transfer presses can be effectively guarded with a sliding gate or fixed guard. However, because of the diversity of operations, requiring molds of many sizes and shapes and sometimes cumbersome methods of removing molded parts, guarding around the press with the use of hinged or sliding gates is not always practical. Therefore press operating controls which require the operator to use both hands to keep

the electrical circuit closed until the mold has closed are often more practical and are used instead of guards. Should the operator release either hand, the press will stop.

On presses employing hand valves, the operator should work the valves to apply low and high pressure to the cylinder of the press to close or open the mold. With this type of action two-hand controls are required. Most presses utilize a cycle controller which, once set in motion by an electrical push button, can carry out all the cycling necessary to produce moldings. A potential hazard exists if the operator can reach into the mold while it is closing. This hazard should be eliminated by two-hand electrical push button system working in series, or by other methods. As an extra safety measure, mechanical safety levers or bars can be installed in conjunction with cycle controllers. Cycle controls should be checked periodically to make certain that they are functioning at all times.

In addition to the predominantly used manually operated machines, there are automatically and semi-automatically operating compression/transfer molding machines. Such equipment is designed to incorporate specific provisions for safety such as safety gates and doors. It is extremely important that operators should be supervised to make certain that shortcuts and other improper work practices do not develop.

It is equally important that definite measures be adopted to prevent unauthorized personnel from working on or adjusting machinery. Automatic equipment should be area guarded, i.e. fenced off with guard rails and signs strategically placed to alert non-authorized personnel that the presses are in automatic operation or cycle.

Prior to mold change, care should be taken to note if the mold is hot. Molds may be changed rather frequently, and each new mold installation should be carefully examined to eliminate installation hazards prior to start up.

Operators of compression/transfer molding machines should be trained to observe the following safe practices:

- The machine should be inspected before starting it. If there is any doubt about any working part, the operator should check with the supervisor.

- When relieving an operator, the relief person should ask if there have been any changes that may affect the operation.
- Hands should never be placed in or on moving parts of the press.
- All personnel should stay clear of the press in motion.
- One should not lean or rest the feet or any other part of the body against the press while it is closed, even though it is not in motion.
- When compressed air is used to blow flash from the mold the pressure should not exceed thirty psi and the air stream should be directed away from other work areas. Safety glasses with side shields or full face protection should be worn.
- All molds should be inspected before pressure is applied, to ensure that they are clear of extraneous material and that clamping bolts are secure.
- When handling molds, loose pieces, or heavy parts it is recommended that safety shoes be worn.

Safe operation of auxiliary equipment machines is just as important as proper operation of the primary machine. Such equipment includes preform machines and dielectric heaters.

- (1) Preform machines: Thermoset molding compounds are frequently preformed to facilitate the compression or transfer molding process and to provide a more uniform dispersion of the components of the molding compound. Some machines have a "jogging" switch, which permits short increments of motion of the punches without overriding. A brake also is employed to ensure that the machine will stop even though it may be in an unbalanced position. Operators should be trained to understand and follow the proper operating procedures, thereby preventing injuries as well as damage to the equipment.

- (2) Dielectric heaters: Dielectric or high-frequency preheating equipment is used in the majority of compression and transfer molding plants. Thermoset molding compounds are frequently preformed and then electronically pre-heated just prior to molding to secure better flow, which is often needed on heavy sections and large parts. Heaters are normally enclosed to protect the operator from exposure to nonionizing radiation and as specified by the Federal Communications Commission, to reduce electronic, radio and TV interference. Heaters should have safety interlocking switches and high-voltage grounding switches which relieve the high voltage when covers are removed or when the door is open. It is strongly urged that safety features be discussed thoroughly with the equipment manufacturer and that safe operating procedures be set up for trained personnel. (See Section IV on Nonionizing Radiation - Microwaves.)

6.0 AUXILIARY AND OTHER EQUIPMENT

Various auxiliary machines are required to service and support primary processing operations. These include machines for size reduction, cut-off saw with rotating blade, cellular plastic cutters, mold temperature controllers and chillers, and drum tumblers and container tilters. The safe operation of auxiliary equipment associated with a specific type of machine was discussed previously with the equipment it supports; safe operation of equipment which is used in several different types of processing operations follows.

Granulating Equipment

Thermoplastic materials can be processed repeatedly when reduced to a coarse consistency in material reduction equipment such as grinders, dicers and pelletizers. A commonly used type of reduction equipment, a grinder, is equipped with a double set of knives -- one set is stationary, while the second set moves through a slicing or cutting motion. Processed thermoplastic material is fed into the grinder through a feed hopper. The following precautions should be observed:

- All hoppers should extend high enough to prevent the operator's hand from reaching the rotating blades.

- Hoppers should be so tightly attached to the granulator that a wrench is required to loosen the bolts.
- Hoppers which pivot to permit access to the cutting chamber must be electrically interlocked.
- A gate should be provided and positioned at the front entrance to the hopper in such a manner that openings are normally closed except for charging of scrap.
- Access openings for maintenance, cleaning or inspection should be covered with solid, securely fastened plates and must be electrically interlocked if knives can be reached through the opening.
- The grinder must be totally de-energized (disconnected or locked out) before the hopper is opened or any access is gained to the cutting chamber or rotating parts. It is suggested that a warning sign be affixed near the point of operation to advise the operator.
- Grinder operators should wear suitable eye protection.
- The grinder manufacturer should be contacted for updating machines to current standards.

See Section IV of this Reference Guide for information on noise control and hearing conservation.

Mold Temperature Control and Chilling Units

Mold temperature controls and chilling units regulate the temperatures of molds, rolls, platens, mixers, reactors, extruder screws and dies. The units are of the liquid-circulating type. Water, water/glycol, synthetic heat transfer fluids are among the liquids used.

Start or operational controls should be so located to protect against accidental activation. Stop or emergency stop controls should be accessible to operators of the equipment from their normal operating position. Only the fluids recommended by the equipment manufacturer should be used and only under the temperature and pressure limitations established for those fluids in the system.

The water heating unit should have pressure relief at the heater tank and that relief should be open to the atmosphere and arranged so that if the relief valve blows it will not endanger personnel. Mold temperature control units should have fluid over-temperature protection independent of the main operating control. All hot areas including the point of connection and the supply and return hoses should be protected. Temperature control units, the hoses, and mechanical connections from the unit to the process should be rated for the operating temperatures and pressures of the system. The design and operation of the refrigerating systems shall be based upon the latest published revision of the Safety Code for Mechanical Refrigeration.

Barrel or Drum Tumbling Equipment

Tumbling is used to remove flash, blend resins, mix compounds or apply finish to small parts. The operation is performed in equipment of various types. Tumbling equipment should be completely enclosed by a barrier. The entrance should have a gate with an interlocking switch which de-energizes the tumbling equipment. The operating switch which activates the movement of the tumbler should be located outside the enclosure.

Refer to Section IV of this Reference Guide for a discussion of precautionary measures.

Hand and Power Tools

Many different types of hand and power tools are used in plastics processing plants. They include small hand tools, drills, saws, trim presses, sprayers, and other equipment normally used in machine shops.

Power equipment used in small maintenance shops presents hazards to employees if not properly guarded or employees are not adequately instructed in safe operating practices. Some procedure should be established to prevent unauthorized personnel from using shop equipment. The equipment should be given periodic inspection for electrical grounding.

The improper use of hand tools such as tongs, long-nozzled air hoses, scissors, clippers, side cutters, trimming knives and files can be a cause of accidents. Safe work practices in areas where small tools are used are as critical as instructions relative to capital equipment.

Cutting tools should be kept sharp so a minimum of effort is required to remove excess stock. Sharp burrs on tools should be blunted to reduce the danger of puncture wounds to employees.

Additional suggestions for hand finishing departments are:

- to train employees to cut away from the body
- to require employees to use sturdy work tables or other stable work surfaces
- to provide uncluttered work areas
- to provide trimming bins for salvage stock
- to provide well lighted work tables
- to provide the right tool for the job

When a machine requires the use of wrenches and keys, the operator should be instructed to store them where they will not be thrown or fall when the machine is energized. All unnecessary tools should be removed from the machine before the motors are energized.

Filing, Drilling, Reaming and Sawing

When machine filing is used to produce production parts, it should be combined with feed and limit mechanisms as part of the machine set up to satisfy the requirements of the operation. There are four accepted methods of machine filing:

- reciprocating, using a die file or jigsaw fitted with a file or fitted in a drill press or arbor press
- rotary filing using round or disk files in a stationary arbor
- band filing, which is similar to band sawing
- moving a production part past a stationary file

Files used in machine filing are easily installed and tool life is relatively short. Increased pressure caused by material accumulation on the tool can cause the production part to shatter and create a hazard to the operator.

Safety requirements on drill presses include mechanical guarding of belts, pulleys and gears in the power assembly. In large drill presses where a counterweight is used, safety chains should be provided to prevent the counterweight from falling. The chuck holding the tool should be free of burrs or projections and be dressed and cleaned as required. Drills especially designed for plastics are commercially available and should be used.

When horizontal or vertical drill presses are in use, single, gang or multiple spindles are common. To prevent injuries and to provide better quality finished parts the pieces being drilled or reamed should be held in a fixture and not hand-held.

Instructions for regrinding, sharpening or dressing drills can be obtained from the tool supplier and should be followed to retain the best results in finishing.

When portable circular hand saws or bench saws are used to remove excess stock from heavy plastic moldings, the equipment should be in top condition and the operator should be trained in its use and protected by the approved industrial eyewear such as safety goggles and face shields. The material must be fed at a proper rate and angle to avoid twisting of the blade and material and overheating. A cooling agent is often used to keep the material below its melting point. Injuries can result from the kickback of material or from the melting of the plastic in contact with the blade.

Band sawing is used to make large circular cuts or cuts that are not straight. Very thick sections of material can be cut by band sawing. The replacement of blades and adjustment of the machine should be done by an experienced operator or supervisor. The selection of the correct blade, proper adjustment of the guides and control of the tension on the blade are necessary for safe operation. Additional safety rules for safe operation are as follows:

- Proper eye protection should be worn.
- Blades should be in good condition.
- All adjustments should be made with the power off.
- All guards should be in place.
- A brush should be used to remove chips from the saw table.
- Gloves or loose fitting clothing should not be worn.
- Saw feeding should not be forced.
- Floors and work areas should be kept clear of scrap stock.

Power Press Trimming

Proper guarding, advanced design, and automatic ejection have made press trimming a valuable and safe tool in plastic finishing operations. ANSI Standard B11.1-1971 Mechanical Power Presses describes safe design and operation of such equipment.

In addition to point-of-operation protection, presses need other types of guarding against hazards that are likely to cause injury. All presses should be designed to prevent overriding of the the stroke when the treadle is released. Non-repeat devices operate either by means of a single stroke clutch or a mechanical arrangement that disconnects the treadle after each stroke of the clutch.

Among the devices useful in protecting operators of power presses are:

- mechanical feeding devices
- two activating buttons

- hand tools to place and remove the material in the die
- safety straps to pull the operator's hands out of the danger zone

Grinding

Abrasive wheels or grinding wheels are dangerous if they are improperly used. Wheels operated at speeds in excess of their rating can disintegrate while in use, propelling fragments over a wide area.

Some grinding wheels are designed for low speed operation only and all wheels are rated as to the maximum number of revolutions per minute (rpm) to which they may be safely subjected. Other practices which should be observed when operating grinding wheels include the following:

- The equipment should be thoroughly inspected before use. If any defects are noticed, the wheel should not be used and should be exchanged for a new one. The supervisor should instruct the operator to report defects to him.
- Grinding wheels should be mounted tightly on the arbor with flange washers on each side (flange washers one-half the diameter of wheel). A wheel that does not run true should not be operated.
- Grinding wheels should be equipped with guards.
- The work rest should be within one-eighth inch of the wheel and securely clamped in place.
- Impact resistant goggles with a clear lens or a face shield should be worn when a grinding operation is in progress.
- Pressure should be applied gradually to a cold wheel to give the wheel a chance to warm up. Excessive pressure should not be applied to the

wheel at any time. The wheel should not be struck suddenly, especially on the side.

- Grinding on the flat sides of straight wheels is hazardous and should be avoided.
- Handling and storing of grinding wheels is very important. They should be stored in a dry place where they will not fall or be struck.
- Portable grinders should not be used in a restricted area (i.e. where the presence of combustible material may pose a fire hazard). Hot sparks can be a source of ignition.
- The motor should be turned off when not in use.
- Proper storage facilities in the tool room and on the job should be provided.
- Wheels should be dressed on a periodic schedule.

The consensus standard for use, care and protection of Abrasive Wheels is ANSI B7.1-1978.

Conveyors

Conveyors employed in plastics processing move materials by gravity, ball bearings, roller bearings, chutes, belts, chains, screws, pneumatics, monorails, and overhead trolley mechanisms.

All power transmission apparatus such as gears, sprockets, and sheaves, should be properly guarded. Conveyor belts should be guarded within 18 inches in front of the nip points. Standard handrails and toe boards should be placed on crossovers, platforms, catwalks and openings through floor levels. Overpasses and underpasses for employees to escape in an emergency should be built in accordance with the N.F.P.A. Life Safety

Codes (N.F.P.A. Sec. 101, Vol. 9, 1978 edition). At the very least, an inspection should be periodically made of brakes, overload switches and anti-run-away devices.

Overhead conveyors should have guards or covered enclosures to prevent objects from falling on employees passing underneath. Conveyors going through fire walls should be fitted with self-closing doors or sprinkler protection to inhibit the spread of fire.

Start and stop controls for conveyors should be clearly labeled and strategically located (especially for open conveyors). Start buttons should be located where the operator can see the majority of the line. If parts of the line are obscured, the operator should check the line for any obstructions or potential contact by other employees before starting the conveyor. Emergency stop devices should be located:

- at the operator's station
- within 40 feet of each other
- where the conveyor passes through a floor or wall

In addition, the conveyor should be designed to stop automatically if it becomes overloaded or if a blockage occurs downstream in a connecting hopper, bin, or conveyor. If the conveyor is inclined, it should have a protective device to keep it from reversing in the event of an electrical or mechanical failure.

In cases where conveyors have stopped unexpectedly, operators should not restart the conveyor until they have:

- discovered the reason for the stoppage
- corrected the problem
- inspected the line for other obstructions

Loading Hoppers

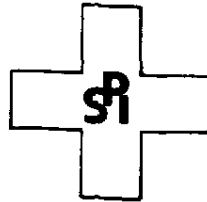
Loading hoppers associated with conveyor systems must be electrically grounded with proper wiring for the voltage used. If the top of a loading hopper is at the level of, or near the level of, a floor or platform, it should be protected by a bar guard with

openings not greater than two inches in one dimension (i.e. openings measuring two inches by twelve inches or fourteen inches by two inches). Protection may also be afforded by standard forty-two inch railings and toeboards.

Decorating Equipment: Roll Leaf Hot Stamping

Roll leaf hot stamping machines are basically of three types. The first, hand operated, where the stamping pressure is obtained by means of a hand lever, requires no guarding and only nominal care to operate. Contact with the heated stamping head must be avoided. The second and third types (reciprocating presses and roll transfer mechanisms) are driven by means of pneumatic, hydraulic or electric power and must be guarded or controlled to eliminate the possibility of inserting any part of an operator's body into the work areas during the decorating operation.

Reciprocating presses may close under pneumatic, hydraulic, or mechanical linkages. They may be manually fed directly into the stamping area, or may be provided with feeding devices manually loaded outside of the stamping area, or equipped with automatic devices to feed and eject the work. A press which is to be manually loaded into the work area should be equipped with dual hand controls requiring simultaneous operation by both hands, controls sufficiently separated to prevent operation by an elbow and hand of one arm; they should be provided with circuitry to prevent a repeat stroke from a single operation; they should provide for the press to automatically open if one control is released before the head has closed to within 1/4" of the work; the control system should prevent operation if one control is held in the closed position, i.e., "tied down." Reciprocating presses equipped with feeding devices to be loaded outside of the stamping area should be equipped with guards at the work area to prevent the operator's hands or fingers being inserted between any sections of the moving feeder, or of the press head. Feeders which slide into the work area should also be provided with dual hand controls as described above, with contact to be maintained until the work has passed through any pinch point of the device itself. Feeding devices of the rotary table type should be provided with guards to the stamping area, to prevent insertion of hands or fingers during the operation and preferably should be of the type that will cause the press to stop and open if contact is made with the guard. All other



PlasTIPS

SECTION III

**SAFE MATERIALS-HANDLING
PROCEDURES**

SPI-24703

parts of the press, which would provide pinch points or nip areas (i.e., roll leaf feeds, etc.) should be guarded to prevent fingers or hands being pinched.

The third type of equipment is equipment with heated rollers through which the work is fed and must be provided with fixed guards at all nip points, or swing guards which will open the nip point, and stop the operation.

Guards and controls for all equipment should be designed and constructed to prevent easy removal or over-riding by the operator. Only duly authorized setup personnel should be equipped with special tools to remove guards or over-ride controls, or have keys for locked gates, etc. All electrical systems should be installed in accordance with the National Electrical Code at the time of delivery. Only authorized personnel should be permitted to maintain and service equipment and under no circumstances should safety controls or guards be removed or modified without the express instructions of the manufacturer.

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SECTION III - SAFE MATERIALS-HANDLING PROCEDURES

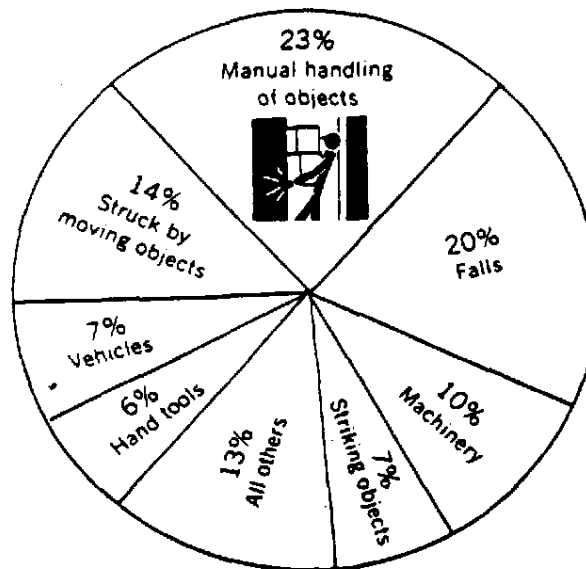
Many compensable injuries in the workplace result from accidents that happen during materials handling operations. The occurrence of lifting, falling, and bumping accidents when raw materials, parts in process, finished parts, and scrap in plastic processing are handled, can be minimized through:

- good housekeeping (uncluttered floors and aisles)
- safe walking-working surfaces (guarded platforms, sturdy ladders, etc.)
- suitably maintained equipment (cranes, hoists, forklifts, conveyors, etc.)
- proper training and supervision of employees in lifting, driving, and materials handling
- adequate personal protective equipment (for hands, head, feet, and torso)

This section covers some of the important techniques for preventing the more common injuries occurring in materials handling operations. It does not address the handling of corrosive, flammable, or toxic materials; nor does it cover machinery other than cranes, hoists, conveyors, and powered industrial trucks since these topics are considered in other sections.

- For toxic or corrosive chemicals - see
Section IV - Principles of Occupational Health
- For flammable materials - see
Section V - Prevention of Fires and Explosions
- And for machinery hazards - see
Section II - Safe Use of Machinery

The Injury Pie for Compensable Injuries



Handling of materials ranks high as a source of compensable work injuries. General statistics like these are helpful, but more specific information, based on actual experience, is eventually necessary.

Source: National Safety Council

1.0 HOUSEKEEPING

Housekeeping involves an orderly arrangement of operations, tools, equipment, storage, facilities, and supplies. It is a practical method of obtaining high production rates and maintaining a safe work environment. Added benefits include improved employee morale and improved public relations.

Good housekeeping measures, such as adequate lighting and ventilation, are a highly successful means of preventing employees from stumbling, falling, dropping or bumping objects, or being struck by or having various parts of the body caught between objects. Similarly, good housekeeping prevents fires which may result from cluttered and congested conditions.

The Elements of a Good Housekeeping Program

A plant-wide housekeeping program, which affects all operations, may include planned reception and movement of materials and production wastes, proper installation and maintenance of machines, equipment, facilities, and tools, and proper care of the physical plant itself.

Housekeeping efforts, whether departmental or plant-wide, need careful planning and promotion. As an initial step a general plant "clean up" can be undertaken to remove litter, trash, scrap, dirt, and miscellaneous accumulations. The immediate results will be more work room, better facilities and improved employee attitudes. More specific overall and departmental programs can follow the general "clean up."

Good housekeeping can be approached at two levels - departmental and plant-wide - depending on the scope and application of the program; but the basic concept and the specific techniques employed are the same in both instances. While such a program can be initiated on a departmental level, if it is to be truly comprehensive and successful it should eventually be adopted throughout the entire plant. In the ideal situation it is more effective and efficient to initiate the program plantwide; however, local circumstances should be considered to determine how to introduce the program.

To obtain maximum benefits from good housekeeping, a set of standards should be developed which include a program for standards revision and updating. Supervisors and operators together should undertake regular inspections of all areas and rate each on its housekeeping performance and adherence to standards. Development of a checklist (see Exhibit 3-2) detailing housekeeping and maintenance standards will greatly assist the inspection program.

The advantages of good housekeeping go beyond those already mentioned. Companies of all sizes report that the following additional results may be expected from a consistently maintained good housekeeping program:

- It costs less to operate a clean plant. Once a plant is clean and a housekeeping system has been established, less time and effort are required to keep the plant clean.

3-4
Exhibit 3-2
Housekeeping Inspection Checklist

GOOD HOUSEKEEPING INSPECTION SHEET			
AREA: <u>Receiving</u>	SUPERVISOR: _____	DATE: _____	
DEMERITS: <u>10</u>	RATING: <u>90.9%</u>	BONUS: _____	
A - ORDERLINESS, CLEANLINESS (Cluttered, out of place, unnecessary, dirty, de-faced, greasy)		F - LIGHT AND VENTILATION	
1. Floors, aisles, storage space <u>B</u> 2. Trucks, trailers, conveyors _____ 3. Desks, files, foremen's areas, office _____ 4. Corners, out-of-the way places <u>+</u> 5. Machines, furnaces _____ 6. Work places, tables, benches _____ 7. Tool & supply cupboards or containers _____ 8. Tool cribs or areas _____ 9. Mechanics' benches or areas _____ 10. Washrooms, toilets, fountains _____ 11. Lockers - personal <u>+</u> 12. Yard areas _____	1. Condition of fans, blowers, hoods, fixtures _____ 2. Inadequate light, air, ventilation _____ 3. Obstructed by dirt, etc. _____		
B - SCRAP AND RUBBISH 1. Should have been removed _____ 2. No containers _____ 3. Wrong type of containers _____ 4. Scrap containers not tagged _____ 5. Rubbish in scrap containers _____		G - MAINTENANCE (Repairs, overhauls, replacements) 1. Floors, doors, walls, windows _____ 2. Wiring, service pipes, etc. _____ 3. Machines _____ 4. Hoists, tractors, motors _____ 5. Other machine accessories _____ 6. Cranes, tractors, conveyors _____ 7. Trucks, trailers <u>+</u> 8. Tables, stands, benches _____ 9. Racks, trays, skids, platforms <u>A-</u> 10. Miscellaneous equipment _____	
C - TOOLS AND SUPPLIES 1. Inadequate for purpose <u>+</u> 2. Worn out, broken _____ 3. No place for _____ 4. Wasteful or inefficient use _____		H - SAFETY 1. Hazard - direct control _____ 2. Hazard - indirect control _____ 3. Unsafe practice _____ 4. Accessibility of stretchers, fire extinguishers _____ 5. Breach of safety rules _____ 6. Failure to instruct _____	
D - MATERIALS 1. Badly piled or blocked _____ 2. No ticket or identification _____ 3. Should be stocked, scrapped or otherwise disposed of _____			
E - POWER (Wastage, Leakage) 1. Current _____ 2. Steam _____ 3. Compressed air _____ 4. Heat, fuel, light _____		INSPECTOR _____	

Inspection rating sheet can be used as a basis for determining standings in a housekeeping contest, as well as serve as a guide for making inspections. Because of the special conditions and products involved, each company makes its own.

Source: National Safety Council, 444 N. Michigan Avenue, Chicago, IL 60611

SPI-24710

- Removal of obstacles may result in increased productivity.
- Production can be more easily controlled because materials and parts are not lost or mixed up.
- Less scrap is created and fewer rejects are made, which results in conservation of materials and processed parts.
- Maintenance and repair work are facilitated because maintenance personnel have easier access to machines.
- Aisle traffic is improved because an optimum flow of materials and personnel has been established.

Good housekeeping is positively related to efficient production methods. Anything that improves housekeeping is likely to improve production.

Establishing a Good Housekeeping Program

The following techniques have been successfully employed by supervisors and foremen in establishing good housekeeping programs and in obtaining improved worker cooperation and effective participation:

- setting a good example
- appealing to employee's pride by indicating how attractive and neat work areas are
- providing employees with the opportunity to participate directly and actively
- explaining each employee's responsibilities fully and indicating how they are to be fulfilled
- establishing a departmental inspection procedure

- maintaining close control over general working conditions
- encouraging employees to report conditions which contribute to disorder
- establishing temporary storage areas that are clearly identified and easily used
- assuring that space is available for relieving congestion from materials and equipment

Other Elements in a Good Housekeeping Program

In developing a comprehensive good housekeeping program the following additional suggestions should be considered:

- Walls, columns, and ceilings should be cleaned and painted a light reflecting color to improve illumination. This can improve visibility as much as 50 percent. Walls should be cleaned and repainted periodically. Walls and columns should be kept clear, and not used for hanging clothing, job tickets, calendars, ladders, pipes, rags, or similar objects. Damaged walls and columns should be repaired immediately.
- Windows and skylights should be kept in good repair. The inside and outside should be washed as frequently as accumulations of smudge, smoke, and grime require. Window ledges should be kept clear and clean and should not be employed as permanent or temporary storage areas.
- Platforms should be kept in good repair and should not be used for storage.
- Stairs and exits should be well lighted, marked, and kept free from obstructions.
- Stairs should be clean with the treads and handrails in good repair.

- Basements require the same care and attention as other areas of the plant. They should have two well-lighted, unobstructed exits and good lighting and ventilation. Flammable, toxic, or explosive materials should never be stored in basements unless the storage area complies with the National Fire Protection Association (NFPA) regulations for the materials concerned.
- Floor surfaces should be level and made as slip-proof as possible. They should be free of imbedded chips and accumulations of paint or other process materials. Drip pans, splash guards, screens, gutters, and other equipment should be employed to keep floors free from oil. Cracks, splinters, ruts, and breaks in the floor should be repaired as soon as they are discovered.
- Plainly labeled trash containers should be placed in strategic locations and emptied on a set schedule.
- Aisle width should be determined by the type and amount of traffic, (See NFPA Life Safety Code, Standard No. 101). Aisles should be clearly marked. That portion of an aisle to be used for pedestrian traffic should be so designated. Bump rails should be installed around shop offices, machinery, fire-extinguishing equipment, and storage areas for protection from trucks.
- Aisles should never be used as storage space.
- Storage space should be allotted for materials and handling equipment. Storage containers should be kept in good repair and never overloaded. Piling, stowing, and stocking procedures should be safe, orderly, and neat. Any stacked material should be kept below sprinkler heads at a distance prescribed by fire regulations. Cabinets used for storage should be kept closed with a label on the outside designating permissible contents.
- Machine areas should be separated from aisle and storage areas. Machines should be placed so that operators are not exposed to aisle

traffic. Racks or containers should be available for tools, jigs, and fixtures needed in the operation. Tools and fixtures should not be left on machine beds, ledges or on the floor. Excess materials should not be kept in work areas.

- Machines should be lubricated as specified by the manufacturer. Oilers should be trained not to apply excessive amounts of oil and grease and their supervisor should verify that they follow such instructions. Any excess oil or grease should be removed and employees should understand that "clean-up" of oil or grease spills is a component in greasing or oiling operations.
- Any fluid-containing equipment should be periodically checked for leakage. Where leaks are detected the cause should be determined and appropriate repairs undertaken. Drip pans should be used until repairs are completed.
- Absorbents should be handy for soaking up spilled liquids.
- Machines should be painted to make it easy for operators to see the work, to prolong the life of the machines, and to aid in maintenance. Machines should be kept clean. Maintenance of dirty, oily machines is more expensive than maintenance of clean ones.
- Scraps, chips, and cuttings should be dumped directly from the machines into containers and should not be permitted to accumulate on the floor.
- Waste should be removed on a regular schedule.
- Finished or processed parts should be kept in boxes, other containers, or racks, not left on the machine or on the floor.
- "No Smoking" areas and hazardous areas should be clearly designated by readily visible signs. Warning and informational signs should be kept clean and legible. Signs which become obsolete should be removed. For

psychological reasons it is often advisable to replace important signs periodically for added emphasis. In this connection it is also advisable to use new graphics or illustrations to convey the same message in order to catch the worker's attention.

2.0 WALKING - WORKING SURFACES

A potential hazard in plastic processing plants is a floor littered with plastic resin pellets, granules, and beads. Employees should be frequently reminded to "clean up" any spilled resin on working surfaces, walkways, etc. Careful handling techniques and properly designed equipment (hoppers, bins, transferring devices, etc.) should be utilized to keep spillage to a minimum. Spilled oil, grease or other liquids should be cleaned up immediately or temporarily confined to drip cans. If "clean-up" has to be delayed for any reason or a spill cannot be properly contained by using drip cans, the affected area should be "posted" and temporarily cordoned off until the hazard has been removed. Cracks, splinters, and ruts in a floor should be repaired as soon as possible. Slip resistant paints or pads should be applied in wet or slippery areas.

Floors above ground level should have posted load capacity limits which are to be observed at all times. The floor load capacity is the maximum weight which can be safely supported by the floor.

Guard Railings

Standard guard railings consist of a top rail, intermediate rail, and posts. Standard toeboards are used in addition to guard rails wherever persons walking beneath the open sides of a platform (or similar structure) could be endangered by falling objects such as tools. Standard guard railings or their equivalent should be used in the following situations:

- Every open-sided floor or platform four feet or more above the adjacent floor or ground level should be railed on all open sides except where there is entrance to a ramp, stairway, or fixed ladder.
- Every stairway floor opening should be guarded on all open sides except the entrance to the stairway.

- Every ladderway floor opening should be guarded by a standard railing and toeboard on all sides, with passage through the railing constructed so as to prevent a person from walking directly into the opening.
- Every runway or catwalk four feet or more above ground level should have railings on all open sides.
- All floor openings which a person could walk into and all wall and chute openings which have a drop of more than four feet should have guard railings.

Ladders

There are basically two types of ladders: fixed and portable.

Ladders that are permanently attached to objects such as water tanks, chimneys or towers are called fixed ladders.

Portable ladders can be carried to various areas where needed.

Where portable ladders are employed certain precautions should be observed. Ladders should be inspected regularly, and those that cannot be safely repaired should be destroyed.

The safe use of portable ladders includes the following directions:

- Carefully examine a ladder before using it. Do not use a defective ladder.
- Use only ladders fitted with non-skid feet.
- Place a ladder so that the distance from the base of the ladder to the vertical plane is equal to one-fourth the length of the ladder.
- Place the ladder so that both side rails have equal footing and a substantial base. Solid footing should be provided on soft ground.

- Place the top of the ladder against solid support, not against loose boxes, barrels, or round objects. Secure top of ladder. It is also good practice to have another employee support the base while the top is secured or in the event it is impractical to secure the top of the ladder.
- Never place a ladder in front of an open doorway or a door that opens toward the ladder unless the door is blocked, locked, or guarded. Rope off, barricade or provide a guard for the base of the ladder when it is being used in an aisleway.
- Face the ladder when going up or down and hold on with both hands. Make certain shoes are not muddy, greasy or slick.
- Try not to carry tools or materials up or down a ladder. Use a rope to raise or lower material or tools or carry tools on an appropriate tool belt.
- Open a stepladder fully before using it, and make certain it is in the fully locked position.
- Do not climb higher than the third rung from the top of a straight or extension ladder or the second tread from the top of a stepladder.
- Do not adjust height of sectional ladders while standing on the ladder.
- Do not have more than one person on the ladder.
- Carry a ladder so that the front end is high enough to clear a person's head and the back end near the ground. Caution should be exercised when a ladder is being carried through doorways and passageways.
- Only clean and dry non-conductive ladders are to be used when a potential electrical hazard exists or for electrical maintenance use. Never use metal ladders or wooden ladders with metal reinforcements around electrical equipment.

- Ensure that the feet of the ladder are securely positioned.

Fixed ladders should be bought according to standard specifications in design and material construction. Deteriorating or defective ladders should be tagged out and repaired immediately. Cages are necessary for fixed ladders longer than 20 feet and a platform is needed for every 30 feet.

A cage is a fabricated metal design that acts as a safety device by surrounding fixed ladders.

A platform is a raised floor usually secured by supports made from metal or wood.

Scaffolds

For work above floor level, wherever possible, scaffolding or work platforms should be used instead of ladders. *Standard scaffolding designed for the particular operation should be selected. While OSHA Standards 1910.28 contain detailed specifications for the care and use of scaffolds, the following are some important factors to be noted in scaffold safety:

- The scaffold's foundation should be level and adequate to support loads.
- All sections should be securely connected and braced. Extreme care must be exercised in erecting scaffolding. Consideration needs to be given to the hoisting of scaffold sections and to the temporary protection against falls for personnel working above the floor while scaffold guard rails are being installed.
- Safety belts and lanyards may be needed for extra protection; they are required for suspended or swinging scaffolds.
- A sufficient number of scaffold boards with cleats should be used to secure the platform against creeping or falling.
- Scaffold boards should be spaced closely enough to prevent tools from falling through.

- Debris or tools should not be permitted to accumulate on scaffold boards. They may fall or be knocked off and strike another employee.
- Toeboards should be used to prevent objects from falling off.
- A standard guard rail should be installed at the platform level if the scaffold height is five feet or more above ground (or as required to comply with governing codes).
- Overhead protection should be provided if there are potential overhead hazards.
- A safe and convenient means of access to the scaffold platform should be provided. All employees should be discouraged from climbing diagonal cross members and should be encouraged to use both hands to steady themselves when ascending or descending a ladder to the work platform.
- A fixed scaffold should be securely fastened to the building, a nearby structure or piping to prevent it from tipping. Employees should be instructed not to alter the fastening or anchor.
- No changes should be made to the scaffold without approval of an authorized person.
- Scaffold platforms are not to be used for material storage or otherwise overloaded. Only a specified number of employees should be allowed on the scaffold at any time.
- Tools or equipment should be raised and lowered by rope, bucket or sling. They should not be hand carried by persons climbing nor should they be thrown or dropped from one level to another.
- Scaffold structures should be protected from trucks or other vehicles.

Regular inspection of all scaffold members by a qualified person and checks prior to each use are part of an ongoing safety program. Inspection includes:

- Examining the scaffold for cracks in metal members, large knots in wooden components or other defects. Weakened, rusted or damaged members should be tagged for repairs or discarded. Scaffolding components in need of repair should not be used.
- Roping off or barricoding the area immediately below the work area and alerting other employees in the vicinity that overhead work is in progress. This will minimize the potential harm from falling objects.

3.0 MANUALLY LIFTING AND HANDLING OF MATERIALS

Personnel safety is a major objective when considering materials handling in plant operations. Approximately twenty-five percent of compensable injuries are connected with the handling of materials. Strains, sprains, fractures, and bruises are the more common injuries. They are caused primarily by employees carrying too heavy a load or using improper gripping and lifting techniques.

Mechanical equipment has greatly improved materials handling operations. Plastics processing, especially in recent years, has seen the advent of highly sophisticated material and parts handling systems. However, no matter how mechanized the plant becomes, manual handling is a part of every plastics plant operation and therefore safe materials handling is an important consideration in any safety program.

The general pointers which should be given to employees who regularly handle materials are:

- Inspect materials for splinters, jagged edges, burrs, and rough or slippery surfaces.
- Get a firm grip on the object.

- Keep fingers away from pinch points (especially when setting materials down).
- When handling long objects (such as pipe and panels), keep hands away from the ends to prevent them from being pinched.
- Wipe off greasy, wet, slippery, or dirty objects before trying to handle them.
- Keep hands free of oil and grease. When gloves are worn, they too should be dry and free of oil and grease. Clean, leather-faced gloves give better gripping power on smooth objects than do cotton or other glove materials. However, workers should not wear gloves near rotating machinery, conveyors, and similar equipment where the risk of the gloves being caught exists.

Proper Lifting Techniques

Lifting is so much a part of the everyday routine that employees usually do not give this aspect of safety sufficient consideration. This is extremely unfortunate because poor lifting habits can result in strains and sprains, spinal problems and painful hernias.

Lifting an object involves one of the most natural movements, yet it is often approached incorrectly. Experience has shown that the simple act of planning a lift can greatly reduce the incidence of back injuries. Elements of planning a lift include:

- checking the position of the load and knowing how the body will balance it
- inspecting the travel path
- knowing where and how the object will be unloaded

There is a correct way to approach lifting. The six basic steps that should be employed are illustrated in Exhibit 3-3 which highlights the following points about movement and lifting:

- (1) The feet should be parted, with one foot alongside the object being lifted and one behind. Having feet comfortably spread gives greater stability especially when the rear foot is in position for the upward thrust of the lift.
- (2) The body should be bent in a sit-down position with the back straight - but remember that "straight" does not mean "vertical". A straight back keeps the spine, back muscles, and organs of the body in correct alignment. It minimizes internal compression which can result in hernia.
- (3) The chin should be tucked in so the neck and head continue the straight back line. Tucking the chin helps keep the spine straight and firm.
- (4) The palm, not the fingertips should be used to grip the object. Gripping with the palm is one of the most important elements of correct lifting. The fingers and the hand are extended around the object to be lifted, using the full palm. Fingers alone have very little power; the strength of the entire hand is needed.
- (5) The load should be drawn close, and the arms and elbows should be tucked into the side of the body. When the arms are held away from the body, they lose much of their strength and power. Keeping the arms tucked in also helps to keep body weight centered.
- (6) The body should be positioned so that its weight is centered over the feet. This provides a more powerful line of thrust and insures better balance. Start the lift with a thrust of the rear foot.

Lowering an object to the floor is essentially the reverse of lifting it, and the principles just enumerated apply to both lowering and lifting.

Some of the more common mistakes in lifting are:

- twisting while lifting

- keeping the feet too close together which causes loss of balance
- using short jerky movements
- bending the back too much
- holding the object with the fingers instead of the palms
- not checking the location where the object is to be placed

Twisting during a lift is a frequently made error in lifting. If the forward foot is turned out and pointed in the direction of the eventual movement, the probability of twisting the back will be minimized.

Lifting too much weight is another common lifting error. Employees should be instructed not to attempt to lift more weight than they can handle comfortably. Special considerations should be made for the type and size of the object.

Handling Boxes, Cartons, and Bagged Materials

The type and size of the object should be carefully considered. Boxes, cartons, and bags should be handled by grasping the alternate top and bottom corners.

- Boxes and cartons should be handled by grasping the alternate top and bottom corners, then drawing a corner between the legs.
- Bagged materials are also best grasped at opposite corners. When the worker has reached a standing position, he should let the bag rest against his hip and stomach and then swing the bag to one shoulder. As the bag reaches his shoulder, he should stoop slightly and put one hand on his hip so that the bag rests partly on his shoulder and partly on his arm and back. In putting the bag down, he should swing it slowly from his shoulder until it rests against his hip and stomach. If the bag is to be placed on the ground, he should bend his legs and lower the bag keeping his back straight.

3-18
Exhibit 3-3
Lifting Procedures

3—Manual Handling and Material Storage

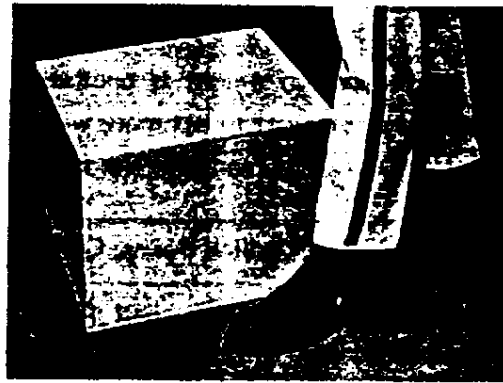
Proper Way To Lift

Lifting is so much a part of many everyday jobs that most of us don't think about it. But it is often done wrong, with bad results: pulled muscles, disk lesions, or painful hernia.

Here are six steps to safe lifting.

1. Keep feet parted—one alongside, one behind the object.
2. Keep back straight, nearly vertical.
3. Tuck your chin in.
4. Grasp the object with the whole hand.
5. Tuck elbows and arms in, and hold load close to body.
6. Keep body weight directly over feet.

FEET should be parted, with one foot alongside the object to be lifted and one behind. Feet, comfortably spread, give greater stability; the rear foot is in position for the upward thrust of the lift.

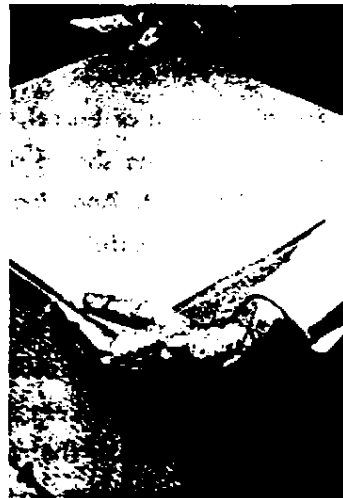


BACK. Use the sit-down position and keep the back straight—but remember that "straight" does not mean "vertical." A straight back keeps the spine, back muscles, and organs of the body in correct alignment. It minimizes the compression of the guts that can cause hernia.



ARMS AND ELBOWS. The load should be drawn close, and the arms and elbows should be tucked into the side of the body. When the arms are held away from the body, they lose much of their strength and power. Keeping the arms tucked in also helps keep body weight centered.

PALM. The palmar grip is one of the most important elements of correct lifting. The fingers and the hand are extended around the object you're going to lift. Use the full palm; fingers alone have very little power. (The glove has been removed to show the finger positions better.)



CHIN. Tuck in the chin so your neck and head continue the straight back line and keep your spine straight and firm.

BODY WEIGHT. Position body so its weight is centered over the feet. This provides a more powerful line of thrust and ensures better balance. Start the lift with a thrust of the rear foot.



Handling Drums and Barrels

Employees should only handle heavy drums and barrels after they have been specially trained to do so.

Devices for upending drums and barrels are available. However, if a full drum must be upended by hand, it should be upended by two persons standing on opposite sides, facing the middle of the drum. They should grasp both chimes near the high point and, while lifting one end, they should release their grip on the bottom and straighten up with the drum.

To roll a drum or barrel, the worker should push against the sides with both hands. Changes in directions should not be accomplished by grasping the end or pushing the barrel with the feet. Applying pressure to one end of the barrel with both hands will change its direction safely.

To lower a drum or barrel down a skid, the drum should be turned and slid endwise. A barrel or drum should never be allowed to roll free. When raising a drum or barrel up a skid, the workers should stand on opposite sides of the skid and outside its rails, not inside or below the object being raised or lowered. If drums or barrels are to be handled on an incline or skid, it is safer to use ropes or other tackle to control their motion. The drum or barrel should be snubbed with a rope, one end of which is securely fastened to the platform from which the drum or barrel is to be lowered. The rope should then be passed around the barrel or drum, so that the operator, keeping a firm grip on the free end, can gradually lower the load.

4.0 MECHANICALLY LIFTING AND HANDLING MATERIALS

A. CRANES AND HOISTS

Proper employee training, a good preventative maintenance program, and sound operational procedures will reduce the incidence of crane and hoist accidents. Safety programs for cranes and hoist operations should include:

- a periodic and recorded inspection program
- training for operators
- enforcement of rules to keep workers clear of overhead loads
- strict load limits within rated capacities
- safe operating procedures, including use of standard hand signals
- appropriate personal protective equipment (safety hats, steel-toed shoes, safety glasses, etc.) for operators and persons working nearby

The manufacturer's literature, and guidelines for operating each individual piece of equipment should be obtained, carefully reviewed and retained where it will be readily available for reference purposes.

Careful inspection of cranes, hoists, and other lifting apparatus should detect any deficiencies in the equipment which need correction. However, no matter how thorough the inspection program, no matter how reliable the apparatus has been in the past, and no matter how well trained the operator, there is always a chance that the suspended load can inadvertently fall to the ground. The basic rule in crane or hoist safety is "Don't get under the load!"

A standard code of hand movements should be learned and practiced by the signal-persons and crane and hoist operators. Signals should be understood by both participants before any movement is initiated. All employees in the area, whether they are working directly with the operator or not, should at least know the signal for stop. Exhibit 3-4 illustrates accepted common signals. For the areas where signals cannot be seen or heard, remote signaling devices can be installed.

Inspection Programs

All hoisting and crane equipment should be inspected regularly. Inspection schedules and the degree of thoroughness will vary with the type and size of the lifting

equipment. As a minimum, the operator should check functioning parts on a daily basis. This should include examination of:

- brakes
- load limits
- safety devices
- warning signals
- ropes, slings, chains, and hooks
- oil, grease, hydraulic levels (where applicable)

Also, a more comprehensive scheduled inspection of the above parts should be conducted periodically.

Inspection of a crane should emphasize bearings, brakes, bridge alignment, bumpers, collector shoes, controllers, couplings, drum wear, end stops, footwalk, guards, cable, hooks, lights, limit stops, lubrication, mechanical parts, rails, wheels, and other parts specified by the manufacturer. All defective equipment should be tagged and removed from service.

Rated Loads

The rated load should be plainly marked on each side of the crane. Each hoisting unit should have its rated load marked on its load block so it is clearly legible from the ground or floor. Employees should be instructed not to use hoists to lift objects in excess of the rated load.

Attaching and Moving the Load

When moving the load the following precautions should be observed:

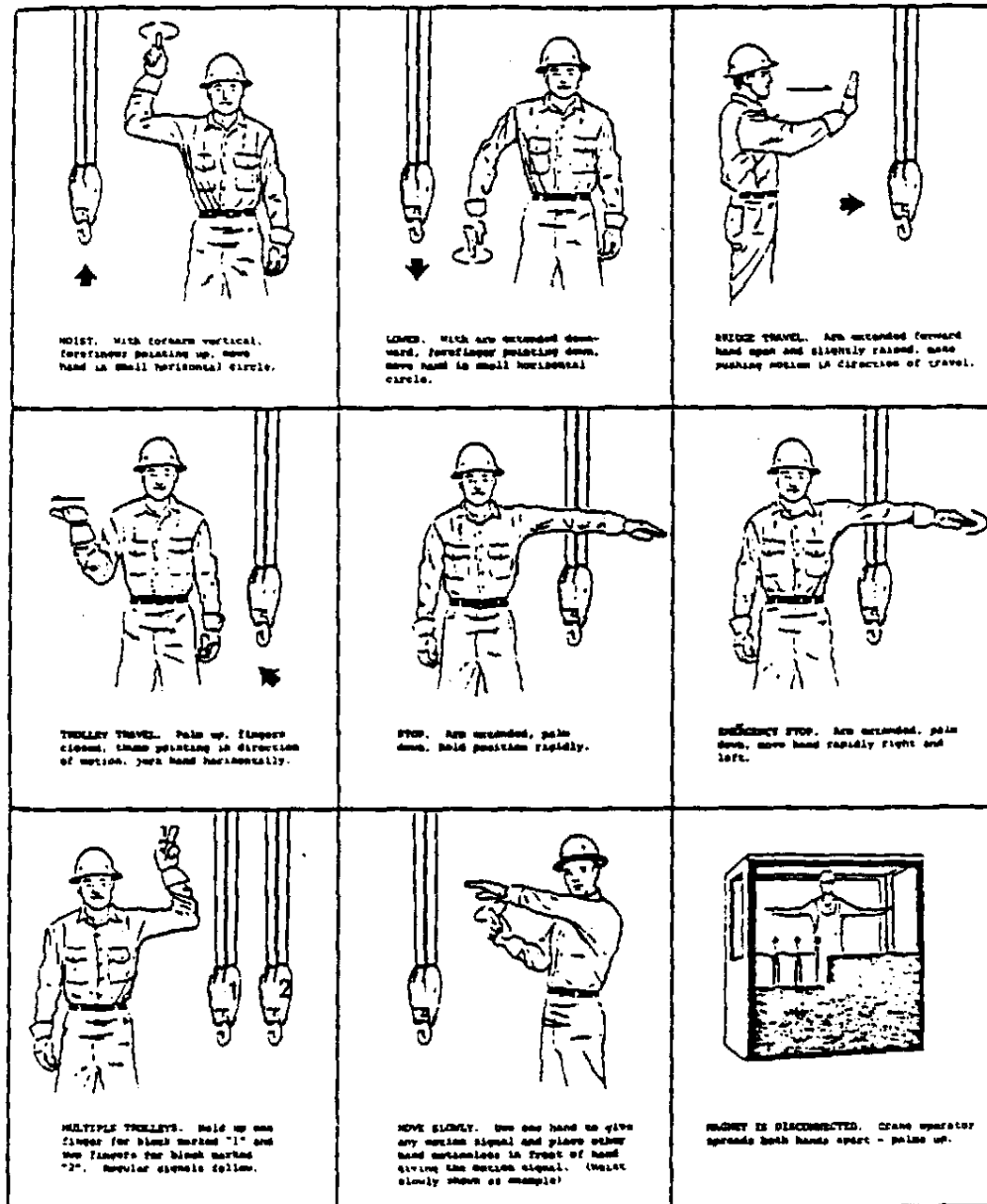
- The load should be well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches.
- Before starting to hoist, the operator should see that the hoist rope has no kinks, that multiple part lines are not twisted around each other,

that the hoist chain is not wrapped around the back, and that the hook is centered over the load to prevent swinging.

- The sling should clear all obstacles.
- During hoisting, care should be taken to avoid sudden acceleration or deceleration of the moving load.
- Cranes should not be used for side pulls without authorization from a responsible person who can determine that the crane will remain stable and its parts will not be overstressed.
- No hoisting, lowering, or travelling should be done while any employee is on the load or hook.
- The operator should not carry loads over people.
- The operator should test the brakes each time a load approaching the rated load is handled, by raising the load a few inches and applying the brakes.
- Loads should not be lowered below the point where less than two full wraps of rope remain on the drum of the hoist.
- If two or more cranes are used to lift a load, one qualified person should be in charge to analyze the operation and instruct all personnel in proper positioning, rigging of the load and movements to be made.
- The operator should not leave the controls while the load is suspended.
- The warning signal should be sounded when starting the bridge and when the load or hook draws near personnel.

For specific details of the OSHA requirements for overhead and gantry cranes consult 29 CFR 1910.179.

Standard Hand Signals for Overhead and Gantry Cranes



From B30.8-1982—"Floating Cranes and Floating Derricks" with permission of the American Society of Mechanical Engineers.

Chains, Ropes, and Slings

The maintenance of chains, ropes, and slings is an essential part of safe lifting operations. A program should be established to ensure that operators, maintenance, and any other personnel who are involved in the lifting apparatus operation, equipment repair, or inspection can identify defects and know what actions are to be taken when a deficiency is observed.

Chains and hooks need to be inspected regularly for

- bent, elongated, distorted, or excessively worn links and hooks
- cracks in weld areas, shoulders, or other sections of links
- scores or markings (especially transverse markings) which tend to weaken the links
- corrosion pits

Ropes are made from natural or synthetic fibers. Supervisors need to be aware of the safe working loads or the breaking strengths of the ropes employed. Ropes should be cleaned periodically to remove damaging dirt. Sharp bends, dragging, and kinks should be avoided. Before each use, all ropes should be inspected for weak spots, broken fibers, deterioration, and abrasion. Synthetic ropes are also weakened by light and organic solvents. Rope slings should be date-tagged and the load reduced by one half after the sling has been in use for 6 months even if there are no signs of wear. All ropes should be stored in a clean, dry, and cool area.

Wire rope deteriorates, particularly from wear, fatigue, and corrosion, and for that reason should be inspected at regular intervals to insure that it is in safe working condition. Written reports of the inspection should be made; such reports should describe the inspection procedure and the findings. Indicators of deterioration are the number of broken strands, the amount of wear on the outside wires, and evidence of corrosion. Defective wire ropes and slings should be removed from service immediately and tagged for repair. Wire rope used for hoisting should not be subjected to working loads in excess of 1/5 of rated breaking strength. All fittings should be appropriate for the load bearing characteristics of the wire rope. Splices should be tested at twice the load before use. Oiling the wire rope periodically is recommended to prevent rust and excessive wear. It is especially important to note that ropes exposed to high humidity or

other destructive environmental conditions should be subjected to thorough periodic examination. Pertinent OSHA regulations are 29 CFR 1910.184.

B. CONVEYORS

The principal types of conveyors used for moving materials are gravity, ball, roller, chute, belt, chain, portable, screw, pneumatic, monorail and overhead trolley.

Strategically located controls for emergency stops should be provided on all power-driven conveyors. Electric motors should have overload protection. It is wise, also, to provide a shear pin, slip coupling, or similar overload device to protect the conveyor and mechanical drive parts.

Interlocking devices should be provided whenever possible to stop a conveyor automatically should another conveyor to which it feeds be stopped or blocked with loads so that it cannot receive additional material.

Belt conveyors are used to move all types of packaged goods, boxes, cartons, crates, bags and loose material. The trough type of belt conveyor is used to handle bulk materials. The pulley at the end of the conveyor belt run should be thoroughly guarded so that fingers cannot be caught in the nip point. A shield guard or housing should completely enclose each end of a belt conveyor running at floor level or in a similarly accessible place. As an added safety measure, guard rails should extend the length of the conveyor.

Operator Training

Before being permitted to operate a conveyor an operator should know:

- proper lifting and unloading techniques
- location of stop buttons
- safety features of the machinery
- when equipment should not be "started up"
- maintenance and repair schedules
- how to lock conveyors before repair or maintenance

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- to tie back long hair and not wear loose clothing, jewelry or other objects which can be caught in the equipment
- that safety shoes are recommended
- how to use any required safety equipment

Special Circumstances

While enclosed conveyors provide additional protection, workers should be wary when the doors are opened or left open. The trough of a screw conveyor should be covered so nothing can enter without the equipment shutting down. Pneumatic conveyors should be similarly protected. Suction lines on vacuum conveyors should have screens or bar guards to prevent accidental contact. Suitable eye protection should be worn when working close to a vacuum or positive pressure conveyor.

Potential fire and dust explosion hazards associated with pneumatic conveying systems are discussed in Section V - Prevention of Fires and Explosions.

C. POWERED INDUSTRIAL VEHICLES

Powered industrial vehicles may appear safer than other vehicles because they are smaller and slower, but in actuality their weight/size ratio and handling characteristics require that operators be skilled and cautious. Operation of an industrial vehicle demands extra precautions because:

- In-plant trucks normally do not have the shock absorbers or air filled tires and therefore are rougher riding.
- Visibility may be poor with a bulky load.
- An in-plant truck has a narrow wheel base and carries suspended loads, and therefore has a greater potential for overturning than most over-the-road vehicles.
- Pedestrians may not hear plant trucks as well as other vehicles because the plant trucks are quieter.

- Pedestrians in a plant often share the same aisles and work spaces and are more apt to "be in the way."

Common causes of accidents include:

- not looking out for pedestrians (pedestrians are involved in one-third to one-half of all truck accidents)
- not inspecting the load before lifting
- traveling with forks too high or too low
- cutting corners too sharply
- not slowing down or sounding horn at intersections
- driving with the load too high
- not centering the load on the lift

Training Programs for Vehicle Operators

Operator training and authorization programs are essential for the safe operation of powered industrial vehicles.

Separate training programs are available for fork lifts, industrial tractors, platform lift trucks, and motorized hand trucks. A one- to two-week probationary period with close supervision is recommended for new drivers.

Most industrial truck manufacturers offer or supply detailed operational procedures as well as packaged training programs. Users of industrial trucks are strongly advised to secure this important information for their in-plant truck safety program. Safe handling of industrial trucks requires that procedures be established for training and screening of drivers and effective servicing and maintenance of vehicles. Safe operating rules and regulations must be observed.

The primary reference source for the safe operation of any powered industrial vehicle is the manufacturer's operating instructional manual. NIOSH has, however, consolidated many important operating procedures in their "Outline for Training Powered Industrial Truck Operators" NIOSH publication 78-199. OSHA regulations are found at 29 CFR 1910.178.

Employee Physical Examinations

The driver of a forklift or similar industrial truck should be examined by a physician before being authorized to operate the vehicle. Vision, hearing, and coordination should be within acceptable standards. Re-examination on a periodic basis is appropriate. Licenses or badges showing authorization should be issued once the training and medical exams are successfully completed.

D. HAND TRUCKS

Powered Hand Trucks

Powered hand trucks are frequently used in the plastics industry. The operator walks while he controls the battery-operated truck.

To prevent collisions with other trucks, fixed objects, and people, these trucks should be equipped with dead man's controls, wheel guards, and an ignition key that can be taken out when the operator is away from the truck.

Operators of powered hand trucks, like operators of other powered equipment should be trained and authorized before they are permitted to use the vehicles. While specific training programs should be based upon the operating instructions provided by the manufacturer, some general principles of safe operation are important and should be included in any comprehensive safety training program. In general, the operator should:

- only operate the truck with dry hands. (Wet or greasy hands reduce operator control)
- lead the truck from either the right or the left side of the handle, and face direction of travel

- back a powered hand truck onto elevators to prevent being caught between the handles and the elevator walls
- operate a truck in reverse whenever it must be run close to a wall or other obstruction
- give pedestrians the right of way at all times
- stop at blind corners, doorways and aisle intersections
- only operate the truck at normal walking pace
- carry flammable or corrosive liquids only in approved containers
- only ride the truck if it is specifically designed for the driver to ride in it
- never permit others to ride on the truck

Non-Powered Hand Trucks

Many types of non-powered hand trucks and dollies, such as two-wheeled, flat, platform, box and lift trucks, and special racks or dollies, can help in manual handling of materials. No single truck is suitable for handling all types of materials found in the plastics industry; therefore, selection of the right truck for the job is important.

Two-wheeled trucks and wheelbarrows should be equipped with knuckle guards to protect the hands and fingers from hitting door frames and other obstructions. Although two-wheeled hand trucks appear easy to handle, employees should be appropriately trained in safe handling practices which emphasize the following points:

- Keep the center of gravity of the load as close to the axle as possible; place heavy objects at the bottom of the load.
- Let the truck carry the load. The operator should only have to steer the truck while providing moving and stopping forces. Good load balance is essential to easy and safe truck travel.

- Place the load so that it will not shift, slip or fall off. Load only to a height which will allow a clear view ahead.
- Avoid walking backwards with a truck.
- When going down an incline, the truck should be in front of the operator. When going up an incline, it should be behind the operator.
- Move trucks at a safe speed.

When lifting a wheelbarrow or two-wheeled truck to operating position, workers should employ safe lifting practices previously described (Section III, pp. 3-16, 3-17).

5.0 PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING

This section covers personal protective equipment other than respirators and hearing protection which are discussed in Section IV. Pertinent OSHA regulations are 29 CFR 1910.132-140.

Overall Considerations

Where hazards cannot be eliminated or controlled at the source, and where ordinary work clothing does not afford sufficient protection, personal protective equipment should be utilized.

The manager of an effective personal protective equipment and clothing program should:

- be able to identify operations where such equipment is needed
- be familiar with and provide the most suitable safety equipment for the operation
- know the procedures for supplying, maintaining, and cleaning the equipment

- establish procedures which will ensure that all employees dress safely and use protective equipment properly

The person responsible for implementing the personal protective equipment program should:

- State what protective equipment should be worn for each operation in each area, and train employees to use this equipment properly. Some companies include in a job description the protective equipment required for that particular task.
- Keep protective equipment and stockrooms neat, clean, and orderly. Employees are understandably reluctant to wear dirty equipment that is issued from a disorderly stockroom.
- Keep ample stocks of various items. If inventory control is poor and stocks become depleted, it is difficult to convince employees that the item has much value and that the company considers the program important.
- Replace worn-out equipment promptly.
- Insist that supervisors set a good example.

Even in companies or departments where personal protective equipment is available, clean, and in good order, employees may be reluctant to use it. While the use of such equipment can be made compulsory, it is more important to provide a proper background and understanding of the importance of the equipment and its use. This should be accomplished through a positive education and training program which emphasizes the potential hazardous nature of certain operations and the protection that safety equipment provides. It is extremely important to approach such a program positively and to remind the employee periodically that the use of such equipment is for his or her personal protection. It is also important to remember that the employer has a legal responsibility to enforce recognized safe work rules.

Eye Protection

Plastics processing operations may expose employees to a variety of eye hazards such as flying objects, splashes of liquids or molten plastic materials, and dusts. Accordingly some form of eye protection is necessary. A plant-wide safety glasses program is strongly recommended.

There are many practical and effective types of eye protection available including cover goggles, faceshields, protective eyeglasses (with or without side shields), cup goggles, chemical goggles and welder's goggles. Criteria for selecting appropriate eye protective devices are listed in Exhibit 3-5. The standard for industrial eye protection is ANSI Z87.1-1979. OSHA regulations are in 29 CFR 1910.133.

Cover Goggles are frequently worn over ordinary glasses to protect both the wearer's eyes and his corrective lenses. Cover goggles guard against eyeglass pitting as well as breaking. Moreover they offer the advantage of being wide enough to protect the eye socket by distributing a blow over a wide area of the face.

Protective Glasses without side shields may be worn where it is unlikely that particles will fly toward the side of the face. Glasses with side shields are advisable where there is that possibility.

Chemical Face Shields and Goggles, with soft vinyl or rubber frames, protect eyes from corrosive chemical splashes and exposure to fine dust or mist. For exposures involving chemical splashes, goggles can be equipped with baffle ventilators on the sides. For vapor or gas exposures, they should be unventilated. Some types are made to fit over eyeglasses. Face shields are worn over glasses and are an added protection for the face from injurious substances such as corrosive chemicals.

Contact Lenses - even if goggles are worn, contact lenses should never be worn where gases, vapors, dust, liquids, or fumes could injure the eyes.

Welding helmets, shields, and impact goggles protect the eyes and face from molten metal splashes and radiation produced by arc welding. Helmets should have the proper filter glass to prevent ultraviolet and visible rays from harming the eyes. A list

Eye and Face Protective Equipment to Be Worn for Various Types of Exposures

	Heavy impact (chipping, grinding, etc.)	Light to moderate impact (belt sanding, most machining operations, etc.)	Frontal impact only, light to moderate	Dusts	Liquid splash, irritating only	Liquid splash eye hazardous	Molten metal splash (melting point below 2,100 °F)	Molten metal splash (melting point above 2,100 °F)	Gases, fumes, mists
Spectacles (3mm glass or plastic lenses)									
" with sideshields									
Spectacles (0.050-inch plastic lenses)									
" with sideshields									
Eye-cup goggles, basic (3mm lenses)									
" with fine-mesh screens									
" with shielded/baffled ports									
Rigid or semirigid mask goggles (3mm lens)									
" with fine mesh screens or baffled ports									
Rigid or semi rigid mask goggles (0.050-inch lens)									
" with fine mesh screens or baffled ports									
Flexible-fitting mask goggles (3mm or 0.050-inch lens)									
" with fine-mesh screens									
" with shielded/baffled ports									
" unventilated									
Foundrymen's goggles (3mm lenses)									
" with fine-mesh screens									
Gas-tight goggles									
Special fabric-cup dust goggles									
Rubber-frame chemical goggles, baffled vents									
" unventilated									
Plastic-visor face shield (0.040-inch)									
" with crown and chin protectors									
Wire-mesh visor (face shield) (0.0295-inch mesh)									



Recommended, Optimum Protection



Permissible



Permissible but has features not needed for hazard cited

Source: National Safety Council, 444 N. Michigan Avenue, Chicago, IL 60611

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of shade numbers recommended for various operations is given in ANSI Standard Z87.1 and in Exhibit 3-6. As eye health and sensitivity vary with age, general health, inherited traits, and health care, two persons doing the same job may require different shaded lenses. Cracked or chipped filter lenses should be replaced, otherwise they will permit harmful rays to reach the welder's eyes.

The following is a guide for the selection of the proper shade numbers. These recommendations may be varied to suit the individual's needs.

Exhibit 3-6 Welding Operation	Shade No.
Shielded metal-arc welding: 1/16-, 3/32-, 1/8-, 5/31-inch electrodes	10
Gas-shielded arc welding (nonferrous): 1/8-, 3/32-, 1/8-inch electrodes	11
Gas-shielded arc welding (ferrous): 1/16-, 3/32-, 1/8-inch electrodes	12
Shielded metal-arc welding:	
3/16-, 7/32-, 1/4-inch electrodes	12
5/16-, 3/8-inch electrodes	14
Atomic hydrogen welding	10-14
Carbon arc welding	14
Soldering	2
Torch brazing	3 or 4
Light cutting, up to 1 inch	3 or 4
Medium cutting, 1 inch to 6 inches	4 or 5
Heavy cutting, 6 inches and over	5 or 6
Gas welding (light) up to 1/8 inch	4 or 5
Gas welding (medium) 1/8 inch to 1/2 inch	5 or 6
Gas welding (heavy) 1/2 inch and over	6 or 8

Impact goggles worn under the helmet protect a welder from flying particles when the helmet is raised. The type with side shields is recommended as minimum protection from flash from adjacent work or from the popping scale of a fresh weld.

A welder's helper should have proper welding goggles or helmet to wear while assisting in a welding operation or while chipping flux away from a bead that has been run over a joint. For workmen performing this latter operation without protection, the danger of foreign bodies becoming lodged in the eye is great.

Acid-proof hoods that cover head, face, and neck are used by persons potentially exposed to the splashes from corrosive chemicals. This type of hood has a window of glass or plastic securely joined to the hood to prevent acid seepage. Hoods made of rubber, neoprene, plastic film or impregnated fabrics are available. The supplier should be consulted for a description of the protective properties of the material being considered.

Using Protective Equipment

The most common reason people give for not using protective equipment is discomfort or reduced vision. Workers cannot be expected to wear uncomfortable protective equipment. The equipment should be carefully fitted and kept clean so that dirt, dust, and grime do not interfere with vision. In addition to providing carefully fitted clothing and protective devices, employees must also be instructed in the proper care and maintenance of their equipment. Employees should not touch the lenses of protective eyewear with dirty hands nor place them in situations where they are liable to become damaged.

Another common complaint is that protective eyewear gives rise to headaches. This complaint can often be corrected by refitting. If, however, complaints persist after the protective devices have been properly fitted, the supervisor should refer the employee to a physician for appropriate examination and treatment.

Foot Protection

A large percentage of disabling industrial injuries are foot injuries which can be prevented by wearing safety shoes. Metal-free shoes, boots and other footwear are available for use where there are potential electrical, fire, or explosion hazards.

Safety shoes formerly were hot and heavy, and users complained they were uncomfortable. New designs now make most safety shoes as comfortable, practical, and attractive as ordinary street shoes. The steel cap weighs about as much as a pair of rimless eyeglasses or a wrist watch. The toe box is insulated with felt to keep the feet from getting too hot or cold.

Some people object to wearing safety shoes because the toe box does not cover the smallest toes. However, studies have shown that most toe fractures happen to the first and second toes. Normally the toe box absorbs the impact on the entire front part of the foot. In the majority of cases, safety shoes give ample protection. Even in the rare cases where the toe box is crushed the foot usually does not suffer serious injury. Applicable OSHA regulations are 29 CFR 1910.136.

Head Protection

Safety hats (commonly known as "hard hats") are essential in situations where there is the possibility of injury from falling objects, flying objects or severe injuries by bumps. ANSI Standard Z89.1, Safety Requirements for Industrial Head Protection, gives specifications that such hats should meet. OSHA regulations for head protection are found at 29 CFR 1910.135.

Impact resistance is essential. Hats should be fire resistant and impervious to moisture. Where contact with energized circuits is possible, hats which have shells made of nonconductive material and which have no conductive fittings passing through the shell should be worn.

In addition to hard hats another type of head protection called the "bump hat" or "bump cap" is available for use in tight spaces where the exposure is confined to bumping only. Bump hats cannot be used in locations where there is exposure to any hazard greater than bumping the head against an obstruction.

Safety hats used for electrical work should be tested periodically, in accordance with ANSI Standard Z89.1 and should be discarded if they fail this test which may occur before their mechanical strength is appreciably reduced.

No attempt should be made to repair the shell of a hat once it has been broken or punctured. Extra shells should be kept on hand as replacements. Workers should not be permitted to drill holes in their safety hats to "improve ventilation" or cut notches in the brim. Such practices can destroy the ability of the hat to protect the wearer.

Workers should not remove the safety hat suspension so they can wear the hat over a parka hood because this practice eliminates the protection factors designed into the hat. Liners are available for cold weather use. A chin strap is useful when the wearer is exposed to strong winds or when the job requires unusual activity. A face shield of transparent plastic can be attached to some types of hats. The shield is hinged under the brim and lies flat against the brim when not in use.

Some workers complain that hats give them headaches. In most cases if the hat fits properly and the wearer becomes accustomed to it, the headaches stop. There is no physiological reason for a properly fitted hat to cause a headache.

Hand Protection (Gloves)

Many different types of protective gloves are available, including:

- heat resistant gloves which protect against burns and discomfort when the hands are exposed to sustained heat
- metal mesh gloves (used by those who work with knives) which protect against cuts and blows from sharp or rough objects and tools
- rubber gloves worn around electrical equipment (they should be tested regularly for dielectric strength if they are used around high potentials)
- rubber, neoprene, and vinyl gloves used when handling chemicals

- chrome-tanned leather or horsehide gloves (used by welders or for heavy, dirty work) which resist sparks, chips, and rough objects and provide some cushioning against blows
- cotton or fabric gloves suitable for protection against dirt, slivers, chafing or abrasion but not suitable for use with very rough, sharp or heavy materials

While gloves are designed to protect against injury, supervisors should also be aware that in some cases gloves are inappropriate and should not be worn. When it is necessary to remove gloves quickly in an emergency situation, the back of the glove should be slit.

Body Protection

The most common protection for the abdomen and trunk is the full apron. Aprons are made of various materials. Leather or fabric aprons, with padding or stays, offer protection against light impact and against sharp knives and cleavers. Aluminized heat resistant coats and aprons are often used by those who work around hot metal or other sources of intense heat.

An apron worn near moving machinery should fit snugly around the waist. Neck and waist straps should be either light strings which are readily broken or fasteners which release instantly should the apron become caught.

Welders are often required to wear leather vests or capes and sleeves, especially when doing overhead welding. These garments protect against hot sparks and bits of molten metal. On jobs where workers carry heavy and angular loads, pads of cushioned leather or padded duck are often used to protect the shoulders and back from injury.

Safety Belts, Harnesses and Lifelines

Safety belts and harnesses with lifelines attached should be worn by those working at elevated levels, in confined spaces, or where they might be buried by loose material. Two basic types of harnesses and lifelines are available; those designed for

normal use, which involves comparatively light stresses, and those designed for emergency situations where the equipment may be subjected to high impact loading (for example in stopping a falling man every part of the belt may be subjected to an impact loading many times the weight of the wearer).

A harness-type safety belt better distributes the shock of an arrested fall. The shock is distributed over shoulders, back, and waist (instead of being concentrated at the waist). The harness permits a person to be lifted with the back straight, rather than bent over a waist strap. This makes rescue easier in most cases and places less stress on the person being rescued.

Manila rope of three quarters of an inch in diameter, or nylon rope of half an inch in diameter, is recommended for lifelines.

Steel cables should not be used as lifelines where free falls are possible, unless a shock-absorbing device is also used. The rigidity of steel cables greatly increases the impact loading. Steel is also an electrical conductor and should therefore not be used near electrical equipment or power lines.

Knots reduce the strength of all ropes. The degree of loss depends upon the type of knot and the amount of moisture in the rope.

Belts and lines should be checked by a trained inspector before each use. All defective equipment should be discarded so that it will not be used inadvertently.

Work Clothing

Ordinary work clothing, if clean, in good repair, and suited to the job, is safe. "Safety clothing" refers to garments designed for specific, hazardous jobs where ordinary work clothing does not give enough protection.

Good fit is important. Pants that are too long should be shortened to proper length, preferably without cuffs. Pants with cuffs should not be worn near operations that produce flying embers, sparks, or other harmful matter that might get caught in them.

Neckties, long sleeve shirts, and loose-fitting garments (especially about the waist) are not appropriate work clothing because they can be easily caught in moving machine parts. Employees should not be permitted to wear jewelry such as necklaces, key chains, or watch chains near moving machinery or near electrical equipment.

Clothing soaked in oil or solvents should not be worn until it has been cleaned. Such clothing should be stored in an approved container. If the clothing cannot be cleaned, it should be discarded. Approved closed containers suitable for storing oily rags can be used to store clothing awaiting disposal.

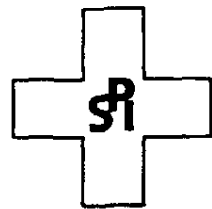
In oily or dusty environments, a cap should be worn to guard against dirt and possible scalp infections. A cap may also help protect the hair from getting into moving machinery.

A number of materials are used in protective clothing. Six major types are described below:

- Aluminum-faced fabric has a coating that reflects radiant heat. Aluminized asbestos is used for heavy-duty suits, and aluminized fabric for fire-approach suits. Asbestos, or a substitute, is used as protection against flames and intense heat.
- Cotton fabric treated with a flame retardant is often worn by employees who work near sparks and open flames. Although the fabric is durable, the flame retardant treatment may have to be repeated after one to four launderings. Flame-resistant treated duck, used for garments worn around sparks and open flames, is light-weight, strong, and long-wearing. It does not afford adequate protection against extreme heat.
- Glass fiber is used in some insulated clothing for protection from excessive heat. The facing is made of glass cloth or of aluminized fabric.
- Impervious materials (such as rubber, neoprene, vinyl, and fabrics coated with these materials) protect against dust, vapors, mists,

moisture, and corrosive materials. Rubber is used widely because it resists acids, caustics, and other corrosives. Neoprene resists petroleum oil, solvents, acids, alkalis, and other corrosives.

- Leather protects against light impact. Chrome-tanned leather protects against sparks, molten metal splashes, and infrared and ultraviolet radiation.
- Synthetic fibers resist acids, many solvents, mildew, abrasion, and tearing. Because some of these fabrics may generate static electricity, garments made from them should not be worn in explosive or high-oxygen atmospheres unless they are treated with an anti-static agent.



PlasTIPS

SECTION IV

BASIC PRINCIPLES OF OCCUPATIONAL HEALTH

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SECTION IV - BASIC PRINCIPLES OF OCCUPATIONAL HEALTH

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SECTION IV - BASIC PRINCIPLES OF OCCUPATIONAL HEALTH

This section outlines the key elements of an industrial health program. The basic approach to controlling potential health hazards is to minimize worker exposure to chemical and physical agents by proper design of facilities, appropriate use of personal protective equipment, and development of good work practices. The goal is a healthful job environment which can contribute to the well-being of the worker.

Today, increased emphasis is being placed on occupational health. The Occupational Safety and Health Administration (OSHA) has directed many of its new regulations towards occupational health, as opposed to more conventional physical safety concerns. Occupational health guidelines have also been developed by organizations such as the Chemical Manufacturers Association, the American National Standards Institute, the National Safety Council, the American Conference of Governmental Industrial Hygienists, the American Industrial Hygiene Association, and others. (See Sources of Information, Section VII.)

Excessive exposure to harmful agents is detrimental to health. Harmful agents can be classified as chemical, physical, or biological: chemical agents may exist as fumes, gases, dusts, or liquids; some examples of physical agents are noise, heat, and radiation; and biological agents include bacteria and viruses. Understanding how such harmful agents exert their effects and the need for their control is an essential element of the science of industrial hygiene. A professional industrial hygienist should be consulted when there is an occupational health concern.

1.0 CHEMICAL SUBSTANCES

Two basic types of plastic materials, or resins, are used by the plastics industry: thermosets and thermoplastics. Once a thermosetting resin has been "cured" or "set" it is infusible; it cannot be melted or appreciably softened. Thermoplastics, on the other hand, can be repeatedly softened by heat and/or pressure and reset upon cooling.

Examples of thermosets are:

- polyesters (unsaturated)
- polyurethanes

- phenolics
- ureas
- epoxies

Examples of thermoplastics are:

- polyvinyl chloride
- polyethylene
- polystyrene
- polyamide
- acrylics
- fluorocarbon polymers

Both thermoplastics and thermosets are used in plastic processing. Additives which aid in the processing or impart improved properties to the resin material are also utilized. Such additives include plasticizers, dyes, pigments, lubricants, fillers, reinforcements and antioxidants. Chemical substances are also employed in auxiliary or support activities, such as paint spraying, welding, electroplating, metal machining, and degreasing.

Chemical substances are the mainstay of plastics processing operations and industry has devised ways to handle them safely. Handling procedures for a given chemical substance are designed to reduce the potential exposure hazard which is dependent not only on its inherent toxicity but also on physical properties which influence the exposure potential. For example, a highly toxic nonvolatile liquid might require less stringent handling procedures than a volatile liquid which is inherently less toxic.

Evaluating Chemical Substances in the Workplace

When chemical substances are introduced into the workplace, these basic questions should be asked:

- What are the potential hazards (corrosivity, toxicity, flammability, etc.)?

- What special handling procedures are required?
- What controls are required to reduce or eliminate exposure?
- What work practices must be instituted to control exposures?
- What specific personal protective equipment is needed (gloves, aprons, boots, etc.)?
- What are the emergency and first aid procedures?
- What are the recommended storage and disposal practices ?
- Are there less hazardous substitutes available?
- What are the applicable OSHA standards and/or regulations?

Much of this information may be in the Material Safety Data Sheet (MSDS) or other technical literature available from the material supplier. (A sample of a MSDS Form OSHA-20 is shown in Exhibit 4-1.) However, the MSDS may not fulfill the plant's needs. The information may be too complicated, not given in sufficient detail, or not be specifically applicable to the user's operations. Additional information sources include:

1. other information available from the material supplier such as product literature, and special handling precautions
2. OSHA standards (especially the 1910.1000 series)
3. organizational literature (from National Safety Council, The Society of The Plastics Industry, American Conference of Governmental Industrial Hygienists, National Institute for Occupational Safety and Health, etc.)
4. references (see Section VII, Sources of Information).

Valuable guidance can also be obtained from industrial hygienists employed by manufacturers, insurance carriers, state and federal labor departments, and consulting

4-4
Exhibit 4-1
Material Safety Data Sheet

U.S. DEPARTMENT OF LABOR		Form Approved
Occupational Safety and Health Administration		OMB No. 44-RJ387
MATERIAL SAFETY DATA SHEET		
Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)		

SECTION I	
MANUFACTURER'S NAME	EMERGENCY TELEPHONE NO.
ADDRESS (Number, Street, City, State, and ZIP Code)	
CHEMICAL NAME AND SYNONYMS	TRADE NAME AND SYNONYMS
CHEMICAL FAMILY	FORMULA

SECTION II - HAZARDOUS INGREDIENTS					
PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)

SECTION III - PHYSICAL DATA			
BOILING POINT (°F.)		SPECIFIC GRAVITY (H ₂ O=1)	
VAPOR PRESSURE (mm Hg.)		PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (_____ #1)	
SOLUBILITY IN WATER			
APPEARANCE AND ODOR			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA			
FLASH POINT (Method used)	FLAMMABLE LIMITS	LeI	UeI
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARDS			

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Exhibit 4-1 (cont.)

SECTION V - HEALTH HAZARD DATA	
THRESHOLD LIMIT VALUE	
EFFECTS OF OVEREXPOSURE	
EMERGENCY AND FIRST AID PROCEDURES	

SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE		
INCOMPATIBILITY <i>(Materials to avoid)</i>			
HAZARDOUS DECOMPOSITION PRODUCTS			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR		

SECTION VII - SPILL OR LEAK PROCEDURES	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	
WASTE DISPOSAL METHOD	

SECTION VIII - SPECIAL PROTECTION INFORMATION		
RESPIRATORY PROTECTION <i>(Specify type)</i>		
VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL <i>(General)</i>	OTHER
PROTECTIVE GLOVES		EYE PROTECTION
OTHER PROTECTIVE EQUIPMENT		

SECTION IX - SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING	
OTHER PRECAUTIONS	

firms. Industrial hygienists can advise the manager of the potential hazards of a given material and provide direction in recognizing, evaluating and controlling worker exposure.

Having reviewed the available literature on the safety and health aspects of the material being considered for introduction into the workplace, the manager will want to review his processing operation to determine how the material can be handled safely. Factors to be considered include:

1. Worker Exposure

- How many individuals are involved?
- How will exposure occur - by breathing of workplace air, by skin contact with the material?
- What is the significance of excessive exposure to the substance?

2. Potential Controls of Exposure

- Can the process be isolated or ventilated?
- Can the process be changed?
- Can engineering controls be installed?
- Can administrative controls be utilized?
- Can protective equipment for employees be used?

3. Flammability and Reactivity Hazards

- Are special storage, handling, disposal facilities and procedures required?

4. Feasibility

- Assess availability and cost of facilities, procedures, equipment needed to handle material safely.

Precautionary Measures

Where the decision is made to introduce or to continue to use a material which is potentially hazardous, appropriate steps should be taken to ensure that the material will be handled properly. Among the considerations are:

1. installing ventilation or process isolation equipment for the processing, storage, and disposal facilities
2. purchasing personal protective equipment such as respirators, gloves, aprons, disposable coveralls, and face shields
3. establishing work practices and housekeeping procedures
4. setting up emergency procedures for:
 - (a) treatment of employees overexposed to the material
 - (b) firefighting
 - (c) spill containment
5. providing for routine medical examinations for employees
6. periodically monitoring the workplace to insure that exposure is not excessive
7. providing training for use of personal protective equipment
8. advising workers as to the nature of the hazards, the health effects, and how to protect oneself

Whatever the material and potential hazards involved, the employees should be advised of the situation and trained to handle the material safely.

In view of these considerations, a common sense approach for the manager to use in assessing chemical exposures would include the following steps:

Step 1: Make a list of the raw materials in the plant. If a chemical reaction is involved, the list should include known intermediates and reaction products.

Step 2: Obtain copies of the Material Safety Data Sheets from suppliers. Also, obtain health and safety data on intermediates and reaction products.

Step 3: Systematically check to ascertain that data is available on material compositions, reactivity, toxicity, first aid, handling procedures, necessary personal protective equipment, spill clean-up, fire fighting procedures, thermal degradation products, and any other items of significance.

Step 4: Check plant materials against lists of known hazardous materials supplied by OSHA, NIOSH, and other recognized occupational health resources. Note permissible exposure limits and other important factors like fire and explosion hazards.

Step 5: Decide which materials are hazardous, what those hazards are, and where they are likely to occur. At this point the plant operator will probably have to seek professional assistance from material and equipment suppliers, consulting firms, NIOSH, OSHA consulting programs, or trade associations. The assistance may include an industrial hygiene survey to identify and measure worker exposures.

Step 6: If potential hazards are found, the plant manager should prepare a control program. This program may include a combination of various approaches such as:

- engineering controls (ventilation, raw material substitution, equipment enclosures, reduced machinery speeds)

- administrative controls (reduced workloads, job rotation)
- work practice controls (housekeeping, materials handling procedures)
- personal protective equipment (gloves, face shields, aprons, respirators, boots)
- appropriate hygiene facilities (showers, lockers, designated break areas)

Step 7: Once controls are in place, the plant manager will need to establish ongoing procedures to ensure continued effectiveness of the program. Such procedures may include hazard evaluations of any new materials, training of employees in good work practices, and periodic inspection and monitoring of the workplace.

Routes of Chemical Exposure

All chemicals require some handling precautions which are determined by the inherent properties of the material. It is important to understand how a chemical can enter the body and what the effects of exposure may be. There are three principal ways by which an individual can be exposed to a chemical: (1) inhalation, (2) skin/eye contact, and (3) ingestion.

Inhalation

The most common route of harmful exposure to chemicals in the workplace is by inhalation. Helpful in understanding this type of exposure is a knowledge of the various forms in which chemical substances exist as air contaminants:

1. Dusts are solid particles generated by crushing, grinding, and other operations that release particles into the air. Loading a powder into a hopper or grinding a plastic piece may generate airborne dust. Most airborne dust that can be seen is composed of particles greater than 10 microns in diameter. When inhaled, such particles do not reach the

inner recesses of the lung but are stopped by the nose, windpipe, or bronchi. The smaller dust particles (0.5-10 microns in diameter) can be deposited in the lower portion of the lungs.

Some dust particles are toxic even if they are too big to reach the lungs, while others are harmful only if they are deposited in the lungs. Metals such as lead, cadmium, and arsenic are potentially harmful when inhaled as dust (or when ingested) regardless of their particle size. The larger inhaled particles that do not reach the lungs may be coughed up and then swallowed, ending up in the stomach and absorbed into the bloodstream. On the other hand, silica is an example of a material which can have toxic effects only if it is a size which can be deposited in the lungs.

2. Smoke is a combination of different reaction products from the incomplete combustion of organic materials. Composed primarily of gases and carbon particles less than 0.1 micron in diameter, the health effects of smoke are difficult to characterize because of the many types of chemical substances present in it. As a general rule, however, inhalation of smoke should be avoided.
3. Gases quickly diffuse into the space in which they are confined. Examples of gases include carbon monoxide, carbon dioxide, and oxygen. Highly water-soluble gases such as ammonia tend to react with the moisture in the mucous membranes of the nose, mouth, and throat, thereby causing localized irritation. However, such gases tend not to reach the lungs unless the concentration in air is very high. Less water-soluble gases such as carbon monoxide are readily transported to the lungs from which they may enter the bloodstream directly and cause systemic injury.
4. Vapors are the gaseous form of a chemical substance which is normally a liquid at room temperature. Vapors are commonly formed from a substance by evaporation of solvents. Many substances have vapors which are heavier than air and will settle slowly. However, air currents can easily diffuse these vapors throughout a room. A liquid that

evaporates quickly (like acetone) will generate greater air concentrations of the vapor than a liquid which evaporates more slowly, such as many plasticizers. Most vapors can enter the bloodstream via the lungs. Effects of inhalation of such materials may range from no effect to mild dizziness or nausea or to serious bodily harm, depending upon the properties of the chemical substance and the amount of exposure.

5. Fumes are very small particles generated from volatilizing metal or other materials which are solid at room temperature, such as plastics. The small particles are formed by condensation from the gaseous state and tend to aggregate or fuse together. (Although the layman often calls vapors, "gases," and other airborne materials "fumes" this is technically incorrect.) Excessive exposure to certain fumes may induce a fever hours after exposure. Fumes generated from welding zinc-galvanized metal or heating certain fluorocarbon resins produce such effects.
6. Mists are suspended liquid droplets formed from the agitation of a liquid (splashing, foaming, etc.) or from condensation from air presaturated with vapor. Mists are common around plating tanks, paint spraying, and machining.

If an airborne chemical hazard is suspected, an industrial hygienist should evaluate the workroom air and measure employee exposures. The hygienist will compare the results of the air sampling with permissible exposure limits for that chemical as defined in OSHA standards or other recognized guidelines. If the exposure exceeds permissible limits, respiratory and/or other appropriate protection should be provided until exposures can be controlled by engineering or administrative practices.

Skin/Eye Contact

Another route of exposure to chemicals in the workplace is through skin and eye contact. Basically skin/eye contact can be hazardous if the chemical causes (1) burns, (2) dermatitis, or toxic effects through skin penetration, and (3) systemic effects.

1. Chemical burns are similar to thermal burns in their destruction of body tissue, resultant loss of body fluids, and potential onset of shock in severe circumstances. The ability of a chemical to cause a burn is dependent upon such factors as its corrosivity, concentration, and temperature.

Shipping containers of corrosive chemicals must be labeled with the black and white diamond-shaped corrosives label which warns of the potential hazard of the contents. Materials Safety Data Sheets for such chemicals will state the hazards to eyes and skin and will outline the precautions and procedures to be taken in the event of a spill or emergency.

2. Dermatitis is an inflammation or irritation of the skin. It represents the single most reported occupational illness and can range in severity from slight dryness or flakiness to serious conditions.

Chemical, physical, and biological agents can cause or aggravate dermatitis. Chemical agents such as acid, alkalies, and solvents destroy or penetrate the outer protective layers of the skin, exposing sensitive tissues. Other chemical agents such as some epoxies may promote dermatitis by triggering an allergic reaction. Still other substances such as glass fibers are mechanical irritants.

Physical agents that promote dermatitis may include heat, changes in humidity, and certain forms of non-ionizing radiation. The biological agents causing dermatitis include fungi bacteria and viruses.

All three categories of agents - chemical, physical, and biological - can act alone or together to produce dermatitis or to worsen a pre-existing condition.

An example of a chemical and a physical agent working together to produce dermatitis is the combination of glass fiber and polyester resin in hand layup work. The resin, particularly the monomer component, and the chemicals used for cleanup (methylene chloride, acetone) can

remove the oils from a worker's skin resulting in dry, reddened skin which is then more susceptible to the mechanical irritation of the glass fiber.

An example of a biological agent worsening a pre-existing condition, is that of an individual who has a chemically induced dermatitis and begins wearing rubber gloves. The worker's hands sweat inside the gloves, thereby creating a warm, damp environment ideal for the growth of certain fungi. The chemically irritated skin is less resistant to fungal infection than undamaged skin. A fungal infection develops, superimposed on the chemically induced dermatitis, and produces a more severe dermatitis than originally existed.

Protective clothing should be worn to minimize the amount of skin contact with chemicals. Wearing rubber gloves often prevents or alleviates dermatitis; however care should be taken to keep the gloves clean and dry. Hands should always be washed thoroughly and dried well before gloves are put on. The inside of gloves should be washed periodically. Between wearings they should be turned inside out and hung where they can dry and will not become contaminated by chemical splashes or other agents. If high humidity or perspiration is a problem, absorbent cotton glove liners or talcum powder can be used to provide greater comfort and to minimize the fungus problem. These inserts should be washed after each wearing; disposable ones are also available.

Personnel are not often aware of their own individual habits which can lead to accidental transfer of agents to various parts of the body. The skin of some areas of the body is much more sensitive than of other areas. For example, work-hardened hands may be insensitive to an agent that will markedly effect an ear lobe. Without realizing it a worker could transfer an agent from his fingers to his ear, forehead or nose causing dermatitis in an unusual location. Workers should be cautioned to look out for and avoid these habits.

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3. Systemic effects resulting from penetration of the intact skin are not common since most chemicals cannot penetrate the skin. However, there are certain chemicals which, upon contact with the skin, will readily be absorbed through the skin and into the bloodstream. Examples of skin penetrants are phenol, aniline, carbon tetrachloride, and tetraethyl lead, all of which can cause serious injury. Chemicals for which skin contact is a significant route of exposure are preceded with "S" or "Skin" in the listing of the allowable levels of air contaminants (see Section VII, Sources of Information). For chemicals which can be absorbed through the skin, it is important to avoid skin contact.

The work operation should be designed to minimize the need for worker contact with materials that are harmful to the skin or eyes. If exposure cannot be avoided entirely, protective equipment should be used. This includes the following:

- Choose gloves which are impervious to the chemical. Selection of the proper glove is important and may require consulting both the chemical supplier and the glove manufacturer.
- Wear face shields, goggles, aprons, and boots where necessary to prevent accidental contact from splashing, spills, or leaks.

Personal protective equipment should be checked for leaks or defects before use. In case of accidental contact with a hazardous chemical, contaminated clothing should be removed and the skin should be flushed with copious amounts of running water.

Ingestion

While ingestion is not the most common route of exposure to chemicals in the occupational situation it does occur occasionally. This usually results from contaminated cigarettes, food, hands, or clothing, or it may be a secondary effect from inhalation of the material, that is, material trapped in the respiratory tract is brought up into the throat and subsequently swallowed. To prevent exposure to substances which can be hazardous when ingested, work practices should include the following measures:

- Good personal hygiene habits and effective housekeeping practices should be encouraged.
- Hands and face should be washed before personnel eat, smoke, drink, or apply cosmetics. Showering may also be necessary. Protective clothing should be worn where appropriate to minimize the amount of skin contact with chemicals.
- Food, drink, cigarettes, or cosmetics should not be brought into areas where the chemicals are stored, processed, or distributed.
- Break areas should be kept free from contamination.
- Laboratory glassware should not be used for food or beverages.
- Concentrations of the substance in the air should be controlled.

Effects of Chemical Exposures

There are two basic types of chemical exposure: acute and chronic. An acute exposure is a brief exposure to a substance, whereas a chronic exposure is a long-term exposure to a substance.

The possible adverse effects from either an acute or chronic chemical exposure can be classified in different ways:

reversible or non-reversible
systemic or localized, and
immediate or delayed

A reversible effect from a chemical exposure means that the body experiences a reaction which will subside when exposure has ceased. An example is the tearing of the eyes when peeling an onion. This tearing stops upon removal of the irritant and no permanent physical change will occur.

A non-reversible effect is more serious because the reaction to the chemical does not disappear. A simple example of a non-reversible effect would be a scar from a chemical burn. While the body heals from the chemical burn, there is still a permanent scar. An example of a serious non-reversible effect with potentially lethal consequences is lung cancer attributed to cigarette smoking.

Another way of describing the effect of a chemical on the body is to classify it as systemic or localized. A systemic effect is one which is spread throughout the body, while a localized effect is limited to a portion of the body. The effects of poison ivy, for example, can be either localized or systemic, depending upon whether the poison ivy contacts the skin and causes a localized rash or enters the bloodstream and affects the whole body.

The third way to categorize effects of exposure to chemicals is to classify them as immediate or delayed. An immediate effect occurs as soon as contact with the chemical is made. An example is pain from applying iodine to an open cut. A delayed effect appears some time after the exposure to the chemical. The period of time which elapses between the exposure and the physiological response is called the latency period. Delayed responses include certain skin conditions, asthmatic responses and even cancer. Cancer characteristically has a very long latency period (10 - 25 years).

Chemicals can have synergistic effects. This means that the combined effect of the two chemicals is much greater than the sum of the effect of each agent alone. One example of a synergistic effect is that of methylene chloride and ethanol. A worker who has been exposed to methylene chloride on the job may find that one after-work drink will have the same effect as several drinks would have normally.

The raw materials used in plastics processing have a broad range of chemical and physical properties; each will differ in its inherent degree of toxicity, its exposure potential and, in its appropriate handling procedures. Fortunately, most of the polymers and resins used in plastic processing are considered biologically inert and show little ability to cause harm. Therefore stringent workplace controls are not required for many plastics processing operations. Nevertheless, all chemicals should be handled with care. Excessive exposure to any chemical should be avoided.

Following are brief descriptions of some of the concerns associated with chemicals:

1. **Odor:** Strong or unpleasant odor is not an indication of toxicity. Many chemicals can be detected by odor at a concentration far below the levels considered harmful while some very harmful substances have no odor. Each chemical has a different odor threshold (the minimum airborne concentration of the chemical at which the average person can detect its smell). Some chemicals, like carbon monoxide, have no odor. Other chemicals like hydrogen sulfide, have an odor at low concentrations but none at higher (and lethal) concentrations.
2. **Sensitizers or Allergens:** Another name for a sensitizer is an allergen. Examples are poison ivy, formaldehyde, isocyanates and the amine hardeners used in epoxies. Typically, an individual experiences no adverse reaction to a sensitizer on the first exposure, or perhaps for many days or weeks. However, exposure to a sufficient amount of the chemical induces certain changes in the body so that after a period of incubation (5 to 7 days or more) the chemical manifests itself through such symptoms as dermatitis, breathing difficulties or respiratory tract irritation. Each subsequent exposure to the substance will result in a new allergic reaction.

Exposure of a sensitized individual to minute concentrations of the substance is often sufficient to cause a reaction. This explains why an employee can work around a sensitizer for a long period of time without any reaction, and then suddenly be unable to tolerate exposures to even small amounts of the material.

3. **Overheated plastics:** All plastics and all organic matter will burn at high temperatures, liberating particulates, vapors and gases. Some processes may generate a smoke-like haze in the molding operation. This haze often is only water vapor given off by the heated resin. For most plastics, operations which generate significant levels of air contaminants involve heating the material to a higher temperature than

recommended by the material supplier. Typically the molded parts produced under such conditions are of unacceptable quality. Therefore, significant exposure to air contaminants produced by overheating plastics usually occurs only in conjunction with some malfunction; such a situation is an emergency condition for which respiratory protection may be required.

4. **Metals and metal compounds:** Although some metals and metal compounds are rather toxic, their use in plastics processing is confined to limited applications such as stabilizers and pigments, and the workplace exposure hazard can be controlled by techniques described earlier. Many metals, such as compounds of lead, arsenic and cadmium can be hazardous by ingestion. Therefore, workplace controls should include protection against these hazards.
5. **Solvents -** Exposure to excessive vapors of some organic solvents may cause dizziness and/or nausea giving the appearance of drunkenness. At higher concentrations some solvent vapors can be lethal. Effects from prolonged exposure to excessive concentrations of solvent vapors will depend on the particular solvent.
6. **Carcinogens -** Exposure to certain chemicals, called carcinogens, increases the risk of cancer. Some chemicals such as asbestos and vinyl chloride are known human carcinogens while other chemicals are suspect, based on their effects in animals. Whether or not a material is carcinogenic is not always a clear cut situation. Chemicals differ in their potency and in effects on different species.

The period of time between exposure to a carcinogen and development of cancer is called the latency period, typically 10 to 25 years. The length of the latency period may vary according to the specific carcinogen and the type of cancer produced.

Measures which must be taken to minimize exposure to known human carcinogens are described in the OSHA regulations. Insofar as practical, employers should avoid using carcinogenic chemicals in their opera-